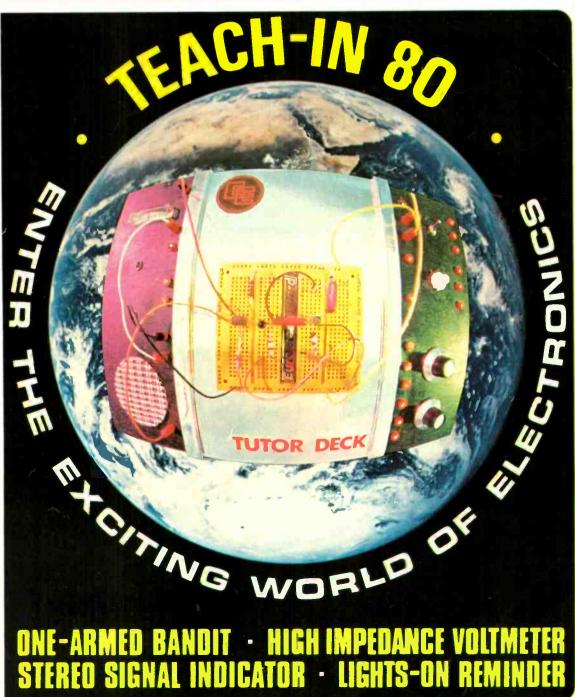
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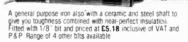
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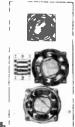
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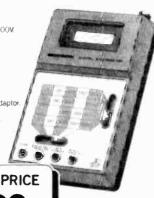
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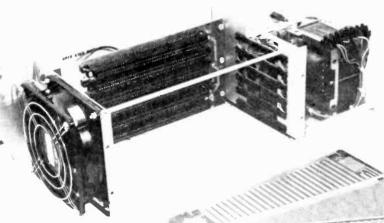
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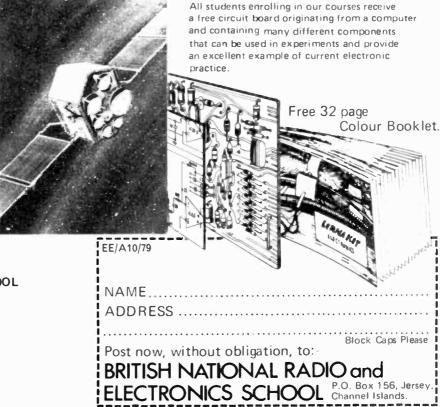
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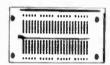
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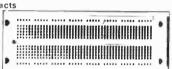
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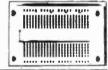
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Projects...Theory... and Popular Features ...

The poor old British public must be punch drunk from the ceaseless bombardment of silicon chips it is receiving from the news media. One day this strangely named little device is going to be the saviour of all mankind; the next, it has turned into a frightening villain hell-bent on depriving most of us of our jobs.

The truth is probably less awesome than either of these extremes. On balance the onward march of high technology must be to the advantage of all. There is nothing mystic about It's just economics. wonderful capability of great computing power within extremely small physical confines-which is really what is implied when the term "silicon chip" is bandied about-must be deployed in vast quantities to be commercially viable, and to recover the large outlay incurred during its development. Expanding markets are essential. This means customers sufficiently affluent to purchase the mass produced articles or services that arise from the economic use of this high technology.

It is also reassuring to remember that this high technology can be cut down to size. The most powerful computer is only a conglomerate of electronic circuits. These basic circuits are universally known and perform in a well understood and predictable manner.

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blocks" can be made up from discrete, or separate, parts such as transistors, diodes, resistors and capacitors-the most commonplace of all electronic components. Or they may be manufactured as a single package, within one tiny slice of silicon, as an integrated circuit. The ultimate size of an integrated circuit knows no bounds, as witness the single-chip computer which has become commonplace.

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Our November issue will be published on Friday, October 19. See page 657 for details.

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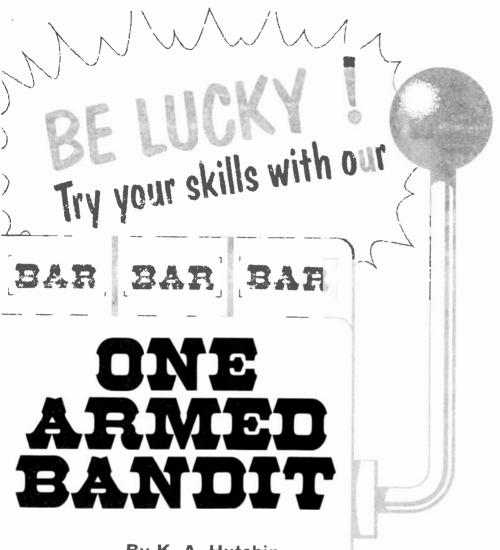
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By K. A. Hutchin

THE One Armed Bandit was designed for entertainment purposes, and therefore, no cash intake, or payout, was included. It has proved to be a popular attraction at a number of fêtes, mainly to younger children, who find it easy and fun to use. It can easily be seen when a winning combination occurs, and the possibility of one or more holds after a win makes it more exciting.

The author's family were using the unit one evening, one person acting as banker, collecting and paying out the money, whilst the other played as a punter. Mum was down to her last penny, when three "Bars" came up, and the unit then held for three goes.

The unit can be run from a battery or from the mains, via a suitable battery eliminator. The circuit consumes an average of 150mA at 9V.

CIRCUIT DIAGRAM

The complete circuit diagram of the One Armed Bandit is shown in Fig. 1. The circuit uses a combination of different i.c. families: TTL (IC2, 3, 4, 5, 6, 13), CMOS (IC8, 10, 12) and linear devices (IC1, 7, 9, 11).

The TTL i.c.s. require a 5V supply which is derived from the 9V supply by a simple Zener stabiliser, R1 and D1. This supply is also used for the linear devices. Although the cmos devices could be powered by 5V, a higher voltage is required to cause the l.e.d.s to illuminate sufficiently to be seen; 9V was found to be adequate.

Transistors TR1, 2 and 3 are used for interfacing TTL to CMOS since the latter require input swings to pass through one- and two-thirds their supply voltage to trigger them. The transistors accomplish this.

DIODE REELS

There are three "reels" simulated by diodes D6 to D12, D13 to D19 and D20 to D26. Each reel has associated with it an astable multivibrator (eg. IC7) feeding a decade counter divider (IC8) via an inter-

facing transistor TR1. Only one of the seven used outputs is on at any one time, stepping sequentially on the receipt of each pulse from IC7. The eighth output is wired to the reset pin so that the output sequence runs from 0 to 7 and repeats for as long as pulses are received.

Pulses are fed from IC7 via G13a and these are transmitted to IC8 provided the level at pin 5 is logic 1 (high). This level is decided by the preceding logic sections. Thus any "reel" may be "held" stationary or caused to stop by causing the level at pin 5 (9 or 12) to go low. This logic circuitry is controlled by IC1 and can be set by switches S2 to S4.

LOGIC CIRCUITRY

IC1 is wired as an astable multivibrator having a time period (1/f) of approximately six seconds. This is the "reel spin" time.

When the unit is switched on, the flip-flop composed of gates G4b and G4c sets so that the output at pin 6, and hence the input to each "spin enable" gate G3b, G3c, G3d, is at logic 1 (high). The outputs are therefore low irrespective of the level at the other input. This prevents pulses from IC7 reaching IC8.

When the START button is pressed, flip-flop G4b/G4c resets and its output becomes lcw causing a high level at G13a pin 5, allowing IC8 to count.

After about six seconds, IC1 output (pin 3) falls which causes the flip-flop G4b/G4c to change state, placing a logic 1 at pin 3 (G36) producing a low output which halts the count in IC8. The "reel" comes to rest. Since the input to G3a pin 12 is now high, the astable multivibrator (IC1) output has no effect. The hold flip-flops are automatically reset by the negative going pulse from G4a when the reels stop spinning.

The changing levels of flip-flop G4b/G4c act as a pulse source for counter IC2 which provides the random hold facility. When the output at pin 9 is high (indicated by D2 illuminating) the three hold flip-flops can each be set by depressing the appropriate switch which sets a logic "1" on the inputs to gates G3b, G3c, or G3d. The result is a low output from any of these gates which prevents the appropriate astable from feeding

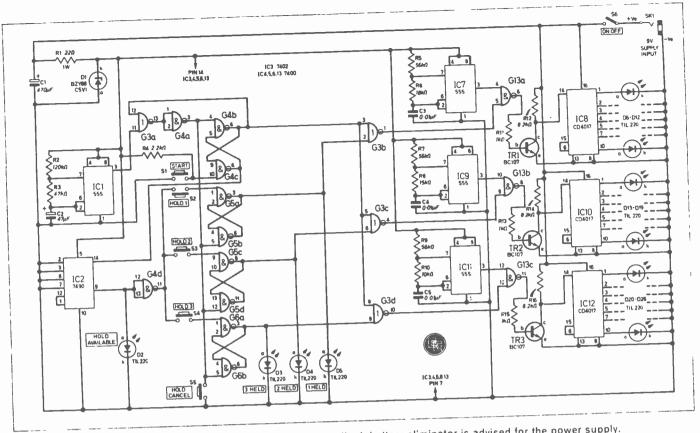


Fig. 1. The circuit diagram of the One Armed Bandit. A battery eliminator is advised for the power supply.

the counter. The l.e.d. position is thus "held" stationary. Pressing S5 sets the outputs of

Pressing S5 sets the outputs of all three hold flip-flops to logic "0" which allows the counters to count once the START button is pushed.

Random stray pulses cause the "held" flip-flops to set and prevent a reel from spinning unless cancelled by S5.

The three astables formed by IC7, 9, 11, operate at frequencies 770Hz, 780Hz and 820Hz respectively.



CIRCUIT BOARD

The prototype circuit was constructed on a single piece of stripboard that has 64 holes x 38 punched strips plus four unpunched strips which are used for mounting purposes.

For clarity, the topside view of the component board is shown in two stages, Fig. 2 showing components and tinned copper link wires (none crossing) with the second topside layout Fig. 4 showing the rest of the links to be made using p.v.c. covered wiring.

Begin by making the breaks on the underside and drilling the fixing holes as shown in Fig 2. Mount all the i.c.s, sockets only for IC8, 10, 12, followed by the "bare" link wires, resistors and finally capacitors. Do not insert the i.c.s in their sockets just yet.

With reference to Fig. 4, make the remaining links on the board. Use of wire with different insulation colours will help avoid mistakes and make checking easier. It is a good idea to tick off these connections as they are made.

The completed and labelled prototype.



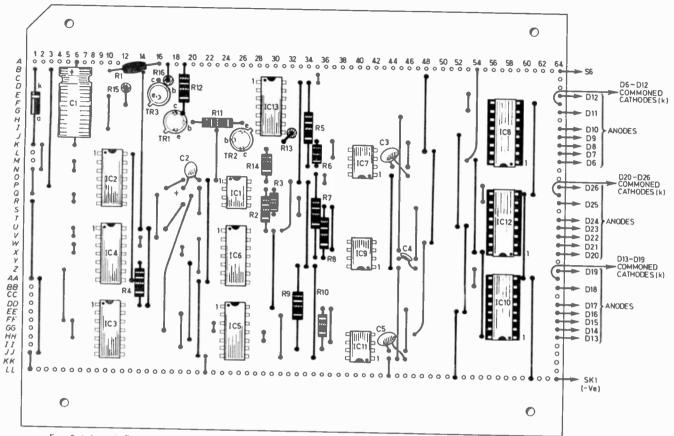


Fig. 2. (above). The layout of the components and the "bare" wire links on the tops de of the board; (below) the breaks to be made along the copper tracks on the underside of the stripboard.

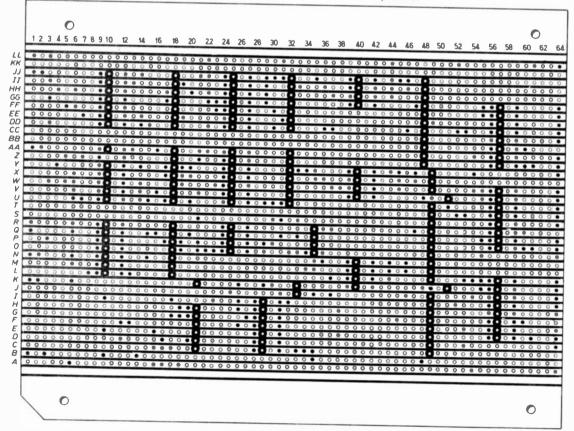




Fig. 3. (right). Underside view of the l.e.d.s and switches in position on the top panel showing interwiring details; (above) wiring of the on-off switch and power inlet socket located on the back panel of the unit. The order of connection to the individual diodes in each of the three columns is unimportant.

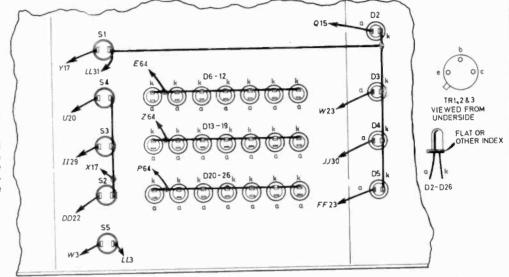
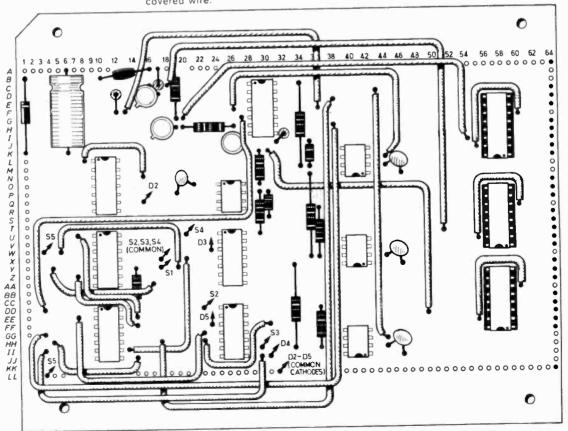
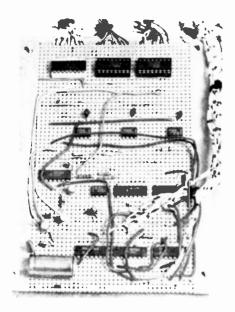


Fig. 4. Shows the interconnections to be made on the topside of the board using p.v.c. covered wire.





The finished prototype board sited in its case.

ASSEMBLY PROCEDURE

The prototype used a two-part aluminium sloping front box with base size 238 x 217mm and maximum height of 90mm, the base and two sides forming one section. The upper section holds all the l.e.d.s

and switches, the integral back panel holding the on/off switch and power-in jack socket, Fig. 3.

Prepare the case to accept these components and secure in position. Carry out all the interwiring between these components including the common connection to the cathodes of the l.e.d.s.

Sufficient lengths of insulated wiring should next be connected to the board to reach the other components, and the board then secured to the case lower section (see photograph). In the prototype the board was supported by four bolts with two nuts acting as spacers to raise the board above the metal base. Place the two sections close together and wire up according to Figs. 3 and 4 to complete the unit.

TESTING

Although the unit can be powered by a PP9 9V battery, a 9V battery eliminator capable of supply 150mA is recommended. This should be terminated in a plug to suit SK1.

Do not insert the cmos i.c.s in their sockets at this stage.

Connect a suitable supply, and switch on. Push the START button, wait for approximately 10 seconds and then push again. After a further 10 seconds, the HOLD AVAILABLE l.e.d. should light up. If it does, push the three HOLD buttons, and check that the correct HELD l.e.d. illuminates each time. Now press the HOLD CANCEL, and all the HELD l.e.d.s should extinguish.

If the HOLD AVAILABLE Le.d. does not light, check the connections to the board, and also check to see if there is a small voltage across the l.e.d., or that the l.e.d. has not been wired in reverse. If this is not the case, check the operation of the flip-flop formed from gates G4b/G4c.

The output from G4c pin 8 should go to a high when the start button is pressed and revert to a low when the 555 ends its timing period. If this is working correctly, the fault lies with the 7490.

If the HOLD AVAILABLE l.e.d. lights but none of the held l.e.d.s light on pressing the appropriate buttons, check the operation of G4d, and the appropriate flip-flop.

Assuming all the circuitry to be working as described, the operation of the three oscillators, and their associated gates, should be checked. This is best accomplished by the use of a logic probe or an oscillator. A simple logic probe can be made from an l.e.d. wired

COMPONENTS Resistors R₁ 22Ω 1 W R₆ 18kΩ R11 1kO R2 $120k\Omega$ R7 56kΩ **R12** 8.2kΩ R3 47kΩ R8 15kΩ R₁₃ 1kQ R4 2 · 2kΩ R9 56kΩ **R14** 8 · 2kΩ 56kΩ R10 10kΩ **R15** 1kO All ${1\over 4}W$ carbon \pm 5% except where R₁₆ 8·2kΩ stated otherwise Capacitors C1 470 µF 10 V elec . 47 µF 6V elect. or tantalum See C3,4,5 0.01 µF disc ceramic (3 off) Semiconductors IC1,7,9,11 555 timer i.c. (4 off) IC₂ 7490 TTL decade counter 7402 TTL Quad 2-input NOR gates IC4,5,6,13 7400 TTL Quad 2 input NAND gates (4 off) CD4017 CMOS decade counter/divider (3 off) IC8,10,12 TR1,2,3 BC107 npn silicon (3 off) BZY88C5V1 5·1V 400mW Zener diode D₁ D2-D26 0.2 inch or similar red l.e.d.s with mounting clips (25 off) Miscellaneous S1 on/off toggle S2,3,4,5 miniature push-to-make, release-to-break push switch (4 off)

3.5mm jack socket (with plug to suit)

front-panel case (see text); rubber feet for case (4 off).

Stripboard: 0·1 inch matrix 46 strips \times 68 holes; p.v.c. covered connecting wire 7/0·2mm, assortment of covering colours; tinned copper wire (links); 16-pin d.i.l. sockets (3 off); 6BA fixings (4 sets); sloping

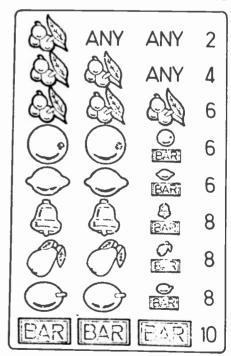
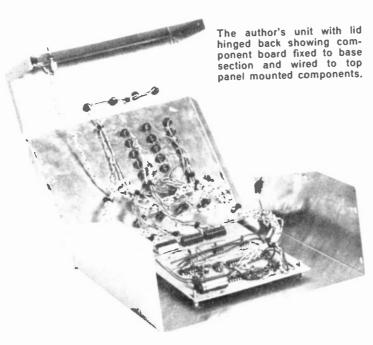


Fig. 5. This "winning line label" can be photocopied, cut out or traced and then coloured and pasted to the unit,



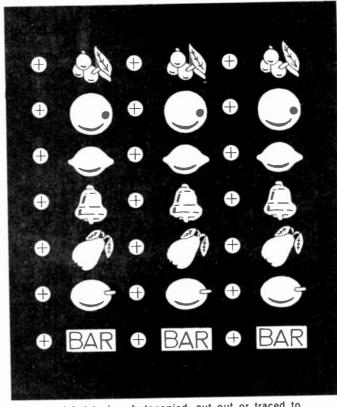


Fig. 6. A label to be photocopied, cut out or traced to identify the l.e.d.s on the top panel. This is reproduced full size and is also intended for use as a template for marking the I.e.d. matrix.

in series with a 1 kilohm resistor.

The output from any of the gate's G13a, b or c should be high until the START button is pressed, whereupon an oscillating output should be observed, indicated on a probe by reduced illumination for the duration of the spin.

If all these checks are satisfactory, the cmos chips may be inand the reel display serted

checked. One l.e.d. on each reel should illuminated when the unit is

switched on; all of the l.e.d.s should light up when the START button is pressed, and when the spin stops, only one l.e.d. in each reel should remain on.

If all is satisfactory the unit can be marked with self-adhesive labels, or Letraset, and the labels in Figs. 5 and 6 to provide endless hours of enjoyment and amusement. Rubber feet fitted to the case will afford protection to the surface supporting the unit as well as enhancing the appearance.

BY D. P. NEWTON

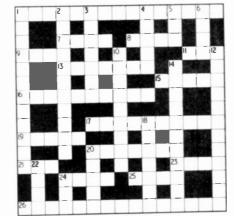
ACROSS

- 1 In other words, ten to two (7, 2, 6).
- 7 Certain.
- first and second 8 Incorrect anode voltages gives such a lack of distinction.
- 9 To cut a tape.
- 11 Georg Simon, as he's latterly known.
- When there's a band on the wireless, give up.
- 15 Adding a bit to the live line makes it weak.
- 16 Ohmic impedance.
- 17 Flip an' wags about and gives lift (Anag.) (1, 6, 4).
- 19 A formal audio output from



- 20 A triboelectric cloth to dodge the issue.
- 21 Selenium cell supplier.

- 23 Once IBM almost gets the goat.
- 24 Beast's base.
- 25 Loosely connected family.
- Applying a voltage in a contrary manner (7, 8).



DOWN

- 1 Dynamic commutative devices (1, 1, 10).
- 2 Lack of balance in a circuit?
- 3 Keeping one up front.
- 4 Coax mismatch eliminator.



- 6 Radio short spots two from each.
- 10 The input and output are this when the gain from the noninverting input is unity.
- 12 Simultaneous transmission of several messages.
- 14 Ferrous field detectors (4, 7).
- 18 Part of the brain's wiring harness?
- 20 Failures in the monostable.
- 22 Powerful encouragement from a surge.
- 24 Static value of the forward current transfer ratio.

Solution on page 666



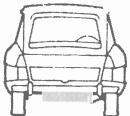






LIGHTS-ON REMINDER









By T. R. de Vaux-Balbirnie

F you leave your car lights switched on there are always those who will take real delight in letting you know—usually when the battery is almost "flat". They will good-naturedly meet you, armed with jump leads, tow ropes and the like, making you feel a fool.

The author has been in this situation more than once so he decided to make an electronic device for the winter months in an effort to prevent it happening again.

There have been several circuits to achieve this purpose already published but, as far as the author is aware, none has been simpler than that to be described. It is fully automatic, requiring no setting or unsetting by the user. It uses few components and may be easily constructed by a beginner.

CIRCUIT FUNCTIONS

The circuit operates in the following way. With the ignition switched "on" the lights may be operated in the normal course of driving. Only if the ignition is switched "off" with the sidelights still "on" is the circuit actuated and a loud warning note is produced from a miniature loud-speaker.

When the lights are switched "off" the alarm is silenced. The lights may be freely operated with the ignition switched "off". If the

lights are switched "off" before the ignition, again, no alarm is given.

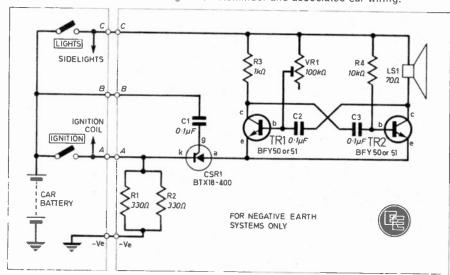
If the operator wishes to leave his lights "on", for example for parking or testing the technique is simple. The lights are switched "off", then the ignition, and finally the lights "on" again. Alternatively, the ignition may be switched "off" first then the lights off and on again (alarm will sound for an instant).

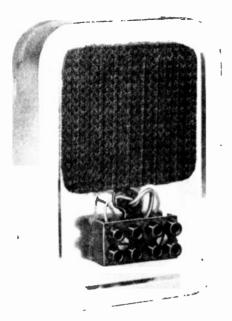
NEGATIVE EARTH ONLY

At this point it must be stated that the circuit is only suitable for vehicles fitted with the "negative earth" system. Most modern cars are of this type but, in case of doubt, the constructor should check by looking at the battery leads. The *negative* terminal should be the one which connects straight to the metal bodywork of the car.

Likewise it should be noted that some cars have their lighting circuits controlled through the ignition switch. The author has in mind certain Italian models, but there may be others. This could easily upset the operation of the circuit. Before construction begins, therefore, a check should be made by switching the lights "on" and ensuring that they stay on steadily

Fig. 1. Circuit of the Lights-On Reminder and associated car wiring.





when the ignition is switched "on" and "off".

If there is any interruption it is better not to construct the circuit. If the lights flick "off" then "on" again a warning tone would only be given during the brief time that the lights were "off".

CIRCUIT DESCRIPTION

The circuit (Fig. 1) consists of two distinct parts. The first is a thyristor (often called a controlled silicon rectifier) and the second a multivibrator which is made up of

COMPONENTS

Resistors

R1, 2 330 Ω (2 off) R3 1k Ω

R3 1kΩ R4 10kΩ

page 630

All ½W carbon : 10% Potentiometer

VR1 100kQ miniature preset horizontal mounting

Capacitors

C1-3 0·1µF moulded polyester 25 V (or higher) (3 off)

Semiconductors

TR1, 2 BFY51 or BFY50 npn silicon transistor (2 off) CSR1 BTX18-400 1 A thyristor

Miscellaneous

LS1 Miniature loudspeaker approx 2½ in. dia., 7012 coil

Stripboard 0.1in. pitch, 31 holes by 12 strips. Miniature 5A terminal block, 4-way. BA nuts and bolts. Case. Connecting wire. Auto-type wire. Connectors.

two transistors and associated components. Under the right conditions the thyristor will "fire" allowing current to flow through the multivibrator section. The multivibrator is an oscillator and, with the values of components given, will produce an audible tone from the loudspeaker. Provision is made for altering the pitch of the note for the best effect with the preset potentiometer VR1.

If the circuit is studied it will be seen that connections are made to it from the car ignition and lighting circuits. These are labelled A and C respectively. These connect to either side of the thyristor, CSBL via the multivibrator section.

THYRISTOR OPERATION

If the ignition and lighting circuits are both "on" or "off" nothing can happen as both sides of CSR1 will be either at 12 volts or 0 and current will not flow between two points at the same voltage.

If the ignition is "on" but the lights are "off", again, no current can flow as this would be in the wrong sense for CSR1. In this respect CSR1 behaves as an ordinary diode—when reverse-biased current cannot flow.

If the lights are "on" but the ignition "off" then C will be positive and A negative so the sense of the current is correct for CSR1.

If CSR1 were an ordinary diode then current would flow, but it differs from a diode in that it will only conduct if it has received a small positive pulse to its gate (g). In the absence of this pulse CSR1 will remain "off". Once "triggered" CSR1 will remain conducting until its main anode-cathode current is interrupted—the gate loses all control over it.

TRIGGER PULSE

In this project, the trigger pulse is provided by the charging of a low-value capacitor C1. If C1 is already discharged then it will be ready to receive charge and CSR1 will be triggered. If C1 is already charged then no pulse will be given.

