

An exciting hobby.... for everyone

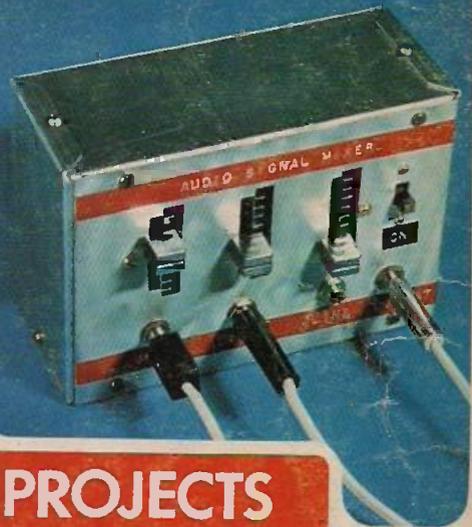
everyday electronics

JULY 73
15p



Replica Crystal Set

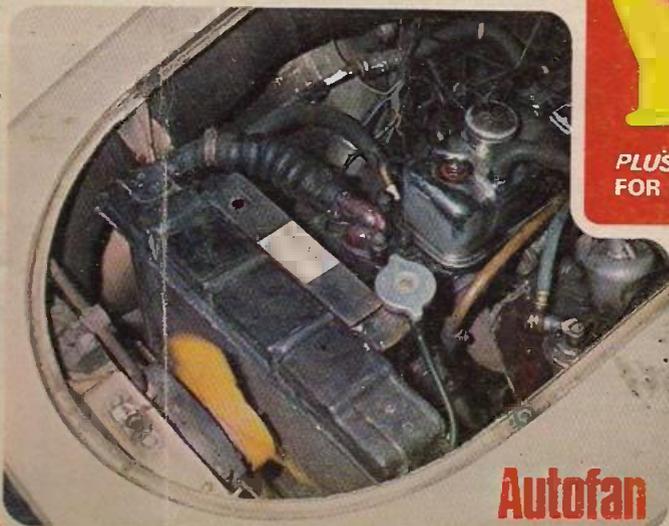
Audio Signal Mixer



SIMPLE PROJECTS
FOR

YOU!!!

PLUS INTERESTING AND HELPFUL FEATURES
FOR ALL HOME CONSTRUCTORS



Autofan

**FREE
COMPETITION**
... Last chance
to enter!

Build yourself a TRANSISTOR RADIO

WITH AFTER SALES SERVICE

ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS ALSO AIRCRAFT BAND

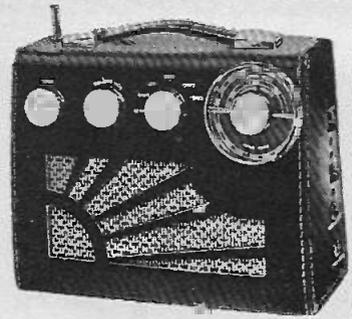
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Fine tone moving coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

Total building cost

£9.35

P. P. & Ins. 52p

Overseas P. & P. £1.05



ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mw transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost **£7.68** P. P. & (Overseas P. & P. £1.05) Ins. 47p.

ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts).

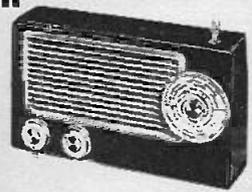
Total building costs **£6.58** P. P. & (Overseas P. & P. £1.05) Ins. 47p.



ROAMER SIX

8 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—5 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Easy build plans and parts price list 25p (FREE with parts).

Total building costs **£4.38** P. P. & (Overseas P. & P. £1.05) Ins. 31p



POCKET FIVE

8 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, super-sensitive ferrite rod aerial. Fine tone moving coil speaker. Attractive black and gold case. Size 5 1/2 x 1 1/2 x 3/4in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs **£2.50** P. P. & (Overseas P. & P. 65p) Ins. 24p

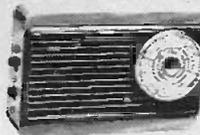


TRANSONA FIVE

5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 5 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs **£2.75** P. P. & (Overseas P. & P. 65p) Ins. 25p

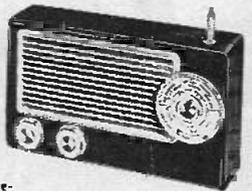


TRANS EIGHT

8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

Total building costs **£4.95** P. P. & (Overseas P. & P. £1.05) Ins. 33p



"EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT.

COMPONENTS INCLUDE:
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: 2 Plugs and Sockets: Battery Clips: 4 Tag Boards: Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three 1/2" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and easy build plans 25p (FREE with parts).

All parts including **£6.05** P. P. & Case and Plans Ins. 33p



(Overseas P. & P. £1.05,

FULL AFTER SALES SERVICE

Callers side entrance "Lavelis" Shop
Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.
PLEASE NOTE: ALL PRICES INCLUDE VAT

RADIO EXCHANGE CO

61a HIGH ST., BEDFORD, MK40 1SA. Tel. 0234 52367
Reg. no. 788372

I enclose £..... please send items marked.

ROAMER TEN	<input type="checkbox"/>	ROAMER SEVEN	<input type="checkbox"/>
ROAMER EIGHT	<input type="checkbox"/>	TRANS EIGHT	<input type="checkbox"/>
TRANSONA FIVE	<input type="checkbox"/>	ROAMER SIX	<input type="checkbox"/>
POCKET FIVE	<input type="checkbox"/>	EDU-KIT	<input type="checkbox"/>

Parts price list and plans for

Name

Address

(Dept. E.E.21.)

* In addition to telling you about our Catalogue each month we would like to bring to your notice one or two items which we believe are **UNIQUE TO HOME RADIO (Components) LTD.**

To start off here is the

'ERSA' SPRINT IRON

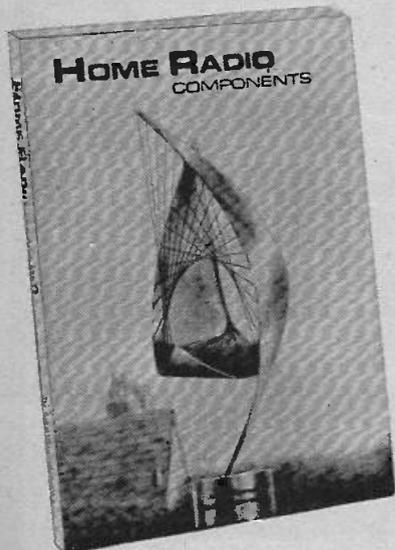
We carry complete spares, right down to the last nut and bolt, even spare mains leads. Our price for this desirable object is only £3.98 plus 18 pence p & p. Essentially this is a tool for the field service engineer or the handyman and experimenter wishing to make a few quick joints. A constructor building something with a large number of joints might find a conventional iron quicker.

To our knowledge this remarkable iron has been in use on the Continent for over ten years. It has several unusual features:

- 1 Heats up in 10 seconds!
- 2 Weighs only 5 ounces.
- 3 Parts can be changed in seconds.
- 4 Can be used on anything from a transistor upwards.

(A friend of ours used one to repair his water tank. We think this is asking too much!)

The "ERSA" SPRINT IRON is just one of the many exciting things to be found in the famous 250-page Home Radio Components Catalogue. No less than 6,785 electronic components are listed and indexed, and 1,750 items are illustrated. A free bookmark with a useful list of technical abbreviations is included. The catalogue costs 55p plus 22p post and packing. Every copy contains 10 vouchers each worth 5 pence when used as directed. Regularly updated price lists are supplied to you free.



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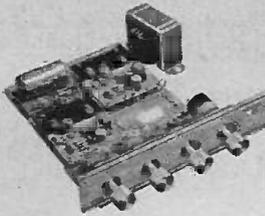


QUALITY STEREO AT BUDGET PRICES!

The STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm x 14 cm x 5.5 cm. This compact unit comes complete with on/off switch, volume control, balance, bass and treble controls. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak Input 1 (Cer.) 300mV into 1M Freq. res. 25Hz-25kHz Input 2(Aux.) 4mV into 30K Harmonic distortion Bass control ± 12 dB at 80Hz typically 0.25% at 1 watt Treble con. ± 14 dB at 14 kHz

£13.48 free p. & p.



STABILISED POWER

MODULE SPM80

£3.25

AP80 especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. Embodies latest circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, will provide outputs of up to 1.5 amps at 35 volts. Size: 63 mm x 105 mm x 20 mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Ideal for many other applications including—Disc Systems, Public Address, Intercom Units, etc. Handbook available. 10p.

TRANSFORMER BMT80 £2.15 p. & p. 27p.

AL50 HI-FI AUDIO AMP 50W pk 25 (RMS)

0.1% DISTORTION

- Frequency Response 15Hz to 100,000—1dB.
- Load—3, 4, 8 or 16 ohms.
- Supply voltage 10-35 Volts.
- Distortion—better than 0.1% at 1kHz
- Signal to noise ratio 80dB.
- Overall size 63 mm x 105 mm x 13 mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry the AL50 was conceived to fill the need for all your A.F. amplification needs. FULLY BUILT—TESTED—GUARANTEED.

BRITISH MADE only £3.58 each

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise FNP devices for use in the input stages. Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION:

Frequency response 20Hz—20kHz ± 1 dB
Harmonic distortion better than 0.1%
Input 1: Tape head 1-25mV into 50K Ω
2. Radio, Tuner 35mV into 50K Ω
3. Magnetic P.U. 1-5mV into 50K Ω

Bass control
Treble control
Filters: Rumble (high pass)
Scratch (low pass)
Signal/noise ratio
Input overload
Supply
Dimensions

± 15 dB at 20Hz
 ± 15 dB at 20kHz
100Hz
8kHz
better than +55dB
+26dB
+35 volts at 20mA
292 x 82 x 35 mm.

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1 dB from 20Hz to 20kHz.

SPECIAL COMPLETE KIT COMPRISING 2 AL50's,
1 SPM80, 1 BMT80 & 1 PA100 ONLY £25.30 FREE p. & p.

only £13.15



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Pack 107 5 pin Din	22p
Pack 108 3 pin Din	20p
Pack 135 2 1/2 Jack	27p
Pack 130 2 1/2 Jack Stereo	50p
Pack 103 Loudspeaker Plug 17p	
Pack 100 Phono Plug	7p
Pack 230 3 pin Socket	25p
Pack 236 5 Pin Socket	33p
Pack 234 L/speaker Socket	33p
READY MADE LEADS	
3 pin to 3 pin Din	70p
3 pin to open end	55p
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5 pin to open end	70p
5 pin to 4 phono plugs	£1
Speaker lead Din to spade 12ft.	40p
Extension lead Din plug to socket 12ft.	70p
All leads approx. 6ft. in length.	
DIAMOND STYLI	
(Send SAE for complete list)	
8TA; 9TA; 9TAHC; GP91;	
ST4; ST9; EV26; GCB	
All at 80p each.	
Double Diamond £1.25.	
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HEADPHONES	
Sennheisser HD414	£10.60
AKG K50	£6.50
Beyer DT485	£35.00
RECORD CARE	
Cecil Watts Dust Bug	£1.20
Parastatic Disc Preener	45p
Antistatic Fluid	20p
Dust Bug Spares (Brush & Roller)	15p
Prices inc VAT and Post.	
CASSETTE TAPES	
Audio-Magnetics C60	
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£1.00 £1.90 £3.20 £6.30	
Cassette Caddy £1.20	
Cassette Head Cleaner 35p	
ZONAL ILFORD TAPE	
5" Standard 600ft	25p
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7" Reel of Leader Tape (Blue of green)	75p
MICROPHONES	
AKG D109	£11.50
AKG D202E1	£39.50
AKG D190C	£17.00
AKG D190E	£18.20
AKG D224	£50.00
Sennheisser MD211N	£45.00
Sennheisser MD413N	£27.00
Sennheisser MD421N	£35.00
Audio RMS7F Radio Mike	£210.00
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E.M.I. 350 Kit 8 ohms	£8.20
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Orbit NM22	£4.00
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Sonotone 9TAHC (Dia)	£2.00
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YES, "YOU'VE GOT THE WHOLE WIDE WORLD IN YOUR HANDS"!! ALMOST UNBELIEVABLE! Think of the year 1984 and what might be produced then—now get the fantastic **ASTRAD 17** and **SEE** for yourself that the incredible Russians have done it all **NOW!** It's the radio perfectionist's dream come true! **THIS ONE SUPERSEDES ALL EARLIER MODELS!** It will probably make your present radio seem like a "crystal set"! Complete with optional battery eliminator for both battery and mains use! We're almost giving them away at only **£18.50**—a mere fraction of even today's Russian miracle price! We challenge you to compare performance and value with £80 radios! Send quickly after receiving goods test 7 days, refund if not delighted. Elegant black & chrome finish fascia, set in fabulous Cabinet built case—constructed of fine Russian hardwood in beautiful Teak Veneer finish—prevents vibration, ensures purer and sweeter tone than ever! Volume controlled from a whisper to a roar that would fill a hall! Much wider band spread, for absolute "pin-point" station selection! Plus "MAGIC EYE" tuning level indicator for ultra perfect tuning sensitivity! Yes, the Russians have surpassed themselves, proving again their fantastic ability in the field of electronics and brilliantly reflecting their advanced micro-circuitry techniques, in the field of space communications. **YES, EVERY WAVEBAND** instantly at your fingertips includes Standard Long, Medium, Short, and Ultra Short Waves to cover the four corners of the earth during 24 hours a day including all normal transmissions. VHF: FM/USW, AM: LW, MW, SW, gets, locally, local and new stations not yet operational, and messages from all over the world! Expensive **TURRET TUNER** side control waveband selection unit (as used on expensive T.V.'s!) Every waveband clicks into position giving incredible ease of station tuning! Genuine push-pull output! ON/OFF volume and separate Treble and Bass tone controls for utter perfection of reproduction and tone! Press-button dial illumination! Take it anywhere—runs economically on standard batteries or direct through battery eliminator from 220/240V AC mains supply. Internal ferrite rod aerial plus built-in "rotatable" telescopic aerial extending to 39 ins approx. It's also a fabulous **CAR RADIO**. Can also be used through extension amplifier, tape recorder or public address system. **SIZE** 14ins x 10½ins x 4½ins overall approx. Magnificently designed, made to give years of perfect service. (U.K. service facilities and spares available for years and years to come, if ever necessary!). With **WRITTEN GUARANTEE** manual with simple operating instructions and circuit diagram. **PLUS** ultra sensitive earphone for personal listening. **ONLY £18.50** (with mains/battery eliminator £2.00 extra). **BOX, POST, ETC. 45p**—**NO MORE TO PAY, BUT WAIT!** for only 75p extra you get the sensational "COMPUTERISED" **WORLD TUNING GUIDE** (it enables you to time, pinpoint & get transmissions the whole world over—even a child can do it in a flash—it even lets you know when to tune into the U.K., when abroad. (NO GUESSING/NO MESSING)!) **PLUS** Standard "longlife" batteries (Sorry—We cannot change these new radios for any earlier model purchased.)

THOUSANDS OF MILES REDUCED TO INCHES? 1973 RUSSIAN RADIO TECHNOLOGY SHRINKS THE WORLD! COMPUTERISED?



BRAND NEW FABULOUS **ASTRAD 17** PORTABLE RADIO & COMMUNICATIONS RECEIVER



28 TRANSISTORS AND DIODES!
WAVEBANDS:
STANDARD LONG and MEDIUM
Plus 5 SHORT WAVEBANDS
Plus ULTRA SHORT WAVES
(V.H.F. AM, FM, MW, LW, USW.)

*** MUST YOU PAY UP TO £80?**

FIRST TIME EVER!
*NOW AVAILABLE WITH fabulous **COMPUTERISED** **WORLD TUNING GUIDE!** NO MORE GUESSWORK! INSTANT DATA at your fingertips—enables you to **TUNE IN A FLASH** to transmissions the world over!

THIS OFFER ONLY FROM US!

BATTERY MODEL **£18.50** **BOX POST ETC. 45p**
MAINS/BATTERY ELIMINATOR £2 extra

BUY ONE FROM US! **fabulous BRAND NEW** **SAVE £21.60 NOW!** **SOLID STATE** **this equipment's got EVERYTHING!**

BATTERY/MAINS AC Combined V.H.F. AM/FM RADIO and CASSETTE TAPE RECORDER & PLAYER

WITH REMOTE CONTROL MICROPHONE **RECOMMENDED RETAIL PRICE £44** **OUR PRICE £22.40** **CARR ETC 39p**

Shopertunities "thunder" ahead with an offer that's FANTASTIC (even by our standards). We've snapped up 500 magnificent machines. Latest sensation in the world of sound! First-class makers! Fabulous VHF, AM/FM Radio AND Cassette Tape Recorder & Player combined and it also runs off standard batteries or mains. (Simply plug in the 220/240V. AC line cord.) Record and play back anything, anywhere! **RECOMMENDED RETAIL PRICE GENUINELY 44! WE OFFER AT ALMOST HALF PRICE!** Wonderful features: Press-button Keyboard Control Panel or latest MASTER SWITCH CONTROL! * "MAGIC EYE" Visual Battery check/recording level indicator or built-in automatic Leveller! * Separate ON/OFF and HI-LO volume controls! * Heavy duty built-in speaker! * Earphone (for personal listening or "monitoring") and extension speaker sockets! * Remote control microphone! * Built-in swivel telescopic extension aerial (24in. approx.)! Magnificently made case with carry handle. (DESIGNS VARY SLIGHTLY.) Takes standard 30, 60, 90 or 120-minute Cassette Tapes obtainable everywhere. AND the amazing built-in full circuit VHF, AM/FM Radio gives you superb clarity of tone, incredible station selection. Unique rotating Station Selector Dial—gets, locally, city and regional stations in every part of the country, plus B.B.C. National, VHF. Picks up dozens of foreign stations. Fabulous in your car! You could pay £46 more for a Car Radio or Car Cassette player **ALONE!** **OUR FANTASTIC PRICE ONLY £22.40, carr. etc. 39p—NO MORE TO PAY!** Complete with simple instructions, remote control microphone with on/off switch and microphone stand. **WITH WRITTEN GUARANTEE.** Send quickly, after receiving goods—test 7 days on mail order approval—refund if not delighted. **BONUS:** Batteries and Cassette Tape 28p extra if req.

FIRST TIME EVER! SAVE £15.21! **BRAND NEW AC/DC BATTERY/MAINS**

Cassette TAPE RECORDER & PLAYER **FIRST CLASS MAKERS**

With remote control microphone. **WE COULD CHARGE UP TO £26.97!** **OUR PRICE £11.76** **POST ETC. 34p**

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COMMERCIAL TRAVELLERS Please note: Merchandising office at our Holborn Store. (PERSONAL SHOPPERS WELCOME AT BOTH STORES).

SHOPERTUNITIES LTD.

Also at 37/39 HIGH HOLBORN (opposite Chancery Lane), LONDON, W.C.1. (Thurs. 7) BOTH OPEN MON. TO SAT. 9 until 6.

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220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2 1/2 x 2 x 2 1/2. \$1.85 each.



NEED A SPECIAL SWITCH

Double Leaf Contact. Very light pressure closes both contacts. 8p each. 10 for 80p. Plastic pushrod suitable for operating. 6p each. 10 for 54p.



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with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £8.85 plus 25p post and insurance.



MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 0v, 9v, 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PE3, PF4, PF6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only \$1.10, plus 20p postage.



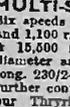
MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—3 pole, 6 way—1 pole, 12 way. All at 22p each.



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Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil can't reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator and are able to offer them about half of the original list price. 85p per (8 oz.) can or 12 cans for £8 post paid. The lubricant is I.C.I. Snon L189.



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Six speeds are available 600, 850 and 1,100 r.p.m. and 8,000, 12,000 & 15,000 r.p.m. Shaft is 3/8 in. diameter and approximately 1 in. long. 220/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia x 3 in. long. Price 97p plus 23p postage and insurance.



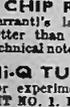
MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 65p. Postage 20p for first one then 10p for each one ordered. 1 1/2 stackmotor 94p. 1 1/2 stackmotor £1.10.



15A ELECTRICAL PROGRAMMER

Learn in your sleep: Have record playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 16 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2.15 + 20p p & p or with glass front chrome bezel 85p extra.



F CHIP RADIO

Perranti's latest device ZN414—gives results better than superbet. Supplied complete with technical notes and circuits. £1.35 each. 10 for £12.

Hi-Q TUNER COMPONENTS

For experimenting with the ZN414.
KIT NO. 1. Plessey Miniature Tuning Condenser with built in LW switch and 3" ferrite slab and litz wound MW coil. 72p.
KIT NO. 2. Air spaced tuning condenser 6" ferrite rod litz wound MW and LW coils. 84p.
KIT NO. 3. Air spaced TC with slow motion drive 8" ferrite rod, with litz wound LW and MW coils. £1.10.
KIT NO. 4. Permeability tuner with fast and slow motion drive and LW loading coils. 60p.

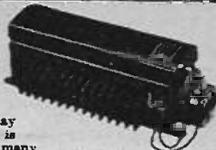
HOUR MINUTE TIMER

Made by Smiths. Complete with control knob and cast brated dial. Useful in kitchen, office, dark-room, etc. Bargain at 55p.



HONEYWELL PROGRAMMER

This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 16 circuits may be changed per revolution. Drive motor is mains operated 6 revs per min. Some of the many uses of this timer are: Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting, animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price £8.85 plus 25p post and insurance. Don't miss this terrific bargain.



MIGHTY MIDGET

Probably the tiniest possible radio, as described in Practical Wireless January 73. All electronics parts £2.20 post paid.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 18 amp fused plugs and on/off switch with neon warning light. Supplied complete with 8 feet of six cable. Wired up ready to work. £8.50 plus 23p P. & I.



HORSTMANN "TIME & SET" SWITCH

(420 Amp Switch) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fire, etc. up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price £1.85 Post and ins. 23p.



MULLARD UNILEX

This D.I.Y. Stereo Amplifier is still available complete at £7.00 for the four Mullard Modules, or Modules can be bought separately as follows:—4 watt amplifier module (2 required) Mullard Ref. No. E.P.9000—£1.60 each. Pre amp module Mullard Ref. No. E.P.9001—£1.98 each. Power module—Mullard Ref. No. E.P.9002—£2.58 each. In addition made to Mullard Specification we offer:—Standard Control Unit with escutcheon and knobs—£8.30 Knobs—Set of 4—50p
SPECIAL OFFER the complete Unilex with control panel at PRE VAT PRICE. £10 post paid.

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—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £8.20—twin stetho-set instead of earpiece 83p extra—post and ins. 20p.



24hr. REPEATING TIME SWITCH

Made by Smiths these are A.C. mains operated. NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours. 5 amp change-over contacts will switch circuit on or off during these periods £2.75 post and ins. 23p. Additional time contacts 55p pair.



FORTYLITE

Fluorescent lighting units with polyester choke and finished white enamel. 40 ins model, ideal kitchen, bedroom, hallway, porch, loft etc. With tube assembled ready to install. £2.20.



HONEYWELL THERMOSTAT

Made by Honeywell for normal air temperatures 40°-80°F (5-26°C). This is a precision instrument with a differential which can be adjusted to better than 1/8°F. A mercury switch breaks on temp. Fine—the switch is operated by a coiled bi-metal element and adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows thermometer above and switch setting scale below—size approx. 3 1/8" x 2 1/4" x 1 1/4" deep—can be mounted on conduit box or directly on wall. Price £1.57 each or ten for £12.52.

KETTLE ELEMENTS

Made by the famous A.E.I. Co. Complete with washers and combined firing ring and plug shroud. Normal 2 round pin and flat pin earth connection. An overload reset push button. 2 Models—1 1/4in (approx.) suitable for Swan and other similar models. 1 1/2in (approx.) suitable for G.E.C., Hotpoint, etc. All quick boil 2 1/2kW elements at 240v. Price £1.88.



BATTERY CONDITION TESTER

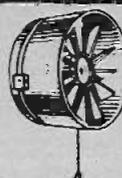
Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nickel—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace", "weak" or "good". The tester is complete in its case, size 3 1/2" x 6 1/2" x 2 1/2" with leads and prods. Price £2.50 plus 20p postage.

12 WAY SUB-MINIATURE MULTI-CORE CABLE

7-0078 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall approx. 3/16in. thick. Price 22p per yard.

SNAP ACTION SLIDE SWITCH

Rated 6a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuum, etc. 6p each. 10 for 54p.



EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bath rooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5 1/2" casing with 5 1/2" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets. £2.75 + 20p P. & P.



CONTROL DRILL SPEEDS

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1.60 plus 13p post and insurance. Made up model also available. £2.50 plus 13p post & p.

DRILL CONTROLLER NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1.60 plus 13p post and insurance. Made up model also available. £2.50 plus 13p post & p.

TELEPHONES

Complete as illustrated. Save your legs, time and temper, simply by putting in some telephones. Ex. G.P.O. not new—but guaranteed in good condition and serviceable. Supplied with diagram and instructions showing how to connect. Price £1.10 each + 50p post or 2 for £2.50 post paid. Also available separately, dials and handsets 50p each + 20p post.



BAKELITE INSTRUMENT CASE

Size approx 5 1/2" x 3 1/2" x 3" deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price 54p each. par lid 11p extra.



SPIT MOTOR

200-250V induction motor, driving a Carter gearbox with a 1 1/2" output drive shaft running at 2 revs p.m. Intended for roasting chickens, also for driving models—windmills, coloured disc lighting effects, etc. £2.05 plus 20p post and ins.



SOLDER GUN

A must for every busy man, gives almost instant heat also illuminated job. 100 watt £2.47 plus post and ins. 20p.



TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7 1/2 to 47in. Hole in box for 6BA screw. 42p. KNUCKLED MODEL FOR P.M. 55p



TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless, August issue. £3.30 plus 20p post and insurance



IMMERSION HEATERS BY REMPOY

Standard fitting for domestic water tanks, made by the famous Remploy Company. Complete with sealing washers suitable for 100-240 volts A.C. Depth into tank 1 1/2". 2kw or 3kw £1.65 plus 20p each post and insurance.



MAINS OPERATED SOLENOIDS

Model TT2—small but powerful 1" pull—approx. size 1 1/2" x 1 1/2" x 1 1/2". Size Model 400p. 60p. Model 400p. 2 1/2" x 2" x 1 1/2". 83p. Model TT10 1 1/2" pull. Size 3" x 2 1/2" x 2 1/2". £1.98 plus 20p post and insurance.



RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1.10 each or £12 per dozen, specify 5, 10 or 15 amp—simply fit in place of switch.



VAT IS INCLUDED IN ABOVE PRICES

RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are:—
 2 track record playback heads 50p each.
 4 track record playback heads 72p each.
 Erase heads are also available separately—
 2 track 17p—4 track 28p.
 New metal mounting shields 39p each.
 2 track heads already fixed on heavy mounting plate with shield £1.05.

I R.P.H. MOTOR

Made by the famous Smiths Company. 240v 80 cycle mains working. Ideal motor to drive clock mechanisms. Price £1.10 each or 10 for £10.

ROCKER SWITCH

13 amp self-fixing into an oblong hole. Size approximately 1" x 1/2" 8p each 10 for 82p.



SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 6BA screws. Size approx. 1 1/2" x 1 1/2" rated 250V lamp. 8p each. 10 for 78p. Ditto as above but for printed circuit 6p each 10 for 63p. Sub Miniature Slide Switch. DPDT 10mm (1/8" approx.) between fixing centres. 20p. each or 10 for £1.80. SP Change over spring return 250V 1 amp. 11p.



HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermostat as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack £6.10.

RELAYS BY KEYSWITCH

Makers Ref. KMK3 Our number Rel. A3. One ten type mains operated coil—3 pairs change-over contacts rated at 6 amps each. Mounted by 1 screw. Solder tag connections. Price 60p each. Ditto but 12V. Our Ref. Rel A4. Price 55p each.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 55p post free.

