Easy to build projects for everyone

Everyday ELECTRONICS

NOV. 77
40p

Probe-less CONTINUITY TESTER

ULTRASONIC REMOTE CONTROL SYSTEM

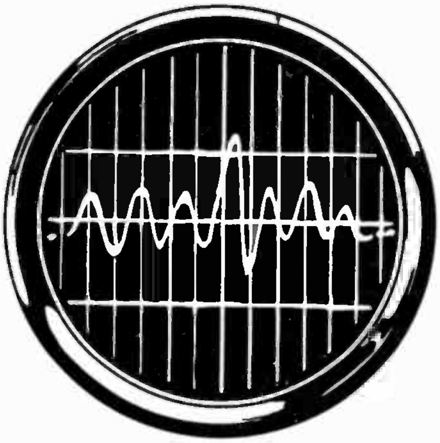
FIND the PAIR

SPECIAL OFFER!

SOLDERING IRON

LOOK! Here's how you master electronics.

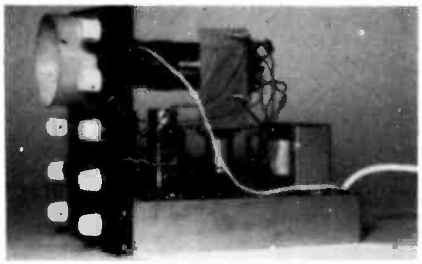
....the practical way.

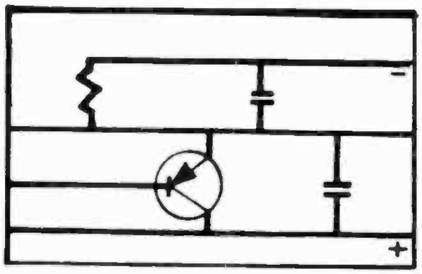


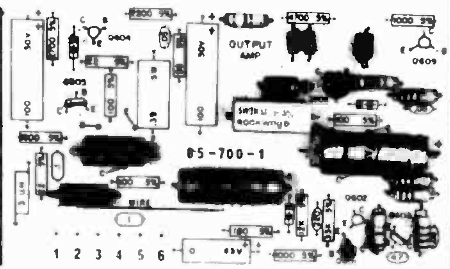
This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to further your career in electronics or as a self-employed electronics engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write, at any time, for advice or help during your work. A Certificate is given at the end of every course.







1 Build an oscilloscope.

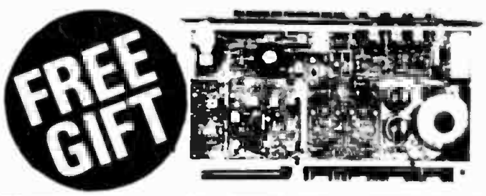
As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property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

2 Read, draw and understand circuit diagrams.

In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computors and countless other electronic devices and their servicing procedures.

3 Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v etc.



All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.

Free!

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.

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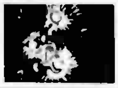
SOUND TO LIGHT UNIT



Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £7·95 plus 95p VAT & Postage.

MAINS OPERATED SOLENOIDS

Model TT2—small but powerful 1in. pull—approx. size 1½ × 1½ × 1⅛in. £1·00.
Model 4001/—⅛in. pull. Size 2¼ × 2 × 14in. £1·50.
Model TT10—1½in. pull. Size 3 × 2½ × 2in. £4·50.
Prices include VAT & postage.

PP3/PP9 REPLACEMENT MAINS UNIT

Japanese made in plastic container with leads size 2" × 1½" × 1½ , this is ideal to power a calculator or radio, it has a full wave rectified and smoothed output of 9 volts suitable for a loading of up to 100mA. £2·53.

3 NEW BOOKS BY G. C. DODDS

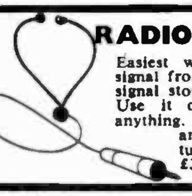
Practical Test Equipment describes the theory, the construction, and the operation of 7 instruments for beginners to make from readily obtainable components: Transistor Tester—Transistor checker—Square wave oscillator—AC Bridge—Signal injector and signal tracer combined in a Multi Checker—Dual range ohm metre, the final chapter deals with a range of test leads and give more detailed notes on signal injecting and signal tracing.
Published price 75p our price 50p.

Practical Electronic Projects describes the construction and uses of 9 projects for beginners, all made from easily obtainable parts describes construction and operation of:—Windscreen wiper delay—Electronic Siren—Drum beat simulator—Lamp dimmer—Light/Dark operated switch—electronic bird, emotional state indicator—telephone amplifier—Solar powered radio.
Published price 75p our price 50p.

Shortwave Receivers for Beginners after a few pages of general notes on wave bands, band spreading etc, the author gives constructional details of a one transistor radio then a two transistor and finally a multi stage receiver with band spreading and reaction.
Published price 60p our price 45p.

FREE If you purchase the other two you get the shortwave one free.

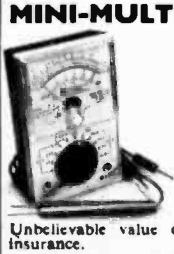
RADIO STETHOSCOPE



Easiest way to fault find, traces, signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Kit comprises transistors and parts including probe tube and twin stetho-set. £3·95 VAT and postage inc.

Breakdown Parcel—four unused, made for computor units containing most useful components, and these components unlike those from most computor panel, have wire ends of usable length. The transistors for instance have leads over 1" long—the diodes have approx. ½" leads.
List of the major components is as follows:—17 assorted transistors—38 assorted diodes—60 assorted resistors and condensers—4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which were made to receive these units). The price of this four units parcel is £1 including VAT and post (considerably less than value of the transistor or diodes alone) DON'T MISS THIS SPLENDID OFFER.

MINI-MULTI TESTER



Amazing, deluxe pocket size precision moving coil instrument—jewelled bearings—1000 opv—mirrored scale.
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DC volts 10, 50, 250, 1000
AC volts 10, 50, 250, 1000
DC amps 0-1 mA and 0-100 mA
Continuity and resistance 0-150K ohms.
Complete with insulated probes, leads, battery, circuit diagram and instructions.
Unbelievable value only £5·50p + 50p post and insurance.

FREE

Amps ranges kit enable you to read AC and DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one send £1·50p.

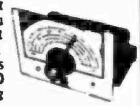
MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £14·00 including VAT and postage.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2·75, VAT & postage 85p.

SHORTWAVE CRYSTAL SET

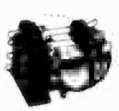


Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £1·90—crystal earphone 55p including VAT and postage.

ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0–30°C. Special snip this month £2·50, post and VAT paid.

MAINS RELAYS



With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one screw fixing, ex unused equipment 60p each, 10 for £5 post and VAT paid.

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HORTSMAN £6·30.
SMITHS Controller 10/100 complete in wall mounting case £7·50.

THIS MONTH'S SNIP

HI FI RECORD PLAYER

Stereo 5 watts per channel. Russian made but guaranteed repairable. Travel damaged or test line rejects, in need of attention, consist of mains operated record deck-mounted in wooden plinth with super 10 watt amplifier. Controls are "on/off", "Tape/phone", "mono/stereo", "Base", "Treble", "Balance", "Volume". We are offering these at price of record deck only so are a bargain not to be missed only £6·75p, post £2·00p. Note cartridge and all spares are available at low prices.

TANGENTIAL HEATER UNIT

A most efficient and quiet running blower-heater by Solatron—same type as is fitted to many famous name heaters—Comprises mains induction motor—long turbo fan—split 2 kw heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct onto base of say kitchen unit—price £4·95 post £1·50 control switch to give 2kw, 1kw, cold blow or off available 60p extra.

TERMS: Cash with order—but orders under £6 must add 50p to offset packing etc.
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IT'S FREE

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

Spares: for Party Times. Circuit diagrams—50p, Cartridges £2·25, Record mats 85p, Mains transformers £3·00, Amplifiers £2·50, Gram motors £3·00.
Ask about any other spares you require—and when you have it working o.k. we can supply the proper Party Time speakers, £9·50 a pair. All prices include post and VAT.

250 watt Mains Transformers—40v secondary, made up of four 10v sections, all the ends of which are brought out to the tag panel, so they can be separated if required—also the 10v coils are all a very heavy gauge wire, thick enough to take 25 amps, so any one of these coils can be loaded up to the full 250 watts, or this wattage can be spread over two or more coils. We can recommend this transformer for heavy duty battery charging—high power amplifier—plastic sealing—soil heating—light welding and dozens of other jobs. Price, still only £4·50 + 36p. Post £1·50 + 12p.

Save Yourself A Fortune. Build your own rechargeable batteries; using our ex-Home Office nickel cadmium cells—these cells are German made, ref. NCB 22M, which we understand are ½ amp hour rating. Normally, these cells retail at about £1·00 each, but a special purchase enables us to offer them at only 30p each, or four for £1·08. Post 30p + 3p.

Free Gift: All those who purchase 12 cells, will receive, free of charge, a mains operator ni-cad charger unit. DON'T miss this offer.

Self Repairing Fuses—not exactly; but our magnetic circuit breakers do the same job and are a boon for the test bench, saving valuable time. In the event of a short, they trip almost instantly, before the fuse can blow. They are rated at 1·5 amps (enough for the average repair bench). Simply wire it in parallel with your bench switch—you would then use the circuit breaker to switch bench supply on, but keep your normal switch for loads over 1·5 amps—a real bargain at 1·00 + 8p.

9v-0-9v Mains Transformer. "C" core construction, ½ amp continuous rating. Very compact, but there is still room to add a few extra turns for an extra winding, or to change the voltage to, say, 20v. In fact, the transformer uses a separate bobbin for the secondary—its not varnished so if you want a special voltage transformer quickly, then this could be the answer. Price £1·50 + 12p. Post 20p + 2p.

6·5v-0-6·5v Mains Transformer. Continental make, but has standard 230/40v 50hz primary and is upright mounting, and is rated at 0·75A. Price £1·75 + 14p. Post 20p + 2p.

Multicore Flex Cables: 14 coloured coded cores, rated at 3 amp, with circular p.v.c. outer—suitable for module inter-connections etc. 10 meter coil £1·00 + 8p.

Sub-Miniature Variable Resistor. 500 ohms, p.c.b. mounting, have had dozens of applications. 10 for £1·00 + 8p.

Vacuum Relay. American made (EIMEC), ref. no. V.S.2 This has a change over action and looks suitable for aerial switching and similar applications. Price £2·50 + 20p. Post 60p + 5p. Operation is by coil over one arm—we do not include the coil, nor do we have any in stock, but they are promised: watch future News letters for details.

Rotary Switch. Heavy duty—made for switching d.c., these will make and break really high a.c. currents. We guess these at 30 or more amp—we have type (A) cover engraved on/off. Price £1·00. (B) cover engraved "on", "high", "off", "low". Six wires can be brought to the switch and would be joined as follows: 1 to 5 and 6 to 2 and in the other position, 1 to 3 and 2 to 4. Prices: (A) £1·00 + 8p. (B) £1·50 + 12p.

Motor with Fan Blades, mains operated, nicely made motor with long bearing for quiet operation and good quality set of fan blades, made by Smiths (air moving division). It is a simple matter to make a stand out of 14 gauge (clothes line) wire, you then have a simple but efficient desk fan. Or if you fit this behind a heating element, in a box, you have a fan heater. Price of motor and fan, £2·50 + 32p. Post 50p + 6p.

Mains Driven Blowers: all have square or oblong outlets for easy fitting to cabinet or trunking. We have a small one, outlet size approximately 2" square, made by Woods. This is a centrifugal type of blower. Price £4·00 + 50p. Post 20p + 3p. We also have a larger unit, made by Smiths, outlet size 3" × 3½". Actually it is a simple matter to stand this on a shelf or counter, put a few paper streamers to the outlet and you start feeling cooler at once. The motor and blades are out of harms way inside the casing. Price £5·75 + 46p. Post 80p + 6p.

This Month's Special Lighting Snips—camping or emergency lights, all made up ready to join to your 12v car battery. Two models,—21" 13w. Price £3·00 + 24p. Post 60p + 5p, and 12", 8w. Price £2·75 + 22p. Post 50p + 4p.

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As used in disco's and stage effects etc.—virtually no white light appear until rays impinge on white collars and cuffs etc—we offer mains B.L. lamps, 175 watts plugs into any lamp holder requires no choke or control gear price £7·00 + 95p post and VAT or for glamorising rock specimens, looking for watermarks etc. a 9" 6 watt tube with starter, choke lamp holds, etc. all for £4·50 post and VAT paid.

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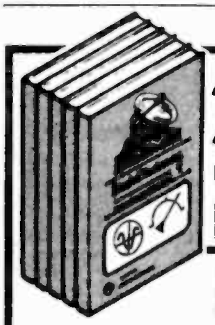

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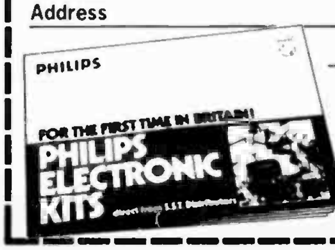

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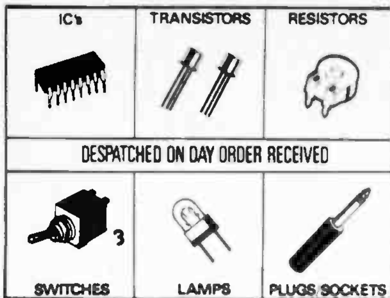

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This connecting block connects any electrical equipment to the mains supply in seconds. Ideal for bench, garage, demonstrations, etc. Max. load 13A fused.

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Also available MAINS TRANSFORMER with 18v 500mA SEC. Price and size same as above.

TI MULTI-METER
Ideal tester for everybody interested in electronics. Weighing less than 100gm. and only 60 × 24 × 90mm.
RANGES: A.C. volts: 0-10v, 50v, 250v, 1,000v. D.C. volts: 0-10v, 50v, 250v, 1,000v. D.C. current: 0-1mA, 0-100mA. Resistance: 0-150Kohm.
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7403	0·15	7412	0·23	7446	0·90	7485	1·20	7496	0·80	74154	1·30
7404	0·15	7413	0·27	7447	0·78	7486	0·30	74100	1·00	74180	1·10
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Projects... Theory...
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We endeavour to present all our projects in such a way so that anyone with but a rudimentary knowledge of electronics will be able to build them successfully. The one special skill needed is in soldering. With today's small components a correspondingly small soldering iron is essential and therefore the whole operation demands a fair degree of finesse. Once equipped with the right kind of instrument and a few small tools, practice will make perfect.

How to solder was explained in the opening part of *Teach-In 78*, last month, and newcomers should certainly study the relevant sections of that article before tackling their first constructional project. As regards the soldering iron, we are happy to give details of a Special Offer to EVERYDAY ELECTRONICS readers—see page 124.

Ultrasonics provide a way of communicating over short distances without interconnecting leads. This technique also keeps us free of licensing regulations. Using sound pressure waves, we find that the air is literally free!

Commercial examples of this use of ultrasonics are commonplace in the form of remote control units for television sets. Other applications will no doubt occur to our readers. We only offer a few suggestions in this month's article *Ultrasonic Remote Control System*, because this is obviously an opportunity for individual ideas to be generated.

All details of the construction of the two units involved in this system will be covered in two articles. The first article describes the transmitter; next month the receiver unit will be covered. So while building the first unit, start considering exactly how you will use this system. You will then be prepared with ideas for any ancillary circuitry and electro-mechanical devices that may need devising to meet the particular need.

(An open-ended project such as the *Ultrasonic Remote Control System* is especially valuable since it encourages further involvement by the constructor other than just following a published design.)

The more immediately obvious applications will be those where electrically operated equipment is simply switched on or off remotely. No great problems here, and the specified receiver relay will cope with a load of up to 1,200 watts. But there are bound to be possible applications where the electrical signal is required to be translated into some form of mechanical action—with the aid of intermediary electric motors or such like. Electronic constructors with a mechanical bent will find something to get their teeth into in solving the electro-to-mechanical interface in such cases.

Fred Bennett.

Our December issue will be published on Friday, November 18. See page 123 for details.

Readers' Enquiries
We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.
Telephone enquiries should be limited to those requiring only a brief reply. We cannot undertake to engage in discussions on the telephone, technical or otherwise.

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

Everyday ELECTRONICS

VOL. 7 NO. 3 NOVEMBER 1977

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Back Number Service and Binders

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ULTRASONIC REMOTE CONTROL SYSTEM

By R. A. Penfold

THE TRANSMITTER

The complete system can be used to remotely switch on and off electrical appliances rated at up to 1200 watts at mains voltage.

INTRODUCTION

This ultrasonic system provides a simple and inexpensive remote control link for which no Home Office licence is required. The maximum operating range of the system is not very large, being something in the region of 10 metres. However, this is sufficient to enable the unit to be employed in a number of useful applications, and this aspect will be fully dealt with later on.

GENERAL ARRANGEMENT

The block diagram which appears in Fig. 1 shows the general arrangement used in the complete system.

A 40kHz oscillator forms the basis of the transmitter, and the output of this circuit is fed to an ultrasonic transducer. The transducers are sold in pairs, one being used in the transmitter and the other in the receiver. These transducers are piezoelectric devices, and can be regarded as being something like a mixture of a crystal earpiece, a crystal microphone, and a quartz crystal.

Like a crystal earpiece, the transducer at the transmitter will produce soundwaves if a suitable electrical stimulus is applied to it, but it does not work very efficiently at ordinary audio frequencies. It does operate efficiently at frequencies just outside the upper limit of human hearing, or ultrasonic frequencies as they are usually termed.

The efficiency of the transducer reaches a peak at a frequency of 40kHz, and it is for this reason that the oscillator in the transmitter is given an operating frequency of 40kHz. This frequency is, in effect, the resonant frequency of the transducer, and is a similar property to that possessed by the piezoelectric quartz crystals which are used in highly stable r.f. oscillators.

A push button switch is connected in the supply line to the oscillator, and the transmitter is activated by operating this switch.

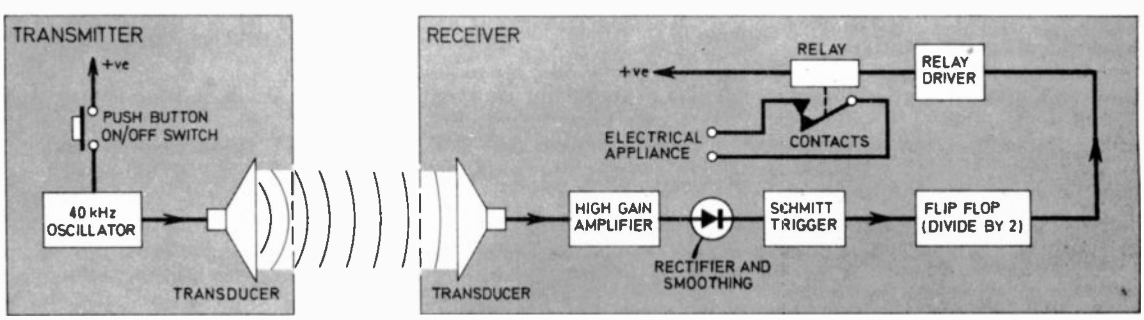


Fig. 1. The block diagram of the complete Ultrasonic Remote Control System.

RECEIVER TRANSDUCER

The second transducer is used at the input of the receiver, and this one acts as a sort of crystal microphone, but again, it is very inefficient at audio frequencies. Also as before, it works well at ultrasonic frequencies, and has a response which peaks at 40kHz. Thus a small 40kHz electrical signal will be produced by the transducer at the receiver when it picks up the ultrasonic sound from the transmitter.

This signal will have only a very low amplitude when the transmitter is at some distance from the receiver, and a considerable amount of amplification must be used if a reasonable operating range is to be attained. The necessary amplification is provided by a simple and very economic two-transistor circuit in this case.

The output of the amplifier is rectified and smoothed to a d.c. bias which is fed to the input of a Schmitt trigger circuit. The voltage at the input of the Schmitt trigger rises and falls only relatively slowly as the transmitter is switched on and off. The stage which follows the Schmitt trigger is a flip-flop divide-by-two circuit, and this must have an input signal with a fast rising waveform if it is to operate reliably. The purpose of the Schmitt trigger is merely to produce a fast rising output from the slow rising input. Provided an adequate input signal is obtained, this arrangement is highly reliable.

Operation of the flip-flop circuit is quite straightforward. This is a logic circuit and as such it can only have an output which is in one of two possible stable states. The output must either be low (logic 0 or at virtually zero volts) or high (logic 1 or at virtually the full supply potential).

The state of the output will change state each time a positive input pulse is received. Thus if the output goes to the low state when power is initially applied to the circuit, it can be triggered to the high state by pressing the push button on the transmitter. When the push button is released there will be no effect on the flip-flop, since this causes a negative input pulse to be generated and the flip-flop will only respond to positive pulses.

If the push button is then pressed again, another positive going input pulse will be applied to the flip-flop and in consequence its output will now go low. There will be no effect on the flip-flop when the push button is released, just as before.

The output of the flip-flop is fed to a relay via a single transistor driver stage. The circuit is arranged so that the relay contacts are closed when the output of the flip-flop is high, and open when its output is low.

Thus if the relay contacts are closed, they can be made to open by briefly operating the push button on the transmitter. They can be closed again by operating the push button a second time, and in fact the relay contacts will change state with successive operations of the push button on the transmitter.

CIRCUIT DESCRIPTION

TRANSMITTER CIRCUIT

The transmitter is an extremely simple device, as will be apparent from its circuit diagram which is shown in Fig.2. It is based on an astable multivibrator which uses a simple CMOS quad 2-input NOR gate (4001) or a quad 2-input NAND gate (4011). Only three of the four gates are used, and they are not in fact used as logic circuits, but instead they have their two inputs connected in parallel so that they act as simple inverters. This is why either a 4001 or a 4011 i.c. can be used.

Components VR1, R1, R2, C1, plus the two inverters in the left hand section of the i.c. form the multivibrator circuit, and R1 enables the frequency of oscillation to be adjusted to 40kHz. The third inverter is used as a buffer stage between the output of the astable (IC1 pin 3) and the transducer. This is necessary in order to prevent the transducer from upsetting the correct operation of the astable.

Switch S1 is a push button on/off type, and the unit has a current consumption of about 3·5mA when this switch is operated. The peak to peak output voltage swing to the transducer is virtually equal to the supply potential, and despite the simplicity of the transmitter circuit it provides quite a good operating range.

