

MAR  
1978

# practical WIRELESS

45 p

**EXTRA**

**SPECIAL 8-PAGE  
SUPPLEMENT:**

**GUIDE TO  
AERIALS**

**Also:  
MYSTERY  
TRAIN TOUR**

**U-DeCNOLOGY  
(New Series)**



the  
**PW**

**'EUROPA'**  
**stereo amplifier**

# T.T.L. 74 I.C.'s By TEXAS, NATIONAL, I.T.T., FAIRCHILD Etc

7400 14p	7413 30p	7432 25p	7454 15p	7490 35p	74121 30p	74139 100p	74156 70p	74174 100p	74189 350p
7401 14p	7414 80p	7437 25p	7480 15p	7491 75p	74122 60p	74141 60p	74157 70p	74175 75p	74190 140p
7402 14p	7416 30p	7438 25p	7470 30p	7492 45p	74123 60p	74142 270p	74160 90p	74176 100p	74191 140p
7403 14p	7417 30p	7440 15p	7472 25p	7493 40p	74125 50p	74143 270p	74161 90p	74177 100p	74192 120p
7404 14p	7420 15p	7441 65p	7473 30p	7495 50p	74126 50p	74144 270p	74162 90p	74178 140p	74193 120p
7405 14p	7422 20p	7442 85p	7474 30p	7496 70p	74130 130p	74145 270p	74163 90p	74179 140p	74194 100p
7406 40p	7423 25p	7445 85p	7475 30p	7497 80p	74131 100p	74146 270p	74164 125p	74180 100p	74195 100p
7407 40p	7425 25p	7446 85p	7476 30p	7498 80p	74132 85p	74147 230p	74165 125p	74181 200p	74196 100p
7408 20p	7426 25p	7447 75p	7477 30p	7499 80p	74133 100p	74148 180p	74166 125p	74182 75p	74197 100p
7410 15p	7427 25p	7448 70p	7478 30p	7500 100p	74134 85p	74149 180p	74167 225p	74183 150p	74198 185p
7411 20p	7428 40p	7449 15p	7479 30p	7501 100p	74135 100p	74150 120p	74168 225p	74184 150p	74199 185p
7412 20p	7430 15p	7451 15p	7481 25p	7502 100p	74136 125p	74151 70p	74169 225p	74185 350p	

## SEMICONDUCTORS by MULLARD, TEXAS, MOTOROLA, SIEMENS, I.T.T., R.C.A.

AA113 10p	BA138 10p	BC188B 14p	BC548C 14p	BF123 45p	BF336 35p	BY164 50p	OC140 150p	TIP35A 230p	2N1305 30p
AAZ17 30p	BA148 10p	BC188C 15p	BC549B 15p	BF127 30p	BF337 35p	BYX84 8p	OC171 45p	TIP35C 280p	2N1306 35p
AC121 30p	BA154 12p	BC189C 15p	BC550C 14p	BF166 30p	BF363 60p	C1120 30p	OC200 80p	TIP36A 350p	2N1308 50p
AC126 19p	BA173 10p	BC172C 12p	BCY34 80p	BF167 25p	BF369 20p	C1164 20p	ORP12 70p	TIP41A 70p	2N1711 22p
AC127 19p	BA178 15p	BC178A 12p	BCY70 15p	BF173 25p	BFX29 30p	E100 42p	R1039 150p	TIP41C 75p	2N2219A 25p
AC127/01 18p	BA216 10p	BC182 12p	BCY71 20p	BF178 35p	BFX29 30p	E300 47p	TIP29 45p	TIP41E 80p	2N2453 30p
AC151 25p	BA216 10p	BC182L 12p	BCY72 15p	BF178C 40p	BFX81 130p	E430 125p	TIP29A 47p	TIP42A 80p	2N2455 30p
AC153 18p	BA216 10p	BC183 10p	BD121 85p	BF178C 40p	BFX84 25p	MAJES40 85p	TIP29C 75p	TIP42B 85p	2N2906 18p
AC153K 40p	BA216 10p	BC183L 12p	BD123 100p	BF181 35p	BFX85 30p	MPSA06 25p	TIP30A 55p	TIP42C 85p	2N2907 25p
AC176 20p	BA216 10p	BC184 10p	BD124 85p	BF182 30p	BFX88 25p	OA10 40p	TIP30B 55p	TIP30E 55p	2N3053 20p
AC177 35p	BA216 10p	BC184L 12p	BD131 35p	BF183 30p	BFY50 20p	OA47 15p	TIP30B 55p	TIP30E 55p	2N3054 50p
AC178 30p	BA216 10p	BC186 24p	BD132 30p	BF186 25p	BFY51 20p	OA90 6p	TIP30C 80p	TIP30E 55p	2N3055 60p
AD139 60p	BA216 10p	BC205 15p	BD133 45p	BF186 25p	BFY52 20p	OA91 8p	TIP31 55p	TIP30E 55p	2N3439 50p
AD151 40p	BA216 10p	BC212 11p	BD135 40p	BF194 10p	BFY52 20p	OA202 8p	TIP31A 55p	TIP30E 55p	2N3702 11p
AD182 40p	BA216 10p	BC212L 12p	BD135 40p	BF196 10p	BFY90 125p	OC23 20p	TIP31B 55p	TIP30E 55p	2N3704 11p
AD191/2MP 30p	BA216 10p	BC213L 12p	BD136 40p	BF197 10p	BRY39 35p	OC28 75p	TIP31C 70p	TIP30E 55p	2N3705 11p
AF114 22p	BA216 10p	BC214 13p	BD137 40p	BF198 25p	BRY56 35p	OC35 75p	TIP32 60p	TIP30E 55p	2N3711 12p
AF115 22p	BA216 10p	BC214L 14p	BD139 35p	BF199 25p	BSX20 20p	OC42 35p	TIP32A 65p	TIP30E 55p	2N3711 12p
AF116 22p	BA216 10p	BC225 13p	BD140 40p	BF200 30p	BSY40 25p	OC43 35p	TIP32B 85p	TIP30E 55p	2N3715 30p
AF117 22p	BA216 10p	BC229 35p	BD181 80p	BF204 30p	BSY40 25p	OC45 35p	TIP32C 85p	TIP30E 55p	2N3715 30p
AF125 50p	BA216 10p	BC237 15p	BD182 80p	BF225 20p	BT100A 80p	OC45 35p	TIP33 100p	TIP30E 55p	2N3819 25p
AF128 25p	BA216 10p	BC238 60p	BD207 70p	BF241 16p	BU105 150p	OC71 25p	TIP33A 105p	TIP30E 55p	2N3866 95p
AF139 35p	BA216 10p	BC238 60p	BD233 50p	BF244B 35p	BU133 75p	OC72 30p	TIP33B 115p	TIP30E 55p	2N3866 95p
AF239 45p	BA216 10p	BC238 60p	BD263 65p	BF257 26p	BU208 220p	OC75 30p	TIP33C 150p	TIP30E 55p	2N3866 95p
AF239 45p	BA216 10p	BC238 60p	BDY10 100p	BF258 25p	BY100 20p	OC81D 25p	TIP34 115p	TIP30E 55p	2N4062 14p
AS226 40p	BA216 10p	BC247 12p	BDY62/01 50p	BF259 30p	BY126 15p	OC83 30p	TIP34A 115p	TIP30E 55p	2N4126 20p
BA114 9p	BA216 10p	BC247B 13p	BF121 45p	BF274 15p	BY127 15p	OC83 30p	TIP34B 145p	TIP30E 55p	2N5061 35p
BA121 9p	BA216 10p	BC248 12p		BF324 30p	BY133 22p	OC84 50p	TIP35 225p	TIP30E 55p	2N5193 35p

**ROTARY SWITCHES BY LORLIN**

1P 12W 40p
2P 6W 40p
3P 4W 40p
4P 3W 40p

**ELECTROLYTIC CAPACITORS**

µF/V	330/35 18p
47/25 5p	330/50 18p
1/16 5p	470/10 12p
1/25 5p	470/25 15p
1/50 5p	470/35 18p
2-2/25 5p	470/50 22p
2-2/35 5p	680/25 25p
3-3/25 5p	1000/16 25p
4-7/10 5p	1000/35 30p
4-7/25 5p	2200/10 28p
4-7/50 5p	2000/35 50p
6-8/25 5p	2200/18 35p
10/10 5p	2200/63 75p
10/16 5p	2200/100 120p
10/25 5p	3300/16 40p
10/35 5p	3300/25 42p
11/16 5p	3300/63 80p
22/10 5p	4700/25 45p
22/16 5p	4700/40 50p
22/25 5p	4700/63 20p
22/35 5p	
22/50 5p	
33/6V3 5p	
33/16 5p	
33/25 5p	
33/40 5p	
33/50 7p	
47/10 6p	
47/16 6p	
47/25 6p	
47/35 6p	
47/50 7p	
100/10 6p	
100/16 6p	
100/25 6p	
100/50 8p	
100/63 10p	
125/15 6p	
220/16 10p	
220/25 12p	
220/50 20p	
330/25 15p	

**RESISTORS CARBON FILM 5%**

.25 W	2-2 Ω-4-7M 2p
.5 W	2-2 Ω-4-7M 2.5p
1 W	2-2 Ω-10 MEG 3-5p

**CMOS**

4000 20p	4023 20p	4055 140p
4001 20p	4024 100p	4056 145p
4002 20p	4025 20p	4060 130p
4006 120p	4026 200p	4066 35p
4007 20p	4027 85p	4067 30p
4009 70p	4028 155p	4071 30p
4011 20p	4029 130p	4072 30p
4012 20p	4030 90p	4081 20p
4013 55p	4032 50p	4082 30p
4015 60p	4043 220p	4082 30p
4016 55p	4046 150p	4510 145p
4017 110p	4047 115p	4511 200p
4018 250p	4049 70p	4516 140p
4020 140p	4050 50p	4518 110p
4022 180p	4054 130p	4528 130p

**BRIDGE RECTIFIERS**

1A 50V 25p	V/REG.	
1A 100V 30p	7805	140p
1A 200V 30p	7812	140p
1A 400V 35p	7815	140p
1A 600V 40p	7815	140p
2A 50V 35p	7818	140p
2A 100V 50p	7824	150p
2A 200V 55p	7824	150p

**SPECIAL SCOOP OFFERS**

LEDS 125  
OR 2 RED ONLY  
100 for £9.00  
1000 for £60.00

**SPECIAL QUOTATION FOR LARGER QUANTITIES**

**ENAMELLED COPPER WIRE 50GR REEL**

14SWG 40p	24SWG 50p	34SWG 60p
16SWG 40p	26SWG 50p	36SWG 65p
18SWG 45p	28SWG 55p	38SWG 70p
20SWG 50p	30SWG 60p	40SWG 80p
22SWG 50p	32SWG 60p	42SWG 80p

**IN4148 DIODES BY TEXAS/ITT**  
100 for £1.50

**TEXAS TIS88A VHF FET 10 for £2.30, 100 for £20.00**

**741 OP AMP 10 for £2.00**

**BY TEC**

400M.W. Zeners 850p

OV7 10p
2V4 10p
2V7 10p
3V0 10p
3V3 10p
3V6 10p
3V9 10p
4V7 10p
5V1 10p
5V6 10p
6V2 10p
6V8 10p
7V5 10p
8V2 10p
9V1 10p
10V 10p
11V 10p
12V 10p
13V 10p
15V 10p
18V 10p
20V 10p
22V 10p
27V 10p
30V 10p
33V 10p
100 Mixed
Zeners 850p

**POLYMER CAPACITORS**  
Mullard or Erie

µF	001 5p
0022 5p	0033 5p
0047 5p	0068 5p
01 5p	022 5p
022 5p	033 5p
047 5p	1 6p
1 6p	22 7p
33 9p	47 12p
100 10p	100 10p
220 12p	2.2 25p
470 15p	4.7 35p
330/25 15p	6.8 40p

**POTENTIOMETERS**

1K Lin 30p
5K Lin 30p
10K Lin 30p
25K Lin 30p
50K Lin 30p
100K Lin 30p
250K Lin 30p
500K Lin 30p
1 Meg Lin 30p
2 Meg Lin 30p
5K Log 30p
10K Log 30p
25K Log 30p
50K Log 30p
100K Log 30p
250K Log 30p
500K Log 30p
1 Meg Log 30p
2 Meg Log 30p

**SPECIAL OFFERS**

BC147 100
BC148 100
BC149 100
BC157 100
BC158 100
BC159 100
BF194 100
BF195 100
BF196 100
BF197 100

**SKELETON PRE-SET POTENTIOMETERS**

0-1W 100R-1m 8p
-----------------

**LEDS**

RED -125 15p
GREEN -125 25p
YELLOW -125 25p
RED -2 15p
GREEN -2 25p
YELLOW -2 25p
DL747 0-8" Display 200p

**XEROZA RADIO**  
306 ST. PAUL'S ROAD,  
HIGHBURY CORNER, LONDON, N.1  
TELEPHONE 01-226 1489

Easy access to Highbury via Victoria Line (London Transport) British Rail

Manufacturers (Large and Small) we welcome your enquiries. Overseas Buyers/Agents etc. let us know your requirements.

PLEASE NOTE ALL PRICES INCLUDE POSTAGE AND V.A.T. AT 8 OR 12 1/2% AS APPROPRIATE

7410	10 for £1.00	7483	10 for £7.00
7412	10 for £1.50	7493	10 for £2.50
7420	10 for £1.00	7496	10 for £4.50
7430	10 for £1.00	74107	10 for £2.00
7432	10 for £2.00	74121	10 for £2.50
7442	10 for £3.50	74153	10 for £4.00
7474	10 for £2.00	74161	10 for £8.00
7476	10 for £2.50		

MARCH 1978 · VOLUME 53 · NUMBER 11

**BRITAIN'S LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR**

Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG

**News and Views**

- 812 **NEWS ... NEWS ... NEWS**
- 825 **PW READER'S PCB SERVICE**—Prices and details of the PCBs available
- 828 **TELEVISION**—Details of the March issue
- 829 **HOTLINES**—Recent developments in electronics ..... *Ginsberg*
- 837 **PRODUCTION LINES**—Information on the latest products ..... *Alan Martin*
- 837 **KINDLY NOTE**—Jubilee Organ. Traffic Light Controller, December 1977  
     Direct Conversion Receiver, January 1978. Proportional  
     Power Controller, January 1978. RAE No. 5, January 1978.
- 841 **PRACTICAL WIRELESS**—Pre-view of our next issue.
- 850 **ON THE AIR**—Amateur Bands ..... *Eric Dowdeswell G4AR*  
     SW Broadcast Bands ..... *Charles Molloy G8BUS*  
     MW Broadcast Bands ..... *Charles Molloy G8BUS*  
     VHF Bands ..... *Ron Ham BRS15744*  
     VHF Personality—*Alan Baker* ..... *Ron Ham BRS15744*

**For our Constructors**

- 814 **ACTIVE TONE CONTROL** ..... *F. G. Canning*  
     A simple yet efficient circuit
- 822 **MYSTERY TRAIN TOUR** ..... *E. A. Parr*  
     An unusual fund-raiser for your local charity
- 826 **μDECNOLOGY Project No. 1** ..... *David Gibson*  
     Simple light modulator
- 832 **"EUROPA" STEREO AMPLIFIER—1** ..... *C. Toms B.Sc.*  
     A thirty-watt per channel amplifier designed with ease of construction in mind
- 842 **AUDIO VISUAL LOGIC PROBE** ..... *Philip Bond*  
     Look and listen to your logic circuits
- 849 **BATTERY STATE INDICATOR** ..... *W. Mooney G3VZU*  
     Don't be caught out by battery failure

**General Interest**

- 816 **SO YOU WANT TO PASS THE RAE?—7** ... *John Thornton-Lawrence GW3JGA and Ken McCoy GW8CMY*  
     Transistors, transmitters and modulation
- 830 **THE 5-METRE STORY—2** ..... *Ron Ham*  
     Memories of the days when amateurs were licensed to operate on the 60MHz band
- 838 **MULTI-RANGE TESTMETERS** ..... *D. Jones*  
     An introduction to the design of simple test instruments
- 845 **IC OF THE MONTH** ..... *Brian Dance M.Sc.*  
     The Sprague ULN-3006T Hall-effect switch

★ **Free This Month**

'GUIDE TO AERIALS'—A special supplement

● **An Apology**

To all who bought our February issue. We are sorry that, due to an oversight, the Active Tone Control which was mentioned on the front cover, did not appear in the magazine. The article appears instead on page 814 of this issue.

**COPYRIGHT**

© IPC Magazines Limited 1978. Copyright in all drawings, photographs and articles published in 'Practical Wireless' is fully protected and reproduction or imitation in whole or in part is expressly forbidden. All reasonable precautions are taken by 'Practical Wireless' to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it. Prices are those current as we go to press.

# WHAT'S NEW?

**ME, semiconductor teaching kit**



the most MODERN, RAPID, ECONOMIC way to master space age electronics. Starting even from ZERO, by performing over

**100 EXPERIMENTS**

and creating more than 20 practical applications

You learn all about the most up to date electronic circuits: how to calculate, repair, and design them, while pursuing your favorite hobby. Start from scratch, or improve your present knowledge. Train and earn money in your spare time turn your pastime into valuable job opportunities. Compare our price: you receive the entire course, "mini laboratory" and components for LESS than the price of the components alone.

**COMPLETE KIT: nothing else to buy\***

**you get:**

- instruction manual : over 200 pages of detailed step-by-step instructions -starting from scratch, explains basic laws and physics of Electricity, semiconductor principles and operation electronic circuits : from diodes (including diac, zener) transistors, triacs to integrated circuits (C.MOS, operational amplifiers) etc...
- Over 200 Electronic components : aerospace technologie printed circuit experiment board, phototransistor, triac, thyristor I.C.S Transistors (including FET, MOSFET) LEDs + résistors , capacitors, speaker, milliammeter, potentiometers, variable capacitor, etc... etc... etc...
- measuring instruments (you assemble yourself from among components furnished in kit.) ELECTRONIC VOLTMETER, LOW FREQUENCY MEASURING AMPLIFIER, LOGIC INDICATORS, REGULATED POWER SUPPLY, MILLIAMMETER.

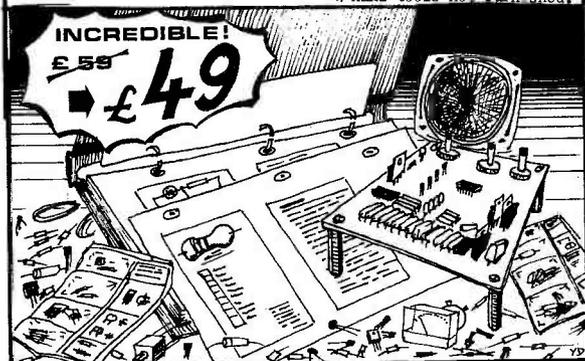
**you perform:**

- over 100 DIFFERENT EXPERIMENTS : from the most basic voltage measurements to radio transmitter circuits and including HI FI, Flip Flops, Ic applications, triac use, etc... etc... etc...

**you construct**

- more than 20 complete functional systems : light modulator, high fidelity amplifier, radio control set, radio receiver and transmitter, electronic gadgets and games and many, many more.

\* Hand tools not furnished.



**INCREDIBLE!**

£55  
**£49**

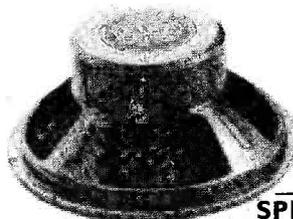
SAVE £10 mail coupon today - SAVE £10 ENGLAND  
**SAGA** PO BOX 401  
KINGSMOOR LANE, KING'S LANE  
CHIPPERFIELD, NR. KING'S LANGLEY,  
HERTS. WD4 9PD

Please send me (QTY) IK2 teaching Kit(s)  
I enclose Cheque/Postal order for £  
NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_

SAGA FRANCE 11 RUE PROSPER DELFAU POST CODE  
30160 BESSÈGES FRANCE.

## FANE NEW "POP" RANGE SPEAKERS

Improved appearance — higher sensitivity



	Rec. Price
12" 'POP' 40 45w	£14.95
12" 'POP' 50H 50w	£16.99
12" 'POP' 75 75w	£22.95
15" 'POP' 65 70w	£25.95
15" 'POP' 80 80w	£29.95
18" 'POP' 100 100w	£49.95
18" 'POP' 150 150w	£55.00

### SPECIALIST RANGE

	Rec. Price
★ 12" DISCO/80 80w Fitted large Tweeter Cone	£28.95
★ 12" DISCO/100 100w	£30.95
★ 12" GUITAR/80L 80w For Lead Guitar	£26.95
★ 12" GUITAR/80B " Prs rec for Bass Guitar	£27.95
★ 12" PA/80 80w Duel Cone For general purpose P.A.	£26.95
15" BASS/85 85w For Bass Guitar	£39.95
15" BASS/100 100w	£42.00

### HIGH FREQUENCY HORNS

**J44** Range: 2-5KHz-15KHz Power: 50w with HPX2R  
30w with HPX1R  
Imp: 8 ohms  
Size approx 3 1/2" x 3 1/2" x 3"  
Rec Price **£7.95**



**J73** Range: 2-5kHz-20kHz Power: 50w with HPX1R Imp: 8 ohms  
Size approx: 7 1/2" x 3" x 6 1/2"  
Rec Price **£11.75**



**J104** Range: 2KHz-15KHz Power: 50watt with HPX1R 70 watt with HPX2R  
Imp: 2 ohms  
Size approx 10 1/2" x 3 3/4" x 7 1/2"  
Rec. Price **£16.95**

**920/2** Range: 1 KHz-10KHz Power: 100w with HPX1. Imp: 8 ohms  
Size approx 14" x 9" x 15"  
Rec. Price **£59.95**

**HIGH POWER "CROSS-OVERS"**  
HPX1R (3-5KHz) **£3.25**  
HPX2R (5KHz)  
Impedance or total impedance of Bass Drivers not to exceed 8Ω. Otherwise use series Horns or attenuation provided with HPX1R and HPX2R.

**FANE SPEAKERS—SUPPLIED TO MOST LEADING U.K. MANUFACTURERS OF GROUP & DISCO EQUIPMENT**  
2 years guarantee on speakers & Horns  
Distributors (Wholesale & Retail)  
**LINEAR PRODUCTS LTD, ELECTRON WORKS, ARMLEY, LEEDS**  
Manufacturers & Export enquiries to:  
**FANE ACOUSTICS LTD, 286 BRADFORD ROAD, BATLEY, YORKS**  
Rec. prices shown correct at 30/11/77  
Rec. Prices INCLUDE VAT.

Start the New Year well by buying this famous Component Catalogue!



- The finest components catalogue yet published.
- Over 200 A-4-size pages.
- About 5,000 items clearly listed and indexed.
- Nearly 2,000 illustrations.
- Bargain List sent free.
- At £1.40, incl. p. & p., the catalogue is a bargain.

Send the coupon below now.  
**HOME RADIO (Components) LTD.,**  
Dept. P.W., 234-240 London Road,  
Mitcham, Surrey CR4 3HD

POST THIS COUPON with cheque or P.O. for £1.40

Please write your Name and Address in block capitals

NAME .....

ADDRESS .....



**HOME RADIO (Components) LTD.,** Dept. EE (Regn No)  
234-240 London Road, Mitcham, Surrey CR4 3HD London 912966

# RSC 200 WATT DISCO SYSTEM

ALL RSC PRICES INCLUDE VAT

**AT A FANTASTIC LOW PRICE**

Consisting of

(1) TWIN T/TABLE CONSOLE with PRE-AMP, and POWER OUTPUT STAGES

(2) & (3) PAIR 100 WATT L'SPEAKERS including 12" UNITS

Rec. Mic. UD 150 Cardioid £9.95 extra with system only

Terms: Deposit £40.00 and 12 monthly payments £15.60 (Total £227.20) Carr. £4.75.

Also available 100 WATT SYSTEM £169.95

## TDI DISCO CONSOLE

Incorporating twin BSR type turntables and Sonotone or Aco's Cartridges with diamond stylus. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls, Separate input for 'mike' with vol. control. Black Vynide covered Cabinet with lid. Or Dep £16.49 & 18 f'tlyly pmts. £6.75 (Total £137.99) Carr. £3.50.

**£199.95**

TD2S STEREO VERSION **£125.00**

### DISCOMAJOR/100 TWIN TURNTABLE POWER CONSOLE £139.95

Twin Full size BSR turntables, Sonotone or Aco's Cartridges with Diamond Stylus. Facilities as TDI Console but with built-in 100 watt Power Amplifier complete with lid. Terms: Deposit £19.95 and 18 fortnightly payments £7.70 (Total £158.55) Carr. £3.50

### TITAN 100W BASS BINS £99.95 value £145

High quality 15" high flux Bass Unit and J104 Horn Tweeter in folded horn enclosure providing amazing level of sound output. Terms Dep. £14.95 and 18 fortnightly payments. £5.58 (Total £115.39) Carr. £3.50.

### DISCOMAJOR/200 £159.95 Carr. £4.00

200 watt version of above. Terms: Dep. £29.95 and 18 fortnightly payments £8.60 (Total £184.75)

### FANE 'NEW POP RANGE' SPEAKERS

Power ratings R.M.S. Cont. 2 YRS GUARANTEE \*Gauss 14000 Imp B-15 ohms. CARR FREE.

ALL MODELS AVAILABLE - CASH or TERMS

12" POP 40 45w	£14.95	15" POP 80 80w	£29.95
12" POP 50H 50w	£16.99	18" POP 100 100w	£49.95
12" POP 75 75w	£22.95	18" POP 150 150w	£55.00
15" POP 70 70w	£25.95		

### RSC PHANTOM 50 COMBO AMP. £69.95

Rating 50 watts, 3 inputs, 2 vol controls, individual Bass & Treble presence. Suitable for Lead or Rhythm Guitar, mic., Radio, Tape, etc. Inc. High Flux 12" 50w Speaker. Dep. £10.95 & 8 monthly payments £8.71 (Total £80.63). Carr. £1.50

### TITAN GROUP/DISCO SPEAKERS GUARANTEED

Carr. £1.20, under £18, over this add 6p per £1. 5 YEARS

Model	Value	RSC Price	Rating RMS
T12/45 12" 45w	£15.00	£11.95	Imp 8-15 ohms
T12/60 12" 60w	£21.00	£13.95	
T12/100 12" 100w	£36.00	£25.95	
T15/60 15" 60w	£26.00	£16.99	
T15/70 15" 70w	£28.00	£19.95	
T15/100 15" 100w	£41.00	£29.95	
T18/100 18" 100w	£47.00	£36.95	

### 100W POWER (SLAVE) AMPLIFIER

Suitable for use with DISCO-Consoles. Also for increasing output of lower-powered Amplifier. Dep. £9.00 and 8 mthly pmts of £6.05 (Total £57.40) Carr. £1.50

**100+100W MODEL £69.95 Carr. £1.50.**

### TITAN TA/50A 50W AMPLIFIER

Solid state, 3 sep. controlled inputs plus Master control. Bass, Treble & Presence Controls. Vynide covered cab. with corner protectives. Value £60. Terms: Dep. £9 & 8 monthly payments £6.05. (Total £57.40) Carr. £1. Carr. £1.50

### TITAN TA/100A 100W AMPLIFIER

TWIN CHANNEL—4 INPUTS (NORMAL OR BRIGHT) £69.95

A De-luxe professional unit with Carr. £1.50 many facilities. R.M.S. Rating. Matching 2 x 12" 120w Cabinet speaker £49.95 with above only. Carr. £1.50

### TITAN TA/100C COMBO

100w R.M.S. Amp. incorporating a fabulous Fane Crescendo 12" 100 watt spkr for really superlative results with Lead Guitar Carr. £5 **£119.95**

Or Dep £17.95 & 18 f'tlyly pmts £6.69 (Total £138.37)

### INTEREST REFUNDED on Credit Purchase, settled in 3 mths

JINGLE MACHINES from £37.95 COLUMN SPEAKERS from £29.95

ECHO CHAMBERS from £53.95 GROUP DISCO SPKRS in cabs., £11.95

### LIGHTING BY PULSAR AND OPTIKINETICS

SUPER-STROBE with 5.5" parabolic reflector **£39.95**

MAXI-STROBE with 7" parabolic reflector **£52.92**

JUMBO-STROBE with 9" parabolic reflector **£76.95**

### TITAN 'ADD-ON' HIGH FREQUENCY HORN UNITS

MODEL TS2H Inc. Pair of highly sensitive Horns. Range 3-15 kHz. Imp 16Ω. Use with 8 or 15Ω 2 x 12" or 1 x 15" or 18" Drive Unit for increased sound clarity and projection Rating 100 fier power output to be 100 watts.

Either model £27.95 Carr. 75p Comparable with units at twice the cost. Terms: Dep £6.95 & 8 mthly pmts £3.12 (Total £31.91)

### PROJECTORS Carr. Free

BUBBLELITE inc wheel	£38.95	PULSAR SL SUPER (Sound to lite)	£58.95
PATTERLITE inc cassette	£39.95	PULSAR ZERO 5000 (Sound to lite)	£24.95
SOLAR 100B inc wheel rotator	£39.95	PULSAR SPOTLIGHTS (less bulbs)	£28.70
BUBBLE GUN inc liquid	£27.95	PULSAR REMOTE CONTROL	£15.95

### RSC MAINS TRANSFORMERS

TYPES FOR VALVE RADIOS & AMPLIFIERS (Inc. L.F. CHOKES & OUTPUT TRANSFORMERS). As previously advertised still available.

FILAMENT OR TRANSISTOR POWER PACK

12v. 1a. £1.10, 6.3v. 1.5a. £1.08, 6.3v. 2a. £1.10, 6.3v. 3a. £1.70, 6.3v. 5a. £2.00, 12v. 3a. or 24v. 1.5a. £2.60, 0-9-18v. 3a. £2.55, 0-12-25-42v. 2a. £3.18, CHARGER TRANS 0-9-15v. 1.5a. £2.08, 2.5a. £2.28, 3a. £2.32, 5a. £2.84, 6a. £3.18, 8a. £3.48.

AUTO (STEP UP/STEP DOWN) TRANSFORMERS 0-110/120v., 200-230-260v., 80w. £2.90; 150w. £5.20; 250w. £6.37; 500w. £9.84.

### FANE HIGH FREQUENCY HORNS 'J' SERIES

MODEL J44 Imp 8Ω

Size approx. 3 1/2" x 3 1/2" x 3" Rating 30-50 watts Range 3-15 kHz **£6.95 Carr Free**

MODEL J73 Imp 8Ω

Size approx 7 1/2" x 3" x 3" Rating 50 watts Range 2-20 kHz **£10.95 Carr. Free**

MODEL J104 Imp 8Ω

Size approx 10 1/2" x 7 1/2" x 3 1/2" Rating 50-70 watts Range 2-15 kHz. Carr. Free **£14.95**

Impedance or total impedance of 12", 15" or 18" Drive units must not exceed impedance of single horn or pair in series. Pair J44, Single J73 or J104 suitable for amplifier power up to 100 watts subject to above and with HPX2R 'Cross-over'

### FAL DISCO LIGHTING SYSTEMS from £58.95

Incl 2 Spotbanks and bulbs **£10.95 Carr. Free**

New Branches at **LEEDS, HANLEY and WOLVERHAMPTON**

OPEN ALL DAY SATURDAYS (5 Day Week)

BRADFORD 10 North Parade (Closed Wed.). Tel. 25349

BIRMINGHAM 30/31 Great Western Arcade. (Closed Wed.) Tel. 021-236 1279

CARLISLE 3 English Street (Closed Thurs.). Tel. 35744

CONVENTRY 17 Shelton Sq., The Precinct. Tel. 25933

DERBY 97 St. Peter's Street (Closed Wed.). Tel. 41361

DARLINGTON 19 Northgate (Cl. Wed.). Tel. 68043

DEWBURY 9/11 Kingsway (Closed Tues.). Tel. 468058

DONCASTER 3 Queensgate, Waterlads Centre. (Closed Thurs.) Tel. 63069

EDINBURGH 101 Lothian Rd. (Cl. Wed.). Tel. 229 9501

GLASGOW 326 Argyle St. (Cl. Tues.). Tel. 248 4158

HANLEY Stoke-on-Trent, 44 Piccadilly Tel. 267764

HULL 7 Whitefriargate (Closed Thurs.). Tel. 20505

LEICESTER 32 High Street (Closed Thurs.). Tel. 56420

LEEDS 16-18 County (Mecca) Arcade, Briggate (Closed Wed.). Tel. 449609

LIVERPOOL TEMPORARILY INOPERATIVE due to serious fire

LONDON 238 Edgware Road, W.2. (Closed Thurs.). Tel. 723 1629

MANCHESTER 60A Oldham Street (Closed Wed.). Tel. 236 2778

MIDDLESBROUGH 103 Linthorpe Rd. (Cl. Wed.) Tel. 247096

NEWCASTLE UPON TYNE 59 Grainger St. (Closed Wed.). Tel. 21469

NOTTINGHAM 19/19A Market Street

PRESTON 41 Friargate Walk, St. Georges Shopping Prec. Tel. 51979

SHEFFIELD 13 Exchange Street (Castle Mkt. Blds.)

STOCKPORT (Closed Thurs.). Tel. 20716

8 Little Underbank (Closed Thurs.). Tel. 480-0777

WOLVERHAMPTON 6, Wulfrun Way (Cl'd Thurs.). Tel. 26612

MAIL ORDERS & EXPORT ENQUIRIES TO:— AUDIO HOUSE, HENCONNER LANE, LEEDS, 18. Tel: 0538 677831.

MAIL ORDERS MUST NOT BE SENT TO SHOPS

TERMS C.W.O. or C.O.D. No. C.O.D. under £3. POSTAGE 60p PER ORDER OR AS QUOTED. Phone or Write for FREE CATALOGUE.

# TRANSFORMERS

ALL EX-STOCK—SAME DAY DESPATCH. VAT 8%

## 12 AND 24 VOLT OR 12-0-12V PRIMARY 220-240 VOLTS

Ref	12V	24V	£	P & P
111	0-5	0-25	2-20	0-45
213	1-0	0-5	2-64	0-78
71	2	1	3-41	0-78
18	4	2	4-03	0-96
70	6	3	5-35	0-96
108	8	4	6-98	1-14
72	10	5	7-67	1-14
116	12	6	8-99	1-32
17	16	8	10-39	1-32
115	20	10	13-18	2-08
187	30	15	17-05	2-08
226	60	30	26-82	0A

## 30 VOLT RANGE Prim 220/240V Sec 0-12-15-20-24-30V 12-0-12V or 15-0-15V available by connection to appropriate taps.

Ref	15Amps	£	P & P
112	0-5	2-64	0-78
79	1-0	3-57	0-96
3	2-0	5-27	0-96
20	3-0	6-20	1-14
21	4-0	7-44	1-14
51	5-0	8-37	1-32
117	6-0	9-92	1-45
88	8-0	11-73	1-64
89	10-0	13-33	1-84

## 60 VOLT RANGE Prim 220/240V Sec 0-24-30-40-48-60V 24-0-24V or 30-0-30V available by connection to appropriate taps.

Ref	15Amps	£	P & P
124	0-5	3-88	0-96
126	1-0	5-58	0-96
127	2-0	7-60	1-14
125	3-0	10-54	1-32
123	4-0	12-23	1-84
40	5-0	13-95	1-64
120	6-0	15-66	1-84
121	8-0	20-15	0A
122	10-0	24-03	0A
189	12-0	27-13	0A

## 50 VOLT RANGE Prim 220/240V Sec 0-20-25-33-40-50V 20-0-20V or 25-0-25V available by connection to appropriate taps.

Ref	10Amps	£	P & P
102	0-5	3-41	0-78
103	1-0	4-57	0-96
104	2-0	6-98	1-14
105	3-0	8-45	1-32
106	4-0	10-70	1-50
107	6-0	14-82	1-64
118	8-0	17-05	2-08
119	10-0	21-70	0A

## MAINS ISOLATING (SCREENED) Prim 120/240 SEC 120/240 CT

Ref	VA (Watts)	£	P & P
*07	20	4-40	0-79
149	60	6-20	0-96
150	100	7-13	1-14
151	200	11-16	1-50
152	250	12-79	1-84
153	350	16-28	1-84
154	500	19-15	2-15
155	750	29-06	0A
156	1000	37-20	0A
157	1500	45-60	0A
158	2000	54-80	0A
159	3000	79-05	0A

## HIGH VOLTAGE MAINS ISOLATING Prim 200/220V or 400/440V Sec 100/120V or 200/240V

Va	Ref	£	P & P
60	243	5-89	1-32
350	247	14-11	1-84
1000	250	35-65	0A
2000	252	54-25	0A

## AUTO TRANSFORMERS

Ref	VA (Watts)	Volts	£	P & P
113	15	0-115-210-240	2-48	0-71
84	75	0-115-210-240	3-95	0-96
4	150	0-115-200-220-240	5-35	0-96
67	500	0-115-200-220-240	10-99	1-64
84	1000	0-115-200-220-240	18-76	2-08
83	1500	0-115-200-220-240	23-36	0A
95	2000	0-115-200-220-240	34-82	0A
73	3000	0-115-200-220-240	48-00	0A

## CASED AUTO TRANSFORMERS 240V line in 115V USA flat pin outlet

VA	£	P & P	Ref
15	4-96	0-96	113W
150	8-48	1-14	4W
250	9-92	1-45	69W
250	10-49	1-45	69W
350	12-53	1-64	53W
500	15-73	1-64	67W
750	18-55	1-76	83W
1000	22-68	0A	84W
1500	28-02	0A	93W
2000	37-65	0A	95W

## SCREENED MINIATURES

Ref	mA	Volts	£	P & P
238	200	3-0-3	1-99	0-55
212	1A, 1A	0-6, 0-6	2-85	0-78
13	100	9-0-9	2-14	0-38
235	330, 330	0-9-0-9	1-99	0-38
207	500, 500	0-8-0-8, 0-8-0-8	2-59	0-71
208	1A, 1A	0-8-0-8, 0-8-0-8	3-53	0-78
236	200, 200	0-15, 0-15	1-99	0-38
214	300, 300	0-20, 0-20	2-56	0-78
221	700 (DC)	20-12-0-12-20	3-41	0-78
206	1A, 1A	0-15-20-0-15-20	4-63	0-96
239	500, 500	0-15-27-0-15-27	1-99	0-38
204	1A, 1A	0-15-27-0-15-27	5-39	0-96
239	50	12-0-12	1-99	0-38
S112500		12-15-20-24-30	2-64	0-78

## PLUS

High Quality Modules	£
10 Watts RMS AMPLIFIER	£3-66
25 Watts RMS AMPLIFIER	£4-57
35 Watts RMS AMPLIFIER	£6-95
125W RMS AMPLIFIER	*£15-95
PRE-AMP for 5-10W	£6-70
PRE-AMP for 25W	£13-88
POWER SUPPLIES 5-10W	£3-30
POWER SUPPLIES 25W	£3-75
TRANSFORMER 5-10W	£3-09
TRANSFORMER 25W	£4-78
P & P Modules 35p. Trans 96p.	
VAT 12½% *VAT 8%	

## STEREO FM TUNER PHASE-LOCK LOOP

Pre-selected stations, Varicap tuning switched AFC, LED Beacon. £20-45 VAT 12½% P & P 40p

## BLOB BOARD (Pack of 3)

2-5" x 5-1" or 2-5" x 5-1" 15"	£0-75
3-75" x 5-1" or 3-75" x 5-1" 15"	£1-14
10" x 6-1" or 10" x 6-1" 15"	£3-78
IC Range	
4-8" x 3-2" £0-96, 4-75" x 7-5" £2-13	
P & P 35p VAT 8%	

## ELECTRONIC CONSTRUCTION KIT

10 projects (including electronic organ). No soldering needed £7-28. VAT 8% P & P 70p

## COMPONENT PACKS

200 Mixed value resistors (count by weight)	
150 Mixed value capacitors (count by weight)	
30 Mixed value precision resistors ¼W 2%	
15 Assorted pots	
10 Reed switches	
15 Wire wound resistors—mixed wattage	
1 Pack wire 50 metres assorted colours	
25 Pre-sets assorted types and values	
Please state pack required. 60p per pack	
VAT 12½% P & P 40p	

Prices correct 27-11-77. Please add VAT after P & P.

## TEST METERS

AVO 8 MK5	£71-00
AVO 71	£29-00
AVO 73	£29-00
AVO MM5	£24-00
AVO TT169 in circuit	400V 4A £0-80
Transistor Tester	400V 6A £1-05
Oscilloscope CL-5 10 meg	500V 10A* £2-35
3 inch tube	VAT 12½% *VAT 8% P & P 15p.
Carriage £4-00 8% VAT.	
Wee Metger £58-80	
U4315 Budget Meter 20KΩ/VDC, 2K/VAC 1000V AC/DC	
2-5A AC/DC, 500K rcs. in robust steel case—leads	
£14-95. VAT 8% P & P £1-15	
AVO cases and accessories	

## BRIDGE RECTIFIERS

200V 2A	£0-45
400V 2A	£0-55
200V 4A	£0-65
400V 4A	£0-80
400V 6A	£1-05
500V 10A*	£2-35
VAT 12½% *VAT 8% P & P 15p.	

Plastic Cases—Flush lids retained with 4BA bolts.  
PB1 77 x 56 x 37mm 46p  
PB2 95 x 71 x 35mm 56p  
PB3 115 x 95 x 37mm 60p  
P & P 28p VAT 8%

## MUSIC CENTRE CHASSIS

FM (STEREO)/MW/LW 15+15W Music Power Inc. Transformer Price £22-50 inc. VAT. P & P £1-50 VAT 8%.

## Battery Eliminator "Save on Batteries"

Stabilised 3-6-7 5-9V/400mA multiplug outlet £5-95  
3300 fits into 13A socket 6-7-5-9V 300mA multiplug outlet £3-30  
B12 3, 4-5, 6, 7-5, 9, 12V 500mA DC plug outlet £5-32  
VAT 12½% P & P 55p

## DECS SOLDERLESS BREAD-BOARDING

S Dec 70 contacts	£1-98
T Dec 208 contacts	£3-63
U Dec "A" for I.C.s etc	£3-99
U Dec "B" for I.C.s etc	£6-99
VAT 8% P & P 46p	

## ANTEX SOLDERING IRONS

15W	£3-75	18W	£3-75
25W	£3-40	Stand	£1-40
25W SM245	£3-30		
16W SM240	£3-68		
VAT 8% P & P 46p			

## MINI-MULTIMETER

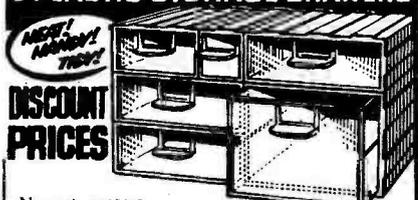
DC-1000V AC-1000V DC-100mA Res-150kΩ 1000Ω/V Bargain £5-86 VAT 8% P & P 62p

## TRANSFORMERS SPECIAL OFFER

BE1 Prim 0-120, 0-120V (120 or 240V) Sec 24V 10A	£5-50 P & P £1-66
BE2 Prim 0-90-110-200-220-240V Sec 0-110V 0-20-24V	2A £2-25 P & P 95p. VAT 8%
BE3 100V line to 4Ω 7/10W £2-05 P & P 66p	
BE4 Prim 120 or 240V 9-0-9 1A	£1-88 P & P 0-38
BE5 15W matching trans. sec 15Ω suit EL89 £1-59 P & P 30p. Ref. 30 240-240 Isolator 200VA £4-20 P & P 30p. Ref 62 240-240 Isolator 250VA £5-20 P & P 96p.	

**Barrie Electronics Ltd.**  
3, THE MINORIES, LONDON EC3N 1BJ  
TELEPHONE: 01-488 3316/7/8  
NEAREST TUBE STATIONS: ALDGATE & LIVERPOOL ST

## INTER-LOCKING PLASTIC STORAGE DRAWERS



Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. 1D and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

AS SUPPLIED TO POST OFFICE, INDUSTRY & GOVERNMENT DEPTS.

