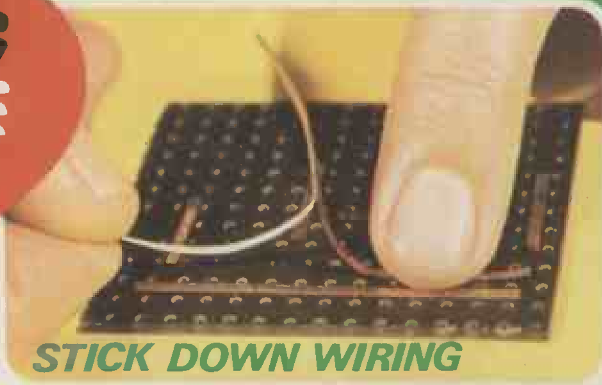
everyday electronics

FEB. 72

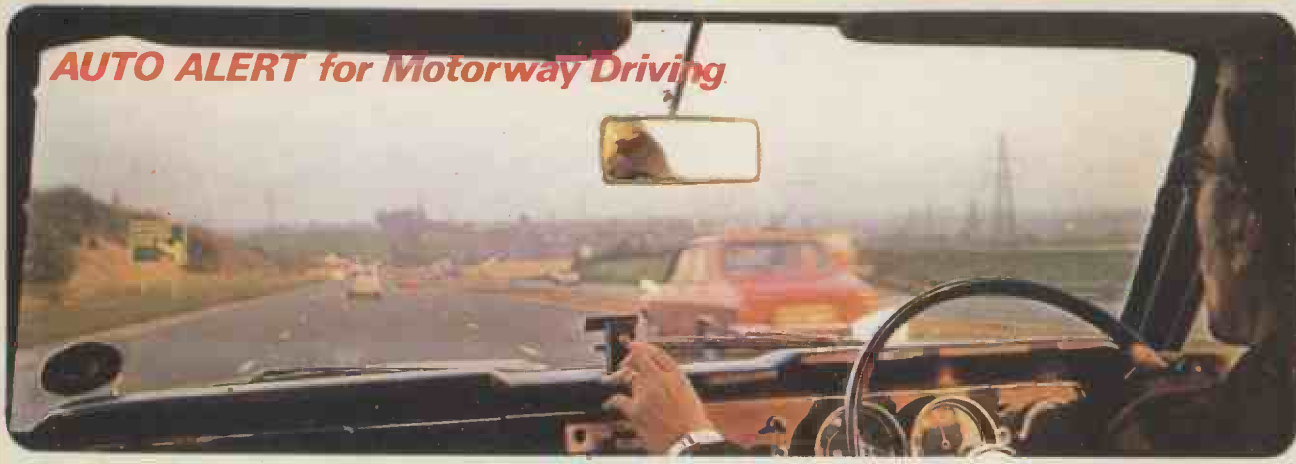
15p

A NEW MAGAZINE BRINGING A FASCINATING HOBBY TO EVERYONE

PROJECTS EASY TO CONSTRUCT
THEORY SIMPLY EXPLAINED



STICK DOWN WIRING



AUTO ALERT for Motorway Driving

WAA WAA PEDAL

RAIN WARNING ALARM

3 WAYS

HOME RADIO (Components) LTD.
Dept. EE, 234-240 London Rd.,
Mitcham, CR4 3HD. 01-648 8422

# of obtaining components *quickly & easily*

1 CALL AT No. 240 London Rd., Mitcham

If you live within easy reach of Mitcham or are in the area at any time do call on us. We are almost opposite Mitcham Baths. We open 9 a.m. every weekday. On Wednesdays we close 1 p.m. and all other days, including Saturdays, 5.30 p.m. On Saturdays we have extra staff to deal with queries. We carry a vast stock of components, and 999 times out of a 1,000 we can immediately lay our hands on the particular item required.

2 JOIN OUR CREDIT ACCOUNT SERVICE

We began our Credit Account Service about 18 months ago and it has proved extremely popular. Little wonder! Our customers find it a very simple and convenient way of purchasing all their radio and electronic needs. We supply pre-paid envelopes and order forms and no matter how many orders you send us you make only one payment per month. There are several other advantages with our Credit Account Service. Please write or phone for details.

3 and ORDER BY MAIL OR TELEPHONE

Although we are kept busy selling "over the counter" we supply even more by Mail Order. You can telephone any time of day or night, Sundays included. If you ring out of office hours a recording machine takes your message for us to deal with as soon as we open shop again. Our number is 01-648 8422. If you wish to order by post our address is in the panel at the top of the page. We deal with all orders promptly.

WHICHEVER WAY YOU CHOOSE you need the Home Radio Catalogue

In its 315 pages are listed over 8,000 components, over 1,500 of them illustrated. Each copy contains 10 Vouchers, each worth 5p when used as instructed. Free Supplements are supplied regularly to keep you up-to-date. The Catalogue costs 50p over the counter, or 70p including postage and packing.

Post this Coupon with Cheque or PO for 70p

Please write Name and Address in block capitals.

Name ....

Address ....

....

....

HOME RADIO (Components) LTD.
Dept. EE, 234-240 London Rd., Mitcham, CR4 3HD

The price of 70p applies only to catalogues purchased by customers in the U.K. and to BFPO addresses.

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. £1·50 plus 13p post and insurance. Made up model also available. £2·25 plus 13p post and p.

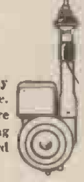
MAINS OPERATED CONTACTOR

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 2¼ × 2 × 2in. £1 each.

NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts. 6p each, 60p doz. Plastic push-rod suitable for operating 5p each, 45p doz.

AUTO—ELECTRIC CAR AERIAL



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. £6 plus 25p post and ins.

TOGGLE SWITCH

3 amp. 250v. with fixing ring 7½p each, 75p doz.

MICRO SWITCH

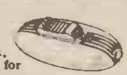
5 amp. changeover contacts. 9p each, £1 doz. 15 amp. Model 10p each or £1·05 doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 18p each, £1·80 dozen, your assortment.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 50p post free.

BLANKET SWITCH



Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element, new plastic case 30p each. 3 heat model 40p.

CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 38p each or 10 for £3·42.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. £2·95 plus 20p post and insurance.

QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. £1·25, post and insurance 14p. 12v. car model also available same price. Jug heater £1·50 plus p. & p. 14p.

SNAP ACTION SLIDE SWITCH

Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 5p each, 10 for 45p.

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3 Price £1·45 each, 10 for £13.

12 WAY SUB-MINIATURE MULTI-CORE CABLE

7·0076 copper cores, each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 20p per yard.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ¼in. thick. Rated at 500 MW, wire ended. 43p with circuit.

0–8 AMMETER

2in. square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price 43p each 10 for £3·90.

THE FULL-FI STEREO SIX

The amplifier sensation of the year. You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled in simulated teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. UNREPEATABLE PRICE is £9 plus 38p post and insurance.

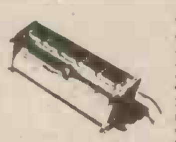
DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, £2 less plug £2·25 with fitted 13 amp plug; £2·40 with fitted 15 amp plug, plus 23p P. & P.

THIS MONTHS SNIP

Smiths 24 hour 2on/2off Time switch this is the popular model, as used in the Autoset and Morphy Richards time switches. Only needs a case and an output socket. 230v 50 cycles. Contacts switch up to 13 amps. Price £2·75p.

TANGENTIAL HEATER UNITS



This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. £3·50. 2kW Model as above except 2 kilowatts £2·50. Don't miss this. Control Switch 35p. P. & P. 40p.

POCKET CIRCUIT TESTER

Test continuity of any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied). 30p or 2 for 50p post paid.

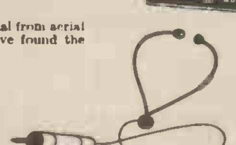
COMPUTER TAPE

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in. wide £1·00 plus 33p post and insurance, with cassette. ½ in wide £1·00 plus 30p post and insurance with cassette. ¼in. wide 75p plus 25p post and insurance with cassette. Spare spools and cassettes—1in 75p. ½in. 75p each plus 20p post and insurance.

1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4¾ × 3¾, which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch £1·15.

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. £2—twin stethoset instead of earpiece 75p extra post and ins. 20p.

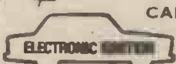
70 THINGS YOU CAN MAKE

Send S.A.E. today for list of 70 constructor projects—instruments—alarms—counters—locks—radios, etc., etc.

SOLDER GUN

A must for every busy man, gives almost instant heat also illuminates job. Dual heat 100/140 watt £3·75 plus post and insurance 20p. BIG JOE 250 watt model £4·75 plus post and ins. 40p.

CAPACITOR DISCHARGE CAR IGNITION



This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version (*Practical Wireless*, June). Price £4·95 plus 20p post. When ordering please state whether for positive or negative systems. Also available, ready made ignition systems for 6v. vehicles. £5·25 plus 20p.

TYPE 25 RELAYS

These are miniature relays. Size approx. 1 $\frac{1}{16}$th inch high × 1¼" wide × ¾" deep. 4 change over silver/gold contacts. Contact rating lamp 100v D.C. Fitted with a plastic cover. Coil operates approx. 250 Mw D.C. available with the following coils :—

28 ohm for 4v– 7·5v   45 ohm for 1v– 2·5v   52 ohm for 4·9v– 6v
90 ohm for 5.5v–11·5v   130 ohm for 10v–15v   530 ohm for 17v–36v
1250 ohm for 27v–44v   2500 ohm for 31v–65v   5800 ohm for 27v–44v

75p each. 10 for £6·75p. Also one with 16,500 ohm coil but this has only 2 heavy duty change over gold contacts. Price £1·45.

DRIVER ALERT
WAA-WAA PEDAL
RAIN SENSOR
and other features

To receive these kits promptly send approximate quoted price and we will refund any change.

Veroboard. We are now stocking this in various sizes. Prices as follows:

	0·1	0·15
2½ × 3¾	22p	16p
2½ × 5	24p	24p
3¾ × 5¾	24p	14p
33¾ × 5	27p	27p
17 × 2½	75p	57½p
17 × 3¾	100p	75p
17 × 5 (plain)	—	75p
17 × 3¾ (plain)	—	52½p
17 × 2½ (plain)	—	37½p
2½ × 5 (plain)	—	17½p
2½ × 3¾ (plain)	—	15p
Pin intersection tool	47½p	47½p
Spot face cutter	37½p	37½p
Pkt. 50 pins	20p	20p

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15–20 w. £1. Kit B—30–40 w £1. Kit C—80 w. £1·20. Kit E—65 w. £1·90. Kit F for 8ft. 125 w. tube £1·75. Kit MF1 is for 6in., 9in. and 12in. miniature tubes £1. Kit MF2 for 21in. 13 w. miniature tube £1. Postage on Kits A and B 23p for one or two kits then 23p for each two kits ordered. Kits C, D and E 23 p on first kit then 18p for each kit ordered. Kit F 33p than 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

Box Sign for Window Display, at home, office or shop, 2ft. wide × 14in. high × 5in. deep. This is an illuminated box sign made from sheet metal hammer finish enamel with a clear plastic window. You simply have your message printed or written on poster board or thick card. (Or use stick down letters available at most stationers). You will then have a box sign normally costing anything between £10–£15. Illumination is by a 2ft. fluorescent tube with control gear enclosed. Message card can be changed quite easily from hinged top back. Price £3 each. plus 65p post, etc.

Motivated Illuminated Box Sign. As previous item but with geared motor moving the message making it change eight times a minute. Very attention arresting. To use this for your own messages you would have to have each sign written on card then cut this up in strips which could be glued to the one supplied with the box sign. Price £4·50, plus 65p post and service.

Geared Motor with take off socket. The gear train is driven by normal type induction motor and gives a final speed of 6 r.p.m. The motor is mounted behind a chrome plate through which the take off drive protrudes and was originally intended to drive a spit for cooking, is also ideal for driving models or for driving a colour changing disc for the local dance hall, discotheque, etc. Really well made assembly, Price £1·75 plus 25p post etc.

2¼kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2¼ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3·95. Post and ins. 38p.

KITS FOR PREVIOUS PROJECTS

Kits of parts available as follows:—

HOME SENTINEL INTRUDER ALARM
Electronic Components with case £3·75

SNAP INDICATOR
All components but not case or battery 75p.

WINDSCREEN WIPER CONTROL
All components including metal for chassis £2·00.

RECORD PLAYER
All components, but not case, loudspeaker, record deck or pick-up £5·50

DEMO DECK
All Components as listed £6·75

ASTRON RADIO
Electronics parts less case £3

REMOTE TEMPERATURE COMPARATOR
All electronic parts less case £4·25

ELECTRO LAUGH
Parts, less case £2

TRANSISTOR MICROPHONE
all parts £1·70

Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semiconductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

J. BULL (ELECTRICAL) LTD.

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

BUDGET HIGH-FIDELITY STEREO SYSTEMS

PREMIER STEREO SYSTEM "ONE" Consists of the new Premier 800 all transistor stereo amplifier, Garrard 2025 T/C auto manual record player unit fitted stereo mono ceramic cartridge with diamond stylus and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. 800 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, Power on/off. Mono/Stereo switch. Stereo Headphone socket. Black leatherette cabinet with aluminium front panel. Size: 12½" × 6¾" × 2¾". (Amplifier available separately if required £16·25. Carr. 40p).

ONLY £40·95 carr. £1·75

PREMIER STEREO SYSTEM "TWO", as above but with Garrard SP25 MK III and magnetic cartridge. ONLY £48. Carr. £1·75.

ONLY £57·75 carr. £1·75

PREMIER STEREO SYSTEM "THREE". This consists of KLINGER KC903 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 earphone 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 EMI units complete the matching system. ONLY £57·75. Carr. £1·75.

FREE
STEREO HEADPHONES
and all leads and plugs supplied with all systems.

PREMIER HI-FI OFFERS

Philips 580 Stereo Amplifier (List £29·00)	£21·00
Rogers Ravensbrook II Stereo Amplifier in teak case (List £52·50)	£39·50
Rogers Ravensbourne Stereo Amplifier in teak case (List £64)	£49·00
Metrosound ST20E Stereo Amplifier in teak case (List £39·50)	£28·50
Goldring GL75 less cartridge (List £41·61)	£29·00
Garrard SP25 III with Goldring G800 cartridge (List £28·35)	£15·50
Garrard AP76 less cartridge	£19·50
Garrard 3500 with Sonotone 9TA stereo cartridge (List £15·50)	£9·97
Garrard 2025 T/C with Sonotone 9TAHC Diamond Cartridge	£9·97
Garrard 2025 T/C with Sonotone 9TAHC Diamond Cartridge ready wired in teak plinth with cover	£14·00

Carriage and Insurance 50p extra any item.

SP25 MKIII SPECIAL!

GARRARD SP25 MK III SINGLE RECORD PLAYER FITTED GOLDRING 800 MAGNETIC STEREO CARTRIDGE as available. COMPLETE IN TEAK PLINTH WITH RIGID PERSPEX COVER. Total list price over £34.

PREMIER PRICE **£18·90** P. & P. 50p.

HI-FI STEREO HEADPHONES

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

£2·47 P. & P. 25p.

STEREO STETHOSCOPE SET Low imp. £1.25 P. & P. 10p

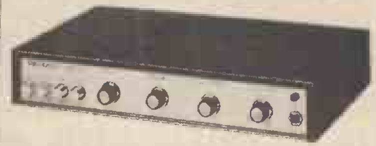
MONO STETHOSCOPE SET Low imp. 52p. P. & P. 10p.

E.M.I. 13×8in. HI-FI SPEAKERS

Fitted two 2½in tweeters and crossover network. Impedance 8 or 15 ohm. Handling capacity 10W. Brand new.

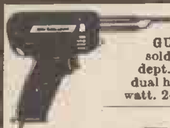
£3·47 P. & P. 40p

NEW LOW COST PREMIER 800 STEREO AMPLIFIER



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. Din sockets for inputs and outputs. Stereo headphone socket. Attractive slim line design black leatherette cabinet with aluminium front panel. Size 12½" x 6¾" x 2¾".

ONLY **£16·25** Carr. 40p.



WELLER "EXPERT" SOLDER GUN. Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat. 100/140 watt. 240 volt A.C. **£4·25** P & P 30p

"Marksman" Soldering Iron. Lightweight $\frac{3}{16}$" pencil bit. Ideal for regular bench use and around the home. 25 watts. 240 volt A.C. £1·50 P & P 15p

TAPE CASSETTES

C60	(60 min.)	37p	3 for £1.05
C90	(90 min.)	62p	3 for £1.80
C120	(120 min.)	87p	3 for £2.55

P. & P. 5p.

FREE CASSETTE HEAD CLEANER with every 10 cassettes purchased.

All cassettes can be supplied with library cases at 3p. extra each

"VERITONE" RECORDING TAPE

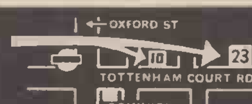
SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED. TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double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

LP3	3"	250'	P.V.C.	28p	LP6	5¾"	1200'	P.V.C.	75p
TT3	3"	450'	POLYESTER	37p	DT6	5¾"	1800'	POLYESTER	£1·12
DT3	3½"	600'	POLYESTER	57p	TT6	5¾"	2400'	POLYESTER	£1·87
SP5	5"	600'	P.V.C.	42p	SP7	7"	1200'	P.V.C.	62p
LP5	5"	900'	P.V.C.	50p	LP7	7"	1800'	P.V.C.	75p
DT5	5"	1200'	POLYESTER	75p	DT7	7"	2400'	POLYESTER	£1·25
					TT7	7"	3600'	POLYESTER	£2·50

TAPE SPOOLS 3" 5p, 5", 5¾", 7" 9p,
Post and Packing 3" 5p, 5", 5¾", 8p, 7" 10p. (3 reels and over Post Free).

PREMIER RADIO

10 & 23, TOTTENHAM COURT ROAD, LONDON, W.1 TEL: 01-636 3451/2639
HEAD OFFICE & MAIL ORDER DEPT. 23, TOTTENHAM CT. RD. TEL: 01-636 3451



Sinclair Q16/Micromatic

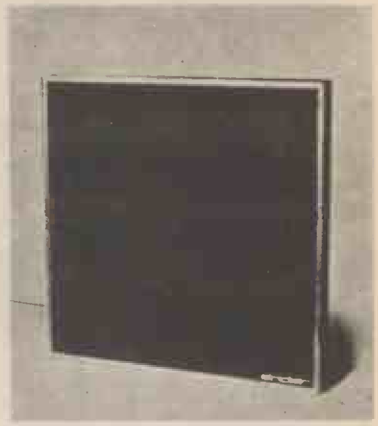
Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts RMS.
Input Impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.
Size and styling: $9\frac{3}{4}$ in. square on face x $4\frac{3}{4}$ in. deep with neat pedestal base. Black all over cellular foam front with natural solid teak surround.
Price £8.98.



Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. Powerful AGC counteracts fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided, matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver ready built and tested, you will find it as easy to take with you as your wrist watch, and dependable under the severest listening conditions.

Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)
Weight: including batteries, 28.4 gm (1 oz.)
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder **£2.48.**
Ready built, tested and guaranteed, with earpiece **£2.98.**
Two Mallory Mercury batteries type RM675 required from radio shops, chemists, etc.

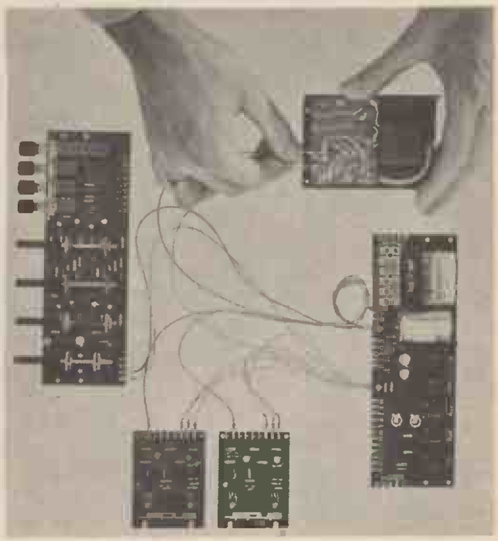
To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send	Name
	Address
for which I enclose cash/cheque/money order	E.E. 4A

Sinclair Radionics Ltd., London Rd, St. Ives
Huntingdonshire PE17 4HJ.
Telephone St. Ives (048 06) 4311

sinclair

Project 605 the new simple way to assemble Sinclair high fidelity modules



For several years now you have been able to assemble your own high fidelity system to world beating standards using Sinclair modules. We have progressively improved these technically but hitherto the method of assembly at your end has remained the same – there has been no alternative to a soldering iron. Now for those who prefer not to solder, there is an alternative – Project 605.

In one neat package you can now obtain the four basic Project 60 modules plus a fifth completely new one – Masterlink – which contains all the input sockets and output components you previously bought separately. Also in the Project 605 pack are all the inter-connecting leads, cut to length and fitted at each end with plugs which clip straight onto the modules, eliminating soldering completely. The pack contains everything you need to build a complete 30 watt stereo amplifier together with a clear well illustrated Instruction Book. All you have to do is to arrange your modules in the plinth or case of your choice and then clip them together – the work of a few minutes.

Your hi-fi system will, as we said, match the finest in the world and you can add to it at any time to increase power or extend the facilities. For example a superb stereo FM Tuner unit is obtainable for only £25.