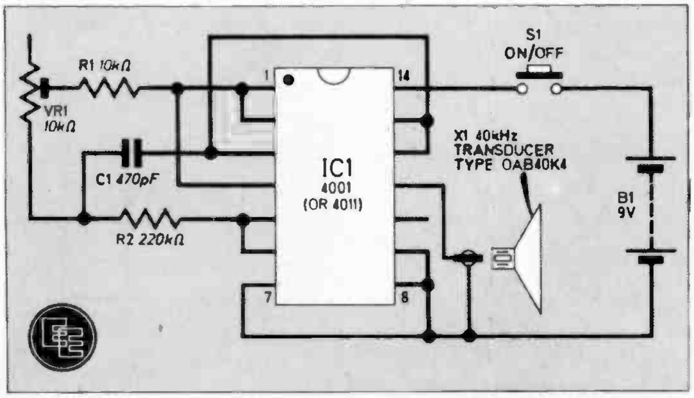


Fig. 2. The circuit diagram of the transmitter section of the Ultrasonic Remote Control System.

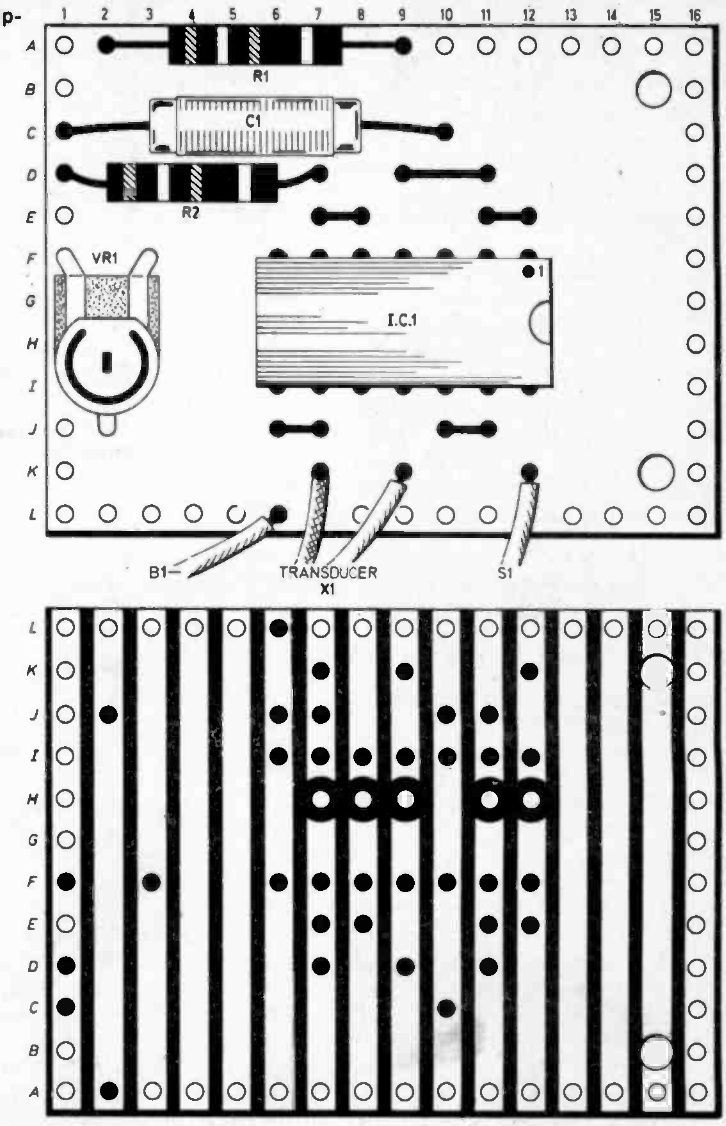
START HERE FOR CONSTRUCTION

A plastic box having dimensions of about 120×65×40mm is used as the housing for the prototype transmitter, but any metal or plastic box of around this size should be suitable. The layout of the unit is very straightforward, as can be seen in Fig.3 and the photographs of the unit.

The transducer is fitted with a phono socket at the rear, and a 12·7mm diameter hole is drilled in the case to accommodate this. The transducer is then glued to the

ULTRASONIC REMOTE CONTROL SYSTEM

Fig. 3 (Right). The layout of the components on the stripboard and the breaks to be made on the underside.



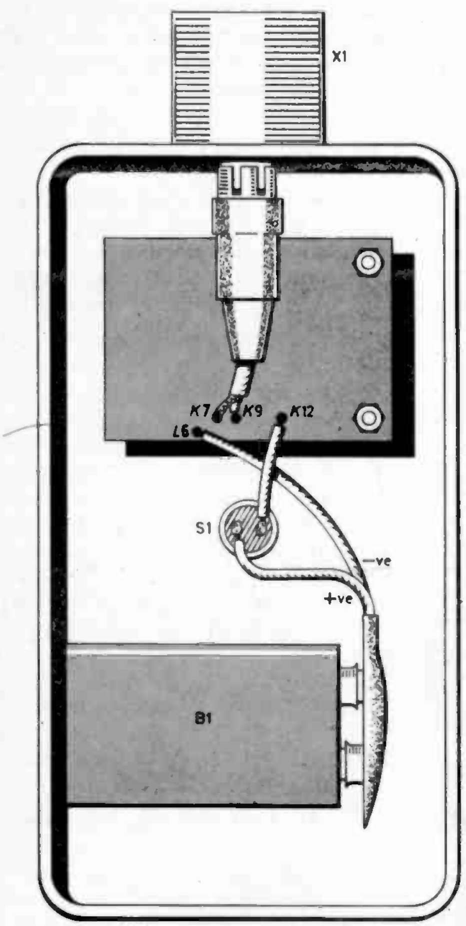
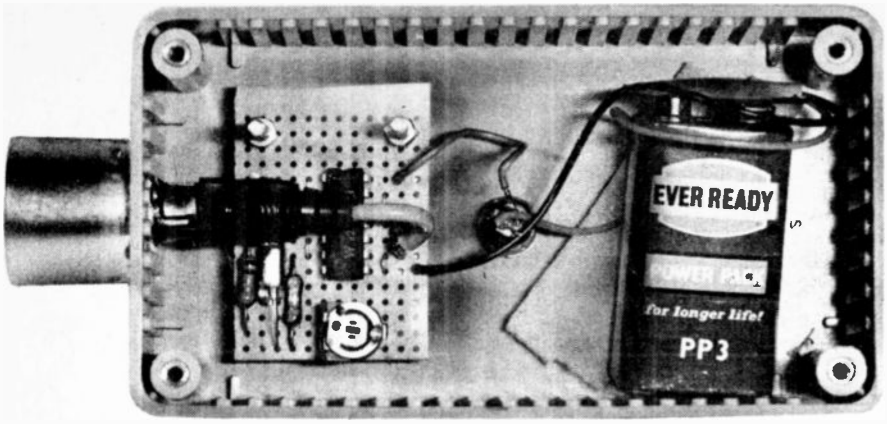
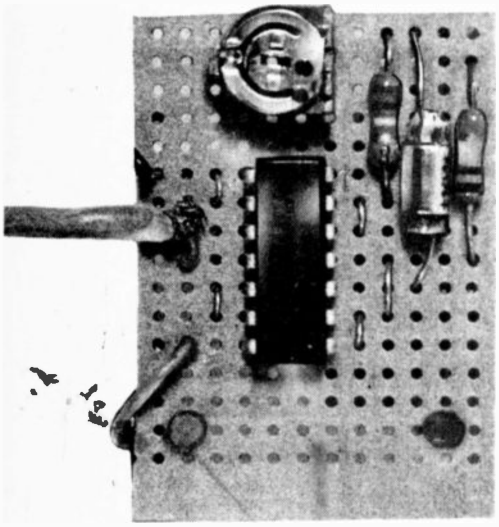


Fig. 4. (Above). The positioning of the component board and other components within the case.

Photograph of the prototype transmitter unit.





Photographs showing the transmitter with lid removed and (left) the prototype component panel.

surface of the case using a good quality adhesive such as Bostik No. 1.

Most of the components are mounted on a 0·1inch pitch stripboard which has 16 copper strips by 12 holes. Details of this panel are shown in Fig.3.

Start by cutting out a panel of the correct size using a small hacksaw, and then drill out the two 6BA clearance mounting holes (3·2mm twist drill). Then the five breaks in the copper strips are made using either the special tool or a small drill bit held in the hand.

Next the panel is wired up to S1, the battery clip, and the transducer before it is bolted to the case. The connection to the transducer is made via a short twin cable which is terminated in a phono plug. This lead does not have to be screened.

If the PP3 battery is found to be a loose fit inside the case, some pieces of foam rubber or a similar material can be used to make it a firm fit.

ADJUSTMENT

In order to obtain maximum range from the system it is necessary to adjust VR1 to produce a frequency of oscillation which coincides with the resonant frequency of the transducers. If an a.c. millivoltmeter is available, this can have its input fed from the so far unused receiver transducer. The transmitter is then switched on and aimed at the transducer, and VR1 is adjusted for maximum reading on the millivoltmeter.

If no suitable test gear is available, the adjustment of VR1 will have to be left until the receiver has been constructed; VR1 can then be tried at various settings in an attempt to find the one which gives the greatest range. This method is not quite as fast or accurate as the other two, but it will give excellent results provided due care is exercised.

COMPONENTS

Resistors
R1 10kΩ
R2 220kΩ
Both ¼W carbon ±5%

Capacitor
C1 470pF polystyrene

Integrated Circuit
IC1 CD4001AE or CD4011 CMOS quad 2-input NOR and NAND gates respectively

Miscellaneous
X1 OAB40K 40kHz transmitter ultrasonic transducer (see *Shop Talk*)
B1 9V type PP3
S1 push-to-make, release-to-break type switch
PL1 phono plug
Stripboard: 0.1 inch matrix 16 strips x 12 holes; plastic case approximately 120 x 65 x 40mm; PP3 battery clip; 6BA nuts, bolts and washers (2 off each); wire; solder

See Shop Talk Page 108

APPLICATIONS

Perhaps the most obvious use for this equipment is in an intruder alarm. In this application the two transducers would be mounted either side of a door or corridor. Ultrasonic sound is very directional and is easily blocked by an obstruction such as a human being. Normally the transmitter would be on and would be directing a beam of sound at the receiver, which would have open relay contacts connected in series with an alarm.

If an intruder should pass down the corridor or through the door, the signal to the receiver would be cut off as they passed through the sound beam, and then restored again once they had passed. As the beam was restored the relay contacts would close and activate the alarm.

The system could probably be adapted for use in car burglar alarm circuits. Here it could be used to switch the alarm on and off from outside the car without the need for any external switches or key switches.

Other applications include the remote control of garage doors, radios, televisions, lights, etc., and there must be many other possible uses for this system.

With the relay specified in the *Receiver* components list (next month), mains voltages up to 5 amps can be switched i.e. electrical appliances rated up to 1200 watts. If it is required to operate equipment of larger capacity, a suitable relay will need to be found and probably a larger case than specified used to house all the circuitry in the receiver.

For d.c. appliances, the specified relay contacts can handle 150 watts (eg 5 amps at 30V, 3 amps at 50V etc.).

To be continued

By Brian Terrell

New products and component buying for constructional projects.

AN ENORMOUS number of enquiries resulted from the *Treasure Locator* article published in last month's issue due mainly to a number of technical errors that appeared in the article and the difficulty encountered by many in obtaining some of the components required to complete the project. We offer our apologies for these errors and detail below the modifications to be made to the article:

1. In Fig.2, the integrated circuit IC1 is incorrectly labelled, it should read MC3360P (as was listed on this page last month).
2. In the component list under the heading of capacitors, there are two C15's. The first of these, 10nF plastic or ceramic should be deleted.
3. Add to the list of capacitors, C17 0·022μF plastic or ceramic.
4. IC1 in the component list should be ammended to read MC3360P.
5. In Fig.3, the capacitor labelled C17 should be labelled C16.

Treasure Locator Component Suppliers

Components that proved difficult to obtain were C3, C4 20nF silver mica capacitors 1 or 2 per cent or polyester with 1 per cent tolerance; C2 1250pF compression trimmer; C16 50pF air spaced trimmer.

Dealing with these in order our investigations proved that 20nF siver mica capacitors are not available on the amateur market the highest value to be obtained being 10nF. Two of this value can be wired in parallel to provide the required 20nF but this will prove to be very expensive.

Closer inspection of the protoype unit revealed that polyester types were used. Tolerance was not marked. The only markings on these capacitors was Yamoto Nissei .02 on a green body. We have been unable to trace a supplier of these. However, Mylar film capacitors of the required value are available with a tolerance of 5 per cent and this will be suitable for this project. They can be obtained from Watford Electronics, 33/35 Cardiff Road, Watford, Herts. The cost is 6½p each including VAT. There is a postage and packing charge of 25p on all orders under £10. You can also obtain the 1250pF compression trimmer and 50pF air spaced trimmer from this firm for a cost of 41p and £1·52 respectively.

Another supplier of the 1250pF compression trimmer is Home Radio, 240 London Road, Mitcham, Surrey. The cost is 60p including VAT but the postage and packing charge is rather on the high side —85p. This makes the single item very costly but is less noticeable if buying more components. Home Radio have been receiving orders for many parts of the *Treasure Locator* and are in a position to offer a complete set of electronic components for this project at an inclusive price of £14.

Also Arrow Electronics have been supplying parts for this project and are able to offer a complete set of electronic components at an inclusive price of £9·99. They also tell us that they can supply a pair of moulded plastic discs that can be fitted on either side of the coil to offer protection and produce a professional looking job. The inclusive price is £1·40p per pair.

V.H.F. Portable Radio

The *V.H.F. Portable Radio* has the highest component count amongst this month's constructional projects but most components should be readily available. Trimmer capacitors are items that often cause supply problems and this project uses two. If you experience any difficulty in obtaining these two devices, you can obtain them from Watford Electronics at a cost of £1·51 for the 10pF type 804 trimmer and 23p for the 30pF beehive trimmer. Both prices include VAT. Add 25p to cover post and packing.

The component list specifies a potentiometer/switch combination (VR2/S1) fitted with a single-pole switch. There is no reason why the more readily available d.p.d.t. type cannot be used and one half of the switch ignored.

The two field effect transistors TR1 and TR2 may have unfamiliar type numbers but are generally available as was borne out by the first three lists of semiconductors that we looked at, these being Maplin Electronic Supplies, Watford Electronics and Marshalls.

If trouble is encountered in locating a telescopic aerial, Maplin and Home Radio list these in their catalogues. The latter also hold stocks of Universal chassis.

Probe-less Continuity Tester

Not many components are required to construct the *Probe-less Continuity Tester* and none should be difficult to obtain. The battery used in the prototype PX-28 is a silver oxide type and should be available from camera shops and stores such as Boots. We contacted Dixons Photographic to find that this can be obtained from them for a cost of £1·68.

As you will notice this is a large proportion of the total cost of the project; fortunately it is not essential—it was chosen for its longer life than standard cells and its small physical size. Any other 6 volt battery can be used but a larger case will undoubtedly be called for.

Ultrasonic Remote Control System

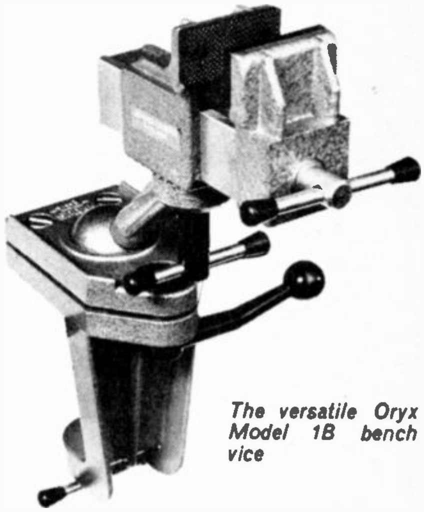
Only the components for the transmitter part of the *Ultrasonic Remote Control System* are listed in the component list this month but has been costed to include the receiver transducer as these are only sold in pairs.

As far as we know, the type specified is only available from Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex. The price for a pair of transducers is £5·29 which includes VAT, postage and packing. Order as RL400PP.

Arrow Electronics plan to offer a set of electronic components for the complete system—transmitter and receiver. More details of this will be available next month.

Find The Pair

No component buying problems are envisaged for the *Find The Pair* project as all are considered to be "standard" and will be available from many sources.



The versatile Oryx Model 1B bench vice

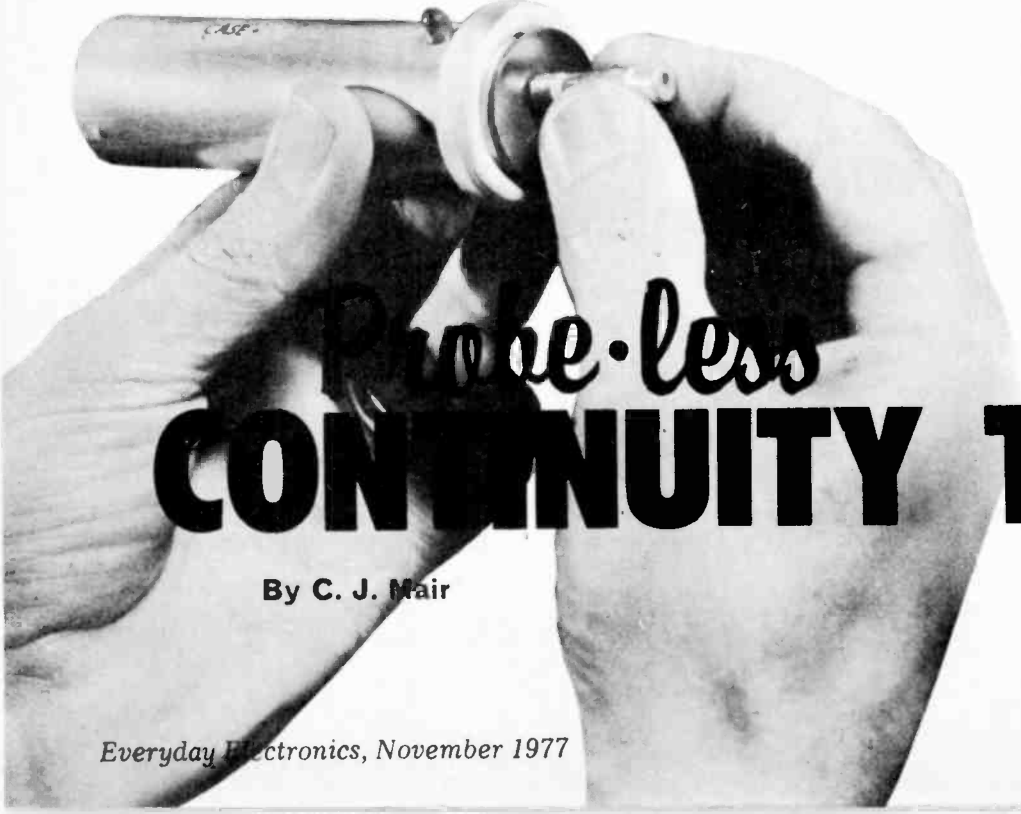
Adjustable Vice

A precision made bench vice which should interest both the model making and electronic constructor enthusiast is now available from Greenwood Electronics, manufacturers of professional soldering irons and equipment.

The Oryx Model 1B vice is a versatile tool with 89mm jaws and is fully adjustable to rotate through 360 degrees and can be locked in any position. The vice is equipped with nylon jaw linings giving a firm grip with no damage to the work piece. Jaw linings are replaceable.

The main components of the vice are cast in high tensile strength lightweight alloy and finished in stove enamelled green.

Cost of the Oryx 1B bench vice is £19·95 plus VAT at 8 per cent and is available from Greenwood Electronics, Dept E.E., Portman Road, Reading, Berks, RG3 1NE.



Probe-less CONTINUITY TESTER

By C. J. Mair

INTRODUCTION

If you have ever wondered whether a fuse is blown, the polarity of a diode, the type of a transistor, if a capacitor is holding charge, or if a wire has a break in it, and you have gone to get your multimeter and then had to juggle with the two probes, the component, and tried to watch the meter at the same time, this instrument should appeal to you.

In the time it took you in the past to dial an ohms range, with this instrument your testing will be complete. You hold the instrument, which acts as one "probe", in one hand and your other hand becomes the other "probe". So if you can hold, or touch the component, you can test it. A light emitting diode is provided which gives a quick, yes or no, indication.

START HERE FOR CONSTRUCTION

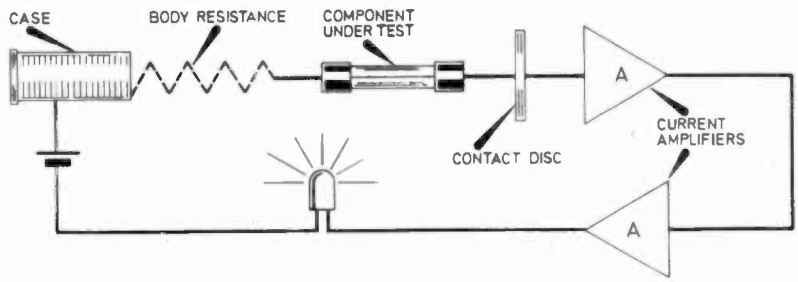
The case is made from an aluminium tube in which one gram vitamin C tablets are sold. Firstly the paint is removed using wire wool. The cardboard in the plastic top, which retains moisture absorbing chemicals, is removed and the top washed out. The plastic protrusion is then cut back to give more available space in the tube. A metal disc, preferably of copper or aluminium, and of approximately 25mm diameter is then attached to the plastic top using a 20mm 6BA bolt. Finally file a slot and drill the holes for the slide switch.

Most of the components including the battery are mounted on a small piece of 0·1 inch pitch stripboard 10 strips by 19 holes. It has to be cut oversize then filed down until the board makes a tight fit in the tube. Next break the copper strips at the points indicated in Fig. 2. The battery should be fitted first, leads are soldered on to the battery contacts, as the battery life should be long. The battery is held in place by two loops of wire. Next all the connecting wires should be soldered to the board, remembering to make them long enough for the top to be removed and the board withdrawn while the switch is fixed in position.

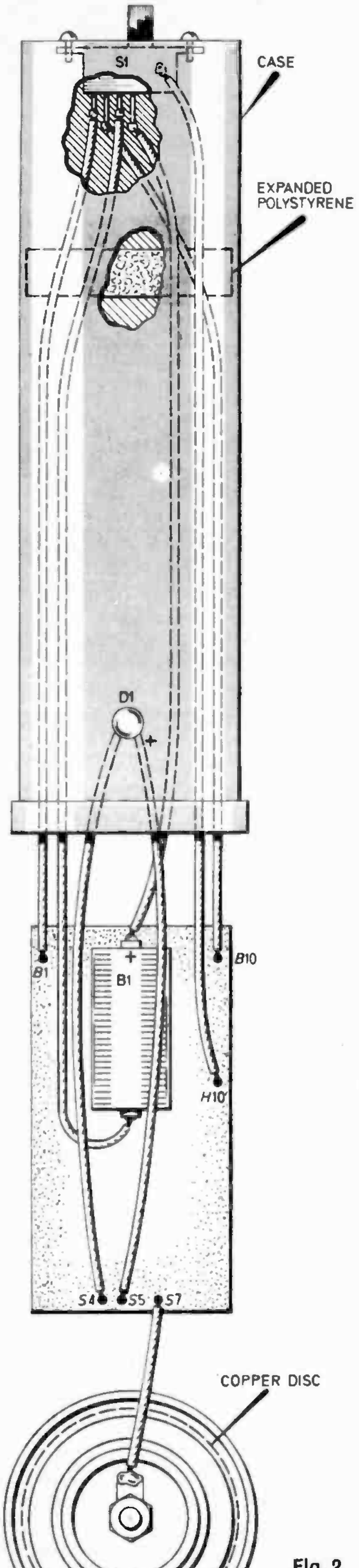
If the connecting wires used are small enough pass them through the holes on the stripboard, so they appear from the copper side of the board. When the board is inserted in the tube, these wires will

HOW IT WORKS...

