

# everyday electronics

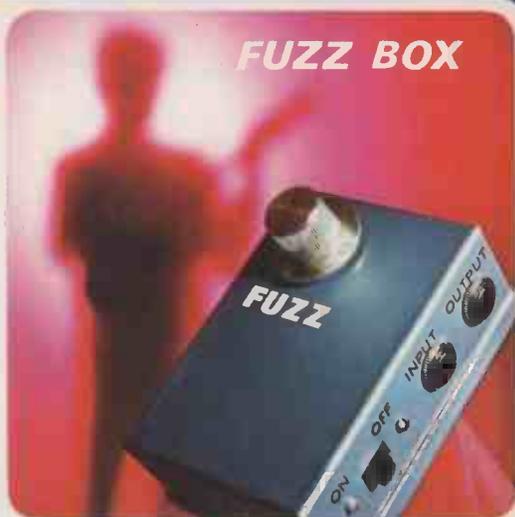
DEC. 71

15p

**A NEW MAGAZINE  
BRINGING A FASCINATING  
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PROJECTS EASY TO CONSTRUCT  
THEORY SIMPLY EXPLAINED

**CIRCUIT BUILDING  
DEMO-DECK  
FOR THE BEGINNER**

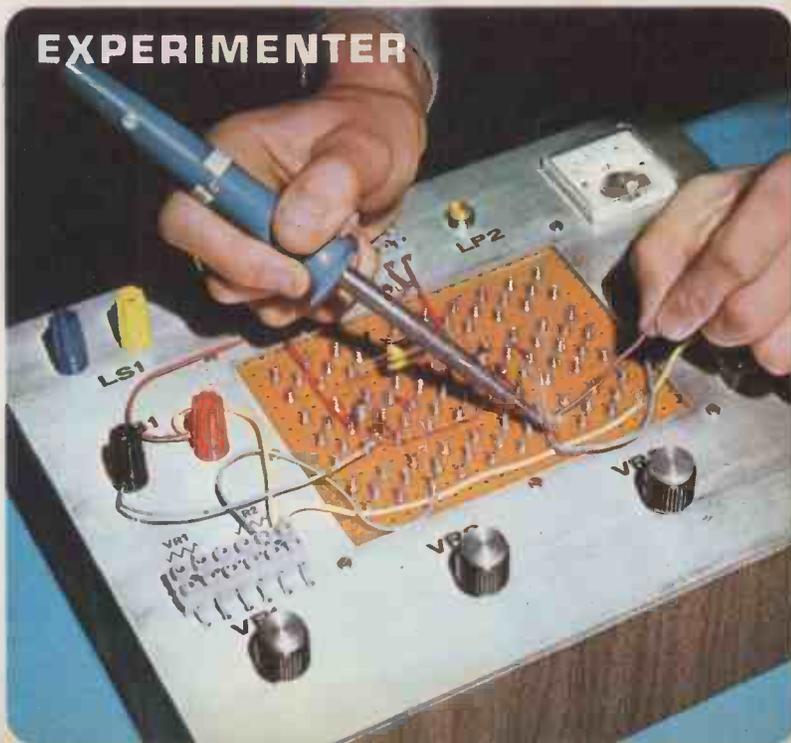
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Special temps. from 250°C—410°C.

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- B 14  $\frac{1}{8}$ " — 2.4 mm CHISEL FACE
- B 24  $\frac{1}{16}$ " — 4.75 mm SCREWDRIVER FACE
- B 12  $\frac{1}{16}$ " — 4.75 mm EYELET BIT
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- B 14 LL  $\frac{1}{8}$ " — 2.4 mm CHISEL FACE
- B 44 LL  $\frac{1}{8}$ " — 4.75 mm SCREWDRIVER FACE



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1/2W Mullard CR25 carbon film—very small body size 7.5 x 2.5mm. 4W  
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Power watts	Tolerance	Range	Values available	Price	100+
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1/2	10%	1Ω-3.9Ω	E12	1-0p	0-8p
1/2	5%	4.7Ω-1MΩ	E12	1-0p	0-8p
1/2	10%	1Ω-10Ω	E12	6p	5-5p

Quantity price applies for any selection. Ignore fractions on total order.

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0.5 watt track 5kΩ to 2MΩ, log or linear (log 1/2W, lin 1/4W).  
E12 pack 325 resistors £2.40. E24 pack 650 resistors £4.70.

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Carbon track 5kΩ to 2MΩ, log or linear (log 1/2W, lin 1/4W).  
Single, 12p. Dual gang (stereo), 40p. Single D.P. switch 24p.

## SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C.  
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Sub-miniature 0-1W, 5p each. Miniature 0-25W, 6p each.

## SEMICONDUCTORS

AC126	12p	BFY52	22p	OC81	12p	2N3055	72p
AC127	12p	BSY56	30p	OC82	12p	2N3702	15p
AC128	12p	BSX21	25p	ORP12	48p	2N3703	14p
AD140	40p	BY124	7p	1N4001	7p	2N3704	17p
AF115	20p	BYZ10	20p	1N4002	10p	2N3705	15p
AF117	20p	BYZ13	20p	1N4003	11p	2N3706	12p
BC107	10p	OA85	7p	1N4004	12p	2N3707	18p
BC108	10p	OA91	5p	1N4005	13p	2N3708	10p
BC109	10p	OA202	7p	1N4006	13p	2N3709	11p
BFY50	22p	OC71	12p	1N4007	13p	2N3710	12p
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ELSTOW STORAGE DEPOT,  
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400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 2 1/2p, 0.0068μF, 0.01μF,  
0.015μF, 0.022μF, 0.033μF, 3p, 0.047μF, 0.068μF, 0.1μF, 4p, 0.15μF, 6p, 0.22μF, 7 1/2p,  
0.33μF, 11p, 0.47μF, 13p.  
160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 3p, 0.1μF 3 1/2p, 0.15μF,  
4 1/2p, 0.22μF, 5p, 0.33μF, 6p, 0.47μF, 7 1/2p, 0.68μF, 11p, 1.0μF, 13p.  
MULLARD POLYESTER CAPACITORS C280 SERIES  
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1.5μF, 20p, 2.2μF, 24p.

## MYLAR FILM CAPACITORS 100V.

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400/4, 6.4/6.4, 25/6.4, 50/6.4, 100/6.4, 200/6.4, 320/6.4, 4/10, 16/10, 32/10, 64/10,  
125/10, 200/10, 2.5/16, 10/16, 20/16, 40/16, 80/16, 125/16, 1.6/25, 6.4/25, 12.5/25,  
25/25, 50/25, 80/25, 1/40, 4/40, 8/40, 16/40, 32/40, 50/40, 0.64/64, 2.5/64, 5/64, 10/64,  
20/64, 32/64.

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2 1/2 x 5	22p	17p
3 1/2 x 3 1/2	24p	21p
3 1/2 x 5	28p	28p
17 x 2 1/2	75p	57p
17 x 3 1/2	100p	78p
17 x 5 (plain)	—	82p
17 x 3 1/2 (plain)	—	60p
17 x 2 1/2 (plain)	—	42p
2 1/2 x 5 (plain)	—	12p
2 1/2 x 3 1/2 (plain)	—	11p
Pin insertion tool	52p	52p
Spot face cutter	42p	42p
Pkt. 50 pins	20p	20p

## JACK PLUGS AND SOCKETS

Standard screened	18p	2.5mm insulated	8p
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Standard socket	15p	2.5mm socket	8p
Stereo socket	18p	3.5mm socket	8p

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**NOW IT'S HERE AT LAST,** after experimenting for four and a half months with a multitude of different circuits and carrying out actual field tests with prototype, our design team have come up with this real winner. This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audio sound and phone used. Uses any transistor radio which fits inside—no connections needed. FINDS GOLD, SILVER, LOST COINS, JEWELLERY, KEYS, WAR SOUVENIRS, ARCHAEOLOGICAL PIECES, METALLIC ORE, NUGGETS ETC., ETC. Outdoors or indoors. Extremely sensitive, will signal presence of certain objects buried several feet below ground. No knowledge of radio or electronics required. Can be built with ease in one short evening by anybody from nine years of age upwards, with the wonderfully clear, easy to follow, step-by-step, fully illustrated instructions—it really is easy as A.B.C. Transistorised—no valves. Uses standard PP3 battery. No soldering necessary. Size of detector head 13 1/2" x 10" x 2 1/2". Great demand expected at this remarkably low price—ORDER WHILE PRESENT STOCKS LAST. All parts including detector head case, nuts, screws, wire, simple instructions, etc., etc. ONLY £2-37 (47/6) + 27p (5/6) p. & p. (Sectional handle as illustrated 75p (15/-) extra). Parts available separately. Made up looks worth £15



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**SHORTWAVE TRANSISTOR RADIO**



**Can be built in one evening**  
At last! After trying countless circuits searching for easy build, work first time short wave. Giving advanced world-wide performance, we chose this 'Sky Roma'. Anyone from 9 years up can follow the step-by-step, easy-as-ABC, fully illustrated instructions. (We built ten prototypes and everyone worked first time) no soldering necessary. 78 stations logged on rod aerial in 30 mins.—Banda, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcast. Uses PP3 battery. Transistorised (no valves). Size only 3" x 4 1/2" x 1 1/2". A tremendous demand anticipated price held to only £2-25 (45/-)-17p (3/6) p. & p. for all parts incl. Cabinet, screws, instructions etc. (Parts available separately.)

**GET A GOOD NIGHT'S SLEEP—EVERY NIGHT! INGENUOUS ELECTRONIC SLEEP INDUCER**

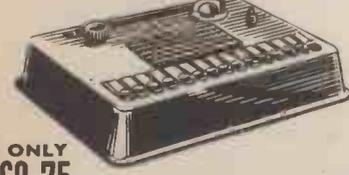
**CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT?** Then build this ingenious electronic sleep inducer. It even stops by itself so you don't have to worry about it being on all night. The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sounds gradually become less and less—until they eventually cease altogether, the effect is as if you were being lulled to sleep. A control is provided for adjusting the length of times etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. No soldering necessary. Works off standard batteries—extremely economical. Size only 3" x 4 1/2" x 1 1/2"—take it anywhere. All parts including case, loudspeaker, components, nuts, wire, screws, etc. etc. THERE WILL BE A GREAT DEMAND FOR THIS UNIQUE NEW DESIGN—SEND NOW £2-75+25p (55/-+6/-) p. & p. (parts available separately.)



**ONLY £2-75 (55/-)**

Makes a Thrilling Christmas present

**REAL WORKING ELECTRONIC ORGAN**



**ONLY £2-75 (55/-)**

Don't confuse with ordinary electric organs that simply blow air over reed-organ type reeds, etc. Eight months were spent in creating and testing this superb, revolutionary electronic organ. Fully transistorised—no valves. Proper self-contained loudspeaker. Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne", play lots and lots of similar tunes on this real working electronic organ. Although it's no theatre organ, it's versatile for no tiny thing, it measures 13 1/2" x 10" x 2 1/2". You have the thrill and excitement of building it together with the pleasure of playing a real, live, throbbing electronic organ. Take it anywhere—play it anywhere, NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED—NONE WHATSOEVER. No soldering necessary. It really is as simple as a.b.c. to make. Can be built in one short evening following the fully illustrated, step-by-step, simply worded instructions. BIG DEMAND ANTICIPATED FOR THIS UNIQUE INSTRUMENT at our low, low building price, ONLY £2-75 (55/-)+25p (4/6) p. & p. for all parts, including case, loudspeaker, transistors, condensers, resistors, knobs, transformer, volume control, wire, nuts, screws, simple (but full) instructions, etc., etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting Christmas gift for someone.

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**TOTAL BUILDING PRICE £1-97 (39/6)**

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# 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.

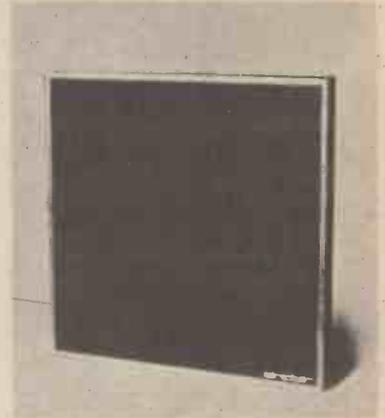
**Input Impedance:** 8 ohms.

**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:** 9½ in. square on face x 4½ 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.*



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

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

Please send

Name

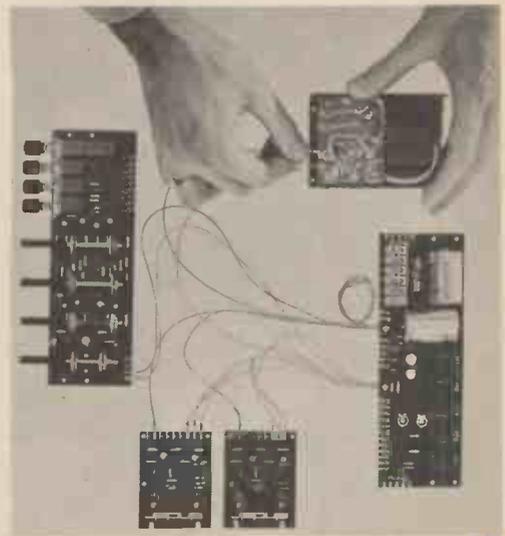
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for which I enclose cash/cheque/money order

E.E. 2A

**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.

**Guarantee** If within 3 months of purchasing Project 605 directly from us, you are dissatisfied with it, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. All-mail charged at cost.

**sinclair**

Sinclair Radionics Ltd., London Road,  
St. Ives, Huntingdonshire PE17 4HJ.  
Telephone: St. Ives (04806) 4311

## Specifications

Output — 30 watts music power (10 watts per channel R.M.S. into 3 Ω).

Inputs — Mag. P.U. — 3mV correct to R.I.A.A. curve 20–25,000 Hz ± 1dB. Ceramic pick-up — 50mV. Radio — 50 to 150mV.

Aux. adjustable between 3mV. and 3V.

Signal to noise ratio — Better than 70dB.

Distortion — better than 0.2% under all conditions.

Controls — Press buttons for on-off, P.U., radio and aux. Treble +15 to -15 dB at 10 kHz. Bass +15 to -15 dB at 100 Hz.

Volume. Stereo Balance.

Channel matching within 1dB.

Front panel — brushed aluminium with black knobs.

Project 605 comprises Stereo 80 pre-amp/control unit, two Z-30 power amplifiers, PZ-5 power supply unit, the unique new Masterlink, leads and instructions manual complete in one pack. Post free

**£29.95**

To SINCLAIR RADIONICS LTD., ST. IVES, HUNTINGDONSHIRE PE17 4HJ  
Please send Project 605 post free  Details and list of stockists

Name .....

Address .....

for which I enclose £29.95 cheque/money order/cash. E.E. 28

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**MIDGET FLEX CONNECTOR**  
Approx. 2 amp rating. Two pin non-reversible midget flex connector. Approx. size: 2in. x 1/2in. Ideal for loudspeaker connections, etc. 8p plus 2p P. & P.

**MAINS TRANSFORMER**  
Fused Primary 240V. Secondary 220V @ 50M/A. 6.3V. @ 1A. This transformer is made to a very high standard and is a small size: 2in. x 2 1/2in. x 2 1/2in. 63p plus 15p P. & P.



### BARGAIN BOARDS

Components galore for the experimenter. Ex computer boards with: Resistors, Capacitors and useful Transistors—at least 4 transistors per board.



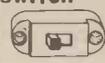
**BARGAIN PRICE** 80p per board  
5 BOARDS £1.20. P. & P. Free on this item.

### SOLID STATE BLOCK MODULES

Phono pre-amp E1311 input 100k; gain 28dB max output 3 volt; max input 50mV. Tape pre-amp as above E1313. Power amp E1314 input 1,000 ohms gain 20dB 300mW. Organ tone osc E1316 tone freq. 200-1k. Hz output 80mV. All above modules 9 volt. Dual flasher E1318 flash time 1-4 secs power 6 volt. Lamp 6v 150mA. All at £1.25 P. & P. 10p



### D.P.D.T. SLIDE SWITCH



SIZE 1 1/4 in long x wide  
13p each  
3p Postage

### WAFER SWITCHES

1 pole 12 way  
2 pole 2 way  
2 pole 3 way  
2 pole 4 way  
2 pole 6 way  
2 pole 8 way  
4 pole 3 way  
25p each. Please inc. 5p P. & P. Up to 3 switches.



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1,000  $\Omega$  per phone... 80p  
2,000  $\Omega$  per phone... 100p  
Plus 10p P. & P. per pair.

TTC  
G1105



### STEREO HEADSET

8 ohm impedance, complete with plug and 5ft lead. A very comfortable phone set. Listen to stereo without noise interrupting the pleasure. Wonderful value. £2.50 plus 10p P. & P.

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Crystal or magnetic plus lead and 3/8 m/m or 2/5 m/m plug. Please state which one required. 10p plus 3p P. & P.

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5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output. With high IMP input this amplifier will work as a record player, baby alarm, etc. amplifier.

Few only at plus 13p P. & P **£1.75**

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2 1/2" 8 ohm 38p 2 1/2" 25 ohm 38p  
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Plus 3p. P. & P. on each Mini Speaker.



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Made from 18 gauge aluminium 4 sided chassis with corner brackets. All are 2 1/2" depth.  
6x4-41p 12x3-53p 14x9-94p  
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Mini Electrolytics all values up to 100MFD @ 15V-7p each. Small PF Capacitors only in packs of 10 but you can mix values—25p for 10.  
250MFD @ 25V-15p  
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Everything for producing your own printed circuits. £1.40p plus 10p. P. & P.

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8x6-10p 10x8-15p  
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An Audio Amplifier designed around the TAA621 Linear I.C.:—  
Supply Voltage... 9-24V  
Speaker Imp... 8-16 ohm  
Frequency... 50Hz-25kHz  
Overall Size... 2in x 3in x 1in  
Ideal Amplifier for radios, record players, stereo units, etc.  
Full technical data and diagrams with each module. All guaranteed and a bargain at



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All types 1" and less diameter. SINGLES DUAL  
5K Log or 5K  
10K Lin Less 10K  
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50K 17p ea, 50K Switch 45p  
100K 250K Double 250K  
500K Pole 500K each  
1M 1M  
2M 25p ea, 2M  
Up to 3 Pots. Please add 5p. P. & P.

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We stock all recognised values of resistors all at 10% or closer tolerance. We regret we can only mail them in lots of ten. You can send for mixed values. All Midget types.  
1/2 watt lots of 10-13p  
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Please include 3p P. & P. for each 10 resistors.

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A TECH-PRESS PUBLICATION

# BUDGET HIGH-FIDELITY STEREO SYSTEMS



**PREMIER STEREO SYSTEM "ONE"** Consists of an 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. 2500 amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector, Power on/off. Solid teak cabinet with aluminium front panel. Size 12" x 4 1/2" x 3 1/2" high (Amplifier available separately if required £14.95 Carr. 40p).  
**PREMIER STEREO SYSTEM "TWO"**, as above but with Garrard SP25 MK III—ONLY £47. Carr. £1.75

**ONLY £40.95**  
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**ONLY £57.75**  
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**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 pickup, tuner, tape in and out. Stereo earphone socket. Garrard SP25 Mk III in teak finish plinth with cover and fitted Sonotone 9TAHC diamond stereo cartridge. A pair of HMF Speakers size 16 1/2" x 10 1/2" x 9" fitted EMI units complete the matching system.  
**ONLY £57.75 Carr. £1.75**

ALL SYSTEMS SUPPLIED WITH FREE LEADS AND PLUGS

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**NEW LOW COST PREMIER 800 STEREO AMPLIFIER**  
5 watts per channel. Ceramic and Magnetic input also tuner and tape inputs and tape outputs.

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- Metrosound ST20E Stereo Amplifier in teak case (List £39.50) **£28.50**
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Garrard 3500 with Sonotone 9TAHC stereo cartridge (List £15.50) **£9.97**

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## SP25 MKIII SPECIAL!



**GARRARD SP25 MK III SINGLE RECORD PLAYER FITTED GOLDRING G800 MAGNETIC STEREO CARTRIDGE** as available. COMPLETE IN TEAK PLINTH WITH RIGID PERSPEX COVER.  
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Fitted two 2 1/2in tweeters and crossover network. Impedance 8 or 15 ohm. Handling capacity 10W. Brand new.

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Battery operated 4-channel audio mixer providing four separate inputs. Size 6 x 3 x 2 1/2in. suitable for crystal microphone low impedance microphone, with transformer, radio, tape, etc. Max. input 1.5v. Max. output 2.5v. Gain 6 dB. Standard jack plus socket inputs, phonoplug output. Attractive teak wood grain finish case.



MONO MODEL **£3** STEREO MODEL **£3.47** P. & P. 12p



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**FREE CASSETTE HEAD CLEANER** with every 10 cassettes purchased. All cassettes can be supplied with library cases at 3p. extra each

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<b>METAL SPEAKER GRILLES</b>		
7 1/2 in. x 3 1/2 in.	6	50p
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No Plug	6	50p
2.5mm Plug	4	50p
3.5mm Plug	4	50p
<b>500 MICRO-AMP LEVEL METERS</b>	1	50p
<b>VEROBOARD, TRIAL PACK 5 BOARDS + CUTTER</b>	50p	

<b>TRANSISTORS</b>		
P.N.P. Untested but mainly	50	50p
O.K.		
N.P.N. Untested but mainly	50	50p
O.K.		
OCF 71 equivalent	5	50p
Light-sensitive Diodes	10	50p
(These produce up to 1ma from light)		
OC44 Mullard 1st grade	4	50p
OC45 Mullard Boxed	5	50p
2G378 Output, Marked	5	50p
2G371 Driver, Marked	5	50p
ASY 22, Marked	5	50p
BY 127 Rectifiers	4	50p
IN4007 Rectifiers (1200V peak)	4	50p
STC 3/4 Rectifiers	6	50p
DIODES (OA 81 & OA 91)	40	50p
<b>WIRE</b>		
Solid Core. Insul. 100yds.	50p	
Stranded ditto 50yds.	50p	
<b>SOLAR CELLS</b>		
Large Selenium	2	50p
Small	3	50p
(6 cells will power a Micro-matic radio)		
<b>CO-AXIAL CABLE</b>		
Semi Air-spaced 15yds.	50p	
<b>CRYSTAL TAPE RECORDER</b>		
MIKES	1	50p
<b>CYRSTAL EARPIECES</b>		
3.5mm Plug	2	50p
<b>TRANSISTORISED Signal Injector Kit</b>	1	50p
<b>TRANSISTORISED Signal Tracer Kit</b>	1	50p
<b>TRANSISTORISED CAR REV. COUNTER KIT (Needs 1 ma. meter as indicator)</b>	1	50p

**STOCKTAKING CLEARANCE! IMPOSSIBLE TO REPEAT!**  
We have huge numbers of components in quantities too small to advertise individually. In order to "clear the decks" we have made up parcels containing a mixture of carbon and wire-wound resistors, electrolytic and paper capacitors, controls, transistors, diodes etc. for a tiny fraction of normal price. It is emphasised that these are mixed parcels only—contents cannot be stipulated! Sold only by weight.

Gross weight 2 lb. ... £1 (postage 20p)  
Gross weight 5 lb. ... £2 (postage 30p)

**G. F. MILWARD, Drayton Bassett, Tamworth, Staffs.** Postage (minimum) per order 15p.

**Unrepeatable Offer !!!!**  
**Surplus VEROBOARDS, 3 1/2" x 2 1/2" x .15"**  
**Only 10p each or £1.00 per dozen**

**TANTALUM CAPACITORS. COMPARE THE PRICE—ONLY 10p EACH !!!!**

<b>Sub-miniature types</b>	<b>Miniature types</b>		5-6 µF	35 volts
0.047µF 50 volts	0.022µF 20 volts		8.2 µF	10 volts
0.056µF 50 volts	0.033µF 20 volts		8.2 µF	35 volts
0.07 µF 20 volts	0.047µF 20 volts		15 µF	35 volts
0.1 µF 20 volts	0.068µF 35 volts		18 µF	35 volts
0.1 µF 50 volts	0.12 µF 35 volts		22 µF	15 volts
0.18 µF 20 volts	0.15 µF 35 volts		27 µF	120 volts
0.33 µF 35 volts	0.22 µF 50 volts		56 µF	15 volts
0.47 µF 35 volts	0.47 µF 50 volts		56 µF	20 volts
0.68 µF 20 volts	0.68 µF 35 volts		150 µF	6 volts
1.0 µF 15 volts	0.68 µF 50 volts			
2.2 µF 3 volts	1.0 µF 35 volts		Standard	
2.7 µF 15 volts	1.0 µF 75 volts		6.8 µF	50 volts
2.7 µF 35 volts	1.8 µF 20 volts		7.5 µF	20 volts
3.0 µF 12 volts	2.2 µF 20 volts		8.2 µF	150 volts
10.0 µF 1.5 volts	2.7 µF 50 volts		12 µF	35 volts
	3 µF 12 volts		12 µF	50 volts
	3.3 µF 15 volts		39 µF	20 volts
	4 µF 20 volts		82 µF	20 volts
	4.7 µF 35 volts		050 µF	15 volts
	5.6 µF 6 volts		270 µF	6 volts

**NEW ! NEW ! NEW ! NEW !**

An aerosol spray providing a convenient means of producing any number of copies of a printed circuit both simply and quickly.

Method: Spray copper laminate board with light-sensitive spray. Cover with transparent film upon which circuit has been drawn. Expose to light. (No need to use ultra-violet.) Spray with developer, rinse and etch in normal manner.

Light sensitive aerosol spray ... £1  
Developer spray ... 50p

# WELCOME NEW READER !!

For those of you who haven't heard of LST:—

LST are one of the oldest companies in Electronics Mail Order.

LST have a reputation for quality and service second to none.

LST stock only top quality components from the biggest names in Electronics.

LST's prices are the lowest possible commensurate with quality.

LST's 44 page catalogue is available FREE, the only Company to our knowledge making this offer!

**SPECIAL EXPERIMENTORS BARGAIN PACK OFFER!**

To introduce the new reader to electronics—a fascinating hobby—LST are offering for a limited period only a special package deal containing common transistors & diodes, common values of resistors and capacitors, solder, circuit board, and other useful brand new components at the special bargain price of £2—Our normal catalogue price over £4!!! Just place a tick in the box—tear out coupon, fill in your name and address, LST will ship your catalogue (free) or your bargain pack (£2) by return.

**£2**



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I ENCLOSE £2 FOR YOUR "BARGAIN PACK" OFFER

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PLEASE PRINT CLEARLY

STOCKISTS-DISTRIBUTORS OF: IR, WELLER, MULLARD, NEWMARKET, SIEMENS, RCA, ISKRA VEROBOARD, S-DECS, TEXAS, G.E., MOTOROLA.

9 Vol Gramophone Unit. Collar battery operated with pick up on unit plate. 4 speed auto-stop turner cartridge. Price £2.50 plus 40p post and insurance.

Buy Time Slot Meter. Made by Sangamo Weston. 3 types—one for each coin, 2p, 5p or 10p. Price £1.75 each plus 25p post and insurance.