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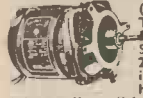

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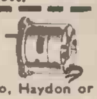

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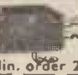

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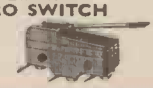

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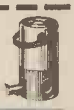

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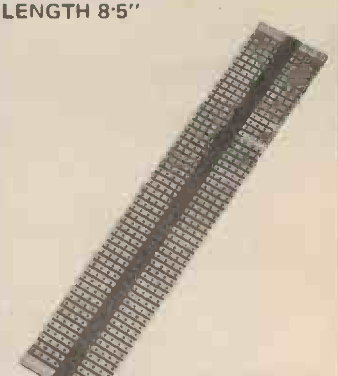

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PROJECTS...
THEORY....

THEORY AND PRACTICE

Many an enthusiastic and impatient beginner has no doubt pondered about the importance of theoretical knowledge to the would-be constructor: just how deeply need one go into the seemingly abstruse subject of circuit theory before starting to build electronic projects?

Well, the honest answer is that if one confiines oneself to building simple designs, such as described in this magazine, then there is no reason at all why one should not do just this, straight away. The detailed diagrams we provide certainly leave little if anything to doubt; the position of every component is indicated and all wiring connections are clearly shown. The accompanying components list gives in each case all the information necessary when asking for or writing for these items. Yes, it should be possible for most beginners to tackle our projects without delay, even though the technical explanations of the circuit operation may not be comprehensible at this stage.

Provided that proper components have been used and wiring connections made exactly as depicted in the diagrams, correct results should be obtained first time. (The value of checking and rechecking the wiring before connecting the power supply cannot be over emphasised.)

PRACTICAL VALUE

All the above is quite true, yet it must not be interpreted as encouragement to turn a blind eye to theory, to ignore fundamental principles entirely.

There is a perfectly sound and strictly practical reason for acquiring a knowledge of at least the basic principles of electronics as soon as possible. If something does go awry with a project due to a faulty component, even an elementary knowledge of the circuit operation will assist in tracking down the defective part. The remedy, likely as not, will then be simple to effect. But without that certain amount of basic knowledge one is of course confronted with an enigma that defies solution.

A BIGGER VIEW

Apart from facilitating fault-finding, an appreciation of the manner in which the circuit operates adds greatly to the general enjoyment one can derive from this hobby. The more advanced one's knowledge, the more attractive electronics becomes. An ever extending vista of interesting and tempting applications is seen as understanding of electronic fundamentals grows.

So, beginners, by all means have a go with the project of your choice. But do also take advantage of our tutorial series *Teach-In*. Then in a short while those circuit descriptions will become less mysterious and each circuit diagram will have its own interesting story to tell.

Fred Bennett.

Our March Issue will be published on Friday, February 18

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VOL. I NO. 4 FEBRUARY 1972

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Approximate cost of components

£

The approximate cost of components given, for constructional articles, in the box shown opposite is an estimated cost compiled from suppliers current catalogue and advertised prices. Parts for some projects may work out more expensive while others may be cheaper than our quoted price, depending on where the components are purchased.

We would like to point out that we, as publishers, cannot supply kits of parts or individual items for any of the published designs.

AUTO ALERT

FOR MOTORWAY DRIVING

By David C. Dick

Keep a check on your awareness. The Auto Alert provides added safety for all long distance drivers.

Approximate cost of components

£ 2·50 inclusive

WITH the ever-increasing growth of new dual carriageway roads and motorways, the average car driver is tempted to travel longer distances than he would previously have tackled.

The urge to "do the whole journey in one go" or to "cover the distance at night while the roads are quiet" has involved many a motorist in a nasty and often lethal accident. The tedium of a long unbroken motorway journey, the monotony of night driving, the hypnotic swishing of windscreen wipers and the blow of warm air from the heater are all possible causes of that lack of concentration (or even nodding off!) which at motorway speeds can be the cause of an extremely dangerous situation.

"DEAD MANS HANDLE"

The "dead man's handle" is the name given to a particular kind of footswitch which is fitted in the driver's cab of modern locomotives. The switch has a middle off position and the driver has to keep it in the middle position in normal driving. If the driver should faint or take ill his foot will either press the pedal fully down or his foot will lift off the pedal. Either way a contact is made and a warning klaxon sounds in the driver's cab. After a certain delay, if the pedal is not reset, the train's braking system will come on automatically.

A footswitch of this kind cannot be fitted in a car as the driver's left foot will be needed from time to time to press the clutch for gear changes and to operate the headlamp dip switch. However, the principle of the switch is a good one and can be adapted for use in a car.

CAR SYSTEM

The Auto Alert consists of a timing unit and two relays that are used to turn on a warning light and to sound the car horn. The Alert is turned on and a push-button or footswitch (whichever is preferred) is depressed to set the circuit. After a predetermined time interval the

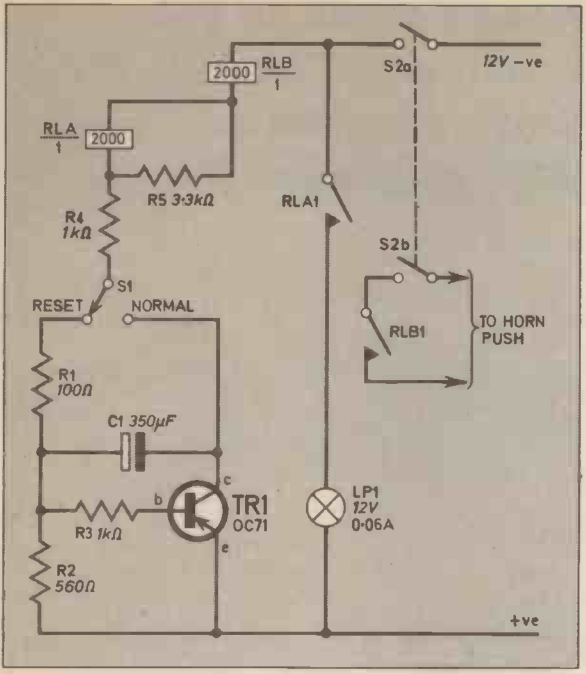


Fig. 1. Complete circuit diagram of the Auto Alert. S1 is the push button or footswitch that resets the unit.

Components....

Resistors
R1 100Ω
R2 560Ω
R3 1kΩ
R4 1kΩ
R5 3·3kΩ
All ½ Watt ±10% carbon

Capacitor
C1 350 µF elect, 15V

Transistor
OC71 Germanium *pnp*

Switches
S1 Single pole double throw micro-switch or push button (see text)
S2 Double pole single throw car type toggle

Relays
RLA G.P.O. 3000 type, 2,000 ohm coil with single pole normally closed contacts
RLB G.P.O. 3000 type, 2,000 ohm coil with heavy duty single pole normally closed contacts

Miscellaneous
LP1 12V bulb and holder
Car switch panel—two hole type (see text)
Metal brackets (2 off see text)
10 way connecting strip, hardboard, connecting wire and 4BA fixings
Materials for foot switch if used (see text and Fig. 5)

Shop Talk Refers

light on the Alert will come on and the driver should press the switch to reset the Alert. If, due to lack of concentration, the driver fails to notice the light and does not press the switch then, after a further short interval, the car horn will sound to warn the driver.

Thus a regular check is kept on the concentration of the driver and any tendency to lose concentration will be noticed before it gets to the eyelid drooping or daydream driving stage.

It is important that the unit is not regarded as an automatic "waker-upper". The first time that the horn operates the driver must take the warning, pull off the road and not drive again until he is sure that he is sufficiently alert.

CIRCUIT OPERATION

Assume the circuit (Fig. 1) to be in the "normal" condition with C1 fully discharged. When voltage is applied TR1 will be passing current due to the voltage at its base being the same as at the collector. As C1 gradually charges up TR1 will slowly turn off and the current passing through the relays will diminish. As resistor R5 is fitted across the coil of RLA the current flowing through RLA at any time will be less than that flowing through RLB; thus RLA will drop out before RLB.

When RLA contacts close lamp LP1 will light and, unless this is noticed within approximately 20 seconds, RLB contacts will also close and sound the car horn. If, however, the light is noticed and the reset button pressed, the circuit will return to the "normal" position (C1 fully discharged) by the following method.

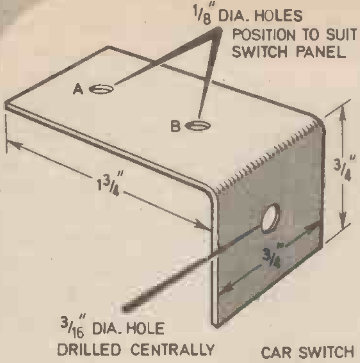
With S1 in the reset position C1, which is now charged up, provides the collector voltage. To discharge C1, TR1 must conduct and it does so because R1 and R2 form a potential divider across the supply so that a negative voltage is applied to the base. Capacitor C1 then discharges through TR1 and R2. During the "reset" time current passing through R1 and R2 will keep both relays energised, so preventing the horn from sounding and extinguishing the warning lamp LP1.

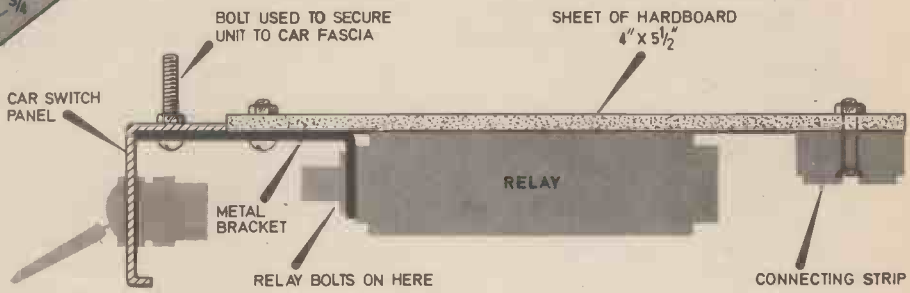
Variation of the value of C1 will alter the time interval—increase C1 to increase the time and decrease C1 to decrease the time.

CONSTRUCTION

The design of the unit was drawn up to enable it to be constructed with only a minimum of skills. First, take a two-hole car switch panel; this is available from any car accessories shop and already has two holes drilled in the outer face with two smaller holes drilled in the top lip. The two larger holes in the face will be used for mounting the switch S2 (see Fig. 3) and the lampholder for lamp LP1. The next components to be fitted are the two metal brackets. The brackets used in the prototype were bought

AUTO ALERT





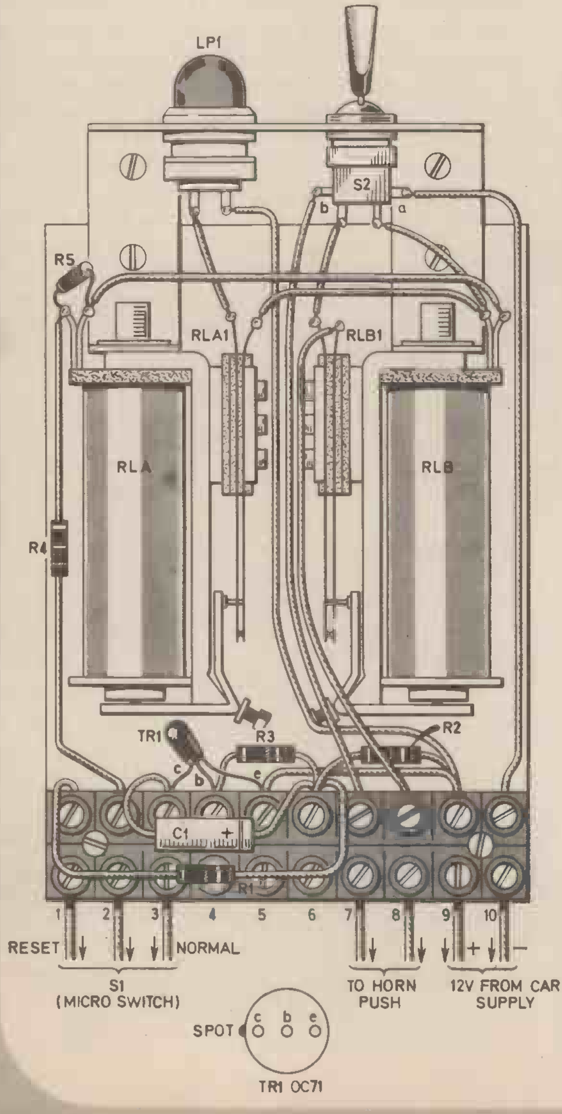
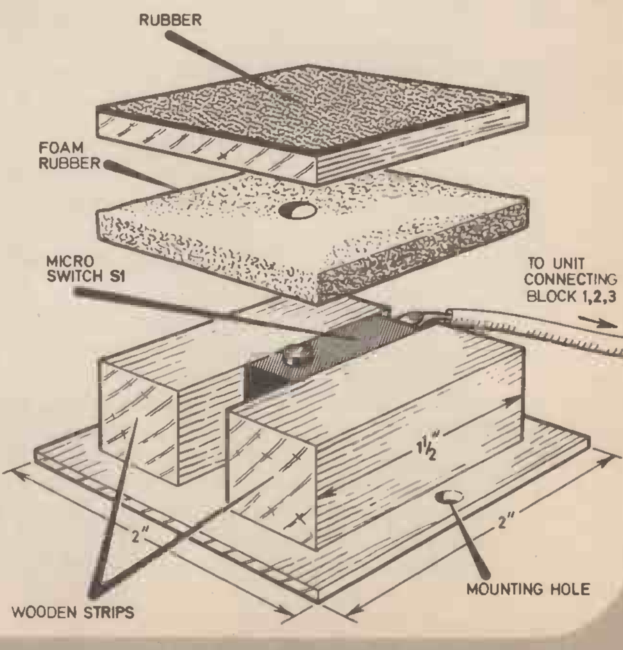


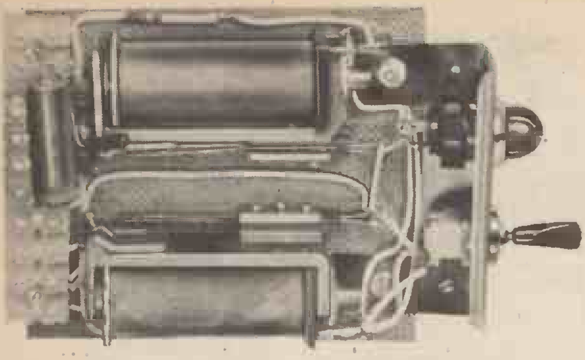
Fig. 2. (top left) Mounting bracket for relays RLA and RLB.

Fig. 3. (above) Showing how the mechanical parts fit together.

Fig. 4 (left) Layout and wiring of all components except SI. The wire from position 2 on the connecting strip goes to the centre contact of SI.

Fig. 5 (below) Construction of the foot switch.





Prototype Auto Alert. Switch S1 and some of the wiring has been slightly modified.

ready drilled from Woolworths for a few pence each. If these are not available they can be made from the measurements given in Fig. 2.

Using two 1 inch long bolts, bolt together the switch panel and the two brackets. The longest legs of the brackets are placed under the top lip of the switch panel (see Fig. 3) and the bolts are placed up through holes "a" in the brackets. The excess length of these bolts will be used later to secure the entire completed unit to the underside of the car dashboard.

A sheet of hardboard measuring 4 inches by $5\frac{1}{2}$ inches is next bolted to the brackets using the remaining small holes "b" in the brackets (see Fig. 3). The hardboard will act as a baseboard for the circuitry and as a dust cover for the relay contacts and other components. A ten-way screw connecting strip is bolted across the bottom of the baseboard as in Fig. 4. This connecting strip is used to mount the components in preference to a conventional tag strip as this makes for easier fitting of the complete unit into the car. If constructors have facilities for soldering in the car (a 12 volt soldering iron or an extension mains lead, for example) then they may prefer to use a normal tag strip and solder all the connections.

We are now ready to mount the components. The lampholder and switch S2 should be mounted on the switch panel, and the two relays are fixed to the brackets.

RELAYS

At the end of the relay next to the coils and spring set tags, there is a square of paxolin with three holes drilled in it. Through the two outer holes are screws which are normally used for the mounting of the relay. These two screws and the paxolin square can be removed as they will not be used. This leaves a circular nut which is used to hold the coil core to the relay frame. This nut should be undone and the bolt from the relay coil passed through the remaining hole in the bracket. The nut should then be screwed back on using a washer. Both relays are thus held securely to the unit. See Figs. 3 and 4.

The relays purchased for the prototype were fitted with further contacts; in this case the unwanted layers of spring contacts should be removed otherwise the relay will not operate at the low current necessary. Relay RLB is used to switch the horn and as the horn takes a substantial current it is considered necessary to fit heavy-duty relay contacts to handle the current. It should be remembered, however, that the relay should hardly ever be used to switch on the horn and therefore heavy-duty contacts are not essential.

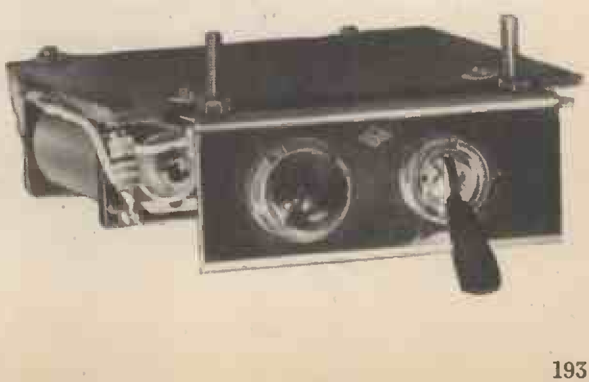
WIRING

The wiring should be carried out as in Fig. 4. Where more than one wire goes into one hole of the connecting strip it is a good idea to solder the wires together before screwing down. This will improve future fault liability.

Remember to connect the electrolytic capacitor in the correct polarity. Also it is important to connect the transistor in the manner given in the diagram. The red spot of the transistor body is at the side next to the collector lead and the base connection is the middle lead. If the leads are reversed the unit will not work and it is probable that the transistor will be destroyed. If you construct the unit using a tag strip or solder the connections affix the transistor after completing the wiring and hold each lead in a small pair of pliers while soldering to prevent overheating and thus damaging the transistor.

RESET SWITCH

Either a footswitch or a dashswitch can be used for S1. The cover illustration depicts a dash-mounted push-button and lamp. If such an arrangement is required the on/off switch and the unit can be placed in the car dash panel and the lamp and push-button can be mounted remotely in a convenient position or with the on/off switch in the panel. A micro-switch is probably best used with the footswitch design given and a normal change-over push-button (momentary contact type) used for a dash-mounted button.



THE FOOTSWITCH

The construction of the footswitch is shown in Fig. 5. The micro-switch is held between two strips of wood, each strip being approximately 1½ inches long and of the same height as the micro-switch body. This means that the operating plunger of the micro-switch will protrude above the level of the wood strips. It was found sufficient to glue the pieces together with Evo-Stik, and this gave a permanent joint. The completed piece can then be glued to the base section. The base section is 2 inches square and can be constructed from any kind of material; in the prototype a piece of hardboard was used. The base should have two holes drilled in it as in Fig. 5, these holes will be used later for fixing the switch to the car floor.

Next, a piece of foam rubber, ½ inch thick and 1½ inches square, should be glued across the wood strips, a hole being cut in the foam around the micro-switch plunger. On top of the foam rubber another piece of hardboard 1½ inches square is glued, this piece of hardboard is covered with rubber to prevent slipping. The footswitch is now complete and can be screwed to the car floor with self-tapping screws.

FITTING

Before fitting carefully check the wiring for any mistakes. Two holes should be drilled in the underside of the car dashboard and the two bolts from the unit pushed through the holes and secured with nuts, preferably using spring or serrated washers. The wiring from the footswitch should now be brought up to the unit and screwed into the connecting strip at the appropriate points. To make the wiring inconspicuous, it can be taken up under carpets, where this is convenient. Wires can now be taken from the unit to the horn wiring and to the supply.

The two leads from the unit to the horn push are connected across the push, the polarity does not matter (one side of the push may be connected to earth). Supply wiring will depend on the earth polarity of the car and this should be checked before connecting the unit. The live supply can be taken from the ignition switch.

Once the wiring to the car is complete the unit is ready for use, press the reset button and hold it pressed until the unit is turned on, then release and check the function of the unit. Remember do not keep your foot on the reset button all the time and do not use the Alert to keep you awake. ▣

Ruminations

By Sensor

An Act of Charity

I thumped the television set on the top right hand corner. That was two months ago and since then it has behaved itself. There was a shift in the tuning position of the three programmes, but the set has remained stable. I did not strike it in anger, although in the circumstances one might have been forgiven for doing so, for it had developed an intermittent fault that caused it to go out of tune, losing sound and vision, usually during the news or when Bamber Gascoigne was giving the answer to one of the "University Challenge" questions. The trouble never occurred during the advertisements. such behaviour could not be allowed to continue, I had to act.

The set is on rental. I ought to have sent for the service engineer, but I know from my own experience that intermittent faults are the most time consuming and frustrating aspects of a serviceman's life, or indeed, of anyone concerned with the reliability and maintenance of electronic equipment. Such faults often fail to appear when the engineer is called but can be depended upon to show up when his van has turned the corner.

Even if the fault does appear in the presence of the serviceman the slight disturbance created by the action of removing the back of the set or of connecting a test meter will often cause it to disappear again. Many of these intermittent faults are caused by "dry" joints (badly soldered connections which develop into high resistance joints after a period of time) and although there are techniques that can aid the serviceman, the diagnostic procedure is largely a matter of poking, prodding, tapping and on occasion, "thumping" various parts of the set, coupled with a keen visual inspection of the soldered joints.

This last is far from easy when the set has been in use for some time and has accumulated a thick layer of grime over the component boards. The idea behind the tapping and thumping business is to cause the fault to appear so that it can be diagnosed by conventional methods; this is why I thumped my television—to present the serviceman with an easier job! However, I achieved a temporary "cure" instead. How long it will last is anyone's guess.