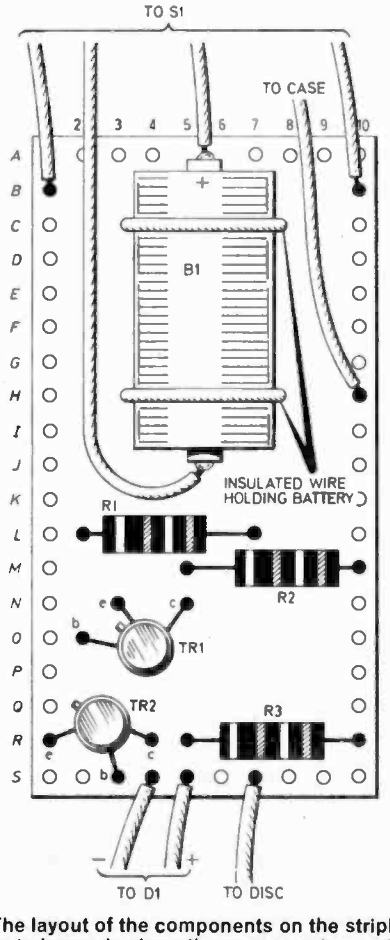
The component under test and the resistance due to one's body are placed in series when the component is held against the contact disc. This completes the circuit (if there is an electrical path through the component) and current flows into the amplifiers. This is only a minute current but is sufficient to cause a much larger current to flow through the light emitting diode, illuminating it to show continuity.

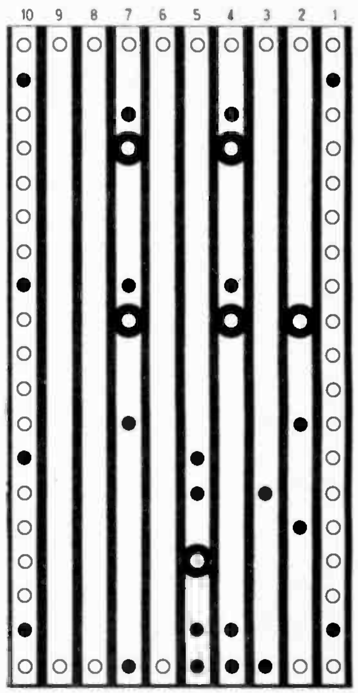


Probe-less CONTINUITY TESTER



Photograph of the prototype component board.





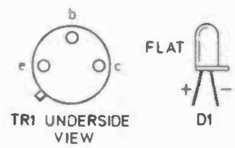


Fig. 2. The layout of the components on the stripboard and the breaks to be made along the copper strips on the underside. Above left shows wiring up to the disc and switch within the tubular case. Note the expanded polystyrene insulating washer below S1.

then curl underneath the board and not tangle up in the components. A loop of strong cotton should also be attached to the board to facilitate the removal of the board in the future. If a tag is used to connect the wire to the bolt holding the disc in place, the top can easily be replaced with a top which has a length of 6BA rod sharpened at one end to make a probe.

Solder the remaining components on the board using a heat-shunt on the leads of the transistors and l.e.d. which should now be connected to its appropriate wires. Then bolt the switch in position, ensuring it is off before doing so, place a piece of expanded polystyrene in the tube to ensure the switch and board are always separated. If the board has been made too small the polystyrene can be replaced with a circular piece

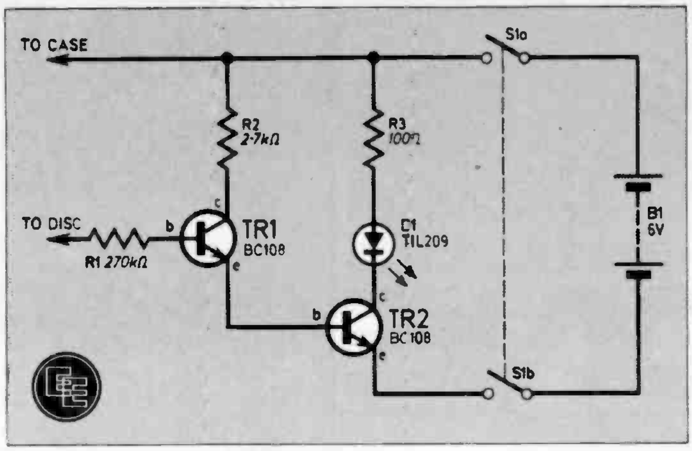
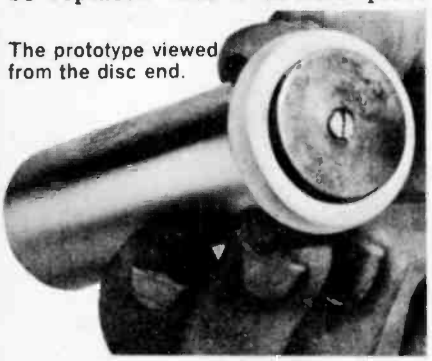


Fig. 1. The complete circuit diagram of the Probe-less Continuity Tester.



The prototype viewed from the disc end.

CIRCUIT DESCRIPTION

The circuit is basically a very high gain d.c. amplifier with a light emitting diode as its load. In order to achieve very high gain and a high input impedance two transistors are used in a Darlington pair configuration. The circuit diagram is shown in Fig. 1. This arrangement provides very high gain as the emitter current of TR1 becomes the base current of TR2, so the total gain is approximately equal to the product of the individual gains of TR1 and TR2.

When testing a component the case is held in one hand and the component touched against the metal disc with the other. In this way the base current for TR1 flows through you (it is limited to 17μA) and the component. Resistor R1 is included to ensure that the circuit cannot be damaged by accidental shorting of the case to the disc. This base current is amplified and illuminates the light emitting diode.

The input impedance of this type of transistor configuration is very high as the input impedance of TR2 becomes the emitter load for TR1. In this way the input impedance is large compared with the resistance of the person using the instrument. This combined with the circuit being designed to put TR2 into saturation easily, makes the brightness of the l.e.d. largely independent of the resistance of the person using the instrument. So when testing fuses, diode action, transistor junctions and continuity the action is very positive. On the other hand when testing capacitors, they can actually be seen to charge up as the time constant is very large due to the high input impedance.

Although the silver oxide battery used to drive the circuit is expensive, a significant current is only taken from it during the short time the l.e.d. is on, the battery should therefore last two or three years even with frequent use.

COMPONENTS

See Shop Talk 108

Resistors
- R1 270kΩ
- R2 2·7kΩ
- R3 100Ω

All resistors are carbon ¼W ± 10%

Semiconductors
- TR1 BC108 silicon *npn*
- TR2 BC108 silicon *npn*
- D1 TIL209 light emitting diode

Miscellaneous
- B1 6V silver oxide battery type PX-28
- S1 d.p.d.t. miniature slide switch

Stripboard 0·1 inch matrix, 10 strips × 19 holes; copper or aluminium disc 25mm diameter; case (see text); 6BA hardware; small length of 6BA rod; 6BA solder tag; connecting wire; plastic sleeving; solder.

of wood with a groove cut to support the board. Now place the board in the tube, ensuring that if the transistors have metal cases they are not touching the metal tube. It is also advisable to place plastic sleeving on the leads of the transistors, as a safeguard against short circuits. Once a hole is made for the l.e.d. it should be held in place with Araldite or similar glue. When this has set, the top can be put on and the instrument tested.

Switch on, hold the case in one hand and touch the metal disc with your other hand. The l.e.d. should light up. If it does not recheck the wiring, the battery polarity and that of the l.e.d. If all is well the tester is then ready for use.

LIMITATIONS

Due to the necessity of making the tester's action independent of the resistance of the person using it, only a very small current, in the order of 2 or 3μA, needs to flow to light the l.e.d. This means that components with leakage currents of this order cannot be tested; this usually applies to germanium devices and not the more common silicon ones. ◻

SQUARE ONE ...FOR BEGINNERS

WE ARE HERE TO HELP YOU – NO MATTER HOW NON-TECHNICAL YOU MAY BE, JUST READ ON!

IDENTIFYING COMPONENTS

Electronic components come in an enormous range of shapes, colours and sizes with their values and type numbers either printed on the body, colour coded or numerically coded. The newcomer to electronic construction may at first be bewildered when opening a package of components but in a short time should be able to instantly recognise components and readily "decipher" their values.

This month we shall deal with the most commonplace basic passive components namely resistors, and capacitors to aid identification together with circuit connection details.

RESISTORS

Resistors are generally cylindrical in shape with a connection lead emerging from each end and can be connected in circuit either way round. Some resistors are made specifically for p.c.b. construction and have short preformed leads pointing in the same direction, but these are rarely featured in these pages and are not readily available on the amateur market. You may see these in surplus stores on computer panels, etc.

The value of the resistor is either in the form of a colour code (see Data Card given free with last month's issue) or simply printed on the side. Printed values can be straight forward such as 6·8kΩ or 180Ω or may be coded e.g. 1k2 (1·2 Kilohms) 5R6 (5·6 ohms) M47 (0·47 megohms or 470 kilohms).

CAPACITORS

Capacitors can broadly be split into two categories, *non-electrolytic* and *electrolytic* types.

The former are colour coded or have their values printed on the body. They come in a multitude of shapes, sizes and colours depending to a large extent on their composition which can be: polyester, ceramic, silver mica, paper, metallised foil, polycarbonate, plastic foil, polystyrene, mixed dielectric mylar film carbonate, to mention the common types, see Fig. 1 for some examples.

Most non-electrolytic capacitors have their values printed directly on the body i.e. 680pF (picofarads), 0·22UF or MFD (microfarads).

You may find some capacitors marked μμF (especially high quality types) eg. 3940μμF. This is another way of writing 3940pF. Alternatively this can be read as 3·94nF (nanofarads). Sometimes a K is printed together with the number. eg. 22K; this is 22,000pF or could be read as 22nF.

It is not uncommon nowadays to receive Russian manufactured capacitors and in particular ceramic plate types where the value on the body may read 3H3 or 10H; these are 3·3nF and 10nF respectively.

Some capacitors such as the Mullard C280 series use colour coding to indicate the value in nanofarads. See the Data Card given in last month's issue for details.

Also marked on the body is the working voltage 250V, 63V etc. The value of the voltage across the capacitor should never exceed this value, but can usually be *any* value below it. Non-electrolytic capacitors are not polarity conscious, that is to say they can be connected in circuit either way round.

Electrolytic capacitors are easily recognised by their physical size (quite large) and by the fact that they are enclosed in a metal case (usually covered in a plastic sleeve. One lead is connected to the metal case, this being the –ve terminal while the +ve lead is marked on the case with a "+" sign. An annular indentation at one end also marks the +ve lead.

The value is always printed on the body together with the working voltage (colour coding is never used). Connections to the capacitor are either axial wires (one from each end) or radial wires or tags (both from same end).

Electrolytic capacitors are polarity conscious and must be connected in the circuit the right way round otherwise they can be destroyed. See Fig. 2, for a selection of electrolytic capacitors.

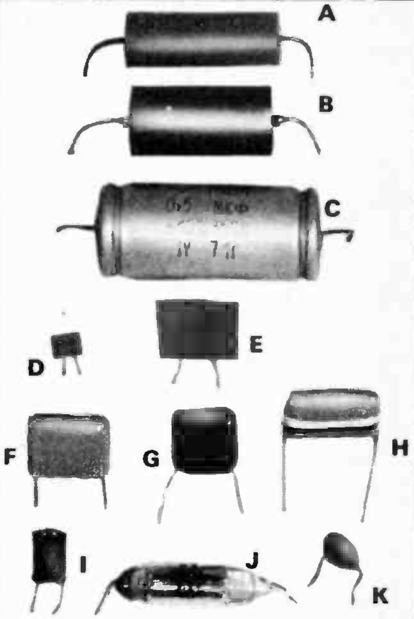


Fig. 1. A selection of non-electrolytic capacitors: **A** plastic (polypropylene); **B** polycarbonate; **C** metallised paper; **D** and **E** ceramic plate; **F**, **G**, **H** and **I** metallised polyester film; **J** polystyrene; **K** disc ceramic.

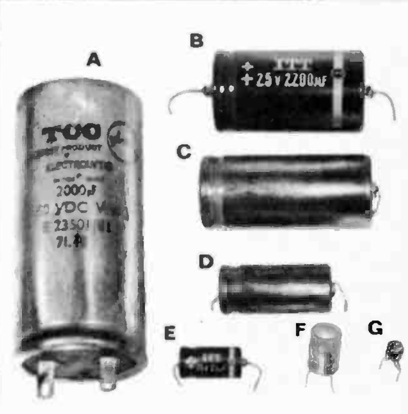
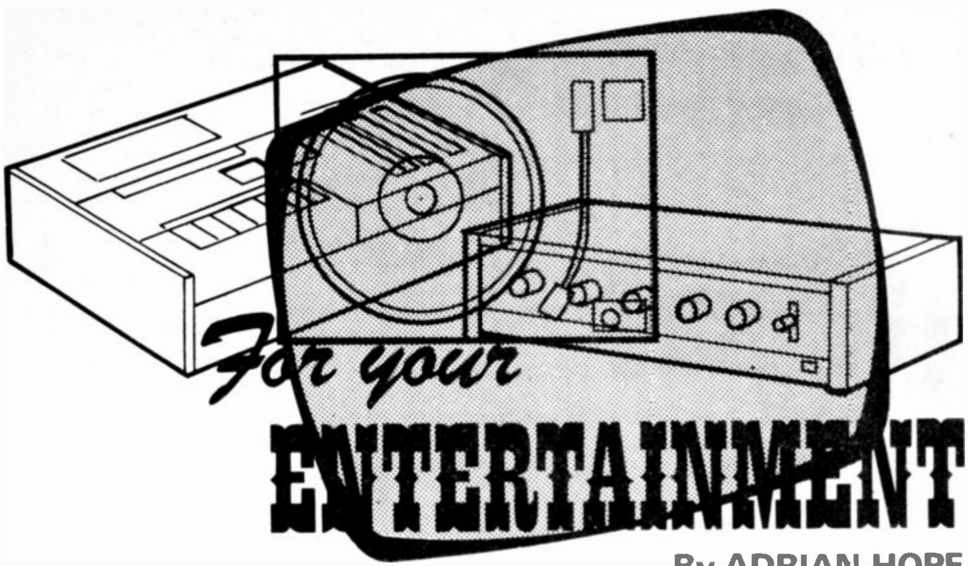


Fig. 2. Electrolytic capacitors: **A** 2000μF 50V; **B** 2200μF 25V; **C** 1000μF 40V; 100μF 40V; **E** 33μF 25V; 100μF 6V; 10μF 10V tantalum.



For your ENTERTAINMENT

By ADRIAN HOPE

A CURIOUS situation has arisen in the hi fi field over recent years. What was once a semi-cottage industry, with firms turning out only a few hundred amplifiers, tuners or loudspeakers a week to meet the demands of only a relatively few devoted enthusiasts, has now become a full-scale industry with mass production. Increasing sales of equipment have created increasing interest in hi fi as a hobby in its own right and this increased interest has stimulated the growth of a whole new industry—hi fi journalism. As even a casual glance round your local bookstall will show, there is now an extremely wide range of different journals. The disease has also spread to the Continent, with almost as many French magazines and some very impressive publications from Germany and Italy.

Although it is easy for a production line to churn out more amplifiers and tuners to meet increased demand, it is far less easy for journalists to do likewise with interesting copy. So there is a continual search in the hi fi world for new authors with something interesting and accurate to say. Inevitably some mistakes have been made, and less-than-accurate statements have found their way into print.

Reviewing

In some cases, without doubt, serious damage has been done to the reputation of essentially good products, and some essentially bad products have been quite unreasonably lauded. The whole business of "amateur" reviewing of sophisticated equipment has been causing such concern, not only to reputable manufacturers but also to professional journalists and reviewers, that it was made the subject of an Audio Engineering Society meeting.

Some interesting points were brought up, that readers should bear in mind when using published technical reviews as a guide to what equipment they buy.

Quality Control

One approach to reviewing is simply to check the specification of a piece of equipment as claimed by the manufacturer in his advertising literature. This is useful, provided the reader understands that small variations between claimed and actual specification (e.g. 99 watts output is measured instead of 100 watts claimed) is significant only in the strictly legal context of the Trade Descriptions Act. The important point to watch here is for reviewers' measurements that drastically differ from those claimed. Such differences may be as a result either of poor Quality Control on the part of the manufacturer (in which case the reviewer has taught the potential buyer something useful), or reliance by the manufacturer on outdated measuring equipment (certainly not unheard of and hardly an encouragement to buy his products).

The other main possibility is that the reviewer is an amateur working with poor or mis-used equipment. Peter Walker, of the British firm, Quad, cited the example of how the incorrect use of 3-terminal (i.e. common earth) testing equipment across the input and output of a 4-terminal amplifier (i.e. without common earth) can drastically and quite unfairly increase the distortion measurements of that amplifier.

Peter Walker also pointed to another pitfall for the inexperienced reviewer trying to compare the performance of different loudspeakers. It has recently been proved by the BBC Research Department that if two loudspeakers are compared side by side, and one of those loudspeakers has a bad dip in it's frequency response, the human ear will compensate for this dip (rather like the automatic gain control of a radio) and thus make the other loudspeaker, which has a good, flat response, sound horribly peaky!

Moratorium

Another approach to reviewing is to start with the question, "Is the product suitable for a given purpose?" But this brings personal opinion into the matter. Indeed, one AES member went so far as to propose a moratorium on all measurements. "Electronics is a technical subject, but hi fi is not," he said. "Measuring the performance characteristics of a piece of hi fi equipment is as pointless as counting the number of words used in the first act of Hamlet. In each case it is the sound that matters."

Currently there is a move afoot to form a club of accredited reviewers. But so far no one has agreed on what the basic minimum requirements should be for entry. One thing is certain, whatever the requirements, I shan't be a member. I have neither the ability nor the test gear to measure equipment, and thus never review on a technical level.

X-Rays

Columns like these can be a useful clearing house for information. A topic to be looked at in the future is the possible detrimental effect that X-rays, as used for heavy dose security checks at airports and docks, can have on electronic equipment such as transistors, i.c.s, and perhaps even liquid crystal displays. If any readers, so far unaware of this phenomenon, suddenly find two and two making five, for instance by recalling how a calculator or electronic watch went haywire after a security check at an airport, I'd be pleased to hear of them, c/o EVERYDAY ELECTRONICS.

In the meantime, just to be on the safe side it might be worth trying to have any such equipment you are carrying abroad handled like film—that is examined by hand, rather than X-rayed.

PLEASE TAKE NOTE

Probophone (*September '77*)

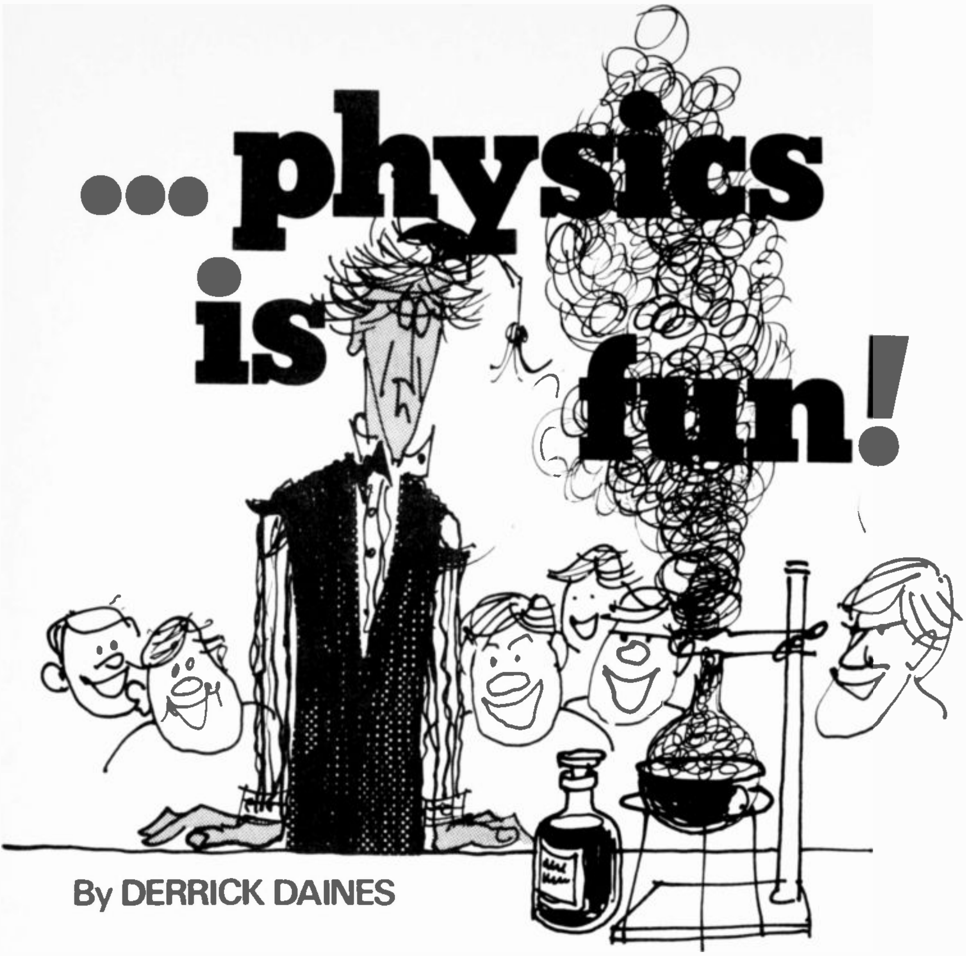
There is link missing between pins 2 and 6 of the i.c. in the circuit diagram of Fig. 7. This is shown correctly on the PCB and stripboard layouts. In the components list resistors R1 and R2 have been interchanged, the values are correct on the circuit diagram. In Fig. 2, the stripboard layout, the two wires to the left hand tag and wiper of VR1 should be transposed. The PCB layout is correct. On the circuit diagram of Fig. 7 the values for the presets are given as 20kΩ although in the components list they are 22kΩ. Although either value would work in the circuit, the 22kΩ presets are more readily available. On the PCB layout for the keyboard, the wire which is annoted TO PROBE should in fact go to the circuit board.