Photo Electric Kit. Contains photo cell, relay, transistor and all parts to make light operated switch. Originally £2. Limited quantity to clear. £1.25 plus 20p post and insurance.

Desk/Hand Mike. Made by Acos. Crystal insert in neat plastic case which opens at right angles for desk or opens completely for hand holding. Good general purpose mike. Price 55p each.

Printed Circuit Kits. Hagato Pk. 3 facilities in kit form include printing, etching, resist removal, polishing and complete manufacture of printed sets to own specifications. Price £1.25+20p.

### DEMO DECK

as described last month  
£6 post free

Laboratory Instruments. For horizontal use in strong black reinforced bakelite cases with screw down terminals especially suitable for experiments and demonstrations. All have precision meters (manufacturers quoted accuracy of better than 1-5%). Following available:

D.C. Voltmeter 0-300v. I.s.d. moving coil mirror scale meter size approx. 5 x 4 1/4 x 1 1/4 in. Price £1.75.

D.C. Voltmeter, 0-30v. I.s.d. moving coil mirror scale meter. Size approx. 5 x 4 1/4 x 1 1/4 in. Price £1.75.

A.C./D.C. Milliammeters 3 range, moving iron mirror scale meter. Range selection 25, 50 and 100mA by selection switch mirror scale (coil resistance marked) size, 7 1/2 x 5 x 3 1/4 in. type 35999/1. Price £9.75.

Micrommeter 100 micro amps f.s.d., moving coil mirror scale precision meter (coil resistance marked) size, 5 x 4 1/4 x 2 1/4 in. type M/109/1. Price £3.

Galvanometer 20-0-20 I.s.d. moving coil precision laboratory instrument of extremely high sensitivity (3 x 10<sup>-7</sup> A per division). Size approx. 6 1/2 x 3 1/4 x 2 in. Price £5.

Farmeko Neptune Series C. Core Transformers. These transformers are beautifully made, steel encased, stove enamelled black, upright mounting. All have normal 50cps. Primary 230/240v. with primary screen and are new and unused. Small quantities only of each type available as follows: Model 6000/76. 275-0-275v. at 330mA, and 6-3v. at 4-6a. Price £4.50, + 50p post.

Model 6000/71. 290-215-0-215-290 at 125mA, and 2 at 6-3v. 6a. Price £4.50 + 40p post.

Model 49. 250v. at 10mA, 6-3v. at 3a., 5v. at 0.75a. Price £2 + 30p post.

Model 47. 620-0-620 at 9mA. 4v. at 1A. Price £4.50 + 40p post.

Farmeko Neptune G. Core Chokes. These are encased and match the transformers above.

Model 6000/73. 4H at 500mA. £2.50 + 40p post.

Model 65. 10H at 100mA. £2.50 + 40p post.

Model 49. 10H at 70mA. £1.50 + 30p post.

Model 68. 10H at 110mA. Price £2 + 40p post.

Fuse Holders. Heavy duty type B.S.S. 88 440. Reyrolle power fuse holders. English Electric type S.100.1, ex. equipment. Price 50p.

Fuses. H.R.C. 100A, 160A, type EA..... Eng. Electric 100A, 160A, type 847F..... Kantark 60 A., new, all at 25p each.

Electronic Car Ignition. In addition to the kits for 12v. cars we can also supply systems for 6v. cars. These are not kits but made up and ready to work. Price £5.50 + 30p post.

Carbon Resistors. We are now stocking these in a big way and will be pleased to quote special prices to quantity buyers. Made by Eric. Morganite or Dubilier.

Price each

1-9	10-99	100-999	1,000 up
1/4 watt	8p	8p	8p
1/2 watt	12p	12p	12p
1 watt	2p	18p	15p
2 watt	4p	32p	30p

Special Resistor Assortment Offer (1). 100 x 1/4 watt resistors made up of 2 each of 50 different values fairly evenly spaced between 1 ohm and 10 meg. Price 50p.

Special Resistor Assortment Offer (2). 1,000 x 1/4 watt resistors made up of 20 each of 50 different values fairly evenly spaced between 1 ohm and 20 meg. Price £4.

Special Resistor Assortment Offer (3). As offer 1 but 1 watt. Price £1.

Special Resistor Assortment Offer (4). As offer 2 but 1 watt. Price £8.

18 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. 1/4 in. thick. Price 20p per yard.

**DRILL CONTROLLER**  
NEW IKW 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.

Neon Indicator Lamps. With amber lens, standard type with built in resistor for mains. 10p each, 10 for 90p.

Condensers. Another addition to our range. 500µF at 50v. 15p each, 10 for £1.25.

**CONTROL DRILL SPEEDS**

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1.50 plus 13p post and insurance. Made up model also available. £2.25 plus 13p post and p.

Neon Indicator Lamps. With amber lens, standard type with built in resistor for mains. 10p each, 10 for 90p.

Condensers. Another addition to our range. 500µF at 50v. 15p each, 10 for £1.25.

### MICROSONIC KEY CHAIN RADIO

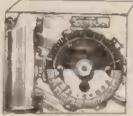
7 transistor Keychain Radio in very pretty case, size 2 1/2 x 2 1/4 x 1 1/4 in.—complete with soft leather zippered bag, 7 transistor, ferrite rod, Loudspeaker.

In transit from the East these sets suffered corrosion as the batteries were left in them but when this corrosion is cleared away they should work—offered without guarantee except that they are new. Price only £1.25 less batteries plus 13p post, 6 for £7 post free. Pair of rechargeable batteries and charger 85p.



### 24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated. NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. £2.50 post and ins. 23p. Additional time contacts 50p pair.



### THE FULL-FI STEREO SIX

The amplifier

In a 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 leak 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.



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.

### THIS MONTH'S SNIP

#### POCKET CIRCUIT TESTER

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



### 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. £2.50. 2kW Model as above except 2 kilowatts £3.50. Don't miss this. Control Switch 35p. P. & P. 40p.



### LAST MONTH'S FEATURES

Kits of parts available as follows:—

#### HOME SENTINEL INTRUDER ALARM

Complete kit, with case £3.75.

#### SNAP INDICATOR

All components but not case or battery 75p.

#### WINDSCREEN WIPER CONTROL

All components including metal for chassis £1.50.

#### RECORD PLAYER

All components, but not case, loudspeaker, record deck or pick-up £5.15

#### DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 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. & I.



#### 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 improved and even more efficient version (P.W. June), price £4.95. When ordering please state whether for positive or negative systems. Plus 30p post.

#### ELECTRONIC IGNITION

#### 15 WATT 12in HI-FI SPEAKER

It is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 15W R.M.S.—Cone moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohm. Chassis diam. 12in.—12 1/2 in. over mounting lug. Overall height 5 1/2 in. A £10 speaker offered this month for £3.75 plus 30p post and insurance.



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

### FUZZ BOX

and colour temperature meter featured in this issue. To receive these kits quickly, send quoted approx price and any change due will be refunded.

Commutator Motor. Small, size approx. 3 in. plus 1 in. of shaft. 3 in. high x 1 1/2 in. wide, but high speed and very powerful. These motors operate from the mains. Are particularly useful as they can be speed controlled by our thyristor kit or by variable resistor. £1 each.

Auto Light Kit. The circuit for this appeared in Practical Wireless, October issue. It is a simple circuit but has many uses: Parking light, porch light, etc. Uses light cell and two transistors. Complete kit, no case 95p. Suitable case 20p. Charger Kit. Comprises of a 3 amp. transformer, 5 amp. rectifier and a pair of hefty crocodile clips. With wiring diagram. £1.40 plus 20p post and insurance.

### SPARTAN Portable RADIO

Long and medium wave, 7 transistor, size 6in. x 4in. x 1 1/2 in. with larger than usual speaker giving very good tone. Built-in microphone aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carrying sling, earplug and case £3.75 plus 25p post and ins.



Thermistor Bead Type. For instruments, medical applications, etc. I.T.T. No. GL23. 75p each. 10 for £6.75.

3 Core Mains Leads. Special offer this month is a 6ft. lead with 23/36 cores and coloured according to the new code (i.e., Brown—live; Yellow/Green—earth; Blue—neutral. Price 6p each or 10 for 50p. Integrated Circuit Mountings. Enables I.C.'s to be plugged in and out for quick substitution and to prevent damage to soldering. 14 pin type 14p each or 10 for £1.26. 16 pin type 16p each or 10 for £1.44. Note these are suitable for use with printed circuit or vero boards.

Plain Paxolin Panels. Medium thickness. Ideal for fronts and for transistor projects generally.

Size 1	10	Size 1	10
6x2 6p	54p	6x6 18p	£1.02
12x2 12p	£1.08	12x6 30p	£2.70
12x3 18p	£1.32	6x8 21p	£1.89
12x4 24p	£1.76	12x8 40p	£3.60
6x4 12p	£1.08	12x12 60p	£5.40
12x4 1/2 24p	£2.16	24x12 120p	£9.00

### 70 THINGS YOU CAN MAKE

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

#### 0-8 AMMETER

2 in. square full vision face for flush mounting. Moving iron instrument. Ideal for charger. Price 48p each, 10 for £3.90.



#### PAPST MINIATURE EXTRACTOR FANS

Beautifully made as are all papet motors. Intended for cooling computers but suitable for any equipment. Size 4 1/4 in. square and 1 1/4 in. thick. Price £2 each. Post and insurance 20p.



#### 24hr CLOCK SWITCH

In metal case with 13 amp. socket. Smiths movement, 2 on and 2 off per 24 hours. Very neatly made and finished. Original retail price £7 each. Few only, new and perfect. £4.00 each.



#### NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3. Price £1.45 each, 10 for £13.



#### 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.



## J. BULL (ELECTRICAL) LTD.

(Dept. E.E.) 7 Park Street, Croydon CRO 1YD

**PHILIPS PORTABLE PLAYER CABINET**



Size 12" x 15 1/2" x 7 1/2". Cut for B.S.R. UA12/14/15/16/25 deck. Amplifier space 14 x 5 x 3 1/2 in. Satin aluminium front grille. Really smart appearance. £4 Post Free  
Black/White. Chrome fittings.

**BSR C.109 SUPERSLIM**

**STEREO AND MONO**

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 18 1/2" x 11 1/2". Above motor board 3 1/2 in. below motor board 2 1/2 in. with STEREO and MONO XTAL £7.75 Post 25p.



GARRARD SINGLE PLAY TA Mk II Stereo/Mono £10  
GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond and Mono Sapphire. SP25 Mk II £15 Model 3500 Stereo and Mono Autochanger £14. Post 25p.

RECORD PLAYER PORTABLE CABINET £3-75  
With space for R.C.S. Amplifiers and most modern autochangers. Two-tone resin covered. Post 25p

BCS DE-LUXE 3 WATT AMPLIFIER. Ready made with 2-stage triode pentode valve. 3 watts output. Tone and volume controls. Isolated mains transformer, knobs, loudspeaker valves ECL82, EZ80. Response 50-12,000 cps. Sensitivity 200mV. Post 25p. £4

R.C.S. TEAKWOOD BASE. Ready cut out for mounting (State player make and model) £2-75

R.C.S. PLASTIC COVERS FOR ABOVE BASE. £2-75  
Durable tinted plastic, attractive appearance.

EMI PICK-UP ARM with mono stail and stylus £1-25.  
HI-FI PICK-UP CARTRIDGES. Diamond Stereo/Mono. 9TA £2-50; GP94 £2-50; GP83 £2-00; Mono GP91 £1-50; GC8 £1-25; ACOS L.P. only 50p.

**AM-FM/VHF TUNING GAG**

Super quality small size 1 1/2" x 1 1/2" plus spindle 1 1/2" dia. 365 + 365 pF with 25 + 25 pF. British made. Geared slow motion drive 6:1. Plastic dust cover. 6BA tapped front fixing. Cast aluminium frame 50p Post Free

**WEYRAD P50-TRANSISTOR COILS**

RA2W Ferrite Aerial. . . . . 65p	Spare Cores . . . . . 3p
Ord. P50/1A0 . . . . . 30p	Driver Trans. LEPT4 . . . . . 50p
I.F. F50/CC4 40 kc/s. . . . . 33p	Printed Circuit, PCA1 . . . . . 50p
3rd I.F. P50/3CC . . . . . 33p	J.B. Tuning Gank. . . . . 65p
PS1/1 or PS1/2 . . . . . 33p	Weyrad Booklet . . . . . 10p
P50/3V . . . . . 33p	OPTI . . . . . 50p

Mullard Ferrite Rod 8 x 1/2 in. 20p. 6 x 1/2 in. 25p.

**VOLUME CONTROLS**

Long spindles. Metal Size 5 p. ohms to 2 Meg. L001 or L1N. L/8 15p. D.P. 25p. STEREO L/8 55p. D.P. 75p. EDGE 5K. S.P. Transistor 20p.

**WIRE-WOUND 3-WATT POTS**

Small type with small knob. Values 10 Ω to 30 K. Carbon 30 K to 2 meg. 25p

**VEROBOARD 0-16 MATRIX**

2 1/2" x 5 1/2 in. 2 1/2" x 3 1/2 in. 16p. 3 1/2" x 5 1/2 in. 26p. EDGE CONNECTORS 16 way 25p; 24 way 35p. PIN 36 per packet 17p. FACE CUTTERS 38p. S.R.B.P. Board 0-15 MATRIX 2 1/2 in. wide 3p per 1 in. 3 1/2 in. wide 4p per 1 in.; 5 in. side 5p per 1 in. (up to 17 in.). S.R.B.P. undrilled 1/4 in. Board 10 x 8 in. 15p.

**BLANK ALUMINIUM CHASSIS**

18 s.w.k. 2 1/2 in. sides. 6 x 4 in. 45p; 8 x 6 in. 50p; 10 x 7 in. 70p; 14 x 9 in. 90p; 16 x 11 in. 90p; 12 x 3 in. 50p.

**ALUMINIUM PANELS**

18 s.w.k. 6 x 4 in. 8p; 8 x 6 in. 15p; 10 x 7 in. 17p; 12 x 8 in. 23p; 14 x 9 in. 27p; 12 x 12 in. 32p.

**1 1/2 INCH DIAMETER WAVE-CHANGE SWITCHES**

2 p. 2-way, or 2 p. 8-way or 3 p. 4-way 25p each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way 25p.

**1 INCH DIAMETER WAVECHANGES "MAKITS"**

1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way, 1 waffer 60p, 2 waffer 90p. Extra waters up to six 30p each.

**TOGGLE SWITCHES**

exp. 14p; dp. 18p; dp. dt. 23p.

**"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER**

200/250 v. A.C. Leaflet S.A.E. £2-35 Post 15p

**RADIO COMPONENT SPECIALISTS**

Minimum Post and Packing 15p RETURN OF POST DESPATCH. HI-FI STOCKISTS. CUSTOMERS FREE CAR PARK. CALLERS WELCOME

**R.C.S. STABILISED POWER PACK KIT**  
All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240v. AC. Output voltages available 6 or 9 or 12 or 15 or 18 or 20v. DC at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. £2 POST Details S.A.E.

**GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE**  
for Mike, Tape, P.U., Guitar, etc.  
Battery 9-12v or H.T. line 200-300v D.C. operation. Size 1 1/2" x 1 1/2" x 1". Response 25 cps. to 25 Kcs. 26db gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. Guaranteed. Details S.A.E. 90p Post 10p

NEW TUBULAR ELECTROLYTICS	CAN TYPES
2/350V . . . 14p	250/25V . . . 14p
4/350V . . . 14p	500/25V . . . 35p
9/450V . . . 14p	1000/25V . . . 35p
15/450V . . . 14p	1000/50V . . . 75p
32/450V 20p	8+8/450V 18p
25/25V 10p	8+16/450V 20p
50/50V 10p	16+16/450V 25p
100/25V 10p	32+32/350V 43p
	100+50/50/350V48p

SUB-MIN. ELECTROLYTICS 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p; 500, 1000mF 12V 18p; 2000mF 25V 35p. CERAMIC 10p 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 μ, 2.2-5000pF 8p; 500-2-200 pF 10p; 2.700-5.600pF 20p; 6.800pF-0.01, mid 30p; each. TWIN GANG. "0-0" 28pF + 17pF, 65p; Slow motion drive 385+385 with 25+25pF, 50p. 500pF slow motion, standard 48p (small 13-rang 500pF 21.0). SEROT WAVE Single 25pF 18p. CHROME TELESCOPIC AERIAL. Swivel base, 23in. 20p. TUNING. Solid dielectric. 100pF. 500pF. 35p each. TRIMMERS. Compression 30, 50, 70pF, 6p; 100pF, 150pF, 8p; 250pF, 10p; 600pF, 10p; 750pF, 10p; 1250pF 10p. SILICON REC. 40-LUCAS D25500 Bridge 70V 5 amp; 21 RECTIFIERS CONTACT COOLED w/air flow 80mA 35p; 85mA 48p. SILICON BYZ3 30p; BY100 30p; BY127 30p. EX-GOVERNMENT RECTIFIERS 250v, 200mA, 30p. NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p. RESISTORS. 1/2 w., 1 w. 20% 1p; 2 w. 5p. HIGH STABILITY. 1 w. 2% 10 ohms to 1 meg., 10p. DHTO 5% Preferred values 10 ohms to 10 meg., 4p. WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K, 10p each; 21 watt, 1 ohm to 5-2 ohms 10p

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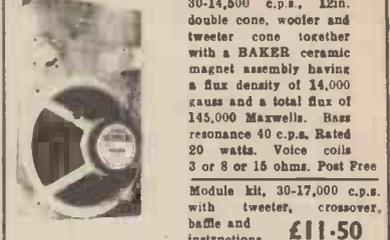
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# everyday electronics

PROJECTS...  
THEORY....

## A DELICATE TOUCH

To anyone not previously familiar with the technical aspect of electronics, the constructional projects included in last month's issue were probably quite revealing. Not least in the modest quantity of parts involved and their small size. It is really surprising what can be achieved with just a few tiny components which one could hold quite comfortably in the palm of the hand.

Maybe it looks altogether too simple for words. And in a sense it is. But beginners should take their first steps with thought and care, and be duly appreciative of the need to develop a certain dexterity in the manual work involved: in the manipulation of the components and wiring, and in the making of good sound soldered joints. A delicate touch closely akin to that of the scientific instrument maker is the kind of manual skill required in modern electronic construction work.

## WHAT'S IN A NAME?

It will be noted that we frequently use the word "gadget" as a general term of convenience applicable to most of the constructional projects featured in this magazine. We employ the word in its original sense, meaning a small fitting or contrivance. However, modern usage has tended to downgrade the word gadget so that in some minds it has become synonymous with "gimmick."

To avoid any misunderstanding, we must explain that all designs offered to private con-

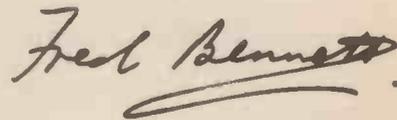
structors are practical items, capable of providing definite useful functions. True some may have a rather more serious application than others, but all are designed to a purpose. For the want of a better or more appropriate term, "gadget" will continue to be used when referring to the small items of electronic equipment. But gimmicks pure and simple, or gimcrack items, will not be our concern.

## PROVED DESIGNS

One further point must be made clear in this connection. All EVERYDAY ELECTRONICS projects are tested and proved by our own technical staff prior to being presented to our readers. We do not deal in "paper designs." A hobby is a hobby: nevertheless time is a valuable commodity, none more so than the "spare" variety. We want to help our readers use it profitably, enjoyably, and economically.

## STOP PRESS

Our thanks to those who have already written following the publication of our first number. Next month we will publish a selection of readers' letters. We welcome all views, so why not drop us a line if you have not already done so?



*Our January issue will be published on Friday, December 17*

EDITOR F. E. BENNETT   ●   ART EDITOR J. D. POUNTNEY   ●   M. KENWARD   ●   P. A. LOATES  
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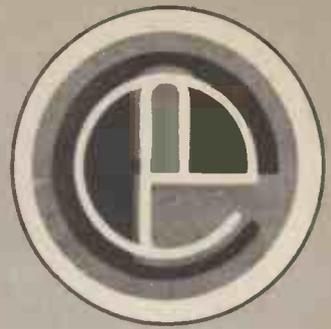
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...EASY TO CONSTRUCT  
...SIMPLY EXPLAINED



VOL. 1 NO. 2

DECEMBER 1971

## CONSTRUCTIONAL PROJECTS

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## Special Offer

As a service to all our readers and especially those who are new to electronic construction we offer the Everyday Electronics Tool Kit at a special price. For further details of this offer see page 97.

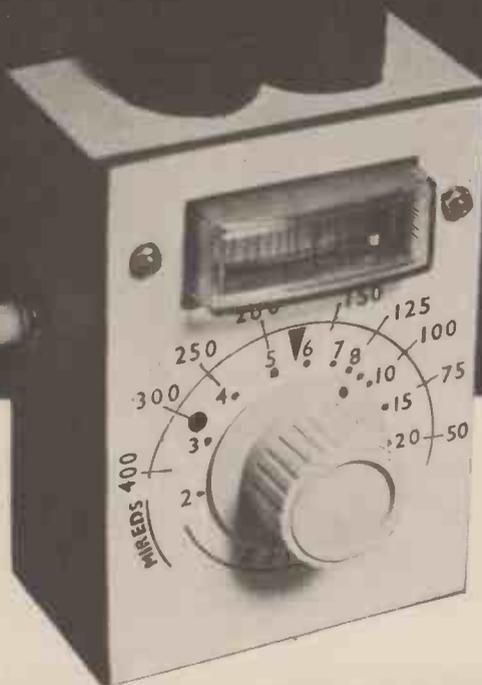
Everyday Electronics, December 1971



# Photographic Colour Temperature

# Meter

By D. Bollen



*Get the colours right with this Photographic Colour Temperature Meter. It tells you simply and quickly what correction filters to fit to your camera.*

**P**HOTOGRAPHERS who use reversal film to make colour transparencies often find that a particular shot turns out to have an unnatural red, yellow, or blue tinge. Unlike the human eye, a colour film cannot compensate for small changes in the "quality" of daylight and other light sources.

A film correctly balanced for standard daylight will record subjects under household tungsten lamp illumination with a deep red hue, but the most perceptive photographer sees the same scene as no more than orange-yellow. Similarly, a subject in shade under a clear blue sky is depicted as deep blue by the film, but is seen as bluish grey by the eye.

A simple colour temperature meter of the type described here will help to reduce the number of failures on a roll of film by showing when colour casts are present, and will also assist in the selection of camera filters to eliminate such casts.

## **COLOUR TEMPERATURE**

If a black body such as a piece of carbon, is heated, it will exhibit a range of colours as its temperature increases, from a dull red, through orange and yellow, to a bluish white. Obviously, the colour of the carbon is closely related to its temperature, and the characteristics of most common light sources are close enough to that of

## Approximate cost of components



2.75 plus case

## Components....

### Resistors

R1 1k $\Omega$   
R2 2.2k $\Omega$

All  $\pm 10\%$ ,  $\frac{1}{4}$  watt carbon except where stated.

### Potentiometers

VR1 100 $\Omega$  horizontal skeleton pre-set  
VR2 2k $\Omega$  slider type pre-set  
VR3 500 $\Omega$  wire wound (1 watt type)

### Light Dependent Resistors

PCC1, PCC2 ORP12 (2off)

### Meter

ME1 100-0-100  $\mu$ A moving coil centre zero, stereo balance type

### Switch

S1 Single pole push-to-make

### Miscellaneous

B1 9V PP3 type  
Cellophane (see text), knob with pointer.  
Plain perforated s.r.b.p. board 2in x 1 $\frac{1}{2}$ in x 0.15in matrix and pins.  
Formica for case or suitable plastic box.  
Connecting wire  
Battery connectors.  
L.D.R. Holders (see text).

a black body to allow a similar correlation between colour and temperature to be used. Table 1 lists the equivalent colour temperatures of several kinds of light source.

One way of measuring colour temperature is by means of two photosensors, one behind a red filter and the other behind a blue filter, with the filters adjusted so that the sensors give equal outputs under standard daylight conditions. If the photosensors are then illuminated by a light source which is either more red or more blue than standard daylight, the sensor outputs will differ by an amount roughly proportional to the change of colour temperature.

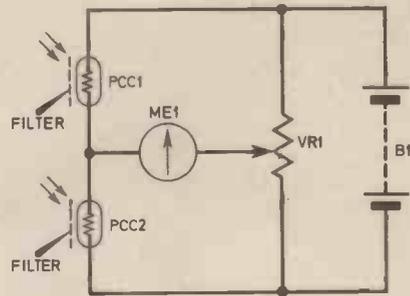


Fig. 1. Basic circuit diagram.

## CIRCUIT OPERATION

It would be possible to wire the two photosensors in such a way that colour temperature could be read straight from a voltmeter scale, but this would involve taking the meter to bits for calibration, and an unwanted load would be placed on the photosensors by the internal resistance of the meter. Such an arrangement would also be sensitive to changes in battery voltage, so a nulling technique was chosen for the colour temperature meter, using an easily calibrated potentiometer.

In the basic circuit of Fig. 1, the photosensors are light dependent resistors (l.d.r.s) PCC1 and PCC2. The resistance of these l.d.r.s decreases when they are exposed to light. As long as both sensors are equally illuminated they should have similar resistance values irrespective of light intensity, and the voltage at the junction of the sensors will remain constant. The slider of potentiometer VR1 in Fig. 1 is adjusted to give the same voltage as the sensors so no current flows through centre-zero ME1, hence, no load is placed on the sensors.

Assume now that sensors PCC1 and PCC2 are provided with blue and red filters respectively. Under even illumination of both sensors, light

Table 1: COLOUR TEMPERATURE OF LIGHT SOURCES

Source	Temperature in degrees Kelvin
Candle	1,900
100 watt household lamp	2,800
Photoflood lamp	3,400
Direct sunlight, sunrise or sunset	2,000-4,000
Direct sunlight, noon	4,500-5,500
Sunlight plus white clouds or haze	5,900
Electronic flash or blue flash-bulbs	5,900
Sunlight plus clear blue sky	6,650
Light overcast	6,650-7,150
Heavy overcast	8,350
In shade, sunlight plus white clouds or haze	7,150
In shade, clear blue sky	9,000-25,000

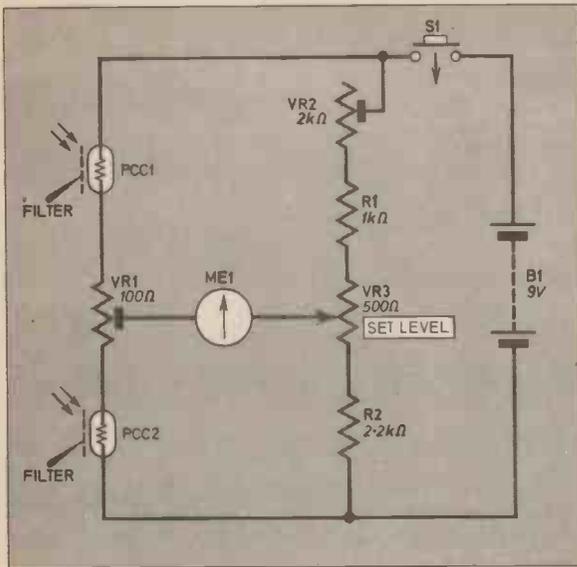


Fig. 2. Complete circuit diagram of the Photographic Colour Temperature Meter.

from a predominantly blue source will pass virtually unhindered through the blue filter to PCC1, but will be blocked by the PCC2 filter. Thus, with more light reaching PCC1, it will have a lower resistance than PCC2 and the voltage at the junction of PCC1 and PCC2 will rise, causing the meter pointer to deflect away from zero.

