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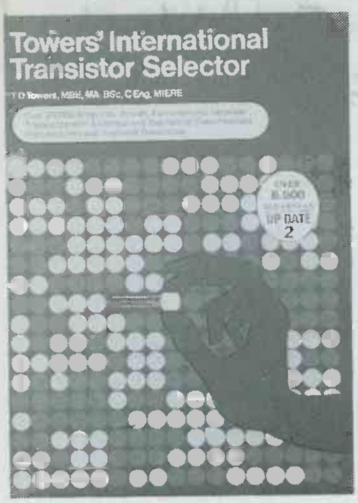
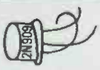


This is dead! 

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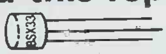

If it takes you longer than 1 minute to find out all about these transistors then you need a copy of TOWER'S INTERNATIONAL TRANSISTOR SELECTOR. It's one of the most useful working books you will be offered this year. And probably the cheapest!

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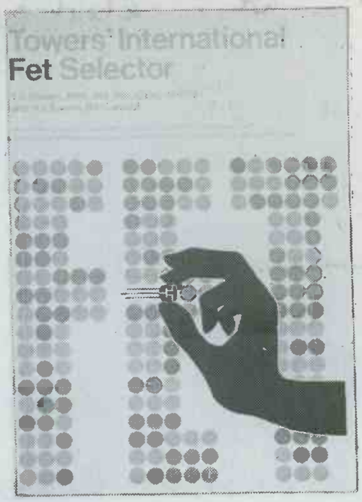

If you deal with field effect transistors, or fet's — whether as a student, a hobbyist, a circuit engineer, a buyer, a teacher or a serviceman — you often want data on a specific fet of which you know only the type number.

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6. Manufacturers
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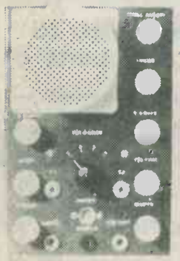

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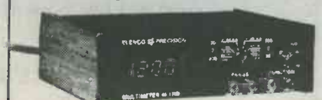

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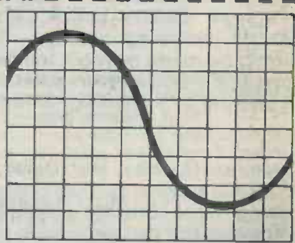

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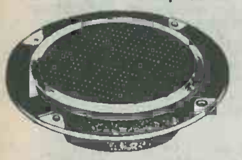
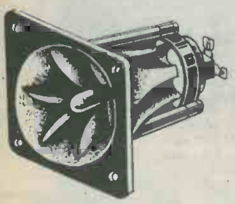


2.5" Direct Radiating Tweeter, maximum rating 25 volts R.M.S. 100 watts across 8 ohms. Freq. range 3.8kHz-28kHz, £3.65



3.5" Super Horn (flush mounting), maximum rating 25 volts R.M.S. 100 watts across 8 ohms. Freq. range 3.8-2.8kHz, £4.50

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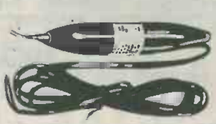

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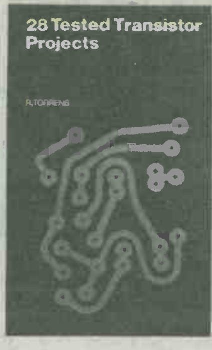

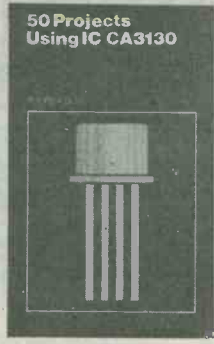

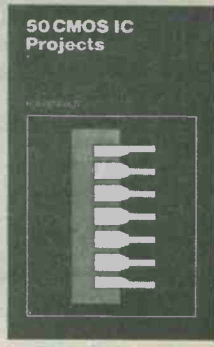

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BRIAN J. REED

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EL81	90p
EL83	85p
EL85	£1
EL86	80p
EL91	£1.85
EL95	85p
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EL822	£4.90
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PY81	70p
PY82	55p
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UU8	£3
UU12	55p
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UY21	£1.30
UY42	75p
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VR92	55p
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VT126	£1.50
VU133	£1.25
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W42	£1
W61	£1.75
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Z66	95p
Z152	60p
Z193	£1.50
Z900T	£1.80
ZA7022	£1.50
Z700U Thyratron Ex equipment	39p

Thyristors

Amp	Volt	Thyristors	
1	240	BTX18-200	35p
1	240	BTX30-200	35p
1	400	BTX18-300	41p
4	500	40506	58p
4	600	2N3228	36p
6.5	500	BT109/SCR957	71p
20	600	BTW92-600RM	£3.40
15	800	BTX95-800 Pulse Modulated	£1
0.8	200	2N5064	18p
3	600	T3N06C00	53p
3	100	T3N1C00	36p
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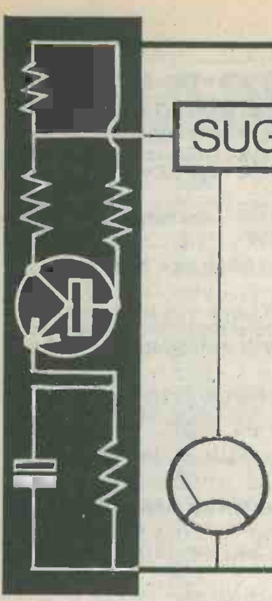
75	800	71CG80	£6
150	1000	151RA100	£10
150	1200	151RA120	£11
12	1000	CR121103-RB	£8
BT 106		70p BT 107	£1
BT 121		70p	

SUGGESTED CIRCUIT



ROBUST BURGLAR ALARM

By G. A. French

A large number of burglar alarm designs are available to the public these days, and they range from very simple installations incorporating little more than a relay, bell and battery to very complicated circuits requiring more than a hundred electronic components. It can be argued that an excessive quantity of parts in a burglar alarm system is not a desirable feature, on the grounds that a large number of components increases the risk of failure.

For normal domestic protection a very high degree of security can be given by quite simple intruder alarms and a suitable circuit for such an alarm is described in this article. The system is intended for installation indoors in dry conditions, and particular emphasis has been placed on running economy. The circuit has an inhibit feature which disarms the alarm for a short period after switching on, thereby allowing the occupier of the premises to turn it on and leave the premises without triggering the alarm. The inhibit circuit is automatically reset when the alarm is switched off again,

OPERATING REQUIREMENTS

A number of conflicting requirements have to be satisfied in the design of a low cost burglar alarm. The question of a power supply has first to be settled, and battery operation is normally to be preferred since there is then no risk of failure to operate due to mains power cuts and the like.

A simple d.c. operated circuit will be employed, in which the alarm is triggered by guard switches or other switching devices installed at or near doors and windows, whereupon the next point which has to be decided is whether triggering is to be given when the guard circuit is opened or when it is closed. With the first method a current flows continually through the guard circuit is opened or when it is closed. With the first method a current flows continually through the guard switches, and these break the circuit to trigger the alarm when the appropriate door or window is opened.

No current flows with the second approach until one of the protective switches is closed. The first method of operation is normally considered the better because it has a fail-safe feature. If any of the wires in the circuit is cut the alarm is triggered. On the other hand, there is the necessity of providing the continual guard current which, if the installation is to be robust and reliable, must have a magnitude of at least a milliamp. With a 9 volt energising supply this corresponds to a working impedance of 9kΩ or less, and there is then little risk of non-operation due to leakage across switch terminals and similar occurrences. The writer recently heard of a continual current installation in which the current was much lower than a milliamp, and in which one of the switches ceased to operate simply because it had been painted over. Even when dry, the paint caused sufficient leakage across the switch terminals to prevent the alarm being triggered when the switch contacts opened.

In these days of CMOS gates which operate at microamp level, a continual current of 1mA or more seems rather large. If an alarm employing a 1mA continual current were switched on for long periods, smaller batteries in the PP3 and PP6 category would become exhausted relatively quickly. Even with a larger PP9 battery, regular checks would be required to ensure that its voltage was being maintained at an adequately high level. Batteries are expensive, and a system which requires frequent battery replacement would prove costly in the long run.

This factor makes it desirable to take a second look at the open-circuit method of operation, with which the guard switches are normally open and no continual current flows. With such a system it is possible to obtain protection against wire cutting which is very nearly as effective as is given in a continual current installation. The alarm to be described requires that connection to the guard switches be made by way of screened cable. If flexible insulated audio cable with a braided wire screen, as opposed to the type having a lapped wire screen, is employed here it becomes extremely difficult to cut the cable without momentarily short-circuiting the screen and centre conductor together. Such a short-circuit can be more than adequate to trip an electronic latch. To sum up, the open-circuit method of operation has much lower running costs, it can offer about the same degree of security as the closed-circuit method and it can include protection against wire-cutting. In the author's experience, the only way of cutting braided screen audio cable without causing a momentary short-circuit is to first remove the outer insulation, cut the braiding all round a diameter of the wire without accidentally contacting the centre conductor, push back the braiding and then cut the centre conductor.

CIRCUIT DESIGN

The full circuit of the burglar alarm is given in Fig.1. It is assumed that there is only one guard switch, this being the normally open switch S1. The switch could be mounted at a door so that it closes when the door is opened, and it connects to the main part of the circuit via screened cable of the type just referred to. The active devices in the circuit are four gates in a quad NAND i.c. type CD4011, and a BC107 transistor.

When switch S2 is moved from the "Off" to the "On" position, power is applied to the circuit and the short-circuit (via current-limiting resistor R3) across C1 is removed. C1 commences to charge slowly via R2. When C1 is in the discharged or only partly charged state, the voltage at pins 1 and 2 of gate G1 is high, and the gate output at pin 3 is low. Gate G2 output is consequently high, and it stays high regardless of whether S1 is open or closed. The outputs of gates G3 and G4 are low. The circuit is now going through its initial inhibit period after switch-on, and it gives time for the occupant of the protected premises to leave and close the door, thereby opening switch S1. Pin 6 of gate G2 is then taken low because the output of gate G4 is low.

After a period, C1 acquires sufficient charge to take pins 1 and 2 of gate G1 low, whereupon the gate output and pin 5 of gate G2 is taken high. The alarm is in consequence armed, and gate G2 has one input high and one input low.

If, now, switch S1 is closed (or the screened wire short-circuited) pin 6 of gate G2 goes high. Its output goes low, the output of gate G4 goes high, and the two gates latch into this new state. The latch remains in this state regardless of whether S1 is closed or opened, and it requires only a very momentary closure in S1 to achieve the requisite triggering. Previously, the output of gate G3 was low, causing TR1 to be cut off. G3 output is now high and TR1, functioning as an emitter follower, energises relay RLA. The relay contacts cause the bell (or any other warning device) to be actuated, and the bell can only be silenced by returning S2 to the "Off" position. Power is then removed from the circuit and C1 is discharged via R3, with the result that the alarm is reset ready for the next time it is switched on.

When, after arming, switch S1 is open, the impedance at its terminals is of the order of 3kΩ, this being given by R4 in series with the output impedance of gate G4. At the instant of closure there is a current pulse of some 3mA before the output of gate G4 goes high. The same impedance still exists across the switch terminals, but there is now, of course, no potential between them. This low impedance working will prevent incorrect operation due to leakage across switch terminals and similar effects.

As C1 charges during the initial inhibit period, the output of gate G1 stays low until its input voltage reaches the level at which linear amplification takes place. The output then swings fairly quickly to the high state. It is quite in order to switch on at S2 and leave S1 continually closed. All that

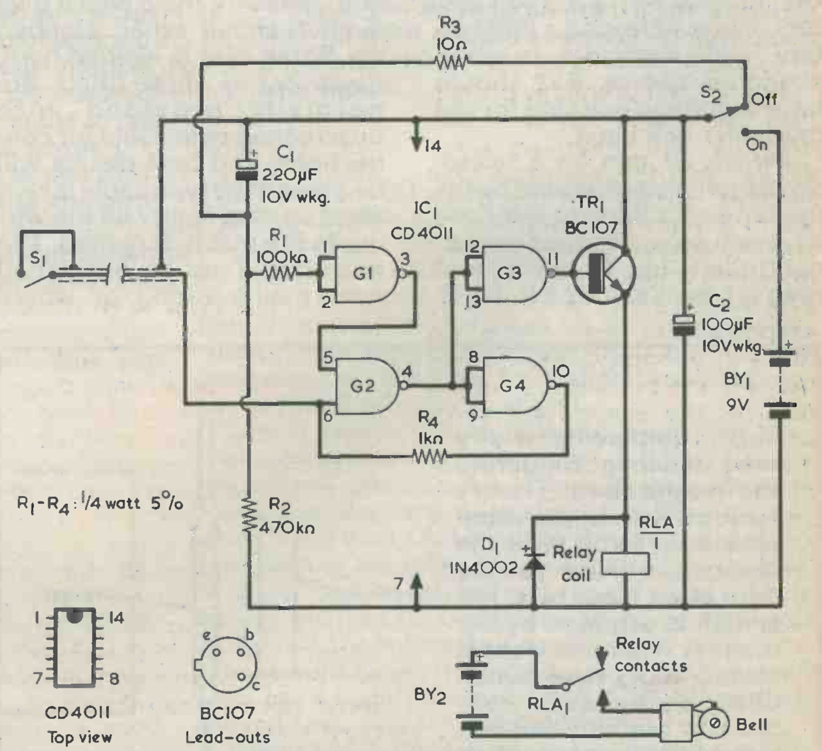


Fig.1. The circuit of the burglar alarm. This features very low running current, automatic latching, turn-on inhibit timing, low impedance guard wiring and protection against wire-cutting.

then happens is that the alarm sounds at the end of the inhibit period. The inhibit period with the prototype circuit was 1 minute and 15 seconds, but this may vary somewhat with units built up to the circuit due to tolerances in value in C1, and differences in transfer characteristic in gate G1. The inhibit period is roughly proportional to the value of C1 and can be extended, if desired, by increasing that value.

Resistor R1 has no effect on circuit performance as so far described, and its only function is to prevent heavy currents flowing in the input protective diodes of gate G1 during switch-off. If the alarm is switched off with the relay energised, there is an instant, with the switch arm between contacts, when C2 discharges rapidly whilst C1 discharges slowly.

COMPONENTS

All the components are standard readily available types. Relay RLA is a miniature "Open Relay" with 410Ω coil, available from Maplin Electronic Supplies. Switch S2 may be a normal toggle type or a type which is operated by a key. Battery BY1 is a 9 volt battery of any type, and a PP9 battery will represent a good economic choice. BY2 should have a voltage suitable for the particular bell used.

Switch S1 can be a microswitch which is operated by the opening of a door or window, or it can be a dry reed switch controlled by a permanent magnet, as illustrated in Fig.2.

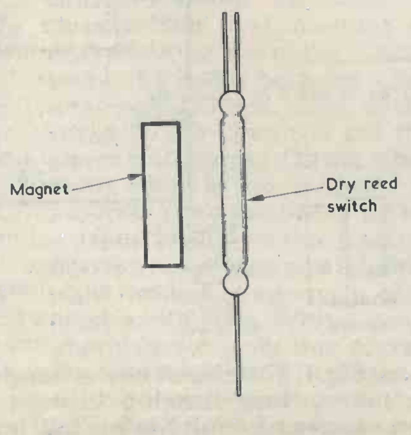


Fig.2. Employing a dry reed switch for triggering the burglar alarm. The dry reed switch is mounted on a door jamb with the magnet, affixed to the door edge, close to it. The switch is actuated by the magnet when the door is closed. A dry reed switch with changeover contacts is required so that two of these make when the door opens.

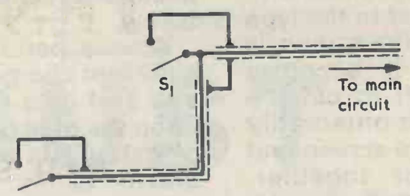


Fig.3. A further guard switch (or switches) is connected in parallel with S1 as shown here.

When more than one switch is required the switches are connected in parallel, as shown in Fig.3. It is important that the braiding of the screened wire is always connected to the positive rail of the circuit, as indicated in Fig.1. Apart from its function of providing a momentary short-circuit when it is cut, the wire screens the centre conductor and prevents pick-up of static and noise which would otherwise be passed to pin 6 of gate G2.

The circuit can also be used with pressure mats which give a short-circuit when stepped on. Some care is needed here, however, as these mats are normally provided with unscreened twin cable for connections, and best results will be given if the twin cable is kept short so that nearly all the wiring to the mat is screened. The mat should not be positioned near mains wiring or where pick-up of electrical noise is likely.

The main part of the circuit can be housed, complete with batteries, in a small case situated in an unobtrusive or hidden location. If the case is metal it should be made common with the positive rail so that it has the same potential as the screened wire braiding.

CURRENT CONSUMPTION

The current consumption of the circuit is very low after an initial few minutes following switch-on. The current consumed by the prototype was first measured with S1 continually open. Immediately after setting S2 to "On" the main current which flows is charging current in C1, which starts at around 20μA. The current rises when gate G1 commences to go through the linear amplification range, rising to a momentary peak of about 1mA. The current then quickly falls to around 100μA, after which it decreases more slowly. Some three to four minutes after switch-on the current drawn from the 9 volt battery is less than 2μA, and it then stays at this very low level. The current is due to leakage in the two electrolytic capacitors, in IC1 and in TR1. If S1 is closed during the inhibit period the current rises to approximately 4mA, falling to the level just described when the switch is opened again,. When S1 is closed after the inhibit period, causing the relay to energise, the current rises to 20mA. ■

STOP-GO CONTINUITY TESTER

By D. Snaith

Very low cost circuit checks continuity and detects resistance.

Fig.1 shows a continuity tester incorporating a red 1.e.d., a green 1.e.d., a silicon diode, two resistors and a 4.5 volt battery. Two test leads with prods connect to the test terminals and the device functions as a low ohms continuity tester.

CIRCUIT FUNCTION

When S1 is closed with the test terminals open-circuit, current flows through D1, LED1 and R2, causing LED1 to light up. About 2 volts is dropped across this 1.e.d. If the test terminals are now short-circuited current flows through LED2 and this 1.e.d. becomes illuminated. The forward voltage dropped across LED2 is also of the order of 2 volts, whereupon the voltage available for LED1 is equal to this voltage minus about 0.6 volt dropped across D1. LED1 extinguishes. Resistor R1 ensures that sufficient voltage is dropped across D1 to give complete extinction of LED1.

Thus, when the circuit is used as a continuity tester, continuity is indicated by the red 1.e.d. going out and the green 1.e.d. turning on.

However, the tester also indicates resistance in the circuit being checked. With the prototype, connecting a resistance of 10Ω across the test terminals results in a just perceptible glow in the red LED1. Increasing resistance across the test terminals results in increasing brightness in LED1. This state of affairs continues until, at a resistance of around 2kΩ, the red 1.e.d. is fully illuminated and the green 1.e.d. is nearly extinguished. In consequence, the circuit indicates very low resistance (only the green 1.e.d. alight) and resistance above 10Ω (both 1.e.d.'s alight).

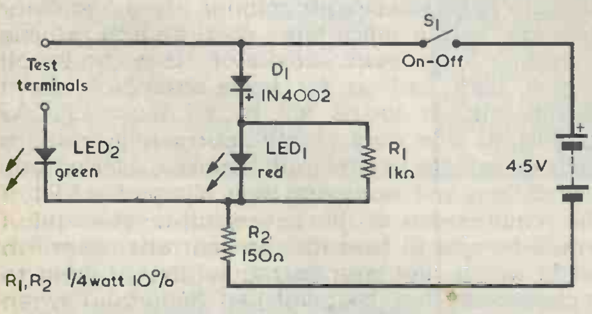


Fig. 1. The circuit of the tester. A short-circuit or very low resistance across the test terminals causes the red l.e.d. to extinguish and the green l.e.d. to turn on.

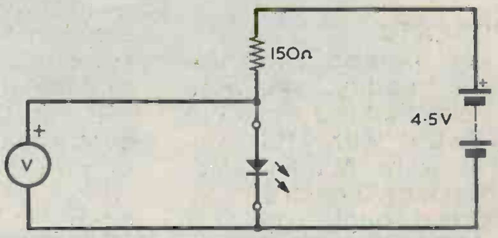


Fig. 2. Before assembling the tester, the forward voltage drops in the l.e.d.'s to be used can be checked with this circuit.

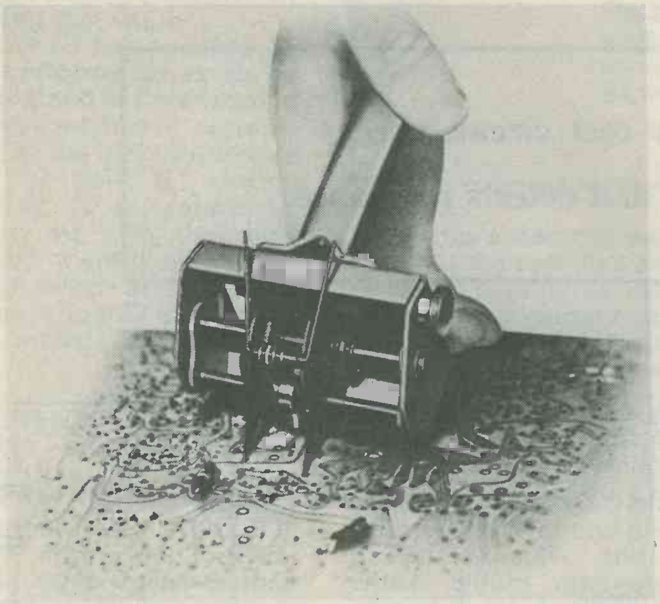
Similar results will be obtained with other continuity testers built up to the circuit. It is desirable for the red and green 1.e.d.'s to have roughly the same forward voltage drop when alight, and this is usually given when both l.e.d.'s are of the same make and type. Before assembly, the forward voltage drop of the l.e.d.'s can be checked with the aid of the 4.5 volt battery and the 150Ω resistor in the test circuit of Fig. 2, in which the voltmeter is a testmeter switched to a low d.c. volts range. It should be found that the green l.e.d. has a slightly lower forward voltage drop than the red l.e.d., and this satisfactory.