Enlarger Timer (*October 1977*)

In Fig. 3 on page 80, an additional break needs to be made on the underside of the stripboard at location *J22* add *D2* should be reversed.

Treasure Locator (*October 1977*). See *Shop Talk*

...physics is fun!



By DERRICK DAINES

ANY oscilloscope will show that an alternating current varies or alternates about zero volts. For example, the heating element (6·3 volts) of a transformer. Other less usual alternating currents may vary about a datum line that is measurably above or below zero volts, while yet others are square, triangular, spiky or any combination of these, Fig. 1. All are loosely termed alternating currents although strictly the term should be restricted to those in which the polarity changes every half-cycle—that is, those that alternate about zero volts.

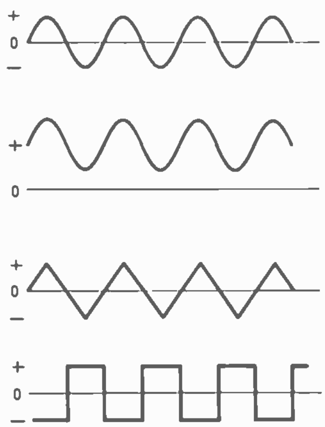


Fig. 1. Examples of different waveforms as seen on the screen of an oscilloscope.

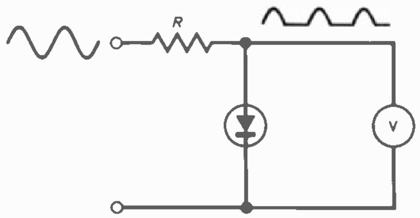


Fig. 2. Measuring a.c. voltages with this type of set-up, false readings are obtained.

A.C. measurement

If a multimeter is placed across an alternating current the needle will show no deflection if both halves of the cycle are equal because the needle does not have sufficient time to respond before the current changes. In currents derived ultimately from the house mains, for example, the 6·3 volt valve-heating tap of a transformer, the current changes at 50Hz (hertz, or cycles per second) in a smooth sinewave and this is far too fast for the needle to respond to. If one half of the cycle is cut out or earthed as in Fig. 2, the needle will indicate a figure above zero volts, but nowhere near the peak voltage of the wave.

Waveforms

Now sometimes we need to know the peak voltage; sometimes we need to know the peak-to-peak voltage, which is twice the peak; sometimes we need to know the power in the current. It all depends. With a sinewave it's all pretty easy; if we know one, we can work out the others, but with other waveforms it can get tricky.

For peak-to-peak measurements we really need a calibrated oscilloscope. If our scope is not calibrated, we can do it for ourselves with the aid of a signal generator. We set the output of the generator at (say) 4 volts peak-peak and then adjust the trace on the scope so that it traces exactly over 4 squares on the graticule, Fig. 3. Each square is thus equal to 1 volt. We make no further adjustments to the scope, but apply the unknown a.c. signal to it, thus by counting off the squares the peak-peak voltage can be measured.

This technique applies to any sort of a.c. signal, even with the datum above or below zero volts.

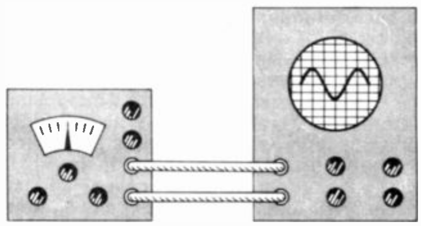


Fig. 3. Calibrating an oscilloscope with the aid of a signal generator.

Power

The power of an a.c. signal is a different matter. Power is the ability to do work and as our experiments on static electricity have shown us, we can have spikes of enormous voltage but little power. Model train enthusiasts will have come across the "pulse power" technique in which pulses of high voltage for a model train are applied continuously, but because they are "off" for as long as they are "on", the model loco creeps along the track and does not race. It is worth noting here that the power of a square wave alternating about zero volts is the same as the power in direct current of the same voltage since the polarity has nothing to do with the power available.

Mathematics has shown us that the power in a sinewave is based on the

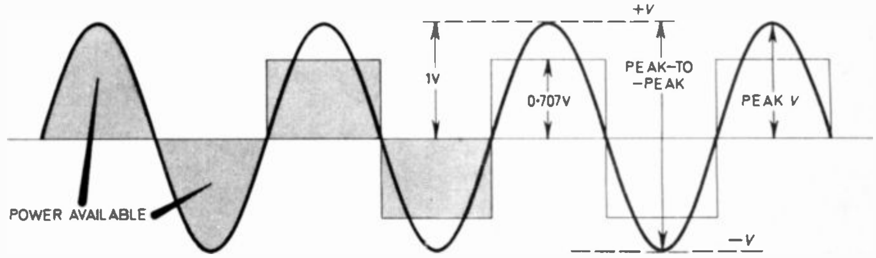


Fig. 4. The perfect sinewave. Note the different relationships. A square wave has also been drawn to compare with.

square root of 2, which is 1·414; Fig. 4 should make the relationships clear. The power available at any instant is based on the voltage, represented by the height of the curve above or below the line. If such a sinewave is traced onto graph paper and the squares counted, it will be found that the average (or mean) is 0·707 of the height of the peak above and 0·707 of the depth below. Twice 0·707 is 1·414. In other words, the effective voltage of a sinewave is 0·707 time the peak voltage. (Note the terminology; peak voltage is half the peak-to-peak voltage.)

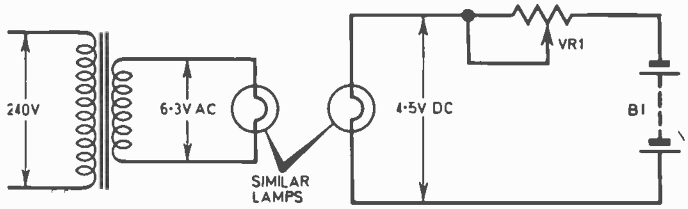


Fig. 5. Circuit arrangement to prove that the effective voltage of a sinewave is 0·707 times the peak voltage. In terms of power, 6·3V a.c. is equal to 4·45V d.c.!

Heating effect

Another way of looking at the whole thing is to say that the power contained in an alternating current is based upon the effective voltage and that the *power* is the *same* as that in a direct current which will produce the *same amount* of heat in a given resistor as that of the a.c. current under consideration. A simple experiment will serve to illustrate the point.

Obtain a bell transformer driven from the mains, with a 6·3V output. Connect a suitable 6·3 volt lamp to this, Fig. 5. Adjacent to it mount another 6·3 volt lamp connected to a source of variable d.c. A suitable method is a variable resistor in series with three or four cell batteries. Adjust the variable resistor until the two lamps are of a similar brilliance. Under these conditions both are consuming the same amount of power and a measurement across the terminals of the second lamp—with the lamp removed—will reveal that the voltage here is roughly 4·5 volts, any discrepancy being due to the different resistance of the meter, plus human error.

The experiment shows that in the a.c. circuit, 6·3 × 0·707 equals 4·45—the effective voltage!

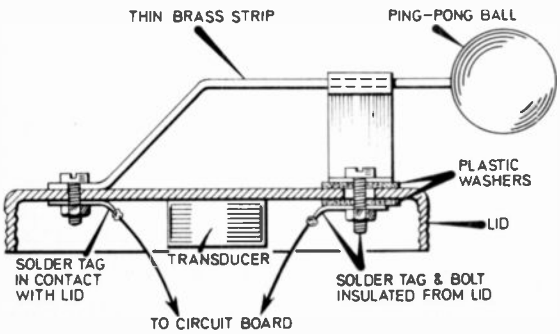
Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

BUOYANCY SWITCH

After reading the article on the *Sight & Sound Fish Attractor* in the June issue of EVERYDAY ELECTRONICS, I came up with another method of switching the unit on and off and so replace the gravity switch. Details of my construction are shown below.

When the unit is submerged in the water, the ping-pong ball will try to float to the surface thus bending one brass strip against the other thereby "making" the switch and turning on the unit. If this method is adopted a heavier bed-weight might be needed.

David Hewitt,
Headington,
Oxford



WIREBOARD

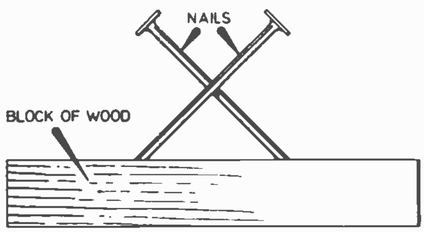
I often find that stripboard is hard to get and when I eventually do find a supplier it is very expensive. To solve this problem I have made an alternative, wireboard. Take a piece of wood the same size as the stripboard, mark on it a matrix of lines about 10mm apart, bang nails in at these points and join them with tinned copper wire. You then have a perfect piece of wireboard which, in my opinion, is equally as good as stripboard.

D. Strong,
Tiverton,
Devon

SOLDERING IRON STAND

A simple and useful soldering iron stand can be made very simply by using two crossed nails in a block of wood. The diagram shows the arrangement. In use it is a simple matter to rest the iron between the two nails.

G. Duggan,
New Ross,
Co. Wexford



CLEANING PCB HOLES

When using copper-clad printed circuit board, it can be very difficult to clear the holes of solder when it is required to replace any component. Take a fairly large pin, which you sometimes get from a new shirt, and using the pointed end push it through the hole with the aid of a soldering iron.

The solder is then wiped away leaving a clean hole.

J. R. Hunt,
Eastbourne,
East Sussex

TEACH-IN 78

By GEORGE HYLTON

Part 2

CIRCUIT MODULE CONSTRUCTION

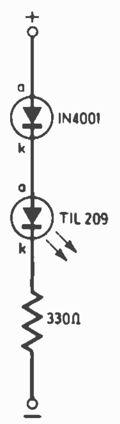
THIS month we continue by describing how to construct the first set of modules to be used in the series. These are the LED, 1000μF CAPACITOR PNP and NPN modules. Also described is the foundation for all our experiments; the module board. When conducting any experiments, the modules to be used are placed on the module board, interconnections are then made easily to the supply lines, etc.

CIRCUIT MODULES

In our experiments we shall need to connect the same transistors, diodes, etc. into many different circuits. These components are delicate and easily damaged by excessive heat. So to protect them against repeated handling and soldering we shall make them up into small sub-assemblies, which we shall call modules, each with its own individual soldering points and some built-in protection against overload. In this way, the delicate components need only be soldered once. Afterwards, all soldering will be done to the soldering points, which are not the same as the component lead-outs but are separated from them by lengths of wire or resistors.

LED MODULE

Our first circuit module is for a light emitting diode (l.e.d.) the circuit is shown in Fig. 2.1. This is a kind of lamp which lights up when the right amount of current is passed through it, in the right direction. If an l.e.d. is connected straight across the battery it takes too much current and is destroyed.



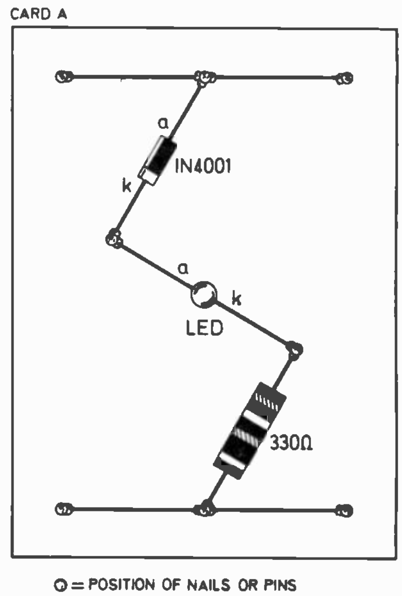
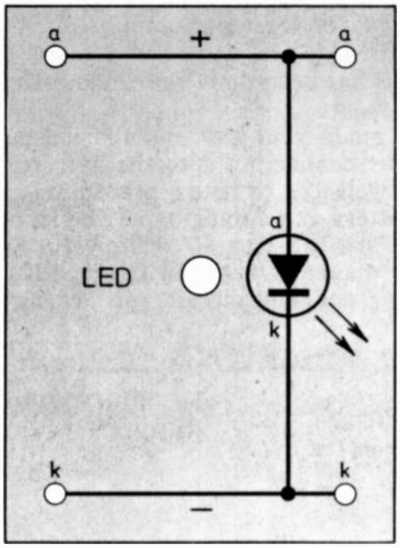


Fig. 2.1 (left). Circuit diagram for the LED module. Fig. 2.2 (right). Full size under card used for the module. This may be traced and used as a template.

To avoid this we shall connect a resistance of 330 ohms *permanently* in series with the l.e.d. and afterwards make all connections in such a way that this 330 ohms is in the path of the current. This limits the amount of current to a value which is quite safe for the l.e.d. specified (and for most other types too). This protective resistance alone may not be enough, however. We have said that the l.e.d. acts as a lamp if the right current is passed through it *in the right direction.*



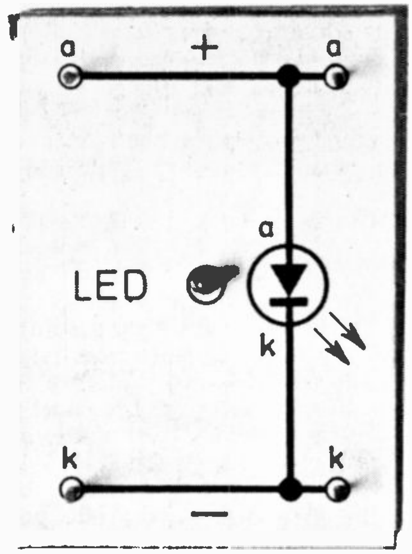


Fig. 2.3. The top card required for the LED module. Again this is drawn full size and may be used as a template. After the symbol and lettering has been finished, it can be sprayed with a colour of the constructor's choice. Shown alongside is a p hotograph of the completed module.

If current flows in the wrong direction the l.e.d. may again be destroyed. To avoid this, we shall include a second protective device. This will allow current to flow only in one direction. Any current in the reverse direction will be blocked. Provided that we connect this second device to the l.e.d. in the right way, it will be impossible for current tò flow except in the right direction. This second protective device is a silicon junction diode of a kind designed to pass easily the sort of current needed to light the l.e.d.

CONSTRUCTION

Two methods of construction may be used by the reader, one is by using pins in hardboard, the second uses nails in plywood. Both methods will be described in detail for the LED module *only*. It is therefore up to the constructor to decide which method is best suited to his needs.

USING PINS

Refer to Fig. 2.2 this shows full size the card required to be fixed to the base and method of wiring up, the same layout is used either for the hardboard or plywood version. First, draw the layout onto stiff white card and then stick it down on the base. If you are using hardboard stick it to the rough side.

We need to hold the pins firmly in the hardboard otherwise any strain imposed on the pins will pull them out and possibly damage the components. We therefore use a simple trick. Instead of inserting the pins into the board from above we shall insert them from below, and pull the shanks through as far as they will go. The heads then prevent the pins from being pulled out.

Insert the pins through the appropriate points on the diagram, pushing or knocking them deep enough for their points to come through the back of the board. To hold the pin steady when hammering grip it with pliers near its head. Now pull the pins out, turn the board over, and insert them through the holes they made on the back of the board. Pull them right through, as far as they will go. You are now ready to wire up the boards on the diagram side.

Bend over the pointed ends so that the points press against the shanks, out of harm's way. If you have found, from earlier soldering, that your pins take solder very easily, you can proceed to the wiring up. If not, tin the lowest parts of the shanks first. Next attach the plain connections. Use tinned copper wire except in the case of connections which cross others: use insulated wire for these. Do not stretch the wire tightly between the pins: leave it loose.

As you solder, slide the wire down the stem of the pin to press against the base, and hold it there with pliers or the tip of screwdriver until the solder hardens.

Next connect the resistor, then the diode and finally the l.e.d. It may help to tin the ends of their leads first. When doing this grip the lead you are working on firmly with the pliers, so that heat running along the lead from the iron towards the body of the component is diverted into the pliers. Use the same technique whenever you solder a component, especially a semiconductor or a plastic capacitor.

Make sure that you identify the anode and cathode of the diode and l.e.d. and connect them to the appropriate points. Similarly with any silicon diode you might substitute for the IN4001.

Most silicon diodes have a band of colour printed round their body near the cathode. Some have the cathode marked with a + sign. Light emitting diodes usually have a "flat" on the plastic casing near the cathode, also, the cathode lead may be shorter than the anode lead. Solder the l.e.d. so that its plastic body sticks up above the board. Stick some cardboard over the back of the board to insulate the pinheads. Cut off or bend over all pins except the four at each corner. Cut a piece of cardboard to fit the module and cut holes to slide over the shanks of the four long pins, also make a hole for the l.e.d. to poke through.

Mark the stiff white card on top of the components with the signs and letters shown in Fig. 2.3 and fit it, by working the shanks of the four pins through the holes. Turn the module over and press a small blob of Blu-Tak to the plain cardboard near each corner. This anchors the module when it is placed on your baseboard.

To avoid snagging yourself on the bent over points of the four long pins, fill the loops with solder.

USING NAILS

Once again draw the layout shown in Fig. 2.2 and stick this down on your piece of plywood. Hammer one inch long veneer pins through the points on the card indicated. The components are then mounted on the nails using our newly found soldering technique as shown in Fig. 2.2 only this time the short nails are cut off whereas in the previous method the pins were bent over. The same card shown in Fig. 2.3 is then placed on top of the components, only this time small pilot holes are made at the appropriate points and forced over the long nails.

The following wiring-up order, designed to minimise the risk to components, should be used for all modules and circuits.

1. Bare wires
2. Insulated wires
3. Resistors
4. Capacitors
5. Semiconductors.

MODULE BOARD

We said in *Part One* that we are going to use a "module board" as the "base" for doing our experiments. The size and materials have already been mentioned all that remains is to describe the actual

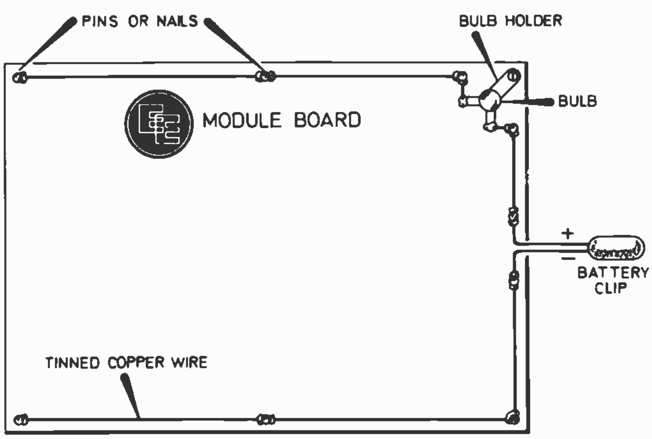


Fig. 2.4. The layout of the Module Board. This is made from a piece of 15mm fibreboard or similar material measuring 305 x 216mm. The tinned copper wire "supply lines" should be raised above the board, soldered close to the heads of the pins or nails as possible.

construction. The module board material is covered with a sheet of white card the layout is shown in Fig. 2.4. The only components to be soldered onto the board is the supply lines from the battery and the bulb holder.

Although the board was sprayed blue in our particular case there is no reason why the colour cannot be changed.

Begin by banging in nails or pins, whichever method you have chosen, and solder the tinned copper wire to the pins. Screw the bulb holder firmly to the base. It does not matter which shape the holder is, it just depends on the type supplied with the kit of components.

Once this has been done your module board is ready for use.

Having made your LED module you can now light the l.e.d. by connecting it to the battery. However, it will be as well first to take a precaution against shorting the battery and damaging it. The safety device we shall use is a 6·3V or 8V 300mA (0·3A) bulb connected permanently between the positive terminal of the battery and any circuit you are using. Fig. 2.5.

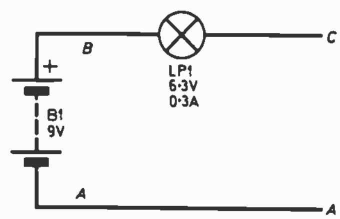


Fig. 2.5. Circuit diagram of the Module Board. Compare this with the layout of Fig. 2.4.

Therefore the "+" battery terminal (*B*) is not to be connected to anything but the bulb. Battery power for circuits is to be taken from point *C*. If *A* and *C* are shorted the bulb lights brightly (at any rate if the battery is new) and may quickly burn out if left on. The battery will quickly run down, too, so disconnect instantly if the bulb ever lights up.

The use of a bulb holder will enable you to switch the power on and off by screwing in or unscrewing the bulb. Connections to the battery terminals can be made with a battery press connector.

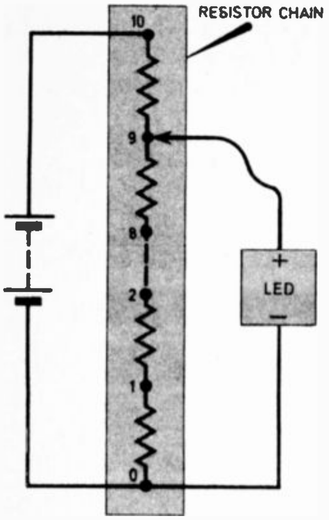
So far we have two modules; a series string of ten 1 kilohm resistors and an LED module with protective diode and resistor.

Used in combination these two modules give a rough and ready support to the idea that resistance tends to reduce the flow of current.

Connecting the LED module to the battery supply. Positive to positive and negative to negative will make it light up, connecting it the wrong way round won't.

Now take your chain of lkΩ resistors and connect the negative end to the negative supply and the positive end of the LED to various points along the chain from the positive end downwards as shown in Fig. 2.6. The arrow-head and wiggly line on the diagram indicate a movable connection. The l.e.d. gets progressively dimmer as you move down the chain towards the negative end. On point 3 it scarcely lights, and it does not light at all on 2 and 1. Naturally, not on 0 either, because it is "shorted".

With the resistor chain across the battery each resistance uses up one-tenth of the battery's voltage. So for a 10V battery each resistance absorbs 1V. Tap 10 is then at 10V, being connected straight to the battery. Tap 9 is at 9V, tap 8 at 8V and so on. Tap 1 is at 1V, but more than 1V is required to light the l.e.d. Tap 2 is at 2V, but about 2·4V is needed. On Tap 3 (3V) it should light. Of course, as soon as the l.e.d. lights, the current it now passes upsets all the voltages along the resistor chain. This is because the current in the l.e.d. must flow through all the series resistances above the tap to which it is connected. This additional current further increases the voltages absorbed by these resistances, leaving less voltage for the l.e.d. itself than would normally be found at whatever tap it is connected to.



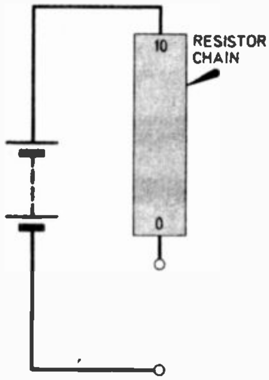


Fig. 2.6. Demonstrating the effect that any resistance tends to reduce the flow of current. Fig. 2.7. (Right). If the RESISTOR CHAIN has one end unconnected—no current flows.