Much the same applies with red light, but here the meter pointer will deflect in the other direction as the voltage at the junction of PCC1 and PCC2 falls. Potentiometer VR1 is adjusted to bring the meter reading back to zero, and the change of colour temperature is given by the angular rotation of VR1 spindle.

### CIRCUIT REFINEMENTS

The circuit of Fig. 1 would not work well in practice, for the following reasons. Sensors PCC1 and PCC2 would have to be perfectly matched if the instrument was not to respond to changes in light intensity as well as colour temperature, blue and red filters would have to be of known density and colour, and only a small centre portion of VR1 total track resistance would be usable.

In the complete circuit of the colour temperature meter Fig. 2, a low value potentiometer VR1 is inserted between PCC1 and PCC2 to eliminate l.d.r. resistance mismatch under high light intensities; this component also protects the sensors against an excessive current flow. In conditions of dim illumination, the resistance of the sensors can be equalised by masking one of them with a spot of ink or paint, as described later.

To simplify construction and reduce cost, the colour temperature meter uses simple blue and red filters made from several layers of coloured

cellophane (obtainable from most stationers), and VR2 is included in the circuit of Fig. 2 to correct individual filter variations and allow for circuit tolerances.

Calibrated potentiometer VR3 in Fig. 2 has a low track resistance in relation to the total resistance of the chain formed by VR2, R1, VR3 and R2, so that full use can be made of VR3 rotation to provide widely spaced calibration points.

### CONSTRUCTION

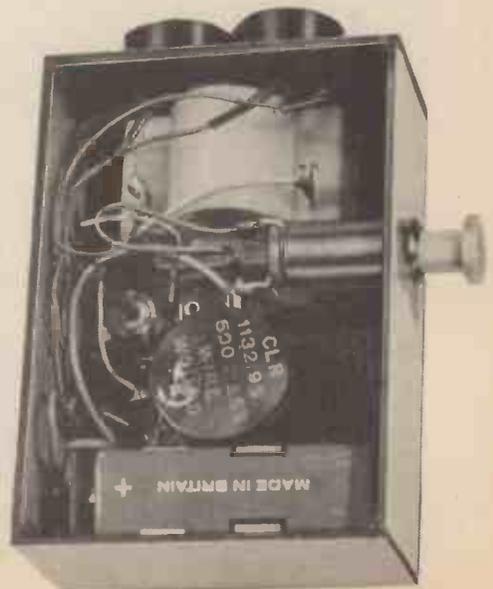
The case for the prototype was constructed from Formica, but almost any non-metallic case of suitable dimensions could be used. The case should be drilled to the dimensions given in Fig. 3 before any further construction is undertaken. Once the drilling is complete meter ME1 can be fixed as can the two l.d.r.'s.

The sensors PCC1 and PCC2 are housed in small, opaque cylinders made from plastic cigar holder stoppers or bottle tops, see Fig. 4. Each l.d.r. holder must be cut-down with a sharp knife to make the internal height equal to the height of the l.d.r., to ensure a wide-angle of light acceptance. Blue and red filters are fitted at a later stage. The l.d.r.'s are glued into the holders which are then glued to the case.

The preset potentiometers VR1 and VR2 are mounted on a piece of plain perforated s.r.b.p. board using mounting pins as indicated in Fig. 5. Potentiometer VR3 can then be mounted through a hole cut in the board and resistors R1 and R2 connected—one pin is used for R2. The board is then fixed inside the case using VR3 mounting.

Switch S1 can now be inserted through its

Photograph showing the inside of the Photographic Colour Temperature Meter.



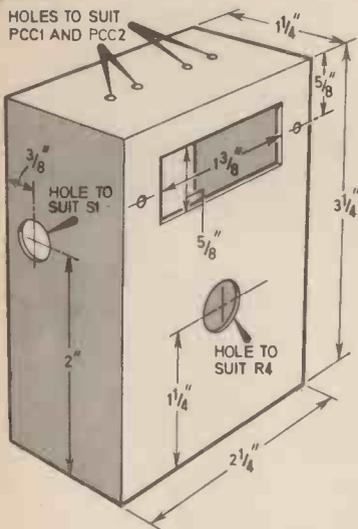


Fig. 3. Case drilling diagram.

# Photographic Colour Temperature Meter



Fig. 6. Dial calibration.

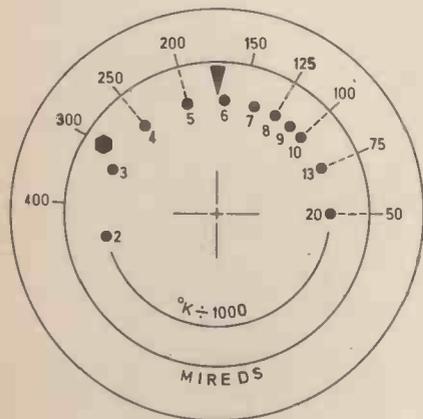


Fig. 4. Details of the l.d.r. and filter mount.

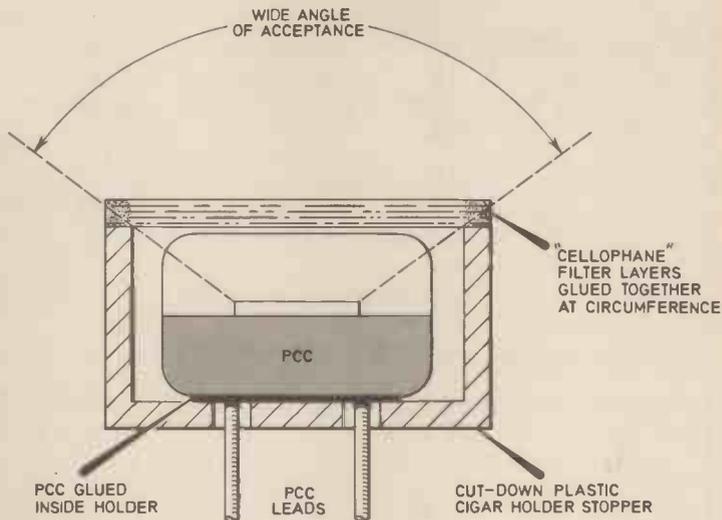
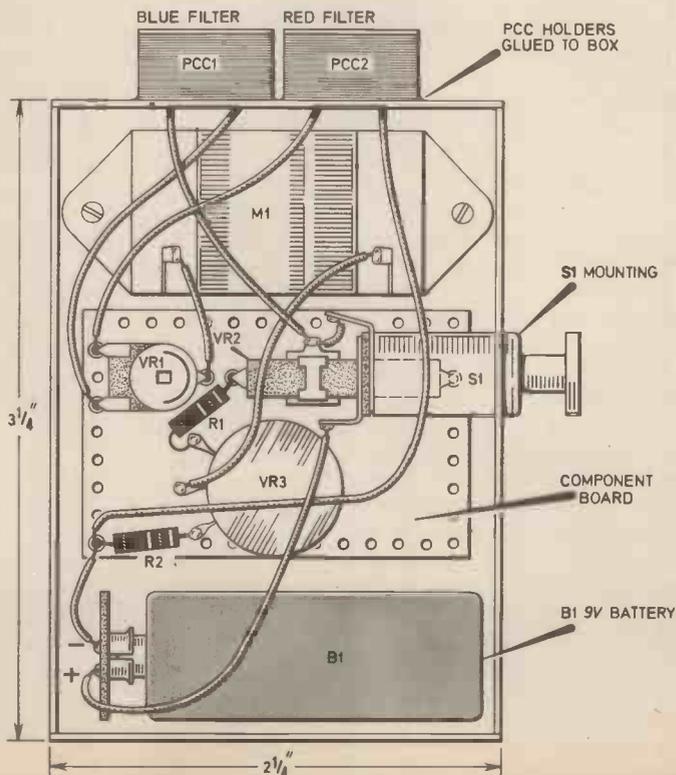


Fig. 5. Layout and wiring of the complete unit S1 is not mounted on the s.r.b.p. circuit board.



mounting hole and securely fixed. Finally, wire up the unit, as shown in Fig. 5, using p.v.c. covered stranded wire. Make sure to leave enough wire between S1 and VR2 wiper for adjustment of VR2. Connect the battery observing the correct polarity and the instrument is ready for setting up.

Apart from the need for both sensors to be placed side by side, as closely as possible, the instrument layout can be modified to suit individual requirements.

## SETTING UP

Adjust VR1, VR2, and VR3 to the mid-track position. Place the colour temperature meter about 3 feet from a 100 watt pearl lamp, aligned so that PCC1 and PCC2 receive exactly the same amount of light. Press S1 and use the tip of a finger to find out which sensor needs masking to bring the pointer of ME1 to zero, then place a spot of ink or paint (black) on the face of the selected l.d.r. to achieve balance.

Next position the colour temperature meter with sensors almost in contact with the 100 watt bulb (maximum illumination), taking care that PCC1 and PCC2 receive the same amount of light. Adjust VR1 for zero balance.

The next stage is to prepare the red and blue filters, made from orange and pale blue (avoid mauve) cellophane respectively. Cut a paper disc to the outside diameter of the sensor holders. Fold orange and blue cellophane several times and cut out the filter discs with sharp scissors using the paper disc as a template. Glue four discs of blue cellophane on the PCC1 holder as shown in Fig. 3.

Take the colour temperature meter out of doors on an overcast day, well away from walls or trees. Set VR3 to the mid position and commence placing red filter discs over PCC2 until ME1 reads near zero when S1 is pressed. About twelve orange cellophane discs (red filter) will be required because the l.d.r. is more sensitive to red than blue light. The red filter discs can now be glued on the PCC2 holder, and the meter is ready for calibration.

## CALIBRATION

In the absence of standard light sources, the following method of calibration is suggested. Make a temporary paper disc dial for VR3, with the scale shown in Fig. 5 lightly pencilled in. Set the pointer of VR3 at 2,800 degrees Kelvin and position the colour temperature meter a few inches from a 100 watt pearl bulb. With PCC1 and PCC2 equally illuminated, press S1 and adjust VR2 for zero balance.

For the next calibration check, choose a heavy overcast day, within an hour of noon, and set VR3 pointer to 8,350 degrees Kelvin in summer, 8,100 degrees Kelvin in spring or autumn, or 7,800 degrees Kelvin in winter. With sensors pointing straight up at the sky, press S1 and

observe the null meter. If the meter does not read zero, adjust VR3 for a null and mark the position of VR3 pointer on the paper disc dial. It should now be possible to gauge the discrepancy, if any, between the VR3 setting and the scale of Fig. 5.

If necessary, reposition the pointer knob on VR3 spindle and go through the above checks again for a new setting of VR2 until agreement is reached with the Fig. 5 scale. It is recommended that the temporary VR3 scale be left on the temperature meter for a few weeks so that various checks can be made, using Table 1 as a guide, and transparencies can be evaluated. When satisfied with results, a permanent scale can be made for VR3. A more accurate calibration technique is possible if several colour correction filters are available.

## MIREN VALUES

Special correction filters may be placed in front of a camera lens to modify the colour temperature of light falling on the film. If the scene being photographed has a blue cast, a reddish filter of the right grade will give the transparency a normal colour balance. Correction filters are also used to achieve special effects, and to match a daylight type film to artificial light or vice versa. There is, however, a practical difficulty in selecting the right filter for the job. A given grade of filter will have a much greater effect at higher colour temperatures than at lower ones.

To make the process of filter selection simple, correction filters are graded in values based on the reciprocal of colour temperature, called the mired, see Fig. 5 and Table 2. A given grade of filter will always produce the same amount of correction anywhere on the mired scale.

Colour correction filters are identified by the letter R or B (standing for red or blue) followed by a number which is the filter rating in mireds divided by ten. For example, an R6 filter will make the colour of a light source more red by an amount corresponding to a shift of 60 mireds. Two filters placed together have an additive effect, a B6 plus a B12 will give a total shift towards blue of 180 mireds.

When the colour temperature meter has been roughly calibrated, it is a simple matter to interpolate between major calibration points with correction filters. Suppose that the colour temperature meter is reading the light from a 100 watt bulb with VR3 set to 2,800 degrees Kelvin (356 mireds), a B12 filter interposed between PCC1, PCC2, and the light source will raise the effective colour temperature by  $356 - 120 \text{ mireds} = 4,240 \text{ degrees Kelvin}$ , thus giving a fresh calibration point. With several filters, and a few known light sources, the whole colour temperature scale can be filled in by the above method.

## USING THE METER

Since the object of the meter is to measure the colour of light sources only, avoid reflected light from brightly coloured objects, clothes, and green grass, etc.

To take a shade reading out of doors, either stand in the shade of a neutral colour building with the meter pointing away from it towards the sky, or interpose the body between the meter and the sun. Always make sure that both sensors receive the same amount of light.

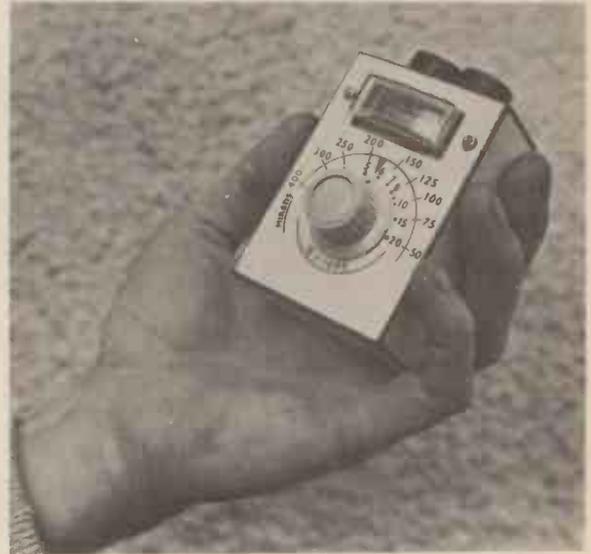
To measure the colour temperature of sunlight, the best method is to angle a sheet of white

paper towards the sun and take a reading from the paper. A similar method can be employed to take an integrated reading of mixed sunlight and skylight, by having the sheet of paper horizontal with the meter looking down at it. Alternatively, point the meter straight up at the sky with the sun illuminating both sensors evenly from front or back. □

Table 2: COLOUR TEMPERATURE AND MIREDS SCALES

Degrees Kelvin	Mireds
2,500	400
2,850	350
3,330	300
4,000	250
5,000	200
6,650	150
8,000	125
10,000	100
13,300	75
20,000	50

$\text{Mireds} = \frac{1,000,000}{\text{degrees Kelvin}}$



## MEMORY STORE

by George Dunning

MY Father, like most of his contemporaries, had been during the late twenties an enthusiastic d.i.y. wireless constructor. Evidently, the radio we know was evolved on hundreds of breadboards in back kitchens—from delicate crystal sets through temperamental t.r.f.s with leaky grids to superhets with horn loudspeakers—by amateurs such as he.

One of my earliest recollections was of a great moment, when after much adjustment and careful tuning he summoned the whole household to the earphones. After a dramatic silence during which the phones were passed around, everybody joyfully agreed that it definitely was the sound of a violin and the earphone was held to my tiny ear to witness the historic event.

Not long after that, fairly reliable sets with cone speakers appeared on the market: the enthusiasm for wireless construction waned and the whole paraphernalia was retired to the shed.

Many years later in a dark corner I discovered a large toroidal

coil and on blowing the dust from its label I read "What are the wild waves saying?" My curiosity was aroused and I asked the inevitable question: "How does wireless work, Dad?" His answer was curt and final; "You've no time to fiddle about with that, lad while there's studies to attend to". It remained a mystery—a thing I dismissed from my mind so that in time I not only did not know, but I did not want to know about things electronic; they were not my line of country.

And so it remained until the mid fifties. At that time I was working as a routine chemist and I began to notice how the advent of electronics enabled automatic physical methods to cut out some of the lengthy analytical chemical methods. It became increasingly clear that my livelihood would eventually be threatened and so, in short, I decided that as I could not beat them then I must join them. Accordingly I enrolled for evening classes in Telecommunications.

Thus I entered the world of electronics comparatively late in life. The wireless theory I acquired led me naturally via journals such as *Practical Wireless* and later

*Practical Electronics* to the fascinating hobby of electronic gadgetry. No elaborate workshop was needed. Armed with a multi-range meter, a soldering iron and a pair of strippers most projects could be tackled on the kitchen table.

For me the fascination lies in innovation. I cannot ever remember having copied a constructional item, component by component. My projects are usually a hotch-potch of several past constructional features and ideas arranged so as to exploit some component new to the amateur market: a thyristor replacing a relay, an i.c. replacing both vibrator and amplifier together. The excitement comes in finding out if it will work.

Looking back, I would say that by learning the theory first I gained greater pleasure and was able to build more efficiently sooner—but it was by no means essential to efficient construction. With only a knowledge of Ohm's Law and a healthy respect for Finnigan's Law anyone at any time can jump in at the deep end and soon be swimming around with those hitherto strange fish; the amateur constructors.

UNFORTUNATELY we have to write the copy for Shop Talk before the previous issue is on sale and hence no "feedback" from you, the readers, is available to tell us if indeed we did solve all your buying problems. However, if any general buying points do arise from various articles we should be able to deal with them in the following issue.

Having had a few phone calls concerning R.S. Components arising from another source it is possibly worthwhile reinforcing what was said last month, and also to mention that one or two firms are now specialising in R.S. Components parts and a look at adverts at the back may be advantageous.

After looking through the components lists this month it would appear that nearly all the components are readily available.

### Photographic Colour Temperature Meter

The slider preset potentiometer may not be easy to get for the *Colour Temperature Meter*, other types could be used but the slider fits in well. Some of the London shops should be able to help if your supplier cannot. The push button used by the author will probably not be obtainable but any "press for on" push button that is not too big should be all right; there are a number generally available.

The original case looks very neat and is made of white Formica, held together with Araldite.



### Fuzz Box

Well, the *Fuzz Box* should be straightforward as far as buying goes. Once again the author's case looks neat and is both strong and inexpensive.

### Demo Deck

Take note of the piece about RS Components above and you should have few problems in buying for the *Demo Deck*. Strangely enough, the only real buying problem Mike Hughes had was in

# SHOP TALK

By Mike Kenward

obtaining the 0.06 amp (60 milli-amp) bulbs. If you cannot get them Home Radio are the people to write to.

Our *Demo Deck* cabinet was made by a professional from Afrormosia Mahogany and looks very presentable. Obviously, many people could not make up such a good cabinet but our design is recommended as it has facilities for all the necessary bits and pieces.

### Teach-In

If you have any problems buying those few resistors for next month's *Teach-In*, you are just not trying. If you get 5 per cent types so much the better, they will probably not cost any more.

### New Products

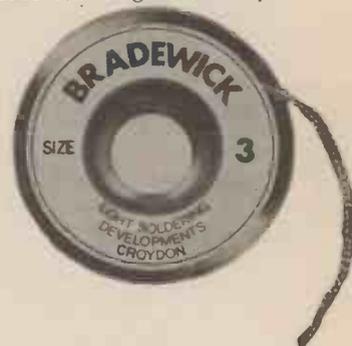
To protect your hands, clothing, the kitchen table and even carpets, a soldering iron stand is a must. You should never hang your iron on equipment or the edge of a table as it is all too easy



to reach across it and burn a hole in your clothing or skin.

If you have an area where you can set up a permanent work bench then buy a good stand and screw it to a bench. If you have to move around or use "borrowed space" then buy a good free-standing iron stand. This will help when you clear the work area as you can move the iron in the stand without having to wait or it to cool.

There are many stands available and most iron manufacturers make a stand for their irons. One universal one that was sent to us some time ago is shown in use with an Adcola Invader Iron left. This stand is well constructed and is available as a free standing or bench mounted type, and will take any iron with an element diameter less than 1/2 inch. It is attractively finished in red anodised aluminium, with a tip cleaning pad, made by Stangard and is available from Home Radio (Components) Ltd., for £1.33 (bench mounted) or £1.83 (free standing as shown).



Bradewick is a sort of "solder sucker," it is designed to remove solder from joints being desoldered. This should prove useful when working on the *Demo Deck* as it will prevent those large blobs of solder from building up around the tag posts.

To desolder a joint, simply apply the wick simultaneously with a soldering iron, the wick will soak up the solder as it melts. The solder-filled part of the wick can then be cut off.

Bradewick is available in four width sizes from 0.025 inch to 0.1 inch, the 0.075 inch sizes (Green Label) should suit most constructors. Available from Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, CR9 2LL, or retail shops, the cost is 90p for approximately five feet of any width.

# Windscreen Wiper Control

Part Two  
By S.B. Squire

LAST month we showed how the unit can be fitted to cars with single speed field coil motors however, some cars are fitted with two speed wipers using a field coil motor, the wiring diagram for these motors is shown in Fig. 6a, Fig. 6b shows how the unit is wired to this system. If required the unit may be used to operate the wipers at either of the two speeds depending on the wiper switch position (1 or 2) that the yellow wire from RLA1 is connected to. Wiring shown in Fig. 6b is for positive earth, reverse X and Y for negative earth systems. The green wire is not used and need not be fitted.

## PERMANENT MAGNET MOTORS

During the last few years permanent magnet wiper motors have been fitted to many cars and these motors are wired up as shown in Fig. 7a. You will notice that the parking switch shorts out the motor when it is turned off. This is so that the motor stops quickly. Most cars fitted with permanent magnet wiper motors are wired negative earth and Fig. 7b shows how the unit

is wired to such a system. Notice that the wire between the wiper switch and the parking switch is broken and the normally closed side of the set of changeover relay contacts inserted in this line (green and blue wires from RLA1).

The normally open contact (yellow wire from RLA1) is wired to the other side of the wiper switch. The blue wire must be wired to the wiper switch—the non earth side.

If your car has a permanent magnet motor and is wired for positive earth, simply reverse wires X and Y shown in Fig. 7b.

The fourth and final system is the two-speed permanent magnet type, again usually wired for negative earth. It is possible to use this unit with these motors but only on the first switched speed, reference to Fig. 8a will show the car wiring normally used with such a motor and Fig. 8b shows how to wire the unit to the motor, note that the normally closed side of the changeover contacts are wired between the wiper switch and the parking switch (blue and green wires from RLA1) while the third—normally open contact (yellow wire from RLA1) is wired

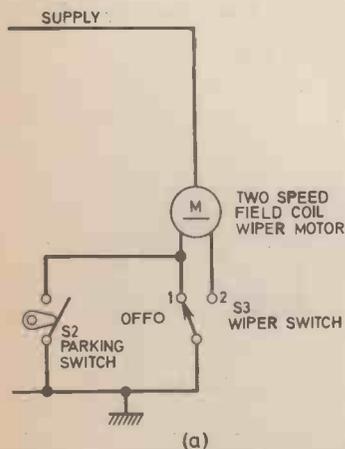


Fig. 6a. Wiring diagram for a two speed field coil wiper motor.

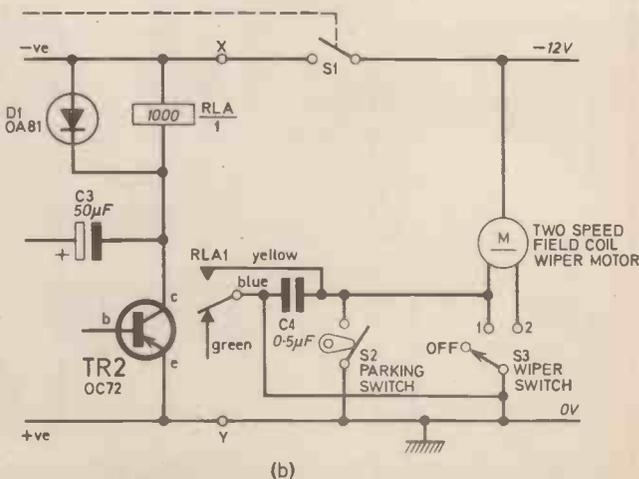


Fig. 6b. Showing how the unit is wired to a two speed field coil system—positive earth shown. In this configuration either speed can be used depending on which wiper switch position the yellow wire is connected to.

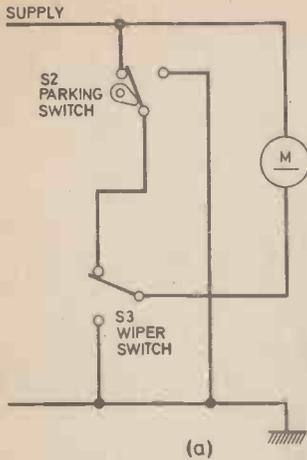


Fig. 7a. Wiring diagram of a three wire permanent magnet wiper motor.

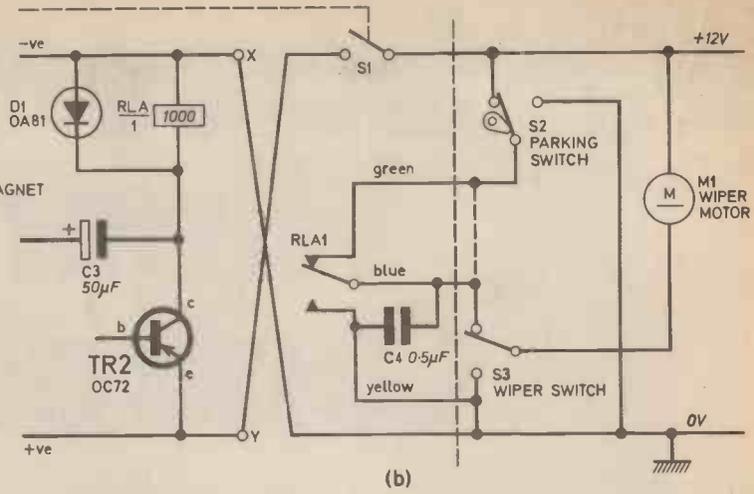


Fig. 7b. Showing how the unit is wired to be used with a permanent magnet motor. Note that the wire between the wiper switch and the parking switch has to be disconnected, and the relay contacts wired in. Negative earth system shown.

to earth. The centre contact (blue) must be connected to the wiper switch as shown.

If your car has a positive earth two-speed permanent magnet motor simply reverse wires X and Y.

### IDENTIFYING THE CAR WIRING

You should be able to determine the type of motor used in your car from the number of connecting wires on the switch, i.e., 2 wires (single speed)—field coil; 3 wires (two-speed)—field coil dual speed; 3 wires (single speed)—permanent magnet; 4 wires (two-speed)—permanent magnet. It should be possible to obtain a wiring diagram and find out which colour wires go where and how the various switches are wired up, but if this is not possible then you

will have to trace the wires on the car to find out how to wire in your controller.

### OPERATION

Once the unit is fitted to the car it is operated without touching the normal wiper switch. With the wipers off, switching on the unit will give one wiper sweep (back to the park position) approximately every five seconds. Further rotation of the control knob will increase the time interval between sweeps up to approximately 25 seconds. The 0 to 10 scale on the knob can be used as a guide to the delay time.