About 15mA flows in either 1.e.d. when it is fully illuminated, giving a good bright glow. The battery can be three 1.5 volt cells connected in series or an Ever Ready "flat" 1289 battery.

NEWS . . . AND

LEAD FORMING TOOL

The hand-held tool which you can see in the photograph is intended for the bending of electronic component lead-outs prior to insertion into printed circuit boards. Known as the lead forming tool Model PR2, it has been introduced by Eraser International Ltd., Unit M, Portway Industrial Estate, Andover, Hants, SP10 3LU. It is intended for axial lead components such as resistors, diodes and capacitors. The wire bends are at right angles with pitch centres between 12mm. and 15mm.



The Eraser International lead forming tool Model PR2. The knob at the right is adjusted so that the two pointers at the bottom line up with the holes in the board into which the components are to be inserted. The tool is then set up and will bend both leads of components to be inserted by operation of the handles.

An ingenious and very simple means of setting up the tool is incorporated. By turning a knob on the side of the tool, two pointers are lined up with the holes on the board into which the component is to be inserted. The bending dies are then automatically set up to the correct spacing, after which it is merely a matter of inserting components into the tool and operating its handles to obtain the desired lead-out bends.

The bending jaws on the tool incorporate a spring system which automatically compensates for different diameter leads and thus eliminates nicking and damage. Further details on the Model PR2 may be obtained from Eraser International.

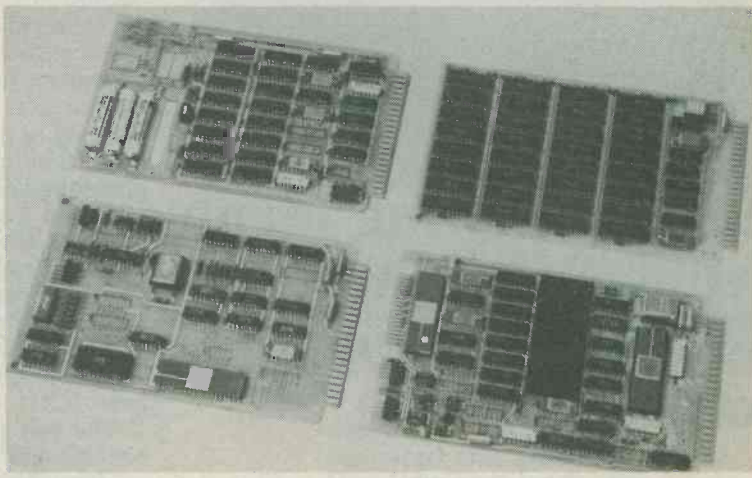
OSCAR 9 DISASTER

Many readers will no doubt, have heard by now that the launch of the European Space Agency LO2 rocket, ended in disaster! The launch date of May 23rd., was adhered to, but the count down was held up for several periods during the 'window' available for launching. Right at the end of this launching time period 'window', the announcement came through that launching was to take place and a successful firing took place. Almost immediately after this successful lift-off, the announcement came that one of the four first stage rocket motors was not functioning properly. This announcement was followed almost immediately by the news that there had been an explosion and the rocket, with its satellites of course, had fallen into the sea, some six hundred kilometres, down course. So that was the end of OSCAR 9!, and of "Firewheel" of course!

Having seen OSCAR 9 during its construction in Washington, and met some of the folk concerned with its design and construction, the writer feels terribly sorry for them having all their work and hopes destroyed in this way. Especially as the satellite itself may well have proved totally satisfactory and functioned perfectly. What the future for AMSAT and the OSCAR 9 project will be, is too early to assess at this stage. It was to have taken the amateur radio satellite programme into a completely new era, with a much more sophisticated satellite, providing a far more satisfactory communications system than had so far been attempted. Great disappointment too is felt by all those OSCAR enthusiasts who were keenly anticipating extending their knowledge to cope with the more difficult orbit calculations and modifying their equipment to meet the requirements of this new satellite technique. It would be nice to hear that another attempt will be made in the not too distant future, to launch a replacement, but the expense required and the amount of work involved in providing a replacement, must be almost too daunting a prospect to contemplate with equanimity. We will, of course, keep readers informed of future plans as we hear of them.

. . . COMMENT

MICROCOMPUTER FAMILY



The second photograph shows a selection of modules from the RCA Solid State CDP1802 COSMAC microprocessor. Designed for the this consists of a complete family of single-board microcomputer systems based on the CDP1802 COSMAC microprocessor. Designed for the smaller volume user who needs to implement a microcomputer system rapidly and economically, the CDP18S600 Microboard family uses a universal plug-in backplane system for ease of setting up and modification, and is based on CMOS technology with its advantages of low power consumption and high immunity to electrical noise.

The RCA Microboard family comprises two single-board microcomputers with differing memory capacities, a range of add-on memory boards and expansion modules, 5-card and 25-card chassis/backplane units, a milliwatt power supply, and two prototyping systems. All Microboard modules are compatible with existing RCA COSMAC Development Systems to facilitate rapid hardware and software development.

Each RCA Microboard module measures 4.5 by 7.5 inches, and any Microboard module works in any location on the universal backplane. Software development can commence as soon as the modules are plugged in, and modules can easily be exchanged or added to match changing design requirements.

The use of CMOS technology means that power consumption is measured in milliwatts, and a complete system can be powered from nickel-cadmium rechargeable batteries. Alternatively, the ability of the CMOS circuitry to operate over a wide voltage range allows low cost power supplies with extended regulation limits to be used. The low power consumption also eliminates the need for special cooling arrangements.

The RCA microcomputer family has excellent immunity to electrical noise, and will operate reliably in high-noise process-control, automotive or production monitoring environments, with no necessity for ground planes or extra decoupling capacitors.

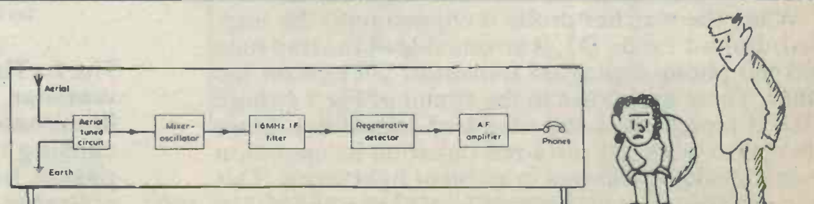
Each of the RCA Microboard computers contains a CDP1802 microprocessor, crystal-controlled clock, read/write memory, parallel input/output ports, serial communications interface, "power-on" reset, expansion interface and sockets for user-selected read-only memories. The two computers are the CDP18S601 (4kbyte RAM; sockets for 4/8kbyte ROM/PROM) and the CDP18S603 (1kbyte RAM; sockets for 4/8kbyte ROM/PROM).

Memory modules include 4kbyte, 8kbyte and 16kbyte RAM boards with battery back-up, and an 8/16kbyte ROM/PROM board. Other expansion modules available on Microboards are a UART interface, a combination memory-input/output module, digital/analogue and analogue/digital converters, and a control and display module.

The two Microboard prototyping systems available from RCA each contain a Microboard computer together with a control/display module, a 5-card chassis in a protective case, a power converter, a breadboard for prototyping, cables and connectors, utility software, and technical literature.

The manufacturers are RCA Limited, Solid State – Europe, Sunbury-On-Thames, Middlesex, TW16 7HW.

"I know you got it out of the book, but it still doesn't sound right!"



WINE TRAP WATCHER

By Owen Bishop

Electronic watcher monitors wine trap bubbles and indicates the end of fermentation.

One of the joys of home wine-making is to sit back and watch the bubbles of gas passing rhythmically through the trap. Each bubble represents in increase in the final strength of the wine, so that the more bubbles the merrier! But when the wine has nearly finished fermenting, bubble-watching can become tedious. Has it really finished or is it "stuck"? Is it time to get on to the next stage of the process? When the bubbles come only once an hour, or even less frequently, a lot of time can be wasted in bubble-watching. Yet if you take your eye off the trap for even one second you can easily miss the bubble that you have been waiting for.

The device described here watches the trap for you. Set it and leave it; when you come back half an hour or more later an l.e.d. will be lit if there has been any bubble while you have been away. If there has been, press the Reset button to extinguish the l.e.d. and re-arm the watcher and return again later.

The trap watcher simply clips on to the main stem of the glass trap, which requires no modification. You only need one trap watcher and you just clip it to the trap of whichever demijohn is currently thought to be reaching the end of fermentation.

For those not yet initiated in the delights of home wine-making, the equipment can be obtained at Boots and from some health food stores. The basics consist of a 1-gallon demijohn, a cork stopper and the trap, which should be glass. The trap is partly filled with water.

HOW IT WORKS

When the watcher probe is clipped onto the trap, the infra-red l.e.d., D1, is on one side of the trap tube and the photo-darlington transistor, TR1, is on the other. These are shown in the circuit of Fig.1 (where TR1 is represented as a standard transistor). Since the device works by infra-red radiation its operation is unaffected by changes in ambient light levels. This is specially important because wines are often left to ferment in cupboards or fairly dark rooms and it would be no use for the watcher to be triggered by the opening of a cupboard door or the switching on of a light. The probe semiconductor components are positioned at the bottom of the trap loop so that the radiation from the l.e.d. passes through that part of the tube which contains water. Under these conditions the radiation is to a certain extent focused by the tube acting as a lens, and sufficient radiation reaches the phototransistor to cause a collector current to flow through R2. A low voltage, of about 1 volt, is passed to pin 1 of the CD4001 quad NOR gate, IC1.

The two gates associated with pins 1 to 6 form a bistable, and it will be remembered that the output of a 2-input NOR gate is high only when both its inputs are low. When the reset button S2 is pressed, pin 4 goes low, as also does pin 2. Since pin 1 is also low, pin 3 is high and the bistable remains in this state when S2 is released. The third gate functions as an inverter, and its output at pin 12 is now low.

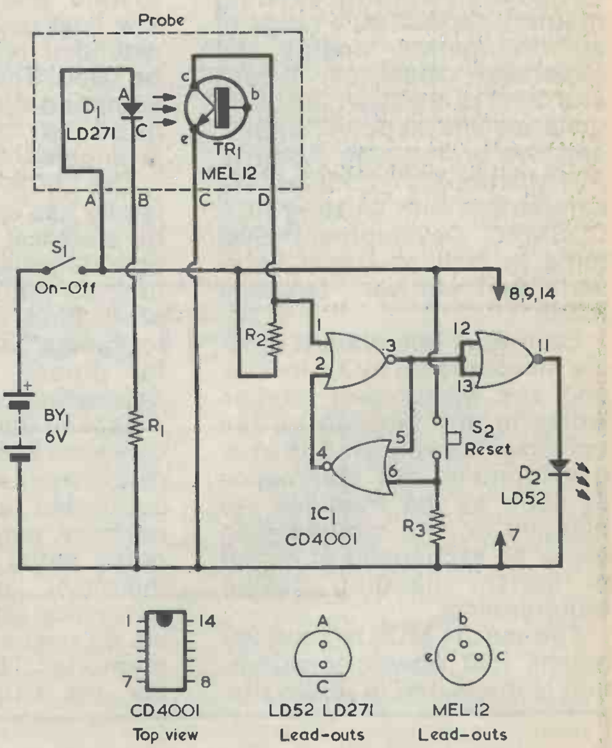
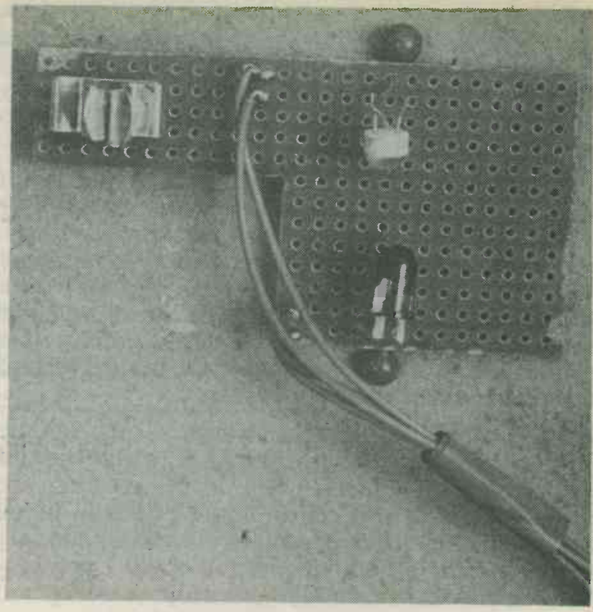


Fig.1. The circuit of the wine trap watcher. The infra-red light from D1 illuminates the phototransistor TR1, causing it to conduct. When a bubble passes between the two devices TR1 collector voltage goes momentarily high, triggers the CD4001 bistable and causes l.e.d. D2 to light up.

When a bubble passes through the trap tube between D1 and TR1 the refraction of light at the surface of the bubble causes a momentary reduction in the amount of radiation reaching the phototransistor. Its collector current reduces and the collector voltage goes high for a very brief period, causing pin 3 of the bistable to go low. Since both inputs of the lower gate are now low its output, at pin 5, goes high and the bistable latches in this new state. The low output at pin 3 turns on l.e.d. D2 by way of the inverter.

The bistable is returned to its previous state, with D2 extinguished, by pressing S2. S2 is also pressed to reset the bistable if it should happen to take up the triggered condition after switch-on at S1.

The phototransistor type MEL12 is available from Maplin Electronic Supplies. The LD271 infra-red l.e.d. specified for D1 may be obtained from A. Marshall (London) Ltd., Kingsgate House, Kingsgate Place, London, NW6 4TA, as also may the LD52 specified for D2. However, D2 is not a critical component and any small red l.e.d. can be used here. Current consumption from the 6 volt battery is about 24mA with D2 extinguished and about 26mA when it is lit. The battery may consist of four HP7 cells, though it is more economical in the long run to use four HP2 cells. These can be fitted in a suitable battery holder. The circuit will work without modification from a 4.5 volt battery or a 9 volt battery, with current consumption proportionally reduced or increased accordingly.



Close-up of the probe assembly. On this are mounted the metal clip, the infra-red l.e.d., the phototransistor and four Veropins for the connections to the main board.

CONSTRUCTION

The infra-red l.e.d. and the phototransistor are mounted on a small piece of 0.1in. Veroboard cut out as shown in Fig.2. A small metal clip of a size suitable for the main stem of the trap is secured to the board with a short 8BA bolt and nut. After cutting out the Veroboard the appropriate hole for the clip is drilled 8BA clear and the three cuts in the strips are made. Note that no connection is made to the base of TR1, and its lead-out may be cut short. After the two semiconductor devices have been soldered in approximately the correct positions, align them carefully by bending their lead-outs so that their axes coincide and so that, when the probe is clipped onto the trap, the radiation from l.e.d. to phototransistor passes across the whole diameter of the trap tube. This adjustment is not difficult to make, there being a tolerance of a millimetre or so in the positioning of l.e.d., phototransistor and tube.

The remaining circuitry is assembled on a Veroboard panel having the layout shown in Fig. 3. If mounting holes are required they may be drilled 8BA clear at holes 017 and C17. If such holes are drilled, it is desirable to cut the strips at P15, 015, N15, D15, C15 and B15 to isolate the mounting nut or spacing washer from the remainder of the board. IC1 is a

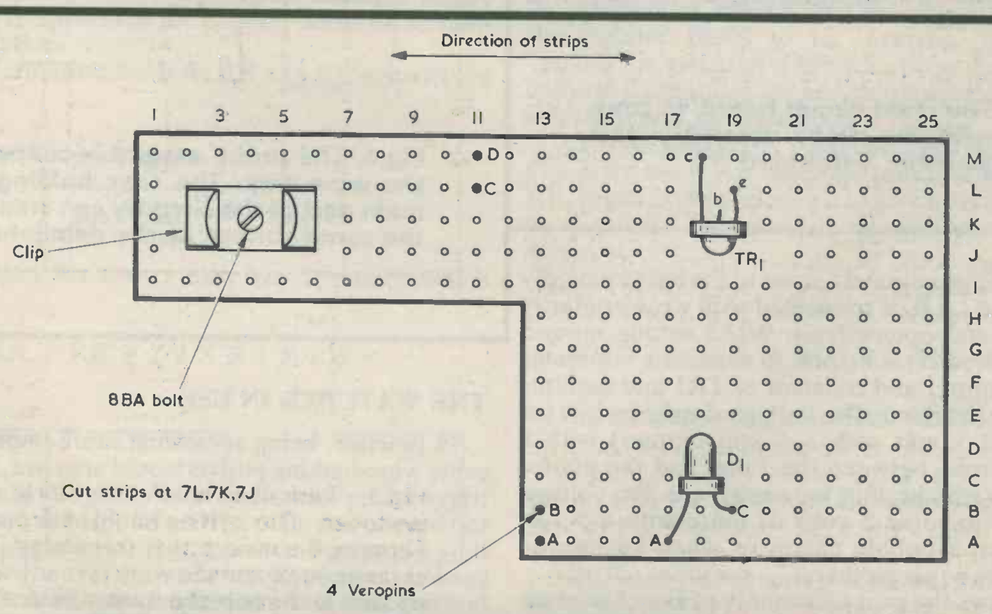


Fig.2. The probe assembly. Four flexible leads from the main circuit board connect to the four Veropins.

CMOS device which can be damaged by high static voltages, and it should be the last component to be soldered to the board, using an iron with a reliably earthed bit. Alternatively, a 14-way i.c. holder may be soldered to the board, and the i.c. plugged into this.

The Veroboard of Fig. 3, together with the on-off switch, Reset switch, l.e.d. D2 and the battery may be fitted into any small plastic case, or plastic case with metal front panel, which will accommodate them. Four flexible leads about 15in. long pass from a hole in the side of the case to the probe board. The prototype, shown in the photograph, employed a sequential action push-button for S1, but a standard toggle switch would be preferable.

There should be no problems in setting up the circuit and getting it to work first time, though there is the difficulty of not being able to see whether the infrared l.e.d. is on, off or not functional. When connected with correct polarity and functioning properly, there is a voltage drop of about 1 volt between the two terminals. If you measure this drop and find it to be approximately equal to the battery supply potential, the l.e.d. is connected with wrong polarity or is faulty and open-circuit. When setting up and testing the circuit it is helpful to connect a voltmeter across the emitter and collector of TR1 and monitor the voltages obtained. The voltage should be low (of the order of 1 volt with a 6 volt battery) with a water-filled tube between the l.e.d. and the phototransistor, or with nothing between them. The voltage should rise (to some 3 volts or more with a 6 volt supply) when a bubble passes or when an opaque object comes between them.

Fig. 4 shows the probe assembly of Fig. 2 in place on the trap for bubble monitoring. The level of water is best adjusted as shown so that it is just about to bubble.

COMPONENTS

Semiconductors
D1 LD271
D2 LD52 (see text)
TR1 MEL12
IC1 CD4001

Resistors
(All ¼ watt 10%)
R1 180Ω
R2 1kΩ
R3 15kΩ

Switches
S1 s.p.s.t. toggle
S2 push-button, press to make

Battery
BY1 6-volt battery (see text)

Miscellaneous
Veroboard, 0.1in. matrix
11-off Veropins, 0.1in. size
Spring clip (0.3in. diameter)
Case (see text)
Nuts, bolts wire and wine.

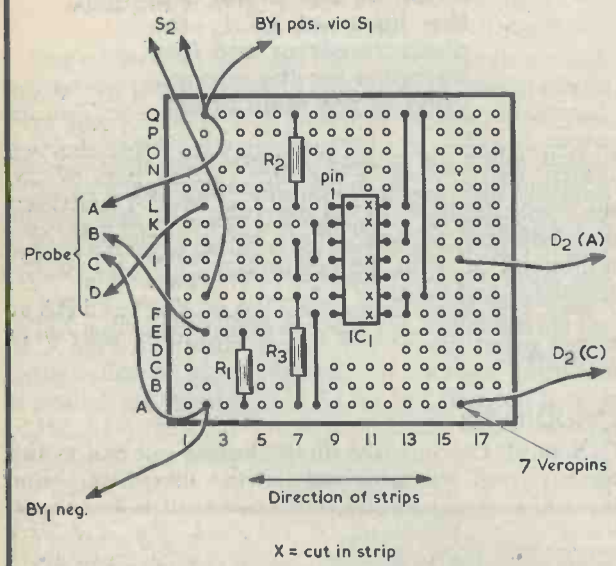


Fig.3. The main circuit board. In company with the probe assembly, this employs 0.1in. Veroboard.