SINGLE UNITS (1D) (5ins x 2½ins x 2½ins).	£2-90 DOZEN.
DOUBLE UNITS (2D) (5ins x 4½ins x 2½ins).	£4-90 DOZEN.
TREBLE (3D) £4-90 for 8.	
DOUBLE TREBLE 2 drawers, in one outer case (6D2), £7-25 for 8.	
EXTRA LARGE SIZE (6D1) £6-25 for 8.	

## PLUS QUANTITY DISCOUNTS!

Orders over £20, less 5%.  
Orders over £60, less 7½%.  
PACKING/POSTAGE/CARRIAGE: Add 75p to all orders under £10. Orders £10 and over, please add 10% carriage.

QUOTATIONS FOR LARGER QUANTITIES  
Please add 8% V.A.T. to total remittance  
All prices correct at time of going to press

**FLAIRLINE SUPPLIES** (Dept. PW3)  
124 Cricklewood Broadway, London NW2  
Tel. 01-450 4844

## Speed up your precision work with MINIATURE POWER EQUIPMENT

### NEW! The P2 Mk2 DRILL

With detachable head	£18-00 pp 86p
In storage case, room for transformer	£19-50 pp 86p
In case with variable transformer	£29-00 pp 86p
S2 Drill stand (holds both drills)	£18-50 pp 106p

**S2 DRILL STAND** A robust, all metal stand with ample throat dimensions. Will take both P1 and P2 Drills. £18-50 pp 106p.

**SUPER 30 KIT** 30 tools incl. Drill P1—without stand. £19-39 pp £1.

P1 DRILL	£9-67 pp 38p
S1 DRILL STAND	£5-13 pp 38p
FLEXIBLE DRIVE SHAFT	£5-94 pp 34p

## TRANSFORMERS

Continuous a/c 12v. D/C	£7-56 pp 81p
Variable speed a/c 12v. D/C	£9-50 pp 81p



All prices include VAT

Drills, Stones, Burrs etc. 40p each. Circular Saw Blades—set of 4 with Arbor £3-50. P & P any quantity 25p. Please send 9" x 4" S.A.E. for leaflet and order form.

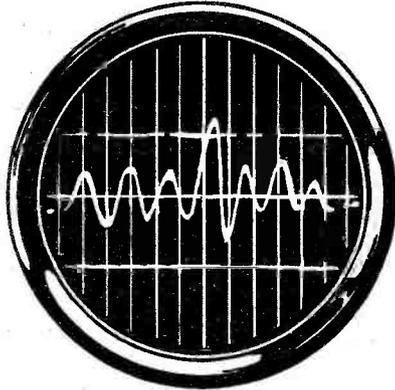


## PRECISION PETITE LTD

119a HIGH STREET TEDDINGTON MIDDLESEX TW11 8HG  
Tel. 01-977 0878

# LOOK! Here's how you master electronics.

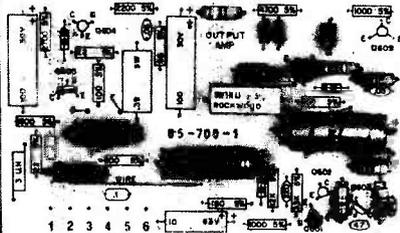
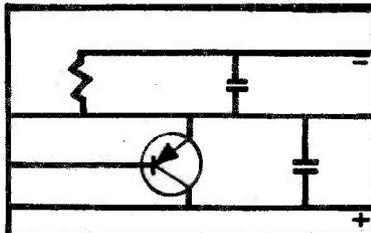
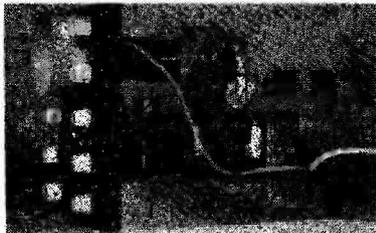
...the practical way.



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

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

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



## 1 Build an oscilloscope.

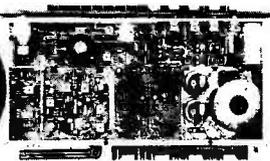
As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property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

## 2 Read, draw and understand circuit diagrams.

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

## 3 Carry out over 40 experiments on basic circuits.

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



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

**Free!**

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

## British National Radio & Electronic School

P.O. Box 156, Jersey, Channel Islands.

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_

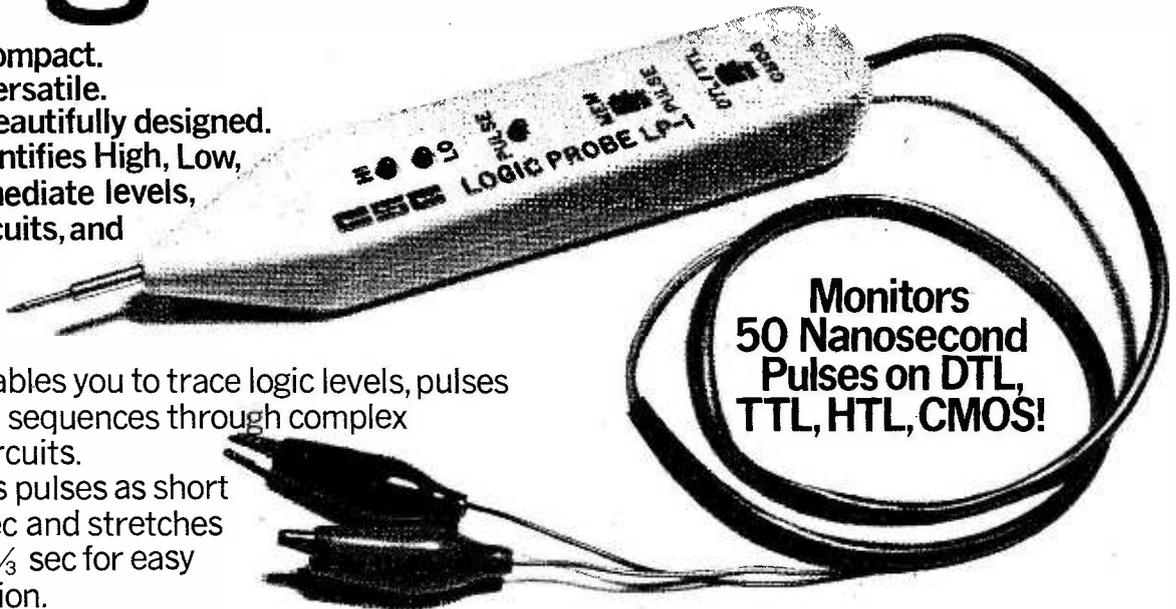
WB 3

Block caps please

# Logic Probe LP-1

It's compact.  
It's versatile.  
It's beautifully designed.  
It identifies High, Low,  
or Intermediate levels,  
open circuits, and  
pulsing  
nodes.

It enables you to trace logic levels, pulses  
and logic sequences through complex  
digital circuits.  
It detects pulses as short  
as 50nsec and stretches  
them to  $\frac{1}{3}$  sec for easy  
observation.



**Monitors  
50 Nanosecond  
Pulses on DTL,  
TTL, HTL, CMOS!**

**Try the LP-1 and you won't know how you ever managed without it!**

## How it works

You just clip the probe leads to the circuit power supply, setting the 'Logic Family' switch to DTL, TTL or CMOS. (CMOS position also covers HTL).

Touch the probe's tip on the node you're investigating and the LP-1 lights up to show you exactly what you've got. The LED marked 'HI' comes on for logic state 1 (High) and 'LO' comes on for logic state 0 (Low).

The third LED, marked 'PULSE', shows the dynamic signal activity at the node under test. Set the switch to 'PULSE' and pulses as narrow as 50 nanoseconds are stretched to  $\frac{1}{3}$  second. Single-shot and low rep. rate pulses are clearly shown - you can't do that even with a fast CRO! High frequency pulses up to 10MHz will make the 'PULSE' LED blink continuously at 3Hz; and with assymetric signals the 'LO' LED will come on for duty cycles under 30%, and 'HI' for those over 70%.

Another useful feature is 'Pulse Memory'.

Put the probe tip on to a node, switch to 'MEM' and the next logic change-positive or negative - or the next pulse edge, will cause the 'PULSE' LED to come on and stay on, until reset. Meanwhile, 'HI' and 'LO' LEDs continue to function as usual. No other probe or logic checking device gives you all that!

## ONLY £29.00

Complete with instruction book, leads, and including VAT (8%) and post and packing.

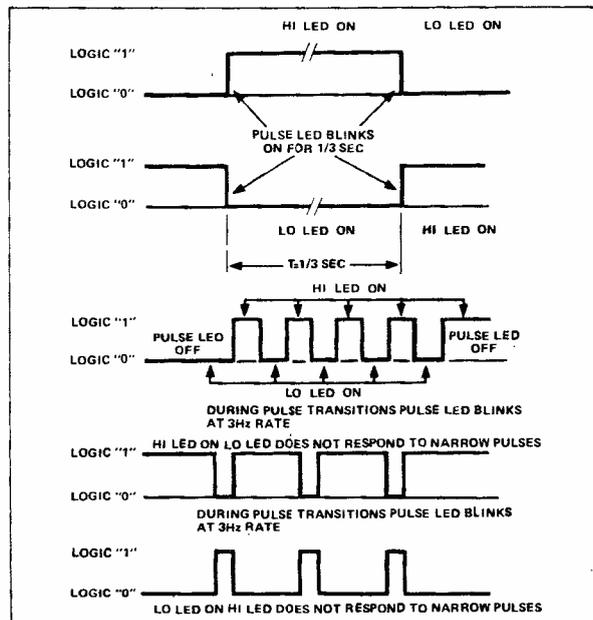
It's easy to order

Telephone 01-890 0782 and give us your Access, Barclaycard or American Express number. Your Probe is in the post same day!

Or, write your order, enclosing cheque, postal order, or stating credit card number and expiry date. (Don't post the card!)

Alternatively, ask for our latest catalogue, showing all CSC time-and-cost-saving products for the engineer and the home hobbyist.

<b>Brief Specification:</b>	Max. input signal frequency:
Input Impedance: 100,000 Ohms, 10MHz constant for all functions.	Power requirements:
DTL/TTL Thresholds:	5 Volt Vcc, 30mA
logic 1, 2.25V $\pm$ 0.15	15 Volt Vcc, 40mA
logic 0, 0.80V $\pm$ 0.10	36 Volts max.
HTL/CMOS Thresholds:	Size: 6.1 x 1.0 x 0.7 inches (155 x 25 x 18mm)
logic 1, 1.70% Vcc	Weight: 3oz (85g)
logic 0, 0.30% Vcc	Power leads: 24 inches (610mm), colour coded.
Min. detectable pulse: 50 nanoseconds	



CONTINENTAL SPECIALTIES CORPORATION



CONTINENTAL SPECIALTIES CORPORATION (UK) LTD., SPUR ROAD, NORTH FELTHAM TRADING ESTATE, FELTHAM, MIDDLESEX TW14 0TJ. TELEPHONE: 01-890 0782. REG IN LONDON: 1303780 VAT NO: 224 8074 71 TRADE MARK APPLIED FOR © CSC (UK) LTD 1977. DEALER ENQUIRIES WELCOME. TELEX: 8813669 CSCLD.

# Get a great deal from Marshall's

**A. MARSHALL (LONDON) LTD. DEPT. P.W.**  
**LONDON**—40-42 Cricklewood Broadway, NW2 3ET  
 Tel. 01-452 0161, Telex 21492  
**LONDON** 325 Edgware Road, W2. Tel. 723 4242  
**GLASGOW**—85 West Regent Street, G2 2QD  
 Tel. 041-332 4133  
**BRISTOL**—1 Straits Parade, Fishponds Road, BS16 2LX  
 Tel. 0272 654201

CALL IN AND SEE US  
 9-5.30 Mon-Fri.  
 9-5.00 Saturday

**EXPRESS MAIL ORDER**  
 Tel Orders on Credit Cards  
 £10 minimum.



## POPULAR SEMICONDUCTORS

2N706	2N5294	BC178	BF167	MJE520	LM380-3
2N708	2N5296	BC179	BF173	MJE521	LM380N
2N1131	2N5298	BC182	BF177	MPF102	LM381 A
2N1132	2N5447	BC182L	BF178	MPF105	LM381N
2N1711	2N5448	BC183	BF179	MPSA05	LM382N
2N2102	2N5449	BC183L	BF180	MPSA06	LM386N
2N2218	2N5457	BC184	BF181	MPSA55	LM387N
2N2219	2N5458	BC184L	BF194	MPSA56	LM388N
2N2220	2N5459	BC212	BF195	TIP29A	LM389N
2N2221	2N5459	BC212L	BF196	TIP29C	LM702C
2N2222	2N6121	BC213	BF197	TIP30A	LM709C
2N2368	2N6122	BC213L	BF198	TIP31A	LM709N
2N2369	2N6123	BC214	BF200	TIP31C	LM710C
2N3053	2N6126	BC237	BF200	TIP32A	LM710N
2N3054	AC126	BC238	BF224J	TIP32C	LM723C
2N3055	AC127	BC239	BF245A	TIP41A	LM741C
2N3441	AC126	BC257	BF257	TIP42A	LM741N
2N3442	AC151	BC258	BF258	TIP42C	LM741-8
2N3702	AC152	BC259	BF259	TIP2955	LM747N
2N3704	AC153	BC307	BF336	TIP3055	LM748-3
2N3708	AC153K	BC308	BF337	TIS43	LM748N
2N3711	AC154	BC309	BF338	TIS50	LM1800
2N3772	AC187K	BC328	BF339	TIS62	LM1808
2N3773	AC188K	BC328	BF340	TIS62	LM1828
2N3819	AD161	BC547	BF341	TIS88A	LM3301
2N3820	AD162	BC548	BF342	TIS90	LM3302N
2N3823	AF106	BC557	BF343	TIS93	LM3401
2N3904	AF109	BC558	BF344	TIS93	LM3401
2N4036	AF139	BC559	BF345	LM3091 A	LM3900
2N4037	AF239	BC559	BF346	LM3091 B	LM3905
2N4058	AF239	BC559	BF347	LM304	LM3909
2N4059	AF279	BC571	BF348	LM307N	MC1310
2N4060	AF109	BC572	BF349	LM308C	MC1458
2N4124	BC107	BD115	BF350	LM308N	NE555
2N4126	BC108	BD131	BF351	LM308N	SN7400
2N4289	BC109	BD132	BF352	LM317K	SN7402
2N4303	BC140	BD133	BF353	LM318N	SN7404
2N4304	BC141	BD136	BF354	LM323K	SN7410
2N4319	BC142	BD137	BF355	LM339N	SN7411
2N4320	BC143	BD138	BF356	LM348N	SN7417
2N4321	BC144	BD139	BF357	LM380N	SN7448
2N4322	BC160	BD140	BF358	LM370N	SN7474
2N4323	BC161	BD140	BF359	LM371N	SN7479
2N4324	BC162	BD140	BF360	LM372N	SN7492
2N4325	BC163	BD140	BF361	LM373N	SN7493
2N4326	BC164	BD140	BF362	LM374N	SN7496
2N4327	BC165	BD140	BF363	LM377N	SN74121
2N4328	BC166	BD140	BF364	LM378N	SN74141
2N4329	BC167	BD140	BF365	LM379S	76023N
2N4330	BC168	BD140	BF366		
2N4331	BC169	BD140	BF367		
2N4332	BC170	BD140	BF368		
2N4333	BC171	BD140	BF369		
2N4334	BC172	BD140	BF370		
2N4335	BC173	BD140	BF371		
2N4336	BC174	BD140	BF372		
2N4337	BC175	BD140	BF373		
2N4338	BC176	BD140	BF374		
2N4339	BC177	BD140	BF375		

Prices correct at 10 Jan. 1978, but please add VAT p&p 40p

## OPTOELECTRONICS

Full range of Opto devices in our new catalogue

**LEDS**  
 3mm Red 19p, Gr 25p, Y 25p  
 5mm Red 21p, Gr 26p, Y 26p  
 TL209 19p, ORP12 84p  
 BPX 25 1.65

**DISPLAYS** 7 Segments  
 Single Double Display  
 DL704 2.00 3.00 0.3in Red  
 DL707 2.00 3.00 0.3in Red  
 DL747 2.50 3.40 0.5in Red  
 DL750 2.50 3.40 0.5in Red



## TRIACS Plastic Pack 400V

6 amp	70	16 amp	1.10
8 amp	75	20 amp	1.70
12 amp	85	25 amp	2.00

## DIACS

ST2	20p
BR100	48p



## BRIDGES

Full range of Bridge Rectifiers and Diodes listed in new catalogue

## THYRISTORS Plastic C106 116

4 amp 100V	0.35	8 amp 100V	0.43
4 amp 200V	0.40	8 amp 200V	0.49
4 amp 400V	0.49	8 amp 400V	0.62

**WHY NOT PAY US A VISIT AT OUR NEW CENTRAL LONDON BRANCH AT 325 EDGWARE ROAD, W2, ABOUT 100 YARDS NORTH OF THE WESTWAY FLY-OVER. EXTENSIVE STOCK RANGE. MANY SPECIAL OFFERS TO PERSONAL SHOPPERS ONLY.**

## NEW 1978 CATALOGUE

ORDER NOW!

AVAILABLE IN MARCH  
 Stocking Distributors Officially Appointed

- NATIONAL ● VERO
- TEXAS ● ANTEX
- MULLARD ● ELECTROLUBE
- SIEMENS ● SIFAM
- SESCOSEM ● ARROW HART

MAKES COMPONENTS BUYING EASY



450 Post Paid or 35p To Callers  
 LARGE 32 PAGES packed with over 8500 LINE ITEMS

"What is a microprocessor?"

A complete teach yourself course with cassettes + brochure - £9.95 inclusive of VAT and p&p.

## SOUTHERN VALVE CO. UPPER FLOOR, 8 POTTERS ROAD, BARNET, HERTS.

Telephone: 01 440/8641

**MAIL ORDER ONLY**  
 ALL NEW & BOXED "QUALITY" BRANDED VALVES GUARANTEED 3 MONTHS. BVA ETC. (TUNGSRAM ETC.). 6% ALLOWED IN LIEU OF GUARANTEE, ALREADY DEDUCTED FROM OUR PRICES. Note: Prices are only correct at time of going to press. PLEASE VERIFY CURRENT PRICES. MIN. 75p!

Some leading makes available. VAT Invoices issued on request.

AZ31 90p	ECL83 75p	EY86/7 42p	PCF80 72p	PCL85 64p	PL608 £1.30	UCL82 60p
DY86/7 50p	EY500A 75p	EY500A 75p	PCF82 50p	PCL 805 1.64p	PL309 £2.50	UCL83 80p
DY802 55p	EP80 40p	£1.50	PCR86 58p	805 1.64p	PL319 £2.80	UP41 75p
RB91 25p	EP85 45p	EZ80/1 45p	PCF200	PCL86 65p	PL325 £2.80	UP89 50p
ECC81 50p	EP86 55p	GY501 £1.20	£1.35	PCL200	PY33 50p	UL41 85p
ECC82 50p	EP89 45p	PC86 75p	PCF801 62p	POA	PY48 50p	UL84 60p
ECC83 50p	EP183 48p	PC88 75p	PD500 £3.50		PY81 50p	UY86 55p
ECC85 55p	EP184 48p	PC87 75p	PF1200 80p		PY800 80p	U25 60p
ECC88 55p	EP90 60p	PC97 75p	PCF805POA	PL36 75p	PY81 50p	U26 60p
ECH42 90p	EL84 £1.25	PC900 60p	PCF806 75p	PL81 50p	PY81 50p	UI91 50p
ECH81 55p	EL41 75p	PCC84 35p	PCF808POA	PL81A 65p	PY88 60p	U30L2 75p
ECH82 55p	EL84 48p	PCC85 48p	PCH200	PL82 36p	PY000A	6BW7 65p
ECH83 85p	EL90/1 48p	PCC88 62p	£1.00	PL83 50p	£1.40	6F23 60p
ECL84 70p	EL509 £2.70	PCC89 62p	PCL82 55p	PL84 50p	UBF89 45p	6F28 POA
ECL80 62p	EM84 70p	PCC89 62p	PCL83 75p	PL84 50p	UC85 60p	6V6 & 6L6
ECL82 55p	EY51 65p	PCC189 55p	PCL84 55p	PL504 1.81	UCR81 65p	6VC. 90p

One valve post 13p, each extra valve 6p. MAX 75p. LISTS & ENQUIRIES, SAE PLEASE! Large valves 14p each. ALL PRICES INCLUDE VAT @ 12½%.

We offer return of post service. CWO ONLY, No C.O.D. Post free over £18. £5 to £18 -75p (max). Items in stock at time of going to press but subject to market fluctuations without notice. ENQUIRIES WELCOME FROM TRADE & RETAIL (same prices).

## HAVE YOU DONE IT LATELY!

Fit a new tape head and transform the performance of your tape recorder

**MONOLITH**  
 THE MONOLITH ELECTRONICS CO. LTD.

QUALITY REEL TO REEL AND CASSETTE TAPE HEADS

Please enclose Full Catalogue 25p 20p P&P with order

B24-RP stereo cassette glass/ferrite record/playback £9.84  
 B12-01 mono cass. playbk. £1.60 B24-Q1 stereo cass. playbk. £2.80  
 A28-05 stereo 8tk cartridge £1.80 E12-09 stereo/mono cass. erase £1.80

5/7 Church St, Crewkerne, Som. Tel. (0460) 74321

## For Semi-Conductors including

- Small Signal Transistors
- Power Semi-conductors
- TTL, CMOS, I.Cs
- Linear I.Cs
- Signal and Power Diodes
- Zener Diodes
- Magneto Resistors
- Hall-effect devices
- Magnetic Proximity Switches
- Opto-electronic devices

Go to  
**ELECTROVALUE**  
 THE PROJECTS YOU BUILD

## For passive components including

- Plastic Film Capacitors
- Electrolytics
- Semi-precision capacitors
- Transformers
- Pot Cores
- R.M. Cores
- Ring Cores, etc.

Go to  
**ELECTROVALUE**  
 THE PROJECTS YOU BUILD

## The Open Door to Quality

It's the Electrovalue Catalogue No. 8 (4th edition black and white cover) with completely up-dated prices. 144 pages, well illustrated. 40p post free with 40p voucher usable on orders for £5 or more. Send for yours now and order in confidence.

GOODS SENT POST FREE IN U.K.  
 FOR C.W.O. ORDERS. Keenly competitive prices plus ATTRACTIVE DISCOUNTS and only best quality goods.

**ELECTROVALUE LTD**  
 (Dept. P.W.1) 28 St. Jude's Rd., Englefield Green, Egham, Surrey TW20 0HB.  
 Phone: Egham 3603. Telex: 264475.  
 North—680 Burnage Lane, Burnage, Manchester. Phone: (061) 432 5945.

# CHROMASONIC electronics

56 Fortis Green Road  
Muswell Hill London N10 3HN  
Telephone 01-883 3705

TRANSFORMERS			DIODES			LIGHT EMITTING DIODES			POLYESTER CAPACITORS			
6-0-6V	100mA	1.00*	BA114 15p	BY105 25p	OA91 10p	9-125" (inc. clip)	1+	10+	100+	Mullard C280 Series 250Vwv		
9-0-9V	75mA	1.00*	BA115 25p	BY126 12p	OA200 10p	TIL209 Red	15p*	13p*	11p*	0-01µf	5p	0-068µf 6p
12-0-12V	100mA	1.15*	BA145 20p	BY127 12p	CA202 10p	TIL212 Yellow(H.B.)	27p*	22p*	17p*	0-015µf	5p	0-10µf 6p
0-8-17V	1A	2.15*	BA146 20p	BY133 25p	IN914 5p	TIL216 Red (H.B.)	27p*	22p*	17p*	0-02µf	5p	0-10µf 25p
0-8-17V	2A	3.25*	BA156 15p	BY182 1.65	IN4003 7p	TIL232 Green(H.B.)	27p*	22p*	17p*	0-033µf	5p	0-22µf 8p
0-8-17V	4A	4.35*	BA156 15p	BY250 30p	IN4007 8p					0-047µf	5p	0-33µf 9p
20-0-20V+	1A	3.25*	BAX16 12p	QA47 12p	IN4148 5p							
24-0-24V	500mA	2.15*	BB105B 30p	QA79 12p	IN5401 15p					Mullard C281 Series 400Vwv		
0-19-25-33-40-50V+	1A	3.25*	BY103 25p	OA90 10p	IN5407 25p					0-01µf	10p	0-068µf 15p
0-19-25-33-40-50V+	1A	3.85*								0-015µf	10p	0-15µf 18p
0-12-15-20-24-30V+	1A	3.25*								0-022µf	10p	0-15µf 18p
0-12-15-20-24-30V+	2A	4.35*								0-033µf	12p	0-22µf 25p
										0-047µf	15p	0-33µf 30p

Please add an extra 50p to items marked +

HEATSINKS			ZENERS			I.C. SOCKETS			CERAMIC CAPACITORS			
TO 92	7p*	TO 5 (5F)	9p*	BZ788	400mW 2.7V-33V	10p	8 pin 10p*	16 pin 14p*	28 pin 30p*	Mullard 632 Series		Mullard 630 Series
TV 2	25p*	TO 18 (18F)	11p*	1ZS	1w 3.6V-100V	10p	14 pin 12p*	24 pin 28p*	40 pin 44p*	1-8pf	10pf	56pf
TV 3	26p*	U1 (TBA800)	16p*				I.C. pins 100 54p*	1,000 £3.78*		2-2pf	12pf	68pf
TV 4	24p*	U2 (TBA810AS)	26p*							7-7pf	15pf	82pf
TV 5	24p*	U3 (TDA2020)	52p*							3-3pf	18pf	100pf
TV 16	33p*	AY 14	51p*							3-9pf	22pf	120pf
CH 106	31p*	1-18 E-17	94p*							4-7pf	27pf	150pf
3-15 E-18	1.49*	(For 1xTDA2020)								5-6pf	33pf	180pf
(For 1xTDA2020)		3-15 E-19	1.58*							8-2pf	47pf	270pf
Transistor Covers		(For 2xTDA2020)										330pf
TO66 and TO3	12p*											1200pf
												2700pf
												3300pf
												3900pf
												4700pf

PLUGS AND SOCKETS			C.Mos			POLYSTYRENE CAPACITORS								
DIN Connectors			4000	18p*	4014	1.09*	4024	78p*	4051	86p*	10pf	100pf	1000pf	10,000pf (0-01µf)
Pins	Plugs	Sockets	4001	18p*	2015	97p*	4025	19p*	4052	86p*	12pf	120pf	1200pf	
2	14p	10p	4002	18p*	4016	53p*	4026	1.78*	4060	1.16*	15pf	150pf	1500pf	
3	14p	10p	4006	1.09*	4017	97p*	4027	38p*	4068	2.2p*	22pf	220pf	2200pf	
4	14p	10p	4007	1.49*	4018	392p*	4028	87p*	4070	2.2p*	33pf	330pf	3300pf	
5 (180)	14p	10p	4009	62p*	4019	58p*	4029	1.18*	4071	2.2p*	47pf	470pf	4700pf	
5 (240)	14p	10p	4010	62p*	4020	1.08*	4040	1.08*	4081	2.2p*	56pf	560pf	5600pf	
6	14p	10p	4011	18p*	4021	97p*	4042	83p*	4082	2.2p*	48pf	680pf	6800pf	
7	14p	10p	4012	21p*	4022	88p*	4049	58p*	4510	1.24*	82pf	820pf	8200pf	
			4013	58p*	4023	19p*	4050	58p*	4511	1.54*				6p each

JACK CONNECTORS			LINEAR INTEGRATED CIRCUITS			SILVER MICA CAPACITORS								
Type	Plugs	Sockets	UA703 (TO99)	£1.00	LM370N	£2.75	SL415A	£2.47	2-2pf	10p	68pf	10p	500pf	15p
2.5mm	15p	25p	UA709 (8 pin DIL)	41p	LM371	£1.75	SL440A	£2.38*	3-3pf	10p	75pf	10p	560pf	15p
3.5mm	15p	25p	UA709 (14 pin DIL)	41p	LM372N	£1.75	SN75491N	95p*	5pf	10p	82pf	10p	680pf	15p
Mono	—	30p	UA710 (TO99)	50p	LM373N	£2.99	SN75492N	£1.15	10pf	10p	100pf	10p	820pf	15p
Stereo	—	37p	UA709 (8 pin DIL)	50p	LM337N	£1.95	SN75501N	£1.40	18pf	10p	120pf	10p	1000pf	20p
			UA710 (14 pin DIL)	50p	LM337N-8	£1.95	SN76003N	£2.45	20pf	10p	150pf	10p	1500pf	20p
			UA710 (TO99)	50p	LM380N	99p	SN76013N	£1.60	22pf	10p	180pf	10p	1800pf	20p
			UA711 (14 pin DIL)	95p	LM381N	£1.75	SN76023N	£1.60	25pf	10p	200pf	10p	2200pf	20p
			UA711 (TO99)	98p	LM322N	£1.35	SN76033N	£2.45	27pf	10p	220pf	10p	2700pf	30p
			UA741 (8 pin DIL)	25p	LM390N	65p	SN76544N	£1.55	30pf	10p	250pf	10p	3000pf	30p
			UA741 (14 pin DIL)	42p	LM3908N	£1.50*	SN76552N	85p	33pf	10p	270pf	15p	4700pf	30p
			UA741 (TO99)	42p	MC1300/LM1303N	£1.10	SN76666N	£1.00	39pf	10p	300pf	15p	5000pf	30p
			UA747 (14 pin DIL)	95p	MC1301P	£1.80	TA A263	£2.50	47pf	10p	330pf	15p	6800pf	40p
			UA748 (8 pin DIL)	42p	MC1312P	£2.15	TA A320A	£2.75	50pf	10p	390pf	15p	8200pf	40p
			UA748 (14 pin DIL)	60p	MC1314P	£3.10	TA A350A	£2.50	56pf	10p	470pf	15p	0-01µf	40p
			UA748 (TO99)	65p	MC1315P	£3.50	TA A350A	£2.50						
			UA753 (8 pin DIL)	£1.95	MC1327P/TDA1327	£1.58	TBA120S	£1.00						
			AY-1-0212	£1.65	MC1330P	£1.15	TBA231	£1.00						
			AY-1-5051	£1.65	MC1350P	£1.00	TBA520Q	£2.00						
			AY-5-1224A	£3.39*	MC1351P	£1.00	TBA530Q	£2.00						
			AY-5-3507	£5.99*	MC1352P	£1.00	TBA540Q	£2.00						
			AY-5-4007	£7.99*	MC1352P/TDA1352	£1.20	TBA550Q	£2.00						
			CA3045	£1.50	MC1357P	£1.20	TBA551	£2.25						
			CA3046	80p	LM2111N	£1.70	TBA750Q	£2.00						
			CA3053	80p	MC1375P	£1.50	TBA780Q	£1.00						
			CA3075	£2.00	MC1456CG	£2.50	TBA805/AS	£1.10						
			CA3080	80p	MC1485L	£2.90	TBA820	£1.10						
			CA3081	£1.50	MC1495L	£1.65	TBA900Q	£2.00						
			CA3082	£1.50	MFC6030A	£1.00	TC A730	£4.69						
			CA3089/TDA1200	£2.20	NE544	£2.25	TC A740	£4.69						
			CA3090	£4.25	NE556	92p	TC A940	£1.75						
			CA3123E/LM1820	£1.50	NE555	35p	TD A2020	£3.50						
			CA3097E	£1.75	NE560	90p*	ZN414	£1.10						
			CA3130S	99p*	NE568	£4.40*	ZN417E	£1.68						
			CA3140S	99p	NE569	£4.40*	ZN421T	£1.08*						
			CA3150S	£1.60	NE569	£4.40*	ZN425E	£3.78*						
			CA3600E	£1.75	NE587	£1.85*	ZN103AE	£3.43*						
			LM301AN (8 pin)	40p	NE587	£1.85*	ZN104E	£3.43*						
			LM301AT (TO99)	50p	SL414A	£1.90	ZN A116E	£6.75*						
			LM303N (8 pin)	90p										
			LM308T (TO99)	£1.40										
			LM339N	£1.00										

SWITCHES			RESISTORS			POTENTIOMETERS			
D.P.D.T. toggle	50p*		Type	Range		5K	250K	Lin and Log less Switch (inc. in Lin)	27p
S.P.S.T. toggle	30p*		1 watt 5% Carbon film	E12 Series 10R-1M	2p each	10K	500K	Lin and Log Dual less Switch	75p
D.P.D.T. Slide	18p*		1 watt 5% Carbon film	E24 Series 3-3R-10M	2p ea.	25K	1M	1 Lin and Log with Switch	60p
D.P.D.T. Slide Miniature	15p*		1 watt 5% Carbon film	E12 Series 10R-1M	5p each	50K	2M	10K, 100K, 500K, 1M Dual log with Switch	75p
Push to Make Miniature	18p*					100K		10K Log + 10K Antilid less Switch	75p

PRESETS			REGULATORS			TRANSISTORS		
100R	5K	250K	723 Variable	45p*	AC126 20p*	BC558 15p	MPP104 40p	2N1302 45p*
250R	10K	500K	78L05A/WC 5V	65p*	AC127 20p*	BC559 15p	MPP105 40p	2N1304 45p*
500R	25K	1M	78L12A/WC 12V	65p*	AC128 20p*	BC547 15p	MPS A05 25p	2N1305 30p*
1K	50K	2.5M	78L15A/WC 15V	65p*	AC176 20p*	BC548 15p	MPS A66 25p	2N1306 45p*
2.5K	100K	5M	7805KC 5V	2.17*	AC187K 35p*	BC549 15p	MPS A56 30p	2N1307 30p*
			7812KC 12V	2.17*	AC188K 35p*	BCY70 18p*	MPS A56 30p	2N1309 45p*
			7815KC 15V	2.17*	AD161 45p*	BCY71 18p*	MPSU05 50p	2N1711 25p
			7818UC 18V	1.2				

**TV GAMES IN FULL COLOUR**  
 AY-3-8500 £3-95.  
 AY-3-8550 £3-95.  
 AY-3-8600 £13-95.  
 4.43 MHz crystals  
 £1-95. Black and white TV games kits: standard model £10-50. Economy model £5-95. Colour TV games kits: standard £18-00. Economy £13-45. Colour generator kit adds colour to most black and white games £7-50. Rifle kit £4-95. Send s.a.e. for giant free data.



**NEW COMPONENT SERVICE**  
 Resistors 5% carbon £2.10 to 10M. 1W 1/2. 1W 3/4. Preset Pots subminiature 0.1W 100 to 4M7 9p. Potentiometers 1/2W 4K7 to 2M2 log or lin. Single 30p. Dual 95p. Polystyrene Capacitors E12 63V 22pf to 8200pf 3/3p. Ceramic Capacitors 50V E8 22pf to 47000pf 9p. Polyester Capacitors 250V E6 0.1 to 1mf 5/2. .15. .22. .33mf 7p. .47 11p. Electrolytics 50V .47. 1. 2mf 5p. 25V 5. 10mf 5p. 16V 22. 33. 47mf 6p. 100mf 7p. 220. 330 9p. 470 11p. 1000mf 18p. Zener Diodes 400mV E24 3V3 to 33V 8/2p.

**MAINS TRANSFORMERS**  
 0-0-0V 100ma 94p. 0-0-9V 75ma 84p. 12-0-12V 50ma 94p. 13V 1A £1-10. 6-0-6V 13A £2-35. 9-0-9V 1A £1-99. 12-0-12V 1A £2-49. 15-0-15V 1A £2-79. 30-0-30V 1A £3-59. 9-0-9V 2A £2-60.

**PRINTED CIRCUIT MATERIALS**  
 PC etching kits: economy £1-70. standard £3-82. 50 sq ins pcb 40p. 1lb FeCl £1-95. Etch resist pens: economy type 45p. Dalo type 85p. Small drill bit 20p. Laminate cutter 75p. Etch in a dish 68p.

**S-DECS AND T-DECS\***  
 S-DC £2-23.  
 T-DC £3-99.  
 u-DeCA £3-97.  
 u-DeCB £6-67.  
 16 dl adaptors: plain 80p., with socket £1-91.



**SINCLAIR PRODUCTS\***  
 Cambridge scientific programmable calculator £13-95. Prog. library £4-95. Mains adaptor £3-20. Cambridge Scientific £8-45. Oxford scientific £10-60. PDMS digital multi-meter £25-95. Adaptor £3-24.

**BI-PAK AUDIO MODULES**  
 S450 tuner £21-95. AL60 £4-86. PA100 £14-95. MK60 audio kit £36-45. Stereo 30 £17-95. SPM80 £3-75. BMT80 £5-95.

**JC12, JC20 AND JC40 AMPLIFIERS**

A range of integrated circuit audio amplifiers supplied with free data and printed circuits.  
 JC12 6 Watts £1-95.  
 JC20 10 Watts £2-95.  
 JC40 20 Watts £4-20.  
 Send s.a.e. for free data.



**FERRANTI ZN414**  
 IC radio chip £1-44. Extra parts and pcb for radio £3-85. Case £1. Data s.a.e.

**BATTERY ELIMINATOR BARGAINS**  
 TV games power unit stabilised 7.7V 100ma £3-25. 3-way models with switched output and 4-w multi-jack: 3/4/4/6V 100ma £2-92. 6/7/9V 150ma £3-30. 100ma radio models with press stud connectors. 9V £2-85. 6V £2-85. 4.5V £2-85. 8V + 9V £4-50. 6V + 6V £4-50. 4V + 4V £4-50.

**Cassette recorder mains unit 7.7V 100ma with 5 pin din plug £2-85. Fully stabilised model switched output of 3/6/7/9V 400ma stabilised £6-40. Car converters 12V DC input. Output 9V 300ma £1-80. Output 7.7V 300ma £1-60.**

**BATTERY ELIMINATOR KITS**  
 Send s.a.e. for free leaflet on range. 100ma radio types with press stud battery terminals. 4V £1-80. 6V £1-80. 9V £1-80. 4.5V + 6V £2-50. 6V + 6V £2-50. 9V + 9V £2-50. Cassette type 7.7V 100ma with din plug £1-80. Transistor stabilised 8-way type for low hum. 3/4/6/7/9/12/15/18V. 100ma £3-20. 1 Amp £6-40. Heavy duty 15v types 4.5/6/7/9/11/13/14/17/21/25/28/34/42V. 1 Amp £4-95. 2 Amp £7-95. Car converter kit input 12V DC. output 6/7/9V DC 1A transistor stabilised £1-95. Stabilised power kits 3-18V 100ma £3-60. 3-30V 1A £9-95. 3-60V 1A £10-95. 3-60V 2A £13-95.

**BULK BUY OFFERS**  
 4.43MHz crystals £17/25. 741 8dl £11/50. NE555 timer 8dl £21-50/50. Dalo pens £10/25. 2N3055 £15-50/50. BD131 £15/50. BC107 £7/100. BC109 £7/100. BC212 £8/100.

**CUT PRICE TELETEXT**  
 Labgear CM7026 ready to use, attractively case complete unit which just plugs straight into the aerial socket of the set, giving full colour and requiring no modification to the TV. Remote control page selection. £325.

Texas Instruments Tifax Module for the experienced 'do it yourself' man £120.

**SWANLEY ELECTRONICS**

DEPT. PW. PO Box 68, 32 Golds Rd., Swanley, Kent BR8 8TQ  
 Mail order only. Please add 30p to total cost of order for postage. Prices include VAT. Overseas customers deduct 7% on items marked \* and 11% on others. Official credit orders welcome.

**WIRELESS TIME :**



approx. 1/2 full size digits shown here  
 National's MA1012 LED digital clock module is a complete clock & alarm unit, operating from 50 or 60 Hz mains, and offering all the features you would expect: Hours-minutes display in bright 0.5" leds with optional seconds, sleep and snooze alarms, fast and slow setting, AM/PM indicator, switched alarm outputs - but best of all no RFL. Thus the MA1012 is suitable for use in any radio/tuner applications, and requires just 1.75 x 3.75 x 0.7" total. (Ex. transformer). £9.45 per module, isolating mains transformer £1.50 each. (\*8% vat) Two modules, and two transformers for £20.00 (+8% vat)

In the latest Ambit catalogue: more TOKO coils, chokes, filters etc., data on the short wave coil sets, a revised price list, micro-microphone inserts, special offer lines etc.

**DETECKNOWLEDGEY**

Metal locator principles and practise, including some of the facts and information manufacturers of £100+ detectors would rather you didn't know. £1.00 each.

The Bionic Ferret 4000 - a VCO metal locator based on the PW seekit, including all parts, plasticwork, ready wound coil etc. Inc. free copy of detecknowledgedey. £34.26 in pp and VAT at 8%.

Special announcement. The Bionic Radiometer metal locator is at last to be released. A full VLF discriminator, with simultaneous display of ferrous, non-ferrous and foil objects. With a little practise, you can actually find objects obscured by junk. Outperforms units costing £150+. Digital control. Demo available at Brentwood, on sale soon for less than £75.SAE info:

**COMPONENTS**

Herewith the list of first quality parts and modules for wireless, inc. Europe's largest range of signal coils and inductors. 1/2m in stock!

CA3089E	FM IF	1.94	BC413	to noise	0.18	MFL 2.4 kHz ssb mech.
KB4402	FM IF	1.94	40238	shld RF	0.25*	filter for ssb gen/IF 455kHz
HA1137W	FM IF	2.20	BF224	6ghz RF	0.22	with matching trans's. 9.95
TBA120	FM IF	0.75	BF274	7ghz RF	0.18	MFH series 4/5/7kHz band-
TBA120S	FM IF	1.00	ZTX212	50v/3w	0.17	width @ 455kHz
sn76660n	FM IF	0.75	ZTX213	30v/3w	0.16	MFk series 7/9kHz bw 1.65
ua720	AM rad	1.40	ZTX214	30v/3w	0.17	<b>Modules/tunerheads etc.</b>
CA3123E	AM rad	1.40	ZTX451	60v/1w	0.18	EC3302 3cct v/cap fm 7.50
HA1197	AM rad	1.40	ZTX551	60v/1w	0.18	EF5600 5cct v/cap fm 12.95
TBA651	AM rad	1.81	BD515	45v/10w	0.27	EF5800 6cct v/cap fm 15.25
MC1350	agc gain	1.00	BD516	45v/10w	0.30	EF5801 (5800+osc op) 17.45
ua753	fm gain	1.80	BD535	60v/50w	0.52	8319 4 v/c, mos mixer 11.45
LM1496	Bal mix	1.25	BD536	60v/50w	0.53	7252 complete fm mono
MC1310P	mpx dec2.20	BD609	80v/90w	0.70	tunerset.afc,agc,mute 26.50	
KB4400	as above	2.20	BD610	80v/90w	1.20	7253 complete fm stereo
ca3090aq	mpx dec4.35	BF256	1ghz fet	0.34	tunerset. afc, agc, mute 26.50	
HA1196	mpx dec4.20	E176	p ch swt	0.38	7020 10.7MHz fm if 6.95	
LM380	2w AF	1.00	MEM614	(40822)	0.38*	7030 linear phase fm if 10.95
LM381	preamp	1.81	MEM616	(40673)	0.67*	93090 ca3090aq dec 8.36
tda2020	15w AF	2.99	MEM680	to noise	0.75*	92310 1310 decoder 6.95
tda940E	10w AF	1.80	BA102	vhf varic	0.30	91196 ha1196 decoder 12.99
tba810as	7w AF	1.08	BA121	vhf varic	0.30	91197 mw/lw v/cap tun11.35
LM301an	op amp	0.39*	BB104	dual var.	0.45	7122 3 v/c mw (OR lw) tuner
ua741	op amp	0.34*	BB105	uhf varic	0.40	KIT 15v tuning 9.00
LM3900	op amp	0.68*	BB105	uhf varic	0.45	810k 7w af kit comp. £3
7805uc	5v/1amp	1.55*	mvam2	dual AM	1.48	940k 10w af kit 3.95
tda1412	12v/1/2A	0.95*	mvam115	15v/AM	1.05	tda2020k pr. tda2020 ics,
78M20	20v/1/2A	1.20*	mvam125	25v/AM	0.90	pcb, heatsinks for pa 9.35
78M24	24v/1/2A	1.20*	<b>TOKO Coils &amp; Filters</b>			All mpx decoders feature
ua723cn	variable	0.80*	10mm & 7mm (rad cont)			TOKO pilot tone filters.
NE550A	as above	0.80*	32v ref	0.50*	AM IF's with cap	<b>Tuners: complete</b>
taa550b	sig gen	4.50*	FM IF's with cap	0.33	eg	Larsholt signalmaster Mk 8
ic18038cc	timer	0.70*	vco	2.50*	YHCS11098AC2	Best fm tuner kit under £100
NE555v	tone dc	2.50*	YHCS12374AC2	0.30		Looks as good as it sounds.
NE566v	hf pll	3.50*	YHCS11100AC2	0.30		Full instructions 86.95
NE567v	hf pll	3.50*	KALS4520A	0.33		Audiomaster amp. Matching
NE560B	hf pll	2.50*	KACSK586HM	0.33		25+25w rms amp. 79.00
NE561B	quad	1.50	LLC238	7mm	0.33	carriage on above £3 extra ea.
NE565K	quad	1.50	LLC427	7mm	0.33	<b>Misc.</b>
MC1312	650mhz	14.00*	LLC428	7mm	0.33	FX1115 beads 100.25
11C90	30v/3w	0.14	CFS10.7 ceramic	1.50		MW/LW ferrite rod ant 0.90
ZTX107	30v/3w	0.14	BLR3107N mpx	0.90		min. foil trimmers (see pl)
ZTX108	30v/3w	0.14	BBR3132 6pole fm	2.25		22t 100k pots for tuning.45
ZTX109	30v/3w	0.14				RFchokes: 1uH to 120mH

VAT is extra at 12 1/2%, except where otherwise shown (\*8%). PP now 25p per order. Catalogue 45p (inc). Pse send A5 or larger SAE with enquiries. Price lists free with an SAE. Full range of components etc available to callers at our new easy-to-get-to premises.