With the RESISTOR CHAIN connected with its bottom end floating as in Fig. 2.7 no current flows until the LED is connected. So there is no voltage loss in the resistances and the bottom end is at the full battery voltage, say 10V. Naturally when the LED is connected to the bottom tap and current flows through the resistor chain this voltage is drastically reduced. If the bottom end of the resistor chain is not connected to the negative end of the battery, but left "floating" the full 10V must appear at point 0. However, as soon as anything is connected between 0 and negative, current flow in the resistors reduces the voltages.

If you had a perfect voltmeter, you could prove by measurement that with one end the resistor chain floating (and no LED) the full battery voltage really does appear at the floating end of the chain, despite the resistances. A perfect voltmeter should draw no current. We do not have such an instrument, but by using a simple trick we can achieve the same result. The trick involves the use of a new circuit element. This is called capacitance and the component which embodies it is called a capacitor.

CONSTRUCTION

Make up two 1000µF CAPACITOR modules as shown in Fig. 2.8. Each module carries the standard circuit symbol for the component. The white plate is positive and the black plate negative. We shall use these capacitors to collect and store voltages from our RESISTOR CHAIN.

To illustrate what happens when a capacitance is charged by a battery via a resistance a water-flow analogy is helpful, Fig. 2.9. The battery is a water tank whose water level is kept constant. The level corresponds to the voltage. The capacitor is a container with an inlet at the bottom and the resistance is the pipe. You can see that, however wide or narrow, long or short the pipe may be, water flows into the container until the level is the same as in the water tank. Then stops. Using a longer or narrower pipe (that is, increasing the resistance) slows down the process. But given enough time, the container must

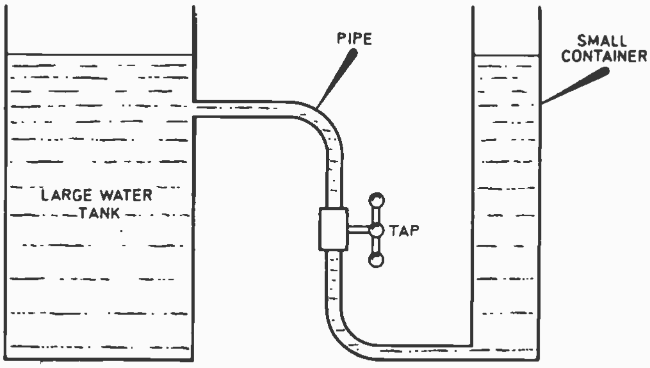


Fig. 2.9. The water-flow analogy shown here is helpful in understanding how a capacitor is charged.

fill to the same level, however high the resistance. If you think about it, you will see that when the tap is first opened water flows into the empty container quickly, but as the container fills the flow is slowed down. This is because the water in the container is now pressing down on the inlet, opposing the inward flow. This effective "head of water" is the difference between the level in the tank and the level in the battery. As the container fills this head of water is reduced. When the container is nearly full the flow is very small indeed. Perhaps the container never gets quite filled up to the tank level, even down to the last drop!

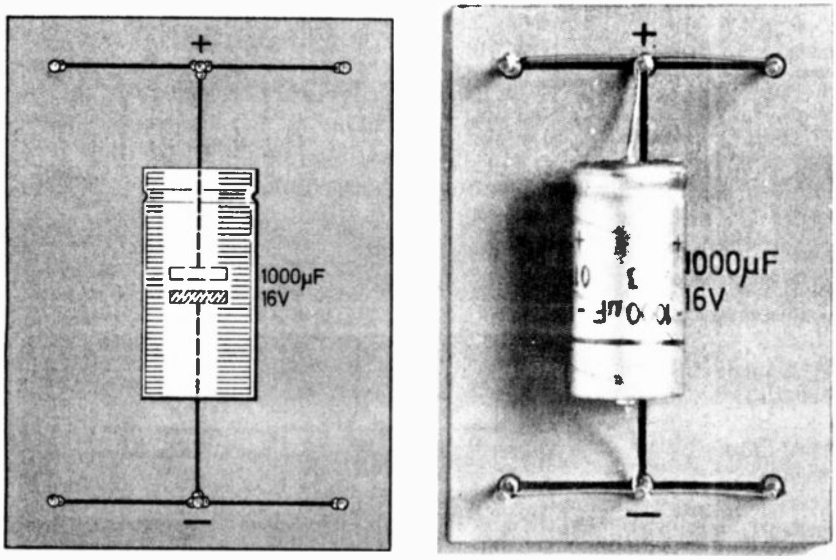


Fig. 2.8. The 1000µF capacitor module. Only one card is required for each module, and is shown full size.

The equivalent electrical circuit shown in Fig. 2.10 shows the same sort of behaviour. When the switch S is first closed, there is no voltage on the

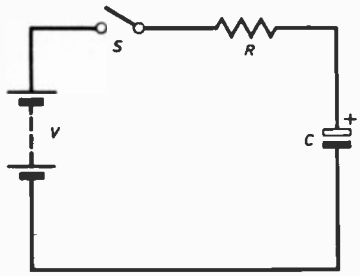


Fig. 2.10. The equivalent electrical circuit of Fig. 2.9.

capacitance. So the full battery voltage V drives current through R. But as soon as any voltage builds up in C, it *opposes* V and the current *decreases*. When the capacitor is charged to very nearly V, the current through R is very small. Perhaps C never quite gets charged to V, though obviously it can be charged to something so close to V that it makes no practical difference.

Anyway, it is clear that if we charge our 1000μF module via a resistance it will eventually charge to the battery voltage, as near as makes no difference. If the complete RESISTOR CHAIN is used, making a total of 10kΩ it takes about 30 seconds to charge almost completely to the battery voltage.

Before using newly bought electrolytics it is advisable to connect them to the battery for a few minutes, observing polarity. This reforms the oxide film if it has deteriorated in storage. A charged 1000μF, applied to the LED with the correct polarity produces a brief flash of light. Check that your 1000μF modules are holding their charge by leaving them disconnected for 5 minutes after charging and then applying them to the LED. If they fail this test discard them.

You can now connect your RESISTOR CHAIN across the battery, Fig. 2.11. Charge a 1000μF from various points, apply to the LED and see the flash. Equal flashes should indicate equal voltages. Your earlier experiment with the RESISTOR CHAIN connected across

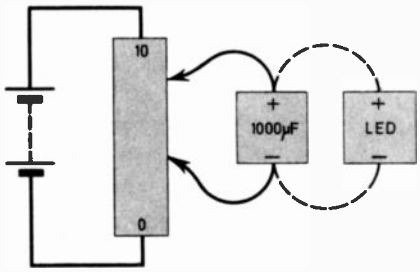


Fig. 2.11. Lighting the LED with a charged 1000μF module.

the battery showed that the voltage drop across the bottom three resistors is just enough to turn on the LED. In fact the drop across *any* three adjacent resistors just lights the LED. (Test this.) You know, however, that the voltages in the RESISTOR CHAIN are changed when the LED is connected. So you cannot be sure that this test gives a true picture of the way in which the battery voltage is shared between the series resistors.

If the capacitor is connected across any three adjacent resistors, making sure to connect the positive plate to whichever of the resistors is nearest the positive end, it will, given time, charge up to whatever voltage exists across the three resistors. After that, it will take no further current and so will not upset the voltages at all. Having charged the 1000μF to the true voltage you can then remove it and apply it to the LED.

Experiment with the 1000μF and LED, comparing voltages across equal numbers of adjacent resistors. Also, prove that when the 0 end of the chain of resistors is disconnected and the 1000μF is charged via the whole chain for a long enough time the flash is as great as when the 1000μF is charged directly from the battery. Also, get an idea of the charging time by connecting the LED as shown dotted then tapping the 1000μF to the same points. The LED goes out then comes on again when C is charged. By now you will have realised that although these "1000μF and LED" tests give a rough indication of circuit voltages they are not precise or convenient. In particular, the short durations of the flashes make careful comparisons difficult. The problem is that the charge in the 1000μF is used up too rapidly. The LED takes too much current, and quickly drains it away.

What is needed is some way of slowing down this discharge of C. A much larger C would achieve this but then it would take longer to charge, too, which

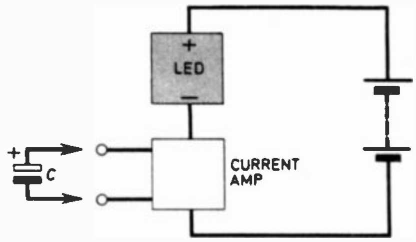


Fig. 2.12. Simple method of reducing the current taken by the LED, is by using a *current amplifier*.

might be tedious. A better way is not to apply the 1000μF to the LED directly, but via a **current amplifier** Fig. 2.12. If the current from the 1000μF is amplified 1000 times, then only a thousandth of the current needed to light the LED need be taken, and it will take 1000 times as long to discharge.

TRANSISTOR MODULES

A transistor is a **current amplifier**. A transistor is a device with three connections Fig. 2.13. A small input current flowing between base(b) and emitter(e) makes a much larger current flow from the battery through collector(c) and emitter(e), typically 100 times larger. This amplified current can be made to light up the LED.

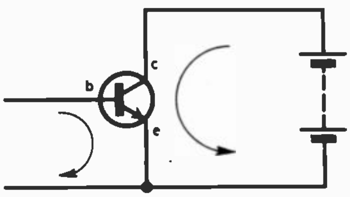


Fig. 2.13. Circuit symbol for a transistor. The current flow of each path is shown by the arrows.

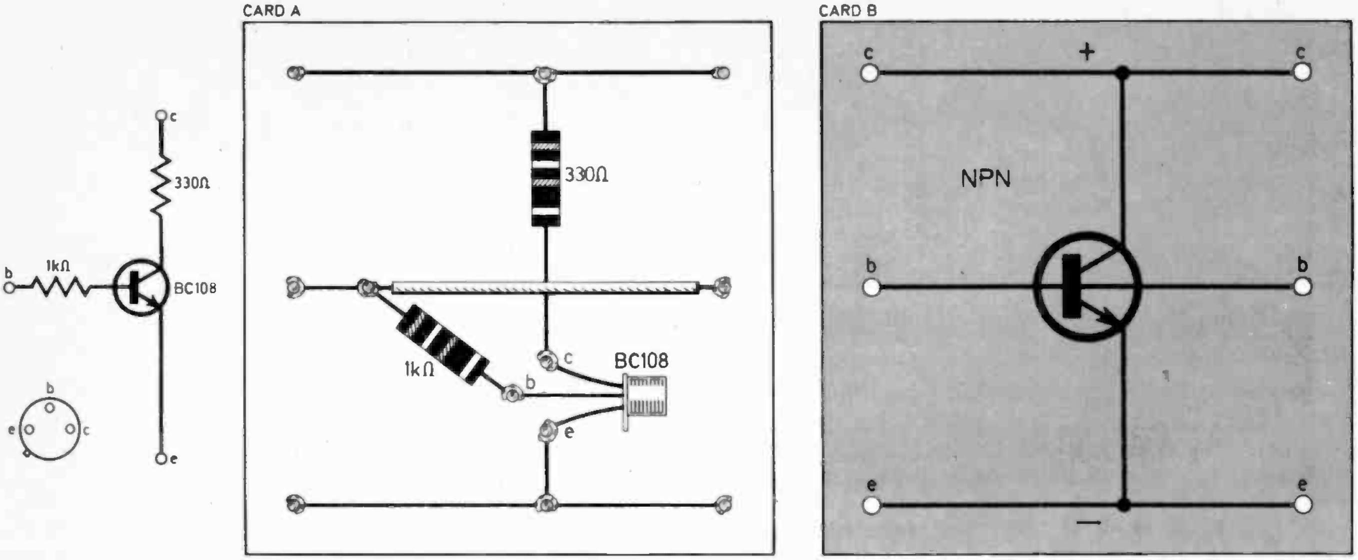


Fig. 2.14. Details of the NPN module. Construction is the same for the previous modules. Both cards are shown full size. Be extra careful when soldering the transistor.

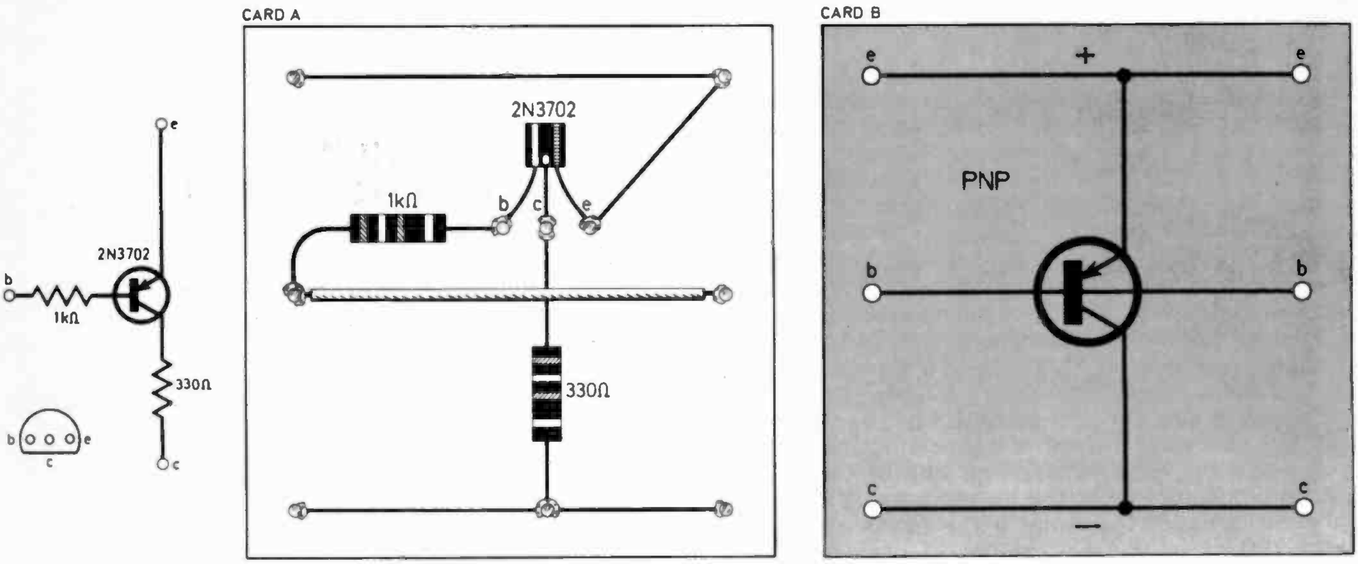
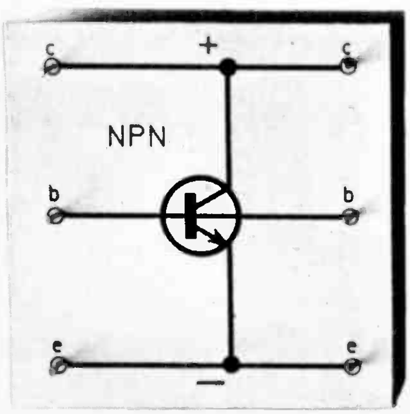
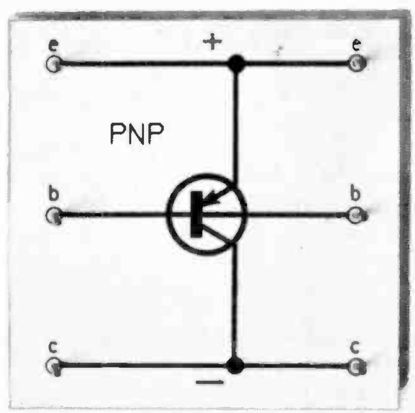


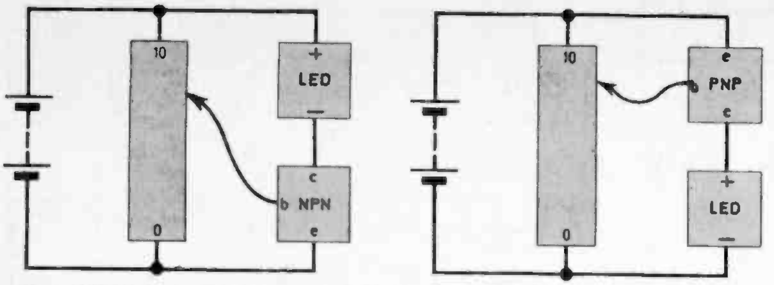
Fig. 2.15. The PNP module. This is constructed in the same manner as the NPN module. So be careful not to get them mixed up!

CIRCUIT MODULE CONSTRUCTION





Two photographs of the NPN and PNP modules.
It is preferable if the two are sprayed in different colours. This then provides a further aid to identification.



Figs. 2.16 and 17. Testing each of the NPN and PNP modules. If you do not get the correct results, re-check the wiring and in particular that of the transistors.

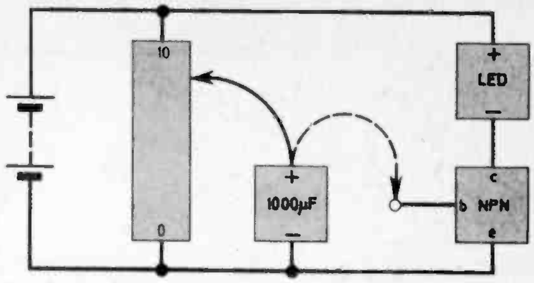


Fig. 2.18. An improvement on the circuit of Fig. 2.11. This time the LED stays illuminated for a longer period of time.

We now make up three transistor modules, two NPN and one PNP. Each consists of a transistor, protective resistors, and pins (or nails) for making the connections. Construction is as before; pins, plain connections, resistors, and finally the transistors. The circuit of each module and their construction are shown in Figs. 2.14 and 2.15.

Be careful to connect the transistors correctly as shown. The BC108 has a tag on it's case which is a marker for the emitter lead(e). Similarly the flat on the 2N3702 serves the same purpose. Use pliers or tweezers as a heat shunt when soldering and blow on the joint as soon as it is made, to cool it. Mark the top of the modules as shown.

Now connect the LED, the resistor chain and one NPN module as shown in Fig. 2.16. You should find that the LED lights when the base(b) of the NPN module is connected to any tap on the RESISTOR CHAIN except for 0. This means that the current flowing into the base of the NPN module is enough, after amplification to light the LED, even when the voltage from the RESISTOR CHAIN is only 1 volt. We found earlier that it takes over 2 volts to turn the LED on. Evidently less than 1 volt will turn on the transistor in the NPN module.

Now test the PNP module by connecting the modules as shown in Fig. 2.17. This time you should find that the LED lights on all taps expect 10.

Reconnect the NPN/LED modules as shown in Fig. 2.18. But this time instead of connecting the base(b) to the resistor chain, charge up one of the 1000µF capacitor modules from the RESISTOR CHAIN (any tapping will do) and then transfer the charged capacitor to the base(b) of the NPN module. The LED now lights for a length of time which will vary depending on the amount of charge in the capacitor.

This is a much better arrangement than just the capacitor and the LED module. The time that the LED stays illuminated now gives some indication of the voltage. Even so, it is not an entirely satisfactory way of measuring voltages. For one thing, the duration of the LED is not exactly proportional to the voltage. If it were, then it would last ten times as long for a 10 volt charge as for a 1 volt charge, but it doesn't, then again timing the LED is rather tedious.

Have you been wasting your time? Not at all.

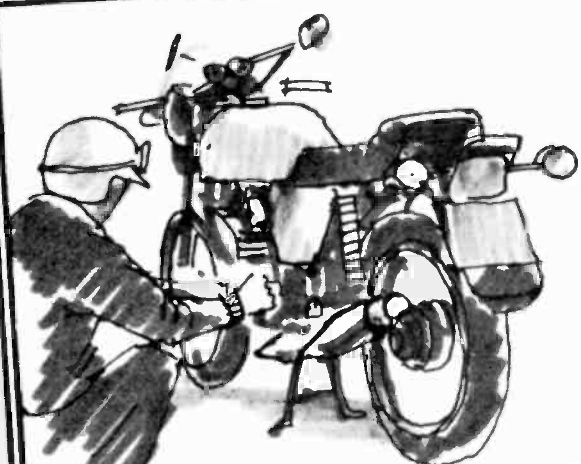
Next month we shall return to the subject of resistance and capacitance, but in greater detail.

QUESTIONS

1. Most silicon diodes have a band of colour printed round the;
   a. middle
   b. cathode end
   c. anode end
2. When wiring up circuits, semiconductors should be connected;
   a. last
   b. first
   c. after the resistors
3. If a 12 volt battery is connected to a 2 kilohm and a 1 kilohm resistors in series, the voltage across the 1 kilohm resistor is;
   a. 4 volts
   b. 6 volts
   c. 8 volts
4. A capacitor is required to pass audio frequency voltages from a point at +18Vdc to a point at +5Vdc. Which of these capacitors is most likely to be suitable?
   a. 10µF 10V electrolytic
   b. 560pF polystyrene
   c. 3·3µF 100V electrolytic
5. The typical current amplification of a transistor is;
   a. 100
   b. 5
   c. 3000
6. A potential divider of 10 kilohms and 2 kilohms divides it's input voltage by;
   a. 3
   b. 6
   c. 5

Answers next month

NEXT MONTH



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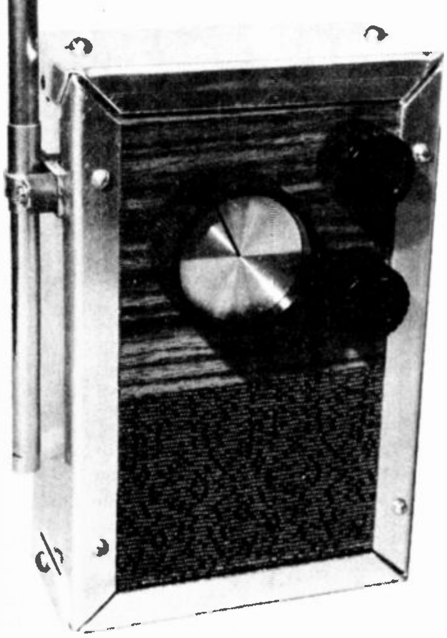

THE super-regenerative type of v.h.f. receiver is of particular interest on the grounds of simplicity (compared with a superhet) and the ease with which it can be adapted to cover a wanted range of frequencies. It has high sensitivity, is relatively inexpensive to build, and has no ganging or trimming difficulties. It lacks the selectivity of a superhet, but this does not generally prove to be too important over the range of about 55MHz to 198MHz or so which can be tuned here.

The present design has been well proven and tested, and although we make no claims about the quality of reproduction, it will give the constructor an insight to what goes on at v.h.f. frequencies. For this reason no set frequency band has been mentioned, instead a table of values for particular components has been provided together with the associated frequency range covered in each case. It should therefore be clear to the constructor that the present design can be modified to cover any frequency desired, within the frequency ranges shown and is suited to those who wish to experiment with radio reception within the v.h.f. bands.