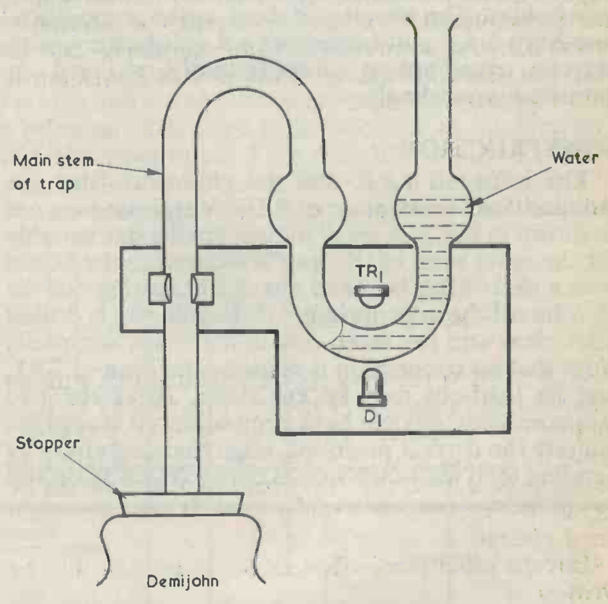


Fig.4. The probe assembly clipped to the wine trap. The case holding the main part of the circuitry can stand on the same surface as the demijohn.

THE WATCHER IN USE

In practice, being somewhat more impatient than some wine-making purists would approve, I leave the trap watcher for half an hour or slightly longer if I am too busy to attend to it. If no bubble has passed by the time I return, I consider that fermentation has proceeded far enough and the wine is ready for racking, bottling and, in the happily not too distant future, for drinking.

Cheers! ■

CALCULATORS AND PARALLEL – R

By R. J. Caborn

Parrallel-R problems with low cost calculators are easy

Is your pocket calculator one of those inexpensive types with very basic logic and no memory? This is the sort of calculator which simply does the last thing you tell it to do. Ask it to solve 2 + 6 x 4 and it will give you an answer of 32 instead of doing the multiplication before the addition and giving a proper answer of 26.

At first sight, such a calculator cannot do parallel-R calculations without fiddling about with paper and pencil. However, provided the calculator has a reciprocal (1/x) key it can tackle parallel-R problems with a very easy keying sequence. As we shall see, the sequence is also suitable for calculators with higher level logic.

PARALLEL-R

In Fig. 1 the total resistance, RC, of two resistors, RA and RB, in parallel is given by the question.

$$\frac{1}{RA} + \frac{1}{RB} = \frac{1}{RC}$$

At first sight the only way of tackling this with an inexpensive calculator is to begin by keying in RA, finding its reciprocal and writhing that reciprocal down on a piece of paper. Then clear, key in RB, find its reciprocal, add the reciprocal of RA and finally key up the reciprocal of the answer. Hardly a streamlined operation.

But the equation for RA, RB and RC can also be written as

$$\frac{RA + RB}{RA \times RB} = \frac{1}{RC}$$

This makes for a very easy key sequence which runs:

RA + RB = 1/x X RA X RB =

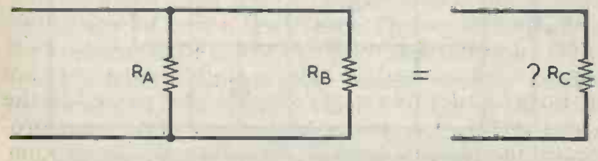


Fig. 1. A common problem in electronics. We know the values of RA and RB, but how do we find their combined value, RC?

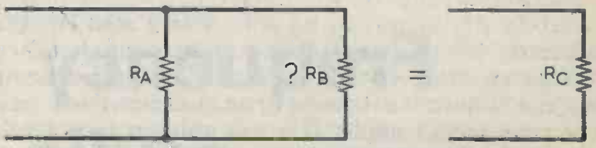


Fig. 2. Another version of the problem. What resistance, RB, do we need to connect across RA to give a required combined value of RC?

The answer after the second "equals" is RC. What we are doing here is adding RA and RB, and then inverting the result by pressing 1/x. After that we march all the way below the fraction bars of the equation with the multiplications by RA and then RB. The final answer is RC without further inversion because RC is also below the fraction bar. Try it with RA at 30Ω and RB at 10Ω. The answer is 7.5Ω. Again, run the sequence with RA at 27kΩ and RB at 39kΩ. The answer (corrected to 2 significant figures) is 16kΩ.

FINDING RB

Funnily enough, the first "equals" is not really required with the more inexpensive machines. After the addition of RA and RB the answer is already in the register ready to be inverted. But the first "equals" is essential with more powerful calculators because it separates the addition from the subsequent inversion and multiplication.

Another parallel-R problem crops up when, as in Fig. 2, we know RA and want to find what resistance, RB, to put in parallel with it to give a known RC. If we carry out the same sort of calculation as before, we arrive at

$$\frac{RA - RC}{RA \times RC} = \frac{1}{RB}$$

The corresponding calculator key sequence is:

RA – RC = 1/x X RA X RC =

Use the sequence to find what value (RB) we need to connect across 20Ω (RA) to give a final resistance (RC) of 12Ω. You'll find that the answer is 30Ω precisely.

Happy calculating! ■

Modulated Alarm Generator

By I. M. Attrill

Frequency modulated audio alarm with 10 watt output.

There are many types of electronic project where a relay is used to switch on an audible alarm generator when the circuit is activated. These are primarily alarm projects, such as burglar alarms, fire alarms, freezer alarms, etc. The audible signal can be produced by a bell, or other form of electromagnetic device, but it is increasingly common for an electronic circuit driving a loudspeaker to be used. This type of arrangement gives excellent reliability, and is usually very effective because quite complex sounds can be generated with little difficulty. It should perhaps be explained that for best results from this type of equipment a complex sound is far better than a simple one, such as a sine wave or other straightforward type of signal. Simple signals tend to be not very noticeable due to their monotonous nature and because they are readily masked by other noises. On the other hand, signals which are continually changing in some way are much more noticeable and are not easily masked by other sounds.

The circuit described in this article is for a powerful audible alarm generator which can be used in burglar alarm systems or for other warning purposes. When used with an 8Ω speaker and a 28 volt supply it offers an output power of over 10 watts, and this should be more than adequate for any normal applications. In some cases such a power would be in excess of what is required, but lower output powers can be provided by simply using lower supply voltages.

Alarm generators of this type normally give an amplitude or frequency modulated tone. A frequency modulated tone is, in general, more capable of catching attention, and frequency modulation is employed in the circuit presented here. The audio output tone is modulated up and down in pitch at a rate of a few Hertz, giving a sound that immediately makes its presence felt.

TWO OSCILLATORS

The circuit is given in Fig.1, and this really breaks down into two sections, a high power audio oscillator based on IC2 and a low frequency modulating oscillator based on IC1. Both oscillators use the same type of circuit. The modulating oscillator employs an operational amplifier type 741 whilst the audio oscillator, which directly drives the speaker, uses a power amplifier type TDA2030. IC2 has an inverting (–) input and a non-inverting (+) input and can be looked upon as an operational amplifier incorporating a high power Class B output stage.

The TDA2030 is a modern device and it has the advantage that its heatsink tab is common with its

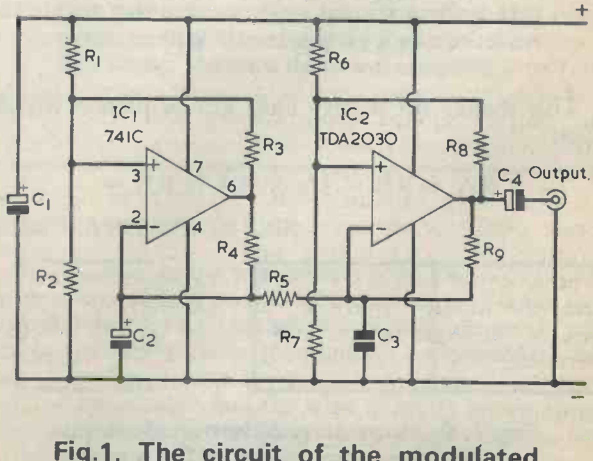
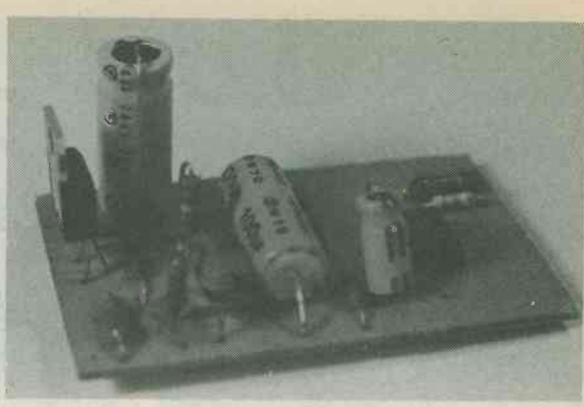


Fig.1. The circuit of the modulated alarm generator. Power output is dependent on the supply voltage.

The completed alarm generator unit. The use of a power i.c. with inverting and non-inverting inputs allows a low component count.



negative supply pin. In consequence there is normally no necessity for its heat tab to be insulated from its heatsink and the latter can be bolted directly to the tab. If the warning generator is housed in a metal case the i.c. heat tab can be bolted to one side of the case, whereupon the case itself provides heatsinking. It is necessary for the case to be common with the negative supply but such a connection is, of course, one that is normally employed.

The oscillator in which IC2 appears functions in the following manner. If R8 were not in circuit, the non-inverting input would be biased at half the supply potential by the equal value resistors, R6 and R7.

At switch-on C3 is discharged, whereupon the inverting input is negative of the non-inverting input and the i.c. output swings fully positive. R8 then causes the non-inverting input to be taken positive of the half-supply potential. C3 charges via R9. After a period, C3 charges sufficiently for the voltage at the inverting input to approach and become equal to the voltage at the non-inverting input. The amplifier output starts to swing negative and, due to the presence of R8, this causes the non-inverting input to go negative also. The result is that the inverting input is now further positive of the non-inverting input, so that the i.c. output swings more negative again. The regenerative action provided by R8 causes the i.c. output to very quickly swing fully negative, at which potential it is held by the charged C3.

C3 next commences to discharge via R9 into the now low amplifier output. As C3 discharges the inverting input goes negative until it approaches the voltage at the non-inverting input. A reverse process then takes place, with R8 again providing regeneration, and it ceases with the output fully positive again and with C3 once more charging.

Further cycles proceed in the same manner, giving an output square wave which, with the values specified and assuming that no frequency modulation is applied, is of the order of 1kHz.

As already mentioned, IC1 appears in the same basic oscillator circuit, but the component values around it are such that it oscillates at a much lower frequency, of only a few Hertz. The waveform across the continually charging and discharging C2 is roughly triangular, and the voltage on the positive terminal of C2 is applied via R5 to C3 in the audio oscillator. This arrangement provides frequency modulation of the audio oscillator, whose frequency increases as the voltage from C2 goes positive.

The output of IC2 couples to the loudspeaker via d.c. blocking capacitor C4. C1 is a supply decoupling capacitor.

CONSTRUCTION

A suitable printed circuit design for the project is given in Fig.2, in which the board is reproduced full-size. This is etched and produced in the usual way and should not provide any difficulties. Other constructional methods incorporating stripboard or plain matrix board can be used if preferred, and the layout is not particularly critical provided that wiring is reasonably short.

IC2 is mounted vertically, with its heat tab just slightly outside the edge of the board. This allows it to

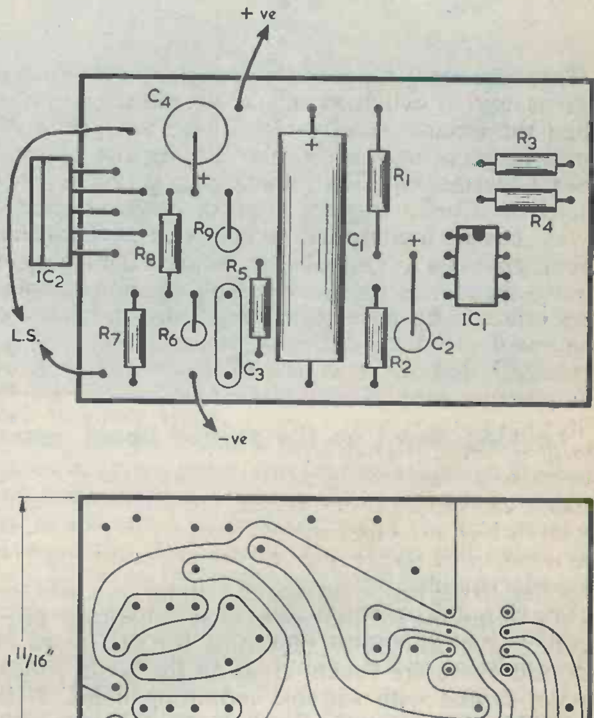
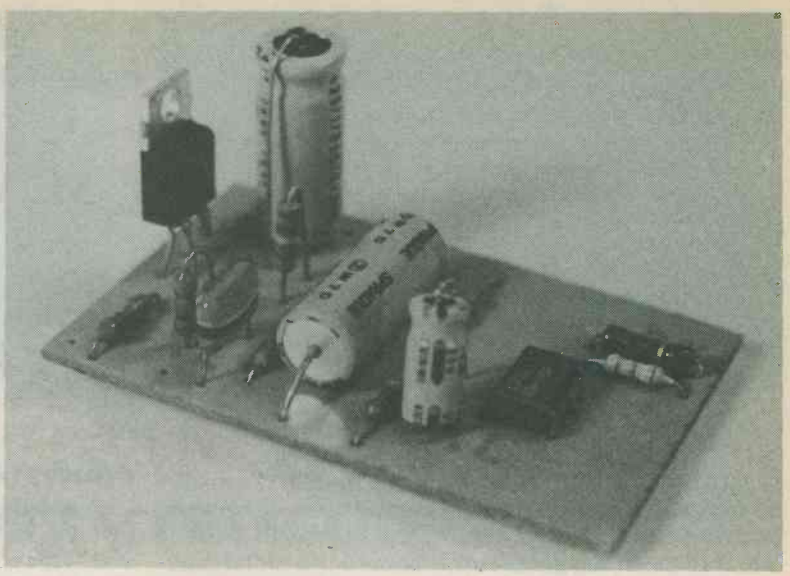
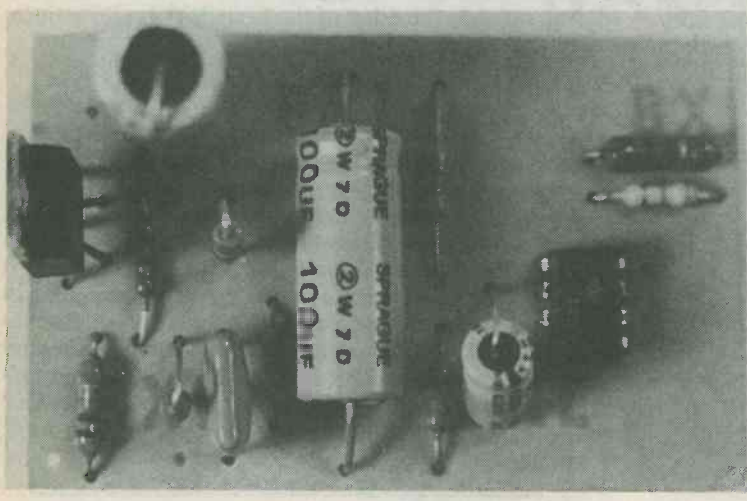


Fig.2. The alarm generator is assembled on a small printed circuit board. The heatsink surface of IC2 is just slightly outside the left hand edge of the board.

Another view of the modulated alarm generator. The heat tab of IC2 is intended to be bolted to the side of a metal case.





Looking down on the printed board assembly.

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 4.7kΩ
R2 4.7kΩ
R3 22kΩ
R4 39kΩ
R5 27kΩ
R6 56kΩ
R7 56kΩ
R8 270kΩ
R9 120kΩ

Capacitors
C1 100μF electrolytic, 40 V. Wkg.
C2 10μF electrolytic, 25 V. Wkg.
C3 0.022μF type C280
C4 220μF electrolytic, 25 V. Wkg.

Semiconductors
IC1 741 in 8 pin d.i.l.
IC2 TDA2030

Miscellaneous
8Ω loudspeaker of suitable power rating
Printed circuit board.

be bolted to the inside surface of a metal case, whereupon a mounting for the board is automatically provided. If a more robust mounting for the board is required, there are vacant areas on the p.c.b. which can be drilled with suitable mounting holes. It is advisable to mark out the five holes for IC2 pins with the aid of the i.c. itself, to ensure that the pins will fit snugly and without strain.

When used with a 28 volt supply and an 8Ω speaker, the circuit gives an output power of a little over 10 watts r.m.s. and has a current consumption of about 550mA. The power supply voltage is reduced for lower output powers. With an 8Ω speaker the output is approximately 5 watts r.m.s. with a 20 volt supply, 2 watts r.m.s. with a 12 volt supply and 1 watt r.m.s. when a 9 volt supply is used. Current consumptions at these three supply voltages are approximately 400mA, 275mA and 140mA respectively. The supply voltage must not be allowed to exceed 36 volts, which is the maximum permissible for both the i.c.'s. It is important to ensure that the 8Ω speaker is capable of handling the output power fed to it.

Returning to the subject of heatsinking, this is mainly required with supply voltages of more than about 15 volts, and a small commercial finned aluminium heatsink of about 25 by 50mm. will suffice if anything more substantial is difficult to arrange. However, it is always preferable, wherever possible, to employ a heatsink that is significantly larger than the minimum required. The TDA2030 has thermal shut-down circuitry, and will simply stop working and draw very little supply current if it should be allowed to overheat. It will then work normally again when it has cooled down to a more acceptable temperature. The device also has output short-circuit protection circuitry. ■

PASSIVE LOGIC PROBE

By M. V. Hastings

DETECTS HIGH, LOW, FLOATING AND PULSING OUTPUTS.

SUITABLE FOR T.T.L. AND CMOS.

A logic probe is a very useful item of test equipment for anyone who deals with digital circuits, even if they do so only occasionally. The purpose of a logic probe is merely to indicate the logic state at the point under investigation, and this can be accomplished with a simple passive circuit. Although they have their limitations such circuits are perfectly adequate in practice for nearly all logic rests. A very simple and inexpensive logic probe with an extended performance is described in this article, and it is suitable for use with CMOS and t.t.l. circuitry.

CIRCUIT DESIGN

In its most basic form, a logic probe can consist of an l.e.d. indicator and series resistor, as shown in Fig.1 (a). The terminal marked "NEG" is connected to the negative supply rail of the logic circuit being checked, and the "IN" terminal is applied to the logic test points. If a test point is at 1 (or high) the l.e.d. will light up and if it is at 0 (or low) the l.e.d. will remain extinguished.

There are drawbacks with this ultra-simple arrangement. If the test point is between the two logic states, or is switching rapidly between the two states, the l.e.d. will glow reasonably brightly, giving the impression of a steady logic 1 state. Also, if the test point is open-circuit the l.e.d. will not light up, giving the same indication as for a logic 0.

These problems can be partially overcome with the circuit of Fig.1(b), which has two l.e.d. indicators to show the logic state at the test point. As in the previous circuit the "NEG" terminal connects to the logic circuitry negative rail. The "POS" terminal connects to the positive supply rail, and the "IN" terminal to the test point. If the test point is at 1 RA and DA are effectively short-circuited, whilst DB lights up. The reverse happens with the test point at logic 0, and DA then becomes alight.

With the input disconnected, or connected to an open-circuit test point, current flows through DA and DB, and both l.e.d.'s light up. They will also both light up, to indicate a fault condition, if the test point is between the two logic levels. There still exists the flaw, however, that both l.e.d.'s will light up if the test point is switching rapidly between the two logic levels. What is required, ideally, is additional circuitry to allow differentiation between a faulty output state and a rapidly pulsing one.

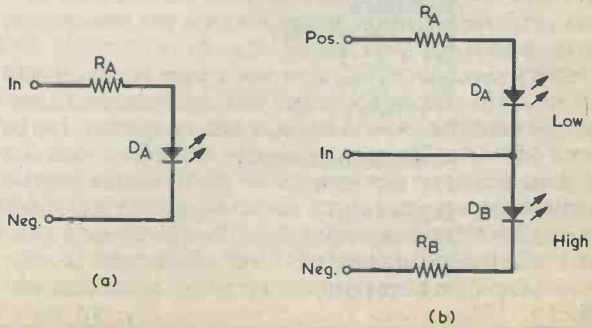


Fig.1 (a). In its simplest form, a logic probe can consist of an l.e.d. and a series current limiting resistor (b). More meaningful indications are given with a probe having two l.e.d.'s.