**ambit INTERNATIONAL**

Number 2, Gresham Road, Brentwood, Essex. CM14 4HN  
 telephone (0277) 216029  
 Our new premises are only 200 yards from Brentwood station - with parking facilities outside the door !!

**Random Flasher Unit**  
 Wired ready for use. Complete with three 100 watt coloured lamps that flash independently at random.  
 £19-95

**TWIN BANK 6 LIGHT UNIT**  
 (less lamps) LENGTH 14 1/2 inches  
 B.C. Fitting £11-35  
 E.S. Fitting £11-35

**Sound to Light MASTER UNIT**  
 600 WATTS PER CHANNEL  
 £30-95  
 INCLUDING CHANNEL OUTPUT PLUGS AND MAINS INPUT SOCKET

**TYPE A SPOT**  
 (less lamp)  
 B.C. Fitting | E.S. Fitting  
 £2-30 EACH | £2-30 EACH

**TYPE B 3 BANK UNIT**  
 (Less Lamps)  
 B.C. £7-99 | E.S. £7-99  
 Fitting EACH | Fitting EACH

**TWIN BANK 12 LIGHT UNIT**  
 Length 31 1/2  
 (less lamps)  
 B.C. £18-50 | E.S. £18-50  
 Fitting EACH | Fitting EACH

**100 WATT SPOT LAMPS**  
 RED, YELLOW, GREEN  
 BLUE, CLEAR  
 £1-50 each | £4-50  
 Minimum 3 lamps  
 B.C. or E.S. Fitting

**ALBEN ENGINEERING CO LTD**  
 DEPT. PW THE CRESCENT, WORSTHORNE,  
 BURNLEY, LANCAS. Tel Burnley 20940

# B. BAMBER ELECTRONICS

Dept. P.W.5 28-108 ROAD, LITTLEPORT, CAMBS., CB6 1QE  
Telephone: ELY (0353) 860185 (2 lines) Tuesday to Saturday

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

## A RANGE OF DRAPER TOOLS FOR THE ELECTRONICS ENTHUSIAST

**MAINS TESTER SCREWDRIVERS** 100 to 500V. Standard size 50p. Large 70p.  
**RADIO PLIERS** 6 1/2: £1.60, 6 3/4: £1.80.  
**DIAGONAL SIDE CUTTERS** 6 1/2: £1.99.  
**SMALL SIDE CUTTERS** L2. Standard £3.70. L17 (with wire holding device) £4.10.  
**MIDGET OPEN ENDED SPANNER SETS** 0+12+23+34+44+54+64+74 sizes £2.85 set of 5. 4+4.5 5+5.5 6+6 7+7 8+9 10+11 MM sizes £3.50 set of 6.  
**MINIATURE FILE SETS.** Set of 6 £1.90. Set of 10 £3.25 (Round, flat, etc.)  
**TAP AND DIE SETS** (18 piece) contain 1 each of 0, 2, 4, 6, 8, BA SIZES in Dies, Plug Taps, Taper Taps + American type tap wrench, T type tap wrench, Die Holder. £11.60.

**LARGE ELECTROLYTIC PACKS.** Contain range of large electrolytic capacitors, low and high voltage types, over 40 Pieces, £3.00 per pack (+12% VAT).

**Slider Switches.** 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

## A NEW RANGE OF QUALITY BOXES & INSTRUMENT CASES.

Aluminium Boxes with lids.		
AB10	5 1/2 x 4 x 1 1/2	60p
AB13	6 x 4 x 2	80p
AB14	7 x 5 x 2 1/2	£1.00
AB15	6 x 6 x 3	£1.30
AB16	10 x 7 x 3	£1.50
AB17	10 x 4 1/2 x 3	£1.30
AB25	6 x 4 x 3	£1.00

**Vinyl Coated Instrument Cases**  
Light Blue tops and White lower sections.  
Very smart finish

WB1	5 x 2 1/2 x 2 1/2	60p
WB2	6 x 4 1/2 x 1 1/2	£1.10
WB3	8 x 5 x 2	£1.50
WB4	9 x 5 1/2 x 2 1/2	£1.80
WB5	11 x 6 1/2 x 3	£2.00
WB6	11 x 7 1/2 x 3 1/2	£2.25
WB7	12 x 6 1/2 x 3 1/2	£2.60
WB853	8 x 5 1/2 x 3 1/2	£2.00

## PUSH BUTTON TELEPHONES

Ten digit Intercom type with handset. Finished in smart grey Plastic, ex-equipment, but good cond. £2.50 each.

**MAINS TRANSFORMERS.** Type 15/300 240V Input. 15V at 300mA output. £1.50 each.  
**MAINS TRANSFORMERS.** Type 45/100, 240, 220, 110, 0V Input. 45V at 100mA output. £1.50 each.

**VIDICON SCAN COILS** (Transistor type, but no data) complete with vidicon base £6.50 each. Brand New.

**FULL RANGE OF BOOKS/BABANI ELECTRONICS BOOKS IN STOCK. S.A.E. FOR LIST.**

**NEW FOR THE VHF CONSTRUCTOR.** A range of tuned circuits on formers with slugs and screening cans. Frequencies quoted are approximate and range can be greatly extended by using varying capacitors in parallel.

Type S (1/2 in. square, dummy type).  
Type SA 20 to 30MHz (when 33pF fitted in parallel).  
Type SB 35 to 50MHz (with link winding).  
Type SC 70 to 100MHz (with link winding).  
Type SD 135 to 175MHz (with link winding).  
Type M (Min. 1/2 in. square types).  
Type MA 19 to 28MHz (when 33pF fitted in parallel).  
Type MB 22 to 32MHz (when 33pF fitted in parallel).  
Type MC 25 to 35MHz (when 33pF fitted in parallel).  
Type MD 38 to 50MHz (when 33pF fitted in parallel).  
Type ME 45 to 60MHz (when 33pF fitted in parallel).  
Type MF 100 to 200MHz (without slug) when 0 to 30pF variable fitted in parallel.  
All the above coils available in packs of five only (same type) at 50p per pack of 5.

**SEMICONDUCTORS**  
BSX20 (VHF Osc/Mult). 3 for 50p.  
BC108 (metal can), 4 for 50p.  
PBC108 (plastic BC108), 5 for 50p.  
BFY51 Transistors, 4 for 60p.  
BCY72 Transistors, 4 for 50p.  
PNP audio type TOS Transistors, 12 for 25p.  
BF152 (LHF amp/mixer), 3 for 50p.  
2N3819 Fet., 3 for 60p.  
BC148 NPN SILICON, 4 for 50p.  
BC158 PNP SILICON, 4 for 50p.  
BAV31 Signal Diodes, 10 for 35p.  
BA121 Varicap Diodes, 4 for 50p.

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

741CG op amps by RCA, 4 for £1.  
**RED LED's** (Min. type) 5 for 70p.

**PLASTIC PROJECT BOXES** with screw on lids (in black ABS) with brass inserts.  
Type NB1 approx 3 1/2 in x 2 1/2 in x 1 1/2 in 40p each  
Type NB2 approx 3 1/2 in x 2 1/2 in x 1 1/2 in 50p each  
Type NB3 approx 4 1/2 in x 3 1/2 in x 1 1/2 in 60p each

**MULLARD 85A2 85V STABILISER VALVES** (Brand New) 70p each or 2 for £1.20  
TO3 transistor insulator sets, 10 for 50p

**PERSPEX TUNER PANELS** (for FM Band 2 tuners) marked 88-108MHz and Channels 0-70, clear numbers, rest blacked out, smart modern appearance, size approx. 8 1/2 in. x 1 1/2 in. 2 for 35p.

**PLUGS AND SOCKETS**  
N-Type Plugs 50 ohm, 60p each, 3 for £1.50.  
P1259 Plugs (PTFE) brand new, packed with reducers, 53p each.  
SO239 Sockets (PTFE), brand new (4-hole fixing type), 50p each.

**SOLDER SUCKERS** (Plunger type). Standard Model. £5. Skirted Model £5.50. Spare Nozzles 80p each.

**NEW MARKSMAN RANGE OF SOLDERING IRONS.**  
S125D 25W 240V £4.00.  
S140D 40W 240V £4.50.  
S125DK 25W 240V + bits etc., KIT £4.90.

**BENCH STAND** with spring and sponge for Marksmen Irons £2.70.  
Spare bits MT9 (for 18W) 60p, MT5 (for 25W) 50p, MT10 (for 40W) 55p.

**ALL PRICES + 8% VAT.**  
**TC2P TEMPERATURE CONTROLLED IRON.**  
Temperature controlled iron and PSU. £30 + VAT (£2.40).

**SPARE TIPS**  
Type CC single flat. Type K double flat fine tip. Type P, very fine tip. £1 each + VAT (8p).  
**MOST SPARES AVAILABLE.**

**MULTICORE SOLDER**  
Size 5 Savbit 18 s.w.g. in alloy dispenser, 32p + VAT (3p).  
Size C1SAV18 Savbit 18 s.w.g., 56p + VAT (4p). 1/2 Kg. (1.1lb) 60 x 40, 20 s.w.g. on plastic reel £3 + VAT (24p).

## WELLER SOLDERING IRONS

**EXPERT.** Built-in spotlight illuminates work. Pistol grip with fingertip trigger. High efficiency copper soldering tip.  
**EXPERT SOLDER GUN** £10.00  
**EXPERT SOLDER GUN KIT** (apart bits, case, etc.) £15.00.  
Spare bits 40p pair.

**A LARGE RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES, S.A.E. FOR LIST.**

**MIXED COMPONENT PACKS.** containing resistors, capacitors, pots, etc. All new. Hundreds of items. £2 per pack, while stocks last.

**ALU-SOL ALUMINIUM SOLDER** (made by Mullcore). Solders aluminium to itself or copper, brass, steel, nickel or tinplate. 16 s.w.g. with multicore flux, with instructions. Approx. 1 metre coil 40p pack. Large reel £2.75.

**VARICAP TUNERS** Mullard type ELC1043/05. Brand New, £4.40 + 12% VAT.

**BARGAIN PACK OF LOW VOLTAGE ELECTROLYTIC CAPACITORS.** Up to 50V working. Seatronic Manufacture. Approx 100. £1.50 per pack + 12% VAT.

**OSMOR REED RELAY COILS** (for reed relays up to 1/2 in dia. not supplied) 12V, 500 ohm coil, 2 for 50p.

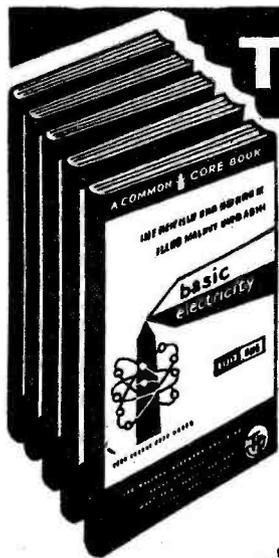
We now stock Spiralux Tools for the electronic enthusiast. Screwdrivers, Nut spanners, BA and Metric sizes, pop rivet guns, etc. S.A.E. for list.

Dubilier Electrolytics, 50uF, 450V, 2 for 50p.  
Dubilier Electrolytics, 100uF, 275V, 2 for 50p  
Plessey Electrolytics, 470uF, 63V, 3 for 50p.  
TCC Electrolytics, 100uF, 30V, 3 for 60p.  
Dubilier Electrolytics, 5000uF, 35V, 50p each.  
Dubilier Electrolytics, 5000uF, 50V, 60p each  
ITT Electrolytics, 6800uF, 25V, high grade screw terminals, with mounting clips, 50p each.

**PLEASE ADD 12 1/2% VAT TO ALL CAPACITORS.**

**TV PLUGS AND SOCKETS**  
TV Plugs (metal type), 4 for 50p.  
TV Line Connectors (back-to-back sockets), 4 for 50p.  
**PLEASE ADD 12 1/2% VAT.**

Terms of Business: CASH WITH ORDER. MINIMUM ORDER £2. ALL PRICES INCLUDE POST & PACKING (UK ONLY) SAE with ALL ENQUIRIES Please. PLEASE ADD VAT AS SHOWN. ALL GOODS IN STOCK DESPATCHED BY RETURN. CALLERS WELCOME BY APPOINTMENT ONLY



# The Pictorial Method

## BASIC ELECTRICITY (5 vols) ELECTRONICS (6 vols) TELEVISION (3 vols)

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

**YOUR 100% GUARANTEE**

Should you be, in any way dissatisfied with the MANUALS your money will be refunded by return of post.

The series will be of exceptional value in training mechanics and technicians in Electricity, Radio and Electronics.

The Selray Book Co., 70 Hayes Hill, Bromley, Kent, BR2 7HP.

### WHAT READERS SAY

Interesting, absorbing, a joy to study. More power to your elbow. C.B.T., Wood Green

To say I am completely satisfied is inadequate as to the fabulous value. B.W.J., Stoke-on-Trent

The volumes are way ahead of any self-taught instruction books available. A.B., Brockenhurst

It is a great pleasure to meet up with such excellent publications. C.W., Sawbridge

To The SELRAY BOOK CO., 60 HAYES HILL, HAYES, BROMLEY, KENT, BR2 7HP

Please find enclosed P.O./Cheque value £.....

BASIC ELECTRICITY 5 parts £10.50

BASIC ELECTRONICS 6 parts £12.50

BASIC TELEVISION 3 parts £6.50

Tick Set(s) required. Prices include Postage

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

NAME .....

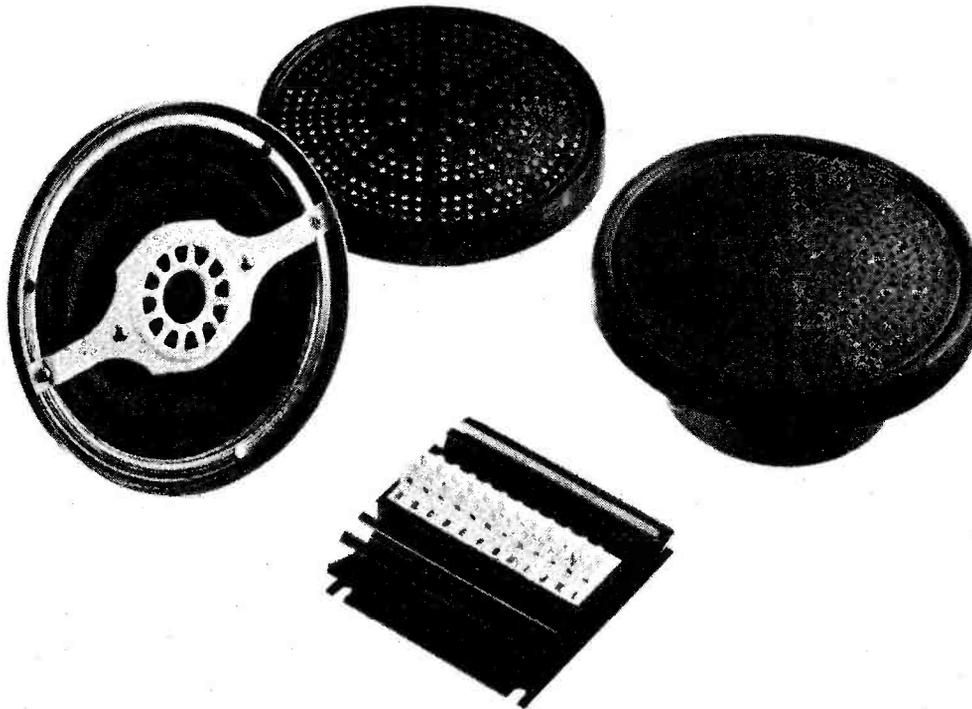
BLOCK LETTERS

FULL POSTAL.....

ADDRESS .....

**POST NOW FOR THIS OFFER!**

# THE DYNAMIC DUO



The C15/15 is a unique Power Amplifier providing Stereo 15 watts per channel or 30 watts Mono and can be used with any car radio/tape unit. It is simply wired in series with the existing speaker leads and in conjunction with our speakers S15 produces a system of incredible performance.

A novel feature is that the amplifier is automatically switched on or off by sensing the power line of the radio/tape unit hence alleviating the need for an on/off switch.

The amplifier is sealed into an integral heatsink and is terminated by screw connectors making installation a very easy process.

The S15 has been specially designed for car use and produces performance equal to domestic speakers yet retaining high power handling and compact size.

#### C15/15

15 Watts per channel into 4Ω  
 Distortion 0.2% at 1KHz at 15 watts  
 Frequency response 50Hz - 30KHz  
 Input Impedance 8Ω nominal  
 Input sensitivity 2 volts R.M.S. for 15 watts output  
 Power line 10 - 18 volts  
 Open and Short Circuit protection  
 Thermal protection  
 Size 4 × 4 × 1 inches

#### Data on S15

6" Diameter  
 5½" Air Suspension  
 2" Active Tweeter  
 20oz Ceramic magnet  
 15 watts R.M.S. handling  
 50 Hz - 15KHz frequency response  
 4Ω Impedance

C15/15 Price £17.74 + £2.21 VAT P & P free

S15 Price pre pair £17.74 + £2.21 VAT P & P free

**TWO YEARS' GUARANTEE ON ALL OF OUR PRODUCTS**

**I.L.P. Electronics Ltd.,  
 Crossland House,  
 Nackington, Canterbury,  
 Kent CT4 7AD.  
 Tel. (0227) 63218.**

Please Supply .....  
 Total Purchase Price .....  
 I Enclose Cheque  Postal Orders  Money Order   
 Please debit my Access account  Barclaycard account   
 Account number .....  
 Name & Address .....  
 Signature .....

# A. P. ELECTRONICS

Manufacturer and Distributor of Electronic Components

3 MILDMAY ROAD, ROMFORD, ESSEX  
RM7 7DA

Telephone: ROMFORD 28882

## BONANZA

**4 MILLION RESISTOR'S** Brand new. A fabulous range of  $\frac{1}{4}$  Watt,  $\frac{1}{2}$  Watt, 1 Watt and 2 Watt. Carbon Film Resistor's. 1,000 mixed values. For the lowest price ever, VAT included **£3.50** only.

This is a bargain you cannot miss, only from A. P. ELECTRONICS. Count by weight. Post & Pack only **45p.**

**$\frac{1}{2}$  A MILLION MINIATURE CERAMIC PLATE CAPS.** 200 for only **£1.25**. Mixed values all brand new VAT included. Post & Pack **25p.** Count by weight.

**$\frac{1}{2}$  OF A MILLION MULLARD C296 POLYESTER'S** Many values, 75 for only **£1** VAT included. Post & Pack **30p.** Brand new. Count by weight.

**MULLARD C280** 75 mixed values for only **£1** VAT included. Post & Pack **20p.** Count by weight.

**A FABULOUS PACK OF HARDWARE.** Self tappers, nuts, bolts, washers, spacers, grommet's, etc. etc. **£1** VAT included. Post & Pack **40p.**

**200 METRES** of connecting PVC covered wire single and stranded mixed colours for only **£1.25** VAT included. Post & Pack **25p.**

**50 ELECTROLYTICS CAPACITORS.** Mixed values for only **£1** VAT included. Post & Pack **25p.**

**50 WIREWOUND RESISTORS.** From 2.5 Watt. Mixed values for only **£1** VAT included. Post & Pack **30p.** Count by weight.

OVERSEAS POST AT COST.

**EX-STOCK.** Transistor's, Diodes, I.Cs, C.MOSs, Thyristors, Knobs, Pre-sets, Resistors, Capacitors, Tant's, Bridge-Rectifiers, Transformers.

Open all day from 9am till 5.30pm.

Open all day Saturday.

MAIL ORDER DEPT:-

## CRESCENT RADIO LTD

1 ST. MICHAELS TERRACE, WOOD GREEN,  
LONDON, N22 4SJ

TELEPHONE: 888-4474

### 3 KILOWATT PSYCHEDELIC LIGHT CONTROL UNIT

1000 WATT PER CHANNEL.

Three channel: Bass, Middle, Treble. The input of this unit is connected to the loudspeaker terminals of an amplifier and the required lighting is connected to the output terminals of the unit thus enabling you to produce a fascinating sound to light display.

Full instructions supplied or S.A.E. for details.

Fantastic Value at **£20.00 + 8% VAT.**

### LOUDSPEAKER SELECTION + 12 1/2% VAT

2 1/2" 8, 40 and 75 ohm at **£1.10**

(Please state which impedance is required)

5" 8 ohm CERAMIC at **£1.70**

8" GOODMANS 'Audion SPA' 8 ohm

15w at **£5.95**

10" 'ELAC' Dual Cone 8 ohm 10 watt

at **£4.75**

### POWER SUPPLY UNITS + 8% VAT

PP1—Switched 3, 4, 6, 7, 9, 12v at 500mA with on/off switch and pilot light. Approx size: 130 x 55 x 76mm **ONLY £6.00.**

PP5—Heavy duty 12 volt power supply. 1.5A at 12 volt DC. Approx. size: 155 x 90 x 95mm. **ONLY £8.00.**

### BARGAIN TRANSFORMERS

240v primary, 12-0-12v 500mA secondary. Approx size: 60 x 40 x 50mm. Fixing centres 75mm. **PRICE: £1.80 + 8% VAT.** Also available Mains transformer with 18V 500mA sec. Price and size same as above.

### EAGLE TRANSFORMERS

LT44 Miniature driver transformer  
PRIM. 20K  $\Omega$ . SEC. 1K  $\Omega$ .  
LT700 Miniature output transformer,  
200mW.

PRIM. 1.5K  $\Omega$ . SEC. 3-2  $\Omega$ .

PRICE: EITHER OF THE ABOVE

21p + 12 1/2% VAT.

### MAINS TRANSFORMERS

MT6 240v PRIM. 6/0/6v 100mA SEC.

MT12 240v PRIM. 12/0/12v 50mA SEC.

PRICE: MT6, MT12 **£1.17 + 8% VAT.**

MAINS TRANSFORMERS WITH TWO

INDEPENDENT SECONDARY

WINDINGS.

MT100. PRIM. 240v. SEC. 0-24v, 0-24v

@ 100mA.

MT150. PRIM. 240v. SEC. 0-12v, 0-12v

@ 150mA.

MT280. PRIM. 240v. SEC. 0-6v, 0-6v

@ 280mA.

PRICE: MT100, MT150, MT280

**£2.52 + 8% VAT.**

### MAINS TRANSFORMERS

MT40. PRIM. 240v. SEC. 20/0/20v @ 1A.

PRICE: **£5.86 + 8% VAT.**

MT68. PRIM. 240v. SEC. 28/0/28v @ 1A

PRICE: **£8.26 + 8% VAT.**

MT10, MT15, MT20 100 volt line

transformers.

PRICE: MT10, MT15 **£2.25 + 8% VAT.**

MT20 **£2.66 + 8% VAT.**

INPUTS ON THESE: 8 or 16 OHMS.

S.A.E. for details on these or any of the

above.

Please add 25p p&P to all orders for

Eagle Transformers.

### PIEZO ELECTRIC HORN UNITS 100 watt

High Quality, High Power Tweeter.

No Cover required. Freq. Response:

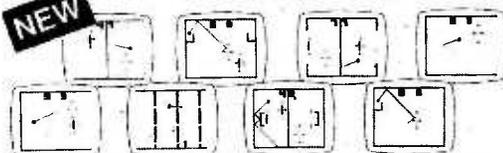
3-KHZ to 28KHZ. Spec. Sheet sent on

receipt of S.A.E.

OUR PRICE: **£7.60** each + 8% VAT.

ACCESS AND BARCLAYCARD ACCEPTED—PHONE ORDERS WELCOMED  
ALL PRICES INCLUDE POSTAGE UNLESS OTHERWISE STATED—PLEASE ADD  
V.A.T. AS SHOWN—S.A.E. WITH ALL ENQUIRIES PLEASE.  
Personal callers welcome at: 21 GREEN LANES, PALMERS GREEN, N.13. Phone: 888-3806  
and 13 SOUTH MALL, EDMONTON N9 Phone: 808-1685

Impress the neighbours with a game they haven't seen yet and proudly tell them you made it yourself



## 8 GAME T.V. PROJECT

BASED ON AY-3-8600

- ★ Basketball ★ Grid-Ball ★ Hockey ★ Tennis ★ Squash ★ Football
- ★ Two-Player Games ★ Horizontal and Vertical Bat Coverage
- ★ Automatic Ball Speed-Up ★ Players Colour Coded
- ★ Three Tone Sound-Effects ★ Sound from T.V.
- ★ Ball Colour Coded to indicate turn in Squash-Game
- ★ All Components supplied guaranteed including sound and vision modulator C.H. 36 UHF.
- ★ Power requirement 9v battery ★ Just add controls and case.

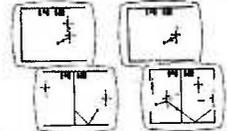
Basic AY-3-8600 Paddle II Kit B + W only **£15.99**  
Colour only **£20.99**

---

**NEW** **JOY STICK CONTROLS**  
DESIGNED FOR T.V. GAMES  
(AY-3-8550-AY-3-8600) Subminiature Size  
UNBEATABLE LOW PRICE Two off **£3.50**

---

## POPULAR AY-3-8500 PADDLE 1



- ★ Three Tone Sound Effects
- ★ All components supplied guaranteed just add controls, speaker and case
- ★ UHF varicap modulator (B+W)
- ★ Power requirement—9v battery
- ★ Stock clearance price down

Black + White **£10.50** **£9.90** Colour CH36 **£16.50** **£15.90**  
Mini-Pack P.C.B. + chip B + W **£8.90** Colour **£7.90**

All Projects supplied with easy to follow assembly instructions.  
All prices include VAT + Postage. Orders under £10.00 — Add 20p p & p.  
Make all Cheques or Postal Orders payable to

## TELEVISION

Retail Shop and Demonstrations — 14 Station Road, New Barnet, Herts.  
For further Details and Technical Help — Phone 01-440 7833  
(French and German spoken) Quantity discount negotiable.  
For extra speed phone your order on Barclay-or-Access Cards.



# HOME MICROCOMPUTER

**NORTHERN SEMINAR  
MANCHESTER**

**APRIL 1 £5.50**

After the enormous success of the Wembley Seminar, Lynx have been persuaded that there are sufficient Northerners waiting to attend their own show. All Day. Microprocessor Lectures and presentation of the Nascom I. Only 350 seats.

**Z 80**

**MONITOR PROGRAM**

**2K R.A.M.**

**P.C.B.**

**QWERTY KEYBOARD**

**VDV INTERFACE (TV)**

**CASSETTE INTERFACE**

**TELETYPE INTERFACE**

**EXPANDABLE SYSTEM**

**NASCOM I £197.50 + VAT**

**LYNX ELECTRONICS (LONDON) LTD. 92 BROAD STREET, CHESHAM, BUCKS.**

02405 75151

## PRACTICAL WIRELESS T.V. SOUND TUNER

(Nov. 75 article by A. C. Ainslie) Copy of original article supplied on request

IF Sub-Assembly (G8) £6.80. P & P 75p.  
Mullard ELC1043 V'cap UHF Tuner £4.50. P & P 35p.  
3-way Station Control Unit £1.20. P & P 25p.  
6-way Station Control Unit (Special Offer) £1.00.  
Power Supply Prtd Circuit Board £1.00. P & P 30p.  
Res, Caps, Semiconds, etc. for above £5.80.  
Mains Transformer for above £2.50. P & P 30p.

Add 12½% VAT to price of goods. P & P all items 85p.

Callers welcome at shop premises.

**MANOR SUPPLIES**

172 WEST END LANE, LONDON NW6  
(Near W. Hampstead Tube Stn.) Tel. 01-794 8751

## TRAMPIUS



**BARGAIN MONTH! POST FREE £5+**

FREE 1978 CATALOGUE SALE LIST, MANY SURPLUS & CLEARANCE LINES. SEND S.A.E. DO YOURSELF A FAVOUR A SEMICONDUCTOR POWER HOUSE.

TRAMPIUS ELECTRONICS LTD. 58-60 GROVE ROAD, WINDSOR, BERKS. SL4 1HS. TELEPHONE WINDSOR (07535) 54255.

Fast service on ex stock product. Normally 24 hour turn around. Quality devices to manufacturers specifications. No minimum order charge except Barclaycard or Access by post or telephone £5 minimum. Send C.W.O. post free over £5, except invoiced or credit card orders, otherwise add 20p post & packing. Add 8% VAT to items marked \*. 12% VAT to unmarked items.



LEDs 1/2" & 0.2" dia.  
Red no clip 9p  
0.2" or 209 & clip 12p  
Colour LEDs all 16p

**DISPLAY**  
0.3" DL704/2 & 707/2 59p  
0.6" DL747/2 £1.50  
TGS Gas Detectors £5

**CAPACITORS**  
Ceramic 22pf to 0.5 5p  
Electrolytic 1uf to 200uf 7p  
1000uf/25v 20p  
Tantalums only 16p ea

**RESISTORS 1/8w 2p ea**  
Presets 10p Pots 25p

**VERO 0.1 MATRIX**  
2 1/2" x 3 1/2" 42p 3 1/2" x 5" 59p  
3 1/2" x 1 1/2" £2.50 2 1/2" x 5" 50p  
Dfl Board 6" x 4" £2.50  
Dato PCB Pen 85p  
Nylon Board Copper 6 x 4 60p  
Tub FEC Etch 1/2kg £1.50  
RS Sleeper 12v £1  
Knobs: Cheap 10p  
Relay, Multi Pole 12v £1  
Silicon Grease Satchel 25p  
\*Digital Clock IC £2

**BULK BUY BARGAINS  
FULL SPEC PAKS.**

All £1 each  
PAK A: 12 x Red LEDs £1\*  
PAK B: 5 x 7415 PIN £1\*  
PAK C: 4 x 2N3055 90W £1\*

PAK D: 12 x BC109 £1\*  
PAK E: 13 x BC182 £1\*  
PAK F: 13 x 2N3704 £1\*  
PAK G: 7 x BFV51 £1\*  
PAK H: 7 x 2N3819E £1\*  
PAK J: 6 x 2N3053 £1\*  
PAK K: 40 x 1N4148 £1\*  
PAK M: 4 x Pair NPN/PNPZA £1\*

PAK N: 50 x OAB1/91 £1\*  
PAK P: 20 x Plastic 109 £1\*  
PAK R: 14 x BC107 £1\*  
PAK S: 14 x BC108 £1\*  
PAK T: 10 x NPN 2A 60v £1\*  
PAK U: 4 x 1A 50vSLR £1\*  
PAK V: 40 x 5MFD 10v £1\*  
PAK W: 20 Electrolytics £1\*  
PAK Y: 4 x LM301/14 £1\*  
PAK Z: 20 x 2N3702 £1\*  
Type PNP £1  
NEW PAK X: 4 x 555 £1  
TRIAC: 10A 400V £1  
SCR: 4A 400v (106) 50p\*  
DIAC: BR100/ST 25p  
SCR: TAG 1A/800v 60p

DIL Sockets: Lo Profile 8 pin 12p  
14 or 16 pin 15p

**REDUCED LINES  
IC's & TRANSISTORS**

BC107	8p*	MJE2955	£1*
BC108	8p*	MJE3055	55p*
BC109	8p*	ORP12	50p*
BC109C	15p*	TIP2955	65p*
BC177/8/9	20p*	TIP3055	55p*
		2N3055	45p*
BC182/3/4	7p	2N3702/4	8p*
BC212/3/4	7p	2N3819E	18p*
BCY70/1/2	7p	2N3820	38p*
		2N2646	50p*
BD131/132 eq	20p*	2N5457	50p*
		Matching -20p	
		Ins Bush Sets	
MJ2955	39p*	AOD	10p*
	£1.50*		

ZENERS 400MW 9p  
DIODES: IN4148/914 5p  
IN4001 5p 4004 7p\*

<b>LINEARS: IC's</b>	7812	£1*		
301/14pin	29p*	7815	75p*	
3080PA	£1*	78013	£1.49*	
	555	29p*	LM309K	£1*
	741/8	21p*	LM380	89p*
	747	89p*	LM381	£1.55*
	748/14	29p*	LM3900	69p*
	748/8	39p*	MC1310	£1
	7805	£1*	2N4148X	75p*
7400TTL	12p*	7480	45p*	
7401	8p*	7490	33p*	
7405	8p*	74121	27p*	
7413	27p*	74123	50p*	
7420	8p*	74157	50p*	
7430	8p*	CMOS etc		
7445	50p*	4001	19p*	
7447	79p*	4011	18p*	

FREE: 1978 CATALOGUE SALE LIST. SEND S.A.E. BARGAIN OFFERS!

**THIS MONTH'S SNIPS. LIMITED STOCKS.**  
TUNER MODULE, BRAND NEW EXPENSIVE, EX MUSIC CENTRE MW, LW, FM, MPX PUSH BUTTON £22.50  
7 wat STEREO AMPLIFIER MODULE £31.69

TUNING GANG,  
AIR SPACED 0-360/395  
PC, HALF PRICE £1 ea.

**FREE CATALOGUE/ORDER FORM SEND S.A.E.**

500+ Top quality Transistors, I.C.'s, Resistors, Capacitors, Plugs/Sockets, Veroboard/cases, Indicators, Knobs, Switches, Wire and Books at prices you can afford.

741 ONLY 30p	555 ONLY 50p	TIL209 ONLY 15p	IN4001 ONLY 5p
--------------	--------------	-----------------	----------------

All prices include VAT. P&P FREE over £2.

Name \_\_\_\_\_  
Address \_\_\_\_\_

**ACE**

Get an ACE up your sleeve!

ACE MAILTRONIX LTD  
Dept. MW Tootal Street  
Wakefield, W. Yorkshire WF1 5JR

# BENTLEY ACOUSTIC CORPORATION LTD.

7a GLOUCESTER ROAD, LITTLEHAMPTON, SUSSEX  
All prices inclusive of V.A.T. at 12½% Telephone 6743

OA2	-85	3AM8A	-70	8F95	1-00	7R7	2-00	14H7	-75	50CD6G				
OB2	-40	8AN8	-70	8F26	-45	7Y7	2-00	1487	1-00					
OC3	-50	8AQ5	-70	8F28	-85	7YA	-80	18	1-25	50BHE	-85			
OD4	-55	8AQ8	-60	8F82	1-00	7Z4	-80	18AQ5	-65	50L6GT1-00				
OE5	-60	8AR5	-1-05	8G66	1-00	8D2	-50	19BG6G		66KU	1-00			
OF6	-65	8AR7	1-50	8G88A	-80	8D8	-52	1-00	72	-70	DK40	1-00		
OG7	-70	8AT6	-80	8GK5	-75	9BW6	-80	19G6	6-50	77	-45	DK91	-50	
OH8	-75	8AU6	-82	8GK6	2-00	9D7	-70	19H1	4-00	85A9	1-40	DK92	1-00	
OI9	1-00	8AV6	-85	8GT7	-90	9U5	-45	19Y3	-40	85A3	1-40	DK94	1-00	
OJ0	1-00	8AW8A	1-15	8H9GT	-50	10C2	-70	20D1	-70	90C1	1-50	DL63	-70	
OK1	-80	8AX4	-75	8J6GT	-85	10C14	-52	20D4	2-50	108C1	-40	DL82	1-00	
OL2	-85	8BG9	-75	8J6	-35	10D1	1-00	20F2	-85	150C2	-85	DL92	-85	
OM3	-85	8BA8	-65	8J7G	-80	10DE7	-80	20L1	1-20	218S8	-80	DL94	1-00	
ON4	-90	8BB8	-90	8J7M	-85	10F1	-87	20P1	1-00	955	-50	DL96	1-00	
OO5	-90	8BE8	-70	8J7RA	-90	80P3	1-00	807	1-10			EC92	-50	
OP6	-75	8BG6G	1-00	8K7G	-80	10F18	-85	20P4	-84	1825	3-50	DM71	1-75	
OQ7	-80	8BH6	1-10	8K8G	-80	10L14	-45	20P5	1-50	1821	1-00	DW4	1-15	
OR8	-40	8BF6	-75	8K8GT	-55	10LD11	-75	25A6G	-70	5702	1-20	DY51	2-00	
OS9	-35	8BK7A	-85	8L1	2-80	10LD12	-45	25B6G	-70	8783	2-75	DY78/76	52	
OT0	-80	8BZ8	1-00	8L7	1-50	10PL12	-70	25Y5	-80	6067	2-00	EY803	-50	
OU1	-70	8BQ5	-48	8L12	-30	10PL13	-80	25Y6	-80	6080	2-00	EY804	-75	
OV2	-85	8BQ7A	1-40	8L18	-60	10P14	2-50	25Z4G	-80	6087	2-00	EY805	-45	
OW3	-85	8BR7	1-00	8L19	2-00	12A8	-1-00	28Z5	-78	8146	4-70	EY806	-50	
OX4	-75	8BR8	1-25	8LD12	-48	12AC6	-80	28Z6G	-80	8463	2-00	EY807	-50	
OY5	-70	8BW6	3-50	8LD20	-80	12AD6	-80	28D7	2-00	7025	2-00	EY808	-50	
OZ6	-65	8BW7	-85	8NTGT	-70	12AE6	-80	30A5	-75	7193	2-00	EY809	-50	
PA7	-85	8BZ6	-40	8PL19	-80	12AT6	-45	30C1	-80	7475	1-25	EY810	-50	
PB8	-40	8BZ7	-45	8P15	-48	12AT7	-52	30C15	1-00	9002	-55	EY811	-50	
PC9	-80	8BZ8	1-50	8Q7G	-75	12AT8	-52	30C17	-90	9006	-45	EY812	-50	
PD0	-70	8C4	-50	8Q7GT	-75	12AT9	-52	30C18	2-25	A3042	6-80	EY813	-50	
PE1	-85	8C6	-45	8Q7(M)	-75	12AV6	-60	30F5	70	ACPEM	1-00	EY814	-50	
PF2	1-00	8C8	2-00	8R7G	-70	12AX7	-52	30L1	-35	ACPEM	1-00	EY815	-50	
PG3	-75	8C10	1-00	8S47	-70	12B15	-75	30L5	-75	7193	2-00	EY816	-50	
PH4	-85	8C12	-45	8S6G	-70	12BE6	-85	30P4M	-98	98	DD	1-00	EY817	-50
PI5	-85	8C16G	4-00	8S7	-70	12BH7	-85	30P12	-74	ACPEM		EY818	-50	
PK6	2-00	8C18A	-90	8S7J	-70	12B1	2-50	30P19	-70	AC/P4	1-00	EY819	-50	
PL7	1-00	8C16	-75	8SK7	1-00	12C15GT	-40	30P4	-90	AC/P4	1-00	EY820	-50	
PM8	1-00	8C18A	-85	8SK7GT	-70	12C16	-70	30P18	-50	ACTH1	1-00	EY821	-50	
PN9	-85	8C17	1-00	12K5	1-50	12C18	-60	AL60	1-50			EY822	-50	
PO0	-85	8C18	-85	68Q7	-1-00	12K7GT	-50	30P11	1-25	ARF3	-80	EY823	-50	
PP1	-75	8C19	-50	6U4GT	1-00	12K8	-75	30P12	-62	ATP4	50	EY824	-50	
PQ2	-80	8D3	-75	6U7G	-55	12Q7GT	-80	30P13	1-80	AZ1	-80	EY825	-50	
PR3	-80	8D7	-90	6U8	-50	12S47	-50	30P14	1-50	AZ31	1-00	EY826	-50	
PS4	1-40	8D7GA	-85	6V6G	1-00	12S7GT	-70	30P15	-50	AZ41	-50	EY827	-50	
PT5	-70	8EVA	-85	6V6GT	1-00	12S7	-55	30P16	-1-00	B36	-75	EY828	-50	
PU6	-85	8E5	1-00	6X4	-95	12S87	-50	30P17	-50	B719	-50	EY829	-50	
PV7	-70	8F1	-80	6X5GT	-50	12S7	-60	30P18	-50	B729	-90	EY830	-50	
PW8	-70	8F6G	-70	6Y6G	-95	12S87	-60	30P19	-80	30S8GT	-80	EY831	-50	
PX9	-70	8F12	-70	6Y7G	1-25	12SN7GT		35W4	-85	30S8	2-00	EY832	-50	
PY0	-85	8F14	-65	7A7	-1-00			32Z3	-80	CV6	-60	EY833	-50	
PZ1	-85	8AK6	-45	7B6	1-00	12SQT	-80	85Z4GT	-70	CV88	1-00	EY834	-50	
QA2	1-50	8F16	1-00	7B7	1-00	12SQT	-80	85Z4GT	-80	CV988	-25	EY835	-50	
QB3	-85	8F18	-80	7D6	2-00			43	1-25	CV10	-80	EY836	-50	
QC4	-85	8F23	1-00	7F8	2-00	12S87	-75	80B5	-85	CV81	1-00	EY837	-50	
QD5	-70	8F24	-80	7H7	1-00	13D8	2-00	50C5	-70	D1	-50	EY838	-50	

D83	-50	EC53	1-00	EL32	1-00	KT93	-70	PFL200	1-15	UL41	-90	AA199	-18	BF173	-44
DAC32	-80	EC54	1-00	EL37	3-00	KT66	3-00	PL33	1-00	UL84	-85	AAZ13	-21	BF180	-35
DAF91	-35	EC86	-84	EL41	1-00	KT71	1-00	PL36	-80	UM80	1-00	AC107	-18	BF181	-47
DAF96	1-00	EC88	-84	EL81	1-00	KT81	2-00	PL81	-40	UT9	1-00	AC113	-30	BF185	-47
DC90	-70	EC90	-80	EL83	1-00	KT88	6-75	PL81A	-75	UT12	-45	AC126	-14	BFY60	-38
DD4	-80	EC92	1-00	EL84	-45	L63	-85	PL82	-50	UT41	-70	AC127	-80	BFY61	-33
DF33	-75	EC93	-75	EL86	-60	LN19	-70	PL83	-70	UT42	-70	AC128	-28	BFY62	-33
DF91	-30	EC93C	1-00	EL89CC	4-50	LN162	-55	PL84	-59	UT85	-70	AC132	-23	BY100	-81
DF92	-25	EC93S	2-00	EL90	-75	LN309	-75	PL95	1-00	U10	1-00	AC164	-30	BY114	-81
DF96	1-00	EC95	2-00	EL95	-85	LZ319	-80	PL504/500	U12/14	1-15	AC186	-23	BY126	-18	
DH63	-75	EC94	1-00	EL96	2-50	M8162	2-00	1-05	U18	2-50	AC187	-30	BY127	-81	
DI4	-80	EC94	-52	EL96E	2-00	MEL14	1-00	PL509	2-50	U19	4-00	AC186	-30	BY128	-80
DE77	-80	EC92	-82	EL509	2-50	MELD6	-98	PL509	2-50	U25	1-00	AC186	-30	BY211	-30
DE81	1-00	EC93S	-53	EM80	1-00	MKT4	1-20	PL519	2-80	U26	-90	AC186	-44	BY212	-80
DE82	-80	EC94	-50	EM81	1-00	MU14	1-15	PL802	2-30	U38	1-75	AC176	-64	BY213	-80
DE83	-80	EC95	-50	EM83	1-00	MX40	1-00	PT4D	1-00	U36	1-75	AC177	-82	PSY11A	-38
DE84	-80	EC96	2-00	EM84	1-00	N150	1-00	PY33/2	-50	U37	2-00	AC178	-28	PSY12A	-38
DE85	-80	EC98	-72	EM85	1-20	N30A	-98	PY80	-50	U81	-80	AC179	-28	OA9	-14
DE86	-80	EC91	-35	EM87	1-45	N709	-48	PY81	-60	U191	-50	ACT23	-30	OA47	-12
DE87	-80	EC918	1-00	EMM603		P61	-60	PY82	40	U251	1-00	ACT21	-80	OA70	-18
DE88	-80	EC904	-90	2-50	PABC80	-45	PY83	-60	U301	1-00	ACT23	-18	OA78	-18	
DE89	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	ACT28	-21	OA79	-11
DE90	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD140	-50	OA81	-11
DE91	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE92	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE93	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE94	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE95	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE96	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE97	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE98	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE99	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11
DE00	-80	EC98	-80	PY88	-1-12	U403	-90	PY88	-1-12	U403	-90	AD161	-50	OA85	-11

Special offer of EF50 valves, sorted, but new and tested, £1 each.  
All goods are unused, tested, and guaranteed. Despatch charges:—50p on all orders below £25 in value. Orders over £25 post free. Orders despatched same day as received. All parcels insured against damage in transit for 5p per parcel extra. Terms of business available on request. Many others in stock too numerous to list. Please enclose S.A.E. for reply to any queries. All prices subject to change without notice.