When the ignition is switched "on" the terminals of Cl are effectively short circuited through the gate-cathode of CSR1 so it is discharged and so ready to charge. A triggering pulse will be given.

therefore, the moment the ignition is switched "off"—when A becomes negative. When the lights are then switched "off" CSR1 stops conducting as explained earlier.

If the ignition is already "off" then Cl will be charged—its terminals are effectively across the supply via the gate-cathode of CSR1. No triggering pulse can be given when the lights are switched on and off.

MULTIVIBRATOR

The rest of the circuit consists of the multivibrator based on TR1 and TR2 and this drives a miniature loudspeaker LS1. It was not thought necessary to provide a volume control; it was assumed that the warning should be as loud as possible. It was thought desirable, however, to provide a means by which the pitch of the note could be altered. The preset variable potentiometer VR1 achieves this.



CIRCUIT BOARD

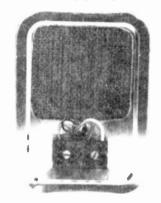
Construction is very straightforward and for the prototype was based on a piece of 0·lin pitch stripboard 31 holes by 12 strips.

The strips must be cut in the places indicated—a small twist-drill may be used if the special tool is not available. Even a carefully used knife blade will do. During the soldering stage care must be taken to avoid "bridging" adjacent copper strips.

A small case, either of metal or plastic will be needed to house the unit. More care is needed in the case of a metal container to avoid short circuits. A tobacco tin was

£3.20

LIGHTS-ON REMINDER



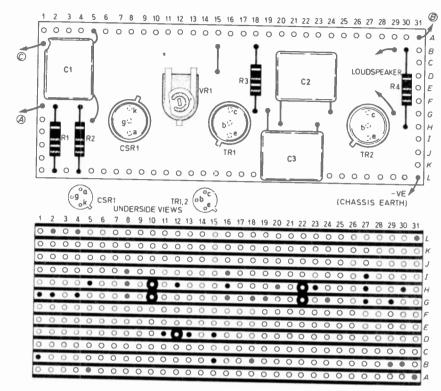


Fig. 2. Top and underside views of the circuit board.

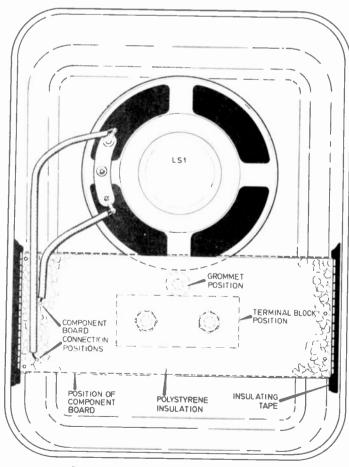
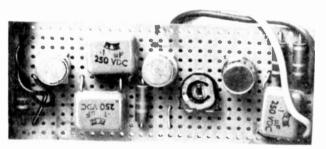


Fig. 3. The complete assembled circuit.



The completed circuit board ready for wiring to the loudspeaker and terminal block.

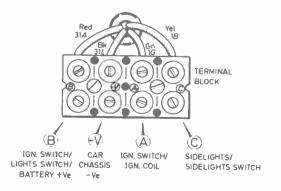
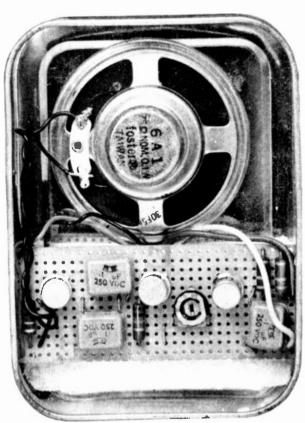


Fig. 4. Details of wiring to the terminal block which is mounted on the front of the case.



The finished unit showing positioning of circuit board on a block of polystyrene for insulation.

used for the prototype. Insulating strips were provided where the stripboard touched the sides, and a piece of polystyrene was sandwiched between the stripboard and the tin to completely isolate the "live" parts.

EARTHING ARRANGEMENTS

A separate "earth" connection was provided but it is possible to use the tin itself so that when it is attached in position to the metalwork of the car the earth will be complete.

A good plan is to fix the lid of the box in position and the box containing the electronics snapped on to it. This has the advantage that the unit may be removed easily at any time. Do not rely here on a good connection being automatically produced between the two halves of the tin. An additional bonding lead should be fitted, secured at one end with screw and nut to facilitate removal.

The external connections A, B, C and "earth", if used, are brought to a piece of miniature terminal block mounted on the front of the case. If a metal case has been used it is essential to run the wires from the circuit panel through a grommet. A hole is cut in the case slightly smaller than the loudspeaker, and Epoxy resin adhesive used to attach this unit. Such adhesive must be used sparingly just around the rim.

INSTALLATION

The easiest way to make the connections A. B and C to the car will be at the car fuses. Using a small 12-volt bulb with one side "earthed" a fuse is found which is only "live" when the ignition is switched "on". This will be connection "A".

In the same way, a tuse is found which is "live" all the time. This gives connection "B". Finally, a fuse is found which is only "live' when the sidelights are "on". This provides connection 'C'

On some cars the lights are not protected by a fuse. In such cases it will be necessary to connect to a sidelight wire or to the lighting switch. To be safe, it would be wise to include a line fuse holder here (of the type used for car radios) with a low-value fuse in it.

When making the connections to the fuses it is important to use the "dead" sides, that is "dead" when the fuse is removed. If the other side of the fuse is used then the benefit of the fuse will be lost. This point may be checked with the 12-volt bulb.

GOOD CONNECTIONS **ESSENTIAL**

It is essential to make proper connections. Breaking leads, making a twisted connection, then taping it all up is most unsatisfactory. Such a connection is likely to fail in service when the wire is under vibration. Worse still, a short circuit may be caused to the body of the car.

Proper connectors are easily bought from a car accessory shop. In cases where all available terminals have been used to a given fuse, "piggyback" connectors can

be bought which turn one terminal into two. Single-strand wire must never be used for the external connections—only proper auto type wire. This has thick insulation which will withstand hard use.

FARTH CIRCUIT

The "earth" connection, where used, should be run to an existing earth point or a small hole drilled and an eyelet used secured with a self-tapping screw.

At this point the purpose of RI and R2 will be mentioned. These were included in the prototype to give a definite path to earth from "A'. It is quite likely that such a path will exist anyway via accessories which are "on" when the ignition is "on". For example, warning lights. (The ignition coil will only serve when the points are closed.)

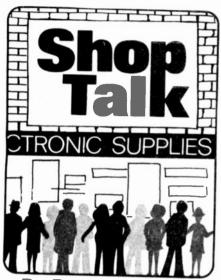
Constructors may wish to see whether the circuit will work without R1 and R2 but in cases of doubt they should be fitted. Without R1 and R2, of course, no "earth" connection to the circuit is necessary.

It will be noted that R1 and R2 are a pair of equal resistors in parallel. This gives a value of 165 ohms. If a single 12 watt resistor were used it could become rather too warm in use. If a single resistor is used it should be of the I watt type. The author considered that many constructors build up a small stock of 12 watt resistors though not of 1 watt so the parallel arrangement was thought best.

FINAL ADJUSTMENTS

Before fitting the unit to the car, VR1 should be set to about midposition. The circuit should be checked by proving that audible tone is produced when the lights are left "on" after turning the ignition "off". If all is well, the pitch of the note may be varied by altering the setting of VRI. This must not be adjusted too near its zero resistance position (with the slider not too near C) as excessive base current to the transistors might damage them.

After final checking and adjusting, the unit may be forgotten until one day-perhaps in the not too-distant future---it will bravely signal your thoughtlessness!



Dave Barrington

Case for Components

It is a very rare occasion when we are able to pass on some information that will benefit our advertisers and, we hope, eventually prove beneficial to our readers. But this month we have received two snippets of news that should interest both parties.

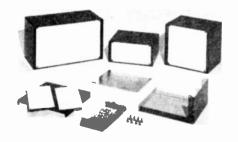
Looking for retail outlets for their new "Pack Flat" range of instrument case are Perancea Ltd. These cases come, as their name implies, in flat packs for easy storage and postage.

The main feature of these cases, which seems to be a novel idea, is that they require only eight screws (four in the front and four in the back panel) to hold them together. This is made possible by the arrangement of folds in the side panels and top and bottom plates. The side panel "folds" are sprung and interlock with the top and bottom plates to form a rigid construction.

We particularly like the idea of a separate aluminium chassis on which components and/or circuit boards can be mounted. The chassis also held by the fixing screws so avoiding any unsightly fastening on the exterior of the case.

Available in eight stock sizes, from the SPIB (180 · 152 · 80mm) to the SP8B (307 > 152 > 156mm) we are unable to quote a recommended

Range of Perancea Pack Flat Cases



retail price, but for further information write to Perancea Ltd., Department EE, 131 First Avenue, Bush Hill Park, Enfield, EN1 1BP.

There was a time when Japanese products were widely advertised and one of the cheapest quality items. particularly transistors, on the market. Now, due no doubt to the strength of the Yen, Japanese components are becoming increasingly uneconomical for advertisers to import and stocks are fast disappearing from their shelves. This obviously leads to problems when trying to find replacements when components breakdown.

Recognising this fact, Australia's largest component suppliers to the hobbyist, Dick Smith Electronics Pty Ltd., has just established a purchasingcum-trading office in Hong Kong. The aim of the office is to supply equivalent quality products from Hong Kong, Taiwan and Korea at, they claim, better prices. In fact, its their boast that they will even quote for one off items.

They issue an excellent 104-page Jumbo Catalogue which is certainly worth the trouble of writing for at S4.00 (U.S.) airmail. The address to write to is Dick Smith Electronics (HK) Ltd., Dept EE, 29-39 Ashley Road, Kowloon, Hong Kong. Advertisers should ask for wholesale price lists.

Disco catalogue

With the ever increasing popularity of Discos on the entertainment scene, Roger Squire Ltd. have just released a new catalogue featuring over 1000 new disco products.

The catalogue covers such items as replacement cartridges, styli, decks and a range of lighting effects units.

The catalogue is available free of charge from Roger Squire Ltd., Freepost, Dept EE, Barnet Trading Estate, Park Road, Barnet, EN5 5SA

Components catalogue

Another new catalogue received this month is the Marshall's 1979/80 Components catalogue.

This latest 60 page edition contains many new items including an expanded range of i.c. and microprocessors. Twin reply paid order forms are

printed in the catalogue to ease orderina.

To coincide with the publication of the new catalogue, Marshall's are launching their "budget" credit card scheme in conjunction with RETRA. They claim they are the first UK electronic component retailer to offer such a scheme.

The catalogue costs 50p from any branch or 65p, post paid, from Marshall's, Dept EE, Kingsgate House, Kingsgate Place, London, NW6 4TA.

Late news

We have just received news that Precision Instrument Laboratories have been appointed sole London Distributors for Continental Specialities Corporation range of products.

One of the reasons given for winning this franchise is the excellent large showroom premises in the Old Kent Road. Items on display will include, breadboard systems, logic probes and chips, function generators and frequency counters. PIL will also be offering the CSC range through their newly introduced Mail Order System.

Further information and a catalogue is available from Precision Instrument Laboratories, 727 Old Kent Road, London SE15

CONSTRUCTIONAL **PROJECTS**

Try as we may we cannot find any components that will cause buying problems this month.

The Lights on Reminder project calls for a 70 ohm 2 inch diameter loud. speaker. However, this can be any high impedance type ranging from approximately 50 to 80 ohms. The most common type listed in catalogues seems to be 64 ohms.

The prototype unit for the One Armed Bandit used "Standard (0.2in)" red, yellow and green l.e.d.s. but a small saving can be made by using the common TIL209 red l.e.d.s throughout. Of course, if 209's are used then smaller diameter holes must be drilled in the chassis.

Complete kits of parts for the EE Tutor Deck are available from the firms listed below.

SUPPLIERS OF KITS FOR TEACH-IN 80

LIST "A"-All electronic components for construction of Tutor Deck as specified on page 634.

LIST "B"-Electronic components needed for Teach-In experiments during first 6 parts of the Series as illustrated on page 640.

Greenweld. 443 Millbrook Road.

Lists A & B £21 -50

A. Marshall (London) Limited. Kingsgate House,

Kingsgate Place.

London NW6 4TA

£21:50 £3 · 75

Southampton, SO1 0HX Home Radio (Components) Limited.

234 London Road. List A £15 · 80 Mitcham, Surrey, CR4 3HD List B £3.20 Lists A & B £18:50

NOTE: All prices quoted are inclusive of VAT, postage and packing.



In order to follow the experiments in the Teach-In 80 series, it is recommended that the experimental Tutor Deck described here is constructed. The following instructions describe the construction of the deck referred to in the series but the design can be adapted to suit requirements of the user.

GENERAL DESCRIPTION

The Tutor Deck consists of all the commonly used components secured to two fixed top panels connected to 1mm sockets for easy access. Plugs with 7/0·2mm stranded p.v.c covered wire are used to connect these components to the breadboard on which any ancillary components are placed, see Fig. 1.

There is a centre section in the deck reached by sliding back a centre panel, in which all the nonfixed components for use in experiments may be stored along with some small tools. This compartment is further divided to hold the batteries which form the d.c. power source enabling them to be easily replaced when they are exhausted.

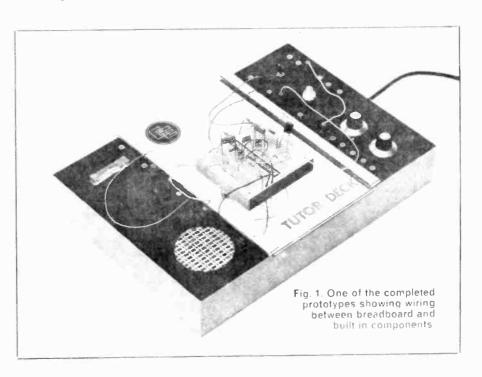
A mains transformer is used to derive the alternating current (a.c.) used in some of the experiments and this is kept in a sealed compartment so as to keep risks to a minimum. Read the instructions carefully on wiring the trans-

former and if in doubt ask someone with experience to assist.

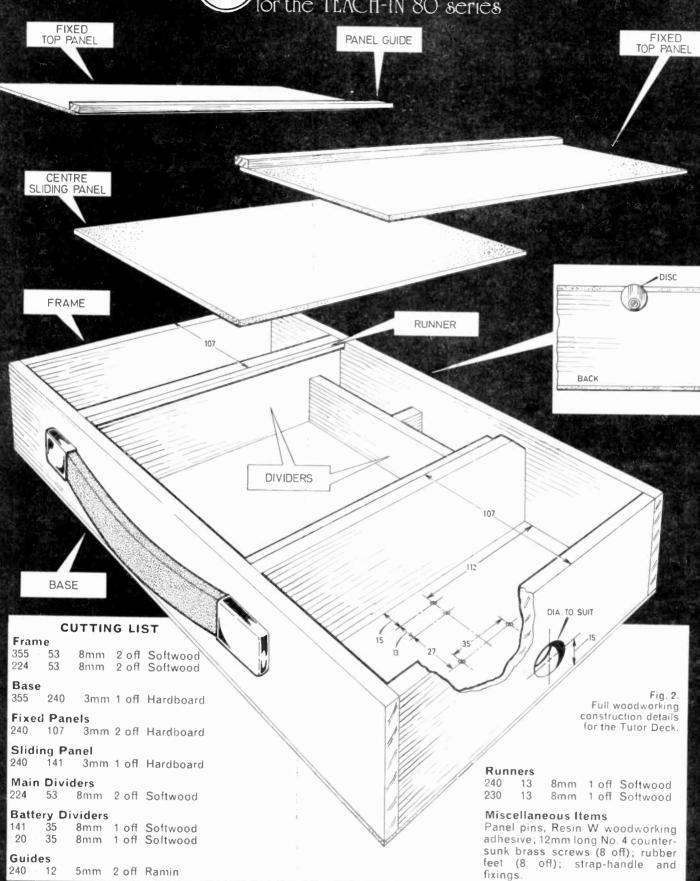
BY S. R. LEWIS B.Sc.

WOODWORK

The basic structure of the deck consists of a rectangular box formed from hardboard for the



TUTOR DECK for the TEACH-IN 80 series



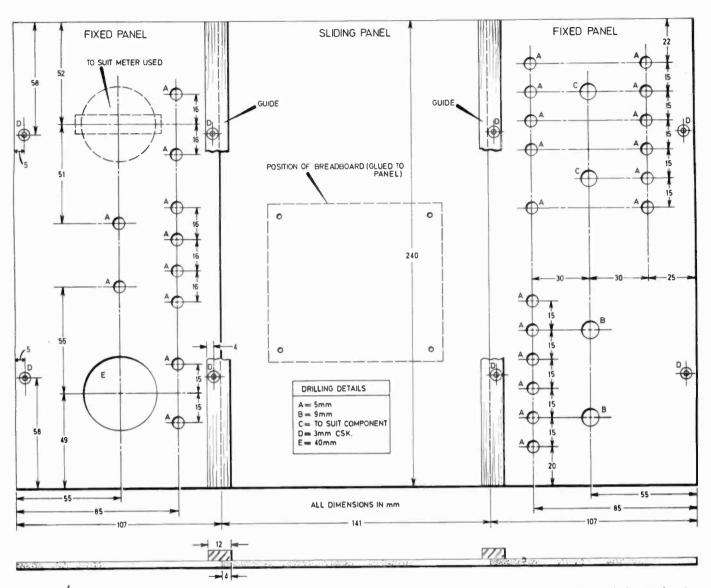


Fig. 3. Dimensions and drilling details of the three top panels in situ. Hole dimensions for some components, i.e. switches and meter may need to be altered to suit component supplied.

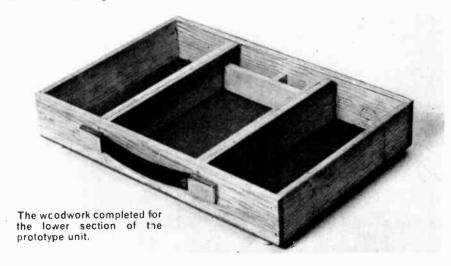
top and bottom and softwood for the sides and dividing sections. The centre sliding section holds the breadboard and covers the battery and storage compartment, see Fig. 2.

First cut to size all the pieces as detailed in the cutting list. Drill a hole in one of the shorter frame members to accommodate the mains inlet "plug". Pin and glue the two longer frame members to the base panel. Resin W wocdworking adhesive is advised. Next pin and glue the remaining frame members to form an open box.

The two runners should next be fitted to the main dividers and these then pinned and glued in position in the box. The siting of these dividers is critical since they are used as fixing bases for the top panels. Note the diagonal cut-out on one divider to allow the battery

leads to reach the centre comparment. Finally glue the two small sections to form the battery compartment to substantially complete the woodworking.

The two fixed panels should now be drilled according to Fig. 3 and the guides glued in place. Carefully drill the panel fixing holes to allow clearance of the screws.



METER CUT-OUT

The hole size for the meter will vary according to the style of meter obtained so the measurements in Fig. 3 should only be regarded as a guide unless an identical meter is used. The easiest way to cut a rectangular hole is to first drill a few holes in the middle of the rectangle and then use a chisel to achieve the required shape.

In the prototype, the top panels were temporarily fitted in their correct positions using Sellotape and the panel fixing holes used as guides for the smaller holes to be drilled in the box ends and dividers to accommodate the fixing screws. Countersink the upper holes for flush screw fitting.

Secure the panels to the box and check that the centre sliding panel moves freely between the guides.

An adjustable stop to prevent

this panel from dropping out when the deck is being carried is made from a small disc of aluminium with an offset fixing hole held in place on the rear of the box by a roundhead screw and washer as shown in the inset in Fig. 2.

If all is satisfactory, the top panels (and the remainder of the box) should be painted/varnished before fixing the components (handle and rubber feet—rear and bottom).

CIRCUIT AND WIRING

The "circuit diagram" of the Tutor Deck components is shown in Fig. 4 together with the layout on the top panels.

The positions of these components on the top panels, interwiring and wiring of the mains transformer is shown in Fig. 5. Fix all the components using the fixing

A typical kit of components required to construct the Tutor Deck. Designated List A. (A) Three-pole mains floating socket and panel mounting plug; (B) potentiometers with indexed knobs; (C) three-core mains cable; (D) p.v.c. covered stranded wire; (E) 1mm sockets (black); (F) 1mm plugs (black); (G) Eurobreadboard; (H) light emitting diodes and fixing clips; (I) two versions of s.p.d.t. toggle switches; (J) 1mm sockets (red); (K) 1mm plugs (red); (L) 20mm fuses and chassis fixing fuseholders; (M) miniature mains transformer; (N) monetary action push switch; (O) two versions of $\pm 100\mu A$ meter; (P) PP3 battery connections; (Q) miniature loudspeaker.



COMPONENTS

LIST A

Potentiometers

VR1 $1k\Omega$ carbon lin. VR2 $100k\Omega$ carbon lin.

Diodes

D1, D2 0-2 inch red light emitting diodes including fixing bush/ clip (2 off)

Sockets

SK1 to SK25 1mm nut-fixing sockets 16 red, 9 black (25 off) SK26 3-pole mains

3-pole mains floating socket

Plugs

PL1 to PL25 1mm plugs 16

red, 9 black (25 off)

3-pole mains panel mounting plug (to suit SK26)

Switches

PL₂₆

S1 s.p.d.t. toggle

S2 momentary action pushto-make, release to-break

Meter

ME1 100-0-100 µA to 250-0-250 µA moving coil meter

Loudspeaker

LS1 miniature moving coil speaker, impedance 40 to 80 ohms

Transformer

T1 mains primary/20-0-20V 30mA secondary (R.S. 196-280)

Fuses

FS1, FS2 100mA 20mm fuse with chassis mounting holders (2 off)

Batteries

B1, B2 9V type PP3 (2 off)

Miscellaneous

5 metres p.v.c. covered stranded wire, 7/0·2mm, selection of insulation colours; 1 A mains cable approx. 2 metres; knobs, with index spot or line (2 off); battery connectors to suit B1, B2 (2 pairs); 6BA fixings (4 sets) Eurobreadboard

For suppliers of complete kits see page 630

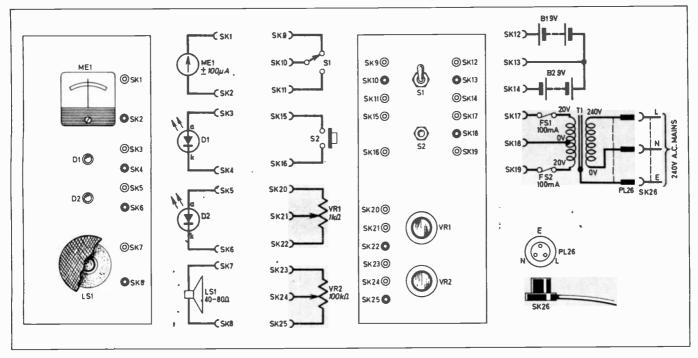


Fig. 4. The circuit diagram of the Tutor Deck showing connection points on the top panels.

nuts/clips provided in the case of the potentiometers, sockets, l.e.d.s and switches and small metal clips in the case of the speaker—if provided. Alternatively the speaker will need to be glued in place.

The meter fixing will vary as to the type. If there are no obvious fixing holes then it may be necessary to make a small bracket out of metal to hold the meter in place. Alternatively it can be glued in place. Next wire up all the components as shown in Fig. 5. Note carefully how the transformer is wired to the 1mm sockets. It is the secondaries (marked 20V 0 20V) which go to the sockets (via FS1 and FS2). The primary marked 0, 240V goes to mains input chassis mounting plug.

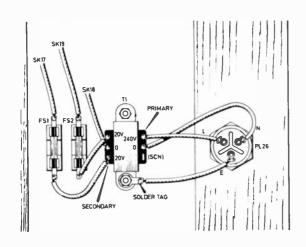
BREADBOARD FIXING

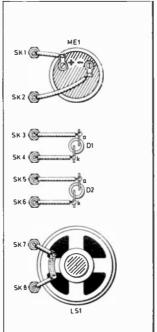
The breadboard is fitted to the centre sliding section. Countersunk bolts pushed up through the board into the breadboard with the nuts at the top can be employed. Make

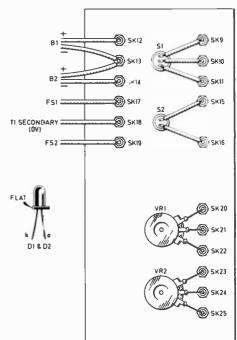
sure the heads of the bolts are flush with the board or the panel will not slide in. Alternatively, a neater appearance will be obtained if the breadboard is glued in place.

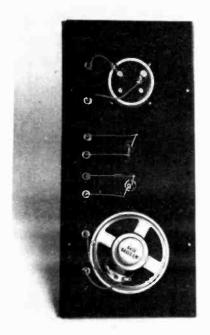
Double-sided Sellotape or selfadhesive pads can be used. These will allow the breadboard to be removed at a later date, if required, without damaging the protective rubber backing. Some readers may wish to leave the breadboard free and be able to store it in the compartment be-

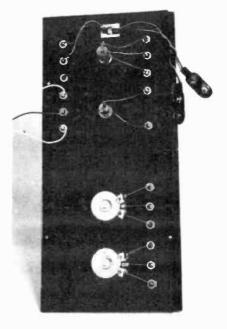
Fig. 5. (right) The wiring on the underside of the top panels. Pay special attention to the polarity of the l.e.d.s and meter; (below) shows the wiring up to the mains inlet plug to the transformer. Extreme care and attention should be paid to this operation as a wrong connection could prove dangerous and disastrous. The position of the transformer on the base panel is critical to avoid any contact with top panel components.



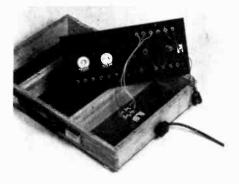




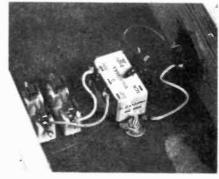




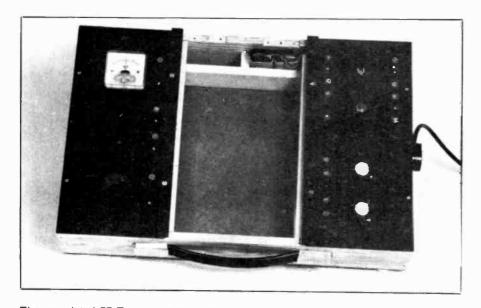
Shows the wiring on the underside of the prototype top panels.







Wiring to and from the transformer in the prototype Tutor Deck.



The completed EE Tutor Deck with centre panel removed showing storage and battery components.

neath at the end of their experiments. The rubber backing is slip-resistant.