AMPLIFIER IN CASE WITH SPEAKER

Marketed by British Relay under the name Lixitor. This is in a very neat looking cabinet and is ideal around the home or in the workshop for trouble shooting or for testing out a quick laugh up. Size approx. 9 1/2" x 6 1/2" x 3 1/2" deep. Input is via a matching transformer and volume control and amplifier may be powered by an internal battery or an external 110v source. Speaker is an R-A elliptical 6" x 3 1/2" 10,000 gauss. The amplifier proper is a Newmarket model Ref. P.C.S. Price £3.85 each. 10 for £31.50. Post and insurance 20p.

EDUCATIONAL KITS—all with pictorial instructions



THIS BALANCE KIT FREE

Eagle educational kits. Japanese made these are excellent value for money. We do not expect

to be able to repeat this offer once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give FREE an accurate 11 picon balance kit. Price of kits 44p each post paid. Special price for all 7 kits £3.00 with free balance kit.

KA2 Lens Kit. Eleven parts, including concave and convex lens, stage and slit frame, etc. Watch light rays bend as they pass through different lenses.

KA3 Water Pump Kit. Thirteen parts. Top of pump is transparent so that operating parts may be observed. Small parts are brightly coloured to be seen easily while working. Three types of pump may be made: Lift pump, Force Pump and Force Pump with reservoir and nozzle.

KA4 Buzzer Kit. Eleven parts. Transparent covers allow the operation of buzzer to be seen. Illustrates and teaches how electromagnetism with an automatic switch results in an operating buzzer.

KA7 Electro-Magnet Kit. Fifteen parts, includes compass. Makes two electro-magnets, one with one layer of wire and one with several layers of wire. Picks up tacks, nails and any small parts showing how magnetism works.

KA8 Current and Resistance Kit. Twenty-nine parts, including bench and light bulb. Conduct interesting and educational projects to learn the application of "OHMS LAW" and see the difference in current and resistance with different types and lengths of wire.

KA9 Bell Kit. Eight parts, including bell and push button switch. Build a complete electric bell and see how the hammer is triggered to make the bell ring.

KA10 Morse Key buzzer and bell kit. 25 part kit easy to construct, simple to operate.

TERMS:—10% discount if ten of an item ordered, send postage where quoted—other terms, post free if order for these over £6.00 otherwise add 20p.

AUDIO MIXER AUTO FAN

To receive parts for these and other projects featured in this issue, send quoted approximate amount any cash adjustment can be made later.

THYRISTOR LIGHT DIMMER

Domestic model for any lamp up to 250 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price £2.95. Industrial model 5 amp module with control knob £3.80.



PSYCHEDELIC LIGHTING can be yours with our mains motor driven cam switch. 8 came drive 8 switches slots in came make and break 10 amp contacts as they rotate. Hundreds of combinations possible to give all sorts of effects. Switches can handle more than 10kW of lighting. £3.85 each plus 20p post and insurance.



MULLARD 4 WATT 4-1-F1

Sensational "Once in a lifetime offer" because Mullard over produced—definitely not repeatable once our stocks (now over half sold) are cleared. Hi Fi 4 transistor amplifier complete in case ready to use. Battery, car or mains operated—freq. range 50Hz-15KHz—distortion better than -2%—suitable mono or stereo. Comes complete with guarantee and data. FREE to purchasers. Great handbook published by Mullard "tells all you need to know" to build your own stereo. £1.60 + 20p packing & post.

COMPUTER TAPE

2,400ft. of the Best Magnetic Tape money can buy. Some users claim good results with Video and sound. 1in wide. £1-10 plus 30p. post. Spare spools and cassettes 85p. 1/2" Scotch tape. Brand new. Suits most video recorders. £3.30 for 3,600ft.



STANDARD WAFER SWITCHES

Standard size 1 1/2" water—silver-plated 5-amp contact, standard 1/2" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	44p	44p							
2 poles	44p	44p							
3 poles	44p	44p							
4 poles	44p	44p							
4 poles	44p	44p							
6 poles	44p	44p							
7 poles	77p	77p	77p	£1.04	£1.32	£1.32	£1.32	£2.15	£2.15
8 poles	77p	77p	77p	£1.04	£1.32	£1.32	£1.32	£2.42	£2.42
9 poles	77p	77p	77p	£1.04	£1.32	£1.32	£1.32	£2.70	£2.70
10 poles	77p	77p	77p	£1.04	£1.32	£1.32	£1.32	£3.00	£3.00
11 poles	77p	77p	77p	£1.04	£1.32	£1.32	£1.32	£3.25	£3.25
12 poles	77p	77p	77p	£1.04	£1.32	£1.32	£1.32	£3.52	£3.52

DIGITAL COUNTER TIMER

Very stable and reliable crystal controlled circuit. Capable of work in excess of 15 MHz. Construction simplified by use of 15 integrated circuits. Complete kit with case £43.50 or construction data and price list 50p.



BURGLAR ALARM KIT

Protect your home & family by frightening away the intruder. With our circuit, a mains door bell rings directly the door or window is opened. Kit comprises 10 recd switches, 10 magnets, relay, mains transformer and bell with circuit. Price £7.85.



INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a month-life NPN matched pair. Regular price of parcel well over £5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only £1 post paid. DON'T MISS THIS TERRIFIC BARGAIN.

GOOD COMPANION

We can now offer these again in L.E. version using Ferranti ZN414 and Mullard AF Modules 1172. Excellent tone wood cabinet. Cabinet size approx. 11in wide x 6in high x 3in. deep. Complete assembly instructions £5.75 plus 25p post and ins.



VAT IS INCLUDED IN ABOVE PRICES

J. BULL (ELECTRICAL) LTD.

(Dept. E.E.), 7 Park Street, Croydon CRO 1YD
 Callers to: 102/3 Tamworth Road, CROYDON.

MINIATURE SEALED RELAY

American made. Our Ref. No. REL A1. Measures only 2" wide x 1" thick and 1 1/2" high and it's double change over, we don't know the contact rating but estimate this at 3/5 amps. The coil resistance is 600 ohms and 9-12 volt will close it. Ideal for models and miniaturised equipment. It's a plug in relay but we supply complete with base. Price 23p including base.

COMBINATION SWITCH

This comprises of 12 miniature change-over microswitches. Joined in banks of 3 and mounted on frame with four digital numbered thumb wheels and a removable lever for locking the thumb wheel—the thumb wheel operates 3 banks. Over 4,000 combinations are possible but by rewiring the switch connections underneath then thousands more variations are possible. If you are making equipment which you don't want switched on accidentally or without authority then this is a switch to consider—this can also be used as a coding switch for many other operations. Very neat and compact and measuring approx. 4" x 1 1/2" x 1 1/2" deep. Priced at £2.75.

MAGNETIC CLUTCH

XEROX 1215494-JUN 10-1110 PN986-10. We have no information on this but it appears that the main section with coils fits to the spindle of the machine and there is a contact plate to fit on a stationary part. It appears also that the clutch can be used as a partial brake by putting reduced voltage into it, as a normal brake with normal voltage or as emergency stop by putting increased voltage into it. American made and very well made at that. Price £1.85.

SUB. MINIATURE MICROSWITCH

Made by Burgess, their ref. V476—our ref. MS.A1. These measure only 1" x 1" x 1/2" thick—has change over contacts and tag connection—Price 16p each or 10 for £1.44.

INSULATED TERMINALS

For mounting through metal panel. These are heavy duty 2 B.A. type. Good quality and made originally for government contracts. All black but it is a simple matter to paint the flat front faces with any appropriate colour. This type of terminal normally sells at 16p each. Our Price only 6p each or 10 for 54p.

3 BANK CONTACTORS

Coil closing voltage only 24V AC. Just the thing for switching heaters with the Honeywell precision thermostat which we have. Heavily insulated. We reserve the right to substitute components should deliveries be protracted so as to avoid undue delay. Reprints of projects available 1 for 30p. for 60p. or 6 for £1. post paid.

KITS FOR PREVIOUS PROJECTS

Unless otherwise stated, kits contain electronic parts only. The case and special items can be obtained locally. Also batteries are not included. Kits may be returned for refund if construction has not been started. We reserve the right to substitute components should deliveries be protracted so as to avoid undue delay.

- Reprints of projects available 1 for 30p. for 60p. or 6 for £1. post paid.
- HOMESENTINEL INTRUDER ALARM £3.75
- SNAP INDICATOR 75p
- WINDSCREEN WIPER CONTROL £2.25
- RECORD PLAYER £5.50 (amplifier components only)
- DEMO DEC £7.00
- FUZZ BOX £1.85
- PHOTOGRAPHIC COLOUR TEMPERATURE METER £2.65
- ASTRON RADIO £3
- REMOTE TEMPERATURE COMPARATOR £4.25
- ELECTRO LAUGH £2
- RAIN WARNING ALARM £1.80
- WA-WA PEDAL £2.90
- SIGNAL INJECTOR 80p
- SOIL MOISTURE METER £3.00
- SIMPLE CALCULATOR £2.20
- DC POWER SUPPLY £5.00
- BABY ALARM £4.00
- AUDIO TONE GENERATOR £2.60
- METAL LOCATOR £4.00
- LIGHT TO SOUND CONVERTER £1.70
- THRU LENS LIGHTMETER £3.50
- DRILL SPEED CONTROLLER £2.00
- ELECTRONOME £1.75
- SHAVEN INVERTER £3.75
- I.R. BURGLAR ALARM £3.50
- L & M RADIO TUNER £2.50
- TAPE POWER SUPPLY MAINS CAR £2.00
- ELECTRONIC MOUSE-TRAP £1.10
- REACTORMATIC £2.75
- RADIO CONTROL RECEIVER £3.00
- RADIO CONTROL TRANSMITTER £5.50
- BIT SAVER £1.50
- ICE WARNING DEVICE £1.40
- BETA TREBLE BOOST & FUZZ £6.00
- AUDIO COLOUR UNIT £6.50
- U.H.F. TV AERIAL £1.50
- DAMP LOCATOR £1.15
- ENLARGER & EXPOSURE METER £4.50
- EGG TIMER £3.75
- NEON NOVELTY £1.50
- MAINS PACK FOR NEON NOVELTY £0.85

A DEXTER DIMMASWITCH

ALLOWS COMPLETE



LIGHTING CONTROL

The DEXTER DIMMASWITCH is an attractive Dimma unit which simply replaces the normal light switch. It is available as a complete "ready to install" unit or "simple to assemble" kit. Two models are available controlling up to 300W or 600W of all lights, except fluorescents, at mains 200-250V, 50Hz. All DEXTER DIMMASWITCH models have built-in radio interference suppression.

600 watt £3.52 Kit form £2.97
300 watt £2.97 Kit form £2.42

All plus 12p post and packing

Prices include VAT. Please send c.w.o. to:

DEXTER & COMPANY

5 ULVER HOUSE
19 KING STREET
CHESTER CH1 2AH
Tel: 0244-25883

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TO H.M. GOVERNMENT
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SUPER "FUZZ" UNIT KIT. CONNECTS BETWEEN GUITAR & AMPLIFIER. OPERATES FROM 9v BATTERY (not supplied). ALL COMPONENTS AND PRINTED CIRCUIT BOARD WITH FULL INSTRUCTIONS. KIT PRICE: £2.86 post paid.

CREATE "PHASE" EFFECT ON YOUR RECORDS, TAPES ETC., UNIQUE CIRCUITRY ENABLES YOU TO CREATE PHASE EFFECT AT THE TURN OF A KNOB. OPERATES FROM 9v BATTERY (not supplied) COMPLETE KIT OF COMPONENTS WITH PRINTED CIRCUIT BOARD & FULL INSTRUCTIONS. KIT PRICE: £2.86 post paid.

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S.A.E. ALL ENQUIRIES.

DABAR ELECTRONIC PRODUCTS

88a, LICHFIELD STREET,
WALSALL, STAFFS. WS1 1UZ

EX COMPUTER PC PANELS
2 x 4 in. packed with semiconductors and top quality resistors, capacitors, diodes, etc. Guaranteed min. 35 transistors plus data. 10 boards 50p (9p).

SPECIAL BARGAIN PACK
25 boards £1 (25p).
Panels with 4 power transistors sim. OC28 50p (9p)

ELECTROLYTICS
10,000µ 75v, 68,000µ 16v, 4½ x 2 in. dia., 25,000µ 25v, 20,000µ 30v, 5,000µ 90v, 35,000µ 15v, 8,000µ 55v, 4½ x 3 in. dia., 50p (12p). 15,000µ 15v, 10,000µ 25v, 4½ x 2 in. dia., 30p (10p). 2,000µ 25v wire ends 15p (5p), 12 for £1.50 (15p).

20A DIODES 4 for £1 (7p)
3A DIODES 4 for 50p (5p)
8 BLACK TOGGLES dpst 50p (8p)
250 MIXED CAPACITORS 60p (8p)
250 MIXED RESISTORS 60p (8p)
150 HI-STAB RESISTORS 60p (8p)
200 SI PLANAR DIODES 50p (5p)
Sub min. co-ax. plugs & skts.

REED RELAYS MIXED 10 for 50p (5p)
MICROS MIXED 8 for 50p (8p)
ASSORTED RELAYS 8 for £1 (12p)
MIN. GLASS NEONS 12 for 50p (5p)
10 WAY TERMINAL BLOCKS 10 for 55p (5p)

QH BULBS 12V 55W 50p (5p)
PAPST EXTRACTOR BLOWER FANS 100 cfm 4½ x 4½ x 2in. £3.50 (28p)

Postage and packing shown in brackets. Please add 10% V.A.T. to prices.

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You'll find it easy to learn with this outstandingly successful PICTORIAL METHOD. The essential facts are explained in the simplest language, one at a time, and each is illustrated by an accurate cartoon-type drawing. These clear and concise illustrations make study a real pleasure. The books are based on the latest research into simplified learning techniques. This easy-approach-to-learning method has proved beyond doubt that acquiring knowledge can be an enjoyable experience.

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YOUR 100% GUARANTEE. If after 10 days examination you decide to return the Manuals your money will be refunded in full.

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PREMIER 800 STEREO AMPLIFIER



(As used in SYSTEM '800')

A truly high quality stereo amplifier—compare the specification, compare the price. Output: 5 watts per channel. Frequency response: 30-20,000 Hz = 2 db. Distortion: 1%. Output Impedance 8 ohms nom. Inputs equalised to R.I.A.A. Magnetic 4mV. Ceramic 100mV. Tuner 100mV. Tape 100mV. Tape out 150mV. Dia sockets for inputs and outputs. Controls: Bass, Treble, Volume, Balance, Selector. Mono/Stereo switch. Stereo headphone socket. Attractive slim line design black leatherette cabinet with aluminium front panel. Size 12½" x 6½" x 2½".

ONLY £16.50 Carr. 50p.

Mk. 11 Version available with Teak Finish Cabinet. £17.57 Carr. 50p.

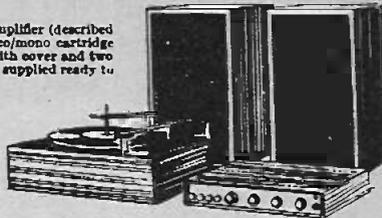
PREMIER HI-FI STEREO SYSTEMS

SYSTEM "800"

Consists of the Premier 800 Mk II all transistor stereo amplifier (described left) Garrard auto/manual record player unit fitted stereo/mono cartridge with diamond stylus and mounted in teak finish plinth with cover and two cloth front loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 800 Mk II amplifier has an output of 5 watts per channel with inputs for ceramic and magnetic pick-up, tape and tuner also tape output socket and headphone socket. Controls: Bass, Treble, Volume, Balance, Selector. Mono/Stereo switch. Headphone socket. Power on/off. Teak finish cabinet with aluminium front panel. Size: 12½" x 6½" x 2½".

£36.50

Carr. £1.75



SYSTEM "TWO"

as above but with slotted front teak finish loudspeakers. Garrard SP25 Mk. III and magnetic cartridge.

£46.50

Carr. £1.75

SYSTEM "THREE"

This consists of KLINGER KC902 stereo amplifier giving 6 watts rms per channel with Bass, Treble, Volume and Balance Controls. Inputs for Magnetic and Ceramic pick-up, tuner, tape in and out. Stereo headphone socket. Garrard SP25 Mk. III in teak finish plinth with cover and fitted Sonotone 9TAHCD diamond stereo cartridge. A pair of HMF Speakers size 16½" x 10½" x 9" fitted HMI units complete the matching system.

£60.00

Carr. £1.75

FREE
LEADS
AND PLUGS
SUPPLIED
WITH ALL
SYSTEMS

PREMIER PARAGON STEREO HI-FI AMPLIFIER



Gives the best possible reproduction of records, radio and tape at a reasonable price.

Fitted with all the controls and facilities you're ever likely to want, the Paragon gives you a degree of sophistication that is usually only found with amplifiers costing twice the price. It has bass and treble slide controls, volume and balance knobs, and eight push-buttons. There's also a standard stereo jack socket on the front panel, plus a ceramic/magnetic cartridge switch and a mains outlet socket on the back panel.

Specifications 10 + 10 watts into 8 ohms. Power/frequency response: 0dB 10 watts into 8 ohms -3dB 20Hz - 25KHz. Distortion typically less than 0.25%. Inputs for Magnetic phono (4mV) Ceramic phono (68mV) Radio/Tape (100mV). High and low filters. Teak finish cabinet. Size: 12½" x 5½" x 10½".

£27.00 P. & P. 50p.

PREMIER STEREO SYSTEM '64'

Consists of the Premier Paragon Stereo Amplifier, Garrard SP25 Mk III in teak finish plinth with cover and fitted Goldring G500 stereo magnetic cartridge plus a pair of Marston Hall Annex 100 Loudspeaker Systems. Complete with Free leads and plugs.

£64 Carr. & Insurance £1.75

VERITAS STEREO/MONO SOUND MIXER

Battery operated audio mixer. Size 6 x 3 x 2in. suitable for crystal microphone low impedance microphono. with transformer, radio, tape, etc. Max. input 1.0v. Max. output 2.5v. Gain 6 dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.



PREMIER PRICE £3.80

P. & P. 15p



E.M.I. 13x8in. HI-FI SPEAKERS

Fitted two 2½in tweeters and crossover network. Impedance 8 or 16 ohm. Handling capacity 10W. Brand new.

£3.80 P. & P. 50p

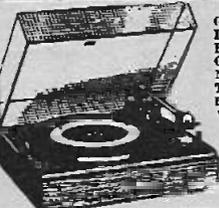
NEW PREMIER COMPACT STEREO SYSTEM



All transistor stereo amplifier mounted into teak finish plinth with cover and Garrard 2025 T/C autochanger and a pair of matching teak finish cloth front speaker systems.

- ★ Output 4 watts rms per channel.
- ★ Separate volume, bass, treble and balance controls.
- ★ Stereo/Mono ceramic cartridge.
- ★ Tape/Tuner input and Tape output sockets.
- ★ Complete with all leads ready to use.

PREMIER PRICE ONLY £31.00 Carr. & Ins. £1.50



GARRARD SP25 MK III SINGLE RECORD PLAYER FITTED GOLDRING 800 MAGNETIC STEREO CARTRIDGE. COMPLETE IN TEAK FINISH WITH COVER.

PREMIER PRICE

£16.86

P. & P. £1

METER BARGAIN

MODEL LT 102 MULTIMETER

A precision made pocket sized test meter, ideally suited for testing electronic circuits or electronic appliances. Supplied complete with test leads and batteries. RANGES—DC Voltage: 15, 150, 600 (1,000 opV). AC Voltage: 15, 150, 600 (1,000 opV). DC Current: 150mA. Resistance: A-100K ohms. (centre 2.5K ohms) £27.1 p. & p. 25p complete with test leads and battery



HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2½in. speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft lead and stereo jack plug.

£2.47 P. & P. 25p.

BOGERS

RAVENSBROOK

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OUR PRICE £12.10

AKAI A8E98 £6.00

SKENESSER £9.90

HD414 P. & P. 25p each



E.M.I.

LOW NOISE CASSETTES in library cases

C60 48p

C90 70p

C120 92p

P. & P. 10p



LOW-NOISE COMPACT CASSETTES

Screw fixing—fully guaranteed. In Library cases.

	EACH	3 for	6 for	10 for
C60	31p	89p	£1.71	£2.75
C90	44p	£1.22	£2.38	£3.85
C120	57p	£1.54	£3.04	£4.95

P. & P. 10p each (3 and over 15p)

QUALITY RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED. VEMILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped—attractively boxed.

TT8 3' 450'	POLYESTER	60p	DT8 6½' 1800'	POLYESTER	£1.23
DT8 3½' 600'	POLYESTER	62p	TT8 6½' 2400'	POLYESTER	£2.06
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LP5 6' 900'	ACETATE	55p	LP7 7' 1800'	ACETATE	82p
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TAPE SPOOLS 3' 5p, 5' 5½, 7' 9p. Post and Packing 3' Sp. 5' 3½, 7' 10p (3 reels and over Post Free).

"Litesold" Soldering Iron. Lightweight 4" pencil bit. Ideal for regular beach use and around the home. 25 watts. 240 volt A.C. £1.55 P. & P. 10p.

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Tel: 01-935 7197

PREMIER RADIO

23, TOTTENHAM COURT ROAD, LONDON, W.1 Tel: 01-636 3451

ZN414 £1.25 POST FREE

The LC. Radio in a T018 can. Supplied complete with data sheet No. 10 which contains specification, circuit and details and pieces of components such as ferrite rods, compression trimmers etc.

I.C. Sockets

Out-in-line or Zig-Zag (Dwi), 14 and 16 pin
Our Price 1p per pin

VDR's & Thermistors

A16B	75p	GL23	£1.00	VA1005	15p
C21	15p	R53	£1.32	VA1026	13p
C24	13p	R54	£1.46	VA1033	13p
C213A	13p			VA1040	10p
E298 ED/A258	16p			VA1053	10p
E298 ZZ/06	16p			VA1055S	10p
GL16	£1			VA1034	10p

Potentiometers



5K Ω 10K Ω 25K Ω 50K Ω 100K Ω 250K Ω 500K Ω 1M Ω 2M Ω

log or lin less switch (& 1K Ω lin) 12p
log or lin with switch 24p
dual less switch 40p
dual with switch 10K, 100K & 1M log only 52p
10K log | 10K antilog less switch 40p

Capacitors

disc ceramic	low voltage		
0.1 μ F 18v	5p	0.1 μ F 30v	5p
0.22 μ F 18v	5p	0.22 μ F 6v	5p
0.47 μ F 12v	5p	0.47 μ F 3v	5p
ceramic plate	30V		
1000pf	10p	4700pf	10p
2200pf	10p	10,000pf	10p

Slider Pots

Single	Dual	log
10K	10 + 10K	or
25K	25 + 25K	lin
50K	50 + 50K	
100K	100 + 100K	Knobs
30p	50p	10p.

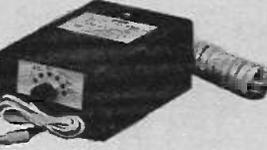
Resistors

1/2 watt 5% Carbon Film - low noise Hi-Stabs

All E24 values 1p each plus p. & p. 7p for up to 50 Resistors and a further 2p for each additional 50. Deduct 33% for 100 of one type or 25% for mixed orders over £1 in value.

1W 10% Carbon Composition 3p each
2W 10% Carbon Composition 6p each
2.1W 5% Wire wound 9p each
5W Wire wound 9p each
10W Wire wound 10p each plus p. & p. 7p for up to 25 resistors plus 1p for each additional 25

Eliminators



6 volt for 50mA £1.50
9 volt for 50mA £1.50
6 + 6 volt, 50mA £2.50
9 + 6 volt, 50mA £2.50
7.5 volt for cassette recorders £2.00
6, 7.5 or 9 volt £3.00
3, 4.5, 6, 7.5, 9, 12 for 500mA (flus.) £3.99
Car Battery Converter fully stabilised to provide 6, 7.5 or 9 volts (p. & p. 15p on all types) £4.99

Ceramic - plate 63V (C333)

1.8p	8.2p	33p	120p
2.2p	10p	39p	150p
3.3p	12p	47p	180p
3.9p	15p	56p	220p
4.7p	18p	68p	270p
5.6p	22p	82p	330p
6.8p	27p	100p	
8.2p			

NEW LISTS

LOUDSPEAKERS No. 4
COILS AND INDUCTORS No. 5
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Diodes & Rectifiers

AA119 9p	BA156 15p	BY176 £1.50
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BA102 25p	OA79 9p	IN4001 6p
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BA148 20p	BY100 15p	IN4005 12p
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BA155 14p	BY127 16p	IN4007 15p

SGS EA1000

3 Watt Audio Amplifier

101 less 15%
251 less 25%
1001 less 35%

1 Watt Audio Amplifier

Our Price £3.99
Less quantity discount.

Presets

Vertical or Horizontal

0.1 watt 5p	0.25 watt 7p	1M Ω
100 1K Ω	10K Ω 100K Ω	1M Ω
250 2.5K Ω	25K Ω 250K Ω	2.5M Ω
500 5K Ω	50K Ω 500K Ω	5M Ω

mylar film 100V

1000pf	2p	0.1 μ F	3p	0.68 μ F	4p
2000pf	2p	0.22 μ F	3p	1 μ F	4p
5000pf	2p	0.47 μ F	3p	2 μ F	5p
		0.5 μ F	3p		

polystyrene 180V

10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68, 3p each

metallised polyester 250V (C280)

0.1 μ F 3p	0.68 μ F 3p	47 μ F 8p
0.1 μ F 3p	1 μ F 4p	47 μ F 11p
0.22 μ F 3p	1.5 μ F 4p	1 μ F 13p
0.33 μ F 3p	2.2 μ F 5p	1.5 μ F 20p
0.47 μ F 3p	3.3 μ F 6p	2.2 μ F 24p

metallised polyester 400V (C281)

0.1 μ F 4p	0.68 μ F 6p	22 μ F 10p
0.15 μ F 4p	0.68 μ F 6p	33 μ F 14p
0.22 μ F 4p	1 μ F 7p	47 μ F 15p
0.33 μ F 5p	1.5 μ F 8p	

silvered mica 1% (-50p) 500V

2.2p-820pf 7p	4.7nF-5600pf 19p
1nF-2.2nF 9p	6800pF-0.1 μ F 29p
2.7nF-3.6nF 16p	

mixed dielectric 600V

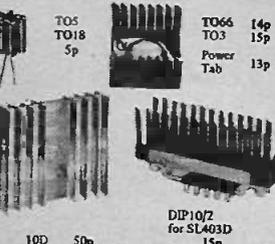
0.1 μ F 7p	0.47 μ F 7p	22 μ F 16p
0.22 μ F 7p	0.68 μ F 8p	47 μ F 26p
0.33 μ F 7p	1 μ F 8p	1 μ F 33p

CHROMASONIC electronics PLEASE ADD 10% VAT TO ALL ORDERS

MAIL ORDERS: Where no p. & p. charge is shown, a minimum of 7p applies, p. & p. on overseas orders is charged at cost.

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T05 5p
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TO66 14p
TO3 15p
Power Tab 13p

10D 50p
DIP10/2 for SL403D 15p

Transistors & Integrated Circuits

AC107 25p	BC147 19p	BF198 15p	OC81 19p	2N1304 22p	ZMS172 15p
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AC127 15p	BC149 19p	BF272 53p	OC170 23p	2N1853 30p	ZEMERS 48p
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AC187K 25p	BC169 15p	BSX21 28p	2T1X109 15p	2N3055 49p	MC1303 £1.50
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AD140 28p	BD133/2M.P. MPF103 37p	MPF103 37p	2T2094 25p	2N3706 16p	MFC4000A 45p
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AD140 28p	BF180 21p	MPF105 40p	2T2096 15p	2N3708 12p	LM380 £1.48
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AF115 18p	BF173 20p	OC28 48p	2T2098 15p	2N3710 12p	TA14100 £1.50
AF116 18p	BF180 25p	OC28 48p	2T2099 15p	2N3711 12p	TA14100 £1.50
AF117 18p	BF181 20p	OC44 15p	2T2104 28p	2N3712 12p	TA14100 £1.50
AF130 28p	BF184 25p	OC45 15p	2T2105 28p	2N3713 12p	TA14100 £1.50
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BC107 10p	BF185 25p	OC71 11p	2N2706 18p	2N3715 12p	TA14100 £1.50
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BC109 19p	BF195 15p	OC75 15p	2N2708 15p	2N3717 12p	TA14100 £1.50

mixed dielectric 1000V

1000pf 6p	6800pf 9p	1 μ F 12p
2200pf 6p	10 μ F 9p	22 μ F 22p
3300pf 6p	0.22 μ F 9p	47 μ F 30p
4700pf 6p	0.47 μ F 12p	

Ceramic

12KV.d.c. 8KV.d.c. HI-K 750V.