START HERE FOR CONSTRUCTION

CASE

This needs to be prepared first, as the r.f. section is built directly onto the front panel. The box is a 150×100×50mm universal chassis, with an extra 150×100mm flat plate for the back. All the major dimensions are shown in Fig. 1. First cut a hole about 45 to 50mm in diameter for the speaker, which is near the bottom of the panel. This can be done with a large chassis punch, with an adjustable hole or tank cutter, or by drilling a ring of small holes and cutting away the excess metal. Also drill or punch holes for C5, VR1 and VR2, and for the two tagstrips, as well

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ESTIMATED COST OF COMPONENTS £10 excluding case

as for 6BA bolts to secure the sides by their flanges, and for the audio board. Correct fitting for the latter can be obtained by drilling the board and metal panel together, in advance.

The receiver front was finished by securing fabric over the speaker opening with adhesive, bolts for the audio board having been fitted with lock nuts. These bolts are countersunk, as are those holding the tag strips, this part of the front being covered with self-adhesive material.

Bolts to secure the aerial pass through a strip of insulating material and insulating washers. This side is bolted on when wiring is finished.

RF WIRING

The layout of the r.f. section is shown in Fig 2. Note that C1, C2 and C3 should be tubular or disc ceramics, which are convenient for their small size, this type may also be used in other positions. Connections to C1, C2, C3, C5, C6, and C8, in particular, should be as short as possible.

The trimmer C6 is soldered directly to the solder tags of C5, and a stout wire just clearing the moving plates goes to the rotor tag. Note that TR1 and TR2 have different drain, gate and source lead positions. A tag on one bolt holding the aerial is connected to TR1 gate.

Resistor R3, and the leads to VR1 wiper and C9 to VR2 should be kept close against the metal panel.

Of various transistors tried, the BF244 was found best for TR1, and an MPF102 for TR2. True, equivalents should be suitable, but similar types intended for lower frequencies (such as the 2N5459/ MPF105) ceased to regenerate at frequencies over about 100MHz so cannot be used here. There is of course no reason why different types cannot be tried.

COIL CONSTRUCTION

Coil L1 is wound with solid insulated wire, and has two turns fairly close together, with an outside diameter of about 10mm or 0·4in.

The second coil, L2 is of similar diameter, and can be 18s.w.g. or 20s.w.g. wire.

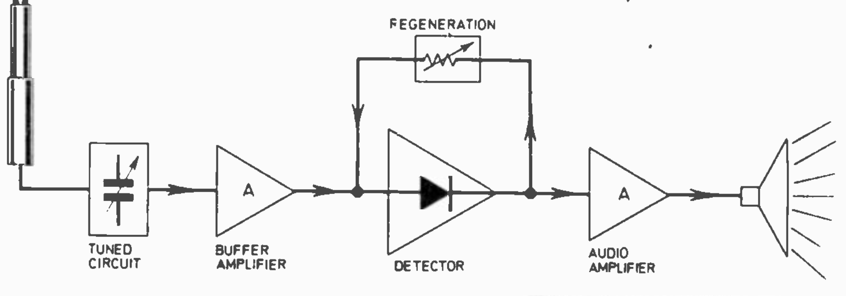
With three turns, spaced to occupy about 15mm coverage was 155 to 165MHz with C6 fully unscrewed. Screwing C6 down lowers the frequency.

A coil with four turns, 15mm long, covers approximately 130 to 155MHz with C6 fully unscrewed, this changing to 115 to 130 MHz with C6 slightly screwed down, and 85 to 115MHz with C6 nearly half closed.

Stretching or compressing L2 will also alter the frequency coverage. Amateur 2-metre signals will be found around 145MHz. Coil L1 is placed quite close to L2, but not so near that regeneration is not obtained.

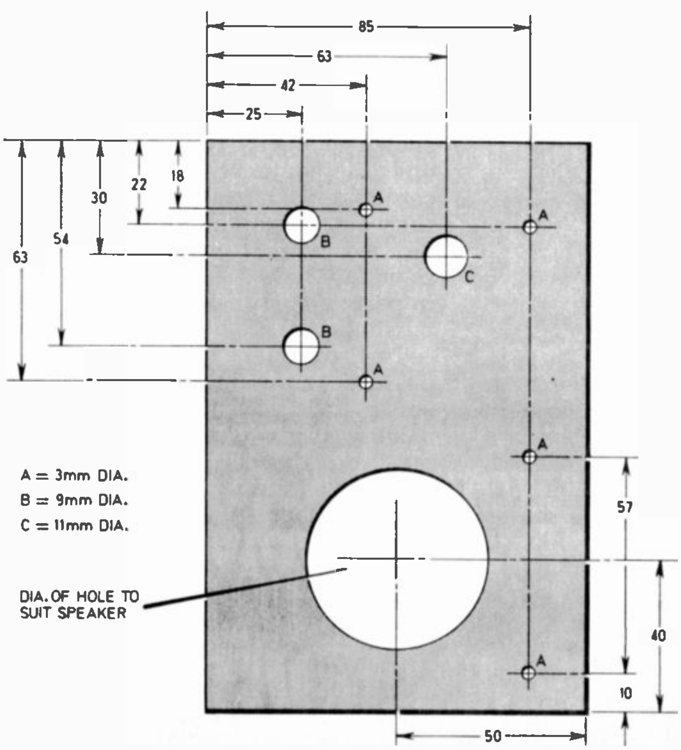
HOW IT WORKS...

Signals induced into the aerial are selected by the tuned circuit. This part of the circuit consists of a coil and variable capacitor to select the required frequency. The signal is then passed via a buffer amplifier which merely isolates the aerial from the remainder of the circuit. The selected signal is then rectified by the detector which consists of a transistor which goes in and out of oscillation at the working frequency. The rate of oscillation is controlled by the regeneration control. The detected signal is then passed to the audio amplifier where it is amplified to a sufficient level to drive a loudspeaker.



The radio frequency choke L3 consists of approximately 40 turns of 42s.w.g. enamelled copper wire, wound side by side, on a 4mm diameter insulated former. A 2·2 megohm resistor, was actually used, with the 42s.w.g. wire soldered to the resistor leads. The choke was not found to be critical, and can be wound on a small piece of insulating material. The winding should *not* be covered with adhesive, varnish, or wax.

Although not exactly a coil, capacitor C7 needs to be constructed from wire. It consists of two insulated wires twisted tightly together for a length of 50mm. The two free ends are then soldered to the appropriate points on the wiring diagram. On no account should a single piece of wire be used, it could short out the transistor.



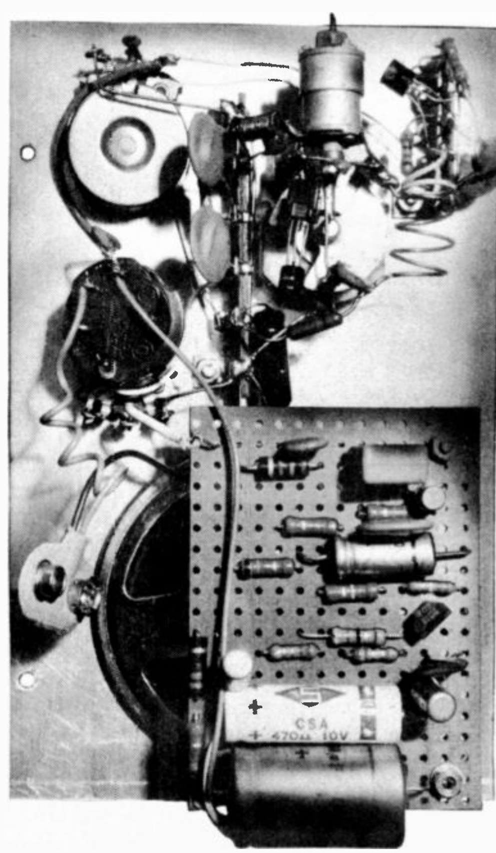


Fig. 1. The front panel with major dimensions. This is shown with the inside facing the reader. A photograph of the prototype component board and other front panel components is shown right.

V.H.F. PORTABLE RADIO

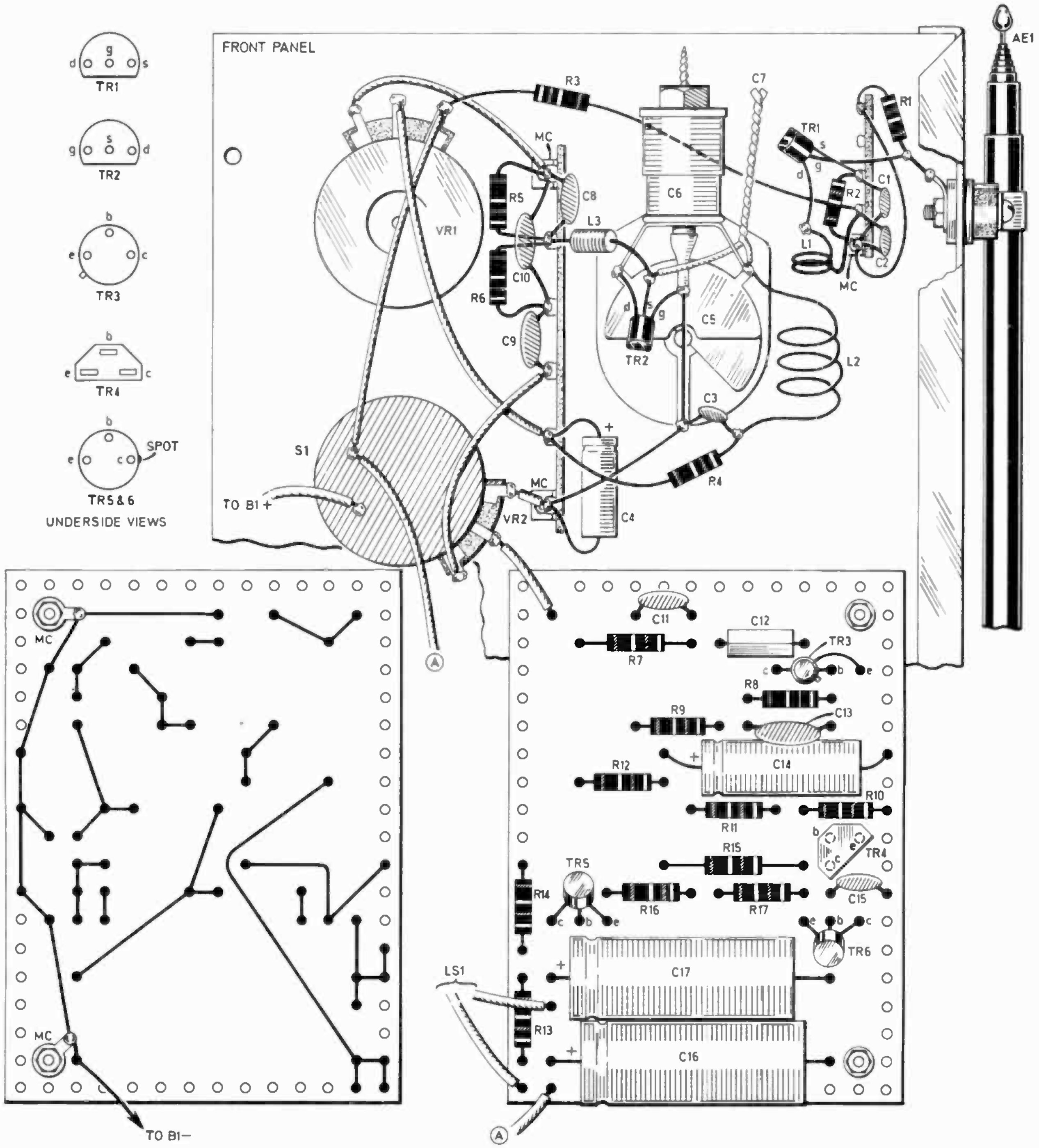


Fig. 2. Complete wiring details for the V.H.F. Portable Radio. The audio board is mounted on two long spacers arranged to clear the speaker underneath. The two insulated wires which form C7 should be arranged to point down towards the audio board. It will then be easier to adjust.

COMPONENTS

Resistors

R1	47kΩ	R10	220kΩ
R2	180Ω	R11	270kΩ
R3	560Ω	R12	1·5kΩ
R4	1kΩ	R13	1·5kΩ
R5	10kΩ	R14	680Ω
R6	15kΩ	R15	47Ω
R7	5·6kΩ	R16	2·2Ω
R8	1·8MΩ	R17	2·2Ω
R9	8·2kΩ		

All resistors are carbon ¼W ± 5%

See Shop Talk Page 108

Potentiometers

VR1 4·7kΩ lin.
VR2 100kΩ log. with single pole switch

Capacitors

C1	1nF	C9	0·1μF polyester
C2	1nF	C10	10nF
C3	1nF	C11	4·7nF
C4	22μF 10V elect.	C12	0·1μF polyester
C5	10pF variable (Jackson type C804)	C13	0·47μF polyester
		C14	125μF 10V elect.
C6	30pF beehive trimmer	C15	20nF
C7	1·5pF see text	C16	1000μF 10V elect.
C8	5nF	C17	470μF 6·3V elect.

All low value capacitors are tubular or disc ceramic, except where stated.

Semiconductors

TR1 BF244 *n*-channel f.e.t.
TR2 MPF102 *n*-channel f.e.t.
TR3 BC108 silicon *npn*
TR4 BC149 silicon *npn*
TR5 AC141 germanium *npn*
TR6 AC142 germanium *pnp*

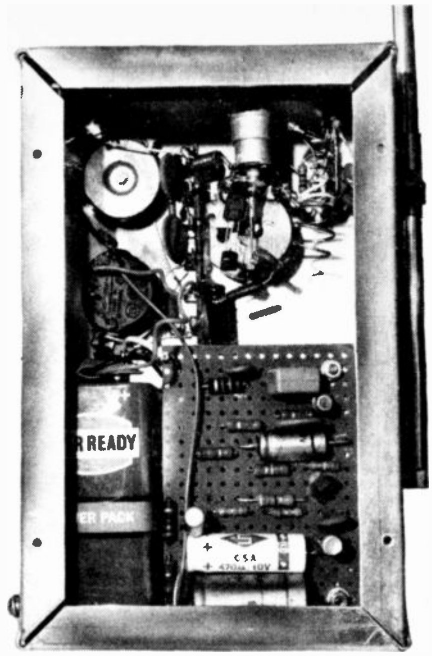
Miscellaneous

AE1 telescopic aerial, about 90cm long
L1 two turns insulated wire, 10mm diameter, see text
L2 four turns 18 s.w.g. wire, 10mm diameter spaced to 15mm, see text
L3 r.f. choke, 402 turns of 42 s.w.g. wire, wound on a 2·2MΩ resistor, see text
B1 PP3 9V battery
LS1 8 ohm 55mm round loudspeaker
Universal chassis 150 × 100 × 50mm; extra flat plate 150mm × 100mm; plain stripboard 0·15 inch matrix 19 × 14 holes; one 6-way tagstrip with two tags earthed; one 5 way tagstrip with one tag earthed; two small round knobs; one large round knob; covering for the front panel; 6BA hardware; insulating material for aerial; sleeving; connecting wire; solder.

Table 1. Frequency coverage (MHz) for different values of L2 and C6

Setting of C6	Number of turns: Two	Three	Four
Fully Unscrewed	168 to 198	144 to 174	58 to 70
Slightly screwed down	114 to 170	128 to 146	55 to 98
Screwed halfway down	118 to 120	106 to 114	80 to 88

The frequencies covered in each case are only typical, variations in component tolerances will alter the final results obtained.



Photograph of the prototype with lid removed. Note the insulator between aerial and case.

USING THE RECEIVER

When the receiver is in use, VR1 is rotated until a loud rushing sound is obtained, which ceases when a signal is tuned in. This sound, which indicates quenching of the regeneration, may not be obtained if C6 is screwed down too far, or if TR2 cannot operate at the frequency wanted, or if L1 is too close to L2. The value of C7 also influences results, and may if wished be substituted by a small trimmer capacitor instead of the short insulated wires. Individual adjustment can then be made, if wished.

Ideally, the hiss should be obtained with VR1 rotated clockwise about one-half to two-thirds, but its setting is not very critical, except for exceptionally weak signals. With signals of ordinary strength, a type of self-limiting effect is obtained.

AUDIO BOARD

Both sides of the audio section board are shown in Fig 2, and uses plain 0·15inch matrix board. Temporarily secure two solder tags at the points marked MC. In most places the wire ends of components will reach to the necessary points and sleeving only need be added where wires might touch each other. Provide leads for the speaker and battery connections, and bring the lead from R7/C11 up through the board, so that

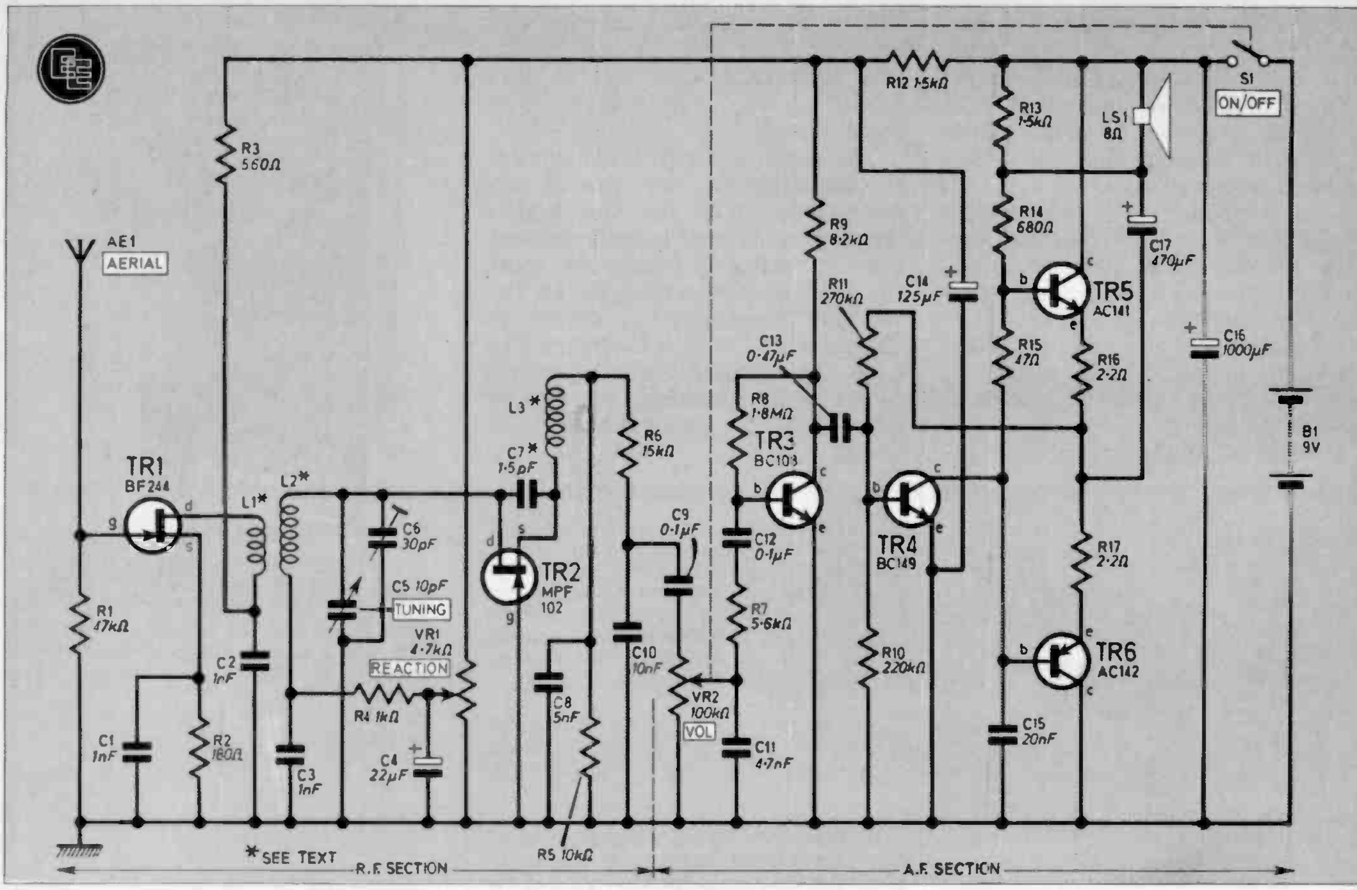


Fig. 3. Circuit diagram of the V.H.F. Portable Radio. The circuit may be logically split into two sections, the r.f. and a.f. stages.

CIRCUIT DESCRIPTION

RF SECTION

Referring to Fig. 3 this shows (to the left of the dotted line), the r.f. (radio frequency) section of the receiver, AE1 being the telescopic aerial.

Transistor TR1 is operated as a grounded source amplifier, whose main purpose is to isolate the aerial from the detector stage. Bias for the transistor is provided by resistor R1, R2 and R3. Coil L1 couples signals from the aerial to the second coil L2. This coil together with the variable capacitor C5 and trimmer C6 form a tuned circuit. The trimmer C6 provides some adjustment to the band covered by C5.

Transistor TR2 is the super-regenerative detector, with regeneration controlled by VR1. In operation TR2 goes in and out of oscillation at a frequency determined by the values of L2, C5 and C6, this results in high sensitivity, and a slight background hiss. The latter ceases when a signal is tuned in.

Detection of the signal is arranged by TR2, the gate to source junction providing the actual rectification. The radio frequency choke, C8, C10 and R5 are provided to filter out any remaining r.f. before the audio is passed to the amplifier via R6 and C9.

Since we are using a fairly simple circuit we do not obtain the full benefits from the hi fi quality of f.m., the mode used on these sort of frequencies. Nevertheless good quality can be obtained by this method of slope-detection.

The upper limit to the frequency depends on the individual transistor used for TR2, and short wiring. For this reason a holder was used for TR2, and wiring kept as short as possible. It is therefore recommended that the front panel layout be followed as closely as possible.

AUDIO AMPLIFIER

The circuit of this section is also shown in Fig. 3 and is to the right of the dotted line.

Should a receiver for headphone reception be wanted, TR3, with C11, C12, R7 and R8 may be assembled on a small board or tag strip, and high impedance phones may be wired in place of R9. With the full amplifier, TR3 is the first a.f. stage, followed by TR4 to drive the complementary output pair TR5 and TR6. This provides enough volume for an 8 ohm or similar speaker fitted in the case. It would be possible to use headphones by adding an output jack socket, but caution should then be taken to keep VR2 turned well back.

This part of the receiver is wired on a board, afterwards fitted behind the speaker.

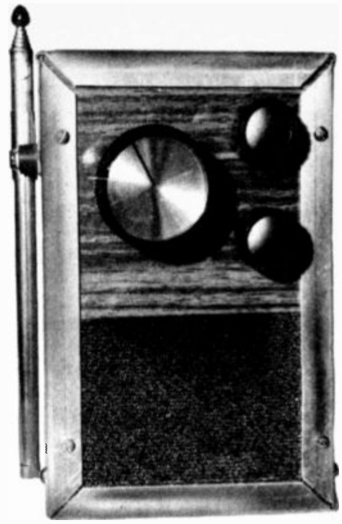
it can be connected to VR2.

