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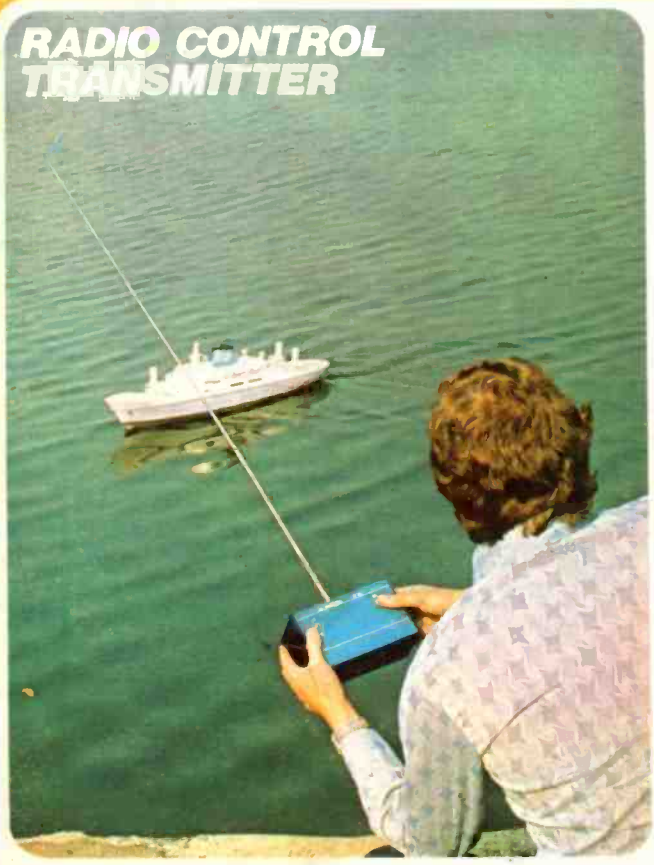

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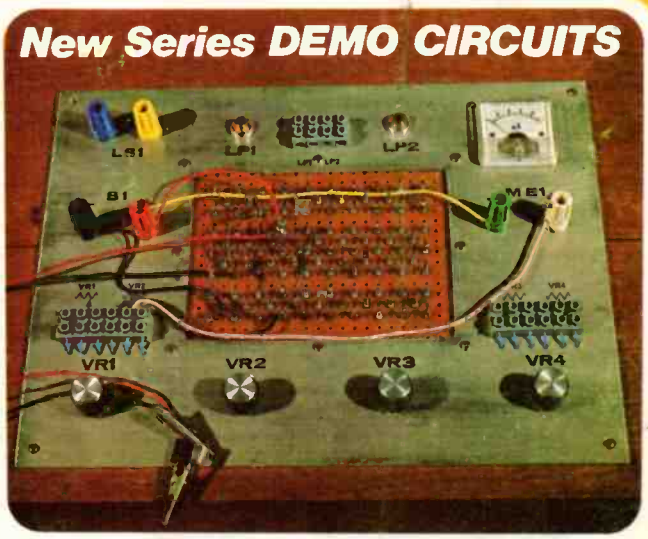


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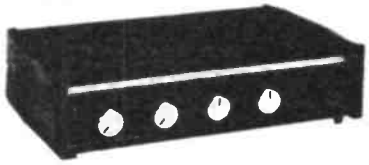

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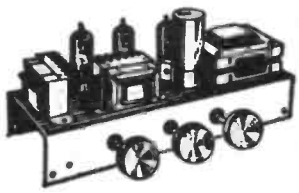

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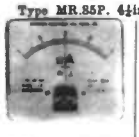

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|---|---|---|---|
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| 100mA | £3·10 | 50-0-50μA | £3·40 |
| 500mA | £3·10 | 100μA | £3·40 |
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| 5 amp. | £3·10 | 300V. A.C. | £3·10 |
| 15 amp. | £3·10 | 8 Meter 1mA | £3·15 |
| 30 amp. | £3·20 | VU Meter | £3·95 |
| 20V. D.C. | £3·10 | 1 amp. A.C.* | £3·10 |
| 50V. D.C. | £3·10 | 5 amp. A.C.* | £3·10 |
| 150V. D.C. | £3·10 | 10 amp. A.C.* | £3·10 |
| 300V. D.C. | £3·10 | 20 amp. A.C.* | £3·10 |
| 300V. A.C. | £3·10 | 30 amp. A.C.* | £3·10 |

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

| | | | |
|---|---|---|---|
| 200mA | £1·75 | 50μA | £2·30 |
| 300mA | £1·75 | 50-0-50μA | £2·10 |
| 500mA | £1·75 | 100μA | £2·10 |
| 750mA | £1·75 | 100-0-100μA | £1·95 |
| 1 amp. | £1·75 | 200μA | £1·95 |
| 2 amp. | £1·75 | 500μA | £1·80 |
| 5 amp. | £1·75 | 500-0-500μA | £1·75 |
| 10 amp. | £1·75 | 1mA | £1·75 |
| 3V. D.C. | £1·75 | 1-0-1mA | £1·75 |
| 10V. D.C. | £1·75 | 2mA | £1·75 |
| 15V. D.C. | £1·75 | 5mA | £1·75 |
| 20V. D.C. | £1·75 | 10mA | £1·75 |
| 50V. D.C. | £1·75 | 20mA | £1·75 |
| 100V. D.C. | £1·75 | 50mA | £1·75 |
| 150V. D.C. | £1·75 | 100mA | £1·85 |
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| 50V. A.C. | £1·85 | | |
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| 500V. A.C. | £1·85 | | |
| 8 Meter 1mA | £1·85 | | |
| VU Meter | £2·30 | | |

**Type MR.52P. 2½in. square fronts.**

| | | | |
|---|---|---|---|
| 50μA | £3·40 | 10V. D.C. | £2·20 |
| 50-0-50μA | £2·85 | 20V. D.C. | £2·20 |
| 100μA | £2·85 | 50V. D.C. | £2·20 |
| 100-0-100μA | £2·75 | 300V. D.C. | £2·20 |
| 500μA | £2·55 | 15V. A.C. | £2·30 |
| 1mA | £2·20 | 300V. A.C. | £2·30 |
| 5mA | £2·20 | 8 Meter 1mA | £2·30 |
| 10mA | £2·20 | VU Meter | £3·50 |
| 50mA | £2·20 | 1 amp. A.C.* | £2·20 |
| 100mA | £2·20 | 5 amp. A.C.* | £2·20 |
| 500mA | £2·20 | 10 amp. A.C.* | £2·20 |
| 1 amp. | £2·20 | 20 amp. A.C.* | £2·20 |
| 5 amp. | £2·20 | 30 amp. A.C.* | £2·20 |

**Type MR.65P. 3½in. x 3½in. fronts.**

| | | | |
|---|---|---|---|
| 50μA | £3·70 | 10V. D.C. | £2·40 |
| 50-0-50μA | £3·00 | 20V. D.C. | £2·40 |
| 100μA | £3·00 | 50V. D.C. | £2·40 |
| 100-0-100μA | £2·90 | 150V.D.C. | £2·40 |
| 200μA | £2·90 | 300V. D.C. | £2·40 |
| 500μA | £2·65 | 15V. A.C. | £2·55 |
| 500-0-500μA | £2·40 | 50V. A.C. | £2·55 |
| 1mA | £2·40 | 150V. A.C. | £2·55 |
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| 50mA | £2·40 | 8 Meter 1mA | £2·60 |
| 100mA | £2·40 | VU Meter | £3·70 |
| 500mA | £2·40 | 50mA A.C. | *£2·40 |
| 1 amp. | £2·40 | 100mA A.C. | *£2·40 |
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| 50 amp. | £2·75 | 20 amp. A.C. | *£2·40 |
| 5V. D.C. | £2·40 | 30 amp. A.C. | *£2·40 |

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

| | | | |
|---|---|---|---|
| 50μA | £2·50 | 5 amp. | £1·85 |
| 50-0-50μA | £2·30 | 10V. D.C. | £1·85 |
| 100μA | £2·30 | 20V. D.C. | £1·85 |
| 100-0-100μA | £2·05 | 50V. D.C. | £1·85 |
| 200μA | £2·05 | 300V. D.C. | £1·85 |
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| 1mA | £1·85 | 8 Meter 1mA | £2·05 |
| 5mA | £1·85 | VU Meter | £2·50 |
| 10mA | £1·85 | 1 amp. A.C.* | £1·85 |
| 50mA | £1·85 | 5 amp. A.C.* | £1·85 |
| 100mA | £1·85 | 10 amp. A.C.* | £1·85 |
| 500mA | £1·85 | 20 amp. A.C.* | £1·85 |
| 1 amp | £1·85 | 30 amp. A.C.* | £1·85 |

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| | | | |
|---|---|---|---|
| 1 amp. | £2·15 | 25μA | £3·85 |
| 5 amp. | £2·15 | 50μA | £3·00 |
| 15 amp. | £2·15 | 50-0-50μA | £2·60 |
| 30 amp. | £2·15 | 100μA | £2·60 |
| 50 amp. | £2·15 | 100-0-100μA | £2·50 |
| 5V. D.C. | £2·15 | 500μA | £2·45 |
| 10V. D.C. | £2·15 | 500-0-500μA | £2·15 |
| 20V. D.C. | £2·15 | 1mA | £2·15 |
| 50V. D.C. | £2·15 | 1-0-1mA | £2·15 |
| 150V. D.C. | £2·15 | 5mA | £2·15 |
| 300V. D.C. | £2·15 | 10mA | £2·15 |
| 50mV D.C. | £2·40 | 50mA | £2·15 |
| 100mV D.C. | £2·40 | 100mA | £2·15 |
| 30V. A.C.* | £2·20 | 500mA | £2·15 |
| 50V. A.C.* | £2·20 | VU Meter | £3·40 |
| 150V. A.C.* | £2·20 | | |
| 300V. A.C.* | £2·20 | | |
| 500mA A.C.* | £2·15 | | |
| 1 amp. A.C.* | £2·15 | | |
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| 10 amp. A.C.* | £2·15 | | |
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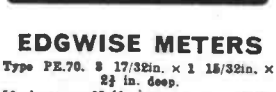
| 1A d.c. | £4·85 | 500mA/5A d.c. | £5·10 |
| 5A d.c | £4·85 | 5V/50V d.c. | £5·10 |
| 10V d.c. | £4·85 | | |



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| | | | |
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| 50μA | £3·40 | 500μA | £3·05 |
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| 100μA | £3·30 | 300V. A.C. | £2·70 |
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Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY £1·97 P. & P. 13p.

### SKYWOOD SW-500

50K Ω/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. DC Current 20uA/6/600mA Resistance 10K/100K/1 Meg/10 Meg. Decibels — 20 to +57 db. £7·50. P & P. 15p.

**TMK MODEL TW-50K** 46 ranges, mirror scale, 50K/Vol. D.C. 5K /Volt A.C. D.C.: Volts ·125, ·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: —20 to +81·5 dB. £8·50. P. & P. 17½p.

**TE-16A Transistorised Signal Generator.** 5 ranges 400kHz—30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ x 5¼ x 3¼in. Complete with instructions and leads. £7·97. Post 25p.

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Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions £15. Carr. 37½p. Size 140 x 215 x 170 mm.

### FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and ICO. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6·97½. P. & P. 15p.

**240° Wide Angle 1mA Meters**

MW1-6 60mm square £3·97½
MW1-8 80mm square £4·97½
P. & P. extra

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A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 meg Ω 6 Ranges ±1% L.1 μ H - 111 HENRYS 6 Ranges 2 = %C.10pF ± 1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA Meter indication. Attractive 2 tone metal case. Size 7½ x 5 x 2in. £20. P. & P. 25p

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**HIOKI MODEL 720X 20,000 O.P.V.** Overload protection. 5/25/100/500/1000 VDC. 10/50/250/1000 VAC. 50 mA/250 mA. 20K/2 meg ohms. —5 to + 62db. £4·97. P. & P. 15p.

**Model S-100TR MULTIMETER TRANSISTOR TESTER 100,000 o.p.v. MIRROR SCALE OVERLOAD PROTECTION** 0/·12—·6/3/12/30/120/600 V DC. 0/6/30/120/600 V. AC. 0/12/600uA/12/300MA/12 Amp. DC. 0/10K/1 MEG/100 MEG. —20 to + 50 db. 0·01— ·2 mfu. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. £13·50, P.P. 25p.

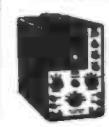
**MODEL 500 30,000 O.P.V. with overload protection mirror scale** 0/·5/2·5/10/25/100/250/500/1,000 V. D.C. 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω. £8·87½. Post paid.

**TMK LAB TESTER.** 100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K /Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100 MEG Ω. Decibels: —10 to +49 db. Plastic Case with Carrying Handle. Size 7½in. x 6½in. x 3½in. £18·90. P. & P. 25p.

### RUSSIAN 22 RANGE MULTIMETER

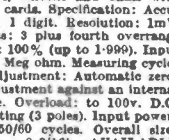
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100 uA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3M Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5·97 P. & P. 25p.

### TO-3 PORTABLE OSCILLOSCOPE



3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps –800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300 KHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £40·00. Carr. 50p

**HONEYWELL DIGITAL VOLTMETER VT.100**



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0·2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5½in. x 2 13/16in. x 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED ONLY £35·00. Carr. 50p.

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Also see opposite page

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* Stereo Cartridge

All other models less Cartridge
Carriage 50p extra any model.

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Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7½ × 3 × 4½in. £5·97. P. & P. 15p.

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OUR PRICE £22·95 Carr. 37p.

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Solid state. Coverage on 5 bands 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning. BFO. AVC. ANL. 'S' meter. AM/CW/SS B. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 x 266 x 150 mm. Complete with instructions and circuit. £30·00. Carr. 50p

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All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. £5·97. P. & P. 15p.

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Extremely sturdy instrument for general electrical use. 667 o.p.v.
0/·3/1·5/7·5/30/60/150/300/600/900 VDC and 75mV.
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0/300uA/1·5/6/50/60/150/600MA/1·5/6 AMP. D.C.
0/1·5/6/15/60/150/600MA/1·5/6 AMP. AC.
0/200 Ω/3K/30K Ω.
Accuracy DC 1%, AC 1·5%.
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### MCA. 220 AUTOMATIC VOLTAGE STABILISER

Input 88-125 VAC or 176-250VAC. Output 120VAC or 240VAC. 200VA rating. £11·97. Carr. 50p.

## SINCLAIR IC-12

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Tests PNP or NPN transistors. Audio indication. Operates on two 1·5v batteries. Complete with all instructions etc. £4·50. P. & P. 20p

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2 speeds 33⅓ and 45 rpm. Lightweight tubular counterbalanced arm. Belt driven low speed synchronous motor. Viscous damped pick up lift/lower device. Complete with teak plinth and hinged cover. GA308 less cartridge (List £36·55).
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GA308 PU with GP400 stereo magnetic cartridge (List £47·65)
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Project 60. Package offers.

2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. £15·95 Carr. 37½p. Or with PZ6 power supply £18·00 Carr. 37½p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. £20·25. Carr. 37½p.
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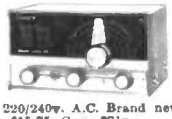

4 Bands covering 550kc/s-30 mc/s. B.F.O.
Built-in Speaker 220/240v. A.C. Brand new with instructions. £15·75. Carr. 37½p.

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General coverage 150–400kc/s. 550 kc/s–30mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter, S. Meter, Bandspread. RF Gain. 15" x 9¾" x 8½". 18 lbs. 220/240v. A.C. or 12v. D.C Brand new with instructions. £50. Carr. 50p

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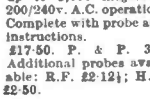

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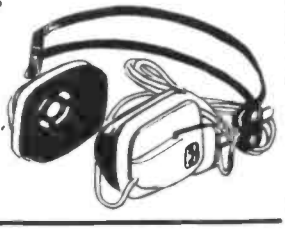

A particularly well designed stereo headphone with smooth response throughout its frequency range 23–13,000 Hz. The rubber padded earpieces are adjustable for personal fitting. Model G.1111 is presented in two-tone grey with 4' matching lead and fitted plug. Impedance is 8 ohms.
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Single push-pull 4 pole switches **0·28p**
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Goldring G800
Teak plinth and tinted cover. All leads supplied.
**Please add £1·25 for P. & P.**

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**Please add 75p for P. & P.**

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| BSR MP60 | £9·40 |
| Goldring GL72 | £21·60 |
| Goldring GL72/P | £28·35 |
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## AMPLIFIERS

**Please add 75p P. & P.**

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| Amstrad IC2000 | £26·90 |
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| Sinclair PRO60 2 x Z30/PZ5 | £14·70 |
| Sinclair PRO60 2 x Z30/PZ6 | £16·70 |
| Sinclair PRO60 2 x Z50/PZ8/Trans | £20·95 |
| Sinclair AFU (Filter Unit) | £4·20 |
| Sinclair 605 | £17·90 |
| Sinclair 2000 | £20·95 |
| Sinclair 3000 | £28·20 |
| Wharfedale Linton | £42·75 |
| Teleton SAQ206B | £20·50 |
| Teleton SAQ307 | £22·50 |
| Rotel RA 310 | £33·75 |
| Rotel RA 610 | £50·75 |

## TUNERS

**Please add 75p P. & P.**

| | |
|---|---|
| Amstrad Multiplex 3000 | £28·65 |
| Armstrong 523 | £39·50 |
| Armstrong 524 | £31·45 |
| Rogers Ravensbrook FET4 (Chassis) | £31·00 |
| Rogers Ravensbrook FET4 (Cased) | £34·95 |
| Rogers Ravensbourne FET4 (Chassis) | £43·00 |
| Rogers Ravensbourne FET4 (Cased) | £47·50 |
| Sinclair PRO60 (Module) | £15·75 |
| Sinclair 2000/3000 Tuner | £31·00 |
| Philips RH690 | £33·00 |
| Leak Delta FM (Cased) | £53·75 |
| Leak Delta AM/FM (Cased) | £60·75 |
| Alpha Highate FT 150 | £34·95 |

## TUNER/AMPLIFIERS

**Please add 75p for P. & P.**

| | |
|---|---|
| Alpha Highgate 150 | £44·25 |
| Armstrong 525 (Teak cased) | £69·45 |
| Armstrong 526 AM/FM (Teak cased) | £77·75 |
| Leak Delta 75 | £120·95 |
| Philips RH781 | £50·00 |
| Philips RH702 | £82·50 |
| Teleton 2100 | £29·45 |
| Goodmans One Ten | £98·00 |
| Rogers R/brook (Teak) | £77·50 |
| Rogers R/brook (Chassis) | £72·00 |
| Alpha FR 3000 New prod. | £66·00 |

## SPEAKERS

**Please add £1 25 P. & P. per pair**

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|---|---|
| Amstrad 138 | £14·70 |
| Wharfedale Denton 2 | £28·50 |
| Wharfedale Linton 2 | £35·75 |
| Wharfedale Melton 2 | £47·45 |
| Wharfedale Dovedale 3 | £59·90 |
| Celestion Ditton 120 | £38·50 |
| Celestion Ditton 15 | £52·00 |
| Celestion Ditton 25 | £85·50 |
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| Goodmans Mezzo 3 | £46·95 |
| Goodmans Magister | £76·95 |

**£3·20***
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Finished in teak veneer with tinted dust cover fully assembled. For Garrard SP25, 2025TC, 3000, AT60, 2000, 2500, 3500, S100, 1025, SL65B. Also for BSR McDonald MP60 and others. For AP76; AP75; SL72B; SL75; SL95B; **£4·20** plus 55p P. & P. Also finished in walnut to match Japanese equipment—at no extra.

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|---|---|
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| Goldring G800 | £5·50 |
| Goldring G800E | £7·50 |
| Goldring G800 Super E | £14·15 |
| Shure M3D | £3·85 |
| Shure M447 | £4·95 |
| Shure M55E | £5·60 |
| Shure M75E Type 2 | £10·00 |
| Sonotone 9TAHC | £1·65 |

*All prices correct at time of press E & O.E. and are subject to alterations*

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DISTRIBUTORS FOR A.K.G. HIGH QUALITY MICROPHONES.

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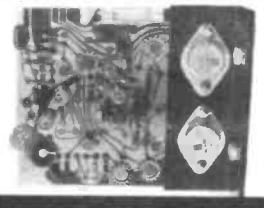

THESE THREE MODULES HAVE ENJOYED UNPARALLELED SUCCESS DURING THE FIRST FEW MONTHS OF THEIR BEING MADE AVAILABLE TO THE GENERAL PUBLIC. WE ARE PLEASED TO ANNOUNCE THAT WE CAN NOW OFFER FAST DISPATCH ON MOST OF OUR ADVERTISED ITEMS, INCLUDING THESE THREE MODULES.

**SA25 £2·95** carr. free
25 WATTS RMS. 7 transistors 7 diodes

**SA35 £4·45** carr. free
35 WATTS RMS. 7 transistors 7 diodes

**SA100 £10·90** carr. free
100 WATTS RMS. 11 transistors 6 diodes

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

### BRIEF SPEC. FOR ALL THREE MODULES

| | |
|---|---|
| Freq. response | 15–40,000 Hz ± 1dB |
| Distortion | 0·2% at 1 kHz |
| Loads | 4 to 16 ohms |
| Quiescent current | 15 mA |
| Noise | Better than −75 dB |
| Supply voltage | 25–45 volts SA25/35<br>40–70 volts SA100 |
| Size | 4½" x 4" x 1" (SA100)<br>4" x 3" x 1" (SA25/SA35) |

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

### POWER SUPPLIES FOR THE SA25/35 & SA100 AUDIO MODULES

| | | |
|---|---|---|
| Stab PS45 | Stabilized module for 2 SA25's or two SA35's | £3·50 carr. free |
| MT45 | Transformer for above, heavy duty | £2·85 carr. 20p |
| MT30 | Transformer for unstabilized supply complete with rectifier diodes mounted | £3·50 carr. 20p |
| PU70 | Unstabilized supply for one or two SA100 | £7·75 carr. 40p |
| PS70 | Stabilized supply module for one or two SA100's | £4·90 carr. free |
| MT70 | Transformer for PS70 | £4·90 carr. 40p |

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

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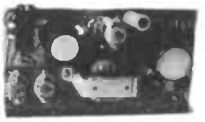
### 120 WATT HEAVY DUTY MODULE

£13·90 + 20p carr. or with supply £18·95 + 40p carr.

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



**SPECIFICATION**

| | |
|---|---|
| Power output | 120 watts into 8 ohms |
| Freq. response | 20-20,000 HZ ± 2dB |
| Input sensitivity | 200 mV into 10K |
| Construction | Fibreglass board |
| Size | 8" x 4" x 4" (5" with supply) |

Low distortion parallel push-pull output stage.

NEW 160 watt version & supply **£27·90**

### SINGLE CHANNEL SOUND/LIGHT CONVERTER

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

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

**SPOT BANKS INCLUDING 3 SPOTS**
STATE COLOURS: RED, BLUE, GREEN.
£10·25 complete, carr. 40p.

**£8·90** carr. free

### THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3000 watt (3kw) this unit is unique for its price in that not only bass, middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads, etc. Supplied in tough white steel case with a blue stelvette hooded cover. Fully guaranteed.

**£19·75** carr. 30p

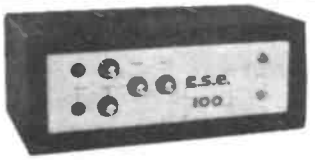
MONO VERSION £6·50 carr. 20p (As illustrated left S.A.E. details 9 volt operation) Outputs up to 1 volt RMS


**£15·80** carr. 30p

**SAXON STEREO CONTROL UNIT**

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½" x 3" x 4" deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass, treble, mains on/off.
**THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCOTHEQUE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE.** (N.B.—Stereo only has mic input.)

### COMPLETE AMPLIFIERS




**The CSE 100. £34·90** carr. free

This versatile unit is now available in a black vynide case and so represents even better value than ever delivering speech and music powers of up to 100 watts RMS and continuous signal outputs of 70 watts. Two individually controlled inputs with wide range bass and treble controls. Ideal for small groups D.J.S., etc.

**The SAXON 100 £48·50** carr. free


With an RMS output of 120 watts speech and music, 100 watts continuous power, four individually controlled FET input stages and wide range bass and treble controls, this amplifier has established itself as a unit offering quality and reliability at low cost.