10p	9p	200p	9p	1000p	5p
15p	9p	220p	9p	1100p	5p
22p	9p	250p	9p	2000p	5p
68p	9p	270p	9p	3000p	5p
82p	9p	300p	9p	5000p	5p
100p	9p	750V DISC	10,000p	6p	
120p	9p	470p	5p	feed.	
140p	9p	1000p	5p	47 μ F	26p
150p	9p	5000p	5p	through	
180p	9p	10,000p	5p	1000p	5p

Veroboard

Copperclad	Plain
0.1"	0.15"
0.15"	0.15"

2 1/2" x 1"	6p
2 1/2" x 3 1/2"	20p
2 1/2" x 5"	24p
3 1/2" x 5"	24p
3 1/2" x 7 1/2"	27p
17" x 2 1/2"	67p
17" x 3 1/2"	90p
17" x 5"	70p

Spot-face Cutter 36p
Fin Insertion Tool 47p
Terminal Pins 19p per pack of 36

INDCOLA INVADER

ROTARY MAINS SINGLE WAFER ROTARY

Coax Plug 5p
Coax (Flush) Socket £6.66 1/6
Coax (Surface) Socket 8p
Din Plug 15p
Din Socket A, B, C 8p
Insulated TERMINALS 13p each
Loudspeaker Plug takes 4mm each
Loudspeaker Socket 10p

4mm PLUG. Stackable same colours (except Grey) as terminals.

Sawb! Solder Dispenser. Contains 12 H. of coiled 18 x .0.9. Enlin Multi-core Solder Alloy.

8p wash
18p

TOGGLE D.P.D.T. 250V. 1A 26p

Mullard B Siemens Electrolytics

CAP μ F	VOLTAGE				
	4	6.3	10	25	40
1.5					8p
1.8					6p
2.2					6p
2.7					6p
3.3					6p
4.7					6p
6.8					6p
10					6p
15					6p
22					6p
33					6p
47					6p
68					6p
100					12p
150					10p
220					10p
330					11p
470					12p
680					12p
1000					40p
1500					40p
2200					50p
3300					50p
4700					50p

Quantity Prices on application.

Aluminium Boxes

Including baseplate and screws

No. L.	W.	D.	Price	p. & p.
(7)	2 1/2"	5 1/2"	1 1/4"	35p
(8)	4"	4"	1 1/4"	35p
(9)	4"	4"	2 1/4"	35p
(10)	4"	5 1/2"	1 1/4"	40p
(11)	4"	2 1/2"	2"	35p
(12)	3"	2"	1 1/4"	32p
(13)	6"	4"	2"	50p
(14)	7"	5"	2 1/4"	58p
(15)	8"	6"	3"	75p
(16)	10"	7"	3 1/2"	95p

Hi-Volt Electrolytics

1: 2: 4: 8 μ F 450V	14p	32 μ F 450V	20p
16 μ F 450V	15p	50 μ F 350V	20p
8 + 8 μ F 450 V.W	18p	32 + 32 μ F 450 V.W	25p
8 + 16 μ F 450 V.W	20p	32 + 32 μ F 450 V.W	25p
16 + 16 μ F 450 V.W	25p	50 + 50 μ F 350 V.W	35p

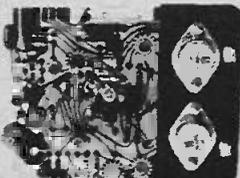
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STANDARD & CUSTOM-BUILT AUDIO & ELECTRONIC EQUIPMENT
NEW & SECONDHAND MUSICAL INSTRUMENTS.
DISTRIBUTORS FOR A.K.G. HIGH QUALITY MICROPHONES.

SA25 - SA35 - SA100 LOW-PRICED AUDIO MODULES

FOR DOMESTIC
& COMMERCIAL
USE

New Versions using 3A
'Plastic Power' Driver
Transistors Now Available



THESE THREE MODULES HAVE ENJOYED UNPARALLELED SUCCESS DURING THE FIRST FEW MONTHS OF THEIR BEING MADE AVAILABLE TO THE GENERAL PUBLIC. WE ARE PLEASED TO ANNOUNCE THAT WE CAN NOW OFFER FAST DISPATCH ON MOST OF OUR ADVERTISED ITEMS, INCLUDING THESE THREE MODULES.

SA25 £2.95 carr. free

25 WATTS RMS. 7 transistors 7 diodes

SA35 £4.45 carr. free

35 WATTS RMS. 7 transistors 7 diodes

SA100 £10.90 carr. free

100 WATTS RMS. 11 transistors 6 diodes

ALL THREE MODULES HAVE OPEN & SHORT CIRCUIT PROTECTION, AND THE SA100 IS PROOF AGAINST OVER-DISSIPATION & FAULTY INDUCTIVE LOADS. ONLY ADVANCED DESIGN TECHNIQUES MAKE THESE EXTRA-ORDINARILY LOW PRICES POSSIBLE.

BRIEF SPEC. FOR ALL THREE MODULES

Freq. response	15-40,000 Hz \pm 1dB
Distortion	0.2% at 1 kHz
Loads	4 to 16 ohms
Quiescent current	15 mA
Noise	Better than -75 dB
Supply voltage	SA25/35 25-45 volts SA100 40-70 volts
Size	4 1/2" x 4" x 1" (SA100) 4" x 3" x 1" (SA25/SA35)

Circuits, connecting instruction and application data are supplied free with all modules.

POWER SUPPLIES FOR THE SA25/35 & SA100 AUDIO MODULES

PU45	Unstabilized supply for 2 SA25/35	£4.90
PU70	Unstabilized supply for one or two SA100	£7.75 carr. 40p
PS45	Stabilized module for 2 SA25's or two SA35's	£3.50 carr. free
MT45	Transformer for above, heavy duty	£2.85 carr. 20p
MT30	Transformer for unstabilized supply complete with rectifier diodes mounted	£3.50 carr. 20p
PS70	Stabilized supply module for one or two SA100's	£4.90 carr. free
MT70	Transformer for PS70	£4.50 carr. 40p

ALL MODULES ARE BUILT ON
GLASS FIBRE P.C. BOARD
AND ARE SUPPLIED FULLY TESTED

Orders and personal shoppers to:

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Telephone 01-684 6385

Hours 9.30 a.m.-5.30 p.m.

TRADE & EXPORT ENQUIRIES INVITED

OTHER SAXON PRODUCTS . . .

120 WATT HEAVY DUTY MODULE £13.90 + 20p carr. or with supply
£18.95 + 40p carr.

Featuring a rugged class A driver stage, this module will run from all our mixers, etc., and most other makes of mixer. It delivers 120 watts into an eight ohm load and employs 4 T03 can (115 watt) output transistors.

SPECIFICATION

Power output	120 watts into 8 ohms
Freq. response	20-20,000 HZ \pm 2dB
Input sensitivity	200 mV into 10K
Construction	Fibreglass board
Size	8" x 4" x 4" (5" with supply)
Low distortion parallel push-pull output stage.	

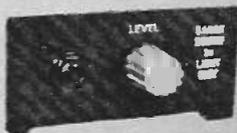


NEW 150 watt version & supply **£27.90**

SINGLE CHANNEL SOUND/LIGHT CONVERTER

This compact and reliable unit operates from amplifiers with outputs from 5-100 watts. Does not impose a heavy load on the amplifier, or, if connected in the wrong polarity, cause any damage, as with some units.

Operation is simplicity itself and the unit is fully fused. The unit is supplied to function from bass notes but may easily be converted to respond only to treble or mid-range notes by the addition of components costing less than 5p.



£8.90 carr. free

THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3000 watt (3kw) this unit is unique for its price in that not only bass, middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads, etc. Supplied in Tough Steel case for free mounting or panel fixing. Fully guaranteed.

£19.75 carr. 30p

MONO VERSION £6.50 carr. 20p (As Illustrated. S.A.E. details 9 volt operation) Outputs up to 1 volt RMS



£15.80 carr. 30p

SAXON STEREO CONTROL UNIT

Two decks, and full headphone monitoring. The unit is mains operated and measures 17 1/2" x 3" x 4" deep and is finished with a smart white on black fascia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass, treble, mains on/off. THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCO THEO AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE. (N.B. Stereo only has mic input.)

COMPLETE AMPLIFIERS

CSE 100. £34.90 carr. free

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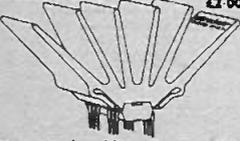


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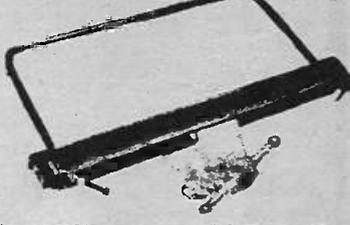
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PROJECTS..
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AGE-LESS APPEAL

The much talked about "generation-gap" is conspicuous in our pages—by its absence. The age-less appeal of electronics is clearly demonstrated by the correspondence we receive. All age groups can be identified, from schoolboys to senior citizens.

Of course it's really no surprise that enthusiasm for practical involvement in electronics starts young. Electronics in all its various manifestations is very much part of everyday life. It is natural enough for those of a practical bent to seize the opportunities this subject offers as a worthwhile hobby. And it's a safe bet that many of the future generation of professional engineers will have cut their teeth in their early teens through experience in building EVERYDAY ELECTRONICS projects.

The teenager with his simple radio receiver or pop music effects unit will become the householder of tomorrow, with new responsibilities and different situations to meet. He will find that electronics awaits to be exploited in and around the home, for the benefit of all. Here perhaps is the hobby at its selfless best, for the end result can be of genuine value and usefulness to all members of the household.

Time marches on. Yet enthusiasm does not wane. Indeed with advancing years a re-awakeness of interest seems often to follow. Thus many are destined to become life long devotees to electronics, following an early introduction while still at school.

Yet there are, additionally, those "late recruits" who first take up an active interest in electronics at a mature age. Retirement provides extra leisure time, and home construction is just the kind of activity to keep one usefully occupied, and at the same time in touch with developments in an ever-changing technology. It's a good prescription for keeping young in mind, as quite a few of our readers will agree.

Thus we span the ages. This is reflected in our pages by the diversity of applications of the constructional projects. But all enthusiasts have a very definite common bond, which overrides any discrepancies of age or personal preferences.

ECONOMICS

Cost is a very important factor, especially for those at either end of the age span. We are very conscious of this, and all designs published are planned to keep the material cost to the minimum. Our practice of quoting an approximate total cost for each project has been warmly welcomed by readers.

These suggested costs are realistic. They are based upon known prices prevailing; thus, if anything, they are likely to be on the high side, rather than low. By carefully shopping around it should be possible in many cases to effect savings on the figure quoted.

Fred Bennett

Our August issue will be published on Friday, July 20

EDITOR F. E. Bennett ● ASSISTANT EDITOR M. Kenward ● B. W. Terrell B.Sc.

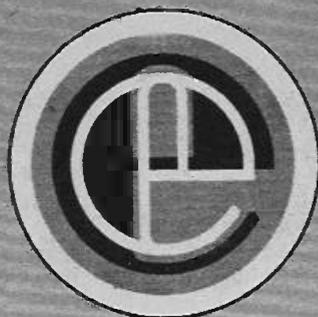
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EASY TO CONSTRUCT SIMPLY EXPLAINED



VOL. 2 NO. 7

JULY 1973

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Cheques, postal orders and money orders should be made payable to IPC Magazines Ltd., and crossed.

INDEX

An index for volume 1 (November 1971 to December 1972) is now available—see previous column.

FEW, except very expensive tape recorders, have mixing facilities so that one can simultaneously mix speech, music etc. and also fade them in or out as required. The signal mixing unit to be described overcomes this problem and will allow independent mixing and fading of signals from a microphone and two high level (music) signal sources.

The microphone input is suitable for microphones of medium impedance (200 to 1000 ohms) or very low impedance microphones with matching transformers having the usual semi-high output impedance of around 10,000 ohms. The microphone input is not suitable for crystal microphones which have a very high impedance.

The two line inputs are suitable for any signals of 100mV or more, such as those from a hi fi pre-amplifier or another tape recorder.

The output signal level available is, averagely 1 volt r.m.s. at fairly low impedance and therefore suitable for the radio or line input on

practically all tape recorders; it can also be connected to any amplifier input rated at around 500mV.

PASSIVE NETWORK

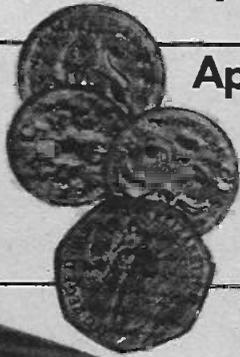
As with all passive mixing networks i.e. a signal mixing circuit with no amplifier, there is a loss of around 12dB due to the nature of the network. This loss must be recovered if the mixer is to be of any real use and to do this it is necessary to employ an amplifier after the mixing network which, in the case of the circuit given in Fig. 1, consists of the three potentiometers, VR1, VR2, and VR3, and the series resistors R7, R8 and R9.

The line amplifier, as it is usually called, is TR3 which not only recovers the signal level loss but provides an additional gain of about 6dB. The microphone pre-amplifier is of course necessary to amplify the normally very small signals obtained from a microphone and which may averagely be only a millivolt or so.

CIRCUIT DESCRIPTION

The complete circuit diagram is shown in Fig. 1. Transistors TR1 and TR2 form a direct coupled pair microphone pre-amplifier with an

AUDIO SIGNAL MIXER



**Approximate cost
of components
including V.A.T.**

£3.50 plus case

**A "must" for
the tape
recorder enthusiast.**

By F. C. Judd



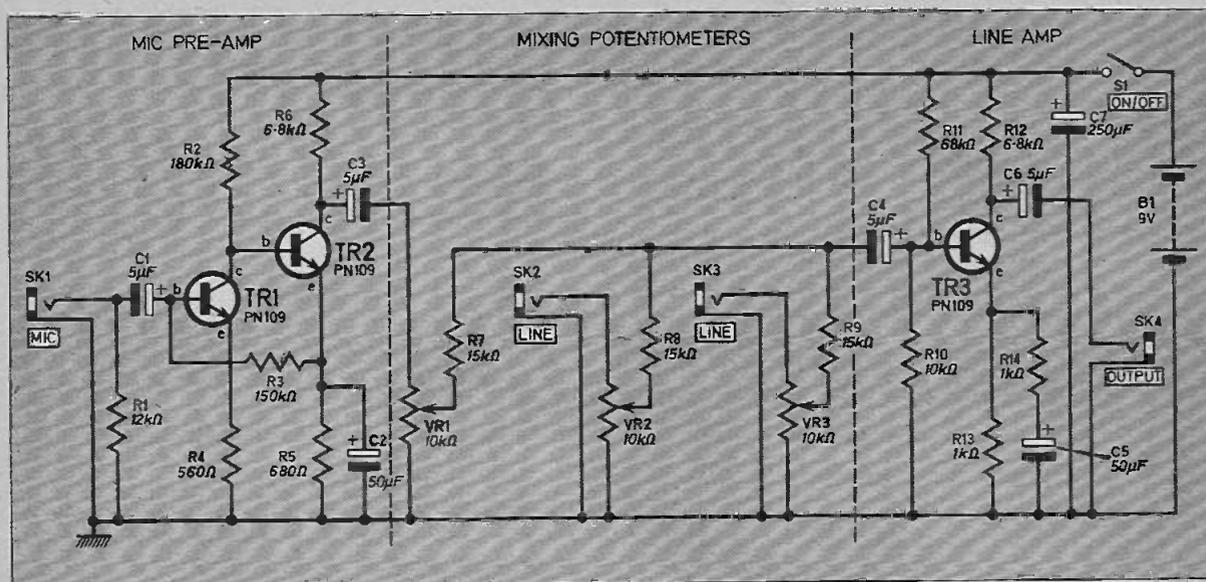


Fig. 1. The complete circuit diagram of Audio Signal Mixer.

input impedance suitable for microphones of 200 to 1000 ohms or very low impedance 25 to 30 ohms) microphones having a matching transformer with a medium to high impedance secondary.

The gain control for the microphone pre-amplifier is VR1 and this is connected, like VR2 and VR3, via a series resistor to the input of the line amplifier TR3. The gain of TR3 is set by the inclusion of resistor R14 in series with the emitter bypass capacitor C5 and which introduces negative feedback. The three gain controls VR1, VR2 and VR3 are slide type

potentiometers of 10 kilohms each.

The circuit will operate quite economically from a PP6 9V battery as the total current consumption is only 2mA.

The frequency response from all inputs is 20 to 20,000Hz \pm 1dB and the signal/noise performance with reference to 1 volt r.m.s. output is -50dB. The microphone input has a sensitivity of approximately 0.1mV for 800mV output and each line input a sensitivity of 400mV also for 800mV output.

Harmonic distortion reference to 1 volt r.m.s. output is less than 0.2 per cent. The mixer

Components . . .

Resistors

R1	12k Ω
R2	180k Ω
R3	150k Ω
R4	560 Ω
R5	680 Ω
R6	6.8k Ω
R7	15k Ω
R8	15k Ω
R9	15k Ω
R10	10k Ω
R11	68k Ω
R12	6.8k Ω
R13	1k Ω
R14	1k Ω

All $\frac{1}{2}$ watt carbon \pm 10%

Potentiometers

VR1, VR2, VR3 10k Ω log. slide type (3 off)
(Eagle type RR5 supplied with knobs)

SEE
**SHOP
TALK**

Capacitors

C1	5 μ F elect. 12V
C2	50 μ F elect. 12V
C3	5 μ F elect. 12V
C4	5 μ F elect. 12V
C5	50 μ F elect. 12V
C6	5 μ F elect. 12V
C7	250 μ F elect. 12V

Transistors

TR1	PN109 or BC109 npn silicon
TR2	PN109 or BC109 npn silicon
TR3	PN109 or BC109 npn silicon

Miscellaneous

S1	on/off d.p.d.t. slide type
SK1-SK4	standard Jack sockets
B1	PP6 9V

Plain Veroboard 0.15in. matrix size 2 x 3 $\frac{1}{2}$ in. (2 off); half inch spacers 4BA or 6BA clearance (2 off); aluminium angle $\frac{1}{2}$ x $\frac{3}{8}$ x 1 $\frac{1}{2}$ in. (2 off); 4BA or 6BA nuts and bolts; battery clips; Universal chassis parts (Home Radio Ltd.) or other suitable case materials; plain Veroboard or aluminium for sub-chassis.

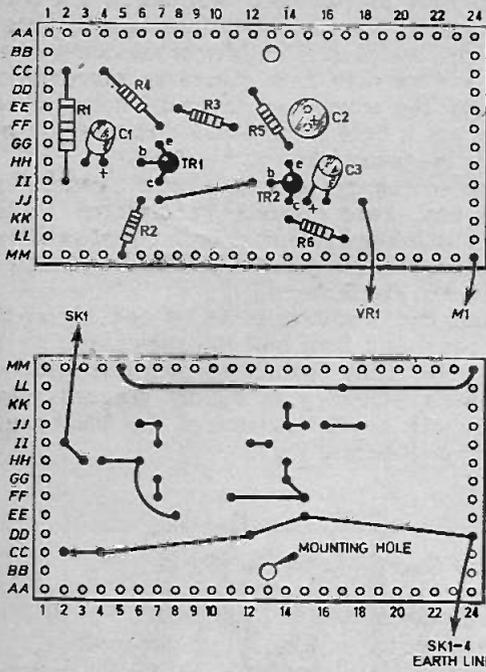


Fig. 4a. The layout of the components on the line amplifier board.

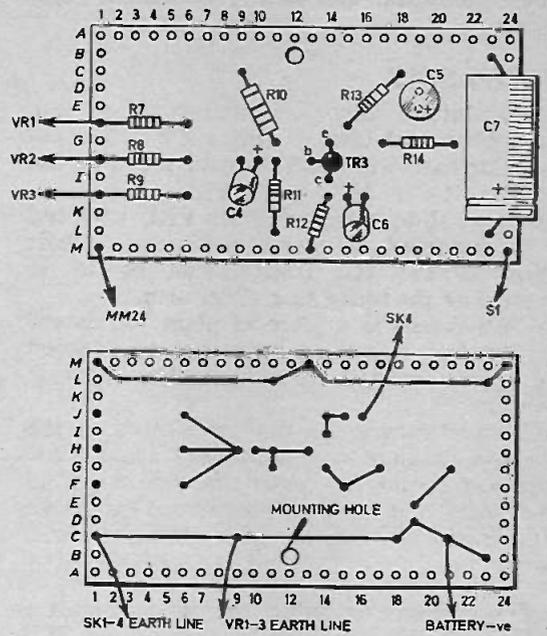


Fig. 4b. The layout of the components on the microphone pre-amplifier board.

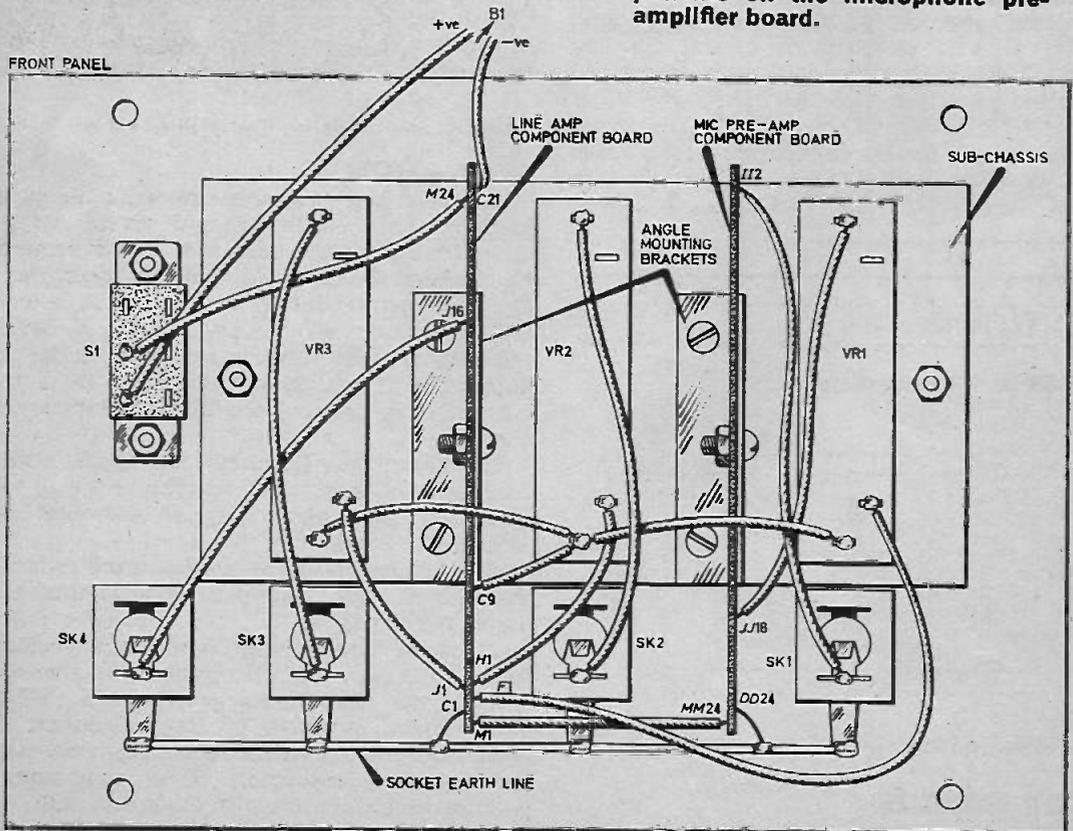


Fig. 5. Complete wiring details of the Audio Signal Mixer.

therefore has a performance comparable with the best domestic and semi-professional tape recorders.

SUB-CHASSIS

The prototype unit was housed in an aluminium Universal Chassis size 7 x 5 x 3in. but any similar case will do. The front panel layout and drilling details are given in Fig. 2.

The three slide potentiometers VR1, VR2 and VR3 are mounted on a sub-chassis spaced half an inch behind the front panel so as to accommodate the fairly long slider arms.

The sub-chassis is a piece of plain Veroboard with slots and mounting holes cut as detailed in Fig. 3; this could, if desired, be 18 or 20 s.w.g. aluminium.

Mount and secure the potentiometers on the sub-chassis making sure that they are all the correct way round, i.e. when the sliders are all at the same end they all measure maximum (or minimum) resistance between the slider and the same end.

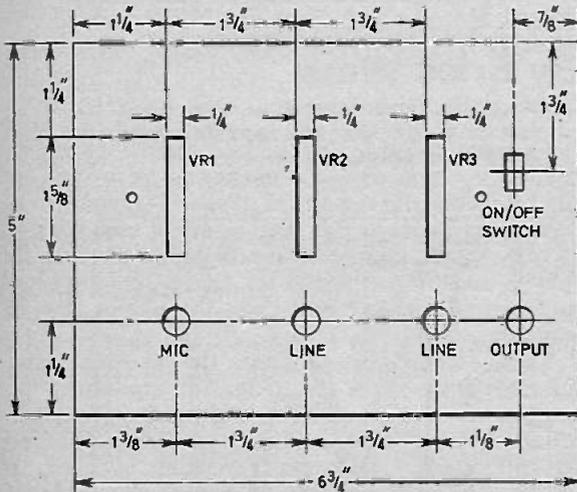


Fig. 2. Details of the front panel.

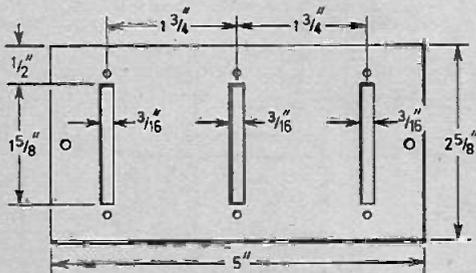


Fig. 3. Cutting details for the sub-chassis.

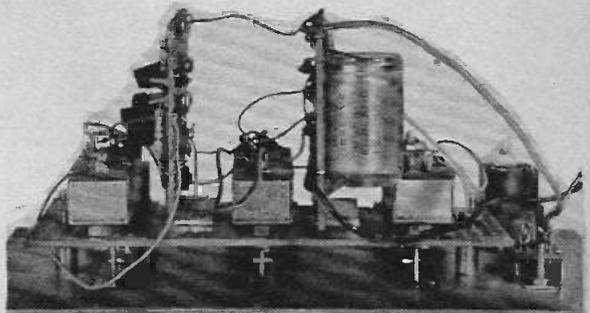
CIRCUIT BOARDS

Two circuit boards are required, one for the microphone pre-amplifier section and the other for the line amplifier section.

The size of the boards is the same in each case, 0.15in. matrix plain Veroboard 2 x 3⁵/₈in. The layout of the components on these boards is shown in Figs. 4a and 4b. Mount the components in accordance with these diagrams remembering to solder the transistors in position last of all and to use a heat shunt when doing so. Do not connect the flying leads at this stage.

When completely satisfied that the component boards have been correctly constructed, fix the small aluminium bracket to each board as shown and secure them in position on the sub-chassis as indicated in Fig. 5.

Mount the components SK1-4 and S1 on the front panel, and then bolt the sub-chassis to the front panel using spacers so that the complete sub-chassis assembly is rigidly secured about half an inch above the back of the front panel. Wire up as shown in Fig. 5.



Photograph showing the unit wired up.