CONNECTING LEADS

The next task is to make the connecting leads. There are 25 sockets on the Tutor Deck and in the event that all will be in use, 25 connecting leads fitted with a plug at one end should be constructed.

P.V.C. stranded wire is recommended as this is more flexible than the solid core type and less likely to fracture with frequent use. Lengths of about 200mm should suit all needs.

A short length (3mm) of the insulation should be removed from one end and the strands neatly twisted together. This requires "tinning"—heating the wire and allowing the solder to flow on to the wires to effectively form a solid core. This is then soldered to the plug.

The other end of the wire should be stripped—about 5mm—twisted and tinned in the same way. This can then easily be pushed into the "sockets" on the breadboard.

A selection of colours should be used, possibly red and black for connection to polarised components, e.g., the meter, l.e.d.s, d.c. power supplies — the negative (-9V) lead preferably being a third colour.

For the a.c. connections, same colour for each 20V outlet and a different colour for the 0V outlet.

Use of as many other "coloured" leads would allow instant recognition of lead function during experiments.

Besides these "plugged" leads a number of different shorter lengths are required to be used for interconnections on the breadboard itself. These need to be stripped about 5mm at each end, twisted and tinned as before.

For neatness and convenience all the leads can be placed in a polythene bag and kept along with a selection of tools and the mains cable (when not required) in the Tutor Deck storage compartment.

It only remains to label the functions on the top panels. Letraset or a similar rub-down lettering is suitable, and can be applied directly to the painted hardboard.

See next page for the start of Teach-In 80.



THE NEWCOMER to electronics is faced with a truly bewildering array of interesting devies which, with little or no knowledge of the subject, must remain nothing more than useless pieces of hardware.

In this series it is hoped to give some insight into the basic principles of electronics with particular regard to the uses of components in practical circuits. To this end a special Tutor Deck is used to construct circuits and it is recommended that the building of this deck be carried out as soon as possible so that the practical examples in the series can be copied and learnt from.

ELECTRONICS AND THE CONSTRUCTOR

To understand fully the new semiconductor technologies which have enabled industry to set its sights on million-transistor integrated circuits by the mid-nineteen eighties, it is necessary to have a deep understanding of the physical basis of matter.

The semiconductor designer needs to know intimately the workings of the atom and to do this he must have an excellent grasp of highly complex physics and mathematics.

We, as constructors, only wish to make use of the devices he has designed and, though a thorough understanding of semiconductor principles is required if one wants to get the most out of a device, there are certain guidelines which enable us to understand and build perfectly good, though maybe not optimum, circuits.

It is the purpose of this series to introduce such guidelines.

THE ELECTRON

Fundamental to the whole of electronics is the tiny fragment of the atom which we call the electron. The electron, being an extremely small entity, is difficult to describe in terms of physical quantities which we are familiar with in everyday life.

Terms like mass, size and even position are really not precise terms when it comes to describing atomic particles. Indeed, scientists today are still searching for new and better ways of visualising the electron.

However, certain attributes of the electron have enabled it to be defined as having a mass so small that 1,840 of them would be needed to equal the weight of even the lightest atom, hydrogen. How then can anything so small be so powerful?

The answer to this can be split into two halves. First, individual electrons are rather insignificant; it is only when vast numbers of them move in unison that exciting things happen. Secondly, it is not the mass of the electron that gives it its usefulness but its strange property which we call electric charge.

Electrons each possess a tiny quantity of negative electricity. Atoms are normally electrically neutral because the charge on the electrons is exactly balanced by the positive charge in its central core which is called the nucleus. The particles in the nucleus with positive charge are called protons but these are heavy particles whose energy is not so simple to harness as that of the electron.

The force which holds the electrons in an atom varies according to the position of the electron with respect to the nucleus and the type of atom which is being considered.

In some elements all the electrons are firmly bound to the nucleus but certain elements have electrons that seem to wander freely from atom to atom. In still other atoms the electrons are sometimes firmly held but can be made to move freely by certain forces. We shall see the significance of these variations later on.

All atoms contain electrons; indeed, it is the electrons which determine the *chemical* as well as *electrical* properties of matter.

ELECTRIC CHARGE

When two charges are brought near to each other they are found to either repel each other, if the charges are the same, or attract each other if they are opposite. This effect can be described by imagining a field of force existing in the vicinity of the charge. We call this field of force the electric field. It is the interaction of the electric charge with the electric field that gives the electron its complicated properties.

In electronics, we are not just interested in electrons at rest but much more so in electrons in motion.

In a solid whose temperature is above absolute zero, each electron

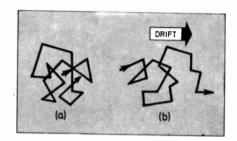


Fig. 1.1 (a) With no electric field electrons move around randomly with no net motion in any particular direction. (b) If a field is applied a slow drift is seen against the field.

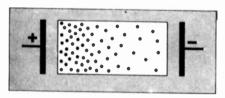


Fig. 1.2 Placing an electric field across a solid produces an uneven distribution of electrons as they try to neutralise the field.

is in continuous random motion; each electron moves around at vast speeds, colliding with other atoms as it goes (Fig. 1.1a). In this state it is impossible to see any overall change in the distribution of electrons—any particular volume has the same number of electrons as any other.

When an electric field is applied across the solid the random motion goes on but there is a general drift in the direction against the field (Fig. 1.1b). The velocity of the electrons is very high as they career about but the drift velocity is quite low.

The motion of the electrons continues until they have redistributed themselves so that the field they create exactly balances the external field. Now, if we look at the solid, we see more electrons in one part than in another (Fig. 1.2).

If the solid is connected to a source of electromotive force (e.m.f.), that is a generator of some sort which can absorb or supply charge for maintaining the internal electric field, then there is a continuous flow of charge circulating around the circuit. The flow of charge we call electric current (Fig. 1.3).

What has just been described is the simplest electric circuit: a piece of wire (the solid) placed across the terminals of a battery (the source of e.m.f.).

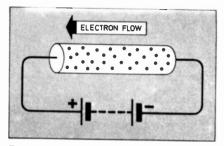


Fig. 1.3 Connection of a source of electromotive force (e.m.f.) across a conductor produces a steady flow of electrons. "The simplest electric circuit".

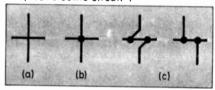


Fig. 1.4 (a) Circuit symbol for two lines crossing with no join. (b) two wires joined, direct cross-over—sometimes used but NOT recommended. (c) two wires joined—either of these "staggered" arrangements are preferred.

CIRCUIT SYMBOLS

To visualise the physical components in an electric circuit it is usual to use a symbolic representation of components.

A circuit diagram tends to represent real components as ideal components. For instance, connecting wire is represented by a solid line which we take to represent zero **resistance** to current flow. Batteries are represented simply as sources of e.m.f., the other properties such as resistance are ignored.

Remember that a circuit diagram of a given real circuit is simply an approximate representation of real components. Its usefulness lies in the fact that it enables us to make calculations about circuit performance which are perfectly good provided we realise that real components are not ideal. Of course, the circuit diagram can be elaborated upon so that real components are represented as many ideal components, but in simple circuits we need not be bothered by this.

Let us look at a few symbols used in circuit diagrams. Connecting wire, as stated above, is shown as a solid line. Where wires cross without any connection we just show two lines crossing each other. An electrical joint is represented by a black dot on the junction (Fig. 1.4).

A battery is represented by a series of identical cells—here the symbol reflects the physical con-



Fig. 1.5 The circuit symbol for a battery.

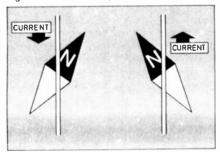


Fig. 1.6 A compass needle will be deflected by the magnetic field produced when current flows in a wire. The direction of the deflection depends on the direction of the current.

struction of the battery. The longer thinner line of the cell represents the **positive** (+) terminal and the shorter, thicker one the **negative** (-) (Fig. 1.5).

The labelling of the supply lines on a circuit diagram is something that can easily confuse a beginner. Two circuit diagrams may be encountered, both of which show a single 9V battery as the power supply but in one the lines are marked 0V and +9V, and in the other they are marked 0V and -9V.

The root of the confusion lies in the fact that if we take the positive terminal of a battery as a reference point and call it 0V then all voltages in a circuit diagram will be negative with respect to this reference.

If we call the negative terminal 0V then all voltages will be positive. Both notations occur because some circuit diagrams are easier to follow with all voltages positive whilst others become clearer with negative voltages. Both notations are equally valid.

Throughout the series extensive use will be made of circuit diagrams and as new components are introduced, their circuit symbols will be given.

UNITS

Quantity of charge is measured in units called **coulombs** (C). The charge on a single electron is very small indeed, it requiring over ten million, million, million (10¹⁹) to make one coulomb. However, there are vast numbers of electrons in matter—in metals there are about

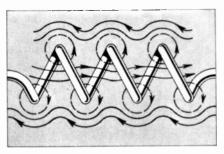
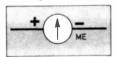


Fig. 1.7 The magnetic fields around the turns in a coil tend to add together.



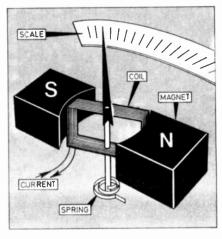


Fig. 1.8 A simple moving coil meter. The magnets produce a force on the coil when a current flows. The circuit symbol is shown alongside.

ten thousand million, million, million (10²²) conduction electrons in each cubic centimetre.

Current is defined as the rate of flow of charge. It is measured in amperes (A or amp), one amp being when charge flows at a rate of one coulomb per second.

In electronics, as opposed to electrical engineering, the ampere (or "amp," as it is usually referred to in speech) is often too large a unit to handle comfortably. We thus use sub-multiples of the amp: thousandths of an amp (milliamps or mA) and millionths of an amp (microamps or μ A). So, rather than saying that there are three thousandths of an amp we can say three milliamps (3mA).

Electromotive force is measured in volts (V). Volts are quite handy-sized units—batteries tend to be 1.5V, 3V, 4.5V, 6V, 9V and so on. But in electronic circuits often we come across thousandths of a volt (mV) and millionths (μV). We will come across the unit volt in connection with another electronic quantity, potential difference (p.d.) but, since this is closely connected with e.m.f. there is no reason to be confused.

When electrons flow they transfer energy. We call the rate at which energy is transferred the power—this being calculated by multiplying the current flow by the e.m.f. The units of power are called watts (W).

MEASUREMENTS

To understand the working of a circuit we need to be able to monitor the current flowing in each section of the circuit. There is no way of actually counting the electrons as they pass a particular point, so some indirect way of

measuring is used.

To measure current, use is made of another force field created by the flow of electrons. This differs markedly from the electric field described earlier and it introduces a new term: magnetic field.

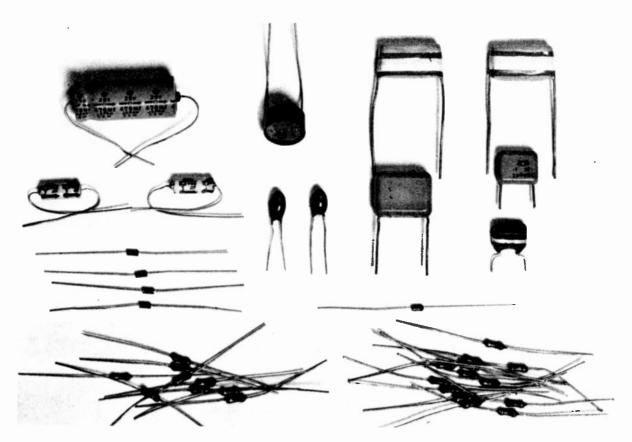
The earliest types of meter made use of compass needles which were in fact thin metal strips which had been magnetised by rubbing them with naturally occurring magnets. When a wire carrying current is placed over the compass needle a deflection from the natural direction of the needle is observed. If the direction of the current is reversed, then the deflection is in the opposite direction (Fig. 1.6).

Modern "moving coil" meters make use of the magnetic field created when a current flows but they are made far more sensitive by using coils of wire rather than a single wire.

Fig. 1.7 shows how the current through each turn of the coil increases the magnetic field. The stationary magnet causes the coil to produce a twisting force about its pivot which is resisted by a fine spring. The greater the current the greater the twisting force and hence the greater the movement of the needle across the scale (Fig. 1.8).

A meter is really converting electrical energy into mechanical movement and thus it must absorb some power. The amount of power the meter takes depends on the type but it should always be remembered that meters affect the currents in a circuit although, hopefully, the effect is negligible.

Modern digital meters are more subtle in the way they make their measurements. In them there is a



The components required for the experiments in the first 6 parts of Teach-In 80. These have been designated List B. The non-polarised capacitors (shown top right hand corner) show alternative types, namely metallised polyester type C280 and moulded cased metallised polyester.

stable, accurately set voltage reference. An ingenious circuit compares the effect of the voltage to be measured with that of the reference voltage.

Other ways of measuring current are available nowadays. One particularly clever one uses a tiny chip of silicon which produces a voltage proportional to the magnetic field through it. Since magnetic field is proportional to current, the probe is simply placed on the wire and current read off.

SOURCES OF ELECTRICAL ENERGY

An electric circuit can be summarised as a source (or many sources) of electrical energy connected with one or more absorbers or dissipators of electrical energy.

Ideally, sources of energy would supply current at a constant voltage no matter how great the current flow was. However, actual sources are far from ideal and the limitations which this implies should be realised.

Chemical

A chemical cell which can produce electric energy is extremely useful as it can be easily transported, is relatively cheap and needs virtually no attention. The common battery is simply a set of such cells connected together to give a useful voltage.

If a PP3 type 9V battery is cut open and examined it will be seen to have six cells. Each one in fact has a voltage of only 1.5V; they are connected in such a way as to add all the individual voltages together. A PP3 can only supply few tens of milliamps. If one tries to draw a greater current then the voltage falls off rapidly.

A car battery can supply far more current because of its much greater physical size. It is also reversible in that it can convert electrical energy back into chemical energy. This process we call charging.

The *voltage* of a cell is determined by the materials from which it is made—not by its physical size. Only the *power* it can supply depends on its physical size.

Mechanical

Virtually all our homes are fed with a ready source of electrical

energy which we call the mains supply. The major proportion of the electrical energy distributed

COMPONENTS NEEDED FOR EXPERIMENTS UP TO PARTS 6 (LIST B)

Resistors

1 off 10 ohm 2 off 680 ohm 10 off 1 kilohm 4 off 10 kilohm 2 off 33 kilohm

2 off 100 kilohm 1 off 1 megohm All ‡W carbon ± 20%

1 off ORP12 light dependent resistor

Capacitors

2 off 0·1μF polyester film type C280, 2 off 0·47μF polyester film PM:T/2R.

2 off 1μF 25V electrolytic, axial lead (63V would suit)

1 off 470µF 25V electrolytic, axial lead

2 off $33\mu F$ 10V tantalum bead

Diodes

4 off 1N4148 or similar silicon diodes
1 off 5·1V 400mW Zener diode

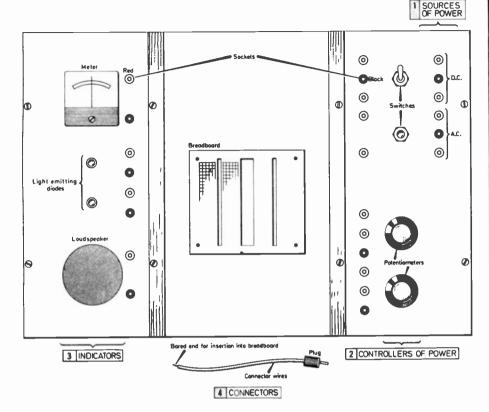


Fig. 1.9 The three types of component on the Tutor Deck.

about the country is produced by machines which convert mechanical energy (produced in its turn from heat) into electrical energy.

Vast rotating machines called generators are used and they produce a special kind of voltageone that changes direction a hundred times a second. When this type of voltage produces a current in a load we call it alternating current, or a.c. for short. One often sees the slightly confusing phrase a.c. voltage. This strictly should be alternating voltage but a.c. voltage and d.c. voltage (d.c. being direct current, that is a current that flows continually in one direction) are in such wide use that the meaning is quite clear.

Light

It is possible to convert light directly into electricity without any intermediate stages. We call the devices that do this solar cells and, in these days of dwindling fuel supplies, these devices are destined to become much more widely used.

Heat

Heat energy can also be converted directly into electrical energy without the need to go through the wasteful step of first

converting it into mechanical energy.

When two different metals are placed in contact with each other an e.m.f. is produced. If the junction is heated then the e.m.f. goes up. In fact, to make use of this e.m.f. we need another junction which is usually held at a low temperature in order to eliminate the e.m.f.s produced where the metals used join with the rest of the circuit, which is usually copper.

The device described is a thermocouple and when a large number of junctions are connected together a device known as a thermoplie is formed. As yet, this type of device has not been used as a source of power, probably because of its cost.

THE TUTOR DECK

Looking at the Tutor Deck it will be seen that there are basically three types of components.

- (1) sources of power, both d.c. and a.c.
- (2) controllers of power and
- (3) indicators (Fig. 1.9).

In fact, virtually all electronic components can be classified in one of these categories, although some may be in more than one.

PART 1 QUESTIONS

- 1.1. Electrons are:
 - a) Tiny pieces of metal
 - b) Part of an atom
 - c) Part of the nucleus?
- 1.2. The following atoms contain electrons:
 - a) Copper
 - b) Uranium
 - c) Silicon
 - d) All of these
 - e) None of these?
- 1.3. Electric current is:
 - a) Electrons moving randomly
 - b) Electrons flowing in a straight line
 - c) Electrons moving randomly but drifting in a given direction?
- 1.4. Current is measured in:
 - a) Coulombs
 - b) Amperes
 - c) Volts?
- 1.5. The voltage of a battery depends on:
 - a) Its size
 - b) The materials from which it is made
 - c) How many cells it contains?

A fourth important circuit element is, of course, the connector. On the Tutor Deck the connections are made with wires which plug into the breadboard. These go through 1mm plugs and sockets into wires which are soldered to the actual components inside the deck.

Again, this illustrates the types of connection found in all pieces of electronic equipment—solder joints where components are never (or very rarely) to be removed and plug and socket joints where either components need to be frequently interchanged or where access to certain parts of the equipment would be otherwise impossible.

In Part 2 we will look at ways of controlling the flow of electrons and in particular at various types of resistor.



IMPEDANCE VOLTMETER

T is perhaps not generally realised, particularly among newcomers to electronics, that d.c. voltage measurements made using an ordinary multimeter can provide erroneous readings under certain circumstances. The most common cause of such erroneous readings is due to circuit loading. This is where the voltage to be measured is significantly altered when the multimeter is connected into circuit.

Thus, although the multimeter correctly indicates the test voltage, this reading is nevertheless a false one as it is only produced while the multimeter is connected to the circuit under test.

CAUSE OF ERRONEOUS READINGS

This effect is only produced when a high impedance circuit is being checked, and the manner in which it occurs is illustrated in Fig. 1. This shows the circuit diagram of a typical high input impedance emitter follower buffer amplifier.

Circuits of this type are usually designed so that the impedance of resistor Ra is roughly equal to the combined parallel impedance of resistor Rb and the input impedance of the transistor. By a simple potential divider action about half the supply potential appears at TRa base, or about 4.5 volts in this example.

If a standard 20 kilohm/V multimeter switched to the 5 volt range were to be used to measure the voltage at TRa base it would give a reading of about 1 volt instead of 4.5 volts. This is because the

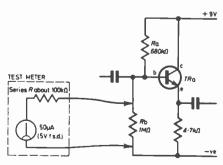


Fig. 1. A testmeter does not always provide reliable readings, as demonstrated here.

multimeter would consist basically of a 50 microampere meter connected in series with a resistor having a value which would give a total meter-resistor series resistance of 100 kilohms.

The total circuit resistance has to be 100 kilohms as it can be shown from Ohm's Law that 5V will then be required in order to force 50μ A through the circuit, and thus produce full-scale deflection of the meter ($I \times R = V$, $0.00005A \times 100,000$ ohms=5V). In other words the multimeter has a sensitivity of 20 kilohm/V, as 20 kilohm of resistance is needed for each f.s.d. volt.

When the test meter is connected to the amplifier circuit its resistance of 100 kilohms is shunted across Rb and the input impedance of TRa. Ra was formerly feeding a combined parallel resistance of about 680 kilohms, but this is now reduced to about 87 kilohms by the presence of the multimeter circuit. By a simple potential divider action only about 1 volt is now produced at the base of TRa. The test meter then correctly, but misleadingly, produces a reading of about 1 volt.

ELECTRONIC VOLTMETER

This problem can be overcome by using an electronic voltmeter when making measurements such as this. An electronic voltmeter has an amplifier added ahead of the meter movement in order to boost the input impedance to a very high level. The input impedance of the unit is then too high to be of significance even when testing high impedance circuits.

The electronic voltmeter described in this article has an input impedance of a little over 11 megohms and it provides six d.c. measuring ranges. These are 0 to 250mV, 1V, 2·5V, 10V, 25V and 100V. This corresponds to sensitivities of between 44 megohms/V and 110 kilohms/V(approximately), which compares very favourably with the 20 kilohms/V of a standard multimeter. It should certainly be sufficiently sensitive for all voltage measurements the amateur is likely to encounter.

The voltmeter can also be used for a.c. measurements, but note that the f.s.d. values are doubled when the unit is switched to the a.c. mode (i.e. the a.c. ranges are 500mV, 2V, 5V, 20V, 50V and 200V). The unit is only suitable for use at audio frequencies.

THE CIRCUIT

The circuit diagram of the high impedance voltmeter is shown in Fig. 2. This breaks down into three main sections, the central one being the amplifier stage. This uses operational amplifier ICl as a unity gain non-inverting amplifier.

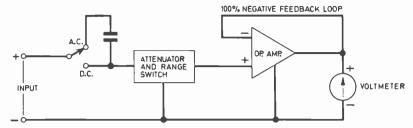
In this configuration the input signal is applied to the non-inverting (+) input and the inverting (-) input is coupled to the output so as to provide a 100 per cent negative feedback loop. This gives the circuit a voltage gain of unity, so that whatever the input voltage is, the output voltage is identical to it

However, the output is at a low impedance and is capable of driving a simple voltmeter circuit. The input impedance of the amplifier is extremely high, the actual figure being typically 1.5 Tohms (1.5 million megohms).

R16, VR1, and ME1 form the last stage of the unit, which is a conventional voltmeter circuit. VR1 is adjusted to produce a f.s.d. sensitivity of 250mV, and this provides the circuit as a whole with a basic sensitivity of 250mV.

In order to extend the voltage range of the unit a six-position step-type attenuator is added at the input, and this is formed by R1

HOW IT WORKS



An operational amplifier i.c. forms the basis of the circuit. This is connected with 100 percent negative feedback so it provides no voltage gain, but its input impedance is so high that no significant input current flows. The unit therefore places very little load on the circuit under test. The output of the unit is fed to an ordinary voltmeter circuit. An attenuator added ahead of the amplifier provides the unit with six measuring ranges.

For a.c. measurements a d.c. blocking capacitor is switched in series with the input. As the circuit only responds to positive input half cycles it provides half-wave rectification, and so no separate rectifier is required.

to R14. S2 is the range switch, which selects the appropriate attenuator output.

A.C./D.C. SWITCHING

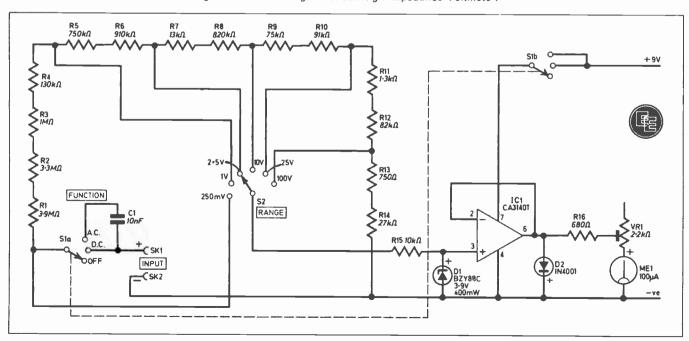
Sla is used to provide a.c./d.c. switching. In the d.c. mode the positive input socket SK1 is connected direct to the input of the attenuator. In the a.c. mode the input is applied to the attenuator via C1 which blocks d.c. signals but permits a.c. signals to pass.

Positive-going half cycles will take the input and output of the IC1 positive, and will cause a deflection of the meter.

Negative-going half cycles will take the input of the amplifier negative of the earth line, but obviously the output cannot do so as this circuit has only a positive supply, and not the usual (for opamps) dual-balanced positive and negative supplies. Thus the circuit provides rectification. However, it is only half wave rectification, and so the f.s.d. sensitivity of the circuit is twice as high as it is in the d.c. mode.

Readers who are familiar with op-amp i.c.s such as the 741C may wonder how this circuit is capable of operating using only a single supply voltage. The reason is





HIGH IMPEDANCE VOLTMETER



Front panel layout and annotation of panel mounted components.

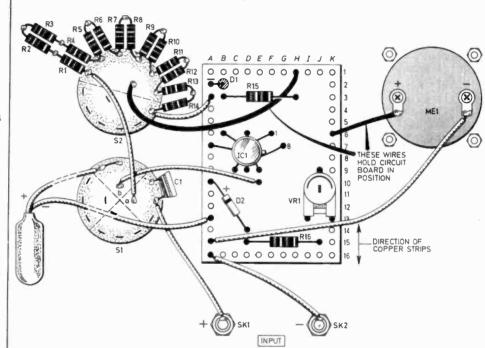
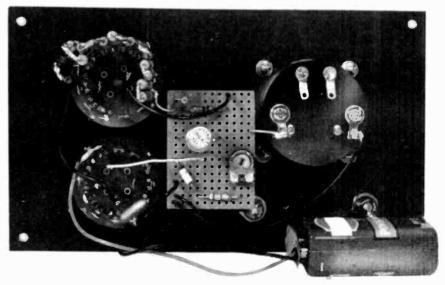


Fig. 3. Constructional details of the High Impedance Voltmeter.



Interwiring and component board positioning details. The range resistors are mounted directly on the switch.