For normal operation of the wipers simply switch off the unit and turn on the wiper switch in the normal way. □

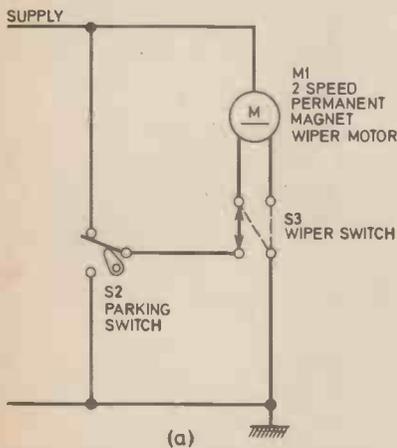


Fig. 8a. Wiring diagram for a two speed permanent wiper motor.

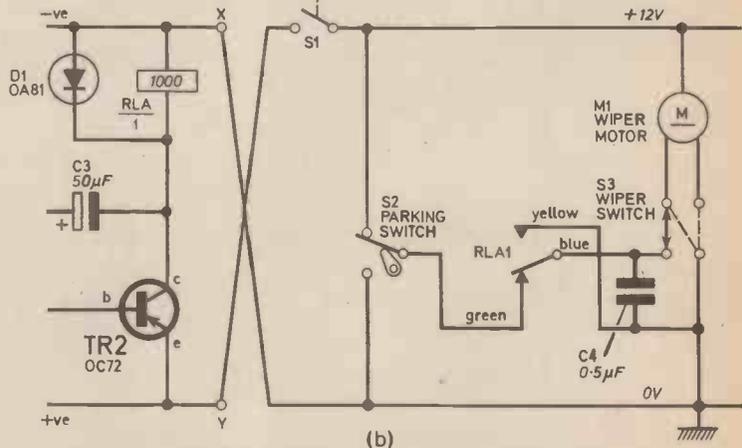
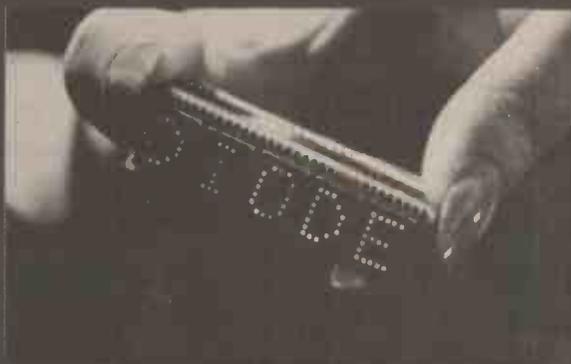


Fig. 8b. Showing how the unit is wired for a two speed permanent magnet wiper motor. Note that the wire between the motor and the first switch position must be disconnected and the relay contacts wired in. Negative earth system shown.

# electronics



## PAST & PRESENT

By Prof. G.D. Sims, OBE, PhD (Southampton University)

The second half of our story opens with the introduction of integrated circuits—and the beginning of microelectronics. Some of the significant new applications that have already emerged as a result of technological developments are mentioned, and finally, some likely prospects for the future are discussed.

Top left: Cold cathode neon filled numerical indicator tubes. Such devices are used in electronic measuring and computing equipment to provide visual readout of data (Mullard)

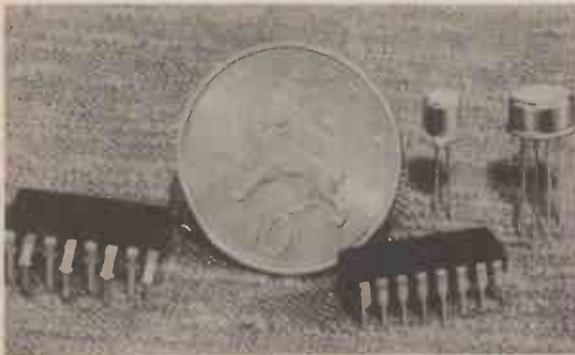
Top right: Small size solid state display made up from a matrix of tiny gallium arsenide phosphide light-emitting diodes. Can be arranged to provide numbers or words of any length (Marconi)

Bottom left: Ferranti Mark I Computer at Manchester University 1951. This was the first British electronic computer. It employed 3,000 valves, and a refrigeration system; cathode ray tubes were used as data stores, in addition there was a magnetic store. This picture shows just part of the computer, the central processor and the control desk (Ferranti)

Bottom right: The latest Ferranti Computer, Argus 500, is a fast computer system for on-line applications. The central processor, the sub-unit at extreme left of picture, can operate with one microsecond core stores. Compare this small sub-unit with the large cabinets required to house the central processor of the Mark I (Ferranti)

**T**HE success of microelectronics as we know it today stems largely from the exploitation of the silicon planar process. A typical integrated circuit may contain a number of transistors, resistors and capacitors all made within the same silicon "chip" the interconnection pattern between them being evaporated on after all of the components have been formed. "Large scale integrated circuits" can contain thousands of devices all made in the same piece of silicon.

The majority of integrated circuits commercially available at the present day, however, are the simpler ones and these alone open up a host of new possibilities in electronic design for both professional and amateur alike.



Integrated circuits for colour television. From left to right: colour demodulator, central signal processor, voltage reference source, and inter-carrier sound i.f. and detector (Mullard)

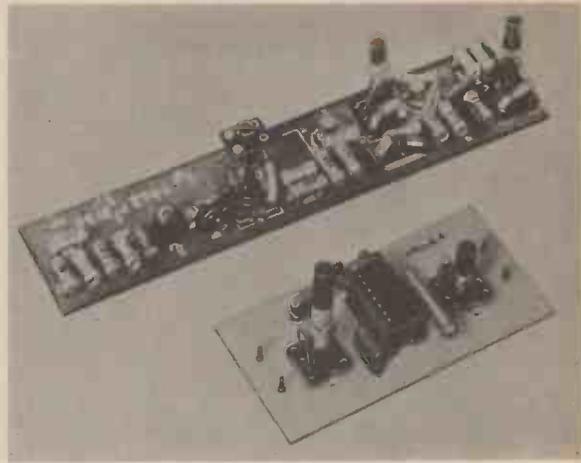
### LINEAR INTEGRATED CIRCUITS

Whereas at one time the task of wiring up separate components to form an amplifier was "bread and butter" to the engineer, it is now often possible to buy a suitable amplifier integrated in a single chip and ready for use. "Linear" integrated circuits (such as amplifiers) are commonly available in a variety of forms and can be regarded as the design blocks of our future systems in much the same way that the transistor, and earlier still the valve, were in the past.

### DIGITAL INTEGRATED CIRCUITS

Integrated circuits, however, have come to be most widely used in "digital" (pulse) applications such as those involved, for example, in the design of the computers to which we have referred.

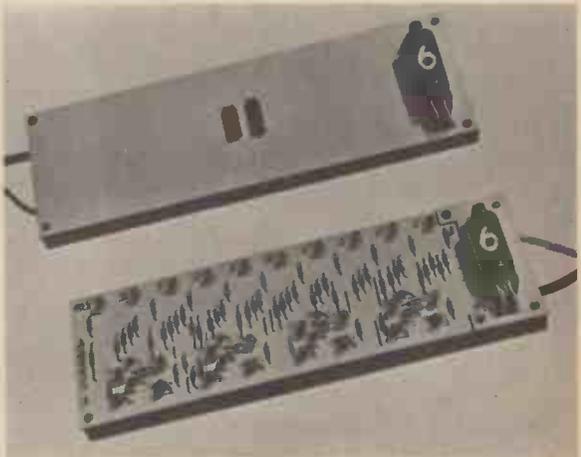
We have already drawn attention to the fact that electronic circuits can make yes/no decisions and hence "think". The design of "thinking" systems therefore is very much concerned with the design of "logical systems", which perform deductive tasks in much the same way that a human being does. It is this link with logic which has given impetus to much of the digital integrated circuit development.



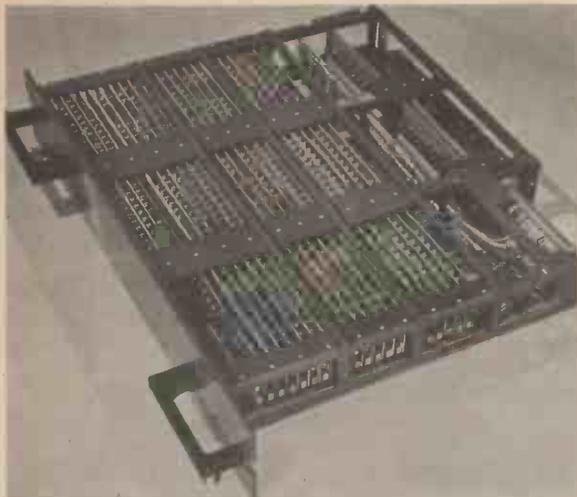
Contrast between the conventional "discrete component" version of a colour receiver i.f. amplifier, and one incorporating a linear integrated circuit (Mullard)

Many "families" of such integrated circuits are available, each forming a comprehensive range of logical functions and some of these are now extremely cheap to buy. In many other applications besides computing, for example in control systems and in communications, it is better to design in terms of digital building blocks rather than around the linear circuits traditionally used; and many future developments, of increasing interest to amateurs, will centre around the uses of these digital modules.

The microcircuit therefore is the key to our future. Let us look at the advances which electronics has made possible in recent years and at the same time some of the problems which lie ahead.



Decade counter using two digital integrated circuits (top) compared with a similar device using discrete components (Mullard)



The central processor of the Argus 500 Computer. This unit incorporates 980 integrated circuits and 220 discrete semi-conductor devices; and is 30in. high, 22 deep and 5in. wide (Ferranti)

### MAN/MACHINE PROBLEMS

One area which is currently exciting great interest is the man/machine interface problem, coupled with the question of how can we replace human functions by electronic systems?

At the present time electronic systems exist which can learn fairly satisfactorily to read even handwriting, though as yet they are far from being sufficiently perfect for use, for example, in letter or parcel sorting. However, if standard alphabets are used the possibility of such tasks as stock control being performed by machines which scan invoices and ultimately, perhaps, even audit books, seems to be within the realms of the possible.

A related problem is concerned with the identification and artificial production of those

attributes of sounds which characterise speech. Clearly knowledge of this kind is vital also to the elimination of those characteristics which produce discomfort in human beings and to the alleviation of noise pollution generally.

Similar techniques to those used in this field of "pattern recognition" can also be used in medical diagnosis to compare patient information with that of previous cases in order to predict appropriate methods of treatment.

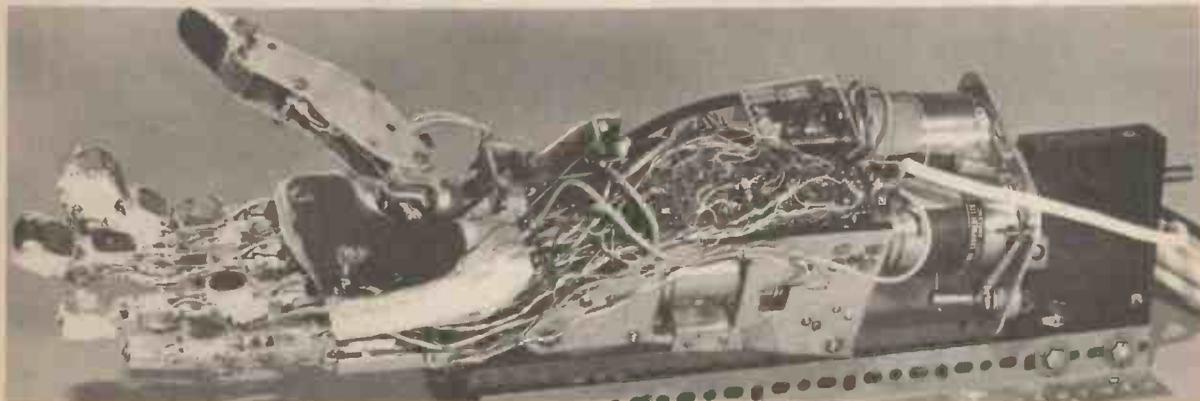
All of these applications depend upon suitable electronic circuits which will recognise, classify, identify and compare, symbols, signals or noises, and it is only with the coming of cheap electronics that such systems—previously regarded as being too expensive or too complicated to make—are now possible.

### ELECTRONICS AND "MEDICINE"

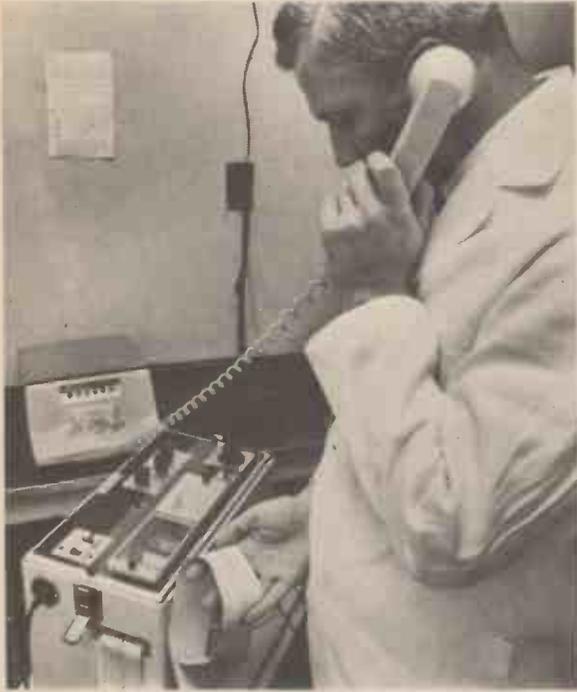
Mention of the medical field touches upon one of those areas where electronics has now started to make very significant contributions; we can for example now produce an artificial hand so sensitive that it can pick up fragile objects without crushing them and so positive that it can hold objects tightly, merely when the human mind controlling the hand thinks that it wishes to perform one or other of these functions. Such a hand is actuated by signals from nerve endings in the body and will imitate any movement which a natural hand would have performed.

Further development is still needed before such aids find general application as certain electromechanical problems still exist, but the pure electronics, which interprets the nerve signals and controls the hand motion, can now be reduced to a volume and weight compatible with a normal limb size: all of this thanks to the development of microelectronic techniques.

A related application also envisages the use of



Prototype model of adaptive artificial hand. It is driven by six compact d.c. permanent magnet motors and contains about thirty transducers. These provide the control system with detailed information about the object being grasped such as its shape, position and stability; they also monitor the forces, velocities and positions of the digits. This experimental device weighs twice as much as its human counterpart. Commands for the control system are derived from myoelectric signals produced by the operator (Dept. of E.E., Southampton University)



**Diagnosis by Computer.** This heart specialist in the United States uses an electronic telephone to transmit a patient's heart record from this electrocardiograph to a computer. The computer will analyze the signals and return a diagnosis in about two minutes (*U.S. Information Service*)

microelectric techniques to produce feedback signals to control nervous or spasm conditions, or to make up for damage to the nerve paths, which act as the normal communication channels between the brain and limbs, such as might be associated with some forms of paralysis. A whole family of related devices, which is now coming under consideration, involves such items as talking aids for those with speech defects, or typing aids for those who have lost the use of limbs.

A voice operated typewriter, actuated by spoken signals in the form of a kind of morse code, can now be made and the possibilities which this kind of device opens up are tremendous. One could, for example, now envisage a small computer making its time available to a range of aids of this type, enabling a complete office or workshop to be manned by people who were disabled in one way or another.

The fact that electronics could now offer employment possibilities to the handicapped is both important and exciting and could not have been contemplated a few years ago. In this area, however, we are only just at the beginning of the road.

## **AUTOMATED DESIGN AND PRODUCTION**

Many other previously manually executed jobs

of course are now already performed by special purpose computer systems. For example, electronic control of machine tools is finding increasing use in industry.

In this case the operator specifies to the control system just what shape the machine is to cut—he does this by way of data on punched tape or cards—and the machine proceeds to produce the work automatically with little need for human intervention.

Further back in the design chain, newly developed electronic draughting machines are also rapidly gaining acceptance. Production of, for example, a radar system may require as many as 20,000 detail drawings, which such a machine, suitably programmed, can produce on command from basic master sketches.

Initially the master is produced from data typed into the machine while other parts of the sketch are drawn in using a light pen controlled by the "draughtsman". Amendments can also be



**Designer in dialogue with computer.** A senior designer is shown adding another stage to the MOS microcircuit which he is designing in co-operation with a Myriad computer. He is using a light pen to put a new section into the main circuit design, having called it from the computer store using the keyboard. (*Marconi*)

made via the light pen and the drawings can thus be amended and up-dated when necessary.

Similar computer based design techniques are used in the production of large scale computer systems themselves where the back wiring diagrams are both devised and produced by computers: the same is true of the printed circuit boards on which the components and individual microcircuits are housed. The computer can lay out these boards in an optimum way and what was once a very tedious and time consuming human operation has now been reduced to a straightforward programming exercise.

## **COMPUTER AIDED DESIGN**

Computer aided draughting to which we have just referred should not be confused with "Computer Aided Design" (C.A.D.), which is attracting

excited interest in all branches of the engineering industry.

In the electronics field, circuit diagrams and systems specifications can be fed into a computer which will in turn calculate all the component values to meet the specification. Before the electronic system is actually built, the machine will simulate any design arrived at, see if it is perfect and in some cases can even lay out the various masks needed to produce microcircuits of which the system will ultimately be built.

Clearly techniques of this kind are unnecessary with simple circuits and systems such as the amateur would need to deal with, but the complexity of many of the things the professional electronic engineer is now called upon to produce is such that only with aids of this kind can he complete his assignment in a realistically short time—if at all.

Present limitations of C.A.D. depend mainly upon the size of the computer needed to deal with really ambitious systems, and on the ability of those engaged in semiconductor device research to produce suitable "models" of their device behaviour from which the computer can work. Such limitations apart, however, it is in principle possible for the computer to design an electronic system right from the initial circuit diagram through to the digital information which will control the making of the masks used to produce the component microcircuits of which the system will ultimately be built. Many of these processes are still in the research stage, but the days of at least partly automated circuit production are rapidly drawing nearer.

In other fields of engineering, C.A.D. techniques are used to produce minimum cost systems, for example, in an electricity supply system optimum sizes and kinds of components can be chosen by the computer, using linear programming techniques, to perform within given safety factors any specified function.

## MODERN COMMUNICATIONS

In communications, with the advance of digital techniques, (for example, pulse code modulation) microelectronics has again found a natural home and the electronic telephone exchanges of the future will be realised in very different form from those currently installed, as increasing degrees of circuit integration are incorporated.

Problems of signal storage still remain, though acoustic techniques, ferromagnetic bubble storage and more particularly the recent improvements in M.O.S. technology offer hopes of early progress on this front too.

In the field of signal transmission, waveguide techniques have now been developed to the point where they offer advantages in some situations over cable or microwave links. Indeed the Post Office is currently installing a 16 kilometre experimental run of multimode helical waveguide, which is due to be incorporated into



This 50mm helical waveguide, seen at the Post Office research station Martlesham Heath, can carry several millions of voice channels (The Post Office)

regular communications use in 1973.

A single 50mm helical waveguide can accommodate several millions of voice channels and though these techniques have been in prospect for several decades, it is only recently that the major difficulties have been resolved and the system has become economic. Trunk waveguide systems may well form the future transmission medium on some of the world's busiest communication routes, for the bandwidth available to us for free space microlinks is rapidly being used up.

Until recently, even given that the waveguide system itself had presented no problems, the terminal equipment to decode the signals and separate the individual channels would have been formidably complicated, without the electronic sophistication available to us today.

## OPTO-ELECTRONICS

What else is in store? We are steadily approaching a new age in which light producing devices offer increasing possibilities as a means of conveying information. New electronic light sources and detectors together with low-loss optical fibres enable us to conduct light round corners and such techniques on a small scale enable the surgeon, for example, to investigate the interior of his patient using illuminated mirrors at the end of a fibre light guide.

In years to come fibres could well serve as a

long- as well as a short-distance communication medium offering even greater bandwidth than that which is offered by the waveguide techniques mentioned previously.

We have seen already that there is good reason to dispense with devices depending upon free electrons (as in the old thermionic valves) wherever possible in favour of solid state devices. There are two areas where we have not succeeded; one is in the design of high power

transmitting valves where the electron tube still reigns supreme; the other is in the display field where the cathode ray tube also remains unchallenged.

Yet, once again much research is directed towards finding solid state replacements for these devices, enabling us prospectively to get rid of high voltages, hot cathodes and relatively short lifetimes. The day of the all solid state camera tube and the solid state display cannot be far away!

## RETROSPECT

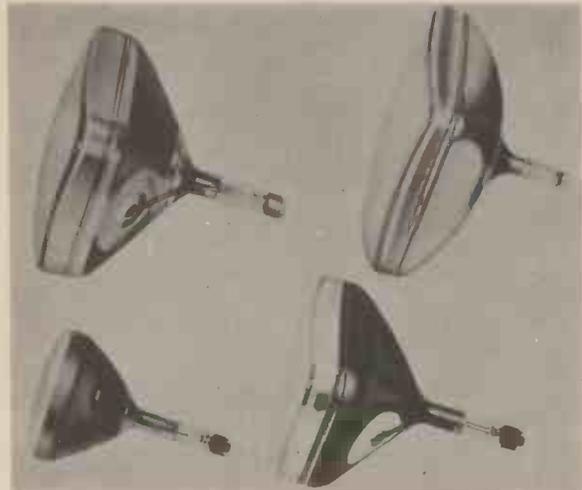
The pace of this advance has been breathtaking and the rapidity with which we have accommodated it equally so. We take for granted already the computers which process our bank cheques, we take for granted the information which is transmitted back to earth from weather satellites and indeed the fact that we can now receive television pictures from, for example, Japan whereas at one time the only way of doing this was to send a film round the world by aircraft.

We take for granted the safety of the navigational systems in the aircraft in which we fly, that the radio altimeter will tell the pilot the correct height when he is coming in to land, or indeed, even more so, that the automatic landing system will handle the aircraft and not miscalculate the point at which it is supposed to meet the ground! We fail to notice the increasing reliability of our telephone system, of which we are perhaps even less conscious when things go wrong!

All of these developments have occurred within the last fifty years, some within the last fifteen, and because of them and more particularly through our television sets we all know far more about the other countries of the world and their peoples than previous generations could have dreamed of. We have all become accustomed to, and indeed have come to expect, ease of communication and travel in all senses. The social effects of these developments all due to electronics have already been immense even if their source has not always been generally recognised.

It may be, as some have suggested, that the era of rapid developments in electronics is now passing and that as we move into the future the progress will be less spectacular. Past experience teaches one to treat such predictions with caution—though, true or not, we may be assured that the demand for electronics equipment and the need for people who understand how to design it will continue.

With the development of simple, easy to use circuits more and more people will find in electronics a diverting pastime which they can put to useful purposes. The main developments may be behind us but the future nevertheless remains tremendously exciting! ■



Development of television picture tubes since 1945: (lower left) 9in., 14.6in. front to back; (lower right) 14in., 16.6in., (top left) 17in., 15.6in.; (top right) 19in., 12in. (Mullard)



The television screen of the future? A new type of display panel using a special "liquid crystal" material is currently under development. Words or other information appear on it when a low voltage is supplied by wires which are concealed in this photograph. Immediate practical uses are likely to be data readouts for control panels, animated labelling for keyboards, and see-through map displays which pilots and drivers can read "head-up" without losing sight of the view ahead. One day, "liquid crystals" might provide television screens thin enough to hang on a wall (Marconi)



# ELECTRONIC CIRCUITS - ..... IN THEORY and PRACTICE

# TEACH-IN ... FOR BEGINNERS

By Mike Hughes M.A.

## 2

## ELECTRIC CURRENT

**T**HE trouble with an electric current is that you cannot see it. Perhaps this simple fact is the main reason why a mystique has built up about electronics. Once you have a grasp of what causes an electric current to flow then a lot of basic electronics can be understood right away.

### CURRENT FLOW

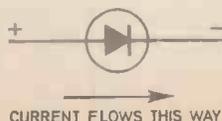
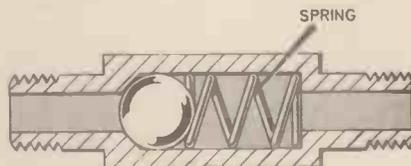
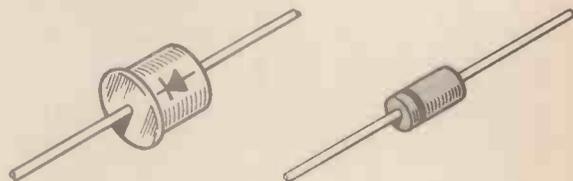
We all take for granted that we can connect a bulb to a battery and make the bulb light up—this is because an electric current flows through the bulb.

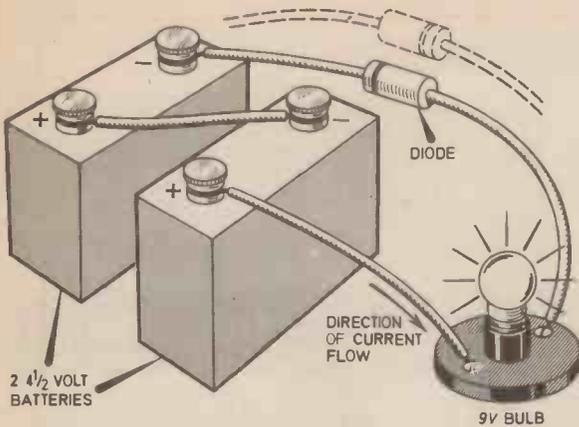
How can we prove that current is “flowing”? To have a flow we must pre-suppose that the flow is in one direction only, like a stream. We can show that there is a directional property to current flow very simply but we will need three components: a 9 volt battery, a 9 volt bulb in a lamp holder, and an electronic component called a diode.

We shall be talking about diodes later so at this stage let us consider it simply as a one way valve to the flow of electric current. If you wish to buy a diode capable of doing this experiment you should ask for one having a forward current of 1 amp and a working voltage of at least 12 volts. There are many types to choose from—perhaps the most common having type numbers 1N4001, 1N4002, 1N4003, 1N4004 (the 1N4001 should be the cheapest because it has the lowest working voltage). Fig. 1 shows the appearance of some common diodes that will do. Note there are two wires and either an arrow shaped symbol pointing along the device or a spot or band around one end.

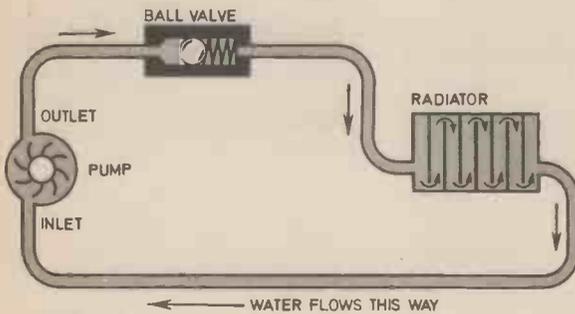
The 1N4001 has a band which corresponds to the end to which the arrow symbol is pointing. This arrow is pointing in the direction along which the diode will allow electric current to flow.