## TECHNICAL TRAINING IN ELECTRONICS TELEVISION AND RADIO SERVICING

ICS can provide the technical knowledge that is so essential to your success, knowledge that will enable you to take advantage of the many opportunities open to the trained person. You study in your own home, in your own time and at your own pace and if you are studying for an examination ICS guarantee coaching until you are successful.

- City & Guilds Certificates:
- Telecommunications Technicians
- Radio, TV, Electronics Technicians
- Technical Communications
- Radio Servicing Theory
- Radio Amateurs
- Electrical Installation Work
- MPT Radio Communications Certificate

- Diploma Courses:
- Colour TV Servicing
- Electronic Engineering and Maintenance
- Computer Engineering and Programming
- Radio, TV, Audio Engineering and Servicing
- Electrical Engineering, Installation and Contracting

POST OR PHONE TODAY FOR FREE BOOKLET  
**ICS To: International Correspondence Schools**

Dept. No. 276Q, Intertext House, LONDON SW8 4UJ or telephone 622 9911

Subject of Interest.....  
Name.....  
Address.....  
Tel:.....

## Complete digital Clock Kits TEAK OR PERSPEX CASE

NON ALARM £12.50  
ALARM £15.50

- FEATURES**
- 4 LED digits 1/2" high. Red.
  - 12 hour display with AM/PM indication
  - Mains frequency accuracy
  - Easy to build: all components included
  - Beautiful real wood case or Perspex: White, Black, Red, Blue, Green
  - Flashes to indicate power cuts

<b>NON-ALARM</b>	<b>ALARM</b>
Complete kit including case .. £12.50	Pulsed Alarm Tone. Automatic Brightness control. .. £15.50
Ready Built .. £14.50	9 minute Snooze. Simple Setting. .. £17.00
Module kit excluding case .. £9.50	Complete kit including case .. £15.50
Ready Built .. £10.00	Module kit excluding case .. £13.00
	Ready Built .. £15.50

TIMER FACILITY: Stopwatch use up to 9min 59secs .. extra 50p.

<b>EXCELLENT VALUE</b>	
------------------------	--

**VERO**

**For the Professional Amateur**

Vero can offer a complete package to help you build your product to a truly professional standard. Full range of veroboards, accessories and housings. Please send 10p discs S.A.E., size 7" x 9" for catalogue.

**Vero Electronics Limited, Industrial Estate, Chandler's Ford, Eastleigh, Hampshire, SO5 4Z.**  
 Telephone: (04315) 2956 Telex 47561 VERDEL G  
 Available worldwide through 3 subsidiary Companies and 25 Agents.

**J. BIRKETT**  
**Radio Component Suppliers**  
 25 The Strait, Lincoln LN2 1JF Tel: 20767

**VERNITRON 10.7 MHz CERAMIC FILTERS @ 50p each.**  
**MINIATURE COIL FORMERS** 1/2" Dia. with core. 5p ea. or 6 for 25p.  
**10 ASSORTED MULTI-TURN TRIM-POTS for 60p.**  
**SAW TELEVISION FILTERS** Untested No data at 3 for 35p.  
**TRANSFORMER 240 Volt Input, out 25 volt Tapped at 14 Volt | Amp @ £1.25 (Post 25p).**  
**F.M. FRONT END 88 to 108 MHz with Conversion details To Aircraft Band or 144 MHz @ £3 plus P.P. 20p.**  
**DUAL GATE MOS FET's like 40673 at 33p, 4 for £1.10.**  
**VHF FET's 2N 3819 Type 20p or 6 for 75p, J310 @ 20p, E201 @ 12p, E111 @ 12p, E112 @ 10p, E113 @ 12p, E174 @ 22p.**  
**100-0-100µA TUNING METERS 1 1/2" x 1 1/2" @ 90p.**  
**UNMARKED GOOD 400mV ZENERS 3.3v, 6.8v, 10v, 11v, 12v, 13v, 16v, 24v, 30v, 33v, 36volt All at 10 for 40p.**  
**30 ASSORTED IOXAJ CRYSTALS Between 5 MHz To 8 MHz for £1.**  
**455 KHz I.F. CRYSTAL FILTER with connections @ 57p each.**  
**NUT FIXING 1000pf 500v.w. FEED THRU'S @ 15p doz.**  
**SOLDER-IN FEED THRU'S 6.8pf, 300pf, 1000pf @ 20p doz.**  
**VARIABLE CAPACITORS 5pf @ 75p, 10pf @ 75p, 30pf @ 85p, 50pf @ 85p, 125+125pf @ 55p, 100+200pf @ 55p, 180+180pf @ 60p, 200+200+25+25pf @ 55p, 500+500pf @ 60p.**  
**CERAMIC TRIMMERS 2.5pf To 6pf, 0 To 8pf, 3 To 10pf, 4-7 To 20pf, 0 To 30pf. All at 10p each.**  
**SUB-MINIATURE DIFFERENTIAL 10 x 10pf AIR SPACED TRIMMERS @ 22p.**  
**MINIATURE BUTTERFLY PRE-SET VARIABLE CAPACITORS** Spindles easily extend. 25 x 25pf @ 50p, 38 x 38pf @ 60p, 38 x 38pf Wide Spaced @ 65p.  
**DAU SEMI-AIRSPACED TRIMMERS 2 To 9pf @ 10p, 5 To 38pf @ 10p, 6 To 45pf @ 10p, 8 To 125pf @ 12p, 8 To 140pf @ 15p.**  
**GUNN DIODES X BAND SIMILAR TO CXY11 @ £1.65 each.**  
**50 BC 107-8-9 METAL TRANSISTORS Untested @ 57p.**  
**50 PLASTIC BC 107-8-9 TRANSISTORS Untested @ 57p.**  
**100 POLYSTYRENE CAPACITORS Assorted for 57p.**  
**SILICON DIODES 100 PIV 10 amp @ 15p, 100 PIV 15 amp @ 18p, 100 PIV 20 Amp @ 25p.**  
**TBA 120S FM IC's Untested with data @ 6 for 60p.**  
**100 ASSORTED MULLARD C280 CAPACITORS for 57p.**  
**ELECTROLYTIC CAPACITORS 20+20µf 450v.w. @ 20p, 32+32µf 275v.w. @ 10p, 32+32µf 350v.w. @ 20p, 50+50µf 275 v.w. @ 15p, 2200µf 100v.w. @ 65p, 3300µf 40v.w. @ 50p, 3000µf 63v.w. @ 65p, 4700µf 63v.w. @ 60p, 5000µf 30v.w. @ 60p.**  
**200 ASSORTED RESISTORS 1/2, 1/4 watt for 75p.**  
**50 AC 128 TRANSISTORS Branded but untested for 57p.**  
**30 AF 117-OC 170 TRANSISTORS Untested @ 57p.**

Please add 20p for post and packing on UK orders under £2, unless otherwise stated, Overseas orders at cost.

**GREENWELD**  
 443 Millbrook Road Southampton  
 SO1 0HX Tel: (0703) 772501

**BUY A COMPLETE RANGE OF COMPONENTS AND THESE PACKS WILL HELP YOU**

★ **SAVE ON TIME—No delays in waiting for parts to come or shops to open!**

★ **SAVE ON MONEY—Bulk buying means lowest prices—just compare with others!**

★ **HAVE THE RIGHT PART—No guesswork or substitution necessary!**

ALL PACKS CONTAIN FULL SPEC. BRAND NEW, MARKED DEVICES—SENT BY RETURN OF POST. VAT INCLUSIVE PRICES.

**K001** 50V ceramic plate capacitors, 5% 10 of each value 22pF to 1000pF. Total 210, £3.35  
**K002** Extended range, 22pF to 0.1µF. 330 values £4.90  
**K003** Polyester capacitors, 10 each of these values: 0.01, 0.015, 0.022, 0.033, 0.047, 0.058, 0.1, 0.15, 0.22, 0.33, 0.47µF. 110 altogether for £4.75  
**K004** Mylar capacitors, min 100V type. 10 each all values from 1000pF to 10,000pF. Total 130 for £3.75  
**K005** Polystyrene capacitors, 10 each value from 100pF to 10,000pF. E12 series 5% 160V. Total 370 for £12.38  
**K006** Tantalum bead capacitors, 10 each of the following: 0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1, 2.2, 3.3, 4.7, 6.8, all 35V: 10/25 15/16 22/16 33/10 47/6 100/3. Total 170 lots for £14.25  
**K007** Electrolytic capacitors 25V working, small physical size, 10 each of these popular values: 1, 2.2, 4.7, 10, 22, 47, 100µF. Total 70 for £3.50  
**K008** Extended range, as above, also including 220, 470 and 1000µF. Total 100 for £5.90  
**K021** Miniature carbon film 5% resistors, CR25 or similar. 10 of each value from 10R to 1M, E12 series. Total 610 resistors, £6.00  
**K022** Extended range, total 850 resistors from 1R to 10M £8.50  
**K041** Zener diodes, 400mW 5% BZY88, etc. 10 of each value from 27V to 36V, E24 series. Total 280 for £15.30  
**K042** As above but 5 of each value £8.70

**71b BARGAIN PARCEL**  
 Hundreds of new components—pots, switches, resistors, capacitors, PC Boards with semiconductors, loads of odds and ends. Amazing value at only £3.45.

**PC ETCHING KIT MK III**  
 Now contains 200 sq. ins. copper clad board, 1lb. Ferric Chloride, D.A.L.O. etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. £4.15

**FERRIC CHLORIDE**  
 Analydour technical quality in 1lb double sealed packs. 1lb £1.00; 3lb £2.18; 10lb £5.60; 100lb £39.00

**CALCULATOR CHIP**  
 Type C500 by GI. 4 function + constant. 8 digit. Multiplexed output for simple keyboard interfacing. 24 pin DIL. With comprehensive data + socket £1.50.

**DARLINGTON COMP PAIR**  
 BD695A and BD696A—45V 8A 70W plastic power!! gain 750 @ 4A. PNP-NPN pair £1.50.

**VERO OFFCUTS**  
 Pack A, All 0.1" Pack B, All 0.15"  
 Pack C, Mixed Pack D, All 0.1" Plain  
 Each pack contains 7 or 8 pieces with a total area of 100 sq. in. Each pack is £1.50. Also available by weight.  
 1lb £4.20, 10lb £32.50.  
 17 x 3 1/2" Strips: 0.1" £2.20; 10 for £15  
 0.15" £1.96  
 0.1" Plain £1.83

Our retail shops at 21 Deptford Broadway, London, SE8 (0-692 2009) and 35 Lower Addiscombe Road, Croydon (01-688 2950) stock some of the advertised goods for personal callers only. Ring them for details.  
 All prices quoted include VAT and UK/BFPO postage. Most orders despatched on day of receipt. SAE with enquiries please. **MINIMUM ORDER VALUE £1.** Official orders accepted from schools, etc. (Minimum Invoice charge £5). Export/Wholesale enquiries welcome. Wholesale list now available for bona-fide traders. Surplus components always wanted.

**SIRENS**  
 Work off 4 x HP7 batteries, emit very loud noise. Overall size 110 x 75 x 60mm. Use as Burglar Alarm in car, house, workshop, etc. ONLY £1.95.

**VEROCASES**  
 Plastic top and bottom, ally panels front and back.  
 Type  
 1410 205 x 140 x 40mm £3.70  
 1411 205 x 140 x 75mm £4.17  
 1412 205 x 140 x 110mm £5.20  
 1237 154 x 85 x 40mm £2.83  
 1238 154 x 85 x 60mm £3.05  
 1239 154 x 85 x 80mm £3.75

**VERO PLASTIC BOXES**  
 Professional quality, two tone grey polystyrene with threaded inserts for mounting PC Boards.  
 Type  
 2518 120 x 65 x 40mm £2.24  
 2520 150 x 80 x 50mm £2.68  
 2522 188 x 110 x 60mm £3.72  
 Sloping front version.  
 Type  
 2523 220 x 174 x 100/52mm £6.90  
 1798 171 x 121 x 75/37.5mm £4.65  
 Gen. purpose plastic potting box 71 x 49 x 24. In black or white 40p.  
 Hand Controller box, shaped for ease of use in the hand, 94 x 61 x 23mm 64p.

**RELAYS and SOLENOIDS**  
**12V DC enclosed, 2 10A c/o contacts £1.**  
 Open construction relay with 2 10A c/o contacts, coil rated 24V ac, but works well on 6V DC 60p.  
**240V ac enclosed, 11 pin plug in base, 3 10A c/o contacts, £1.20.**  
**240V ac open, 2 15A c/o contacts £1.50.**  
 Solenoid, rated 48V DC, but work on 24V. 10mm push or pull action. Single hole fixing. Size 27 x 18 x 15mm. Made by Varley. Only 40p.

**WIRE AND FLEX**  
 Flex pack—5m of 5 diff. colours, thick or thin. 25m for 30p. 25 way (14/0078) cable with braided overall screen and PVC sheath. 40p/m.

**EDGE CONNECTORS**  
 Special purchase of these 0.1" pitch double-sided gold-plated connectors enables us to offer them at less than one-third their original list price!  
 18 way 41p; 21 way 47p; 32 way 72p; 40 way 90p; 49 way 111p.

**SOLAR CELLS**  
 As used on space labs, etc., these tiny cells give 50µA @ 0.5V in sunlight. Ideal for powering small C-MOS projects, etc. Can be banded together for greater power output. Size 19 x 6.5mm. 3 for £1; 10 for £3; 25 for £7; 100 for £25.

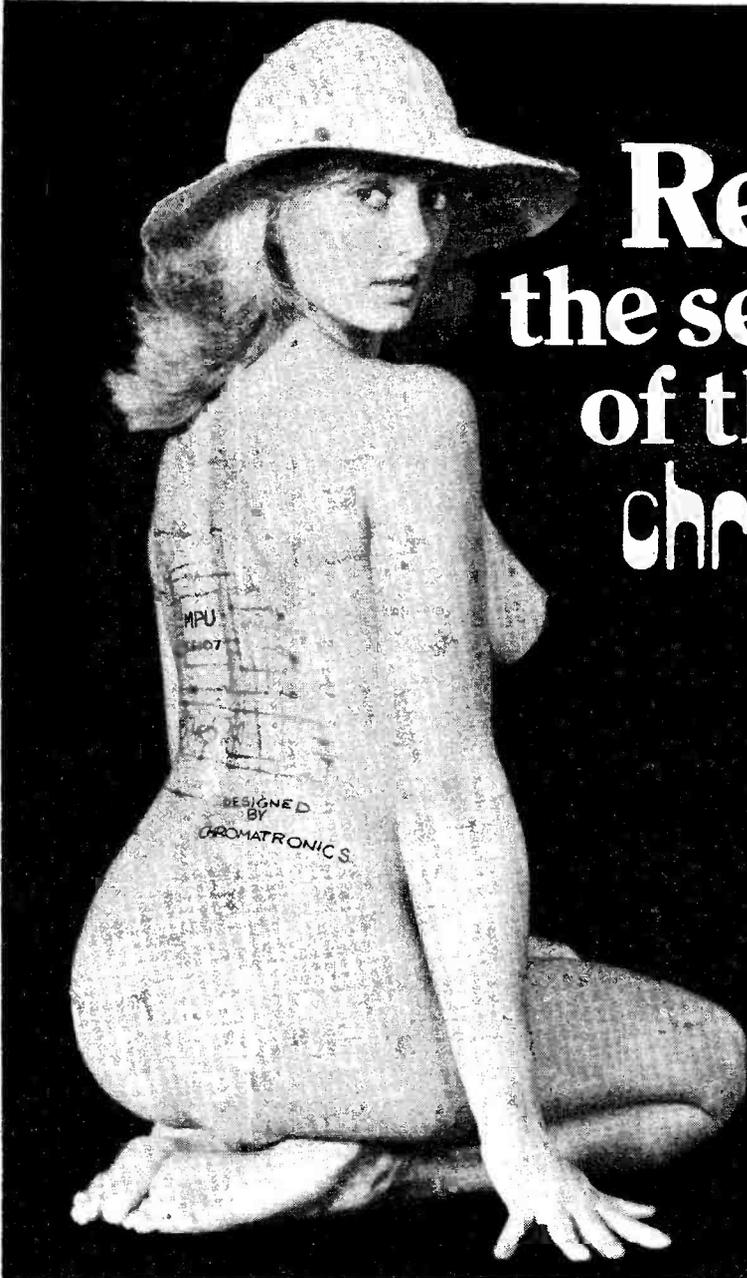
**POWER PACK**  
 Wood grained metal case 90 x 80 x 75mm containing mains transformer giving 6V @ 200mA, 2 co-ax sockets, PC board with 12" fuseholder R's C's, etc. Only £1.

**S-DECS & T-DECS**  
 S-DEC Breadboard £2.25  
 T-DEC Breadboard £3.95

**1977/78 CATALOGUE NOW AVAILABLE — MUCH BIGGER AND BETTER, WITH 50p DISCOUNT VOUCHERS ONLY 30p, Plus 15p POST.**

**COMPONENT PACKS**  
 400 assd. carbon resistors £1.50  
 100 Wirewounds 2-15W £1.50  
 200 Miniature resistors, 1/2, 1/4 and 1W £1.30  
 200 poly, mica, ceramic caps £1.20  
 100 polyester, .01-2.2µF £1.00  
 200 PC resistors 75p

**TEXAS 741**  
 8 Pin DIL—Full Spec.  
 100 off £19.50  
 25 off £5.50



# Revealed... the secret circuit of the 24 tune chroma ~ chime

- Greensleeves • God Save the Queen • Rule Britannia
- Land of Hope and Glory • O Come All Ye Faithful
- Oranges and Lemons • Westminster Chimes • Sailor's Hornpipe
- Beethoven's "Fate Knocking" • The Marseillaise • Mozart
- Wedding March • Cook House Door • Star Spangled Banner
- Beethoven's Ode to Joy • William Tell Overture
- Soldier's Chorus • Twinkle, Twinkle Little Star
- Great Gate of Kiev • Maryland • Deutschland über Alles
- Bach • Colonel Bogie • The Loralie

The Chroma-Chime is the world's first electronic musical door chime to use a pre-programmed microcomputer chip to generate tunes.

Now you can replace your old boring buzz, zing or ding with the sound of this remarkable feat of British engineering\* capable of playing 24 well known melodies.

Really enjoyable to build, this kit will give you the satisfaction of assembling a first class professional product for yourself and give you and your callers entertainment for years to come as well as enhancing your home.

Buy your Chroma-Chime Kit now and get a free large poster (size approx. 23½" x 16½") of the original circuit diagram as above, which incidentally measures 36-24-36.

*\*This one was not done by our bird-brained designer on the back of a cigarette packet, as you can see!*

The CHROMA-CHIME is exclusively designed by  
**CHROMATRONICS** River Way, Harlow, Essex.

To CHROMATRONICS, River Way, Harlow, Essex, U.K.

Please send  Chroma-Chime Kits at £18.00 each including VAT and post and packing  
 PLEASE USE BLOCK CAPITALS

Name \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

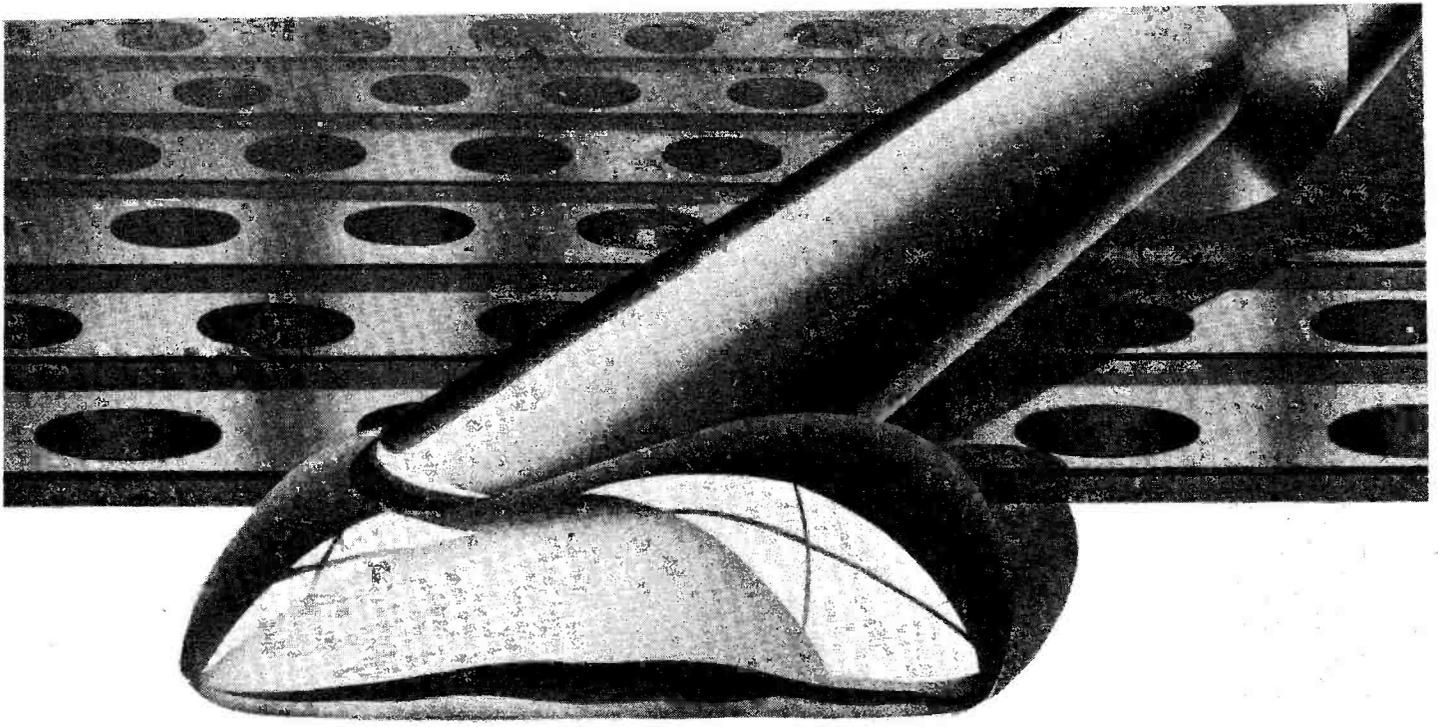
I enclose cheque/PO value £ \_\_\_\_\_  
 or debit my ACCESS/BARCLAYCARD account No. \_\_\_\_\_

\_\_\_\_\_

Signature \_\_\_\_\_

N.B. The CHROMA-CHIME is also available, fully assembled, price £24.95 inc VAT and post and packing.

PW 3-78



# The Blob Story.

Yes, they have got a funny name: Blob Boards.

And if you've never heard of them, you might wonder what on earth they're for.

After all they sound more like sci fi than practical electronics.

But in fact there is a good reason for the name.

It actually describes the way these printed circuit boards work. You just put a tiny blob of solder onto circuit board and component and you've made a perfect contact.

Every time.

There are of course a few other printed circuit boards around.

But we think the prices are a bit shocking.

Our prices, we think you'll agree, are more down to earth.

These Blob Boards are about half the price of the few comparable alternatives.

And unlike those alternatives, on most Bandridge Blob Boards you won't have to break the contact rails to make your circuit. So you'll be able to use them again and again.

The roller tinned copper on Blob Board makes soldering easy, and it won't corrode, so

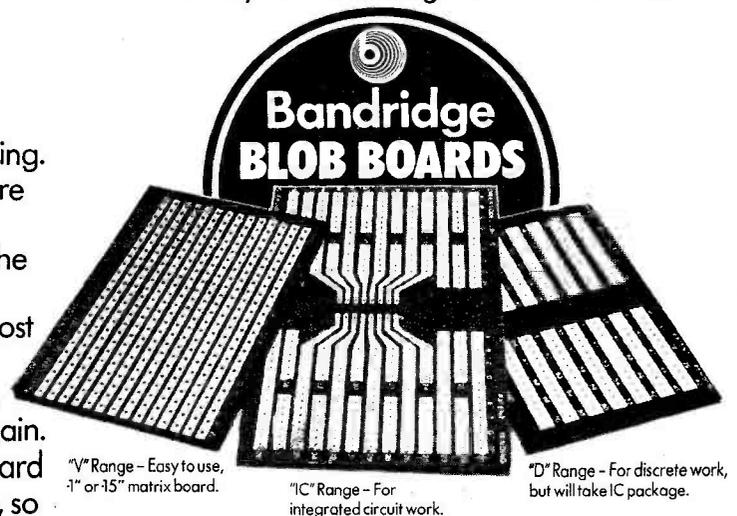
they'll work for as long as you want them to.

You'll find a Bandridge Blob Board for every circuit you'll ever want to make, from the simplest to the most complex.

And if you're using Bandridge solderless DEC's for your prototypes you'll be pleased to learn that there's a Blob Board that exactly matches every DEC.

So when you're looking for a circuit board it'll be worth your while remembering Blob Boards.

As if you'd ever forget a name like that.



"V" Range - Easy to use, 1" or 1.5" matrix board.

"IC" Range - For integrated circuit work.

"D" Range - For discrete work, but will take IC package.



# SAVING SALE

# BI-PAK

## YOU MAKE THE SAVING!

OPT FOR OPTOELECTRONICS! PRINTED CIRCUIT KITS, BOARDS & PENS.

SILICON RECTIFIERS SIMILAR IN4000 SERIES G.E. 1 Amp.			
No. 541	25 Like IN4001	(1A/50V)	60p
No. 542	20 Like IN4002	(1A/100V)	60p
No. 543	18 Like IN4003	(1A/200V)	60p
No. 544	15 Like IN4004	(1A/400V)	60p

SILICON RECTIFIERS—1/2 Amp. G.E.			
No. 548	40 x 50 V.		60p
No. 549	30 x 200 V.		60p
No. 550	20 x 700 V.		60p

G.E. HIGH VOLTAGE SILICON RECTIFIERS			
GR559	10mA 14 KV (14,000 V)	20p each	
GA432	1 AMP. 2 KV (2,000 V)	39p each	
FD2-5	2.5 KV. Voltage Doubler	30p each	

POTENTIOMETERS			
Slider 40 mm. TRAVEL			
Order No.			
16191	6 x 470 Ohm LIN Single		40p*
S24	6 x 1K LIN Single		40p*
S25	6 x 5K LIN Single		40p*
16192	6 x 10K LIN Single		40p*
S26	6 x 10K LOG Single		40p*
16193	6 x 22K LIN Single		40p*
16195	6 x 47K LOG Single		40p*
16194	6 x 47K LIN Single		40p*
S27	6 x 100K LIN Single		40p*
S28	6 x 100K LOG Single		40p*
S29	6 x 500K LOG Single		40p*

60 mm. TRAVEL			
S30	6 x 2.5K LOG Single		40p*
S31	6 x 10K LIN Single		40p*
S32	6 x 50K LIN Single		40p*
S33	6 x 250K LOG Single		40p*
S34	4 x 5K LOG Dual		40p*
S35	4 x 10K LIN Dual		40p*
S36	4 x 100K LOG Dual		40p*
S37	4 x 1/3 MEG LOG Dual		40p*
S38	20 MIXED SLIDER POTS. VARIOUS VALUES & SIZES—OUR MIX 20 FOR ONLY £1.00*		
S39	6 x CHROME SLIDER KNOBS		40p*

WIREWOUND			
A range of wirewound single gang pots. with linear tracks of 1 watt rating.			
Order No.	Value	Order No.	Value
1891	10 ohms	1896	470 ohms
1893	47 ohms	1897	1 K
1894	100 ohms	1898	2K2
1895	220 ohms	1899	4K7
NOW ONLY 35p* each			

16173	15 Rotary Potentiometers. Assorted values and types	40p*
16186	25 Pre-sets Assorted Values and types	40p*
SALE PRICE 40p*		

MULTI-TURN PRE-SETS			
S40	3 x 100 K LIN		ONLY 50p*

AUDIO PLUG AND SOCKET PAKS			
Order No.			
S1	5 x 3.5mm. Plastic Jack Plugs		40p*
S2	5 x 2.5mm. Plastic Jack Plugs		40p*
S3	4 x Std. Plastic Jack Plugs		50p*
S4	2 x Stereo Jack Plugs		30p*
S5	5 x 5 Pin 180° Din. Plugs		50p*
S6	8 x 2 Pin Loudspeaker Plugs		50p*
S7	6 x Phono Plugs Plastic		50p*
S8	5 x 3.5mm. Chassis Sockets (Switched)		25p*
S9	5 x 2.5mm. Chassis Sockets (Switched)		25p*
S10	4 x Metal Std. Chassis Switched Jack Sockets		50p*
S11	2 x Stereo Jack Sockets with instruction leaflet for H/Phone connection		50p*
S12	5 x 5 Pin 180° Din. Chassis Sockets		40p*
S13	8 x 2 Pin. Din. Chassis Sockets		50p*
S14	6 x Single Phono Sockets		40p*

AUDIO LEADS			
Order No.			
117	A.C. Mains Connecting Lead for Cassette Recorders and Radios: Telefunken Type		45p*
118	5 pin Din Headphone Plug to Stereo Socket		78p*
119	2 x 2 pin Plug to Inline Stereo Socket for Headphones		60p*
123	20ft. of Coiled Guitar Lead		£1.15*
124	3 Pin to 3 Pin Din Plug		50p*
125	Audio Lead 5 Pin Plug to 5 Pin Din Plug		50p*
126	Audio Lead 5 Pin Din Plug to Tinned open Ends		50p*
127	Audio Lead 5 Pin Din Plug to 4 Phono Plugs		90p*
129	Audio Lead 5 Pin Plug to 5 Pin Din Plug—Mirror Image		70p*
130	5 Meter Lead 2 Pin Din Plug to 2 Pin Din Inline Socket		45p*
132	10 Meter Lead 2 Pin Din Plug		65p*

HEAVY GAUGE BLACK PLASTIC BOX			
WITH ALUMINIUM LID and FIXING SCREWS Size 6 1/2" x 3 1/2" x 2"			
Order No. S16 ONLY 75p			

**FOR RELIABLE JOINTS—ANTEX IRONS!**  
Practical Wireless, March 1978

74 SERIES TTL ICs											
Type	Quantity			Type	Quantity			Type	Quantity		
	1	100	1000		1	100	1000		1	100	1000
	£ p	£ p	£ p		£ p	£ p	£ p		£ p	£ p	£ p
7400	0-09	0-08	7448	0-70	0-68	74122	0-45	0-42			
7401	0-11	0-10	7450	0-12	0-10	74123	0-65	0-62			
7402	0-11	0-10	7451	0-12	0-10	74141	0-68	0-65			
7403	0-11	0-10	7453	0-12	0-10	74145	0-75	0-72			
7404	0-11	0-10	7454	0-12	0-10	74150	1-10	1-05			
7405	0-11	0-10	7460	0-12	0-10	74151	0-65	0-60			
7406	0-28	0-25	7472	0-24	0-23	74153	0-70	0-68			
7407	0-28	0-25	7473	0-20	0-19	74154	1-20	1-10			
7408	0-12	0-11	7474	0-26	0-22	74155	0-70	0-68			
7409	0-12	0-11	7474	0-24	0-23	74156	0-70	0-68			
7410	0-09	0-08	7475	0-44	0-40	74157	0-70	0-68			
7411	0-22	0-20	7476	0-26	0-25	74160	0-95	0-85			
7412	0-22	0-20	7480	0-45	0-42	74161	0-95	0-85			
7413	0-26	0-25	7481	0-90	0-88	74162	0-95	0-85			
7416	0-28	0-25	7482	0-75	0-73	74163	0-95	0-85			
7417	0-26	0-25	7483	0-88	0-82	74164	1-20	1-10			
7420	0-11	0-10	7484	0-85	0-80	74165	1-20	1-10			
7422	0-19	0-18	7485	1-10	1-10	74166	1-20	1-10			
7423	0-21	0-20	7486	0-28	0-26	74174	1-10	1-00			
7425	0-25	0-23	7489	2-70	2-50	74175	0-85	0-82			
7426	0-25	0-23	7490	0-38	0-32	74176	1-10	1-00			
7427	0-25	0-23	7491	0-65	0-62	74177	1-10	1-00			
7428	0-36	0-34	7492	0-43	0-35	74180	1-10	1-00			
7430	0-12	0-10	7493	0-38	0-35	74181	1-90	1-80			
7432	0-20	0-19	7494	0-70	0-68	74182	0-80	0-78			
7433	0-38	0-36	7495	0-60	0-58	74184	1-50	1-40			
7437	0-26	0-25	7496	0-70	0-68	74190	1-40	1-30			
7438	0-26	0-25	74100	0-95	0-90	74191	1-40	1-30			
7440	0-12	0-10	74104	0-40	0-35	74192	1-10	1-00			
7441	0-60	0-57	74105	0-30	0-25	74193	1-05	1-00			
7442	0-80	0-70	74107	0-30	0-25	74194	1-05	1-00			
7443	0-95	0-90	74110	0-48	0-45	74195	0-80	0-75			
7444	0-95	0-90	74111	0-75	0-72	74196	0-90	0-85			
7445	0-80	0-75	74118	0-85	0-82	74197	0-90	0-85			
7446	0-80	0-75	74119	1-30	1-20	74198	1-90	1-80			
7447	0-70	0-68	74121	0-28	0-26	74199	1-80	1-70			

Devices may be mixed to qualify for quantity price. Data is available for the above series of IC's in booklet form Price 35p

CMOS ICs							
Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.14	CD4022	£0.80	CD4046	£0.95		
CD4001	£0.16	CD4023	£0.18	CD4047	£0.75		
CD4002	£0.16	CD4024	£0.64	CD4049	£0.46		
CD4006	£0.80	CD4025	£0.18	CD4050	£0.46		
CD4007	£0.17	CD4026	£1.85	CD4054	£0.95		
CD4008	£0.80	CD4027	£0.48	CD4055	£1.60		
CD4009	£0.50	CD4028	£0.80	CD4056	£1.15		
CD4010	£0.50	CD4029	£0.95	CD4059	£0.32		
CD4011	£0.18	CD4030	£0.46	CD4070	£0.32		
CD4012	£0.17	CD4031	£1.80	CD4071	£0.20		
CD4013	£0.42	CD4035	£1.40	CD4072	£0.20		
CD4015	£0.80	CD4037	£0.78	CD4081	£0.20		
CD4016	£0.42	CD4040	£0.78	CD4082	£0.20		
CD4017	£0.80	CD4041	£0.68	CD4510	£1.10		
CD4018	£0.85	CD4042	£0.68	CD4511	£1.25		
CD4019	£0.45	CD4043	£0.78	CD4516	£1.10		
CD4020	£0.95	CD4044	£0.78	CD4518	£1.10		
CD4021	£0.85	CD4045	£1.15	CD4520	£1.10		

AUDIO MODULE SALE				
Type	Description	Normal Price	Sale Price	
AL30A	10W RMS Power AMP	£3.65*	£2.95*	
AL60	25W RMS Power AMP	£4.35*	£3.55*	
AL80	35W RMS Power AMP	£6.95	£5.95	
AL250	125W RMS Power AMP	£15.95	£14.45	
SPM80	35V Power Supply	£3.75*	£3.10*	
PS12	20-30V Power Supply for AL30A	£1.30*	£1.15*	
PA12	Stereo Pre-Amp for AL30A	£6.70*	£5.95*	
PA100	Stereo Pre-Amp for AL60/AL80	£13.75*	£12.45*	
S450	Stereo F.M. Tuner	£20.45*	£18.65*	
MPA30	Magnetic-Ceramic Pre-Amp	£2.85*	£2.55*	
Stereo 30	Complete Audio Chassis 7W+7W RMS	£16.25*	£14.95*	

**LOOK & LISTEN!**  
**GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER MODULE**  
The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ±12db. Max. Voltage handling 2 V RMS, T.H.D., 0.05%, input impedance 100 K, Output impedance less than 10 K. Frequency response 20 Hz-20 KHz (3DB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders. (Not supplied with the module). See Paks S31 and 16192.

**ONLY £19.50**  
SG30 POWER SUPPLY BOARD FOR GE100 15-0-15 Volt.

**ONLY £4.50**  
SEND S.A.E. FOR TECHNICAL DATA ON ANY OF THE AUDIO MODULES

**POSTAGE AND PACKING**  
Add 25p for postage and packing unless otherwise shown. Add extra for airmail. Min. order £1.

## SPECIAL OFFER!

COMPONENT PAKS		
Order No.	Quantity	
16164	200 approx. Resistors, mixed values (count by weight)	40p*
16165	150 approx. Capacitors, mixed values (count by weight)	40p*
16167	80 1/2W. Resistors, mixed values	40p*
16168	5 pieces Assorted Ferrite rods	40p*
16169	2 pieces Tuning gangs MW/LW	40p*
16170	50 metres Single strand wire assorted wire	40p
16171	10 Reed switches	40p*
16172	3 Micro switches	40p*
16176	20 Assorted electrolytics Trans type	40p*
16177	1 pack Assorted hardware nuts/bolts, etc.	40p
16179	20 Assorted tag strips and panels	40p*
16180	15 Assorted control knobs	40p*
16184	15 Assorted Fuses 100mA-5 amp.	40p*
16188	60 1/2W. resistors, mixed values	40p*
16187	30 metres stranded wire assorted colours	40p

## 1/2 PRICE BARGAIN!

**£4 worth** (Min. Value) of Electronic Project Books, Technical, Semiconductor Data and Equiv.—Books of Assorted Titles.  
**OUR CLEARANCE PRICE—**  
Order No. S80 **£2.10 per bundle**

## SUPER SOUND SAVING!

METROSOUND  
LOW NOISE CASSETTES  
Order No. S53A **10 for £2.50\***



**BIB GROOVE-CLEAN**  
Model 60 Chrome Finish Plastic  
Order No. 829 **£1.40\***

**ANTEX SOLDERING IRONS**  
ORDER No. 1931 X25 25 WATT LOW LEAKAGE  
Usually £3.40 NOW ONLY £2.95  
PLUS FREE Heatshunt  
1948 Model C 15 watt General Purpose  
Usually £3.40 SALE PRICE £2.95  
PLUS FREE Heatshunt  
Order No. 1939 ST3 Soldering Iron Stand suitable for either Iron £1.20

**NEW Siren Alarm Module**  
American Police Screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, Freezer breakdown, and other security purposes.  
Order No. S15 ONLY £3.50

**AVDEL BOND**  
Cyanocrylate adhesive Bonds—plastic, rubber, Transistors, Components in Seconds.  
Order No. 143 55p per 2gm. phial

**ORDERING**  
PLEASE WORD YOUR ORDERS EXACTLY AS PRINTED, NOT FORGETTING TO INCLUDE OUR PART NUMBER.  
**VAT**  
ADD 12 1/2% TO PRICES MARKED\*. ADD 8% TO OTHERS EXCEPTING THOSE MARKED†. THESE ARE ZERO RATED  
Postage & Packing add 25p. Add extra for air mail

# BI-PAK

Dept. P.W.3, P.O. Box 6, Ware, Herts.  
COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.



**EDITOR**

Geoffrey C. Arnold

**ASSISTANT EDITOR**

Dick Ganderton, C. Eng., MIERE

**ART EDITOR**

Peter Metalli

**TECHNICAL EDITOR**

Ted Parratt, BA

**NEWS & PRODUCTION EDITOR**

Alan Martin

**TECHNICAL SUB-EDITOR**

Peter Preston

**TECHNICAL ARTIST**

Rob Mackie

**SECRETARIAL**

Sylvia Barrett  
Lynda Goddard

**EDITORIAL OFFICES**

Westover House, West Quay Road,  
POOLE, Dorset BH15 1JG  
Telephone: Poole 71191

**ADVERTISING MANAGER**

01-261 5000 Roy Smith

**CLASSIFIED ADVERTISING**

01-261 5762 Colin R. Brown

**ADVERTISING OFFICES**

King's Reach Tower, Stamford Street,  
London SE1 9LS

**BINDERS**

Binders, for either the old or the new format, are £2.85 and Indexes are 45p (Inc VAT) and can be obtained from the Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF. Remittances with overseas orders for binders should include 60p to cover despatch and postage.

**BACK NUMBERS**

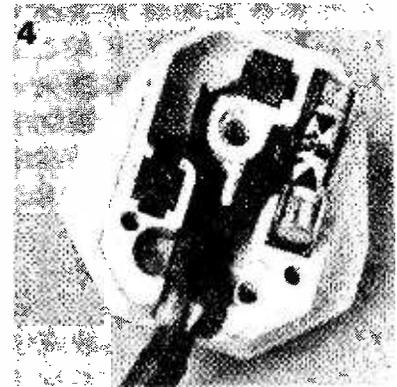
We are very glad to announce the re-establishment of a PW Back Numbers Service for our readers. In future back numbers dated from June 1977 only will be available from our Post Sales Department for 65p, which includes postage and packing. Cheques and Postal Orders should be made payable to IPC Magazines Ltd.

Send your orders to:- Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

NEWS..

NEWS..

**Are you guilty?**



1. Cord grip not in use, earth conductor detached from terminal as a result—the two most common faults pinpointed in the survey.
2. Broken plug body, possibly through being dropped onto hard floor, has exposed live and earth terminals. Use of resilient-clad plugs in areas where there is a risk of breakage (e.g. Kitchens) could minimise this problem.
3. Reversed polarity, cord-grip loose, cable sheath cut back too far necessitating binding together of conductors with insulating tape.
4. Reversed polarity, cord grip discarded by householder.

**PLEASE NOTE**

We do not operate a Technical Query Service except on matters concerning constructional articles published in PW. We do not supply service sheets or information on commercial radios, TV's or electronic equipment.

All queries must be accompanied by a stamped self-addressed envelope otherwise a reply cannot be guaranteed.

More than 70 million electric plugs used in British homes could be potentially dangerous according to a report published last November by the Electrical Research Association.

Britain's largest manufacturer of plugs and other electrical wiring accessories, MK Electric Ltd, commissioned ERA to carry out the survey and isolate the most common faults present in plugs used in the home.