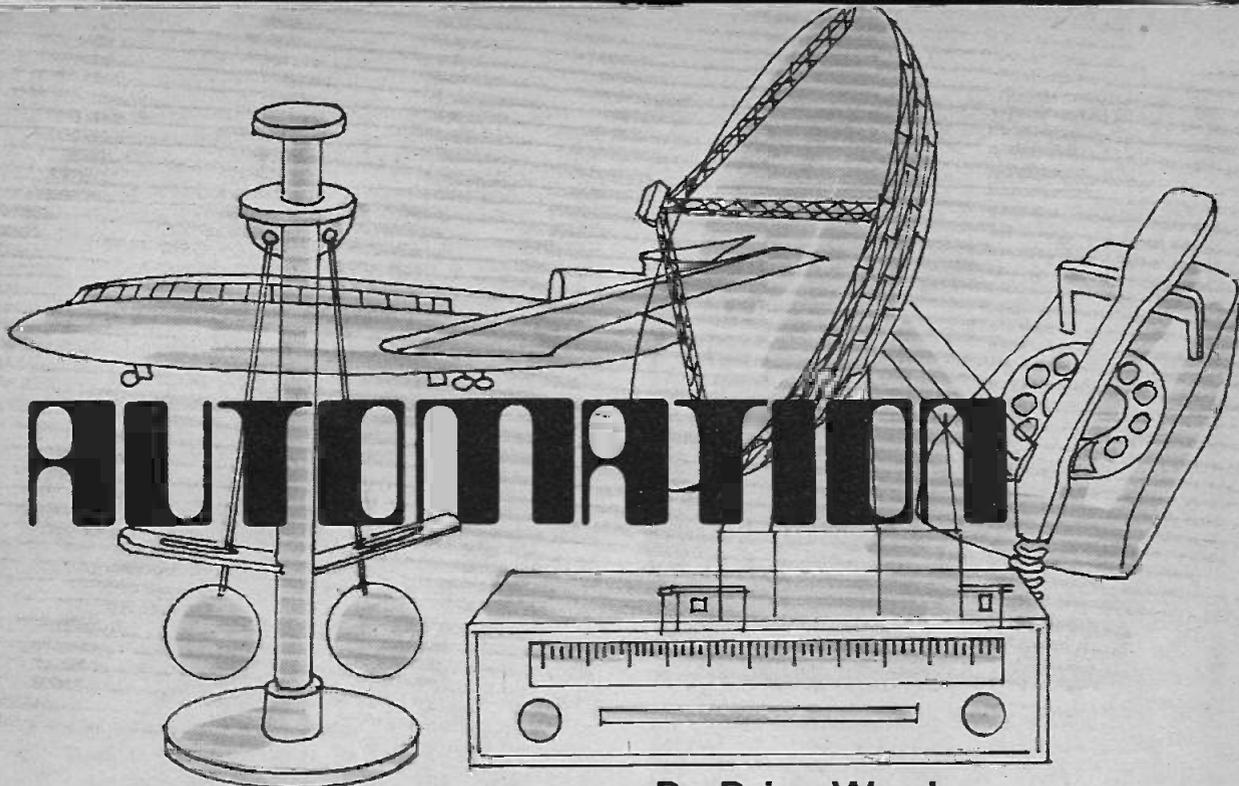
OPERATION

A milliamp meter in series with the positive lead from the battery should reveal not more than 2mA current consumption but remember that when the unit is first switched on the decoupling capacitor C7 will take a high current for a fraction of a second until it becomes charged so first set the milliamp meter to a high current range and then go to a lower current range to read the unit current consumption.

The output can be connected to the radio or line input of any tape recorder, most of which have an input sensitivity of between about 100mV and 1 volt.

The setting of the recording level control on the recorder will depend to some extent on the input sensitivity of the tape recorder but the best way of determining its optimum position is to connect up the microphone to the mixer and set the microphone gain control (VR1) to about three quarters of its movement. Now adjust the tape recorder recording level control for optimum recording level and note its position for future use with the mixer unit.

When inputs on the mixer are not being used the appropriate gain controls should be set to zero. □



By Brice Ward

THE Concise Oxford Dictionary says "automation, n. Automatic control of the manufacture of a product through successive stages, (loosely) use of machinery to save mental and manual labour . . .". This definition should make it clear that the subject of automation is very broad indeed.

Several devices that one uses every day are automated. When you pick up the telephone receiver and dial a number, the selection of the proper telephone out of thousands of subscribers is automated.

At one time, and in some parts of the world still, an operator sat at a console to which all

lines were routed. You picked up the receiver, turned a crank and the exchange answered by plugging one of a pair of plugs into your line.

When you gave her the number you wished to talk to, she plugged the other plug of the pair into a socket connected to the called number and turned a crank that rang the phone at that number.

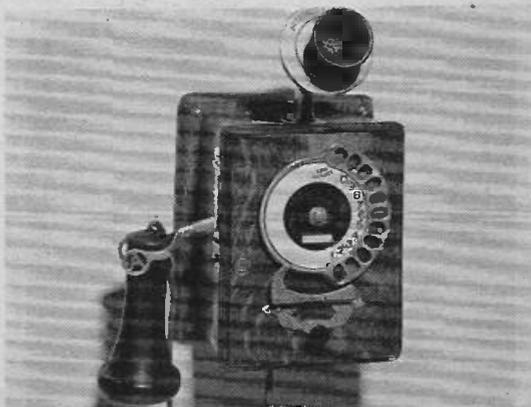
Today when you pick up the receiver, you automatically set a great deal of equipment in motion to serve you. For example, you get a "dialling tone" that indicates you have reached the automatic exchange. You then proceed to dial the desired number and dozens of telephone

The first "automatic" telephone.

Telephone exchange in St. Pauls Churchyard, 1901.
(Post Office)



(Lent to Science Museum by the Automatic Telephone Manufacturing Co. Liverpool)





The first pulse code modulation tandem exchange relays record the digits you are dialling. (Post Office)

exchange relays record the digits you are dialling.

Once you have completed dialling, other equipment tests the line called to determine whether or not it is engaged. If it is engaged, the equipment transfers to a device that transmits a "busy" signal to you. If not, the called number is rung by this central equipment and when the called party answers, the ringing signal is discontinued so that you can talk.

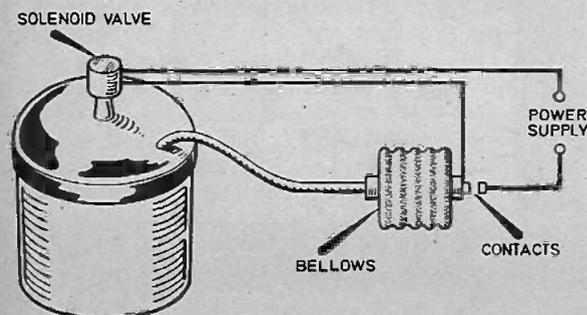
And when you replace the receiver, all of this equipment is returned to its original condition ready for the next subscriber.

HISTORY

In 1679 Denis Papin invented a pressure cooker. To keep the lid on, he used a weight that would allow the pressure to rise but was not heavy enough to cause the cooker to burst. This was automation in a rudimentary form.

Its modern counterpart still uses a similar device but there are a number of other ways that the same thing could be done. In Fig. 1, the increasing pressure expands a brass bellows.

Fig. 1. Pressure switched pressure cooker.



Everyday Electronics, July 1973

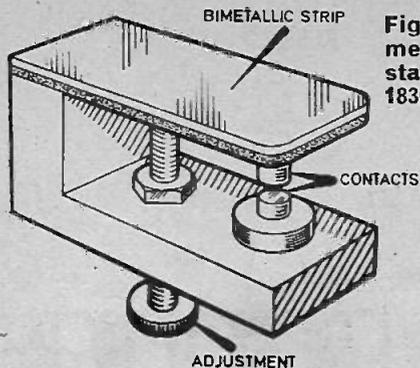
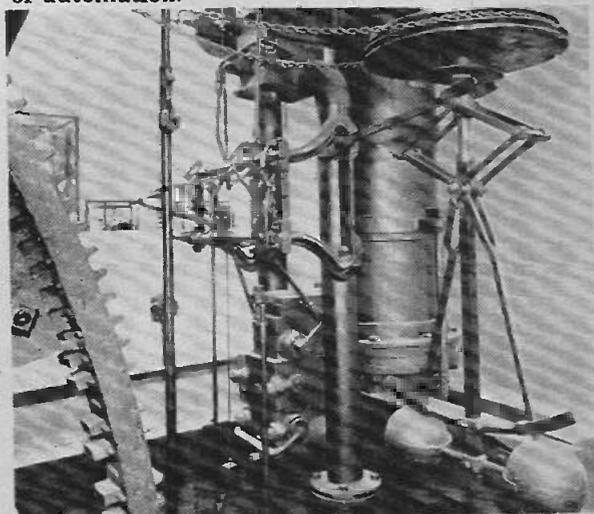


Fig. 2. Basic bimetallic thermostat invented in 1830.

When the pressure reaches a critical point, the contacts close, energizing a solenoid that releases the pressure.

This same type of arrangement could be used to control the source of heat, reducing the temperature *before* the pressure reached a critical point. And this is really the way most existing automated systems have been developed; that is by adding new ideas little by little.

The "governor" developed by James Watt to control the speed of a steam engine and the bimetallic thermostat (Fig. 2) invented by Andrew Ure in 1830 are other early examples of automation.

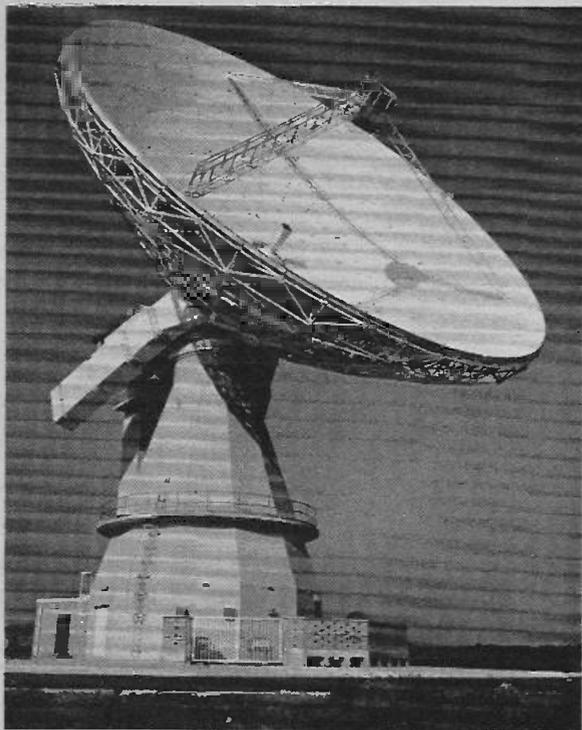


The James Watt steam governor (1788).

(Crown Copyright, Science Museum)

But a French engineer named Léon Farcot may have ushered in the "age of automation" with the invention in 1868 of a steam-operated rudder. When the tiller was operated, steam was allowed to turn the rudder but the closing of a valve by the rudder as it reached its new position made it "automatic". Farcot called it a servomechanism.

And today, huge antenna systems are positioned accurately to seconds of arc by the simple turning of a small handcrank or knob. And here again, advanced electromechanical servomechanisms are used.



The latest Goonhilly satellite communications aerial.

(Post Office)

OPEN-LOOP

In Figure 3, an "open-loop" system is shown. In an open-loop servosystem, a human operator intervenes. When the antenna is to be repositioned he turns a handcrank that is physically connected to a small device called a synchro transmitter. The synchro transmitter is a device that generates a signal over three wires indicating its angular position.

This information is accepted by a synchro receiver which follows the motion of the synchro transmitter and in turn drives a device called a "differential transformer". The differential



Main control console for the three Goonhilly aerials.

(Post Office)

transformer is mechanically coupled to the antenna and develops an error voltage which is fed to an electromechanical amplifier called an amplidyne. The output of the amplidyne turns the antenna which turns the differential transformer until the error voltage is reduced to zero.

To complete the loop, a synchro transmitter attached to the antenna sends the new bearing information back to the operator via a synchro receiver and indicator. The operator is responsible for ensuring that the antenna is properly oriented by noting the new bearing information presented by the indicator and correcting any error in bearing.

CLOSED LOOP

In a "closed-loop" system the operator simply keys in a new antenna position via an adding

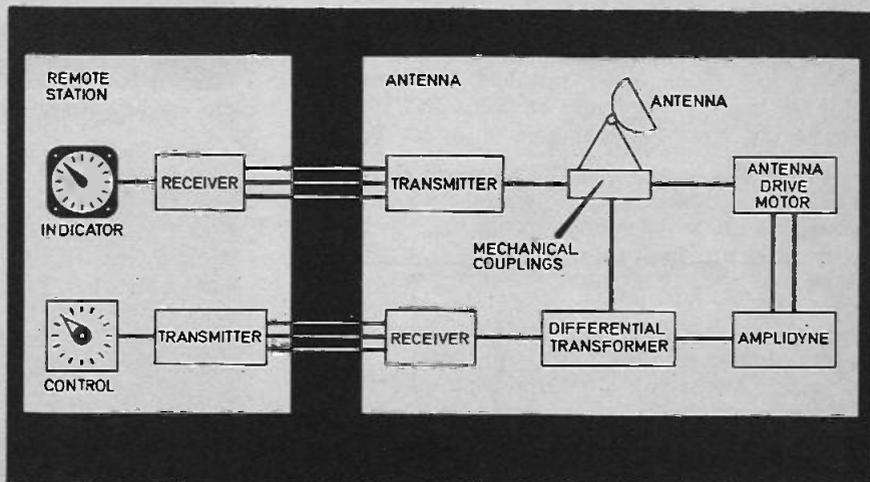
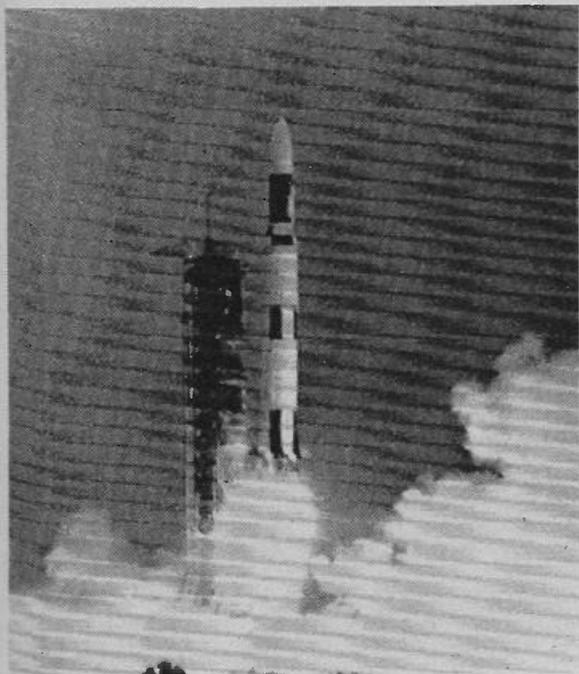


Fig. 3. An open-loop servo system for controlling an aerial installation.



The Saturn V rocket carrying Skylab blasts off.

machine type keyboard for example which transmits a digital indication of the new position desired to the antenna control circuitry. Instead of a differential transformer, a digital transducer or shaft encoder output is compared with the new position information and the digital difference applied to a digital-to-analogue converter to generate an "error signal".

The antenna is then driven in a direction that decreases the error signal until the antenna is at the new desired bearing. And the system can become even more complex when directing a satellite communications antenna where the new position for the antenna is being calculated by a computer and fed to the antenna control circuitry thus controlling the position to a very precise degree without human intervention.

PRINCIPLES

Automation depends on sensing a particular condition and operating some device in response to the condition sensed. A number of mechanical devices are automated. The automatic transmission in an automobile senses the r.p.m. of the engine and changes gears in response through a very intricate hydraulic system.

A record changer senses the acceleration or position of the pickup arm at the end of a record and either changes the record or turns the record changer off.

Jacquard's weaving loom senses the presence or absence of a hole in a punched card to lift or leave a warp thread in position while the weft thread is woven to make patterned cloth. And a player piano senses the presence or

absence of a hole to actuate the proper keys.

All of these devices could be electronically automated but for the cost of developing the necessary equipment. Every manufacturer must decide whether the full automation of a manufacturing process is a viable proposition, but the field is wide open to the willing inventor who would like to tackle some of the modern manufacturing problems.

SPACEFLIGHT

Perhaps one of the most advanced and sophisticated automatic systems is that used to launch a modern Saturn or other launch vehicle and place a payload in orbit.

Once a mission of this type is committed, everything is done automatically because human response would simply be too slow to respond. The engines are ignited, fuel flow controlled, engines gimballed and course plotted, predicted and controlled automatically using radar, gyros and other sensing devices coupled to a huge "real-time" computer complex.

The result is a near perfect record of launch and recovery in the NASA manned spaceflight operations.

But, like your own sense of sight, sound, touch, taste and smell, every one of the processes depends on sensing devices such as temperature transducers, pressure transducers, light transducers, position transducers and others to sense the required information and allow the system to respond properly through some hydraulic or motorized response system.

Next month: Automation applied to electronic circuits and other automated systems.

A hand operated washing machine of the 1920's and its electronically controlled modern counterpart.



Replica

CRYSTAL

SET

By F.G. Rayer



A replica of an original type set using a galena crystal.

IN the early days of radio, receivers of the type described in this article were found in many homes, and were used with one or two sets of headphones for family listening. In addition to being a novelty which excites attention, the set can of course be used for reception of local BBC programmes.

Crystal receivers have no battery or other power supply, and are not capable of long distance reception. In fact the volume and reception range depend very largely on the aerial and earth system which is used. When circumstances permitted and the effort had been made to put up a high, long aerial, a satisfactory reception range of 100 to 150 miles or so from a major BBC transmitter was expected.

For average installations, a maximum range of about 50 miles or so was expected, while this would be considerably reduced by unfavourable conditions or a poor aerial. Satisfactory reception of one or two programmes would thus be possible in most parts of the country.

RECEIVER CIRCUIT

Most modern receivers use a variable capacitor for tuning, but as this item was so costly in the early days of radio (and sometimes difficult to obtain) other means of tuning were often chosen.

Tuning, or the selection of the wanted transmission, consists of adjusting a circuit to reson-

ance with the required signal. The adjustment of frequency for this purpose can be by altering the parallel capacitance across a coil or inductor, or by leaving the capacitance unchanged, and varying the number of turns in circuit on the inductor.

In this receiver circuit, Fig. 1, the capacitance across the tuning coil or inductor is provided by the aerial/earth system, and is shown in dotted lines. A sliding contact moves along the turns of the coil, to change the number of turns in circuit. This is the means of adjusting the resonant frequency, or tuning. The main advantage of this system lies in its ability to cover a large range of frequencies.

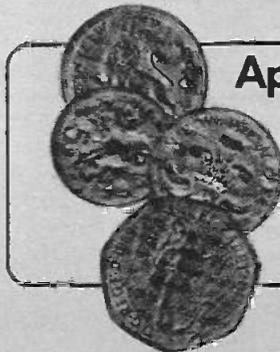
A signal voltage is developed across the coil. This has been amplitude modulated by the transmitter and to recover the programme some form

**Approximate cost
of components
including V.A.T.**

£4.20 inclusive

£2.65 less headphones

For kit details see Shop Talk



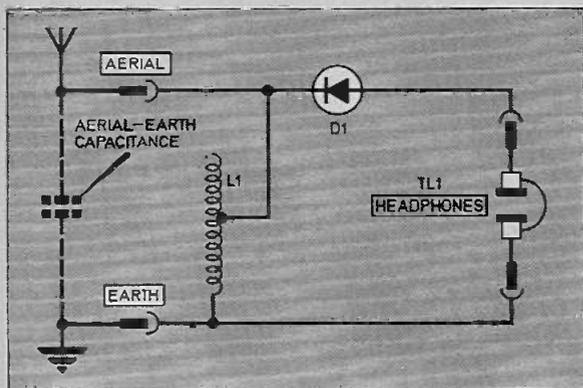


Fig. 1. Complete circuit diagram of the crystal set.

of demodulator, or detector, must be used. In this receiver, the detector is a cat's whisker and crystal combination.

DETECTOR

In the early days of radio, considerable effort was given to finding efficient combinations for such detectors, two crystals sometimes being used. Some combinations were carborundum with steel or silicon, tellurium with galena or zincite, and iron pyrites with silicon.

All these and others, when correctly adjusted, gave results about the same as those obtained with a modern semiconductor diode, though they generally had to be re-adjusted by hand quite frequently.

The audio signal from the detector goes directly to headphones, though it was occasionally taken to an amplifier, to give loudspeaker reception, and this could be so with the present receiver.

CONSTRUCTION

Constructional details are shown in Fig 2. Though there is no reason why other items should not be used, the ready-wound coil and sawn wooden base which are available will greatly simplify building the receiver. Drilling positions can be taken from Fig. 3.

Holes to clear 4BA are drilled for the earth, aerial, and phones terminals. A similar hole is necessary for the threaded crystal cup, and for the two brackets which hold the detector ("cats whisker") arm. The holes are recessed underneath with a $\frac{3}{8}$ inch or similar drill to clear the screw heads so that they do not project. At the same time two small holes are drilled for the connections to the coil and slider bar.

Narrow channels are cut in the underside of the board, with a chisel or sharply pointed knife, to take the leads. It is then possible (at a later stage) to glue on the piece of hardboard provided and attach rubber feet at each corner to prevent scratching furniture.

SLIDER AND COIL

The slider moves on a square bar, and should not be taken off as an internal spring is present, to assure good contact. The bar is fitted between the brackets, with the thicker washers inside the brackets, the coil then fitting correctly between them.

The threaded rod is put through the lower bracket holes, and the coil is pushed upwards so that the spring contacts on the slider bear on the turns of the coil. The nuts on the threaded rod and slider bar are then tightened.

Enamel insulation must be removed from the coil turns where the slider contacts press on the wire. This can be done with a small file, with a knife, or with fine abrasive paper. The receiver cannot work if there is no metal to metal contact here.

The coil and slider assembly is fixed with four wood screws, and connected as shown.

CRYSTAL DETECTOR

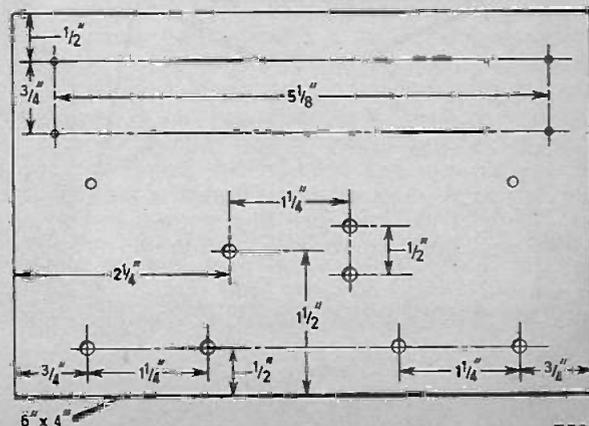
The thin wire provided is formed into a "whisker" by winding it round a small screw-driver blade, or anything similar, leaving about $\frac{1}{4}$ inch straight at each end. A slot is provided in the detector arm for the wire. One end of the whisker is fixed either by putting it in the slot and closing this to grip the wire with pliers, or by soldering.

The shaped clamps for the arm hold it as in Fig. 2, but it can be slid along, or tilted, to adjust the position and pressure of the whisker on the crystal.

A thumbscrew holds the crystal in the cup. This is tightened enough to hold the crystal firmly, but not with such force that the crystal is broken. The best surface of the crystal for detection purposes is likely to be that having the most facets and irregularities, so this should be upwards.

(It is interesting to note that "resistance movement" detectors were made in the last war by using a contact resting on the oxidized surface

Fig. 3. Base drilling details.



Replica

CRYSTAL SET

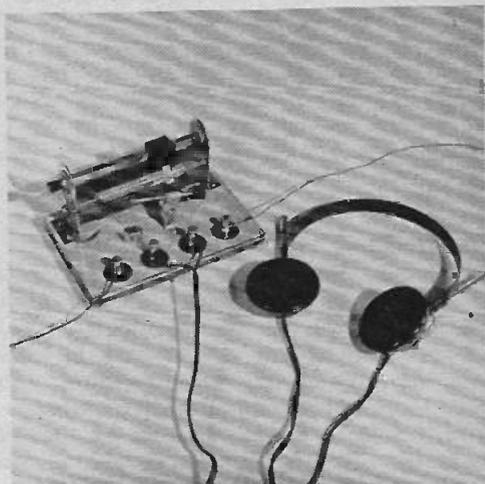
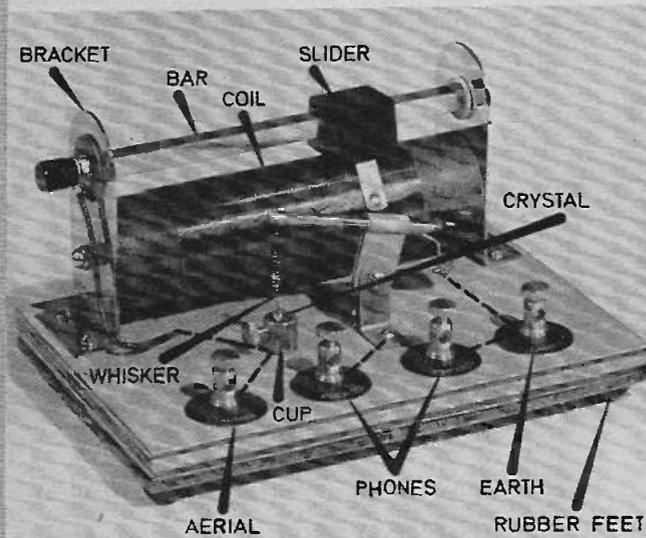


Fig. 2 (above) Photograph showing the complete construction of the Crystal Set. The dotted lines indicate wires running under the wooden base.

Fig. 4 (below) A typical aerial/earth set up for good reception.

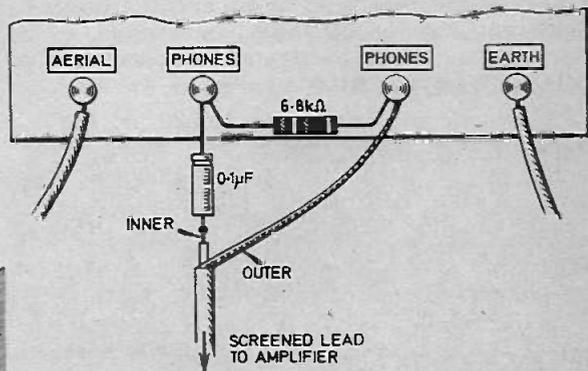
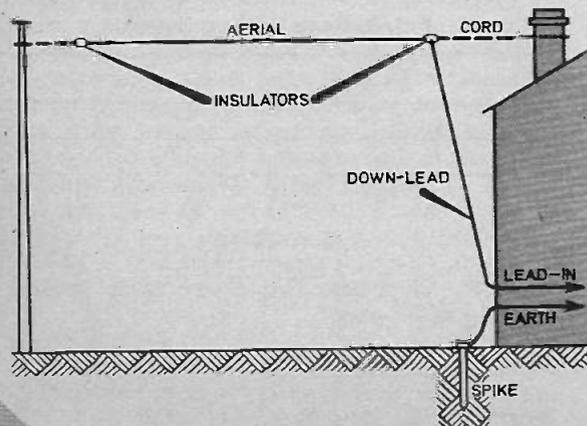


Fig. 5 (above) Method of connecting the Crystal Set to an amplifier. Screened lead should be used as shown.

of a safety-razor blade, and in fact any likely detector or semi-conductor combination can readily be tried here.)

The detector is adjusted by moving the arm to change the point where the whisker touches the crystal, and also the pressure, until a sensitive spot is found. That is, one giving the best volume.

HEADPHONES

Headphones which are most suitable will usually have a coil resistance of between about 500 and 4,000 ohms, and will be intended for use with crystal sets or similar receivers. The crystal radio cannot amplify; signals which may be at comfortable volume with suitable headphones may be too weak with unsuitable headsets designed for other purposes. Low impedance or moving coil headphones are not suitable.

Reception or listening is generally more satisfactory with a complete headset with headband and two earpieces, than with the small personal phone type of receiver, for one ear only.

AERIAL

Both the aerial and the earth, are essential parts of the whole installation. In areas where signal strength is good, an insulated wire suspended along two walls of a room, near the ceiling, may give enough volume. Such an aerial is likely to be better in an upstairs room.