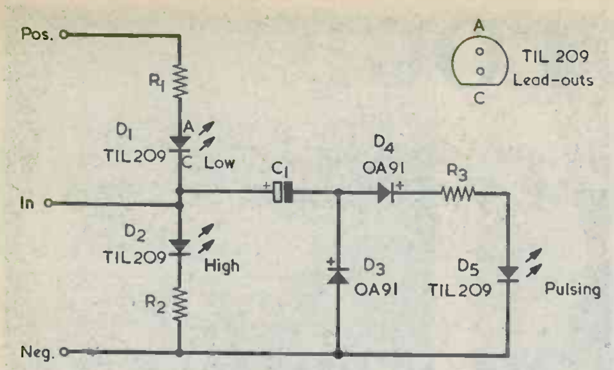


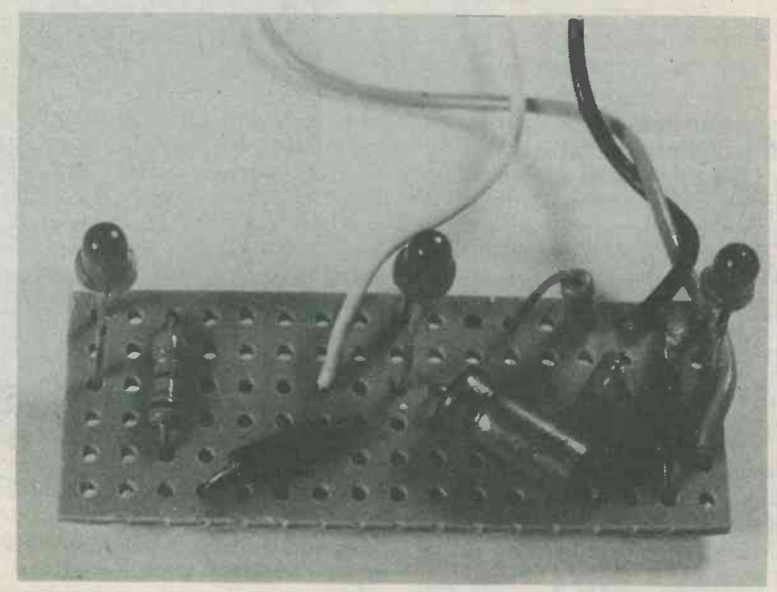
Fig.2. The circuit of the passive logic probe.

TABLE

INPUT STATE	PROBE INDICATION
Low	D1 lights up
High	D2 lights up
Floating	D1 and D2 light up
Between logic levels	D1 and D2 light up
Fast pulsing	D1, D2 and D5 light up
Slow pulsing	D1, D2 and D5 pulse on at the appropriate rate

The circuit which was finally adopted is shown in Fig.2. and this overcomes the shortcomings of the previous circuits. R1, D1, D2 and R2 are the same as RA, DA, DB and RB in Fig. 1 (b), and behave in precisely the same manner. When there is a steady state at the input, no matter what this state happens to be, C1 provides d.c. blocking and the third l.e.d., D5, cannot be turned on. If, on the other hand, the test point being checked is switching rapidly between the two logic levels, the input signal is coupled via C1 to diodes D3 and D4, which rectify it. The resultant positive pulses are then fed to D5 via current limiting resistor R3, and this time D5 does light up.

The accompanying Table summarises the logic probe indications for all the possible input states.



The logic probe components are soldered to a 0.1in. Veroboard panel.

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 1.8kΩ
R2 1.8kΩ
R3 560Ω

Semiconductors
D1 TIL209
D2 TIL209
D3 OA91
D4 OA91
D5 TIL209

Capacitor
C1 10μ Felectrolytic, 25v. Wkg.

Miscellaneous
Verobox type 75-1469L
Veroboard, 0.1in. matrix
3 panel-mounting l.e.d. bushes
2 crocodile clips (see text)
6BA or M3 bolt, 1in. or more
Wire, solder tag, etc.

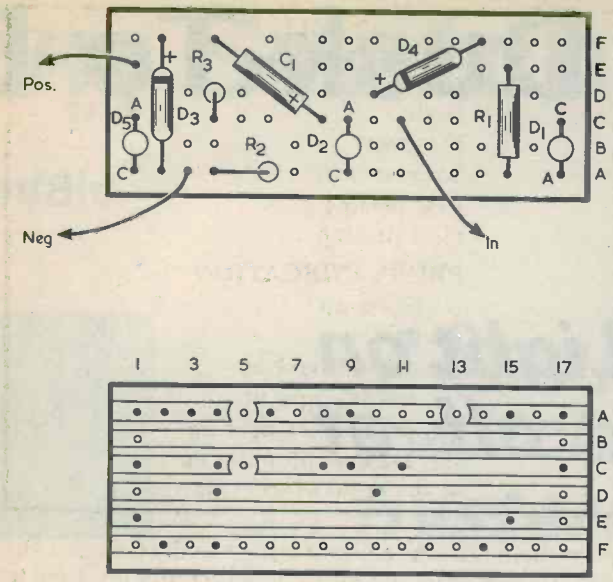


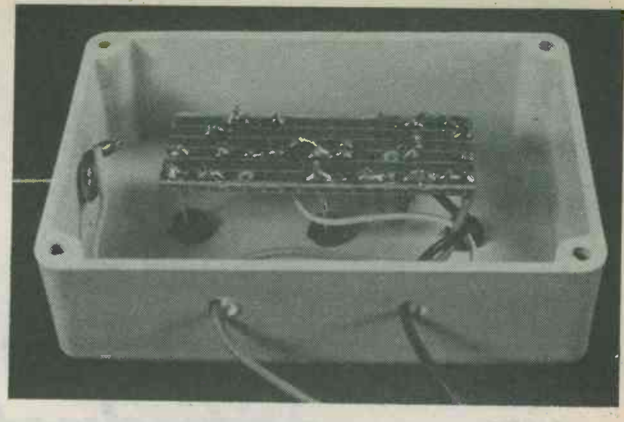
Fig.3. All the components are assembled on a small Veroboard panel, as shown here.

ASSEMBLY

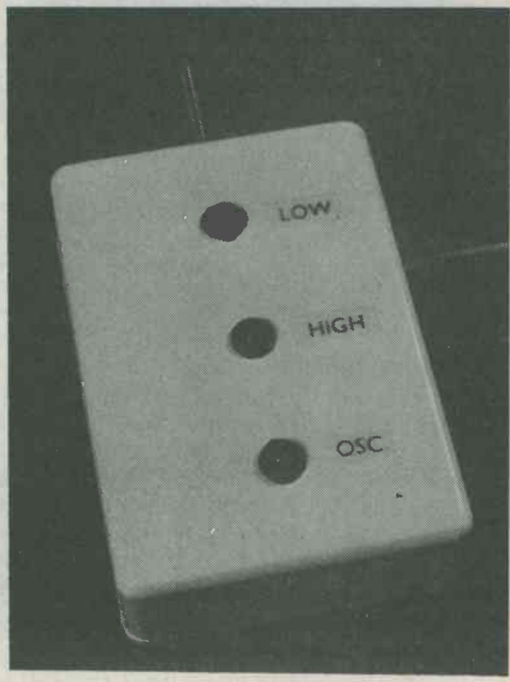
The components are accommodated on a small piece of 0.1in. Veroboard having 6 copper strips by 17 holes. This board is illustrated in Fig. 3. Be careful not to omit the three breaks in the copper strips, and remember that D3 and D4 are germanium diodes which can be overheated if the soldering iron is applied to their lead-outs for too long a period.

There are no mounting holes in the board, because it will be held in place firmly when D1, D2 and D5 are fitted into their panel-mounting bushes. The author's probe is housed in a plastic Verobox type 75-1469L, which has nominal outside dimensions of 71.5 by 49 by 24.5mm. A small case of this nature is required because it is intended that it be held in the hand whilst probing logic circuits.

The three holes for the l.e.d. bushes are drilled on the side of the case which is opposite the removable lid, and their centres are spaces by 0.8in. The layout is shown in the photographs. Legends taken from Panel-Signs Set No.4 (available from the publishers of this journal) are affixed to the panel alongside the l.e.d.'s, with D1 identified as "LOW", D2 as "HIGH" and D5 as "OSC". A test prod is secured to the case at the D1 end, and it consists of a 6BA or M3 bolt at least 1in. long. A solder tag is secured under the bolt head inside the case, and the "IN" connection from the component board is soldered to this. Two small holes are drilled in one of the 71.5 by 24.5mm. sides of the case, and the positive and negative supply leads pass through these. Flexible insulated leads about 2ft. long are required here. The positive lead should be red and the negative lead black. The leads are terminated in small crocodile clips with vinyl insulating sheaths having, preferably, the same colours as the wires.



The board is secured inside the plastic case by passing the three l.e.d.'s into their panel-mounting bushes.



The three l.e.d's take up the positions illustrated here

USING THE PROBE

In use, the two crocodile clips are connected to the appropriate supply rails of the equipment under test, and the prod at the end of the case is applied to the circuit points which are being investigated. The current consumed by the logic probe depends on the supply voltage in the equipment being checked, but will only be in the order of 1.5 to 8 mA. The l.e.d. current can be quite low when the probe is used to check low voltage circuits, but results are satisfactory using standard l.e.d.'s, such as the TIL209 indicated in the Components list. "High brightness" l.e.d.'s are now available however and, if used will give even better results. ■

Dusk-To-Da

By R. A

•Turns Light on at dusk, off at dawn.

This device is a light operated switch which turns on a lamp when darkness falls and switches it off again at dawn. It has two main uses, one of which is to automatically operate a porch light or a light in the hall. The other is to act as a burglar deterrent, for use when premises are to be left unoccupied for a few days. In this case the unit can switch on a hall light, a table lamp in a front room or any other light which will be visible from outside. An observer would then be given the impression that the premises are occupied.

MAINS OPERATION

Since the unit will be controlling a mains load and will need to be switched on for prolonged periods, both circuit convenience and economy of use call for mains operation. As can be seen from the circuit diagram shown in Fig. 1, a simple unregulated mains power supply is employed. The mains supply is applied via on-off switch S1 to the primary of transformer T1, which provides isolation from the mains and offers a suitably low secondary voltage. This is full-wave rectified by D1 and D2, with C1 acting as a reservoir and smoothing capacitor. The off-load voltage (when the relay is de-energised) across C1 is about 17 volts, this falling to about 13 volts under maximum load conditions (when the relay is energised). These quite large variations in supply voltage are unimportant in the present application.

A rather unusual feature in the light switching circuitry is the use of an LM380 audio power amplifier. In practice, this represents a good choice because the LM380 has high output current capability together with differential inputs. In consequence it behaves as an operational amplifier having a high power output stage.

The voltages applied to the non-inverting input at pin 2 of the LM380 is taken from the junction of R1 and the photoconductive cell PCC1. The resistance of PCC1 varies with the light falling upon it; the resistance is greater than 200mΩ in total darkness and falls to a few kilohms when the cell is brightly illumi-

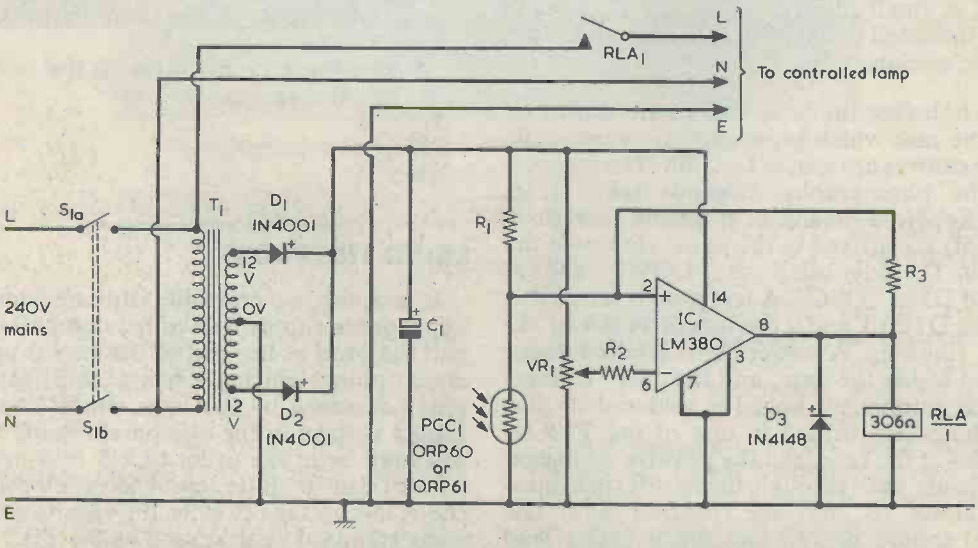


Fig.1. The circuit of the dusk-to-dawn switch. IC1 functions as a voltage comparator with feedback to its non-inverting input via R3

awn Switch

A. Penfold

•Snap-action switching with hysteresis.

nated. The voltage applied to pin 2 therefore goes more positive as the illumination on the cell decreases.

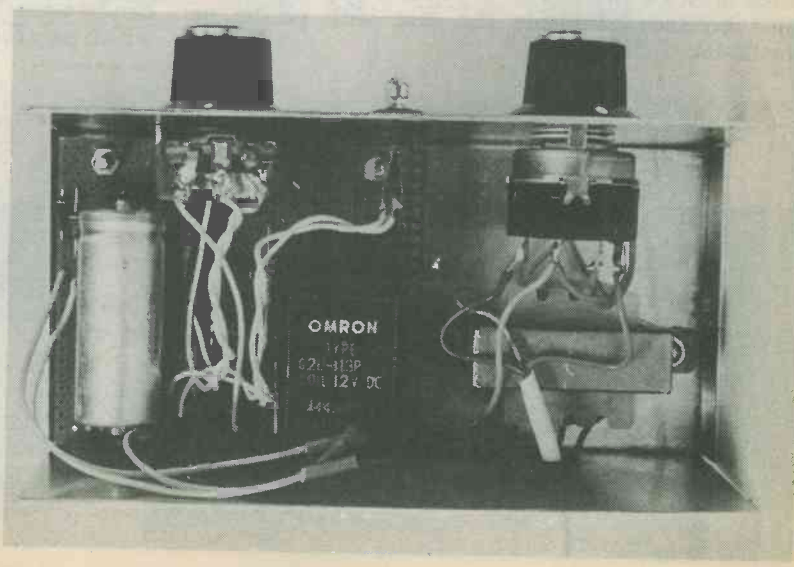
A reference voltage selected by VR1 is applied to the inverting input at pin 6 via R2. VR1 is adjusted to give a reference voltage suitable for the conditions in which the unit is to be used. If the light on the photoconductive cell is high the non-inverting input of the LM380 is negative of the voltage on the inverting input and the output of the i.c. is fully negative. As the light falling on the cell decreases in intensity the voltage at the non-inverting input rises until it becomes equal to and commences to pass that at the inverting input. The i.c. output then swings fully positive. The reverse action takes place if the illumination on the photoconductive cell is initially low and then increases.

The coil of a relay is connected between the output of the LM380 and the negative rail and this is de-energised when the i.c. output is fully negative. It becomes energised when the i.c. output goes fully positive. The lamp which is controlled by the unit is coupled to the mains via a make contact set on the relay, with the result that this lamp lights up when the light incident upon the photoconductive cell falls below the preset level. D1 is a protective diode which prevents the formation of a high reverse e.m.f. across the relay coil when the relay de-energises.

Reference has not yet been made to resistor R3, which provides a "snap-action" triggering effect, as well as hysteresis. The triggering effect is required because it would otherwise be possible for a certain critical light level to cause the ouput of the LM380 to lie at voltages which are mid-way between the fully negative and positive conditions. This is undesirable, because it could result in the relay alternating between the de-energised and energised states, with the controlled lamp being switched on and off accordingly. Hysteresis introduces a resistance to change. If the lamp is switched on at one low light level, the light intensity has to increase above that level by a significant amount before the lamp switches off again. The hysteresis ensures that the lamp is not switched on and off needlessly when the light on the photoconductive cell falls to the triggering level.

The effect of R3 is to provide positive regeneration from the output of the LM380 back to its non-inverting input. If the light intensity is high the

Inside the case, the mains transformer is behind the on-off switch. The component panel is below and behind the sensitivity potentiometer. Connections to the photoconductive cell are made to its lead-outs, which project inwards from the front panel



LM380 output will be fully negative and R3 will be effectively in parallel with the photoconductive cell. As the light intensity decreases the voltage at the non-inverting input of the i.c. becomes equal to that at the inverting input. The i.c. output starts to go positive, whereupon R3 causes the non-inverting input to go further positive. The regenerative action results in the i.c. output changing rapidly to its full positive state. R3 is now effectively in parallel with R1 so that, to trigger the circuit to its previous state, the photoconductive cell resistance must fall to a lower value than that needed to trigger the i.c. output positive.

CONSTRUCTION

The prototype switch is housed in a vinyl covered aluminium box having dimensions of 127 by 63 by 57mm. This is a case type WB1, available from Maplin Electronic Supplies. Any similar metal case will be suitable provided that it is large enough to accommodate the components.

S1 is mounted on the left-hand side of the front panel with VR1 on the right hand side. PCC1 is mounted in the centre of the panel, being held in a reasonably tight fitting rubber or p.v.c. grommet. If desired, the cell could be remote from the main unit, being coupled to it by way of a short length of 2-core cable. This could be terminated in a plug fitting into a suitable 2-way socket in the panel centre. However, the cable connecting to the cell should be kept well clear of mains wiring in case pick-up of hum or noise causes unpredictable operation. There is no risk of this when the cell is mounted as in the prototype, since the metal case automatically provides screening.

The cell can be either an ORP60 or an ORP61. These are identical except for the positioning of their light-sensitive areas. The ORP60 has its sensitive surface facing the end of the glass encapsulation, whereas the ORP61 has this surface facing one side (indicated by a coloured dot on the body of the component). When fitted as in the prototype, the ORP60 should be used.

Mains transformer T1 is mounted behind the on-off switch, well to the rear of the case. A solder tag is secured under one of its mounting nuts to provide a chassis connection. Two holes are required in the rear panel, one for the mains input lead and the other for the output lead passing to the controlled lamp. Both holes must be fitted with grommets and both leads must be secured inside the case with plastic or plastic-faced clamps.

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated)
R1 470kΩ
R2 470kΩ
R3 2.2MΩ 10%
VR1 47kΩ potentiometer, linear

Capacitor
C1 1,000μF electrolytic, 25 V. Wkg.

Transformer
T1 mains transformer, secondary 12-0-12V 100mA

Semiconductors
IC1 LM380
D1 1N4001
D2 1N4001
D3 1N4148

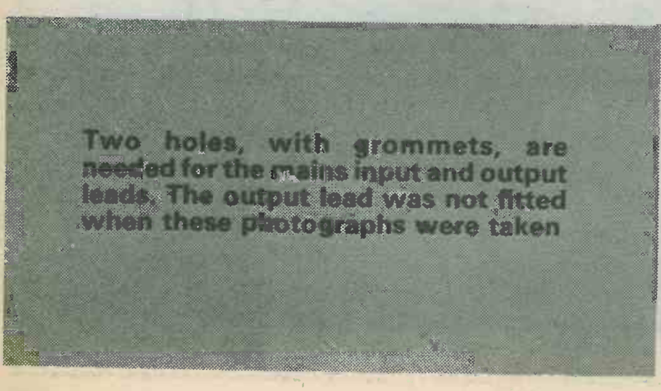
Photocell
PCC1 ORP60 or ORP61 (see text)

Relay
RLA1 306Ω relay with changeover contact set (see text)

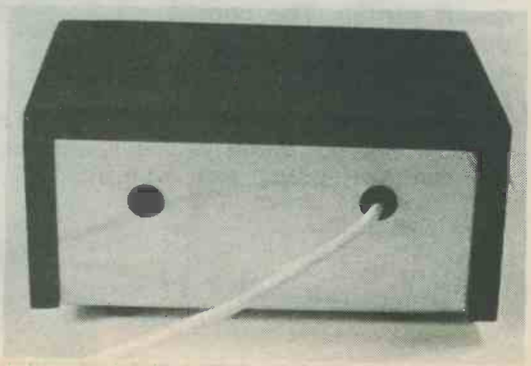
Switch
S1(a) (b) d.p.s.t., rotary toggle

Miscellaneous
Metal case (see text)
Plain matrix board, 0.1 in.
2 control knobs
Mains lead
Wire, nuts, bolts, etc.