If the layout is followed carefully, no difficulty should arise here. If wished, the amplifier can be tested by taking an audio input to R7/C11, keeping this quite low to avoid overloading.

A piece of insulating material is fixed to the back of the speaker with adhesive, as a precaution against short circuits, and the board is fixed by the long bolts previously described, and held with washers and lock nuts. Space is left for a PP3 9 volt battery at the side of the board.

Volume is controlled by VR2 in the usual way, but generally this will not be turned to maximum, and advancing VR2 too far may easily cause overloading with some signals.

The aerial actually fitted extends to about 86cm, but this is unnecessarily long for the higher frequencies. There is little adavantage in using a length of more than about $\frac{5}{8}$-wavelength at the working frequency. A dipole or similar aerial with a feeder can be used by closing the telescopic aerial and attaching the feeder conductors to receiver case and aerial. ⌑



Improved steady hand

When building the *Steady Hand Tester* in the July issue, I have found the following improvements can be made;

1. A switch can be included in the circuit so that sensitivity can be selected between high and low. In practice the switch is placed across VR1 and R1.
2. A switch can be included between the collector of TR3 and TL1. This will allow the buzz to be disconnected if it causes annoyance to other people.
3. A third switch can be included to provide a "panic" facility. In use the switch connects a potentiometer between the positive supply and the positive end of C1. When the unit is switched on, current will flow through the resistor and charge up C1. After a certain time the voltage on C1 will cause TR1 to conduct and operate the alarm. In this way a player is given a certain time to complete the course. Thirty seconds is a reasonable figure.

S.D. Lang,
Stepps,
Glasgow.

We thank you for your improvements to the Steady Hand Tester. *We are always pleased to hear from readers who find our projects interesting, and are able to improve them.*

It's not all electronics!

Electrician: Thats an old Volks Wagon you have there,

Car owner: Yes, but the problem is that the VW is only 6 volts,

Electrician: What! only 6VW, it must have a huge capacity.

A.W. West,
Potters Green,
Coventry.

The reason why

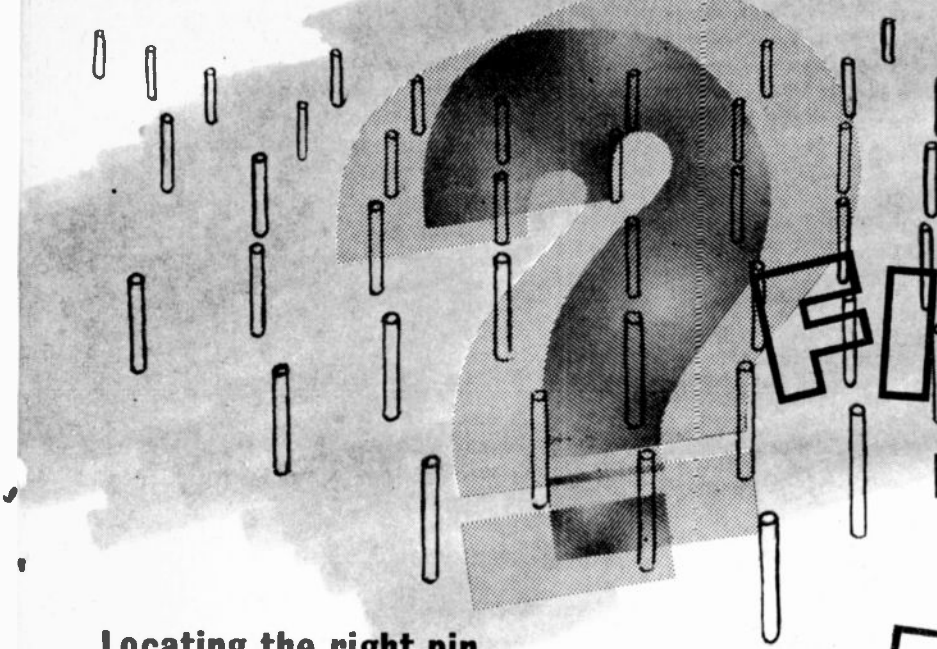
Like many readers I can only praise you on an excellent magazine, with quite an interesting and varied selection of projects. But, I feel I must say this, why oh why does some bright spark have to change the size of the magazine two thirds of the way through the year, expecially as I like many others have all six binders.

D. Walker,
Nottingham

Thank you for your recent letter, and fo the fine comments you make concerning our magazine.

Regarding your criticism of the change to a larger size, we agree with you that the timing was rather unfortunate. This was a decision made elsewhere, and was governed chiefly by the paper supply situation. As you will have noted, we have started a new volume (No. 7) with the September issue, and the new binder will accommodate 16 issues. Volume 8 will commence in January 1979, and then things should be back to normal, we hope!

JACK PLUG & FAMILY...



FIND THE PAIR!

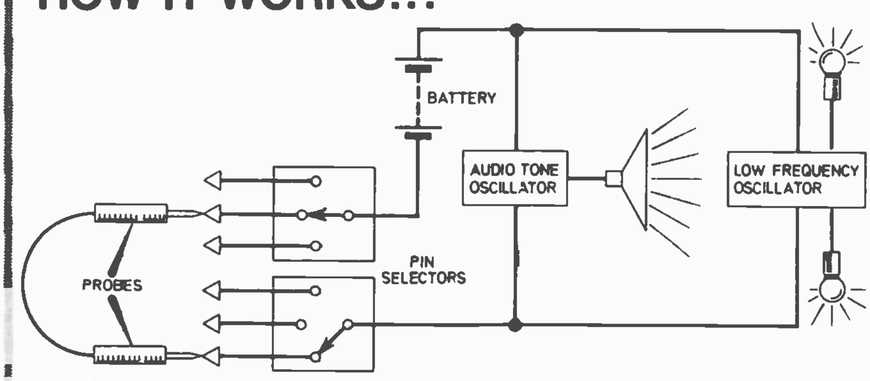
Locating the right pin combination will produce an audible tone and flashing lights

By F. G. Saddler

INTRODUCTION

THE ELECTRONIC game to be described here was originally designed to be used at school fetes as part of a fund-raising scheme. By all accounts it was very successful, a small prize being given to the person who found the pair. Use is made of two multivibrators, one operating a pair of lamps, the other operating a small loudspeaker to indicate a successful attempt. By using two multiway switches a large number of different pairs may be switched into the circuit, this of course being necessary so everyone who tries to find the pair has an equal chance, thus foiling the person with a good memory!

HOW IT WORKS...



This *Find The Pair* game consists of two oscillators connected in parallel. One oscillator will produce an audible tone while the other is wired to cause two lamps to flash on and off. Normally both oscillators are off. The probes are used to complete the circuit when they are in contact with the correct pair of pins (selected by the switches) which then results in the production of a tone and flashing lights.

START HERE FOR CONSTRUCTION

Construction can begin with the case. This has a size of 255 x 115 x 75mm, and is constructed from 3mm ($\frac{1}{8}$ inch) hardboard. The case is first constructed as a four-sided box, with wood or metal angle at each of the four corners.

Two pieces of wood are then screwed to each of the longer sides thus providing a mounting for the base. One open end now forms the top. This is covered with a sheet of Formica similarly fixed by two pieces of wood as before. The layout of the top panel really depends on the choice of the constructor and the size of components. For this reason no drilling dimensions have been given.

The matrix comprises a sheet of perforated board, 0·1 inch matrix, 16 x 33 holes. This is fixed to a small piece of wood 155 x 75 x 12mm, this being mounted on the Formica panel. A cut-out in the wood needs to be made to allow access to the pins on the board, a similar size cutout is also made in the Formica; the two panel lamps and the loudspeaker are similarly provided with holes in the Formica.

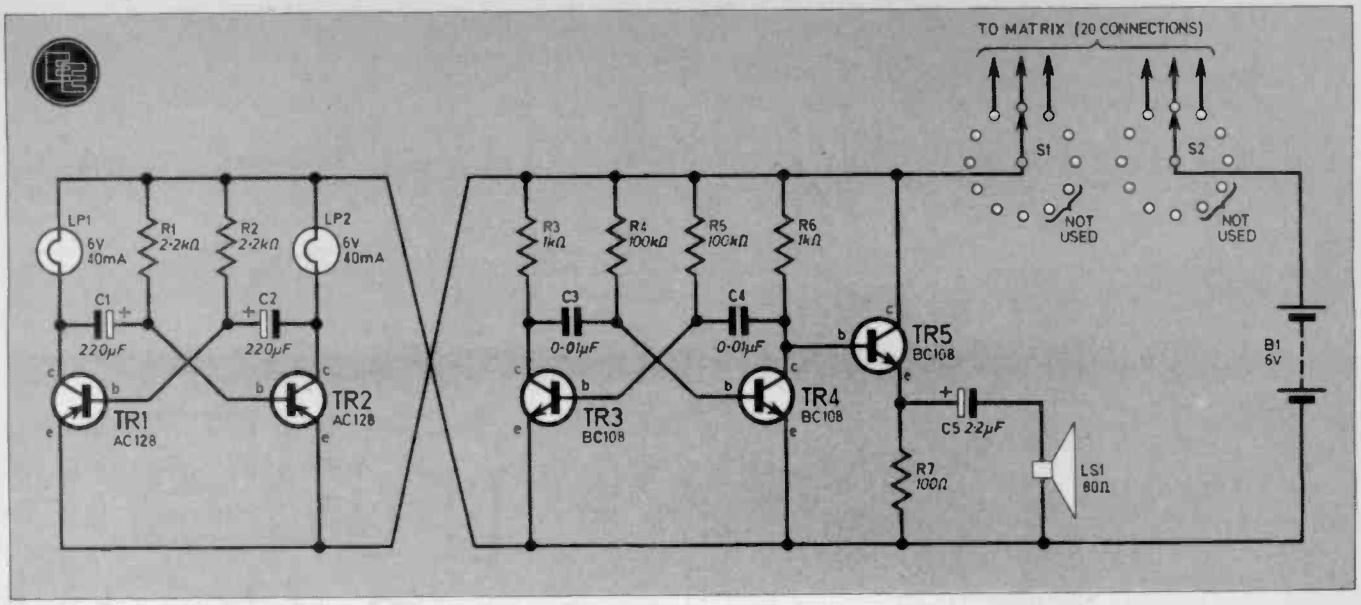


Fig. 1. The complete circuit diagram of the Find The Pair game.

CIRCUIT DESCRIPTION

The complete circuit for the game is shown in Fig. 1. It consists of two astable multivibrators, one driving a pair of lamps and the other a loudspeaker. The two separate multivibrators are similar in appearance but one uses *pnp* transistors and the other *npn*. Since the action of each is virtually similar apart from the voltages being opposite, the *npn* type, which is the most common, will be described. The operation of the second multivibrator will then be easily understood if the voltages are reversed.

When power is first connected to the circuit both transistors will begin to turn on, as both will be receiving base current via the appropriate resistor. However, due to component tolerances one will begin to turn on faster than the other, for the sake of this explanation we will assume that it is TR3 that turns on the faster.

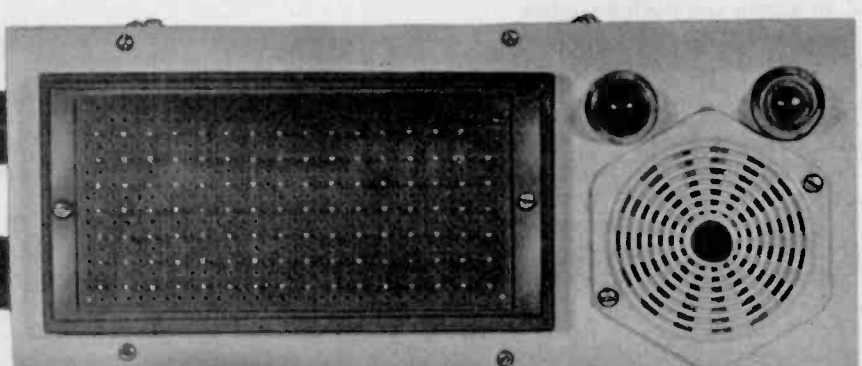
As it does so it will provide a negative signal to the base of TR4 via C3. This has the effect of turning TR4 off. TR3 thus turns hard on while TR4 is held in the off state. When the potential on the collector of TR3 has fallen to that of the negative supply voltage, obviously no further signal can be applied to the base of TR4 via C3. This capacitor therefore charges via R5 until about 0·65V is present at the base of TR4. TR4 then begins to turn on, in doing so a negative signal is applied via C4 to the base of TR3. This has the effect of turning TR3 hard off, the positive signal thus produced across R3 is fed by way of C3 to the base of TR4, turning it fully on.

Capacitor C3 then begins to charge through R4 and when about 0·65V is present at the base of TR3, TR3 begins to turn on. A regenerative action similar to that which has just occurred will now take place, except that it is TR3 which finishes hard on, and TR4 hard off.

It should now be possible to follow the action of the second multivibrator, only this time all the voltages are reversed when reading the above description.

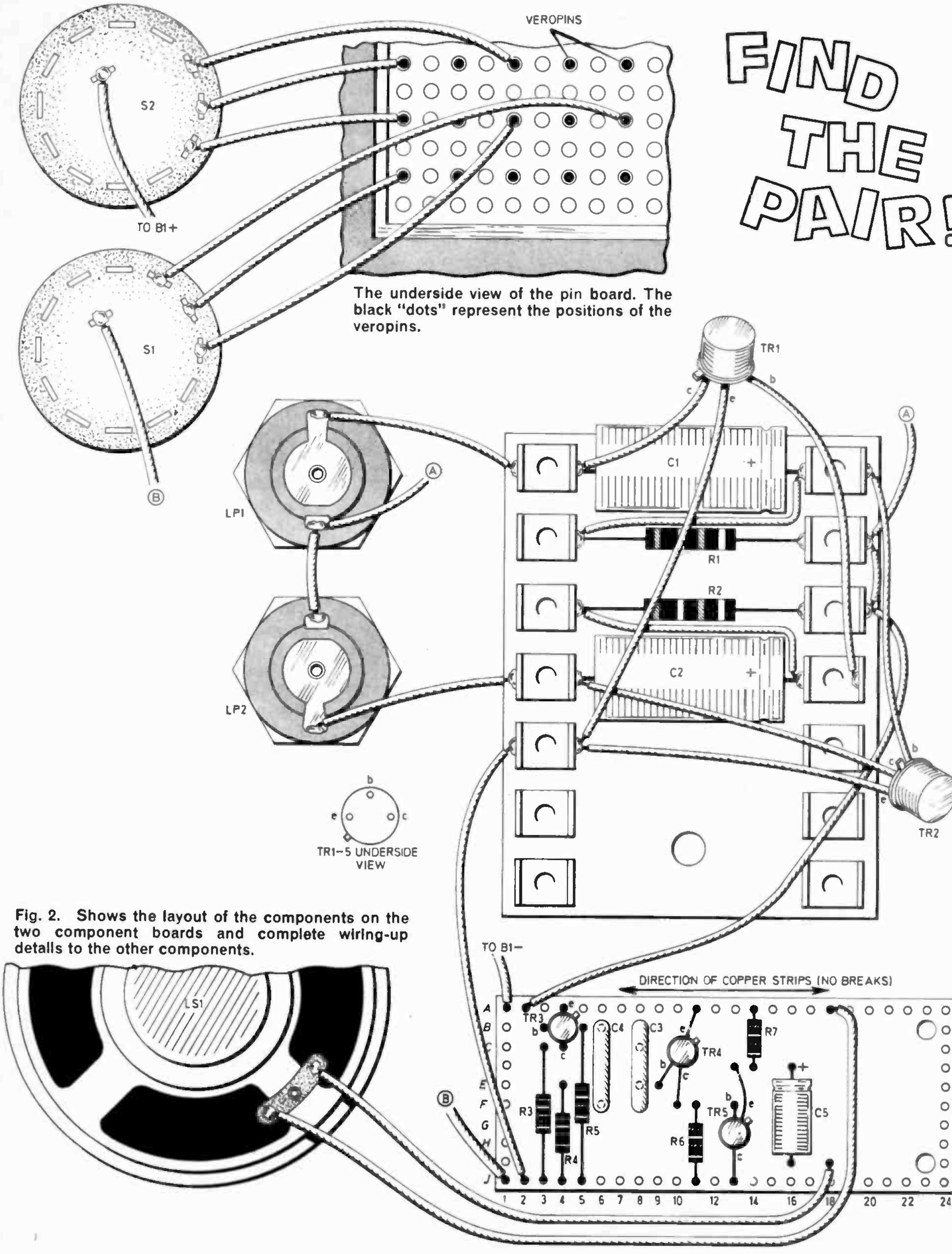
Transistor TR5 is a simple amplifier which is used to provide enough output to drive a small loudspeaker.

The supply to each multivibrator is applied via the two switches and the matrix of pins. Each switch is able to select up to ten different pins, we thus have a total of 100 pins which means 50 pairs. A very large number indeed, even for any "memory man"!



Photograph of the prototype unit showing layout of pin board, loudspeaker and lamps.

FIND THE PAIR!



The underside view of the pin board. The black "dots" represent the positions of the veropins.

Fig. 2. Shows the layout of the components on the two component boards and complete wiring-up details to the other components.

COMPONENTS

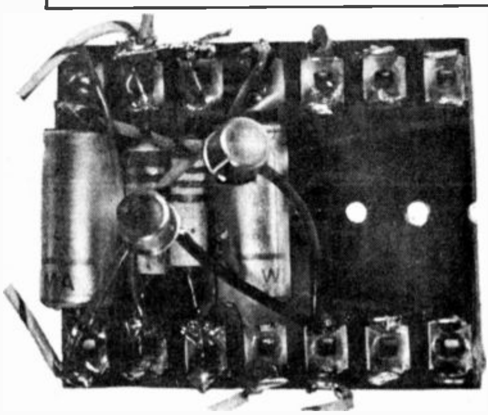
Resistors
R1 2·2kΩ
R2 2·2kΩ
R3 1kΩ
R4 100kΩ
R5 100kΩ
R6 1kΩ
R7 100Ω
All resistors are carbon ¼W ± 10%

Capacitors
C1 220μF 10V elect.
C2 220μF 10V elect.
C3 0·01μF polyester
C4 0·01μF polyester
C5 2·2μF 10V elect.

Semiconductors
TR1, 2 AC128 germanium *pnp*
TR3, 4, 5 BC108 silicon *npn*

Miscellaneous
S1, 2 1-pole 12-way rotary switch, two tags unused (2 off)
B1 PP1 6V battery
LS1 80 ohm 70mm round loudspeaker
LP1, 2 6V 40mA m.e.s. bulbs complete with lampholders (2 off)
Plain stripboard 0·1 inch matrix 16 × 32 holes; Veropins 112 off; two large round knobs; seven-way tagboard; stripboard 0·1 inch matrix, 10 strips × 24 holes; 1mm diameter sleeving for TR1 and TR2; material for case; hardboard, sizes as required, Formica for front panel, metal or wood brackets, four strips of softwood, block of wood 150×75×12mm; speaker grill (often used as airvents for cupboards); wood screws or glue as preferred for making case; connecting wire; battery clip; solder.

See Shop Talk Page 108



Photograph of the low frequency oscillator component board.

The general arrangement is shown in the photographs.

Sufficient space has been provided inside the case to mount the two multivibrators and a battery. The exact position of each is a matter of personal choice, the layout is not critical in any way.

As arranged in the prototype the two circuit boards are mounted by means of wood screws to the sides. A piece of wood may be mounted across the case to hold the battery in place, thus preventing it from damaging the electronics if it is knocked around too much.

The speaker may either be glued in place or as in the prototype solder tags were used, together with 6BA nuts and bolts to form clamps which hold the speaker in place without damaging it.

The two rotary switches are mounted at one end of the case, these being provided with two large knobs. The two multivibrators are built separately, one on tag board the other on a small piece of stripboard. All the necessary wiring is shown in Fig. 2.

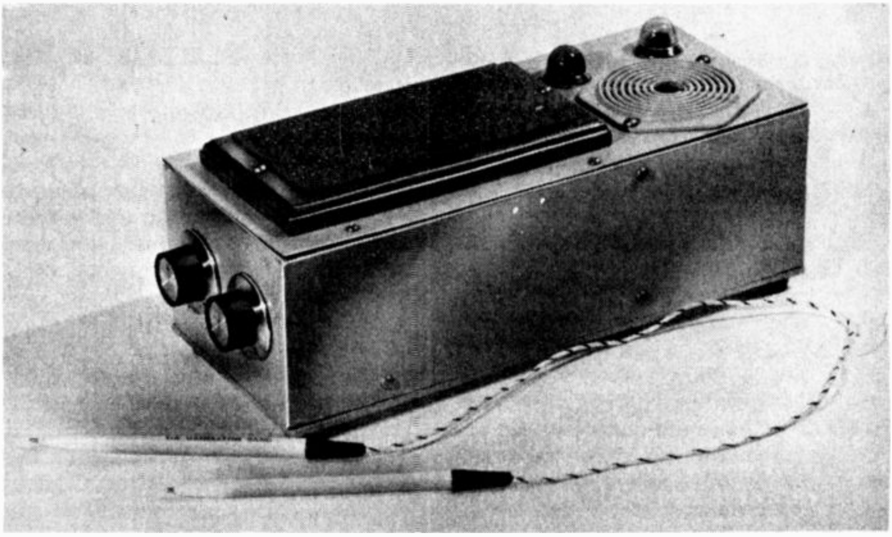
WIRING OF THE MATRIX

As shown in Fig. 2, only part of the matrix is shown. There is a total of 112 veropins mounted on the perforated board, in a pattern similar to that shown. There is a total of 20 connections to be made from the switches to the matrix, the exact wiring details are left to the constructor, six examples are shown. It might be a good idea to wire two or three pins together and take the connection to one tag of the switch, similarly with the other switch several pins may be wired together. This will then prove even more difficult to find the pair.