The four pictures reproduced on the opposite page show some of the most common faults, we at *Practical Wireless* hope that you are not guilty of using plugs in these sort of conditions! The survey found that just over 18 per cent of the sample had inefficient cord grips. The grip, which prevents strain on the terminal connections was in many cases found to be loose, not in use, missing or to have lost one screw. 7.4 per cent of the terminals had faulty connections, largely as a result of inefficient cord grips.

Many people were still using plugs which had been damaged, probably as a result of being dropped onto hard floors. Some of these were in a very dangerous condition because damage had left live terminals exposed. The moral here is to throw away any broken plugs and to use a resilient clad plug in areas where the floor is hard such as the kitchen.

1.5 per cent of householders had reversed the live and neutral connections. Frightening isn't it? Get to know the colour code, brown is live, blue is neutral and green/yellow is earth.

The survey states that most of the faults are due to lack of consumer education although manufacturers could be more helpful in the design of cord grips and clearer wiring instructions.

MK reckon that a conservative estimate of the number of plugs in use in this country is 400 million, which means that, if the results of the ERA survey hold good for the country as a whole, over 73 million plugs could be in a dangerous condition through inefficient cord grips alone, another 12 million because of physical damage and 6 million with incorrect connections.

If that doesn't frighten you then we don't know what will!

*Practical Wireless*, March 1978

### 'Pianocorder'

An intriguing invention, which is in essence an extension of the early work by Edward Welte in 1904, is the 'Pianocorder'. Manufactured and developed by Superscope, the unit "plays" a piano by interpreting pulses recovered from magnetic tape.

Welte produced what could only be described as a 'machine' which used a paper roll as the storage medium. Each note on the keyboard was fitted with a small carbon-tipped prong which made contact with a tray of mercury when depressed, and a similar arrangement was fitted to the pedals. When the circuit was made, the initial transients and durations were recorded on the paper in a manner similar to that of a pen recorder. The resulting traces were then punched out by hand.

The player mechanism itself consisted of a wooden box fitted with eighty felt-tipped fingers and two actuators for the pedals. The entire unit was placed in front of the piano in the normal playing position and operated by vacuum, the punched paper providing the keying sequences, timing and pedalwork.

Superscope have collected thousands of these original paper rolls and transcribed the information on to magnetic tape, employing a digital process. The cassettes are fed into a controller, located at the front of the instrument, and operate solenoids and relays within the piano.

In addition to the playback of pre-recorded cassettes, the device will also initiate its own recording. Thus it could be regarded as an extremely useful teaching tool for the pianoforte student, as well as an entertainment medium—if the f.o.b. price of around 1600 dollars can be accommodated, that is!

### Stereo for AM broadcasts

Further details of the Harris Corporation's Compatible Phase Multiplex (CPM) system, providing a stereo AM capability, have been made available to us.

The system is uncomplicated and straightforward in its technology; a modified quadrature system, in fact,

with right and left channel sideband pairs being transmitted at  $\pm 15^\circ$  from the carrier. There is absolutely no increase in occupied bandwidth or spectral density and no loss of mono coverage. Modulation of +125% and -100% is maintained.

The public can expect economical and stable receiver implementation with CPM. Tests conducted by the designers have shown that existing integrated circuits can be used for the AM/CPM receiver.

Because the CPM bandwidth is no greater than that of mono AM, there is good envelope detector compatibility, even with narrow-band receivers. As it is a linear additive system, stereo receivers will not generate distortion in any case—even under skywave conditions. Unlike non-linear systems, Harris CPM does not require flat receiver response and complex correction functions. Loudness is equal to the mono signal, unlike VHF/FM which has a loudness reduction when changing from mono to stereo. A conventional pilot indicator can be used, similar to that fitted to most VHF/FM tuners, and no stereo break-up with high modulation occurs.

Existing transmitting equipment may be used for CPM with only minor modification and the addition of a stereo exciter. Although listeners would need re-designed receivers for AM stereo in their homes or cars, costs are expected to be fairly economical and a vast consumer market is envisaged when the system is introduced and gains popularity.

### Good News

We are pleased to announce the reintroduction of the publishers subscription service for *Practical Wireless*. The annual cost to either UK or overseas addresses is £10.60.

Application may be made to:  
*IPC Services,*  
*Subscriptions Department,*  
*Oakfield House,*  
*Perrymount Road,*  
*Haywards Heath,*  
*Sussex.*

Remittances should be made payable to IPC Services.

# active tone control

F. G. CANNING

This article describes an active tone control for general use in audio amplifiers, having a good performance which is largely unaffected by the input and output characteristics of the associated pre-amplifier and power amplifier stages. The permissible output of 0.84 volt r.m.s. (1.17 V peak) at 1kHz, with both controls in the "flat" position, will be sufficient to load the input stage of most power amplifiers, while still permitting use of the maximum bass boost of 17dB at 30Hz without exceeding the output limit of 6 volts for 1 per cent total distortion at that frequency. The required input from the pre-amplifier under these conditions is 0.14 volt r.m.s. (0.2 volt peak). With both controls centred, the response is linear within 0.15dB from 30Hz to 20kHz.

## The Circuit

The circuit (Fig. 1) is a feedback tone control based on P. J. Baxandall's circuit, first published in the 1950s, which with various detail modifications has become something of a world standard, largely displacing the loss-type controls previously used. The present design uses linear potentiometers without tapings, and achieves almost ideal control characteristics. A brief look at the design philosophy follows.

The basic control stage comprises Tr2 and the network connected between its base and the emitter or Tr1, with negative feedback from Tr2 output to the network. This stage provides the whole of the available gain and it is possible, as in the present case, to obtain sufficient open-loop gain (i.e. with feedback disconnected) to provide for the full range of boost

## ★ specification

Input voltage:	140mV r.m.s.
Input resistance at 1kHz:	1 megohm approx.
Voltage gain (controls flat):	X6.5 (16.2dB)
Maximum output voltage for 1% distortion:	6 volts r.m.s.
Effective noise voltage at output into 100kΩ load (controls flat):	< 150 microvolts
Range of tone controls:	
Bass (at 30Hz):	+17 to -21dB } relative to
Treble (at 20kHz):	+21 to -20dB } 1kHz
Distortion (over range 50Hz to 15kHz):	
at output of 1V r.m.s. under 0.13%	
" " 2V " 0.25%	
" " 4V " 0.4%	
" " 6V " 1.0%	
Supply:	25 volts at 4.2 mA approx.

and cut—about 20dB plus or minus—and still leave a useful positive gain over the mid-range of around 17dB. Thus, the tone-control is far from being a mere passenger, much less a "losser".

Circuits of this type work best when fed from a low impedance source, which is not normally available from a practical pre-amplifier having gain; furthermore the operation of the tone controls is liable to affect adversely the output characteristics of such a

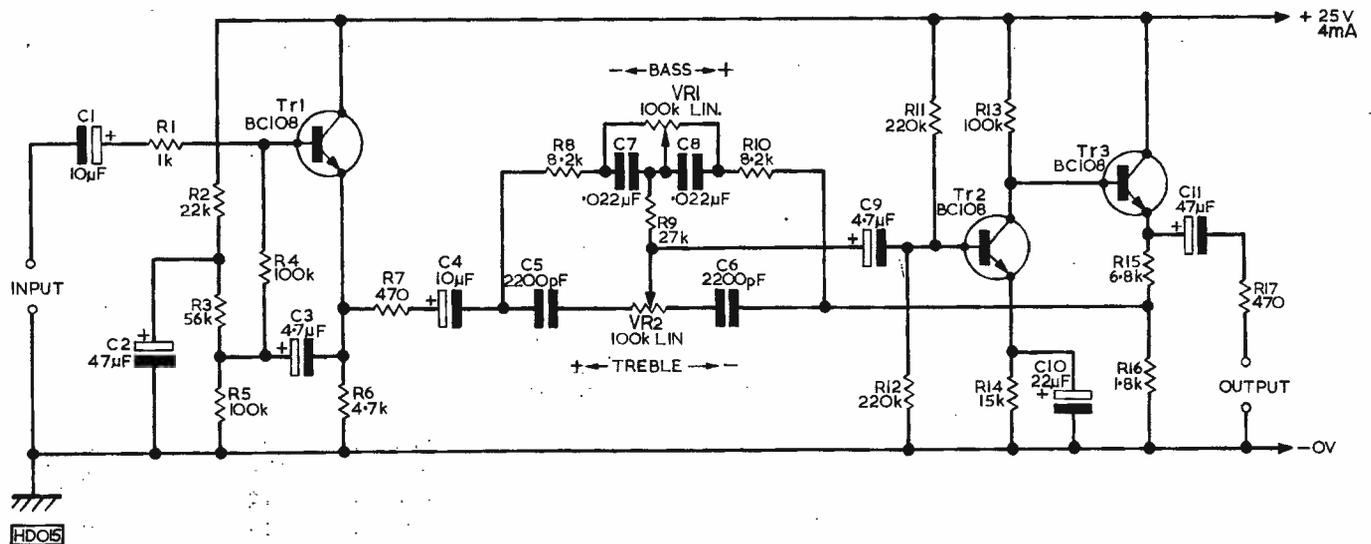


Fig. 1: Complete circuit diagram of the Active Tone Control.

pre-amplifier. Accordingly the present design employs Tr1 in an emitter-follower (common collector) circuit as an impedance transformer, to isolate the pre-amplifier from the effects of the tone controls and to provide them with the desired low-impedance source. Additionally, Tr1 input circuit is bootstrapped via capacitor C3 and its input resistance is thus raised to over a megohm, which is high enough to leave unaffected any normal pre-amplifier output circuit.

In the same way the feedback to the tone-control network is best derived from a low-impedance source, since operation of the controls causes the effective impedance of the network to vary markedly, which tends to spoil the desired uniform gain of Tr2 and also to limit its undistorted output. Therefore a second emitter-follower (Tr3), is used, DC coupled to Tr2 collector, and the feedback connection is taken from a tapping on its emitter load (this is permissible as there is no phase-reversal in an emitter-follower).

In this way the tone control stage gets its feedback from the desired low impedance and Tr2 works unhampered into a very high impedance which imposes very little loading on it and has a flat frequency response over the desired range. At the same time a low-impedance output is provided whose operation will be largely independent of the load presented by the input of the following power amplifier, unless this is very low indeed. The complete tone control unit should therefore be usable without modification between a wide variety of pre-amplifiers and power amplifiers, regardless of their input and output impedances. The two emitter-followers together reduce the effective gain to around 16dB.

The circuit of Fig. 1 of course shows a single channel only; two are needed for a stereo installation, with twin bass and treble potentiometers ganged together.

## Overload

The question of possible overload and consequent distortion when using the maximum available boost is a point not always clearly brought out in connection with such tone controls. A published circuit may be accompanied by a claim that the total distortion is less than, say, 0.1 per cent at an input not exceeding a given figure. However, closer study may show that this statement is true only while the bass and treble controls are at or near the "flat" position. In such cases distortion in the bass or treble regions may rise rapidly with an increase of bass or treble boost and can reach an unacceptable figure, or even the limiting point, before maximum boost has been obtained. The input signal must then be reduced substantially if full boost is required without excessive distortion. This assumes, of course, that the signal up to the tone control input is substantially level at all frequencies concerned.

In the present design the maximum available output swing at low distortion (1 per cent) is 6 volts r.m.s. (8.4 volts peak). The maximum bass boost available is +17dB at 30Hz relative to 1kHz (0dB). Therefore the maximum permissible output swing at 1kHz, if the boosted bass is not to be badly distorted, is 17dB down from 6 volts, namely 0.84 volt r.m.s. or 1.17 volt peak, and this should be the maximum designed *mid-band* input voltage required by the driver stage of the power amplifier to give an acceptable output volume around 1kHz, while still having

## ★ components

Resistors (All 1 watt 10% carbon film)			
R1	1kΩ	R8, R10	3.2kΩ
R2	22kΩ	R9	27kΩ
R3	56kΩ	R11, R12	220kΩ
R4, R5, R13	100kΩ	R14	15kΩ
R6	4.7kΩ	R15	8.2kΩ
R7, R17	470Ω	R16	1.8kΩ
Potentiometers			
RV1, RV2	100kΩ linear carbon		
Capacitors			
C1, C4	10μF	30V	Electrolytic
C2, C11	47μF	25V	
C3, C9	4.7μF	10V	
C10	22μF	10V	
C5, C6	2200pF	polystyrene or polyester, 10%	
C7, C8	0.022μF	polyester, 10%	
Transistors			
Tr1, Tr2, Tr3	BC108		

enough power in reserve to accept a 17dB increase of signal input without overloading in any part of the power amplifier. This is not always easy to achieve economically. Overload due to maximum treble boost is not, perhaps, so serious for the resulting distortion products will mostly be outside the audible range, though some purists would probably dispute this.

Assuming, therefore, a permissible mid-range output from the tone control of 0.84 volt r.m.s. and an effective gain conservatively stated as 6 times (15.5 dB), the required input to the tone control unit from the pre-amplifier will be 0.84/6, or 0.14 volt r.m.s. = 0.2 volt peak. At these levels the total harmonic distortion will be less than 0.1 per cent at any frequency within the range, with both controls in the "flat" position, and should not exceed 1 per cent at any frequency when maximum boost is in use.

## Components

None of the component tolerances is very critical and 10 per cent will generally be good enough. One of the advantages of using linear potentiometers is that they are generally better matched than the logarithmic type. Layout is not very important apart from guarding against stray hum fields, and there should be no stability problems.

Other transistors of roughly similar type can be used without much change in performance, e.g., BC107, BC109, or their plastic-cased counterparts, but they must be able to accept the 25 volt supply without risk of failure. A practical point concerns the setting of the control knobs on their shafts; the mid-point of the resistance range may or may not be the mid-point of shaft rotation (speaking now of conventional carbon-type controls) and the actual total resistance is unlikely to be exactly 100,000 ohms. Use an ohmmeter to measure the actual total resistance of the potentiometer concerned, rotate its spindle to give half the measured total from either end, and then secure the knob to the spindle to indicate 0dB at that setting.

# So you want to pass the R.A.E. (Radio Amateurs' Examination)?

No. 7

John Thornton Lawrence GW3JGA & Ken McCoy GW8CMY

The passing of the Radio Amateurs' Examination, set by the City and Guilds, requires a certain level of theoretical technical knowledge. Whether one considers that this level is too high or too low is beside the point. The course that follows is intended, with the help of certain external aids, to prepare the reader to pass the examination. It will not teach him all about electronics!

## Transistors

The diagram in Fig. 47 shows an npn transistor. Note that the base-emitter junction (a) is forward biased whilst the base-collector junction (b) is reverse biased.

The base region in a transistor is made very thin so that current carriers, entering from the emitter, experience the attraction of the collector voltage and are able to pass right through the base region and cross the base-collector junction, to the collector. A small proportion of current carriers from the emitter will recombine in the base region and these form the base current.

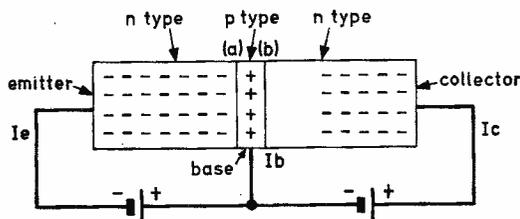
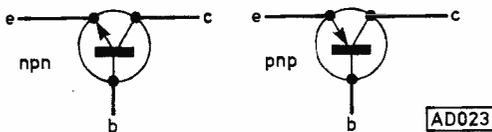


Fig. 47: Construction of an NPN Transistor.



AD023

INPUT IMPEDANCE	OUTPUT IMPEDANCE	CURRENT GAIN	POWER GAIN	INVERSION OF SIGNAL
LOW <100Ω	VERY HIGH >100kΩ	0.99	1000 (30dB)	NO
MED 1kΩ	HIGH >10kΩ	50	10,000 (40dB)	YES
VERY HIGH >100kΩ	LOW 100Ω	50	40 (16dB)	NO

AD024

Fig. 48: General characteristics of circuit configurations.

$$\text{DC beta or } h_{FE} = \frac{I_c}{I_b} \text{ e.g. } \frac{0.98\text{mA}}{0.02\text{mA}} = 49$$

The DC beta or  $h_{FE}$  is the usual method of quoting the DC current gain of a transistor.

As you can see, there is a fixed relationship between the currents in a particular transistor, if you vary one then the other two will also vary by the same proportion.

In transistor amplifiers, input signals may be applied to the emitter or the base and the output taken from the collector or emitter. The general characteristics of each type of circuit configuration is shown in Fig. 48. The circuits have the biasing and supplies omitted for the sake of clarity.

In the common base arrangement (where the input signal is applied to the emitter), the emitter and collector currents are almost equal but, because the input impedance is low (forward-biased junction) and the output impedance is high (reverse-biased junction), there is a power gain. The signal power, (P<sub>R</sub>) in the collector is higher than the power (P<sub>R</sub>) in the emitter.

In the common emitter arrangement not only is there some power gain due to the output impedance being higher than the input, but there is also current gain (beta) from the base to the collector, giving the highest power gain of all the configurations. It is also the circuit which inverts the signal (positive-going signal in produces a negative-going signal out). The

These currents can be expressed simply as,

$$I_e = I_c + I_b$$

For example, typical values might be:—

$$1\text{mA } (I_e) = 0.98\text{mA } (I_c) + 0.02\text{mA } (I_b)$$

The actual ratio of the emitter, base and collector currents depends on the type and construction of the transistor.

The ratio of the collector to emitter current is known as the DC alpha.

$$\text{DC alpha } (\alpha) = \frac{I_c}{I_e} \text{ e.g. } \frac{0.98\text{mA}}{1.00\text{mA}} = 0.98$$

and the ratio of collector to base current is known as the DC beta or  $h_{FE}$

common collector circuit, or emitter follower as it is popularly known, has less power gain but its useful features are a high input impedance and a low output impedance.

## Practical transistor circuits

In general, valve circuits have a high input impedance and are fed with an input signal voltage. Transistor circuits, on the other hand, have a medium to low input impedance (except for the emitter follower) and are usually fed with an input signal current.

The biasing of a transistor common emitter amplifier stage has already been discussed in some detail in section No. 3, page 501. These conditions apply to most small signal AF, IF and RF amplifiers, although in some instances the input and output signals may be coupled through suitable transformers or tuned circuits.

## Transmitters

To state the obvious, the purpose of the transmitter is to generate a radio frequency signal for transmission to a distant receiving station. In addition, the transmitted signal must conform to the Amateur Sound Licence requirements in terms of power, frequency band, frequency accuracy and stability, absence of spurious emissions, etc., particularly when keyed or modulated by the information to be sent. Full details of these requirements are given in "How to become a Radio Amateur" Appendix B, published by the Home Office.

A block diagram of a simple CW transmitter (Emission Type A1) for 160 metres, 1.8-2.0 MHz, is shown in Fig. 49. It consists of a Variable Frequency Oscillator followed by a Buffer Amplifier and a Power Amplifier.

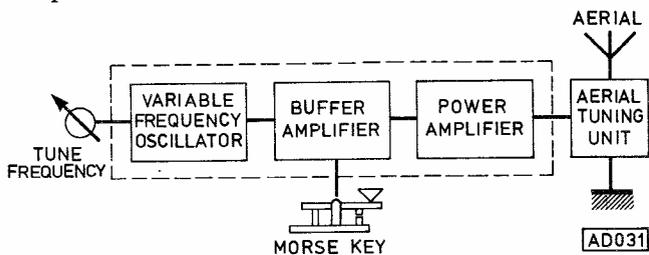


Fig. 49: Block diagram of a CW transmitter.

It is usual for the Oscillator to be operated in Class A or B, the Buffer Amplifier in Class B and the Power Amplifier in Class C. The various classes of operation refer to the condition under which the valve or transistor operates and these are summarised below and shown graphically in Fig. 50.

## Classes of amplifier operation

### Class A

In Class A, the transistor or valve is biased to near the centre of its linear operating range and the signal amplitude is insufficient to cause operation outside this range. A Class A amplifier has a low efficiency typically 50% or less (less than half of the input power is converted into useful output) but it does not distort the signal or generate harmonics.

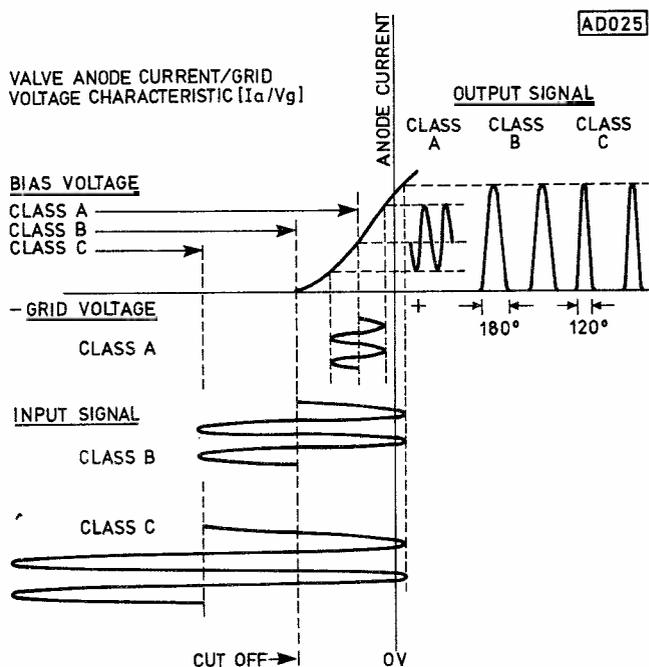


Fig. 50: Classes of operation.

### Class B

In Class B, the valve or transistor is biased to the cut-off point and the input signal drives the device into full conduction for one half of the cycle of input signal (180°) and beyond cut-off during the other half. The efficiency is higher than Class A, being 60%-65% for CW (continuous radio frequency wave) operation.

A Class B amplifier stage with a single valve or transistor distorts the signal passing through it, producing mainly second harmonic distortion. In a Class B audio frequency amplifier, two valves or transistors are required. These operate in push-pull, one handling one half cycle and its partner the other, so eliminating the distortion.

A single valve or transistor Class B amplifier can be used for RF purposes in a transmitter because of the "flywheel" effect of the output tuned circuit. This type of amplifier has a reasonably linear transfer characteristic (the output signal is proportional to the input signal) and therefore an amplitude modulated RF signal can be amplified with little distortion, an important property which is essential in single sideband transmitters, as we shall see later.

### Class C

In a Class C amplifier, the valve or transistor is biased well beyond cut-off and the input signal is required to have a larger amplitude in order to drive the device into conduction. Conduction only occurs for about one-third of a cycle of the input signal (120°) and the efficiency can be in the region of 70%.

The output of the device contains a high proportion of harmonics and the output circuit must be correctly tuned to the fundamental frequency to reduce the possibility of harmonics being radiated.

The Class C amplifier has a non-linear transfer characteristic and is therefore unsuitable for amplifying an amplitude modulated input signal although, as we will see later, it can be used to amplitude modulate a carrier wave.

A Class C amplifier can be employed intentionally as a harmonic generator or frequency multiplier by increasing the bias still further so that the device is only conducting for a quarter of a cycle (90°) of the input signal.

In this condition, the output is rich in harmonics and by making the output circuit resonant at the desired harmonic, power can be obtained at this frequency. For example, the input could be at 7MHz and the output tuned to the second harmonic (14MHz) and then further amplified for transmitting on the 14MHz band or the third harmonic selected for transmitting on the 21MHz band.

In Fig. 50 the bias conditions are shown in relation to a valve anode current ( $I_a$ )/grid voltage ( $V_g$ ) characteristic, although they could apply, similarly, to a transistor characteristic.

## Simple CW Transmitter 160 metres (1.8-2.0MHz)

The circuit of the transmitter, illustrated in block diagram form in Fig. 49, is given in Fig. 51.

The VFO is a series tuned Colpitts oscillator. The oscillator feedback is obtained from a capacitive tap (the junction of C3 and C4). Memory aid: "C" is for Colpitts and Capacitive tap. (When the feedback tap is an inductive one, on the coil, then the circuit becomes a Hartley oscillator.) The frequency stability of the oscillator depends mainly on the coil and tuning capacitor VC1 having good mechanical stability and on Tr1 being coupled in such a way that any change in its internal capacitance has little effect on the frequency. This is done by arranging that C3 and C4 are effectively across Tr1 and are large enough to swamp any small changes that might occur.

The output from Tr1 is fed to the tuned circuit L2, C5 which has a coupling winding L3 feeding Tr2. The bias for Tr2 is provided by R5 and R6 with decoupling by C6. The output from Tr2 is fed to the tuned cir-

cuit L4 C7 with a coupling winding L5 feeding the base of Tr3. Note that Tr3 is normally cut-off and only conducts when driven with an input signal. The emitter biasing resistor R8 provides extra biasing voltage when the stage is operating giving the correct Class C conditions. The output is fed to a suitable impedance matching point on L6 which, with VC2, resonates at the output frequency. Output coupling to the aerial tuning unit is provided by an adjustable coupling coil L7.

## Keying and the Keying Filter

The transmitter is keyed on and off by connecting the morse key in the emitter circuit of Tr2. When the key is "up" no current will flow through Tr2 and there is no output. With the key "down" normal output is obtained.

Keying a transmitter by abruptly starting and stopping the carrier wave results in spurious signals being radiated and these are received as "key clicks" over a wide range of frequencies. To overcome this problem the transmitter must turn on and off less quickly and a key click filter L8, C9, R9 is included for this purpose. L8 restricts the rate of rise of current through Tr2 when the transmitter is keyed on and C9, the fall of current when keyed off, as shown in Fig. 52. The values of L8, C9 and R9 are often chosen experimentally, but the values given are typical.

## Modulation

To transmit voice information by radio wave it is necessary for the microphone output signal to vary or modulate the RF carrier wave in a way that will allow the AF signal to be extracted at the receiver. The two basic methods are amplitude modulation and frequency modulation, each method having its particular advantages and disadvantages.

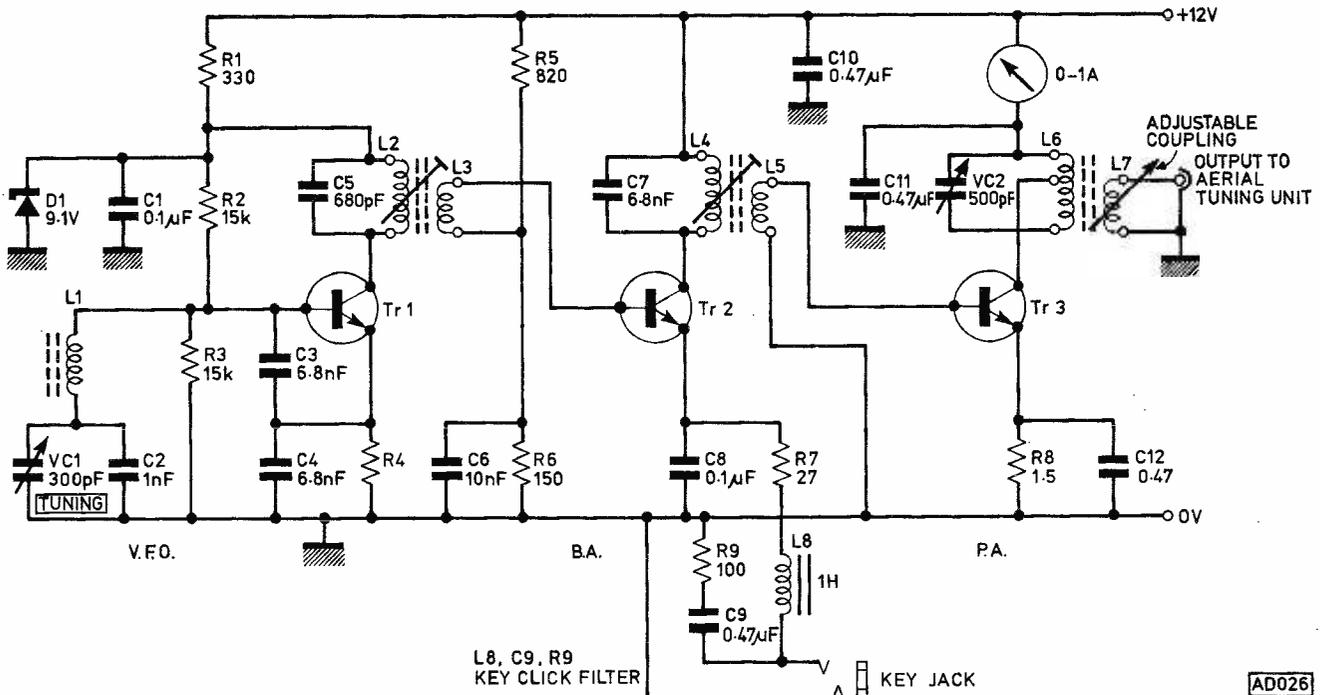


Fig. 51: The circuit diagram of the CW transmitter shown in Fig. 49.

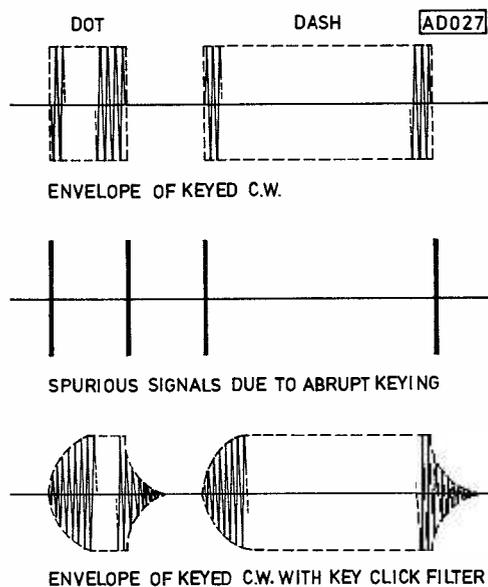


Fig. 52: Signal envelopes with and without key click filter.

## Amplitude Modulation

Amplitude Modulation is produced by mixing the modulating signal with the carrier wave in a non-linear device or amplifier. Modulation can be carried out at high power level in the output stage of the transmitter or at low power in an earlier stage providing the subsequent amplifiers are linear (Class A or B).

Amplitude Modulation is shown in two ways in Fig. 53 a, b and c. On the left is a representation of the carrier wave, the modulating signal and the resultant modulation envelope as would be seen on a conventional oscilloscope. The graphs on the right show the same conditions but with frequency along the baseline. When two frequencies are fed into a non-linear stage, the output will contain a number of signals in addition to the original input signals. The main ones being the "sum" and "difference" frequencies, as shown below.

Input signals  $f_1$  and  $f_2$ .

Output signals  $f_1$ ,  $f_2$ ,  $f_1 + f_2$ ,  $f_1 - f_2$ .

If the carrier frequency is 1000kHz ( $f_1$ ) and the modulating frequency is 1kHz ( $f_2$ ) then two side frequencies are generated, the higher one at 1001kHz ( $f_1 + f_2$ ) and the lower one at 999kHz ( $f_1 - f_2$ ). It is the sum of the carrier and the two side frequencies which forms the "modulation envelope" shown in Fig. 53b.

The speech signal from a microphone consists of a band of frequencies between about 300Hz and 3.3kHz varying in frequency and amplitude with the voice patterns. Modulation by a speech signal results in two sidebands, the upper sideband and the lower sideband. These sidebands, which carry the AF modulation information, are mirror images of each other. The carrier wave remains constant irrespective of whether modulation is present or not and although it carries no information its presence is required at the receiver for the demodulation process.

Since the carrier wave conveys no intelligence it is possible to dispense with it altogether as shown in Fig. 53d (thus saving a great deal of transmitter power), provided it is generated again, locally, at the

receiver for demodulation purposes. Unfortunately this carrier must be in the correct phase relationship with the sidebands or serious distortion will result. A double sideband suppressed carrier transmission is very difficult to tune in and requires a sophisticated receiver for satisfactory reception. However, if the

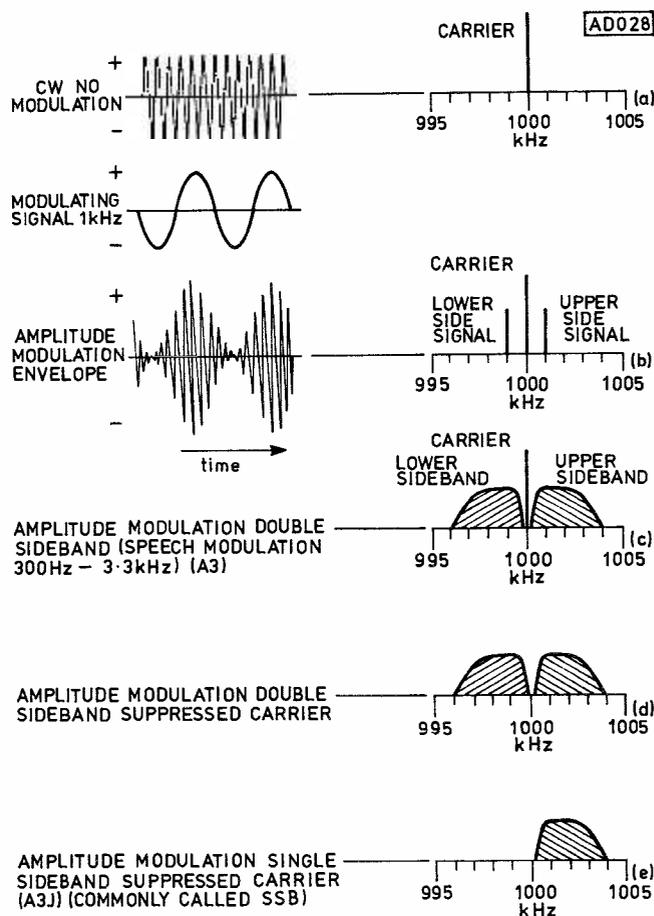


Fig. 53: Examples of AM envelopes, showing sidebands.

carrier and one of the sidebands are removed and the remaining sideband transmitted then this exact phase relationship is no longer essential and the carrier can readily be inserted at the receiver.

As the two sidebands contain identical modulation, removing one of them does not result in any loss of information and effects a further saving of transmitter power. This type of transmission, shown in Fig. 53e, is known as single sideband suppressed carrier or Emission type A3J and commonly abbreviated to just SSB.

## Single Sideband

SSB has several advantages for the Radio Amateur.

1. Saving in transmitter power or the ability to run the equivalent of higher power for the same rating of output amplifier.
2. No carrier radiated so it does not cause the usual heterodyne interference.
3. Requires only half the usual bandwidth.
4. Less affected by transmission path disturbances.

## Amplitude Modulation Transmitter

Amplitude Modulation, (A3) can be performed at high signal level in the output stage of the transmitter by applying the modulating audio voltage to the bias or to the HT supply voltage as shown in Fig. 54. In a transistorised transmitter it is usually necessary to modulate the driver or buffer stage as well as the power amplifier. High level amplitude modulation requires appreciable power from the modulator output stage. For example, a transmitter PA drawing 150 watts would require at least 75 watts of modulation power for full modulation.

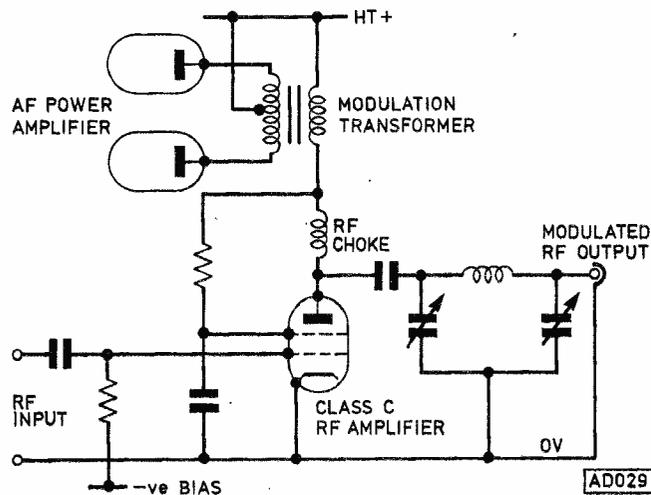
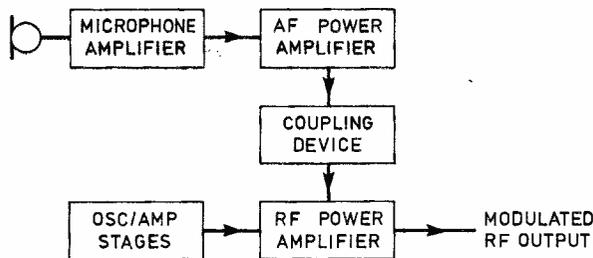


Fig. 54: An AM transmitter.

## SSB Transmitters

The SSB signal is usually generated either by a phasing method, shown in Fig. 55a or by the use of a balanced modulator and filter, shown in Fig. 55b.

In the phasing method, the AF signal is processed in a phase shifting circuit which generates two signals having a  $90^\circ$  phase relationship over the audio frequency band, 300Hz to 3.3kHz. The RF signal is also phase shifted by  $90^\circ$  and fed with the AF signals, to two balanced modulators with a common output. The result is that the carrier is removed and one sideband is cancelled out. Upper or lower sideband can be selected by reversing the AF or RF inputs to the modulators.

In the filter method, the RF signal is modulated in a balanced modulator to provide a double sideband suppressed carrier signal and then one of the sidebands is selected by a high grade crystal filter to

produce an SSB signal. The filter method is the simpler of the two, but requires an expensive, or very carefully home-made crystal filter.

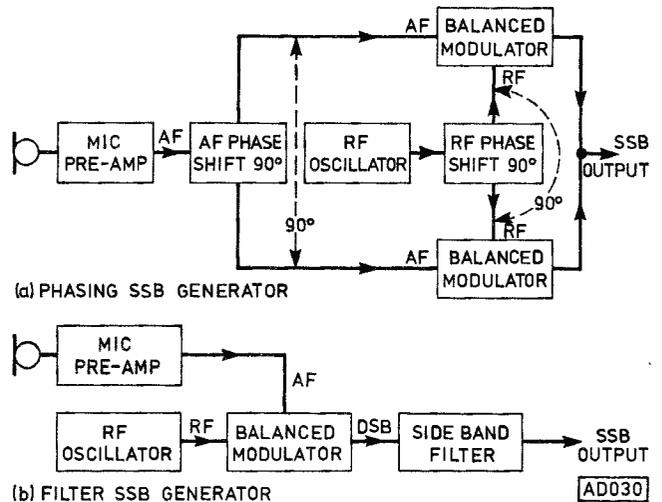


Fig. 55: Two methods of generation of an SSB signal.

## Balanced Modulator or Mixer

The balanced modulator can take many forms but in essence it is a balanced circuit in which the RF input signal is cancelled or "nulled" out.

The simplest form is a diode bridge arrangement shown in Fig. 56. Here the RF input is fed to a bridge circuit where the centre of the diodes is a null point. RV1 and TC1 enable the bridge to be accurately balanced to provide adequate suppression of the carrier. An AF signal input causes D1 and D2 to conduct alternately, on each half cycle, unbalancing the bridge and producing a double sideband suppressed carrier signal at the output.

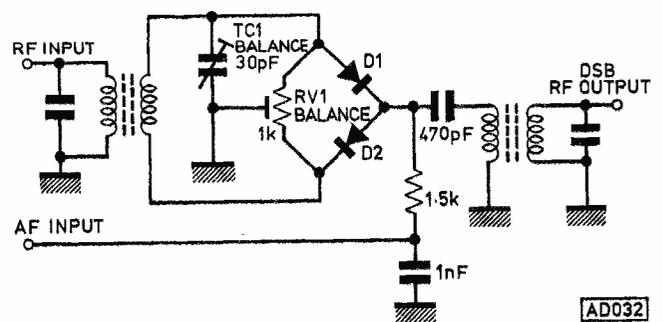
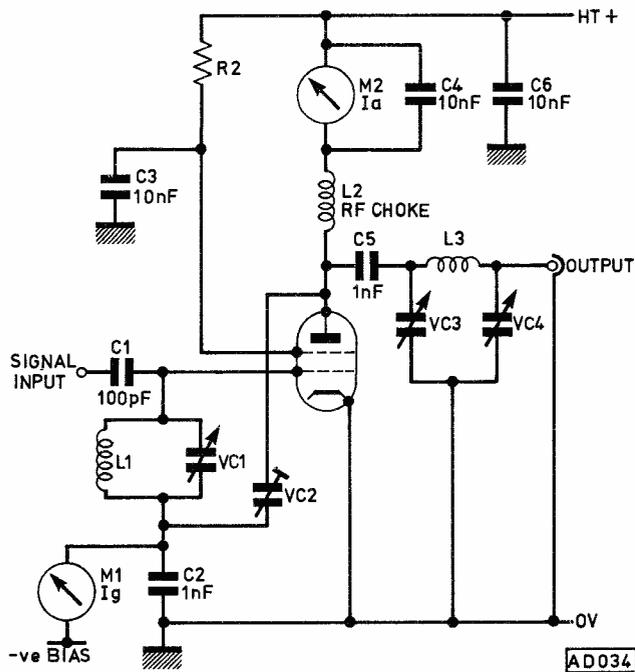


Fig. 56: Diode bridge modulator.

## Simple SSB Transmitter

The block diagram in Fig. 57 shows a simple SSB transmitter for use on one band 14.00-14.35MHz. In this transmitter the SSB signal originates from a 9MHz crystal oscillator feeding into a balanced modulator and then to a crystal filter. The 9MHz SSB signal is mixed with a VFO, tuning 5.00 to 5.35MHz. The sum of the two frequencies 14.00 to 14.35MHz is selected at the output. This signal is amplified in a



AD034

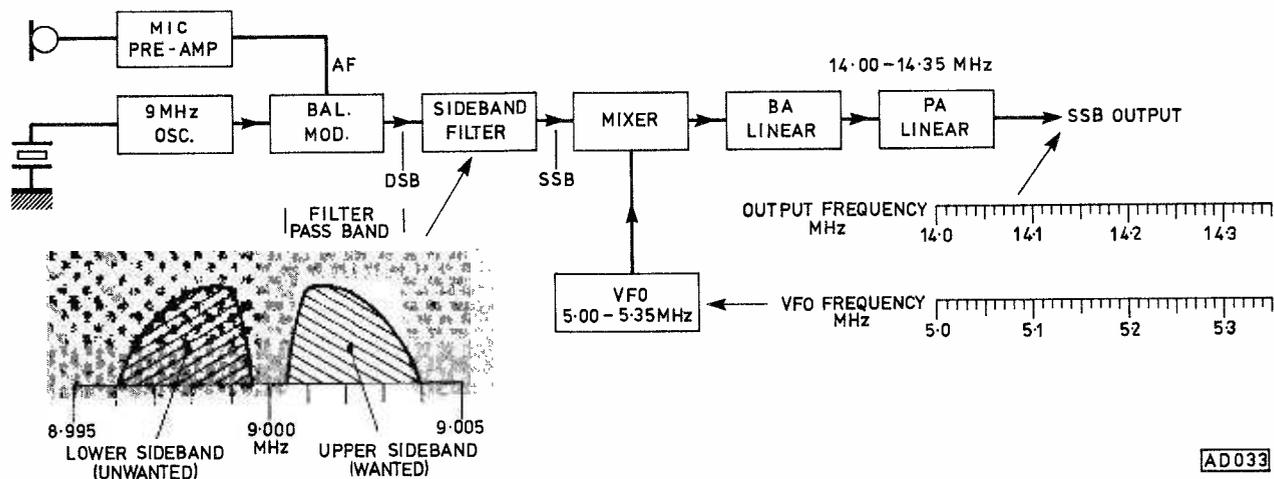
Fig. 58a: Single band SSB transmitter, above, and Fig. 58b, bridge circuit, top right.

linear buffer amplifier and then a linear power amplifier to give the required SSB power output. Operation on other bands would be possible by changing the VFO frequency.

It is essential that, once the amplitude modulated SSB signal is generated, subsequent amplification must be linear or severe distortion will result. Class C amplifiers are unsuitable for this purpose.