Fig. 1. Two common diode encapsulations are shown above a ball-valve which represents a diode. Water can flow from left to right but not from right to left, likewise a diode allows electric current to flow only in the direction of the arrow in the symbol (shown below the ball valve). This assumes that current flows from positive to negative.





**Fig. 2. The bulb lights with the diode connected as shown but will not light if the diode is reversed as in the broken line drawing.**



**Fig. 3. Water analogy of Fig. 2.**

Connect the lamp to the battery with two wires and see that the lamp lights. Reverse the leads to the battery: the lamp still lights. Now put the diode in the circuit. Connect the banded end of the diode (arrow head end) to the *negative* terminal of the battery; the other end to the bulb; the other side of the bulb to the *positive* terminal (we say that the battery, bulb and diode are connected in series). The lamp lights again. Now reverse the diode in the circuit so that the banded end is pointing towards the bulb. The lamp does not light because the diode does not allow current to flow through it this way round (Fig. 2).

By referring to the way the diode was connected in the circuit we can decide which way the current was flowing. It was, in fact, from the positive terminal through the bulb and diode into the negative terminal. This simple circuit has a nice analogy if we consider water as electricity, a pump as our battery (producing pressure), a spring loaded ball valve as our diode, and a radiator as the lamp (Fig. 3).

**DEFINITION**

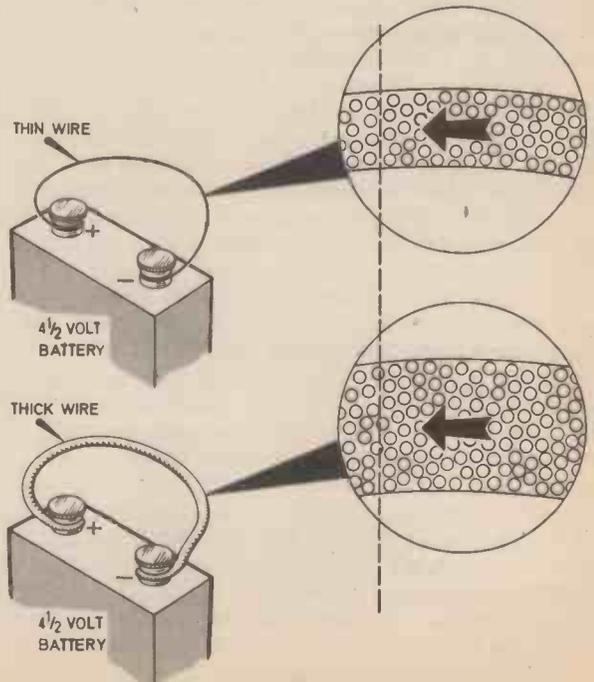
We shall return to this analogy shortly but first let us simply describe what constitutes an electric current. It is quite simply the transfer

of energy from one place to another, the energy being transmitted by the movement of minute particles of matter called electrons. These electrons have a negative charge and like north and south poles of a magnet the negatively charged electrons are attracted to positive potential (voltage)—they are repelled by a negative voltage.

Every material has a number of free electrons within it; copper has a great many and hence is capable of carrying more electric current (for a given cross section) than most other materials—we call it a good conductor. Glass has very few free electrons and hence we call it a bad conductor (or an insulator).

If a piece of copper wire connects the positive terminal to the negative terminal of our battery (do not do this in practice because you will run the battery down) we can imagine the free electrons in the copper moving from the negative terminal to the positive. Note that here is an ambiguity; although electrons move from negative to positive we say (by definition passed down through the ages) that current flows from positive to negative. This sounds confusing but does not usually cause many headaches and because it is such a ridiculous ambiguity it is easy to remember. Unfortunately the definition cannot be changed easily because all the rules of electromagnetism are based on it. During the series we will always assume that conventional current flows from positive to negative.

**Fig. 4. More electrons move pass the dotted line per second with a thick wire than do with a thin wire.**



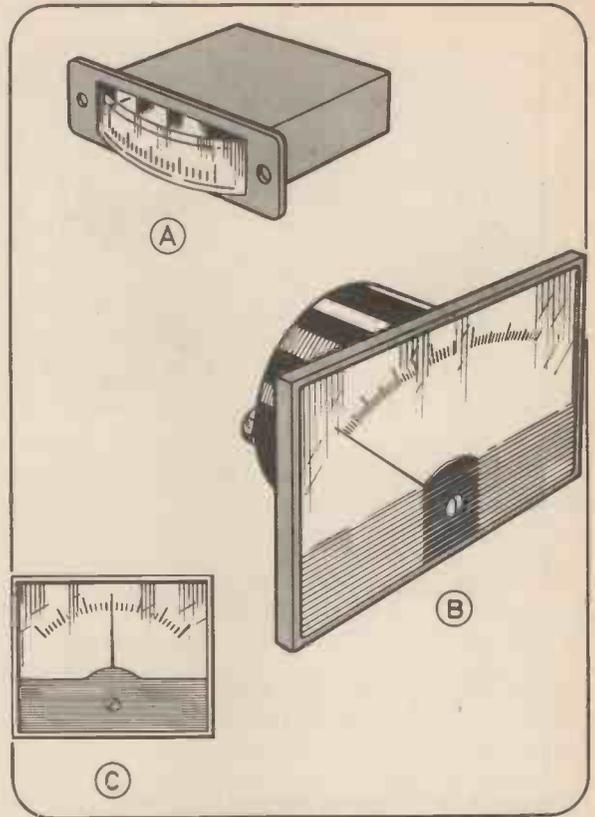
If we had a thick piece of copper wire we would expect more electrons to move past a given point per unit of time than with a thin piece (Fig. 4). Likewise if our battery had a higher voltage it would seem logical that we would get the same sort of effect. This is exactly what does happen. We call the rate of movement (flow) of electrons the **electric current**, the battery voltage is the pressure or motive force driving them, we call this the **electro motive force** (e.m.f. for short) and the copper wire is the conductor which has the ability of allowing large numbers or small numbers of electrons to move depending on its area of cross section; we call this the **resistance** to flow.

## WATER ANALOGY

Having defined the basic elements of a real electric current let us now return to our analogy with water. We have already used the terms pressure and flow. We can demonstrate electrical resistance by having a water pipe of small bore connected in series with a pump—similar to a domestic central heating system. The smaller the bore, or the more radiators we have, the higher the pressure we need from our pump to maintain the flow.

It is common practice to measure water pressures relative to a given "head" of water. At the inlet of the pump the pressure is zero because this is our reference point. At the outlet the pressure will be high and positive and in between the various radiators we will still measure positive pressures but they will get less and less as we go round the circuit (Fig. 5).

If we took the junction of radiators B and C as our reference we would measure positive pressures on the "upstream" side of the point and negative pressures on the "downstream" side. What we are in fact measuring is the "pressure difference" between two points. If we have a high resistance to flow between two points we will get a corresponding high pressure difference. This is exactly what happens with an electric current. Let us replace the pump with a battery and the radiators with electronic components called resistors (Fig. 6.)—these are devices which have been specially designed to restrict the flow of current and have values measured in ohms. The drawing on the left shows the components as they would appear in real life but now look at the schematic diagram on the right which uses symbols to represent the components. B1 is the battery, R1, R2, R3, and R4 represent resistors. The voltage (or e.m.f.) of the battery is the driving pressure, say 4 volts. If all the resistors have identical value we can say that relative to the negative terminal of the battery the potential at the junctions of R1 and R2 is +3 volts, between R2 and R3 is +2 volts and between R3 and R4 is +1 volt.

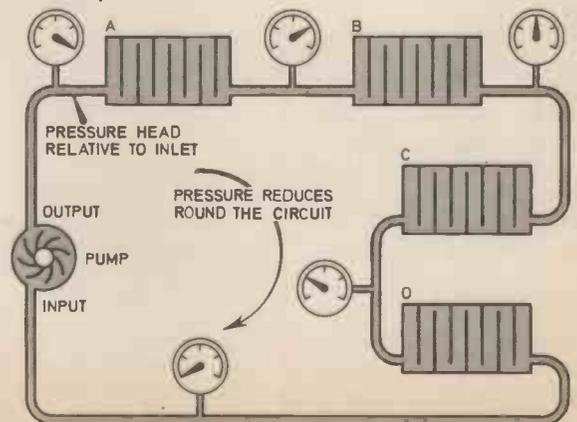


Three types of moving coil meters. A. Edge wise type. B. The "standard" type used in the Demo Deck. C. Centre zero type.

## MEASURING CURRENT

It is all very well talking about currents and potential differences but how do we measure them? We have seen that a current flowing through a resistor produces a potential difference. Similarly an e.m.f. across a resistor will produce a current. There is a relationship between these, therefore we should be able to measure potential difference in terms of current. This will be covered in more detail later.

Fig. 5. Water analogy of a circuit showing difference in pressures.



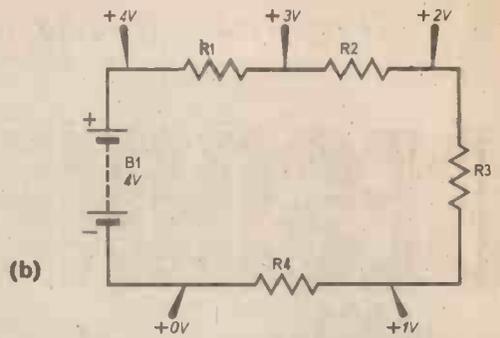
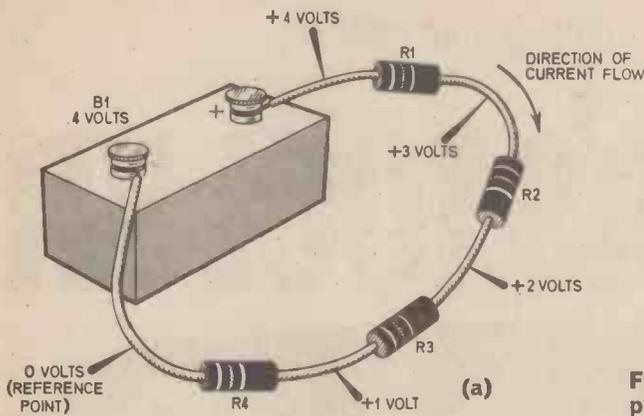


Fig. 6(a). The electronic components that replace Fig. 5. (b). The electronic Circuit diagram.

Most instruments in their basic form measure current and are modified to use the relationship mentioned to measure potential difference (voltage). The most common type in use today is the moving coil galvanometer. A small electric current made to pass through a coil of wire pivoted in a strong magnetic field makes the coil move on its pivot against the action of a spring (Fig. 7). A fine pointer attached to the coil moves over a graduated scale calibrated in units of current (amp or fractions of an amp).

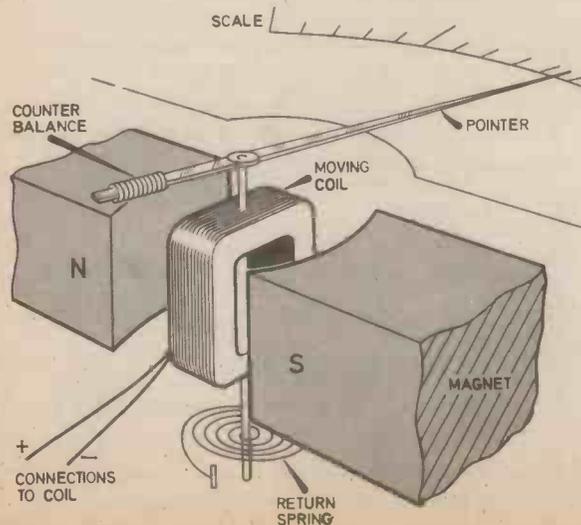
Moving coil meters are specified in terms of their sensitivity. For example those used in cars do not have to be very sensitive as the currents measured are very high (10-20 amp) and the coil is usually only a turn or two of very heavy wire. In electronics we are usually concerned with minute electric currents in the order of thousandths or even millionths of an amp and it is quite common to have a meter having a full scale deflection of 100 millionths of an amp (100 microamp). The wire used for the coil in this case is extremely fine and there are many turns. The price of meters is directly proportional to

their size and sensitivity; obviously it is not sensible to buy something that is too good for an application but when obtaining a meter it is always better to err on the side of higher sensitivity—it can always be reduced.

Next month we shall go into more detail about the relationship between current, potential difference and resistance and will carry out some simple experiments. In preparation for this it is suggested that this month you make the *Demo Deck*. This "table top laboratory" will be used frequently during the series and for those with a limited amount of working space it should permit work on the dining room table without too many severe repercussions!

You might be tempted to start experimenting with the *Demo Deck* at this stage; if you are, be extremely careful that you do not pass excessive current through the meter. If you do not understand what this means it is safer to leave things as they are until next month when we shall be putting the deck through its paces, using a few extra components.

Fig. 7. Basis of the movement of a moving coil galvanometer.



The electronic components required are:

2 1,000ohm  $\pm 10\%$   $\frac{1}{4}$  watt resistors, 2 10,000 ohm  $\pm 10\%$   $\frac{1}{4}$  watt resistors and 2 22,000ohm  $\pm 10\%$   $\frac{1}{4}$  watt resistors

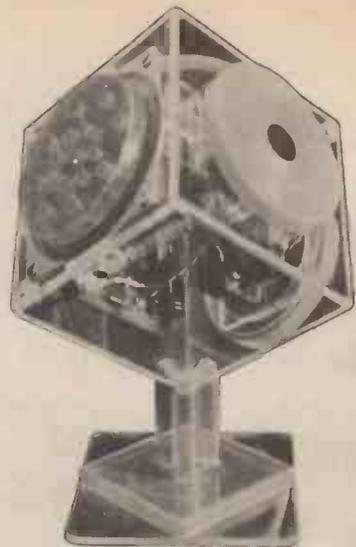
Next month: Ohm's law explained and used to make a volt meter on the *Demo Deck*



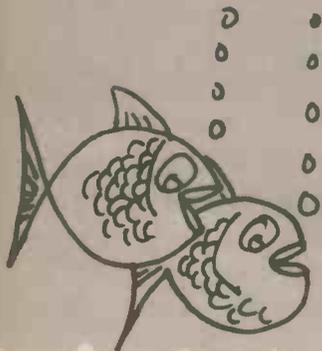


# CLEARLY

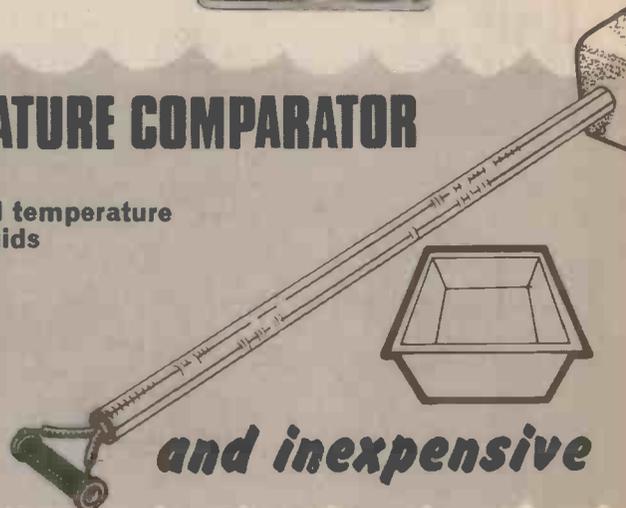
YOU WILL WISH TO BUILD THE  
**Astron M.W. RECEIVER**



## ..AND THE REMOTE TEMPERATURE COMPARATOR



Measures small temperature  
changes in liquids



*...simple*

*and inexpensive*

## ELECTRONICS AND THE MUSIC SCENE

Describes the way in which electronics has changed the "musical sound" in recent years and the devices that produce the "special effects" now in common use

*Some of the fascinating  
features to be found  
in the  
JAN '72  
issue of*



ON SALE  
FRIDAY, DECEMBER 17

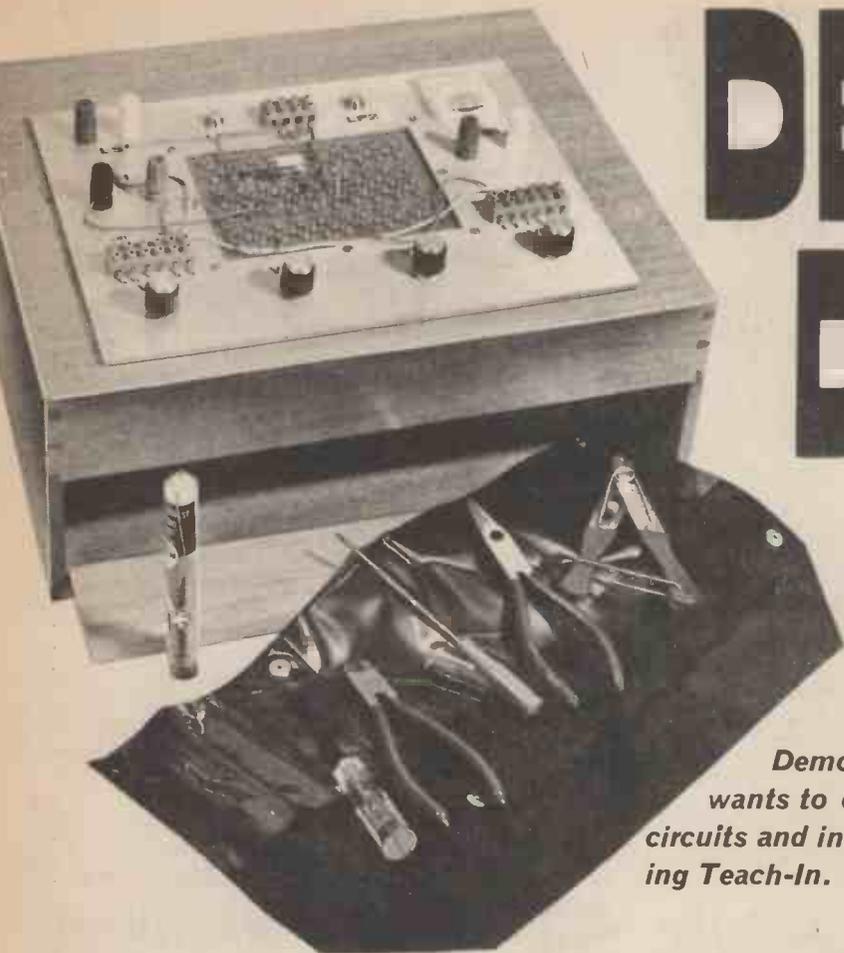
## TEACH-IN

### PART 3

Explains fully the resistor colour code. Various experiments are carried out using the Demo Deck in which Ohm's law is verified

# DEMO DECK

By Mike Hughes M.A.



*Demo Deck for everyone who wants to experiment with electronic circuits and in particular for those following Teach-In.*

**T**HE Demo Deck has been designed for the constructor who wishes to carry out simple experimental work with the minimum amount of space utilisation, and who desires also the possibility of re-using components several times over. Most particularly it is used as the work horse of the *Teach-In* series and those readers who are following this in a practical sense are strongly advised to make a Demo Deck so that they can perform the exercises and experiments exactly as described.

## THE DECK

The deck itself has no circuit diagram but is a flat bed on which is mounted a range of components, together with a sturdy re-usable soldering board. An important feature of the deck for those with limited space is the special cabinet.

The deck is mounted on a specially designed cabinet, this provides accommodation for tools and components and also housing for the loud-speaker and batteries. Thus at the end of experimental work everything can be tidied away neatly and the unit itself—if built well—is quite attractive in appearance.

No doubt it will be repeated in *Teach-In*, but

it is important in any hobby that care is taken—you are your own master but you should set yourself high standards for workmanship and never settle for something that you think you could possibly do better. This is an attitude that should always be taken in electronics because most problems ultimately boil down to untidy or slip-shod workmanship. Make as good a job of this table top laboratory as possible; remember you will be using it as a tool for the rest of this series and probably much longer.

There is no need to follow the details exactly, but those following *Teach-In* are advised not to deviate too far from the published design. Some more advanced constructors may like to use the basic design suitably modified to their own purposes. For the benefit of beginners we shall

Approximate cost of components



5.50 plus cabinet

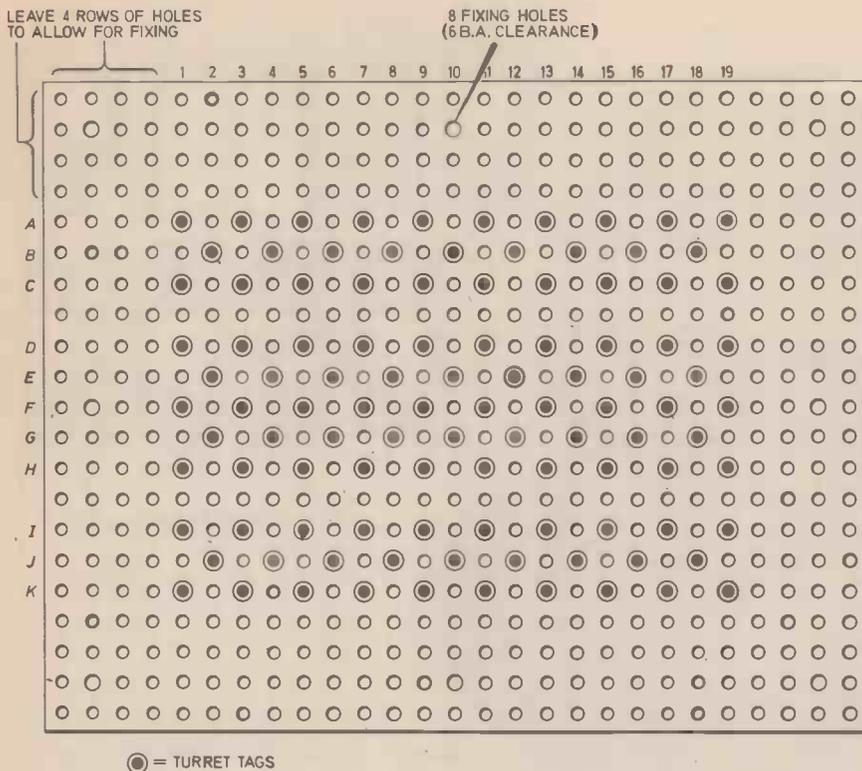


Fig. 1 Pin layout on the small perforated board, note the area left for mounting to the chassis.

specify the components in detail but, of course, some latitude is possible and costs can be cut by careful shopping around.

### TAG BOARD

The basis of the Demo Deck is the tag post board which can be used for soldering up experimental circuits. This is made on a standard piece of R.S. Components perforated board that has holes set on a 0.25 inch matrix. The tags used are from the same manufacturer and are the ones typed "small". The standard layout of pins—that will be used in the *Teach-In* series—is shown in Fig. 1. It can be seen that not all the perforations are used; this is for reasons of economy and clearness of layout; experienced constructors might prefer a full matrix of pins.

To rivet the pins in position hold the special die (this is supplied with a gross packet of tags) in a vice and insert the long shank of the pin in the die. Offer the perforated board to the short shank end of the rivet—which is protruding from the die—so that the pin is firmly seated in the hole then use a centre punch to splay out the end and, using a small hammer, firmly flatten the rivet and make sure it is holding tightly, see Fig. 2. This should be done for all relevant positions on the board—make sure that the margin around the board is kept clear of pins as this will be used for mounting purposes.

### CHASSIS

The chassis of the prototype deck was made out of 14 gauge aluminium plate and obviously

this makes a very sturdy job even though the material is a little difficult to work. Other materials can be used but it should be remembered that the unit is designed to give quite some service, therefore ensure that the material is strong enough. A good alternative would be  $\frac{3}{16}$  inch plywood or a strong grade of hardboard. If a wooden panel is used it must ultimately be coated with varnish or enamel paint so that lettering can be added.

The layout of the components can be seen in the photographs so holes should be cut in the panel to facilitate mounting; dimensions for the components used in the prototype are shown in

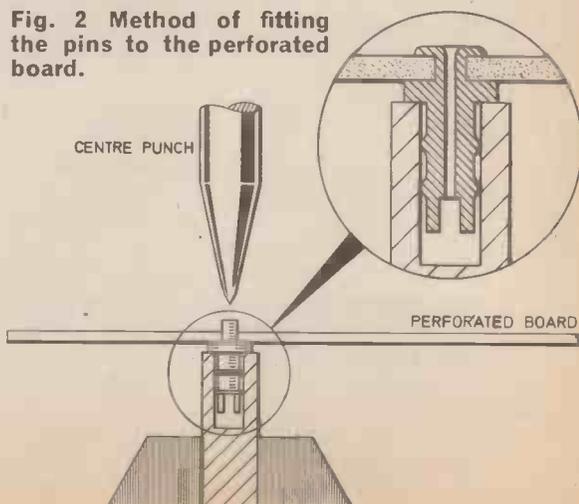


Fig. 2 Method of fitting the pins to the perforated board.

# Components....

## Potentiometers

- VR1 100 ohm wirewound
- VR2 5,000 ohm (5 kilohm) carbon
- VR3 25,000 ohm (25 kilohm) carbon
- VR4 500,000 ohm (500 kilohm) carbon

## Lamps

- LP1 6 volt 0.06 amp MES bulb and holder
- LP2 6 volt 0.06 amp MES bulb and holder

## Loudspeaker

- LS1 35 ohm 3½ inch diameter (R.S. Components)

## Meter

- ME1 1 milliamp full scale deflection moving coil meter with 1½ inch square face (S.E.W. type MR38P)

## Battery

- B1 4½ volt screw terminal bell battery (2 off)

## Miscellaneous

- 1 small perforated board (R.S. Components)
- 1 gross box small turret tags (R.S. Components)
- 2 ten way 2 amp terminal blocks (R.S. Components Barrier Strip 2A)
- 6 Slim screw terminals, different colours (R.S. Components)
- Banana plugs to fit screw terminals (optional accessory)—if alternative terminals are used these may not have facility for plugs
- Small or medium crocodile clips (optional accessory)
- 2 yards (approx.) single strand insulated connecting wire
- 2 yards (approx.) light duty twin flex (for leads to B1 and LS1)
- 2 yards (approx.) seven strand insulated connecting wire (for connecting leads)
- Aluminium or other material for chassis (see text)
- Wood for housing (see Fig. 5). Lettering sheet. Varnish etc.