An Uplifting Experience

Low insulation resistance can cause strange and sometimes dangerous faults to develop. An acquaintance of mine who worked for the electricity board was sent to investigate a complaint made by the trustees of an old chapel. It was alleged that ladies using the chapel toilet had received electric shocks.

My acquaintance, rather daringly, poured a bucket of water down the toilet and was rewarded for his boldness by a mild but stimulating electric shock. It was discovered that the insulation of some nearby cable had deteriorated and an earth leak had developed via the concrete floor. Users of the toilet thus formed a parallel path for the leakage current, with disconcerting but fortunately not disastrous results.

RADIO CONTROL MONITOR

Provides a quick check on radio control transmitter function. Pocket size and self powered for ease of operation "in the field."

By F. G. Rayer, A.I.E.R.E.

THE 27MHz radio frequency (r.f.) band used for the control of models by radio, extends from 26·96MHz to 27·28MHz; transmissions for this purpose may consist of an unmodulated carrier wave. or a carrier wave which is modulated by one or more audio frequency tones. Signals which are radiated by the transmitter can be checked with a monitor.

The simple monitor described here is self powered and of compact size, so it can readily be carried out of doors, with the transmitter, model and other equipment. It allows a quick check of normal carrier-wave power and frequency, and of any audio modulation tones which may be used.

CIRCUIT

The complete circuit is shown in Fig. 1. A coil consisting of three windings, L1, L2 and L3 forms the basis of the circuit. L1 is the tuned winding, and the operating frequency is set to that of the transmitter by means of the trimmer C1. With the coil and trimmer described, the whole of the model control band is easily covered. When the transmitter and the tuned circuit (L1 and C1) are set to the same frequency, and the monitor is held in a position where it picks up sufficient r.f. (radio frequency) energy, L1 absorbs some of the power from the transmitter. The monitor has two indicating devices, operated by the power absorbed.

Winding L2 is inductively coupled to L1 and when L1 absorbs r.f. power this is induced in L2 and provides current for the small lamp LP1. Resonance between the transmitter and monitor frequencies is shown by maximum brightness of this lamp. The brightness of the lamp also shows that the transmitter is producing its normal r.f. power.

Winding L3, with the diode D1 and earpiece TL1, give audible monitoring of the tones produced by the transmitter. So the control and tone-producing circuits of the transmitter can be immediately checked, by listening with the earpiece. The diode acts as a detector to extract the audio signal from the amplitude modulated r.f. signal that the transmitter provides.

Some changes in components will not unduly affect the circuit. The earpiece TL1 can be between 35 and 250 ohms impedance, of the kind used with transistor radio receivers. It would also be quite possible to use a different wire gauge or tube size for the coil, although some experiment with the number of turns would then be necessary.

The lamp must be a low-consumption type; a 6 volt 0·04 amp bulb, as used for cycle dynamo rear lamps, is most suitable, but a 6V 0·06A could be used. Bulbs which take the smallest current will give the more sensitive indication.

CONSTRUCTIONAL DETAILS

The monitor is constructed to the details shown in Fig. 2, then inserted in a $3\frac{1}{2}$ inch long by $1\frac{1}{4}$ inch diameter paxolin tube.

A piece is 1/16 inch thick paxolin $3\frac{1}{2}$ inches long is cut to such a width that it is a tight fit inside the $1\frac{1}{4}$ inch tube. For part of its length the paxolin is further reduced in width, so that it fits tightly inside a 1 inch diameter paxolin tube. The paxolin sheet is best cut slightly oversize, and then filed to fit.

The 1 inch diameter tube that is the coil former is 1 inch long. All windings are of 24 s.w.g. enamelled copper wire, wound side by side. Drill six 1/16 inch holes in the tube as shown in Fig. 2, thread the wire through hole A, smear part of the tube with Bostik 1, or similar adhesive or cement, and wind on nine turns to form L1,

R.C.MONITOR

Approximate cost of components

£ 1·30 inclusive

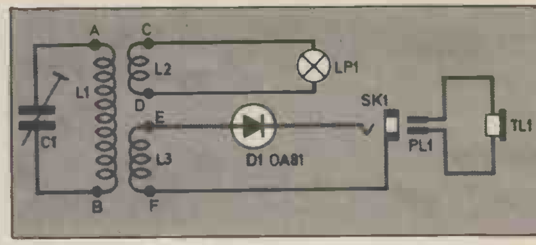


Fig. 1. Complete circuit diagram of the Radio Control Monitor.

Components....

Capacitor
C1 6—25pF ceramic trimmer

Diode
D1 OA81

Shop Talk refers

Lamp
LP1 6V 0·04A screw in bulb (see text)

Earpiece
TL1 35Ω to 250Ω earpiece with miniature jack plug (PL1)

Socket
SK1 Miniature jack socket to suit earpiece plug

Miscellaneous
24 s.w.g. enamelled copper wire
P.V.C. covered connecting wire
$\frac{1}{16}$ inch s.r.b.p. or paxolin board $3\frac{1}{2}$ in. x $1\frac{1}{2}$ in.
Thin paxolin $1\frac{1}{4}$in. square for end pieces (2 off)
Paxolin tube 1 in. x 1 in. diameter and $3\frac{1}{2}$ in. x $1\frac{1}{4}$ in. diameter

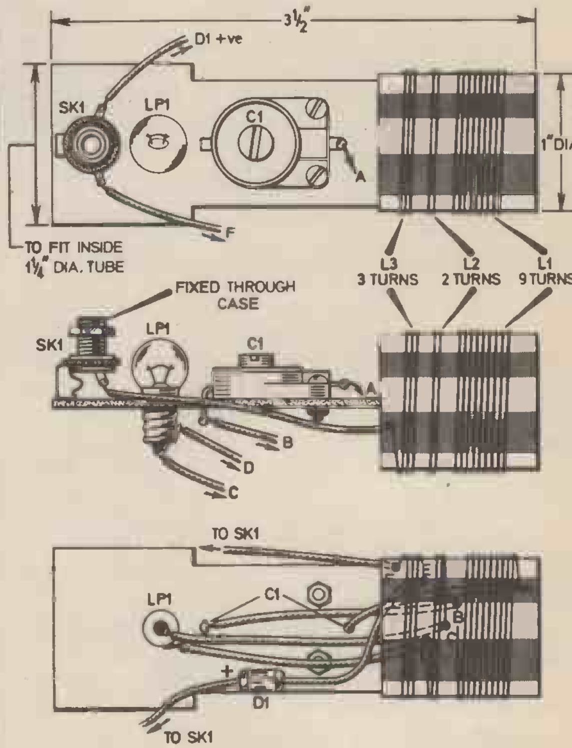


Fig. 2. Constructional details showing the complete unit without the case. The three views show the top, side and underside of the unit. SK1 is mounted through the outer case.

finishing by pulling the end through hole B. Make L2 (two turns) and L3 (three turns) the same way.

The tube is then cemented in place on the panel, with the wire ends running back (as shown in Fig. 2) identified with coloured 1mm p.v.c. sleeving. The lamp LP1, is a screw fit in a hole drilled through the panel. Leads C and D are soldered to its side and end pip. Since, with careful use, the bulb should never need replacing, this method of fixing is suitable. Two 8BA bolts hold the trimmer, and the miniature jack socket is fitted through a hole in the outer tube.

TESTING

To test the monitor, set the trimmer about half open, using a non-inductive trimming tool, and bring the monitor coil into the field of the transmitter aerial (tank) coil. Rotate the trimmer with the trimming tool to tune L1 to resonance with the transmitter; this is shown by maximum brilliance of the lamp. At the same time move the monitor away from the transmitter coil, as required, so that the bulb only glows dimly.

If the transmitter is of a type producing audio tones, plug in the earpiece, operate the transmitter, and listen for the audio signals.

Slight re-adjustment of the trimmer is necessary after the monitor has been fitted in its protective case. The tubular case has a $\frac{1}{4}$ inch hole for the jack socket, a similar hole through which to see the lamp filament, and a third smaller hole allowing the trimmer to be adjusted with a trimming tool. Both ends of the tube are closed with paxolin discs cemented on. The tubular case must not be made of metal of any type.

METHOD OF USE

The monitor is held by the jack end, and its coil brought near the power amplifier or tank coil of the model control transmitter. The trimmer is adjusted with a non-inductive trimming tool, and tuning should be quite sharp. Move the monitor slightly away from the transmitter, so that LP1 filament only just glows at the correct tuning point. This gives the sharpest resonance indication, and avoids blowing the filament.

If the transmitter is totally enclosed in such a way that the tank coil cannot be approached, a loop consisting of one or two turns of insulated wire can be placed in the aerial connection, and the monitor approached to this.

If the transmitter has variable frequency tuning, as with self-energised oscillators, a check on transmitter frequency can be made by noting that its tuning agrees with maximum brilliance of the lamp, keeping coupling loose.

Where the transmitter has tuning adjustments which govern the output power, note that these are set so that the lamp lights with its usual brightness. For tone transmitters, plug in the earpiece and listen in turn for each normal tone. Lack of any indication at all will show that the transmitter has failed. ▣

DIGITAL COMPUTERS

By C. N. Seal and A. Smith

MANY aspects of modern life use a computer; more and more of us find that computers have become part of our everyday lives. We feel their effect most in the management of our financial affairs. Our cheques are processed by computers which read magnetic ink patterns printed on the cheques; internal banking transactions, such as transfers from one account to another, are performed by computer. Our salaries, with bonus, overtime, and other remunerations, are calculated by computers which also deduct tax, National Insurance contributions, and so on. Details are then printed onto our payslips and salary cheques.

Invoices are processed and printed by computers which also calculate and subtract discounts, and prepare all necessary bills. Large scale industrial control can be performed continuously by computers in places such as oil refineries, steel mills, breweries, car manufacturing plants, and so on.

Any of you that have travelled by air would probably have had all details of your booking stored in a computer. At each booking point there would be a computer terminal—a link between the booking clerk and the computer—which indicates details of any flight, and in particular, whether there are any spare seats available.

Computer terminals are not confined to airline booking offices. Many small companies with a need for computer aid, but without the necessary funds to own their own computer system, utilise a time-sharing process. These users each have a remote terminal linked to the central computer system via the Post Office telephone lines.

The computers used for these systems are capable of processing several different user's programmes, apparently simultaneously. This is called multiprogramming. The link between the terminal and the computer is made after the operator has dialled the correct number on a conventional telephone. The time taken for processing the customers programme is recorded, and is consequently used to determine the cost.

DEFINITION

A computer may be defined as a device capable of automatically accepting data, applying a sequence of processes to the data, and supplying the results of these processes to its user. There are basically two types of electronic computer; analogue and digital.

Heading photograph. Magnetic discs and tapes can store massive amounts of information. Each of the disc drives in the foreground can store 18·4 million characters of data, enough to store the entire contents of the Bible twice. The tape drives at the rear can store 14 million characters. (*Honeywell Information Systems Ltd.*)

An analogue computer is a machine in which the value of a signal is proportional to the value which it represents. Such a signal is continuously variable, and may take any one of a large number of possible values. For instance, a car engine tachometer reading reflects the changes in the engine rotational rate. The indication is analogous to engine speed.

In contrast to the analogue signal, the digital signal has a discrete numerical value. It either exists and has one value, or it does not exist and has another value. This gives us the two "states" we require for use in the digital computer. A positive signal can represent the figure one, and no signal can represent zero.

DIGITAL COMPUTER

For the purposes of this article we shall only consider the digital computer. To understand digital computer functioning we must first appreciate the number system used for making the calculations.

The earliest system resulted from man's desire to know "how many." To answer this he used the tally system; for each item counted he made a mark, or tally. Whilst providing some means of measuring, this system proved very limited and unwieldy for even comparatively small numbers.

For convenience we now use the decimal system which runs through a cycle of ten symbols before any are repeated. It is said to have a base of ten. Any decimal number can be broken down into a number of tens, a number of tens of tens (hundreds), and so on.

Although the decimal system is logical and consistent, it requires the use of ten digits which makes it unsuitable for electronic representa-

The cleanliness of the modern computer room can be seen here. The girl operator is using the keyboard to enter information into the computer memory. (*International Computers Ltd.*)

An operator uses a console to write instructions directly into the main or control memory areas of the computer. (*Honeywell Information Systems Ltd.*)

tion. We must, therefore, study an alternative system which we call binary.

In the binary system the base number is two, and each binary digit, or bit, can only have one of two possible values, zero or one. The rules for the construction of this system are similar to those for decimal, as also are the rules for addition and subtraction; we just carry when the count becomes greater than one, or borrow two instead of ten.

As the numerical value increases, the number of bits required to represent it also increases. In the computer we must restrict the number of bits per character or per work to keep the calculations manageable. Usually computers confine the length of a character or a word to between six and forty bits.

SOFTWARE

Software is a term describing the programme of instructions, usually supplied by the computer manufacturer, to enable communication with the computer and control of its operation. So great is the importance of software that investment in its production represents a high percentage of funds allocated for design, development, and marketing of computer systems. Indeed, computer sales can depend on the availability and versatility of the software, and not on the hardware—the mechanical and electronic parts of a computer.

Software includes all manner of operating procedures and programmes, such as assemblers or compilers—programmes which convert programmes written in symbolic languages such as FORTRAN and COBOL into the machine code required by the computer.

Other types of programmes include Executives—programmes which control the operation

A pair of visual display units are shown here against a background of magnetic tape drives. Information is shown on the face of a cathode ray tube, as in a television set. (*Burroughs Machines Ltd.*)

of other programmes; Subroutines—programmes designed to perform routine calculations; and Diagnostic Routines—programmes used by the service engineer to facilitate fault finding, and to indicate whether the system is functioning correctly.

Assemblers, Executives, and Subroutines form part of a processing package—a software package enabling the user to fulfil his data processing requirements. This package is normally called an Applications Package, and is software written especially to the users own requirements.

As previously mentioned, hardware comprises the physical units in a computer system—the mechanical and electronic assemblies.

HARDWARE

Computer system hardware consists of two main areas. The first is the Central Processor, more commonly called the C.P. which performs all the major calculative and control functions. We shall consider C.P. operation later in this article. The second area embraces the peripherals commonly called input/output devices.

PERIPHERALS

To place a programme and the associated data into the C.P., we must have some form of reading, or input device. The commonest input device is the operators keyboard, or console, which enables direct manual communication with the C.P. It is generally used to instruct the C.P. to read data from an input source, or to input parameters and additional data during programme runs.

The information typed into the keyboard, or console, may be printed on paper, or displayed on a television monitor type unit which presents the information on the screen of a cathode ray tube.

There are basically four methods of supplying new data to the computer. The most common method is probably the punched card.

PUNCHED CARD

This is a card containing rows and columns punched with holes in the required code. Punched card readers can have either optical or mechanical reading arrangements.

Optical readers contain lamps and photocells arranged so that the card passing between them causes a pulse of light for each hole detected.

In the mechanical systems, the card passes between a set of contacts and metal fingers which press lightly against the card. When a hole passes a contact the finger is allowed to press against the contact and complete the circuit.

Speeds of card readers vary between 400 and 1,000 cards per minute, with about 800 cards per minute being typical. The cards are relatively cheap, easy to sort, and in some cases the data contained on the card is printed along the top edge allowing the card to be read visually. However, they are bulky, making them difficult to store. They are affected by atmospheric conditions, particularly humidity, and are easily damaged.

PUNCHED TAPE

Punched paper-tape is another common input medium. The tape is normally a one inch wide strip of paper-tape on a spool. The data is contained in rows, or frames, punched in a computer readable code. Tape is often produced by other devices, such as a typewriter or cash register. Tape readers are normally optical devices, operating similarly to the optical card reader.

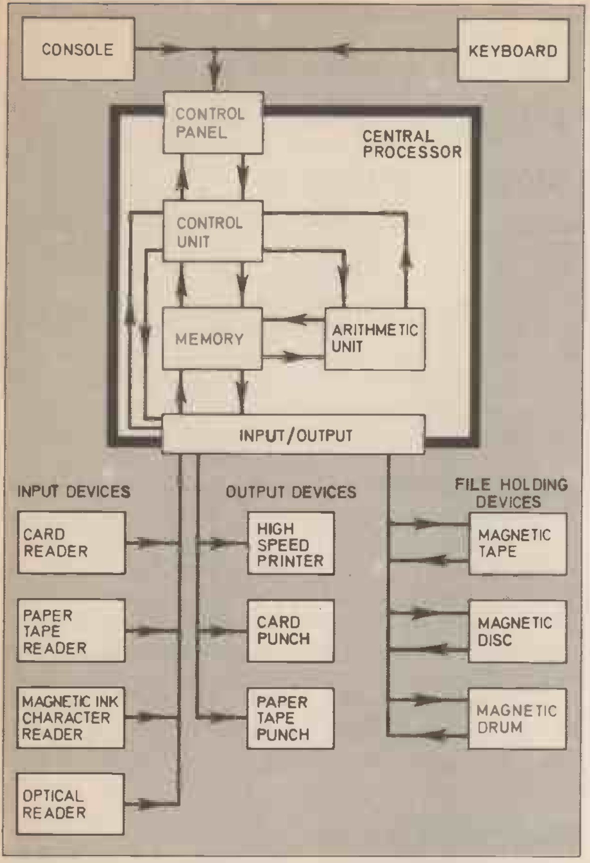
Tape readers can operate at speeds of between 300 and 2,000 frames per second, with around 1,000 frames per second being typical. Paper tape is inexpensive, but because the data is punched serially it cannot easily be amended.

MAGNETIC INK READERS

Magnetic ink character readers enable cheques and similar documents to be read. Each cheque contains a series of numbers printed in magnetic ink. The reader senses the shape of the magnetic field emitted by each character. Cheque readers can process up to 1,600 cheques per minute.

OPTICAL READERS

Optical character readers have not yet been fully developed as a method of reading handwriting, such as signatures, but most in use are able to read standard shaped letters of the alphabet, using a photoelectric cell to scan characters



This illustrates the general organisation of a typical computer system. Major data and control paths are indicated. A system may use some, or all of the input and output devices, and in the case of the file holding devices, the system may utilise a number of each type.

printed in ordinary black ink.

The devices mentioned so far have been input devices, supplying data to the computer. Punched cards and paper tape can also be used to take data from the computer. Card and tape punches are, however, rather slower than the readers.

OUTPUT

The commonest output device is the high speed line-printer. This is a machine which types the data onto paper in complete lines, instead of a character at a time. Speeds vary from 300 lines per minute to around 1,500 lines per minute, with 650 lines per minute being typical. A line can be up to 132 characters wide.

These high printing speeds are extremely useful where large quantities of information are required. A line-printer is considered essential for all commercial computer applications, for presentation of report and analysis details, and financial statements.

A finance company uses this large computer installation for the maintenance of the accounts for customers and dealers. The system uses a variety of peripheral devices, including a high speed printer, magnetic tape drives, magnetic disc drives and a paper tape reader. (*The National Cash Register Company Ltd.*)

STORAGE

The third group of peripherals are known as storage, or file holding devices, and are input and output devices. These peripherals operate on similar principles to the domestic tape recorder, by placing a pattern of magnetic fields on a ferrous oxide surface.

Magnetic recording tape is similar to domestic recording tape, but has a finer grade of oxide coating enabling a higher density of data to be held. It is also wider than domestic tape, $\frac{1}{2}$ inch being a standard.

The data is recorded in serial form, and consequently, if some data near the end of the tape is required, some time is taken to reach it—this is called the "data access" time. This is ideal for storing information used in a serial form, such as programmes.

Magnetic discs, another storage device and much faster access time than any other type, look similar to a stack of records on an autochanger spindle. Both side of each disc are coated with oxide. Read/write heads project into the gaps between pairs of discs and can read from, or write to, both discs.

The magnetic discs revolve at a very high set speed, and by synchronising the head position, information can be read, or written. This type of device is called a direct access device because any item of data can be found easily and quickly.

Magnetic drums are cylinders coated with ferrous oxide on the outside. Read/write heads are spread along the length of the drum, and as the drum rotates at a set speed, data is transferred to, or from the required area of the drum.

An engineer uses a light pen to amend an engineering diagram. This system is used in the development of printed and integrated circuits. (*Digital Equipment Company Ltd.*)

CENTRAL PROCESSOR

The central processor unit, or C.P. is the nerve centre of a computer operation. It is here that all calculative and control functions are performed. To do this the C.P. must contain four essential circuit areas. These are; memory, control, arithmetic, and input/output.

When we make any sort of calculation we must have some means of retaining the facts required to arrive at the solution. We use our brain when doing this manually, or perhaps a pencil and paper for the more complex operations. The combination of these could be called our memory unit. The computer memory performs this type of function. It is simply an area in which it can store the data, the programme to process the data, and the results obtained.

MEMORY

The computer memory is like a large electronic filing system. It contains hundreds of "memory locations", each with an exclusive address, and each capable of containing one data statement, or a programme command.

Each location consists of a number of magnetic cores, which are minute ferrous oxide impregnated rings. Each binary bit is stored in one of these cores, and can be read in less than one microsecond.

The programmer arranges his programme so that the instructions occupy a sequential block of memory locations. When the programme is run the address of the first location is entered into a programme counter. As each instruction is executed the counter is incremented, and therefore contains the address of the next instruction. Consequently the machine can complete all the required calculations automatically.

An instruction to the computer does not contain the data that is to be processed, but the address of the location in the memory.

When executing the instruction, the computer control takes the data from memory, and moves it to the arithmetic area for modification as prescribed by the instruction.

ARITHMETIC UNIT

The arithmetic unit of the C.P. is the workhorse area in which all calculations are carried out. It consists basically of an accumulator, or a number of accumulators, and an adding network.

To add two numbers together the machine takes the first number from memory and places it in the accumulator. The second number is then removed from memory, added to the accumulator and the sum of the two is retained in the accumulator. The result may then be stored in a new memory location to leave the arithmetic unit free to continue other processes.