## Linear Power Amplifier

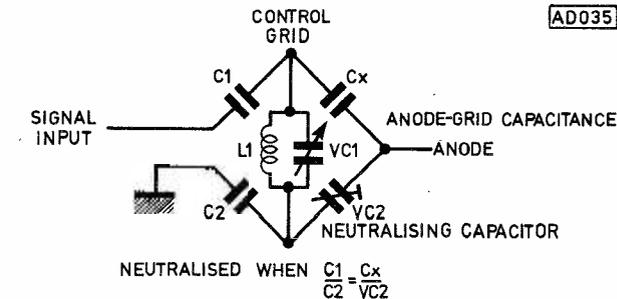
A typical linear power amplifier, for use on one HF band is shown in Fig. 58a. The valve is biased to operate in Class B for good linearity combined with high efficiency.



AD033

Fig. 57: Block diagram of a single band SSB transmitter.

The SSB signal is applied to the input tuned circuit and the control grid. The output signal, at the anode, is developed across the RF choke, L2 and fed via C5 to the output tuned circuit, L3, VC3, VC4. This output



circuit is called a "pi" network (similar in shape to the greek letter pi,  $\pi$ ). In operation, VC3 tunes the output circuit to resonance and VC4 effectively provides a variable capacitive tapping point on the tuned circuit and enables the output of the transmitter to be correctly matched to the load.

## Neutralisation

There is usually some stray capacitance existing between the anode and grid of the valve both in the valve itself and in the wiring. Signal feedback through this capacitance affects the grid and anode tuning and may cause self oscillation. A neutralising capacitor VC2 feeds a small amount of RF signal from the anode to the opposite end of the grid tuned circuit and neutralises the effect of the anode-grid capacitance. The circuit is rearranged in Fig. 58b to show that the neutralising capacitor forms part of a "bridge" circuit. To set VC2, the HT is temporarily disconnected, an input signal is applied and VC1 adjusted for maximum drive indicated on M1. With VC4 at maximum VC3 is rotated and any variation on M1 noted. VC2 is then adjusted for negligible variation of M1, indicating correct neutralisation.

In the next section we will finish looking at Linear Amplifiers and cover Frequency Modulation and FM Transmitters, Receivers and Converters.

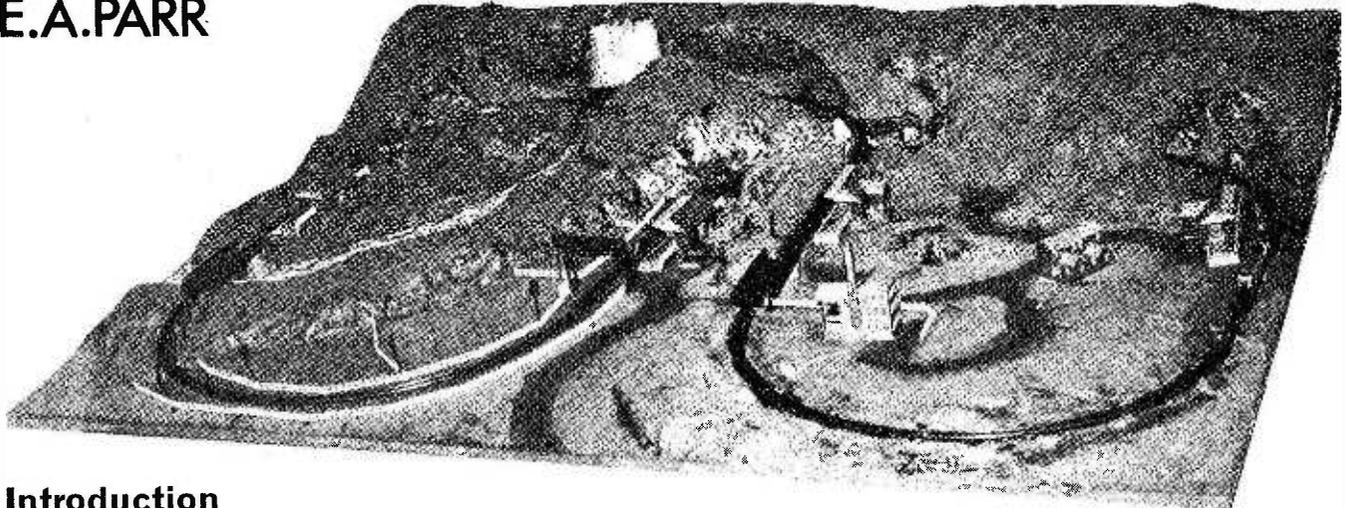
There is an excellent new book available, "Radio Amateurs' Examination Questions and Answers",

compiled by the RSGB Education Committee and available from the Radio Society of Great Britain, RSGB Publications (Sales), 35 Doughty Street, London WC1N 2AE. Price £2 inc. postage.

# 'MYSTERY TRAIN TOUR'



E.A.PARR



## Introduction

Most clubs, churches and societies have fund raising ventures such as bazaars, cheese and wine parties and the like. These usually have side shows and competitions, one of the most popular being the "spin the arrow" game.

This article describes a similar game using a model railway train. A simple model railway layout has four stations (in the prototype named Euston, Crewe, Carlisle and Glasgow). A button is pressed and the train runs for about 30 seconds then stops at one of the stations. Players put money on the stations getting their money back, with a bonus, if the train stops at their station.

## Circuit Description and Track Wiring

Before describing the circuit it is necessary to describe the railway layout and how it is split into sections. If the track circuit was continuous and power was simply removed, it is most unlikely that the train would stop exactly at a station. For four stations it is therefore necessary to split the track into eight sections. Four longer running sections all wired together, and four short station sections which can be isolated individually (see Fig. 1).

Originally it was thought that the running sections would be permanently energised, and all the stations sections commoned and driven off a 555 timer. The train would then run for 30 seconds, and stop in the next station section. However the period of the 555 was found to be predictable, and it was possible to guess the station with a fair degree of accuracy.

The final circuit, Fig. 2, was therefore developed. On this the running sections are again permanently energised, but at the end of the 30 seconds one station section is randomly de-energised. The train keeps running until it reaches the de-energised section when it stops.

The run time and the random stops are controlled by a 556 dual timer IC1. The 'a' section is connected

as a monostable (period 30 seconds) and the 'b' section as an oscillator (frequency about 50 kHz) gated by the 'a' section so that it only runs during the 30 second period. This gating is carried out by pins 5 and 8.

The pulses from the 50kHz oscillator which appear on pin 9 of IC1 go to a two bit counter made from two D type flip flops (IC2). At the end of the thirty second period this will contain a "random" number from 0 to 3 inclusive. This is decoded by IC3 and used to turn off one of the four transistors TR1 to TR4, de-energising one of the station sections. The high frequency of the oscillator and long period for which it runs gives a sufficiently random count.

The positive supply for the track is derived from a very simple series regulator TR7, allowing the train speeds to be controlled by RV2. Players can be allowed to drive the train as it does not affect the station the train ultimately stops at.

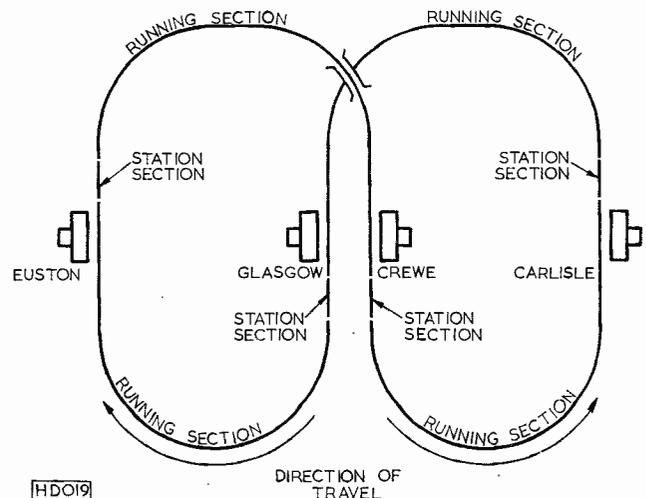


Fig. 1: The track circuit layout.

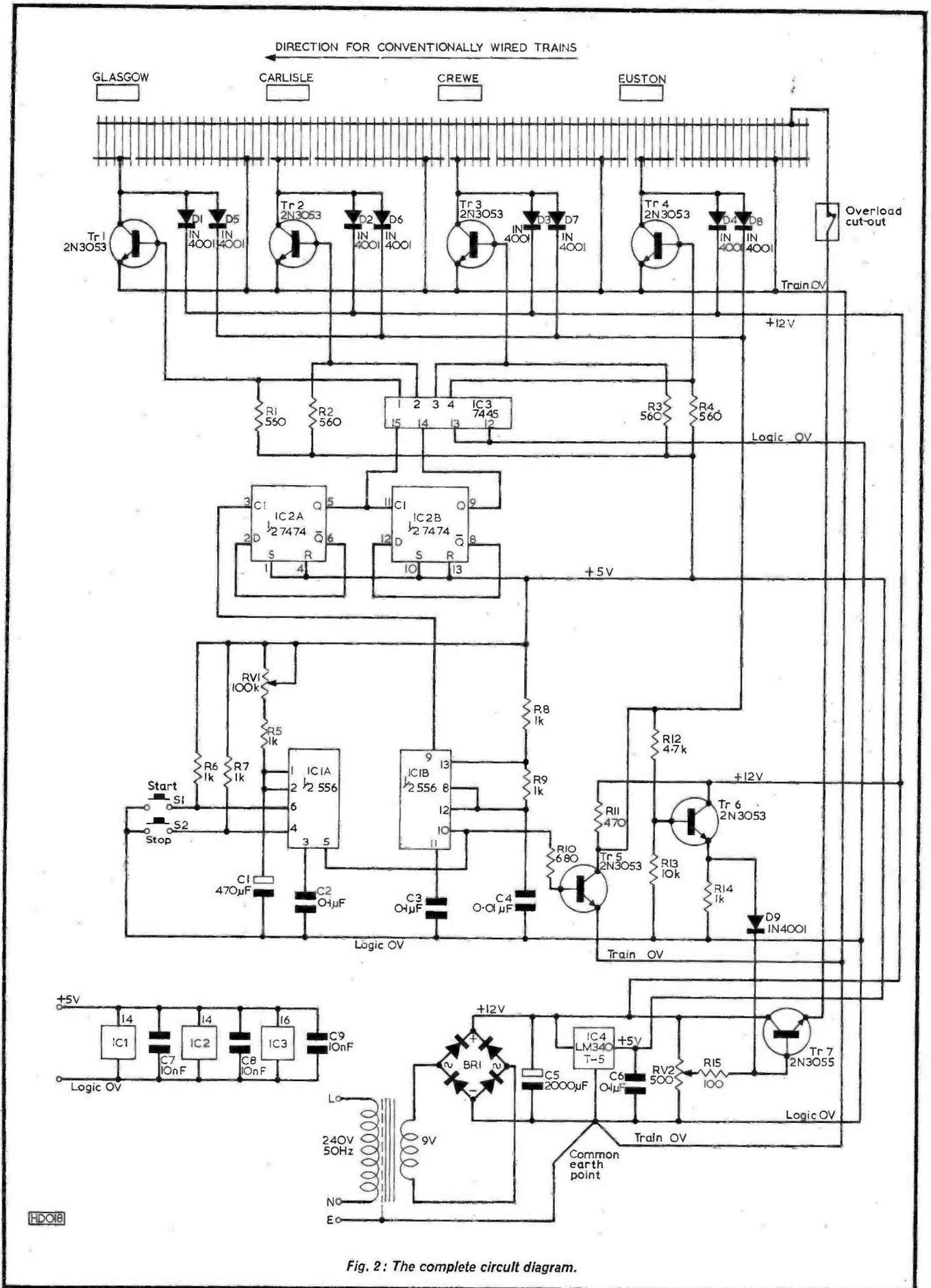


Fig. 2: The complete circuit diagram.

When the monostable times out, TR5 turns off and TR6 emitter rises to about 9V. This brings the loco supply up to 9V when the 30 second period is over, taking control away from the players.

Whilst IC2 is counting, the transistors TR1-TR4 are being briefly turned off at regular intervals. The effect of pulsing a small motor at 50kHz was not known, so diodes D5, 6, 7 and 8 are used to hold the negative supply to the track during the 30 seconds that IC2 is counting. TR5 is turned on when the monostable is running and off when it times out.

The period of IC1a can be varied by RV1, and the running period can be terminated prematurely by pressing the stop button. If it is wanted to make this a game of 'skill' the stop button could be operated by the player.

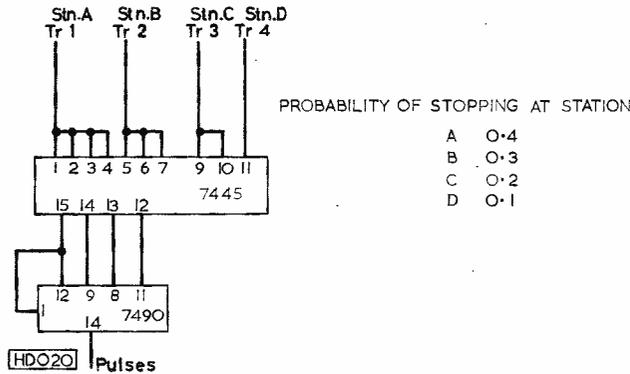


Fig. 3: The probability loading circuit diagram.

The power supply is straightforward, the 5V supply being derived from an IC regulator. Good decoupling is essential on the 12V supply to prevent noise spikes from the locomotive motor getting into the logic.

With a 7490 and a 7445 connected as shown in Fig. 3 a "loading" can be introduced, and the train will stop on average four times at station A, three times at station B, twice at station C and once at station D in ten runs. The returns to the players should be varied accordingly so as to make an overall profit on the game.

It is recommended that the trains be run in one direction only, as it is not possible to position the stations so that the train will stop at the station from each direction (remember that the loco has to stop past the station for the coaches to be at the platform).

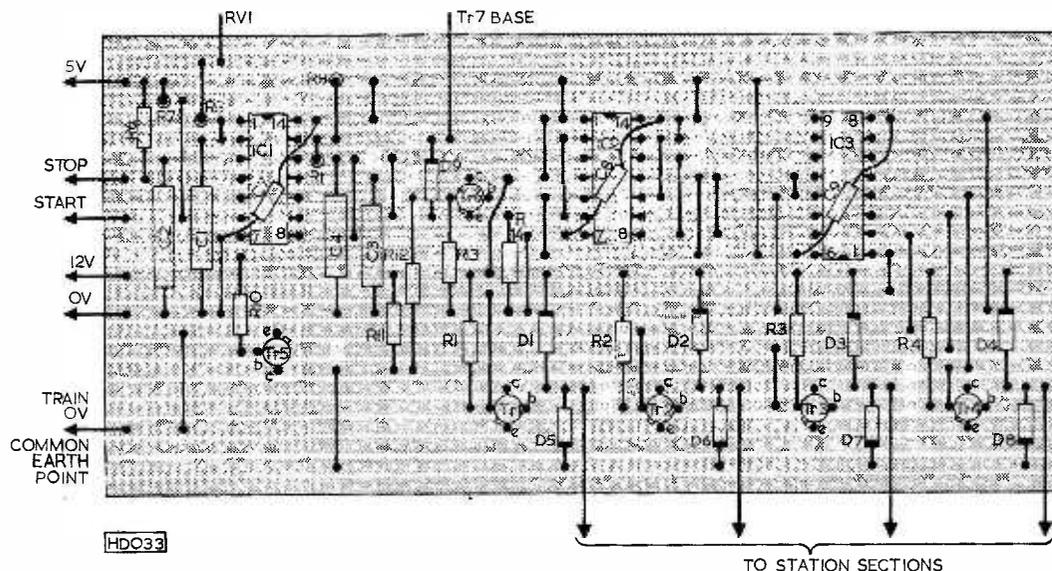


Fig. 4: General Veroboard layout of the unit.

## ★ components

<b>Resistors</b>	
R1-R4	560Ω
R5-R9	1kΩ
R10	680Ω
R11	470Ω
R12	4.7kΩ
R13	10kΩ
R14	1kΩ
R15	100Ω
<b>Variable Resistors</b>	
RV1	100kΩ
RV2	500Ω
<b>Capacitors</b>	
C1	470μF 15V Electrolytic
C2, C8, C9	0.1μF Polyester
C4	0.01μF Polyester
C5	0.0001μF 25V Electrolytic
C7, C8, C9	10nF Disc ceramic
<b>Semiconductors</b>	
IC1	NE555
IC2	SN7474N
IC3	SN7445N
IC4	5V regulator LM340T-5 or similar
TR1-TR6	2N3053
TR7	2N3055
D1-D9	1N4001 or similar 1-Amp diode
BR1	Bridge rectifier 100V 1A
<b>Switches</b>	
S1, S2	Push to make single pole push button switch
<b>Miscellaneous</b>	
	9V 1A transformer
	Veroboard 0.1 inch pitch
	0.5A overload cut-out (as sold by model railway shops)

## Construction

The prototype was constructed on 0.1 inch pitch Veroboard with the layout shown in Fig. 4. No particular difficulty should be encountered in the construction. IC4 (the 5V regulator) and TR7 are mounted on the unit case.

## Warning

The laws of this country regarding games of chance are somewhat complex, and are often overlooked by function organisers. Many premises and societies are licensed for gaming, many are not. If it is decided to use this for some fund raising venture and other games of chance (as opposed to games of skill) are being used then the venture is licensed (or the club is already taking a risk).

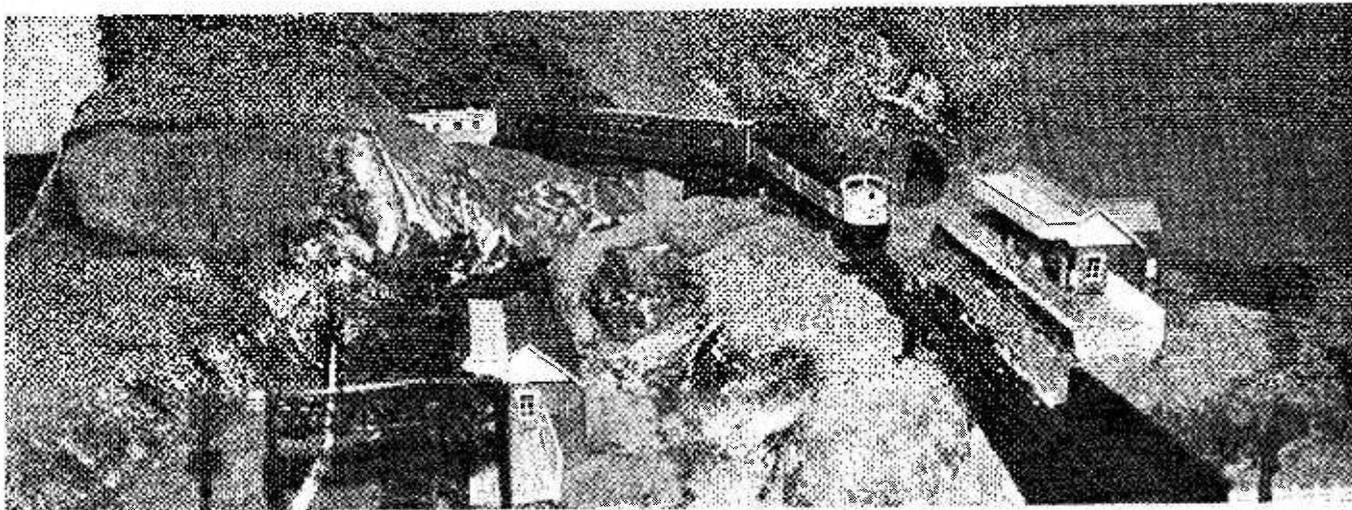
If there is any doubt, the local police should be consulted.

The layout was built on a 3ft x 4ft base board to a design as shown on Fig. 1. This gives a lot of track in a small area.

N gauge was used, and 6 inches was found to be a reasonable length for the station sections. The actual stations should be placed just before the station section and positioned so the coaches will be at the platform when the train stops.

The whole layout was landscaped with fields, cuttings, a waterfall and a tunnel so the simple track layout was not immediately apparent.

There is actually more work in building the layout than in the electronics. The electronics were built in one evening, but laying the track and building the scenery took nearly a fortnight!



# READERS PCB SERVICE

To:- READERS PCB SERVICES LTD,  
PO BOX 11, WORKSOP, NOTTS

Please supply PCB's as indicated by tick/s in box/es.....

Issue	Project	Ref	Price P/P	
Dec 75	Sound-To-Light Display	DN0798	1-15+12	<input type="checkbox"/>
Dec 75	Disco System, Amp. (2 req'd) each	AM0421	4-40+22	<input type="checkbox"/>
Dec 75	Disco System, Light Modulator	AM0423	3-50+22	<input type="checkbox"/>
Mar 76	CMOS Crystal Calibrator	AM0438	1-19+12	<input type="checkbox"/>
Apr 76	Auto. Slide Synchroniser	AM0441	2-33+15	<input type="checkbox"/>
June 76	Dig. Freq. Meter (set of 5) A015 and 4x A004	A015 and 4x A004	3-17+15	<input type="checkbox"/>
July 76	Disco Preamplifier	A003	0-65+12	<input type="checkbox"/>
Aug 76	Cassette Player Power Supply	A001	0-65+12	<input type="checkbox"/>
Oct 76	Digital Car Clock (set)	A011/012/013	2-58+12	<input type="checkbox"/>
Oct 76	Interwipe	DN8JM	0-80+12	<input type="checkbox"/>
Oct 76	Video-Writer (set)	D002/3/4/6 A007	21-44+50	<input type="checkbox"/>
Oct 76	Hazard Flasher	D005	0-76+12	<input type="checkbox"/>
Nov 76	Low Level Battery Indicator	A016	0-40+12	<input type="checkbox"/>
Nov 76	Electronic Thermostat	A017	1-30+12	<input type="checkbox"/>
Nov 76	Cirtest Probe	A018	0-48+12	<input type="checkbox"/>
Nov 76	Burglar Alarm	A019	0-50+12	<input type="checkbox"/>
Dec 76	Chromachase	A021	5-70+22	<input type="checkbox"/>
Jan 77	Oscilloscope Calibrator	A023	1-25+12	<input type="checkbox"/>
Jan 77	Icelert	A020	1-45+12	<input type="checkbox"/>
Feb 77	Transistor Checker	A026	1-18+12	<input type="checkbox"/>
Apr 77	Tug 'o' War (set)	A029/030	2-88+12	<input type="checkbox"/>
Apr 77	Gas/Smoke Sensor Alarm	A028	0-65+12	<input type="checkbox"/>

May 77	2-Way Intercom	D019	1-28+12	<input type="checkbox"/>
May 77	Protected Battery Charger	A027	2-38+12	<input type="checkbox"/>
May 77	Seekit Metal Locator	A031	3-38+12	<input type="checkbox"/>
June 77	Reverberation Amplifier	A032	2-38+12	<input type="checkbox"/>
June 77	Versatile AF Generator	A033	2-38+12	<input type="checkbox"/>
June 77	Tele-Games	D029	3-22+18	<input type="checkbox"/>
July 77	20W IC Amplifier	A034	1-38+12	<input type="checkbox"/>
July 77	Radio 2 Tuner	A035	1-68+12	<input type="checkbox"/>
July 77	Digital Clock Timer	A036	3-28+12	<input type="checkbox"/>
Aug 77	Shoot (Telegames)	D035	1-55+15	<input type="checkbox"/>
Aug 77	Atomic Time Receiver	D036	2-65+15	<input type="checkbox"/>
Aug 77	Morse Code Tutor Cards (SRBP)	A037	4-75+15	<input type="checkbox"/>
Sept 77	Jubilee Electronic Organ	A038	19-00+75	<input type="checkbox"/>
Sept 77	Electronic Car Voltage Regulator	D037	1-25+12	<input type="checkbox"/>
Oct 77	Audio Level Indicator	D039	0-98+12	<input type="checkbox"/>
Oct 77	Sine-Square Wave Generator	D040	2-35+15	<input type="checkbox"/>
Nov 77	Laboratory Power Supply	A039	3-50+12	<input type="checkbox"/>
Jan 78	Proportional Power Controller	DN9JM	0-78+12	<input type="checkbox"/>
Mar 78	Audio/Visual Logic Probe	R001	1-40+15	<input type="checkbox"/>

Post and packing is for one board or set of boards. Prices include VAT. Remittances with overseas orders must be sufficient to cover despatch by sea or air mail as required.

I enclose Postal Order/Cheque ACCESS welcome.  
Send card number only.

No.....

for £.....made payable to READERS PCB SERVICES LTD

NAME .....

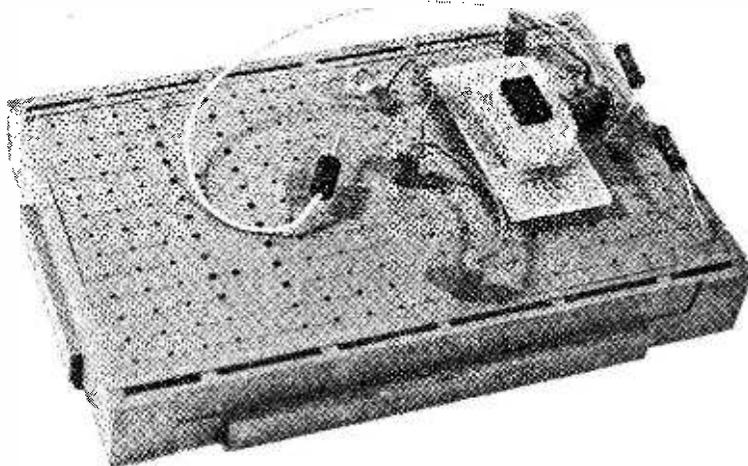
ADDRESS .....

.....

..... Post Code.....

Any correspondence concerning this service must be addressed to READERS PCB SERVICES and not to the Editorial offices.

# μ-DeCnology



DAVID GIBSON

1



THIS MONTH



## 'Simple Light Modulator'

This new series of simple projects continues where the previous S-DeCnology articles left off. The S-DeC projects all used discrete components, but the new series will feature circuits which employ one IC.

All projects will be built on a  $\mu$ DeCB. Like the S-DeC it has lettered and numbered holes into which the components are plugged using their lead wires. Beneath the holes in the plastic top, tiny retaining clips/sockets (connected electrically) connect up the individual components. Their connection patterns are shown as raised lines on the plastic top surface of the DeC.

Whereas the S-DeC had but 70 holes, the  $\mu$ DeCB has 208. It will accept discrete components, but also has provision for taking two ICs. Special IC carriers are employed to avoid damaging the IC pins by repeatedly plugging them in and out. Two types of IC carrier are available but we will use the one which accepts standard 16-pin DIL flat packages (the other carrier accepts round ICs in TO-5 packages).

Wherever possible, the circuits to be described will use the same component values. Thus once a circuit is built, the components may be simply unplugged and used again for future projects. Circuits which are required in permanent form can either be

transferred directly onto Blob Board, or a small PCB may be designed, drawn and etched.

The circuits have been designed with cost in mind, and to this end the first IC chosen was the ubiquitous 741 operational amplifier—advertised in *Practical Wireless* for as little as 24p including VAT.

Let us get to know our new friend, the 741 IC. The pin connections are shown in Fig. 1. The transistors we used in the last series each had three leads. The IC isn't really so complex (connectionwise) since we are only going to use 5 leads. And because pins 7 and 4 got to the positive and negative battery terminals respectively, then we have, like the transistor, just three wires or leads. See how easy these ICs really are!

There is just one odd thing to resolve; we have one output (pin 6) but two inputs—pins 2 and 3. We'll talk about those later, but first let's look at some of the figures or specs for our 741 op amp.

It has low frequency gain, between input and output, of some 100,000. Each of its inputs has an input impedance of around  $1M\Omega$  while the output impedance at pin 6 is of the order of a few hundred ohms.

The positive (pin 7) and negative (pin 4) power connections are straightforward, and all amplifiers have an output (pin 6 in our case). So let's look at those two inputs.

The input at pin 2 marked with a negative or minus sign gives an "inverted output" at pin 6. Alternatively, pin 3 (marked with a plus or positive sign) will give a "non-inverted output" at pin 6.

### ★ components

R1 100k $\Omega$	IC1 741 op amp (8-pin DIL)
R2 100k $\Omega$	LED1 almost any LED
R3 100k $\Omega$	One $\mu$ DeC B
R4 1k $\Omega$	One DIL $\mu$ DeC B carrier
9V battery	solid cored wire, or DeC jumper leads

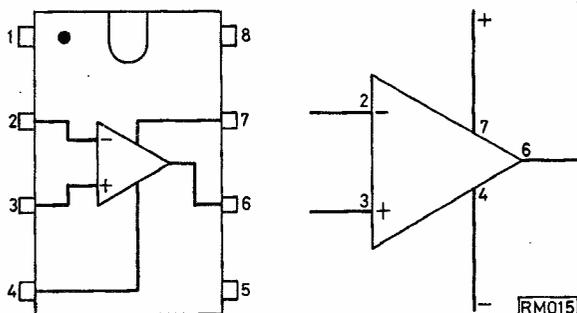
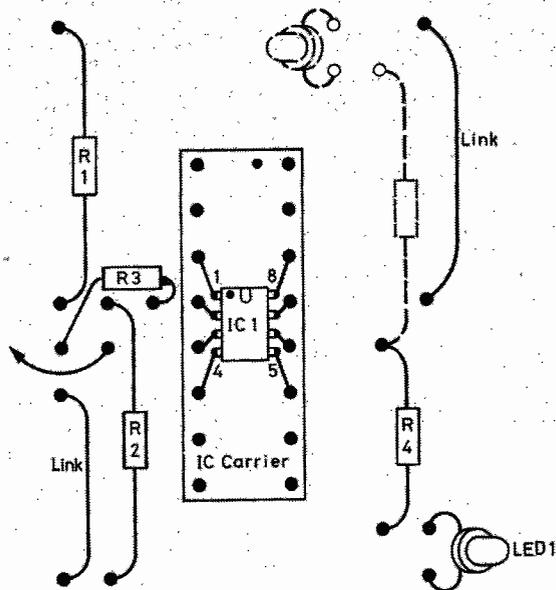


Fig. 1: The 741 op. amp. pin connections.



This merely means that if we apply a positive voltage to the negative input (pin 2) with pin 3 grounded, then the output will swing negative. In other words; positive input = negative output: inverted.

Conversely, if we applied our positive voltage to pin 3 (with pin 2 connected to ground this time) the output would swing positive. So: positive input = positive output: non-inverted.

Now let us examine two preliminary circuits to get the feel of the 741 op amp, and to actually see what we mean by inverting and non-inverting. You can easily build these on your  $\mu$ DeC if you wish.

Figure 4 has a 741 op amp, 6 resistors and an LED. The circuit is powered from a single 9V battery. Pin 3 is held at half the battery voltage (4.5V) by the potential divider R1/R4. We can vary the voltage applied to the negative input (pin 2) from negative ground (zero volts, or "low") up to positive 9V or

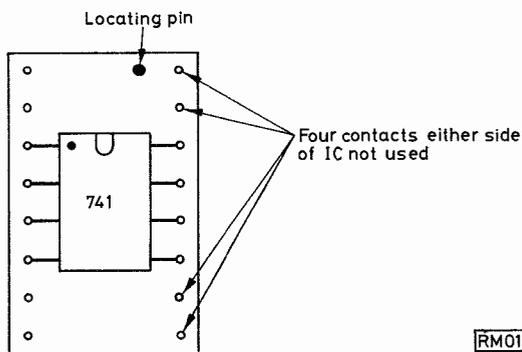


Fig. 2:  $\mu$ DeC carrier with 741 in position.

"high". In other words we can make pin 2 up to +4.5V above pin 3 or -4.5V below it since at either end of its track the potentiometer will connect pin 2 to +9V or zero respectively. Resistors R2 and R3 are included to prevent excessive currents flowing. This is particularly relevant when VR1 is at the top or most positive end of its track.

A clear indication of output voltage is given by the LED. Resistor R5 limits the current drawn by the LED.

The diode will light when the output voltage is

positive or "high", and extinguish when it is low. If you wanted to be absolutely sure what the input was, then you could ignore the potentiometer and take a wire from point X connecting it in turn first to the positive battery terminal and then to the negative

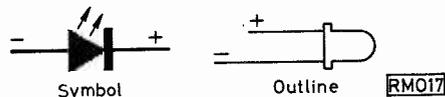


Fig. 3: L.E.D. symbol and outline.

one. It can then be seen that when the connection is made to the negative or "low" terminal, the output at pin 6 is "high" and the LED lights. Connecting the wire to the positive terminal extinguishes the LED showing the inverting action of the circuit.

To see the effect of the non-inverting circuit, look at Fig. 5. Again we have a potentiometer and series resistor (R1). The LED and its limiting resistor also remain. Connecting the 100k $\Omega$  resistor R2 directly between output and the negative input (pins 6 and 2) means that the voltage at pin 2 is the same as the output voltage at pin 6. One can again turn the potentiometer from negative ground (zero volts, or "low") up to +9V or "high". Here it will be seen that when the input to pin 3 is high (+9V) the output is also high (LED lights). When pin 3 is "low" the LED does not light. Thus we have a non-inverting situation.

The above simplified theory is important and we will return to it when building other projects in this series.

Our first suggested project makes use of the very high gain and input resistance mentioned earlier. Figure 6 shows the circuit. Because of the high gain and high input impedance, pin 3 is easily affected by surrounding conditions.

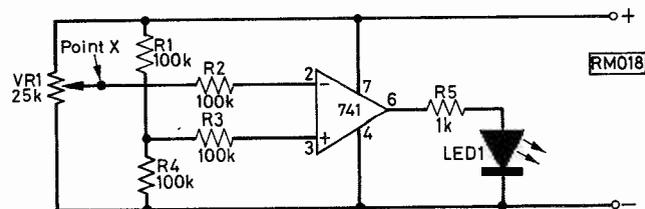


Fig. 4: Inverting op. amp. circuit.

The inverting input (pin 2) is fixed at 4.5V by the potential divider R1/R2. Pin 3 is also taken to the potential divider via R3. Pin 3 is now extremely sensitive to changes. So much so that if the end of the probe wire from  $\mu$ DeC hole B13 is merely touched the LED will immediately light up. In the prototype, just gripping the insulation of the probe wire caused the LED to illuminate.

On test, the circuit was found to function at 5V. Voltages above 9V are not recommended.

The project can be used for numerous things. For example, it could be useful to send visual morse by 'tapping' the probe wire. Hams might consider using

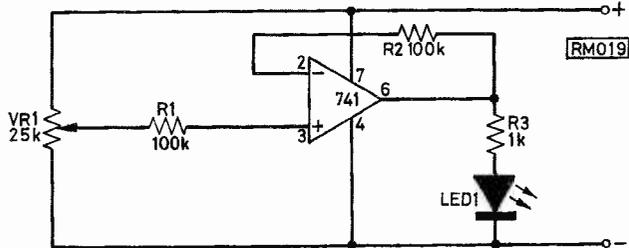


Fig. 5: Non-inverting circuit.

the circuit as a noiseless morse key. The input or probe wire could be connected to a small (say 15mm<sup>2</sup>) aluminium plate. The c.w. could be sent with one finger touching out the morse characters. The 741 might be used to drive a transistor or thyristor to effect actual keying of the rig. With the touch wire connected to a metal door knob the circuit could be used as some form of alarm—how about trying it on the metalwork of your car?

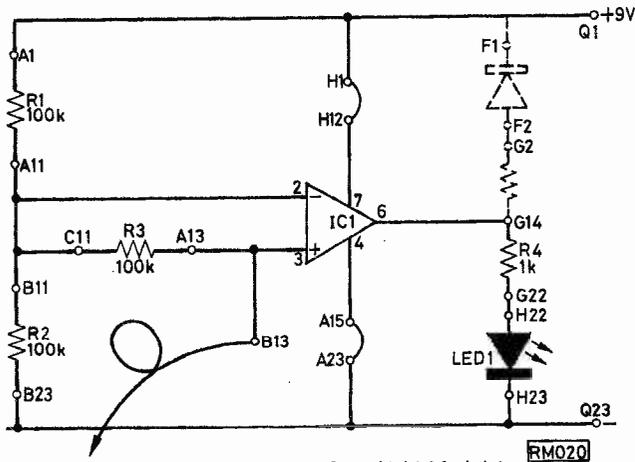


Fig. 6: Circuit diagram of the Light Modulator.

By connecting a crystal microphone between pin 3 and earth (unplug the probe and connect the mike to  $\mu$ DeC holes B13 and D23) the LED can be modulated by speech and/or music. The circuit can thus be used as a simple light modulator.

When building  $\mu$ DeC projects watch out for jumper or shorting wires—they are easy to forget because they are not actual electronic components. There are two in this month's project; between holes H1/H12, and B15/C13.

The IC carrier will only fit one way round into the  $\mu$ DeC so there is no danger of error here. Note that our 741 is the 8-pin DIL type (because it was the cheapest!). This is plugged into the middle eight sockets in the carrier, and it is helpful to label the different pin numbers on the DIL carrier with a felt pen (or whatever). This makes wiring easier and helps enormously when checking out a circuit.

next month in

# TELEVISION

## ● TV AERIAL MASTS

As recent high winds have shown, the aerial mast is a vital but vulnerable part of a TV installation where reception from alternative transmitters is required. To buy and have erected a professional lattice mast is an expensive business – too expensive for most enthusiasts. There are alternative ways of going about raising the aerial(s) to a good height however, as Garry Smith and Keith Harmer show. Detailed guidance is given on the hardware required and safety precautions.

## ● RECONDITIONING SETS

Many service engineers make a worthwhile sideline out of reconditioning and selling old TV sets. There are enough of them around, at bargain prices, but care is required in selecting suitable candidates. Steven Knowles advises on what to look for and the repairs it's worth making.

## ● MONITOR CONVERSION

Sets designed as video monitors tend to be expensive. It's cheaper to adapt an off-air receiver for the purpose. This can be done without too much difficulty, as David Matthewson explains.

## ● SERVICING FEATURES

John Law on the Pye 67 chassis, a recommended set for renovation, while the second Saba article deals with the line timebase – of particular interest in being of the thyristor variety.

PLUS ALL THE  
REGULAR FEATURES

ORDER YOUR COPY ON THE FORM BELOW:

TO .....  
(Name of Newsagent)

Please reserve/deliver the MARCH issue of  
TELEVISION (50p), on sale February 20th, and  
continue every month until further notice.

NAME .....

ADDRESS .....

# HOTLINES

## A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

### Charging meters

Having made use of rechargeable batteries I know how long it takes to fully recharge them. There have been some achievements in this area and at least one manufacturer had cells which could be recharged in just four hours.

Now I read with great joy about a sealed lead-acid battery which can be recharged to its full capacity in exactly 60 minutes if one follows the manufacturers special recharging procedure. Perhaps, instead of parking meters of the future we will have charging meters for the electric car—it charges your battery while you shop, and charges you when you return!

### Electronic au-pairs

Doubtless everyone is all for labour saving devices—things which make life easier in the home (apart from one au-pair franchise!) are naturally popular. One manufacturer has given thought to a number of things and has sought to combine all the answers in one unit.

The original item of manufacture was an environmental chamber into which various pieces of electronics were put. These were then subjected to anything from freezing cold to tropical heat, salt spray, high humidity, etc., etc.

The makers then had a brilliant idea—why not make an environmental chamber for the home. A combined sauna, cold water bath, tropical sunshine sun-tanner, you-name-it-we-do-it chamber.

It seems that they've hit onto a winning idea, too. Orders are flooding in from health hydros, hotels and motels all over the place.

Needless to say the whole thing is electronically controlled and each sequence of whatever you've dialled in is electronically timed. Instead of having a sauna and then having to rush out and hurl yourself into a freezing puddle, you can climb into your environmental chamber, press a button, and immediately after your carefully timed sauna is over—a freezing puddle will rush in and hurl itself all over you!

And just for the record; the same company is manufacturing things called "whirlpool tubs". One's imagination could run riot here, thinking of

things like automatic brushes which pop up to scrub your back—although faulty body positioning could prove fatal!

### Radio Sundial

With electronic watches ever keeping up with the times I often wonder if there is any real limit to it all. At a recent electronics show at Basel, a famous watch manufacturer hung up an electronic watch with a conventional face. It was powered by its own solar cells and contained a radio receiver which was tuned to time signals broadcast from Switzerland. The result was that the clock maintained an accuracy of  $\pm 0.1$  second per day. When the time signal went off the air, the watch went on ticking away to a frequency set by its own internal quartz crystal. Immediately the Swiss time signal came back on the air, the clock would synchronise and automatically correct any error which had crept in. We've come a long way since sun dials.

### Phonemes

Chatting to a computer is a common enough happening in television science fiction, but it isn't quite so far away as one might think. If you haven't already—meet the Phonic Mirror Handvoice. Don't shake hands with it too eagerly; it costs around £1111.00 excluding VAT!

So; what do you get for the money. Well, all words are made up of sounds. These basic sounds (which make up everything we say) are called phonemes. The device above has a memory which accepts up to 40 commands from a small keyboard (the whole unit is a little larger than a calculator). Inside is an electronic analogue of the human voice—a thing called a phonetic synthesiser. It produces all these basic sounds or phonemes. When the 'talk' button is depressed, the memory sends the commands to the phonetic synthesiser which then emits all the right squeaks and moans in the right sequence and the result is 'human' recognisable words.

Perhaps the most obvious question is how limited is the vocabulary. In theory, since it produces all the necessary phonemes, the vocabulary

is virtually limitless. Surprisingly there aren't all that many phonemes required—about 45 for 90% of our normal usage. By making different sensor inputs it is envisaged that even severely handicapped people could 'talk'. A sensor might sense breath, or perhaps muscle movement etc. Needless to say, the unit boasts a micro-processor in addition to its read-only memory and synthesiser.

### Oh for my PL81

I can remember when a large semiconductor manufacturer claimed to have reduced the colour television receiver to just five integrated circuits. "Wonderful!" mumbled an awed Press gathering. An even more "awed Ginsberg" heard recently that a German manufacturer had succeeded in reducing the number of ICs required to process colour TV signals down to three little chips. Apparently this current video miracle has been achieved by putting both luminance and chrominance amplifiers onto a single chip. While I bow my head to such great technical achievements I believe that it is sometimes a double-edged weapon. Think; as more and more is crammed onto a single chip—how much more complex and expensive that chip becomes. How very much more difficult it is to service—to check that chip as it comes off the production line.

Sad, sad, I still hold fond memories of my local TV service man assuring me, "It's yer PL81 mate—they always go about this time of year".

### Goodbye pot!

If you have a light dimmer it's certain that you're using a potentiometer, with a knob on the end, as the control. Well, a manufacturer has come up with a touch plate plus complementary IC to change all this to touch control. Just touch the plate and the light will brighten or dim automatically. The punch line is that the cost of the IC and touch plate will be less than the cost of a potentiometer and knob! Look out knob twiddlers—this is your life!



Following the great success of the Crystal Palace tests it was decided to attempt further experiments with aircraft and on June 18th, 1933 two De Havilland Dragon-Moth aeroplanes were fitted with transmitters and receivers for 56 Mc/s. One aircraft was again chartered by the *Daily Herald* and the other by *Popular Wireless*. Douglas Walter's gear was installed in the *Herald's* plane and George Jessop fitted his sets into the *Popular Wireless* plane. The Dragon-Moth was chosen because of its large cabin which normally held six passengers. Several seats were removed in order to provide space for the radio equipment and the associated power supply.

Ordinary 2V valves were used as oscillators (Osram P2's) and modulators (Osram PT2's in parallel). The power supply consisted of 200V from Helleesen super-capacity batteries, specially supplied for the occasion. The aeriels were half-wave and slung inside the cabin and a transmitter power of about 5W was used. The receivers were conventional 3-valve super-regens as used before. When both planes were airborne, two-way radio communication was established between them. Owing to thick mist and heavy rain, the two aircraft lost sight of each other but met again over Harrow. At this time, Doug could hear George Jessop working duplex phone with G2JV of Harrow and shortly after, Doug did the same. Later they worked G6YK and G6NF with absolute ease and when both planes landed at Romford Aerodrome they talked about the running commentary given by G5CV as he was landing.

## Radio in Gliders

After spending an afternoon on Dunstable Downs watching the London Gliding Club's flying activities, Doug Walters decided that radio could really assist gliding. Pilots attempting long distance flights could obtain the latest information from ground stations and instructors correct faults and give advice to their pupils. Once more here was an opportunity to prove again the efficiency of 56Mc/s for reliable "local" communication.