COMPONENTS

Resistors

 $3.9 M\Omega 5\%$ R1 $3.3M\Omega$ 5% R₂ 1MΩ 5% 130kΩ 5% **See** R3 R4 R₅ 750kΩ 2% R6 910kΩ 2% 13kΩ 5% 820kΩ 2% R7 R8 75kΩ 2% R9 page 630 R10 91kΩ 5% 1·3kΩ 5% R11 R12 82kΩ 2%

R16 680Ω 5% or 10%

7500 5%

27kΩ 29

R15 $10k\Omega$ 5% or 10%

All 1 or 1 watt, tolerance as indicated, or better

Potentiometers

VR1 2·2kΩ sub-miniature horizontal preset

Capacitor

R13

R14

C1 10nF plastic foil

Semiconductors

IC1 CA3140T CMOS operational amplifier

Zener diode BZ88C3V9 (3.9 volt 400mW)

D2 Rectifier diode 1N4001

Switches

S1 3-way 4-pole rotary type (only two poles used)

6-way 2-pole rotary type (only one pole used)

Miscellaneous

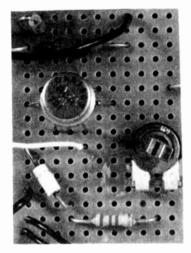
ME [*100//A moving coil meter. Sloping front case or similar housing about 160 . 95mm. $\check{6}0 \times 45$ mm. Two control knobs. Two 2mm wander sockets, test prods; etc. 0.1in. matrix stripboard (16 holes / 11 strips). PP3 battery and connector to suit. Wire, solder,

simply that the CA3140T i.c. has a p-channel mosfer input stage which enables it to operate with its inputs at voltages as low as the negative supply rail.

Ordinary op-amps having bipolar input stages cannot operate correctly with the inputs at voltages of less than about 2V. Also, the outputs of most op-amps will not go to within about 2V of the negative supply rail.

The output of the CA3140T will swing to within a few millivolts of the negative supply rail, so there is no significant voltage across the meter with no input

signal. Apart from obviating the



The completed circuit board.

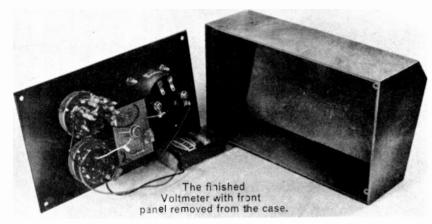
need for a negative supply, this also means that no electrical zeroset control for the meter is needed.

OVERLOAD PROTECTION

In order to protect the i.c. against accidental input voltage overloading, a simple Zener clip-clipping circuit has been added at the non-inverting input. This consists of R15 and D1, which clip the input at 3.9V in the event of a serious overload.

This circuit also protects the unit against overloads of incorrect polarity, as in such an event D1 acts as an ordinary forward-biased silicon diode, and clips the input voltage at about -0.6V.

The meter is protected against severe overloading by D2, which limits the output voltage of the i.c. to about 0.5V. This limits the current through the meter to about double its f.s.d. value, and this is not sufficient to damage the meter, even if sustained for some time.





CASE

A plastics box measuring $160 \times 60 \times 85$ mm and having a sloping aluminium front panel is used as the housing for the prototype Voltmeter. The general arrangement of the unit can be seen from the photographs. The meter requires a large 38mm diameter cutout, and this can be cut using a fret-saw or a miniature round file. The input sockets are ordinary wander types.

WIRING

Some of the components are mounted on a 0-lin matrix stripboard which has 16 holes by 11 copper strips. The other components are wired up on the two switches. All the wiring is shown in Fig. 3.

The leadout wires of R1 to R14 must be cut fairly short if these components are to fit neatly into the available space. This makes it important that they are soldered into place quickly and efficiently, as otherwise they could be adversely affected by the heat from the soldering iron. It is advisable to clean the ends of the leadouts and tin them with solder prior to making a connection.

Construction of the component panel is commenced by carefully cutting out a panel of the correct size using a small hacksaw. Any rough edges are then filed flat. (There are no breaks in any of the copper strips and no mounting holes are drilled in the panel.) The six components are then soldered into position.

The remaining wiring can then be completed, with the leads which connect the panel to the wiper of S2 and the positive meter terminal being left until last. These leads are made from thick, single-strand wire (a couple of pieces cut from the attenuator resistors will do) and they should be as short as possible. They will then provide the component panel with a firm mounting.

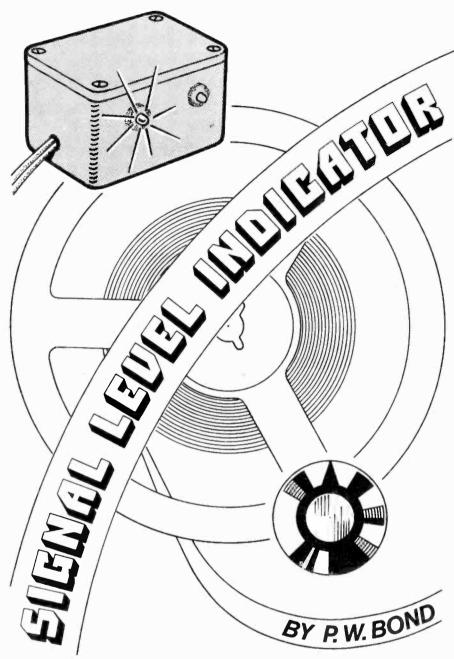
Current consumption of the unit is only about 2.5mA and so a PP3 battery can be used as the power source, and will have a long life.

ADJUSTMENT

Switch the unit to the 250mV range, short the test prods together, and then switch the unit on. A small positive deflection of the meter might then be noticed, although at worst this should be hardly perceptible. In the event that a small meter deflection is produced, this can be offset by mechanically zeroing the meter.

In order to calibrate the unit it is necessary to have a suitable calibration voltage. This could, for example, be a 9V battery, the exact voltage of which has been checked using a multimeter. With the high impedance voltmeter switched to the 10V range and the battery connected to the test prods, VR1 would then be adjusted for the appropriate voltage reading on the unit.

If desired, the front of the meter can be unclipped and the scale plate removed so that additional scales can be added. However, this is not essential as it is quite easy to convert meter readings into the voltages they represent. \square



When making recordings on cassettes or spool tape it is necessary to control carefully the recording level so that distortion does not occur or, on the other hand, the signal does not get lost in the hiss of unmagnetised tape. This project describes a cheap unit which helps the process of recording by providing a visual indication of the level of the signal source.

AUTO OR MANUAL CONTROL

Many domestic tape and cassette recorders have only two heads, as opposed to three on professional and semi-professional machines. One head is used to erase the tape and the other is a combined record and replay head.

Where the combined head is used the only way of ensuring that distortion does not occur is to monitor and adjust the recording level control. The adjustment of the recording source level can be done in one of two ways.



First, a simple manual volume control can be used which requires the operator to adjust the level to produce a satisfactory recording. Secondly, a system which requires no adjustment is automatic volume control or a.v.c.

AUTOMATIC VOLUME CONTROL

The a.v.c. method has its advantages and disadvantages. For recording an interview or outdoor sounds into a microphone a.v.c. is ideal. The electronic circuit in the a.v.c. changes the recorded signal loudness in response to the level of the signal from the microphone.

When the a.v.c. is used with a recording of music though, the compressing effect causes the sound to be jumpy and with classical music this effect is irritating.

To take full advantage of cheap electronics the present trend is for recorder manufacturers to use both systems. The choice is then left to the user, but for optimum results when recording music it is best to use the manual control.

MANUAL CONTROL

To get good results the manufacturer will recommend that the signal is to be kept to limits as indicated on some form of meter. In many instances this meter is inaccurate or too small and is therefore pretty useless for people with poor eyesight. Whilst a larger indicator such as a VU (Volume Unit) meter would be ideal, it could still be difficult to see unless lit from behind. And what is more, there may not be sufficient room to fit one on the machine.

The unit described here enables the correct recording level to illuminate a light emitting diode dimly. If the signal is too low then the l.e.d. will not light-up at all, and if the level is such that a distorted recording will be made then the l.e.d. glows brightly.

The l.e.d. is physically quite small and could be incorporated into a tape deck if the associated circuit board can be accommodated. The author's prototype was to be used with an open reel recorder and the unit was built into a cassette case with the power supply being derived from the tape recorder. There are many variations on the design and the actual boxing it not critical, but

remember that if the unit is to be battery operated then there must be enough room for the PP3 battery.

STEREO OR MONO VERSIONS

Since there are a number of stereo cassette and open reel tape decks on the market it seemed a good idea to build a stereo signal indicator and this is described in the article. However, since the signal indicator was designed initially for a mono tape recorder and some readers may wish to construct the mono only version this is easily accomplished. The stripboard is divided and only the section indicated needs to be built for mono use.

negative half cycles of the input waveform cause TR1 to conduct less collector current. The collector voltage of TR1 thus rises and allows C2 to charge and TR2 to conduct.

With very large signals applied to the input from the signal source, TR1 is allowed to switch off completely and the voltage at its collector will be allowed to rise to the supply rail voltage. C2 is allowed to charge to the supply rail voltage but in practice it only attains a value of about 2.5 volts and this causes the l.e.d. to glow at its brightest.

SLOW DECAY

If the signal returns to a low level, the collector voltage of TR1

falls to 0·1 volt again. However, D2 prevents C2 from discharging rapidly and the voltage at the base of TR2 decays fairly slowly. The l.e.d. thus dims and so indicates that the signal level returns to normal.

The slow decay feature was incorporated to prevent the l.e.d. from flickering—this could be an annoyance to the person making the recording.

VR1 is pre-adjusted so that only high level source signals which would produce a distorted recording produce a very brightly lit l.e.d. More is said regarding the setting of the signal indicator in the last part of this article.

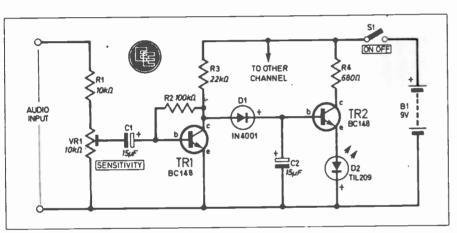


Fig. 1. Circuit of the Signal Level Indicator-mono version.

CONSTRUCTION

The original unit was a mono signal indicator and was used in a mono recorder. However, there is so much stereo equipment in use these days that it seemed more useful to have a stereo signal indicator. It is the stereo signal indicator that is described here.

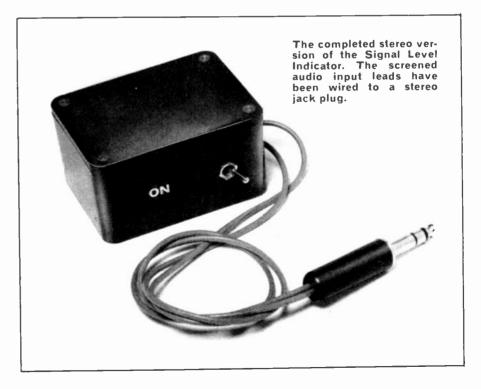
CIRCUIT DESCRIPTION

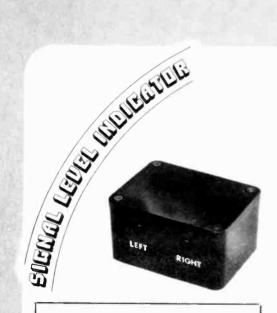
Referring to Fig. 1, this shows the circuit for one channel. For a stereo version, this circuitry is duplicated, save for the battery B1 and the switch S1 which are common to both channels.

The signal indicator unit is connected to a low impedance monitor point on the tape deck, and a socket is often provided for this purpose. Alternatively, the headphone socket could be used.

The input signal is applied to the input of the circuit and the level is adjusted by R1 and VR1; the latter acts as a preset sensitivity control. Under quiescent, nosignal conditions, the transistor TR1 is biased to be conducting and the collector voltage is only about $0 \cdot 1$ volt. Consequently TR2 is held non-conducting and the l.e.d. D2 is not lit.

When the signal is applied to the unit, the amplitude of the





COMPONENTS

Resistors

R1 $10k\Omega$

R2 $100k\Omega$ R3 $22k\Omega$

R4 680Ω

All ‡W carbon ± 5%

Potentiometer

VR1 10k Ω lin. preset (horizontal mounting)

Capacitors

C1 15µF Tantalum C2 15µF Tantalum Both 10 volt wkg.



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Semiconductors

TR1 BC148 npn silicon transistor

TR2 BC148 npn silicon transistor

D1 1N4001 diode

D2 TIL209 Red light emitting diode (with Bezel)

Note that for a stereo indicator two of each of the above components will be required.

Miscellaneous

B1 PP3 9V battery
S1 Single-pole switch
(miniature SPST)
Stripboard, 17 holes 19
strips. Case, 80mm 2 40mm 2
60mm approx. Screened lead,
plug & socket as necessary.

PP3 Battery connector. Wire.

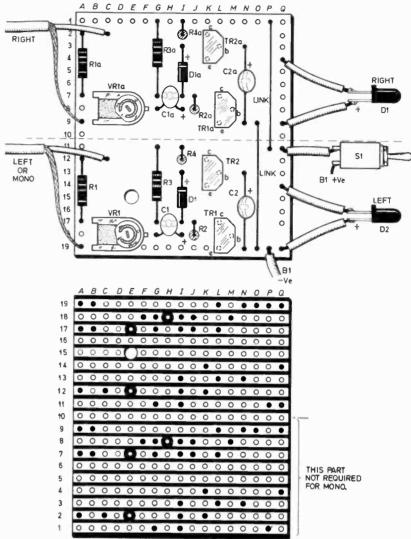
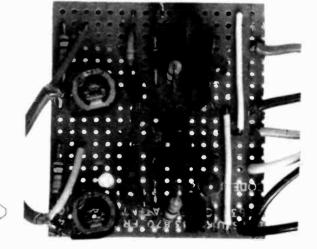


Fig. 2. The stripboard with components in position and view of underside showing breaks in the strips.



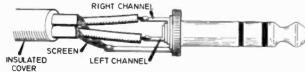


Fig. 3. Jack plug connections.

Completed circuit board for the stereo version.

The unit was built into a small plastics case and connection to the tape equipment was made with two screened leads, with a jack

plug.

Two complete signal indicator circuits (Fig. 2) are built side by side on a piece of stripboard only 19 strips by 17 holes, and this left ample space for a PP3 battery inside the case. The use of 0.1 inch matrix stripboard enabled the BC148 transistors to be mounted properly. The BC148 is almost the same as a BC108 in its basic parameters but it has a plastic case which does affect the package dissipation which can be tolerated. In this project though, this is not important, and it is a few pence cheaper than the BC108.

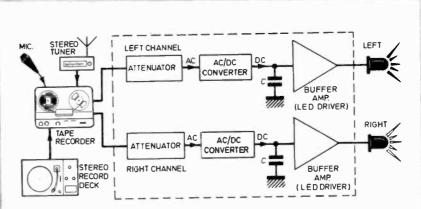
LOCKFIT TRANSISTOR

When the BC148 was designed, it was to be functionally identical to the BC108 but with a special lead. This comprises a flat metal leadout wire so shaped that if it was pushed through the appropriate hole, the lead would lock into place and so support the transistor. The base, emitter and collector are arranged in a triangle like the BC108, but each lead has the self support property known as "Lockfit." When the transistors are mounted, the leads should be carefully pushed into the holes in the stripboard so that the leadout wire end just protrudes on the copper side of the board.

MOUNTING RESISTORS

In order to conserve space on the board, there are certain resistors which are mounted vertically and this entails bending the leads back through 180 degrees. In some cases if the lead is bent too close to the body of the resistor, the connection to the composition inside the resistor can undergo damage. This applies to all cases where resistors are mounted in this way. The risk of damage is avoided if the lead is bent about 3mm away from the body of the component.

The stripboard is drilled in accordance with the diagram in Fig. 2 and the breaks in the strip are indicated on the same figure. For a mono signal indicator the lower half of the stripboard need only be used, which has a mounting hole for securing the unit to the case or equipment.



HOW IT WORKS

The signal from the source to be recorded is monitored by the Signal Level Indicator and a visual indication of very loud signals, liable to produce distortion, is given by a light emitting diode. When the I.e.d. lights brightly, the operator must adjust the controls of the tape dechand reduce the signal from the microphone, tuner or record deck until the I.e.d. dims.

The input signals are fed to the indicator where their level is adjusted by a potential divider which forms a kind of attenuator. The signals are then presented to the input of an a.c./d.c. converter. This changes the alternating currents of the signal to a proportional voltage which has

only one polarity.

This unidirectional voltage is used to charge a capacitor C. Connected to the capacitor is a buffer amplifier which monitors the voltage across the capacitor, and produces a current which is sufficient to illuminate the light emitting diode. The brightness of the l.e.d. is controlled by the amplitude of the signals coming from the input to the tape deck.

The signal may reduce to a quiet level due to adjustment by the operator, or simply the source signal itself reduces in level naturally. The charge on the capacitor then dies away slowly and the l.e.d. dims proportionately.

The block diagram shows a two-channel version of the Signal Level Indicator. A mono version can be built simply by omitting one channel.

LIGHT EMITTING DIODES

connections are wiring shown in Fig. 2. Note that the l.e.d.s have a polarity and must be wired the correct way or they will never emit any light. The l.e.d.s should be supplied with a bezel and this is used to support the device in position on the case, front panel or whatever. In this project the l.e.d.s have to be mounted on the side of the case to allow the lid to be easily removed for the gain adjustments to be made. The l.e.d.s are the TIL 209 type and the cathode (marked "+" on the diagrams) is identified by a notch or flat on the body, or other distinguishing mark.

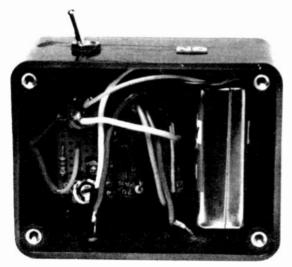
OBSERVE POLARITIES

The transistors and diodes have their polarities indicated on the wiring diagram. Small tantalum bead capacitors have been used. These have a polarity too, and this must be observed when wiring into position.

Some types of this component have colour codes, and no written identification is put onto the body of the component. A coloured spot on the body of the capacitor indicates the multiplication factor of the colour codes. Assuming that the value supplied is correct the anode is the lead which is on the right, when the spot on the component is nearest the viewer.

The l.e.d. leads can be colour coded and the choice of colour is left to the constructor but a simple colour code is Red for Right and Lemon for Left. This code could be the same as the input leads.

The battery was secured with double-sided adhesive tape since it is a very light component. Once the diodes and other components have been checked for polarity the unit can be tested. This procedure is described in the following section of the article.



The completed Signal Level Indicator (stereo version) with the top panel removed.

Care must be taken when positioning the circuit board to avoid damaging the light emitting diode leads. The position of the battery is also shown.

signal-to-noise ratio. In everyday language this means that the hiss or hum will appear to be quite loud in relation to the recorded sound.

Once the adjustment has been made the lid can be replaced and the unit need never be re-aligned with the same tape deck. The unit will allow persons who are not so technically minded to make good quality recordings. Remember—Red means distortion and demands that the record volume control needs turning back until the l.e.d. dims.

Once testing is complete and the unit is aligned as described, the circuit board can be secured with an insulated washer and a 6BA nut and bolt.

TESTING AND SETTING UP

The left- and right-inputs are connected to the monitor points on the tape deck, as suggested in the description earlier. The leads should be preferably taken to a socket or plug (Fig. 3) or, if the unit is to be permanent, they may be hard-wired.

When the unit is connected to the tape deck the microphone or chosen source should be connected to the recorder input. A trial recording should be made and the monitor unit preset potentiometers should be adjusted so that the very loud passages of source material cause the l.e.d.s to glow brightly.

On average undistorted passages the l.e.d.s should have a dim but fluctuating glow. On very low signals and hence very quiet passages the l.e.d.s should hardly glow if at all. This indicates that the recorded signal will have a poor

OTHER APPLICATIONS

The Signal Indicator could be used by the radio enthusiast as a signal strength indicator in a receiver. In the transmitter at the modulator, the unit can give a simple display of the level from the microphone amplifier and so prevent distortion.

In the disco, the unit could show the levels of the audio signal from the mixer console to the power amplifiers and thereby prevent overload distortion and possible damage to the power amplifier, and loudspeakers.

BRIGHT IDEAS

SCALES FROM SCRATCH

The appearance of many projects can be marred by the messy execution of panel legends and markings. As a Graphic Designer, the writer has used many lettering systems and methods, in the search for a perfect finish to various projects that are often examined by friends, for looks more than for effectiveness. In most cases, the most suitable method available for unique scales and markings turns out to be the use of 'Scraper Board.'

British Scraper Board can be purchased in packets from art shops and most stationers, and is available in a range of sizes from 150×100 mm to 610×480 mm, in black and white. Pack number five, for example, which costs about 50p, contains three sheets of black scraper board, one white, each 150×100 mm, and a cutting tool. Full instructions are given in every packet, but the basic idea is that you scribe through the black coated surface of the board, with the tool provided, or with a craft knife or similar, to reveal white beneath.

For starters, use the tool, in a pen holder, fixed to a school type compass for the arcs needed for marking scales round rotary potentiometers. A steel straight edge can be used for other lines. The basic outline required can first be drawn lightly with pencil. Mistakes can be touched over with felt pen or brushed Indian Ink. Lettering is best executed with

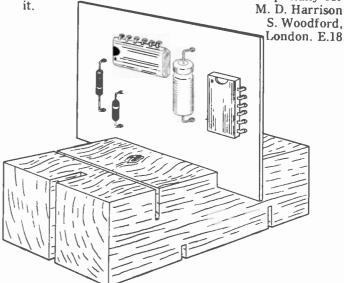
white Letraset, and the final touch is to give the panel a coat of spray-on varnish, to withstand rough usage.

The white Scraper Board can also be coloured with ink, brushed evenly, in any colour to suit the project box.

K. Croft,
Broadstairs, Kent.

PCB HOLDER

I have evolved a very simple but effective way of holding circuit boards while soldering. It consists of a piece of wood with slots of varying widths for different thickness of board, the drawing shows the general arrangement. The holder can be held in a standard vice, or a stand can be made especially for it



Everyday Electronics, October 1979



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	Prices
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BRUEL & KJAER 2203 Precision sound level meter	400
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to 2203 & 2204 4216 Artificial Mouth	25
#2624 Charge Amplifier	65
CEL	
112 LEQ meter-digital readout	450
Bridges etc.	
DAWE 210B Decade Capacitance box	
0 1 μF-1 mF 0.1 μfstep	20
MUIRHEAD	
D30A Wheatstone bridge test set	75
SULLIVAN	90
T1098 Decade resistance bridge	30
WAYNE KERR B601Z RF bridge to 5 MHz 1	
SR268 Source for B601Z	275
Cable Test Equipment	
MARCONI	
TF2091A/TF2092A White noise generator/receiver 300 channel	
system complete	350
#TF2333 Transmission Test Set	575
STC 74226B Telephone cable test set	120
#74216A Noise Generator CCITT	240
#74261 A Psophameter CCITT	475
Circuit Magnification	
MARCONI	
TF1245/46/47 'Q' Meter with Oscillators	525
Counter Timers	
HEWLETT PACKARD	
5263A Time interval plug in	60
MARCONI	170
TF2414A DC-40 MHz 7 digits TF2422 Frequency divider to 300 MHz	30
RACAL	
9024 10 Hz-600 MHz 7 + 1 digits	325
9059 DC-560 MHz with battery pack 9835 DC-15 MHz 6 digits	300 1 45
9B37 DC-80 MHz 6 digits	190
Function Generators	
HEWLETT PACKARD	
3300A 0 01 Hz-100 kHz sine square triangular	100
3301 Auxiliary plug-in	
Logic Analysers	
HEWLETT PACKARD	
1601L Logic state analyser 12 channel display	600
Mains Monitors	
AMPROBE	
LAV3X Mains voltage recorder	46
GEC FB31A Surge monitor records mains	
spikes + filter	85
RUSTRAK	
288 + CT Clamp-on AC recording ammeter	96
Modulation Meters	
AIRMEC	
#2101-300 MHz AM/FM	195
#409 3-1500 MHz AM/FM	325

am r		110111
	Oscilloscopes	
400 475	ADVANCE	2.
4/5	OS1000A DC-20 MHz dual trace COSSOR	3.
250	110/111 DC-20 MHz dual trace	3.
25	110/112 DC-1 MHz differential	2
65	HEWLETT PACKARD	
450	184A + 1801A + 1822A DC - 50 MHz	
400	system, T.B. and amplifier included storage facility (storage delirated	
	please ask for details)	68
	1707B20 DC-75 MHz dual trace D T B	70
20	1710B DC-200 MHz dual trace	125
	TEKTRONIX	
75	5103N/D15	
	Storage system 800 div/ms DC-2 MHz	38
90	7A13 DC-100 MHz differential	35
	comparator 78.70 Dual time base with 78.71 \	
275	delayed sweep (for 7000 series)	27
	536 Mainframe 11 MHz X Y	10
	5191 GHz Real Time Matching	
	accessories included	95 25
	535A/CA DC-15 MHz dual trace DTB 545B/CA DC-24 MHz dual trace DTB	35
350	585A/81 DC-80 MHz dual trace DTB	55
575	454 DC-150 MHz dual trace DTB	135
120	TELEQUIPMENT	_
240	D54 DC 10 MHz dual trace	24
475	D75 DC-50 MHz dual trace D T 8 (Portable)	56
	DB3 DC-50 MHz dual trace D T B	-
	(Bench)	57
	D53/CD/G DC-15 MHz Dual Trace	
525	with differential amplifier	22
	Oscilloscope Probes -	
60	Current TEKTRONIX	
80	P6021 AC current probe to 20 MHz	20
170	Oscilloscope Probes -	_
30	Voltage	
	HEWLETT PACKARD	
325 300	1121A 500 MHz	9
145	TEKTRONIX	_
190	P6046 Differential probe DC 100 MHz	2
	Oscilloscope Cameras HEWLETT PACKARD	
	195A Pack film polaroid	15
100	198A Pack film polaroid	1
100	TEKTRONIX	
	C30AR Roll film polariod	1
	Power Meters	
	HEWLETT PACKARD	
600	432A 478A 10 MHz 10 GHz wideband with bolometer	3
	Power Supplies	_
45	HEWLETT PACKARD	
43	6265B DC stab variable 40 V/3 A	11
	ROBAND	
85	T101 50 V 1 A Variable	
	SOLARTRON	
95	As 751 50 V 1 A Variable	
20	STARTRONIC 117 20 V 0.5 A Variable	
	SYSTRON DONNER	
195	LNG 16-10 16 V/10 A variable	
325	Pressure & Displacement	
	Transducers	
520	ELECTRO MECHANISMS	