**LOUDSPEAKERS** British made bargains!!
12" 25 watt 8/15 ohms £5·95 carr. 30p. 15" 50W.8/15 ohm £14·50 carr. 50p.
12" 40 watt 15,000 gauss magnet system 8/15 ohm £11·50 carr. 40p.
**A.K.G. MICROPHONES** suitable for disco, group or general P.A. use.
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D190C High Z rrp £21·50 our price £17·45 post free
D1000C 24 ct gold plate rrp £37·00 our price £32·00 post free

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TRADE & EXPORT enquiries invited.

## now YOU can CATCH SHOALS OF BIG FISH with new electronic miracle

*special introductory offer* **£2·50**

First time marketed in England, this exciting electronic instrument the "Decoytronic" is the one responsible for starting the electronic fish-lure rage in the U.S.A. just recently. Uses ingenious double-action method of attracting all kinds of fish from hundreds and hundreds of feet away . . . saltwater or freshwater. Why this device is so fantastically successful is because it *actually imitates the sound of wet insects milling about the surface.* These sound waves spread out hundreds of feet in all directions. Although this peculiar sonic frequency won't sound like much to you—to all the fish in the area it's their dinner bell! But that's not all . . . *electroluminescence neon tubes cunningly flicker intermittently*, penetrating the area for hundreds of feet around, at a frequency fish are unable to resist. The fish mistake this flickering glimmer for the soft phosphorescence glow given off by Plankton . . . a favourite delicacy of most fish!!! All you do is switch on, lower into the water (it's completely water resistant) allow around 5 minutes—then start reeling 'em in. We'll bet you won't be able to reel 'em in fast enough. Self-contained batteries last ages—cost pence. Kit of all parts including special easy as a.b.c. directions only £2·50 + 25p. P. & P. (Parts available separately).

## BUILD 5 RADIO AND ELECTRONIC PROJECTS

**ONLY £2·45**

Amazing Radio Construction set! Become a radio expert for £2·45. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box 45p extra as illus. (if required) (parts available separately) no soldering necessary. Send £2·45 + 20p p. & p.

## SOOTHE YOUR NERVES RELAX WITH THIS AMAZING RELAXATRON

**ONLY £2·75**

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES!—The RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering. £2·75 + 25p p. & p. Parts available separately.

## ELECTRONIC ORGAN

**ONLY £3·25**

*Don't confuse with ordinary electronic organs that simply blow air over mouth organ type reeds etc.* Fully transistorised. SELF-CONTAINED LOUDSPEAKER. *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live portable electronic organ. NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED. No soldering, simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated, step-by-step, simple instructions.* ONLY £3·25 + 25p. p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

## READY BUILT AND TESTED TREASURE LOCATOR MODULE

**ONLY £4·95**

FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and phones and it's working. Put it in a case, screw a handle on and YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20! Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. *So sensitive it will detect certain objects buried* SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN £4·95 + 30p carr. etc.

## UNIQUE RADIO FOR BEDROOM OR OFFICE No batteries, no electricity, never wears out ONLY £1·70

Tune in your favourite programmes or the news, or sports in the Office or in your bedroom. Uses sensitive, germanium diode originally evolved from Wartime radar. Never buy a battery. Never use electricity. Never replace. Covers all medium waves. Clear beautiful tone. Size 4½" x 2½" x 1¾" in beautiful case. ONLY 7 CONNECTIONS AND IT'S WORKING. No soldering necessary. CAN BE BUILT ALMOST BLINDFOLD IN UNDER 15 MINUTES! Ideal for absolute beginner from 8 years of age upwards. SPECIAL PRICE TO CLEAR STOCKS OF COMPONENTS, ONLY £1·70 + 20p. P. & P. for all parts including beautiful case. Germanium semi-conductor, tuning condenser, personal phone, wire, nuts, screws. SIMPLE AS A.B.C. INSTRUCTIONS (Parts available separately).

## *"READ PEOPLE'S MINDS"—TEST THEIR NERVES—BEAT THEM AT CARDS, ETC. WITH THIS ASTONISHING* ELECTRONIC BRAIN BOX Only £2·87

With this "Brain-box" you will be able to *perform mind-boggling feats.* THE MIND READING DEVICE will make people swear you have "telepathic" powers. THE AMAZING CARD TRICK UNIT completely mystifies and baffles from one to six people. *You correctly "guess" the two cards each person has selected at random from a pack they themselves shuffled.* THE ELECTRONICS NERVES TESTER puts your friends to a very lively test. It gives out fail and finish signals (the winner is the person with lowest number of fail signals.) *Can be adjusted from the weakest to strongest person.* THE ELECTRONIC MAZE *tests the mental ability of the player* because it uses psychology with an electronic twist to it. You can change the maze pathways in seconds to prevent the maze becoming too stale after lots of use. Completely safe and foolproof. Size 18" x 12" x 6" (Max.). You can play all these games and more beside after building the "Brain box". No soldering, you get pictorial, easy as a.b.c. step-by-step simple instructions. ONLY £2·87 + 33p. p. & p. for all parts including chassis, switches, stylus, signalling lights, wire, nuts, screws, etc. etc. Uses standard battery. Presentation Box 33p. extra as illus. if reqd. (PARTS AVAILABLE SEPARATELY) FULL OPERATING DIRECTIONS WITH EACH OF THE PROJECTS.

## the amazing "Phototron" SOUND OPERATED FLASH

**ONLY £4·50**

Take flash pictures at the exact instant of the bursting of a balloon-A champagne cork leaving the bottle. The split second a hammer strikes a light bulb. *The mind boggles at the possibilities of the "Phototron" . . . the only limit is your imagination.* Now that inexpensive flash guns are on the market in quantity, it has made possible, with the help of electronics the production of a wide variety of exciting photography effects, once strictly limited to the professionals. The duration of an electronically produced flash is extremely brief and normally measured in Milliseconds. Now, providing the camera shutter is left open in a dark or subdued light, it is the timing of the flash that determines what is imprinted on the film—not necessarily anything done by the camera. As electronic flash guns are fired by making a switched connection then it becomes obvious that one of the latest Silicon Controlled Relay's can be used. If we make this S.C.R. operate by sound (with variable sensitivity control for soft/loud sounds) some real "way out" photography effects can be captured forever on film. Easily built in a couple of hours or so, the "Phototron" is fully solid state, uses self contained PP3 battery. No soldering necessary using our special printed circuit terminal board (pat. Applied for). All parts including special pictorial step-by-step plans, transistors, microphone, S.C.R., potentiometers, switches, test lamp, case, nuts, screws, etc. etc., ONLY £4·50 + 25. P. & P. *Made up must be worth at least* £10. (parts available separately).

Eavesdrop on the exciting world of Aircraft Communications—

## V.H.F. AIRCRAFT BAND CONVERTER ONLY £2·85

*Listen in to* AIRLINES, PRIVATE PLANES, JET-PLANES. *Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower, Hear for yourself the disciplined voices hiding tenseness of talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK, ETC. ETC. CLEAR AS A BELL. This fantastic fully transistorised instrument can *be built by anyone over nine in under two hours.* No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). NO CONNECTIONS WHATEVER NEEDED. SEND ONLY £2·85 + 20p. p. & p. for kit including case, nuts, screws, wire, etc. etc. (parts available separately).

## INGENIOUS ELECTRONIC SLEEP INDUCER

**ONLY £3·25**

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 sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* All transistor. No knowledge of electronics or radio needed. Step-by-step instructions included. *No soldering necessary.* Kit includes case, nuts, wire, screws, etc. SEND £3·25 + 25p p. & p. (parts available separately).

## FIND BURIED TREASURE!

### Transistorised Treasure Locator

**ONLY £2·85**

This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC. *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 sho't evening by anybody from nine years of age upwards,* with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts screws, wire, etc. ONLY £2·85 + 25p. p. & p. (Sectional handle as illustrated 95p. extra). Parts available separately. Made up looks worth £15.

## SHORTWAVE TRANSISTOR RADIO

**ONLY £2·75**

Anyone from 9 years up can follow the step by step, easy as ABC fully illustrated instructions No soldering necessary. 76 stations logged on rod aerial in 30 mins.—RUSSIA, AFRICA, USA, SWITZERLAND, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4½" x 1½" Only £2·75 + 20p p. & p. Kit includes cabinet, screws, instructions. etc. (Parts available separately.).

## *AMAZING* MAGIC MUSIC BOX

*make electronic music waving your hands about*

**only £2·75**

Everyone's heard the weird, wonderful, but beautiful music used in Science Fiction Films, Horror Films etc., also on Radio and Television. This unearthly, eerie music is almost always produced by a little known electronic device measuring only a few inches . . . called a Theremin. All you have to do is switch on your radio (almost any type will do) and place the Theremin close by. Switch on the Theremin and proceed to wave your hands mysteriously in the air like a magician. The most fantastic musical sounds are then produced, and with a little practice people can learn to play all the well known tunes. Apart from it's musical value, it's small size allows it to be used to best advantage at parties, gatherings of friends etc., where it attracts tremendous interest. Provides hours and hours of pleasure to young and old. Uses standard PP3 battery which lasts ages. The 3 Transistor circuit, though fairly advanced is simple to build with our pictorial step-by-step plans. No soldering necessary. Easily built in an hour or so using our special printed circuit *terminal* board (Pat. Applied For). All parts including nuts, bolts, case etc., ONLY £2·75 + 25p. P. & P. (Parts available separately.

## *INGENIOUS* ELECTRONIC SINGING & WARBLING CANARY only £4·50

*Actually whistles & warbles like a real live Canary!* Amazing circuitry faithfully reproduces the Canary's magnificent song. Just switch on and leave it—whistling down scale for some seconds, suddenly breaking into a delightful warble, then several seconds later shutting off for a second or two—only to start automatically again in a few seconds. People listen to the delightful song all day and never get bored! Relax, as the sweetest nerve-soothing birdsong takes you to leafy woods and glades. Provides countless hours of joy to young and old alike. Standard self-contained battery lasts ages. Easily built in an hour or so with special pictorial step-by-step plans. No soldering necessary. All parts including printed circuit terminal board (pat. applied for) transformers, loudspeaker, transistors, nuts, screws, wire, etc. + case (which fits under cage—cage and toy bird not supplied) ONLY £4·50 + 25p. P. & P. (parts available separately).

**CONCORD ELECTRONICS LTD. (E.E.12) 8, Westbourne Grove, London, W.2.** *Callers welcome 9 a.m.—5.30 p.m.*

# everyday electronics

PROJECTS... THEORY.....

## IN ASSOCIATION

Quite a number of leisure activities rely upon electronics—to some greater or lesser degree. And the number seems to be steadily increasing. There are also certain activities which are entirely inseparable from electronics, since they depend upon some branch of this technology for their very existence.

Radio control of models is one such example. This very popular hobby brings the model maker with his particular skills and often artistic, even romantic, eye for points of detail, into association with the electronics enthusiast.

## RADIO CONTROL

The subject *Radio Control of Models* was introduced in a general feature last month. We now present in this issue a detailed constructional design for a single-channel model control transmitter. This will be complemented by a second article next month describing a simple model control receiver.

These designs are necessarily of a fairly basic character, within the scope of this magazine's declared policy. Thus the functions they permit are of a somewhat limited nature, but will provide reward and pleasure to the builder and operator.

No doubt these projects will launch many a reader into this associated field of radio control, where the possibilities for the use of more advanced electronics are quite wide and extensive. We hope these articles may also induce a number of model enthusiasts to take-up electronics generally, and thus discover an even wider range of applications.

## BBC JUBILEE

Mention headphones to our senior readers and this will surely conjure up memories of listening-in to the wireless in those pioneer days of broadcasting. The faint, thin-sounding voices and orchestras borne over the mysterious ether were far, far removed from hi fi. Yet no present day audiophile with the very latest in four-channel headphones clamped on his head listening to quadraphonic or surround sound will have a more immense and unforgettable thrill than those early listeners experienced during the first broadcasts half a century ago.

The ancestor of today's all important transistor was also in at the start of radio. Reference to twiddling the cat's whisker will be incomprehensible to our younger readers, and certainly will cause some to believe we are as old as Methuselah; so we will desist.

We wish the BBC, or "Auntie" if you prefer, hearty congratulations. To say "we don't know what we would do without you" is just the plain truth—very few could say in all honesty that they are immune from the blandishments of the loudspeaker or TV tube.

Fred Bennett

***Our January issue will be published on Friday, December 15***




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# .EASY TO CONSTRUCT
# .SIMPLY EXPLAINED

VOL. 1 NO. 14 DECEMBER 1972

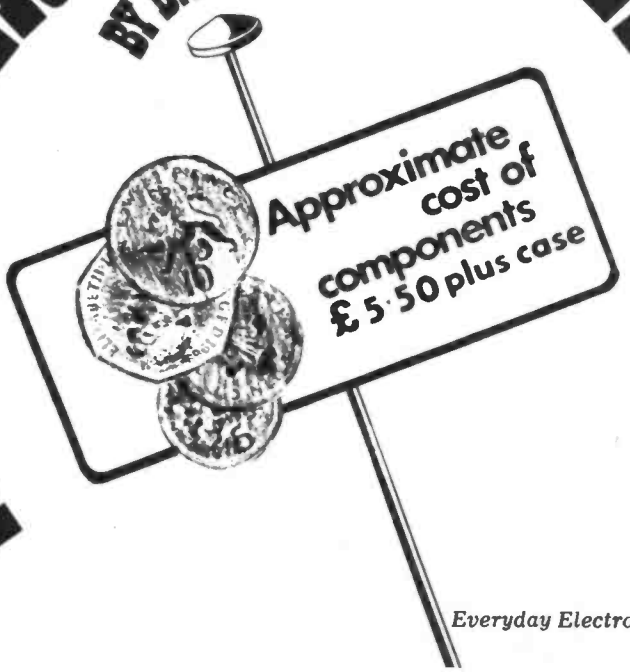
## CONSTRUCTIONAL PROJECTS



## GENERAL FEATURES

# RADIO CONTROL TRANSMITTER

BY D. BOLLEN




**A simple single channel transmitter for radio control of a boat or aeroplane.**

THIS single channel model control equipment for novices is probably the simplest that can be devised while still satisfying the range requirements of model aeroplane enthusiasts and the requirements of the Post Office.

The transmitter and receiver are both assembled on Veroboard, for ease of construction, and the receiver offers direct, relayless operation of a rubber or clockwork driven escapement, or a motorised actuator. Maximum ground range in open country with the prototype equipment was one mile.

Due to the small size of the receiver (detailed next month) we do not advise anybody who has not yet constructed any equipment to embark on the building of this project.

## WORKING PRINCIPLE

The transmitter supplies 27MHz radio frequency energy (carrier) which is switched on and off (modulated) by an audio frequency tone of 500Hz. If modulation was not used, it would be much more difficult to amplify the received signal and obtain a useful working range. The receiver detects the modulated carrier and converts this into a d.c. current whenever the transmitter key is pressed.

The crystal, X1, used in the prototype transmitter (and receiver next month) had a third harmonic frequency of 27·145MHz but any frequency in the range 26·970-27·270MHz may be used. There are 13 frequency bands within this range, each separated by 25kHz. The 27MHz frequency band is allocated by the Post Office for this and similarly operated transmitters; see the *Radio Control* article in the November issue of EVERYDAY ELECTRONICS. (This issue is no longer available from the publishers).

The block diagram of the complete control system is shown in Fig. 1. The transmitter carrier is generated by a low power, crystal controlled oscillator, which does not need to be calibrated to function at the correct frequency.

A second oscillator in the transmitter delivers a square wave tone of 500Hz to a diode gate via a keying switch. The diode gate is situated between the crystal controlled oscillator and the power amplifier and is opened and closed 500 times per second whenever the keying switch is pressed.

With the keying switch off, virtually no radio frequency energy reaches the power amplifier, but when the keying switch is held on short bursts of 27MHz energy are passed to the power

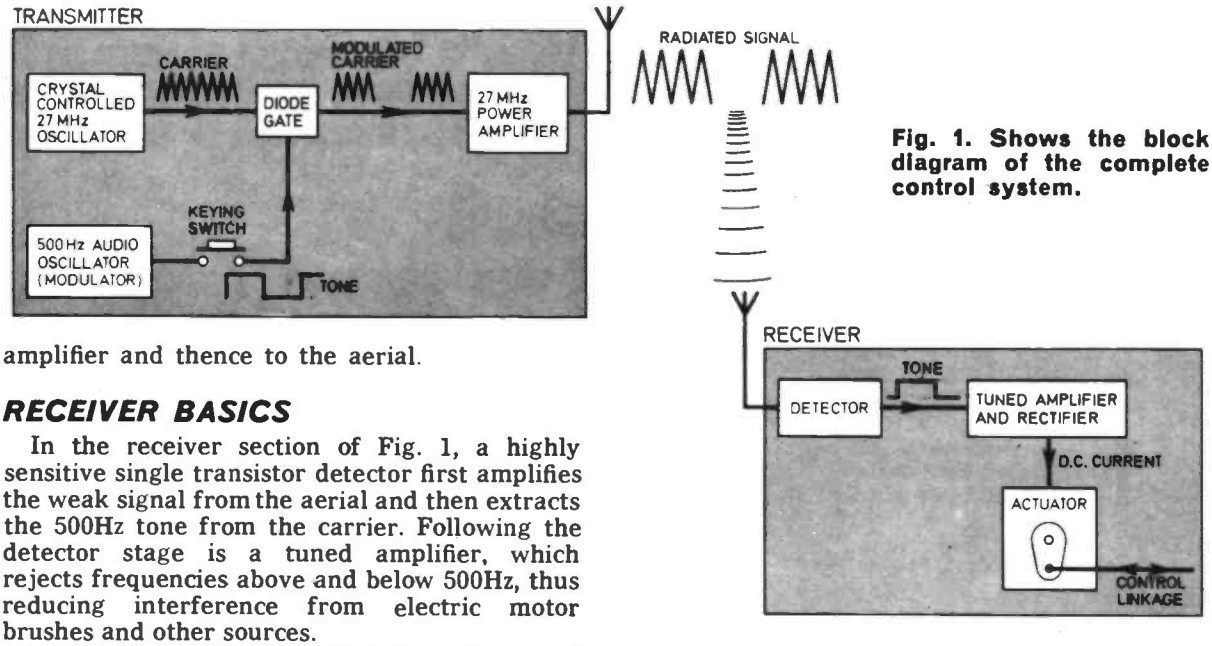



**Fig. 1. Shows the block diagram of the complete control system.**

amplifier and thence to the aerial.

## RECEIVER BASICS

In the receiver section of Fig. 1, a highly sensitive single transistor detector first amplifies the weak signal from the aerial and then extracts the 500Hz tone from the carrier. Following the detector stage is a tuned amplifier, which rejects frequencies above and below 500Hz, thus reducing interference from electric motor brushes and other sources.

Finally, the 500Hz a.c. output from the tuned amplifier is converted into a steady d.c. current (rectified) of sufficient power to operate an electromechanical device.

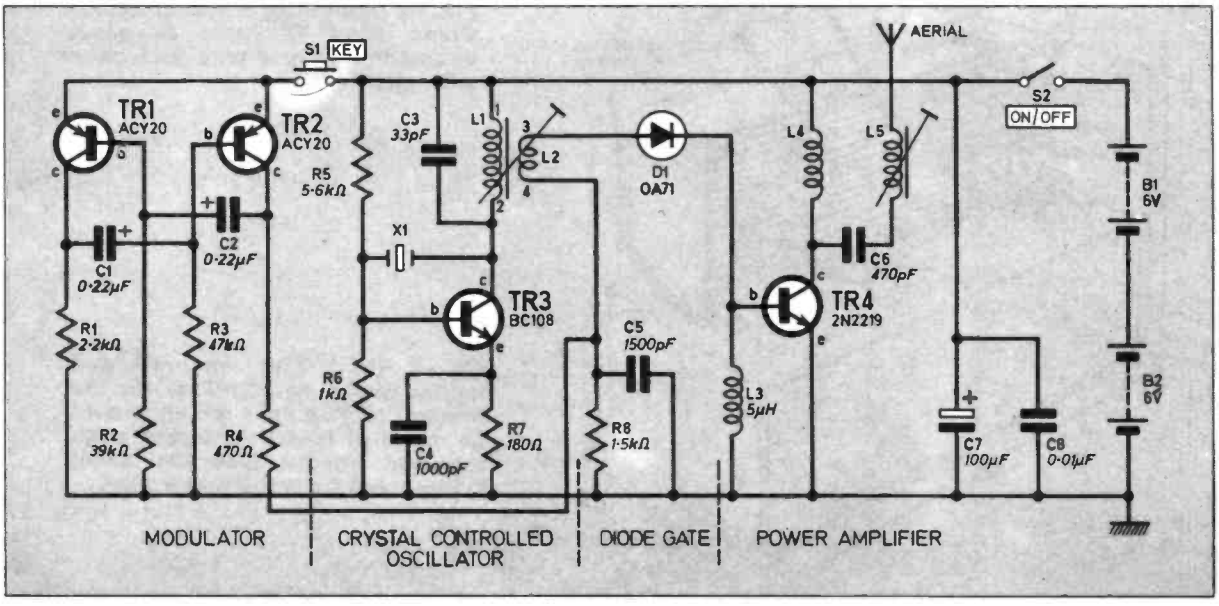
## TRANSMITTER CIRCUIT

The complete transmitter circuit is shown in Fig. 2. Modulator transistors TR1 and TR2 form a multivibrator oscillator which functions at a frequency determined by the values of C1, C2, R2, and R3. When S1 is keyed, this switches on the modulator and operates the diode gate.

It will be noticed that the collector load of TR2 is made up of the combined resistance of R4 and R8, and thus the diode gate switching voltage appears at the junction of these two resistors.

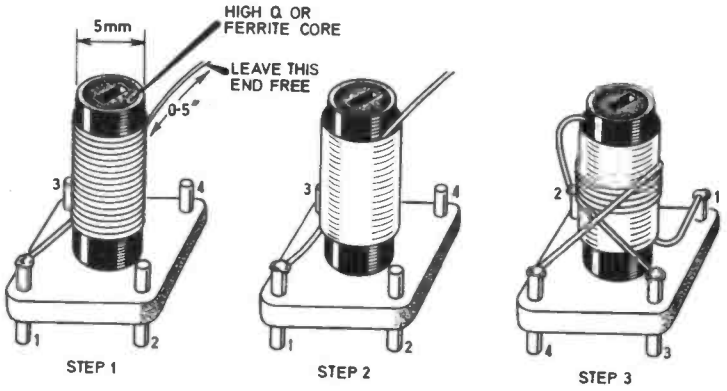
Looking next at the crystal controlled oscillator TR3, this is broadly tuned by C3 and L1 to approximately 27MHz. Crystal X1 serves the dual role of providing a positive feedback path to make TR3 oscillate, and constrains the circuit to oscillate only at a fixed frequency, which is marked on the crystal.

**Fig. 2. The complete circuit diagram of the transmitter.**



# RADIO CONTROL TRANSMITTER

Fig. 3a. (right) L1 and L2 coil winding details. (1) Close wind 20 turns 28 s.w.g. enamelled copper wire. (2) Cover with plastic insulating tape. (3) Close wind 5 turns 28 s.w.g. enamelled copper wire and then solder the finish of L1 to pin 2.



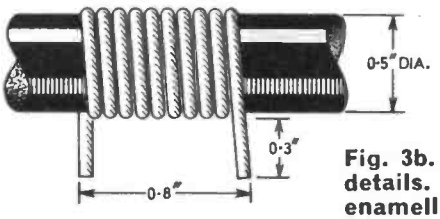




Fig. 3b. (left) L4 winding details. 10 turns 16 s.w.g. enamelled copper wire on 0·5in. mandrel.

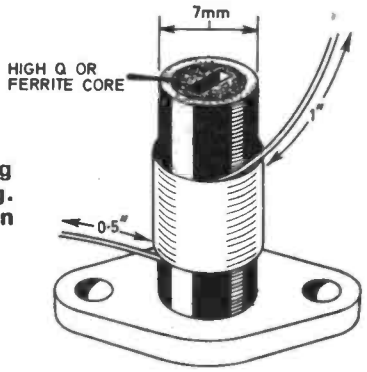



Fig. 3c. (above) L5 winding details. Close wind 12 turns 28 s.w.g. enamelled copper wire and cover with plastic tape.