One fine Sunday in 1934, "the old firm" of Walters and Jessop arrived on Dunstable Downs with a car load of 56Mc/s apparatus including a midget 5m receiver specially made by George. It had three valves housed in an aluminium case and measured 6 x 5 x 2½ in. A 60V HT battery and a small unspillable accumulator were contained in a small suitcase which was placed in a recess behind the seat of the glider. The aerial was a 3ft length of wire inside the suitcase!

While the glider was being towed up the hill, Doug tested out his transmitter which was totally enclosed in an aluminium cabinet and mounted immediately below the feeder of their wire dipole, which was suspended between two 6ft rods supported at each end by the car. When the glider was airborne, Doug told the pilot that he was the first person to "listen-in" while gliding, and then asked him to "bank" to the left, which he did, as if to salute the expertise of G5CV and G6JP!

## 56 Mc/s Field Days

Field days have always brought out the best in both operators and equipment and records have often been established and broken and new ideas tested out. During a local 56Mc/s Field Day in 1934, BRS157 took his receiver to the top of Chanctonbury Ring in Sussex and heard G6CJ (50 miles), G2YL and G6NF

# THE 5 METRE STORY part 2

Ron HAM BRS15744

(both 27 miles) and G5NF (30 miles). These listener reports were valuable in those early days because they could evaluate the differences between several stations.

The first 56Mc/s National Field Day was held in July 1937 and certificates of merit were awarded by the RSGB to T. P. Allen G16YW and W. Jones GW6OK in recognition of the first 56Mc/s contact between Northern Ireland and Wales. Good distances were covered from various locations in the UK. For instance, G2DC/P located in Buxton, Derbyshire worked G6OK/P (85m), G6MX/P (77m) and G5MQ (40m), while down in Sussex at Kithurst Hill, near Storrington, G5MA/P worked G2NH/P, G5CM/P, G6RD, G5JW/P, G2MV, G6GR and G8IX/P. Up in Cumberland G6JZ using a QRP rig heard no signals all day, but over in Bristol G5JU/P contacted G6FV (14m) and heard G5BK/P at 60 miles.

One of the highlights of the second 56Mc/s NFD, held in 1938, was the contact between GW6AA/P on Snowdon and EI2J (98 miles) running 0.5W input to a type 30 valve from his car on a hill behind Dublin. Although the official report shows that the number of transmitting logs was down from 19 (1937) to 15 the prize for enthusiasm must go to G2NM/P operated by the West Sussex SW and TV Club situated on Bury Hill, in Sussex. Their transmitter was a 6L6 Tritet ECO, 6L6 PA, modulated with a 6N7 in Class B and was powered from a rotary converter giving 110V AC. Many receivers were used besides the receiver associated with the field day transmitter. There was quite a gathering on the site with 35 members and visitors being present. They had a good log to show for their day's work: 11 contacts made and six stations heard, compared with G2JK/P on Epsom Downs, Surrey, who worked 14 and heard eight, and G5MA at Holybourne Down, Hants, who made 13 contacts and heard 10, while up on Snowdon, GW6AA/P worked 11 and heard one plus very strong signals from 5m police stations.

Thirteen listener logs were submitted compared with nine for the 1937 field day, and, apart from 2CIL's record entry, the leading stations were BRS2601 (Ewell, Surrey 21 stations), 2AAH (Chichester Sx 12), and 2DFG accompanied by BRS3322, each with their

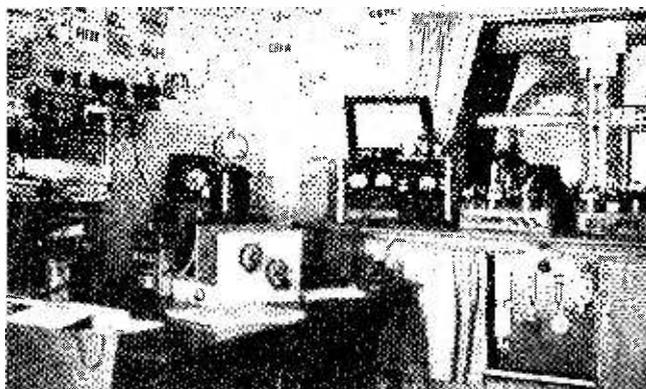
own receiver, situated on Ditchling Beacon, Sx. Between them they heard 13 different stations, eight were on phone and 11 on CW.

## 1939

While researching this story, the author realised that the report of the 56Mc/s NFD held in July 1939 was published in the September issue of the *T & R Bulletin*, several days after the outbreak of World War 2, and the withdrawal of the amateur radio transmitting licence. The RSGB estimated that about 100 amateurs took part in the portable operations during this event, in addition to the large number of fixed stations who joined in from home. During this event, BRS1173 heard three European stations, F8AA, F8NW and ON4DJ, but unfortunately none of the portable stations was able to work them.

The RSGB was pleased to see that their policy of encouraging the use of crystal-controlled transmitters and modern types of receiver was bearing fruit. Of the 16 portable transmitting stations who entered logs no less than 11 employed crystal control and many of them used Acorn valves as RF amplifiers in their receivers.

The adjudicators decided that C. J. Rockall G2VZ and his partner E. Cosh 2DDD were the joint winners of the RSGB's Mitchell-Milling Trophy, not so much on the actual performance of their station or the number of contacts made, but for the clear, concise, and extremely interesting log which they submitted. After the war Eric Cosh became G2DDD and was one of the pioneers of both the 70cm and 23cm bands.



The "shack" of Constance Hall G8LY, in the mid-30's, located at North Waltham Rectory, Winchester.

He spent the summer of 1975 going through the author's collection of *T & R Bulletins* (1930-1940) marking all the references to the 5m band. This work was of great value to the author when writing this story. Eric died in 1976 having devoted his life to the experimental side of amateur radio.

Miss Constance Hall G8LY also qualified for a transmitting award of merit, again not so much for the number of contacts made but for the interesting report which accompanied her entry, including a plan showing the direction and distance of each station that she heard or worked. The equipment used by G8LY was housed in one cabinet and operated from the rear seat of her car and she could rotate her beam aerial through the window.

The third transmitting award went to Ernie Dedman G2NH, partly for his interesting report but more particularly for the consistency with which contacts were made during the whole event; 21 QSOs were made in 10 hours.

In the receiving section two awards of merit were made; one to G. F. Keen 2BIL and the other to J. Cymerman BRS3101 because of the general excellence of their results and well written reports. 2BIL proved the value of CW for making DX contacts, hearing three CW stations over 100 miles away, 11 over 50 miles, but none over 50 miles were received on telephony.

## The Trail Blazers

A small group of experimenters known as the "Folkstone Radio Amateurs" established the first 56Mc/s link between England and the Continent in March 1936. This was arranged through correspondence between the group's chairman G2IC and F8WY. On 29th March the operators at G2FA heard F8NW working F8AA. They gave F8NW a short call and to their great joy he came back, giving them R7 QSA5. Mutual congratulations were exchanged, and it must have been amusing to hear each of the 10 club members present take the microphone in turn and try his hand at French. Later they made contact with F8WY, F8ZF and F8AA.

The apparatus used at G2FA was a long-lines oscillator with a couple of Tungram 15/400 valves in push-pull and an input of 8W at 250V. The aerial was a vertical dipole, Windom fed, with a reflector spaced at a quarter wave. The receiver was a two-valve self-quenching super-regen with a vertical doublet aerial.

TO BE CONTINUED

FR.



Tel.: NATIONAL 4321  
Extension No. 358

Your Reference W/A 3453  
P.O. Reference W/A 3453  
By GEORGE LEE O.B.E., M.C., M.I.E.E.,  
Engineer-in-Chief

ENGINEER-IN-CHIEF'S OFFICE (Radio Branch),  
(G.P.O.), ARMOUR HOUSE,  
LONDON, E.C.1.

14<sup>th</sup> April 1939.

Miss C. R. Hall,  
North Waltham Rectory,  
Winchester,  
Hants.

Dear Madam,

Experiments in Wireless Telegraphy.

In accordance with a recent recommendation made on your behalf by the Radio Society of Great Britain, I am to say that on Saturdays and Sundays from now until the end of September, 1939, you are authorized to instal and use your experimental wireless station G8LY in the open air (on land) within a radius of 10 (ten) miles of your address as shown above, but not within one mile of any Government wireless station.

The terms and conditions of the licence dated 4th June 1938 as extended by the letter of the 5th October 1937 /so far as they are applicable shall be strictly observed with the exception that transmissions shall be confined to the 56 mc/s band only, and the power used shall not exceed 10 (ten) watts.

Yours faithfully,  
*W. H. H. H. H.*  
for Engineer-in-Chief.



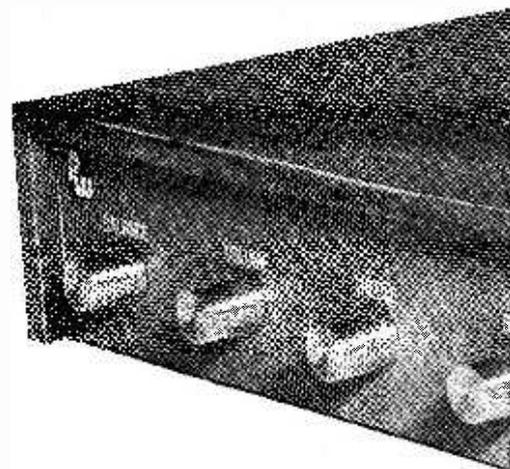
The permit issued to Constance Hall G8LY allowing her to operate with portable equipment. The authorisation "until the end of September 1939" was somewhat prophetic!

This is a general-purpose quality amplifier which has been specially designed with the amateur constructor in mind. Virtually all the components are mounted on a single printed circuit board, greatly simplifying assembly and eradicating the intangible problems of earth loops and hum pick-up from the power supply section. A simple, but very effective, method of heat sinking the output stage is used which, again, avoids a bugbear for the home constructor. Even though construction is simple the circuit is fairly sophisticated and it is imperative that there is no variance from the specified component values. Equally, because of the large number of components, care must be taken to insert them in the right places on the p.c.b.

The design provides push-button input switching and equalisation for a magnetic pick-up cartridge, a tape recorder playback head, a tuner and one auxiliary channel. The output stage provides maximum power into a 4 ohm loudspeaker; however, it is permissible to use 8 or 16 ohm loads provided the reduction in output power is acceptable. Controls are quite conventional utilising ganged potentiometers for Volume, Treble and Bass together with a Balance control. A simple switchable rumble filter can be introduced when required.

A nominal 56V power rail supplies the power amplifiers without stabilisation and has proved to be more than adequate. Nevertheless to avoid damage to speakers from switch-on surges a slow turn-on circuit

# PW EURO stereo



## ★ Author's specification

**INPUT Mag. PU** 5mV RIAA equalised  
**Tape head** 5mV NAB equalised  
**Tuner** 350 to 500mV Low Impedance 'Flat'  
**Auxiliary**, sensitivity 100 to 180mV. Low impedance, 'flat', suitable for:  
 Transistor radio or tape recorder earpiece  
 Or, medium output crystal cartridge with 470k $\Omega$  series resistor  
 Or, ceramic cartridge using 100k $\Omega$  series resistor

**POWER OUTPUT** Continuous, both channels driven, 30 + 30 watts into 4 $\Omega$  load

**TOTAL HARMONIC DISTORTION** (75dB gain at 1kHz) Better than 0.05 to 0.1% typical up to clipping level

**CROSSOVER DISTORTION** at 1W into 16 $\Omega$ -nil

**HUM AND NOISE** 115dB below 50W

**RUMBLE FILTER** -7dB at 100Hz

**CHANNEL SEPARATION** 45dB at 1kHz

**FREQUENCY RESPONSE** 10Hz to 18kHz

**TREBLE/BASS CONTROLS** -20dB to +20dB

**OUTPUT IMPEDANCE** Minimum 1 $\Omega$ , maximum to infinity  
 Open and short circuit protected

**STABILITY** Unconditionally stable

has been incorporated. This will be described later. The supply to the pre-amplifier is 30V; obtained from a conventional series stabiliser circuit.

## Pre-amplifier

The circuit of one pre-amplifier channel is shown in Fig. 1. The heart is an LM381AN integrated circuit which contains two ultra-low-noise amplifiers. They are completely independent and draw their power from an internal power supply decoupler-regulator that provides better than 120dB supply rejection and 60dB channel separation.

The alternative pin numbers shown on IC1 refer to the second channel connections.

Gain, and equalisation, options for the various inputs are selected by switching components into the feedback circuit for IC1. For example, when S4 is depressed the magnetic cartridge input is selected. Resistors R11, 12 and 13 together with C4 and C5 are switched into the feedback loop. R11 and R13 in conjunction with R4 set the d.c. working point of the amplifier and the frequency dependent components -C4, C5 and R12 shunted across R11 determine the compensatory roll-off for the RIAA recording characteristics.

Switch S3 selects the tape-head input. Note that this is designed to accept a signal direct from a tape recorder head and NOT after a tape pre-amplifier stage! NAB playback equalisation is provided by C2 and R7 shunted across R9 in similar manner to that for the magnetic cartridge.

# PA amplifier

C. Toms B.Sc

Part 1

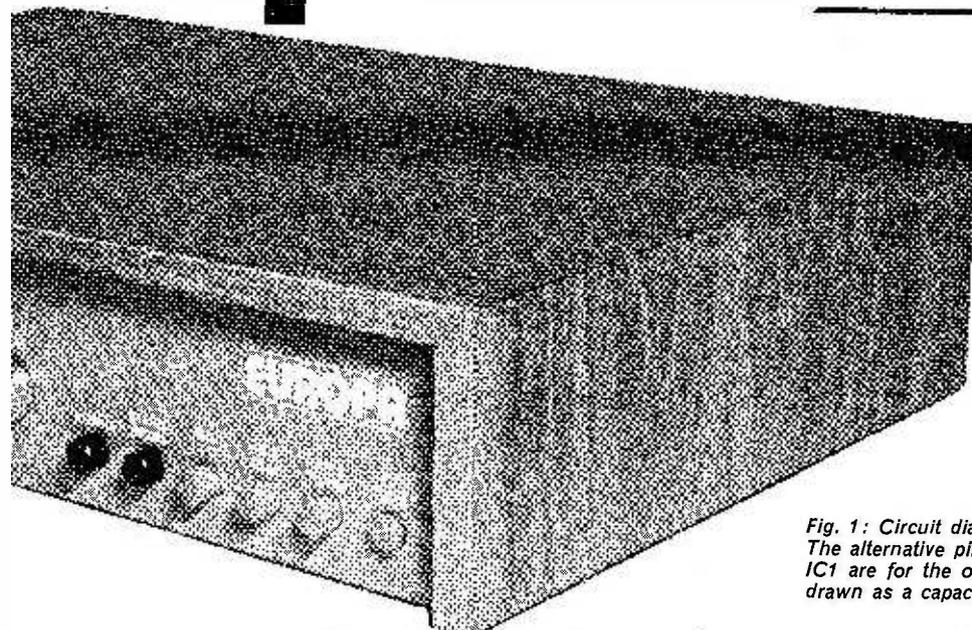
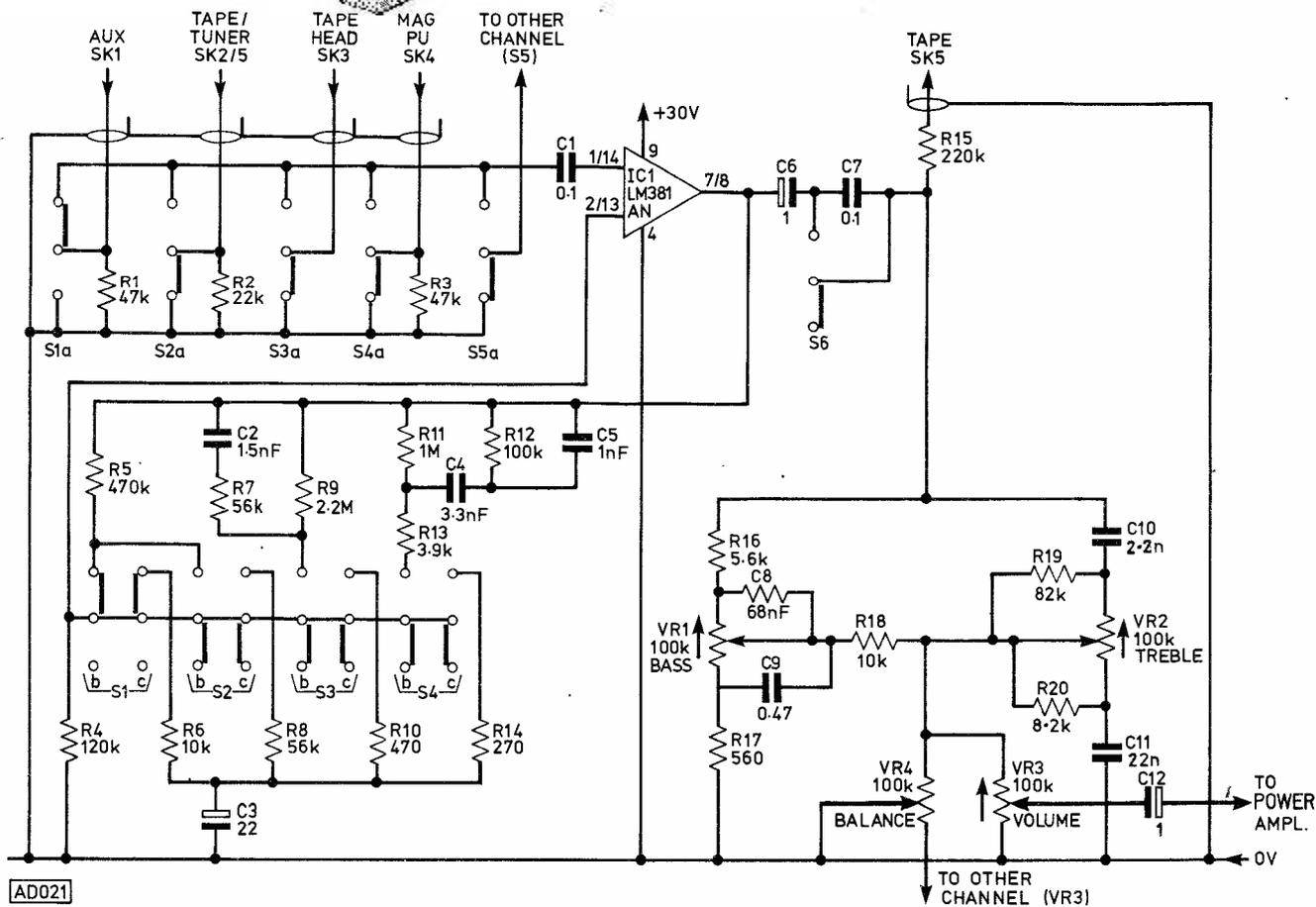


Fig. 1: Circuit diagram of one channel of the pre-amplifier section. The alternative pin numbers given against the inputs and output of IC1 are for the other channel. Note that C8 should (of course) be drawn as a capacitor!



# ★ components

## Resistors (all $\frac{1}{2}$ W unless otherwise stated)

R1 47k $\Omega$	R22 10k $\Omega$ $\frac{1}{2}$ W Metal oxide
R2 22k $\Omega$	R23 330k $\Omega$
R3 47k $\Omega$	R24 820 $\Omega$ $\frac{1}{2}$ W Metal oxide
R4 120k $\Omega$	R25 10k $\Omega$ $\frac{1}{2}$ W Metal oxide
R5 470k $\Omega$	R26 39k $\Omega$
R6 10k $\Omega$	R27 150k $\Omega$
R7 56k $\Omega$	R28 270k $\Omega$
R8 56k $\Omega$	R29 27k $\Omega$
R9 2.2M $\Omega$	R30 6.8k $\Omega$
R10 470 $\Omega$	R31 1.5k $\Omega$
R11 1M $\Omega$	R32 1k $\Omega$
R12 100k $\Omega$	R33 220k $\Omega$
R13 3.9k $\Omega$	R34 12k $\Omega$
R14 270 $\Omega$	R35 2.2k $\Omega$
R15 220k $\Omega$	R36 100 $\Omega$ $\frac{1}{2}$ W Metal oxide
R16 5.6k $\Omega$	R37 100 $\Omega$ $\frac{1}{2}$ W Metal oxide
R17 560 $\Omega$	R38 27 $\Omega$
R18 10k $\Omega$	R39 1k $\Omega$ 2W Wirewound
R19 82k $\Omega$	R40 560 $\Omega$
R20 8.2k $\Omega$	R41 120k $\Omega$
R21 18 $\Omega$	R42 1k $\Omega$
	R43 See Specification

Two off each resistor required, except R39 and R40.

## Potentiometers

- VR1 100k $\Omega$  + 100k $\Omega$  ganged lin.
  - VR2 100k $\Omega$  + 100k $\Omega$  ganged lin.
  - VR3 100k $\Omega$  + 100k $\Omega$  ganged lin.
  - VR4 100k $\Omega$  lin.
  - VR5 100k $\Omega$  min. horizontal preset
  - VR6 1k $\Omega$  min. horizontal preset
- Two off each preset VR5 and VR6 required.

## Capacitors

C1 0.1 $\mu$ F poly.	C12 1 $\mu$ F 25V elect.
C2 1.5nF poly.	C13 0.1 $\mu$ F poly.
C3 22 $\mu$ F 25V elect.	C14 100 $\mu$ F 63V elect.
C4 3.3nF ceramic	C15 4.7 $\mu$ F 63V elect.
C5 1nF ceramic	C16 22 $\mu$ F 63V elect.
C6 1 $\mu$ F 25V elect.	C17 1nF ceramic
C7 0.1 $\mu$ F poly.	C18 1 $\mu$ F 35V tant.
C8 68nF poly.	C19 2200 $\mu$ F 30V elect.
C9 0.47 $\mu$ F poly.	C20 0.1 $\mu$ F poly.
C10 2.2nF poly.	C21 3300 $\mu$ F 63V elect. (high ripple)
C11 22nF poly.	C22 220 $\mu$ F 40V elect.

Two off each capacitor required, except C21 and C22.

## Switches

- S1 6 p.c.o. push button
  - S2 6 p.c.o. push-button
  - S3 6 p.c.o. push-button
  - S4 6 p.c.o. push-button
  - S5 4 p.c.o. latching push-button
  - S6 2 p.c.o. latching push-button
  - S7 S.P.S.T. mains on/off
- } interlocking

## Semiconductors

- Tr1 BC147
  - Tr2 BC147
  - Tr3 BC461
  - Tr4 BC109c
  - Tr5 BC109c
  - Tr6 BC109c
  - Tr7 TIP31A
  - Tr8 BFY56
  - Tr9 BC461
  - Tr10 TIP3055
  - Tr11 TIP3055
  - Tr12 BFY50
  - IC1 LM381AN
  - D1 3A 200V bridge
  - D2 BZY88 C30V 400mW 30V Zener
- Two off each transistor Tr1–Tr11 required.

## Transformer

- T1 Low profile, low flux leakage transformer
- Pri: 240V 50Hz
- Sec: 45V off load
- 38V at 2A r.m.s.

## Fuses

- FS1 2A 20mm
  - FS2 500mA 20mm
  - FS3 2A 20mm
- Two off fuses FS3 required.

## Connectors

- PL1 3-pole, chassis-mounting mains plug
  - SK1 5-pole DIN (180°)
  - SK2 5-pole DIN (180°)
  - SK3 5-pole DIN (180°)
  - SK4 5-pole DIN (180°)
  - SK5 5-pole DIN (180°)
  - SK6 2-pole DIN speaker socket
  - SK7 3-pole, chassis-mounting mains socket
- Two off sockets SK6 required.

## Miscellaneous

- Insulating mounting kits for Tr7, Tr10, Tr11 (two off each)
- Heat-sinks for Tr3, Tr8, Tr9 (two off each)
- Horizontal mounting clip for C21
- Printed circuit board, (available from Reader's PCB Service)
- Materials for chassis, heat-sink and case.
- Knobs for VR1–VR4. Fuse holders for FS1–FS3 (4 off)

NOTE—Many components need to be duplicated (as indicated above) for the two stereo channels

The mains transformer T1 and switch assembly comprising S1–S6 are available from WKF Electronics, 60 Welbeck Street, Whitwell, Worksop, Notts.

The remaining two inputs, selected by S2 and S1, are very similar to each other. Neither is provided with equalisation networks so when these are selected it can be assumed that the amplifier exhibits a flat response. They are therefore suitable to match the outputs of tuners, transistor radios, tape recorder pre-amplifiers and, provided a suitable series input resistor is incorporated, crystal or ceramic cartridges.

An equalised output is provided to feed an external tape recorder via R15 if required and this, of course, is not affected by the pre-amplifier tone, balance or volume controls.

## Tone controls

Due to the high gain of IC1 and its large output signal it becomes possible to use a passive tone control system. This obviates the need for further feedback loops and reduces the chances of introducing instability or noise from an extra stage. The circuit is very similar to that which is normally incorporated in a feedback loop and provides bass and treble boost or cut from a centrally flat characteristic.

Potentiometer VR1 is the Bass control and when its wiper is nearest R16 maximum bass is obtained.

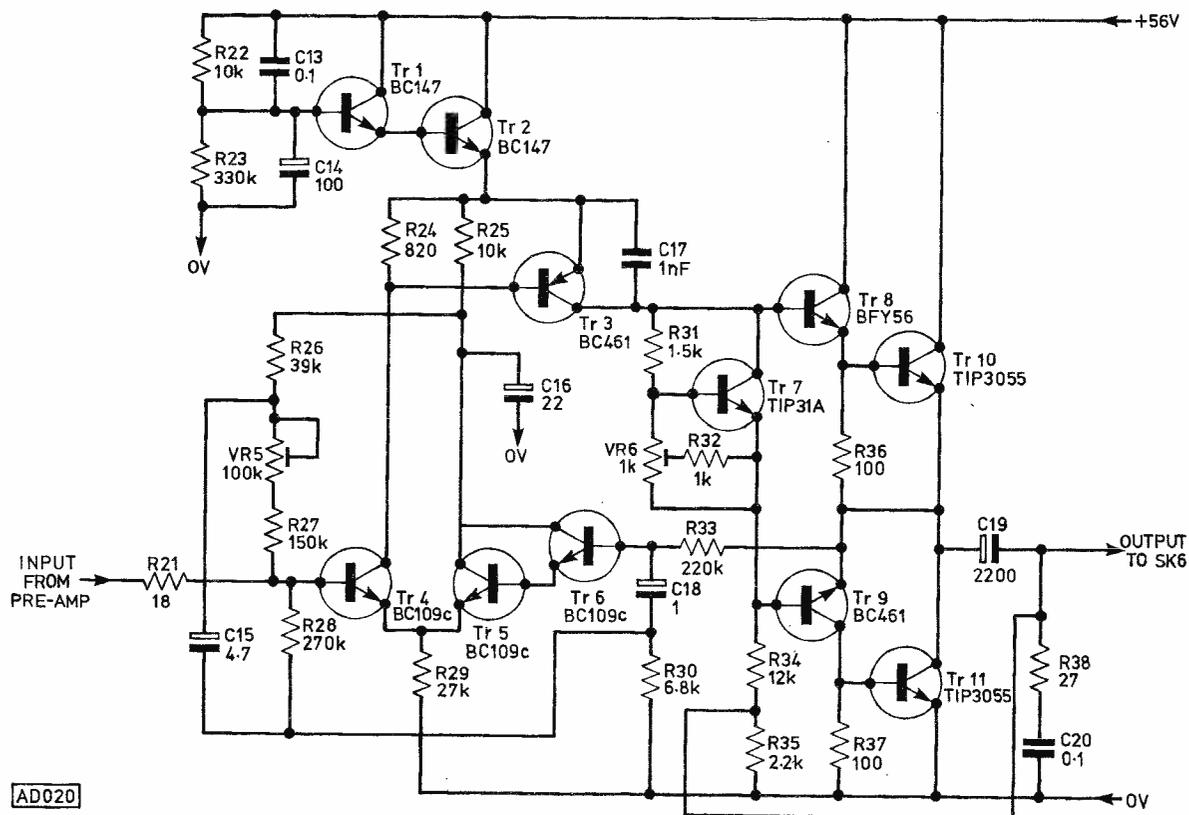


Fig. 2: Circuit diagram of one channel of the power amplifier section.

VR2 provides maximum treble boost when its wiper is nearest C10. A simple rumble filter is incorporated before the tone controls. This is C7 which is in circuit when S6 is released, providing a low-frequency roll-off, but shorted out when S6 is depressed.

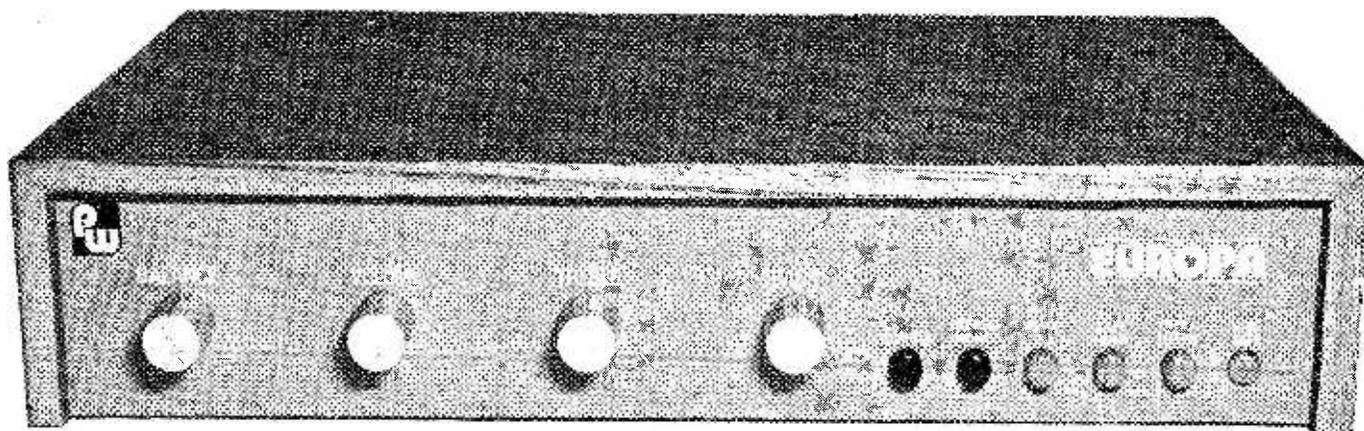
## Power amplifier

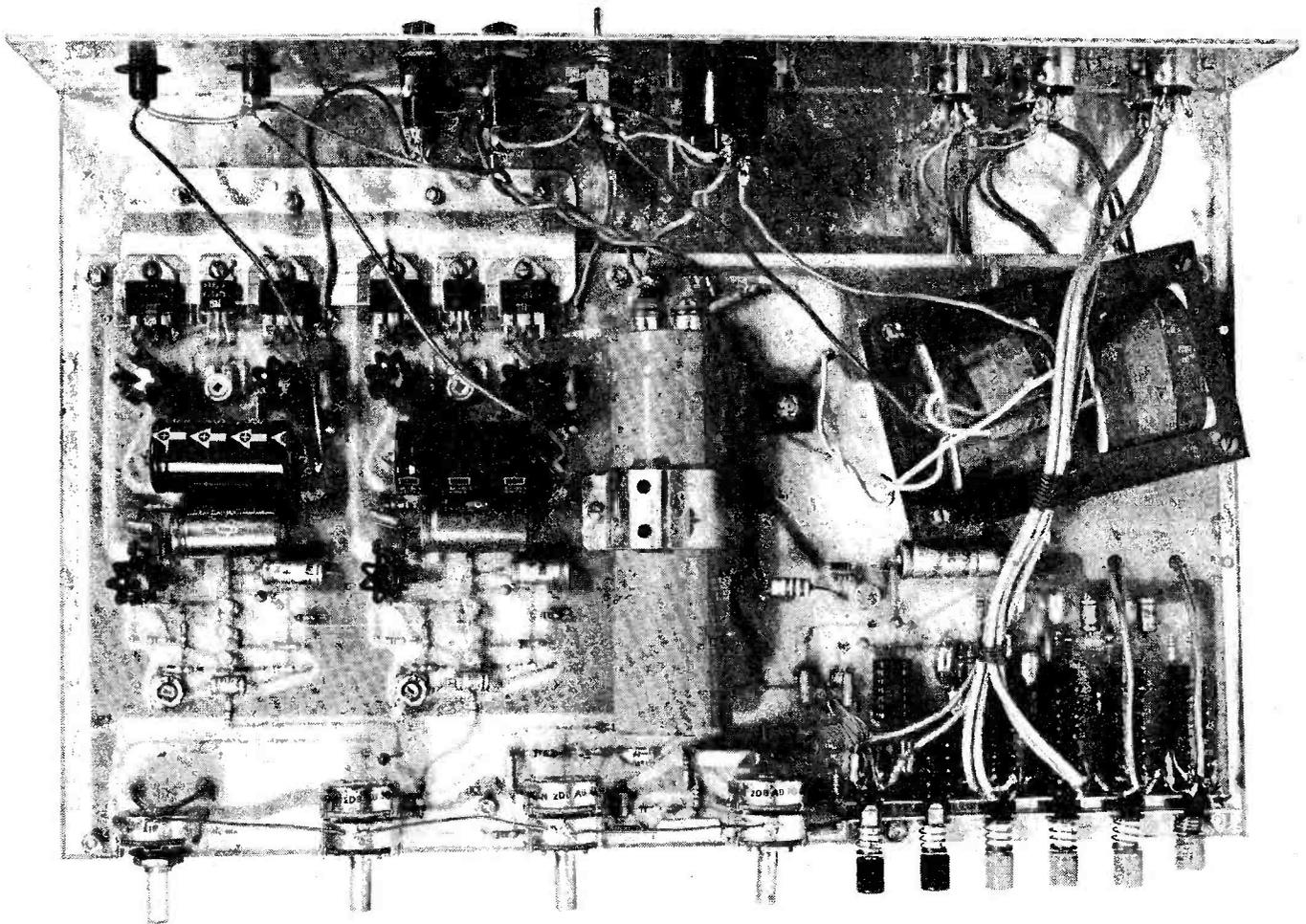
The circuit of one channel's power amplifier is shown in Fig. 2. Transistors Tr4, 5 and 6 make up a differential input stage. The base of Tr6 is the inverting input which is used for main feedback stabilisation. Naturally the centre voltage of the quasi-complementary class B output is going to depend on

this d.c. feedback and the state of balance of the long-tailed pair input stage. The latter can be adjusted by means of VR5 and this control is used during the setting-up procedure to make sure that the quiescent voltage at the positive end of the output capacitor C19 is mid rail.

The two transistors Tr1 and 2 are not in the main audio route but serve as a slow turn-on circuit which prevents a surge of power from damaging the loudspeakers. Rate of application of power to the input and driver stages is determined by the charging curve of C14 on the base of Tr1.

Biasing of the output stage is controlled by Tr7 and can be adjusted by VR6 to set the standing output stage current and minimise cross-over distortion.





Internal view of one of the prototype amplifiers. There are minor differences in layout compared with the final version of the p.c.b., which will be shown next month.

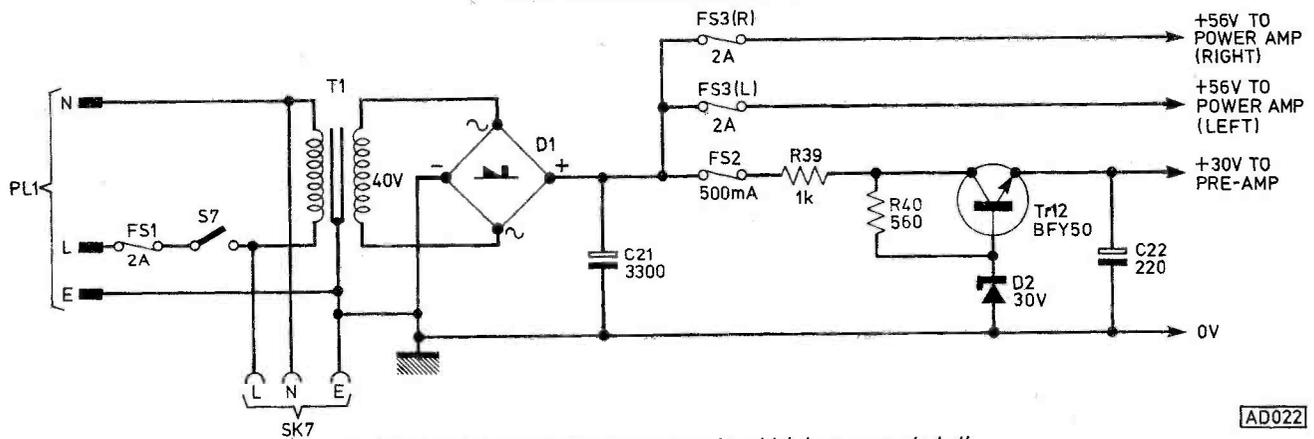


Fig. 3: Circuit diagram of the power supply, which is common to both channels.

AD022

## Power supply

The circuit of the power supply is shown in Fig. 3. A low-profile, twin-bobbin transformer is used which gives extremely low flux leakage and it is precisely located on the printed circuit layout to minimise any flux linkage with the pre-amplifiers and input switching. The transformer delivers 40V a.c. to a conventional bridge rectifier and thence to the smoothing capacitor C21 which is specified to have a high ripple rating. No regulation is provided for the power amplifier supply; however the pre-amplifier supply is taken from a small stabiliser based on Tr12, R40 and D2.

# NEXT MONTH

## CONSTRUCTION

## AND SETTING UP

# PRODUCTION LINES

alan martin

## Versatile clock module

The LT601 red LED display electronic clock module can function as both a 12 or 24hr display system and operates at 50 or 60Hz.

The series provides four basic selectable display modes; time, seconds, alarm and sleep display, and is a 4-digit, 0.5in LED display complete in itself apart from the mains transformer and function switches.

Featuring power failure indication the module includes brightness control capability, 'sleep' and snooze times, alarm 'on' and PM indicators, direct drive—no r.f. interference, fast/slow time setting control, pre-settable 59min sleep timer, 9 min snooze alarm and lead zero blanking.

For the 12hr display modules the colon flashes at one hertz rate and for 24hr displays it is fixed.

The module finds application as a clock radio timer, desk clock, alarm clock, television-stereo clock and instrument panel clock.

At £6.00 plus VAT and 30p P&P, the module type LT601, manufactured by Litron Electronics is available with full specification and application information from:

*Bywood Electronics Ltd., 68, Ebbens Road, Hemel Hempstead, Herts, HP3 9QR.*

## New ABS boxes

A new range of ABS boxes, manufactured in four colours (orange, blue, black and grey) is now available. Each incorporates slots on all four sides for holding 1.5mm (0.062in) thick P.C.B's. The 1.5mm thick front covers sit recessed into the front of the boxes

and are held by four fixing screws, running into threaded brass inserts. Available in three sizes measuring from 56 × 85 × 28.5mm to 96 × 161 × 52.5mm, BIM4000 BIMBOXES have excellent electrical insulation properties, rated at 85°C (185°F) and are supplied with four self-adhesive rubber feet. Prices range from 80p to £1.49 plus VAT and P&P each.

*BOSS Industrial Mouldings Ltd., Higgs Industrial Estate, 2, Herne Hill Rd., London SE24 0AU. Tel: 01-737 2383*

## Scrub up

We have recently received a handy little tool for cleaning electrical contacts and surfaces.

The cleaning tool consists of a plastic body in which is mounted a stiff spun glass insert. The tool works on the same principle as a propelling pencil, as the exposed end of the insert wears, its length may be adjusted by a screw at the top of the tool.

The E105 contact cleaner is suitable for a variety of cleaning applications especially the cleaning of contacts, joints and pcb tracks prior to soldering.

The E105 costs 0.98p inclusive of P&P and VAT from:

*Eraser International Ltd., 2/3, Hampton Court Parade, East Molesey, Surrey KT8 9HB. Tel: 01-979 8141/2.*

# KINDLY NOTE!

## Jubilee Organ, Part 2, October 1977 PW

ICs 3, 4, 5 and 6: connections to pins 8 and 14 are shown reversed. It is unlikely that damage will occur as a result of this error, but these ICs will not function connected as previously shown.

## Traffic Light Controller, December 1977 PW

C1 is shown reversed. The positive end should connect directly to +6V, i.e. between pins 1 and 7 of IC1. To suit variations in timing, C1 may be varied from 1000µF to 3000µF. In the components list, IC3 is shown as SN7411A. This should read SN7441A.

## Direct Conversion Receiver, January 1978 PW

The resistor, ident R7 in the PCB layout on P655 (Fig. 8) should be shown as R11. The circuit diagram is correct.

## Proportional Power Controller, January 1978 PW

C5 voltage rating was omitted; this should be 600V DC working (300V AC). If single polystyrene types are not available, one 10nF and one 22nF in parallel will suit. The jack socket should be a fully insulated type (for TH1) and care must be taken to ensure correct polarity of connection to the mains. IC1 is basic type L121 (Doram order code 65-600-9).

## RAE No. 5, January 1978 PW

We regret that two errors occurred in formulae on page 662.

For the Parallel Impedance case, left-hand column, line 6, please read:

$$Z = \frac{R \cdot X}{\sqrt{R^2 + X^2}}$$

For the current flowing in a Series Resonant Circuit, right-hand column, line 14, please read:

$$I = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$$

# MULTI-RANGE

# TEST METERS

D. JONES

The small savings made in building a multi-range meter, rather than purchasing a commercially-produced model, do not as a rule justify the decision. The commercially assembled product is more often than not of greater accuracy and reliability. However, were it possible to build such a device at a considerable saving whilst maintaining a high degree of precision, then the project must surely be considered worthwhile.

This article covers the theory which will enable readers to produce an accurate instrument at favourable cost. It can be applied to movements of any FSD or coil resistance.

## Ammeter Formulae

In order for a meter to read higher than its basic movement will allow, it is necessary to divert a proportion of the current away from it. This is achieved with a by-pass resistance—known as a “shunt”—which is placed across (or “in parallel with”) the movement. Fig. 1 shows this in circuit form. The shunt  $R_P$  is of a precisely-calculated value and diverts a finite proportion of the total current away from the movement.

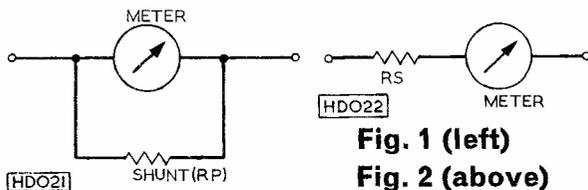


Fig. 1 (left)  
Fig. 2 (above)

Thus the meter will pass a percentage of the total current in the circuit, the remainder being carried by  $R_P$ , whose value may be determined from the formula:

$$R_P \text{ (ohms)} = \frac{V_{FSD} \text{ (volts)}}{\text{Required FSD} - \text{Meter FSD (ampères)}}$$

The FSD Voltage of the meter coil ( $V_{FSD}$ ) can be obtained from:

$$V_{FSD} = \text{FSD (amps)} \times \text{meter resistance (ohms)}$$

Problems are likely to occur when shunt resistances become very small and attention has to be directed to difficulties arising from manufacturing techniques; even the contact resistance of range switches must be taken into account. Accurate resistors below a few ohms in value are difficult to obtain and will probably have to be made from resistance wire.

## Voltmeter Formulae

The principle in the voltmeter is to measure the amount of current produced by applying a voltage across a fixed resistance. If the meter itself does not present a high enough resistance to the circuit,

excessive current will be drawn and the meter will swing hard over or even burn out. In this case a series resistor will have to be inserted “in line” with the meter to reduce the current to a value within the range of the movement. This is illustrated in Fig. 2.