CONTROL UNIT

All the data movements and manipulations must be correctly sequenced and routed. This is the task of the control unit which acts as switching device. As each programmed instruction is extracted from the memory it is translated into a series of actions which direct the memory and arithmetic units to supply and process the appropriate data. The control unit also directs the input/output unit when an instruction requires action on the part of a peripheral device.

THE FUTURE

Future developments look towards the building of smaller computers. Increased use of integrated circuits has already caused the central processor to become one of the physically smaller units of a system.

It appears that the domestic computer may soon become a reality. Industry and commerce will be able to draw data from central banks via a world-wide computer network, using satellite communication systems. ▣

Computer usage is not restricted to office and factory. Here, a small computer is mounted on an experimental potato picking machine. The use of this computer is to control and evaluate the performance of the machinery. (*Digital Equipment Company Ltd.*)

ELECTRONIC CIRCUITS–
.....IN THEORY and PRACTICE

TEACH-IN
...FOR BEGINNERS

By Mike Hughes M.A.

4 POWER

LAST month when we connected the 10 kilohm resistor in series with a 1mA meter, the reading in milliamps had the same numerical value as the voltage that was driving the current. Go back to using the single 10 kilohm in series with the meter and change the voltage of the battery to 4·5 volts. The current will be 0·45mA. Thus by changing the scale of the meter, we have a simple voltmeter which can measure up to 10 volts full scale. By putting two 10 kilohm resistors in series we have a voltmeter with a full scale reading of 20 volts. A two range voltmeter is shown in Fig. 1.

Make yourself a simple voltmeter using these principles. Initially it can be made up on the Demo Deck but if desired a separate meter could be bought and a separate instrument made.

A voltmeter of this type will usefully measure voltages in many electronic circuits but it suffers from a problem. This problem is that it has a resistance that in itself can "shunt" the circuit which is providing the voltage to be measured.

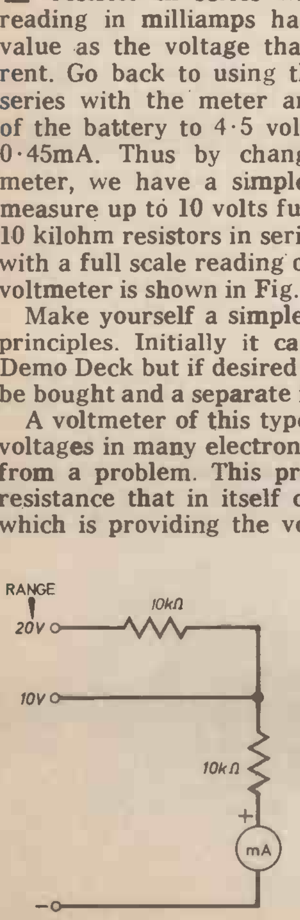


Fig. 1. A two range voltmeter. The numerical value of the current (in milliamps) gives the voltage value being measured.

This upsets the balance within the circuit and an erroneous voltage will be measured which will always read lower than actual. This means that the meter lacks sensitivity.

SENSITIVITY

The sensitivity of a meter is rated as the number of ohms the meter presents for every volt it measures. The unit we have just made is 1,000 ohms per volt and is fairly poor; more typically one requires a meter having a sensitivity of at least 10,000 ohms per volt. To make this we would have to use a basic movement having a sensitivity of 100 microamps (a microamp is one millionth of an ampere) and all our resistors would have to be scaled up in value by a factor of 10.

Test the effect of poor voltmeter sensitivity by connecting two 22 kilohm resistors in series across a 9V battery, and then use our 1,000 ohms per volt meter to measure the voltage between one end of the resistors and the common junction of the two (Fig. 2), then do the same with two 1 kilohm resistors. The reading should be 4·5V.

Justify in your own minds exactly what is happening and why the actual reading is less. The reason for this is that the 10 kilohm resistance of the meter has more shunting effect on the circuit using 22 kilohm resistors than with that using 1 kilohm resistors.

POTENTIAL DIVIDERS

The circuit of Fig. 2 is sometimes called a potential divider because the midpoint of two resistors has a potential which is based on the

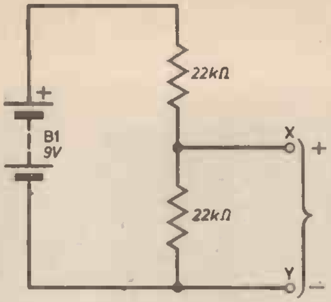


Fig. 2. Circuit for demonstrating voltmeter sensitivity.

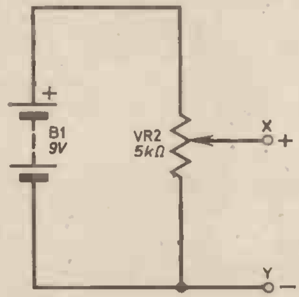


Fig. 3. The circuit diagram to be wired up on the Demo Deck to illustrate the function of a "potential divider."

potential difference across both resistors and the ratio of their values.

Substitute VR2 for the two resistors and use the wiper as the midpoint which can be varied in position to alter the ratio of the resistances either side of the wiper (Fig. 3). Measure the voltage between one end and the wiper as the knob is turned. You should get a smooth change from zero to 9V. Now try the same experiment with VR3 and VR4.

There is a great deal one can say about the principles of resistor networks, but in this beginners guide we have covered just sufficient to be of use later.

POWER

We are all familiar with the term POWER when applied to electricity. In any context it is the ability to do work whether it be manpower, horsepower or electrical power. In the latter case it is usually associated with the ability to heat something, light something or move something—the cone of a loudspeaker for example.

Driving voltage itself is not sufficient to do work—we must have current flow as well. Power is a function of both voltage and current and is measured in units of or fractions of a "watt".

Power measured in watts, $P = V \times I$

where V is the potential difference in volts and I is current flow in amperes. We can use this expression to calculate any one of the terms if the other two are known.

The current drawn by an electric fire of power 1·5 kilowatt (1·5kW) running from 250V mains

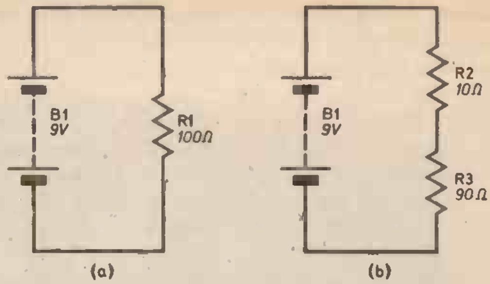


Fig. 4. The power dissipated in R1 is greater than in each of R2 and R3, but the total power dissipated in each circuit is identical.

will be given by

$$I = \frac{P}{V} = \frac{1500}{250} = 6 \text{ amperes}$$

Most frequently we are concerned with calculating the amount of power required by or dissipated in a circuit. The power dissipated in a resistor shows itself as heat, and is calculated from the current flowing through the resistance and the potential difference across it. The "potential drop" is equal to the value of the resistor multiplied by the current flowing through it (Ohm's Law)—$V = I \times R$. We can substitute $I \times R$ for V in the expression for power and obtain

$P = I \times I \times R$ this is usually written $P = I^2 \times R$

This means that we can calculate the power dissipated in any resistor purely from knowing the current flowing in the resistor and the ohmic value of the resistor.

Look at Fig. 4a. We have a 100 ohm resistor connected across a 9V battery. What is the power dissipation in it? First of all calculate the current:

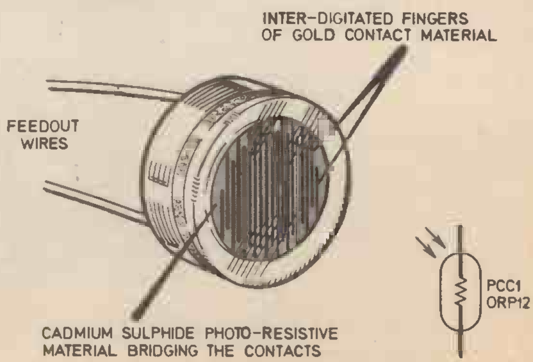
$$I = \frac{V}{R} = \frac{9}{100} = 0{\cdot}09 \text{ ampere}$$

The power dissipated is therefore,

$$0{\cdot}09 \times 0{\cdot}09 \times 100 = 0{\cdot}81 \text{ watt.}$$

Resistor R1 would have to be capable of dis-

Fig. 5. The ORP12, a typical photo conductive cell, shown in diagramatic form together with the circuit symbol and designation, PCC, for these devices.



sipating this amount of heat without undue rise in its temperature and the nearest commercially available type is a one watt device.

Fig. 4b shows two resistors in series across a 9 volt battery. Try calculating the dissipation in each resistor. First of all calculate the current flowing through the circuit as a whole then use this value of current in conjunction with the ohmic value of each of the resistors in turn. The answers are 0·08W for R2 and 0·73W for R3. Note that, although they are in the same circuit there is considerable difference in their respective dissipation. To prevent overheating the nearest commercial grades that we would use are $\frac{1}{8}$ and 1 watt devices respectively.

LIGHT DEPENDENT RESISTOR

Some electronic components have their maximum rating specified in terms of power as opposed to current. This is usual when overheating is likely to cause irreparable damage to the component. A typical example of this is the photo conductive cell or light dependent resistor. This is a very interesting and useful component because it enables us to make a whole range of simple but fascinating circuits that are actuated by light.

As its name implies it is a resistor whose ohmic value varies as light falls on it. The one we shall be talking about is readily available

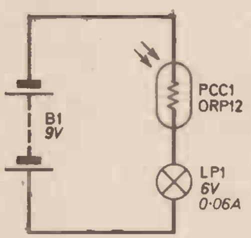
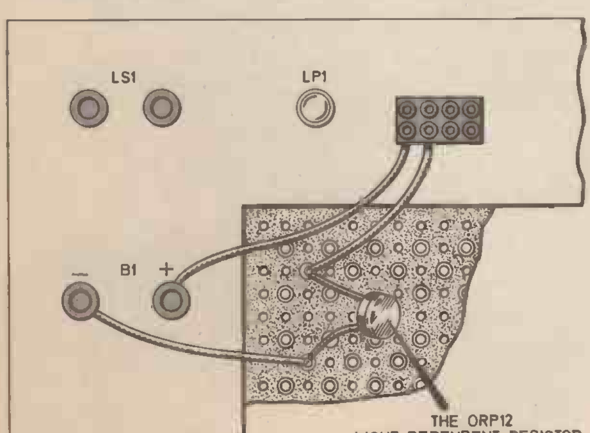


Fig. 6. (above) The circuit to demonstrate the action of a photocell. When bright light is incident on the cell, the lamp LP1 will light. (below) The wiring of this circuit on the Demo Deck.



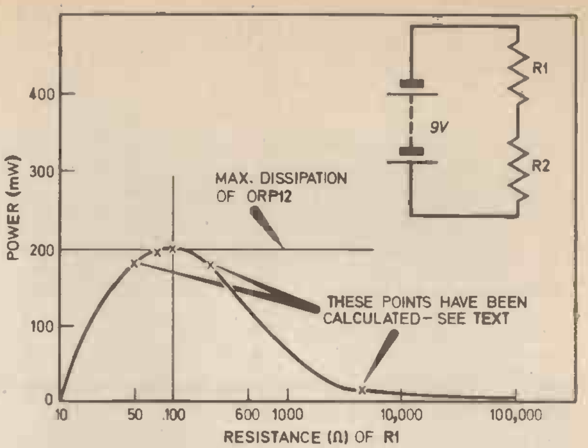


Fig. 7. Graph showing the power dissipation in R1 for various values of resistance with R2 held constant at 100 ohms. This is a maximum when R1 = R2.

and comparatively cheap—the ORP12. The appearance of the device is shown together with its symbol in Fig. 5; you can see that, like a resistor, there are two leads from it and the polarity of connection is not important.

There are several different types of this device (the ORP12 is perhaps the most common) but they can all be recognised by the distinctive interlocking fingers making contact with the photosensitive material—cadmium sulphide (CdS). Photographers will no doubt be familiar with the device because it is used as the sensor in CdS exposure meters.

The manufacturer of the ORP12 states that the resistance will typically vary from 10 Meg ohm in absolute dark conditions to approximately 75 ohm in conditions of extreme brightness. They also state that at no time may one dissipate more than 200mW in the device nor may one operate it with a potential difference greater than 110V across it.

EXPERIMENT

Use the Demo Deck to wire up the simple circuit of Fig. 6. Under normal room lighting conditions the resistance of the cell will be in excess of 500 ohm and this will prevent sufficient current to light the lamp. If you shine a very bright torch at the cell from close range you can make its resistance fall to approximately 75 ohm and the lamp will light up. You will probably be aware that the sensitivity of this circuit is poor because all the control is effected with extreme levels of light. This is because we are requiring the cell to pass quite a high current (60mA) to light the lamp and it is rather difficult to make its resistance fall sufficiently to do this.

Try working out the power dissipation in the photo cell for various light levels and see if we are exceeding the manufacturer's rating. The resistance of the photo cell varies typically from 5 kilohm down to 75 ohm for the range of lighting we are considering. Because the current

Table 1: REFERENCE DATA AND CHARACTERISTICS OF THE ORP12

Maximum power dissipation (ambient temp 25 degrees centigrade)	200mW
Absolute maximum cell voltage	110V
Cell resistance at 50 lux	2·4 kilohm
Sensitive area	0·6 cm²
Typical resistance at 1000 lux with lamp colour temperature 2700 degrees Kelvin	75–300 ohm
Ultimate dark resistance at 110V	10 Megohm
Nominal rise time of resistance	75mS
Nominal fall time of resistance	350mS

through the cell will change as its resistance changes we cannot say that the power dissipation will be the same for every condition, in fact it is quite definitely *not* the same.

Try calculating the power dissipation in the photo cell when it has the following resistance values: 5 kilohm, 200 ohm, 100 ohm, 75 ohm and 50 ohm. To help you, assume that the bulb is simply a 100 ohm resistor.

You should find that when the photo cell resistance is 100 ohm the power dissipated is 202mW and at either side of this resistance value the dissipation is less. This is very important to appreciate because it tells us that the power dissipated is a maximum when the resistance of the cell equals the resistance of the load (the bulb). Strictly speaking, we are overstretching the capabilities of the photo cell by about 1 per cent when its resistance is exactly 100 ohm. In practice, however, this condition is unlikely to be maintained for any considerable period of time and besides, the dissipation limitation has a safety factor on its side and a momentary stress in excess of the rating can be permitted.

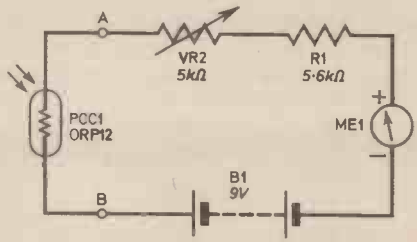
SPECIFICATIONS

Sooner or later one will need to refer to the manufacturer's specifications regarding components. Through this series we shall give you the most important specifications of the components we are using. The ORP12 is quite easily specified—see Table 1.

The parameter "Lux" is a measurement of light intensity; 50 lux is that equivalent to a dimly lit room while 1,000 lux is an exceptionally bright light—the intensity to be obtained a few inches away from a 100 watt bulb. The only parameter which you might not understand at this stage is the rise and fall time. These indicate that it takes a period of time for the cell to respond to changes in light level—the times shown for the ORP12 are quite long by electronic standards and are due to the fact that the reaction within the cell is almost a photochemical effect. Some other types of photoelectric devices can respond to millions of changes of light per second!

EXPOSURE METER EXPERIMENT

We have already said that the light dependent resistor is used in cadmium sulphide exposure



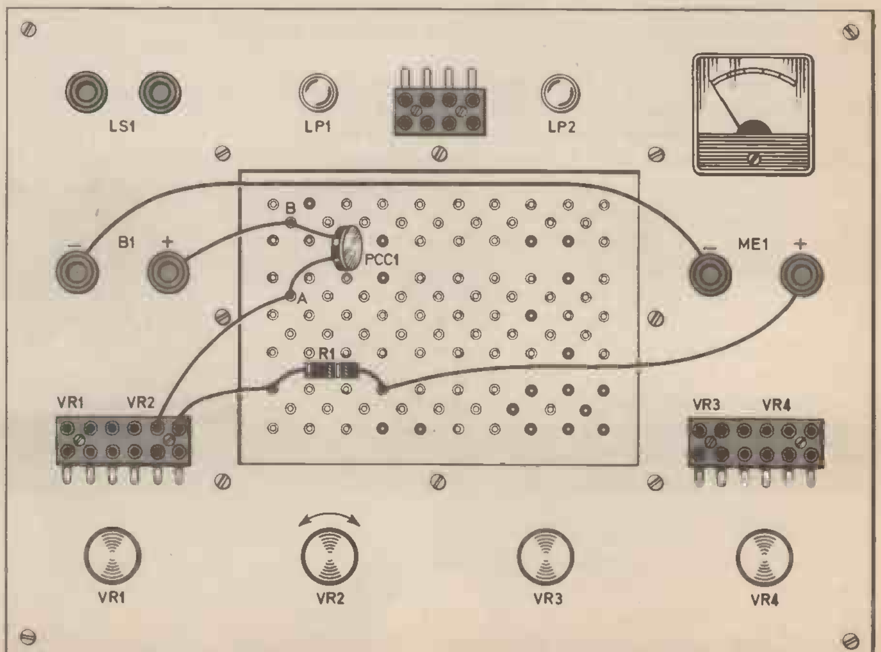
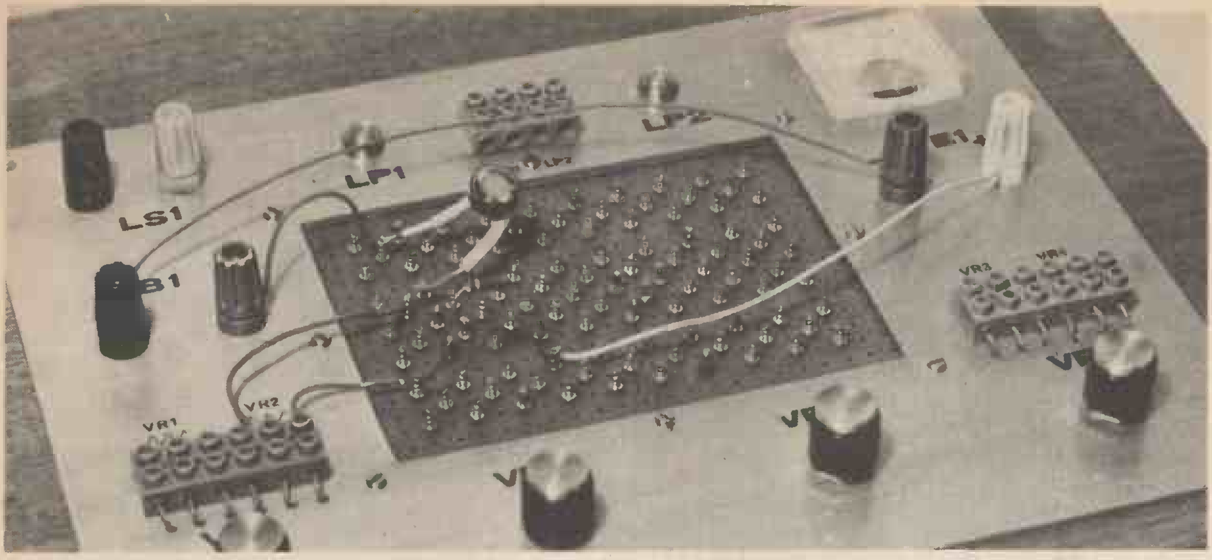


Fig. 8. (above right) The circuit diagram for a simple ohm meter which can be calibrated for use as an exposure meter. (right) This circuit wired up on the Demo Deck.



meters so now we will use the Demo Deck to make a simple version of this. Fig. 8 shows the circuit. It is a simple ohm meter where the ORP12 is a resistor whose ohmic value we shall be constantly observing.

It is usual with ohm meters to have zero ohm reading full scale on the meter. We are using a 1 mA (f.s.d.) meter, so must arrange that when we short circuit the input to the meter (across points A and B) exactly 1 mA is permitted to flow. As we are using a 9 volt battery we must incorporate a limiting resistor.

This is calculated using Ohm's Law,

$$\text{i.e. } R = \frac{V}{I} = \frac{9}{0{\cdot}001} \text{ ohm}$$
$$= 9 \text{ kilohm}$$

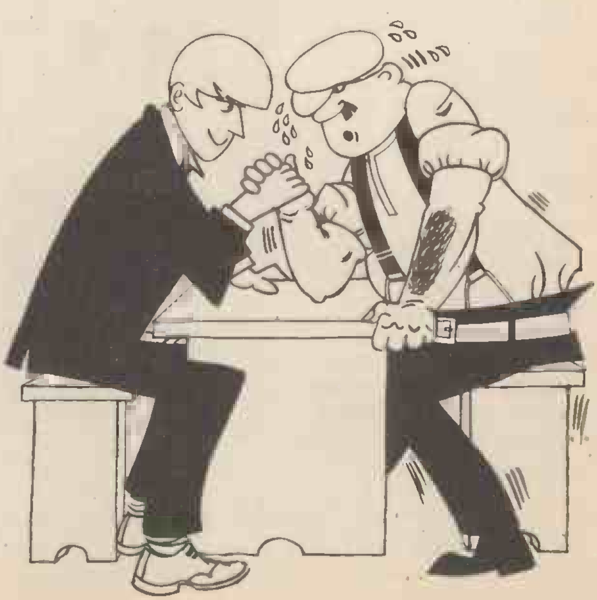
Because the battery voltage will vary a little with time we must make this resistor variable so that we can always set a zero ohm reading of full scale.