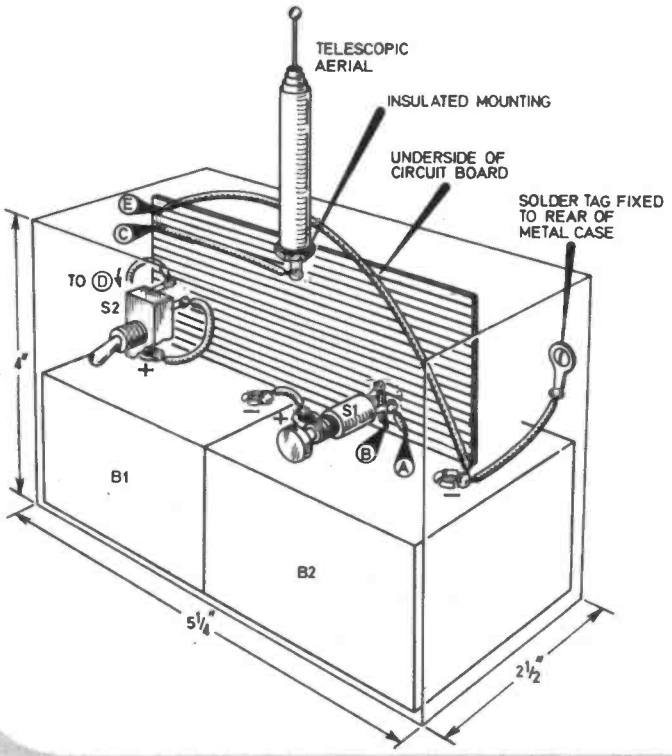



Fig. 5. (left) The recommended layout of the components for the transmitter in a case which should be made of metal. Note the earth tag and ensure that the aerial is insulated from the metal case.

The ferrite or high 'Q' dust slug in L1 coil former therefore serves only to bring L1 to resonance with the crystal frequency, so that maximum output is developed across the secondary winding L2.

Radio frequency energy from L2 is taken via diode D1 to the base of TR4, with a return path provided by capacitor C5.

The coil L3 prevents the low frequency modulator output from reaching the base of TR1, while allowing the high frequency carrier to pass unhindered. For maximum efficiency, TR4 is operated in the "class C" mode, that is to say, with collector current flowing during less than one half of an a.c. cycle, hence the absence of base biasing resistors.

The action of the modulator is to forward bias the diode D1 whenever TR2 conducts, and to allow D2 to become reverse biased by the output from L2 when TR2 is off. When reverse biased, D1 blocks the input to TR4 base.

Power amplifier TR4 steps up the output from the crystal oscillator and feeds this energy to the aerial via C6 and L5. The purpose of L5 is to match the aerial impedance to the impedance of TR4 collector. L4 merely serves as a broadly tuned collector load.

Capacitors C7 with C8 in parallel are necessary to prevent instability by providing a low impedance path to audio and radio frequency energy across the relatively high impedance batteries.

## COIL CONSTRUCTION

Commence construction by winding 10 turns of 16 s.w.g. enamelled copper wire for L4 on a 0·5in. diameter mandrel, see Fig. 3b. A piece of wood dowel or metal tubing would serve. The spacing between L4 turns can be adjusted after removal of the mandrel.

With sandpaper or a razor blade, remove the enamel coating from the ends of L3 and carefully tin the bare copper with solder.

For L5, close-wind 12 turns of 28 s.w.g. enamelled copper wire on a 7mm diameter former, and anchor the winding with a wrapping of plastic insulating tape. Remove enamel from the ends of L5 leads and tin with solder (Fig. 3c).

After practise with L4 and L5, sufficient confidence will have been gained for a start to be made on the more complicated L1 and L2 coils.

First, bare and tin the end of a reel of 28 s.w.g. enamelled wire and solder this to pin 1 on the coil former, see Fig. 3a. Close-wind 20 turns, as neatly as possible on the 5mm former and secure the windings with a layer of plastic insulating tape. The 0·5in. end of L1 should be left free while winding L2.

For L2, clean and tin the end of the wire on the reel, and solder this to pin 3, then close wind five turns over the insulating tape covering L1, approximately in the middle of the 5mm former, and then anchor the end of L2 to pin 4. To complete the coil, clean and tin the free end of L1 and solder to pin 2.

## Components....

SEE **SHOP TALK**

**Resistors**

| | |
|---|---|
| R1 | 2·2kΩ |
| R2 | 39kΩ |
| R3 | 47kΩ |
| R4 | 470Ω |
| R5 | 5·6kΩ |
| R6 | 1kΩ |
| R7 | 180Ω |
| R8 | 1·5kΩ |

All ¼ watt ±10% carbon

**Capacitors**

| | |
|---|---|
| C1 | 0·22μF tantalum bead |
| C2 | 0·22μF tantalum bead |
| C3 | 33pF polystyrene |
| C4 | 1,000pF polystyrene |
| C5 | 1,500pF polystyrene |
| C6 | 470pF polystyrene |
| C7 | 100μF elect. 15V |
| C8 | 0·01μF polyester |

**Semiconductors**

| | |
|---|---|
| TR1 | ACY20 germanium *pnp* |
| TR2 | ACY20 germanium *pnp* |
| TR3 | BC 108 silicon *npn* |
| TR4 | 2N2219 silicon *npn* |
| D1 | OA71 |

**Switches**

| | |
|---|---|
| S1 | Single-pole push to make release to break |
| S2 | Single-pole toggle |

**Miscellaneous**

| | |
|---|---|
| X1 | Subminiature third overtone 27MHz crystal with socket (see note 1) |
| L3 | Radio frequency choke 5μH—1A TV type choke |

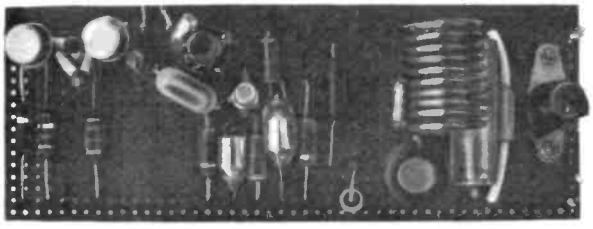
B1, B2 PP1 6V (2 off)

Coil formers: for L1, L2, 5mm diameter, length 16 mm, printed circuit mounting with ferrite or high Q core (see note 2); for L5, 7mm diameter, length ⅜in., ¾in. fixing centres with ferrite or high Q core (see note 3); Veroboard 4·7in. x 1·7in. x 0·1in. matrix; terminal pins; 16 s.w.g. enamelled copper wire; 28 s.w.g. enamelled copper wire; metal box 5in. x 4in. x 2½in. minimum dimensions; telescopic aerial 3½ to 4 feet extended; m.e.s. bulb holder; 6V 60mA m.e.s. bulb; TO5 heat sink.

Note 1. Henry's Radio type 2mm with socket

Note 2. Henry's Radio type 1 with 1f ferrite core

Note 3. Home Radio CR4 with Z81B core



## ASSEMBLY OF TRANSMITTER COMPONENTS

Transmitter components are assembled on a piece of 0·1in. matrix Veroboard measuring 4·7in. x 1·7in., see Fig. 4. Terminal pins are used to mount L1, L2, the crystal holder, and L4, and also as anchor points for circuit board leads (labelled A-E).

Cut the circuit board to size and drill two holes for the L5 mounting screws. Break the copper strips on the underside of the board with a spot-face cutter as detailed in Fig. 4. The extra cutaways around the collector of TR4 and the connection to L5 are to minimise stray capacitance. Insert and solder all terminal pins, and then proceed to mount all components, starting at the R1 end, but solder the semiconductors in position last of all.

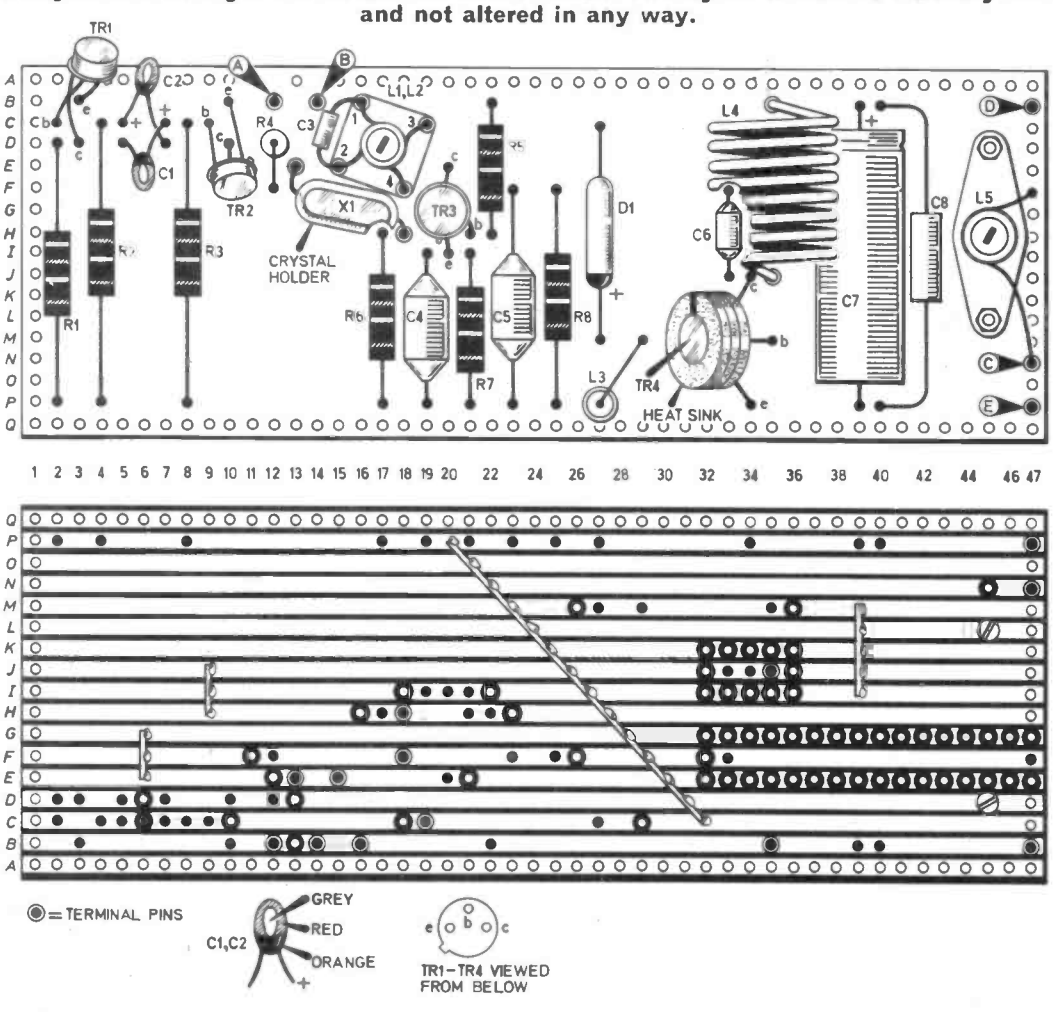
The following important points should be observed during assembly: make sure that the polarity of C1, C2, D1, and C7 is correct; the crystal should **not** be in its holder when this is soldered to the terminal pins; avoid prolonged contact with the soldering iron when mounting semiconductors and use a heatshunt; fit TR4 heat sink prior to mounting; check that stray blobs of solder do not bridge any of the copper strips on the underside of the circuit board.

Thoroughly check-out all connections before proceeding. The layout should not be altered in any way.

## ALIGNING THE TRANSMITTER

A Model Control Licence should be obtained before operating the transmitter. An application form is available from the Ministry of Posts and Telecommunications, Radio Regulatory Division

**Fig. 4. Layout and wiring of the transmitter circuit board. The layout should be carefully followed and not altered in any way.**



(Amateur and Special Licencing Branch), Waterloo Bridge House, Waterloo Road, London S.E.1. The licence costs £1·50 for a five year period.

Solder a temporary shorting link across terminal pins A and B on the transmitter circuit board, and attach insulated battery leads to pins D and E. Connect one terminal of an m.e.s. bulb holder to pin C with a short length of insulated wire.

Place the transmitter circuit board on an insulated surface, preferably on a floor, and hook up a three or four foot vertical length of insulated wire as a temporary aerial to the remaining terminal of the m.e.s. holder. Insert a 6V 60mA bulb in the holder to monitor aerial current. If a 0-100mA meter is available, this could usefully be employed to measure battery consumption, in series with the positive battery lead, but this is not essential. Adjust both coil slugs so that they are flush with the top of their formers.

Connect the negative end of battery B1 to the positive terminal of B2 and the negative terminal of B2 to pin E and dab the wire from pin D on the positive terminal of B1 while adjusting L4 slug for aerial bulb glow; this technique will prevent the destruction of TR4 in the event of a circuit fault.

If the bulb glows and TR4 runs just warm, the positive battery lead can be left in position. Now trim L5 and L1, L2 slugs for the brightest bulb glow. When the wire link between pins A and B is cut the bulb should cease to glow. Current consumption is shown in Table 1.

In the event of no bulb glow, overheating of TR4, or abnormal current consumption, check the circuit board for faults.

**Table 1: Specifications**

| | |
|---|---|
| **Transmitter** | |
| Idling current | 20mA |
| With modulation | 70mA |
| Approximate aerial input power | 250mW |
| Power supply | 12V |
| Modulation frequency | 500Hz |
| **Receiver** | |
| Weight with leads | 1oz |
| Size | 2½in. x ⅞in. x ⅝in. |
| Approximate output | 3V at 0·5A |
| Power supply | 4·8V |
| Idling current | 15mA |

## FINAL ASSEMBLY

The transmitter circuit board is now ready for installation in a metal box, complete with S1, S2, batteries and a telescopic aerial (Fig. 5).

For final adjustment, place a bulb in series with the aerial as before, and trim L5 for maximum output with the aerial held well away from buildings or trees. The bulb is then replaced by a short wire link straight from pin C to the aerial. Secure tuning slugs with a dab of paint.

Part 2 next month deals with the receiver.

*The model boat shown in the front cover photograph was kindly loaned by Beatties of London (Models), 112 High Holborn, W.C.1.*

# Fifty Years

B.B.C. 50—The Technical Story is the title of a two-month exhibition staged at Mullard House, Torrington Place, London, W.C.1., jointly by Mullard and the B.B.C. It was opened by Lord Hill, chairman of the B.B.C., on Thursday November 2 and will run until December 21.

The exhibition, which has the full support and co-operation of the Post Office, is complementary to that organised by the B.B.C. at the Langham, near Broadcasting House, and its aim is fourfold: to show how technical innovation has contributed to the growth of broadcasting, to stress the pioneering effort that has gone into it, to give the public a better idea of the technical side of broadcasting and to show how research and development are continuing for the future.

The Mullard House exhibition is open to the public from 12 noon to 9 p.m. on Mondays, Thursdays and Fridays and 12 noon to 6 p.m. on Tuesdays, Wednesdays and Saturdays. Admission is free.

The company's role in colour television is illustrated by a feature called Colour TV Look-In. Housed in a separate room, this is a six-minute presentation—using film, video tape, recorded sound, programmed lighting and television itself—which tells the story of colour television and Mullard's contribution in simple everyday terms.

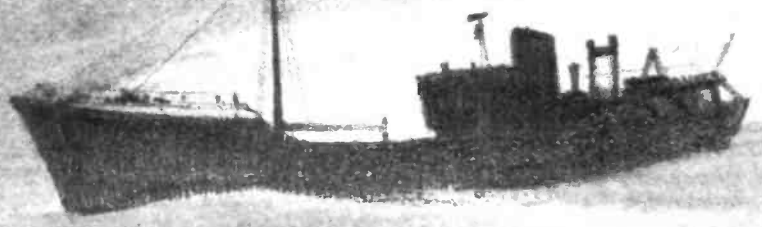
A major exhibit in the section dealing with current sound and vision broadcasting techniques is a working demonstration—in which the public can take part—of colour separation overlay. This technique enables the image of a person appearing on the TV screen to be superimposed on a variety of pictorial backgrounds. He can be shown, for example, on the moon or in the depths of the jungle, without ever leaving the studio.

A demonstration of three dimensional television, broadcasting from satellites, cameras that can see in the dark and Post Office plans for future transmission techniques are among exhibits that give visitors a peep into the future. There is also a viewing lounge where they can relax and watch colour programmes.

A programme of talks and films is being presented in the Mullard House Theatre throughout the run of the exhibition. A total of 23 films will be shown, covering a variety of subjects. They range from a behind-the-scenes story of the Post Office Tower to the operation of a colour TV camera. Thirty-three talks will be given by BBC, Mullard and other specialists on topics ranging from satellite TV broadcasting to digital techniques and, in a more general vein, from running a local radio station to organising TV sports coverage.

A detailed programme of talks and films, together with a timetable, is available; tickets for particular films/talks on specific days can be applied for. All requests regarding programmes and tickets should be made to Mrs. Doreen Smith, Mullard Ltd., Mullard House, Torrington Place, London, WCIE 7HD. No tickets are required for admission to the exhibition itself.

# Electronics at Sea



## Fishing Vessels and Coasters

By W. Machonachie

A previous article in this magazine dealt with the ways in which electronic equipment is employed on board merchant ships of 1,600 tons or more—most of them, in fact, ocean-going vessels much greater in size than this, and only passing mention was made of smaller ships in Class III (500 tons or more but less than 1,600 tons) and Class IV (300 tons or more but less than 500 tons) and of fishing vessels.

### MINIMUM REQUIREMENTS

So far as the requirements of the Merchant Shipping (Radio) Rules are concerned ships in Classes III and IV, are, broadly speaking, treated alike in that they must be fitted with approved radio-telephone (R/T) installations capable of reception on 2182 kHz and at least 20 other spot frequencies between 1605 and 3800 kHz, and of transmission on 2182 kHz and at least eight other spot frequencies, while a device capable of generating the R/T two-tone alarm signal must also be fitted. As an alternative they may, if their owners so desire, have an approved radio telegraph installation, in which case the crew must include a qualified radio officer.

These are, it must be emphasised, the minimum requirements to comply with the law. In practice relatively few small ships do have telegraphy installations and radio officers, with the exception of some passenger-carrying craft, but on the other hand a great many of them—one might almost say the majority—do fit electronic equipment well in excess of the mandatory minimum.

Radar is, as might be expected, an almost universally chosen "extra", possibly because little ships sailing in busy coastal waters like to see the big fellows in case the big fellows fail to see them. Decca Navigator receivers are also widely used in coastal waters, as are echo sounders, while v.h.f. radio-telephones are invaluable for short range communication, since such ships are on short voyages between ports.

Also, because these ships are seldom out of range of shore TV transmissions for very long, a television receiver may usually be found on board. Increasing use is made nowadays of relatively simple intercom. systems, even though it might seem that the man on the bridge has only to shout to be heard all over the ship.

### FISHING FLEET

Fishing vessels have a separate set of radio rules of their own and the statutory require-

**A trawlerman making a radio-telephone call with his s.s.b. h.f. and m.f. equipment.**

ments for their electronic installations are very different and much less stringent, although the Holland-Martin Report on safety of fishing vessels made a number of recommendations which may have the effect of tightening the regulations in a number of ways.

So far as British-flag fishing boats are concerned compulsion to carry specific minima applies in general only to those over 140 feet long, except for portable survival craft radio, which must be carried by all boats over 80 feet in length, and by those between 60 and 80 feet long when fishing alone and not in company with other vessels. Apart from this requirement for battery-powered survival craft radio, there is at present no radio legislation affecting fishing vessels less than 140 feet long, of which there are many in the British fishing fleets.

The regulations applying to trawlers of 140 feet and upwards demand that each must have either a radio-telegraph installation, consisting of approved transmitter and receiver, automatic keying device, auto-alarm receiver, and a loudspeaker watch receiver (which may be part of the auto-alarm) covering 500 kHz, or an approved radio-telephone installation with a loudspeaker watch receiver covering 2182 kHz and a two-tone alarm generator operating on the same frequency. She must also carry either two portable battery-powered survival craft radios or one set powered by a hand-driven generator.

## COMPLEX OF EQUIPMENT

As was clearly apparent from the Holland-Martin Report, the regulations do not go far enough and even the full radio telegraphy installation specified does not meet the needs of a trawler battling with Arctic conditions off Bear Island in winter.

Trawlermen and trawler owners have long recognised this obvious fact and as a result the use of electronics in British commercial fishing craft, even the smaller ones, far exceeds the mandatory minimum. In fact, the majority of distant-water trawlers—those which fish the far grounds—are fitted with a complex of equipment more numerous in units and wider in scope than that to be found on many a foreign-going cargo vessel, supertanker, or passenger liner.

These trawlers fish far afield nowadays, a number of them are "factory ships" which even freeze and package their catch at sea, and their requirements are highly specialised. They are continually on the air with communications to their owners' offices and to other vessels in their fleet; their skippers indulge in a sort of radio espionage to the extent that they try to listen in on other trawlers' radio traffic to find out if they are making good hauls; and they all use electronics as an aid to fishing as well as to navigation and safety.

## TRAWLER COMMUNICATION

While even a small North Sea herring drifter will have not only the statutory survival craft radio and a voluntarily-fitted radio-telephone installation, she will almost certainly have in addition a Decca Navigator, an echo sounder (perhaps two), radar, and a direction-finder, as well as TV for crew entertainment. The electronics usage graph climbs steeply in the larger boats fishing the White Sea and other distant grounds.

A trawler of this type will have—and use to the full under extremely arduous conditions—a high-power s.s.b. (single side-band) transmitter providing both telegraphy and telephony communication over long distances on h.f., and with this two or perhaps three main receivers.

A secondary radiotelephone installation operating in what used to be called the intermediate frequency band around 2182 kHz will also be fitted and used principally for inter-ship speaking over shorter distances, while her skipper will use v.h.f. for close-range work when he does not want rivals to know that he is "on a good living" and getting full hauls.

An interesting sidelight on this, and one that most trawlermen will strenuously refute, is the frequent use of a direction finder unit with the receiver of the 2182 kHz R/T to take snap bearings on the transmissions of a rival who is rash enough to go on the air and boast that he is fishing well. The skipper who manages to obtain such a bearing will then stem straight down it until he meets the careless talker when he, too, streams his nets among the shoal.

## POSITION FIXING

Most trawler skippers know the banks and contours of the seabed as well as many of us know the streets of our home town. Position-fixing in conditions of poor visibility is therefore vital to the trawlerman, for he can only identify the ground he seeks by its geographical position, aided by echo sounding as a cross-check. To help him in this he makes use of direction-finding, radar, echo sounding, and usually one of the hyperbolic systems such as Loran or Decca.

His electronics installation in the wheelhouse, in addition to that in the radio room, will therefore include at least one instrument for each of these facilities, and he will most probably have two direction-finders, one of them automatic and capable of taking bearings on 2182 kHz as well as the other medium frequencies; at least two, perhaps three or even four echo sounders; two radars with interswitching; and possibly both Loran and Decca receivers.

The trawler skipper is, in this respect at least, a belt-and-braces man, with a couple of safety pins for good measure. His time at sea is too precious for him to risk wasting any of it because of equipment failures.

**The "fishing cockpit" at the starboard side of a modern trawler's bridge. From the left the units are: crew call controls, Decca navigator, a radar set, four recording and one cathode ray tube echosounders, and propeller pitch adjustment for fine speed control.**

## ECHO-FISHING

Echo-fishing is one of the fisherman's most valuable electronic tools, helping him to identify the contours of the undersea hills and valleys where he knows from experience he will be most likely to find fish; showing him the nature of the sea bed over which he will trawl; and above all letting him "see" whether fish are indeed there in justifiable quantity and, so far as discernible, what kind of fish they are. All these things the modern echo sounder, coupled with his own skill and experience and knowledge of the grounds, will tell him.

His belt-and-braces philosophy, therefore, demands at least two recording sounders, frequently reinforced by a cathode-ray tube presentation set which, once he has observed fish on the recorder instrument, gives him a "close-up" view of the stratum of water in which they are swimming, and thus a supporting indication of their density and type.