The remaining components are assembled on a plain 0.1 in. matrix board having 27 by 22 holes. This is cut down from a larger board, after which the two mounting holes are drilled. Wiring is then carried out as in Fig.2, with component lead-outs pressed flat against the board underside and soldered to each other as required. Where lead-outs are too short, bridging leads of around 22 s.w.g. tinned copper wire can be used. The relay employed has connecting pins which pass through the board holes as indicated in the



Two holes, with grommets, are needed for the mains input and output leads. The output lead was not fitted when these photographs were taken



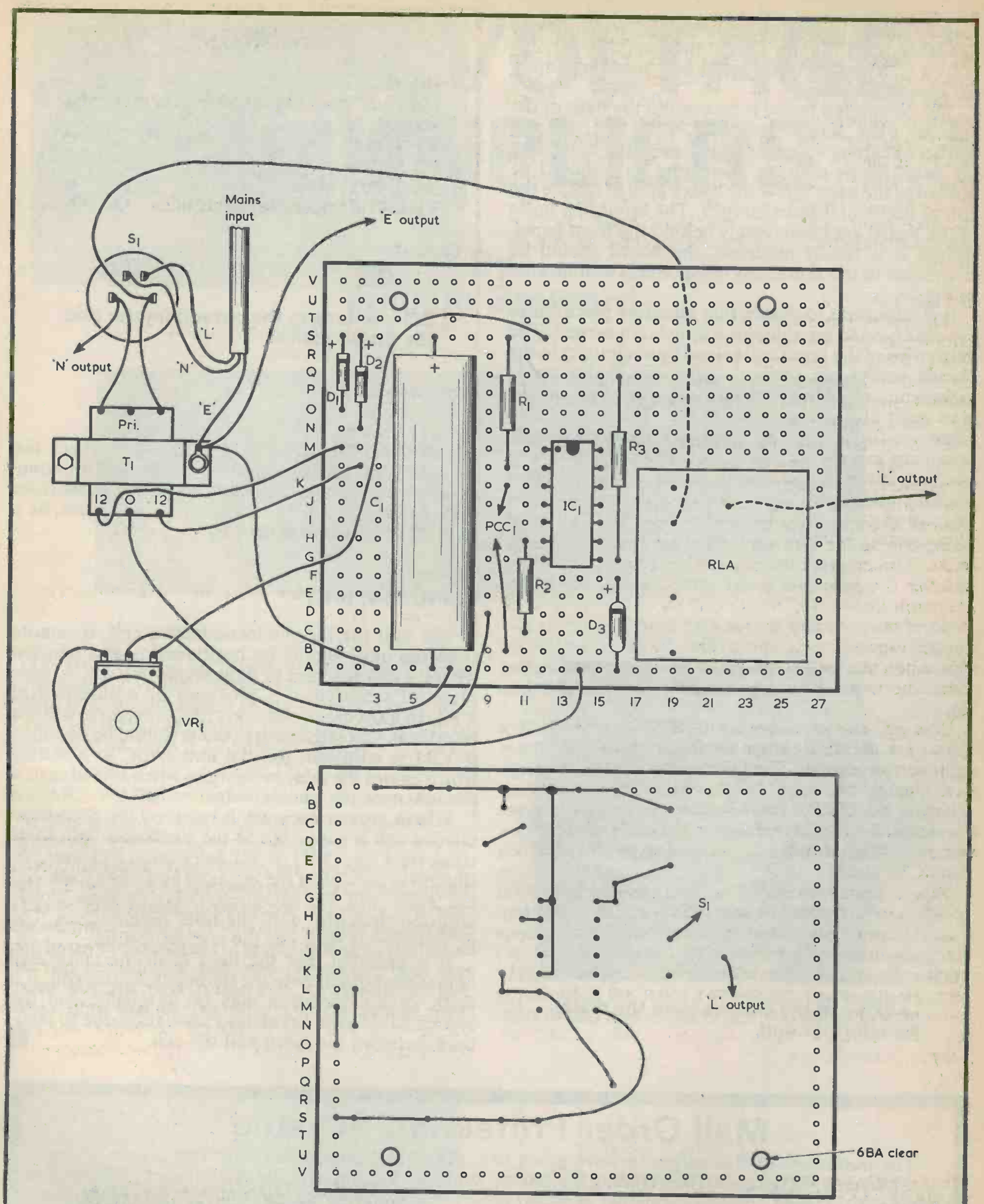
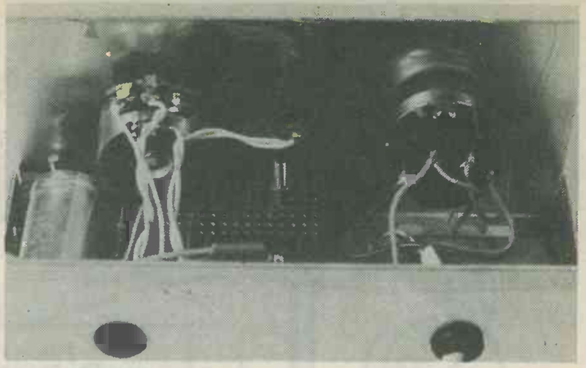


Fig.2. Most of the components for the switch are assembled on a plain matrix board. Interconnections are made below the board by way of component lead-outs and bridging wire.

diagram. This is a "Relay Flat 12V", which is also available from Maplin Electronic Supplies. At 250 volts a.c., its contacts are rated at 8 amps maximum for resistive loads.

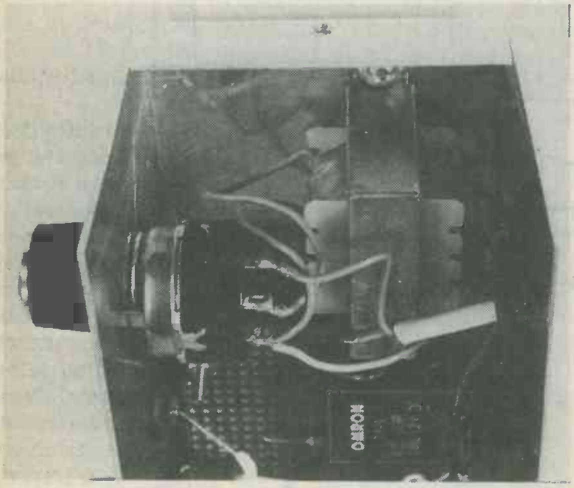
The completed board is secured to the base of the case by 6BA screws and nuts, 12.5 mm. spacing washers keeping its underside clear of the bottom of the case. Strips of p.v.c. insulating tape should be affixed to the base below the board area to reduce the risk of accidental short-circuits. The mounting holes of the board are immediately behind the front panel. Before it is finally mounted, the board should be connected to the remaining components as indicated in Fig.2.

It is important to ensure that all safety precautions are observed so far as mains wiring is concerned. The earth wire of the input mains lead must connect to the chassis solder tag secured under the mains transformer mounting nut, and the earth wire of the output lead must also connect to this tag. The output lead passes to the controlled lamp and, if this is a table lamp, any metalwork on the lamp should be properly earthed. If the output simply passes to a lampholder without metalwork then the output lead will not require an earth wire. The unit should not be coupled into existing installed lighting circuits.



Connections to the potentiometer and the on-off switch

Before connecting to the on-off switch, check the tag positions with a continuity tester. With some switches the relative tag positioning may differ from that shown in Fig.2. The switch must, of course, be a type suitable for mains voltages.



Looking at the chassis from the mains transformer end

USING THE UNIT

The unit (or the photoconductive cell, if remote from the unit) should be positioned near a window where it can respond to light levels outside. A wide range of sensitivities is provided by adjustment of VR1. In most cases, the exact triggering level will not be critical, and satisfactory results should be obtained if VR1 is adjusted, by trial and error, to a setting which causes the relay to energise when a hand casts a shadow over the photoconductive cell.

Where greater accuracy is required the photoconductive cell is subjected to the particular light level concerned and VR1 is set fully anti-clockwise. Its slider will then be at the negative end of its track and the relay will be energised. VR1 is then slowly adjusted clockwise until the relay de-energises. The potentiometer then has the correct setting.

It is essential that the light from the controlled lamp does not fall onto the photoconductive cell. If it does, circuit operation may be unreliable and the system could even break into oscillation due to feedback between the lamp and the cell. ■

THREE VOLTAGE MULTIPLIERS

By
William Steward

Obtaining increased voltages from fixed voltage supplies.

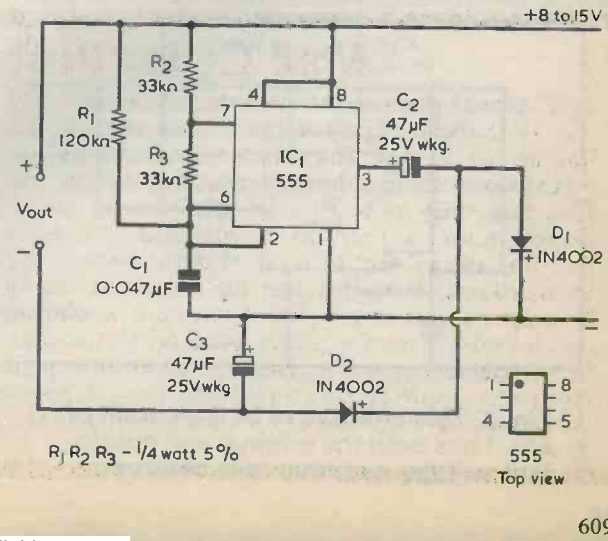
The circuit shown in Fig. 1 is capable of stepping up a fixed direct voltage between 8 and 15 volts to a higher level for the supply of low current equipment. It can, for instance, provide a low current supply of some 20 volts from a 12 volt car battery.

SQUARE WAVE

IC1 is a bipolar 555 timer and it produces, at its output pin 3, a square wave having a frequency of approximately 350Hz. When the output voltage is high, C2 becomes charged via diode D1, whilst diode D2 is reverse biased. During the following low voltage output at pin 3, D1 becomes reverse biased and the negative terminal of C2 goes negative of the negative supply rail. D2 becomes conductive and the charge in C2 is passed into C3. An output voltage higher than that of the 8 to 15 volt supply then becomes available between the original positive rail and the negative terminal of C3.

For maximum efficiency, the 555 output should be a 50:50 square wave in order that C2 should charge via D1 for the same length of time in which it then discharges into C3. A 50:50 output is achieved due to the choice of values for R1, R2 and R3. R2 and R3 are the two timing resistors normally associated with a 555 multivibrator and are given equal values. R1 is given a value which is 4 times (approximately) that of either R2 and R3. R1 increases the charging current for C1 and decreases the discharge current during the multivibrator cycle, and with the resistance ratios specified causes the 555 to produce a 50:50 output. (A fuller explanation of this effect was given in "50:50 Output From The 555" by J.R. Davies, which appeared in the April 1978 issue. The resistor value ratio is also applicable to the CMOS ICM7555).

Fig. 1. One of the voltage multipliers. Basically a voltage doubler, it produces an output voltage that is higher than the original supply voltage



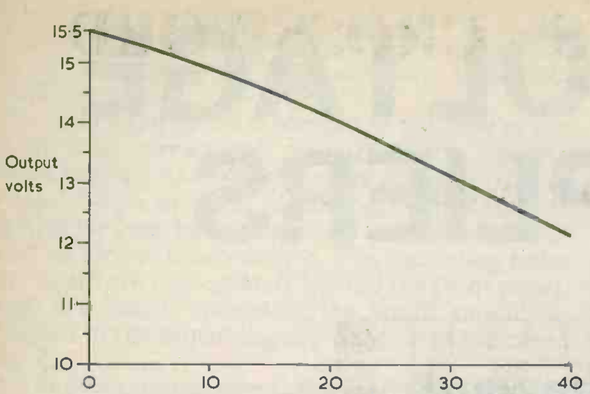


Fig. 2. Regulation curve showing multiplied output voltage at different output currents with a 9 volt supply

to slightly more than 14 volts at 20mA and to slightly more than 13 volts at 30mA.

Rectifiers in the 1N4001 to 1N4007 series can function with square waves up to around 5kHz before losing rectification efficiency, and so the choice of 350Hz for multivibrator frequency is reasonable. This frequency allows C2 and C3 to have fairly low values and no significant improvement in the regulation is given by increasing these.

An alternative circuit offering the same performance as that of Fig. 1 is shown in Fig. 3. R1, R2, R3 and C1 have the same values as in Fig. 1. This time, C4 charges via D3 when the 555 output is low, and then discharges via D4 into C5 when the i.c. output is high. With Fig. 3 the negative supply and multiplied voltage rails are common, whilst with Fig. 1 it is the positive rails which are common. These factors may determine which of the two circuits is chosen for any application.

VOLTAGE DOUBLER

The circuit of Fig. 1 is a classic voltage doubler but, in practice, the output voltage is significantly less than twice the supply voltage. This is due to four causes. First, there is an 0.6 volt drop in D1 when C2 charges and, second, there is another 0.6 volt drop in D2 when C2 discharges into C3. Thirdly, pin 3 of IC1 does not go fully to the negative rail when the output is low. The pin 3 voltage is about 0.1 volt positive of the negative rail at a sink current of 10mA, rising to some 0.5 to 0.8 volt at 40mA. The fourth cause is the most serious of all and is given when pin 3 of the i.c. is high. At very low source current the voltage at pin 3 is typically 1.2 volt negative of the positive rail, and this drop rises to about 1.5 volt at a source current of 40mA. These four factors cause the multiplied output voltage at zero output current to be equal to about 2.5 volts less than twice the original supply voltage. For a 9 volt supply the zero current output voltage is therefore 18 minus 2.5, or 15.5 volts, and for a 12 supply it is 21.5 volts.

The regulation of the output voltage is fairly good and a typical regulation curve for a 9 volt input is shown in Fig. 2. The output voltage drops from 15.5

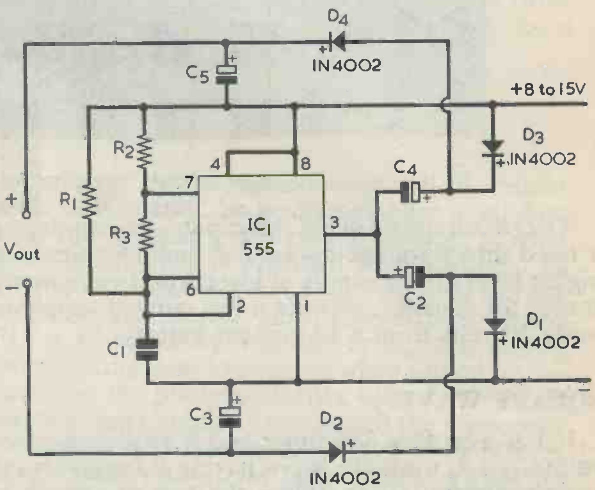


Fig. 4. The two circuits combined. Component values are the same as were shown in Fig. 1 and Fig. 3

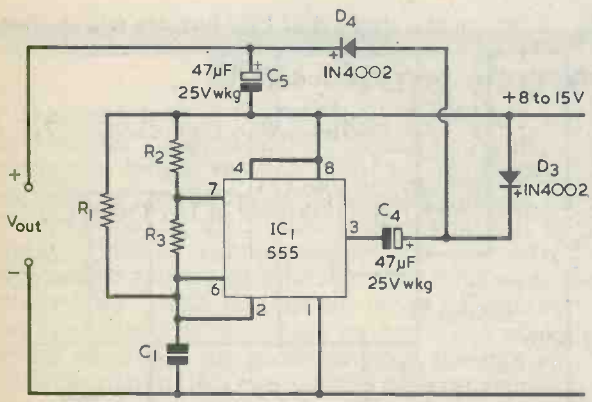


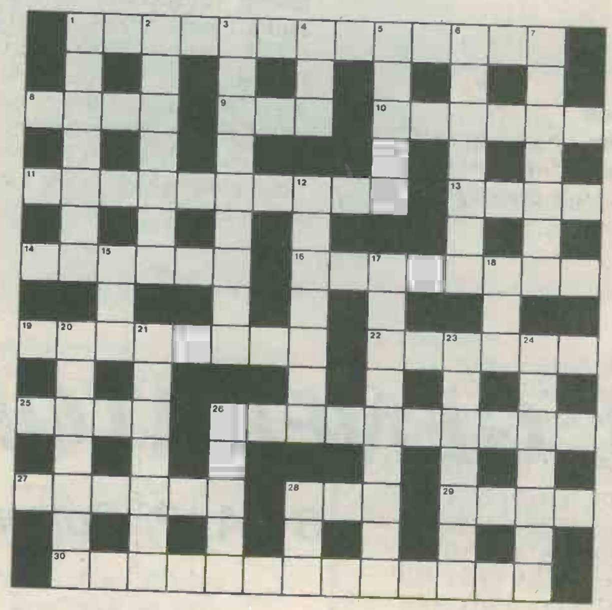
Fig. 3. This alternative to the circuit of Fig. 1 has both the original and multiplied voltage negative rails common

The two circuits are combined in Fig. 4 to give output voltages which are both positive and negative of the original supply rails. The zero current output voltage is now 3 times the original supply voltage less about 5 volts. However, the regulation is about 4 times worse than the regulation curve of Fig. 2 because the 555 output has to drive two circuits at the same time instead of one, and output voltage drops by some 5 volts at an output current of 10mA. An attractive application for Fig. 4 could be to have it power an operational amplifier whose output voltage is required to swing up to and outside both the original supply rails.

In all the circuits, the current drawn by the 555 for zero output current is around 5mA for an 8 volt supply rising to some 10mA for a 15 volt supply. The current drain increases proportionately with increasing output current from the multiplied output voltage. ■

CONSTRUCTOR'S CROSSWORD

Compiled by J.R. Davies



Clues Across

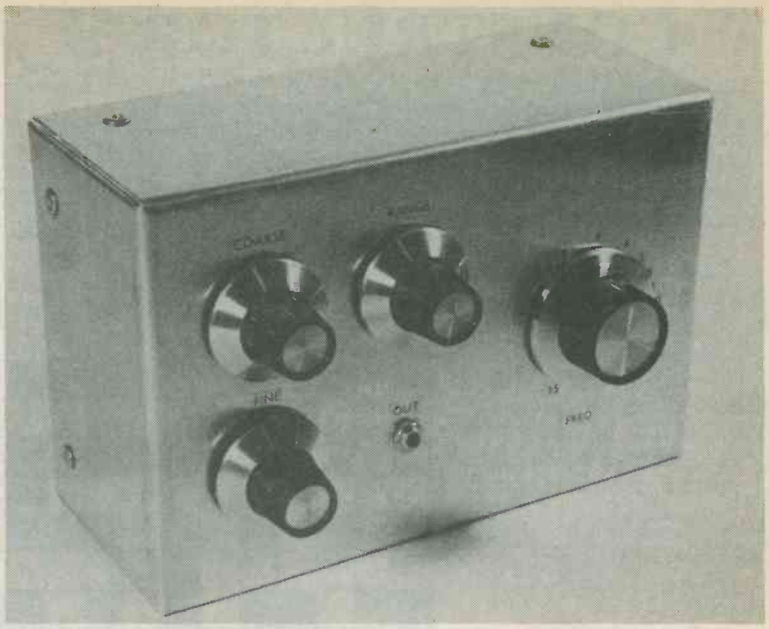
1. Powerful X-measuring device. (13)
8. One small item lost in radio tape transfer. (4)
9. This PP3 battery gives more than 9 volts. (3)
10. Cliff-hanging transmission has its bits in sequence. (6)
11. Active device can sort strain out. (10)
13. Copper wiring aid. (4)
14. To react and/or resist. (6)
16. All one's inputs give zero output here. (4,4)
19. What good little red, green and blue beams do. (8)
22. To put in, with ion loss shows transducer shortcoming. (6)
25. This cell controls light intensity. (4)
26. Sees, dreads, mixed-up, words in RAM? (10)
27. Expansion of 16's function. (3,3)
28. Talk down to airmen. (1,1,1)
29. Large fire fairly does this to household current. (4)
30. F.M. circuit responding to proportional representation. (5,8)

Clues Down

1. Computer controller favours metric units. (7)
2. Aintree beginner. (7)
3. Descriptive of distorting amplifier. (3-6)
4. Brute force morse modulation. (1,1,1)
5. Low noise microwave amplifier. (5)
6. Rotating the lathe controls. (7)
7. A display of digits. (4-3)
12. Another wiring aid comprises 6 of one and 4 of the other. (3-4)
15. TV camera horizontal sweep. (3)
17. Sound studio circuit which blanks out background. (5,4)
18. Even on the shelf, that PP3 battery will do this. (3)
20. Sixty seconds squared. (3,4)
21. Out of the norm. (7)
23. First component the serviceman checks. (7)
24. Put the data in again. (2-5)
26. Electronically sound. (5)
28. British radar could double at the races. (3)

(Solution on page 625)

WIEN BRIDGE A.F. SIGNAL GENERATOR



By A. P. Roberts

15Hz to 25kHz in 3 switched ranges

Automatic gain control maintains pure sine wave output.

An a.f. signal generator is a very useful piece of equipment to have in an electronics workshop, and even a simple instrument can prove to be invaluable on numerous occasions. The unit described here provides a sine wave output of good purity over a frequency range of about 15Hz to 25kHz. This is covered in three bands which have the following approximate limits: Range 1, 15Hz to 250Hz; Range 2, 150Hz to 2.5kHz; Range 3, 1.5kHz to 25kHz. The maximum output amplitude is about 1 volt r.m.s., but this can be attenuated to 100mV or 10mV r.m.s. by means of a switched attenuator. A continuously variable output attenuator is also incorporated. The circuit is battery powered.

WIEN OSCILLATOR

In common with many other a.f. signal generators, this design employs a Wien Bridge oscillator. A Wien network has the basic circuit of Fig.1 (a), with the input-to-output frequency response of Fig.1 (b). In

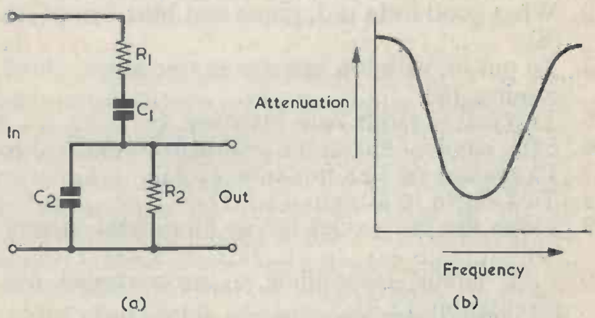


Fig.1(a). A Wien network has two resistors and two capacitors connected as shown here

(b). The network offers minimum attenuation at a frequency which is governed by the values of resistance and capacitance

effect, R1 and C1 form a high pass filter which attenuates lower frequencies, whilst R2 and C2 function as a low pass filter attenuating higher frequencies. If R1 is made equal to R2, and C1 equal to C2, the frequency of minimum attenuation is given by:

$$f = \frac{1}{2\pi RC}$$

Where R and C are the values of R1 and C1.