LVDT DC linear variable $\pm\,0.50$ inches

25 75

25

			Voitmeters - Analogue	
ices		Prices	AIRMEC	
m £	Pulse Generators	from £	264 Millivoltmeter 3 mV-1 V ranges	45
2	E. H. RESEARCH		AVO	
	G710 5 V/50 Q 30 Hz 50 MHz RT 5 ns	100	#8 Mk V AC/DC/OHMS	60
	132AL 50 V/50 Ω 5 Hz 3 MHz RT 12 ns		BOONTON	
310	LYONS INSTRUMENTS		93A 20 Hz-20 MHz True RMS	260
	PG2E 10 V/50 Ω 1 Hz-16 MHz RT 10 ns	130	BRADLEY	
325	PG23 10 V/50 Ω 1 Hz-10 MHz RT 5 ns	135	CT471C AC/DC/Ω/current	
275	SYSTRON DONNER		multimeter and RF	165
	101 10 V/50 Q 10 Hz-10 MHz RT 5 rs	95	DAWE	
	Recorders & Signal	-	614C Millivoltmeter 0 3 mV - 300 V	
			ranges	25
650	Conditioning Equipment		HEWLETT PACKARD	
	BRUNO WOELKE		427A AC/DC/Ω multimeter	275
700	ME102B Wow and flutter meter	75 90	3406A 10 kHz-1 2 GHz	395
250	ME102C Wow and flutter meter	30	KEITHLEY	
	Recorders & Signal		610B Electrometer recorder O/P	330
	Conditioning Equipment			330
350	BRUEL & KJAER		LINSTEAD	25
	2305B Stylus Recorder includes		M2B DC/AC 10 Hz-500 kHz	20
350	50 db pot	650	MARCONI	
275			TF2603 AC voltmeter to 1 5 GHz	300
2/5	HEWLETT PACKARD		NORMA	
100	17502A Plug-in for 7100 series		U - Function Dual channel	325
	recorder temperature module	25	peak/RMS meter	320
850	SE LABS		PHILIPS	
250	3006DLT 12 channels UV 6 inch chart	450	PM2454B AC voltmeter to 12 MHz	228
350	A100C Galvo 600 Hz 0 34 mA, cm	30	Voltmeters - Digital	
550	MICROMOVEMENTS		ADVANCE	
350	M400 Galvo 300 Hz 50 μA/cm	25	DMM3 1999 FSD AC/DC/Ω/current	88
	M1000 Galvo 600 Hz 0 34 mA/cm	25 25	DANA	
240	M1600 Galvo 1000 Hz 0 4 maA/cm	25	5230 119999 FSD AC/DC	175
	M8000 Galvo 5 kHz 15 5 mA cm	2.5	FLUKE	
550	SIEMENS		8300A 119999 FSD DC only	150
	KOMF III 2 pen potentiometric roll	425		
575	chart	420	HEWLETT PACKARD	185
	Signal Sources &		3474/2 9999 FSD AC/DC/Ω	185
225	Generators		SOLARTRON	
	ADVANCE		A200 19999 FSD DC only	160 300
	H1 15 Hz-50 KHz	40	A205 19999 FSD AC/DC/Ω	295
	DAWE		#7045 19999 Auto AC/DC/OHMS	395
200	410C J 1 Hz-10 KHz	40	#-7050 99999 Auto AC/DC/OHMS	390
			Wave Analysers	
	EH RESEARCH	30	GENERAL RADIO	
	967 Attenuator 25W 0-40 db	30	1232A Tuned amplifier and null	
	HEWLETT PACKARD		detector 20 Hz - 20 KHz	75
90	200CD 5 Hz 600 kHz O/P 10 V RMS	75	HEWLETT PACKARD	
	8693/100 3 7-8 3 GHz 5 mW		302A 20 Hz - 50 kHz 75 db range	378
215	sweeter plug-in	525		371
	* 608E 10-480 MHz AM	410	THE METERS	
	# 618C3 8-7-6 GHz FM	1600	A321 20 Hz - 20 KHz Sens - 75 db	125
190	# 620B 7-11 GHz FM	1600	#Equipment added this month	
120	MARCONI			
	TF791 FM Deviation Meter 4-1024 Mi			
130	TF801D1 10-470 MHz AM PM	150		
	TF885 0-12 MHz Sine/Square	75		
	TF995A/2 1 5-220 MHz AM FM	350		
	TF995B/5 0 2 - 220 MHz AM FM	475		hazili
350	TF1060 0-1 2 GHz AM PM	150		
	TF2005A Two tone 20 Hz-20 KHz	200	test equipment into cash? P	iing
	ROPDE & SCHWARZ		us and we'll make you an of	fer.
195	SWOB 10 5-400 MHz 75Ω	225	, , , , , , , , , , , , , , , , , , , ,	
. 30	SW09 II 0 5-1200 MHz 50Ω with		MAT abased at Canadas & Date	
30	delay line and accessories	1250	VAT charged at Standard Rate	
30				
25				000

	S121 10 Hz-120 KHz 022B 10 Hz-10 MHz	25 75
ı	Spectrum Analysers	
ı	HEWLETT PACKARD	
ı	141T Display unit storage 8552A I.F. Plug-in	845 1600
ı	8553L 1 kHz-110 kHz Plug-in 8554L 500 kHz-1250 MHz Plug-in	1650 2100
ı	T.V. Test Equipment	2100
ı	MARCONI	250
ı	TF2909 Gray scale generator Temperature & Humidity	230
8	COMARK 1604BLU Analogue thermometer	
	0-100°C	40
	LEE-DICKENS HP5 Humidity probe	130
	HUMIGUN Temp/humidity-probe with meter	215
	RAYTEK	200
	T1000 Infra-red thermoprobe Vibration	200
1	DAWE	
ğ	1461 CV(M) Portable Vibration Analyser Kit	450
	Voltmeters - Analogue	
es	AIRMEC 264 Millivoltmeter 3 mV-1 V ranges	45
£	AVO	60
00 75	#8 Mk V AC/DC/OHMS BOONTON	00
	93A 20 Hz-20 MHz True RMS	260
30 35	BRADLEY CT471C AC/DC/Ω/current	
95	multimeter and RF DAWE	165
-	614C Millivoltmeter 0 3 mV - 300 V	25
	ranges HEWLETT PACKARD	25
75 90	427A AC/DC/Ω multimeter 3406A 10 kHz-1 2 GHz	275 395
30	KEITHLEY	
	610B Electrometer recorder O/P LINSTEAD	330
	M2B DC/AC 10 Hz-500 kHz	25
50	MARCONI TF2603 AC voltmeter to 1 5 GHz	300
	NORMA U-Function Dual channel	
25	peak/RMS meter	325
50	PHILIPS PM2454B AC voltmeter to 12 MHz	225
30	Voltmeters - Digital	
25 25	ADVANCE DMM3 1999 FSD AC/DC/Ω/current	85
25 25	DANA 5230 119999 FSD AC/DC	175
23	FLUKE	150
125	8300A 119999 FSD DC only HEWLETT PACKARD	150
	3474/2 9999 FSD AC/DC/Ω	185
	SOLARTRON A200 19999 FSD DC only	160
40	A205 19999 FSD AC/DC/Ω #7045 19999 Auto AC/DC/OHMS	300 295
40	#-7050 99999 Auto AC/DC/OHMS	395
	Wave Analysers GENERAL RADIO	
30	1232A Tuned amplifier and null	70
75	detector 20 Hz-20 KHz HEWLETT PACKARD	75
525	302A 20 Hz-50 kHz 75 db range	376
110 300	WAYNE KERR A321 20 Hz - 20 KHz Sens - 75 db	125
300	#Equipment added this month	
95		
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Prices from £

TEXSCAN VS40 1 - 300 MHz sweeper WAYNE KERR

Redundant **Test Equipment**



Contact David Kennedy

Carston Electronics Limited, Shirley House, 27 Camden Road, London NW1 9NR. Telex: 23920

MARCONI

#:TF2300A 1~1000 MHz AM/FM

Everyday News

MAKING BUBBLES

The electronics industry and the technical media has long been telling us that the next leap forward in technology will be the expansion of the capabilities of magnetic bubble memories.

Its heartening to see that Plessey are to the forefront of this new development and are already producing a 64K bit bubble memory in a 14-pin package. In fact their single-board memory systems are capable of up to 2M bytes.

A major advantage of the magnetic bubble system is, it is claimed, that solid state technology (against tape or disc) offers greater ruggedness and reliability with high storage density. An immediate demand is seen in telecommunications, data terminals, aerospace and defence.

The PBM80S memory is a "Multibus" compatible 12M bit card with eight on-board 64K bit devices. The unit offers a 100K byte per second data rate when operated as a program loader or backing store.

The PBM80M bubble memory card is expandable up to 2M bytes. An average access time of 7m sec gives the 2M bit card a substantial speed advantage over disc and tape memories when interfaced to the "Multibus" via a controller. Up to eight memory cards can be bussed from one controller

SURPRISE PURCHASE

Surprise news this month is that Binatone International Ltd, have purchased the interests of Sinclair Radionics Ltd. The deal gives Binatone full rights to the Microvision miniature television and Sinclair's range of pocket calculators.

Trading under the name of Sinclair Electronics, the Instrument Division is continuing operations and is

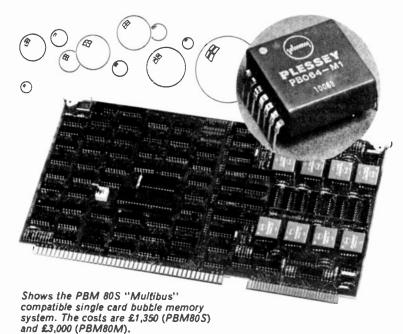
based in St. Ives, Huntingdon.

The "wallet-sized" 4in flat screen TV project is continuing and discussions are being held with third parties, with a view to its long-term development being taken up in partnership with an existing, undisclosed, company in the industry. This development work is supported by the NRDC.

Girls Look to Engineering

After hearing that nearly 800 sixth-form girls applied to attend a one-week teach-in on engineering as a career, held at Loughborough College, for which there were only 30 vacancies, GEC-Marconi has sponsored a similar course at Essex University.

One day was devoted to visits to company factories in the Essex area.



CB SOON?

Citizens Band (CB) radio could come to the UK in a few years. The new Government has conceded there is no objection in principle, only on technicalities on frequencies, types of set permitted, and administration.

The CB Association, a pressure group in favour of "freedom of the air" mates that nearly 100,000 sets are currently in illegal use on the 27MHz band. If CB is allowed in the UK it seems fairly certain that in-built station identification will be compalsory to deter bad language and other abuses which have given CB a bad image in other countries.

The Conservative MP, Mr Patrick Wall, is leading a committe of backbench MPs in a new bid to persuade the government to authorise zen's Band (CB) radio in UK.

The Home Office, however, is likely to stick to its view that CB would be difficult to control and would lead to widespread abuse.

The president of IBM, John R. Opel, forecast recently that by the end of the 1980s the packing density of trans-sistors, logic and memory would be a hundred times greater than in today's devices and the cost per function would fall by a facor of twenty.

=TRAFFIC NEWS=

Car radio is big business in Germany with 2.3 million sets sold in the domestic market last year.

The top price models have decoders which detect official traffic announcements and p. ovide an automatic override of either radio reception or cassette playback and put the set back on normal volume level if it has been turned low.

German drivers regard their sets as a driving information system as well as for en route entertainment.

Drive to MPUs

Ford cars in the 1980s will incorporate MPUs for fuel management to comply with exhaust emission regulations and to increase fuel economy.

Intel has won big contracts for the system com-ponents. But Motorola, Fairchild, Signetics, Texas Instruments and National Semiconductors are all in the race to supply car manufacturers throughout the world with energy saving electronics.

The Japanese are also competing and have produced an electronic control for fuel injection systems as well as for normal carburettors.

An Electronic Dash

The day of the universal electronic dashboard in our cars is drawing nearer. General Instrument Microelectronics have a prototype system to perform all the functions, speedo, odometer, trip meter, fuel level, oil pressure, rev counter, all on one microcomputer chip.

The whole lot of the elec-

tronics, say GIM, can be mounted on a double-sided PCB only 212 inches square.

... from the World of Electronics



According to ITT, 65 per cent of its 16-inch colour TVs marketed as a portable second set end up as a household main set. Reason seems to be that the small screen is still big enough to give fine picture definition while the compact size of the set suits small rooms.

BICC Bids for Vero

Home constructors will be interested to hear that circuit board manufacturers Vero Electronics Ltd is in negotiation for acquisition by cable and electrical engineering giant BICC. Both companies, at the time of going to press, were looking to a favourable outcome of the talks.

CRYSTAL GAZING

A crystal gazing scientist at Sperry Univac, Earl C. Joseph, forecast a density of 10,000 million gates in a single component as achievable by 1990. It would be a six-inch wafer component rather than present techniques where a smaller wafer is diced into individual chips.

An intermediate step would be a 3,000 million gate device which could be in production by 1985. There would remain a problem of how to programme and

Prestel Problems

gramme is on time with its

extension plans to have the

service available to 60 per

cent of the population by the

ject planned for the autumn

will be postponed to spring

next year as there is no point

in publicising the service while receivers are in short

supply. Reasons for the short-

fall in Prestel-equipped TVs

is industrial trouble last

winter and continued com-

ponent shortages say the set

A big media promotion pro-

The Post Office Prestel pro-

use such a powerful device.

mid-1980s.

ANALYSIS

THE ENERGY EQUATION

Suddenly, everyone is doing sums. The motorist his petrol bill, the householder his winter fuel costs, the manufacturer his genuine as distinct from imagined power needs, county councils, central governments, the whole world is at it.

A Middle East war followed a few years later by a political revolution in one country, and our way of life is distorted, if nothing worse. But this is no tragedy—only a challenge to meet change, and civilisations have been challenging and mostly triumphing over change since the days of antiquity.

Nobody is doing sums more diligently at present than the electronics industry, expecting to profit from new demands. It is not long ago that atomic energy enthusiasts were despairing that the future was in doubt because, despite early promise, cost per kilowatt/hour produced was still more expensive than that from coal or oil-fired conventional generating stations. Today, atomic energy is the cheapest and opposed now on environmental rather then economic grounds.

Similarly, the crackpot ideas like solar cells and wave power, not to mention the long-discarded old-fashioned windmill, are now emerging as possible solutions, not only practical but relatively economic, too. The windmill, incidentally, died only because of the availability of cheap

rural electricity in the first half of this century.

Electronics will play a huge part in energy adaptation in the years ahead, in conservation, in power generation and in energy management. In the home, office and factory, electronic sensors and timers for more efficient air conditioning, in the car MPUs and electronic ignition for more miles per gallon.

The drive is now on, principally in the United States but also in Europe, to produce solar cells which will produce electricity at a cost fully competitive with conventional power. Semiconductor manufacturers are spearheading the attack, getting conversion efficiency up and manufacturing costs down. As oil prices rise so the gap narrows. And narrows again as solar cell technology improves as, indeed, it is doing month by month.

Of course solar energy either from solar panels or solar cells is not always convenient, being intermittent and in need of a storage system. Even the most optimistic proponents of solar energy talk only of a 10 per cent or so contribution to our total energy needs. But well worth considering when a 5 per cent shortfall in oil is regarded as a

world crisis!

So far universally unacknowledged is the enormous contribution electronics has already made to energy conservation. Imagine the waste in megawatts of extra heat dissipated if the countless millions of TV and radios now in use were all still using thermionic valves. Not to mention computers. The famous ENIAC of 1946 used 18,000 valves consuming 100 kilowatts of power and had a processing capability less than a 1979 mini while being far more temperamental.

Meantime, while the electronic industry and readers of EE come up with new ideas, I can only suggest that everyone follows my own example on the energy problem-

save it!

Brian G. Peck

The controversial INMOS project to mass produce l.s.i. circuits in the UK is not to be axed under Government spending cut-backs.

Sir Keith Joseph, Industry Secretary, stated that a contractual commitment has been made through the NEB for £25 million and the future of INMOS would be reviewed at the appropriate time.

CABLE BOOM

Cable TV offering interference free multiple-choice programmes and films is booming in the United States.

One company, Cox Cable Communications Inc, has ordered 4,000 miles of cable to be sure of meeting immediate and near-future demand. The first few hundred miles are scheduled for a system in Oklahoma City.

Computer



manufacturers.

The new Hewlett-Packard HP41-C programmable calculator has so many facilities, including substantial built-in memory, that it is already being hailed as the world's first hand-held computer.

The basic instrument is expected to have a UK price of under £200 with peripheral extra options such as a printer, magnetic card reader and electronic "wand" for reading printed-bar codes. Additional ROM can also be added.

More than 3,000 programs are available from H-P's User Program Library.

653



This month's Mini Module is the last of the series. It is rather different from the earlier ones. They were mostly circuits designed for a specific purpose such as testing transistors or handling audio signals. The Universal Oscillator, on the other hand, though it does do one standard task is really a handy box of tricks for the experimenter who will invent his own ways of cashing in on its capabilities.

I've had one on my own workbench for years and I've used it for all these jobs: as a "poor man's Qmeter" to assess the goodness of a tuned LC circuit; in conjunction with a frequency meter to measure inductance and capacitance; as a selective amplifier; as an aid to matching capacitors and resistors; and as a crude signal generator.

A VERSATILE CIRCUIT

These are only a few of the possible uses of this simple but versatile circuit. What it really does is to make other circuits oscillate. That is, if you connect it to almost any other circuit, from a simple capacitor or resistor up to a complete active circuit such as an amplifier, the complete circuit can be set oscillating and in a controlled way.

If the circuit which is made to oscillate is a parallel combination of inductance and capacitance—an LC tuned circuit—it is possible to make a measurement of one of its basic properties.

A parallel-tuned circuit has an impedance which rises to a maximum at its resonant (tuned) frequency. At this frequency the circuit behaves as if it were a resistance, the so-called dynamic resistance. Knowing the dynamic resistance enables the experimenter to estimate the gain when the LC circuit is used as the load impedance of a tuned amplifier and other useful things.

If you also know the frequency and the value of L or C you can then calculate the Q, because the dynamic

resistance is just Q times the impedance of L or C at the tuned frequency.

For example, if the dynamic resistance as read off the Universal Oscillator's easily-calibrated control is 1,000 ohms and the reactance of C is 100 ohms then Q is 10.

What's more you don't have to fiddle about to set the right frequency. The circuit automatically oscillates at the resonant frequency. All the user has to do is set the regeneration control so that the circuit just oscillates: the value of its dynamic resistance can then be read off. This is child's play compared with fiddling about with bridges or signal generators to do the same job.

COMPONENTS

Resistors

R1 $1M\Omega$

R2 See to t

R3 1MΩ

R4 $10k\Omega$ All 1% carbon film $\pm 5\%$

Potentiometer

VR1 $47k\Omega$ or $50k\Omega$ carbon track, log. law

Capacitors

C1-3 100nf (0·1µF) metallised polyester (e.g. Mullard C280 series) (3 off)

Semiconductors

TR1 BC107. BC108 or BC109 TR2 BC214 (If possible both transistors should be of the same gain group. e.g BC108B and BC214B)

Miscellaneous

Two-ounce rectangular tobacco tin or other small metal case. White card for covering panel etc. Veroboard, 0·15in. matrix, 9 strips of 11 holes. Wood strips (e.g. ‡in. square moulding). Glue, 1in. panel pins (6) for leadouts. Crystal earphone for testing. Pointer knob for VR1.

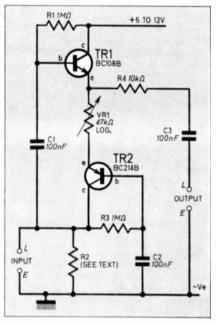


Fig. 1. Universal Oscillator circuit.

PRACTICAL CIRCUIT

So much for theory. The circuit (Fig.1) consists of a common-collector stage TR1 driving a common-base stage TR2 via the regeneration control—the "throttle", if you like—VR1.

The output of TR2 is coupled back to TR1 via C1 to complete the positive feedback loop. If the impedance connected to the input terminals is more than a few hundred ohms the circuit oscillates at some settings of VR1—in fact at any setting where VR1 is appreciably less than the external impedance. Thus if a 1 kilohm resistor is connected across the input the circuit oscillates when VR1 is appreciably less than 1 kilohm.

By selecting an appropriate value of R2 (as described later) the circuit can also be made to oscillate even when nothing is connected to its input. It then acts as a low-frequency pulse generator.

CONSTRUCTION

I used a small piece of 0·15-inch matrix Veroboard as a base (Fig. 2). It has nine strips of 11 holes and no breaks in the copper are needed. But any of the other circuit board bases described in this series will do.

A metal case for screening is advisable. It seemed fitting, for this poor man's Q-meter, to use a recycled case in the shape of a rectangular two-ounce tobacco tin.

After drilling 38 inch holes in the lid for the terminal lead-outs, strips of wood were glued behind the lid to cover the holes and act as insulating supports for the lead-outs, which are just 1 inch steel panel pins pushed through pilot holes and if necessary secured with glue.

OUTPUT WOOD STRIP GLUED TO LID A C DE 0 PANEL PINS OTR 0 0 000000 CARDROARD GLUED TO LID INPU *SEE TEXT HIE

Fig. 2. Assembly of the universal oscillator components upon the lid of a tobacco tin. Note that wire from "input E" pin is soldered to case.

The circuit board is adequately secured by the interconnecting leads. A piece of cardboard is glued to the lid immediately below the circuit board to insulate from the metal lid.

Covering the top of the lid with white card provides for scale markings etc. A piece of cardboard is glued to the inside of the tin for insulating purposes.

SETTING UP

Because of the wide tolerance (usually ± 30 per cent) on log. law carbon potentiometers (VR1) it is best to select R2 by trial and error. If R2 is too high, pulse oscillation occurs at all settings of VR1. If too low, oscillation stops long before VR1 has reached maximum resistance (knob fully clockwise) and this in effect wastes part of VR1 track.

The aim is therefore to select R2 so that it just kills pulse oscillation when VR1 is turned almost fully clockwise. This enables almost the whole of VR1 track to be calibrated, giving the most open scale.

After completing and checking the circuit connect a crystal earphone to the output (or feed the output to an amplifier with loudspeaker so you can hear the circuit pulse-oscillating).

Set VRI fully clockwise. Connect 10 kilohm or thereabouts across the input and switch on. Nothing will happen, but if you now turn VRI slowly anticlockwise a point will be reached where oscillation starts (a whistle or buzz) and it will continue, with variation in pitch, as the potentiometer is turned down towards zero.

Having checked the working of the circuit in this way remove the 10 kilohm and try resistances in the range 33 kilohm to 60 kilohm until you find a value which allows oscillation to persist except when VR1 is

almost clockwise. The selected resishe tor can soldered place either on base board the or behind the panel to the **INPUT** leadouts.

Alternately vou can begin incorporatbv R2 = 68ing kilohm permanently on the baseboard then necessary) trim it to size by means of a second resistance across the input terminals. (I did this in the prototype

and the trimming resistance came out as 150 kilohm, but with a 30 per cent tolerance anything from 60 kilohm upwards is theoretically possible)

CALIBRATION

You are now ready to calibrate VRI. Connect carbon resistances (5 per cent tolerance is quite good enough) across the INPUT and adjust VRI each time until the circuit just begins to oscillate. Mark the setting with the value of resistance in use at the time.

A reasonable number of initial calibration points is obtained using test resistances of: 330 ohms, 1 kilohm, 3·3 kilohm, 10 kilohm, 33 kilohm, 100 kilohm and 330 kilohm.

With some samples of TR1 and TR2 you may be able to obtain oscillation with a test resistance of 100 ohms, giving an extra calibration point at the low end. There is no point in calibrating beyond 330 kilohm at the high end as the markings will be too close together to be of any use.

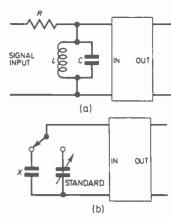


Fig. 3. (a) Selective amplification. (b) Capacitance comparison.

USING THE "UNIVOSC"

Measuring dynamic resistance has already been mentioned. Connect the *LC* circuit to the input, set to the just-oscillating point and read off the dynamic resistance from the scale of VR1. For *LC* circuits tuned above the audio range you'll need a receiver, h.f. voltmeter or oscilloscope to detect the onset of oscillation.

The circuit will oscillate at up to around 20MHz but its measuring ability gets progressively worse as the frequency increases so it should be regarded as unreliable above say a couple of MHz.

The Univosc is really a controllable negative resistance circuit and as such can be used in a number of ways. Fig.3a shows how to connect it as a selective amplifier tuned by L and C. R should be at least as high as the dynamic resistance of L, C for good selectivity. Setting just short of oscillation increases both selectivity and gain.

Fig.3b shows how to compare an unknown capacitance with a standard, using a voltmeter, oscilloscope, or best of all a frequency meter as an indicator (equal readings for equal capacitances).

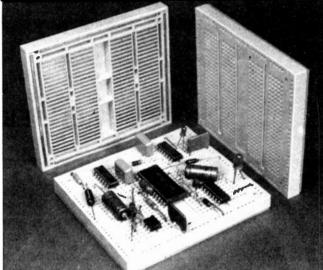
Resistances (if non-inductive) can also be compared but inductors behave as tuned circuits because of stray capacitance and this should be swamped by connecting a large capacitance across the input as well. (Use 1000pF for h.f. inductors and 10nF for l.f. ones.)





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A PLUG FOR SAFETY

You will not have been an electronics hobbyist for long when friends and relatives start to (a) off-load all their old radios and record-players etc., in your direction and (b) ask you to mend various electrical appliances.

If you have looked at the mains plugs on some of these items you will have been appalled at the wiring of the plugs. Slip-shod, hazy, crazy, higgledy-piggledy, etc., etc., many descriptions of the wiring come to mind, but whatever else, all DANGEROUS.

MAGING AROU

Quite intelligent people, some of them, yet quite incapable of wiring a plug correctly. They realise the dangers of escaping gas, because they have seen photographs of the resulting explosions (and anyway, you can smell gas). But they equate poor electrical connections with poor plumbing, "I must get that dripping tap/buzzing plug seen to, next month, or the month after..."

No amount of jumping up and down, apoplexy, etc., on your part, will make them realise the dangers of such a lackadaisical attitude towards electricity. Short of forcibly ramming their fingers into a ten amp two pin socket (there are still some in use, believe it or not!), they do not learn, until it is too late, alas.

If the radio or what have you was a good present, or the people concerned are dear to you, a constant gentle reminder might not go amiss. The Electrical Association For Women market an Irish linen tea towel, which shows the colours of old and new types of cable colour coding, and square-pin and round-pin plug connections. It also shows how to prepare the cable-ends for insertion into both pillar- and clamp-type terminals.

With such a tea-towel in the offending household, the chances are more in favour of a mains plug being wired correctly. In my experience, women are not the big offenders here—they are more likely to ask someone else to wire a plug if they are not sure about it. The greatest offenders are men, who when asked to wire plugs, have no idea how, but feel to admit such a thing would be an affront to their masculinity, so they "do their best!"

masculinity, so they "do their best!"

The price of the E.A.W. Tea Towel (headed Can You Wire A Plug?) is £1.03, postage and packing included, (make cheques or PO payable to E.A.W. Publications Ltd.) and the address is: Electrical Association for Women. 25 Foubert's Place. London WIV 2AL.

Since I decided, six months after my first project was completed. that electronics was from now on my number one hobby I have been collecting components from old radios and recorders given to me and from cheap component packs.

Storage of the components thus accrued became more and more of a problem. Plastic storage drawers would be ideal, but too expensive for the likes of me, so word was sent round the grapevine of the small town in which I live: "Keith wants all old household match-boxes!"