## RADAR AND FISHING LIMITS

National extensions of territorial fishing limits, underlined by Mr Rippon's recent Common Market negotiations and the Icelandic "Cod War", together with the heavy penalties imposed for encroachment on territorial waters, have made radar more important than ever to the trawlerman. Limits are not defined by a line drawn on the water and in bad weather or poor visibility it is only too easy to steam inside them. With accurate radar ranging a trawler can fish close up to the limit line without actually crossing it while, nedles to say, radar observation will also show the skipper if a patrol vessel is nearby, should he be inside the limit.

He also uses radar to keep station on a good fishing area. It has long been practice, once a good haul has been taken, to mark the spot with a dhan buoy and then fish round it. The dhan is traditionally no more than a pole buoy with a small identity flag on it and, in poor visibility which so often exists in Arctic waters, it is difficult to keep in sight. With a radar reflector on top of the pole, dhan observation is made easy in darkness or fog.

The fisherman therefore looks on radar as much more than a navigational and anti-collision aid. Nevertheless, its value for anti-collision purposes cannot be underestimated, particularly on busy grounds cluttered with trawlers, all with nets streamed, and a dual installation with interswitching of units is not regarded as an expensive form of insurance.

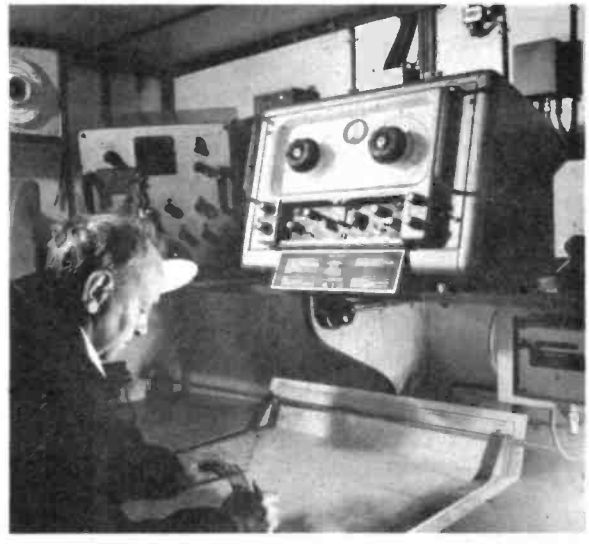
## WEATHER CHARTS

Advance warning of imminent adverse weather conditions is even more vital to the trawler in northern waters than to the big merchantman plodding across the Atlantic, and here the facsimile weather chart receiver can be of tremendous value, even if only from the safety point of view. It can also help in fish-finding, for the World Meteorological Organisation service also broadcasts water temperature and ice formation charts and since fish, like people, like to be in the temperatures they are used to, warm or cold layers in the sea can affect fish movements.

## INBOARD COMMUNICATIONS

Distant-water trawlers make great and constant use of internal communications systems. Unlike the average merchant ship on passage, with all her cargo safely stowed and therefore relatively little work going on on deck, a trawler, once she has reached the fishing grounds, is catching, cleaning, processing and stowing her cargo and

**An automatic direction finder in use in the chart room of a distant water trawler.**



the crew are at work round the clock every day and night—on deck, in the fish holds, in the engine room—in what are for most of the time the most difficult and dangerous conditions.

The skipper on the bridge must therefore be in constant touch with all working positions and be able to speak to, and receive an immediate reply from, any working point in his vessel and even the messrooms and cabins.

For this he must have a robust and comprehensive sound distribution network with full crew-call and talk-back facilities. Special glass-fibre waterproof loudspeakers are fitted in all open-deck locations, with waterproof talk-back switches. Often as many as four separate and independent systems are installed—belt-and-braces again—with master over-ride control so that urgent orders and announcements can break into any circuit, including the entertainment speakers in messrooms and cabins.

### QUART IN A PINT POT

It will be clear that the modern commercial fisherman is highly conscious of the help that electronics techniques can provide in what is a highly competitive business as well as a dangerous occupation, and he uses them to the full. With the sheer amount of electronic equipment carried by a distant water trawler, which is not really a very big vessel, every cubic inch of available space is at a premium, a wide assortment of units and instruments must be crammed into the smallest possible space and yet be installed in such a way that everything is instantly accessible and easily operable, even by fingers often numbed with cold and swollen with salt water. Even planning the layout of a trawler installation is a task not to be lightly contemplated.

### OUTLINES

Within the limits of an article such as this it is difficult to draw anything more specific than an outline sketch of the many ways in which electronics work to help the seaman and the fisherman. Detailed description of any one of these ways has therefore been impossible.

It is to be hoped, however, that these outlines have given some indication of the general picture and have served to show that marine electronics is much more than a man sitting tapping on a Morse key and to illustrate the extent to which the shipowner and the men who sail his ships rely upon the electronics industry to help them in their business "upon the great waters".

Could Marconi, one wonders, have dreamed what might develop within a mere 75 years as he stood on the shore of the Bristol Channel that May day in 1897? And what limits would we dare to set, today, on what might be achieved tomorrow? ▣


With the winter coming it is often necessary or useful to know when the temperature falls to freezing point. This device can be set to indicate "ice" conditions or similar temperature levels.

## Radio Control receiver

A receiver to match the single-channel transmitter described in this issue.

## BETA treble boost & fuzz

The effects units used in the Beta guitar

## Basic electricity magnetism

Part 3 of the series for beginners deals with magnetism and describes the construction of an electric buzzer.

**All in the January**

**On sale Friday, December 15**

It occurs to us that since this is our December issue, Christmas will only be about five weeks away when you read this—less if you only read it as an after thought! So now is the time to start dropping a few hints like "my pen would write better if it was solid gold" or "these cheap cuff links are staining my shirt—silver ones might be better." If, however, like the rest of us, you cannot number Onasis among your personal friends, perhaps "this old soldering iron is coming to the end of its life" might be more fruitful and more to the point—by all means try the others first and watch for a reaction!

# SHOP TALK

By Mike Kenward

Assuming the last hint is greeted with signs of delight at having solved the annual problem, then perhaps one of the two irons described below might just be suitable.

Although the Antex X25 soldering iron has been on sale for some months now we have recently received one for testing. The iron is easy to use and looks very smart with its red and black handle. The low leakage current and high insulation (tested at 1500V a.c.) make this iron very safe, even when used on "live" semiconductor circuits.

One thing we particularly like about this iron is the ease with which the bit can be changed. The X25 is fitted with a $\frac{1}{8}$ inch iron coated bit when purchased and this should prove excellent for most constructors' needs; $\frac{3}{32}$ and $\frac{3}{16}$ inch bits are also available. The cost of the iron is £1·75.

The second soldering iron item consists of an iron, an iron stand (both previously mentioned in this page), a box of solder, two spare bits and some hints on soldering all for £3·99 from Adcola Products, who advertise in our pages. The cost of the iron and stand alone is £3·83, so for 16p you get two bits, a box of solder and some hints, in a very smart presentation pack; just the thing if you are starting in the electronics construction hobby. The soldering iron is the 23 watt Invader with stand to match.

## Radio Control Transmitter

With all the notes and information provided in the *Radio Control Transmitter* article, by the author, concerning the supply of the "more difficult" components it is hard to give any more information. However, the case to be used may present some problems. The one shown on the front cover was specially made up for the project but one of the Veroboxes mentioned last month should be suitable and, with a coat of paint on the plain panels, would make a very smart, lightweight case.

Both the aerial and the crystals used should be available from some of the larger shops specializing in the supply of radio control equipment and models. We advise readers to take heed of the warning to constructors printed at the beginning of the transmitter article. Although the transmitter is reasonably easy to construct, the receiver (to be described next month is rather more compact and may prove difficult for a complete beginner.

## Bit Saver

Small metal cases such as those used for the *Bit Saver* are available from a number of retail components shops or one could be made up using 18 s.w.g. aluminium. The mains indicator neons used in this project are normally sold with the series resistor incorporated—if you get the neons on their own, place a 270 kilohm $\frac{1}{4}$W ± 10 per cent resistor in series with each neon.

We have quoted the diode ratings necessary, any diode with at least the required voltage and current ratings will be suitable, the type numbers we have given are for the diodes shown in Fig. 3. Other types may vary in size and shape.

## Beta Pick-Ups and Fittings

In order to make the construction of the *Beta Electronic Guitar* more simple, one or two components are rather special. The matching transformer is a good example of this, to save you winding about 5,000 turns of very fine wire on each pick-up the guitar uses a special transformer, designed and wound by Zeta Windings specially for the Beta.

The transformer is therefore only available from a few firms. It can be purchased for £1·70 (including post and packaging from Zeta Windings Ltd., 26 All Saints Road, London W.11., H. L. Smith and Co., (not G. W. Smith note) 287-289 Edgware Road, London W.C.2. and Tidman Mail Order Co., 236 Sandycombe Road, Richmond, Surrey.

Two other components that are rather special are the pick-up changeover switch and the jack output socket, these are produced by Re-An Products and are available from them at Burnham Road, Dartford, Kent. The button magnets used for the pick-ups are made by Eclipse and are available from most hardware shops.

## Demo Circuits

There should be no trouble buying the components to make up the simple voltmeter described in the first part of *Demo Circuits*. However, for those people who are going to build a Demo Deck from the reprint now available (price 15p), a word or two about the components used in its construction.

All the potentiometers are linear, the meter is available from G. W. Smiths, the circuit board and loudspeaker from Home Radio who can also supply the bulbs if you have any difficulty.

Please note (once again) that R. S. Components *do not sell direct to the general public* but any component supplier or radio and T.V. repair shop can order from them and delivery is usually fairly quick. There are also one or two firms who specialise in the supply of R. S. Components parts; they sometimes advertise on our pages.

# BIT SAVER

## A useful project for all constructors. Prevents pitting of a soldering iron bit between making joints

By T. P. Manning

IT is a great source of annoyance when using a soldering iron to find that the once clean and smooth bit has become badly pitted due to being left on for long periods between making soldered joints.

This article describes how the power supplied to the iron may be halved when the iron is not in use. Thus the iron will keep warm and heat up quickly when required but will not get hot enough to damage the bit.

### THEORY

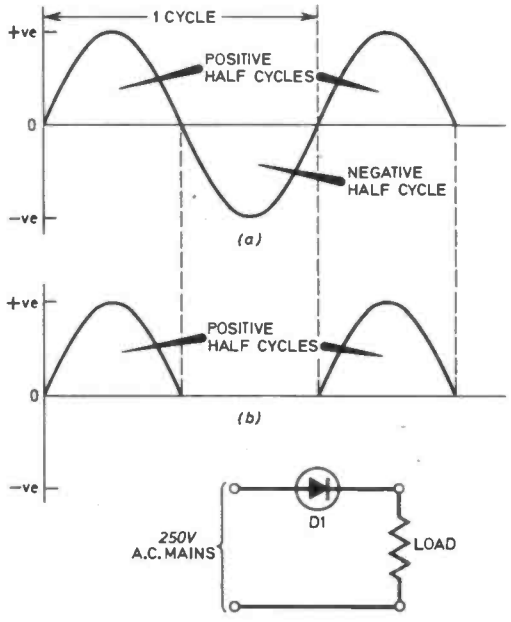
The theory behind the unit to be constructed is concerned with half wave rectification; this means that the alternating current taken from the mains is fed through a diode before being passed to the load—in this case the soldering iron.

Fig. 1a shows the 250 volts a.c. taken from the mains, when this is passed through a diode (D1) only the positive half cycles of the waveform can pass (Fig. 1b). Thus only half of the total mains voltage is applied to the load.


### CIRCUIT

The complete circuit diagram is shown in Fig. 2. Switch S1 is the change over switch that selects half or full power and D1 is the rectifier diode that feeds the load. When S1 is in the half power position D1 conducts the positive half cycles only, supplying approximately 125 volts to the load. D2 will also conduct in a similar manner and supply 125 volts to the neon LP1. Diode D3 does not conduct as only a positive

**Fig. 1. The sine wave and half wave rectification.**



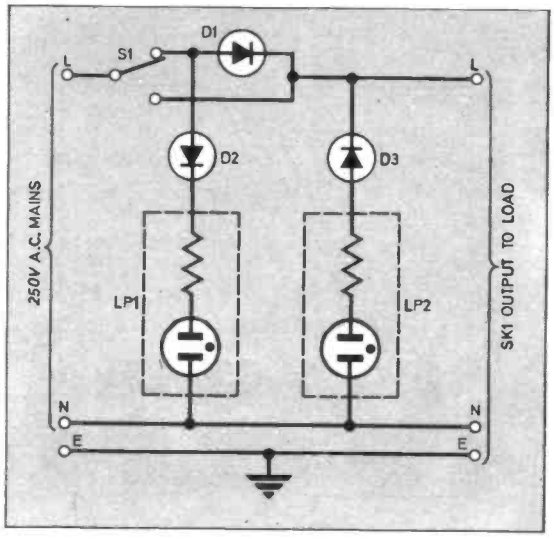



**Fig. 2. Complete circuit diagram of the Bit Saver.**

voltage is present from D1 and this cannot pass through D3 to light LP2.

When switch S1 is in the full power position the 250 volts a.c. is applied to the junction of D3 and D1 and directly to the load. The positive half cycles are not able to pass through either diode (D3 or D1) but the negative half cycles may pass through both, thus 125 volts is applied to LP2 which lights. The negative pulses which pass through D1 are unable to pass D2 and LP1 is prevented from lighting.

The neons used for LP1 and LP2 are mains indicators, incorporating series resistors as shown in Fig. 2, but have been found to work satisfactorily on 125 volts.

## CONSTRUCTION

The unit can be constructed in two ways—the first incorporating a toggle switch for S1 so that the unit is manually changed from half to full power and back; the second incorporating a micro-switch actuated by the iron when it is not in use. Thus the unit "automatically" changes from one state to the other when the iron is rested on a lever connected to the micro-switch.

The construction of the manually operated unit is shown in Fig. 3 while Fig. 4 shows the modification for "automatic" operation—the toggle switch is not included with this arrangement. The prototype unit was housed in an aluminium case measuring 4in x 2½in, plastic cases are not recommended for this application as they are easily damaged by a hot soldering iron. The case should be earthed using a solder tag under the tag strip mounting as shown, and the tag strip should be mounted on stand-off pillars to prevent the tags or diodes from touching the case.

The approximate cost of components shown for this project was calculated for the automatic unit and includes all items except the case and lever arm.

## Components.... SEE SHOP TALK

**Diodes**
D1 IS103 or any 300V 1A silicon rectifier
D2 IS103 or any 300V 100mA silicon rectifier
D3 IS103 or any 300V 100mA silicon rectifier

**Neons**
LP1, LP2 mains indicator neons incorporating series resistors (2 off)

**Switch**
S1 Single pole 2 way toggle or micro-switch (see text)

**Socket**
SK1 3 way miniature mains socket and plug to suit

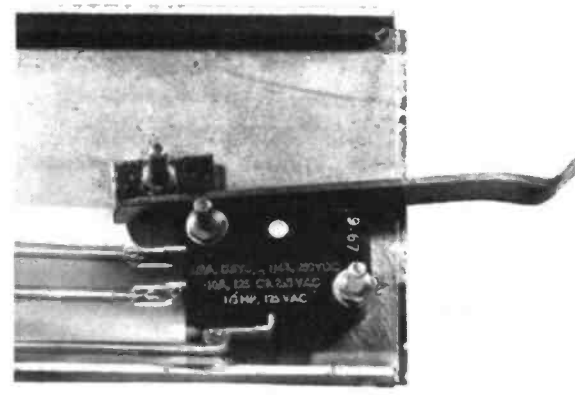
**Miscellaneous**
Case 4 in x 2½in x 2 in aluminium, 4 way tag strip, stand off pillars (2 off), 4BA fixings, earth tag, grommet, 3 core mains lead, connecting wire, metal for micro-switch lever if used (1/16 in aluminium or brass strip 4 in x ½ in).

## USE

The iron is connected to the unit by way of SK1 and allowed to warm up as required. Between soldering operations it should be switched to half power and returned to full power when needed. If the micro-switch in the automatic unit fails to operate with lightweight irons the operating lever can be lengthened or a weight affixed to its outer end.

At half power the iron was found to stay hot enough to keep any solder on the bit molten but not hot enough for successful soldering. On full power the normal working temperature is quickly regained and the iron is ready for use. ■

**Microswitch assembly for the automatic units.**



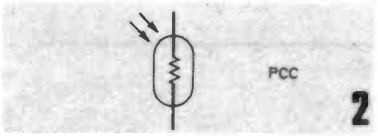
*Advert missing*

# guide to circuit

## Crystal


Two electrode plezoelectric crystal

## Semiconductors




Photoconductive cell with symmetrical conductivity, e.g. light dependent resistor

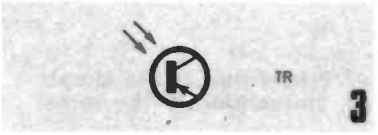



Photo transistor *pnp*

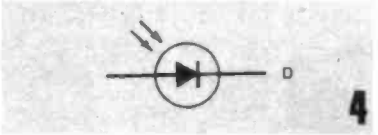
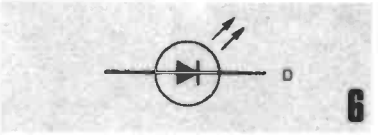
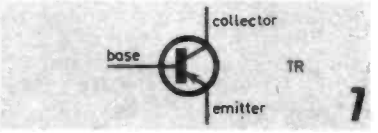



Photo diode *pn*

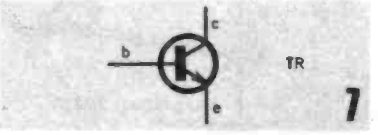

Photo voltaic cell



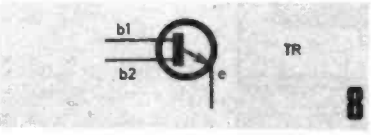

Light generating semiconductor diode, e.g. gallium arsenide diode



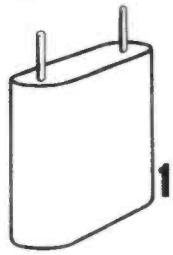

Transistor, *pnp*



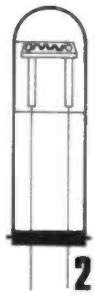

Transistor, *npn* (note: if collector is connected to envelope, dot joint at c)



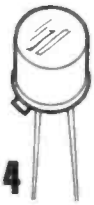

Unijunction transistor with *p* type base

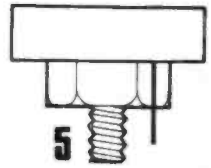


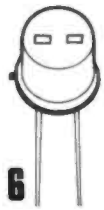




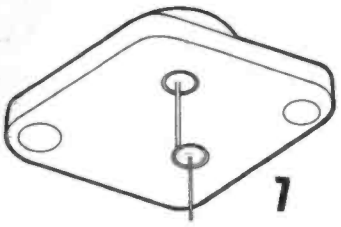


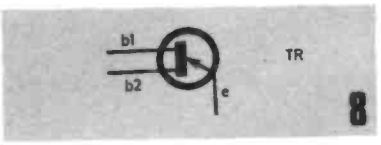


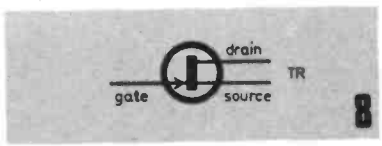




# symbols . . . part 6

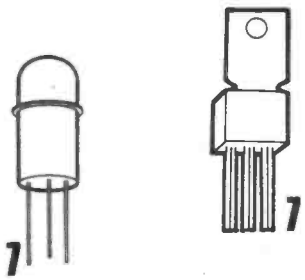


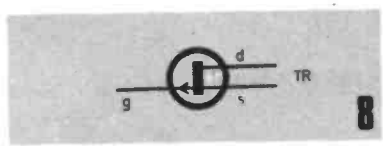




Unijunction transistor with *n* type base




Junction gate field effect transistor, *n* channel




Junction gate field effect transistor, *p* channel

## Block Symbols

Equipment

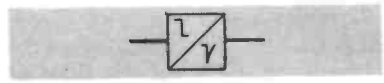
Signal path, arrow to signify flow direction


Non-rotating sine-wave generator

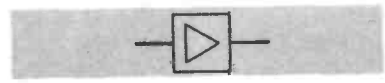

Non-rotating saw tooth generator


Non-rotating pulse generator

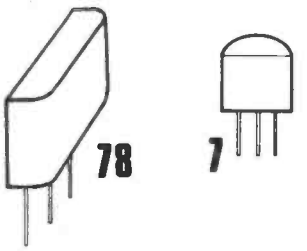

Non-rotating variable frequency sinewave generator



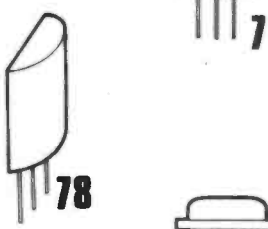
Differentiator

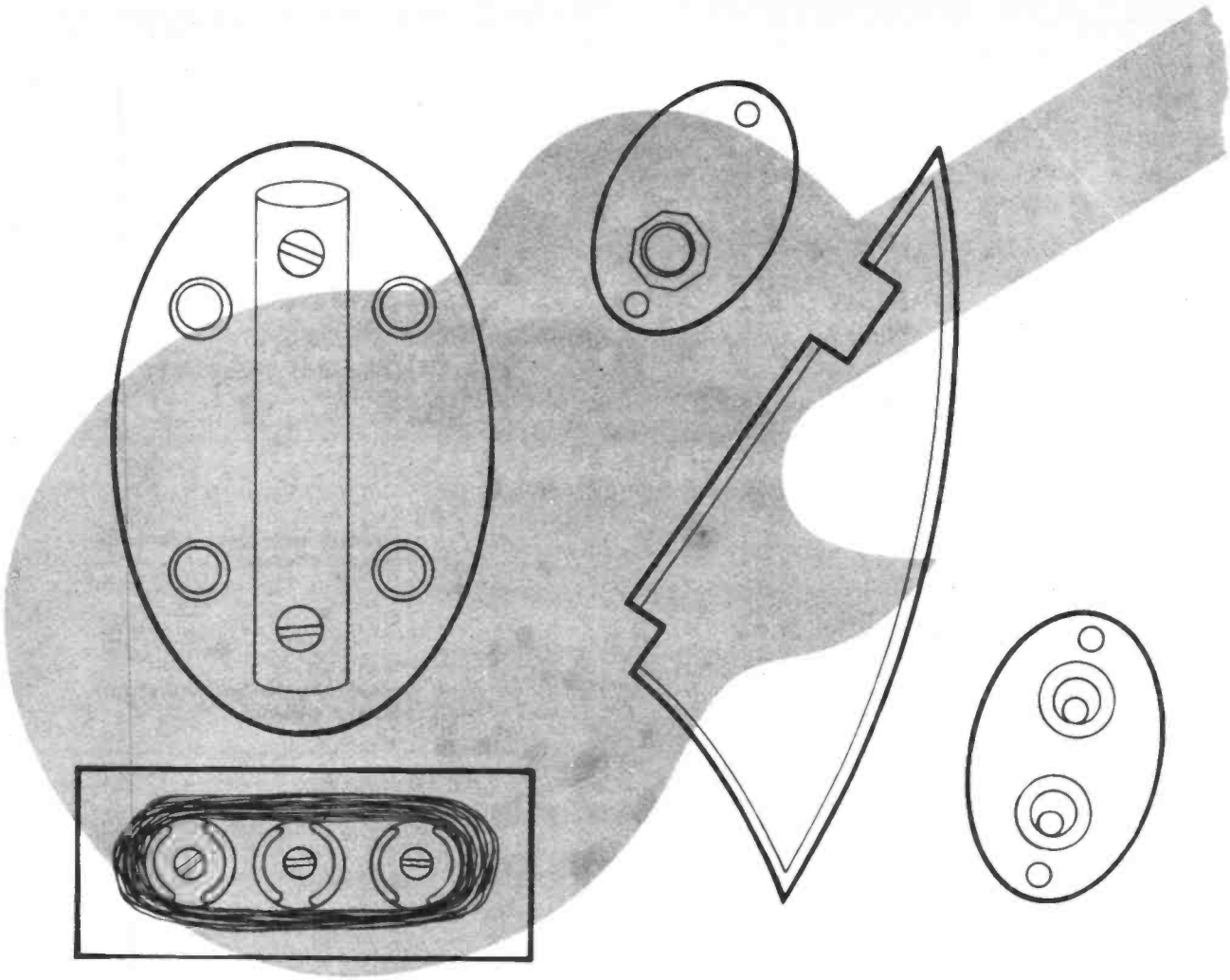


Amplifier, the triangle points in the direction of transmission







# ELECTRONIC GUITAR

## PICK-UPS & FITTINGS by Brian W. Terrell B.Sc.

LAST month we saw how the Beta body, neck and fretboard were constructed with details of the cut-outs and recesses to be made to house the fitments.