Fig.2 shows a typical Wien Bridge oscillator, in which the output of an operational amplifier is fed back, to the non-inverting input, by way of the Wien Bridge network. The circuit is capable of oscillating at the frequency of minimum attenuation in the network

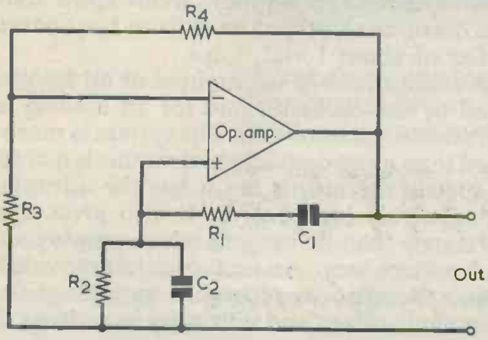


Fig.2. Basic circuit for a Wien Bridge oscillator. Negative feedback is provided by R4 and R3, and these should provide just sufficient gain to allow oscillation to occur

provided that the amplifier has sufficient gain to overcome the loss in the network which is given at that frequency. The voltage gain required by the amplifier is quite small, being only about 3 times.

It is, of course, an easy matter to provide such a low voltage gain. On the other hand it is important that the amplifier voltage gain should not be higher than that required to just produce oscillation at the Wien Bridge frequency, since the oscillation can then become violent, with clipping of the amplifier output signal and the creation of harmonics. Amplifier gain can be reduced by the negative feedback to the inverting input which is given by R4 and R3, whereupon the voltage gain is equal to R4 divided by R3.

At first sight it might appear that all that is required for satisfactory oscillation is to simply make R4 3 times the value of R3, and this could be achieved by using a pre-set variable resistor for one of these two components, the variable resistor being set up so that the amplifier has just sufficient gain to allow oscillation without clipping. In practice, however, a single setting of the resistor could not cater for slight variations in gain due to changes in temperature, supply voltage and loading, and the situation is made worse when, as in the present design, the resistances and capacitances in the Wien Bridge network are adjusted to provide different output frequencies. The only way of solving the problem is to use a gain control circuit in which the level of negative feedback is automatically adjusted to suit the particular operating conditions and the frequency at which the oscillator is running.

COMPONENTS

Resistors

(All fixed values ¼ watt 5% unless otherwise stated)

R1 4.7kΩ
R2 4.7kΩ
R3 680Ω
R4 39kΩ
R5 680Ω
R6 4.3kΩ 2%
R7 430Ω 2%
R8 47Ω 2%
R9 180kΩ
R10 390Ω
VR1 10kΩ dual-gang potentiometer, linear
VR2 5kΩ or 4.7kΩ potentiometer, linear, with switch S3

Capacitors

C1 100μF electrolytic, 10V. Wkg.
C2 100μF electrolytic, 10V. Wkg.
C3 1μF plastic foil, 5%
C4 0.1μplastic foil, 5%
C5 0.01μF plastic foil, 5%
C6 1μF plastic foil, 5%
C7 0.1μF plastic foil, 5%
C8 0.01μF plastic foil, 5%
C9 10μF electrolytic, 10V. Wkg.
C10 10μF electrolytic, 10V. Wkg.
C11 100μF electrolytic, 10V. Wkg.

Semiconductors

IC1 LF351
TR1 BC109
D1 1N4148
D2 1N4148
D3 TIL209

Photocell

PCC1 RPY58A

Switches

S1 3-way 4-pole rotary (only 2 poles used)
S2 3-way 4-pole rotary (only 1 pole used)
S3 s.p.s.t. toggle, ganged with VR2

Socket

SK1 3.5mm. jack socket

Miscellaneous

Metal case (see text)
Veroboard, 0.1in. matrix
9-volt battery type PP3
Battery connector
4 control knobs
Nuts, bolts, wire, etc.

THE CIRCUIT

The full circuit of the a.f. signal generator is given in Fig.3. In this diagram the operational amplifier is an LF351, which has an f.e.t. input and gives low levels of noise and distortion. The non-inverting input is biased to half the supply potential by R1 and R2, the junction of these two resistors coupling to the input via R3 and VR1 (a). The junction is effectively at earth potential for audio frequencies due to the high value bypass capacitor, C2. This configuration allows the circuit to function with a single supply instead of the dual supplies that are normally employed with operational amplifiers.

The resistive parts of the Wien network are given by R3 plus VR1(a) and R5 plus VR1(b). VR1(a) and VR1(b) are the two halves of a dual-gang potentiometer, and this potentiometer provides continuous adjustment of oscillator frequency within the range selected by S1(a) (b). The switch selects the capacitive sections of the network, consisting of C3 and C6, C4 and C7, and C5 and C8, to give the three oscillator ranges.

Voltage gain is controlled by the negative feedback components PCC1 and R4. PCC1 is a cadmium sulphide photoconductive cell whose resistance decreases as the light intensity falling on it rises. When it is in total darkness (as it can be in the present design) it has a resistance of at least 200k Ω which would allow a voltage gain in the operational amplifier of at least 5 times. Such a gain is sufficient to cause violent oscillation.

The output from the oscillator is coupled via C10 and R9 to the voltage doubling rectifier and smoothing circuit comprising D1, D2 and C11. The rectified positive voltage is then applied to the base of TR1 and, if it is sufficiently high, causes this transistor to become conductive and to turn on the l.e.d., D3. R10 is a current limiting resistor.

The components are physically arranged so that the light output from D3 is aimed at the sensitive surface of PCC1. Thus, as soon as the l.e.d. lights up the resistance of PCC1 reduces, as also in consequence does the voltage gain of the operational amplifier. The circuit is then caused to stabilize at an output level from the operational amplifier which just allows D3 to turn on. The circuit cannot operate at a higher output level because D3 would then be brighter and reduce the resistance of PCC1, and it cannot operate at a level below that at which D3 is turned on because the PCC1 would then allow an excessively high gain. The circuit therefore gives gentle oscillation and a very pure low-distortion output. The component values in the rectifier circuit allow stabilization to occur at an output level from the operational amplifier of about 1 volt. r.m.s.

This stabilization is maintained at all frequencies covered by the oscillator and for all loading levels, within reason, on its output. The system is more complicated than more conventional methods incorporating a special thermistor but it has the advantage of being relatively inexpensive. It also gives a better performance than do systems which employ an f.e.t. in the feedback loop. An f.e.t. does not provide a true resistance because its resistance varies significantly with applied voltage and it thereby introduces distortion.

The output of the operational amplifier is applied

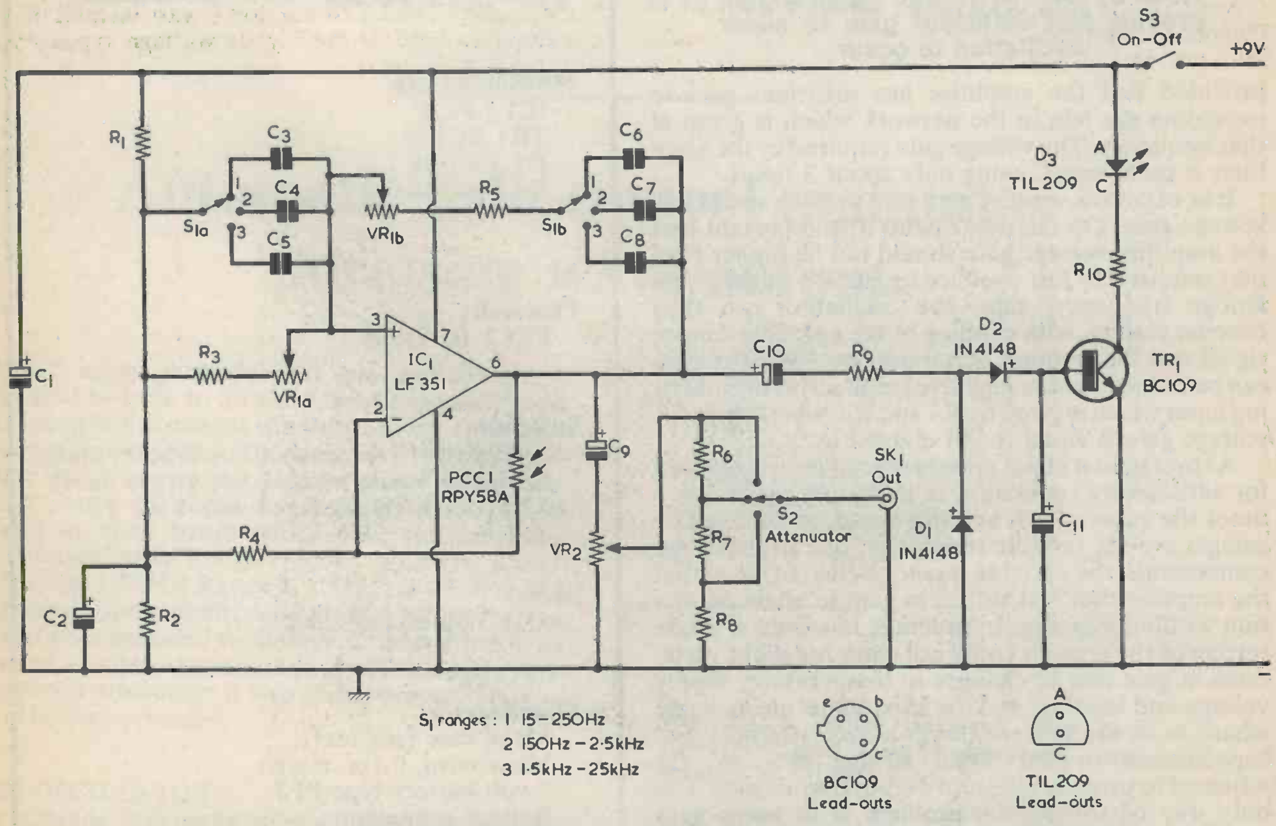
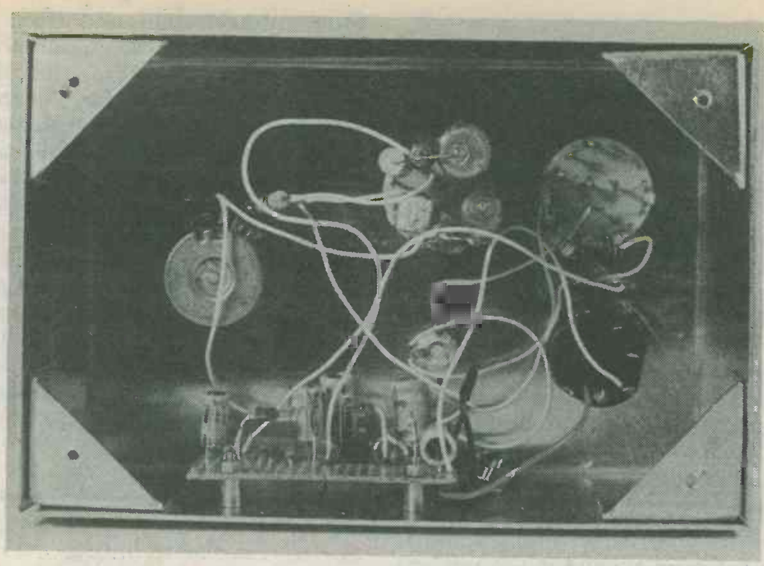


Fig.3. The complete circuit of the a.f. signal generator. The light output from D3 falls on the photoconductive cell PCC1, and this provides an automatic control which maintains amplifier gain at the level required for correct oscillation

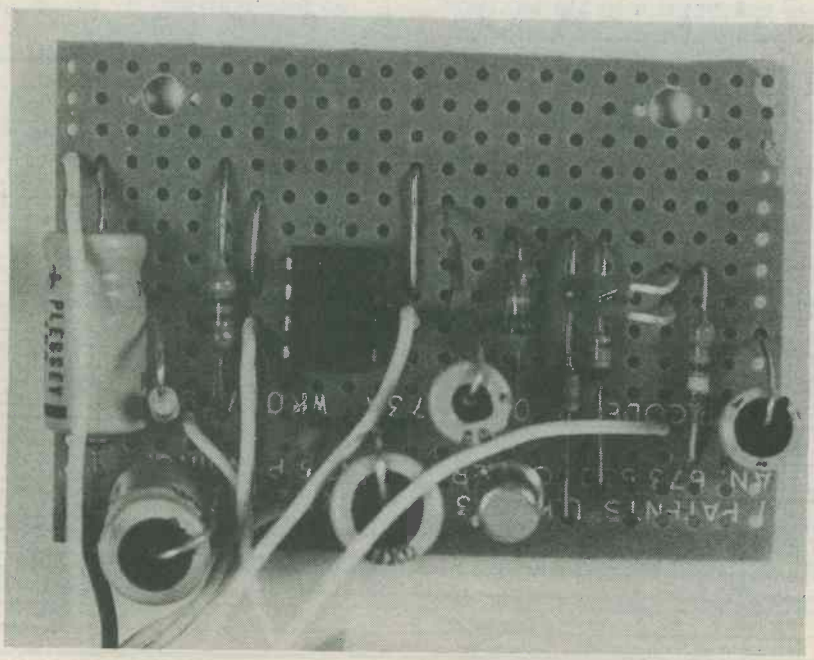


Apart from the components associated with the front panel, the main part of the circuitry is assembled on a Veroboard panel

via C9 to the continuously variable attenuator, vR2. The slider of this potentiometer connects, in turn, to the 3-step attenuator, given by R6, R7, R8 and S2. The output socket, SK1, is a 3.5mm. jack socket.

S3 is the on-off switch and C1 is the only supply decoupling component which is required. Current consumption from the 9 volt battery is only 3.5mA.

Most of the components are generally available. The photoconductive cell required for PCC1 is available from Maplin Electronic Supplies as also is IC1. A reasonably good frequency registration between ranges is given if the capacitors in the Wien network have tolerances on value of 5% or better. Polycarbonate capacitors with 5% tolerance can be obtained from Maplin Electronic Supplies. The three attenuator resistors, R6, R7 and R8 should have a tolerance on value of 2% or, better, 1%. It is, of course, quite in order to employ ½ watt instead of ¼ watt resistors here, if the higher wattage types are more readily available.



The Veroboard module. The l.e.d., D3, can be discerned with its light output directed towards the photoconductive cell

CONSTRUCTION

The signal generator should be housed in an all-metal case, and the author employed an aluminium chassis with baseplate measuring 6 by 4 by 2½in. The baseplate becomes the rear panel of the box thus formed. Any other metal case of about the same dimensions will be satisfactory and, for instance, an aluminium box measuring 6 by 4 by 3in. is listed by Harrison Bros., P.O. Box 55, Westcliff-on-Sea, Essex, SS0 7LQ. The general layout can be seen in the accompanying photographs, and is not particularly critical.

Looking at the front panel, S2 and VR2 are to the left, with S2 above VR2. S1(a) (b) is to the right of S2 and the output jack socket is to the right of VR2. Further to the right, and fitted with a larger knob, is the dual-gang potentiometer, VR1(a) (b). Secured to the bottom of the case with 6BA screws, nuts and spacing washers in the Veroboard assembly. The Vero-board is oriented such that its mounting holes are to the rear of the case. There is plenty of space for the battery, which can be held in place with a simple home-made clamp. The metal case is common with the negative supply rail, the connection being made via the mounting bush and nut of SK1.

The Veroboard is illustrated in Fig.4 and this is prepared and wired up in normal fashion. Note that IC1 has a Jfet and not a MOSFET input, so that it does not require any special handling precautions. The lead-out wires of D3 are bent at right angles, so that it is directed at PCC1. The two components do

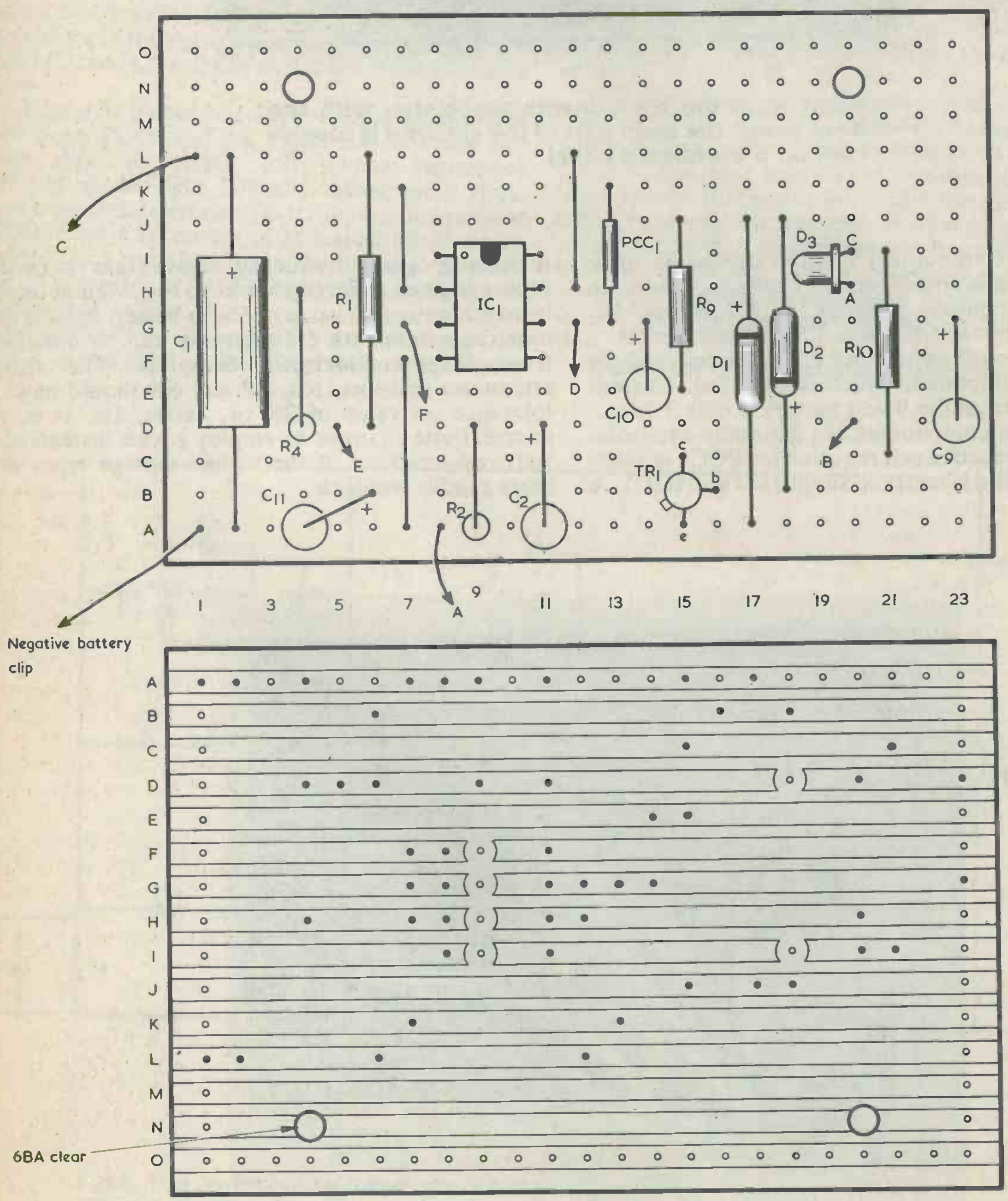


Fig.4. Details of the Veroboard assembly. The leads of D3 are bent through a right angle so that its light output is directed towards PCC1

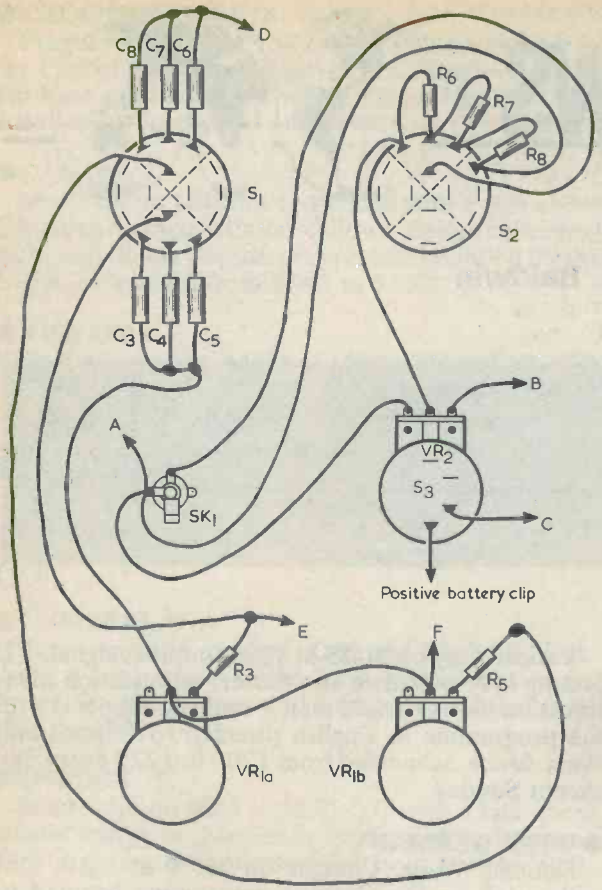
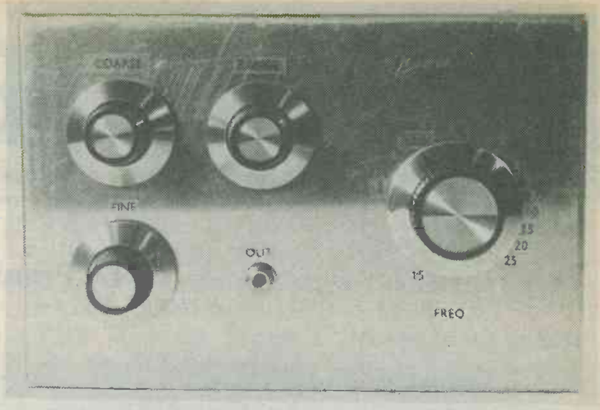


Fig.5. The point-to-point wiring to the front panel components. The two sections of dual-gang potentiometer VR1 are shown separated to assist clarity. A tag on the adjacent pole of S2 is used as an anchor tag for R8. The letter references "A" to "F" correspond to the similar letters in Fig.4



Front panel layout of the prototype.

not have to be adjusted so that they are right next to each other and they do not have to be carefully aligned. This is because in operation only a very small amount of light has to be received by PCC1 from D3 to produce the required stabilizing action. Even a poor coupling between the two devices will prove sufficient. The light sensitive surface of PCC1 faces the l.e.d., and this is the surface to which its lead-out wires do not connect.