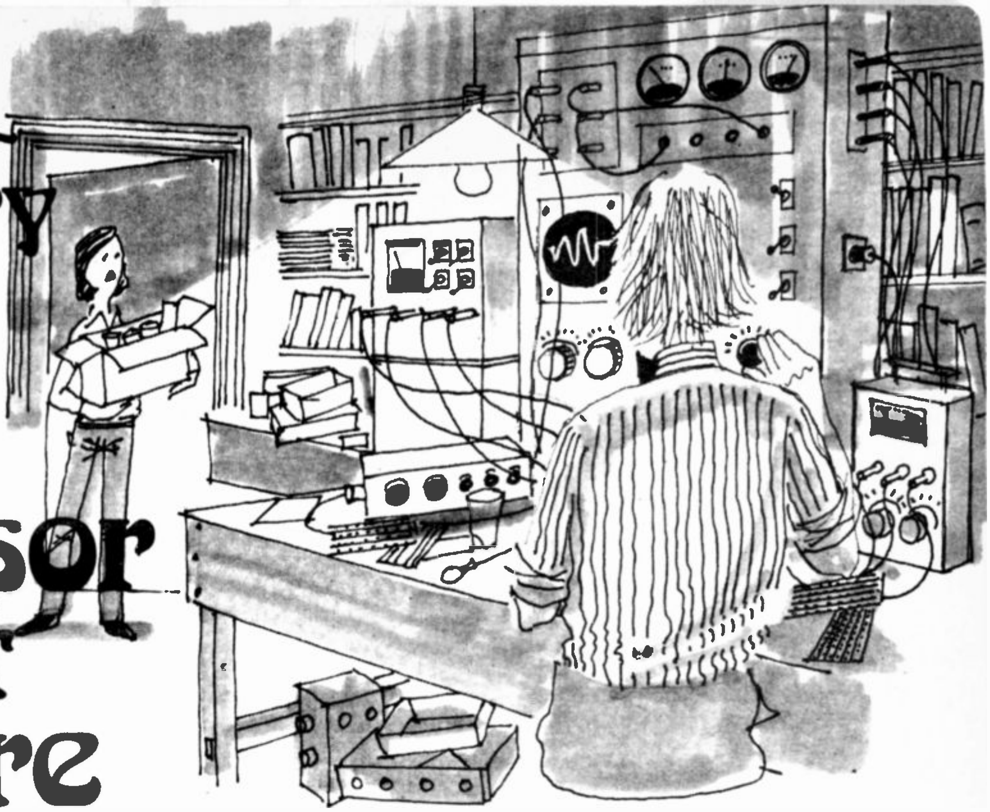
PROBES

The probes are made from discarded ball pens which have had the ink thoroughly cleaned away. A length of stranded insulated wire is then pushed down the inside of the ink container, the brass tip is temporarily removed and mounted in a vice to make soldering easier. The end of the wire is then carefully soldered to the tip. Once the soldered joint has cooled the pen can then be reassembled. The remaining end is constructed in a similar manner.

Finally the case is painted in a colour of the constructor's choice, after which the game is then ready to infuriate those who try to find the pair!



The Extra-ordinary Experiments of Professor Ernest Eversure



by Anthony John Bassett

BOB and the Prof. were repairing some electret condenser microphones. Whilst the Prof. went to investigate possible replacements for an unmarked faulty transistor which appeared to carry no means of identification other than a coloured splodge on top, Bob had connected the electret unit directly through to an audio amplifier by means of a length of screened cable.

He found that the microphone still worked quite well, but did not sound so natural as one where an f.e.t. pre-amplifier is used between the electret unit and the audio amplifier.

CABLE CAPACITANCE

"This is caused by the effects of the capacitance between the screen and the inner wire of the connecting cable, whereby the higher audio frequencies tend to be shunted to the screen and partially lost. Although you can compensate for this by turning up the treble control on the amplifier, the compensation is usually not accurate, and as you have just found, Bob, the microphone will still not sound so natural as one which is fitted with an f.e.t. pre-amplifier, even though there is plenty of treble sound present."

"What is so magical, then Prof., about these f.e.t.s? I thought that they just amplified the signal a bit, to give more volume without having any effect, good or bad, on the tone."

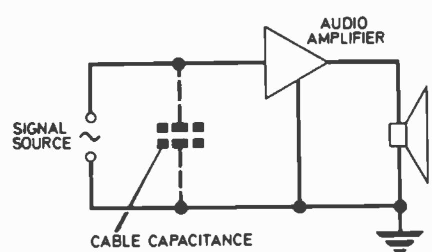


Fig. 1. A length of screened cable at the input of an amplifier acts as a capacitor (dotted) across the input.

"The f.e.t. pre-amplifier does not itself have much effect on the tone, Bob," the Prof. informed him, "but it does very effectively reduce the problems caused by cable capacitance. Let us first consider what these problems are, when you connect up a signal source such as this electret unit, to an amplifier, by way of a length of screened audio cable."

The Prof. drew a sketch. Fig. 1.

"The effect of the cable capacitance is so great that we may as well represent the cable, in this diagram, by way of a capacitor connected between the signal source and the amplifier. Now it is important to remember that the electret unit is not a very energetic signal source, but a very sensitive one.

"The sensitivity of the electret unit is achieved by use of a very thin diaphragm, typically only a few thousandths of a millimetre in thickness and this is what enables it to give a good audio response over the entire audible range. In graph form this is what an ideal response (A) would look like (Fig. 2), and the output of the electret unit conforms more closely to this than do most other microphones.

RESPONSE CURVES

"However if the electret unit is connected to a capacitive cable, or a capacitor as in this diagram (Fig. 1) it has to charge and discharge the capacitor at audio frequencies. This means at the higher audio frequencies, charging and discharging the capacitor several thousand times a second. As you know, Bob, each time a capacitor is charged it absorbs energy, and stores it. At higher frequencies the rate of absorption of energy by the capacitor is higher than at the lower frequencies of the same amplitude.

"At these higher frequencies the diaphragm simply does not receive sufficient energy from the audio vibration in the air, to charge the

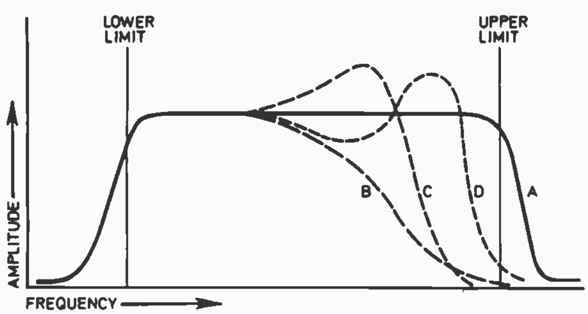


Fig. 2. Typical response curve (A) of an electret microphone. Curve (B) shows effect of capacitive loading each input lead and (C) and (B) the results of the attempts to reduce this effect by boosting the high frequencies by means of a treble boost control.

capacitor up to the voltage level represented by the ideal response curve.

"It needs an additional source of energy if this is to be achieved, and in these microphones the additional source of energy is usually a 1·5 volt cell. The release and disposal of this energy in order to achieve the desired response is controlled from the electret unit by means of the f.e.t. circuit."

The Prof. sketched out a few more response waves.

"When the electret unit is loaded by the cable capacitance, the resultant loss of high frequencies would make its response curve 'droop' at the upper end, like curve B, and when you try to compensate by turning up the treble controls, this usually improves matters. However, the action of the treble control on the amplifier is unlikely to match the action of any particular length of screened audio cable which you might happen to use, and the result will be a response curve with humps and dips in it (curves C and D), this does not sound quite so natural as the level curve. This is because the level of response signifies the least amount of interference with the sound which has been produced naturally."

IMPEDANCE

"Prof., I've quite often seen references to the use of f.e.t.s for conversion of signals from a high impedance source to a low impedance load, but here we do not seem to be doing this, as the microphone is connected to a high impedance input on the audio amplifier."

"Ah, but Bob, here, it is the connecting cable which is of low impedance at high frequencies due to the capacitance between the screen and centre wires, although the microphone will operate well into an amplifier input of low impedance, usually as low as 600 ohms or even 200 ohms.

"The concept of impedance can be the basis of a very useful form of 'intellectual shorthand' enabling people to interconnect complex items of electronic equipment without having to consider in detail, or even know, what they are really doing. This helps enormously by giving people more confidence in the handling and setting-up of electronic equipment whose technical operation they do not understand.

"It will be very interesting to relate your experiment, Bob, to the extremely useful concept of impedance. This concept of impedance is often in order to avoid description or detailed consideration of the various factors which limit the transfer of energy from one point to another. Factors such as capacitance, inductance, resistance, and mechanical factors such as friction, and inertia which are important in transducers such as the electret unit we have here.

"In these terms the electret unit is a high impedance signal source with a very limited current output. The input of the f.e.t. pre-amplifier is an almost ideal match for this, provided that it is connected with very short lengths of wire; and the 'source-follower action' at the output of the f.e.t. to match various lengths of cable, and loads of both high and low impedance with very little distortion or loss of high frequencies."

FOLLOWER CIRCUITS

"Prof. I have seen that there are quite a lot of books and magazine articles which describe this source follower action of f.e.t.s and I think I will have to study some of these a little more, as I did not know how such a simple circuit can compensate for various load impedances and conditions. This simple experiment has really given me food for thought!"

To be continued

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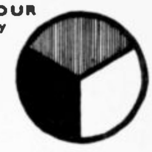

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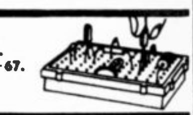

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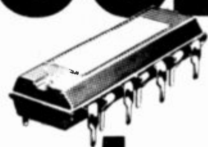

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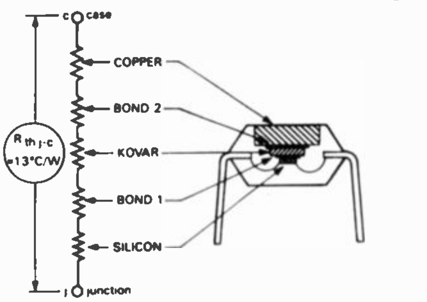

Standard plastic package with copper slug.

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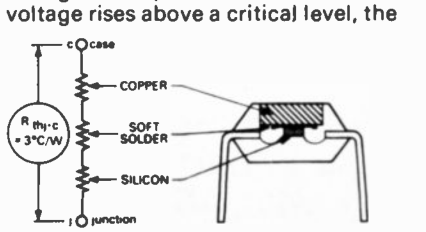

SOC20 plastic package with chip directly soft-soldered to copper slug.

drive is adjusted to bring the transistors within safe operating limits.

The amplifier can drive speakers of any impedance – maximum power will only fall outside the recommended 4 Ω – 8 Ω range.

And *any* pin on the chip may be shorted to *any* voltage in the system for *any* length of time . . . and *no* damage will occur!

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Specification

Maximum supply voltage
± 22 V (44 V total)
Output power
20 watts continuous 4 Ω or 8 Ω
Open loop gain
100 dB
Supply voltage rejection
50 dB
Input noise voltage
4 nV
Number of transistors
18

Supplied with free printed circuit board, heat sink mounting bracket, comprehensive instructions, and suggested applications.

The SOC20 will work on any supply from 12-44 volts and therefore can be used for in-car as well as domestic applications. Apart from its obvious audio uses the fact that it is DC coupled throughout makes it ideally suited for servo systems – in radio-controlled models for example.

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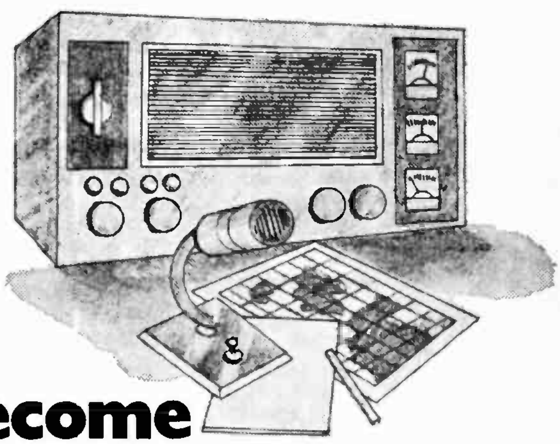

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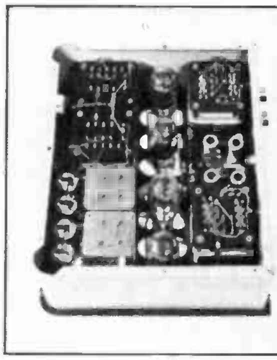

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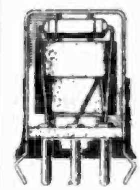

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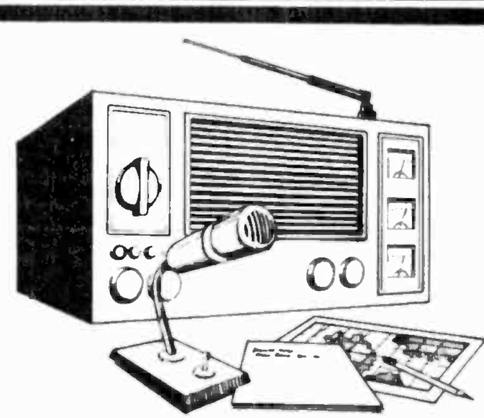

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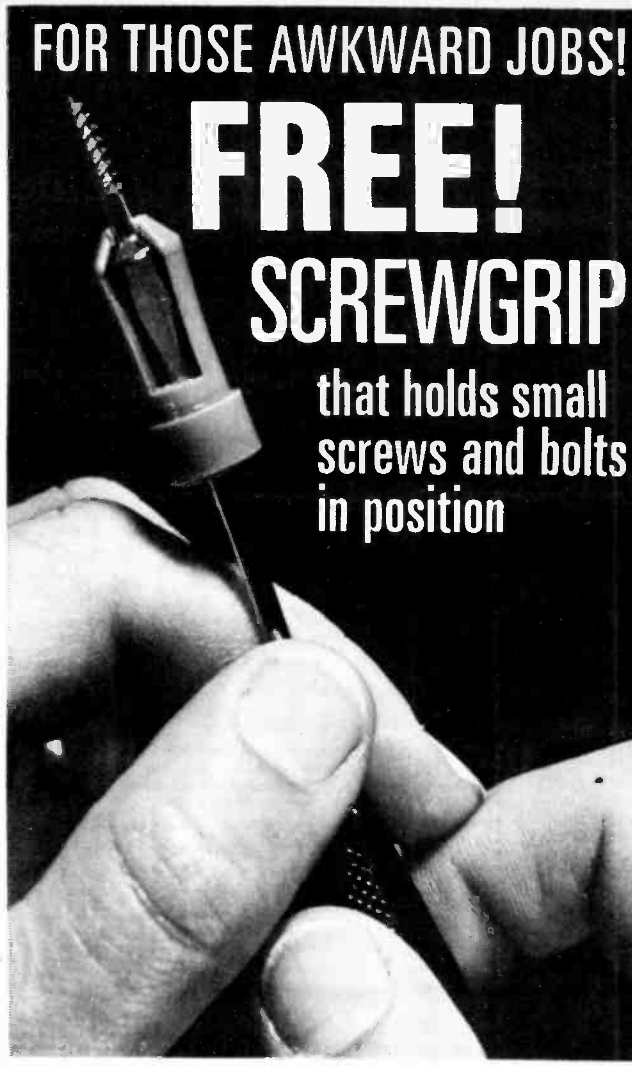

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TAA550	·60
TAA560	1·75

TAA570	2·30
TAA611B	1·85
TAA621	2·15
TAA661A	1·50
TAA661B	1·50
TAA700	3·91
TAA930A	1·30
TAA930B	1·30
TAD100	1·95
TBA120	·75
TBA400	2·00
TBA500	2·21
TBA500Q	2·30
TBA510	2·21
TBA510Q	2·30
TBA520	2·21
TBA520Q	2·30
TBA530	1·98
TBA530Q	2·07
TBA540	2·21
TBA540Q	2·30
TBA550	3·13
TBA550Q	3·22
TBA560Q	3·22
TBA570	1·29
TBA570Q	1·38
TBA641B	2·70
TBA651	2·20
TBA700	1·52
TBA700Q	1·61
TBA720Q	2·30
TBA750	1·98
TBA750Q	2·07
TBA800	1·25
TBA810	1·25
TBA820	1·25
TBA920	2·90
TBA920Q	2·99
TBA940	1·62
TCA160C	1·85
TCA160B	1·61
TCA270	2·25
TCA280A	1·30
TCA290A	3·13

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Built and tested—requires only switches and transformer to complete. 12 or 24hr alarm modules.

MA1002E 12 hr 5in display	£10·90
MA1002H 24hr 5in display	£10·90
MA1010E 12hr 84in display	£14·50
MA1010G 24hr 84in display	£14·50

CAR CLOCK MODULE
MA1003 Built Tested 12V supply and four-digit module. Crystal controlled 17·00. Data Sheet 5p + SAE.

DIODES

AA116	0·12	BA158	0·38	BYX10	0·27	IN4005	0·10
AA118	0·12	BA159	0·51	OA47	0·13	IN4006	0·11
AA119	0·14	BA202	0·09	OA90	0·08	IN4007	0·12
AA129	0·09	BAX13	0·07	OA91	0·08	IN4148	0·07
AAZ17	0·18	BAX16	0·10	OA95	0·10	IN4150	0·19
BA100	0·18	BB103	0·30	OA200	0·10	IN5400	0·14
BA102	0·18	BB104	0·40	OA202	0·14	IN5401	·165
BA144	0·12		0·30	IN914	0·07	IN5402	·175
BA145	0·18	BY126	0·29	IN916	0·07	IN5404	·185
BA154	0·10	BY127	0·38	IN4001	0·06	IN5406	·225
BA155	0·12	BY182	1·50	IN4002	0·07	IN5407	0·27
BA156	0·15	BY206	0·20	IN4003	0·08	IN5408	0·40
BA157	0·29	BY207	0·22	IN4004	0·09	IS44	0·07

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Full range of Opto devices in our New Catalogue

LEDS
Til 209 19p 100 + pcs 12p
3mm Red **18p**, Green **25p**, Yellow **25p**
5mm Red **21p**, Green **26p**, Yellow **25p**
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DL747	2·50	3·40	·5″ Red
DL750	2·50	3·40	·5″ Red

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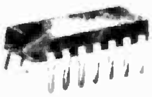
74C00	0·26	74C85	1·90
74C02	0·26	74C86	0·68
74C04	0·26	74C90	0·91
74C08	0·26	74C107	1·30
74C10	0·28	74C151	2·62
74C20	0·26	74C157	2·35
74C30	0·26	74C160	1·18
74C32	0·26	74C161	1·18
74C42	0·92	74C162	1·18
74C48	2·30	74C163	1·18
74C73	0·58	74C164	1·04
74C74	0·69	74C173	0·95
74C76	0·58	74C174	0·95

LOW PROFILE SKTS

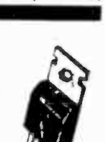
		18 pin	0·27
		22 pin	0·30
8 pin	0·15	24 pin	0·35
14 pin	0·16	28 pin	0·45
16 pin	0·18	40 pin	0·55

CMOS LOW POWER SCHOTTKY



CD4000	0·24	CD4018	1·15	CD4041	0·96	CD4059	5·45	CD4081	0·25	74LS02	0·24	74LS138	1·27
CD4001	0·24	CD4019	0·70	CD4042	0·96	CD4060	1·27	CD4082	0·25	74LS04	0·27	74LS151	1·13
CD4002	0·24	CD4020	1·27	CD4043	1·15	CD4063	1·25	CD4085	0·81	74LS08	0·24	74LS157	1·17
CD4006	1·34	CD4021	1·15	CD4044	1·05	CD4066	0·80	CD4086	0·81	74LS10	0·24	74LS160	1·40
CD4007	0·24	CD4022	1·10	CD4045	1·59	CD4067	4·25	CD4089	1·77	74LS13	0·65	74LS161	1·50
CD4008	1·10	CD4023	0·24	CD4046	1·52	CD4068	0·25	CD4093	0·91	74LS32	0·25	74LS162	1·50
CD4009	0·64	CD4024	0·84	CD4047	1·15	CD4069	0·25	CD4094	2·13	74LS42	1·01	74LS162	1·50
CD4010	0·64	CD4025	0·24	CD4049	0·64	CD4070	0·65	CD4095	1·19	74LS74	0·48	74LS163	1·50
CD4011	0·24	CD4027	0·64	CD4050	0·64	CD4071	0·25	CD4096	1·19	74LS75	0·60	74LS164	1·52
CD4012	0·24	CD4028	1·02	CD4051	1·06	CD4072	0·25	CD4510	2·00	74LS76	0·40	74LS173	2,35
CD4013	0·60	CD4029	1·30	CD4052	1·06	CD4073	0·25	CD4511	2·30	74LS85	1·45	74LS174	1·20
CD4014	1·15	CD4030	0·64	CD4053	1·06	CD4075	0·26	CD4516	2·00	74LS86	0·48	74LS175	1·20
CD4015	1·15	CD4031	2·53	CD4054	1·32	CD4076	1·17	CD4518	2·00	74LS90	1·00	74LS	
CD4016	0·64	CD4035	1·34	CD4055	1·50	CD4077	0·66	CD4520	2·00	74LS92	0·90		
CD4017	1·15	CD4037	1·10	CD4056	1·50	CD4078	0·25	74LS00	0·24	74LS107	·44		

TRIACS plastic pack 400V



6 Amp	0·70	16 Amp	1·10
8 Amp	0·75	20 Amp	1·70
12 Amp	0·85	25 Amp	2·00

THYRISTORS Plastic C106 118

4A 100V	0·35	8A 100V	0·43	12A 100V	·57
4A 200V	0·40	8A 200V	0·49	12A 200V	·65
4A 400V	0·49	8A 400V	0·62	12A 400V	·81

VOLTAGE REGULATORS

500mA TO202 Positive 5, 12, 15, 24v	1·10
500mA TO202 Negative 5, 12, 15, 24v	1·05
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1 Amp TO220 Negative 5, 12, 15, 24v	2·00

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·1 MATRIX COPPER BACKED BOARD

2·5″ x 5″	50p	3·75″ x 5″	55p
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Stand £1·40 Mod x 25 25 watt	£3·40
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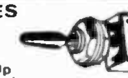
SWITCHES



SPST 60p
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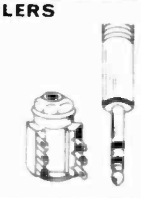

	PL.	SK.	Line
DIN 2 pin loudspeaker	10p	7p	10p
3, 4, 5, 6, 7 pin	15p	12p	15p
COAX Standard T.V.	10p	10p	30p
PHONO. Red, Bl., Wh., Gr. Yel	10p	7p	10p
JACK ¼″ mono plastic	16p	20p	20p
¼″ mono screened	25p	—	30p
¼″ stereo plastic	25p	25p	25p
¼″ stereo screened	35p	—	45p
3·5m standard	10p	12p	10p
2·55m standard	10p	10p	—
MAINS USA 2 pin flat	15p	15p	15p

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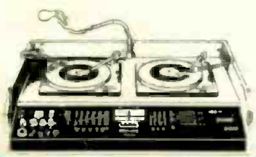
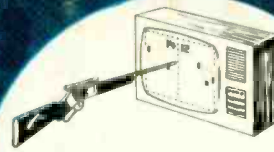
100W RMS STEREO DISCO

A genuine 100W RMS per channel (Both channels driven) stereo disco with auto fade on microphone, VU meters, full monitoring and cueing facilities and a very high quality light show. Complete constructor booklet MES41 price 25p. Cabinet comes complete with lid and carrying handles.





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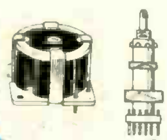

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