This month deals with the making of all these fittings including the two pick-ups and the wiring-up of a temporary circuit. This temporary wiring-up will enable the guitar to be played until the January issue of EVERYDAY ELECTRONICS when the "electronics" will be installed.

### TAILPLATE

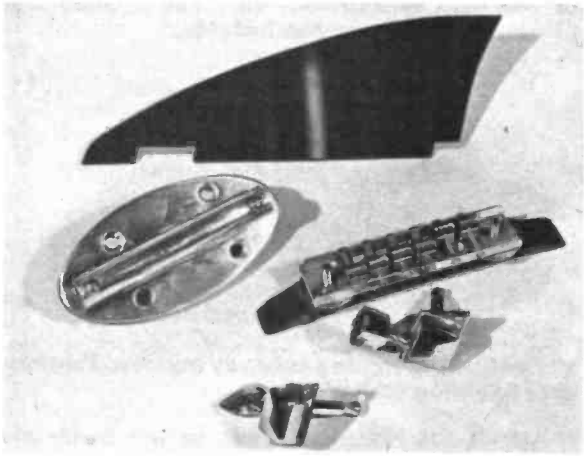
The tailplate assembly is shown in Fig. 5 and is drawn full size. It consists of an elliptical base plate made from $\frac{1}{4}$in. aluminium which is screwed to the body in the recess already made by means of four 1in. countersunk screws.

Bolted on top of the base plate is an aluminium tube of about $\frac{1}{2}$in. diameter to take the strings. This tube can be either solid or hollow (as shown).

The tube is bolted to the base plate by means of two 6BA round headed bolts. Araldite is then used to securely fix the tube to the plate. This is done by putting a line of Araldite on either side of the tube where it meets the plate. In the prototype the base plate was tapped to take the bolts; if a suitable tap is not available two nuts may be used to secure the tube to the base plate. Drill the necessary sized clearance holes for these securing bolts into the body.

Six $^1/_8$in. diameter holes are drilled through the tube, parallel to the base plate (not shown in Fig. 5). They should be countersunk and equi-spaced and span $2^3/_8$in. about the centre line through the guitar body.

If care is taken in preparing this fitment and it is filed smooth, polished with a fine grade of emery cloth and then polished with a metal polish such as Solvol Autosol, the finish can be brought up to sheen like chrome plate. A thin layer of clear varnish will preserve this sheen.



**Photograph of some of the fitments: scratch plate, tailplate assembly, bridge and machine heads.**

## OTHER METAL FITMENTS

There are two other metallic fitments, the jack socket cover, Fig. 10, and the stem support plate, Fig. 3.

First the jack socket cover—this is to be made from $^1/_{16}$in. aluminium to the dimensions given in Fig. 10. The curvature of this piece should be made identical to that on the body edge where it is to be fitted. It should be polished and protected in a similar way to that described in the tailplate section.

Screw the jack socket into the cover plate and fit into position and secure with two small $^1/_2$in. chrome screws.

The stem support plate is to be made from $^1/_{16}$in. steel plate to the dimensions given in Fig. 3. When made this should be polished and given a layer of clear varnish for protection against rusting.

## OTHER FITMENTS

The other fitments are shown in Figs. 6, 7, 8 and 9, and a recommended material is $^1/_8$in. thick Perspex as was used in the prototype.

Perspex is normally sold with a protective paper covering so tracing the shapes of these parts is a fairly easy matter using the carbon paper method described last month. Perspex can be cut with an ordinary hacksaw blade and filed smooth with a fine file.

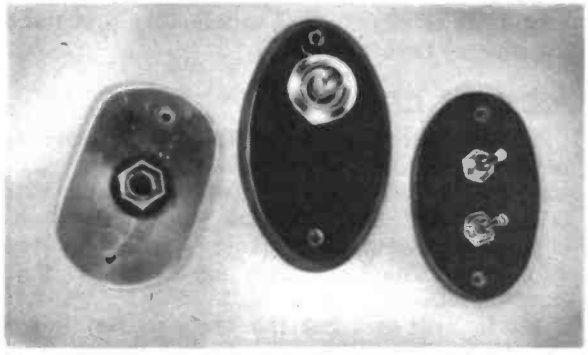
In the prototype, the scratch plate (Fig. 6) and the switch covers (Figs. 8 and 9) had their edges chamfered with a smooth file, and polished with fine emery paper and Solvol Autosol.

When drilling be careful not to press too hard else the Perspex may split. An ordinary metal drill will do the job adequately.

The final positions of these fitments is clearly shown by cross-hatched regions in Fig. 1. Secure these pieces in position with small round-headed chrome screws.

## BRIDGE

No details have been given for the construction of a bridge since a lot of mechanical work would be involved and besides, these are usually available from suppliers of guitars and other stringed instruments, and are inexpensive. It is recommended that an adjustable type is obtained.



**Photograph showing the Perspex switch covers and jack socket cover.**

## PICK-UPS

The Beta guitar uses two identically wound low impedance pick-ups which are matched to commercial amplifier inputs by means of a small matching transformer T1 (5 ohm to 50 kilohm).

Full details of the pick-ups and covers are shown in Figs. 11, 12, 13 and 14.

Begin making one of the pick-ups by cutting a piece of Veroboard to the dimensions shown in Fig. 13 and make the cut-outs along the copper strips and the magnet fixing holes as indicated.

Using 6BA nuts and bolts secure the three button magnets (Eclipse 821) in position as indicated ensuring that the magnet polarities agree with those of Fig. 13. This can easily be done by remembering that unlike poles attract one another and that each button has one north pole and one south.

A blob of solder placed on the copper strip either side of the fixing nut will ensure a permanent fixing.

## COIL WINDING

Approximately 20 yards of 30 s.w.g. enamelled copper wire is needed for each coil (pick-up).

Cut a piece of cardboard size $1\frac{1}{4}$in. by $2\frac{1}{2}$in. approx. and glue centrally on top of the three magnets. In the prototype double-sided Sellotape was used.

Clean one end of the enamelled wire by scraping off the enamel, tin this and solder in location F3 on the Veroboard. Now wind on 100 turns in a clockwise direction around the three magnets as a whole. Try to make the turns as neat as possible, although this is not very critical. Clean and tin the other end of the coil winding, and solder in location E2 on the Veroboard.

A dab of paint, nail varnish or lacquer should now be applied to the coil winding to prevent it coming unravelled. Solder on a piece of screened lead as shown in Fig. 13. Do **not** use the television aerial type of cable. Repeat the above procedure for the second pick-up.

Using an ohmeter or battery and bulb, test for continuity of the coils. If satisfactory proceed to the pick-up covers.

## PICK-UP COVERS

These covers must be made from a non-magnetic metallic material that can be easily soldered. For these reasons copper or brass plate is recommended. Aluminium would be suitable if aluminium solder is available but this is rather expensive. The prototype used 1/16in. thick copper plate.

Mark, drill and cut the plate as detailed in Fig. 11 (one for each pick-up) and then bend to shape as illustrated in Fig. 13. Now solder the internal joints so that the cover is rigid and leakproof. It will be necessary to use a large soldering iron for this job, 60 watts or more. If this is not available, the soldering can be carried out using the kitchen gas stove as follows: with the cover bent to final and accurate shape, grip with a pair of nose pliers and hold one joint over the hotplate on the stove. Heat until the solder freely flows in the joint. Dip in cold water to cool and then dry. Repeat for the other three joints.

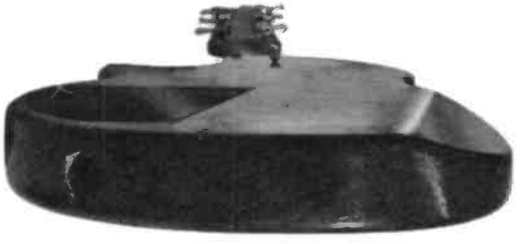
When satisfied with your soldering, the sharp edges and corners should be filed smooth and then cleaned with emery cloth.

With reference to Fig. 14, assemble the pick-up, pushing the magnet/coil assembly in as far as possible as shown. Now solder the copper strips of the Veroboard (pick-up baseplate) to the cleaned inside faces of the covers as shown. Use a soldering iron for this job and **not** the gas stove otherwise damage may result to the pick-up coil. Repeat for the second pick-up and assemble similarly.

When finished, both pick-up covers can be brought to a high sheen with fine emery paper and metal polish. To preserve the sheen a coat of clear varnish or polyurethane may be applied. If so desired the covers may be painted—this will not affect pick-up performance.

## ASSEMBLY

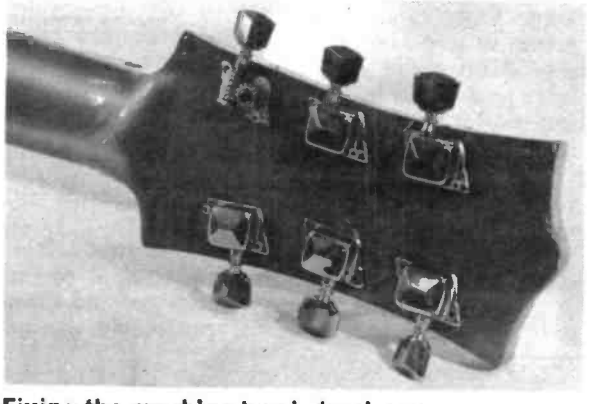
Before complete assembly to check out the instrument, clean up all the woodwork and carry out any refinements you may desire. On the prototype all the edges on the body were rounded off and a large slope was put on one side of the back of the body to make holding and playing a little more comfortable.



**View showing sloping cutaway for more comfortable handling whilst playing.**

Attach the machine heads to the head and place the nut in position for inspection. Affix all the fitments to the body of the guitar with the exception of the control section back plate. Start with the pick-ups; screw these in position and thread the cables through to the control section.

Screw in position the tailplate assembly, scratch plate and switch covers, jack socket cover with socket attached, and the tailplate assembly.



**Fixing the machine heads in place.**

Now attach the neck to the body with the six 2in. screws through the stem support (Fig. 3) and tighten fully.

Thread the strings through the tube on the tailplate from the front end such that the strings will pass over the tube on their way to the machine heads over the bridge and nut.

Position the bridge so that the distance between the bridge and 12th fret is the same as

# ELECTRONIC GUITAR

Fig. 11 (below). Marking and cutting details of the pick-up cover. Dotted lines represent bending lines.

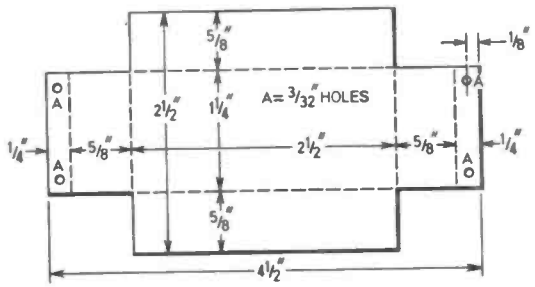



Fig. 12 (above). Photograph of a completed pick-up cover with rounded edges and corners.

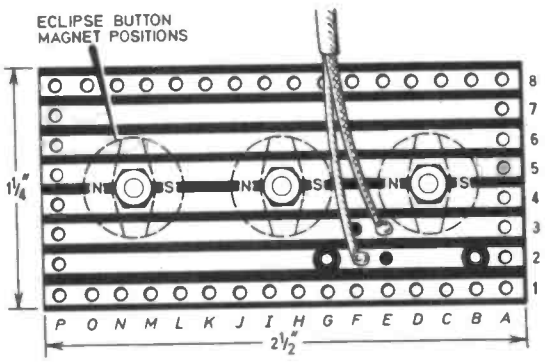
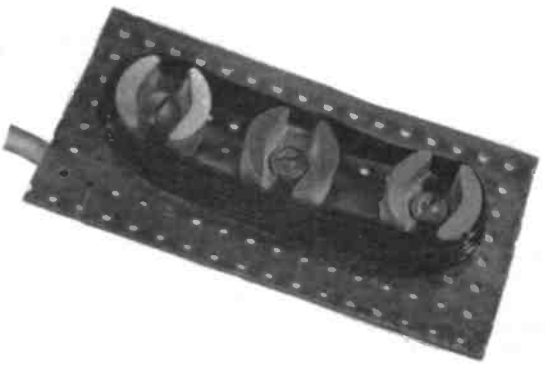



Fig. 13 (above). Underside view of the pick-up baseplate made from a 0·15in. matrix Veroboard. Shown dotted are the button magnets mounted on the top side of the Veroboard.



Photograph (above) of the coil wound on the magnets with insulated top removed.

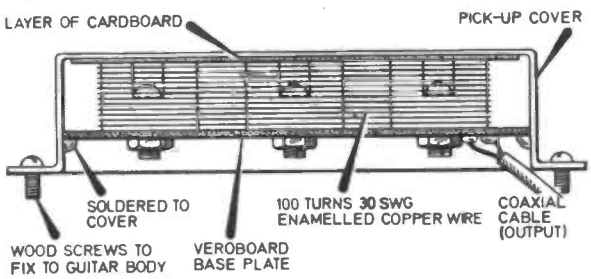



Fig. 14 (left). Details of assembling the pick-up coil into its metallic case. Note the cardboard layer between magnets and cover.

that from the nut to the 12th fret.

If the depth of the nut slots are satisfactory, loosen the strings and glue the nut securely in position. If not, correct and then glue.

Thoroughly check the performance of the fretboard at every position for each of the six strings and remedy if not completely satisfactory by filing down any high frets.

## TEMPORARY CIRCUIT

The circuit used is a temporary one until next month when the effects units—fuzz and treble boost—will be fully described. This circuit enables the guitar to be played through a commercially available amplifier with normal input impedances until the January issue.

As can be seen from Fig. 15 the two pick-ups, PU1 and PU2 are connected in parallel, and are inputted to the transformer on the Veroboard. The output is then taken direct to the jack socket SK1.

## VEROBOARD—WIRING UP

The size of the Veroboard to be used is 23×12 holes by 0·15in. matrix and this will be used next month to install the effects units.

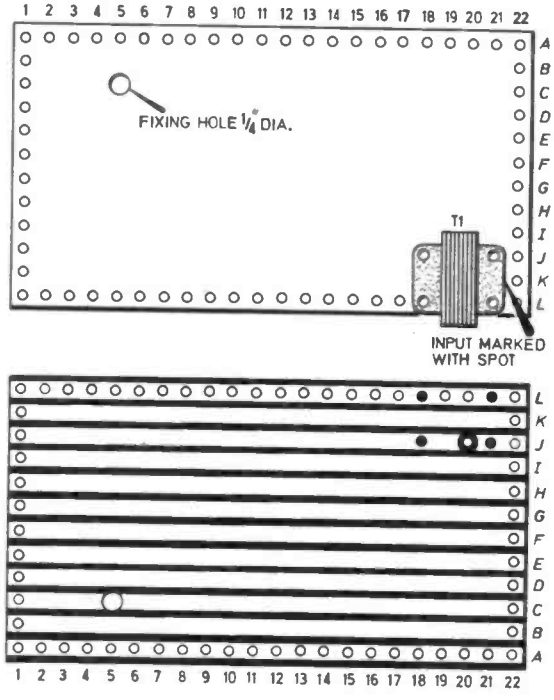



**Fig. 15. Shows the transformer T1 mounted in position on the Veroboard and regions of copper strip to be removed from underside.**

Make the cut-outs as shown in Fig. 15 and mount the transformer T1 as shown. The transformer is marked with a spot between its input terminals—ensure that this is correctly observed. The transformer is a very delicate component so

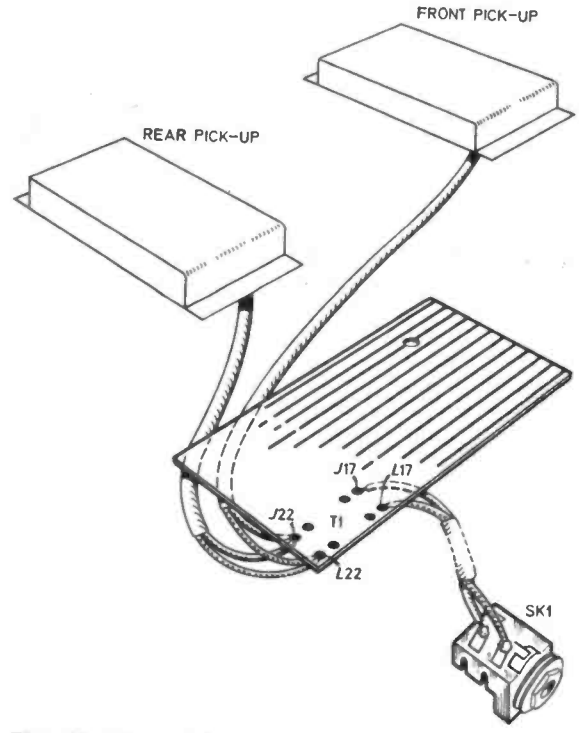



**Fig. 16. The wiring up of the two pick-ups and Veroboard panel to the ouput socket. The pick-ups are in parallel.**

extra care should be taken when placing and soldering in position. Do not apply too much heat or the transformer may become damaged. It has been designed to sit comfortably in 0·15in. matrix Veroboard.

Now wire up as detailed in Fig. 16 using co-axial cable for all connecions. If co-axial cable is not used, considerable noise and interference may be experienced.

The Veroboard should now be fixed to the base of the control recess with a small wood screw located at position C5 as indicated in Fig. 16. Screw on the control recess back plate and the guitar is ready to play through an amplifier.

**Next month:** adding the fuzz and treble boost effects units

## Components....

**T1** matching transformer type M218 5Ω to 50KΩ (Zeta Windings Ltd.)

**SK1** jack socket type R26/I (Re-an Products Ltd.). Toggle changeover switch for pick-up selection for use next month is also available from Re-an Products Ltd.

**Miscellaneous**

Eclipse button magnets type 821 (6 off); 30 s.w.g. enamelled copper wire; brass or copper plate size 4½in x 2½in. (2 off); Veroboard 0·15in. matrix: 2½in. x 1½in. (2 off), 3·3in. x 1·8in.; co-axial cable (12in.).

# BASIC Electricity

## 2 Current flow through liquids

By Maureen Birch

LAST month we considered how a chemical action inside a dry cell produces an electric current. Now we can set up a very simple experiment to show the reverse effect; i.e. how the passing of a current can cause a chemical reaction.

### CURRENT THROUGH A LIQUID

Connect a wire to the positive terminal of a battery and another wire to the negative terminal. Cover the bared free ends of the wires with aluminium cooking foil ensuring that the foil makes contact with bare wire ends. Place the foils into a glass of water making sure that they do not touch each other and that only the foil is under the surface of the water (none of the wire) Fig. 2.1.

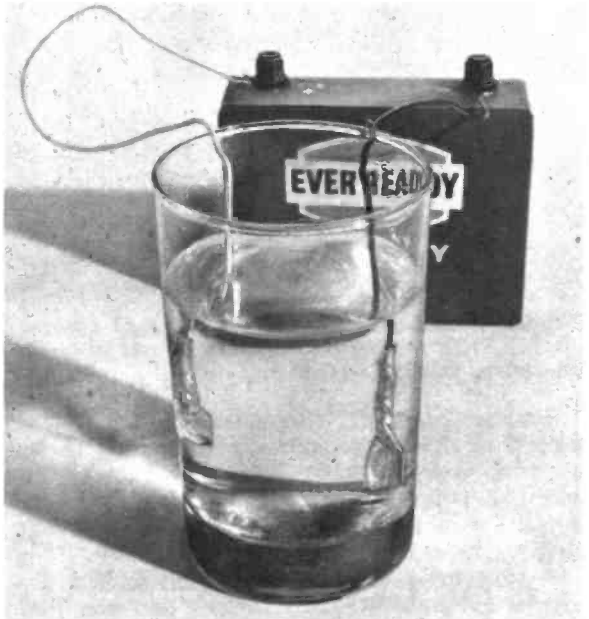



**Fig. 2.1. Electrolysis of water. You should see tiny bubbles at both electrodes.**

If you look closely you should see a stream of bubbles coming from each piece. These are bubbles of hydrogen and oxygen—the elements from which water is made.

The bubbles of hydrogen are coming from the wire connected to the negative terminal of the battery and this we call the **cathode.** The oxygen bubbles come from the end connected to the positive terminal—or **anode.** The two pieces of aluminum foil are collectively called electrodes. Thus as the electric current passes between the anode and cathode it breaks the water down to its two elements.

### ADDITION OF SALT

To make a success of this experiment a teaspoonful of salt should be added to the water to increase the conductivity since water by itself is not a very good conductor of electricity.

Now set up the experiment shown in Fig. 2.2. Putting a bulb in series with our basic circuit we can investigate the effect of adding more salt to the water. You should immediately see that


**Fig. 2.2. Adding table salt increases current flow and the bulb glows more brightly.**

adding more salt has the effect of increasing the number of bubbles evolved at the anode and cathode and at the same time the bulb glows more brightly.

It must be that the salt is helping the current to flow and the larger the current, the more bubbles there are produced. Now why should this be?

We must remember that an electric current is a flow of negatively charged particles called electrons. Since the bulb in Fig. 2.2 continues to glow, the current must be flowing around a complete circuit and therefore it must be flowing through the salt solution between the anode and cathode. To differentiate between current flow in solids and liquids we say that the liquid conductor is an **electrolyte** and the process of conduction that leads to the chemical breakdown of the electrolyte is called **electrolysis.**

## CHEMICAL THEORY

We will now try to understand exactly why the current flows in the electrolyte. When the salt is dissolved in water both the salt and the water break up into charged particles called **ions.** The salt, which is sodium chloride, (chemical formula NaCl) breaks up into positively charged sodium ions (abbreviated as $Na^+$) and negatively charged chloride ions ($Cl^-$). Water, which has the chemical formula $H_2O$ breaks up into positively charged hydrogen ions ($H^+$) and negatively charged hydroxyl ions ($OH^-$).

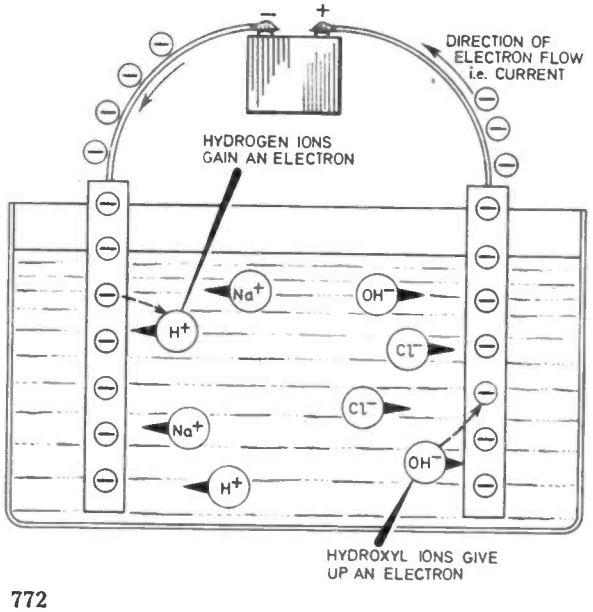
The solution remains electrically neutral because the total numbers of positive and negative charges are the same.

These charged ions migrate to the electrode of the opposite charge (Fig. 2.3) under the influence of the electrical pressure (voltage). Thus the chloride and hydroxyl ions migrate to the anode (positive) carrying electrons with them; these electrons are given up by the hydroxyl ions, oxygen is released and electrons flow away into the wire connected to the electrode.

At the cathode, $H^+$ and $Na^+$ ions arrive. The hydrogen ions collect the electrons that the hydroxyl ions had given up at the anode (it has moved round the outside circuit and is available at the cathode for this effect to take place) and hydrogen gas is formed.

There is a chemical law that governs which ions are discharged at the electrodes but we need not concern ourselves with the details of this.