The wiring external to the Veroboard is shown in Fig.5. Interconnections to the board are identified by the letters "A" to "F". For example, point "A" in Fig.4 connects to point "A" in Fig.5. The two sections of VR1(a) (b) are shown separately for reasons of clarity.

When wiring has been completed and checked out, the signal generator is ready for testing and calibration.

CALIBRATION

To obtain maximum usefulness from the signal generator it is necessary to provide a scale or otherwise indicate output frequencies around the control knob of VR1. Ideally, the dial would be calibrated with the aid of a frequency meter. If an accurately calibrated a.f. signal generator is already available this can be used to calibrate the unit. By listening to the outputs of both generators it is possible to adjust them to produce the same note and thus bring them to the same operating frequency. Another possible alternative is to use an oscilloscope and compare the signal generator output with the 50Hz mains supply. Calibration on any one range should be adequate for the other two ranges.

If no suitable test gear for calibration is available, the scale shown in Fig.6 can be copied and used. This will give reasonable accuracy, although not as great an accuracy as is possible with the other methods.

Several points need to be made before ending. After switch-on, or when S1(a) (b) or VR1(a) (b) is adjusted, the circuit may take a second or two to adjust the gain to the required level. During this brief period the generator may oscillate violently or cease to oscillate. This slow response time is quite normal in signal generators of this type and, indeed, is desirable in the interests of low distortion since it means that the resistance of PCC1 cannot alter at oscillation frequency.

Finally, the signal generator can only function if ambient light is excluded from PCC1. The circuit will therefore fail to oscillate when the rear panel of the case is removed, or even if the case is not reasonably light-proof. ■

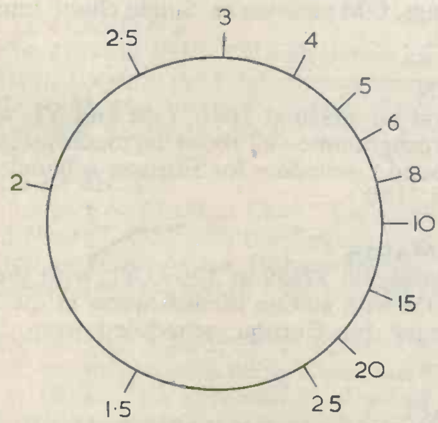
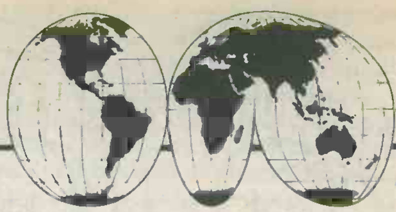


Fig.6. This scale may be copied if suitable test instruments for calibration are not available

SHORT WAVE NEWS
FOR DX LISTENERS



By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

We are now in the season for LA (Latin American) dx'ing and many listeners will be burning the midnight and early morning oil in attempts to log some of the many transmitters currently operating from that continent. Listed below are a few recently received stations logged on the 60 metre band – the paradise for LA-philes.

● COLOMBIA
La Voz del Cinaruco, Arauca, on **4865** at 0211, OM with a talk in Spanish about Colombian internal affairs. "The Voice of Cinaruco" has a 24-hour schedule and the power is 1kW.

La Voz del Norte, Cucuta, on **4875** at 0213, local-style dance music, OM with full station identification at 0215. The schedule is from 1000 to 0500 and the power is 5kW.

Emisora Meridiano 70, Arauca, on **4925** at 0234, OM with announcements in Spanish followed by a sports commentary. The schedule is from 1000 to 0330 (to 0500 on Saturdays) but all times are variable. The power is 1kW and this station identifies as "Radio Centro".

● ECUADOR
Radio Centinela del Sur, Loja, on **4890** at 0223, OM with announcements in Spanish, local-style music, identification and sports commentary at 0230. The schedule is from 1145 to 0430 (variable closing time), the power is 2.5kW and it identifies as "Radio Musical".

● HONDURAS
Radio Progreso, El Progreso, on **4920** at 0230, OM announcements in Spanish, identification. Schedule is from 0900 to 0500 (Sundays to 0700) and the power is 5kW.

AROUND THE DIAL

● VATICAN
Vatican City on **11700** at 2100, interval signal followed by station identification and the French programme for West Africa, scheduled from 2100 to 2115.

Vatican City on **21485** at 1200, interval signal, YL (young lady = female announcer) with station identification then OM (old man = male announcer) with the programme in English directed to Central and West Africa, scheduled from 1200 to 1220 every day except Sunday.

● WEST GERMANY
Deutche Welle, Cologne on **21590** at 1210, OM with a talk in the German programme beamed to South America, scheduled on this channel from 1200 to 1220.

● GREECE
Athens on **21455** at 1217, YL with songs, local-type music in the Greek programme intended for North America, scheduled from 1200 to 1250.

● ALGERIA
Algiers on **11810** at 2104, OM with a newscast in the English programme radiated in the External Service – target area unknown – scheduled from 2100 to 2130. Also logged in parallel on **11740.**

● SAUDI ARABIA
Riyadh on **15060** at 1858, Arabic-type music, YL with songs, OM announcer. Single chime time-check at 1900.

● SPAIN
Madrid on **15340** at 2046, OM and YL with the English programme – all about the medieval battles in and around Grenada – for Europe, scheduled from 2010 to 2110.

● ROUMANIA
Bucharest on **17850** at 1307, YL with the world news, OM with station identification in the English programme for Europe, scheduled from 1300 to 1330.

● ISRAEL
Jerusalem on **11630** at 1512, OM with a talk in Hebrew in a relay of the domestic service Network B for listeners abroad, scheduled from 1400 to 2315 on this channel.

● **CZECHOSLOVAKIA**
Prague on **17840** at 1532, OM with a newscast in the English programme for Africa, South Asia, the Far East and Europe, scheduled from 1530 to 1625. Also logged in parallel on **11990.**

● **CANADA**
Montreal on **11935** at 1550, OM with a talk about Canadian financial affairs – fellow inflation sufferers I gathered – in the English programme intended for the USSR, scheduled from 1545 to 1600.

● **KUWAIT**
Radio Kuwait on **11665** at 1803, OM and YL with the English programme to Europe, and the Arabian Gulf, scheduled from 1800 to 2100 on this channel.

● **AUSTRIA**
Vienna on **6155** at 1834, OM with the local news in the English programme for Europe, East and South Africa and the Middle East, scheduled from 1830 to 1900.

● **SWITZERLAND**
Berne on **6165** at 1841, OM and YL with 'Talkback', a programme in the English transmission for Africa, South America and Europe, scheduled from 1815 to 1845.

● **SWEDEN**
Stockholm on **6065** at 1850, YL with a talk about atomic energy in Sweden in the English programme for Europe and Africa, scheduled from 1830 to 1900.

● **BULGARIA**
Sofia on **17825** at 1857, OM with station identification in the English programme to Africa, scheduled from 1830 to 1900.

● **NETHERLANDS ANTILLES**
Bonaire on **17695** at 2115, OM with a programme about stamp collecting in the English transmission to Central and West Africa, scheduled from 2030 to 2120. This is a relay of Radio Nederlands, Lopik.

● **NEW ZEALAND**
Wellington on **15345** at 0442, light orchestral music, OM announcer in English, six 'pips' and announced time-check for "five p.m.", station identification at 0500.

● **SWITZERLAND – 2**
Berne on **21570** at 1315, YL with station identification and world news in the English programme for the Far East, South and South East Asia, Europe and North America, scheduled from 1315 to 1345.

● **SOUTH AFRICA**
Johannesburg on **21535** at 1309, "Big Band Sound with Ted Heath", OM with the English programme for Central and East Africa, Europe and the Middle East, scheduled from 1300 to 1550 (to 1600 on Sundays).
Johannesburg on **3250** at 1812, YL with pop song in English, the programme being wiped out by interference at 1814., This is 'Radio Five' which broadcasts in English and Afrikaans from 0300 to 0545 and from 1535 to 2200.

● **CHINA**
Radio Peking on **6590** at 1810, YL with the English programme for South Asia, scheduled here from 1800 to 1900.
Radio Peking on **7480** at 1814, OM with the programme in Persian directed to Iran and Afghanistan, scheduled from 1800 to 1830.
Radio Peking on **7525** at 1805, OM with the programme in Standard Chinese to Europe, North Africa and West Asia, scheduled on this channel from 1730 to 1830.
Radio Peking on **9900** at 1918, YL with Chinese songs in the Hausa programme intended for West Africa, scheduled from 1900 to 1930.
CPBS (Central People's Broadcasting Station) Peking on **11290** at 2005, OM in Chinese in the Domestic Service 1 programme for local consumption, scheduled on this frequency from 2000 to 2200.
Radio Peking on **11575** at 1912, Chinese orchestral music during the French programme to Europe and Africa, scheduled from 1830 to 1930.
Whilst trying to receive the foregoing channels, why not try **6520** between 1830 and 1925 GMT when Radio Peking broadcasts in Russian with a reversed tape transmission? The purpose of such transmissions is unknown although several theories have been advanced. Even if you don't understand what you hear – and who does? – at least you can enter into your log one of the strangest of all short wave broadcasts.

● **NORTH KOREA**
Seoul on **7550** at 2007, OM with the local news in the English programme for Africa and Europe, scheduled from 2000 to 2030.

● **CONGO**
R.TV Congolaise, Brazzaville, on **3265** at 1820, local-style music, drums, YL with a song in vernacular. The schedule is from 0400 to 0700 and from 1700 to 2100 (closing time is variable) and the power is 50kW.

● **LIBERIA**
ELWA Monrovia on a measured **3227** at 1825, OM with a sports commentary in English. The schedule is from 0600 to 0800 and from 1805 to 2220 and the power is 10kW. Supposedly only a vernacular service on this channel!

● **CAMEROON**
A new one here. Bafoussam on **4000** at 1835, OM with a news commentary in English. Schedule and power unknown at the time of writing, but thought to be about 20kW.

● **PORTUGAL**
Lisbon on **6185** at 0517, OM with the local news in the English programme for Western Canada and all USA, scheduled from 0500 to 0530.

● **JAPAN**
Tokyo on **21610** at 0747, YL with songs in Japanese, OM announcer in the French programme to Europe, scheduled from 0730 to 0800. OM with station identification and announcements at the commencement of the English programme for Europe at 0800, scheduled from 0800 to 0830.

● **AUSTRIA**
Vienna on **6000** at 0458, interval signal of chimes, YL with many identifications in Austrian, schedule of the 0500 programme on this channel is unknown.

In your work-shop

THE SHUDDERY PICTURE

Here's your chance to beat Smithy at his own game.

"Shuddery Picture"

Dick looked at the tag tied to the black and white television set on his bench and frowned. For many years he and Smithy had been servicing sets which were frequently sent to them without an indication of their faults, so that not only did they have to repair each set but they had first to find out what it was in the set that *needed* repairing. In most cases the faults were obvious enough but there had been one or two annoying misunderstandings. There had been the perfectly serviceable colour television receiver which Smithy had decided to put on soak test for several days to check whether it had an intermittent, only to find later that the customer's aerial had blown down and was picking up only sufficient signal to resolve a noisy monochrome picture with little colour. And there had been the little novelty radio housed in a very realistic copy of a Coca-Cola bottle which had stood on the "For Repair" rack for over a week because Smithy thought that Dick had brought it in for lunch-time refreshment whilst Dick had thought that Smithy had done precisely the same thing.

So Smithy had started a campaign and now nearly all the sets came in with a note defining the customer complaint. Some of these had mildly surrealistic undertones, such as the description "Power Getting Through" appended to a music centre with an almost ear-shattering mains hum, but in general the system was working well.

"Shuddery Picture" looked promisingly explicit. Dismissing the fleeting thought that perhaps the set only worked when Hammer horror films were being transmitted, Dick connected an aerial to it, plugged it into the mains and switched on.

PICTURE TROUBLE

The sound channel of one of the local transmitters became audible and, after a short while, the picture appeared. Dick looked at it carefully. It was rock-steady with not a trace of movement which could conceivably fall into the category of "shuddery". The receiver had a rotary tuning control and Dick adjusted this to pick up, in turn, the other two local channels. On both of these the picture locked in solidly, with no tremors or shakiness whatsoever in either the horizontal or vertical directions. Experimentally, Dick adjusted the control so that the tuning passed slowly through, from either side, the last local channel he had selected.

As soon as the tuning was sufficiently close to the correct setting for video information to appear the picture snapped firmly into position. Dick tuned the set properly again and gazed at the picture. The receiver was presenting a nature documentary in which one particularly revolting little arthropod was engaged in doing quite unspeakable things to another equally repulsive insect. A commentary droned on in the background.

Dick adjusted the contrast and then the brightness control. All that the contrast control did was to vary the contrast of the picture and all that the brightness control did was to vary the brightness. The only control left on the front panel of the set was for volume. Dick turned this up, and his eyes sharpened as a momentary tiny spasm shook the lower half of the picture. He advanced the control to its full extent, causing the Workshop to be filled with the sound of the commentary.

Whenever the reproduced sound reached a peak there was a definite vertical tremor in the picture. The movement was small but noticeable and would certainly be a source of irritation to any perfectionist viewer. It was, without a doubt, a shuddery picture within the meaning of the Act.

Dick turned down the sound, causing the picture to resume its former steadiness, and walked over to the filing cabinet. The service manual for the set was in stock and he returned to his bench, studying its circuit diagram. Laying the manual down on the bench, he concentrated on the audio amplifying section. (Fig.1.)

After some moments, he once more turned the receiver volume control to its maximum position, to observe again the return of the picture jitter. There was a grunt of irritation from the other side of the Workshop, where Smithy was deeply engrossed in examining the entrails of a multi-transistor music centre. A sudden inspiration caused Dick to rummage through his spares box, and he produced a 3.5mm. jack plug to which no wires were connected. He inserted the plug into the earphone socket of the receiver, whereupon the circuit to its internal speaker was broken and it became silent.

The picture jitter at once disappeared.

Dick pulled out the jack plug, to cause the return of both the sound and the picture jitter, and then reinserted the plug to remove both.

"For the love of Mike," roared out Smithy from his bench, "Can't you do any servicing without deafening everybody within a mile's radius?"

"I'm trying," said Dick reproachfully, "to find out what's wrong with this TV."

"Do you have to do it with the sound going full blast?"

Dick assumed the tone of one who conveys an elementary fact of life to an idiot.

"The fault," he remarked patronisingly, "only comes on when the sound is turned up high. The picture then trembles up and down."

"Oh."

There was silence for some moments.

"Is it," called out Smithy, "a modern solid-state set?"

"It is," confirmed Dick.

"Oh."

Again there was silence.

"We used to get that sort of trouble," stated Smithy after a pause, "with the old TV sets which used valves. Valves sometimes went microphonic and they used to cause quite weird faults when the sound from the speaker caused their electrodes to vibrate."

Dick scanned the circuit diagram in the manual.

"There are," he said positively, "no valves in this set."

"Oh."

ENTER SMITHY

The silence fell again, but was broken this time by the scraping of Smithy's stool on the floor. Resignedly, the Serviceman dropped his test prods on his bench and walked over to his assistant's side.

"I suppose," he sighed, "I'm once more going to get hooked on one of your jobs instead of getting on with my own work, but at least I'd like to see what this fault looks like."

"Okay," said Dick, turning down the volume control on the receiver. "Now, if I take this jack plug out you"ll see how the set behaves when the output volume is low."

He removed the plug. Smithy examined the picture closely.

"As you can see," resumed Dick, "everything's just as it should be and the picture is perfectly steady. Now I'll turn the volume up."

Dick adjusted the control to its maximum setting.

"Yes, I can see the trouble," stated Smithy, raising his voice to compete with the sound level from the speaker. "It's vertical frame judder which coincides with high level peaks of sound from the speaker. There's not a great deal of judder, but still enough to spoil the entertainment value of the picture."

"Right," said Dick. "Now, I'll put in this jack plug and silence the speaker."

He proceeded to do so, and Smithy gazed at the now perfectly stable picture on the tube screen.

"Humph," he grunted. "Well, in the old days, the first thing I'd have done would have been to change the oscillator valve or valves in the vertical timebase. A microphonic valve here would be the obvious thing to suspect since it could be affected acoustically by the sound from the speaker. But you say this set is all solid-state, don't you?"

"Here's the circuit," said Dick, pointing to the service manual. "If you look at the a.f. amplifier section you'll see that it's got an earphone socket which mutes the speaker when a jack plug is inserted. That's what gave me the idea of

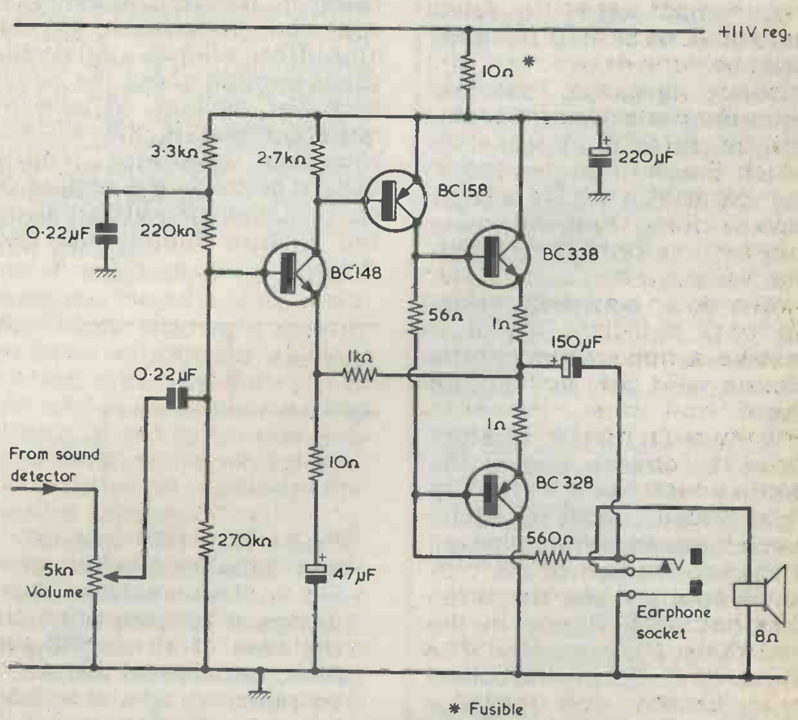


Fig.1. Typical a.f. amplifier section for a television receiver. Inserting a jack plug in the earphone socket mutes the speaker.

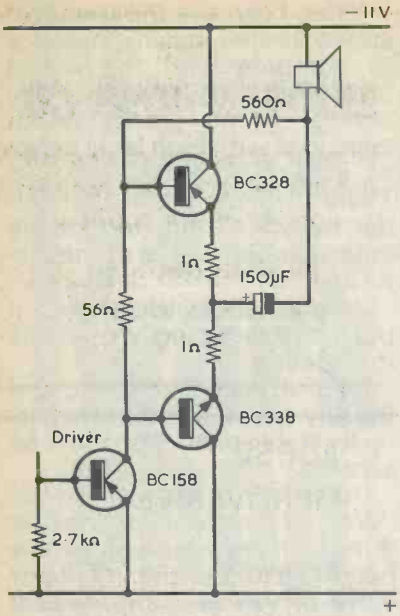


Fig.2. If the driver and output transistor circuitry is redrawn with the negative rail at the top (and the earphone socket omitted for simplicity) the 560Ω resistor is plainly seen to be a bootstrap resistor.

seeing what would happen when there was no sound from the speaker. Incidentally, that a.f. amplifier looks a bit funny to me."

"In what way?" queried Smithy as he turned his gaze towards the circuit.

"Well," said Dick, "the two emitters of the output transistors couple to the speaker in the usual way through a 150μF electrolytic. But there's a 560Ω resistor going back from the speaker to the base of the bottom transistor."

"That's a bootstrap resistor."

"A bootstrap resistor? At the chassis end of the output stage?"

"It doesn't matter whether it's at the chassis end or the positive rail end," replied Smithy. "If you were to redraw the circuit with the negative rail at the top instead of the bottom, you'd see the bootstrap function more clearly in the way it's usually presented. The bootstrap resistor is the collector load of the driver transistor and, since the end of the resistor which couples to the speaker goes negative in sympathy with the voltage at the output emitters, it ensures that there's always plenty of base current available for the p.n.p. output transistor." (Fig.2.)

"Ah yes," said Dick slowly. "I can see what you mean now. It's the way the circuit is drawn that threw me. There's another thing."

"What's that?"

"There's a 10Ω resistor with an asterisk alongside it." (Fig. 3).

"That's a special fusible resistor," explained Smithy. "It's designed to burn out if a fault condition in the amplifier causes excessive current to be drawn from the regulated 11 volt supply."