We could use a 10 kilohm potentiometer to do this but there is a danger that while adjusting it one might inadvertently reduce the resistance value to zero and pass excessive current through the sensitive meter. To prevent this happening we shall use a fixed resistor of 5·6 kilohm in series with VR2 (5 kilohm) on the Demo Deck. The combined effect of these two resistors will give us a variable range from 5·6 to 10·6 kilohm—ample to allow for battery variations but at the same time it will be impossible to pass more than about 2 mA through the meter (this would not cause any serious damage to the meter). With new batteries we should get our full scale zero ohms reading with VR2 set to almost maximum resistance.

METHOD

When set for zero ohm at full scale, disconnect the short circuit between points A and B and allow the ORP12 to come into circuit. We are now introducing extra resistance, thus the current through the meter will fall. If a lot of light is falling on the cell its resistance will be low (say 100 ohm) and this will have very little effect on the total circuit resistance, hence the meter will still read fairly high up the scale. If you prevent light falling on the cell, its resistance increases rapidly and the current displayed on the meter falls dramatically. Different levels of light between these extremes will give graded readings on the meter. For a given film speed one could carry out some trial exposures and experimentally produce a scale (or graph) which will convert the meter current reading into photographic light value numbers.

Next month : Capacitors



rain warning ALARM

By Frank Brown

Protect the washing from rain, snow and damp with this simple device.

THE device to be described will provide an alert when rain or snow is falling or when the atmosphere is saturated as when steam or mist is forming. It can serve as a water level alarm with no modifications to the sensor input and, as it is sufficiently sensitive to detect a human breath at a foot range, it could find use as a novelty item at parties.

Two alarm circuits are offered; an audio tone generator pitched at 2·5kHz and a lamp flasher. While a tone is to be preferred for remote hailing a flashing lamp would be preferable to a person hard of hearing or if the device is used in a party role.

COMPOUND PAIR

The transistors TR1 and TR2 in Fig. 1. are so arranged to very much magnify any small current that might appear at the base/emitter junction of TR1. This compound pair configuration is a cheap way of making up what is, in effect, a very high gain transistor with an amplification factor that approximates to the product of the individual transistor gains.

The small current to be amplified is produced whenever snow, rain or moisture bridges the copper strips of a 0·1 in. matrix veroboard sensor which appears in the input circuit.

These strips are so connected (Fig. 2.) as to make the whole board area moisture sensitive.

The load of the compound pair is the alarm circuit comprising TR3 and TR4. Since the smallest of input currents to TR1 is capable of switching TR2 hard on, this means that nearly all of the line volts will appear at the junction of the collectors of the compound pair.

AUDIO ALARM

The audio alarm circuit consists of a *pnp/npn* free running multivibrator designed to produce a penetrating tone without recourse to a transformer.

The Fletcher-Munson curves of equal loudness show that the human ear is most sensitive to sounds between 2kHz and 4kHz. Using the components specified, the alarm will produce a note of approximately 2·5kHz and, although the power output from the alarm is relatively small the note produced is quite piercing.

With moisture completing the input circuit and TR2 switched on, C1 charges by way of R2, R3 and LS1 until the voltage it acquires is sufficient to switch on TR3 which, in turn, switches on TR4. The collector of TR4 is thus taken to a negative potential. The switching process is hastened by feedback through C1 so that TR4 is very rapidly bottomed.

This change cannot immediately be followed

Approximate cost of components

£ 1.80 excluding case

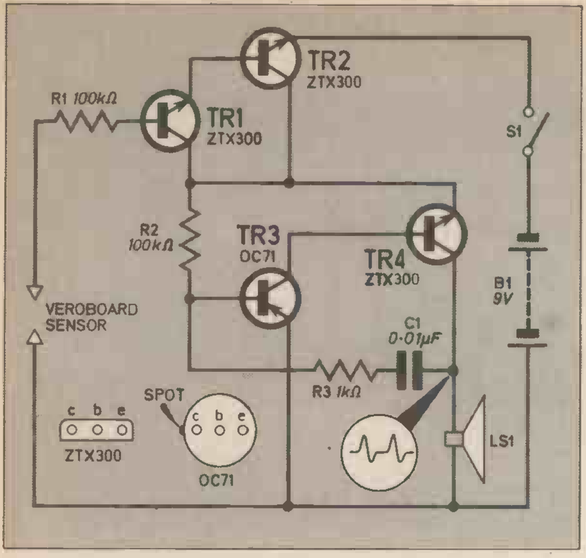


Fig. 1. Circuit diagram of the rain warning alarm.

by C1 which discharges via R3 and TR3 base/emitter. Having R3 in circuit increases the discharge time constant and therefore, the mean d.c. level to the loudspeaker which, of course, means a greater sound output.

With the discharge of C1 both TR3 and TR4 are cut off and the oscillator recycles. The frequency at which the transistors are turned on and off and therefore the frequency of the tone generated depends on the value of C1 and the resistance of its charge path; an increase in either means a decrease in frequency and vice-versa. The output waveform appearing across LS1 is shown in Fig. 1.

If at any time after the unit is built greater sound output is required a 0·47µF capacitor connected across the loudspeaker will prove a simple expedient rather than experimenting with different values for R3. It must be realised that any increase in output will mean a heavier current drain. With the components given, consumption with the oscillator functioning worked out at around 15mA.

LAMP FLASHER

Since this type of multivibrator circuit provides periodic short bursts of power (see output waveform) to a load it is ideal for flashing a lamp.

To change the alarm circuit of Fig. 1. for lamp operation means the change of only three components. A 6V 0·06A lamp replaces LS1, and R2 and C1 are changed to 470 kilohms, and 2·2µF respectively. If an electrolytic is used for C1, the positive side must be connected to the collector of TR4.

For the timing components given above the flash rate is about two flashes every second. Since the flash interval is very brief battery power taken is small compared to the audio alarm.

CONSTRUCTION

The majority of components are mounted on a $2^1{}_2$ inch x 1 inch, 0·15 inch matrix piece of

Components....

Shop Talk refers

Resistors

R1 100kΩ (or 500kΩ lin. potentiometer—see text)
R2 100kΩ
R3 1kΩ
All ½ watt ±10% carbon

Capacitor

C1 0·01µF

Transistors

TR1, TR2, TR4 ZTX 300 silicon *npn* (3 off)
TR3 OC71 germanium *pnp*

Loudspeaker

LS1 8Ω 2in diameter (or similar small speaker—see text)

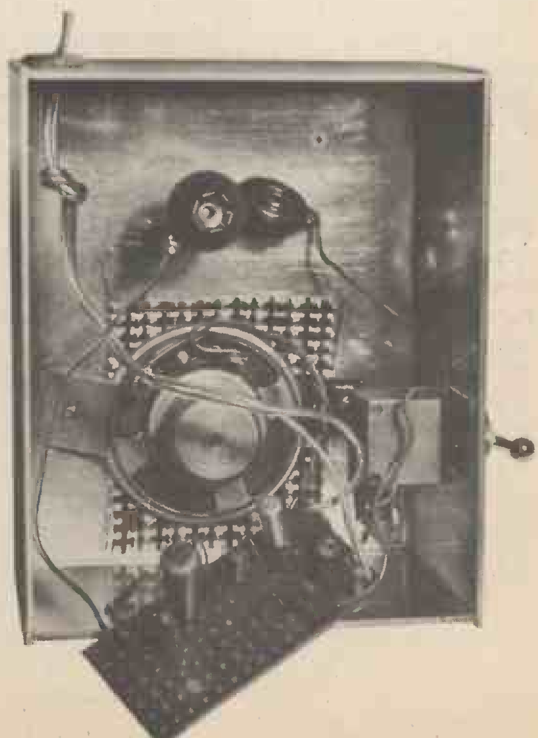
Switch

S1 Single pole on/off toggle

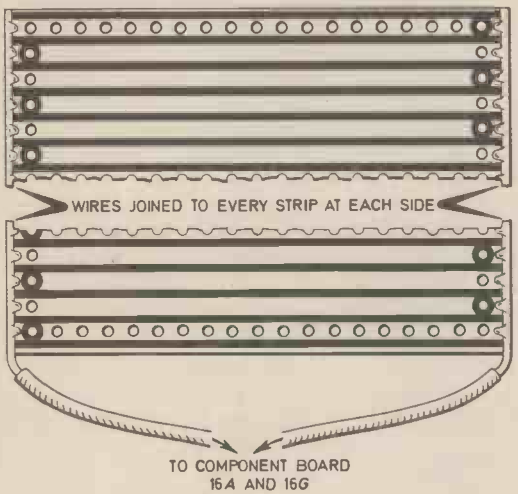
Miscellaneous

B1 PP9 battery, 5in x 4in x 2½in aluminium chassis, Veroboard 16 holes x 7 strips 0·15 matrix (see text), 4in x 3in x 0·1in matrix (for sensor), wire, 4 BA fixings.

Prototype construction of the Rain Warning Alarm.



rain warning ALARM



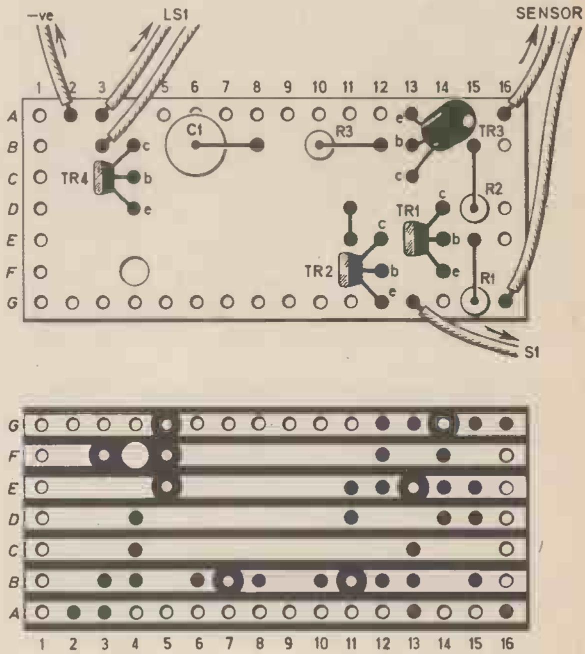
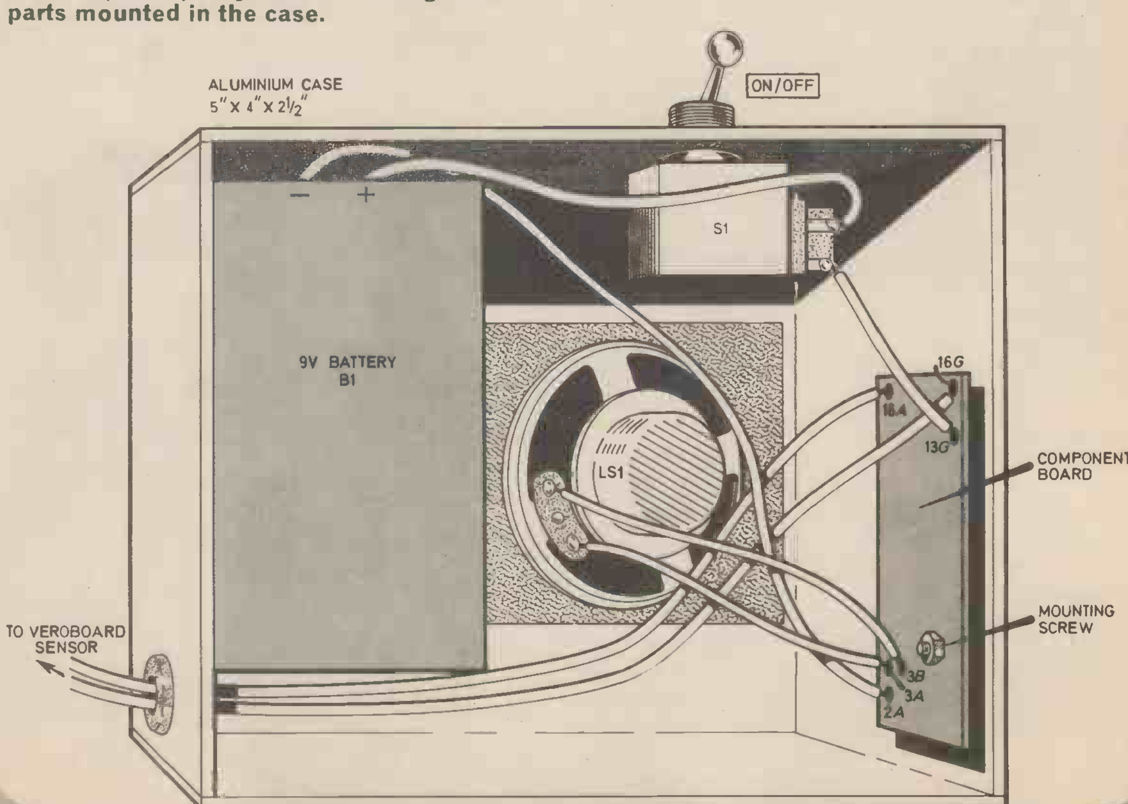
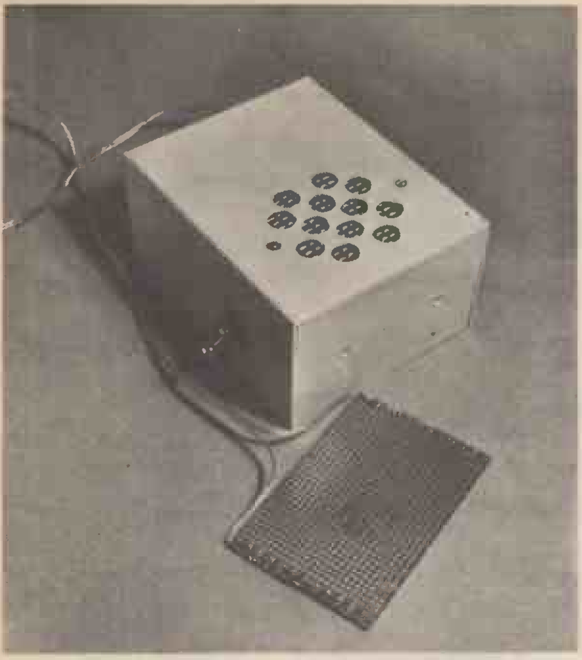


Fig. 2. (above) Wiring of the Veroboard strips to form the sensor.

Fig. 3. (right) Layout and wiring of the components mounted on the Veroboard.

Fig. 4. (below) Layout and wiring of all parts mounted in the case.





The completed unit with the sensor

Veroboard (the same size as that given away with the first issue), with the speaker and switch arranged on a small aluminium case.

The circuit performance will not suffer from alternative forms of layout so tag-strip or Cir-kit can be used.

The Veroboard layout and wiring diagram is shown in Fig. 3. The size of the piece of board used could be reduced slightly if a very compact unit is required, however since the battery used should be fairly large for a long life, reduction in size of the Veroboard was not considered advantageous. Construct the board as shown in Fig. 3 taking care when soldering the transistors not to overheat them. This particularly applies to the OC71 which is a germanium device and which should be soldered in, using a heat shunt, after all other components and leads have been attached.

After checking the board for mistakes, mount it in the case and connect up S1, LS1 B1 and the sensor (Fig. 4). Finally check the circuit and the battery polarity and switch on. A quick operational check can be made by touching the copper strips on the sensor with one finger, the unit should immediately give the warning signal. Test the sensitivity of the alarm by blowing on the sensor.

If required a small two-way socket may be included in the lead to the sensor (which is not polarity conscious) so that the sensor could be disconnected from the unit for installation.

When making up the Veroboard sensor simply solder on two lengths of wire at either end of a 4 inch x 3 inch piece of 0·1 inch matrix Veroboard so that the wire bridges all the copper tracks. Then, with a spot-face cutter or twist drill, make breaks on either side to alternate tracks as in Fig. 2. If high sensitivity is not required the size of the piece of Veroboard used may be reduced. The 0·1 inch matrix board is however most suitable.

If other values of loudspeaker are to hand, such as 3 or 15 ohm types, these can be used but it will mean experimenting with the value of C1 since substitution will produce frequency change.

APPLICATIONS

When siting the sensor the only requirement is that it should be placed on a flat surface. The length of lead to the sensor will not affect circuit performance.

If a 500 kilohm potentiometer is substituted for R1 the input sensitivity can be made variable. Since the base/emitter breakdown voltage of the ZTX 300 is 5V there is no danger of transistor destruction for the condition of maximum sensitivity with little resistance in the input line.

For use as a water level alarm the sensor should be arranged vertically with the lower two tracks at the required height. Obviously, rising water bridging these tracks will trigger the alarm.

As a novelty item the Veroboard could be attached to the top of the aluminium chassis. For this the lamp flasher circuit is used so that anyone breathing or blowing on the sensor literally blows the lamp on. ▣

USING STICK DOWN WIRING

The Waa Waa Pedal featured in this issue utilises stick down wiring; this article describes how to use it.

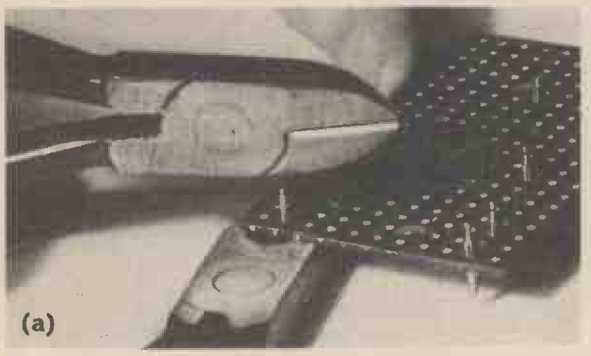
THE series of photographs below show how to use stick down wiring; photographs (a) to (e) show the *Waa Waa Pedal* being built.

Stick down wiring or Cir-kit, to use its trade name, is available in two sizes $\frac{1}{16}$ and $\frac{1}{8}$ inch width, and can be used with either plain or perforated, mounting panels. The *Waa Waa Pedal* unit described in this issue utilises $\frac{1}{16}$ inch width Cir-kit with a perforated s.r.b.p. panel. The Cir-kit forms the connections in the same way that the copper on Veroboard or a printed circuit form connections for the components.

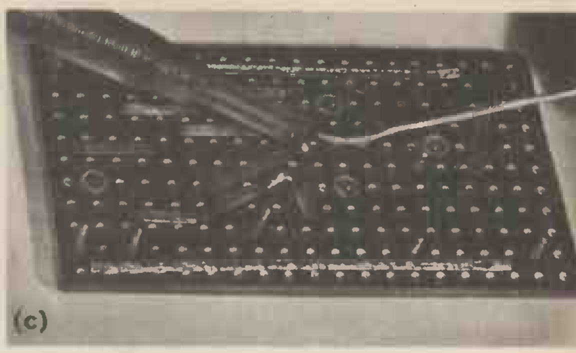
LAYING THE CIRCUIT

To use stick down wiring first design a component layout or use that provided in the article (Fig. 3 in *Waa Waa Pedal*), cut the circuit board to size using a hacksaw, drill any mounting holes and de-burr the board. The *Waa Waa Pedal* design utilises Veroboard pins for the connection of flying leads and this practice is to be recommended when using Cir-kit. The pins provide firm anchorage points for the leads and hence no strain is put on the copper strips. The pins should be inserted by supporting the board under the pin and tapping the pin in gently until it is half-way through the board (a). Mark the position of each copper strip on the board using a felt tip pen. Once all the pins have been inserted and checked the Cir-kit can be laid.

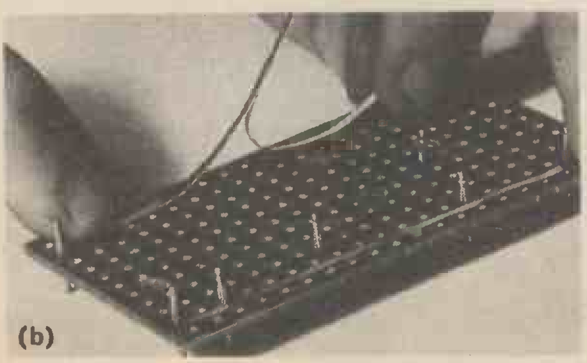
Lay the copper strip along the first section marked and cut the strip to the required length for this section. Check the length and position and carefully peel off part of the white backing strip, taking care not to touch the self adhesive back. Position the strip, peel off the remaining



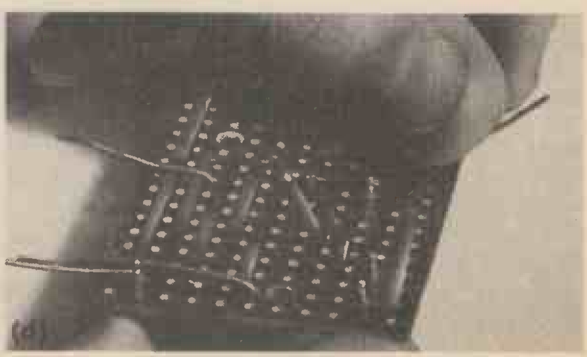
(a)



(c)



(b)



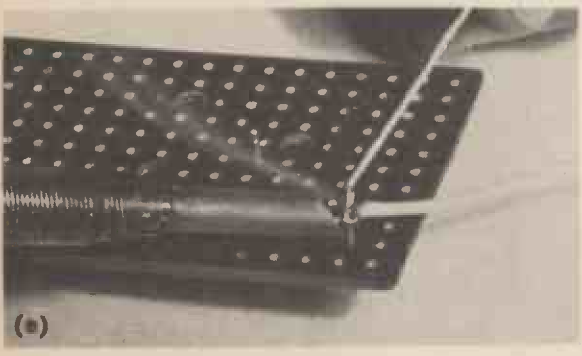
(d)

backing and lay the strip in place pressing the ends firmly down (b). Continue to lay each strip until all are in place, check the layout and firmly press all strips down; this can be done using the side of a pencil or a finger nail, run along each strip. If a strip is found to be incorrectly positioned it can be carefully removed, before pressing firmly down, and replaced.