In most areas, where signal strength is lower, some form of outdoor aerial is really required. This can be of 7/26 stranded wire, 14 s.w.g. or 16 s.w.g. hard-drawn copper wire, or other aerial wire. In order to get up enough length, two suspension points will usually be necessary. One can be at a house bedroom window, or at the eaves or a chimney. The distant support may be a pole, tree, or other building.

AERIAL/EARTH LAYOUT

Maximum signal strength is obtained when the top portion is long, high, and clear of earthed objects, and the down-lead is at least two feet from walls and similar objects, Fig. 4 shows a typical aerial/earth system, such as would have been provided in the early days of radio, but in many cases circumstances make something not quite so good as this necessary.

The aerial, down-lead and lead-in can be one uncut piece of wire, and ought to total at least 50 feet for good signal pick-up. Aerial wire can be bought in any length, and it would be usual to have the aerial as long and high as circumstances allow, for best possible reception.

Polythene line or cord is ideal for suspending the aerial, with an egg insulator at each point. The lead-in may pass into the room through a lead-in tube, or through a hole drilled in a

window frame, or in some cases it can be squeezed between an opening window and the frame.

EARTH

An inefficient aerial will weaken signals, and the earth is in normal circumstances essential. Disconnecting or omitting the earth will cause a very great loss of signal strength.

The earth connection can be of the same wire as used for the aerial, and is run to any earthed object. Earth spikes can be obtained and driven into the ground. A similar result is achieved by soldering or bolting the earth lead to a metal sheet, can, or any reasonably large metal object, and burying this in a hole. (The latter type of earth is likely to deteriorate from corrosion, after a time.)

In some cases some earthed metal may be present, to which the lead can be attached. Do not use mains earths, or connect the earth lead to gas or water pipes, however.

USING THE RECEIVER

With aerial, earth and phones connected, move the whisker into contact with the crystal, and slide the contact assembly along the bar to tune in the wanted transmission, which will generally be from a local BBC station. The detector should then be re-adjusted as necessary, to find a sensitive spot on the crystal.

Maximum volume naturally depends on the best adjustment of the detector, which may require a little care and patience. It is a good idea to have available a modern semiconductor diode, which will allow comparisons to be made. (This is included in the kit.)

Connect the diode from the aerial terminal to the adjacent phone terminal, and move the whisker clear of the crystal. Best possible adjustment of the old-style detector should give about the same volume as will be obtained with the diode.

COVERAGE

The receiver will cover the usual medium wave band. Where volume is adequate but one programme is heard at the same time as another and cannot be separated, a small fixed capacitor can be put in the lead to the aerial terminal. This is most likely to be needed with a very long aerial. The capacitor would usually be about 100pF to 300pF. Small values improve sharpness of tuning (selectivity) but may cause too much loss of signal strength.

Where output from the receiver is to be fed into an amplifier, the connections shown in Fig. 5 can be used. □

Note No components list is given for this item as most of the parts are not readily available—for kit details see *Shop Talk*.

SEMICONDUCTORS

TWO

DIODES

J.B. DANCE M.Sc.

THE two types of semiconductor materials, *p*-type and *n*-type, were discussed last month and it was explained that the *n*-type (negative carrier) semiconductor material contains fixed positive charges with free electrons moving amongst them, while the *p*-type material contains fixed negative charges with mobile positive holes moving amongst them.

PN JUNCTION

Let us now consider what would happen if the piece of *n*-type and the piece of *p*-type material could be brought together so as to make a single crystal containing a fairly sharp junction between the two materials.

One might expect that electrons from the *n*-type material would wander across the junction and combine with holes in the *p*-type material, whilst holes from the *p*-type would pass in the other direction to neutralise electrons in the *n*-type.

This movement of holes and electrons in opposite directions across the junction does occur at first, but this movement of the charges renders the *n*-type material positively charged with respect to the *p*-type material.

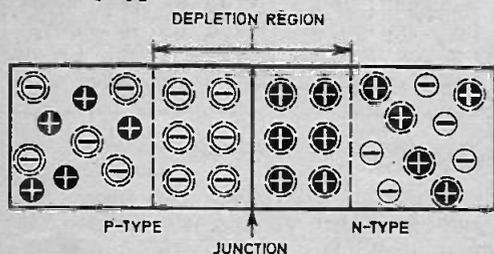


Fig. 2.1. A *pn* junction showing the depletion region.

As shown in Fig. 2.1, there are now more positive than negative charges in the *n*-type material, whereas the opposite is the case on the *p*-type side of the junction.

In other words, a voltage is developed across the junction which can be called the natural junction potential.

In actual practice, good *pn* junctions cannot be made by bringing together pieces of each type of semiconductor material, since the junction must be present as part of a single crystal. Junctions are actually manufactured by intro-

ducing suitable impurity materials into part of the volume of a single crystal of the semiconductor material.

DEPLETION REGION

The positive charge of the *n*-type material repels any holes which may attempt to cross the junction, whilst the junction potential also repels any electrons away from the junction into the *n*-type material.

The natural junction potential therefore creates a region in the neighbourhood of the junction which contains very few mobile charges.

This region is known as the depletion region, since it is depleted of both electrons and holes. As it contains hardly any mobile charges, it acts as an insulator.

The natural junction potential cannot be measured by merely connecting the two ends of the semiconductor crystal to a voltmeter, since opposing voltages are generated at the points where the connecting wires join the semiconductor materials.

These opposing voltages must just balance the natural junction potential, since otherwise the junction could be used as an inexhaustible battery to provide perpetual motion. This would violate the law of conservation of energy.

A suitably constructed junction of *p* and *n*-type materials is known as a semiconductor junction diode. We shall now see why such a diode will conduct easily in only one direction.

FORWARD BIASING

Imagine that an external voltage is applied to the diode of Fig. 2.1, the polarity (or direction) of this voltage being such that it tends to make the *p*-type material more positive relative to the *n*-type.

The basic circuit for applying such a voltage is shown in Fig. 2.2. The resistor is included in the circuit to keep the current to a safe value if the diode suddenly becomes conducting.

Let us first consider the case where the applied voltage is less than the natural junction potential of the diode.

In this case, the *p*-type material will remain negative with respect to the *n*-type material, since the applied voltage is too small to over-

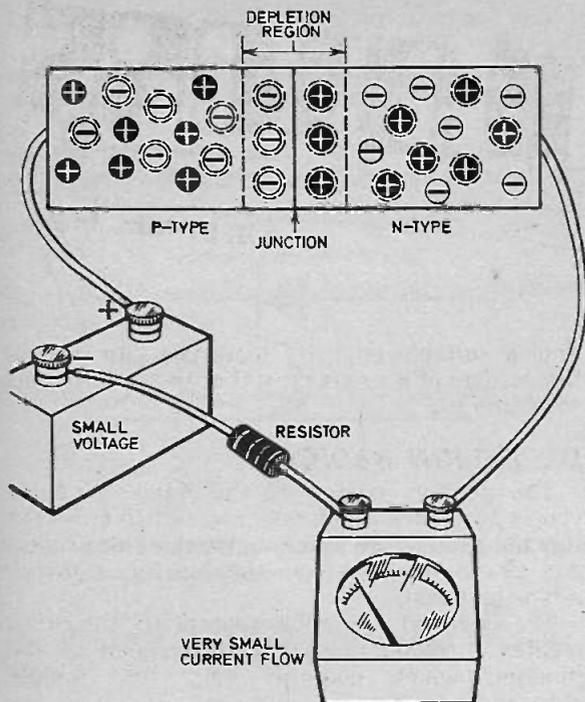


Fig. 2.2. A *pn* junction with a forward bias of less than the natural junction potential.

come the natural junction potential, although it does reduce it.

As shown in Fig. 2.2, very little current will flow, since the total voltage across the junction is still of the polarity which repels holes into the *p*-type material and electrons into the *n*-type material.

The depletion region is still present, although it is narrower than in an unbiased junction since the net voltage repelling the charge carriers away from the junction has been reduced by the applied voltage.

The absence of mobile charge carriers in the junction region prevents the flow of current through the device.

If the polarity of the applied voltage remains unaltered so that it still tends to make the *p*-type material positive, but the value of the applied voltage is increased so that it is larger than the natural junction potential, the situation changes to that depicted in Fig. 2.3.

The *p*-type material is now positive with respect to the *n*-type and electrons from the *n*-type are attracted across the junction into the *p*-type instead of being repelled away from the junction into the *n*-type.

Similarly, the *n*-type side of the junction attracts holes from the *p*-type material. Both types of charge carrier therefore pass across the junction in large numbers.

The meter in the external circuit therefore shows a relatively large current, the value of which will be limited almost entirely by the

presence of the series resistor.

The application of a voltage in this direction (no matter whether it is smaller or larger than the junction potential) is called **forward biasing**. A diode is said to conduct easily in the forward direction. It is easy to remember that the *forward* direction occurs when the *p*-type material is positive.

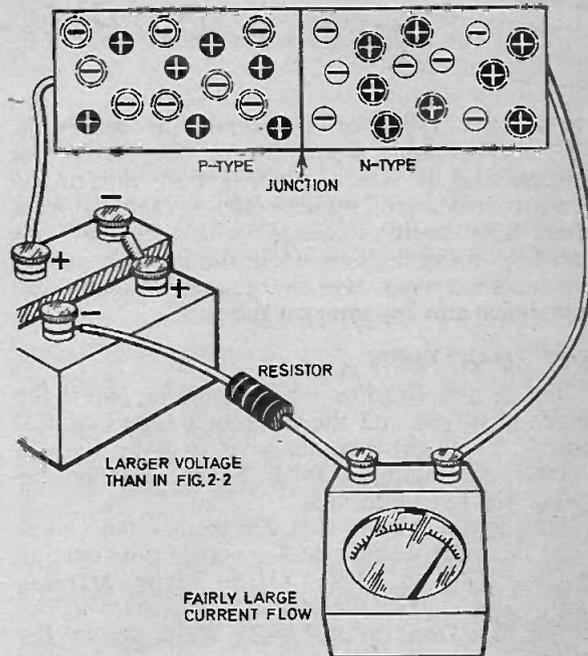


Fig. 2.3. A *pn* junction with a forward bias large enough to produce conduction.

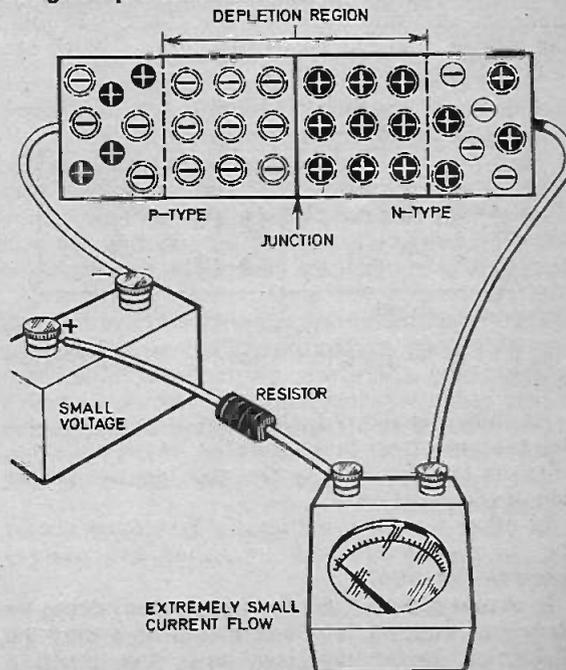


Fig. 2.4. A reverse-biased junction showing the large depletion region.

REVERSE BIASING

If a voltage is applied to the junction which has the effect of making the *p*-type material negative with respect to the *n*-type, the applied voltage is effectively added to the natural junction potential.

As shown in Fig. 2.4, the holes are repelled from the junction into the *p*-type material, whilst the electrons are repelled into the *n*-type. The width of the depletion layer is greater than that for the unbiased junction of Fig. 2.1 and very little current passes through the device.

A diode biased in this direction is said to be reverse biased and any small current which flows through it is known as the reverse current.

It is easy to remember that reverse biasing occurs when the *p*-type material is negative, since the *p* and *n* are effectively opposites.

MINORITY CARRIERS

One might expect that no current at all would flow through a reverse biased diode. However, *p*-type semiconductor materials do contain very few free electrons, whilst *n*-type materials do contain very few holes. These minority carriers are attracted across the reverse biased junction of Fig. 2.4 since to them it appears like a forward biased diode.

For example, the positive minority hole carriers in the *n*-type material are attracted towards the negatively biased *p*-type material.

A current will therefore flow through a negatively biased diode, but this current is a very small one, since the number of minority carriers is a very small fraction of the number of majority carriers.

The minority carriers will pass across the junction even when the diode is unbiased, since the natural junction potential has the same polarity as that of a reverse biased diode.

This flow of minority carriers will tend to reduce the natural junction potential very slightly, but this reduction allows an equal number of majority carriers to flow in the opposite direction to completely cancel the minority carrier flow.

The concentration of minority carriers is much greater in germanium than in silicon at the same temperature, therefore, germanium diodes normally pass a reverse current which is much higher than that of silicon diodes, although this is still very small.

The reverse current is also known as the leakage current.

SYMBOL

The symbol for a semiconductor diode is shown in Fig. 2.5. The circle indicates that the diode is suitably encapsulated. Sometimes a diode is represented by only half an arrow (with or without a circle), as shown.

The forward current flows in the direction of the arrow.

In a practical diode, the manufacturer puts a ring marking around the diode (or sometimes a red spot) at the connection out of which the forward current flows. This connection corresponds to the cathode of a thermionic valve.

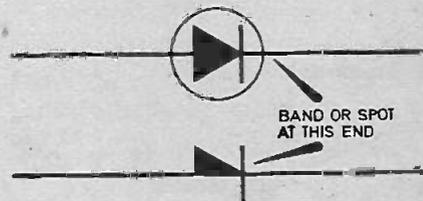
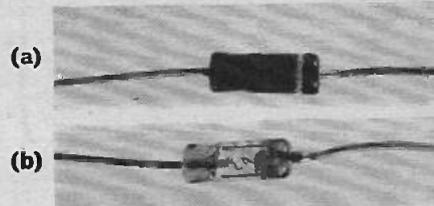


Fig. 2.5. Alternative symbols for the diode.



Photograph of two common diodes (a) silicon IN4148, (b) germanium OA91.

CHARACTERISTIC CURVES

The characteristic curve of any electronic device is a graph of the current flowing through the device plotted against the voltage present across the device.

The forward characteristics of a germanium and a silicon diode are shown in Fig. 2.6.

The natural junction potential of a silicon diode is about 0.5V and therefore it does not pass a large current until the applied forward voltage exceeds this value.

The natural junction potential of a germanium diode is about 0.15V, however, diodes manufactured from this material pass a large current at fairly small forward voltages. Natural junction potentials vary somewhat with temperature.

Forward characteristics may be plotted using the type of circuit shown in Fig. 2.7. The voltage is varied by moving the slider of VR1. This potentiometer may have a value of about 1 kilohm, whilst the battery may be a 1.5V dry cell. A value of about 47 ohms is satisfactory for the current limiting resistor, R, if D1 is a normal small diode, since the maximum possible value of the current passing through the diode will then be

$$1.5/47 = 0.033A = 33mA$$

A 150 ohm resistor must be used if the maximum permissible value of the diode forward current is 10mA.

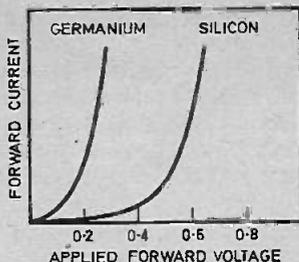


Fig. 2.6. Forward characteristics of germanium and silicon diodes.

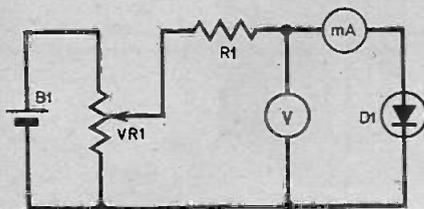


Fig. 2.7. Circuit for plotting the forward characteristics of a diode.

The milliammeter of Fig. 2.7 can normally have a full scale deflection of about 10mA, but the voltmeter should have a full scale deflection of about 1V.

The data sheets issued by the manufacturers of each type of diode state a maximum permissible value of the forward current; if this value is exceeded, the diode may be damaged by overheating.

REVERSE CHARACTERISTICS

When a reverse voltage is applied to a silicon diode, the current remains very small and fairly constant until the value of the voltage increases to a point at which breakdown occurs and the current then increases very rapidly as shown in Fig. 2.8.

Germanium diode reverse characteristics normally show a more steady increase of reverse current with reverse voltage.

Part of the reverse characteristics of a germanium diode may be plotted using the same type of circuit as shown in Fig. 2.7, but the diode should be connected with the opposite polarity.

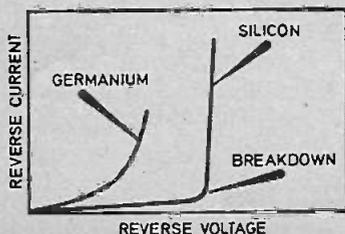


Fig. 2.8. Reverse characteristics of junction diodes.

In addition, a more sensitive meter will be required to measure the current; a 0-250 μ A meter may be suitable for some germanium diodes. The battery voltage should also be increased to about 9V.

It is more difficult to plot the reverse characteristic of a silicon diode, since the reverse current is so small. Some silicon diodes pass a reverse current of about one microamp, but other types pass only a nanoamp (a thousandth of a microamp).

The reverse current increases very rapidly with temperature, roughly doubling in value for each 10 degree centigrade rise provided that the applied voltage is well below that required for breakdown. This can easily be demonstrated by applying a small reverse voltage to a germanium diode, measuring the reverse current and then warming the diode with one's hand.

The heat energy causes the number of minority carriers to be greatly increased and these flow across the junction. Silicon diodes show the same effect, but the current is more difficult to measure, as it is so small.

In general, diodes should be used in circuits which ensure that reverse voltages near to the breakdown value will never be applied, since the diode will be destroyed if a large current flows under such conditions. However, voltage regulator diodes are designed to operate under breakdown conditions.

SILICON AND GERMANIUM DIODES

Suitable silicon junction diodes can be used at higher reverse voltages than germanium devices and can also operate at higher temperatures. Thus silicon diodes are more suitable for use as power rectifiers, especially at medium and high voltages.

High current silicon diodes are often mounted on pieces of metal which help to dissipate the heat developed in the diode.

The pieces of metal are known as heat sinks; the metal has a larger area than the diodes themselves and can therefore pass the heat more easily to the surrounding air.

Germanium diodes have the advantage that the forward voltage drop is less than that of silicon diodes (see Fig. 2.6); they are often used at radio frequencies.

Manufacturers can choose the doping levels on each side of the junction, the junction area and many other variables to produce diodes with a very wide number of properties.

Different manufacturing techniques can produce different characteristics; for example, silicon planar epitaxial diodes can be made with relatively low voltage drops at high forward currents in combination with other desirable characteristics.

Next month: Various diode types.



Thermostatically controlled car engine cooling fan. 

By D. C. Halliday

MANY cars in this country tend to be over-cooled by the engine driven fan. If this fan is removed, not only does a quicker "warming-up" time result but also a certain saving in power is achieved. Removal of the fan, however, creates the problem of overheating, say, in a traffic jam, when there is no longer an air flow to cool the engine.

This article overcomes this problem, by describing the construction of an electric fan which is controlled by a temperature sensing circuit, where, as the temperature of the engine rises and reaches a certain point, the fan is switched on to cool the engine.

CIRCUIT DESCRIPTION

The circuit of Fig. 1 is basically a Schmitt trigger with the thermistor (RTH1) acting as the temperature sensing device. Potentiometer VR1 alters the triggering level and allows the temperature at which the fan operates to be varied. This temperature point is made independent of the varying car supply by using the stabilising effect of the Zener diode D1.

Transistor TR1 is normally conducting and TR2 is cut-off. As the engine temperature rises, the resistance of the thermistor falls and eventually TR1 is turned off and TR2 on, thus operating the relay RLA1. Any 12V relay may be used, providing it has a set of normally open heavy duty contacts and the relay's current requirement does not exceed the maximum current rating of TR2 (800mA). The diode D2 absorbs the back e.m.f. of the relay and so prevents damage to TR2.

The supply for the circuit is taken directly to the ignition switch since the consumption is so



**Approximate cost
of components
including V.A.T.**

**£1.75 plus
motor and fan**

small, a separate on/off switch is considered unnecessary. A switch is, however, wired across the relay contact to act as a manual override and a light is provided to indicate fan operation.

It may be found that sparking of the relay contacts cause spurious triggering of the circuit and this can be eliminated by connecting a capacitor (C1) across the contacts. Provided the circuit is isolated from the car body, it may be used for positive or negative earth cars.

THERMISTOR

The thermistor used in the prototype was of the type used in TV heater lines and it had a resistance of 600 Ω when cold and 250 Ω at the temperature at which the fan was required to operate. If a thermistor of a different value is used a little experimentation with the value of VR1 may be necessary.

CONSTRUCTION

There is nothing critical about the component lay out, any form of convenient construction being adopted. The prototype was built on Vero-

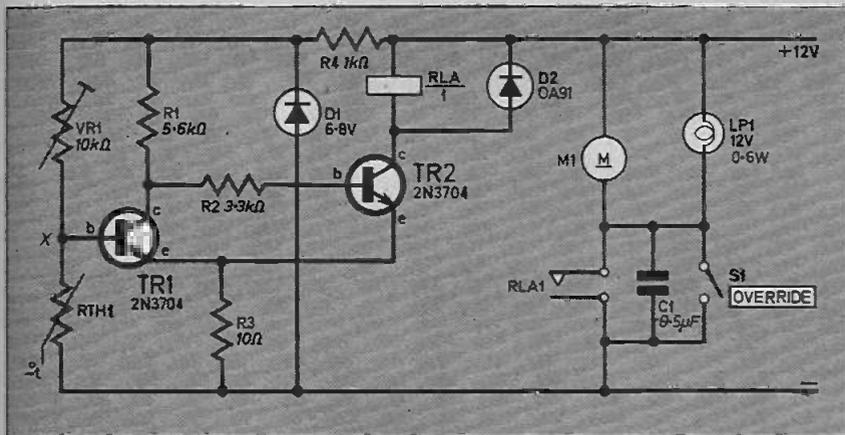


Fig. 1. Complete circuit diagram of the Autofan showing fan and switch wiring.

board (Fig. 2) and then mounted, together with the relay, in a small plastic box under the dash board. The manual override switch and indicator light were mounted on the dash board.

The thermistor can be mounted on the thermostat housing of the engine, in the following way, a small metal clamp is formed around the thermistor as shown in Fig. 3, taking care not to overtighten the bolts of the clamp and so crack the thermistor; the securing bolts are tightened so that the two pieces just grip the body. A hole is drilled in the end of the clamp, large enough for the thermostat housing bolt to pass through, to clamp the thermistor mounting to the engine.

With this form of mounting, the engine heat is conveyed to the thermistor. If the car is negative earth, one side of the thermistor can be earth returned and only one wire is then necessary to connect the other side to point X on the circuit. For positive earth cars two wires will be required. The clamp and thermistor can be painted for protection.

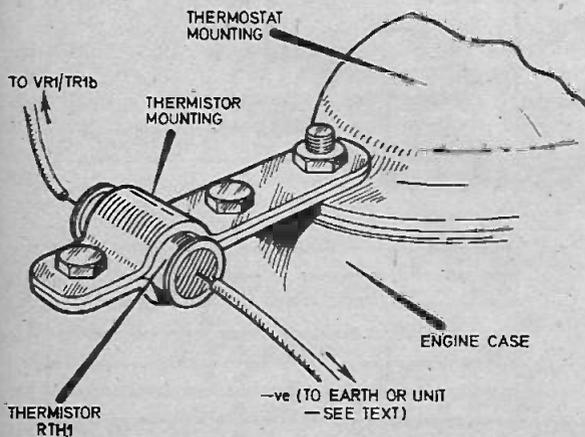


Fig. 3. Method of mounting the thermistor to the thermostat housing on the engine. This may vary with different engines.

Components....

SEE
**SHOP
TALK**

Resistors

- R1 5.6kΩ
- R2 3.3kΩ
- R3 10Ω
- R4 1kΩ

All $\frac{1}{4}$ W \pm 10% carbon

Capacitor

- C1 0.5μF, 400V

Semiconductors

- TR1 2N3704 silicon npn
- TR2 2N3704 silicon npn
- D1 6.8V 250mW Zener diode
- D2 OA91

Miscellaneous

- VR1 10kΩ carbon preset
- RTH1 CZ4 or similar thermistor (see text)
- RLA1 12V relay with one set of normally open heavy duty contacts
- M1 Car heater fan motor (see text) and plastic fan
- LP1 12V 0.6W bulb and dash mounting holder
- S1 S.p.s.t. toggle switch

Materials for mounting M1 (see text), Veroboard 2.5 x 1 x 0.15 inch matrix, wire, case for the Veroboard and relay (see text), materials for mounting RTH1 (see text)

FAN CONSTRUCTION

To drive the fan a 12V heater motor unit of the "snail type" construction is required, this can be obtained quite cheaply from a scrap car dealer. The motor and "squirrel cage" type fan are removed from the unit and the fan cut down to leave a flat disc which is designed to lock on to the motor spindle (Fig. 4).

Next, a plastic fan, already fitted to many cars these days, is removed from the engine pulley or also obtained from the scrap dealer and, taking

AUTOFAN

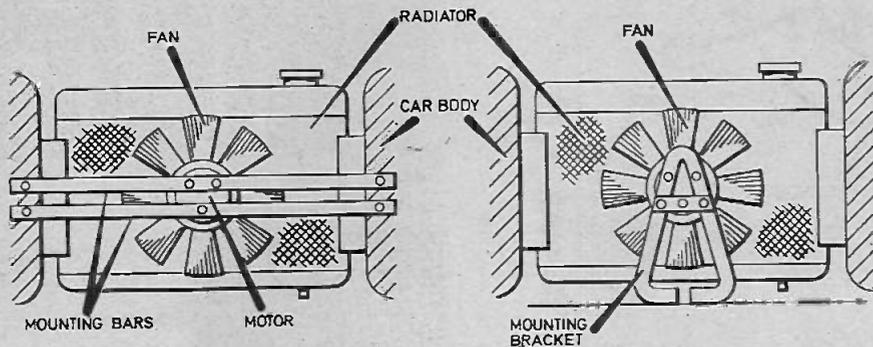


Fig. 5. (above) Two methods of mounting the fan in front of the car radiator.



Photograph of the prototype Autofan Veroboard wiring.

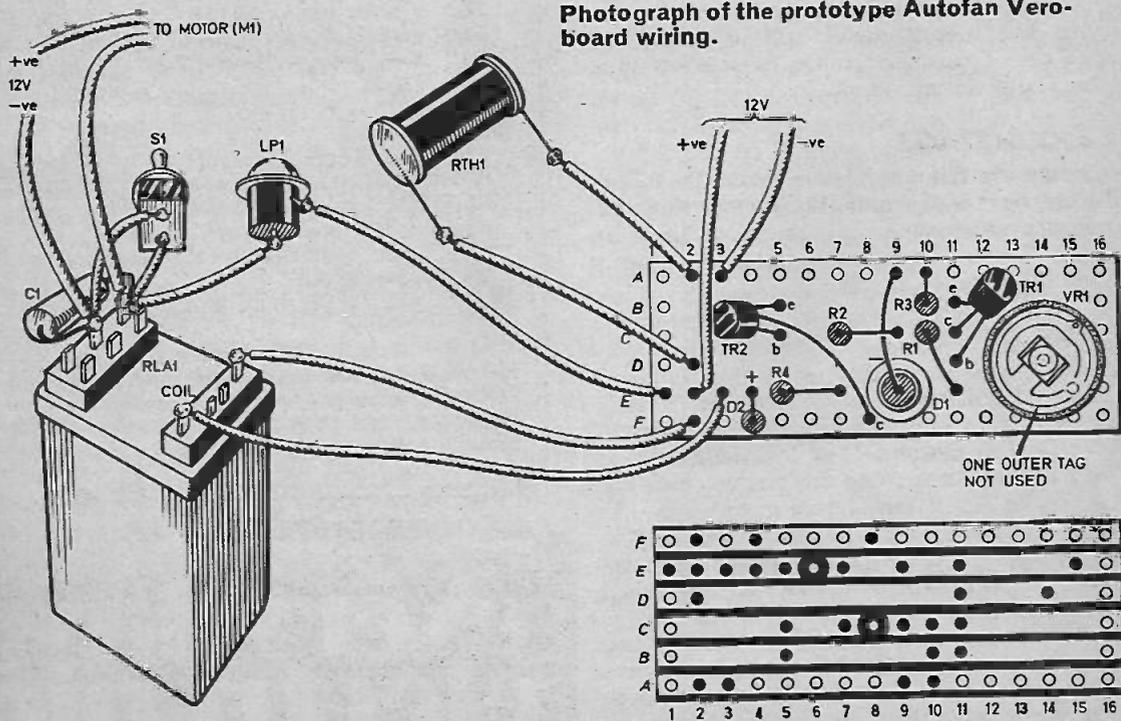


Fig. 2. Complete layout and wiring of the Autofan unit. RTH1 is mounted on the engine.