**Fig. 2.3. Movement of ions in a salt solution under the influence of an external battery.**




## ELECTROPLATING EXPERIMENT

Thus the ions in the liquid are responsible for transporting the current between the electrodes. Let's see what happens if we replace the salt solution with another liquid—copper sulphate solution.

You should be able to get blue copper sulphate crystals from your local chemist but failing this a science teacher at your local school might be able to help.

**Fig. 2.4. Demonstrates the principle of electroplating. The enamel must be removed from the immersed portion of the wire coil.**

Set up the circuit shown in Fig. 2.4 making sure that the metal spoon is connected to the negative terminal of the battery and the copper wire to the positive terminal. After a few minutes you will see that the spoon has been coated with a thin layer of copper.

A very brief explanation of this is that the copper sulphate ($CuSO_4$) ionises and the positive copper ions ($Cu^{++}$) travel to the negative electrode (the spoon) where they are deposited as a layer of copper metal. If you examine the

copper wire which you have been using as the anode you may just be able to see that it looks a little "frayed", this is because some of the copper from the anode has been passing into the solution as ions. This has the effect of keeping the concentration of the copper sulphate solution constant. The electrolysis merely transfers copper from anode to cathode and this is the principle of **electroplating**.

You should be able to clean the spoon using an abrasive.

## INDUSTRIAL TECHNIQUE

A similar process called **electro-typing** is used in the printing industry for making engraved copper plates. An impression of the required plate is made in wax, then the face of the wax is covered with a layer of graphite (to conduct the current) and this wax mould is placed in a copper solution. The graphite/wax mould is made the cathode and a sheet of copper is used for the anode. When a current is passed, a layer of copper is deposited on the wax.

After several hours the mould is taken out and the wax melted off leaving a copper plate with the desired impression on it. Dies for making bank notes, coins and medals and gramophone records can be made this way. In fact this process is used whenever an exact reproduction is required.

## ANODISING

In our first two experiments with water, and salt solution, we saw that oxygen bubbles were given off at the aluminium foil anode. One interesting point to mention here is that using suitable electrolytes this oxygen can be made to react with the aluminium forming a layer of aluminium oxide. This is the principle of a process called **anodising** that is used to produce protective and decorative films on aluminium.

The main difference between anodising and electroplating is that in anodising, the articles are made the anode in a diluted acid solution and not the cathode as in electroplating.

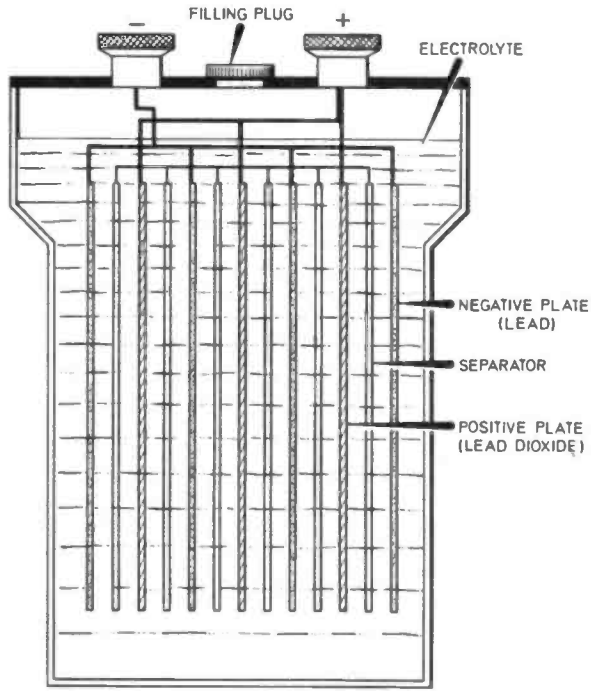
Strangely, the acids used in the anodising process dissolve about half the aluminium oxide as it is formed on the surface of the article and this has the effect of making the anodised layer porous. Because of this it will readily absorb dyes giving the decorative finish we can see on many articles around us eg. saucepan lids, motor car trims and lettered facia panels etc.

Electrolysis, electroplating and anodising are all examples of what is called "the chemical effect" of an electric current. Another similar effect is the charging of a type of cell called an accumulator.

## ACCUMULATORS

The dry cells mentioned last month have to be thrown away when their chemical energy is exhausted. Cells which can be re-charged i.e. have their chemical energy restored, are called accumulators or storage batteries. You might also see them referred to as "secondary-cells" to distinguish them from the "throw away" primary cells.

**Fig. 2.5. Shows the arrangement of plates in a lead-acid accumulator.**




The most common form of accumulator, see Fig 2.5, is the lead acid type found in motor cars and basically it consists of lead plates standing in dilute sulphuric acid. When a cell is first charged by passing an electric current through it, the positive plates become coated with red/brown lead dioxide and the negative plates remain unchanged. When the cell discharges and a current is drawn from it, the lead dioxide becomes lead sulphate, the negative plates also become coated with lead sulphate and the sulphuric acid becomes less dense.

In re-charging, the acid becomes denser again and the plates become lead dioxide and lead once more.

One of the quickest and easiest ways of testing the state of the cell is to check the density of the sulphuric acid using a small float called a hydrometer. There is in fact no "accumulation" or storage of electricity in this cell, charging simply converts electrical energy into chemical energy which is ready to produce electricity again when connected to an external circuit.

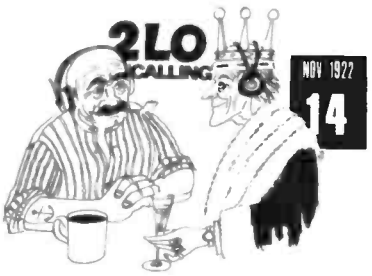
**Next month:** the magnetic effect of current.

# Ruminations By Sensor

# LONDON CALLING...

## The BBC

On November 14 1922, the British Broadcasting Company later to receive its charter and become the British Broadcasting Corporation began transmitting from station 2L.O. in London. Listeners throughout the country adjusted the tuning of their receivers and pressed the headphones closer to their ears so that they should not miss any part of the historic moment.




*Dustman and Duke shared the same programmes,*

Few, perhaps of those listeners could foresee how much their lives, and the lives of their children would be affected by this new medium. At the touch of a switch or the tickle of a cat's whisker, a voice, music or laughter came from out of the air to comfort the lonely or to cheer the sad. Dustman and Duke shared the same programmes, the same courteous address; for all listeners are equal, each scarcely aware of the other but each connected by radio waves to a common point.

But what of the material effects? The new industries of radio and radio component manufacturer, given impetus by this novel form of entertainment, were quick to respond with improved equipment. The amateur constructor and experimenter played a large part in the evolution of a scientific "toy" to a reliable simply operated domestic appliance. The use of short waves for telecommunications was pioneered by the "hams" who were forced into the higher frequencies by commercial pressures as the demand for broadcasting stations increased.

## Do it Yourself

The electronics construction hobby had its beginning with the opening of 2L.O. and so November 14 is also the 50th anniversary of our own hobby. Fifty years ago our grandfathers and our fathers drilled ebonite panels, wound honeycomb and basket coils and built variometers. Many mastered the art of soldering with a soldering iron heated in a gas jet (or even in the fire), a stick of solder and a tin of flux—no resin cored solder in those days!

Most components had screwed terminals—even small capacitors, and so those who could not "tin" the soldering iron could still indulge in the hobby. It is interesting to note that in those days, grid leak resistances were often formed by drawing pencil lines on the baseboard—a similar principle to that now used in modern thick film circuits!

Many of these receivers were cunningly designed to look like something else; my wife recalls a crystal set that was built into a flower bowl with terminals for aerial, earth and headphones at the back. In these early days it was thought necessary to disguise the "wireless" so that it would blend in with the home furniture; it must have been difficult to hide a horn loudspeaker, though.

A good outside aerial installation was necessary, except for strictly local reception, and every listener had his inverted "L", complete with "egg" insulators, draped across backyard or garden. The earth connection was little understood and consequently was regarded by many with great awe and a proper sense of respect.

## Radio Times

During the war, the BBC news broadcasts were an essential part of our lives. In order to prevent any attempt by the enemy to hoodwink the British listener, the BBC news readers began to announce their names at the beginning of each news broadcast, so that listeners would be able to identify them and thus forestall a would-be impersonator. At first, this was quite strange and in my family we used to vie with each other to name the news reader before he announced himself.

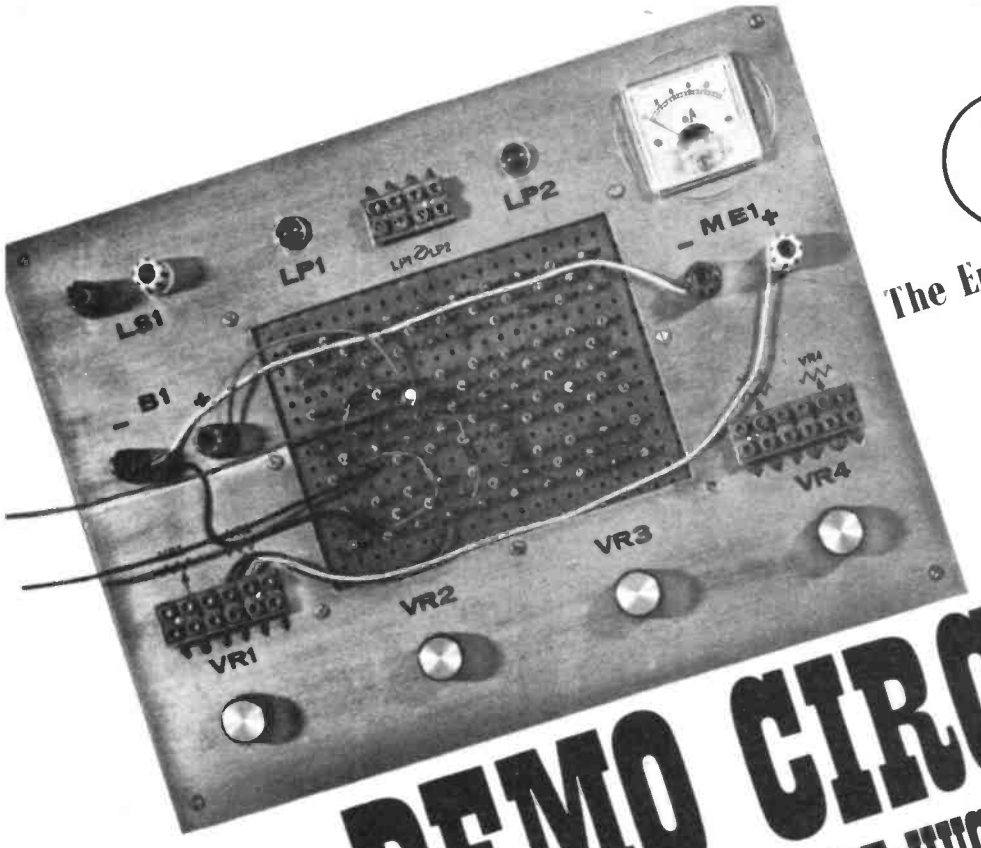
## Television

The first public television broadcasting service in the world had been started by the BBC in 1936. The transmissions were intended to serve only the London area and the service was closed down during the war so that enemy aircraft could not use the transmitter for navigational purposes.

I saw television for the first time at the Science Museum, South Kensington, after the war and resolved to build a receiver myself, I wound coils, drilled chassis and worked feverishly at night to try to line up the vision strip on the signal before the transmitter went off the air. What a thrill it was when the modulation on the tube melted into a picture!

Thank you, BBC for that moment, and for the pleasure I got from my first home-built crystal set, as a boy of eleven, lying in bed wearing headphones and using the steel mattress as an aerial.

Many happy returns, BBC, you may not have pleased all of the people all of the time, but you deserve full marks for trying.




# 1 The Emitter Follower

# DEMO CIRCUITS

## By MIKE HUGHES

IN this series we shall be describing a number of useful circuits. Some of them—such as that described this month—will be functioning pieces of equipment in their own right; others will be basic circuits that are often encountered in larger systems.

We shall describe the workings of each circuit in full detail and give some suggested experiments to verify the way in which they work. It is suggested that the circuits are built and the various measurements carried out, therefore to economise on components—many of which can be used several times over—we shall give layouts that refer to the Demo Deck. (A reprint of the Demo Deck article describing construction is available, price 15p, see page 749.)

Should you wish to, there is no reason why you should not use other forms of construction, e.g. Veroboard, standard pattern printed circuit board or one of the several forms of experimental "breadboards" that are available. Unfortunately we cannot give details that will cover all these other possibilities.

## EMITTER FOLLOWER

This month we look at the workings of the **emitter follower** stage and use it to make a simple, single range, high resistance voltmeter using the 1mA meter movement of the Demo Deck as the display. Fig. 1.1 shows the basic configuration of an emitter follower—it is sometimes called a **common collector** or **grounded collector** stage because the collector of the transistor goes straight to the power supply rail.

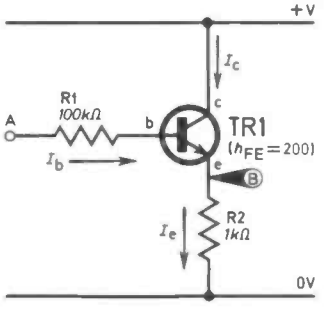



**Fig. 1.1. The basic circuit configuration of the emitter follower.**

To make TR1 conduct between collector and emitter we have to make the base positive (for an *npn* device) with respect to the emitter and pass base current ($I_b$). This causes collector current ($I_c$) to flow and the emitter current ($I_e$) will be the sum of base and collector currents.

$$I_e = I_b + I_c$$

But $I_e$ is controlled by the base current and the d.c. current gain of the transistor ($h_{FE}$) so we can say $I_e$ is the same as $I_b \times h_{FE}$.

$$\text{therefore } I_e = I_b + (I_b \times h_{FE})$$
$$= I_b(1 + h_{FE})$$

For a typical *npn* transistor such as the BC108, $h_{FE}$ is between 150 and 250; let us assume it is 200 as a round figure. $I_e$ will be $201 \times I_b$, i.e. about 0·5 per cent greater than $I_c$ would be. Because of this we can justifiably say there is very little difference between $I_e$ and $I_c$ and, to all intents and purposes (provided the transistor has a high enough gain), the emitter current is directly proportional to the base current—the linking factor being the gain ($h_{FE}$) of the device in question.

## CIRCUIT THEORY

We'll assume that we are using a BC108 for TR1; as it is a silicon device we must make the base at least 600mV positive with respect to the emitter before base current starts to flow. Assume point A is held at +4V and R1 and R2 are 100 kilohm and 1 kilohm respectively.

Initially the transistor is not conducting therefore point B will be zero volts; therefore the current flowing through R1 will be given by the potential difference between A and B minus the forward voltage drop of the base emitter junction divided by R1 i.e. $\frac{3 \cdot 4}{100{,}000} = 0 \cdot 034$mA. By rights this should cause a current of $0 \cdot 034 \times h_{FE}$ milliamps to flow through R2, i.e. $0 \cdot 034 \times 200 = 6 \cdot 8$mA.

If this were to happen we should get a voltage drop across R2 of $1{,}000 \times 0 \cdot 0068$ volts (6·8V) which would make point B a more positive potential than point A. Obviously this cannot be because as soon as point B reaches a potential 600mV less than point A base current ceases to flow and hence the emitter current is automatically self limiting. What happens is that the potential at point B rises towards A, the effect of this happening reduces the amount of base current which in turn prevents the emitter current rising further. This is a form of negative feedback.

Provided the current needed through R2 (to make point B rise in a positive direction) is not too great we can arrange matters so that whatever voltage we apply at A, the potential at B will be approximately the same (less 600mV) and the transistor will draw whatever base current it needs to do this through R1. We must, of course, make R1 a low enough value so it is the transistor that decides when enough is enough and not the resistance of R1.

In practice R1 can usually be considerably higher in value than R2 therefore we can convert voltage changes in high resistance circuits to similar changes in low resistance circuits. We say the emitter follower has a high input impedance (because it does not draw much current) and a low output impedance.

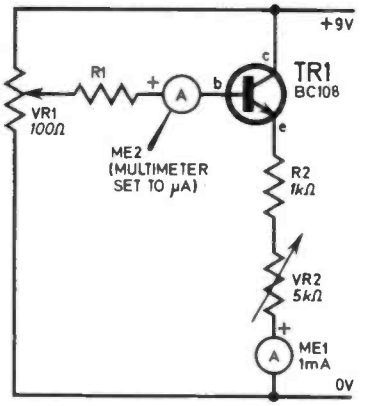



**Fig. 1.2. Test circuit for the emitter follower.**

## TEST CIRCUIT

You can check some of this for yourselves by using the circuit of Fig. 1.2. First wire up R2, VR2 and ME1 in series and adjust VR2 (with a 4·5V battery connected between the top end of R2 and the negative end of the meter) so you get a reading of 0·9mA. You now have a 5V full scale voltmeter with an internal resistance of approximately 5,000 ohms (1,000 ohms per volt).

Wire up the rest of the circuit and, if you have one, connect a multimeter (set to its lowest current measuring range) in series with R1. Alternatively connect R1 direct to the base of TR1. Start off with R1 being 10 kilohm.

The voltmeter we have made serves two purposes: (a) it enables us to measure the voltage between the emitter and ground by means of the current flowing through it and (b) it is the emitter load. Potentiometer VR1 has very low resistance and hence can be ignored when it comes to calculating current flow in R1.

Set VR1 about a quarter of a turn up from its bottom end (this corresponds to about 2·5V being applied to R1). You should read about 0·4mA on ME1 (this means the emitter voltage has risen to about 2V—roughly 600mV below the input voltage). Now check the base current on ME2—it will be about 2 or 3 microamps (depending on the gain of your transistor).

Leaving everything else as it is remove R1 and substitute another resistor of lower value (say 1 kilohm). You might expect the base current to increase dramatically, but it does not because the transistor draws only what it needs for the emitter voltage to follow the input. As a further experiment try increasing the value of R1 to 100 kilohm and then 1 megohm.

With the 100 kilohm resistor you should not see much change in base current or emitter current (ME1) but when you put in a 1 megohm resistor the base current will fall and there will be an appreciable drop in emitter current because, although the transistor is trying to draw the right amount of base current to keep matters correct, this current is now being limited by R1 and we lose the emitter follower effect.

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| IN4004 | 400 | 8 |
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| PL4002 | 100 | 9 |
| PL4003 | 200 | 10 |
| PL4004 | 400 | 10 |
| PL4005 | 600 | 12 |
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3 Amp T048


15 Amp T048

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| B1/20 | 200 | 30p |
| B1/60 | 600 | 35p |
| ONE AMP (G.I.) TUBULAR | | |
| W005 | 50 | 30p |
| W01 | 100 | 35p |
| W02 | 200 | 40p |
| W06 | 600 | 45p |
| TWO AMPS ½ H × ½ L × ¼ | | |
| B2/05 | 50 | 35p |
| B2/100 | 100 | 40p |
| B2/200 | 200 | 45p |
| B2/600 | 600 | 50p |
| B2/1000 | 1000 | 60p |
| FOUR AMPS ½H × ½L × ¼ | | |
| B4/100 | 100 | 60p |
| B4/200 | 200 | 65p |
| B4/400 | 400 | 70p |
| B4/600 | 600 | 75p |
| B4/800 | 800 | £1·00 |
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| B6/200 | 200 | 75p |
| B6/400 | 400 | 90p |
| B6/600 | 600 | £1·00 |



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| CR8 1/10 | 100 | 30p |
| CR8 1/20 | 200 | 30p |
| CR8 1/40 | 400 | 35p |
| CR8 1/60 | 600 | 45p |
| THREE AMP (TO48) | | |
| CR8 3/05 | 50 | 30p |
| CR8 3/10 | 100 | 30p |
| CR8 3/20 | 200 | 35p |
| CR8 3/40 | 400 | 45p |
| CR8 3/60 | 600 | 55p |
| FIVE AMP (TO66) | | |
| CR8 5/400 | 400 | 60p |
| SEVEN AMP (TO48) | | |
| CR8 7/100 | 100 | 60p |
| CR8 7/200 | 200 | 65p |
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1 Amp T05


3 Amp T048

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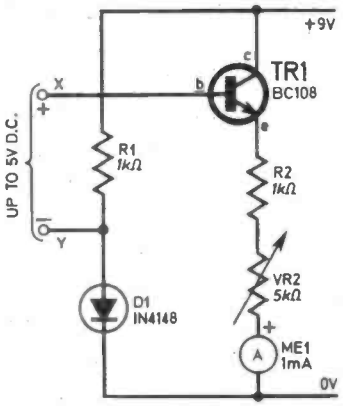
## INPUT IMPEDANCE

We say that an emitter follower has an input impedance, but this is **not** caused by the resistor in series with the base (R1 in Figs. 1.1 and 1.2) the input impedance is an imaginary resistance the value of which we can calculate from the input voltage and the current the transistor wants to draw from it. To a first approximation this impedance is the value of the emitter resistance multiplied by $h_{FE}$.

In our experimental circuit of Fig. 1.2 we can say that the input impedance of the transistor is $200 \times 5{,}000 = 1{,}000{,}000$ ohms. You can see now why adding resistors up to about 100 kilohm had little effect, but as soon as we made R1 1 megohm the potential at the base of TR1 falls by the potential divide effect of R1 (1 megohm) and the input impedance (also 1 megohm).

## PRACTICAL CIRCUIT

A practical circuit is shown in Fig. 1.3. This uses the same emitter load as Fig. 1.2 and we will use the circuit to measure voltages across points X and Y. Point Y is above a forward biased silicon diode so all input voltages at X will be biased up by +600mV. This counteracts the drop between base and emitter of the transistor.



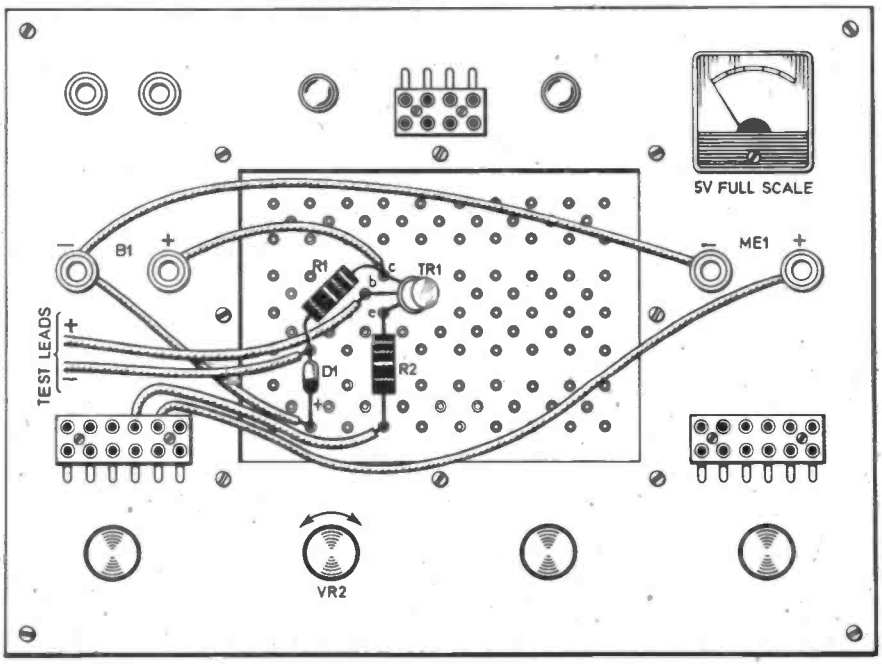

Provided VR2 is set exactly as before we have a 5V range voltmeter monitoring the emitter potential and this, we now know, will be to all intents and purposes the same as the potential difference applied between points X and Y.

The circuit will not draw much current from the voltage source being measured because of the high input impedance of the emitter follower. This being about 1 megohm, corresponds to a sensitivity of around 200,000 ohms per volt.

The circuit of Fig. 1.3 is shown wired up on the Demo Deck in Fig. 1.4.