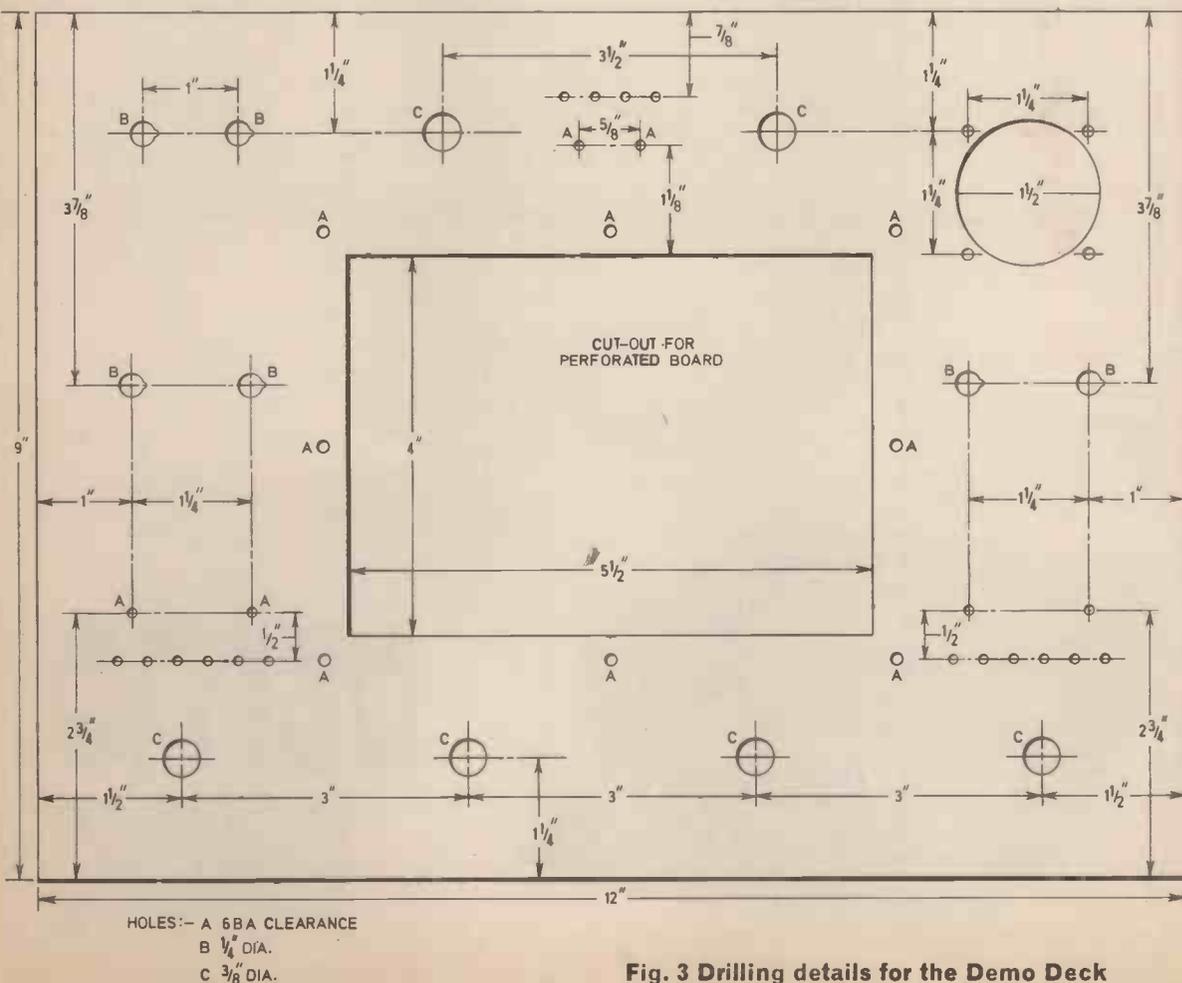
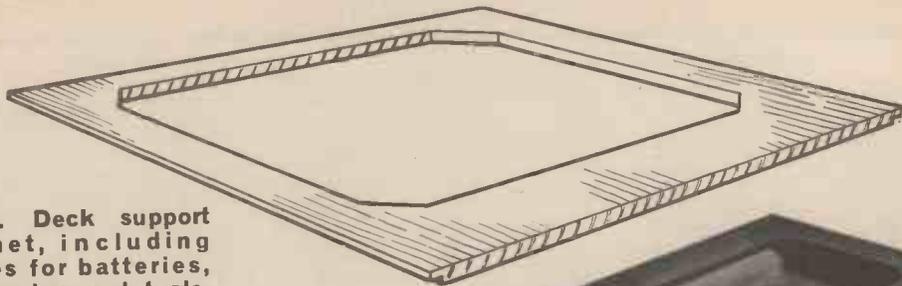
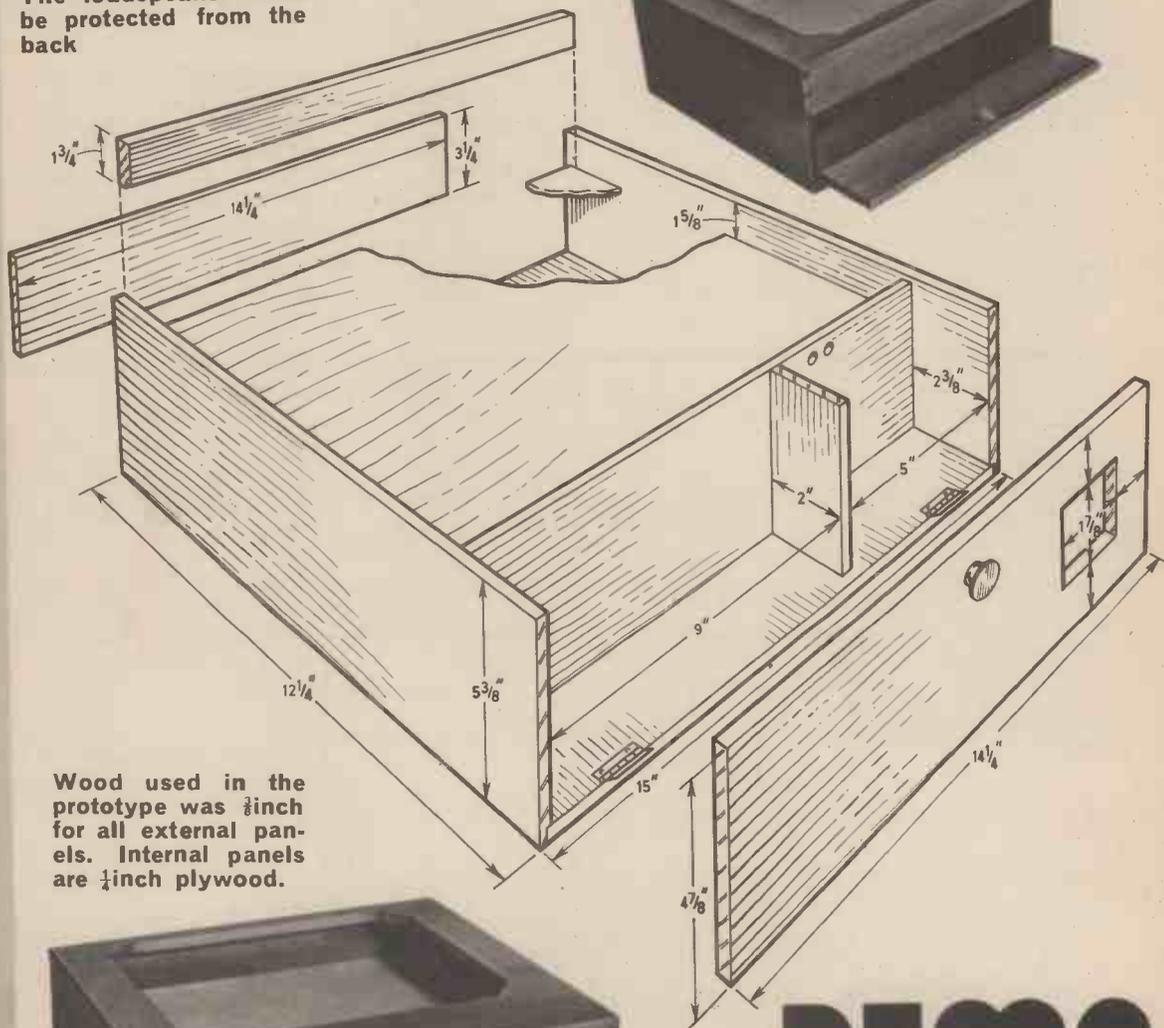
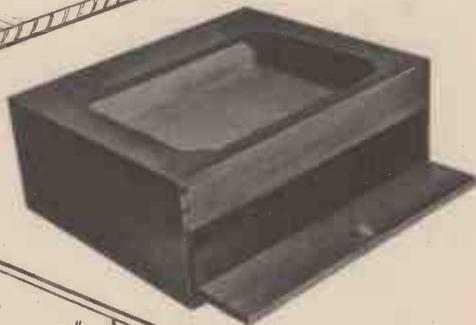


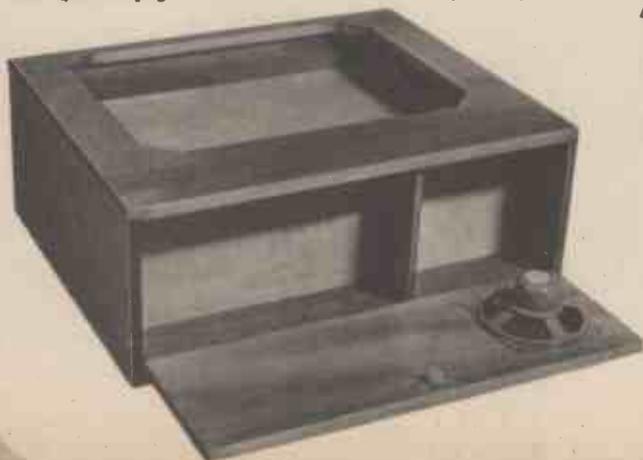
Fig. 3 Drilling details for the Demo Deck



**Fig. 5. Deck support cabinet, including spaces for batteries, loudspeaker and tools. The loudspeaker must be protected from the back**



Wood used in the prototype was  $\frac{3}{4}$  inch for all external panels. Internal panels are  $\frac{1}{2}$  inch plywood.



# DEMO DECK

the layout drawing (Fig. 3). It is as well to check the diameter of fixing holes because some components of different manufacture can vary in physical dimensions.

Check that the potentiometers, lamp holders, terminals and meter will fix correctly and then finish off the surface of the Demo Deck. If aluminium is used, make a satin finish by scrubbing the surface in a horizontal direction with fine grade wire wool; lightly dust off the metallic powder produced without getting finger marks on the surface and immediately apply a coat of polyurethane varnish. When dry apply lettering either with transfers or Letraset and then give a final protection coat of varnish. If you have used a wooden surface apply one or two coats of a hard gloss paint and when dry carry out the lettering as above. Finish off with a coat of clear varnish. Each tag should be identified by a number/letter code and this can be applied to the chassis around the edge of the board. The designations are applied as shown in Fig. 1.

## WIRING

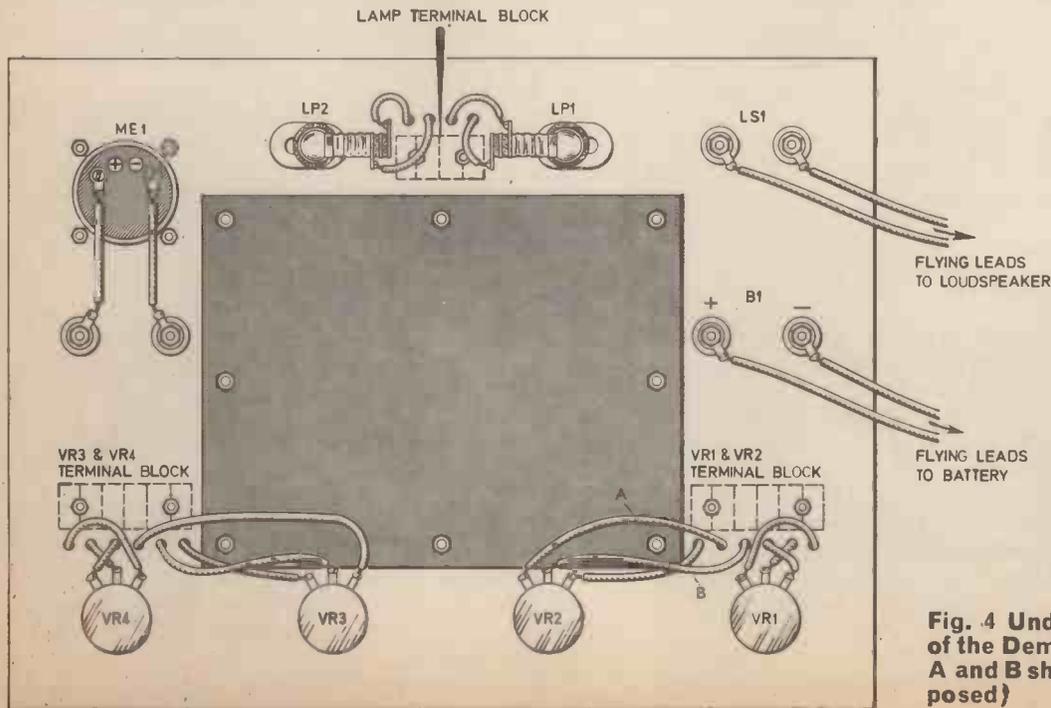
Now is the time to mount permanently all the components. Take care when handling the 1 milliamp meter and make sure that you have the potentiometers mounted in the right places. If necessary cut the shafts of the potentiometers, to take the knobs, before mounting on the deck. The values of resistance are printed on the side of the potentiometer cans. The underside wiring is only to route the terminals of the components to the Demo Deck terminals

and Fig. 4 shows the details. Take note that there is a cross-over in the wiring sense of the potentiometer terminals and ensure that the polarity of the meter is correct. All meters should have the positive terminal marked + or with a red spot of paint. Leave the flying leads from the battery and loudspeaker terminals about 18 inches long: these will be connected to the components mounted in the wooden cabinet.

Set the deck aside and make a suitable support. It is recommended that a cabinet similar to that described in Fig. 5 be made. This will hold the batteries and loudspeaker, as well as having a compartment for tools and small extra components. Fig. 5 shows an exploded view of the prototype design. Make sure that you leave sufficient room to gain access to the batteries and that the rear of the loudspeaker is protected.

All that remains to be done is to make up some accessory leads. It is suggested that you keep an assortment of single ended and double ended crocodile clip leads and two or three single ended banana plug leads. These will be extremely useful for experimentation and can save a lot of frustrating time wasting.

There is only one word which need be said about the use of the deck. While the tag posts can be re-soldered many times it is worthwhile attempting to use the minimum amount of solder otherwise there will be a tendency to build up a large "blob" which can be annoying and ultimately make further soldering difficult. Should the wiring panel reach a condition when it can no longer be used it can be replaced simply by undoing the eight screws and dropping it out. □



# simple FUZZ box

By N.D. Jones

Build this simple fuzz box and add weird and interesting effects to your music.



**W**ITH the revival of the fuzz sound now that "heavy" groups are becoming more and more popular, a fuzz box using the minimum of components has been designed.

The unit is constructed using Veroboard and this is mounted, together with sockets, switch, fuzz control potentiometer and battery inside a constructed aluminium case measuring only 4in.  $\times$  2 $\frac{7}{8}$ in.  $\times$  1 $\frac{1}{2}$ in.

## CIRCUIT

The circuit diagram for the fuzz box is shown in Fig. 1. It is basically a two-stage transistor amplifier using *npn* transistors. The input is first amplified by TR1 and then passed to the base of TR2. This second stage acts as an over-driven amplifier which clips and distorts the signal, producing the effect called "fuzz."

The bias on the base of TR2 can be adjusted by means of the potentiometer VR1. This changes the nature of the distortion and provides a certain amount of control over the "quality" of the fuzz.

The pre-set VR2 is incorporated to act as a variable attenuator so as to prevent overloading

of the main amplifier where permanent damage could be sustained if the output from the fuzz box was too high.

The values of the capacitors C2 and C3 have been chosen so as to provide a certain amount of treble boost which is a desirable effect with the fuzz sound. If more treble boost is required, this can be obtained by decreasing the values of C2 and C3.

## WIRING THE VEROBOARD

The position of the components and the wiring on the Veroboard is shown in Fig. 2. All the resistors, capacitors and transistors can quite easily be mounted on a piece of standard Veroboard size 2 $\frac{1}{2}$ in.  $\times$  1 $\frac{1}{2}$ in.  $\times$  0.15in. matrix. The copper strips on the underside of the board should be cut as shown in Fig. 2, either with a small drill or the special Veroboard cutting tool that can be obtained from most stockists.

A mounting hole should be drilled at location E1 on the Veroboard so that it may be secured to the lid of the metal case by means of a 6BA nut and bolt.

Mount and solder all the components and

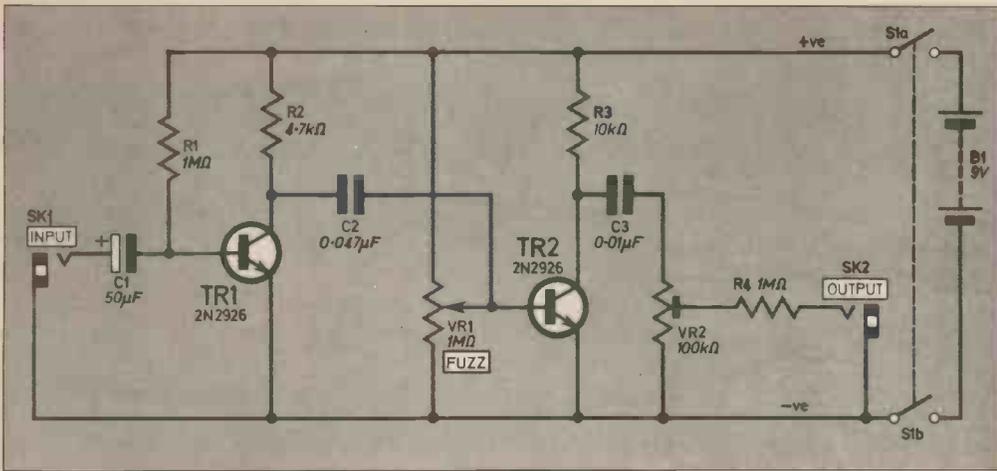


Fig. 1. The circuit diagram of the fuzz box.

flying leads on the board as shown, taking special care when soldering the transistors. It is recommended that a heat shunt be used, such as a pair of pliers gripping the transistor lead being soldered. This conducts away the heat from the soldering iron which would otherwise damage the transistor.

Some form of insulation should be placed between the Veroboard and the lid to ensure there is no "shorting" of the rear of the Veroboard by the metal lid. A piece of insulation tape stuck to the lid, under the Veroboard, is sufficient to prevent this.

### CASE CONSTRUCTION

The size, shape and material of the case may be tailor-made to individual requirements, but the one shown in the photograph and described here was, besides having a neat appearance, found to be easy to construct and readily able to house all the components in a neat and tidy fashion.

The prototype case was made from 1/16in. thick aluminium sheet to the dimensions given in Fig. 3.

All holes should be drilled before the metal is bent to shape.

The holes for fixing SK1, SK2, and VR1 will require large drill bits, up to 1/2in. diameter. If these are not available, a smaller hole should be drilled first and then filed with a circular file until the correct size is obtained.

The slot for accommodating the slide on-off switch is easiest made using the "drill and file" method. That is, drill holes at the extremes of the rectangular area to be removed and then straighten up the perimeter with a small file.

The lid, which forms the base, is made from the same material as the body of the case and should have a 1/4in. lip to enable attachment to the body by means of 2 small self-tapping screws.

The case is now ready for assembly.

### ASSEMBLY

Fix SK1, SK2, VR1 and S1 firmly in their positions in the case as shown in Fig. 4, and then wire them to the Veroboard. The length of all these wires should be about 5 to 6 inches.

Screened cable must be used for the connections between SK1, SK2 and the Veroboard. This eliminates interference.

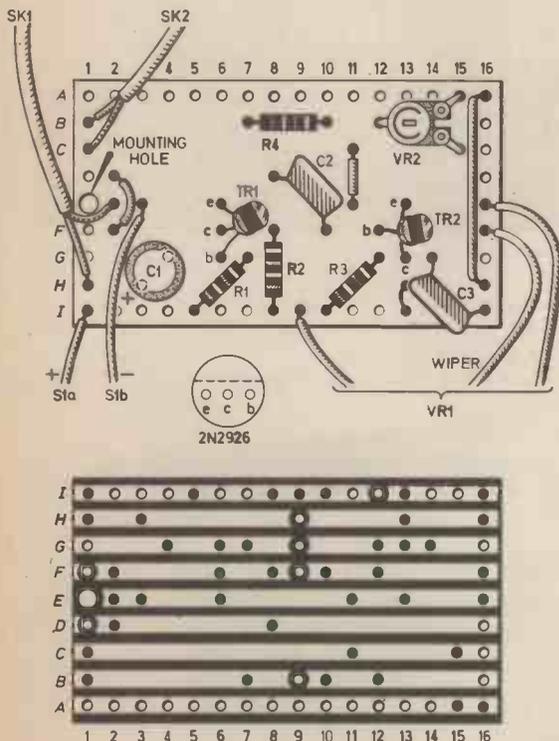
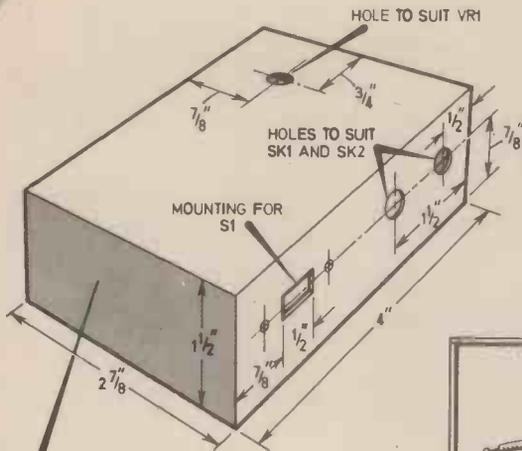


Fig. 2. The layout of the components on the top side and underside of the veroboard. Note that the flying leads to SK1 and SK2 are of screened cable. The transistor base connections as viewed from underneath are shown below. The larger drilled hole at E1 is for mounting purposes.

# simple FUZZ box



SIMPLE ALUMINIUM CASE WITH DETACHABLE BASE

Fig. 3. The case dimensions and positions of holes to be drilled.

Approximate

£

cost of components

1.60 plus case

## Components....

### Resistors

R1	1M $\Omega$
R2	4.7k $\Omega$
R3	10k $\Omega$
R4	1M $\Omega$
	All $\frac{1}{4}$ W $\pm$ 10%

### Potentiometers

VR1	1M $\Omega$ log. or linear
VR2	100k $\Omega$ skeleton preset

### Capacitors

C1	50 $\mu$ F elect. 15V
C2	0.047 $\mu$ F
C3	0.01 $\mu$ F

### Transistors

TR1, TR2	2N2926 silicon npn (2 off)
----------	-------------------------------

### Miscellaneous

SK1, SK2	Standard jack sockets (2 off)
S1	Slide on/off switch

B1 9V battery (PP3) and connecting terminal,  $\frac{1}{8}$  inch, aluminium sheet for case. 12 in. screened lead. 16 holes x 9 strips x 0.15 in. matrix Veroboard. Control knob.

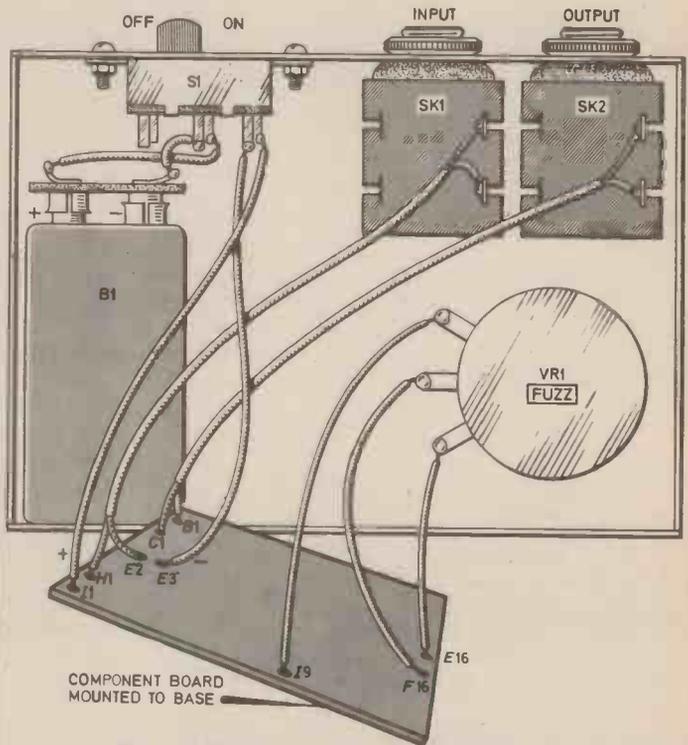


Fig. 4. View of the completed fuzz box from below, showing the wiring of the Veroboard to the switch, sockets and potentiometer.



# ANTEX

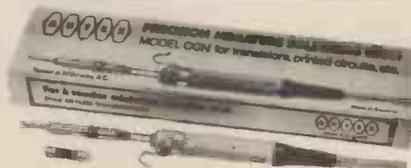
## the soldering appliance specialists



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E.240 20 watt 240 volts soldering iron fitted with 1/4" iron coated bit. Spare bits 3/32", 1/8" and 3/16" available. Can also be supplied for 220 and 110 volts. Price £1.80.

ES.240 25 watt 240 volts soldering iron fitted with 1/8" iron coated bit and packed in a transparent display box. Spare bits 3/32", 3/16" and 1/4" available. Can also be supplied for 220 and 110 volts. Price £1.83



### SK. 1 SOLDERING KIT

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder." Also available for 220 volts.

Price £2.75



### SK. 2 SOLDERING KIT

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

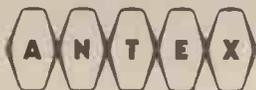
Price £2.40.