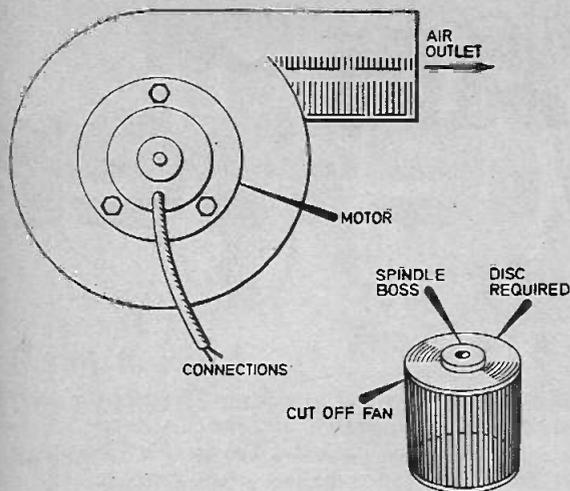


Fig. 4. The fan and motor required. Modification to the original fan to mount the new blades are indicated.

care to ensure it lies centrally on the disc to avoid running vibration, holes are drilled using the existing fan holes as a guide. The fan is bolted to the disc using shake-proof nuts and the fan assembly then locked on to the motor spindle.

Finally, using the mounting holes on the motor case, the completed fan is mounted behind the radiator grill and in front of the radiator (Fig. 5). The author used two metal strips across the car body but the motor could just as easily be mounted on a triangular frame, or another suitable method of fixing found.

FAN MOUNTINGS

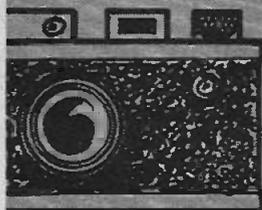
Obviously, the fan will have to be on the motor spindle the right way around to force air through the radiator. Alternatively, the connections to the motor brushes can be reversed to achieve the same direction of air flow.

SETTING UP

The car engine is brought up to the temperature at which fan operation is required. This is best done using an engine temperature thermometer (about 90 degrees C or 195 degrees F is suitable), alternatively, run the engine with the normal fan on, until the engine is hot—the car should be stationary for this—and then set the control to operate the electric fan at this temperature. To do this adjust VR1 carefully until the relay operates.

It will be found that the cooling effect of the fan counteracts any further rise in temperature and there is sufficient back-lash in the circuit to hold the fan on until the temperature falls below the initial triggering point, when the circuit reverts to its initial state, switching off the relay, and hence the fan. □

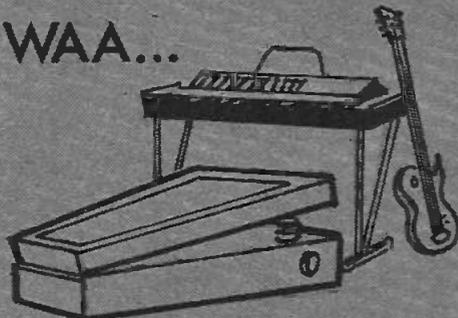
NEXT MONTH



SLAVE FLASH

Photographers, don't miss this simply constructed unit that enables one flash to be automatically triggered from another.

WAA WAA...



For use with guitars, organs etc. This effects unit has been designed to be easy to build and uses no inductors.

DOORBELL...



Not, in fact, a bell but an electronic circuit that produces an unusual sound when the button is pressed.

... PROJECTS FOR ALL TO BUILD IN ...

everyday electronics

Printed Circuit viewer

A circuit board
construction aid
By G. P. Chayney

CHECKING a printed circuit board, or tracing a circuit off a printed circuit board can be a tedious and time-consuming task. However, by using the Printed Circuit Viewer described here, the job is made so much easier as it is possible to see the components on the top of the board and the copper circuitry underneath the board, at the same time.

The viewer is limited to single clad boards of up to $\frac{3}{32}$ in. thick but this also depends on the board material.

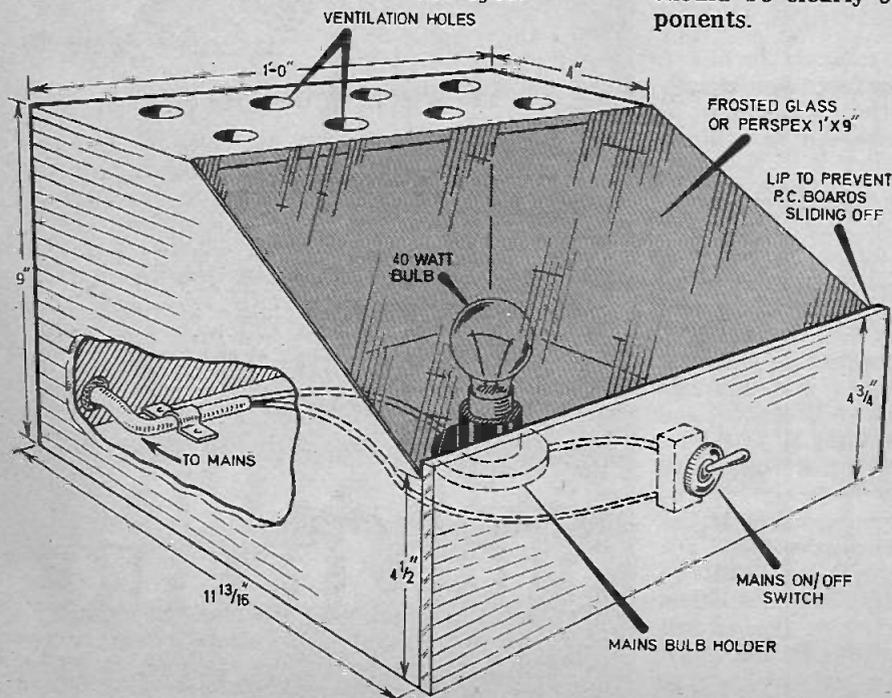
The Printed Circuit Viewer is shown in Fig. 1 and is seen to basically consist of a top plate (screen) made of frosted glass or Perspex through which a 40W lamp shines. The reason for using a "frosted" material for the screen is to produce an even diffused light which at the same time does not strain the eyes.

Ventilation is provided by holes in the top of the case, drilled at an angle, so that light emerging from these holes is guided away from the eyes of the user.

The construction of the prototype is shown in Fig. 1 but it is by no means critical. The only thing to be careful of is that the case is adequately ventilated. If desired a small fan can be incorporated to produce a forced draught, but this was not found necessary on the prototype.

The interior can be painted white or lined with kitchen foil to produce good all round illumination.

To use the unit, merely place the circuit board under examination, copper side down on the screen, and switch on; the copper outline should be clearly seen together with the components.



COST

No approximate cost has been given for this project since it depends mainly on the type of materials used.

Fig. 1. Details of the complete Printed Circuit Viewer.

DEMO CIRCUITS

8 By MIKE HUGHES

The Thyristor

THIS month's project is a little unusual because the circuit we shall consider is one that simulates the electronic characteristics of a special component called a controlled silicon rectifier (or more usually—a thyristor). Initially we shall describe a working equivalent circuit and then give a very simple experiment to illustrate the operation of a real thyristor.

THE DEVICE

A thyristor is rather like a diode in that it will block current when voltage of one polarity is applied (i.e. it is reverse biased)—reverse the polarity of the voltage and a normal diode would pass current but this is where the thyristor differs. It will not pass current in the forward biased direction until a small amount of current is made to flow into a third electrode—the gate.

The thyristor is what we call a "four layer device" and is made up of a sandwich of *p*, *n*, *p* and *n* type silicon as shown in Fig. 8.1. This structure is easier to understand if you think in terms of having two transistors of opposite types cross connected so that the base of the

Fig. 8.1. Basic thyristor structure and circuit symbol.

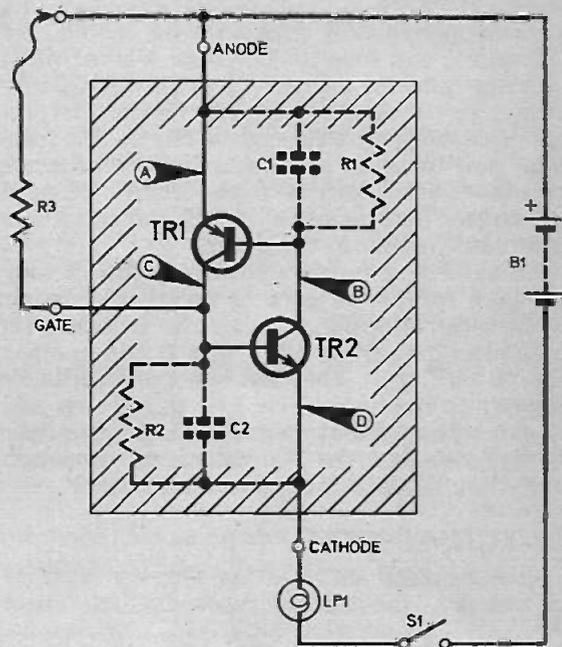
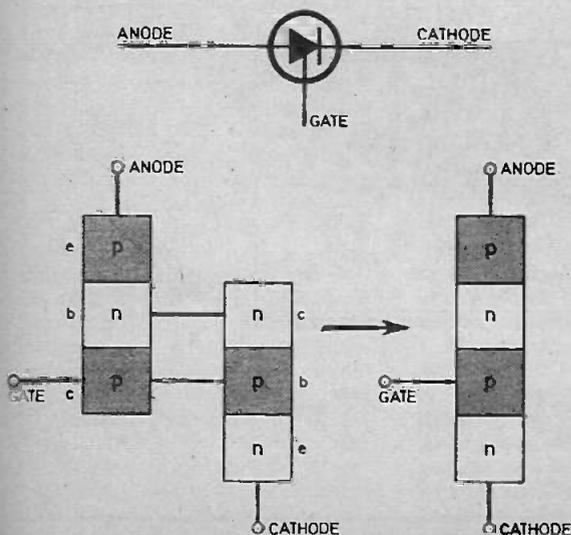


Fig. 8.2. The simulated thyristor used.

pnp type is connected to the collector of the *npn* type and vice-versa. Look at the two transistors connected in this manner in the shaded region of Fig. 8.2.

The dotted components C1, C2, R1 and R2 are shown to represent the fact that the doping levels in a thyristor are fairly high and this gives rise to poor quality junctions that show reasonably high capacitance and quite a lot of reverse leakage; this is something to be avoided at all costs in conventional transistors but is very necessary to make a thyristor work as we shall soon see.

THYRISTOR ACTION

Assume that initially R3, leading from what we call the gate, is disconnected from the positive supply rail and that we close S1. Neither transistor will conduct, the reason being that to make a transistor conduct we have to pass base current and to do this the base of an *npn*

transistor must be taken to a potential more positive than the emitter and vice versa for a *pnp* type.

In this case the base of TR1 cannot initially go more negative than its emitter because the parasitic capacitance (C1) momentarily keeps the base at the same potential as the emitter; likewise C2 prevents the base of TR2 going positive. If no base current flows no collector current can flow and neither transistor will pass current; it is therefore impossible for current to flow from point A, through the transistors, to point D and LP1 will not light up.

Leave S1 closed and now consider what will happen when we connect R3 to the positive rail. We will immediately provide base current for TR2 and it will turn on but from where will it draw its collector current? The only possibility is through the emitter base junction of TR1 but this constitutes base current in TR1 so this transistor now turns on and wants to draw collector current—where does it come from?—through the emitter base junction of TR2 and this maintains base current in the latter.

We have gone round a positive feedback loop and both transistors go into very hard conduction; current flowing through the network via two routes, one from A via B to D and another from A via C to D. The total effect of both these currents is ample to cause LP1 to light up and what is more we can now remove R3 from the positive rail and the transistors will maintain conduction because of the positive feedback.

SWITCHING OFF

Once switched on it is not easy to see how we can stop the transistors conducting. There

Fig. 8.4 (right). The circuits of Fig. 8.3 and 8.5 wired up on the Demo Deck.

Fig. 8.5 (below). Experimental circuit using an actual thyristor.

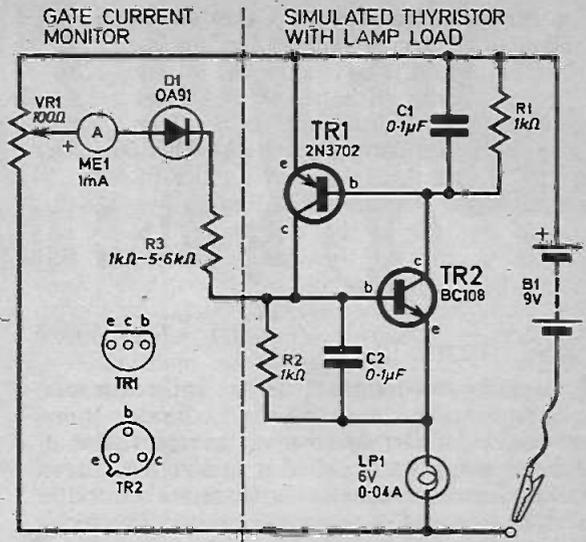
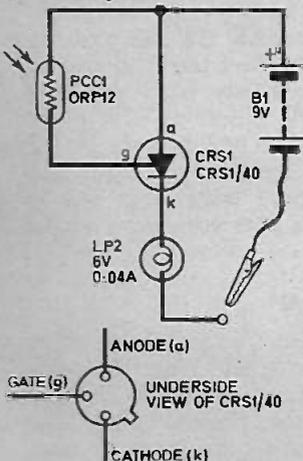
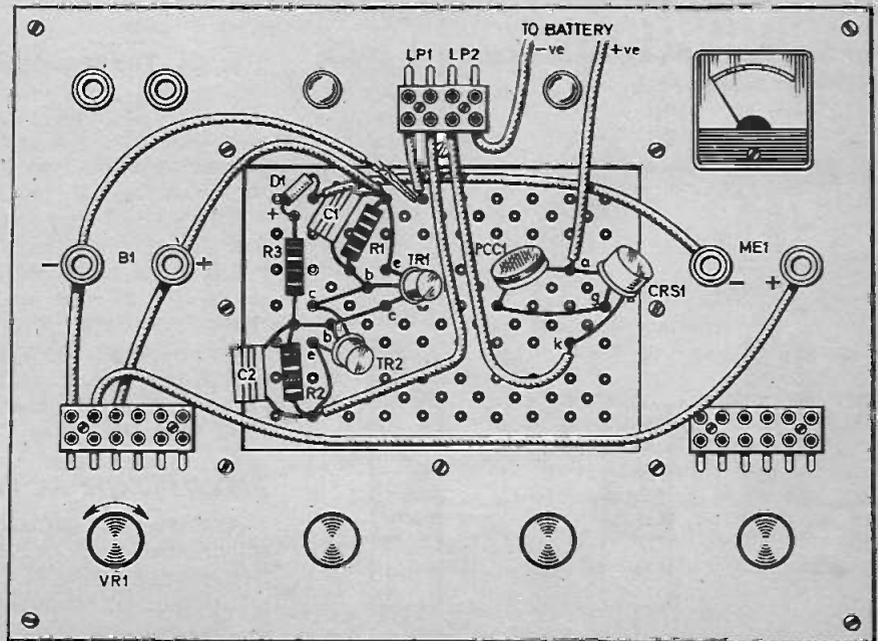


Fig. 8.3. Experimental circuit using the simulated thyristor.

is only one way—which can be reached by three alternative techniques—and that is to momentarily break the current flowing in the positive feedback loop. The simplest way to do this is to open S1, immediately switching the lamp off and causing the loop current to stop flowing—but don't forget the parasitic capacitance of C1 and C2. If we close the switch before these have discharged the circuit will go straight back into conduction.

Fortunately R1 and R2 are there to speed up the discharge of the capacitors and unless we try to switch the circuit off with too short



an interruption to current there should be no problem. The second way of interrupting the feedback current is to reduce the voltage of the supply (not easy with batteries but extremely easy with 50Hz mains which is rising to a peak and back to zero before going negative 50 times a second!) The third way is to make the circuit current, going through the lamp, bypass the simulated thyristor by shorting point A and D.

We have implied that you should stop the current flowing through the transistors completely but this is not strictly true; there is a level of current below which collector currents in the two transistors cannot be maintained—this is called the holding current and for a real thyristor is in the order of 10 or 20mA. There is, of course, a certain level of current that had to flow through R3 in the first instance to cause the transistors to switch on; the minimum value for this current is in the order of 1 to 75mA for real thyristors and varies from type to type—this is called the gate current.

EXPERIMENTAL CIRCUIT

Make up the experimental circuit of Fig. 8.3 on the Demo Deck as shown in Fig. 8.4. Before connecting up the crocodile clip make sure that VR1 is set so that its wiper is nearest the ground (negative) rail. Connect up the battery and you will see the lamp does not light up. Now slowly advance VR1 to provide gate current—which can be monitored directly on ME1. At some level—typically for this circuit between 0.5 and 1mA—we shall establish sufficient cur-

rent for the transistors to conduct and the lamp lights up. Experiment with different values for R3; triggering always occurs at the same current. Diode D1 becomes reverse biased and the gate current falls to zero (without D1, current would flow backwards through the meter into our gate current control circuit).

You can now do anything you like with the gate current monitor—remove it altogether if you like—but you will not be able to turn the lamp off. The only practical ways are to either disconnect the crocodile clip or momentarily short the emitters of TR1 and TR2.

ACTUAL THYRISTOR

While you're at it why not get hold of a real thyristor (we suggest a mains rated one—about 400V, 1A—which will come in handy for other work) and make up the simple circuit of Fig. 8.5, also shown wired up on the Demo Deck. The gate current is provided through PCC1 which will be below the critical minimum level until the cell is fairly brightly illuminated with a match or torch. To switch off, stop illuminating PCC1 and either break the circuit as before or temporarily short between anode and cathode.

IMPORTANT NOTE

Do not under any circumstances use the "simulated thyristor" to replace a genuine thyristor in any other circuits. There is no similarity in the break down voltages or current ratings.

Next month: The Monostable Multivibrator

Ruminations

By Sensor

Caveat Opener

Reading EVERYDAY ELECTRONICS April 1973 I noted the idea submitted to *Bright Idea's* by a Bedfordshire reader. This was a suggestion for making a drilling jig to aid the mounting of power transistors. A good idea—but a word of warning.

Some transistors contain Beryllium oxide, a ceramic-like substance which is good thermal conductor and an electrical insulator, both qualities being necessary in order to conduct heat away from the chip without short-circuiting the device. Unfortunately, despite the aforementioned virtues Beryllium oxide can be dangerous; the dust, when inhaled, is highly toxic.

The material is perfectly stable and harmless under normal circumstances but if someone should chance to grind or braid it the result could be disastrous. The types mentioned in *Bright Idea's* do not contain Beryllium oxide and consequently are quite safe. Transistors containing Beryllium oxide normally bear a warning and one should remember the story of Pandora's Box before opening any transistor.

Large White Board

I was puzzled when looking down the classified advertisements in the newspaper to read "A large white board for sale, three years old". It was only when I saw that I was reading the agricultural column that I realised that the ad referred to a pig! Misprints can make brighter reading; in the same journal someone was reported as pleading "quilty"—perhaps as the theft of an eiderdown!

I was amused to read an advertisement in the technical

press for a sensitive meter with a full-scale deflection of 100amps! The all important μ had been omitted. It reminded me of the time many years ago when I offered to extend the range of a friend's 2.5 volt meter. The meter was a large moving-iron type in a brass case and he wanted to measure mains voltage with it.

I measured the meter resistance and calculated the value required to increase the range to 250 volts, we connected up the resistor and plugged in to the mains, the pointer rose to 240 volts and we both smiled with satisfaction. Then the resistor melted and I suddenly realised that, in my eagerness, I had not really noticed that this old meter needed 2 amps to carry the pointer to full scale deflection.

Although I had calculated the resistance value correctly I had omitted to calculate the power dissipated in the resistor. The meter was intended for cell testing and contained a load resistor.



Capacitors

I am rather confused over the markings on capacitors. Some, I notice, are marked with a number followed by "NF" which means very little to me. Also with electrolytics; I have one or two that are black one end, yet on the body the same end has a + sign. I thought black was negative! To add to my confusion I have a number of capacitors marked 3900/10 and 10000/2 with no other means of identification. Can you help?

The marking NF—which should actually be written nF—stands for nanofarad. A nanofarad is a thousandth of a microfarad or, if you like, a thousand picofarads. Therefore a device marked, say, 10nF has a value of 10 nanofarads which is the same as $0.01\mu\text{F}$ or 10,000pF.

At one time manufacturers used a red rubber seal at the positive end of electrolytics, the negative connection invariably being the metal can. There was no problem in those days. The only thing that has changed is that there is a tendency for them to use black material as a seal—presumably it's better! The thing to remember is that if you have the choice of a metal can connection at one end of the capacitor and an insulated connection at the other the "can" end is invariably negative—unless the capacitor has markings to the contrary.

The capacitors marked 3900/10

and 10000/2 are almost certainly 3,900pF and 10,000pF respectively as these are preferred values and as such are readily identifiable from the manufacturers code number. The 10 and 2 are probably his code for working voltages and without knowing the manufacturer we cannot say for sure what the code is.

Speakers

I have a radio, cassette tape recorder which has, at its extension speaker sockets, an output of 2 watts into an 8 ohm speaker. I wish, however, to run two speakers in separate rooms from this one outlet. How can I do this and what will be the power I get at each?

There are two ways and in either case the power of 2 watts will be split between your speakers—giving 1 watt maximum at each. Either connect two 4 ohm (standard 3 ohm would probably do) loudspeakers in series or, probably a little more expensive, two 15 ohm speakers in parallel. Either way your loudspeakers will approximately match the output of your amplifier.

If using them in the same room experiment with the relative polarity of connections of the two speakers so that they operate in phase. The latter does not affect the electrical characteristics but will result in a better sound.

TV Connection

I read your article on an Audio Colour Unit. Can I operate it from the loudspeaker of my television set? If I can what do I need to do?

The simple answer is never connect anything to a television set. The reason is that, to economise on cost and weight, very few television sets run from a mains transformer. Therefore to maintain circuit continuity the chassis—and hence the ground rail—of a TV set is connected directly to one side of the mains. This may be live or neutral depending on the way you have wired the plug. Even if you know which way the plug is wired it does not help if

the plug is of the "two-pin" variety—*someone else* could plug it in the wrong way.

It is possible to do what you want but it requires the installation of an isolating coupling transformer across the existing loudspeaker; your signal being taken from the secondary of this transformer. We advise neither you nor your friends to attempt doing this unless you are really experienced, however, we are sure your local TV repair man could do the job for you. All you need specify is that you want a 3 to 15 ohm output impedance—he will know the best transformer to use for your set.

Isolation

I have a stereo amplifier that is powered by a rectifier instead of a transformer. This means my speaker output is "live". Can you tell me how to isolate the speaker terminals so that they can be made safe for headphones and tape recording—I keep blowing the fuse because my tape recorder also works from the mains and shorts the amplifier output to ground.

You have experienced what we have warned the previous reader to avoid and you have been very lucky—especially as you were contemplating the use of headphones! We cannot think of a shorter-cut to self electrocution! Our answer could be the same in your case but there is an alternative way, provided your amplifier is not of too high a power. You could use a mains isolating transformer at the point where the mains enters your amplifier.

In selecting a transformer it should have a power rating equal to or greater than the power consumption of your amplifier. If your amplifier is transistorised take the peak output audio power and at least double it to get an estimate of this value. For a valve set do the same but then add on 2 watts for every valve in the set (to allow for the power wasted in the heaters). R. S. Components do a range of mains isolating transformers at various power ratings (available from most suppliers) however they are not cheap and are cumbersome and you might not be able to fit one inside your cabinet.

The X25

Why two shafts?

220-240 Volts or 100-120 Volts.

Model X25

The leakage current of the X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live".

Tested at 1500v A.C. 25 watt. Fitted long-life iron-coated bit 1/8"

2 other bits available 3/32" and 3/16"

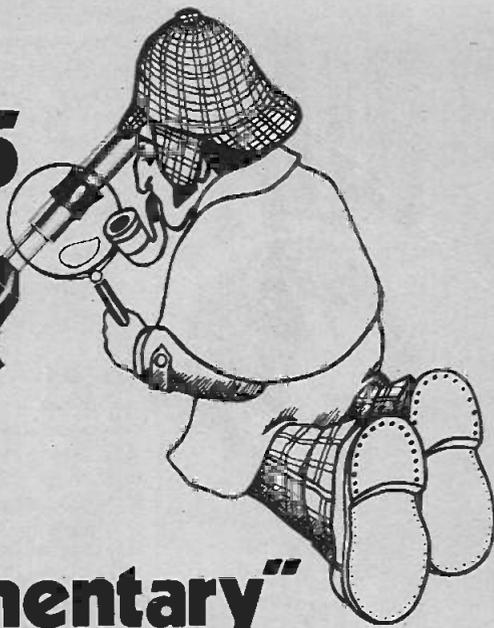
Price: £1.75 (rec. retail) P & P 8p

"elementary"

One ceramic shaft to give you near-perfect insulation and negligible leakage current (only 3-5 microamps) so that you can safely solder delicate and expensive integrated circuits and transistors, even when "live"

Another shaft, of stainless steel, to give you the strength required of an everyday robust general purpose iron.

Plus large volume long-life bits to store the enormous heat-capacity of the 25 watt element. Bits that do not stick (no screws or pins) and bits that slide over the element shaft to give you efficient heat transfer and a capacity equivalent to irons of 2-3 times the wattage.



MODEL CCN

220 volts or 240 volts. The 15 watt miniature model CCN also has negligible leakage.

Test voltage 400v. A.C. Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32". 4 other bits available 1/8", 3/16", 1/4" and 3/64".

PRICE: £1.95. P&P 5p



MODEL G

18 watt miniature iron, fitted with long life iron-coated bit 3/32". Voltages 240, 220 or 110.

PRICE: £1.95 (rec. retail). P&P 5p



All prices mentioned are exclusive of V.A.T.

MODEL CN

Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 3/64", to 3/16". Voltages 240, 220, 110, 50 or 24.

PRICE: £1.75 (rec. retail). P&P 5p

MODEL CN2

Miniature 15 watt soldering iron fitted with nickel plated bit 3/32". Voltages 240 or 220.

PRICE: £1.75 (rec. retail). P&P 5p

MODEL SK.2 KIT

Contains 15 watt miniature iron fitted with 3/16"

bit, 2 spare bits 5/32" and 3/32" heat sink, solder,

and "How to Solder" booklet.

PRICE: £2.60 (rec. retail). P&P 8p

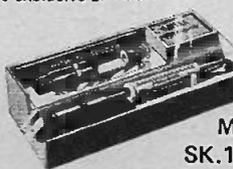


MODEL MES.KIT

Battery-operated 12v. 25 watt iron fitted with 15" lead and 2 heavy clips for connection to car battery.