Where there are bends in the strip cut the copper in sections so that each straight section can be laid with an overlap on the next straight section. Next go over the strips and bridge each corner with solder so that each strip forms a continuous electric circuit (c).

MOUNTING COMPONENTS

Mount all the components (except any diodes and transistors) drilling all holes in the appropriate positions first, if using plain s.r.b.p. board, holding the components in place by their leads bent over onto the copper strip (d). Check that all components are mounted in right positions and that any polarities are correct, e.g., on electrolytic capacitors. Cut off the excess wire so that only a small part is bent over the copper strip to hold the component and solder this part to the copper. Next cut some lengths of p.v.c. covered stranded connecting wire and, after stripping about 3/16 inch of the covering off, twist the strands together and tin the end, connect these wires to the pins by wrapping them around the pin and soldering (e). Check the positions of the components and leads and each soldered joint before continuing.


(e)


(f)

SOLDERING SEMICONDUCTORS

Finally, the transistors and diodes can be mounted and the board checked carefully. When mounting germanium transistors and diodes you must always use a heat shunt to protect them from the heat of the soldering iron and it is wise to carry out this practice when mounting silicon devices also.

The heat shunt, which can be a pair of long nosed pliers or a proper shunt sold for the purpose, is held between the component and the joint to be soldered, on the lead to which the soldering is being carried out. Keep the shunt on the wire until the joint has cooled down before transferring it to the next lead.

Transistors and diodes are mounted on the board and soldered in the same way as other components-checking position and polarity before cutting the leads and checking joints after soldering.

Once all the components and flying leads are mounted it is advisable to check the whole board against the circuit diagram, checking each joint of every component and making sure that no components link with any components or wires that they are not meant to.

ADVANTAGES

Stick down wiring has some advantages that are not apparent from the *Waa Waa* board design. The first of these advantages is that cross-overs of the strip can be made easily by making a "bridge" over one strip using insulation tape and laying the second copper strip over this (f). The copper strip may also be taken around the edge of the component board so that the circuit pattern can be continued on both sides of the board should this be required (f).

Finally a word of warning, when soldering to Cir-kit it is best to be as quick as possible as excess heat will affect the adhesive and eventually lift the copper away from the board. This point should be noted when fitting the components as any desoldering of those mounted incorrectly will hasten the peeling off of the strips. If this does happen another strip will have to be laid to replace the damaged one. ▣

Photographs showing how to use stick down wiring.
(a) Inserting pins for flying leads.
(b) Laying the copper strip.
(c) Joining the corners with solder.
(d) Mounting components—all except semiconductors.
(e) Fixing the flying leads.
(f) A cross-over and continuation of the strip on the other side of the board.

WAA-WAA PEDAL

by P.J. Tyrrell

Add this exciting sound to your world of music

THE waa waa effect so often heard in "pop" music nowadays, is produced by passing the audio signal from a musical instrument such as an electric guitar or electronic organ through a filter network. Varying the characteristics of the filter generates the waa waa sound.

FILTER CIRCUIT

The filter employed in this circuit is comprised of components C2, C4 and L1 (Fig. 2).

If we plotted a graph of the output voltage level against the frequency of the input signal we would obtain the curve (a) shown in Fig. 1.

By varying any of the three filter components, it is possible to shift this curve along the frequency axis as shown by curves (b) and (c) thus varying the characteristics of the filter. By doing this smoothly and continuously the desired waa waa sound is produced.

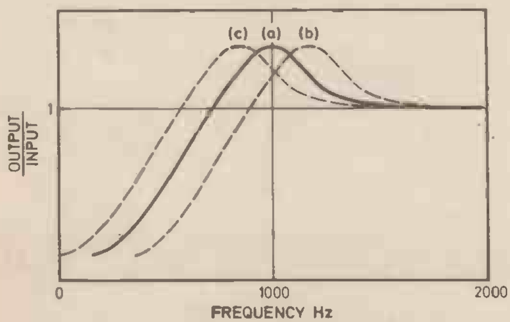


Fig. 1. Filter characteristics.

COMPLETE CIRCUIT

The complete circuit diagram is shown in Fig. 2. The first stage containing transistor TR1 is a standard circuit configuration called an "emitter follower". This is merely a matching device which presents a very high input impedance, such as required by an eletric guitar, with a low output impedance suitable for inputting to the waa waa generator.

The waa waa generator itself is made up of transistors TR2 and TR3 which are both connected in the "emitter follower" mode on either side of the filter network.

Feedback from the output of TR3 is through R7 and VR1 to the input of TR2. This is known as a "positive feedback loop".

The function of capacitors C3 and C5 is to prevent the passage of any d.c., only allowing the a.c. signal to pass unhindered.

The input signal to TR1 emerges at the emitter and is passed via capacitor C2 to the base of TR3 and at the same time applies a voltage to the B side of the inductor L1. The signal out of TR3 is fed back to the base of TR2 via the potentiometer VR1 (which is linked to the pedal) and a signal is caused to pass through the emitter circuit of TR2 applying a voltage to the A side of L1, the magnitude of this voltage being governed by the setting of VR1.

Thus, so far we have deduced that an input signal causes a potential difference to be set up across the inductor L1, and the magnitude of this potential difference is proportional to the amount of signal fed back to side B of L1 via VR1.

Thus by varying VR1, using the foot pedal, the potential difference across L1 can be varied. This variation of potential difference across L1 causes the effective inductance of L1 to vary and hence alter the filter characteristic, producing the waa waa sound at the output.

Approximate cost of components

£ 2.90 excluding case

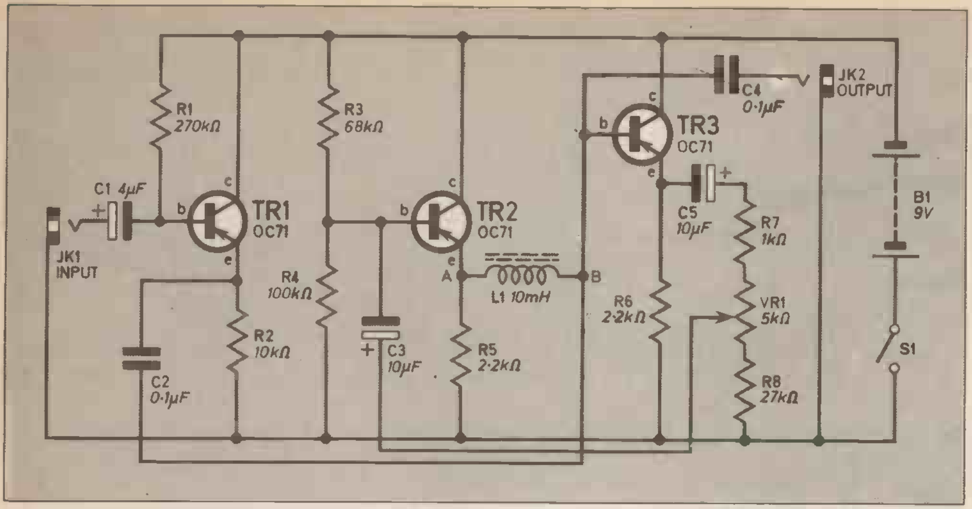


Fig. 2. The complete circuit diagram of the waa waa unit.

Components....

Shop Talk refers

Resistors
- R1 270kΩ
- R2 10kΩ
- R3 68kΩ
- R4 100kΩ
- R5 2·2kΩ
- R6 2·2kΩ
- R7 1kΩ
- R8 27kΩ
- All ¼ watt carbon ±10%

Potentiometer
- VR1 5kΩ linear

Capacitors
- C1 4μF elect. 12V
- C2 0·1μF
- C3 10μF elect. 12V
- C4 0·1μF
- C5 10μF elect. 12V

Transistors
- TR1, TR2, TR3 OC71 Germanium *pnp* (3 off)

Inductor
- L1 10mH (approx) 520 turns of 40 s.w.g. enamelled copper wire wound on a ferroxcube pot core type LA1 or any other coil with an inductance of approximately 10mH

Miscellaneous
- S1 On/off switch
- JK1, JK2 standard Jack sockets (2 off)
- B1 9V battery and clip (PP9)
- 0·15 inch matrix plain Veroboard (12 x 20 holes), Veropins, $\frac{1}{16}$ inch Cir-kit stick-down wiring, 20 s.w.g. aluminium sheet, case and pedal materials: ribbed rubber sheeting, 2½ inch door hinge, foam rubber, knob, small wood screws (10 off), 2 x 6BA bolts for inductor fixing, Meccano parts: 3½ in. perforated strip, 2in. perforated strip with boss at one end, 57-tooth gear, 19-tooth gear, 1¼in. perforated wheel, 1in. rod to suit perforated wheel.

FIXING TO THE BOARD

The main circuitry is built on a piece of 0·15 inch matrix plain Veroboard (12 x 20 holes) using Cir-kit stick-on wiring and Veropins. A full description of how to use this material is given on page 212.

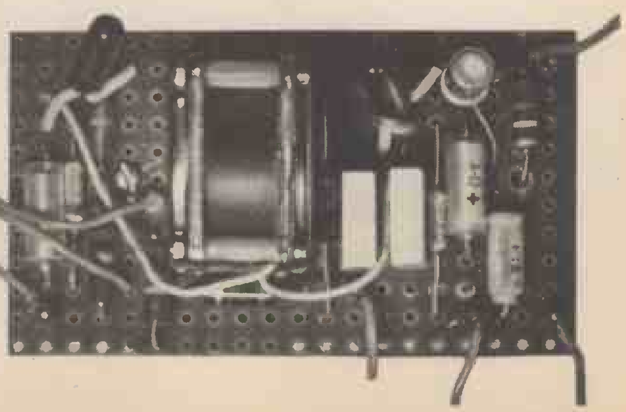
The component and Cir-kit wiring layout and drilling details are shown in Fig. 3 (a) and (b). The layout is not critical and can be rearranged if desired to suit individual requirements. Veropins are used for flying lead connections. They are indicated in Fig. 3 (b) by a circle around the black dot.

THE INDUCTANCE

The inductor is quite easily made by winding 520 turns of 40 s.w.g. enamelled copper wire on an LA1 ferroxcube pot core to give an inductance of 10 millihenries (mH).

If you do not like the idea of winding your own inductor there are some available on the market with values near to 10mH.

This inductor is attached firmly to the board by means of two 6BA bolts through locations E12 and I12 from below before fitting the other components.



Waa-Waa Pedal

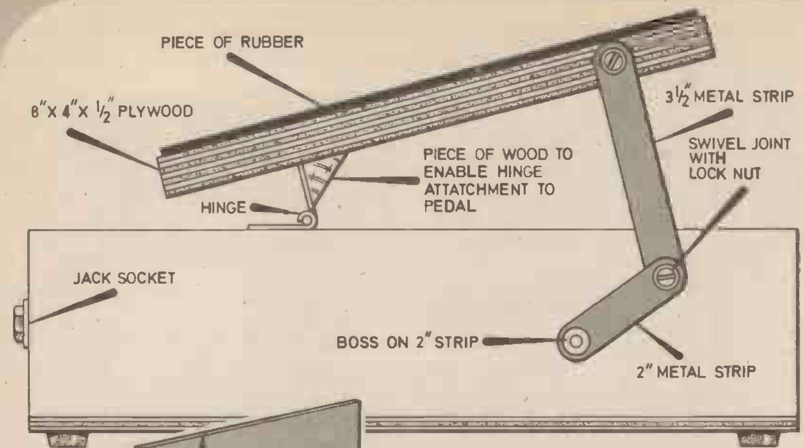


Fig. 4. Side view showing pedal arrangements.

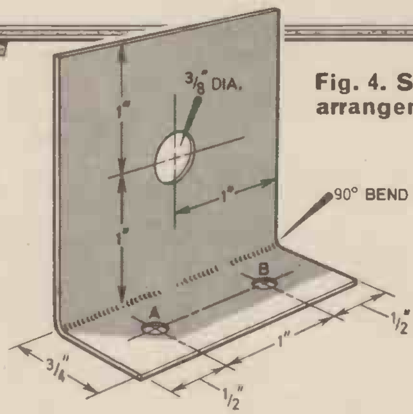
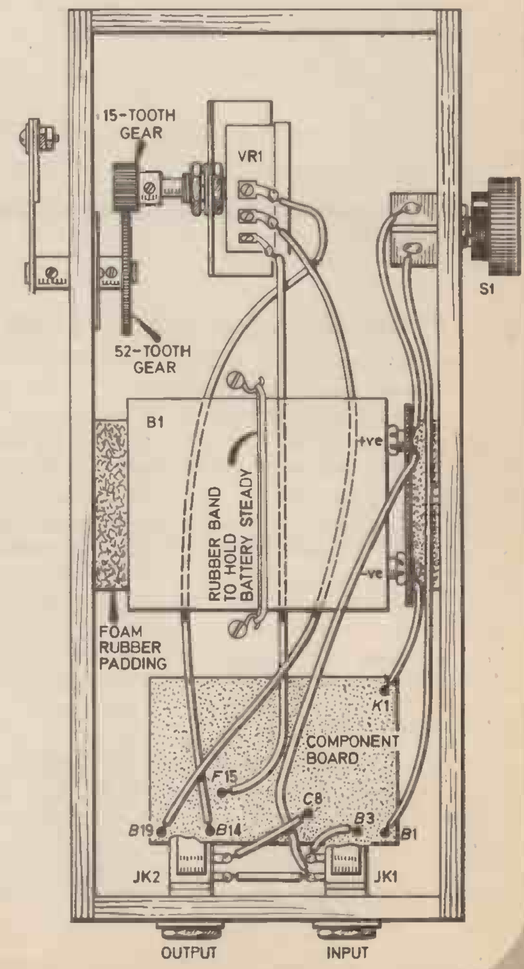


Fig. 6. The bracket dimensions for mounting VR1.

Fig. 5. The underside of the waa waa pedal showing positions of all components.



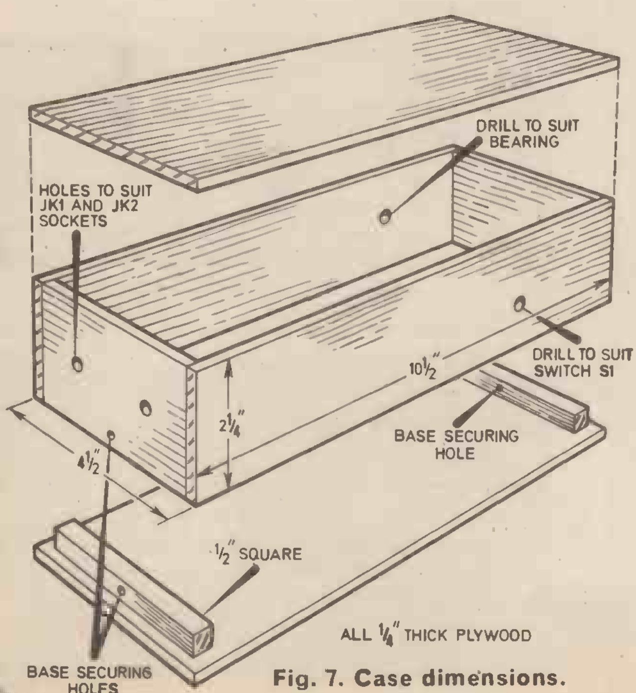


Fig. 7. Case dimensions.

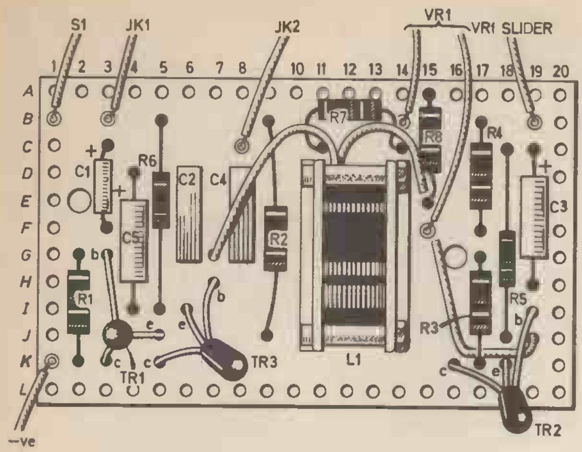


Fig. 3(a). Component layout on top side of board.

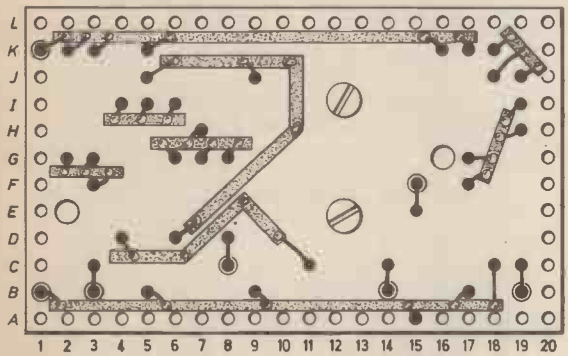


Fig. 3(b). Positioning of Cir-kit wiring on underside of board.

PEDAL POTENTIOMETER LINKAGE

In the prototype the pedal was linked to the potentiometer by means of some Meccano parts as shown in Figs. 4 and 5. A 19-tooth gear was drilled out and fitted on the shaft of the potentiometer, VR1, and a 57-tooth gear was mounted through the case (using a 1 inch length of rod, diameter $\frac{5}{32}$ inch) using a perforated wheel screwed to the inside of the case which acts as a bearing.

Two perforated strips, dimensions in Fig. 4, complete the linkage mechanism.

It is not essential to use the above Meccano parts as brass strips, for example, will do equally well in place of the perforated Meccano strips. Also, the gears need not be as used in the prototype; any set of gears may be used so long as the up and down movement of the pedal moves the slider of VR1 over the majority of its track.

CASE AND PEDAL

The case is shown in Fig. 7 together with its dimensions. The material used in the prototype was $\frac{1}{4}$ inch plywood. All joints were nailed and glued and the completed case was covered in a self-adhesive plastic material with a wood grain finish to give a neat appearance.

The pedal itself was made from a piece of $\frac{1}{2}$ inch thick plywood and attached to the top of the case by means of an ordinary door hinge and a piece of wood as shown in Fig. 4. A piece of ribbed rubber sheet was glued to the top of the pedal to prevent slipping when in use.

ASSEMBLY

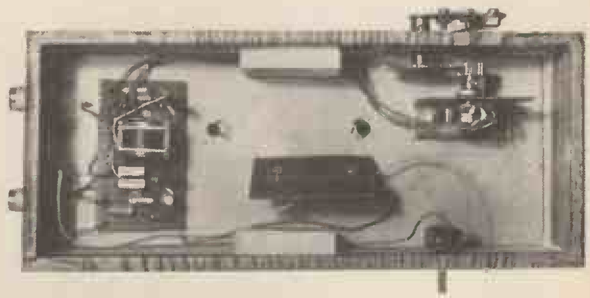
Begin by screwing the pedal to the case top and attach the linkages, bearing and large gear to the case.

Secure VR1 to its mounting bracket, shown in Fig. 6, and screw in position. Turn VR1 fully clockwise, and with the pedal pulled up as far as possible, slide on the small gear and tighten in this position. Depressing the pedal will turn VR1 anti-clockwise.

The input and output sockets, JK1 and JK2, and switch S1 can now be fixed firmly in position. Screw the component board in position and connect up all the flying leads, Fig. 5.

Pieces of foam rubber should now be glued to the sides of the case where the battery will fit, and the battery placed in position. It can be held securely in this position by means of a strong rubber band across the battery fixed by wire clips as shown in Fig. 5.

Screw on the base and the unit is complete and ready for use. If desired four small rubber legs may be attached to the base to prevent slipping when in use.



Photograph of the prototype pedal. Coaxial sockets were originally used for the input and output socket.

USING THE UNIT

This unit was designed for use with an electric guitar but can be used with almost any device since its input impedance is high. It should be interposed between the guitar and the amplifier and the waa waa effect is obtained by moving the pedal up and down whilst playing.

Different rates of pedal movement alters the waa waa effect produced.

If it is to be used with an electronic organ, the first stage of the circuit can be deleted, thus inputting directly to capacitor C2.

ACTION!

ON the borders of the Kent countryside our *Teach-In* author Mike Hughes conducts two evening classes in electronics at the Orpington and District Adult Education Centre. We went along one Wednesday evening to the "advanced" beginners class—Mondays for beginners who, at the time, were all busy building Demo Decks!

The advanced class, eleven of them, come from varied spheres—everything from a quantity surveyor to a printing firm director—and when we took the photographs they were all busy building test equipment. Most of the students took up electronics just over a year ago when Mike first started a beginners class at the centre, they have been aided in their quest for knowledge by a cash allowance from the college to purchase test gear kits.

Reasons for joining Mike's first class varied from general interest in building a specific item to requiring more knowledge of the electronics now being used at work (paint chemist). All the students are keen to learn and some have already built ambitious projects of their own.

The "advanced" beginners class, they are (from left to right, back row first) M. J. Algeo, J. B. Leach, H. A. Fussell, G. E. Gill, R. Hierons, B. B. Cox, Mike Hughes (standing) and P. J. Acock. Between them they are building a range of test instruments for their own use and for demonstration to the beginners class; the class already has an oscilloscope built by Mike Hughes.