**Note:** This series of articles is referred to as *Circuit Experiments* in the Demo Deck reprint.

**Next month:** Relaxation Oscillator



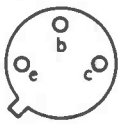




**Fig. 1.3. (above, left) practical circuit for a 5V d.c. voltmeter.**

**Fig. 1.4. (left) The circuit of Fig. 1.3. wired up on the Demo Deck.**

*Photograph: IEE library*

# THEY MADE THEIR MARK

## No7 Henry

**By J. E. Gregory**

**Table 1: THE HENRY (H)**

The unit of self and mutual inductance named in recognition of Joseph Henry's work by the International Electrotechnical Commission at a meeting in Chicago in 1893, who defined it as the inductance of a closed circuit in which an e.m.f. of 1 volt is produced when the electric current in the circuit varies uniformly at the rate of 1 ampere per second.

**Mutual Induction**

When two coils are coupled by their magnetic fields, a changing current in one coil will produce a changing magnetic flux and induce an e.m.f. in the other coil. The mutual inductance is a measure of the closeness of the coupling between the two coils.

**Self Induction**

When the current flowing through a coil changes, the accompanying change of magnetic flux will produce an e.m.f. which tends to oppose the current. The self inductance is a measure of the impedance offered to the flow of current.

In an earlier article we met Michael Faraday and the dynamo. At about the same time, working independently, 3,000 miles away in America on the problems of induction, was Joseph Henry who gave his name to the unit of inductance.

Henry was born in Albany, New York on December 17 1797, the only son of Scottish immigrant parents. Attending a local country school until the age of 13 he showed "little interest in study". He began his career as a watchmaker's apprentice. At the age of 16 he chanced upon a book, "The Problems of Natural Philosophy". This changed his outlook on life and interests so much that he enrolled as a student at the Albany Academy where he studied Chemistry, Anatomy and Physiology with a view to becoming a doctor. In 1825 he received an unexpected appointment to survey a route for a road across New York State from the Hudson River to Lake Erie, this broadened his interests to engineering.

In 1826 he returned to the Albany Academy to teach mathematics and natural philosophy, and it was here that he started his first experiments in electromagnetism. Henry was the first to insulate wire for the magnetic coil. He also invented the "spool" or "bobbin" winding which allowed electromagnets to be wound with extremely long lengths of wire. The resulting electromagnets were more sensitive than their predecessors and could be used for the detection of electric currents sent over great distances. Electrical dynamos or motors use the electromagnet in practically the form in which it was left by Henry.

Using such a magnet in a mile long electric circuit of copper wire, Henry in 1830, caused a small bell to ring at the end of the line. This is believed to have been the first electrical magnetisation of iron at a remote point, the starting point of the telegraph.

Transferring to the College of New Jersey (later Princeton University) in 1832, Henry startled the Campus by setting up a telegraph line between the laboratory and his house. He added the "relay" to his telegraph machine, and is believed to have been the first to use the earth as a return conductor.

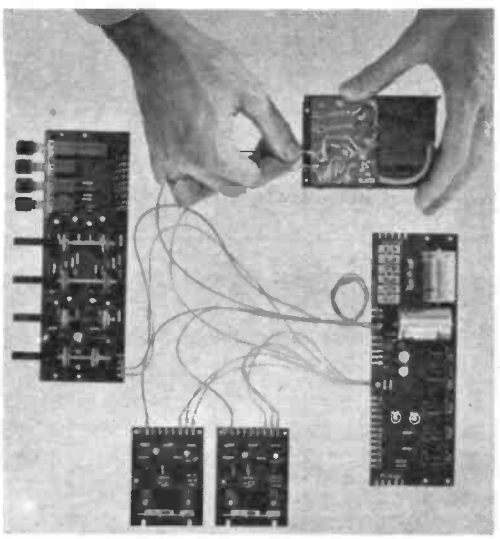
It was also in 1832 that he published his paper on self induction. He found also that a second induced current could induce a third; the third a fourth; and so on, indefinitely, and that these currents could be induced at a distance. Some of his experiments on induction involved the transmission of electric force without wires through the floors and walls of buildings, and in one case he magnetized a needle by the transmission from a lightning flash 8 miles away. This appears to be the earliest record of the action of electromagnetic waves of the type employed in radio telegraphy and telephony today. The discovery of the oscillatory character of the electrical discharge came in 1842.

Henry has been called the "Father of the Wireless Telegraph". Early in his career Samuel Morse of Morse code fame came to Henry for advice and in 1837 when visiting London, Henry met Cook and Wheatstone who were constructing their telegraph line along the Great Western Railway.

In December 1846 Henry resigned the Professorship of natural Philosophy at Princetown to become the organiser and first secretary of the newly formed Smithsonian Institute. Under his secretaryship, government support for all scientific activity was enlisted, but not content to be known only as an administrator Henry continued, with a wide range of practical experiments in various fields. Experiments ranging from researches in meteorology which laid the foundation for the U.S. Weather Bureau, to the invention of a new method for determining the velocity of projectiles.

Henry died in Washington on May 13 1878. The boy who had "shown little interest in studying" had by general consent become one of America's foremost physicists, and scientific administrators.

# 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.

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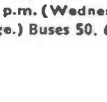

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| B84 | 100 | Silicon Diodes DO-7 glass equiv. to OA200, OA202 | 50p |
| B86 | 100 | Sil. Diodes sub. min. IN914 and IN916 types | 50p |
| B88 | 50 | Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc. | 50p |
| B1 | 50 | Germanium Translstors PNP, AF and RF | 50p |
| H6 | 40 | 250mW. Zener Diodes DO-7-Min. Glass Type | 50p |
| H17 | 20 | 3 amp. Silicon Stud Rectifiers, mixed volts | 50p |
| H15 | 30 | Top Hat Silicon Rectifiers, 750mA. Mixed volts | 50p |
| H16 | 15 | Experimenters' Pak of Integrated Circuits. Data supplied | 50p |
| H20 | 20 | BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts. | 50p |
| H34 | 15 | Power Transistors, PNP, Germ. NPN Silicon TO-3 Can. | 50p |

## MAKE A REV COUNTER FOR YOUR CAR

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system.

**£1 each**

## OUR VERY POPULAR 3p TRANSISTORS

TYPE "A" PNP Silicon alloy, TO-5 can.
TYPE "B" PNP Silicon, plastic encapsulation.
TYPE "E" PNP Germanium AF or RF.
TYPE "F" NPN Silicon plastic encapsulation.

## FULLY TESTED AND MARKED SEMICONDUCTORS

| | £p | | £p |
|---|---|---|---|
| AC107 | 0·15 | OC139 | 0·13 |
| AC126 | 0·15 | OC140 | 0·18 |
| AC127 | 0·17 | OC170 | 0·23 |
| AC128 | 0·15 | OC171 | 0·23 |
| AC176 | 0·20 | OC200 | 0·25 |
| ACY17 | 0·20 | OC201 | 0·25 |
| AF239 | 0·30 | 2N1302-3 | 0·15 |
| AF186 | 0·20 | 2N1304-5 | 0·17 |
| AF139 | 0·30 | 2N1306-7 | 0·20 |
| BC154 | 0·20 | 2N1308-9 | 0·22 |
| BCI07 | 0·10 | 2N3819FET | 0·40 |
| BC108 | 0·10 | 2N4416FET | 0·35 |
| BC109 | 0·10 | 2N3823EFET | 0·30 |
| BC148 | 0·10 | **Power Transistors** | |
| BC169 | 0·12 | OC20 | 0·40 |
| BF194 | 0·15 | OC23 | 0·25 |
| BF274 | 0·20 | OC25 | 0·25 |
| BFY50 | 0·13 | OC26 | 0·25 |
| BSY25 | 0·13 | OC28 | 0·30 |
| BSY26 | 0·13 | OC35 | 0·25 |
| BSY27 | 0·13 | OC36 | 0·27 |
| BSY28 | 0·13 | AD149 | 0·35 |
| BSY29 | 0·13 | AUY10 | 0·75 |
| BSY95A | 0·10 | 2S034 | 0·25 |
| OC41 | 0·15 | 2N3055 | 0·40 |
| OC44 | 0·13 | Diodes | |
| OC45 | 0·10 | AAY42 | 0·10 |
| OC71 | 0·10 | OA95 | 0·07 |
| OC72 | 0·10 | OA79 | 0·07 |
| OC81 | 0·13 | OA81 | 0·07 |
| OC81D | 0·13 | OA95 | 0·07 |
| OC83 | 0·18 | IN914 | 0·06 |

## POWER TRANSISTOR PRICE BREAKTHROUGH!

Plastic cased Silicon Power Transistors of latest design. 40watts and 90watts. PNP & NPN types. All types available at the most shatteringly low prices of all time. All are fully tested, marked and guaranteed!

| | 1-12 | 13-25 | 26-50 |
|---|---|---|---|
| 40W NPN | 20p | 18p | 16p |
| 40W PNP | 21p | 19p | 17p |
| 90W NPN | 24p | 22p | 20p |
| 90W PNP | 25p | 23p | 21p |

PAK PAKS of matched pairs

| | | | |
|---|---|---|---|
| MP40 | | | |
| 40W + 40W | 50p | 48p | 46o |
| MP90 | | | |
| 90W + 90W | 60p | 58p | 56p |

## A CROSS HATCH GENERATOR FOR £3.50 ! ! !

YES, a complete kit of parts including Printed Circuit Board. A four position switch gives X-hatch, Dots, Vertical or Horizontal lines. Integrated Circuit design for easy construction and reliability. This is a project in the September edition of Practical Television.

***This complete kit of parts costs £3.50, post paid.***

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## Our famous PI Pak is still leading in value for money.

Full of Short Lead Semiconductors & Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

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## 8 RELAYS FOR VARIOUS TYPES £1

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## INTEGRATED CIRCUITS

| | | 1-12 | 13-25 | 26-50 |
|---|---|---|---|---|
| Clocked Flip Flop | BMC931 | 20p | 18p | 16p |
| Ex. 2/4-input Buffer | BMC932 | 12p | 11p | 10p |
| 2/4-input Expander | BMC933 | 12p | 11p | 10p |
| Hex. Inverter | BMC934 | 12p | 11p | 10p |
| Hex. Inverter | BMC935 | 12p | 11p | 10p |
| Hex. Inverter | BMC936 | 12p | 11p | 10p |
| Hex. Inverter | BMC937 | 12p | 11p | 10p |
| Decade Counter | BMC938 | 25p | 23p | 21p |
| Div. by 16 Counter | BMC939 | 25p | 23p | 21p |
| Hex. Inverter | BMC940 | 12p | 11p | 10p |
| Hex. Inverter | BMC941 | 12p | 11p | 10p |
| Type D Flip Flop | BMC942 | 20p | 18p | 16p |
| Ex. 2/4-input Power | BMC944 | 12p | 11p | 10p |
| Clocked Flip Flop | BMC945 | 20p | 18p | 16p |
| 4/2 Input | BMC946 | 11p | 10p | 9p |
| Clocked Flip Flop | BMC948 | 20p | 18p | 16p |
| Nand Gate | BMC949 | 12p | 11p | 10p |
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| Dual J/K Flip Flop | BMC953 | 20p | 18p | 16p |
| Dual J/K Flip Flop | BMC955 | 20p | 18p | 16p |
| Dual J/K Flip Flop | BMC956 | 20p | 18p | 16p |
| Quad. 2-input Power | BMC958 | 12p | 11p | 10p |
| 2/4-input Gate | BMC961 | 12p | 11p | 10p |
| 3/3-input NAND Gate | BMC962 | 11p | 10p | 9p |
| 3/3-input NAND Gate | BMC963 | 12p | 11p | 10p |
| Audio Amp. 3w. | SL403D | £1·50 | £1·40 | £1·36 |
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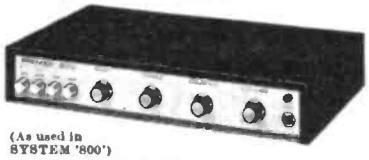
# PREMIER 800 STEREO AMPLIFIER



(As used in SYSTEM '800')

A truly high quality stereo amplifier—compare the specification, compare the price. Output: 5 watts per channel. Frequency response: 30-20,000 Hz = 2 db. Distortion: 1% Output Impedance 8 ohms nom. Inputs equalised to R.I.A.A. Magnetic 4mV. Ceramic 100mV. Tuner 100mV. Tape 100mV. Tape out 150mV. Din sockets for inputs and outputs. Controls: Bass, Treble, Volume, Balance, Selector. Mono/Stereo switch. Stereo headphone socket. Attractive slim line design black leatherette cabinet with aluminium front panel. Size 12¼" x 6¼" x 2¼".

ONLY **£15·00** Carr. 50p.

Mk. II Version available with Teak Finish Cabinet. **£16·25.** Carr. 50p.

# PREMIER HI-FI STEREO SYSTEMS

## SYSTEM "800"

Consists of the Premier 800 Mk II all transistor stereo amplifier (described left) Garrard auto/manual record player unit fitted stereo/mono cartridge with diamond stylus and mounted in teak finish plinth with cover and two cloth front loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 800 Mk II amplifier has an output of 5 watts per channel with inputs for ceramic and magnetic pick-up, tape and tuner also tape output socket and headphone socket. Controls: Bass, Treble, Volume, Balance, Selector. Mono/Stereo switch. Headphone socket. Power on/off. Teak finish cabinet with aluminium front panel. Size: 12¾in x 6¾in x 2¾in.

**£35·00**

Carr. £1·75

## SYSTEM "TWO"

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

**£45·00**

Carr. £1·75

## SYSTEM "THREE"

This consists of KLINGER KC903 stereo amplifier giving 6 watts rms per channel with Bass, Treble, Volume and Balance Controls. Inputs for Magnetic and Ceramic pick-up, tuner, tape in and out. Stereo headphone socket. Garrard SP25 Mk. III in teak finish plinth with cover and fitted Sonotone 9TAHCD diamond stereo cartridge. A pair of HMF Speakers size 16¼" x 10¼" x 9" fitted EMI units complete the matching system.

**£57·75** Carr. £1·75

**FREE**
LEADS AND PLUGS SUPPLIED WITH ALL SYSTEMS

# PREMIER PARAGON STEREO HI-FI AMPLIFIER

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

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

Specifications 10 + 10 watts into 8 ohms. Power/frequency response: 0dB 10 watts into 8 ohms -3dB 20Hz - 25KHz. Distortion typically less than 0·25%. Inputs for Magnetic phono (4mV) Ceramic phono (66mV) Radio/Tape (100mV). High and low filters. Teak finish cabinet. Size: 12¾" x 5¼" x 10¼".

**£32·00** P. & P. 50p.

**Premier Stereo System '69'**

Consists of the Premier Paragon Stereo Amplifier, Garrard SP25/II in teak finish plinth with cover and fitted Goldring G800 stereo magnetic cartridge plus a pair of Marsden Hall Annex 100 Loudspeaker Systems.

**£69** Carr. & Insurance £1·75

Complete with Free leads and plugs.

**WELLER "EXPERT" SOLDER GUN.** Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat. 100/140 watt. 240 volt A.C. **£3·95** P. & P. 50p

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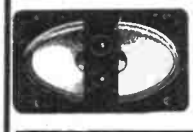

**E.M.I. 13×8in. HI-FI SPEAKERS**

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

**£3·47** P. & P. 50p

# PREMIER HI-FI OFFERS

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|---|---|
| Rogers Ravensbrook II Stereo Amplifier teak | **£38·50** |
| Rogers Ravensbourne Stereo Amplifier teak | **£55·00** |
| Metrosound ST20E Stereo Amplifier teak | **£25·50** |
| Goldring GL72 less cartridge | **£22·00** |
| Garrard SP25 III with Goldring G800 cartridge | **£15·00** |

P. & P. 60p extra any of above.

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

PREMIER PRICE **£17·95** P. & P. £1

| | |
|---|---|
| Garrard AP76 with G800, ready wired to 5 pin Din in plinth with cover | **£29·50** P. & P. £1 |
| Garrard AP76 less cartridge P. & P. 60p. | **£18·80** |
| Garrard 401 Transcription Unit P. & P. 60p | **£26·60** |
| Garrard 2025 T/C with Stereo Ceramic Cartridge | **£8·50** |
| Garrard 2025 T/C with Stereo Ceramic Cartridge ready wired in teak plinth with cover | P. & P. 60p **£12·45** P. & P. £1 |

**CARTRIDGE BARGAINS!**
Goldring G800H £5.00; G800 £5.50; G800E £9·50; P. & P. 10p

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MODEL GT-800 MULTIMETER

A precision made pocket sized test meter, ideally suited for testing electronic circuits or electronic appliances. Supplied complete with test lead and batteries. RANGES—DC Voltages: 10, 50, 250, 1,000V (1,000 opV). AC Voltage: 10, 50, 250, 1,000V (1,000opV). DC Current: 1mA, 100mA. Resistance: 0-150K ohms. Decibel: —10 to +22db (at AC 10V range) £2·47, P. & P. 25p.

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

**£2·47** P. & P. 25p.

## VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 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 plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

MONO MODEL **£3** STEREO MODEL **£3·47** P. & P. 15p

# E.M.I.

## LOW NOISE CASSETTES in library cases

C60 (List 71p) **45p**
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C120 (List £1·48) **85p**
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| SP5 | 5" | 600' | P.V.C. | 42p | SP7 | 7" | 1200' | P.V.C. 62p |
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| DT5 | 5" | 1200' | POLYESTER | 75p | DT7 | 7" | 2400' | POLYESTER £1·25 |
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TAPE SPOOLS 3" 5p, 5", 5½", 7" 9p.
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Easily fitted. Fully guaranteed by makers. Will control up to 600W of all lights except fluorescent at mains voltage. Complete with simple instructions. £3inc. P. & P.

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Easy to build. Solid State. Two full octave (less sharps and flats). Fitted hardwood case. Powered by two penlite 1½V batteries. Complete set of parts including speaker, etc., together with full instructions and 10 tunes. Price £3·00. P. & P. 22p.

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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.

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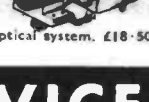
### BIG BLACK LIGHT

400 Watt. Mercury vapour ultra violet lamp. Outer bulb designed to absorb visible light and to transmit u.v. rays. Extremely compact and powerful source of u.v. Ideal for stage, display, discos' etc.



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## 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, 0·2A; 3·5kΩ, 165mA 5 kΩ, 140mA. Diameter 3¼in Shaft length ¾in, dia. ¼ in. All at £1·65 each. P. & P. 7½p.
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*New SIEMENS PLESSEY, etc. Miniature Relays at competitive prices.*

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|---|---|---|---|---|---|---|---|
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| 280 | 9–12 | 2 c/o | 73p* | 700 | 16–24 | 6M | 65p* |
| 410 | 10–18 | 4 c/o | 73p* | 1,250 | 24–36 | 4 c/o | 63p* |
| 700 | 16–24 | 4M 2B | 63p* | 2,500 | 36–45 | 6M | 63p* |
| 700 | 16–24 | 4 c/o | 78p* | 2,400 | 30–48 | 4 c/o | 50p |
| 700 | 12–24 | 2 c/o | 63p* | 9,000 | 40–70 | 2 c/o | 50p* |
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(1) Coil ohms; (2) Working d.c. volts; (3) Contracts; (4) Price (HD) Heavy Duty. All Post Paid. *Including Base.

### 12 VOLT D.C. RELAY 140 OHM COIL

Type 1: 3 sets c/o contacts 5 amp, 78p incl. P & P (almilar to illustration below).
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Manufactured by Clare-Elliott Ltd. (Type F). 2 c/o permanent latching in either direction. Coil 1150 ohm, 15-30 Volt D.C. Size ⅝" high ⅜" wide, ⅜" thick. Complete with 3" leads. New 73p incl. P. & P.

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240v A.C. 5 r.p.m. motor. 2 models available with either 10 cams or 15 cams. Each cam operating a 10 amp c/o micro switch. Cams are individually variable allowing innumerable combinations. Ideally suited for machinery control, automation, etc. Also in the field of entertainment, for chaser lights, animated displays, etc. NEW 10 cam £4·75 p. & p. 25p. 15 cam £5·75 p. & p. 25p.

## 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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### *THE 'SUPER' HY-LYGHT KIT*

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

- Variable speed from 1-23 flash per sec.
- Reactor control circuit producing an intense white light.

Never before a Strobe Kit with so HIGH an output at so LOW a price. ONLY £20 plus 75p P. & P.

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### 7-inch POLISHED REFLECTOR

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| | |
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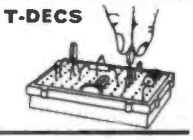

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Complete with free printed circuit board and 44 page Instruction book.

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(p. & p. 15p. on all types)

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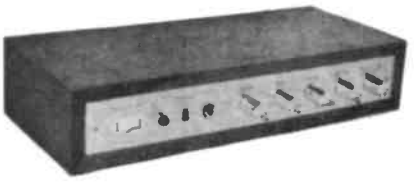
**16p**

(including ZIG-ZAG)

# THE TEXAN



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## Veroboard

| | Coppercl 0.1" | Coppercl 0.15" | Plain 0.15" |
|---|---|---|---|
| 2½" x 1" | 6p | 6p | – |
| 2½" x 3⅞" | 20p | 16p (9) | 10p |
| 2½" x 5" | 24p | 21p (7) | 12p |
| 3⅞" x 3⅞" | 24p | 21p (8) | – |
| 3⅞" x 5" | 27p | 27p (10) | 17p |
| 17" x 2½" | 67p | 50p | 37p |
| 17" x 3⅞" | 90p | 70p | 52p |
| 17" x 5" | – | – | 75p |

Spot-face Cutter 36p
Pin Insertion Tool 47p
Terminal Pins 18p per pack of 36

## Aluminium Boxes

Including baseplate and screws

| No. | L. | W. | D. | Price | p. & p. |
|---|---|---|---|---|---|
| (7) | 2⅜" | x 5⅛" | x 1½" | 35p | 8p |
| (8) | 4" | x 4" | x 1½" | 35p | 8p |
| (9) | 4" | x 2⅜" | x 1½" | 35p | 8p |
| (10) | 4" | x 5⅛" | x 1½" | 40p | 8p |
| 11 | 4" | x 2½" | x 2" | 35p | 8p |
| 12 | 3" | x 2" | x 1" | 32p | 9p |
| 13 | 6" | x 4" | x 2" | 50p | 10p |
| 14 | 7" | x 5" | x 2½" | 58p | 12p |
| 15 | 8" | x 6" | x 3" | 75p | 18p |
| 16 | 10" | x 7" | x 3" | 85p | 20p |

## Resistors

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| | | |
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| 1 watt | 10% Carbon Composition | 3p. each |
| 2 watt | 10% Carbon Composition | 6p. each |
| 2½ W | 5% Wire wound | 9p. each |
| 5 W | Wire wound | 9p. each |
| 10 W | Wire wound | 10p. each |

plus p. & p. 7p. for up to 25 resistors plus 1p. for each additional 25.