### MES. 12

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Price £1.95



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2G303	20p	2N3414	221p	40312	471p	BCY31	30p	B8X61	821p	NKT402	90p
2G306	421p	2N3415	221p	40314	30p	BCY32	50p	B8X76	221p	NKT403	70p
2G308	30p	2N3416	371p	40320	471p	BCY33	25p	B8X77	271p	NKT404	821p
2G309	30p	2N3417	371p	40321	30p	BCY34	30p	B8Y10	80p	NKT405	75p
2G371	15p	2N3570	171p	40324	471p	BCY38	40p	B8Y10	271p	NKT406	621p
2G374	20p	2N3572	971p	40328	371p	BCY39	60p	B8Y11	271p	NKT451	821p
2G381	221p	2N3605	271p	40329	30p	BCY40	50p	B8Y24	15p	NKT452	821p
2N404	221p	2N3606	271p	40344	271p	BCY42	15p	B8Y25	15p	NKT453	471p
2N696	20p	2N3607	221p	40347	571p	BCY43	15p	B8Y26	171p	NKT603F321p	
2N697	171p	2N3702	11p	40348	521p	BCY44	321p	B8Y27	171p	NKT603F321p	
2N698	25p	2N3703	10p	40360	421p	BCY54	221p	BSY28	171p	NKT674F30p	
2N706	15p	2N3704	11p	40361	471p	BCY59	221p	BSY29	171p	NKT677F30p	
2N705A	181p	2N3705	10p	40362	571p	BCY60	971p	BSY32	25p	NKT713	25p
2N708	15p	2N3706	09p	40370	321p	BCY70	20p	BSY36	25p	NKT781	30p
2N709	621p	2N3707	11p	40406	571p	BCY71	25p	BSY37	25p	NKT1045930p	
2N718	25p	2N3708	07p	40407	40p	BCY72	171p	BSY38	221p	NKT10439	
2N724	20p	2N3709	09p	40408	521p	BCZ10	271p	BSY39	221p		
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2N714	171p	2N3711	12p	40467A	571p	BD116	12p	BSY51	321p		
2N916	171p	2N3715	21-25	40468A	30p	BD121	65p	BSY52	321p	NKT20329	
2N918	30p	2N3716	11-30	40600	571p	BD123	821p	BSY53	321p		
2N929	221p	2N3791	22-00	AD 107	30p	BD124	80p	BSY54	40p		
2N930	271p	2N3793	35p	AD 108	30p	BD131	75p	BSY56	90p	NKT20339	
2N1090	221p	2N3823	971p	AC127	25p	BD132	85p	BSY78	471p	NKT5011	
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2N1132	25p	2N3855	271p	AC176	25p	BDY17	21-50	BSY90	571p		
2N1302	171p	2N3855A	30p	AC187	621p	BDY18	11-76	BSY95A	181p	NKT80113	
2N1303	171p	2N3856	30p	AC188	371p	BDY19	11-971	BSW41	421p		
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2N1307	25p	2N3859	271p	ACY20	25p	BDY61	21-25	C425	55p		
2N1308	30p	2N3859A	321p	ACY21	25p	BDY62	21-00	C426	40p	NKT80213	
2N1309	30p	2N3860	30p	ACY22	20p	BF115	25p	C428	371p		
2N1307	171p	2N3866	21-50	ACY28	20p	BF117	471p	C744	40p	NKT80214	
2N1613	25p	2N3877	40p	ACY40	40p	BF163	30p	D1P1	371p		
2N1631	35p	2N3877A	40p	ACY41	25p	BF167	18p	D1P2	40p	NKT80215	
2N1632	30p	2N3900	371p	ACY44	40p	BF173	19p	D1P3	371p		
2N1638	271p	2N3900A	40p	AD140	521p	BF177	30p	D1P4	40p	NKT80216	
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2N1671B	21-00	2N3903	35p	AD150	621p	BF179	30p	GET103	30p	OC20	
2N1711	25p	2N3904	45p	AD161	371p	BF180	35p	OC22	50p		
2N1689	851p	2N3905	371p	AD162	871p	BF181	321p	OC23	60p		
2N1893	871p	2N3906	371p	AF106	421p	BF184	25p	OC24	60p		
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2N2148	571p	2N4059	10p	AF115	95p	BF194	171p	OC26	271p		
2N2160	571p	2N4060	121p	AF116	25p	BF195	15p	OC29	621p		
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2N2193A	421p	2N4092	181p	AF118	621p	BF197	421p	OC35	621p		
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2N2217	871p	2N4285	171p	AF124	221p	BF200	521p	OC41	221p		
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2N5266	321p	2N5246	421p	ASy51	321p	BFX89	621p	OC171	30p		
2N5271	25p	2N5249	871p	ASy54	25p	BFX93A	70p	OC200	40p		
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2N2926	15p	2N5367	371p	BC140	371p	BFY43	30p	TI846	11p		
Green	14p	2N5457	371p	BC147	10p	BFY51	20p	TI847	11p		
Yellow	121p	28005	75p	BC148	10p	BFY52	23p	TI848	121p		
Orange	121p	28020	22-00	BC149	12p	BFY53	171p	TI849	121p		
2N3011	30p	28102	50p	BC152	171p	BFY66A	571p	TI850	171p		
2N3014	321p	28103	50p	BC157	20p	BFY76	30p	TI852	121p		
2N3055	25p	28104	25p	BC158	11p	BFY75	221p	TI852	121p		
2N3054	46p	28101	321p	BC159	12p	BFY77	571p	TI853	221p		
2N3055	62p	28502	35p	BC160	621p	BFY90	871p	TI860	221p		
2N3133	30p	28503	271p	BC167	11p	BFW58	871p	TI861	25p		
2N3134	30p	3N83	40p	BC168B	10p	BFW59	25p	TI862	271p		
2N3135	25p	3N128	45p	BC168C	11p	BFW60	25p	TI862	271p		
2N3136	25p	3N143	721p	BC169B	11p	BFX25	41-33	TI863	271p		
2N3390	25p	3N141	721p	BC169C	12p	BFX29	41-80	TI863	271p		
2N3391	20p	3N142	55p	BC170	121p	BFY10	21-45	TI863	271p		
2N3391A	30p	3N143	871p	BC171	15p	BFY39	371p	TI863	271p		
2N3392	171p	3N152	871p	BC172	15p	BSX19	171p	TI863	271p		
2N3393	15p	R.C.A.	521p	BC175	221p	BSX20	171p	TI863	271p		
2N3394	15p	2N3394	15p	BC176	15p	BSX21	15p	TI863	271p		
2N3402	221p	40251	321p	BC183	09p	BSX26	45p	TI863	271p		
2N3403	221p	40309	321p	BC184	11p	BSX27	471p	TI863	271p		

**TTL LOGIC I.C. NEW PRICES**

	1-11	12-24	1-11	12-24	1-11	12-24		
	sp	sp	sp	sp	sp	sp		
SN7400	0.80	0.18	SN7433	0.80	0.75	SN7472	0.32	0.30
SN7401	0.20	0.18	SN7437	0				

Connect the battery terminal as shown in Fig. 4 making sure that the polarity is correct, otherwise damage to the transistors may result.

All that remains to be done is to fix the Vero-board to the lid by means of a small nut and bolt, clip in the battery and secure the lid. The fuzz box is now complete and ready for use.

If required a foot switch may be included in the fuzz box to switch in and out the fuzz effect. Such a switch must be arranged to connect the input to the output (SK1 to SK2) and screened lead should be used to wire up the switch.

## USES

The fuzz box is used extensively and mostly by "groups" for lead guitar where it is placed between the guitar and the main amplifier, but it may be employed for effect with almost any instrument, such as bass guitar, electronic organ, and even microphone. Weird and interesting sounds may be obtained by using the fuzz box

in conjunction with a microphone used to amplify musical instruments such as a trumpet and trombone. This device is a must for the musical sound experimenter. □



## Ruminations By Sensor

### The I.C. man cometh

The reductions in size and production costs and the improvement in reliability of complex electronic systems, brought about by the use of integrated circuits has lead to their incorporation into all kinds of equipment. Apart from the more obvious applications such as computers and kindred equipment, radar, television and communications systems; integrated circuits can now be found in applications as diverse as washing machines, model aircraft control and in fuel injection and ignition systems for motor cars. With these facts in mind, I began to wonder what the future electronic "foreigner" will be like.

Before writing anything else I must hasten to add that I am not going to discuss genetics; a "foreigner", in industrial terms, is a private job carried out on works premises. The foreigner can take many forms, it may be a small repair job which requires facilities not normally available in the home, such as welding or turning, or it may be a complete piece of equipment, designed and built within the works. Foreigners are

usually relatively small in dimensions, or capable of being broken down into small units, so that they can be hidden from authority and eventually smuggled out of the factory.

One thing common to all foreigners is that they seldom reach completion; in the first flush of enthusiasm there is much frenzied activity which is highly infectious. Colleagues will rush to assist with ideas and materials, other departments will lend expertise and facilities, and if these offers of help are not strongly resisted from the outset, the original creator will find that his precious brainchild has been wrenched from his grasp to be broken down into a number of sub projects spread throughout the works.

Further sub-division may then take place and it can be said that the more sub-divisions there are, the less likelihood there is of the project being completed. Also, the rate of working falls off very rapidly after the initial fervour has evaporated—as there are few things more boring than old foreigners, especially other people's foreigners. These rules can be expressed in simplified form as:

$$t_0 = F_r U_s T_{rate} + \Sigma I$$

where  $t_0$  = time to completion  
 $F_r$  = "foreigner receptiveness" (a constant for the factory)

$U_s$  = the number of unit sub-divisions

$T_{rate}$  = the rate of toiling

$\Sigma I$  = the sum of all the inertia factors of everyone involved (similar rules apply to bona fide jobs but  $F_r$  is replaced by a term  $O$  representing official support).

But what, you may ask, has all this to do with integrated circuits? Well, integrated circuits are small—one of the essential features of a foreigner; (though I heard that a 60 foot maypole was once built as a foreigner; but that is another story!) they are virtually complete in themselves and often merely require connection to a power supply and some ancillary input or output equipment and they are ready for use. A wide range of timing circuits and audio circuits exists and the versatile operational amplifier lends itself to many projects.

Can we expect to see a flood of baby alarms, exposure timers, model railway controllers and electronic roulette games pouring through the factory gates? I think not, for there is still the problem of the box, case or cabinet. This is where the greatest inertia is traditionally encountered and where  $F_r U_s T_{rate}$  approaches infinity. Until we discover how to "grow" boxes around our foreigners, they are doomed to remain what they have always been—memorials to frustrated creativity.

# COMPONENT BUYING & SUPPLYING



## No. 2 Suppliers

Second of a series of three articles

by Alan Sproxton, Home Radio (Components) Ltd.

... wonderful! ... I have been searching everywhere for one".

I AM sure I am speaking not only for my fellow component suppliers, when I say nothing delights us more than to hear a customer say "Have you got such and such in stock? ... wonderful! ... I have been searching everywhere for one". At the other end of the scale there is the customer who reduces us all to the depths of despair and seems to assume that we run out of something he wants purposely to thwart his plans.

On the whole, you, the customer are sympathetic and understanding, but when you have heard some of our problems, I'm sure you will be even more so. First there are the obvious problems, that we are dealing with thousands of different items and added to that, change in electronics is so rapid that obsolescence is also fast. This is particularly noticeable in transistors, where frequently some types are superseded by new versions before the originals have even reached the public.

### The Middlemen

What increases our difficulties is the fact that we are the men in the middle. We are dependent on manufacturers or wholesalers and should they decide that a certain item is not worth handling they stop making it, usually all our tears won't make them change their minds!

There are two factors involved here, percentage of gross profit and stock turn round. The percentage of gross profit can be varied by altering the buying or selling price, but the stock turn (which

simply means the speed at which an item sells) depends entirely on the demand!

### Stock Turn-Over

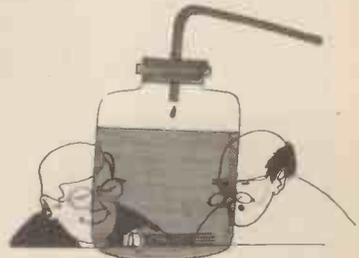
On the average a supplier might expect to turn his stock over six times during the year for example, if he has 12 plugs in stock, he would expect to sell 72 during a year. One very large firm of electronic wholesalers has a very rigid policy on this and once sales have slumped below a certain level on an item, they just drop it completely. With smaller firms such as ours, if we thought the item irreplaceable we would try and keep it going as a service to customers; but to illustrate how difficult that can be in practice, let me tell you of one actual case.

We used to purchase Pyrex glass aerial strainers from Eddy-stone Radio. They decided to discontinue them so we went to the manufacturers. They agreed to supply us in minimum quantities of 250, so we went ahead. Then about two years ago they politely informed us that they would not supply us with less than 1,000! As the nett price was over 20p each, this meant an outlay of over £200 for an item we sold at the rate of one or two hundred a year!! Naturally we were compelled to give them up.

### Combined Operation

It is with the object of overcoming this difficulty that I recently formed a Group of Suppliers called "Group One". I am very pleased to say that our successes

as a group have been reasonably high and we have been able to prevent many items from disappearing altogether. To quote a few, the Standard Maka Switch Kit, Acoustic Acetate Wadding, and the Electroniques SMD2 Drive and Dial. Wherever we see an item threatened which we think ought to remain available to you, the customer, we act to preserve it. Our other basic aim is to keep down prices. It might be appropriate at this point to mention prices because it is one of our most thorny problems.



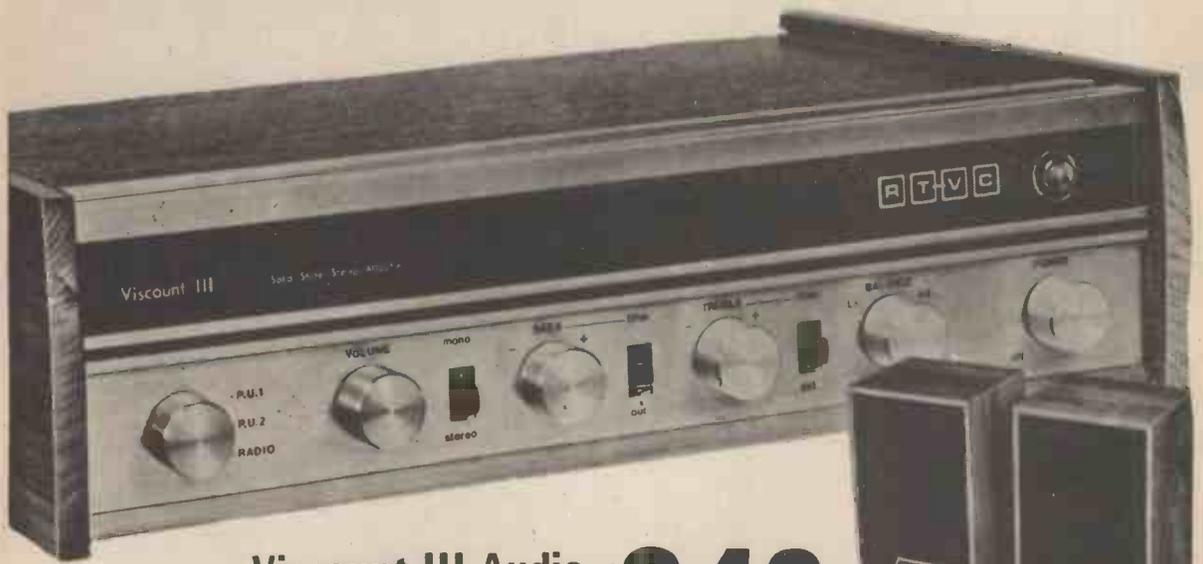
... we act to preserve it

### Price Increases

Ever since the last war, prices have been rising faster and faster. When there is a price increase, a manufacturer or wholesaler simply writes to us and states "As from today's date the price of X has gone up by Y per cent". Often they don't even tell us and we only discover it from the invoices.

What a contrast to the position of us dealers! Many of us have thousands of brochures and cata-

# 28watts, 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. cartridge 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 6½". 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 250mV 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 13½" x 9" x 3½".

# R+TV

Radio and TV Components (Acton) Ltd. 21e High Street, Acton, London W3 6NG  
 323 Edgware Road, London, W.2. Mail orders to Acton. Terms C.W.O. All enquiries S.A.E.  
 Goods not despatched outside U.K.

The components you want plus good service, prompt delivery & attractive discounts **EE. 2**

# ELECTROVALUE

## Electronic Component Specialists

### THIS MONTH'S SELECTION OF POPULAR ITEMS FROM THE ELECTROVALUE CATALOGUE

#### TRANSISTORS

No.	Type	Purpose	Price
2N997	Sil. NPN	General	18p
2N1304	Ger. NPN	"	28p
2N1305	PNP	"	28p
2N2646	Sil. UJT	Oscillator, SCR driver	47p
2N2924	NPN	Small sig. amp	11p
2N3055	NPN	High power	60p
2N3702	PNP	Low power	13p
2N3704	NPN	Low power	13p
AC126	Ger. PNP	Small sig./driver	20p
AC128	PNP	Low power	20p
AD149	PNP	High power	58p
AC176	NPN	Low power	18p
AD161	NPN	Med. power	33p
AD162	PNP	Med. power	36p
BC108	Sil. NPN	Small signal	11p
BC109	NPN	Low noise	18p
BC168	NPN	Small signal	10p
BC169	NPN	Low noise	11p
BF194	NPN	RF amp.	14p
BFT51	NPN	Med. current	20p
OA90	Ger. diode	RF detector	8p
OA91	"	General	8p
SD1	"	Silicon Rectifier 1 amp	10p
W02	"	Silicon bridge 1 amp	40p

(Sil. = Silicon. Ger. = Germanium)

#### CAPACITORS

Non-polarised		Electrolytic	
10pF	3p	1mF 40V	6p
22pF	3p	5mF 64V	6p
100pF	3p	10mF 64V	6p
220pF	3p	20mF 64V	6p
470pF	3p	25mF 25V	6p
1000pF	3p	50mF 25V	6p
2200pF	3p	80mF 25V	6p
4700pF	3p	100mF 25V	10p
		470mF 25V	12p
		1000mF 25V	20p
		2000mF 25V	30p
		5000mF 25V	62p

Polyester M K T		Many other higher and lower ratings will be found in the catalogue.
0.01mF	5p	
0.02mF	5p	
0.047mF	6p	
0.1mF	6p	
0.22mF	6p	
0.47mF	10p	
1mF	14p	

#### RESISTORS

½ watt and ¼ watt, all at 1p each in the following values (in ohms):—  
10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and all values in this series up to 10 Megohms.

**Power Resistors**  
3 watts—7p each; 7 watts—9p each.  
Values as for ¼ watt series, but up to 10 Kohms only.  
Many other types and values available.  
Full details in catalogue.

#### VEROBOARD

The universal circuit building board  
Unclad, 0.1" matrix  
2" x 3.75" 10p  
2.5" x 3.75" 15p  
5" x 3.75" 25p  
Copperclad Veroboard also in stock in all standard sizes and matrices; also edge connectors, pins, etc.

**PEAK SOUND ENGLEFIELD 80**  
Brilliantly designed hi-fi amplifier with facility to take add-in stereo FM tuner. Superb performance. 20+20 watts RMS into 8 ohm speakers. As advertised £49.50. Brand new, and guaranteed in maker's carton  
**£33.75**  
(+75p carr in U.K.)

#### VOLUME CONTROLS, ETC.

Very wide ranges carried including the following popular types:—  
4.7Kohms, 10Kohms, 22 Kohms, 47, 100, 220, 470 Kohms; 1 Megohm, 2.2 Megohms.



Log or linear tracking  
MONO 12p each; STEREO (matched tracks) 42p  
Any type with double pole mains switch—12p extra

**STEREO BALANCE CONTROLS**  
Log/Antilog 10K, 47K, 1M  
Dual antilog 10K only.

#### MAIN LINE AMPLIFIERS

70 watt power amplifier in module form ready to build into any system. With full instructions.

Amplifier module ... net £12.60  
Power supply kit ... net £6.00  
Matching pre-amplifier kit (for magnetic or ceramic pick-up) ... net £3.30

Note—All the above prices are for mono.

**FOR STEREO** for building into your own cabinet. Two amplifier modules and pre-amp kits are required with matched controls plus one power supply kit, net price £38.40

#### MISCELLANEOUS ITEMS

**INDICATOR LAMPS**  
NEON chrome bezel, round red NR/R, 24p; chrome bezel, round amber NR/A, 24p; chrome bezel, round clear NR/C 24p. Neon, square red type LS5C/P, 18p; amber type LS5C/A, 18p; clear type LS5C/C, 18p. All above are for 240V mains operation. Fillament types: 6V, 0.04A square red type LS5C/R-6V, 30p, 6V 0.04A amber type LS5C/A-6V, 30p; 6V 0.04A clear type LS5C/C-6V, 30p; 6V 0.04A green type LS5C/G-6V, 30p; 12V 0.04A LS5C/R-12V, 34p; 34V 0.04A LS5C/R-28V, 45p.

**COLVERN 3 watt Wire-wound Potentiometers**, 10Ω, 15Ω, 25Ω, 50Ω, 100Ω, 150Ω, 250Ω, 500Ω, 1K, 1.5K, 2.5K, 5K, 10K, 15K, 25K, 50K, 32p each

**DIN CONNECTORS**

		plug	socket
Loudspeaker	2-pole	12p	10p
Audio	3-pole	13p	10p
Audio	4-pole	14p	12p
Audio	5-pole 180 deg	15p	12p
Audio	5-pole 240 deg	15p	12p
Audio	6-pole	15p	13p

**HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES**, 40p. (Postage 3p if ordered alone).

**KNOB-NUTS, SCREWS, WASHERS — CIR-KIT — LOUDSPEAKERS — TRANSFORMERS**

**OVERSEAS CUSTOMERS WELCOME**

#### COMPONENTS DISCOUNTS

allowed on all items other than those at net prices.

**10% on orders for £5 or more**      **15% on orders for £15 or more**

**POSTAGE & PACKING FREE** on orders for £2.00 or more. Please add 10p if under.

Overseas orders welcomed. Prices subject to alteration without prior notice.

10p CATALOGUE FREE WITH ORDERS FOR £1.00 OR MORE

The Electrovalue catalogue (64 pages and cover, 8½ x 5½ins) is crammed with money saving items, and illustrated technical information. FREE with orders for £1.00 or more. Sent separately it costs you 10p post free. Write your order on a sheet of paper with coupon attached

# ELECTROVALUE

28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY,  
Hours 9—5.30 : Sat. 1.0 p.m.  
Telephone: Egham 5533 & 4757 (STD 0784-3) Telex : 264475

To ELECTROVALUE, ENGLEFIELD GREEN, EGHAM, SURREY  
Please send a Goods to value of £..... as detailed on sheet attached, plus FREE copy of catalogue.  
b Copy of catalogue.  
(strike out item which does not apply)

NAME .....  
ADDRESS .....  
.....  
(Enclosed please find £.....cash/cheque/money order.)

logues in circulation and consequently we shall be receiving too little money for our goods. When the price jump is big, we finish up selling below cost! We must then, either write to you, the customer, asking for more money (which does not help the customer-dealer relationship), or we must lose money.

Many years ago, we took our prices out of our catalogue and put them in a separate supplement as we argued that although we couldn't reprint the catalogue for every price change, at least we could change a price supplement several times a year. Lately, the rapidity of price changes made even this unworkable and we have now installed an Offset Litho Machine to print our own Price Supplements on the spot. Price changes can be made within minutes and at last we are keeping up with them!



... Price changes can be made within minutes

### Packing and Postage

One minor problem which I think we have solved fairly well is making a part charge towards the cost of packing and postage. After much thought, we decided to average out the cost of all postage and charge this as a standard rate. At the moment it is 18p per parcel. Naturally the customer who orders some heavy transformers is happy, but the customer who orders 25p worth of resistors less so.

Occasionally a customer might write and say "You charged me 18p for post and packing and I noticed that my 25p worth of resistors were just put in a padded bag with a 3p stamp on it". It is then necessary to point out that our gross profit on the transaction is probably 8p and apart from the bag costing us 3p and the stamp 3p, the staff handling it are earning about 1p per minute! But I must be fair and say we probably receive less than 12 letters a year in this vein. I think even with "cash with

order", that probably all dealers lose money on orders under £1—but again it is a service to the customer. We stress again and again, try and send one big order instead of several small orders, help yourself to save postage and also help us!

### Stock Control

Nothing frustrates you, the customer, more than to be told that an item you require is out of stock. You may put this down to bad management and poor stock control. Well, a few years ago, one of the giants in the electronic components industry decided to go into the retail side, and produced magnificent catalogues, spent thousands in advertising and yet after a year or two, it was obviously not going according to plan.

Knowing that we had achieved a very modest success in the business, two of the firms executives came and took my partner and I to lunch and it was apparent they wanted to find out what made us tick! When they got round to stock control, they said "What do you do?" and we said "What do you do?" "Well," they said, "when an order comes in it is fed into the computer. The computer makes out the invoice, types the label, checks the stock, and when the stock falls below a certain pre-determined level, re-orders! And now, what do you do?"

"Oh!" we replied, "well if we pick up a box and it's empty, we re-order, if the box is battered and worn out (they are cardboard by the way) we obviously should order bigger quantities, if there is more than a certain pre-determined thickness of dust on the box, this item is a slow seller and should be discontinued."

The two executives stared at us in disbelief until we convinced

... more than a certain predetermined thickness of dust



them that we were telling them the truth, and when we pressed them, they admitted they were out of stock of various goods far more often than we were!! We then went on to tell them why—there are too many variables for any computer to cope with, therefore one might just as well do it the simplest way!

Next month I will discuss the influence of magazine constructional articles upon the supply situation.

## EVENING ELECTRONICS

Many readers, both newcomers to electronics and experienced hobbyists, may be interested in evening classes or clubs for electronic enthusiasts. There are many evening classes run for both beginners and experienced constructors all over the country and we know that some evening Institutes run more than one course. Although these courses will have been going on for more than a month when you read this, most of them will gladly accept newcomers.

If you are interested in joining such a class, we recommend you to get in touch with your local education authority, who can inform you of all the courses in your area. For Londoners the booklet "Floodlight" available from most newsagents gives all the courses being held in the Greater London area.

As well as evening classes there are some electronics clubs operating within the British Isles, the largest of these being the British Amateur Electronics Club. For more information about this club and its activities please write to:

Mr. C. Bogod, The Secretary,  
B.A.E.C., 26 Forrest Road,  
Penarth, Glamorgan.

EVERYDAY ELECTRONICS may be visiting some evening classes and club activities and reporting on them during the coming months. So if you run or belong to such a group and you feel that you have something interesting to show us or that the arrangement and activities of your group warrant mention, then let us know.

### BODINE TYPE N.C.I. GEARED MOTOR



(Type 1) 71 r.p.m. Torque 10lb. inch. Reversible. 1/70th h.p. 50 cycle, 0-38 amp (Type 2) 28 r.p.m. Torque 20lb. inch. Reversible. 1/80th h.p., 50 cycle, 0-28 amp. "As new" condition. Input voltage of motor 115V a.c. Supplied complete with transformer for 230/240V a.c. Input. Price, either type £3-15 plus 35p. P. & P. or less transformer £2-13 plus 27p. P. & P.

### 12 VOLT DC MOTOR

Powerful 1 amp. REVERSIBLE motor. Speed 3,750 RPM complete with external gear train (removable) giving final speed of 125 RPM. Size 4" x 2 1/2" dia. Price 95p inc. post.



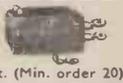
### 230V/240V COMPACT SYNCHRONOUS GEARED MOTORS

Manufactured by either Sangamo, Haydon or Smith. Built-in gearbox. 1 rev. per hour. Anti-clockwise rotation. 2 revs. per hour. Clockwise rotation. 3 revs. per hour. Anti-clockwise rotation. 15 revs. per hour. Anti-clockwise rotation. 60 revs. per hour. 1 r.p.m. Clockwise. Fraction of makers' price. Allat 75p incl. P. & P.



### MICRO SWITCH

5 amp c/o contacts. Fitted with removable push button assembly. Ex. P.O. 20 for £1 inc. post. (Min. order 20)



### MINIATURE LEVEL METER

Approximately 300 micro amp basic, as fitted to Tape Recorders, etc. Strip type dual coloured dial. 50p + 8p P. & P.



### ELECTRONIC ORGAN KIT

Easy to build. Solid State. Two full octave (less sharps and flats). Fitted hardwood case. Powered by two penlite 14V batteries. Complete set of parts including speaker, etc., together with full instructions and 10 tunes. Price £3-00. P. & P. 22p.

### 50 IN 1 ELECTRONIC PROJECT KIT

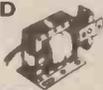
50 easy to build Projects. No soldering, no special tools required. The kit includes Speaker, Meter, Relay, Transformer, plus a host of other components and a 56-page instruction leaflet. Some examples of the 50 possible Projects are: Sound Level Meter, 2 Transistor Radio, Amplifier, etc. Price £7-75. P. & P. 30p.