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AF186	0·50	2N1302-3	0·20
AF139	0·37	2N1304-5	0·25
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OC44	0·13	AUY10	1·25
OC45	0·13	2S034	0·25
OC71	0·13	2N3055	0·63
OC72	0·13	**Diodes**	
OC81	0·13	AAY42	0·10
OC81D	0·13	OA95	0·19
OC83	0·20	OA79	0·09
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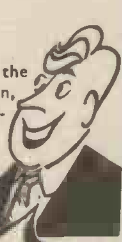

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16/450V	15p	1000/50V	47p	32+32/250V	18p
32/450V	20p	8+8/450V	18p	32+32/450V	33p
25/25V	10p	8+16/450V	20p	350+50/325V	50p
50/50V	10p	16+16/450V	25p	32+32+32/350V	43p
100/25V	10p	32+32/350V	25p	100+50+50/350V	48p

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p; 500, 1000mF 12V 18p; 2000mF 25V 42p. CERAMIC 1pF to 0·01 mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V-0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p. SILVER MICA. Close tolerance 1% 2·2-500pF 8p; 500-2·200 pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p; each. TWIN GANG. "0-0" 208pF+176pF, 65p; Slow motion drive 365+365 with 25+25pF, 50p 500pF slow motion, standard 45p; small 3-gang 500pF £1·60. SHORT WAVE, SINGLE. 10pF 30p; 25pF 55p; 50pF 55p. CHROME TELESCOPIC AERIAL, swivel base, 23in. 20p. TUNING. Solid dielectric. 100pF. 500pF, 35p each. TRIMMERS. Compression 30, 50, 70pF, 5p; 100pF, 150pF, 8p; 250pF, 10p; 600pF, 10p; 750pF 10p; 1250pF 10p. SILICON REC. 40—LUCAS 2DS500 Bridge 70V 5 amp £1. RECTIFIERS CONTACT COOLED ½ wave 60mA 38p; 85mA 48p. SILICON BYZ13 30p; BY100 30p; BY127 30p. EX-GOVERNMENT RECTIFIERS 250v, 200mA, 30p. NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p. RESISTORS, ¼ w., ½ w., 20% 1p; 2 w. 5p 10 ohms to 10 meg HIGH STABILITY. ½ w. 2% 10 ohms to 1 meg., 10p. Ditto 5% Preferred values 10 ohms to 10 meg., 4p. WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K, 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p

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250-0-250 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£2·00
350-0-350 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£2·00
300-0-300 v. 120 mA., 6·3 v. 4 a. C.T.; 6.3 v. 2 a.	£2·50
MINIATURE 200 v. 20mA., 6·3 v. 1 a. 2½ × 2½ × 2in.	75p
MIDGET 220 v. 45 mA., 6·3 v. 2 a. 2½ × 2½ × 2in.	90p
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MINI-MAINS 20v, 100mA. 1½ × 1½ × 1¼in.	50p
HEATER TRANS. 6·3v. 3 a.	60p
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6·3 v. 1½ amp.	80p

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AUTO TRANSFORMERS 115v. to 230v. or 230v. to 115v. Input/Output. 150w. £2·00; 500w. £5; 1000w. £12.

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All transformers Postage 25p extra.

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Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 15 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9in. Modern design with fluted wood front. Highly recommended. **£5** Post 25p

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12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

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For 12in. dia. speaker 20 × 13 × 9in.	£9. Post 25p
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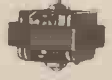

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MEMORY STORE

Retrieval By

Dick Railton

ELECTRONICS today offers reward in so many different areas of our lives that it is difficult to remember clearly those times when it hardly existed at all, and then only in the form of the mysterious "wireless". Perhaps it became my hobby because of the thrill experienced the first time I heard an identifiable voice in a pair of uncomfortable headphones attached to my very own "crystal set".

The greatest single item then in favour of wireless was that a boy, with the aid of normal workshop tools, a lump of the magic crystal, tuning condenser (now called a capacitor) and headphones, could achieve results equal to the best minds of the century—almost anyway. Thus the sense of power which could grow from this may well be the key, though I think not.

To me, my hobby went hand-in-hand with Wells, Huxley and Willy Von Braun, long before Peenmunde, Flash Gordon and the slowly growing ranks of Science Fiction writers. Our faith in journeys through space to conquer the Universe could only be supportive of and by our hobby. It may be easy to say, but hindsight has shown the dreams of youth to be true. After all, it is not a question now of "Is there life elswhere in the Universe?", it is more a case of where and how much.

The war itself gave tremendous impetous to the growing electronics industry and, via the Government surplus stores, the hobby benefited accordingly. Here, in fact, electronics began to emerge as something applicable outside mere wireless. Slowly it produced applications in medicine, industry, the cinema, the theatre and the home. Examples abound.

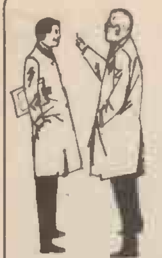
The most successful valve amplifier ever is undoubtedly the Williamson, designed by the man of the same name—an amateur/professional. The equipment was largely amateur-proved before commercial adoption. The same can be said of the Dinsdale solid-state equipment and the Lindsay-Hood class A equipment. All these are audio equipments and represent only a tiny part of electronics as a hobby. You can't ask much more of any hobby than that it allows you to be amongst the first to do something and that at the same time you enjoy the doing.

The person coming to electronics for the first time nowadays has far more scope in real terms than was available years ago. Thus it seems difficult to me to see how anyone cannot be interested.

ABBREVIATIONS

The following is a list of abbreviations used in the text of articles and in components lists. Only the direct meaning of the abbreviations is given, no attempt has been made to describe the meaning of the words in full. For further information and full descriptions readers should follow the Teach-In series.

a.c.	alternating current
a.f.	audio frequency
a.f.c.	automatic frequency control
a.g.c.	automatic gain control
a.m.	amplitude modulation
BA	British Association (nut and bolt sizes)
cm	centimetre
d.c.	direct current
d.p.d.t.	double-pole double-throw
elect.	electrolytic
e.h.t.	extra high tension
e.m.f.	electromotive force
f.e.t.	field effect transistor
f.s.d.	full scale deflection
f.m.	frequency modulation
ft.	feet
g.	gram
h.t.	high tension
i.c.	integrated circuit
in.	inch
l.d.r.	light dependent resistor
lin.	linear
log.	logarithmic
l.t.	low tension
m	metre (measurement of length)
mm	millimetre
m.w.	medium wave
npn, pnp	transistor structure (two types)
oz	ounces (avoirdupois)
p.i.v.	peak inverse voltage
p.v.c.	polyvinyl chloride
r.f.	radio frequency
r.m.s.	root mean square
s.p.s.t.	single-pole single-throw
s.r.b.p.	synthetic resin bonded paper
s.w.g.	standard wire gauge
t.r.f.	tuned radio frequency
u.h.f.	ultra high frequency
u.j.t.	unijunction transistor
v.h.f.	very high frequency
%	per cent
A	ampere (amp)
dB	decibel
F	Farad
H	Henry
Hz	Hertz (cycles per second)
Ω	ohm
V	volt
W	watt
p	pico ($\div$ 1,000,000,000,000)
μ	micro ($\div$ 1,000,000)
m	milli ($\div$ 1,000)
k	kilo ($\times$ 1,000)
M	Mega ($\times$1,000,000)



SHOP TALK

By Mike Kenward

ONE or two readers have made enquiries as to substitute components that can be used in our circuits. There are some points concerning substitutes that will probably be useful: first resistors. In general we use ±10 per cent, ¼ watt carbon types; ±10 per cent is now a more common tolerance than ±20 per cent and this is often the reason for quoting the lower figure. If you wish to use ±5 per cent (or better) types by all means do so. A similar point can be made with wattages, ¼ watt types are common but you can use ½ watt, 1 watt or even larger types provided they will fit on the component board. Never use a lower wattage type than that specified.

Capacitors

Capacitors are more difficult to lay down rules about, electrolytic types often have tolerances of −10 per cent to +100 per cent or −10 per cent to +50 per cent so you can see that substitution by a similar value to that which we quote should not unduly affect the circuit e.g. for a 25μF capacitor having a −10 per cent to +50 per cent tolerance its value could be anything between 22·5μF and 37·5μF so you could probably use values between 20μF and 40μF without seriously affecting operation of the circuit. Voltage of electrolytics is more important and you should not use types having a lower voltage rating than that given—higher ratings may be used but it is a good idea to stay within four times the specified voltage e.g. for a 12V electrolytic you could use capacitors having working voltages from 12V to about 50V.

With most other types of capacitor we do not state a tolerance or working voltage and often no specific type. In these cases the general rule is buy the cheapest available and do not worry about working voltage unless we state it. Incidentally condenser is the old term for capacitor—motor mechanics and some "behind the times" firms still use condenser, don't be put off by it.

Auto Alert

The G.P.O. type relays used in the *Auto Alert* may be expensive if new ones are purchased, there are plenty of shops selling second hand ones in good condition for about 50p and this could save as much as £2 when buying both. It is important that each relay only has one set of normally closed contacts, if the one you buy has more, undo the mounting screws and remove the unwanted contacts. You must make sure that the coils on the relays are 2000 ohms, there are other values.

If a dash mounted push button is used remember that it must be a push to changeover and release to restore type; there are various types available from the larger suppliers. The micro-switch used with the footpedal is of a similar operational type—this is standard for most micro-switches so buy a cheap one, the current rating is not important.

Radio Control Monitor

"Powerless", pocketable and very useful, the *Radio Control Monitor* is also easy to build. Variable capacitors may vary slightly (sorry about that) but most types will be satisfactory. Any trouble with the tube can be overcome by a good look at all the catalogues you bought.

It is possible to make up the tube with paper and varnish, wrapped around suitable formers but it may be a bit messy.

Rain Warning Alarm

The loudspeaker used in the *Rain Warning Alarm* is not critical either in size or impedance. The 8 ohm impedance, 2 inch diameter speaker specified could be slightly increased in size and still fit inside the case described. However, as stated in the text, any small 3 to 15 ohm speaker could be used if these are more easy to obtain. The power rating of this speaker should be between 50mW and 1W.

As stated in the text the Veroboard sensor should be made from 0·1 inch matrix. If you have some 0·15 inch matrix board to hand, this could be used but the sensitivity of the alarm will suffer.

Waa Waa Pedal

The inductor will probably be the most difficult part to obtain for the *Waa Waa Pedal*. The Ferrox cube pot core is available from some of the larger suppliers and may also be in local shops. If you buy this you will have to take it apart (quite a simple process) and wind the 500 odd turns on the bobbin inside. Although this takes some time it is a simple process. However, we have seen some inductors of about 10 millihenries (8-12 mH will suffice) advertised in the catalogues. These are wound on ferrox cores similar to that specified and they are probably cheaper than buying the cube and the wire and winding your own.

Meccano parts for the gears and pedal linkage are available from most toy and model shops.

Cir-Kit, the stick down wiring, that is used on the *Waa Waa* component board is available from most of the component shops. The $\frac{1}{16}$ inch wide type should be used as this fits between the holes on the perforated board.

New Products

Very little new products information has found its way into the office this month, in fact the only worthwhile new product for amateurs is a 12V 35W soldering iron shown below with its bayonet fitting metal transit cover.

The iron is fitted with 12ft of lead and 25 amp battery clips to enable easy connection to a car battery. Just the job for soldering in the car projects that we give designs for, such as the *Auto Alert* in this issue. The heat shroud enables the iron to be packed away immediately after use. Manufactured by Solderstat Limited the "Motorist Pack" costs £2·87.

28 watts, r.m.s. 40Hz to 40kHz ± 3dB

Viscount III Audio Suite complete £49

There are two stereo amplifiers—the R100 for ceramic cartridges, the R101 for magnetic and ceramic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.

PRICES SYSTEM 1

Viscount III R101 amplifier	£22·00+90p p&p
2 x Duo Type II speakers,	£14·00+£2 p&p
Garrard SP25 Mk. III with MAG. cart ridge plinth and cover	£23·00+£1·50 p&p
Total	£59·00

Available complete for only £52·00+£3·50 p&p

SYSTEM 2

Viscount R101 amplifier	£22·00+90p p&p
2 x Duo Type III speakers	£32·00+ £3 p&p
Garrard SP25 Mk. III with MAG. cartridge, plinth and cover	£23·00+£1·50 p&p
Total	£77·00

Available complete for £69+£4 p&p

SYSTEM 3

Viscount III Amplifier R100	£17·00+90p p&p
2 x Duo Type II speakers, pair	£14·00+£2 p&p
Garrard SP25 Mk. III with CER. diamond cartridge, plinth and cover	£21·00+£1·50 p&p
Total	£52·00

Available complete for only £49·00+£3·50 p&p

SPEAKERS Duo Type II
Size approx 17" x 10½" x 6¾". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet.
£14 pair+£2 p&p.

Duo Type III Size approx 23½" x 11½" x 9½". Drive unit 13½" x 8½" with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32 pair+£3 p&p.

SPECIFICATION R101
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ± 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. −58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾" x 9" x 3¾".

R+TV

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323 Edgware Road, London, W.2. Mail orders to Acton. Terms C.W.O. ***All enquiries S.A.E.***
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Goldring G800H
Teak plinth and tinted cover. Ready wired for immediate use. Please add £1·25 for post and packing.

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Pioneer SA900	£92·00
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Rogers R/bourne Chassis	£44·00
Rogers R/bourne Cased...	£48·50
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Sinclair 2000 Mk. II ...	£22·50
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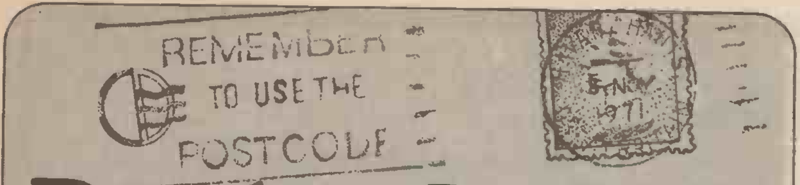

Readers Letters

Projects

Congratulations (if not too late) on your new magazine EVERYDAY ELECTRONICS. I never thought this magazine would interest the "whole family" and now we look forward to the next edition to arrive.

My reason for writing is to ask if you intend to print in future editions any projects like intercoms? My three children are always asking me to install an intercom unit in their three bedrooms. Will this be a future project? If not would you be so kind as to advise me where to obtain the necessary diagrams etc.

Peter Pleydell
Coventry.

I am writing to you on behalf of my colleagues and myself to ask if you have any circuit diagrams concerning high power amplifiers suitable for electric guitars. I would be most grateful if you could send me a circuit diagram for an amplifier of about 100 watts. I have made the *Fuzz Box* you described in issue 2 of EVERYDAY ELECTRONICS. I found it most enjoyable and interesting to make and results were very pleasing.

I think that many people would enjoy making a treasure locator and I suggest that this would be a very interesting constructional project for a future edition.

Philip Crossland,
Derek White
Yorkshire.

Unfortunately we cannot supply circuit diagrams or designs other than those published. The 100 watt amplifier is rather too complicated to form an E.E. project. However the other suggestions—the intercom and treasure locator will almost certainly be dealt with in future issues.

Binders

May I make a suggestion? Offer self binders indexed volume by volume attractively produced and gold titled to grace a modern library shelf to hold your issues as they appear and keep them in good clean reference order.

Price today? Haven't a clue; perhaps £1·25 to £1·50 each, the cheaper the selling price that can be maintained, the better.

L. F. Tearry
Kent.

We have already thought of making binders available and when we know what they will look like and how much they will cost, we will publish a notice giving full details—so watch the next few issues.

Clear Fuzz

First, congratulations to you and your staff on a first class magazine. I am so pleased with it that I shall soon be placing a subscription order to ensure that I don't miss an issue.

Secondly, with reference to your *Fuzz Box* project; I am a keen follower of any electronic music developments so I decided to build this project for experimentation purposes. I have never used Veroboard before, but I have managed to get the entire circuit onto the piece provided in the No. 1 edition. An even bigger surprise was the fact that it worked first time. In fact this is the first time this has ever happened to a project I have built.

The unit is now in use by a professional pop group, one of who is a friend of mine, and has proved exceptionally reliable even under overload. As suggested I included the bypass footswitch to switch the effect in and out.

I, however, take none of the credit for this as it is due to you for a well laid out, easy-to-understand way of going about the various projects.

C. A. Bradberry
West Dulwich.

Although you are well satisfied with your Fuzz Box *some readers have had problems. With the circuit as published there is a danger of damaging transistor TR2. To avoid this a 10 kilohm resistor should be placed between the potentiometer VR1 and the positive line. Also, if a footswitch is fitted, the unit should be made to turn off when the input and output are shorted together.*

Reversed Sentinel

May I take this opportunity to tell you that I look like being an ardent fan of EVERYDAY ELECTRONICS, for a long time to come. Having had, for a long time, the urge to "have a go" at something in the electronics field, but always being beaten due to the lack of knowledge on the subject, I was delighted when your magazine came out. It looked at last as if even I was going to be able to tackle something with some hope of success, and after the clear concise way you are presenting the projects, I had every confidence this would be the case.

But alas, no. I have just completed the *Home Sentinel* and let me say right away—but the wrong way round.

With light falling on the cell face the relay is pulled in, when the light is interrupted, the relay clicks out. Following the instructions in the article, with light on the cell face, I backed off the variable resistor until the relay clicked out, but when the light is cut off to the cell, the relay will not pull in, and no amount of adjustment will make it function as it was intended to. I must say, even in its present state, I am highly delighted to think I have been able to make it, and to have it function at all.

Could you please suggest what could have gone wrong with it. I am afraid that if it will involve the use of test equipment, I will have to be content with it.

A suggestion I would like to make, that I am sure a lot of other readers in the same position as myself will endorse, would be the inclusion in the magazine of a readers "Questions and Answers" section. In this way, someone always asks the question that has been bugging everyone else, and then they all have the answer.

Another suggestion is that once a month is too long to wait for the next issue, please let us have an issue once a week, or at worst, once a fortnight.

If you could spare the time to answer my query, I would be extremely grateful.

D. Hill
Leeds.

The contacts on your relay are obviously normally open types—the use of normally closed contacts would solve the problem. If the relay you have does not have normally closed contacts then reverse the positions of PCC1 and R1 and all will be well.

Once a month may well be too long for some readers but we often find it too short a period in the editorial offices—one reason why some readers are still waiting for replies to their letters.

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		20V. D.C.	£2·80
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50µA	£3·60	150V. D.C.	£2·80
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500µA	£2·30	15V. A.C.	£2·10
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10mA	£2·00	VU Meter	£3·20
50mA	£2·00	1 amp. A.C.*	£2·00
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50-0-50µA	£2·75	20V. D.C.	£2·20
100µA	£2·75	50V. D.C.	£2·20
100-0-100µA	£2·65	150V. D.C.	£2·20
200µA	£2·65	300V. D.C.	£2·20
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500-0-500µA	£2·20	50V. A.C.	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	8 Meter 1mA	£2·37
100mA	£2·20	VU Meter	£3·37
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp.	£2·20	1 amp. A.C.*	£2·20
20 amp.	£2·20	5 amp. A.C.*	£2·20
30 amp.	£2·30	10 amp. A.C.*	£2·20
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5V. D.C.	£2·20	30 amp. A.C.*	£2·20

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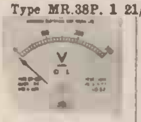

		200mA	£1·60
		300mA	£1·60
		500mA	£1·60
		750mA	£1·60
		1 amp.	£1·60
		2 amp.	£1·60
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		10 amp.	£1·60
50µA	£2·10	3V. D.C.	£1·60
50-0-50µA	£1·90	10V. D.C.	£1·60
100µA	£1·90	15V. D.C.	£1·60
100-0-100µA	£1·75	20V. D.C.	£1·60
200µA	£1·75	100V. D.C.	£1·60
500µA	£1·65	150V. D.C.	£1·60
500-0-500µA	£1·60	300V. D.C.	£1·60
1mA	£1·60	500V. D.C.	£1·60
1-0-1mA	£1·60	750V. D.C.	£1·60
2mA	£1·60	15V. A.C.	£1·70
5mA	£1·60	50V. A.C.	£1·70
10mA	£1·60	150V. A.C.	£1·70
20mA	£1·60	300V. A.C.	£1·70
50mA	£1·60	500V. A.C.	£1·70
100mA	£1·60	8 Meter 1mA	£1·70
150mA	£1·60	VU Meter	£2.10

Type MR.45P. 2in. square fronts.