Unfortunately, many other uses for old matchboxes have already been found, and most housewives already seem to be committed to supplying various handymen, modellers, etc. My frantic appeals have so far only produced about forty boxes, and a lot more storage receptacles than that are needed, to file all the collected components.

Other containers used at present include thirty-five two-litre ice-cream cartons, from a never-ending supply: my own family of millions of guzzling children! Components collected in small numbers, e.g., transistors of T018 size, are stored in small matchboxes. Sellolaped logether in blocks three wide and six high.

The big problem was to find suitable storage for resistors, about fifty separate compartments were needed. The solution came to me suddenly, as I was sitting in a

Section of ceiling graticule

Handle

Sheet of hardboard

friend's office. His office is one of those modern open-plan types, that the inhabitants partition off with judicious arrangement of office cabinets and cupboards.

An electrician was changing a strip light tube, and managed to knock one of the ceiling graticule things down, which broke two corners off when it hit the ground, and my feet. My friend thought I was mad when I asked if I could have the missile that had nearly been the subject of a claim from his Public Liability insurance policy.

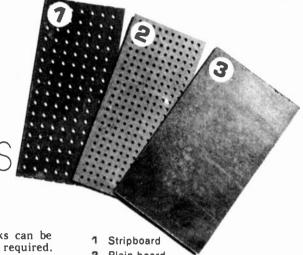
Back in the workshop, the piece of "ceiling" was cut down to a portion six squares by ten. The cutting proved easy, as it was moulded out of material similar to chipboard. When cut it was smeared with "Thixofix" glue over the edges of one side, and then tacked to a sheet of hardboard, see diagram.

The tray of sixty compartments, each about 50mm square and 30mm deep, is now a drawer under my workbench that houses all my low wattage resistors. Cost: about 25p and a sore foot!

Now, the complete MK 14 micro-computer system from Science of Cambridge







THE usual method of building up a circuit is to mount the individual components on a piece of "plastics" board. The material in general use for this purpose is actually syntheticresin-bonded-paper, referred to as s.r.b.p. for short.

This material is a good electrical insulator, it is strong yet easy to cut and drill. Thus it makes an ideal base

for electronic circuits.

It is available as plain board, in various sizes and thicknesses. Also, perforated with holes to suit the leads of electronic components. The holes are arranged on either a 0.1 inch or 0.15 inch matrix.

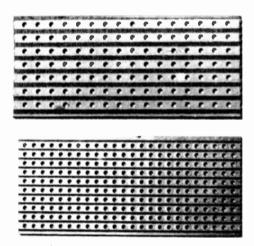
It is easy to use, and breaks can be made in the copper strips as required, by using the special spot-face cutter tool available, or failing that, a twistdrill bit or even a pocket knife blade. The tip of the cutting tool is placed in the appropriate hole and the tool then rotated by hand until a circular area of copper has been removed cleanly from the strip.

The two sections of this strip are now electrically isolated.

Sometimes two or more strips are required to be joined together. This is easily done by soldering link wires from one strip to the other. Such links should always be on the top

- 2 Plain board
- 3 Copper-clad board

When mounting components develop the habit of carefully checking and double-checking the location of each component on the circuit board against the published component layout diagram before finally soldering into position. It is also a wise additional precaution to cross-check the physical location against the circuit diagram. Apart from preventing possible errors, this habit will lead to a closer understanding of electronic circuits-in both theory and practice.



The two types of stripboard used in the majority of the projects In EE.

00000000000000 0 H 0 G F 0 E BREAK 0 D 0 C 0 B • 0 0 0 0 0 0 0 0 0 0 0 0 0 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Fig. 1. Method of identifying and using stripboard. (a) copper strip, (b) hole, break in copper, (c) solder joint. The matrix of holes and strips are given letters (strips) and numbers (holes) for easy cross-reference.

STRIPBOARD

Both above-mentioned forms of s.r.b.p. have their uses in electronic construction, but the most popular and versatile board is Veroboard. This is the proprietary name for a product consisting of a sheet of s.r.b.p. with copper strips bonded to one side of the board. Hence the common name by which it is also known-"Stripboard". It is available with holes punched on 0.1 inch and 0.15 inch matrix. The 0·1 inch type is in more general use.

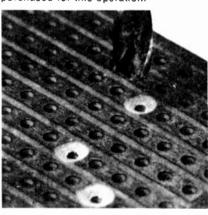
Stripboard features in Everyday ELECTRONICS constructional projects more than any other form of board.

(plain) surface of the board. Sleeved. insulated, wire should be used for this purpose wherever there is danger of contact with adjacent component

MATRIX CODE

Reference to typical constructional articles in this magazine will show clearly how stripboard is used in practice. The custom of identifying individual strips and holes by numerical and alphabetical codes is very useful and a great assistance to the constructor, especially with the larger size boards used for the more complex projects.

Using a twist drill to make breaks in the copper tracks. A special tool can be purchased for this operation.





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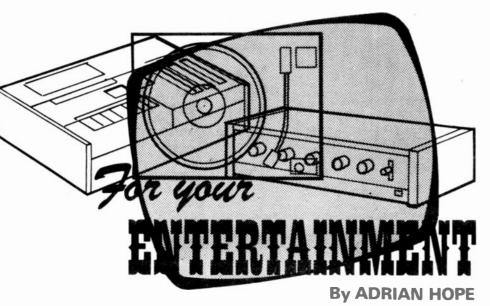


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Restrictive Dish

The manufacturers of microwave ovens have not surprisingly been quick to reassure the public that there is virtually no risk of radiation leakage from a properly maintained oven.

Microwave sales had plunged after claims were made that some people's eyes had been damaged by leaking radiation. Now, just as the reassurances have been accepted and the public has started to buy microwave ovens again, comes a report from Cheshire which could throw the whole issue back in the melting pot again.

Sir Bernard Lovell is Professor of Radio Astronomy at Manchester University and Director of the Laboratories which run the Jodrell Bank radio telescope. Recently Sir Bernard argued to the Cheshire County Council Planning Committee that they should continue to restrict housing development anywhere near the giant Jodrell Bank telescope.

Why? Because according to Sir Bernard, some microwave ovens leak so much radiation that if they are within even a few miles of the telescope they play havoc with its reception. I wonder what the oven makers will have to say about this?

Power Packs

From Japan comes news of paper-thin batteries; and by paper thin I mean literally paper thin. Matsushita has produced a manganese dioxide dry cell, with zinc for the negative electrode and a very, very thin stainless steel plate as the positive electrode. This is instead of the usual carbon rod. One battery stack of cells still only the size of a stick of chewing gum can operate a liquid crystal display calculator for a thousand hours continuous running.

So far these batteries aren't on sale in the UK but oddly enough you can get something almost the same, effectively free gratis and for nothing. In fact they are currently being unwittingly thrown away by the thousand in the UK!

When you take a picture using the Polaroid SX70 instant film system, the print is pushed out of the camera by a very powerful motor-driven feed system. This motor and all the other camera electronics, are driven by a battery inside the film pack.

The decision to incorporate the battery inside the film pack was taken at an early stage in development of the SX70 system. The main reason was to ensure that users always had fresh batteries for every film shot; another reason was to keep the size of the camera as small as possible.

Ten years ago now Polaroid commissioned ESB Inc. of Philadelphia, who make Ray-o-Vac batteries, to design a battery powerful enough to drive the SX70 electrics, reliable enough to have a good shelf life and compact enough to fit inside the film pack. After all manner of production difficulties Polaroid and ESB finalised a 6 volt, flat, manganese dioxide battery formed from a sandwich of nineteen plastic and metal layers sealed together.

Because the system has to have a substantial safety margin for power, it is almost always the case that the battery which is thrown away with the exhausted SX70 film pack still has plenty of useful life left. Informal tests carried out by Polaroid suggest that every fresh film pack battery has sufficient power to shoot between a hundred and fifty pictures; that is to say ten or fifteen times the power necessary for the ten shot film pack.

To put the unused life to free advantage, all you do is break open the exhausted film pack and pull out the flat battery. One side is printed over with symbols and warnings to discourage anyone from cutting open, stripping down or burning the battery. On this printed side there are two round metal terminal tags, of which

the one nearest a symbol denoting a pair of scissors is the positive.

The easiest way to attach a pair of leads to these tags is to overclamp them with Blue Tac, Plasticine or chewing gum. Surprisingly, this can make a very firm electrical joint. A couple of Polaroid batteries in series, of course, gives 12 volts or a couple in parallel gives more power.

Waste not, want not, used to be a war time motto. But it still makes good sense.

About Time

It shouldn't be long now before some readers will have owned an l.c.d. watch or clock for five years. Well, anyone who has owned or used one for as long as this should take a close look at it. Is the display as clear and easy to read as it was in the beginning—or has it started to fade?

The chances are that your five year old display will be far less easy to read than it was in the beginning. When l.c.d. displays first came on the market they were criticized for poor reliability and this was subsequently put down to poor sealing of the cells.

The signs are that this may well not be the whole story. One of the largest electronic watch companies in the world, Citizen, has now incorporated a very significant disclaimer in its instruction manuals."The liquid crystal display has a finite life which, under normal conditions of use, is approximately 50,000 hours (about five years)" the manual reads; "Replace the liquid crystal display when it begins to fade".

In other words Citizen, who should know more about the life time of l.c.d. time displays than any other company, is promising no more than five years use. Recently I saw a watch that has been used for four and a half years. Sure enough the l.c.d. readout is now so faint as to be virtually unusable.

Repair Time

Of course, it isn't unreasonable to expect a repair bill for a watch or clock after five years of use, even on top of the routine cost of replacing the batteries. But here's the rub. Consumer electronic products like watches, clocks and calculators, are now changing very fast, very often. So very few firms will be able to keep a whole range of spares available for the five years or more that will be necessary if owners of l.c.d. gadgets are to "replace the liquid crystal display when it begins to fade".

I'll bet that many of the firms today producing gadgets with I.c.d. displays won't even be in the same business in five years time. And even if I.c.d. replacements are available, how much will it cost to have them refitted? And how easy will it be to find someone to take on the job?

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M8

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M10

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M11

10:084

M7

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M12

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M15

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E. & O.E.

RADIO WORLD

By Pat Hawker, G3VA

WARC 1979

For everyone interested with a professionally or as amateurs in as listeners/ viewers, in any of the many uses of the radio spectrum for communications, broadnasting, radio astronning radio navigation, safety and emergency behaviors and the like, the next two months (specifically from September 24 to about the end of November) must be a time of anxiety and hope and nail-biting. It is during those weeks, several thousands of delegal'ss, representing some 150 countries, will be in Geneva for the World Administrative Radio Conference (WARC) of the International Telecommunication Union (ITU). Nowadays the ITU is a specialised agency of the United Nations, although its history can be traced back almost 115 years when telegraphic communication began to cross frontiers and people realised you cannot have effective communications without into national coloperation.

The task of WARC is to look at the full span of the radio spectrum—radio frequencies from a tew kiloheitz up to hundreds of gigaheitz (1 GHz is a 1000MHz) and to decide just which radio services have most need for and claim to each portion of the spectrum. Also whether different services could successfully share the use of the same bands or whether they need to be kept rigidly separated in the three different ITU regions of the world.

WARC, it should be noted, will not allocate particular frequency channels to individual stations but instead will determine which services can use each block or band. It has to make all sorts of value judgements between, for instance, broadcasting and taxi-cah radio, safety at sea and the use of medical and industrial equipment.

Cutting the cake

Some parts of the radio spectrum are suitable for long distances, some are virtually confined to line of sight and so can be used many times over provided the stations are sufficiently far apart. Some transmissions, such as television and broad-band multi-channel microwave telecommunications links (terrestrial or satellite) gobble up larger chunks of band width than others. One television channel could be used for about 40 f.m. radio channels; almost 1000 a.m. radio channels; some 2500 radio-telephone circuits or about 25,000 radio-teleprinter channelsand, at least theoretically, hundreds of thousands of morse transmissions

For some four years, the Home Office, working through many committees, have agreed a set of proposals which have the support of the main users of the radio spectrum. But, of course, the 150 other countries are also putting forward their

own proposals—and no two sets of proposals appear to be entirely the same.

What will happen?

There seems a good chance that frequencies allotted for v.h.f./f.m. sound broadcasting in Europe will be extended, possibly to 104 or 108 MHz but there is bound to be great pressure on the v.h.f. band, due to the explosion in the mobile two-way radio field

The subject of Citizens Band is unlikely to be raised at WARC since this is not an internationally defined radio service (though this would not prevent the Hone Office from subsequently making frequen

cies available for CB).

Probably some parts of the radio spectrum will continue to be allotted much as at present. But between 3—30MHz where much comme cial traffic has been transferred to space satellites, there may be extra frequencies given to short-wave broadcasting, and radio aniateurs have modest hopes of new bands around 10, 18 and 24MHz (although few European countries except the UK appear to be officially supporting the introduction of these bands).

Only an optimist will expect to emerge from WRAC with their own hopes entirely fulfilled. It will be extremely difficult to achieve agreement between 150 countries and there is a real danger of further regionalization and a proliferation of "footnotes". Footnotes are the means by which counties reserve the right to use frequencies in a manner different to that of the final international Table of Frequency Allocations.

But radio signals do not stop at or recognise political frontiers—and more than ever before there is a need for international co-operation, goodwill and it necessary compromise: otherwise we shall face increasing chaos in radio

Already there are signs of countries jumping the gun, particularly in the field of external broadcasting, where the spectrum is intentionally polluted by jamming. Again, the Russians have ignored the international regulations in operating their network of "Woodpecker" over the horizon radar stations which continue to cause widespread interference with other services.

Also there are signs that although much military traffic is carried by satellites, there has been no corresponding slackering of defence interest in h.t. circuits, since these might be needed if satellites were deliberately destroyed or jammed.

Morse and the novice

One of the international Radio Regulations that often comes under at ack is the requirement that (below 30MHz) radio amateurs must have proficiency in morse

(cw) operation. Only in Japan is this requirement waived for some classes of low-power amateur licences.

There appears to be a widespread belief that morse is now an "obsolete" form of communication, too slow and largely discarded except by ships and amateurs. Those who use morse, however, firmly believe that it is still the most effective means of communicating information between people with not ommon language other than "telegraphese" while equipment and aerials can be simple and low-cost and many hundreds of stations can operate in narrow bands.

Few people actually enjoy learning moise and many give up when they find their progress appears to be slow and uncertain. To a beginner, the Post Office moise test at 12 words per minute seems a distant, unreachable target and he soon discovers that in practise operating speeds are usually appreciably higher than this. One result is that many potential amateurs trust towards the more limited "Citizens Band" concept which has far less to offer to the technically interested.

A number of countries have successfully introduced "novice" licences which enable newcomers to go on the air, and learn while enjoying operating, after reaching about 5 words per minute. Now a gio ip of active cw amateurs ("European CW Association") which represents a number of different clubs has been actively promoting the early introduction of a cw only "novice" licence in the UK.

The Association has recently persuaded the Radio Society of Great Britain to set-up a sub-committee of its Telecommunications Liaison Committee to investigate these proposals with a view to the RSGB making an official approach to the Home Office.

The difficulty still remains of convincing people that morse is worth learning and is still widely used by amateurs for effective international working. Unfortunately only those who use it regularly know this to be the case.

CB and amateurs

Amateurs are sometimes accused of being "anti-CB". Very occasionally this may be true. Full I find that far more often amateurs feel that the "pro-CB" lobby is misleading the politicians and the public about such questions as interference to television and the transmission of anonymous obscenities, etc.

A professional engineer who is also a radio amateur recently wrote forcefully in the IEE journal "Electronics and Power": "It is easy to make a case for CB radio in the UK, but is an uncertain proposition. Those who stand to gain from it are those who scll equipment and who are looking for new products to exploit now, that the "hi-fi" and colour TV markets are virtually saturated."

LETTERS

Just the ticket

Your contributor Adrian Hope, see For Your Entertainment April issue, may be interested to hear that the fare dodging French simply slined their tickets lengthwise and had two anceptable Metro tickets for the price of one, the magnetic coding was shared between the two halves.

The implied criticism of British Transport for installing magnetic rollers to erase tickets and thus preventing the issue of "season" tickets is surely invalid, coded instructions to route a season ticket around the magnetic rollers would surely be a simple solution.

J. Baker Llantwit Major

True Situation

Looking back over some old issues I was reading the feature entitled Your Career In Electronics by Peter Verwig. In the April 1976 issue, he discussed the career of Ship's Radio Officer. As always, this feature is well researched and most informative. However, in view of the existing situation. I would like to comment.

Ever since the end of the Second World War, the British Merchant Navy has been shrinking, both in the number of ships flying the Red Ensign and in the number of men employed. New nations such as Nigeria, India and Pakistan have been building their own ships and employing their own crews. No longer do we carry the commercial cargoes of the World. Even a country like Cyprus has its own ships and its own national crews.

At the present time in the United Kingdom, there are scores, if not hundreds of qualified marine radio officers, waiting and hoping for employment on board British Merchant Ships. In one case

recently, a fully qualified man wrote 134 letters to Shipping Companies seeking employment as a Ship's Radio Officer and failed to obtain an offer of employment. Scores of qualified men are on the "dole" and have been lonking for work for the past two years.

I would like to further inform you that the present training time for ship's radio officer is about three years and that one has then to spend three years at sea to quality as a grade 1 radio officer. A further 7 years is required before one can hope to be a senior radio officer.

Nowadays marine radio officers tend to remain longer in the Merchant Navy. This is due to better conditions improved status and very much longer leave. The outlook to employment is poor and it will get worse. There are schemes afoot to combine the dutie of radio officer with that of ship's electrician etc. There is even talk of phasing the job out due to the advent of satellite communications.

I think in fairness, the many young men who read your magazine each month, should be informed of the true situation. Also, the many marine radio training schools in the United Kingdom should not mislead young nien by advertising long training courses for jobs that may never become available.

Wishing your magazine every success.

P.B. Killeen
Radio Officer
M.V. "London Enterprise"

Equal Tempered

I have just finished constructing the Electronic Tuning Fork that you featured in August's edition. As a guitarist I find it extremely useful to have a means of adjusting my instrument to concert (equal tempered) tuning.

However, I would like to point out that it is impossible to correctly set the oscillator frequencies using the 100 kilohms presets (VRT-6) suggested in the circuit. After some experimenting I solved the problem by mounting a six-way tag board inside the unit and using six 4-7 kilohm presets as fine adjusters.

By putting a 4-7 kilohm preset in series with a 100 kilohm preset I was able to roughly set up a frequency before doing fine adjustments at my leisure. For those building the cricuit using "stock components" it may be useful to know that the series resistances for E. A. D. G. B. E were approximately 53 kilohm, 40 kilohm, 30 kilohm, 22 kilohm, 17 kilohm and 13 kilohm respectively

Phil Allen, Bournemouth

Sound Dip

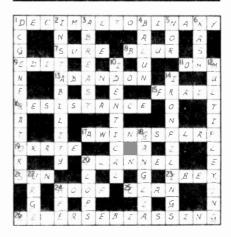
I found Mr. Lovett's point on noise exposure in the August issue ("Subjective Response"—Letters Page) very interesting

The so called "4K dip" is well known in those who have been exposed to heavy industrial noise. It could well be that males who go out to "bring home the bacon" are more at risk of suffering such a dip than a wife who stays at home looring after the house and children.

Perhaps womens liberation and the trend towards sexual equality will produce more women with 4K dips who no longer complain at the sound of loud music

Adrian Hope London

Crossword No. 20-Solution



LET HIM REST. HE'S COMPLETELY EXHAUSTED. WORSE—HIS CALCULATOR FAILED TO WORK DURING A MATHS PERIOD AND HE HAD TO THINK. RUGBY AT COLLEGE?

CM	os	4020 4022 4023	50p 50 p	4050 4060	25p 80p
-		4023	13p 40p	4066 4068	30p
4001	13p	4025	13p	4069	13p
4002	13p	4026	90p	4070	13p
4007	13p	4027	28p	4071	13p
4009	30p	4028	45p	4072	13p
4011	13p	4029	50p	4081	13p
4012	13p	4040	55p	4093	36p
4013	28p	4041	55p	4510	60p
4015	50p	4042	55p	4511	60p
4016	28p	4043	50p	4518	65p
4017	47p	4046	90p	4520	6 0p
4018	55p	4049	25p	4528	60p

FULL DETAILS IN CATALOGUE!

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III	•	7473 7474	20p 22p	74141 74145	55p 55p
7400	10p	7475	25p	74148	90p
7401	10p	7476	20p	74150	550
7402	10p	7485	55p	74151	40p
7404	12p	7486	20p	74154	65p
7406	22p	7489	135p	74157	40p
7408	12p	7490	25p	74164	55p
7410	10p	7492	30p	74165	55p
7413	22p	7493	25p	74170	100p
7414	39p	7494	45p	74 1 74	55p
7420	12p	7495	35p	74177	50p
7427	20p	7496	45p	74190	50p
7430	12p	74121	25p	74191	50p
7432	18p	74122	35p	74192	50p
7442	38p	74123	38p	74193	50p
7447	45p	74125	35p	74196	50p
7448	50p	74 1 26	35p	74197	50p
7454	12p	74132	45p	74199	90p

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LED's	0.125in.	0.2in	each	100+			
Red	TIL209	TIL220	9 _p	7 5p			
Green	T1L211	T1L221	13p	12p			
Yellow	T1L213	T1L223	13p	12p			
Clips	3р	3р					
DISPLAYS							

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Size in.	0 1 in	0.15in	Vero
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2.5 x 5	54p	54p	Pin insertion
3.75 x 5	64p	64p	too! 108p
3.75 × 17	205p	185p	

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	CA3046	55p	LM3911	100p	ZN414	800
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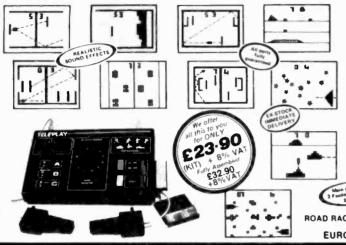
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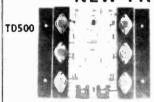
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Files and filing

Filing, in essence, is the removal of unwanted material, most commonly metal. Material can be removed to present a smooth finish, to reduce it in size, or perhaps to a specific shape, or to increase holes in size in varying shapes.

Let me qualify the opening statement. A file can, if nothing better is available, be used on any material, but the softer the material, the more rapidly the teeth of the file will clog up and reduce its efficiency. Frequent cleaning is therefore necessary if the optimum efficiency of the file is to be realised.

The Flat File is parallel for about two-thirds of its length, and then tapers inwards in width and thickness. Both faces are cross-cut, both edges being single-cut, with no safe edge.

Round file

The Round File is of circular crosssection and tapers towards the end. It is used for enlarging round holes and the like. It is cross-cut on the rough and bastard types over 6 inches long; below 6 inches the rough and bastard files are single-cut as are the second-cut and smooth files.

The Half Round is not truly that, only partly so. The flat face is cross-cut,

WORKSHOP MATTERS

By Harry T. Kitchen

As a general rule, then files are used on the harder metals. But what is a file and how does it work?

Every file contains a number of sharp cutting teeth set at an angle of about 60 degrees. The fewer teeth per square inch, the coarser the file; the converse also applies.

Teeth normally run in two directions that intersect to give the well-known diamond pattern. These are commonly referred to as cross-cut files.

Single-cut files are also available, and these have one set of teeth running in parallel lines.

A file works because, as they are passed over a piece of metal, every tooth removes a portion of that metal. A coarse file will remove larger portions, and will cut deeper into the metal, leaving its impression on it. A fine file will remove significantly smaller portions and will not penetrate the metal as deeply and so will leave a much finer impression.

Apart from the number of teeth, files come in varying shapes and sizes, and it is rewarding to look at these in detail.

Types of filing

Most useful in the electronics workshop are the Hand File and the Flat File. The former is parallel throughout its length, but tapers downwards in thickness towards the end. Both faces are cross-cut; one edge is single-cut, the other is uncut, to provide a "safe" edge to prevent one face being cut into whilst the other is being tiled.

the curved face being single-cut for the second-cut and smooth types.

The Rasp file, sometimes called a Dreadnought, is quite outstanding for the removal of large chunks of metal. Since it is a crude tool, it must be followed by a finer file it finish is important.

File sizes vary from around 4 inches to around 20 inches long. Finishes range from rough; bastard; secondcut; smooth; and dead-smooth, in increasing fineness.

Depending on your purse and interests you will end up with a variety of files; the greater the variety of files, the greater the variety of work you can tackle successfully.

Bending metal

Metal can be bent, crudely, by grasping it in some way and exerting brute force. To bend metal with some pretensions to precision, and in a pre-determined form, requires some form of tools and thought.

Easily the most precise way of bending sheet metal, the form we are most concerned with, is to use a proper bending tool. Mostly easier said than done. With a little thought it is quite possible to bend sheet metal to an acceptable degree of precision using very simple tools.

An essential is a stout vice securely fastened to an equally stout bench, your own or borrowed. Also necessary are two pieces of strong angle iron somewhat longer than the longest sheet of metal that it is anticipated will be bent

Angle iron clamps

The angle iron is likely to be roughly finished with a Galvanised surface. The roughness must be removed prior to use. In order to do this, clamp the two pieces of angle iron very firmly between the vice, back to back. Level them off as accurately as you can, so that the two upper surfaces appear to be one. Then file them smooth, so that they really do appear to be one. This is important in obtaining accurate bends free from indentations.

Next drill a hole at each end, about one inch in. The size should suit any bolts and nuts you have available (if you have none, a suitable size is 1 inch UNF). Drill the holes carefully, so that the two angle iron pieces are not displaced relative to one another. The size of hole should result in a tight fitting bolt; this ensures repeatability when the angle iron pieces are next reassembled.

The sheet of metal, cut to size and duly marked out, is clamped immovably when the nuts are tightened and the whole assembly is clamped in the vice. We now have a simple but highly effective bending tool.

Marking out the panel

A panel can be simple or complex. If it has many holes it is worth knocking up a sketch, however rudimentary. Errors, on paper, are simply rectified; on the panel rectification may prove difficult or impossible. But there is a snag.

The snag? The drawing must be in reverse, for the panel must be marked out in reverse, or wrong side. Marking out requires the scribing of lines as reference points. If the panel is marked out on the correct side, these lines will be visible, a sign of careless or inexperienced workmanship. And we can't have that. Can we?



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DIGITAL RECORDING

BY ADRIAN HOPE

THE idea of digital sound isn't new. It was dreamed up and patented in the late thirties by a British engineer, Alec Reeves, who was at the time working for STC in France. But like television, magnetic recording, and the moving coil microphone, all of which were first patented way back in the 19th century, the idea of digital sound couldn't become a reality until practical technology had caught up with the theory.