Packed in strong plastic wallet with booklet "How to Solder"

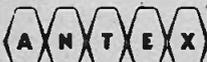
PRICE: £2.05 (rec. retail). P&P 12p



MODEL SK.1 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE: £2.95 (rec. retail). P&P 12p



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2G303	0-25	2N3404	0-27	3N140	1-38	AP240	0-72	BCY32	0-78	BFX30	0-25
2G306	0-30	2N3414	0-10	3N142	0-81	AP240	0-64	BCY34	0-54	BFX44	0-33
2G309	0-40	2N3415	0-10	3N142	0-81	AP240	0-72	BCY34	0-35	BFX63	2-48
2G345B	0-25	2N3416	0-15	3N152	0-58	AFY42	0-74	BCY38	0-40	BFX68	0-30
2G371	0-15	2N3417	0-21	3N153	0-75	APY21	0-55	BCY39	1-05	BFX84	0-24
2G374	0-18	2N3570	1-25	3N153	0-81	AL103	0-70	BCY40	0-81	BFX85	0-29
2N174	1-40	2N3571	1-87	3N154	0-94	ASV26	0-80	BCY43	0-80	BFX86	0-29
2N3574	0-43	2N3572	0-67	3N159	1-17	ASV27	0-89	BCY48	0-21	BFY19	0-25
2N456	0-75	2N3702	0-10	3N200	2-49	ASV29	0-80	BCY59	0-22	BFX89	0-20
2N456A	0-75	2N3703	0-10	3N201	1-05	ASV30	0-80	BCY66	0-68	BFY10	0-35
2N457A	0-80	2N3704	0-14			ASV30	0-80	BCY67	0-94	BFY11	0-45
2N491	3-25	2N3705	0-10			ASV35	0-85	BCY70	0-17	BFY17	0-90
2N494	0-25	2N3706	0-09	40050	0-78	AU103	1-25	BCY72	0-22	BFY18	0-25
2N496	0-25	2N3707	0-13	40051	0-81	AU107	0-14	BCY87	3-47	BFY20	0-50
2N497	0-15	2N3708	0-07	40309	0-33	BC108	0-13	BCY88	2-40	BFY29	0-40
2N498	0-25	2N3709	0-08	40310	0-59	BC109	0-14	BCY89	0-80	BFY37	0-20
2N499	0-25	2N3710	0-12	40313	0-92	BC113	0-13	BCZ10	0-35	BFY41	0-43
2N705	0-10	2N3711	0-09	40316	0-50	BC114	0-12	BCZ11	0-30	BFY43	0-42
2N706A	0-12	2N3712	0-05	40318	0-82	BC115	0-15	BD115	0-75	BFY50	0-16
2N708	0-13	2N3713	0-06	40321	0-82	BC116	0-15	BD116	0-68	BFY61	0-18
2N709	0-15	2N3714	1-15	40360	0-46	BC116A	0-18	BD121	0-75	BFY62	0-16
2N711	0-30	2N3715	1-23	40361	0-48	BC117	0-21	BD123	0-62	BFY63	0-15
2N718	0-21	2N3716	1-30	40362	0-50	BC118	0-11	BD124	0-67	BFY65	0-44
2N718A	0-30	2N3717	2-35	43063	0-88	BC119	0-27	BD130	0-67	BFY64	0-41
2N720	0-30	2N3718	2-35	43089	0-48	BC121	0-28	BD131	0-40	BFY75	0-40
2N721	0-55	2N3719	0-58	43094	0-66	BC123	0-29	BD132	0-50	BFY76	0-22
2N814	0-22	2N3776	6-45	40338	0-50	BC125	0-18	BD135	0-43	BFY77	0-24
2N819	0-20	2N3778	2-25	40406	0-44	BC126	0-20	BD138	0-49	BFY78	0-38
2N818	0-30	2N3779	3-15	40407	0-32	BC132	0-30	BD137	0-55	BFY90	0-60
2N819	0-20	2N3780	4-50	40408	0-50	BC134	0-11	BD138	0-68	BSX39	0-33
2N829	0-14	2N3781	3-87	40409	0-82	BC135	0-11	BD139	0-71	BSY19	0-14
2N830	0-14	2N3782	8-27	40410	0-63	BC136	0-15	BD140	0-69	BSX21	0-20
2N1090	0-23	2N3789	1-76	40414	3-55	BC138	0-20	BDY11	1-50	BSX26	0-34
2N1091	0-20	2N3790	2-20	40438	1-44	BC140	0-34	BDY17	1-50	BSX27	0-34
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2N1132	0-20	2N3794	2-06	40474	0-69	BC142	0-34	BDY19	1-97	BSX29	0-47
2N1302	0-16	2N3792	1-08	40650	0-69	BC143	0-21	BDY20	0-92	BSX30	0-38
2N1303	0-16	2N3792	1-08	40650	0-69	BC144	0-24	BDY21	0-92	BSX39	0-38
2N1304	0-20	2N3819	0-47	40651	0-67	BC145	0-21	BDY60	0-90	BSX60	0-54
2N1305	0-20	2N3820	0-47	40652	0-58	BC147	0-11	BDY61	0-85	BSX61	0-42
2N1306	0-25	2N3823	0-97	40654	0-56	BC148	0-10	BDY62	0-75	BSX76	0-15
2N1307	0-25	2N3824	0-75	40636	1-10	BC149	0-18	BF115	0-23	BSX77	0-28
2N1308	0-25	2N3826	0-23	40673	0-30	BC153	0-18	BF117	0-43	BSW70	0-25
2N1309	0-25	2N3854	0-16	AC107	0-55	BC154	0-18	BF119	0-38	BSY26	0-15
2N1483	0-30	2N3854A	0-16	AC113	0-17	BC157	0-14	BF121	0-25	BSY26	0-15
2N1507	0-24	2N3855	0-16	AC115	0-16	BC158	0-13	BF122	0-27	BSY27	0-15
2N1613	0-20	2N3855A	0-16	AC117	0-20	BC159	0-14	BF125	0-25	BSY28	0-15
2N1631	0-20	2N3856	0-16	AC121	0-18	BC160	0-37	BF127	0-27	BSY28	0-15
2N1638	0-27	2N3856A	0-16	AC126	0-25	BC167B	0-11	BF132	0-20	BSY38	0-15
2N1701	1-10	2N3858	0-16	AC127	0-25	BC168B	0-13	BF153	0-29	BSY38	0-15
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2N1839	0-20	2N3859A	0-16	AC142K	0-25	BC169C	0-13	BF159	0-27	BSY52	0-25
2N2102	0-30	2N3860	0-16	AC151V	0-11	BF170	0-11	BF160	0-23	BSY53	0-25
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2N2148	0-60	2N3877	0-25	AC153	0-22	BF172	0-11	BF163	0-20	BSY66	0-79
2N2192	0-40	2N3877A	0-25	AC153K	0-23	BF182	0-10	BF166	0-35	BSY68	0-15
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2N2194	0-37	2N3900A	0-21	BC184	0-08	BF184	0-11	BF178	0-25	BU104	1-42
2N2194A	0-30	2N3901	0-32	BC184L	0-11	BF179	0-30	BF180	0-35	BU105	1-25
2N2195	0-37	2N3903	0-30	ACY17	0-25	BF186	0-25	BF181	0-35	C111	0-68
2N2195A	0-30	2N3905	0-17	ACY18	0-15	BF187	0-25	BF182	0-30	D40N3	0-55
2N2218A	0-18	2N3905	0-21	ACY19	0-20	BF187A	0-11	BF183	0-40	GET111	0-45
2N2219	0-20	2N3906	0-22	ACY20	0-20	BC205	0-10	BF183	0-40	GET112	0-20
2N2219A	0-21	2N4036	0-63	ACY21	0-18	BC206	0-11	BF184	0-17	GET113	0-20
2N2220	0-20	2N4037	0-42	ACY22	0-13	BC207	0-10	BF185	0-17	GET114	0-20
2N2221	0-20	2N4038	0-18	ACY23	0-18	BC208	0-09	BF186	0-14	GET115	0-50
2N2221A	0-23	2N4039	0-09	ACY30	0-42	BC209	0-10	BF190	0-15	GET120	0-25
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2N2222A	0-21	2N4051	0-11	ACY41	0-17	BC212K	0-10	BF197	0-15	GET336	0-20
2N2368	0-11	2N4062	0-11	ACY41	0-17	BC212L	0-16	BF198	0-15	GET336	0-20
2N2369	0-39	2N4302	0-25	ACY44	0-31	BC214L	0-23	BF199	0-18	GET338	0-20
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2N2647	1-20	2N4914	0-87	AD140	0-55	BC238	0-09	BF225J	0-14	GET387	0-20
2N2711	0-12	2N4915	0-96	AD142	0-50	BC239	0-09	BF227	0-22	GET390	0-22
2N2712	0-12	2N4916	0-20	AD143	0-45	BC231	0-20	BF244	0-16	GET393	0-25
2N2713	0-17	2N4917	0-17	AD149V	0-56	BC253	0-23	BF245	0-33	TIP29A	0-49
2N2714	0-17	2N4918	0-50	AD149V	1-28	BC257	0-23	BF246	0-43	TIP30A	0-53
2N2904	0-18	2N4919	0-68	AD150	0-68	BC257	0-09	BF247	0-49	TIP31A	0-62
2N2904A	0-25	2N4920	0-60	AD161	0-49	BC258	0-09	BF255	0-14	TIP32A	0-74
2N2905	0-28	2N4921	0-50	AD162	0-51	BC259	0-12	BF256	0-14	TIP33A	1-01
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2N2906A	0-23	2N4926	0-90	ADZ11	1-50	BC263	0-23	BF259	0-48	TIP36A	3-70
2N2907	0-18	2N4927	1-00	ADZ12	1-75	BC300	0-42	BF261	0-23	TIP41A	0-70
2N2907A	0-25	2N4928	1-80	AF106	0-27	BC302	0-27	BF261	0-23	TIP42A	0-90
2N2923	0-12	2N4929	2-58	AF109A	0-40	BC303	0-54	BF264	1-46	TIP205S	0-98
2N2924	0-12	2N4930	2-92	AF114	0-25	BC304	0-43	BF270	0-25	TIP205S	0-60
2N2925	0-12	2N4931	2-70	AF115	0-24	BC304	0-54	BF271	0-31		
2N2926	0-10	2N5172	0-08	AF116	0-25	BC307	0-10	BF272	0-33		
Green	0-10	2N5174	0-22	AF117	0-20	BC307A	0-10	BF273	0-23		
Yellow	0-10	2N5176	0-22	AF118	0-50	BC307V1	0-10	BF274	0-23		
Orange	0-10	2N5178	0-22	AF121	0-22	BC308	0-09	BF457	0-53		
2N3035	0-31	2N5245	0-43	AF124	0-24	BC308A	0-09	BF458	0-53		
2N3035A	0-25	2N5100	0-32	AF125	0-25	BC308B	0-09	BF459	0-53		
2N3054	0-45	2N5101	0-98	AF126	0-19	BC309	0-10	BF461	2-10		
2N3055	0-60	2N5192	1-24</								

BRIGHT IDEAS



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

A piece of plastic Rawlplug makes an ideal Insulated spacer for mounting component boards and can be held in place by self tapping screws. An off cut of about $\frac{1}{4}$ inch can also be used in place of a 2BA nut if insulation is required. A 2BA screw forms a thread on its way through the Rawlplug.

D. Wardle
Luton

When it is necessary to use a heatshunt whilst soldering components such as semiconductors, three hands are needed, one for the iron, one for the solder and a third for the heatshunt. By soldering two thin plates of copper to the jaws of a crocodile clip the need for a third hand is eliminated.

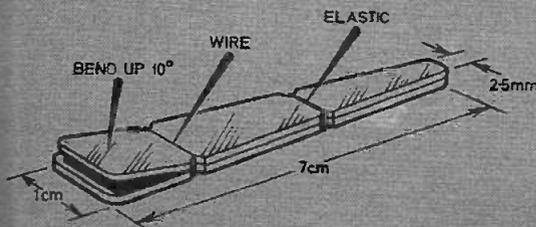
L. H. Brown,
Yorkshire.

I recently discovered a way of making a cheap and effective heatsink for use when soldering semiconductors.

Two pieces of $\frac{1}{16}$ in. thick aluminium are cut to size and shape as shown below. Bend one piece about 10 degrees about the notches and then secure the two together by wrapping a few strands of wire about the sets of notches and then tie off.

An elastic band wrapped around the assembly forms a sprung heatsink.

M. Rudkin,
Liverpool

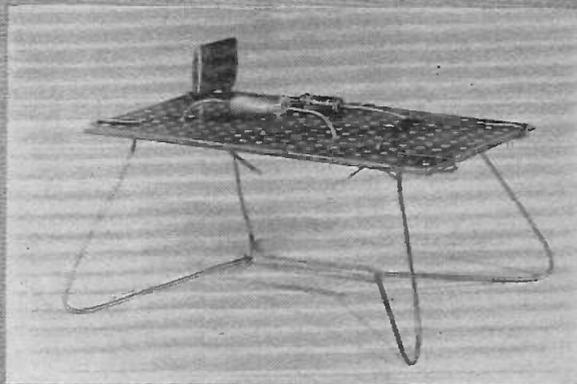


For those who strip and make up matrix type component boards (eg. Veroboard) on the kitchen table and find it difficult to hold the board firm and have both hands free, I would like to suggest the following.

This simple structure, shown below, makes a small table when clipped to the matrix board. To make this structure bend two lengths of stout copper wire 14 s.w.g. or thicker as shown and tie together with an elastic band.

This device is particularly useful for soldering all the components in position (after they have been secured in place) since the matrix board will not "rock" during soldering due to different sized components.

E. R. Wall,
Charlton, London



I am sure many amateurs, like myself, like making small cheap units but have trouble trying to hold the Veroboard when soldering. I have come up with this cheap holder that anybody can make.

It consists basically of one large waverley clip (obtainable from stationers), a woodscrew and a piece of softwood about 3 x 2 x 6 inches. The block of wood should be quite large to counter-balance any weight put on the clip. The woodscrew holds the clip on the edge of the block and the Veroboard is held in the clip.

L. Green
Norwich.

Here's an idea for a single penlight battery holder, made from a plastic throat lozenge case.

First drill a hole in the bottom of the case. Then, using the wire from the back of a spiral bound note book, cut off a short length and form a helical spring.

Next drill a hole in the top and insert a piece of wire with one end stripped and knotted to form a positive terminal.

If the holes through the plastic are sealed you then have a water resistant battery holder.

M. J. Lambeth
East Barnet.

Please Note: this column is intended for constructional ideas and ideas relating to electronic construction. It is not our intention to publish circuits of any description.

All items submitted should be original and not previously published. If similar ideas are submitted by two or more readers the first received will be published.



THIS month one of our projects deviates from our normal pattern in that we have arranged for a complete kit of parts to be available from which to build the unit.

The project is the *Crystal Set* and we have made this arrangement because most of the parts are not generally available. In fact the crystal detector has been specially made and the actual crystal obtained just for this set.

As regular readers will know it is not our normal practice to arrange a kit as generally we do not feel that we should give the trade to just one supplier, thus discouraging competition for your business; also one supplier is hardly ever able to offer all the items at a competitive price and you can often save money by shopping around.

Having made the above statement we must point out that the *Crystal Set* is outside our normal "rules" because of the points stated above and thus Home Radio (Components) Ltd., 240 London Road, Mitcham, Surrey, CR4 3HD will supply a complete kit for the set, including ready wound coil and the wooden base for £4.20 including a set of headphones, or for £2.65 without headphones; both prices cover the cost of package and posting. Aerial and earth wire is not included as this can be purchased in most electrical shops.

Audio Signal Mixer

The main difficulty with components for the *Audio Signal Mixer* is likely to be obtaining the Eagle RR5 slider potentiometers specified. If your local dealer cannot supply the best bet will be to contact G. W. Smith's or Henry's Radio who should have some in stock.

The Eagle sliders are complete with knobs—some other types, which could be substituted (with some mechanical modifications) may be supplied ex. knobs. If you use different types make sure they are all 10 kilohm and log, or as Eagle say semi-log, whatever that means!

Case for prototype mixer was made from Home Radio Universal Chassis parts but any suitable—preferably metal—case would do.

Autofan

Supply difficulties with parts for the *Autofan* are likely to be concerned with acquiring the fan and motor. If your car is not fitted

with one of the plastic type fans, we suggest that you obtain one from a garage or breaker's yard as this type is much better for this job than the older metal ones.

The fixings for the motor will have to be made up to suit individual requirements. Some thick aluminium sheet or steel tube may be best for this, again you will have to find a local sup-plier.

The only electronic parts likely to cause trouble are the relay and the thermistor, however most of the larger suppliers should be able to help with these items.

P.C. Viewer

Not really an "electronic" project but a very useful tool when making printed circuit boards the *P.C. Viewer* presents no electronic component buying problems and only one other, as far as we can see; the glass or Perspex.

Firstly decide which you are going to use, Perspex is tougher but can be scratched and melted with a soldering iron and may eventually sag under the heat from the lamp. Alternatively the glass will have sharp edges and can be broken but will not scratch as easily or be melted. If you use glass make sure it is fairly thick, especially if you make the box larger than we show, and get the edges ground or cover them with plastic edging material.

Local glass suppliers should be able to provide glass cut to size—Perspex can often be obtained from a sign manufacturer or from some hardware stores.

What do you know?

CAPACITORS

- 1 A circuit specifies a 10 μ F 12V capacitor and you only have a 12 μ F 10V, a 12 μ F 24V and a 15 μ F 12V. Which one would you use?
- 2 What are the values of the following five capacitors? (a) 470/400 (in a large can) (b) 10K, 20% (c) 10nF (d) 1000H (e) 8MFD 250V wkg.
- 3 What is the overall value of two 10 μ F capacitors connected in (a) series (b) parallel?
- 4 What is a dielectric, and how many different kinds can you list?

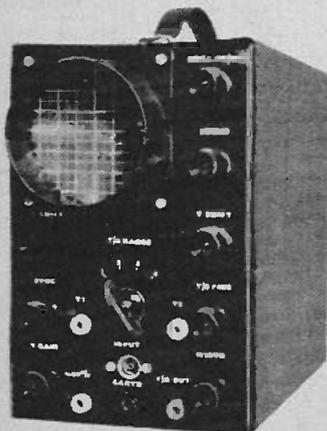
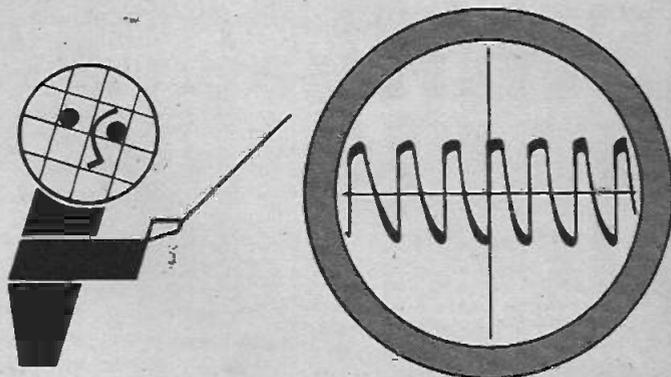
ANSWERS

- 1 You would use the 12 μ F 24V capacitor since its capacitance is closest to the one specified and its working voltage is not below that specified. Remember, electrolytic capacitor tolerance is usually +100 to -25%.
- 2 (a) 470 microfarads (μ F) 400 volts working (b) 10,000 picofarads (pF) \pm 20 per cent (c) 10 nano-farads, 10,000pF or 0.01 μ F (d) 1000 picofarads. (e) 8 μ F 250 volts working.
- 3 (a) 5 μ F (b) 20 μ F.
- 4 A dielectric is a material having a low electrical conductivity. It is the material between the "plates" of a capacitor. Some of the more common dielectrics used are: silver mica; poly-ester; polycarbonate; polystyrene; paper; metal-lised paper; metallised polyester; metallised polycarbonate; ceramic.

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RAPY

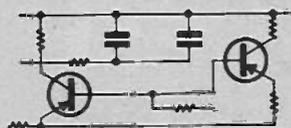
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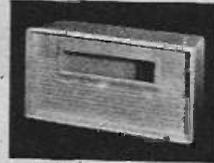
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ALL PRICES INCLUDE VAT

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(For complete kit of parts including case.)



This 4 digit 24 hour clock is available to readers at this special price for 1 month only. Parts would normally cost over £25. Kit of parts includes twelve IC's, indicators, and a smart white plastic case.

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1	25	1	25	1	25
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SN7406	58p	55p	SN7433	84p	82p
SN7407	58p	55p	SN7437	73p	68p
SN7408	20p	18p	SN7438	75p	69p
SN7409	20p	18p	SN7440	18p	15p
SN7410	17p	15p	SN7441	74p	70p
SN7411	27p	25p	SN7442	74p	70p
SN7412	28p	25p	SN7443	1.43p	1.37p
SN7413	28p	25p	SN7444	1.33p	1.27p
SN7414	47p	43p	SN7445	2.00p	1.92p
SN7417	47p	43p	SN7446	1.07p	1.02p
SN7420	16p	15p	SN7447	1.10p	1.03p
SN7422	65p	60p	SN7448	1.10p	1.03p
SN7423	55p	50p	SN7450	16p	15p
SN7425	55p	50p	SN7451	16p	15p
SN7427	49p	46p	SN7452	16p	15p
SN7428	77p	72p	SN7454	16p	15p
SN7430	18p	15p	SN7460	16p	15p
SN7432	49p	46p	SN7470	28p	26p
SN7433	84p	82p	SN7472	33p	29p
SN7437	73p	68p	SN7473	43p	39p
SN7438	75p	69p	SN7474	41p	38p
SN7440	18p	15p	SN7475	50p	47p
SN7441	74p	70p	SN7476	44p	43p
SN7442	74p	70p	SN7480	73p	70p
SN7443	1.43p	1.37p	SN7481	1.32p	1.30p
SN7444	1.33p	1.27p	SN7482	87p	85p
SN7445	2.00p	1.92p	SN7483	1.10p	1.05p
SN7446	1.07p	1.02p	SN7484	1.10p	1.05p
SN7447	1.10p	1.03p	SN7485	3.96p	3.85p
SN7448	1.10p	1.03p	SN7486	38p	35p
SN7450	16p	15p	SN7489	6.05p	5.55p
SN7451	16p	15p	SN7490	74p	72p
SN7452	16p	15p	SN7491	1.10p	1.04p
SN7454	16p	15p	SN7492	74p	72p
SN7460	16p	15p	SN7493	74p	72p
SN7470	28p	26p	SN7494	85p	72p
SN7472	33p	29p	SN7495	85p	72p
SN7473	43p	39p	SN7496	95p	82p
SN7474	41p	38p	SN74100	8.00p	7.50p
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SN7476	44p	43p	SN74105	1.09p	1.06p
SN7480	73p	70p	SN74107	44p	42p
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SN7482	87p	85p	SN74111	1.37p	1.27p
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* Devices may be mixed to qualify for Price Breaks
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Electrolytic Capacitors

4 VOLT		16 VOLT		40 VOLT	
47µF	6½p	15µF	6½p	47µF	6½p
100µF	6½p	33µF	6½p	100µF	9p
220µF	6½p	68µF	6½p	150µF	10p
330µF	6½p	150µF	8p	220µF	11p
1000µF	6½p	220µF	9p	470µF	19p
4700µF	29p	680µF	17p	680µF	25p
		1000µF	17p	1000µF	25p
		1500µF	25p	2200µF	44p
		2000µF	43p		
6.3 VOLT		25 VOLT		63 VOLT	
33µF	6½p	10µF	6½p	1µF	6½p
68µF	6½p	22µF	6½p	2.2µF	6½p
150µF	6½p	47µF	6½p	4.7µF	6½p
470µF	11p	100µF	8p	6.8µF	6½p
680µF	13p	150µF	8p	10µF	6½p
1500µF	18p	220µF	10p	22µF	6½p
2200µF	18p	470µF	13p	47µF	6½p
3300µF	26p	680µF	20p	6.8µF	6½p
		1000µF	22p	10µF	6½p
		1500µF	26p	22µF	6½p
		2200µF	26p	47µF	6½p
		3300µF	26p	100µF	11p
10 VOLT		40 VOLT		2N2980	
22µF	6½p	6.8µF	6½p	55p	
47µF	6½p	15µF	6½p	unbranded	
100µF	6½p	33µF	6½p	tested	
220µF	8p				
330µF	10p				
470µF	10p				
1000µF	11p				
1500µF	20p				
2200µF	24p				

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Unmarked Packs	Pack of 25 IN4148 55p
Pack of 10 BC108 55p	Pack of 10 Plastic BC109 55p
Pack of 10 BC165 (unmarked) but tested 55p	Pack of 10 2N2964 (unmarked) 33p each 55p
Pack of 10 2N2980 55p	Unbranded but tested 26p
Unbranded but fully tested 2N3055 27p	
1-9 10 plus 33p 27p	
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AD161, AD162 M/P	
1-9 10 plus 59p 63p	
BC107-BC108 BC109	
1-9 10 plus 9p 61p	
BC 182L-3-4-212-4 1-9 10 plus 8p 8p	
AG127 or AG128 1-9 10 plus 11p 11p	
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All voltages 9-33 Volts 9p each	
1 watt 5% All voltages 6-8-200 Volts 14p each	
10 watt 5% All Voltages 7.5-100 Volts 51p each	

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301 TO99 55p	723c TO99 95p
301 8 PIN DIL 46p	741c 8 PIN DIL 38p
301A DIL 69p	741c 14 PIN DIL 39p
301A TO99 69p	741c TO99 41p
301A 8 PIN DIL 69p	741c DIL 46p
307 DIL 69p	748c DIL 39p
307 TO99 69p	748c TO99 41p
307 8 PIN DIL 69p	1437 DIL 1-27p
308 TO99 6-45p	1458 TO99 1-27p
308A TO99 6-40p	1458 DIL 84p
709c DIL 31p	3046 DIL 1-87p
709c TO99 31p	7503 DIL 1-87p



Transistors

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AC126 14p	BC142 33p	BF229 18p	OC45 14p
AC127 13p	BC143 33p	BF230 18p	OC70 22p
AC128 13p	BC144 30p	BF290 37p	OC71 14p
AC142 23p	BC146 26p	BF284 23p	OC72 14p
AC141K 20p	BC147 26p	BF285 23p	OC81 14p
AC175 15p	BC148 48p	BF286 23p	OC82 22p
AC187 18p	BC149 9p	BF287 23p	OC84 23p
AC187K 20p	BC153 16p	BF288 26p	OC88 22p
AC188 13p	BC154 17p	BF290 26p	OC89 22p
AC188K 20p	BC157 13p	BF291 17p	OC91 14p
AC17 24p	BC158 12p	BF292 17p	OC92 14p
AC18 21p	BC159 14p	BF293 17p	OC93 14p
AC19 25p	BC167 17p	BF294 17p	OC94 14p
AC20 22p	BC168 11p	BSX20 19p	OC95 14p
AC21 23p	BC169 11p	CA07 22p	OC96 14p
AC22 18p	BC177 15p	CA26 33p	OC97 14p
AC29 68p	DC179 19p	CA28 81p	OC98 14p
AD140 40p	BC182L 9p	CA50 17p	OC99 14p
AD143 44p	BC183L 9p	MP8111 45p	OC100 14p
AD149 38p	BC184L 9p	MP8112 45p	OC101 14p
AD150 60p	BC186 33p	MP8121 35p	OC102 14p
AD161 28p	BC212L 11p	MP8122 44p	OC103 14p
AD162 29p	BC213L 11p	MP8123 50p	OC104 14p
AD M/P 50p	BC258 9p	NKT211 22p	OC105 14p
AF114 14p	BC259 9p	NKT212 22p	OC106 14p
AF115 14p	BC267 14p	NKT214 22p	OC107 14p
AF116 14p	BC268 16p	NKT217 55p	OC108 14p
AF117 14p	BC290 40p	NKT261 28p	OC109 14p
AF118 82p	BC301 32p	NKT271 22p	OC110 14p
AF124 27p	BC302 30p	NKT274 20p	OC111 14p
AF139 39p	BC303 50p	NKT275 25p	OC112 14p
AF239 41p	BC304 40p	NKT403 71p	OC113 14p
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AL102 66p	BCY71 37p	NKY603F	OC115 14p
AL103 55p	BCY72 17p	OC116 14p	OC117 14p
ASY26 31p	BD123 69p	NKT613G	OC118 14p
ASY27 40p	BD130 50p	OC119 14p	OC120 14p
AU103 99p	BD131 68p	NKT674 26p	OC121 14p
AU110 41.10p	BD132 90p	NKT677G	OC122 14p
AV111 77p	BD135 42p	OC123 14p	OC124 14p
BC107 9p	BD136 65p	NKT713 32p	OC125 14p
BC108 9p	BD141 61.87p	NKT732 27p	OC126 14p
BC109 9p	BD142 50p	OC127 14p	OC128 14p
BC113 15p	BF159 33p	OC129 14p	OC129 14p
BC116 16p	BF173 28p	OC130 14p	OC130 14p
BC125 16p	BF177 28p	OC131 14p	OC131 14p
BC126 23p	BF178 29p	OC132 14p	OC132 14p
BC128 16p	BF179 33p	OC133 14p	OC133 14p
BC134 16p	BF194 15p	OC134 14p	OC134 14p
BC135 16p	BF195 17p	OC135 14p	OC135 14p
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250V P.C. mounting: 0.01µF, 0.015µF, 0.02µF, 3µF, 0.33µF, 0.047µF, 0.068µF, 4p, 0.1µF, 4p, 0.16µF, 0.22µF, 5µF, 0.33µF, 7p, 0.47µF, 9p, 0.68µF, 12p, 1.0µF, 14p, 1.5µF, 22p, 2.2µF, 27p

MULLARD POLYESTER CAPACITORS C296 SERIES
400V: 0.001µF, 0.0015µF, 0.002µF, 0.003µF, 0.0047µF, 2p, 0.0068µF, 0.01µF, 0.015µF, 0.022µF, 0.033µF, 3p, 0.047µF, 0.068µF, 0.1µF, 4p, 0.15µF, 6p, 0.22µF, 8p, 0.33µF, 12p, 0.47µF, 14p

MULLARD POLYESTER CAPACITORS C296 SERIES
150V: 0.01µF, 0.015µF, 0.02µF, 0.033µF, 0.047µF, 0.068µF, 8p, 0.1µF, 8p, 0.15µF, 4p, 0.22µF, 5p, 0.33µF, 6p, 0.47µF, 8p, 0.68µF, 12p, 1.0µF, 14p

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Log or Linear
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SINGLE GANGED, LOG or LIN 1k to 1M, 45p each
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Small high quality type (linear only).
All values 100-5 meg ohms.
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-2.5 watt 6p each

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FREE! COMPETITION

**... Win this VISCOUNT Audio System!
100 other prizes for Runners-up**

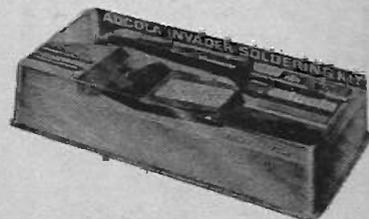
Here's your second and last chance to try for this Viscount Audio System—in our free competition open only to EVERYDAY ELECTRONICS readers. The system comprises the new RTVC Viscount III R102 stereo amplifier, two duo type III speakers and a Garrard SP25 Mk III turntable mounted on a Perspex covered plinth. It's selling for around £70!