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100µA	£2·10	20V. D.C.	£1·50
100-0-100µA	£1·87	50V. D.C.	£1·50
200µA	£1·87	300V. D.C.	£1·50
500µA	£1·75	15V. A.C.	£1·80
500-0-500µA	£1·70	300V. A.C.	£1·80
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5mA	£1·70	VU Meter	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
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1 amp	£1·70	30 amp. A.C.*	£1·70

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		50 amp.	£1·90
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		20V. D.C.	£1·90
		50V. D.C.	£1·90
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25µA	£3·50	30V. A.C.*	£1·95
50µA	£2·75	50V. A.C.*	£1·95
50-0-50µA	£2·35	150V. A.C.*	£1·95
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100-0-100µA	£2·25	500mA A.C.*	£1·95
500µA	£1·90	1 amp. A.C.*	£1·95
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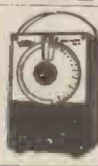

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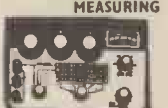

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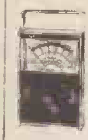

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Transistors

		2N3415	22p	2N5458	35p	BC114	15p	BFW90	22p	NKT219	30p
		2N3416	27p	2N5459	40p	BC115	15p	BFW91	20p	NKT223	27p
2G301	20p	2N3417	37p	2S102	25p	BC116	15p	BFX12	22p	NKT224	22p
2G302	20p	2N3439	130p	2S103	25p	BC118	15p	BFX13	22p	NKT225	22p
2G303	20p	2N3440	97p	2S104	25p	BC119	30p	BFX29	25p	NKT229	30p
2G306	30p	2N3564	17p	2S301	50p	BC121	20p	BFX30	25p	NKT237	35p
2G308	30p	2N3565	15p	2S302	50p	BC122	20p	BFX37	30p	NKT238	25p
2G309	30p	2N3566	22p	2S303	60p	BC125	15p	BFX44	37p	NKT240	27p
2G371	15p	2N3568	25p	2S304	75p	BC126	25p	BFX68	67p	NKT241	27p
2G374	20p	2N3569	25p	2S501	32p	BC134	12p	BFX84	25p	NKT242	20p
2G381	22p	2N3570	125p	2S502	35p	BC135	12p	BFX85	30p	NKT243	62p
2N388A	49p	2N3572	97p	2S503	27p	BC136	15p	BFX86	25p	NKT244	17p
2N404	20p	2N3605	27p	3N83	40p	BC137	15p	BFX87	25p	NKT245	20p
2N696	15p	2N3606	27p	3N128	70p	BC138	20p	BFX88	20p	NKT261	20p
2N697	15p	2N3607	22p	3N140	77p	BC140	35p	BFX89	62p	NKT262	30p
2N698	25p	2N3638	18p	3N141	72p	BC141	35p	BFX93A	70p	NKT264	20p
2N699	30p	2N3638A	20p	3N142	55p	BC147	10p	BFY11	42p	NKT271	20p
2N706	10p	2N3641	18p	3N143	67p	BC148	10p	BFY18	25p	NKT262	20p
2N706A	12p	2N3642	18p	3N152	87p	BC149	12p	BFY19	25p	NKT274	20p
2N708	12p	2N3643	20p	40050	55p	BC152	17p	BFY21	42p	NKT275	20p
2N709	45p	2N3644	25p	40250	50p	BC153	20p	BFY24	45p	NKT278	25p
2N718	25p	2N3645	25p	40251	32p	BC154	20p	BFY29	40p	NKT281	27p
2N718A	30p	2N3691	15p	40309	32p	BC157	15p	BFY30	40p	NKT401	87p
2N726	25p	2N3692	18p	40310	45p	BC158	11p	BFY41	50p	NKT402	90p
2N727	25p	2N3693	15p	40311	35p	BC159	12p	BFY43	62p	MKT403	75p
2N914	17p	2N3694	18p	40312	47p	BC160	35p	BFY50	20p	NKT404	55p
2N916	17p	2N3702	10p	40314	37p	BC167	11p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	40315	37p	BC168B	12p	BFY52	20p	NKT406	62p
2N929	22p	2N3704	12p	40316	47p	BC168C	15p	BFY53	15p	NKT451	62p
2N930	20p	2N3705	10p	40317	37p	BC169B	14p	BFY56A	57p	NKT452	62p
2N937	52p	2N3706	10p	40319	55p	BC169C	15p	BFY76	42p	NKT453	47p
2N1090	22p	2N3707	12p	40320	47p	BC170	12p	BFY77	57p	NKT713	20p
2N1091	22p	2N3708	10p	40323	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1131	25p	2N3709	10p	40324	47p	BC172	15p	BSX19	17p	NKT734	27p
2N1132	25p	2N3710	10p	40326	37p	BC175	22p	BSX20	15p	NKT736	35p
2N1302	17p	2N3711	10p	40329	30p	BC177	20p	BSX21	20p	NKT773	25p
2N1303	17p	2N3713	187p	40344	27p	BC178	20p	BSX26	45p	NKT781	30p
2N1304	22p	2N3714	200p	40347	57p	BC179	20p	BSX27	47p	OC16	50p
2N1305	22p	2N3715	220p	40348	52p	BC182	12p	BSX28	32p	OC19	37p
2N1306	25p	2N3716	285p	40360	40p	BC182L	10p	BSX60	82p	OC20	85p
2N1307	25p	2N3773	240p	40361	40p	BC183	9p	BSX61	62p	OC22	50p
2N1308	25p	2N3791	275p	40362	50p	BC183L	9p	BSX76	15p	OC23	60p
2N1309	25p	2N3819	34p	40370	32p	BC184	11p	BSX77	20p	OC24	60p
2N1507	17p	2N3820	55p	40406	57p	BC184L	11p	BSX78	25p	OC25	40p
2N1613	20p	2N3823	50p	40407	40p	BC186	25p	BSY24	15p	OC26	25p
2N1631	35p	2N3854	27p	40408	52p	BC187	27p	BSY25	15p	OC28	60p
2N1632	30p	2N3854A	27p	40409	55p	BC212L	12p	BSY26	17p	OC29	60p
2N1637	30p	2N3855	27p	40410	62p	BC213L	12p	BSY27	15p	OC35	50p
2N1638	27p	2N3855A	30p	40412	50p	BC214L	15p	BSY28	17p	OC36	60p
2N1639	27p	2N3856	30p	40467A	57p	BCY10	27p	BSY29	17p	OC41	22p
2N1701	162p	2N3856A	35p	40468A	35p	BCY30	30p	BSY32	25p	OC42	40p
2N1711	24p	2N3858	25p	40528	72p	BCY31	40p	BSY36	25p	OC44	15p
2N1889	32p	2N3858A	30p	40600	57p	BCY32	60p	BSY37	25p	OC45	12p
2N1893	37p	2N3859	27p	40603	50p	BCY33	30p	BSY38	20p	OC46	15p
2N2147	72p	2N3859A	32p	AC107	30p	BCY34	35p	BSY39	22p	OC70	15p
2N2160	57p	2N3860	30p	AC126	20p	BCY38	45p	BSY43	50p	OC71	12p
2N2193	40p	2N3866	150p	AC127	24p	BCY39	67p	BSY51	32p	OC72	12p
2N2193A	42p	2N3877	40p	AC128	20p	BCY40	50p	BSY52	32p	OC73	30p
2N2194	27p	2N3877A	40p	AC151	18p	BCY41	15p	BSY53	37p	OC74	30p
2N2194A	30p	2N3900	37p	AC152	22p	BCY42	15p	BSY54	40p	OC75	25p
2N2217	25p	2N3900A	40p	AC154	22p	BCY43	15p	BSY56	90p	OC76	25p
2N2218	20p	2N3901	97p	AC176	20p	BCY54	32p	BSY79	45p	OC77	40p
2N2219	20p	2N3903	20p	AC187	25p	BCY58	22p	BSY90	57p	OC78	20p
2N2220	25p	2N3904	25p	AC188	25p	BCY59	22p	BSY95A	12p	OC81	20p
2N2221	25p	2N3905	30p	ACY17	27p	BCY60	97p	C424	15p	OC81D	20p
2N2222	20p	2N3906	25p	ACY18	24p	BCY70	15p	C450	15p	OC82	20p
2N2222A	25p	2N4058	12p	ACY19	24p	BCY71	20p	GET102	35p	OC82D	15p
2N2297	30p	2N4059	10p	ACY20	20p	BCY72	15p	GET113	25p	OC83	25p
2N2368	15p	2N4060	12p	ACY21	20p	BCY78	30p	GET114	20p	OC84	25p
2N2369	15p	2N4061	12p	ACY22	10p	BCY79	30p	GET118	20p	OC139	25p
2N2369A	15p	2N4062	12p	ACY28	17p	BCZ10	27p	GET120	25p	OC140	40p
2N2410	42p	2N4244	47p	ACY39	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2483	27p	2N4248	15p	ACY40	14p	BD112	50p	GET880	45p	OC171	30p
2N2484	32p	2N4249	15p	ACY41	15p	BD116	112p	GET887	15p	OC200	40p
2N2539	22p	2N4250	18p	ACY44	25p	BD121	65p	GET889	22p	OC201	75p
2N2540	22p	2N4254	42p	AD140	47p	BD123	80p	GET890	22p	OC202	80p
2N2613	35p	2N4255	42p	AD149	47p	BD124	75p	GET896	22p	OC203	40p
2N2614	30p	2M4284	17p	AD150	62p	BD131	75p	GET897	22p	OC204	40p
2N2646	47p	2N4285	17p	AD161	35p	BD132	80p	GET898	22p	OC205	75p
2N2711	25p	2N4286	17p	AD162	35p	BDY10	125p	MAT100	25p	OC206	95p
2N2712	25p	2N4287	17p	AF109	45p	BDY20	105p	MAT101	25p	OC207	75p
2N2713	27p	2N4288	15p	AF114	25p	BDY61	125p	MAT120	25p	OCP71	42p
2N2714	30p	2N4289	12p	AF115	25p	BDY62	100p	MAT121	25p	ORP12	50p
2N2904	20p	2N4290	12p	AF116	25p	BF115	25p	MJ400	107p	ORP60	40p
2N2904A	25p	2N4291	15p	AF117	20p	BF117	47p	MJ420	80p	ORP61	42p
2N2905	25p	2N4292	15p	AF118	44p	BF152	28p	MJ421	80p	P346A	22p
2N2905A	20p	2N4294	17p	AF121	30p	BF154	20p	MJ430	102p	ST140	15p
2N2906	20p	2N4303	47p	AF124	22p	BF158	15p	MJ440	95p	ST141	20p
2N2906A	25p	2N4964	15p	AF125	19p	BF159	35p	MJ480	97p	TI834	62p
2N2907	23p	2N4965	18p	AF126	16p	BF163	35p	MJ481	125p	TI843	40p
2N2923	15p	2N5027	52p	AF127	16p	BF167	25p	MJ490	100p	TI844	12p
2N2924	15p	2N5028	57p	AF139	28p	BF170	33p	MJ491	137p	TI845	12p
2N2925	15p	2N5029	47p	AF178	42p	BF173	30p	MJE340	50p	TI846	12p
2N2926G	12p	2N5030	42p	AF179	45p	BF177	30p	MJE370	80p	TI847	12p
2N2926O	12p	2N5172	12p	AF180	50p	BF178	25p	MJE371	80p	TI848	12p
2N2926Y	12p	2N5174	52p	AF181	40p	BF179	30p	MJE520	75p	TI849	12p
2N3011	20p	2N5175	52p	AF186	39p	BF180	35p	MJE521	70p	TI850	12p
2N3014	25p	2N5176	45p	AF239	30p	BF181	35p	MPF102	42p	TI851	10p
2N3053	20p	2N5232A	30p	AF279	47p	BF182	30p	MPF103	35p	TI852	11p
2N3054	49p	2N5245	45p	AF280	47p	BF184	20p	MPF104	37p	TI853	22p
2N3055	72p	2N5246	42p	AFZ11	32p	BF185	20p	MPF105	37p	XB112	12p
2N3133	25p	2N5249	67p	ASY26	25p	BF194	15p	MPS3638	32p	XC141	35p
2N3134	30p	2N5265	325p	ASY27	30p	BF195	15p	NKT124	42p	ZTX107	15p
2N3135	25p	2N5305	37p	ASY28	24p	BF196	15p	NKT125	27p	ZTX108	12p
2N3136	25p	2N5306	40p	ASY29	27p	BF197	15p	NKT126	27p	ZTX109	15p
2N3390	25p	2N5307	37p	ASY50	25p	BF198	15p	NKT128	27p	ZTX300	12p
2N3391	20p	2N5308	37p	ASY51	32p	BF200	35p	NKT135	27p	ZTX301	15p
2N3391A	30p	2N5309	62p	ASY54	25p	BF224	14p	NKT137	32p	ZTX302	20p
2N3392	17p	2N5310	42p	ASY67	45p	BF225	19p	NKT210	30p	ZTX303	20p
2N3393	15p	2N5354	27p	ASY86	32p	BF237	22p	NKT211	30p	ZTX304	25p
2N3394	15p	2N5355	27p	ASZ21	51p	BF238	22p	NKT212	30p	ZTX500	15p
2N3402	22p	2N5356	32p	AUY10	150p	BF244	32p	NKT213	30p	ZTX501	15p
2N3403	22p	2N5365	47p	BC107	10p	BFW61	47p	NKT214	20p	ZTX502	20p
2N3404	32p	2N5366	32p	BC108	10p	BFW87	25p	NKT215	22p	ZTX503	17p
2N3405	45p	2N5367	57p	BC109	10p	BFW88	23p	NKT216	35p	ZTX504	40p
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CA3000	180p
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CA3018A	110p
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CA3020A	160p
CA3021	156p
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CA3023	126p
CA3026	100p
CA3028A	74p
CA3028B	105p
CA3029	87p
CA3029A	165p
CA3030	137p
CA3035	122p
CA3036	72p
CA3039	82p
CA3041	109p
CA3042	109p
CA3043	137p
CA3044	120p
CA3045	122p
CA3046	81p
CA3047	137p
CA3048	204p
CA3049	180p
CA3050	185p
CA3051	134p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	102p
FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
IC10	250p
IC12	250p
L900	40p
L914	40p
L923	40p
MC724P	60p
MC780P	247p
MC788P	146p
MC790P	124p
MC792P	66p
MC799P	66p
MC1303L	100p
MC1304P	225p
MC1305P	386p
MC838P	549p
MC1435P	345p
MC1552G	461p
MC1709CG	94p
MFC4000P	75p
PA222	280p
PA230	140p
PA234	92p
PA237	210p
PA246	160p
PA424	235p
PA264	190p
PA265	200p
SN7400	20p
SN7401	20p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	80p
SN7408	20p
SN7409	20p
SN7410	20p
SN7411	23p
SN7413	30p
SN7420	20p
SN7430	20p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7446	100p
SN7447	135p
SN7448	125p
SN7450	20p
SN7451	20p
SN7453	20p
SN7454	20p
SN7460	20p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
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SN7495	87p
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SN74107	52p
SN74153	140p
SN74154	220p
SN74160	180p
SN74161	260p
SN74164	220p
SN74165	225p
SN74192	175p
SN74193	175p
TAA241	162p
TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
TAA350	175p
TAA435	147p
TAA521	132p
TAA522	360p
TAA530	495p
TAA811	445p
TAB101	97p
TAD100	150p
TAD110	150p
SL403D	150p
SL702C	147p
UA702A	280p
UA702C	77p
UA703C	137p
UA709C	125p
UA710C	125p
UA716	187p
UA723C	162p
UA730C	160p
UA741C	87p

BRIDGE RECTIFIERS PLASTIC ENCAPSULATED

600 PIV 1A	50p	50 PIV 4A	60p
50 PIV 2A	55p	100 PIV 4A	70p
100 PIV 2A	60p	200 PIV 4A	70p
200 PIV 2A	65p	400 PIV 4A	75p
400 PIV 2A	75p	50 PIV 6A	62p
		100 PIV 6A	75p
		200 PIV 6A	75p
		400 PIV 6A	100p

SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

	IN SERIES 1 AMP	PL SERIES 1·5 AMP	CL SERIES 3 AMP
4001 50PIV	7p	8p	19p
4002 100PIV	7p	9p	20p
4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
4006 800PIV	12p	15p	27p
4007 1000PIV	15p	16p	30p

50+ less 15% 100+ less 20%

SILICON RECTIFIERS STUD MOUNTING

	6A	10A	17·5A	35A
100PIV	—	45p	50p	£1·22
200PIV	25p	50p	55p	£1·42
400PIV	30p	55p	62p	£1·77
600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50+ less 15% 100+ less 20%

ZENER DIODES

400MW	1·5 WATT	10 WATT
3·3-33 V	2·4—100	3·9—100V
10p each	25p each	40p each

25+ less 15% 100+ less 20%

TRANSISTOR DISCOUNTS:- 12 + 10%; 25 + 15%; 100 + 20% any one type. Postage on all Semi Conductors 7p extra.
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6AG7	40p	35Z5	50p	PC88	60p
6AK5	35p	50B5	50p	PC97	45p
6AK6	60p	50C5	50p	PC900	48p
6AL5	20p	80	55p	PCC84	40p
6AM6	30p	85A2	50p	PCC85	40p
6AQ5	38p	807	50p	PCC88	55p
6AS6	40p	1625	50p	PCC89	50p
6AT6	35p	5763	70p	PCC189	55p
6AU6	25p	6146	160	PCF80	30p
6AV6	30p	AZ31	55p	PCF82	34p
6BA6	25p	CY31	35p	PCF84	60p
6BE6	30p	DAF91	30p	PCF86	60p
6BH6	75p	DAF96	45p	PCF800	80p
6BJ6	50p	DF91	22p	PCF801	50p
6BQ7A	40p	DF96	45p	PCF802	50p
6BR7	90p	DK91	40p	PCF805	80p
6BR8	70p	DK92	55p	PCF806	70p
6BW6	85p	DK96	50p	PCF808	75p
6BW7	80p	DL92	35p	PCL82	35p
6BZ6	40p	DL94	48p	PCL83	65p
6C4	33p	DL96	45p	PCL84	45p
6CD6	125p	DM70	40p	PCL85	40p
6CL6	50p	DY86	32p	PCL86	45p
6CW4	65p	DY87	33p	PFL200	65p
6F1	62p	E88CC	100p	PL36	55p
6F6G	35p	E180F	100p	PL81	50p
6F13	45p	EABC80	35p	PL82	45p
6F14	70p	EAF42	35p	PL83	45p
6F15	65p	EB91	20p	PL84	40p
6F18	50p	EBC41	55p	PL500	75p
6F23	85p	EBC81	30p	PL504	80p
6H6	17p	EBF80	40p	PY32	55p
6J4	50p	EBF83	40p	PY33	63p
6J5	25p	EBF89	32p	PY80	40p
6J5GT	30p	EBL21	60p	PY81	30p
6J6	20p	EC86	60p	PY82	35p
6J7	45p	EC88	60p	PY83	38p
6K8G	40p	ECC40	65p	PY88	40p
6L6GT	45p	ECC84	30p	PY800	40p
6LD20	50p	ECC85	40p	PY801	50p
6Q7	40p	ECC88	40p	U25	80p
6SA7	40p	ECF80	35p	U26	80p
6SG7	40p	ECF82	35p	U50	40p
6SJ7	40p	ECF86	65p	U52	35p
6SK7	40p	ECH21	57p	U191	75p
6SL7	35p	ECH35	100p	U281	40p
6SN7	35p	ECH42	75p	U282	40p
6SQ7	40p	ECH81	30p	U301	40p
6U4	65p	ECH83	45p	U801	£1·80
6V6G	25p	ECL80	45p	UABC80	40p
6V6GT	32p	ECL82	35p	UAF42	55p
6X4	35p	ECL83	70p	UBC41	50p
6X5G	30p	ECL86	40p	UBC81	40p
6X5GT	40p	EF37A	120p	UBF80	40p
10C2	50p	EF39	50p	UBF89	35p
10F1	75p	EF40	50p	UCC84	49p
10P13	60p	EF41	65p	UCC85	40p
10P14	£1·10	EF42	70p	UCF80	55p
12AT6	30p	EF80	25p	UCH21	60p
12AT7	30p	EF85	35p	UCH42	70p
12AU7	30p	EF86	30p	UCH81	40p
12AX7	30p	EF89	25p	UCL82	35p
12AV6	40p	EF91	30p	UCL83	60p
12BA6	40p	EF92	35p	UF41	60p
12BE6	40p	EF183	35p	UF80	35p
12BH7	45p	EF184	35p	UF85	40p
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20D1	50p	EL34	50p	UL41	65p
20F2	65p	EL33	£1·25	UL84	40p
20L1	£1·10	EL41	60p	UY41	48p
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20P4	£1·10	EL84	25p	VR150/30	35p
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AA119	7p	BAY31	7p	OA10	25p
AA129	10p	BAY38	15p	OA9	10p
AAZ13	10p	BY100	15p	OA47	10p
AAZ15	10p	BY103	22p	OA70	10p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	10p
BA110	25p	BY126	15p	OA81	8p
BA111	27p	BY127	15p	OA85	7p
BA112	70p	BY164	57p	OA90	8p
BA115	7p	BY210	30p	OA91	7p
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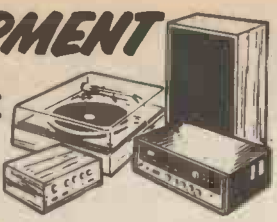

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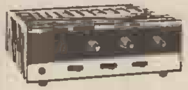

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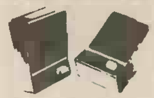

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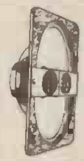

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Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms.
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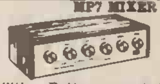

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9¼" x 5" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono mag. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.
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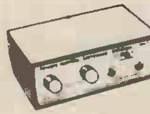

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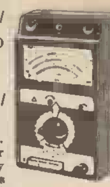

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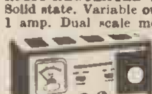

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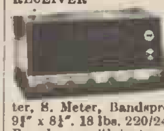

General coverage 150–400kc/s, 550 kc/s–30mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter, S. Meter, Bandspread. RF Gain. 15" x 9¼" x 8¼". 18 lbs. 220/240v. A.C. or 12v. D.C Brand new with instructions. £45. Carr. 50p.

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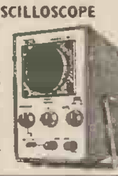

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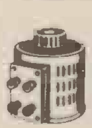

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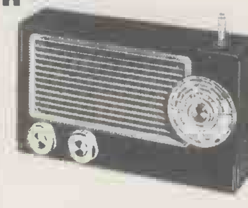

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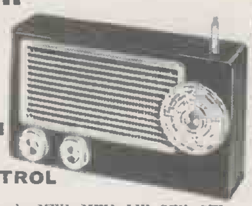

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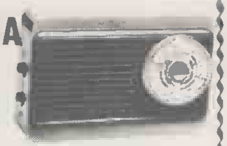

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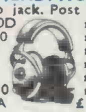

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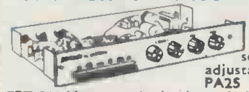

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