This happened in the late 60's when the BBC adopted a digital sound system based on Reeves' ideas for carrying radio signals across the country

between transmitters

So what exactly is digital sound? Sound waves in the air are analogue, as are electrical audio signals. They fluctuate continuously and represent, or are "analogues" to, the original sound. Digital signals move in steps, not smoothly and slowly. To digitise an analogue wave form it has to be chopped up into individual steps. This is called "sampling".

SAMPLING

If the wave is chopped up into large steps then the original wave can never be accurately recreated. So the smoother the steps the higher the fidelity. It is now generally accepted that the minimum sampling rate that is necessary if the waveform is to be accurately re-created is twice the highest frequency present in the original signal.

The BBC's radio transmissions only extend up to 15kHz, so a sampling rate of 32kHz is used when sound is converted into digital form for routing between transmitters. Where wider bandwidth is required, for instance for studio recordings in digital manner, a sampling rate of over 40kHz is necessary. This will give a fidelity

bandwidth of over 20kHz.

QUANTISING

Sampling an analogue waveform is only half of the converstion battle. The other half is to "describe" the samples by quantising them. This is usually done in so-called binary code. In some respects binary code represents a modern version of the old

morse code. In morse codes the dots and dashes are used to describe letters of the alphabet and in binary code pulses the gaps (where pulses could be) are used to denote ones and zeros to build up a number in mathematical fashion. The more "bits" (ones or zeros) that are used to describe each sample, the more accurate the description and the better the signal-to-noise ratio of the analogue sound eventually retrieved from the digital

The BBC use of 13-bit code, that is 15 pulses or pulse absences to describe each of their 32.000 samples per second. Codes for studio quality recording are often 16 bit. In general, the faster the sampling rate used the better the frequency response and the more code bits used per sample, the cleaner the sound.

DIGITAL RECORDING

Sooner or later digital sound recording will arrive in a big way because it has great advantages. First and foremost, perhaps, a digital recording can be copied a virtually infinite number of times without any degradation of quality from one generation copy to the next, But whether digital sound arrives sooner or later depends entirely on how soon or how late the industry can organise itself into

standardisation.

To cut a long story short no one can agree on what sampling rates and quantising codes should be used in the recording studio or for domestic recorders Another difficulty is that video recorders are often used to record the pulse stream because this stream is equivalent to a very high frequency signal (1MHz or more) and video recorders can easily handle a signal of this bandwidth. It is for the same reason that video discs make an ideal medium for digital sound.

INCOMPATIBLE

But video recorders and video disc systems are tied to television standards. The frame rate (number of pictures that appear on the screen per second) varies between Europe and the USA and Japan, as does the colour system used and the number of lines

from which the picture is made up. It is thus impossible to play an American or Japanese video recording on European equipment. It thus becomes impossible to take a digital recording made on standard video equipment in the USA or Japan and play it on even superficially similar equipment.

This situation governing world TV standards (or more accurately nonstandards) is unlikely to change in the foreseeable future, but it should be possible for the digital disc designers to agree a world coding standard independent of TV standards so that a digital sound recording made in the USA or Japan will play back on European equipment and vice-versa. This seems of prime importance. Imagine the situation if the gramophone record bought in one country was unplayable in another.

DIFFERING VIEWS

Philips has now announced its plans for a digital audio disc. This uses the company's laser-based video disc technology but is not tied to television picture standardisation and is thus (hopefully) playable world wide.

However, other companies in the video disc market place have their own ideas over digital audio. The road to standardisation will not be smooth. For instance although the Japanese companies believe that homes of the future should have a single player, capable of handling both video disc and digital audio disc. Philips has argued that homes of the future should have two players, one for video discs and one for digital audio discs. In the meantime some companies such as Decca are making studio or master recordings on digital tape and issuing them on conventionl LP discs.

The lack of agreement over digital (also called PCM, short for Pulse Code Modulation for reasons which should now be clear) is also partly responsible for the upsurge of interest

int) direct-to-disc recording.

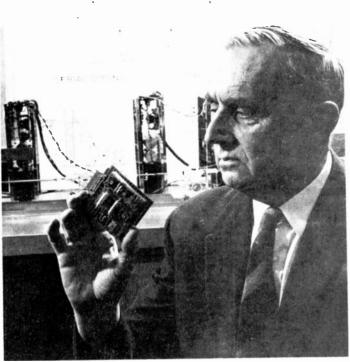
DEVELOPMENT OF RECORDING

When Edison and Bell were first recording sound a hundred years ago they did so by cutting a groove direct into a rotating cylinder. When flat disc records started to compete with the cylinder, thanks mainly to the efforts of Emile Berliner, the groove was also cut directly into the record surface. By the 1930's the cylinder record had disappeared and 78r.p.m. discs were standard.

Until 1939, 78r.p.m, records were made by cutting a groove direct into a 78r.p.m. master disc in the studio. Then the US recording industry changed over to recording 16-inch masters which rotated at 331₃r.p.m. but had a standard_sized groove (rather than a very fine, or microgrove, as on modern 33¹₃r.p.m. LP records). The recordings were subsequently dubbed onto 78r.p.m. masters.

TAPE INTERMEDIARY

The next step in what we know to have been a downhill path in some respects, came soon after the war.

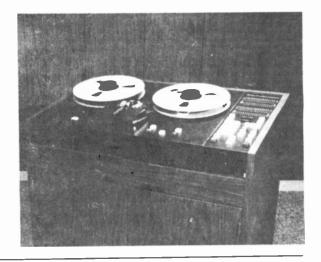


(Above). The late Alec Reeves who dreamed up and patented the idea of digital sound in the late 1930's.





A "digital disc" player from JVC.



The industry gave up recording direct onto discs altogether and went over to'magnetic tape as an intermediary step.

For years the use of magnetic tape went unchallenged because the distortions introduced (tape has inherently non-linear recording characteristics which must be straightened out by bias and equalisation) went unnoticed. The distortions went unnoticed because reproduction equipment was on the whole not good enough to show them up.

But by the early 60's, with the move to microgroove stereo records, the overall standard of available reproduction equipment started to improve by leaps and bounds. By the late 60's domestic hi fi systems could outperform some of the records being played on them. So the distortion introduced by the use of magnetic tape in the recording studio started to show.

RETURN TO DIRECT-CUT

In 1968 two Americans, Doug Sax and Lincoln Mayorga, opened the Mastering Lab in California, a recording studio equipped to eliminate the use of magnetic tape. Sax and Mayorga had found that, especially on piano music, some recordings made in the 30's (while recording studios were still cutting direct onto 78r.p.m. masters) sounded better than recordings made in the 40's (when the studios were using those 16 inch stan-

dard groove 331₅r.p.m. masters and better also than post war recordings made using magnetic tape.

DIRECT-CUT MICROGROOVES

In their Mastering Lab Sax and Mayorga could cut direct onto 331₃-r.p.m. microgroove discs. Their first direct-to-disc recording was "Lincoln Mayorga and Distinguished Colleagues" and it is now unobtainable. The pressing stampers made from the original direct-to-disc master have long since worn out and no more copies can be pressed.

Although this Sax-Mayorga direct cut was by no means the first direct-to-disc microgroove recording (I still have a 1963 direct-cut recording made by the Ziff-Davis Publishing Co. of New York as a special demonstration record for a hi fi magazine) the Mastering Lab disc was the first really to catch the public's enthusiasm. Its clean sound made almost any hi fi system sound better and before long virtually every hi fi firm was using it to demonstrate their equipment in public shows. The public then bought the records so more were produced.

IN VOGUE

Currently there are several hundred direct-cut discs on sale around the world, originating from almost as many small record companies. The cost of a direct-cut is high, due mainly to the limited production run possible.

There is no doubt that some companies have jumped on the direct cut band-wagon hoping to sell musical rubbish under the direct-cut banner. So beware. The British firm Quadramail, which exhibits at most hi fi shows currently has the most comprehensive list of respectable direct cut recordings.

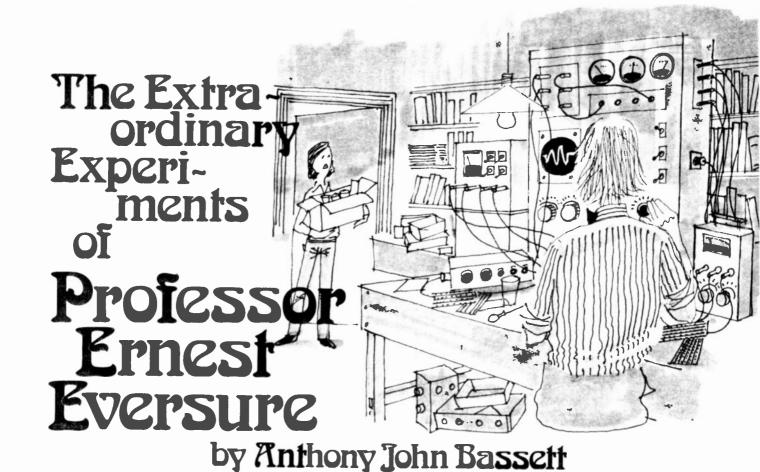
Direct-cuts will last only as long as the current chaos on PCM or digital recording standards persists.

DIGITAL RECORDING WILL TAKE OVER

As soon as the recording industry can standardise itself on a digital code it will become routine for studio recordings to be made digitally on magnetic tape. Digital recording overcomes all the old distortion problems of analogue tape but with the added advantage of facility to edit, albeit using sophisticated electronic equipment. There is of course no possibility of editing a direct-to-disc master.

Decca is only one of many companies now using digital tape and personally I give the direct-cut craze only a year or so. After that digital recording will take over.

Although initially conventional vinyl LP's will be pressed in analogue form from digital tape, as soon as digital sound reproduction equpiment is standardised and sold at domestic price levels, we shall see digital discs sold for home use.



Tom and Maurice are forming a Space Age Rock Band with electronic instruments and effects, plus as many unusual gadgets as

they can get on stage.

The Prof. is repairing a Spring Line Reverberation Unit for the boys. He examined the unit and drew out a circuit diagram (Fig. 1).

"As you can see", he pointed out to Bob. "This unit contains two integrated circuit amplifiers type 741, one of which ICl acts as the spring line driver amplifier whilst IC2 is the pickup amplifier, and also carries the "straight through" signal. If these amplifier circuits are faulty the reverberation unit will not function".

The Prof. used a multimeter to check the d.c. voltage conditions on the 741 integrated circuits, and found that, apart from Pin 7 the 18V positive supply, all the other pins read very low, their voltages being at or near OV.

"Does this mean that both the integrated circuits are faulty, Prof.?" Maurice asked.

"Not necessarily, Maurice. The fault is most likely to be located in the bias circuit, which feeds half of the 18-volt supply voltage to pin 3 of each i.e. If this voltage is not correct, the i.e.s will not function as they should."

The Prof. turned his attention to the bias circuit, which consisted of two $10 \mathrm{k}\Omega$ resistors (R16, 17) wired in series across the 18 volt supply. A $22 \mu\mathrm{F}$ electrolytic capacitor, C6, was connected from this 9 volt bias point to the 0V line, and this was the cause of the trouble. It had developed a fault, and was allowing the bias to leak away, so that the bias point, instead of being at 9 volts positive, read almost zero on

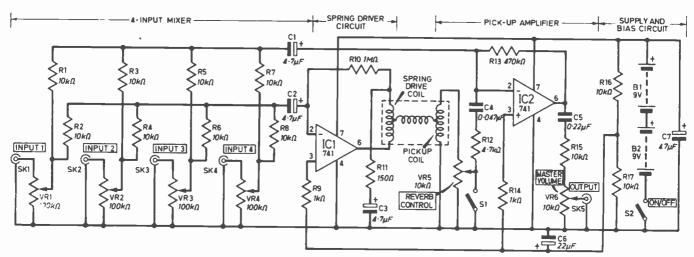


Fig. 1. Circuit diagram for a four input Spring Line Reverberation Unit. The supply bias components are R16, R17 and C6.

the Prof's multimeter.

When the Prof. replaced the electrolytic capacitor with a new one the voltages on the input and the output pins of IC1 and IC2 rose to their correct working point of 9 volts.

UNNECESSARY COMPLICATION

"Prof., it seems to me that this reverberation unit could do without this particular bias circuit", remarked Bob. "We could get the same voltage from one of the batteries. This would save:

- 1. Three components (2 resistors and 1 capacitor).
- 2. Battery current which flows in the bias circuit.
- 3. Risk of breakdown of the bias circuit components.

The unit would become more reliable.

"Prof., why should this bias circuit be necessary?"

"This has been done in order to simplify the on/off switch. Bob. If an individual connection is made to each battery, then a double-pole switch becomes necessary in order to switch off both batteries. In order to use a single-pole switch, which can easily be incorporated in the output jack-socket, the bias circuit has been included. In practice, however, it may be possible in some circuits to omit the bias circuit as you suggest and still use only a single-pole on/off switch.

LOOSE SPRING

This is because the bias current taken at the non-inverting input is so small that it could simply be left connected, without doing any harm to the batteries or the circuit, and only the main battery power supply need then be switched off and on".

Bob connected the output socket of the reverberation unit to the input of an audio amplifier and switched "on". He plugged a microphone into one of the four inputs and turned up the volume control. When he spoke into the microphone, however, his voice came out of the speaker without any noticeable reverberation effect even though the reverberation control was turned up full.

He gently tapped on the frame which carried the reverberation springs and coils, with his finger and as he did so, the sounds of vibrating springs could be clearly heard through the loudspeaker.

"This means that the pickup coil and the pickup amplifier are O.K." Bob remarked, "but it seems there must still be a fault in the spring driver circuit."

Suddenly there came a crackle from the speakers, followed by a 'twanging' sound, and Bob found that when he spoke into the microphone there was now plenty of reverberation effect, as if he were speaking inside a huge cavern.

"I didn't do anything, Prof! Why has it suddenly started to work?" "Yes you did, Bob, you tapped it with your finger. Obviously there is something loose in the Spring Driver part of the circuit. There are not many components in this part of the circuit, so the fault should not be difficult to locate."

The Prof. began to prod the various components of the Spring Driver circuit gently with the end of a plastic trimmer tool, as he did so, the reverberation effect came and went; it did not seem to matter very much which component he touched.

"It seems that the break in the circuit must be very small; microscopic, so that the minute amount of flexing in the board which is produced when I touch any component causes it to touch or part unpredictably. The fault will be more difficult to locate because it comes and goes so unpredictably."

PSYCHIC WORK

"Perhaps, Prof.", Maurice suggested, "This is an opportunity for me to try psychic fault-finding techniques, which have been demonstrated to me by a friend of Lilian, the dowsing Lady we met recently. I have been wanting to try it out for myself ever since.

Lilian's friend is a flower power mystic who earns his living as a computer operator with a large computer company. Like me, he does not know much about electronics, but when the repair technicians are having trouble in locating a difficult fault in a complicated computer circuit, he sometimes helps out.

Even though some of the skilled technicians are furious that someone with so little knowledge should be able to find the source of the trouble much more easily than they can, they reluctantly let him loose on the equipment because it saves them hours of difficult work under the pressure of a firm who want the computer repaired fast."

Maurice rooted in his duffel bag and soon produced a small plastic pendulum similar to the one which Bob and the Prof. had seen Lilian use. He held it over one corner of the circuit board of the reverberation unit, and it soon began to swing along a line, which Maurice marked across the board using a ruler. Now he held it over another corner of the board and soon produced another line; the two lines intersected over one end of the electrolytic capacitor C3.

Maurice gently touched the capacitor, and one of its connecting wires broke loose. "That's the fault" he announced, and indeed when Bob replaced the capacitor, the reverberation unit worked perfectly.

PSYCHIC BRAIN

"How do you explain this psychic fault-finding, Prof?" Bob asked.

"At present, Bob, there is no generally accepted objective explanation. Investigators have found that some phenomena claimed to be psychic have in fact been the results of fraud; but there remain a lot where this has not been a plausible explanation, and scientists are forced to listen unhappily to the tantalisingly mystical subjective explanations given by the 'psychic experts.'

These often involve mysterious factors such as 'energy fields' of a nature undetectable by conventional physical instruments, and invisible 'spirit beings' and many people find these explanations dubious or frightening.

However, brainwave investigations appear to be giving some clues and in psychic healing, for instance, it has been stated that the brainwave pattern of the patient changes, and come to resemble the brainwave pattern of the healer as the healing progresses."

ELECTRONICS and THE LOCH NESS MONSTER

"Obviously in such investigations, electronics is relied upon to provide the apparatus for brainwave monitoring and many other functions, which may help to link psychic phenomena to particular brainwave patterns."

"Prof., at school we were discussing the mystery of the Loch Ness Monster, and it seems that in some circles this is held to be, not a real physical flesh and blood monster, but an elemental psychic phenomena. If it is true that perception of such things is linked to particular brain wave patterns, maybe the use of electronic brainwave equipment could help clear up this mystery?"

"Perhaps you could persuade one of Lilian's talented friends to teleport the Laiboratory to Lock Ness for a while, so that we could investigate there! Meanwhile, we've still got: a Spring Line Reverberation Unit on the bench."

"I was going to mention next," the Prof. remark ed, "that this is a very simple example of a Spring Line Reverberation Unit, and that it is possible to buy or construct more elaborate units

SUSTAIN AND REPEAT

Sustain sound effects can be produced by feeding some of the

reverberation signals back to one of the inputs.

Repeat effects can be produced by passing the signal from the pick-up coil through a tremolo unit. If more than one tremolo unit is used, with the outputs through different channels of a stereo or quadrophonic system, the sounds produced become very interesting, and can produce even more effectively the illusion of playing in a much larger hall or room.

To be continued



nce a year around this time, I repeat myself word for word, and I am quite unrepentant about it. The reason is simply that around September and October I know many new readers will join us, and I think one of the most; useful functions I can perform, is to give them the best advice I can on buying their components. So, new readers read on, and regular reacters, I beg your indulgence.

Buying components

You may be one of the lucky ones and have a little man round the corner who can supply your every need, but the odds against it are a hundred to one. Even in London it is not easy to find component shops, and the provinces are hardly likely to be better served, but do not let this in any-way deter you.

Once you have accepted the fact that you are unlikely to get all your requirements from one supplier, and also that you will have to rely mainly on mail order, your troubles are practically over.

Your first purchases should be as many catalogues as you can afford. Study them carefully and then compile a list of all the items you are likely to need: resistors, capacitors, variable capacitors, switches, potentiometers, transistors, integrated circuits, hardware, tools. It's a long list and you are certain to add to it from time to time.

Now take each item and find it in each of the catalogues. You could with advantage code each it em by giving it a number from one to five (in relation to each catalogue of course), five denoting a goor 1 selection, and one rather poor. You could apply the same test with reference to prices.

The price comparison would be particularly useful if only to show you that if Dealer "As" resist ors cost one penny, and Dealer "Bs" cost sixpence, that everything that Dealer "B" sells is not six times as dear as Dealer "A". If this were the case, Dealer "B" would not stray long in business.

Once you have made yo ur list, keep it handy and you will alway s know from whom to buy any particula ir item.

Ordering

With reference to ordering, always use the firm's own order form if they provide one, it makes life easier for them and it follows that it is less likely that mistakes will occur. With costs continually rising everything has to be cut to a minimum, and today it is not unusual for a mail order firm to return your corder form with your goods while keeping no copy themselves. They will usually tell you that in the event of a quiery, the paperwork must be returned. I would in your own interest (especially if your handwriting is anything like mine)

write your name and address in block capitals.

Finally and I regret having to say it, our postal service, is not as fast as it used to be. Make allowances for this, and if, according to your bank statement, your supplier has cashed your cheque and you are still awaiting your goods, take my word for it, he has not done it so he can lay his hands on your money as quick as possible, but in order to give you positive proof that he has received your order.

Wishing you every success with the best of all hobbies.



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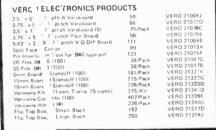
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ABS Box, CIW Brass Bushes, and Lid in Orange
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L112 W62 D31 87 L150 W80 D50 115 L190 W110 D60 195 L 150 W80 D50 L 190 W110 D60

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Order Code

W105 D143 H32 (56)

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P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying

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W250 D167.5 H 68.5 (Chessis 153mm Deep) 1480 Case BIM3000 OR

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0.5W, E24 Values, IM-33M, 5% Tol. 10 ee. 5.40/100 (Mult 10/Value)

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Case BIM8006 OR

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Bulbs, Low Voltage, L.E.S.

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Metal Film, Fixed 0.5W, £24 Values, \$RI-IM, 2% Tol. 2.5W, £12 Values 10R-27K, 5% Tol.	6 es. 13 es.	3:80/100 (Mult 10/Value) 7:90/100 (Mult 10/Value)	£32,40/1000 (Mult 100/Value)	Res M. R. Res Pf. U	

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5 15 V E 5 W HEF 4000 MEF 4000 MEF 4000 MEF 64000 MEF 64000 MEF 64000 MEF 64000 MEF 64010 MEF 64070 MEF 64	es. Up to 20MHz 14 MEFA046 100 14 MEFA047 87 1 14 MEFA067 87 1 14 MEFA050 28 1 14 MEFA050 28 1 14 MEFA050 28 1 14 MEFA050 72 1 15 MEFA050 72 1 16 MEFA050 72 1 17 MEFA050 72 1 18 MEFA050 72 1 18 MEFA050 14 1 19 MEFA050 14 1 10 MEFA050 14 1 11 MEFA050 14 1 12 MEFA050 14 1 13 MEFA050 14 1 14 MEFA050 14 1 15 MEFA050 14 1 16 MEFA050 14 1 16 MEFA050 14 1 17 MEFA050 14 1 18 MEFA050 14 1 19 MEFA050 14 1 10 MEFA050 14 1 11 MEFA050 14 1 12 MEFA050 14 1 13 MEFA050 14 1 14 MEFA050 15 1 15 MEFA050 15 1 16 MEFA050 15 1 16 MEFA050 15 1 16 MEFA050 15 1 16 MEFA050 15 1 17 MEFA050 15 1 18 MEFA050 15 1 18 MEFA050 15 1 19 MEFA050 15 1 10 MEFA050 15 1 10 MEFA050 15 1 10 MEFA050 15 1 10 MEFA050 15 1 11 MEFA050 15 1 11 MEFA500 15 1 12 MEFA500 15 1 13 MEFA500 15 1 14 MEFA500 17 1 15 MEFA500 17 1 16 MEFA510 1 10 16 MEFA510 1 70 16 MEFA510 1 10 16 MEFA511 1 10	HEFA515 299 N,740 TN 11 N,7 MEFA517 382 N,740 SN 11 N,7 MEFA517 382 N,740 SN 11 N,7 MEFA517 382 N,740 SN 11 N,7 MEFA519 55 N,740 SN 12 N,7 MEFA519 55 N,740 SN 12 N,7 MEFA519 188 N,740 SN 12 N,7 MEFA519 188 N,740 SN 17 N,7 MEFA519 10 N,740 SN 11 N,7 MEFA519 10 N,741 SN 18 N,7 MEFA519 10 N,742 SN 18 N,7 MEFA519 10 N,742 SN 19 N,7 MEFA519 11 N,742 SN 19 N,7 MEFA519 11 N,7 MEFA519 11 N,742 SN 10 N,7 MEFA519 11 N,743 SN 21 N,742 N N,7 MEFA519 11 N,744 SN 21 N,742 N N,7 MEFA519 11 N,744 SN 21 N,742 N N,744 SN 21 N	144N 83 N74127N 145N 145N	
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54 OC71 TRANSISTORS untested for 75o WIRE WOUND POTENTIOMETERS 2K 2 watt, 10K 2 watt, 5 K 4 wa'd, 100 K 4 wall.
All at 25p each.
PLASTIC POWER TRANSISTORS 8D 175, 8D 187, 80th 25p each 400mW ZENERS unmarked, Good. 3 6, 6 8, 10, 11, 12, 13, 16, 18, 24, 30, 33, 36volt. All at 10 for 480. MINIATURE 12 WAY CERAMIC TAG STRIPS # 15p. OPTO ISOLATORS TYPE 11-74 with data " 50p.

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50 ASSORTED DISC CERAMIC CAPACITORS # 60p. 58 1 AMP S.C.R's TO5 Can unlested a £1, 25 5 AMP S.C.R's Stud Mounting untested a 75p. 20 10 AMP STUC MOUNTING DIODES untested # 60p. 19 29 AMP STUD MOUNTING DIODES untested # 60p.
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SEMI-AIRSPACED DAU TRIMMERS 2 to 8pi, 7 to 35pi, 8 to 125pi, 8 to 140pi, Ali at 16p each. 300 TO 75 ohm BALUM TRANSFORMERS # 200 SPECIAL OFFER OF VHF, UHF FET 800 MHz BF 256C # 4 for 75().

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NON POLARISED MINIATURE POLYESTER CAPACITORS 1 ut 63v.w., # 5p.
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10 ASSORTED PUSHBUTTON BANKS less knobs for £1 30.
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FT 241A CRYSTALS 21 1, 21 2, 21 5, 21 7, 21 8, 22, 22 2, 22 7, 12 8, 22 9, 23 3, 23 4, 26, 65 1, 26 4, All 54th Harmonic. 36 3, 36 4, 36 5, 36 6, 36 7 MHz, All 72nd Harmonic. All 15p each. 10 for £1.
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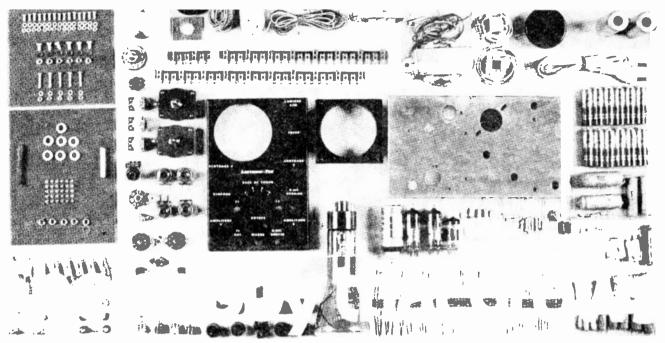
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We've been producing our Electronics Components Catalogue for over 20 years. During that time we've learned a lot, not only in the art of catalogue production but in building a business that serves the needs of constructors. Little wonder that we have a reputation second to none for our catalogue—and for the service that backs it up. Experience both for yourself. Just send £1·25 with the coupon and a catalogue will come by return of post.

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What you see above is a kit of parts that builds into a fully working oscilloscope.

No toy, this vital piece of functional equipment can be found in any professional electronics workshop. It is a valuable instrument of true professional quality.

By building the oscilloscope you will be taking the first steps to a rewarding hobby that knows no bounds.

Each constructional stage is a complete lesson.

in the basics of electronics practice and carefully designed to be understood by those with no previous knowledge. Once built, this instrument can be used to complete a course of practical study and experimentation that will reveal the secrets of printed circuitry, testing and servicing of T.V. and radio and the vast majority of electronic equipment.