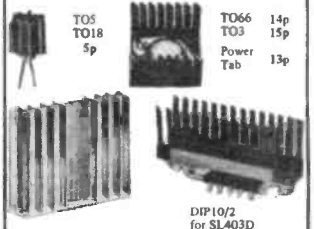
## Semiconductors

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AC107 | 25p | AF239 | 30p | BF197 | 15p | 2N1304 | 22p | AA120 | 9p |
| AC126 | 17p | BC107 | 10p | BU105 | £2 | 2N1893 | 30p | AA129 | 9p |
| AC127 | 15p | BC108 | 10p | MPF102 | 40p | 2N2926 | 10p | BA100 | 15p |
| AC128 | 15p | BC109 | 10p | MPF103 | 37p | 2N3053 | 23p | BA154 | 13p |
| AC176 | 20p | BC147 | 10p | MPF104 | 37p | 2N3055 | 49p | BA155 | 14p |
| AC187 | 25p | BC148 | 10p | MPF105 | 40p | 2N3702 | 12p | BA156 | 15p |
| AC187K | 25p | BC149 | 10p | MPF106 | 45p | 2N3704 | 17p | OA47 | 10p |
| AC188 | 25p | BC157 | 12p | OC28 | 40p | 2N3819 | 35p | OA79 | 9p |
| AC188K | 25p | BC158 | 10p | OC35 | 40p | IN914 ) | 6p | OA81 | 7p |
| AD140 | 40p | BC159 | 12p | OC44 | 15p | IN4148 ) | | OA90 | 7p |
| AD149 | 40p | BC169 | 15p | OC45 | 15p | IN4001 | 6p | OA91 | 7p |
| AD161 ) | 60p | BF180 | 25p | OC71 | 11p | IN4002 | 7p | OA200 | 10p |
| AD162 ) | | BF181 | 30p | OC72 | 17p | IN4003 | 8p | OA202 | 10p |
| AF114 | 18p | BF184 | 25p | OC170 | 23p | IN4004 | 8p | SL403D | £1.50 |
| AF115 | 18p | BF185 | 25p | OC171 | 30p | IN4005 | 10p | μA709C | 45p |
| AF116 | 18p | BF194 | 15p | 2N697 | 18p | IN4006 | 12p | μA710 | 45p |
| AF117 | 18p | BF195 | 15p | 2N706 | 12p | IN4007 | 15p | μA741C | 50p |
| AF139 | 28p | BF196 | 15p | 2N708 | 15p | AA119 | 9p | μA723C | £1.05 |

## Thermistors

| | |
|---|---|
| R53 | £1.32 |
| VA1005 | 15p |
| VA1026 | 13p |
| VA1033 | 13p |
| CZ1 | 15p |
| CZ4 | 13p |
| CZ13A | 13p |
| GL16 | £1.00 |
| GL23 | £1.00 |
| A15B | 75p |

## Heat Sinks



TO5 TO18 5p

TO66 14p
TO3 15p
Power Tab 13p

DIP10/2 for SL403D 15p

10D 50p

# CHROMASONIC electronics

## Capacitors

### Mylar – 100V

| | | | |
|---|---|---|---|
| 1000pf | 2p | 0.04μF | 3p |
| 2000pf | 2p | 0.05μF | 3p |
| 5000pf | 2p | 0.068μF | 4p |
| 0.01μF | 3p | 0.1μF | 4p |
| 0.02μF | 3p | 0.2μF | 5p |

### Polystyrene – 160V

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

### Mullard C280 - 250V

| | | | |
|---|---|---|---|
| 0.01μF | 3p | 0.22μF | 5p |
| 0.015μF | 3p | 0.33μF | 6½p |
| 0.022μF | 3p | 0.47μF | 8p |
| 0.033μF | 3p | 0.68μF | 11p |
| 0.047μF | 3p | 1μF | 13p |
| 0.068μF | 3½p | 1.5μF | 20p |
| 0.1μF | 4p | 2.2μF | 24p |
| 0.15μF | 4p | | |

### Mullard C281 - 400V

| | | | |
|---|---|---|---|
| 0.01μF | 4½p | 0.1μF | 7p |
| 0.015μF | 4½p | 0.15μF | 8p |
| 0.022μF | 4½p | 0.22μF | 10p |
| 0.033μF | 5½p | 0.33μF | 14p |
| 0.047μF | 6p | 0.47μF | 15p |
| 0.068μF | 6p | | |

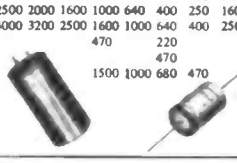
## Mullard C426,015 & 016 all 6p each

| Voltage | | | 10 | 16 | 25 | 40 | 63 |
|---|---|---|---|---|---|---|---|
| 2.5 | 4 | 6.4 | 10 | 16 | 25 | 40 | 64 |
| Capacity μF | | | 22 | 15 | 10 | 6.8 | 1 |
| | | | 47 | 68 | 22 | 47 | 2.2 |
| | | | 100 | 150 | 47 | 100 | 4.7 |
| | | | 220 | | 100 | | 10 |
| | | | | | 150 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 10 | 8 | 6.4 | 4 | 2.5 | 1.6 | 1 | 0.64 |
| 40 | 32 | 25 | 16 | 10 | 6.4 | 4 | 2.5 |
| 80 | 64 | 50 | 32 | 20 | 12.5 | 8 | 5 |
| 160 | 125 | 100 | 64 | 40 | 25 | 16 | 10 |
| 320 | 250 | 200 | 125 | 80 | 50 | 32 | 20 |
| 500 | 400 | 320 | 200 | 125 | 80 | 50 | 32 |

## Mullard C437 & 017

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2.5 | 4 | 6.4 | 10 | 16 | 25 | 40 | 64 | |
| 1000 | 800 | 640 | 400 | 250 | 160 | 100 | 64 | 8p |
| 1600 | 1250 | 1000 | 640 | 400 | 250 | 160 | 100 | 10p |
| 2500 | 2000 | 1600 | 1000 | 640 | 400 | 250 | 160 | 13p |
| 4000 | 3200 | 2500 | 1600 | 1000 | 640 | 400 | 250 | 16p |
| | | | 470 | | 220 | | | 10p |
| | | | | | 470 | | | 12p |
| | | | 1500 | 1000 | 680 | 470 | | 18p |



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Feedthrough ceramic 1000pf; 350V. 5p
Disc ceramics, monolithic ceramic, high voltage types; tantalums etc.

## Mullard C431

| | | | | | |
|---|---|---|---|---|---|
| 10 | 16 | 25 | 40 | 64 | |
| 2000 | 1250 | 800 | 500 | 320 | 33p |
| 3200 | 2000 | 1250 | 800 | 500 | 40p |
| 5000 | 3200 | 2000 | 1250 | 800 | 50p |
| 10000 | 6400 | 4000 | 2500 | 1600 | 74p |
| 16000 | 10000 | 6400 | 4000 | 2500 | 93p |

## HT Electrolytics

| | | |
|---|---|---|
| 1; 2; 4; 8μF | 450V | 14p |
| 16μF | 450V | 15p |
| 32μF | 450V | 20p |
| 50μF | 350V | 20p |

## TV & Radio Types

| | | | |
|---|---|---|---|
| 8 + 8μF; 450 V.W | 18p | 32 + 32μF; 350 V.W | 25p |
| 8 + 16μF, 450 V.W | 20p | 32 + 32μF; 450 V.W | 43p |
| 16 + 16μF; 450 V.W | 25p | 50 + 50μF; 350 V.W | 35p |
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| 32 + 100 + 125 + 200μF; 275 V.W. | | | £1.23 |
| 32 + 100 + 200 + 200μF; 300 V.W. | | | £1.23 |
| 100 + 100 + 100 + 150 + 150μF; 320 V.W. | | | £1.66 |
| 100 + 100 + 200 + 300μF; 275 V.W. | | | £1.23 |

60+100+200μF; 300 V.W 93p
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## Potentiometers

| | | |
|---|---|---|
| 5KΩ | 50KΩ | 500KΩ |
| 10KΩ | 100KΩ | 1MΩ |
| 25KΩ | 250KΩ | 2MΩ |

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

## Slider Pots

| Single | Dual | |
|---|---|---|
| 10K | 10 + 10K | log or lin |
| 25K | 25 + 25K | |
| 50K | 50 + 50K | |
| 100K | 100 + 100K | |
| 30p | 50p | |

Knobs 10p.

## Presets

Vertical or Horizontal
0.1 watt 5p 0.25 watt 7p

| | | | | |
|---|---|---|---|---|
| 100 | 1K | 10K | 100K | 1M |
| 250 | 2.5K | 25K | 250K | 2.5M |
| 500 | 5K | 50K | 500K | 5M |

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**To receive parts for these and other products featured in this issue send quoted approximate amount and cash adjustment will be made later.**

### TAPE HEADS

We are gradually obtaining more information about the Truvox tape heads we have, we are told that these have been wound in a very ingenious way so that winding may be coupled either in parallel or in series depending whether high or low impedance is required. We also have matching erase heads and now offer these in pairs. 1 record and 1 erase head. Price of the 2 track 45p per pair. 4 track 75p per pair. Pair mounted on plate 45p extra.

### 1 R.P.M. MOTOR

Made by the famous Smiths Company. 240v 50 cycle mains working. Ideal motor to drive clock mechanisms. Price £1 each or 10 for £9.

### DRILL CONTROLLER

*NEW IKW MODEL*

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 & p.

### MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2½ × 2 × 2in. £1·50 each.

### HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack £5·50.

### AUTO—ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £5·75 plus 25p post and insurance.

**WATERPROOF HEATING ELEMENT**

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

### MULTI-SPEED MOTOR

Replacement in many well-known food mixers. Six speeds are available 500, 850 and 1,100 r.p.m. from either or both of the nylon sockets (where the beaters of the food mixer normally go) and 8,000, 12,000 and 15,000 r.p.m. (ideal polishing speeds) from the main drive shaft. This drive shaft is ¼ in. diameter and approximately 1 in. long. A further point about this motor is that being 230/240v. AC-DC series wound its speed may be further controlled with the use of our Thyristor controller. This is a very powerful and useful motor size approx. 2 in. dia. × 5 in. long, mains 230/240v. Price 88p plus 23p postage and insurance, 12 or more post free.

### ISA ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp. on/off switch. Switch on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £1·95 + 20p p & p or with glass front chrome bezel 75p extra.

### 0-8 AMMETER

2in square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price 60p each. 10 for £5·40.

### NUMICATOR TUBES

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

### 12 WAY SUB-MINIATURE MULTI-CORE CABLE

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

### LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ¼in. thick. Rated at 500 MW, wire ended. 43p with circuit. Also ORP 12 light cell 45p.

### 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.

### THYRISTOR LIGHT DIMMER

For any lamp up to 200 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price £2·95 plus 20p post and insurance.

### TANGENTIAL HEATER UNITS

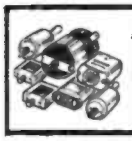
This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW. element and 1kW. element allowing switching 1, 2 and 3kW. and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. £3·50.

2kW. Model as above except 2 kilowatts £2·50. Don't miss this. Control Switch 35p. P. & P. 40p.

### DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2·25 plus 23p P. & P.

### THIS MONTH'S SNIP



A bargain parcel of 7 motors for £1. Some not as large as a postage stamp and only ⅞" thick, largest is 1½" × 1½" dia. Some work off 1½v some as high as 18v. These motors are used in racing cars, power toys etc. The largest is so powerful that it will drive a Mini drill, model lathe, or similar. This is a 4 pole motor, optimum working 16·5v but very powerful even as low as 4½v. Don't miss this wonderful snip.

**TIMAC 24 hour amp Clock Switch.** Self-contained unit for flex connection to the mains. Clock switches 2 on/offs per 24 hours. Operates a 15 amp switch. All neatly made up in an ivory moulded case with outlet socket. The only snag is that the outlet socket is the continental type. Plugs for these can be brought in this country alternatively you could fit a connector strip in place of the outlet socket. Overall size of this unit is approx. 4" × 2½" × 3" and the clock has a clear perspex cover which is easily removable for reprogramming. Ideal for blanket controller, etc. Price £2·75 each.

### STANDARD WAFER SWITCHES

Standard size 1½" wafer—silver-plated 5-amp contact, standard ¼" spindle 2" long—with locking washer and nut.

| No. of Poles | 2 way | 3 way | 4 way | 5 way | 6 way | 8 way | 9 way | 10 way | 12 way |
|---|---|---|---|---|---|---|---|---|---|
| 1 pole | 40p | 40p | 40p | 40p | 40p | 40p | 40p | 40p | 40p |
| 2 poles | 40p | 40p | 40p | 40p | 40p | 40p | 40p | 70p | 70p |
| 3 poles | 40p | 40p | 40p | 40p | 70p | 70p | 70p | 95p | 95p |
| 4 poles | 40p | 40p | 40p | 70p | 70p | 70p | 70p | £1·20 | £1·20 |
| 5 poles | 40p | 40p | 70p | 70p | 95p | 95p | 95p | £1·45 | £1·45 |
| 6 poles | 40p | 70p | 70p | 70p | 95p | 95p | 95p | £1·70 | £1·70 |
| 7 poles | 70p | 70p | 70p | 95p | £1·20 | £1·20 | £1·20 | £1·95 | £1·95 |
| 8 poles | 70p | 70p | 70p | 95p | £1·20 | £1·20 | £1·20 | £2·20 | £2·20 |
| 9 poles | 70p | 70p | 95p | 95p | £1·45 | £1·45 | £1·45 | £2·45 | £2·45 |
| 10 poles | 70p | 70p | 95p | £1·20 | £1·45 | £1·45 | £1·45 | £2·70 | £2·70 |
| 11 poles | 70p | 95p | 95p | £1·20 | £1·70 | £1·70 | £1·70 | £2·95 | £2·95 |
| 12 poles | 70p | 95p | 95p | £1·20 | £1·70 | £1·70 | £1·70 | £3·20 | £3·20 |

**MULLARD AUDIO AMPLIFIERS.** All in module form, each ready built complete with heat sinks and connection tags, data supplied.

Model 1153 500m watt power output 75p.
Model 1172 750m watt power output 85p.
Model EP9000 4 watt power output £1·45p.
10% discount if 10 or more ordered.

### 13 AMP TWIN GANG SOCKETS

Offered at less than wholesale price your opportunity to replace those dangerous adaptors—brown bakelite flush mounting—standard fitting. Unswitched 20p each, separately switched 30p each. Separately switched and with neon on/off indicators 45p each. Less 10% ten or more + 20p postage if order under £5.

**50 MICRO AMMETER** Square, panel mounting type. £2

### INTEGRATED CIRCUIT BARGAIN

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

*DON'T MISS THIS TERRIFIC BARGAIN.*

### MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10·7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self-oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 85p each. 10 for £7·85. With connection dig.

### POCKET CIRCUIT TESTER

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

### AMPLIFIER IN CASE WITH SPEAKER

Marketed by British Relay under the name Luxistor. This is in a very neat looking cabinet and is ideal around the home or in the workshop for trouble shooting or for testing out a quick lash up. Size approx. 9½" × 6½" × 3½" deep. Input is via a matching transformer and volume control and amplifier may be powered by an internal 9v battery or an external 110v source. Speaker is an R-A elliptical 5"×3½" 10,000 gauss. The amplifier proper is a Newmarket model ref. P.C.4. Price £3·50 each, 10 for £31·50. Post and insurance 20p.

### BAKELITE INSTRUMENT CASE

Size approx. 6½"×3½"×2" deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price 45p each.

### TELEPHONES

**Complete as illustrated. Save your legs, time and temper, simply by putting in some telephones. Ex. G.P.O. not new—but guaranteed in good condition and serviceable. Supplied with diagram and instructions showing how to connect. Price 75p each+50p post or 2 for £2 post paid. Also available separately, dials and handsets 50p each + 20p post.**

### ROCKER SWITCH

13 amp self-fixing into an oblong hole. size approximately 1" × ⅝" 6p each, 10 for 54p.

### SLIDE SWITCHES

**Slide Switch.** 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in x ⅝in rated 250V lamp. 6p each. 10 for 54p, 100 for £5·10, 500 for £24. Ditto as above but for printed circuit 5p each 10 for 45p, 100 for £4·25. **Sub Miniature Slide Switch.** DPDT 19mm (¾in approx.) between fixing centres.18p. each or 10 for £1·08. 8P Change over spring return 250v 1 amp. 10p.

### EDUCATIONAL KITS—all with pictorial instructions

**THIS BALANCE KIT FREE**

Eagle educational kits. Japanese made these are excellent value for money. We do not expect to be able to repeat this offer once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give **FREE** an accurate 11 piece balance kit. Price of kits 40p each post paid. Special price for all 8 kits £3·00 with free balance kit.

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

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

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

**KA6—2-Pole Motor Kit.** Twenty-four parts including enamel wire, armature and pole piece, etc. Motor operates from 1½ volt battery. Illustrates and teaches how electro-magnetism operates a motor.

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

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

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

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

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

## J. BULL (ELECTRICAL) LTD.

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# Build yourself a TRANSISTOR RADIO

**WITH AFTER SALES SERVICE**

## ROAMER 10 WITH VHF INCLUDING AIRCRAFT

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

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

**Total building cost**

**£8·50**

P. P. & Ins. 50p

(Overseas P. & P. £1)

## ROAMER EIGHT Mk I

**NOW WITH VARIABLE TONE CONTROL**

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).
Earpiece with plug and switched socket for private listening 30p extra.

**Total building cost** (Overseas P. & P. £1) **£6·98** P. P. & Ins. 45p.

## ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts).
Earpiece with plug and switched socket for private listening 30p extra.

**Total building costs** (Overseas P. & P. £1) **£5·98** P. P. & Ins. 45p.

## ROAMER SIX

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3, Trawler, band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 15p (FREE with parts).

**Total building costs** (Overseas P. & P. £1) **£3·98** P. P. & Ins. 30p

## POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1½ × 3½in. Easy build plans and parts price list 10p (FREE with parts).

**Total building costs** (Overseas P. & P. 63p) **£2·29** P. P. & Ins.23p

## TRANSONA FIVE

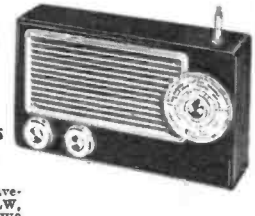
**5 TRANSISTORS AND 2 DIODES**

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ × 4½ × 1¾in. Easy build plans and parts price list 10p (FREE with parts).

**Total building costs** (Overseas P. & P. 63p) **£2·50** P. P. & Ins. 24p

## TRANS EIGHT

**8 TRANSISTORS and 3 DIODES**



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band.
Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

**Total building costs** (Overseas P. & P. £1) **£4·48** P. P. & Ins. 32p

## NEW! "EDU-KIT"

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

**COMPONENTS INCLUDE:**
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 3 inch Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards: Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¼" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction

**All parts including Case and Plans** (Overseas P. & P. £1) **£5·50** P. P. & Ins. 32p

**FULL AFTER SALES SERVICE**

- Callers side entrance "Lavells" Shop
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|---|---|---|---|
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| ROAMER EIGHT | ☐ | TRANS EIGHT | ☐ |
| TRANSONA FIVE | ☐ | ROAMER SIX | ☐ |
| POCKET FIVE | ☐ | EDU-KIT | ☐ |

Parts price list and plans for .....

Name .....

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ALL YOUR ELECTRONIC REQUIREMENTS WITHIN 200 YARDS. CALL IN AND SEE FOR YOURSELF.

## BUILD THE TEXAN

(As featured in "Practical Wireless" May to August 1972)

### 20 + 20 WATT INTEGRATED I.C. STEREO AMPLIFIER

★ FREE TEAK CABINET with complete kits!

**FEATURES.** New slim design with 6 - IC's, IC Sockets, 10 silicon transistors, 4 rectifiers, 2 zeners. special Gardeners low field slim line transformer. Fibre glass PC panel. Complete chassis work.

HIGH QUALITY & STABILITY ARE PREDOMINATE FEATURES —DEVELOPED BY TEXAS ENGINEERS FOR PERFORMANCE, RELIABILITY AND EASE OF CONSTRUCTION.

**FACILITIES.** On/off switch indicator, headphone socket. separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, Input selector; Mag. P.U. Radio Tuner, Aux. Can be altered for Mic., Tape, Tape-head. etc (Parts list Ref. 20 on request).
Constructional details Ref. No. 21 30p

SPECIAL KIT PRICE

**£28·50** P & P 45p

★ SLIM DESIGN WITH SILVER TRIM
Overall chassis size 14½" x 6" x 2" high

COMPLETE WITH FREE TEAK CABINET

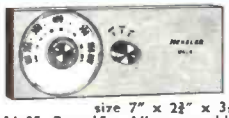
*Designer approved kits distributed by Henrys!*

### LOW COST HI-FI SPEAKERS

E.M.I. Size 13¾" × 8¾". Large Ceramic Magnet.
**TYPE 150** 6 watt, 3, 8 or 15 ohms £2·20. Post 22p.
**TYPE 150 TC** Twin cone version £2·75. Post 22p.
**TYPE 450** 10 watt with twin tweeters and crossover. 3, 8 or 15 ohms. £3·85. Post 25p.
**TYPE 350** 20 watt with tweeter and crossover. 8 and 15 ohms. £7·70. Post 28p.

**POLISHED CABINETS** 150, 150TC 450 £4·60. Post 30p.
ASSEMBLED IN POLISHED CABINETS (8 ohms)
SERIES 6 (Assembled 150 T/C) per pair £16·50. Post 70p
SERIES 8 (Assembled 450) per pair £18·95. Post 70p

### ML-3 MW/LW TUNER to BUILD

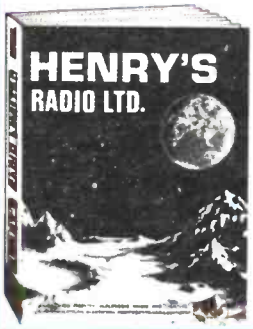


Uses Mullard Module. Slow motion tuning. Built in battery. Ferrite aerial. Overall size 7" x 2⅞" x 3¾". TOTAL COST TO BUILD £4·85, Post 15p. All oarts sold separately. Leaflet No. 6

### "BANDSPREAD" PORTABLE TO BUILD

Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bandspread for extra selectivity. Also slow motion geared tuning, 600 mW push-pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance.
TOTAL COST TO BUILD £7·98, p.p. 32p. (Battery 22p). All parts sold separately—Leaflet No. 2

### CATALOGUE

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PRICE **55p** Post Paid
(40p FOR CALLERS)

**PLUS! FIVE 10p VOUCHERS**

Send to this address—HENRY'S RADIO LTD. (Dept.E.E.) 3 ALBEMARLE WAY, LONDON, E.C.1.—for catalogue by post only. All other mail and callers to "303" see above.

### TEST EQUIPMENT Just a selection!

| | | |
|---|---|---|
| SE250B | Pocket Pencil Signal Injector | £1·90 |
| SE500 | Pocket Pencil Signal Tracer | £1·50 |
| THL33D | Robust 2K/Volt | £4·55 with case £4·95 |
| TE15 | Grid Dip Meter 440 KHz–280 mHz | £13·45 |
| 500 | 30 K/V Multimeter | £9·25 With leather case £10·50 |
| 200H | 20K/V Multimeter | £4·20. With case £4·95 |
| AF105 | 50K/V Multimeter | £8·50. With case £9·50 |
| U4341 | AC/DC Multimeter with transistor tester with steel case | £10·50 |
| TE20D | RF Generator 120KHz–500MHz | £15·95. Carr. 35p |
| TE22D | Audio Generator 20Hz–200KHz | £17·50. Carr. 35p |
| CI-5 | 3" Pulse Scope 10Hz–10mHz | £39·00. Carr. 50p |
| TE65 | Valve Voltmeter 28 ranges | £17·50. Carr. 40p |

ALL NOMBREX MODELS IN STOCK

### PA-Disco-Lighting

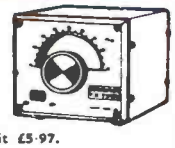
UK's Largest Range—Write phone or call in. Details and demonstrations on request.

| | | |
|---|---|---|
| DJ30L | 3 Channel sound to light unit, 3KW. | £29·75 |
| DJ40L | 3 channel Mic (built-in) to light., 3kW | £38·75 |
| DJ70S | 70 watt Disco amp/mixer. | £49·95 |
| DISCOAMP | 100 watt amp/mixer, | £66·50 |
| DJ105S | 30 watt Disco amp/mixer, | £32·75 |
| | Anti-Feedback Quality Mic., | £11·50 |
| DJ500 | 50 watt PA Amplifier GROUP 300 150 watt rms Group Valve Amplifier | £86·00 |

FIBRE OPTICS LIGHTING. — MICS. EFFECTS. PROJECTORS. SPOTS. DIMMERS — STANDS. MIXERS. SPEAKERS. Everything for PA — Disco — Lighting.
**FREE Stock List Ref. No. 18**

- PORTABLE DISCOS — DETAILS ON REQUEST
- CREDIT TERMS FOR CALLERS

### BUILD THIS VHF FM TUNER



5 TRANSISTORS 300 kc/s BANDWIDTH, PRINTED CIRCUIT, HIGH FIDELITY REPRODUCTION. MONO AND STEREO
A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it—VHF FM gives the REAL sound. All parts sold separately. Free Leaflet No. 3 & 7.
**TOTAL** £6·97, p.p. 20p. Decoder Kit £5·97.
Tuning meter unit £1·75
Mains unit (optional) Model PS900 £2·47. Post 20p
Mains unit for Tuner and Decoder PS6/12 £3·25. Post 20p

### SINCLAIR PROJECT 60 MODULES —SAVE POUNDS!

| | | |
|---|---|---|
| Z30 | £3·57; | Z50 £4·37 |
| STEREO 60 | | PZ5 £3·97 |
| | £7·97; | PZ8 £4·77 |
| PZ6 | £6·37; | |

Transformer for PZ8 £2·95
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