The competition is all about soldering and so, appropriately, are the rest of our prizes. Just take a look at this list of soldering goods making up the 100 runner-up awards:

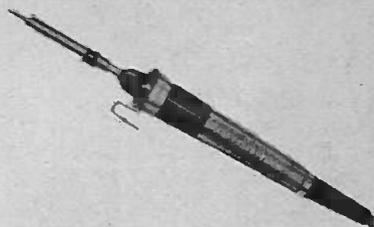
From Adcola Products Ltd. Soldering kits, soldering irons and iron stands.
From Antex (Electronics) Ltd. Soldering kits and soldering irons.
From Multicore Solders Ltd. Soldering handbooks, wire strippers and solder dispensers.



The Viscount Audio System



An Adcola soldering kit



An Antex thermostatically controlled soldering iron

HOW TO ENTER

Listed below are eight points which make for successful and efficient soldering. All you have to do is place them in what you consider to be their order of importance in contributing to a perfect soldered connection. For example, if you consider that "Use non-corrosive flux cored solder" is most important of all, write C in the box marked 1st on your entry coupon. The key letter of your second choice goes into the box marked 2nd, and so on for all eight.

Complete the coupon, all in ink or ball-point, with your full name and address, then post it in a sealed envelope to:

EVERYDAY ELECTRONICS SOLDERING COMPETITION,
16 GARRICK STREET,
LONDON, WC2E 9PR.

IMPORTANT

All entries must be with us by Friday, July 27, 1973—the closing date. Regular readers submitting last month's entry coupon as well, may send both in the same envelope.

- A Parts to be soldered should be cleaned and tinned.
- B Use soldering iron of correct size and weight.
- C Use non-corrosive flux cored solder.
- D Use soldering iron with tip of correct size.
- E Maintain heat on joint until solder flows evenly over it entirely.
- J Keep tip of iron "wet" with solder.
- K Use soldering iron of correct temperature and wattage.
- L Make good mechanical contact prior to soldering.

COMPETITION RULES

There is no entry fee, but each attempt must be fully completed in ink on the proper printed coupon cut from Everyday Electronics, and bear the entrant's own full name and address.

Every accepted entry will be examined and the first prize, as described, will be awarded to the entrant who, in the opinion of an expert panel of judges, and in any one attempt, has shown the most skill and judgement in listing the eight features in order of importance. The other prizes will be awarded to the senders of the 100 next best attempts in order of merit. No entrant may win more than one prize. In the event of a tie or ties for any of the prizes, a further eliminating contest will be conducted by post between the tying competitors to determine such winners or winning order.

Any entry which does not comply with the printed instructions or is received after the closing date will be disqualified, as will any received mutilated or illegible, incomplete, bearing alterations, or with more than one key letter in each space. No responsibility will be accepted for entries lost or delayed in the post or otherwise.

The judges' decision, and that of the Editor of Everyday Electronics in all other matters affecting the competition, is final and legally binding. No correspondence can be entered into.

The competition is open to all readers in Great Britain, Northern Ireland, and the Channel Isles except employees (and their families) of IPC Magazines, the printers of Everyday Electronics or any company associated with the prizes.

The winners will be notified, and the result announced in the earliest possible issue of this magazine.

FREE ENTRY COUPON

Please post to:

EVERYDAY ELECTRONICS
SOLDERING COMPETITION,
16 GARRICK STREET, LONDON WC2E 9PR

My order of importance for the eight features is listed on the right. In entering the competition, I agree to the rules as final and legally binding.

NAME
(Mr./Mrs./Miss)

ADDRESS
(Block letters)

Closing date for entries: Friday, July 27, 1973

CUT ALONG THIS LINE

1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	

REMEMBER
TO USE THE
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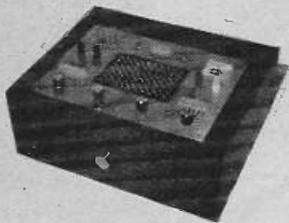


Readers Letters

Late Starter

I enclose herewith a couple of prints for your rogues' gallery! (one shown below).

I have subscribed to EVERYDAY ELECTRONICS since it started but one thing and another kept me from actually switching on the soldering iron until last autumn. So I am now following your Teach-In series almost a year behind.



To be fair I must note that I have a pretty well equipped workshop in which I build fitted units and furniture for our hotel. Catching me making the Demo-Deck when I was supposed to be doing work for the hotel, my wife wondered how others managed who did not have the sort of equipment I've got; and once or twice I've wondered the same thing!

In building your Demo-Deck I stuck rigidly to the specification. The only problems were the "working" of the 14 gauge aluminium and in obtaining the identical components — particularly the small 35 ohm speaker. However, I got all the bits eventually. I made one small addition — unable to guarantee that my cabinet would sit level, I added feet. A couple of washers added before attaching one or two of the feet took out any wobble.

Until now, electronics have been merely equipment which has worked without my knowing why. I have assembled Heathkits which

have worked well from the instant they were switched on, though this is more thanks to Daystrom than to me. Having now experienced component buying, kits undoubtedly eliminate much frustration. But the assembly of a kit in no way compares to the satisfaction of completing a project in which every bit has had to be obtained individually, possibly from many sources. I don't mind admitting that I'm very proud indeed of the completed Demo-Deck!

I shall still make Heath and other kits. In fact the Heathkit MM-1U Portable multimeter is my next job. (I considered the Multimeter you described in E.E. June 1972 but I'm afraid I got ambitious!) I expect I shall also compromise between kits and those sort of "part-kits"—where a supplier of components has assembled a packet of the basic bits for a given magazine article. But ultimately I hope I shall build projects starting with no more than the circuit diagram. When I achieve this my ability to do so will be entirely thanks to you.

I had intended this to be a short note. To judge from the letters published in EVERYDAY ELECTRONICS there are many others who have also found in electronics an absorbing interest.

— May I add my own very sincere

"thank-you."

Mr. R. Macdonnell,
Garve, Ross-shire.

The above letter was addressed to Mr. Mike Hughes. We are very impressed by the quality of the Demo Deck shown.

Amplifier

With reference to the Cassette Amplifier described in the June issue of EVERYDAY ELECTRONICS. I would be interested to know if it would be possible to replace the transformer, rectifier and smoothing capacitor with a 12 volt stabilizing supply. Also, if still using the BD 124 stabilizing transistor would the amplifier still function correctly.

Should the positive and negative connections be made to the transistor and diode or should these components be left out.

Barry Goodman
Launceston, Cornwall

If using a proper stabilized supply all the components shown in Fig. 3 (power supply circuit) can be omitted. The circuit will function at a reduced output power on a reduced voltage and works best at the designed supply level (about 17V).

If using a non stabilized d.c. supply (such as batteries) the components R5, D5 and TR5 should be used and C5 should also be fitted although its value could be decreased (when using batteries) to about 1,000 μ F. The d.c. supply used should be rated at about 18 to 20 volts and be capable of supplying 500mA current.

The use of a fully stabilised supply of the correct voltage and current rating will probably slightly improve the quality of the output.

If you write to us for advice, and wish to have a personal reply you must include a s.a.e. Unfortunately, we cannot prepare special designs, circuits or wiring diagrams to meet individual requirements, nor can we answer queries concerning commercial equipment, or subjects, designs or modifications not published by us.

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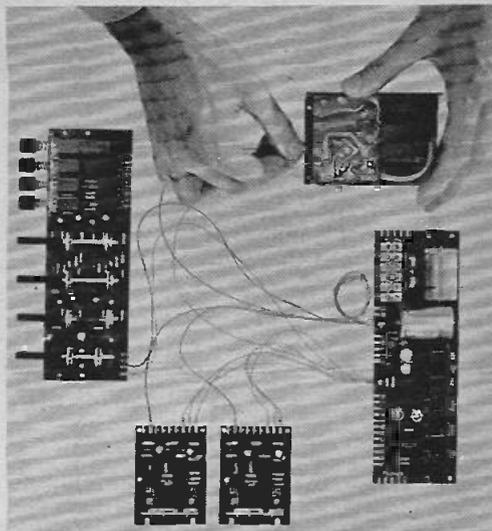
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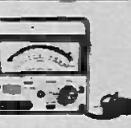
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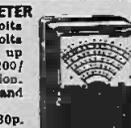
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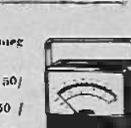
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1mA	\$3.60	5V. D.C.	\$3.60
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300V. D.C.	\$3.60	1 amp. D.C.	\$3.60
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Type SD.830 82.5mm x 110mm Fronts

10mA	\$3.10	500mA	\$3.10
100mA	\$3.10	1 amp.	\$3.10
500µA	\$3.10	5 amp.	\$3.10
10µA	\$3.10	10 amp.	\$3.10
50µA	\$3.40	5V. D.C.	\$3.10
50-0-50µA	\$3.40	10V. D.C.	\$3.10
100µA	\$3.85	20V. D.C.	\$3.10
100-0-100µA	\$3.85	50V. D.C.	\$3.10
500µA	\$3.85	300V. D.C.	\$3.10
1mA	\$3.15	15V. A.C.	\$3.20
5mA	\$3.10	300V. A.C.	\$3.20
		VU Meter	\$3.60

Type SD.640 63.5mm x 85mm Fronts

50µA	\$3.05	500mA	\$2.90
50-0-50µA	\$3.05	1 amp.	\$2.90
100µA	\$3.00	5 amp.	\$2.90
500µA	\$3.00	10 amp.	\$2.90
1mA	\$2.85	5V. D.C.	\$2.90
5mA	\$2.90	20V. D.C.	\$2.90
10mA	\$2.90	50V. D.C.	\$2.90
50µA	\$2.90	300V. D.C.	\$2.90
100µA	\$2.90	15V. A.C.	\$3.00
		300V. A.C.	\$3.00
		VU Meter	\$3.15

Type SD.460 46mm x 59.5mm Fronts

50µA	\$2.80	1 amp.	\$2.60
50-0-50µA	\$2.80	5 amp.	\$2.60
100µA	\$2.75	10 amp.	\$2.60
100-0-100µA	\$2.75	5V. D.C.	\$2.60
500µA	\$2.70	10V. D.C.	\$2.60
200µA	\$2.85	20V. D.C.	\$2.60
1mA	\$2.80	50V. D.C.	\$2.60
5mA	\$2.80	300V. D.C.	\$2.60
10mA	\$2.80	15V. A.C.	\$2.70
50µA	\$2.80	300V. A.C.	\$2.70
100µA	\$2.80	VU Meter	\$2.90



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Type PE.70. 3 1/7 3/32in. x 1 1/2 1/32in. x 2 1/2in. deep

50µA	\$3.15	500µA	\$3.30
50-0-50µA	\$3.80	1mA	\$3.20
100µA	\$3.60	300V. A.C.	\$3.25
500µA	\$3.40	VU Meter	\$3.35

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High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. 3/16 in. dia. shaft. Bulk quantities available.



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50 WATT.	10/25/50/100/250/500/1000/2500 or 5000 ohms.	\$1.35. P. & P. 10p.
100 WATT.	1/8/1/25/50/100/250/500/1000/2500 or 5000 ohms.	\$1.95. P. & P. 15p.

Type MR.85P. 4 1/2in. x 4 1/2in. fronts

50µA	\$3.25	50mA	\$3.10
50-0-50µA	\$3.40	100mA	\$3.10
100µA	\$3.40	100-0-100µA	\$3.30
200µA	\$3.30	8 Meter 1mA	\$3.15
500µA	\$3.20	VU Meter	\$3.25
500-0-500µA	\$3.10	1 amp. A.C.*	\$3.10
1mA	\$3.10	5 amp. A.C.*	\$3.10
1-0-1mA	\$3.10	10 amp. A.C.*	\$3.10
5mA	\$3.10	20 amp. A.C.*	\$3.10
10mA	\$3.10	30 amp. A.C.*	\$3.10

Type MR.52P. 2 1/2in. square fronts

50µA	\$3.50	10V. D.C.	\$2.50
50-0-50µA	\$3.05	20V. D.C.	\$2.50
100µA	\$3.00	50V. D.C.	\$2.50
100-0-100µA	\$2.95	300V. D.C.	\$2.50
500µA	\$2.85	15V. A.C.	\$2.60
1mA	\$2.50	300V. A.C.	\$2.60
5mA	\$2.50	8 Meter 1mA	\$2.60
10mA	\$2.50	VU Meter	\$2.60
50µA	\$2.50	1 amp. A.C.*	\$2.50
100µA	\$2.50	5 amp. A.C.*	\$2.50
500µA	\$2.50	10 amp. A.C.*	\$2.50
1 amp.	\$2.50	20 amp. A.C.*	\$2.50
5 amp.	\$2.50	30 amp. A.C.*	\$2.50

Type MR.65P. 3 1/2in. x 3 1/2in. fronts

50µA	\$3.70	10V. D.C.	\$2.60
50-0-50µA	\$3.15	20V. D.C.	\$2.60
100µA	\$3.15	50V. D.C.	\$2.60
100-0-100µA	\$3.10	150V. D.C.	\$2.60
200µA	\$3.05	300V. D.C.	\$2.60
500µA	\$2.75	15V. A.C.	\$2.60
500-0-500µA	\$3.00	50V. A.C.	\$2.60
1mA	\$2.60	150V. A.C.	\$2.60
5mA	\$2.60	300V. A.C.	\$2.60
10mA	\$2.60	500V. A.C.	\$2.60
50µA	\$2.60	8 Meter 1mA	\$2.65
100µA	\$2.60	VU Meter	\$2.70
500µA	\$2.60	50µA A.C.	\$2.60
1 amp.	\$2.60	100µA A.C.	\$2.60
5 amp.	\$2.60	200µA A.C.	\$2.60
10 amp.	\$2.60	500µA A.C.	\$2.60
15 amp.	\$2.60	1 amp. A.C.	\$2.60
20 amp.	\$2.60	5 amp. A.C.	\$2.60
30 amp.	\$2.60	10 amp. A.C.	\$2.60
50 amp.	\$2.60	20 amp. A.C.	\$2.60
5V. D.C.	\$2.60	30 amp. A.C.	\$2.60

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Type ED.107. Size overall 100mm x 90mm x 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50µA	\$5.50	20V. d.c.	\$4.85
100µA	\$5.10	50V. d.c.	\$4.85
1mA	\$4.85	300V. d.c.	\$4.85
50-0-50µA	\$5.10		
1-0-1mA	\$4.85	Dual range	
1A d.c.	\$4.85	500mA/5A d.c.	\$5.10
5A d.c.	\$4.85	5V/50V d.c.	\$5.10
10V d.c.	\$4.85		

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MW 1-8 80mm square \$4.97
P. & P. extra

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Type MR.38P. 1 21/32in. square fronts

200µA	\$2.25	200mA	\$2.25
300µA	\$2.25	300mA	\$2.25
500µA	\$2.25	500mA	\$2.25
750µA	\$2.25	750mA	\$2.25
1 amp.	\$2.25	1 amp.	\$2.25
2 amp.	\$2.25	2 amp.	\$2.25
5 amp.	\$2.25	5 amp.	\$2.25
10 amp.	\$2.25	10 amp.	\$2.25
SV. D.C.	\$2.25	SV. D.C.	\$2.25
10V. D.C.	\$2.25	10V. D.C.	\$2.25
15V. D.C.	\$2.25	15V. D.C.	\$2.25
20V. D.C.	\$2.25	20V. D.C.	\$2.25
50V. D.C.	\$2.25	50V. D.C.	\$2.25
100V. D.C.	\$2.25	100V. D.C.	\$2.25
150V. D.C.	\$2.25	150V. D.C.	\$2.25
18V. A.C.	\$2.25	18V. A.C.	\$2.25
50V. A.C.	\$2.25	50V. A.C.	\$2.25
150V. A.C.	\$2.25	150V. A.C.	\$2.25
300V. A.C.	\$2.25	300V. A.C.	\$2.25
500V. A.C.	\$2.25	500V. A.C.	\$2.25
8 Meter 1mA	\$2.25	8 Meter 1mA	\$2.25
VU Meter	\$2.25	VU Meter	\$2.25

Type MR.45P. 2in. square fronts

50µA	\$2.70	5 amp.	\$2.40
50-0-50µA	\$3.85	10V. D.C.	\$2.40
100µA	\$2.60	20V. D.C.	\$2.40
100-0-100µA	\$2.50	50V. D.C.	\$2.40
200µA	\$2.50	300V. D.C.	\$2.40
500µA	\$2.45	15V. A.C.	\$2.40
500-0-500µA	\$3.40	300V. A.C.	\$2.40
1mA	\$2.40	8 Meter 1mA	\$2.60
5mA	\$2.40	VU Meter	\$2.70
10mA	\$2.40	1 amp. A.C.	\$2.40
50µA	\$2.40	5 amp. A.C.*	\$2.40
100µA	\$2.40	10 amp. A.C.*	\$2.40
500µA	\$2.40	20 amp. A.C.*	\$2.40
1 amp.	\$2.40	30 amp. A.C.*	\$2.40

"SEW" BAKELITE PANEL METERS

Type MR.65. 3 1/2in. square fronts

1 amp.	\$2.60	5 amp.	\$2.60
15 amp.	\$2.60	10 amp.	\$2.60
30 amp.	\$2.60	50 amp.	\$2.60
5V. D.C.	\$2.60	10V. D.C.	\$2.60
10V. D.C.	\$2.60	15V. D.C.	\$2.60
20V. D.C.	\$2.60	50V. A.C.	\$2.60
150V. D.C.	\$2.60	150V. D.C.	\$2.60
300V. D.C.	\$2.60	60mV. D.C.	\$2.90
60mV. D.C.	\$2.90	100mV. D.C.	\$2.90
100mV. D.C.	\$2.90	30V. A.C.*	\$3.85
50V. A.C.*	\$3.85	50V. A.C.*	\$3.85
150V. A.C.*	\$3.85	300V. A.C.*	\$3.85
300V. A.C.*	\$3.85	500µA A.C.*	\$2.60
500µA A.C.*	\$2.60	1 amp. A.C.*	\$2.60
1 amp. A.C.*	\$2.60	5 amp. A.C.*	\$2.60
5 amp. A.C.*	\$2.60	10 amp. A.C.*	\$2.60
10 amp. A.C.*	\$2.60	20 amp. A.C.*	\$2.60
20 amp. A.C.*	\$2.60	30 amp. A.C.*	\$2.60
30 amp. A.C.*	\$2.60	50 amp. A.C.*	\$2.60
50 amp. A.C.*	\$2.60	VU Meter	\$3.65

Type S-80 80 mm. square fronts

50µA	\$3.50	5 amp. D.C.	\$3.00
50-0-50µA	\$3.40	300V. A.C.	\$3.00
100µA	\$3.40	VU Meter	\$3.70
100-0-100µA	\$3.30		
500µA	\$3.05		
1mA	\$3.00		
1-0-1mA	\$3.00		
5mA	\$3.00		
10mA	\$3.00		
50µA	\$3.00		
100µA	\$3.00		
500µA	\$3.00		
1 amp. D.C.	\$3.00		

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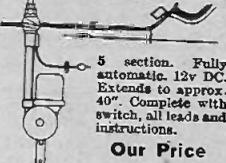


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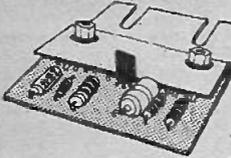
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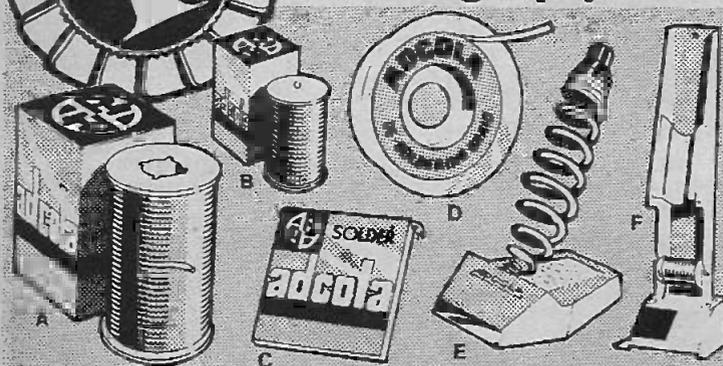
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AC131	12p	AF139	32p	BF173	20p	OC44	12p	2N3706	13p
AC132	12p	AF178	32p	BF177	28p	OC45	12p	2N3707	12p
AC176	12p	AF180	40p	BF178	32p	OC70	12p	2N3708	10p
AC187	22p	AF181	40p	BF179	32p	OC71	12p	2N3709	11p
AC188	22p	BC107	9p	BF180	32p	OC72	12p	2N3710	11p
AD140	45p	BC108	9p	BF181	32p	OC81	12p	2N3711	11p
AD149	45p	BC109	9p	BF194	15p	OC82D	12p	2N4062	12p
AD161	33p	BC147	13p	BF195	15p	2N2904	20p	40360	35p
AD162	36p	BC148	13p	BF197	15p	2N2926R	9p	40361	35p
AF114	20p	BC149	13p	BF200	32p	2N2926G	9p	40362	40p
AF115	20p	BC157	14p	BFY50	20p	2N2926Y	9p	40408	40p
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1-0μF 35V	10μF 25V	100μF 3V	

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36 x 5	24p
17 x 2 1/2	28p
17 x 3 1/2	75p
17 x 3 1/2	100p
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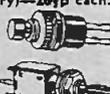
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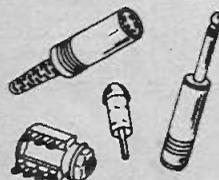


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D.I.N. 3 pin 17p
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D.I.N. 5 pin, 180° 10p
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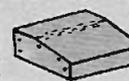
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Wire-wound
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with lids and screws

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GB9*	4in	2 1/2in	1 1/4in	42p	14p
GB10*	5 1/2in	4in	1 1/4in	49p	19p
GB11	4in	2 1/2in	2in	42p	14p
GB12	3in	2in	1in	36p	15p
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* These sizes fit standard veroboards

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1.0µF 63V	7p	150µF 25V	8p
1.5µF 63V	7p	150µF 40V	13p
2.2µF 63V	7p	150µF 63V	15p
3.3µF 63V	7p	220µF 4V	7p
4.7µF 63V	7p	220µF 10V	7p
6.8µF 40V	7p	220µF 16V	8p
6.8µF 63V	7p	220µF 25V	13p
10µF 25V	7p	220µF 40V	15p
10µF 63V	7p	220µF 63V	22p
15µF 16V	7p	330µF 4V	7p
15µF 40V	7p	330µF 10V	8p
15µF 63V	7p	330µF 16V	13p
22µF 10V	7p	330µF 63V	26p
22µF 63V	7p	470µF 6.3V	8p
33µF 6.3V	7p	470µF 10V	13p
33µF 16V	7p	470µF 25V	15p
33µF 40V	7p	470µF 40V	22p
47µF 40V	7p	680µF 6.3V	13p
47µF 4V	7p	680µF 16V	15p
47µF 63V	7p	680µF 25V	22p
47µF 10V	7p	680µF 40V	26p
47µF 40V	7p	1000µF 4V	13p
47µF 63V	8p	1000µF 10V	15p
68µF 10V	7p	1000µF 16V	22p
68µF 16V	7p	1000µF 25V	26p
68µF 63V	13p	1500µF 6.3V	15p
100µF 4V	7p	1500µF 10V	22p
100µF 10V	7p	1500µF 16V	26p
100µF 25V	7p	2200µF 6.3V	22p
100µF 40V	8p	2200µF 10V	26p
100µF 63V	15p	3300µF 6.3V	26p
150µF 6.3V	7p	4700µF 4V	26p
150µF 16V	7p		

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Size
2 1/2in x 3 1/2in 25p
2 1/2in x 5in 28p
3 1/2in x 5in 28p
3 1/2in x 7in 32p
1 7/8in x 2 1/2in 8p
1 7/8in x 3 1/2in 11p

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8µF 450V	18p	2500µF 25V	50p
16µF 450V	20p	2500µF 50V	66p
25µF 25V	71p	3000µF 25V	33p
32µF 50V	11p	5000µF 25V	66p
32µF 450V	30p	5000µF 50V	£1.21
50µF 50V	11p	8-8µF 450V	20p
100µF 50V	12p	8-16µF 450V	22p
250µF 25V	15p	16-16µF 450V	30p
250µF 50V	19p	16-32µF 450V	66p
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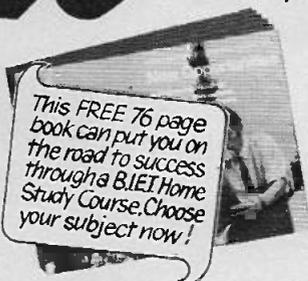
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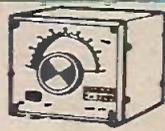
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