"Regulated 11 volt supply, eh? Well, if the 11 volt supply is regulated why do you need that 220μF bypass capacitor after the 10Ω resistor?"

"These TV regulated supplies," said Smithy, "are usually of the discrete transistor type and they aren't always very fast acting. They provide a steady voltage to all the stages they power but the a.f. amplifier section still requires a fat electrolytic like that 220μF capacitor across its supply rails to ensure there's a low supply impedance across it. And, of course, the 220μF capacitor ensures that the 10Ω fusible resistor doesn't provide a common impedance to the amplifier stages. Anyway, that's enough about the audio amplifier section. What's of more interest is the vertical timebase oscillator. That's almost certainly the section of the circuit which will be making the picture judder up and down."

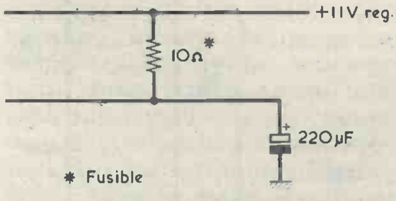


Fig.3. The 10Ω resistor and 220μF capacitor of Fig.1. The resistor is designed to burn out in the case of an amplifier fault, and should always be replaced by a similar component. The 220μF capacitor provides a low supply impedance across the a.f. amplifier.

VERTICAL OSCILLATOR

Smithy pulled the service manual towards him and pointed his finger at the vertical oscillator section. (Fig.4.)

"Here we are," he announced, "and it's it's just a simple multivibrator."

"It's only got one cross-coupling capacitor between the two multivibrator transistors," objected Dick. "The other cross-coupling component is a 10kΩ resistor."

"Not to worry," said Smithy soothingly. "The arrangement is still a simple one. It's pretty obvious, of course, that the right-hand multivibrator transistor is the one which cuts off during the scan period and which turns on during flyback."

"Hell's teeth," said Dick irritably. "How the heck can you say it's pretty obvious which transistor is cut off during the scan period? Dash it all, you've only just *seen* the flaming circuit!"

"I'll explain in a minute," replied Smithy loftily. "Just take my word for it for the time being. Now, if the right-hand transistor is turned off during the scan period the left-hand transistor is turned on, with current flowing to its base from the positive rail through the 2.2kΩ resistor and that 10kΩ resistor you mentioned just now. The transistor to the left of the multivib is the sync separator, and the waveforms in the manual tell us that this has negative-going sync pulses from the received signal at its collector. Okay?"

"So far," admitted Dick guardedly.

"Good! Negative-going line sync pulses are smoothed out by the 15kΩ resistor and the 2,200pF capacitor which follow the sync separator collector, but when the broad vertical sync pulses arrive they are integrated by the 2,200pF capacitor to produce a large negative pulse which is applied via the first diode in the circuit to the base of the left-hand multivibrator transistor. This pulse cuts off the transistor and current flows from the regulated 11 volt supply through the 680Ω resistor and the 0.33μF cross-coupling capacitor into the base of the right-hand transistor, which

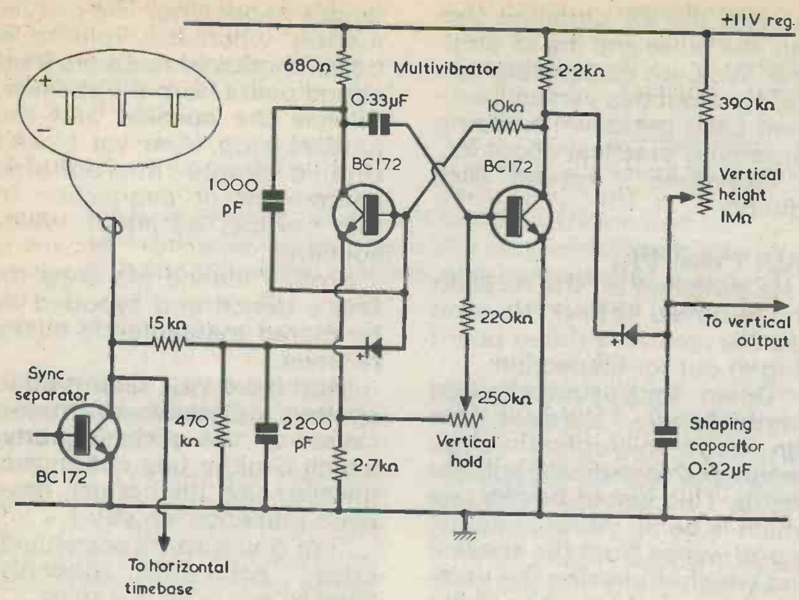


Fig.4. Vertical timebase oscillator employing a multivibrator to discharge a shaping capacitor during flyback. The slowly increasing voltage across the capacitor is applied to the vertical output stage, which drives the vertical deflection coils. This diagram and Fig.1 are slightly simplified versions of monochrome TV circuits encountered in practice.

then turns hard on. The 0.33μF capacitor charges rapidly and, at the end of the vertical sync pulse, the base of the left-hand transistor goes sufficiently positive for it to start conducting again. That process will be assisted by the 1,000pF capacitor between its collector and base, as the collector will still be going positive. The reverse multivibrator changeover then takes place, with the left-hand transistor turning on again and the right-hand transistor cutting off. The charged 0.33μF cross-coupling capacitor will hold the right-hand transistor base negative of its emitter, and the capacitor will discharge slowly via the vertical hold pot and the series 220kΩ resistor. We are now in the scan period of the multivibrator cycle, and the capacitor will have just discharged sufficiently for the next vertical sync pulse to trigger the oscillator into flyback again."

"There's a second diode," said Dick pointing at the circuit.

"It couples the collector of the right-hand transistor to a 0.22μF capacitor going to chassis and also to the vertical height control."

"That 0.22μF capacitor is the vertical shaping capacitor," explained Smithy. "It's discharged by the right-hand multivibrator transistor during flyback, and is then allowed to charge slowly via the height control pot and the 390kΩ resistor above it during the scan period. The gradually increasing voltage across the capacitor provides the vertical scan voltage."

"I'm beginning to understand now," said Dick thoughtfully, "why you were able to say so quickly that it was the right-hand multivibrator transistor which turned on during flyback. It had to be that one because it was the only transistor which could discharge the shaping capacitor."

"You've got it," agreed Smithy. "There are other pointers to which transistor does what but that's the most obvious one."

"I see," commented Dick, "that this circuit is powered by the 11 volt regulated supply rail."

"It is," agreed Smithy. "It's the same 11 volt rail which supplies the a.f. amplifier section, the tuner and the i.f. amplifier. Well, we've done enough talking about this vertical oscillator. Let's get down to doing something practical about it."

"Okeydoke," agreed Dick equably.

FAULT FINDING

He switched off the receiver and removed its back. He soon had the receiver printed board hinged out for inspection.

"Down to business," said Smithy briskly. "Let's see if we can find a microphonic component in this vertical oscillator circuit. This would be the one which is being vibrated by the sound waves from the speaker and which is causing the vertical picture judder when these waves are at a high level. It won't be microphonic in the same way that those old valves were microphonic but it will probably be a component having an intermittent connection at one of its lead-outs or something of that order. All I've got to do," he concluded confidently, "is gently tap each component in turn until I find the one which causes the judder."

Smithy consulted the service manual and located the vertical oscillator components. Dick switched on the receiver, with its speaker silenced by the jack plug fitted in the earphone socket, and gazed at the picture on the screen as Smithy proceeded to tap the components in turn with an insulated rod he had taken from his pocket.

"Nothing's happening," announced Dick after a while, "nothing's happening at all. That picture's absolutely steady. There's no judder, no shudder, no nothing!"

"That's funny," remarked Smithy, puzzled. "I've tapped every component there is in that oscillator circuit. I'll have another go."

Smithy repeated the process, tapping each of the components in turn. Then he tried again. And again. But there was no component or connection which, when tapped, had the slightest effect on the vertical stability of the picture on the tube.

"This is infuriating," snarled Smithy, as he put down the rod. "Let's just summarise what's happening. The picture judders when the volume is turned high and there are loud sound peaks from the speaker. Silence the speaker and the judders stop. And yet I can't find a single microphonic component or connection in this vertical oscillator whatsoever!"

Smithy leaned his arms on Dick's bench and brooded as he glared malevolently at the receiver.

(And have you, dear reader, spotted a possible alternative cause of the picture judder which Smithy has completely missed? All the clues have been presented to you.)

"I'm going to try something crazy," said Dick suddenly, "just to see what happens."

"All right," said Smithy disconsolately. "I'll welcome anything which gives us a lead."

Dick turned down the receiver volume control and removed the jack plug. He then busied himself mysteriously as Smithy maintained his scowling gaze at the television set. About ten minutes passed before Dick gave voice again.

"What I've done," he stated, "is wire up an 8Ω speaker to this jack plug by way of a couple of yards of twin flex. I'm going to plug this into the earphone socket and then hold this second speaker right over the printed board. If I move it around above the board, it might show the location of the part which is causing the trouble!" (Fig.5.)

Smithy grunted and made no comment.

Dick placed the speaker on his bench, well away from the receiver, and plugged the jack plug into the earphone socket. He turned the volume control to full and the sound channel of the local transmission, tinny and high-pitched as reproduced by the unbaffled 8Ω speaker, filled the air.

And the picture recommenced its judder.

"Hold it," called out Smithy excitedly. "Just hold things there!"

(Have you spotted it now? Hint: it's a single passive component, already mentioned by Smithy, which is the faulty one.)

"Hold it!" repeated Smithy. "Just hold things there!"

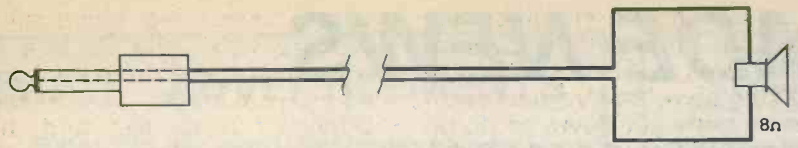


Fig.5. In an attempt at fault location, Dick wired up an external 8Ω speaker to a jack plug which could fit into the television receiver earphone socket.

"Blimey, Smithy," spluttered a startled Dick, "what's eating you?"

"What's eating me," wailed Smithy in an agonised tone, "is that I'm an imbecile! The possible cause of this fault has been staring me in the face all along, and it has nothing to do with microphonic feedback from the speaker at all. Here, see if you can find me a 220μF electrolytic!"

Dick quickly obtained the required component from the spares cupboard and handed it to the Serviceman. Whilst the external speaker still produced its shrill eldritch sound, and whilst the picture still exhibited its vertical judder, Smithy located the 220μF supply bypass capacitor for the audio amplifier section (back to Fig.1.) and, with trembling fingers, bridged it with the new 220μF capacitor Dick had given him.

The vertical juddering ceased.

SUCCESS AT LAST

"Ye gods," commented a dazed Dick as he stared bemusedly at the now completely steady picture. "What's happening?"

"The 220μF supply bypass capacitor for the audio amplifier is open-circuit," pronounced Smithy. "The coupling from the audio output stage to the vertical oscillator section wasn't caused by an acoustic microphonic effect at all, it was caused by the heavy current demands of the output stage on sound peaks modulating the common 11 volt supply rail!"

"But there must have been *some* sort of acoustic coupling," argued Dick. "The vertical judder disappeared when I disconnected the set's speaker."

"What I'd forgotten," moaned Smithy, "is that, without an output load, the audio output stage draws hardly any current from its supply at all. It only draws heavy current peaks when the speaker is connected to it. That's why the judder returned when you connected the external 8Ω speaker. The speaker was much too far away to give an acoustic coupling to the vertical oscillator components and so there had to be some other form of coupling."

"Blow me," said Dick slowly, as he considered this new state of affairs. "Now I wonder how the changing voltages on the supply rail were affecting the vertical scan."

"They were most likely varying the charging current for the shaping capacitor which follows the vertical multivibrator," said Smithy. He wiped his brow. "Phew, that was a hairy one. I thought I was really stymied for once with this fault."

"My crazy idea of wiring up an external speaker wasn't so crazy after all, then."

"It was," stated Smithy, slapping his assistant on the back, "the idea of a man of genius!"

Which seems to be a fitting moment for us to take our leave of the pair as they happily indulge in mutual congratulations. We are all of us human, with human frailties, and you can hardly blame Smithy for having an occasional off-day. Especially if, hopefully, you were able to decide what the possible fault was before he got round to finding it himself! ■

POSTPONED

Due to the recent troubles in the printing industry Part 2 of the "General Purpose 8 watt amplifier" and No. 11 in the "Databuf" series have both had to be postponed to our next issue.

We much regret the inconvenience caused to readers.

Constructor's Crossword

Solution to the puzzle on page 611

Across. 1, Potentiometer. 8, Iota. 9, New. 10, Serial. 11, Transistor. 13, Iron. 14, Impede. 16, NAND gate. 19, Converge. 22, Insert. 25, Kerr. 26, Addressees. 27, NOT AND. 28, G.C.A. 29, Eats. 30, Ratio detector.

Down. 1, Program. 2, Trainee. 3, Non-linear. 4, I.C.W. 5, Maser. 6, Turning. 7, Read-out. 12, Tinlead. 15, Pan. 17, Noise gate. 18, Age. 20, One hour. 21, Variant. 23, Suspect. 24, Re-enter. 26, Audio. 28, Gee.

Notes on the answers

Impedance can consist of resistance or reactance or a combination of the two. Insertion loss is the power loss given when a transducer is inserted in a transmission system. G.C.A. is the abbreviation for Ground Controlled Approach. I.C.W. is short for Interrupted Continuous Wave, and was used in the past by mechanically switching a c.w. transmitter on and off at an audio frequency. Maser is the acronym for Microwave Amplification by Stimulated Emission of Radiation. Working on a similar principle to the laser, the maser is not affected by random electron noise. Radio grade solder is an alloy of 60% tin and 40% lead. A noise gate in a sound studio cuts off any sound signal below a pre-set level.

TRADE NEWS

COMPUTER CATALOGUE

Latest catalogue of Electronic Brokers (who refer to themselves as "The Test Equipment People" and "The Mini-Computer People") has now come out. The full address of the company is Electronic Brokers Limited, 49/53 Pancras Road, London, NW1 2QB.

Electronic Brokers state that they are Europe's largest specialist in quality second user test equipment, mini-computers and associated peripherals.

One reason for their success is the company's policy of continually updating the type of equipment sold. Thus, from selling to private users the business has rapidly developed, and today's customers include leading international companies, research establishments, universities, colleges and government institutions throughout the world.

The Electronic Brokers service laboratory checks each item that arrives at Pancras Road headquarters. Electronic test equipment is then thoroughly cleaned and a schedule prepared for any work which needs to be carried out to meet customers' requirements. Whether new test equipment or used, all items pass through the service laboratory where they are given final tests to ensure that they meet manufacturers' specifications before delivery to the customer.

The catalogue has 62 large pages, of which 43 are devoted to test equipment of all types including, in particular, high grade laboratory measuring equipment. Very nearly all the remainder of the catalogue lists mini-computers and peripherals. Unless otherwise stated, all test equipment carries a 12 month warranty. There is a 90 days warranty for v.d.u.'s and teletypes, whilst computers are offered with on-site acceptance and diagnostic tests (which may qualify them for independent on-going maintenance).

HOBBYIST SPRING KIT

The new Instrument Spring Kit for hobbyists, model-makers and do-it-yourself enthusiasts, from Lee Spring Ltd. It contains 16 cadmium-plated music wire springs in 108 different sizes.

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For those who do a lot of work in the home, these kits offer a cross-section of springs for every conceivable purpose with which to save time and avoid inconvenience in hunting high and low for springs that cannot be found when they are needed, or rushing off to the local shops in search of springs which they may or may not stock.

The Instrument Spring Kit from Lee Spring Ltd. costs £25.00.

Further information from Lee Spring Ltd., Cordwallis Estate, Maidenhead, Berkshire.

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£5 OSCILLOSCOPE. Standard junk box components plus approx. another £5 (Total components approx £12). This unit plugs into TV aerial socket and converts TV to oscilloscope. Circuit and plans £3. Kerr, 27 Coles Road, Milton, Cambridge, CB4 4BL.

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(Continued on page 629)

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(Continued from page 627)

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(Continued on page 630)

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(Continued from page 629)

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(Continued on page 631)

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(Continued from page 630)

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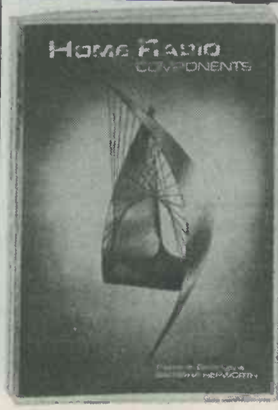
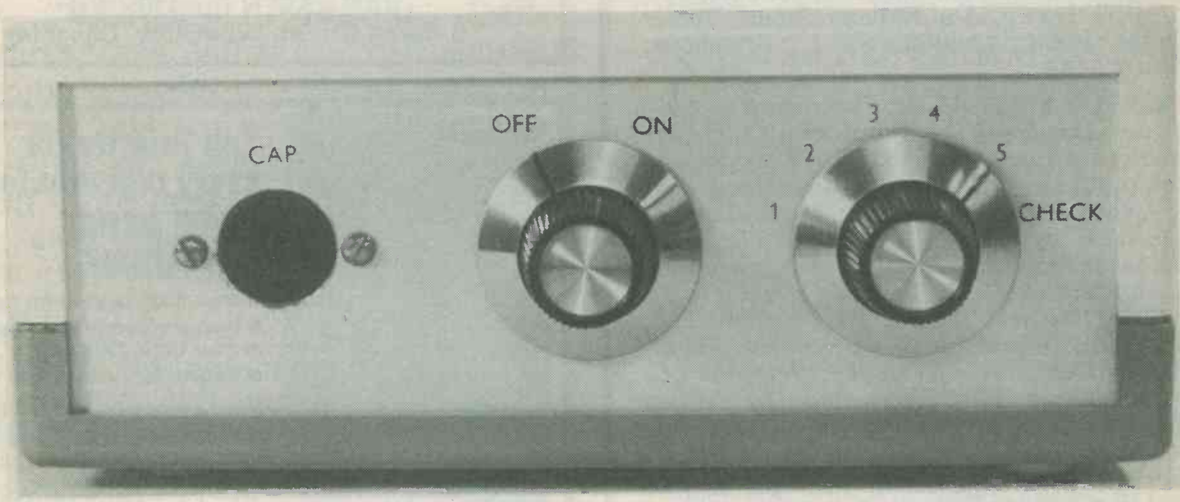


IN OUR NEXT ISSUE

CAPACITANCE MEASURING ADAPTOR



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PLUS MANY OTHER ARTICLES

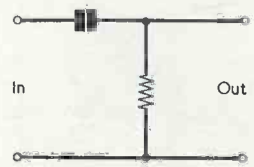
DIFFERENTIATION AND INTEGRATION

Differentiating and integrating circuits are most commonly encountered in television receivers, in which they appear in the synchronising circuits for the horizontal and vertical timebases respectively.

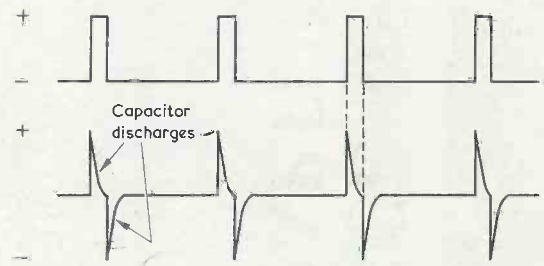
A differentiating circuit appears in (a), whilst in (b) the upper waveform shows a series of short horizontal sync pulses derived from the received signal by the sync separator. These pulses are applied to the differentiating circuit input and the leading edge of each pulse is passed almost unaltered to the output via the capacitor. The capacitor and resistor values are chosen so that the capacitor discharges into the resistor within the duration of the pulse, whereupon the trailing edge causes a negative excursion of the output. After this the capacitor discharges rapidly into the resistor again. The first positive-going output spikes can be used for synchronising the horizontal timebase.

The integrating circuit of (c) does not respond significantly to the short horizontal sync pulses. The vertical synchronising signal consists of a series of broad pulses, as in (d). The integrating circuit capacitor charges via the resistor for the duration of the first broad pulse, discharges for a brief period until the second broad pulse appears at the input, and so on. The output waveform from the integrating circuit consists of a large slowly rising pulse, and this is used to synchronise the vertical timebase.

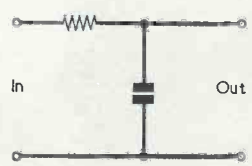
The broad vertical sync pulses are at twice the horizontal sync pulse frequency. The differentiating circuit of (a) can still produce positive-going spikes from each leading pulse edge, thereby maintaining the horizontal timebase in synchronism on alternate pulses whilst the vertical sync signal is present.



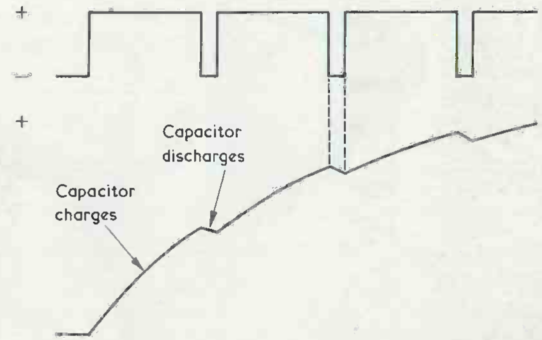
(a)



(b)



(c)



(d)

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