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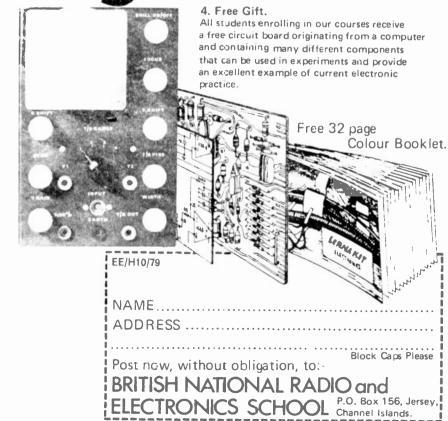
As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.

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World of Knowledge magazine is the most exciting new development in learning aids for children. All mankind's achievements - past and present - will be presented week-by-week in 10 stimulating and absorbing streams of learning using the most up-to-date graphic and illustrative techniques available.

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So build your child's



AUTUMN SALE

24 HOUR CLOCK/APPLIANCE TIMER KIT



Switches any appllance up to 1KW on and off at preset times once per day. Kit contains. AY-5-1230 IC. 0.5 LED display, mains supply, display drivers, switches. LEDs triac, PCBs & full instructions.

11000K Basic Kit.

11000K Basic Kit.

Ready Built

9p DL727 0.5" Square LED
9p 2 digit Display Red Size:
9p CA £1,00 5 5.25
CA £1,00 9x9mm high
12p Display 0.5 31
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digit c.c. 7
segment

70.2" Red LEDS Special offer digit c.c. 7 25 at £1.25 Special offer segment L74 Opto Iso 25 for £1.25

Moulded in high impact ABS. Supplied with lids and screws. Black or white PB2 95×71×35mm 65p PB3 115×95×37mm 70p

RESISTORS

ZENER DIODES 400mW 3.3V-30V 1.3W 7.5-30V

one value) 10p 10 packs (mixed values) 80p

400V Plastic Case (Texas)

LIGHTING CONTROL KITS

follow instructions. TD300K TOUCHDIMMER. Single touchplate

TD300K TDUCHDIMMER Single touchplate with alternate action. Brief touch switches lamp on and off, longer touch dims or brightens lamp. Neon lamp helps find the switch in the dark.

**TDE/K Extension sit for TD300K for 2-ways whiching the TD300K - TOUCHSWITCH & DIMMER. Single touchplate. small knob controls brightness.

TS300K - ON/OFF TOUCHSWITCH. Two touchplates.

TS300K - ON/OFF TOUCHSWITCH. Two touchplates.

**TS300K - ON/OFF TOUCHSWITCH. Two TS300K - ON/OFF TOUCHSWITCH. Two TS300K - ON/OFF TOUCHSWITCH. Two TS400K - AUTOMATIC. Single touchplate.

TS300K – ON/OFF TOUCHSWITCH. Two touchplates. £3.50 TSA300K – AUTOMATIC. Single touchplate. Time detay variable 2 secs. to 3½ miss £3.50 LD300K – LIGHTDIMMER Ktf £2.60

DIGITAL VOLTMETER/ THERMOMETER KIT



Based on the ICL 7106.
This Kit contains a PCB, resistors, presets.
apacitors, diodes, IC and 0.5' liquid crystal display.
Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3m / supply. (PP3 battery)

INTEGRATED CIRCUITS

741 Op. Amp 741 Op. Amp AY-5 - 1224 Clock 22.60 AY-5 - 1230 Clock/Timer 63.80 (CL7106 D.V.M. (L. C. D. Orive) ICM7217 Counter (C. A. L.E. D. or TDA1024 Zero Voltage Switch LM3911 Thermometer LM3911 Dot/bar Driver MM57160 (stac) Timer S566B Touchdimmer S9663 Touchdimmer S9663 Touchdimmer Drive) £1.90 £1.00 £2.60 £5.95 £2.60 £4.86 £1.80

T.K. ELECTRONICS (EE) 106 Studley Grange Road, Condon W/ 2LX Fat: 01-579 9754

SINCLAIR PRODUCTS New 10MHz scope pon. PFM200 £52 59, case £3 40, canactor kit £11 27. Microvision TV UK model £91 44, mains adaptor £6 28. PDM35 £29 76, meins adaptor £6 28. PDM35 £29 76, meins adaptor £3 40, case £1 40. DM350 £11 82. DM450 £102 17, DM355 £52 56, rechaigeable batts £7 99, mains adaptor £3 94, OHIO SCIENTIFIC Superboard 2 built. 8k basic, 4k ram £217 + VAT. COMPUTER GAMES Star chess £62. Chess champlon £594. Chess challenger 10 £152 50. Voice challenger £239. Check challenger £246. Alari video computer £147, cartridges £14 32. COMPONENTS INHAIR1 49.1N40073 1p.

COMPONENTS IN41481 4p.1N4007 3-1p.

COMPONENTS IN41481 4p.1N4007 3-1p.

741 18p. bc182b, bc183b, bc184b, bc212b.

bc213b, bc214c 5p. Resistors jW 5% E12

OR 10 10M 1p. 0 8p 10r 50+ of one value.

16V electrolytics -5/1/2/5/10/22uf 5p. 100uf

6p. 1000uf 10b. 1 b FeCt £1 20. Dalo pen

84p. 40 sq ins pcb 64p. Polystyrene capacitors £19 83V 10 to 100uf 3p. In2 to 10n 4p.

Ceramic capacitors 50V £6 22p 1 to 47n 2p.

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Teramic Section W 100 to 4M77 2p.

Ty GAMES A y-3-850 + kit £9 53. Rifle

kit £5 27. Ay 3-8610 + kit £12 98. Stunt

cycle chup + kit £16 72.

TRANSFORMERS 6-0-6V 100ma 76p,

1½e £2 50, 6 3 V 1½a £2 01.9-0-9V 15ma 76p.

la £2 12, 2a £2:77. 12-0-12V 100ma 92p, la £2 65.

BATTERY ELIMINATOR KITS 100ma radio types with press-studs 4\(\frac{1}{2}\) et 49, 4\(\frac{1}{2}\) et 49, 4\(\frac{1}{2}\) et 49, 4\(\frac{1}{2}\) et 49, 4\(\frac{1}{2}\) et 50 \(\frac{1}{2}\) et 5 MALZ 66.
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ALL PHICES

IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a tew of the Bargains still available from previous lines.

5000 WATT HEATER KIT
Why not make a standby heater, you never know oil, gas even coal could run out this winter so be prepared and in any case a big heater is a good thing to have for an emergency. We are offering the kit at a very special price until September 30th only. The kit consists of:—flow metal bladed tangential blowers, two 2.5 kW mineral filled metal clad heating elements, a three level switch, thermal safety cutout, mains and wiring connector panel, all the necessary tag ended leads and last but not least the wring and assembly diagram. You have to provide the case material yourself, but our diagram gives all the details—the special off season price is £7.95 + £1.20, carriage £2. Price after September 30th is £11.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £11.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £11.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20, carriage £2. Price after September 30th is £1.50 + £1.75 + £1.20 + £1.75

on can usually be replaced separately A DOOR SWITCH

A DOOR SWITCH

Neat tubular pattern for letting into door frame. All you have to do us drill a j" dia hole and chisel out for the fixing. This is a changeover switch, so can be used in opening or closing circuits. Price \$7p..

CROUZET SKELETON MICRO SWITCH

Crouzet ref. 319/C this a changeover switch with unlimited uses, contacts rated 10 amps stackable and very light weight, snap action. Price \$9p..

MINI DECADE THUMB WHEEL SWITCH

Stackable, panet hole size 1j" high and approx j" for each switch. Malt black with white figures—gold plated break before make contacts. Price \$7p.

switch. Matt black with white figures—gold plated break before make contact., Price \$70.

ROCKER SWITCH

Jouble pole 13 amp 250v for hole size \$2.1" white with nickel plated surround. DOT ref. 82(631. Price 41p.

VARIABLE AUTO TRANSFORMERS (Variacs)
We have \$12 only 8 amp variacs, these are unused being removed from new £x Gov. power supplies—these variacs enable normal 230/40 mains to be varied smoothly from 0 volts to 270 volts in one volt steps. The current passing through the variac can be anything up to 8 amps continuous or 12 amps intermittent. These are ideal for dimming lighting or heating, speed control etc and on the work bench for testing unknown transformers etc. The up to date price in letting unknown transformers etc. The up to date price in the trade catalogue is £50 + val, but our price is only £34 50 + £3 carriage.

MOTORS FOR VARIACS
Do you have a job which calls for the remote control of variacs—say the raising and lowering of the house lights in a theater or the control of the air conditioning by thermostats set at different temperatures. If so you may like to know we have motorised cradles to take up to 4 variacs—mains operated, these drive the variacs backwards or forwards and have limit switches at the end of their 320° travel. Price £46 + carriage £5.

LOW TORQUE MICROSWITCH
Can be operated by air flow, coins or other small weights so they have many applications—SPDT silver contacts rated at 250v 5a expected life of 10,000,000 operations. Price 52p. LIGHT DEPENDENT RESISTOR ORP12

A cadmium sulphide i.d.r. with clear end window—resistance reduces as light increases, dark resistance 1 meg plus, sun light resistance 100—200 ohms. Price \$7p.

Wire leads suit 1 matrix board—top adjusting available in following values: 10 ohms, 10%, 20%, 50%, 100%, 200%, 250%,

SUB MINI TRIMMING POTS
Wire leads suit 1 matrix board—top adjusting available in following values: 10 ohms, 10k, 20k, 50k, 100k, 200k, 250k, 500k and 1 meg Price 74p each or 82p if ordered in ten of one

MULTI TURN POT

mULTITURN POT
13" cermet—20 turn metal cased with three leads for p.c.b.—
multi-contact wiper ensures minimum noise and excellent
stability—slipping clutch end stop, one value only at present
this is 2 k1, Price 85p.
SPECIAL CABLES
10 addition

Intis 12 Att. Price \$5p.

SPECIAL CABLES
In addition to the list given in our May/June newsletter we have a few more to add—these have medium duty 7 0076 copper conductors P.V.C. insulated and colour coded, wisted into pairs, each pair braided with a metal screen then all are laid together and covered, black pvc 4 screened pairs \$6p, 5 screened pairs \$6p, 8 screened pairs \$6p, 55 screened pairs \$6p, 8 screened pairs \$6p, 8hl prices are per foot and subject to VAT and \$60 carriage if order under £6.

POWERFUL LOW SPEED MOTOR
230 or 115v mains driven, 45 r.p.m. approx at 50 Mz 60 r.p.m., at 6 Mz. Size is approx 22" dia 22" deep 1" dia shaft 2" long—mountable from front or rear, this extremely powerful, in fact the writer could not stop it by hand. Price £3 75 ± 56p, post 40p

1 M.P. MOTORS Normal base mounting, ex computors but tested, 220—240v 50 hz good length spindle mostly American make. Price £8 52 each. carriage £2 00.

STEREO HEADPHONE LEAD
Black curly, 1011 approx, terminations, stereo jackplug one

STEREO PREADPHONE LEAD
Black curly 10ft approx. terminations, stereo jackplug one
end—miniature two pin plugs on other. Price 57p.
MAINS OPERATED WATER PUMP
Most readers will know that we stock the Jabsco drill pump
which was made to work with most portable drills, the price
them on a metal chapted this to a 110 rpm motor, mounted
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them on a metal chapted this to a 110 rpm motor, mounted
them on a metal chapted this of offer this as a general purpose
pump. It is suitable for most liquids and certainly for water.
The pump will lift the liquid up to quite a head Price £16 50,
post £1 00.

MEAVY DUTY MAINS RELAY
With three c/o 15 amp contacts—fitted with plastic dust
cover, this has push on tags for quick connections. Price
£3 26.

MULLARD UNILEY

MULLARD UNILEX
A mains operalad 4 + 4 stereo
system. Rated one of the
finest performers in the stereo
field this would make a wonderful giftfor almost anyone in
easy - to - assemble modular
form and complete with a pair
of speakers this should sell at
about £36—but due to a special
bulk-buy and as an incentive
for you to buy this month we
offer the system complete at
only £15 including VAT and
postage.



SHORTWAVE CRYSTAL SET

Although this uses no battery it gives Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 10, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £2:38—crystal earphone \$5p including VAT and postage.



WINDSCREEN

RADIO STETHOSCOPE

Easiest way to fault find, traces, signal from aerial to a speaker, when signal stops you've found the fault. Use it on, Radio, TV, amplifier, anything. Kit comprises transistors and parts including probe lube and twin stetho-set

WIPER CONTROL Vary speed of your wiper to suit conditions. All parts end instructions to make £4:25.





DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3:75.

SOUND TO LIGHT UNIT

Will proved circuit flashes up to 750 watts of lamps.
Complete kit includes S.C.P. mains input leads, all parts and very neat plastic case £4 95.

CASSETTE OUTFITS

Complete mechanisms with record/playback and erase heads—all electronics and speaker £9.75 post and VAT paid. Note these are all cased up ready to use but case may be slightly uncomplete, cracked or broken.

VARICAP POCKET RECEIVER CHASER DISPLAY

To quickly receive parts for these and other E.E. projects, send the approximate cost as shown. Any cash adjustment can



MINI-MULTI TESTER

Amazing, deluxe pocket size precision moving coil instrument jewelled bearings—1000 opv—mirrored scale.

FREE Amos ranges kit enable you to read EC 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 £1 50.

TERMS: Cash with order—but orders under £6 must add 50p to offset packing, etc. BULK ENQUIRIES INVITED. PHONE: 01-688 1833.

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LATCHING RELAY
This is 3n fact a double relay, mechanically arranged so that
when relay no. 1 closes it will stay closed until no. 2 is closed.
Each relay has its own coil (50v dc) and its own clo contacts,
useful in burglar alarm and similar circuits. Price £3-45.
DOUBLE ENDED MOTOR

useful in burglar alarm and similar circuits. Price £3-45.

DOUBLE ENDED MOTOR

Mains operated, capacitor run, power estimation at approx.

\$\(\) h.p., this has spindle coming out each side and should
be very suitable for converting into a doubled ended polisher
or grinder, holes conveniently placed in the housing make
it very easy to stand in the right position and the speed
although not high is adequate. We are offering these with
capacitor at £4-76, post £1-50.

THREE POSITION ROCKER SWITCH

10 amp changeover with a centre off standard size pushes
into hole size approx. 1" × 7/18". Special bargain this month,
10 for £2-36.

WATERPROOF MEATING WIRE

As used for electric blankets etc. This has dozens of other
applications—in gloves or socks for people with poor circulation are obvious uses. One unusual use suggested by a
customer is a 'grow' bug heater. The wire which consists
of an element wound on glass fibre then covered by clear
PVC has a resistance of 80 ohms per yard. The price is 23p
per mete.

per metre. FAST RUNNING OUT

Per mere.

PAST RUNNING OUT

The mielature 24hr timer module, with facility for 32 on offs and 16 amp contacts. If you want one of these send your order this month or you will be too late. Price is £7.71. Extra on off triggers £1.15 per set.

ANOTHER UNREPEATABLE BARGAIN

Which will soon be sold out, is the Sensitive Voltmeter/
Relay-rully described in our January newsletter—brand new offered at only about 1/10/10 of manufacturers price namely £8.93 and post £1. The 4½" 1 mA movement alone is worth more than double this and we give a circuit diagram of the non energy consuming relay/alarm circuit built into the voltmeter's case.

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·5 mm	Flat twin		£5-17	£1·75
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Wireless World this device filts an urgent need in that it
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used). The ones we supply are suitable for operating up to
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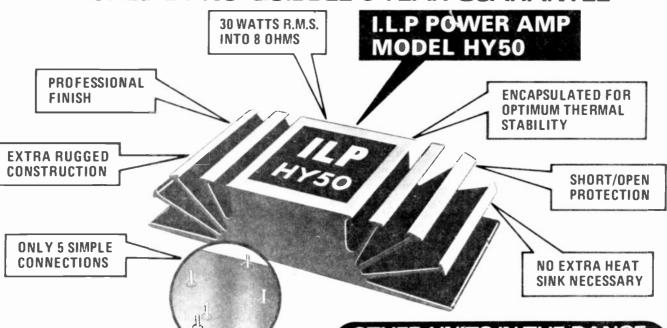


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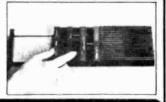
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multiband superhet tuner, constructed using a single IC for RF/IF processing all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) funed FET tunerhead, with ceramic IF filters and interstation mute AM employs a double balanced mixer input stage, with mechanical IF filters: plus a 8FO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon) Complete with MA1023 clock/timer module with dial scale

£99.00 + £14.85 VAT

£66.00 + £9.90 VAT

Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Or use it as a servicing aid - this low powe LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received requency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV

Complete kit £19.50 + £2.93 VAT, built and tested module £27.00 + £4.05 VAT Ambit stocks and distributes a wide range of frequency counter LSI for all types of DFM-

part two of the catalogue contains details of the MSM5523/4/5/6 range, and the versatile MSL2318 divide by ten or hundred prescalar IC. The DFM1 combined counter for AM,FM SW and direct/clock/stopwatch/timers - details available, but SAE please !

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environmental sealing. £37.00+£5.55vat

VHF MONITOR RX WITH PLESSEY IC 4/9 channel version of the PW design but using standard (fundx9) crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +£3.90vat

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FM/AM tuning synthesiser, see details elsewhere in this advertisement

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with latest d	qciaval	ments.	Data photo	осоруі	ng sen	vice described i		list l	nfo.
RADIO ICs	lor FM	vat	SL1600 s	eries		Audio pream	\ps	vat	
CA3089E	1.94	29	SL1610	1.60	24	LM381N	1.81	27	tc. chi ypes
CA3189E	2.45	37	SL1611	1.60	24	LM382N	1.65	25	etc. ach typ
HA1137W	2.20	33	SL1612	1.60	24	KB4436	2.53	38	
HA11225	2.20	33	SL1613	1.89	28	KB4438	2.22	33	20 H 6 E
SN76660N	0.75	1.1	SL1620	2.17	33	TDA1028	3.50	53	- F 7 ~
RADIO ICS	for AM	/FM	SL1621	2,17	33	TDA1029	3.50	53	2000
TDA1090	3.35	50	SL1623	2.44	37	TDA1074	3.75	56	O age of
TDA1083	1.95	29	SL 624	3.28	49	Audio powe	F		Gu ≟ E gi
TDA1220	1.40	21	SL1625	2.17	33	TBA820M	0.75	11	48 v 45
IF AMPLIF		-	SL1626	2.44	37	TBA8 tOAS	1.09	16	
KB4406	0.50	07	SL1630	1.62	24	LM380N	1.00	15	2 2 2 2
MC1350	1.20	18	SL1640	1.89	28	ULN2283	1.00	15	1 to 133
see comms i		10	SL1641	1.89	28	TDA2002	1.95	29	- acx
COMMUNIC		uc.	SL6640	2.75	41	HA1370	2.99	45	2SS from
			SL6690	3.20	48	TDA2020	2.99	45	(A > == N
K84412	2.55	38	MC3357	3.12	47	FETs. MOSI	ETs. b	ipol	ars.
KB4413		41	MC1496	1.25	19	and various			
\$D6000	3.75	56	NE544	1.70	25				-

assurance	e th	at all dev	ices ar	e very best	first qua	from BS9000 lity commerci ck by phone	al types. So	ome LPSN	
TIL	:5	tanc	lar	d An	O LP	Schot	tky All	prices lister	d in
ż	,rsn,	ž,	,rsn,	Š	LSN,	.rsv.	VOLTAGE F 7800 series 1 7900 series 1	Amp pos	95p 100p

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7400	13 2	7472 2	28	74142	265	74257	108	78M series %Amp pos			4011	17	4554 153	BAT
7401	13 2	7473	32 38	74143	312	74260	153	78LCP 100mA	35p	. ⊢I	4012	17	4558 117	BAT
7402	14 21		27 38	74144	312	74273	124	78MGT2C variable	175p	RENT	4013	55	4560 218	
7403	14 21		38 40	74145	65 97	74283	120	79MGT2C variable	175p	E I	4014	95	4562 530	BB10
7404	14 2		37 38	74147	175	74293	95	/23CN variable IC	175p 65p	200	4016	52	4566 159	PIN
7405			38	74148	109 191	74365	49	NE550			4017	80	4568 281	BA4
	18 20		18 36	74150	99	74366	49	L200 variable V and I	195p	히	4018	80	4569 303	TDA
7406	38			74151	64 84	74367	43		-	- 9	4019	60		BA1
7409	17 2		36		64 54			MAINS EMI FILTERS	177	9	4020		4572 25	All
7410	15 2		69	74153		74368	49	(BS etc approved types	1 =	5 Fi		93	4584 63	Pleas
7411	20 2		04 99	74154	96	74373	77	1 Amp in IEC chassis	15	ш	4021	82	4585 100	rieas
7412	17	7486	40	74155	54 110	74374	77	connector	4.83	- 21	4022	90	LINEARS	
7413	30		05	74156	80 110	74377	124	6 Amp in IEC	5.83	5 4	4023	17		
7414	51		33 90	74157	67 55	74379	130	5 Amp wirein	3.87	S	4024	76	CA3130E	84
7415	2	7491	76 110	74158	60	74393	140	IToroid cores in Cat no	31	: (3)	4025	17	CA3130T	90
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7417	30	7493	32 99	74160	82 130	MISC. Cou	inter/t	imer, scalar devices		ا≽	4027	55	CA3140T	72
7420	16 2			74161	78			E556 78p NE558	180p	- C	4028	72	LM301AH	67
7421	29 2			74162	130	LM3909 7		E330 76P NE330	1000		4029	100	LM301AN	30
7423	27	74961		74163	92 78			y 10/11 to 320MHz			4030	58	LM339N	66
		7497 1		74164	104 130				1400p			120	LM348N	186
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7427	27 2	741XX		74167	20			to 175MHz min	420p	2 8	4042	85	709HC	64
7428	35 3	74107	32 3	74169	200			y 10/100 to 175MHz min		2 51	4043	85	709PC	36
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7441	74	74116	198	74177	78				1495p	, O		65	747CN	70
7442	70 9			74181	165 350				1495p	DUCED	4052		748CN	36
7443	115	74118	83	74183	210			DVM (3% digit)	955p		4053	65	NE531N	105
7444		74120	115	74184	135				955p 24.80 955p		4055	135		
7445	94	74121	25	74185	134			DVM (3% digit)			4059	563	7 SEG DISF	LAYS
7446	94	74122	46	74188	275				20.65	川	4060	115	HP5082 seri	ies
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			38 4	4 74193	105 180	received free	quency	display and direct count	er .		4068	25	Yell 7660	
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	Л	1111		MORE FROM THE	GENE	HAL A	MBIT CATALOGUE RANGES:
	-	<u> </u>		Varicap tuning diodes fo	r AM/FR	vi/TV:	MPU controllable digital freg.
4000		4522	149	1-9 v AM tuning (Cr 15:	1) from	TOKO-	synthesiser PCB. Preliminary:
4001	17	4528	102	KV1211 double matche			Serial data controlled, with the
4002	17	4529	141	KV1210 triple reatched	245p		standard swallow count system
4006	109	4532	125	KV1215 triple snap-apa			for maximum speed of operation.
4007	18	4538	150	MVAM115 single 15v			Multiple time constant filters.
4008	80	4539	110	MVAM125 single 25v		16p vat	suitable for AM/FM and other
4009	58	4543	174	MVAM2 double 25v	148p	22p vat	communications/generator
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4016	52	4566	159	PIN DIODES, BANDSWI		pes	
4017	80	4568	281	BA479 PIN attenuator		5p vat	Projected cost of the controller
4018	80	4569	303	TDA1061Pi-form atten.	95p	14p vat	PCB less than £30: comprises the
4019	60	4572	25	BA182 Bandswitch	21p	3p vat	two modulus counter, prog.div.,
4020	93	4584	63	All RF semiconauctors s	tocked i	in depth.	phase detector, multiple TC loop
4021	82	4585	100	Please ask for quantity p	ricing de	tails.	filter/integrators.

1	Varicap tuning diodes for A	AM/FN	1/TV:	
ı	1-9 v AM tuning (Cr 15:1)	from 1	roko-	
ı	KV1211 double matched		26p vat	
ı	KV1210 triple reatched	245p	37p vat	
ı	KV1215 triple snap-apart	245p	37p vat	
ı	MVAM115 single 15v	105p	16p vat	
	MVAM125 single 25v	105p	16p vat	١
	MVAM2 double 25v	148p	22p vat	ı
	BB204/104 double FM	40p	6p vat	ı
	BA102 single A.FC etc	30p	4p vat	ı
ı	BA121/ITT210 single afc	30p	4p vat	l
ı	BB105B single UHF	40p	6p vat	ı
ı	PIN DIODES, BANDSWIT	CH typ	es	ı
	BA479 PIN attenuator	35p	5p vat	ı
	TDA1061Pi-form atten.	95p	14p vat	ı
Į	BA182 Bandswitch	21p	3p vat	ı
	All RF semiconauctors sto	cked i	n depth.	ı
į	Please ask for quantity pric	ing de	tails.	ı

	ynthesiser PCB. Preliminary:
	Serial data controlled, with the
5	tandard swallow count system
f	or maximum speed of operation.
1	Multiple time constant filters,
S	uitable for AM/FM and other
c	communications/generator
ä	applications. Not for beginners.
ı	Full preliminary data package
f	1 + SAE, No phone enquiries
2	enswered on this system for the
8	ime being. Watch this space
F	Projected cost of the controller
F	CB less than £30: comprises the
	wo modulus counter, prog.div.
	phase detector, multiple TC loop
	litter/integrators.

u	TOP GF	RADEL	EDS by	AEG:	PRICES	ARE EXC. VAT (add 15%)
П	SIZE F	Rest G	reen Ye	llo Or	ang Ou	antity discounts for LEDs:
П	5mm 1	4p 16	ip 15	20	p 10	per type - less 10%
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1	6LT06	5 digi	t DFM	display	IGI AYSE	100) mpxed £9.75 + 1.46 vat
	TOKO	COILS,	FILTER	s, CHO	OKES, etc	for AM/FM/TV comms-
	TYPE	Size:	5mm	7mm	10mm	(please add VAT @15%)
п	AM IF		55p	33p	30p	Various for ICs, transistor etc.
ı	FMIF		55p	33p	33p	Various for ICs, transistor etc.
П	SW coils	5			33p	Two impedance series
	OSC coi	ils	55p	33p	33p	For LW/MW/SW
ш	T3/14/e	16			75.0	

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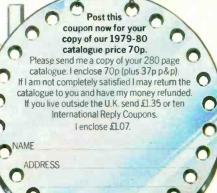
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