### CRYSTAL RADIO KIT

Complete set of parts, including: Crystal Diode, Ferrite Aerial, Drilled Chassis, and Personal Ear Piece. No soldering, easy to build, full step by step instruction. £1-75 inc. post.

### 230v AC SOLENOID

Extremely powerful with approx. 14lb pull, 1" travel. Fitted with mounting feet. Size: 4" long, 2 1/2" wide, 3" high. £2-00 incl. P. & P.



### VENNER Electric Time Switch

200/250V Ex. G.P.O. Tested. Manually set 2 on, 2 off every 24h. Override switch: 10A £2-75, 15A £3-25, 20A £3-75. P. & P. 20p. Also available with solar dial ON dusk, OFF dawn. Price as above.



### LOW POWER UHF TRANSMITTER

In useful black crackle finished metal case. Size 9 1/2" x 5" x 2 1/2". Contains one 12v LT transformer, one 38-334 MHz crystal, multiplier stage, containing three OC170, one AF186, RF output, mains neon, SP toggle, miniature fuse holder etc. etc. Sold for components only, regret no data available on this device. A BARGAIN at 80p plus 30p P. & P.



### VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/140V a.c. 50/60 OUTPUT

VARIABLE 0.260V

All Types (and Spares)

from 1 to 50 amp from stock.

SHROUDED TYPE

1 amp, £7-00 2-5 amp, £8-05

5 amp, £11-75

10 amp, £22-50 20 amp, £49-00

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37-5 amp, £82-00 50 amp, £98-00

All plus £1-00 carr. where not specified.

OPEN TYPE (Panel Mounting) 1 amp, £4-75, 2-5 AMP

1 amp, £7-00 2 1/2 amp, £8-05. Carr. 40p on open type.



### Superior Quality Precision Made NEW POWER RHEOSTATS

100 WATT. 1 ohm, 10A; 5 ohm, 4-7A; 10 ohm, 3A; 25 ohm, 2A; 50 ohm, 1-4A; 100 ohm, 1A; 250 ohm, 0-7A; 500 ohm, 0-45A; 1 kΩ, 280 mA; 1-5 kΩ, 230mA; 2-5 kΩ, 140 mA. Diameter 3 1/2in Shaft length 7in, dia. 1 1/4in. All at £1-50 each. P. & P. 5p.

50 WATT. 1/5/10/25/50/100/250/500/1/1-1/2-2-5/5kΩ. All at £1-12 each. P. & P. 11p.

25 WATT. 10/25/50/100/250/500/1/1-1/2-5/3-5/5kΩ. All at 78p each. P. & P. 15p.



### STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

EXPERIMENTERS' ECONOMY KIT Speed adjustable 1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions £6-30, plus 25p P. & P.

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Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor. Speed adjustable 1-80 f.p.s. Price £10-50. P. & P. 50p.

### HY-LYGT STROBE MK III

This strobe has been designed and produced for use in large rooms, halls and the photographic field and utilises a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0-30 f.p.s. Light output approx. 4 joules. £12-00. P. & P. 50p. SPECIALLY DESIGNED. FULLY VENTILATED METAL CASE. Including reflector. £4-00 P. & P. 45p Post paid with kit.

### AND NOW!

### THE 'SUPER HY-LYGT KIT

Approx. four times the light output of our well proven Hy-Lygt strobe. Incorporating:

- Heavy duty power supply.
  - Variable speed from 1-23 flash per sec.
  - Fantastic Octal based tube with massive electrodes.
  - Reactor control circuit producing an intense white light.
- The brilliant light output of the 'SUPER' HY-LYGT gives fabulous effects with colour filter. Never before a Strobe Kit with so HIGH an output at so LOW a price. ONLY £20 plus 75p P. & P. ATTRACTIVE, ROBUST, FULLY VENTILATED METAL CASE specially designed for the Super Hy-Lygt Kit including reflector £7-00 P. & P. 45p. 7-inch POLISHED REFLECTOR Ideally suited for above Strobe kits. Price 53p, P. & P. 13p or post paid with kits.

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### MINIATURE RELAYS - COMPETITIVE PRICES

1	2	3	4	1	2	3	4
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230	9-12	4 c/o	78p*	1,250	24-36	4 c/o	63p*
280	9-12	2 c/o	73p*	2,500	36-45	6M	63p*
600	18-32	4 c/o	78p*	2,400	30-48	4 c/o	50p*
700	16-24	4M 2B	63p*	5,800	40-70	4 c/o	63p*
700	16-24	4 c/o	78p*	9,000	40-70	2 c/o	50p*
700	12-24	2 c/o	63p*	15k	85-110	6M	50p*

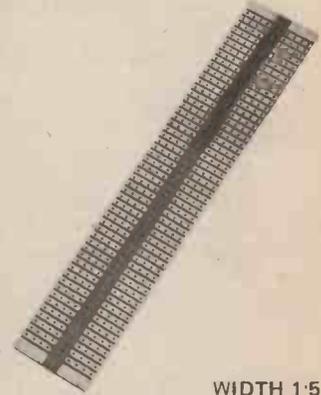
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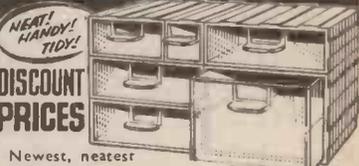
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# SEW PANEL METERS

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## NEW "SEW" DESIGNS! CLEAR PLASTIC METERS BAKELITE PANEL METERS



TYPESW.100  
 100 x 80 mm.

50μA	20V. D.C.	23-10
50-0-50μA	50V. D.C.	23-10
100μA	300V. D.C.	23-10
100-0-100μA	1 amp. D.C.	23-10
500μA	5 amp. D.C.	23-10
500μA	30V. A.C.	23-10
1mA	VU Meter	23-75



TYPE S-80  
 80 mm.  
 square fronts

50μA	20V. D.C.	23-20
50-0-50μA	50V. D.C.	23-10
100μA	300V. D.C.	22-60
100-0-100μA	1 amp. D.C.	22-60
500μA	5 amp. D.C.	22-60
1mA	30V. A.C.	22-60
20V. D.C.	VU Meter	23-37

## "SEW" CLEAR PLASTIC METERS

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



50μA	10V. D.C.	22-80
50-0-50μA	20V. D.C.	22-80
100μA	300V. D.C.	22-80
100-0-100μA	1 amp. A.C.	22-80
500μA	5 amp. A.C.	22-80
500μA	30V. A.C.	22-80
1mA	8 Meter 1mA	22-87
500μA	VU Meter	23-60
500-0-500μA	1 amp. A.C.	22-80
1mA	5 amp. A.C.	22-80
1-0-1mA	10 amp. A.C.	22-80
5mA	20 amp. A.C.	22-80
10mA	30 amp. A.C.	22-80

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

50μA	10V. D.C.	22-00
50-0-50μA	20V. D.C.	22-00
100μA	300V. D.C.	22-00
100-0-100μA	1 amp. A.C.	22-00
500μA	5 amp. A.C.	22-00
500μA	30V. A.C.	22-00
1mA	8 Meter 1mA	22-10
500μA	VU Meter	23-20
500μA	1 amp. A.C.	22-00
1 amp.	5 amp. A.C.	22-00
5 amp.	10 amp. A.C.	22-00

Type MR.85P. 3 1/2 in. x 3 1/2 in. fronts.

50μA	10V. D.C.	22-80
50-0-50μA	20V. D.C.	22-80
100μA	300V. D.C.	22-80
100-0-100μA	1 amp. A.C.	22-80
500μA	5 amp. A.C.	22-80
500μA	30V. A.C.	22-80
1mA	8 Meter 1mA	22-87
500μA	VU Meter	23-37
500μA	1 amp. A.C.	22-80
1 amp.	5 amp. A.C.	22-80
5 amp.	10 amp. A.C.	22-80

**\*MOVING IRON—  
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## SEW EDUCATIONAL METERS



Type ED.107. Size overall 100mm x 90mm x 108mm.  
 A new range of high quality moving coil instruments ideal for school experiments and other bench applications.

meter movement is demonstrate internal working. Available in the following ranges:

50μA	25-00	20V. d.c.	24-40
100μA	24-65	50V. d.c.	24-40
1mA	24-40	300V. d.c.	24-40
50-0-50μA	24-65		
1-0-1mA	24-40	Dual range	
1A d.c.	24-40	500mA/5A d.c.	24-85
5A d.c.	24-40	5V/50V d.c.	24-85
10V d.c.	24-40		

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



50μA	20V. D.C.	22-10
50-0-50μA	50V. D.C.	22-10
100μA	300V. D.C.	22-10
100-0-100μA	1 amp. D.C.	21-75
500μA	5 amp. D.C.	21-75
500-0-500μA	30V. D.C.	21-80
1mA	50V. D.C.	21-80
1-0-1mA	10V. D.C.	21-80
2mA	15V. D.C.	21-80
5mA	50V. A.C.	21-80
10mA	100V. A.C.	21-80
20mA	150V. A.C.	21-80
50mA	300V. A.C.	21-80
100mA	500V. A.C.	21-80
150mA	8 Meter 1mA	21-70
150mA	VU Meter	22-10

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

50μA	5 amp. D.C.	21-70
50-0-50μA	10V. D.C.	21-50
100μA	20V. D.C.	21-50
100-0-100μA	50V. D.C.	21-50
200μA	300V. D.C.	21-50
500μA	15V. A.C.	21-80
500-0-500μA	300V. A.C.	21-80
1mA	8 Meter 1mA	21-85
5mA	VU Meter	22-25
10mA	1 amp. A.C.	21-70
50mA	5 amp. A.C.	21-70
100mA	10 amp. A.C.	21-70
500mA	20 amp. A.C.	21-70
1 amp.	30 amp. A.C.	21-70

## "SEW" BAKELITE PANEL METERS

Type MR.85. 3 1/2 in. square fronts.

50μA	20V. D.C.	22-80
50-0-50μA	50V. D.C.	22-80
100μA	300V. D.C.	22-80
100-0-100μA	1 amp. A.C.	22-80
500μA	5 amp. A.C.	22-80
500μA	30V. A.C.	22-80
1mA	8 Meter 1mA	22-87
500μA	VU Meter	23-37
500μA	1 amp. A.C.	22-80
1 amp.	5 amp. A.C.	22-80
5 amp.	10 amp. A.C.	22-80

Type PE.70. 3 17/32 in. x 1 1/2 in. x 2 1/2 in. deep.

50μA	25-00	20V. d.c.	24-40
100μA	24-65	50V. d.c.	24-40
1mA	24-40	300V. d.c.	24-40
50-0-50μA	24-65		
1-0-1mA	24-40	Dual range	
1A d.c.	24-40	500mA/5A d.c.	24-85
5A d.c.	24-40	5V/50V d.c.	24-85
10V d.c.	24-40		

Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

# MULTIMETERS for EVERY purpose!

MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0.5/3/15/60/300/1,200V. D.C. 0/5/30/120/600/1,200V. A.C. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm—20 to +63 db. 25-974. P. & P. 15p.



MODEL PL486 20KΩ/Volt D.C. 8kΩ/Volt 5 A.C. Mirror scale. -6/3/12/30/120/600V D.C. 3/20/120/600V A.C. 50/600μA/60/600 mA. 10/100K/1 Meg/10 MegΩ. -20 to +48db. 25-974 F & P 12p.

MODEL 502E 57 Ranges, Giant 5 1/2 in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: -125, -25, -1.25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: -5, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 501A, 2.5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: -20 to +85 db. 212-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

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TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

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TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

TKM MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUT-TON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0-0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts: 0-2.5, 10, 50, 250, 1,000V. D.C. Currents: 0-0.05, 0.5, 5, 50, 500mA. 10 amp. Resistance: 0-5K, 5K, 0-500K, 5 MEG. Decibels: 20 to +52db. 211-50. P. & P. 17p.

MODEL TE-200 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50μA/250 μA/250 mA. 0/80K/6 meg. Ω. -20 to +62 db. 23-75. P. & P. 15p.

TKM MODEL MD.120 Mirror scale. 20k/Volt D.C. 10k Ω/Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current: 0-60μA/0-12/0-300mA. 0-60K/0-6 Meg Ω. -20 to +63 db. 24-621. P & P 15p

TKM MODEL MD.120 Mirror scale. 20k/Volt D.C. 10k Ω/Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current: 0-60μA/0-12/0-300mA. 0-60K/0-6 Meg Ω. -20 to +63 db. 24-621. P & P 15p

TKM MODEL MD.120 Mirror scale. 20k/Volt D.C. 10k Ω/Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current: 0-60μA/0-12/0-300mA. 0-60K/0-6 Meg Ω. -20 to +63 db. 24-621. P & P 15p

TKM MODEL MD.120 Mirror scale. 20k/Volt D.C. 10k Ω/Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current: 0-60μA/0-12/0-300mA. 0-60K/0-6 Meg Ω. -20 to +63 db. 24-621. P & P 15p

# SEMI-CONDUCTOR COMPONENTS/VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors	2N3415	2N3416	2N3417	2N3418	2N3419	2N3420	2N3421	2N3422	2N3423	2N3424	2N3425	2N3426	2N3427	2N3428	2N3429	2N3430	2N3431	2N3432	2N3433	2N3434	2N3435	2N3436	2N3437	2N3438	2N3439	2N3440	2N3441	2N3442	2N3443	2N3444	2N3445	2N3446	2N3447	2N3448	2N3449	2N3450	2N3451	2N3452	2N3453	2N3454	2N3455	2N3456	2N3457	2N3458	2N3459	2N3460	2N3461	2N3462	2N3463	2N3464	2N3465	2N3466	2N3467	2N3468	2N3469	2N3470	2N3471	2N3472	2N3473	2N3474	2N3475	2N3476	2N3477	2N3478	2N3479	2N3480	2N3481	2N3482	2N3483	2N3484	2N3485	2N3486	2N3487	2N3488	2N3489	2N3490	2N3491	2N3492	2N3493	2N3494	2N3495	2N3496	2N3497	2N3498	2N3499	2N3500	2N3501	2N3502	2N3503	2N3504	2N3505	2N3506	2N3507	2N3508	2N3509	2N3510	2N3511	2N3512	2N3513	2N3514	2N3515	2N3516	2N3517	2N3518	2N3519	2N3520	2N3521	2N3522	2N3523	2N3524	2N3525	2N3526	2N3527	2N3528	2N3529	2N3530	2N3531	2N3532	2N3533	2N3534	2N3535	2N3536	2N3537	2N3538	2N3539	2N3540	2N3541	2N3542	2N3543	2N3544	2N3545	2N3546	2N3547	2N3548	2N3549	2N3550	2N3551	2N3552	2N3553	2N3554	2N3555	2N3556	2N3557	2N3558	2N3559	2N3560	2N3561	2N3562	2N3563	2N3564	2N3565	2N3566	2N3567	2N3568	2N3569	2N3570	2N3571	2N3572	2N3573	2N3574	2N3575	2N3576	2N3577	2N3578	2N3579	2N3580	2N3581	2N3582	2N3583	2N3584	2N3585	2N3586	2N3587	2N3588	2N3589	2N3590	2N3591	2N3592	2N3593	2N3594	2N3595	2N3596	2N3597	2N3598	2N3599	2N3600	2N3601	2N3602	2N3603	2N3604	2N3605	2N3606	2N3607	2N3608	2N3609	2N3610	2N3611	2N3612	2N3613	2N3614	2N3615	2N3616	2N3617	2N3618	2N3619	2N3620	2N3621	2N3622	2N3623	2N3624	2N3625	2N3626	2N3627	2N3628	2N3629	2N3630	2N3631	2N3632	2N3633	2N3634	2N3635	2N3636	2N3637	2N3638	2N3639	2N3640	2N3641	2N3642	2N3643	2N3644	2N3645	2N3646	2N3647	2N3648	2N3649	2N3650	2N3651	2N3652	2N3653	2N3654	2N3655	2N3656	2N3657	2N3658	2N3659	2N3660	2N3661	2N3662	2N3663	2N3664	2N3665	2N3666	2N3667	2N3668	2N3669	2N3670	2N3671	2N3672	2N3673	2N3674	2N3675	2N3676	2N3677	2N3678	2N3679	2N3680	2N3681	2N3682	2N3683	2N3684	2N3685	2N3686	2N3687	2N3688	2N3689	2N3690	2N3691	2N3692	2N3693	2N3694	2N3695	2N3696	2N3697	2N3698	2N3699	2N3700	2N3701	2N3702	2N3703	2N3704	2N3705	2N3706	2N3707	2N3708	2N3709	2N3710	2N3711	2N3712	2N3713	2N3714	2N3715	2N3716	2N3717	2N3718	2N3719	2N3720	2N3721	2N3722	2N3723	2N3724	2N3725	2N3726	2N3727	2N3728	2N3729	2N3730	2N3731	2N3732	2N3733	2N3734	2N3735	2N3736	2N3737	2N3738	2N3739	2N3740	2N3741	2N3742	2N3743	2N3744	2N3745	2N3746	2N3747	2N3748	2N3749	2N3750	2N3751	2N3752	2N3753	2N3754	2N3755	2N3756	2N3757	2N3758	2N3759	2N3760	2N3761	2N3762	2N3763	2N3764	2N3765	2N3766	2N3767	2N3768	2N3769	2N3770	2N3771	2N3772	2N3773	2N3774	2N3775	2N3776	2N3777	2N3778	2N3779	2N3780	2N3781	2N3782	2N3783	2N3784	2N3785	2N3786	2N3787	2N3788	2N3789	2N3790	2N3791	2N3792	2N3793	2N3794	2N3795	2N3796	2N3797	2N3798	2N3799	2N3800	2N3801	2N3802	2N3803	2N3804	2N3805	2N3806	2N3807	2N3808	2N3809	2N3810	2N3811	2N3812	2N3813	2N3814	2N3815	2N3816	2N3817	2N3818	2N3819	2N3820	2N3821	2N3822	2N3823	2N3824	2N3825	2N3826	2N3827	2N3828	2N3829	2N3830	2N3831	2N3832	2N3833	2N3834	2N3835	2N3836	2N3837	2N3838	2N3839	2N3840	2N3841	2N3842	2N3843	2N3844	2N3845	2N3846	2N3847	2N3848	2N3849	2N3850	2N3851	2N3852	2N3853	2N3854	2N3855	2N3856	2N3857	2N3858	2N3859	2N3860	2N3861	2N3862	2N3863	2N3864	2N3865	2N3866	2N3867	2N3868	2N3869	2N3870	2N3871	2N3872	2N3873	2N3874	2N3875	2N3876	2N3877	2N3878	2N3879	2N3880	2N3881	2N3882	2N3883	2N3884	2N3885	2N3886	2N3887	2N3888	2N3889	2N3890	2N3891	2N3892	2N3893	2N3894	2N3895	2N3896	2N3897	2N3898	2N3899	2N3900	2N3901	2N3902	2N3903	2N3904	2N3905	2N3906	2N3907	2N3908	2N3909	2N3910	2N3911	2N3912	2N3913	2N3914	2N3915	2N3916	2N3917	2N3918	2N3919	2N3920	2N3921	2N3922	2N3923	2N3924	2N3925	2N3926	2N3927	2N3928	2N3929	2N3930	2N3931	2N3932	2N3933	2N3934	2N3935	2N3936	2N3937	2N3938	2N3939	2N3940	2N3941	2N3942	2N3943	2N3944	2N3945	2N3946	2N3947	2N3948	2N3949	2N3950	2N3951	2N3952	2N3953	2N3954	2N3955	2N3956	2N3957	2N3958	2N3959	2N3960	2N3961	2N3962	2N3963	2N3964	2N3965	2N3966	2N3967	2N3968	2N3969	2N3970	2N3971	2N3972	2N3973	2N3974	2N3975	2N3976	2N3977	2N3978	2N3979	2N3980	2N3981	2N3982	2N3983	2N3984	2N3985	2N3986	2N3987	2N3988	2N3989	2N3990	2N3991	2N3992	2N3993	2N3994	2N3995	2N3996	2N3997	2N3998	2N3999	2N4000
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Integrated Circuits	FJH101	FJH111	FJH121	FJH131	FJH141	FJH151	FJH161	FJH171	FJH181	FJH191	FJH201	FJH211	FJH221	FJH231	FJH241	FJH251	FJH261	FJH271	FJH281	FJH291	FJH301	FJH311	FJH321	FJH331	FJH341	FJH351	FJH361	FJH371	FJH381	FJH391	FJH401	FJH411	FJH421	FJH431	FJH441	FJH451	FJH461	FJH471	FJH481	FJH491	FJH501	FJH511	FJH521	FJH531	FJH541	FJH551	FJH561	FJH571	FJH581	FJH591	FJH601	FJH611	FJH621	FJH631	FJH641	FJH651	FJH661	FJH671	FJH681	FJH691	FJH701	FJH711	FJH721	FJH731	FJH741	FJH751	FJH761	FJH771	FJH781	FJH791	FJH801	FJH811	FJH821	FJH831	FJH841	FJH851	FJH861	FJH871	FJH881	FJH891	FJH901	FJH911	FJH921	FJH931	FJH941	FJH951	FJH961	FJH971	FJH981	FJH991	FJH1001
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VALVES	0A2	0B2	0C2	0E2	0F2	0G2	0H2	0I2	0J2	0K2	0L2	0M2	0N2	0O2	0P2	0Q2	0R2	0S2	0T2	0U2	0V2	0W2	0X2	0Y2	0Z2	1A2	1B2	1C2	1D2	1E2	1F2	1G2	1H2	1I2	1J2	1K2	1L2	1M2	1N2	1O2	1P2	1Q2	1R2	1S2	1T2	1U2	1V2	1W2	1X2	1Y2	1Z2	2A2	2B2	2C2	2D2	2E2	2F2	2G2	2H2	2I2	2J2	2K2	2L2	2M2	2N2	2O2	2P2	2Q2	2R2	2S2	2T2	2U2	2V2	2W2	2X2	2Y2	2Z2	3A2	3B2	3C2	3D2	3E2	3F2	3G2	3H2	3I2	3J2	3K2	3L2	3M2	3N2	3O2	3P2	3Q2	3R2	3S2	3T2	3U2	3V2	3W2	3X2	3Y2	3Z2	4A2	4B2	4C2	4D2	4E2	4F2	4G2	4H2	4I2	4J2	4K2	4L2	4M2	4N2	4O2	4P2	4Q2	4R2	4S2	4T2	4U2	4V2	4W2	4X2	4Y2	4Z2	5A2	5B2	5C2	5D2	5E2	5F2	5G2	5H2	5I2	5J2	5K2	5L2	5M2	5N2	5O2	5P2	5Q2	5R2	5S2	5T2	5U2	5V2	5W2	5X2	5Y2	5Z2	6A2	6B2	6C2	6D2	6E2	6F2	6G2	6H2	6I2	6J2	6K2	6L2	6M2	6N2	6O2	6P2	6Q2	6R2	6S2	6T2	6U2	6V2	6W2	6X2	6Y2	6Z2	7A2	7B2	7C2	7D2	7E2	7F2	7G2	7H2	7I2	7J2	7K2	7L2	7M2	7N2	7O2	7P2	7Q2	7R2	7S2	7T2	7U2	7V2	7W2	7X2	7Y2	7Z2	8A2	8B2	8C2	8D2	8E2	8F2	8G2	8H2	8I2	8J2	8K2	8L2	8M2	8N2	8O2	8P2	8Q2	8R2	8S2	8T2	8U2	8V2	8W2	8X2	8Y2	8Z2	9A2	9B2	9C2	9D2	9E2	9F2	9G2	9H2	9I2	9J2	9K2	9L2	9M2	9N2	9O2	9P2	9Q2	9R2	9S2	9T2	9U2	9V2	9W2	9X2	9Y2	9Z2
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BRIDGE RECTIFIERS	100 PIV 4A	100 PIV 6A	200 PIV 4A	200 PIV 6A	400 PIV 4A	400 PIV 6A	600 PIV 4A	600 PIV 6A	1000 PIV 4A	1000 PIV 6A
PLASTIC	50 PIV 4A	50 PIV 6A	100 PIV 4A	100 PIV 6A	200 PIV 4A	200 PIV 6A	400 PIV 4A	400 PIV 6A	600 PIV 4A	600 PIV 6A
ENCAPSULATED	50 PIV 4A	50 PIV 6A	100 PIV 4A	100 PIV 6A	200 PIV 4A	200 PIV 6A	400 PIV 4A	400 PIV 6A	600 PIV 4A	600 PIV 6A

SILICON RECTIFIERS	MINIATURE WIRE ENDED PLASTIC	IN FL CL	SERIES SERIES SERIES	1 AMP 1.5 AMP 3 AMP
4001 50PIV	7p	8p	19p	25p
4002 200PIV	7p	8p	19p	25p
4003 200PIV	8p	10p	25p	30p
4004 400PIV	8p	10p	25p	30p
4005 400PIV	10p	12p	25p	30p
4006 800PIV	12p	15p	27p	30p
4007 1000PIV	15p	16p	30p	

SILICON RECTIFIERS	STUD MOUNTING	6A	10A	17.5A	35A
100PIV	—	45p	50p	52p	52p
200PIV	—	50p	55p	55p	51.42p
400PIV	—	55p	60p	62p	51.77p
600PIV	—	60p	65p	67p	52.12p
800PIV	—	65p	70p	72p	52.47p
1000PIV	—	70p	75p	77p	52.82p

ZENER DIODES	400mW	1.5 Watt	10 Watt
3-3.3 V	1.2-4.0	1.0-3.0	10.0
5.0	25p each	1p each	</

# HI-FI EQUIPMENT

SAVE UP TO  
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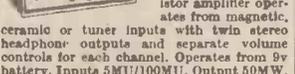
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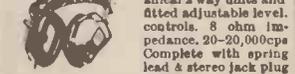
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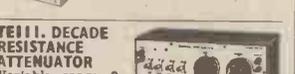


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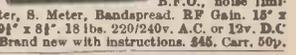
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BC108	11p	2N3704	17p	IN4007	10p
BC147/9	15p	2N3705/6/7	15p	W005	40p
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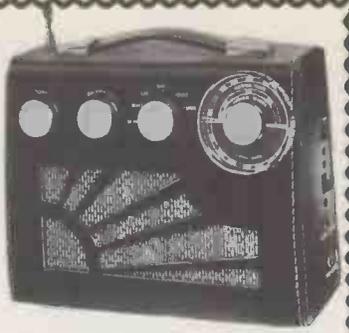
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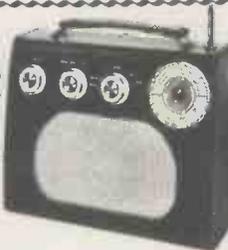
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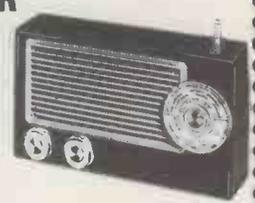
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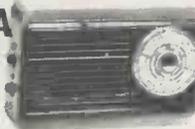
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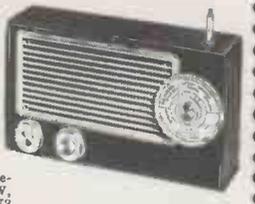


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