The series resistor  $R_S$  can be calculated from:

$$R_S \text{ (ohms)} = \frac{\text{FS reading required (volts)}}{\text{Current for FSD (amps)}} - R_M$$

Again, this formula holds good for all values, but in practice, problems are likely to be met. If the combined meter and series resistance is too low it will

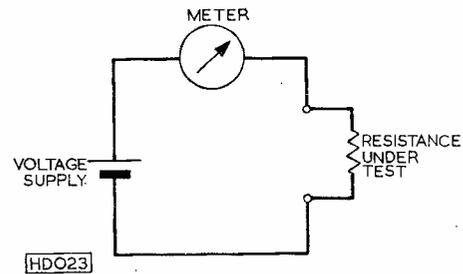


Fig. 3

load the circuit under test, producing inaccuracies. Likewise, if high voltages (in the order of hundreds of volts) are to be measured, the resistors will have to be adequate if breakdown is to be avoided.

## Ohmmeters

With an ohmmeter the idea is to monitor the current passed through a resistor when a known voltage is applied, and this is demonstrated in Fig. 3. Assuming the movement to have little or no internal resistance compared to the device under test, a simple application of Ohm's Law produces the result:

$$\text{Resistance to be tested (ohms)} = \frac{V_{\text{supply}}}{I_{\text{meter}}}$$

Fig. 3 in fact constitutes the simplest form of ohmmeter. Usually a multi-range meter will be used, with a resistor for current-limiting. Several test voltages are often provided and a potentiometer enables the pointer to be set at zero. Fig. 4 is a more likely basic design, providing switched ranges, but here the series resistors for each range may have such widely-differing values that the zero adjustment is inadequate. A more satisfactory solution is to select different current-limiting resistors, and Fig. 5(a) illustrates the technique. A three-gang switch is used to obtain four ranges.

Using the lowest value current-limiting resistor and

adding a high and low value potentiometer offers an overall solution and this is the popular method of achieving switched ranges. Fig. 5(b) shows the final progression.

The scale calibration of an ohmmeter is not linear, see Fig. 6, and this can be explained using Ohm's Law. Doubling the resistance halves the current, so as the needle deflection doubles, the resistance halves. Consider a resistance which will permit 1mA to flow from a 1.5 volt battery (assuming a meter of 1mA FSD),

$$\text{then from Ohm's Law } \frac{V}{I} = R$$

Where V = test voltage, I = current, R = resistance

$$\frac{1.5}{0.001} = 1500 \text{ ohms}$$

The minimum measurable resistance is therefore 1,500 ohms.

Considering the centre point (0.5mA) of the scale:

$$R = \frac{V}{I} = \frac{1.5}{0.0005} = 3000 \text{ ohms}$$

If the scale were linear we would expect its resistance at half-scale to be twice that at full scale and half that at the beginning. However, 3000 is not half of infinity but is twice 1500. Now the peculiarity will be apparent, and the scale will resemble Fig. 6.

Movements in excess of 1mA are rare in ohmmeters and 50µA is sometimes used. Parallel resistances increase the FSD if required.

## Ammeter Shunt Switching

The correct approach for selecting current ranges using a double-pole switch is shown in Fig. 7. Note that any resistance introduced by the contacts is applied to the entire circuit, thus the resistor-to-meter ratio is maintained. The two poles of the selector switch are ganged together to reduce contact resistance to a level negligible with meters having a resistance greater than a few ohms.

## Voltmeter Switching

Range selection in voltmeters is quite simple and if only voltage is required single pole switching as in Fig. 8 can be employed. Contact resistance in this case can be ignored.

Series resistances will be fairly high and values of at least 1000 ohms should be used in order to provide a reasonable accuracy. Sensitivities are usually quoted in "ohms per volt" and this is the resistance of the voltmeter on the 1 volt range. Switching to a higher voltage range will increase the internal resistance by a similar factor. Thus, switching from the 1 volt range to the 5 volt range multiplies the resistance by a factor of 5; e.g. 5000 ohms on a 1000 ohms-per-volt instrument. Note that this is not expressed as 5000 ohms-per-volt, because it is not the resistance of the meter on the 1 volt range. The sensitivity of a meter provides a guide to its accuracy, since the higher the resistance the less loading of the circuit under test. Commonly, meters of 20,000 ohms-per-volt are found and even 100,000 ohms-per-volt is not uncommon. Nowadays most quoted measurements are made using a 20,000 ohms-per-volt standard (i.e. AVO 8 or 9).

Combining a voltmeter with an ammeter requires only the techniques as applied to the ammeter, and Fig. 9 gives a practical circuit for this.

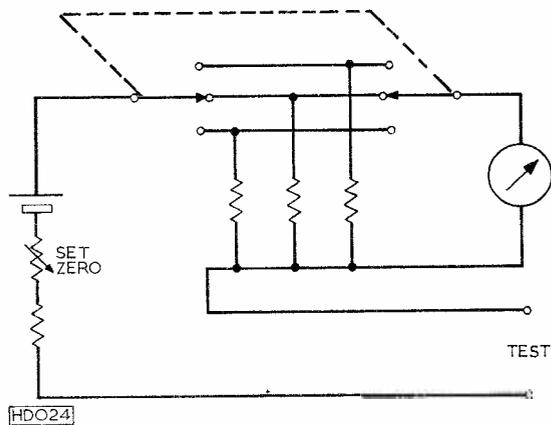


Fig. 4

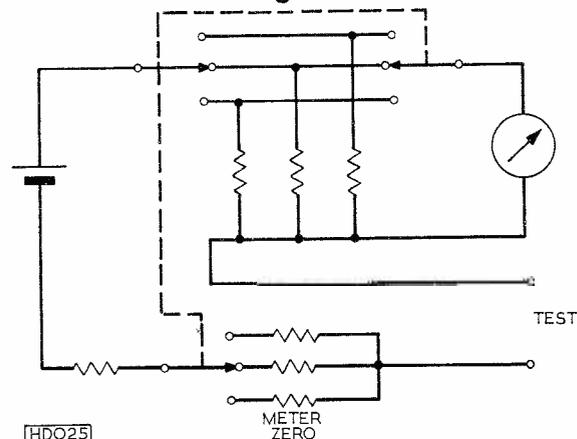


Fig. 5 (a)

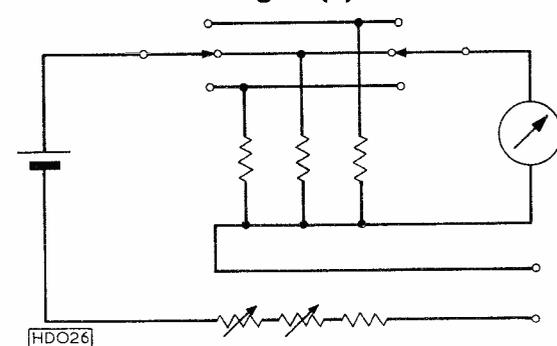


Fig. 5 (b)

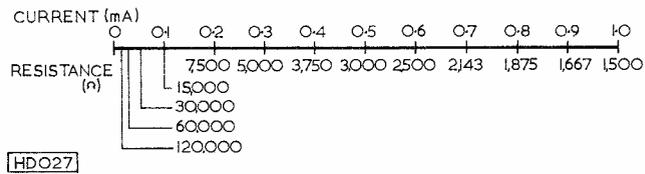


Fig. 6

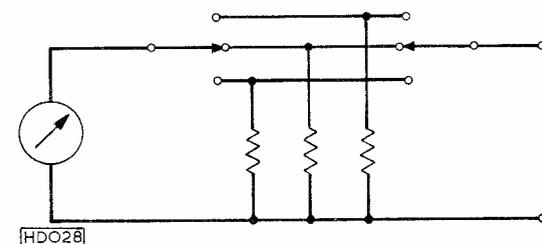


Fig. 7

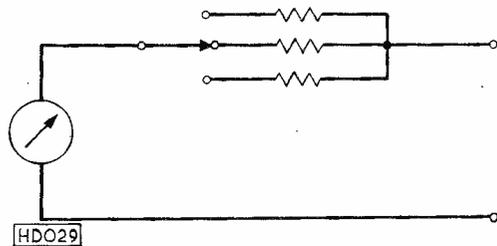


Fig. 8

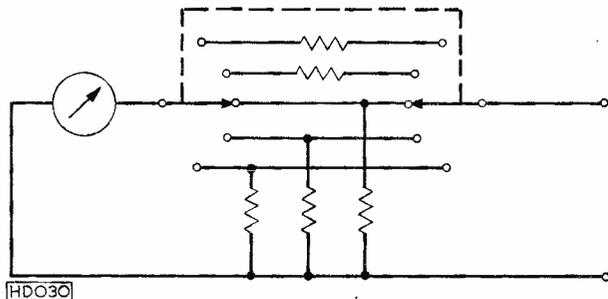


Fig. 9

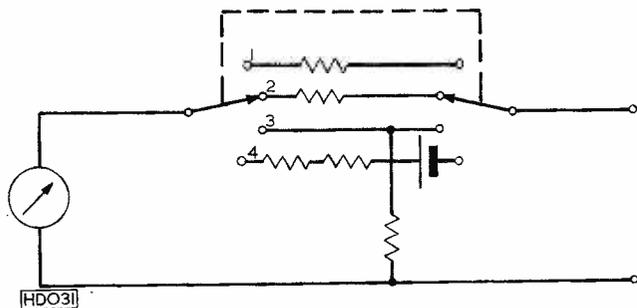


Fig. 10

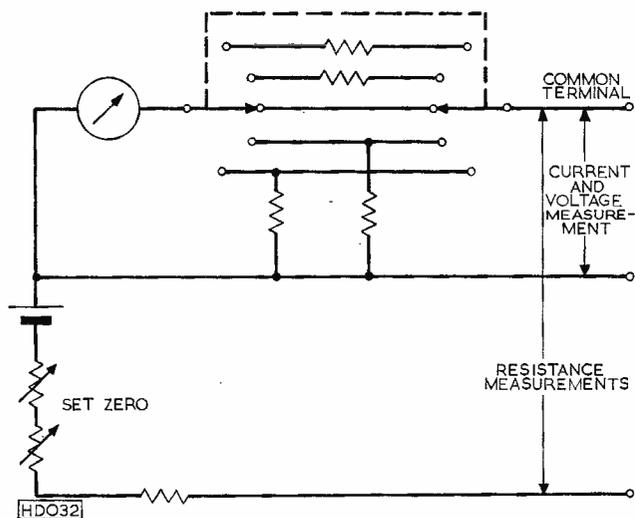


Fig. 11

### Adding an Ohmmeter

Two methods of including an ohmmeter can be utilised; direct wiring into the switch or by using a separate terminal on the instrument. The first of these options is obviously the simpler but reduces the number of ranges available for current and voltage measurement. A basic wiring diagram is shown in Fig. 10.

The latter of the choices offers many advantages; principally, though, it does not use valuable range-

space on the function switch. A disadvantage, however, is the requirement for a third terminal on the multimeter, which may be considered to be confusing. Careful layout should avoid ambiguity in this instance, and a typical circuit is shown in Fig. 11. The separate terminal enables current ranges to be used for extending the lower end of resistance ranges.

Another idea for altering the ranges is to change the test voltage. If this voltage is increased, the lower and upper measuring ranges will decrease and increase respectively.

### Some Notes on General Construction

In most cases, the precise value of resistor will not be obtainable and the solution here is to combine two or more resistors, of one or two per cent tolerance, to achieve the desired value.

Scale calibration is best performed by removing the meter covers and possibly the face as well. This is not always practical, so choose a meter which can be dismantled. The scale as supplied can be copied onto a piece of white card or stiff paper and other ranges calibrated against it.

Resistance ranges can be a little tricky as they are non-linear. The resistance of the current-limiting resistor and that of the meter must be considered, and the following expression is helpful in determining the resistance under test at any given point on the scale.

$$R_D = \frac{V_T}{I_C} - (R_M + R_L)$$

Where  $R_D$  = Resistance indicated meter

$R_M$  = Meter resistance

$I_C$  = Current through circuit

$R_L$  = Limit resistance

$V_T$  = Test voltage

A more elaborate method is to use close-tolerance resistors of known value, "zero" being obtained by shorting the test terminals. Precision resistors of low value can be cut from "resistance wire" using the formula: Resistance = Length × ohms/metre. Typical examples of ohms-per-metre against gauge are shown below for "Eureka" wire.

Gauge	Ohms/metre	Gauge	Ohms/metre
16	0.236	28	4.41
18	0.420	30	5.28
20	0.746	32	8.29
22	1.23	34	11.40
24	2.00	36	16.70
26	2.98	38	26.96

It is important that these resistors should, when made, be less than 75mm long.

When not in use, it will be noted that sharp movement of the instrument causes a violent swing of the meter needle. This is due to 'eddy currents' being induced into the coil. It is therefore good practice to arrange for the meter terminals to be 'shorted' during transportation.

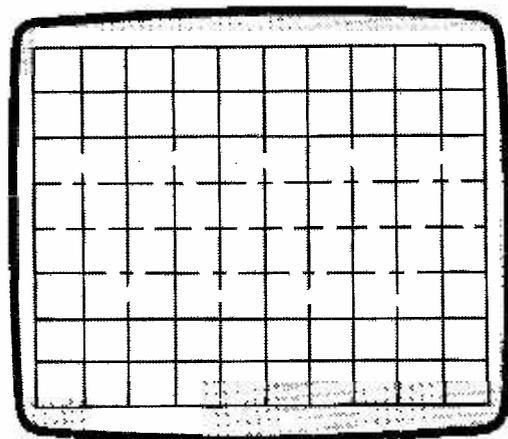
Finally, it will be found that 1000 ohms/volt and 20,000 ohms/volt meters require movements with FSDs of 1 milliamp and 50 microamps respectively. The 50 microamp movement is a good one to use and will cost only a little more than one of 1 milliamp. ●

ON SALE MAR. 3RD.

NEXT MONTH IN...

# practical WIRELESS

## Construct the **PURBECK**



The oscilloscope is probably the most useful instrument in the workshop, enabling as it does the constructor to look at the waveforms occurring in his equipment. The 'Purbeck' is a 5MHz single beam scope especially designed for easy building by the home constructor yet providing him with a professional piece of equipment.

# scilloscope

also:

## 'SLIM JIM'

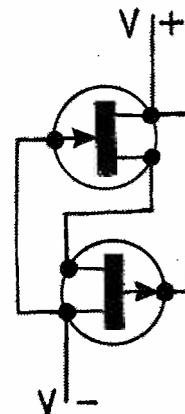
"Slim Jim"—an omni-directional free-space two-metre aerial featuring a radiation efficiency 50% better than a ground plane. It is slender, offering low wind resistance, and will operate with equal facility on lower or higher frequencies, with only minor modification of dimensions.

## 2~METRE AERIAL

and

## VHF WAVEMETER

This is an attractively simple design for checking that the operating frequency of VHF transceivers is within the authorised band, and is cheap to construct, using only ten basic components.



# audio/visual logic probe

PHILIP BOND

## Introduction

Over the past decade the digital electronics scene has passed through several phases. In this time, the amateur electronics market has seen the popularity of digital ICs rapidly increase. At the moment there are two main logic families used in amateur electronics and radio, these are called TTL and CMOS. TTL (which means Transistor-Transistor Logic) was developed in the late 1960s and uses bi-polar transistors to perform the logical operations. CMOS (sometimes called COSMOS which means Complementary symmetry Metal Oxide Semiconductor) uses FETs to perform the operations. Each family has its various advantages, so they will both be in use for some time yet.

This project leads on to construct a logic probe which will aid fault finding and testing on equipment which has either of these families in its design. The display is given by LEDs and an audible output is also given, a low pitched tone for low logic level and a high pitched tone for the high logic level. This is particularly useful when the user does not wish to keep turning to look at the visual display.

In order to enable the device to be used on either logic family, certain design parameters were necessary. These are:—

1. High input impedance to minimise circuit loading
2. Wide supply voltage (5-15 volts)

It must also be:

1. Relatively inexpensive
2. Compact

The device is powered from the logic supply rails of the equipment under test and current consumption is only about 15 mA enabling testing to be carried out on battery powered equipment.

## Circuit description

Let us assume that we have connected the logic probe to the supply rails of the device under test and switched S1 into the "tone on" position. Under idle conditions the potential divider formed by R2, R3, R4 and R5 puts a bias on the inputs of the inverters. The inputs of IC1 (a) and (b) are biased such that they have a logic HIGH on their inputs. Their inverting action causes their outputs to be a logic LOW level. Hence, LED1 is not lit and D1 is reverse biased which prevents the astable from oscillating. Likewise, the bias on the inputs of IC1 (c) and (d) cause LED2 to be off and the output of IC1 (e) is low which reverse biases D2 and similarly stops the astable from oscillating.

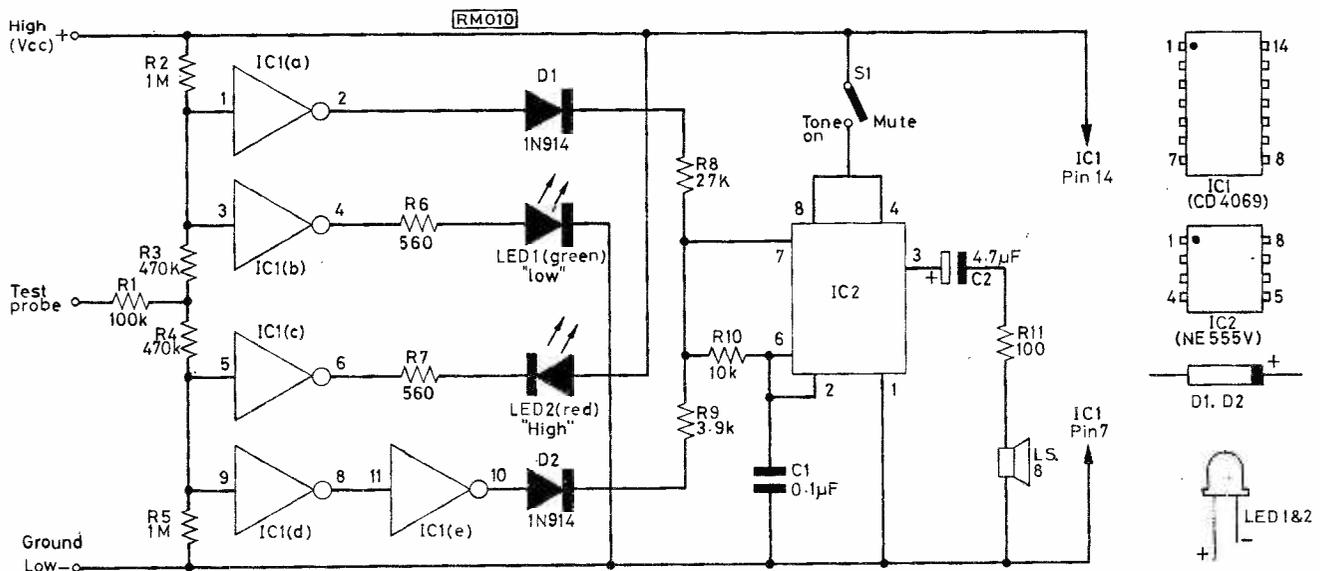


Fig. 1: Complete circuit diagram of the logic probe.

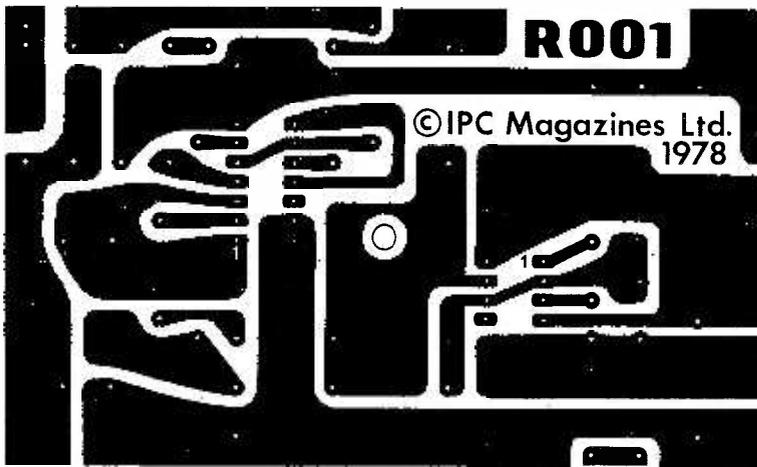


Fig. 2: The PCB viewed on the copper side. This board is obtainable from the PW Readers' PCB service. Details page 825.

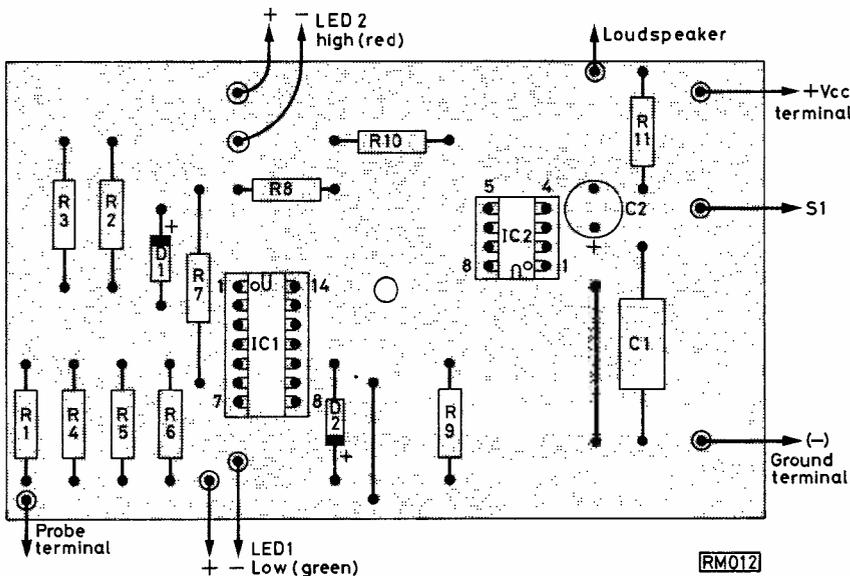


Fig. 3: The PCB viewed on the component side.

Let us now assume that we connect the probe to a HIGH logic level. The inputs of IC1 (a) and (b) are not altered but the inputs of IC1 (c) and (d) are now such that they are almost at the logic HIGH rail voltage. Consequently they invert and their outputs swing LOW. Pin 6 is now low so that LED2 illuminates and pin 10 of IC1 goes HIGH, D2 is forward biased and R9 is effectively connected to the positive (HIGH) supply rail. The astable oscillates at a frequency of about 600 Hz. This is reproduced in the loudspeaker.

Now when the probe is applied to a LOW logic level the inputs of inverters IC1 (a) and (b) are pulled LOW and their outputs swing towards the positive (HIGH) rail. LED 1 is now lit and D1 pulls R8 to the positive rail. Once again the astable action takes place but since the value of R8 is larger than that of R9 the frequency of oscillation is lower. In fact the oscillator (IC2) now operates at about 300Hz, an octave below the HIGH tone.

If the probe is applied to a point in a circuit which is half the supply voltage then no LED will light or tone be heard. Normally these results occur if a point is disconnected, and the fault would soon be isolated. If the tone is not required the oscillator can be disabled by switching S1 to the mute position.

## ★ components

### Resistors

R1 100kΩ	R7 560Ω	
R2 1MΩ	R8 27kΩ	
R3 470kΩ	R9 3.9kΩ	All ¼ or ½ W
R4 470kΩ	R10 10kΩ	5%
R5 1MΩ	R11 100Ω	
R6 560Ω		

### Capacitors

C1 0.1μF (Myjar)
C2 4.7μF 16V (Electrolytic)

### Semiconductors

D1 and D2 1N914
LED1 TIL 209 Green (or TIL 211) with bezel
LED2 TIL 209 Red with bezel
IC1 CD 4069 AE or E (See text)
IC2 NE 555 V timer

### Miscellaneous

Small (3") loudspeaker 8 or 16Ω impedance. Verocase (153mm × 84mm × 79mm) Part no. 75-1239-K. SPST Miniature toggle switch. 2mm Plugs and sockets (Red, black and white). Ball point pen case, paper clip, wire, 6BA nuts and bolts.

## Construction

The neatest way to mount the components is to use a small printed circuit board, and the design for such a board is shown in Fig. 2. The component layout is shown in Fig. 3.

The CMOS IC listed in the table of components for IC1 shows that a CD 4069 AE or E is required. However, there is the possibility that readers may be given a device which does not comply with this number. The different manufacturers use different codes to identify their devices and this takes the form of a prefix group of letters. CD is used by RCA, but you may see ICs with the letters SLC or MC1 printed on them. The important parts are the four figure number code and the suffix, i.e. the "4069 AE or E". The AE is one of many suffix codes used to show the range of characteristics which the device will possess. AE means the device is in a plastic DIL encapsulation, with a voltage range of 5 to 15 volts. There is also an indication of the temperature range of the device within this code too, but that does not matter in this application. The "E" device will operate over a slightly wider voltage range than the "AE" device, but this wider range is not necessary.

CMOS ICs are prone to damage if subjected to large static charges, so the CMOS IC, (IC1) should be the last component to be put in the circuit. Do not remove it from its special conductive packing until you are ready to use it. Damage may also arise if the pins are heated for too long, when soldering the device into the circuit. So if the constructor does solder the device directly in, then make sure the iron is not held at the individual pins for more than 5 or 6 seconds. Alternatively, the problem can be removed by using holders for the ICs.

The board and its subsidiary components were mounted in a plastic box, which was available commercially. This had the advantage that the top could be easily removed if any repair was necessary. Also, the box seemed to be tough enough to withstand a fair deal of knocking about, so it was an obvious choice for a test instrument case.

The loudspeaker and LEDs were mounted in the lid of the case; holes for the loudspeaker and the LED bezels were drilled plus two small holes for accommodating the 6BA bolts which were used to secure the loudspeaker.

The wiring layout is shown in Fig. 4. The LEDs have an anode and cathode like any other diode and the correct polarity must be observed. The longer lead of the two is the anode (positive) and it is best to wire

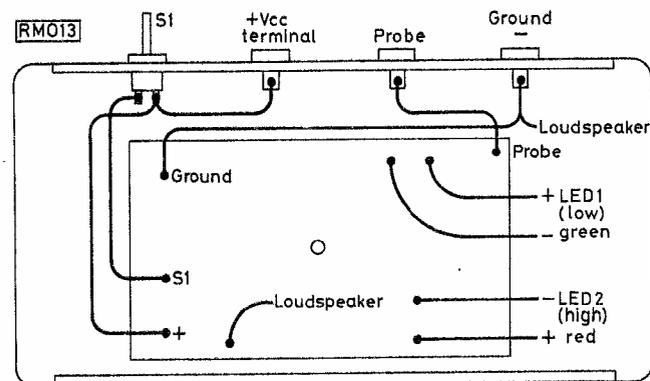


Fig. 4: Wiring the case-mounted components.

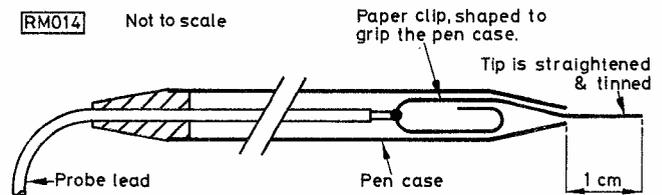


Fig. 5: Details of the probe assembly.

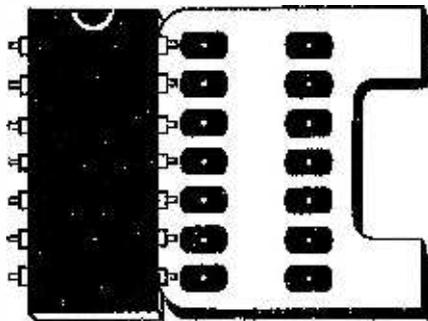
these leads in one at a time so that errors cannot occur when the lead is trimmed short. Also note that S1 must be closed when it is in the lower position. This is the "tone on" state and since down for on is widely used in electronics, this way was chosen here. The panel lettering was done with dry rub-down transfers: Vcc + marks the logic 1 rail, GND (Ground) marks the logic low rail and "probe" indicates the probe terminal.

The probe itself I claim no originality for whatsoever, since the method of making one has bedecked the pages of PW on a number of occasions. A ball point pen case was used as the tube, and the tip was made from a re-shaped paper clip. The clip was partly opened out and tinned (See Fig. 5). A small hole was made in the cap of the pen and the probe lead was passed through the hole and soldered to the paper clip. The clip was then pushed down the tube with a piece of stiff wire until 1 cm protruded through the end. The cap was put on again and the probe lead was terminated on a small plug, which, of course matched the socket on the front panel of the main unit. Two other leads were made but instead of probes they had small crocodile clips on their ends to connect to supply points in the circuit, under test. These leads were also connected to some small plugs which matched the sockets on the front panel. In fact two sets of test leads were made: one set for use where the probe is in close vicinity to the work being done, and a much longer set of leads for when the probe is located some few feet away.

## Testing the unit

With all components mounted and the wiring checked the device can be tested. The device detects whether the probe is at a voltage nearer to the positive rail (Logic HIGH) or negative, in other words at the LOW rail. By connecting the leads of the device to the positive and negative terminals of a PP9 battery, the action of the logic probe can be checked. The probe should then be put to the appropriate connection on the box, and S1 can be switched to the "tone on" state. When the probe is not connected to either terminal, the LEDs should be off (or very dim) and the tone should be non-existent. If the probe is touched to the positive terminal the "HIGH" LED should now light up and the tone will be relatively high in pitch. And conversely when the probe tip is touched to the negative terminal the "LOW" LED will come on and the tone should be about one octave (which is "half" for all readers who are not musicians) below the first tone.

If these results are obtained the device is ready for use. There are many instances when a straightforward logic state display is useful; slow speed logic circuits and combinational logic elements can be checked. It also provides a very powerful teaching aid for those who are teaching or indeed learning the rudiments of digital electronics. ●



# OF THE MONTH 67

Brian DANCE M.Sc

## SPRAGUE ULN-3006T HALL EFFECT SWITCH

This month we will review one of the rather less well known devices, namely a Hall Effect switch. This is a miniature device in a plastic transistor type package which produces a sudden large change in its output voltage when the magnetic field exceeds a certain level.

There are many possible applications of such magnetic switching devices. For example, if a magnet is fixed to a revolving shaft (such as the propeller shaft of a car) and a stationary Hall Effect device is fixed close to it so that the magnet passes near to the device each time the shaft revolves, the pulse rate will be equal to the rate of revolution of the shaft. One can therefore use the pulse rate to measure the rate of rotation of the shaft or, in the case of a vehicle, its speed.

### Applications

The Hall Effect device can also be employed to generate the pulses required for electronic ignition systems by employing a rotation magnet fixed to the camshaft. Similarly, it can be used to detect when the wheels of a vehicle lock on braking and an electronic system can be made which will keep releasing the locked brakes for a small fraction of a second whenever the locking occurs; skidding can then be greatly reduced, if not eliminated.

In general, the ULN-3006T can be used whenever one wishes to detect the close proximity of a magnet to the device, actual contact being unnecessary. For example, it can be used to generate the pulses

required when the magnetic keys of a keyboard are depressed.

### The Hall Effect

In order to understand how the ULN-3006T operates, we must first mention the basis of the Hall Effect. Let us consider a thin slice of silicon of rectangular shape, as shown in Fig. 1. A current flows

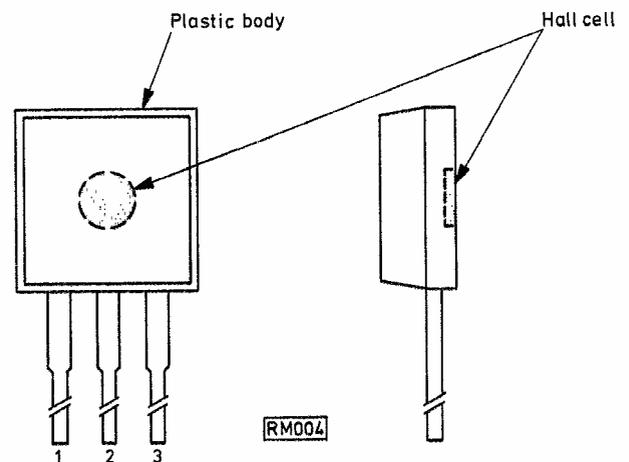


Fig. 2: The packaging of the Sprague Hall Effect device.

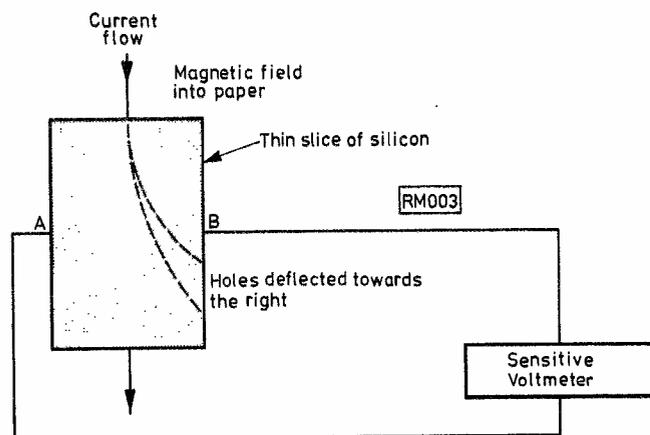


Fig. 1: The basic principle of the Hall Effect, showing deflection of "holes" in relation to current flow.

from the upper to the lower edge and the whole slice is placed in a strong magnetic field which is perpendicular to the plane of the silicon.

The current carriers in the silicon (electrons or holes) are deflected to opposite sides of the semiconductor material, just as an electron beam is deflected to one side in a television tube or oscilloscope tube by the magnetic field generated by the scan coils or by any small magnet brought near to the tube. The deflection of holes is indicated in Fig. 1 although in actual practice the movement would be far less than that indicated.

If the electrodes A and B on each side of the silicon slice are connected to a sensitive voltmeter, a small potential difference will be detected across the slice. This is known as the Hall Effect voltage and is due to the deflection of the current carriers.

Hall Effect voltages have been used to measure magnetic fields and to measure currents. Hall Effect devices have also been used as analogue multipliers, since the Hall Effect voltage is proportional to the magnetic field intensity multiplied by the current passing through the device.

## The ULN-3006T

In the ULN-3006T, the Hall Effect is used as the basis of a simple digital switch which will detect the presence of a magnetic field exceeding a certain intensity. The Hall Effect voltage is applied to the inputs of a differential amplifier, the output from this amplifier being applied to a trigger circuit. The trigger circuit switches suddenly when the input voltage exceeds a certain value and drives an output stage. The Hall Effect cell, the differential amplifier, the trigger circuit, and the output stage are all integrated on a single silicon chip inside the device; the internal circuit contains 36 components, including 14 transistors.

## Package

The miniature ULN-3006T package is shown in Fig. 2, the Hall Effect silicon chip being placed in the centre of the body of the device. There are only three connections and, as shown in Fig. 3, the circuit is extremely simple. In the absence of a magnetic field, the internal output transistor is cut off and passes little current (about  $1\mu\text{A}$ ). The full supply voltage therefore appears at the output of the device. When a magnetic field perpendicular to the body of the device is applied to it, the internal output transistor is driven to saturation and the output voltage falls to about  $+150\text{mV}$  (the maximum for any device is  $+400\text{mV}$ ).

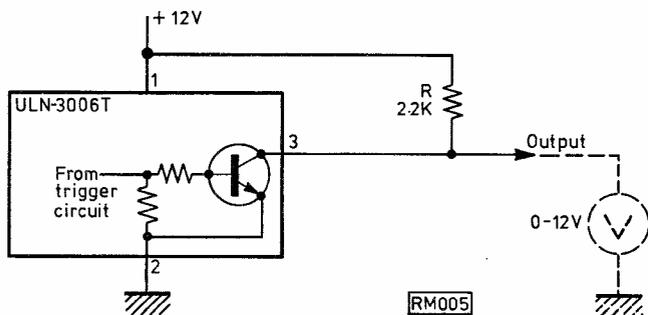


Fig. 3: A typical circuit used with the ULN-3006T. The transistor shown is one of the internal components of the device.

## Power Supply

The absolute maximum permissible power supply voltage for the ULN-3006T is 20V. However, the device characteristics are specified over the range 5V to 16V and it is wise to operate it within these limits. The writer found that satisfactory operation occurred when the supply voltage was as low as 3.4V.

When a small, but fairly strong, bar magnet was brought up to the device as shown in Fig. 4, switching to the low voltage state occurred at a distance of about 2.5mm. The magnet had to be moved back to a distance of about 8mm from the device before the circuit switched back to its high voltage state. Thus there is a built-in hysteresis effect in this type of circuit; that is, the switching to the low and high output voltage states occurs at two different magnetic field intensities.

The current passing to pin 1 of the device increases

from about 7mA to about 12mA (with a maximum of 16mA) as the supply voltage is increased from +5V to +12V. The current passing through the load resistor R of Fig. 3 when the output voltage is low is additional to the current passing to pin 1. The output transistor is capable of sinking (or accepting) currents of up to 15mA, so the load resistor R can have any value exceeding  $1\text{k}\Omega$  with a 15V supply.

Smaller values of load resistor can be used with lower supply voltages provided that the 15mA limit is not exceeded.

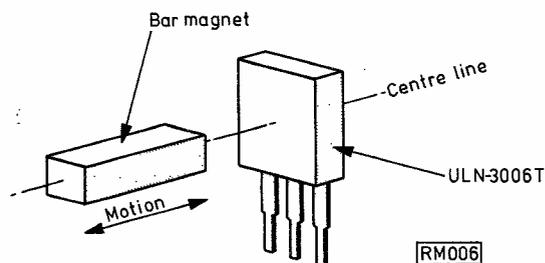


Fig. 4: The use of a magnet in switching the ULN-3006T.

## Magnetic Field

If the magnetic field is applied with incorrect polarity, no switching will occur. In other words, only one end of the bar magnet will be effective when brought up to one particular face of the device. The other end of the same magnet will cause switching when brought up to the other face of the device. Weak magnetic fields will not cause switching. The magnet must produce a field of not less than  $0.075$  Weber/sq. meter (750 Gauss) for certain operation. The device is immune to stray magnetic fields from transformers, relays, etc., since such fields are normally too small in value.

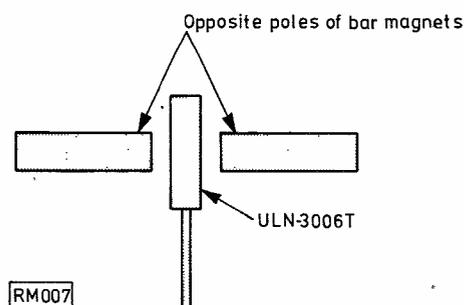


Fig. 5: Arrangement permitting the use of weaker magnets.

If two magnets with unlike poles towards each other are placed on each side of the device (as shown in Fig. 5), the switching will occur with much weaker magnets, since the two fields reinforce one another. Alternatively, a piece of soft iron or other magnetic material placed behind the device on the opposite side from the magnet will concentrate the flux and reduce the strength of the magnet required to produce switching.

# Can YOUR Antenna do all this?

You've read our ads with their recent testimonials and user histories—so this month we thought we'd remind readers of the selling points of the

## JOYSTICK VFA (World Patents)

- ★ Only 7' 6" long, comes in 3 easily assembled sections.
- ★ Tunes 5-30 MHz—no gaps.
- ★ Matching Antenna Tuner.
- ★ No harmonic resonances—means that the highest efficiency transfer of power and waveform from TX to ether takes place. In turn this ensures that TVI and other spurious emissions are just not substantially present.
- ★ Low angle radiation as an effective ground plane—that husbanded power goes on to reach destination with the least number of loss-making skips.
- ★ Gives receiver additional front end selectivity and gain—reduces cross-mod and out of band blocking.
- ★ Your installation can be 'tailored' to space available. Install VFA on mast or chimney or in roof space with a long or short feeder—or **SIMPLY STAND IN THE SHACK**. One delighted user proved his VFA by operating **FROM A BASEMENT!**

ALREADY IN USE BY AMATEUR TRANSMITTING AND SWL STATIONS WORLD-WIDE AND IN GOVERNMENT COMMUNICATION.

**SYSTEM "A" £36.00**

250 w. p.e.p. OR for the SWL.

**SYSTEM "J" £42.60**

500 w. p.e.p. (improved 'Q' on receive).

## PARTRIDGE SUPER PACKAGES

COMPLETE RADIO STATIONS FOR ANY LOCATION

All Packages feature the World Record joystick Aerial (System 'A'), with 8' feeder, all necessary cables, matching communication headphones. Delivered Securicor our risk. Assembled in seconds! **BIG CASH SAVINGS!**

**PACKAGE No. 1** As above with R.300RX **£210.55**  
SAVE £13.87!

**PACKAGE No. 2** Is offered with the FRG7 RX. **£195.00**  
SAVE £12.21!

RECEIVERS ONLY, inclusive delivery, etc.

**R.300 £184.50 FRG7 £162.00**

All prices are correct at time of going to press and include VAT at 12½% and carriage.



Just telephone your card number  
Phone 0843 62535  
(or 62839 after office hours)



or write for details, send 9p stamp



Box 5, Partridge House, Prospect Road, Broadstairs, CT10-1LD. (Callers by appointment).

## ENGINEERS

# FREE



## YOURSELF FOR A BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New opportunities" shows you how to get them through a low-cost, Home Study Course. There are no books to buy and you can pay as you learn.

This easy to follow GUIDE TO SUCCESS should be read by every ambitious engineer. Send for this helpful 44-page free book NOW! No obligation, nobody will call on you. It could be the best thing you ever did.

## CHOOSE A BRAND NEW FUTURE HERE



CUT OUT THIS COUPON

Tick or state subject of interest.

Post to address below.

ELECTRICAL & ELECTRONICS	Radio, Servicing & Repairs <input type="checkbox"/>	Painting & Decorating <input type="checkbox"/>
Practical Radio & Electronics (with KIT) <input type="checkbox"/>	Radio Amateur's Exam. <input type="checkbox"/>	MECHANICAL
Electronic Engineering Certificate <input type="checkbox"/>	AUTO & AERO	A.M.S.E. (Mech.) <input type="checkbox"/>
General Elect. Eng. Certificate <input type="checkbox"/>	Motor Mechanics <input type="checkbox"/>	General Mech. Eng. <input type="checkbox"/>
C. & G. Elect. Installations <input type="checkbox"/>	C. & G. Motor V. Mechanics <input type="checkbox"/>	Inst. Engineers & Technicians <input type="checkbox"/>
Elect. Install. & Work <input type="checkbox"/>	General Auto Engineering <input type="checkbox"/>	Maintenance Engineering <input type="checkbox"/>
C. & G. Elect. Technicians <input type="checkbox"/>	A.M.I.M.I. <input type="checkbox"/>	Welding <input type="checkbox"/>
	Air Registration Board Certs. <input type="checkbox"/>	MANAGEMENT & PRODUCTION
	M.A.A./I.M.I. Dip. <input type="checkbox"/>	Computer Programming <input type="checkbox"/>
RADIO & TELECOMMUNICATIONS	CONSTRUCTIONAL	Inst. of Cost & Managements Accts. <input type="checkbox"/>
Colour TV Servicing <input type="checkbox"/>	Heating, Ventilating & Air Conditioning <input type="checkbox"/>	
C. & G. Telecoms. Technician's Cert. <input type="checkbox"/>	Architectural Draughtsmanship & Design <input type="checkbox"/>	DRAUGHTSMANSHIP & DESIGN
C. & G. Radio, TV & Electronics Mech. Cert. <input type="checkbox"/>	L.I.O.B. <input type="checkbox"/>	General Draughtsmanship <input type="checkbox"/>
Radio & TV Engineering Course <input type="checkbox"/>	Carpentry & Joinery <input type="checkbox"/>	A.M.I.E.D. <input type="checkbox"/>
	Plumbing Technology <input type="checkbox"/>	Electrical Draughtsmanship <input type="checkbox"/>
	General Building <input type="checkbox"/>	



**G.C.E.**

—58 'O' & 'A' Level Subjects  
—over 10,000 Group Passes!

## Aldermaston College

Dept. TPW 23, Reading RG7 4PF

also at our London Advisory Office, 4 Fore Street Avenue, London EC2Y 9DT. Tel. 628 2721.

NAME (Block Capitals)

ADDRESS .....

..... Postcode.....

Other subjects of interest..... Age.....

Accredited by C.A.C.C. Member of A.B.C.C.

HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

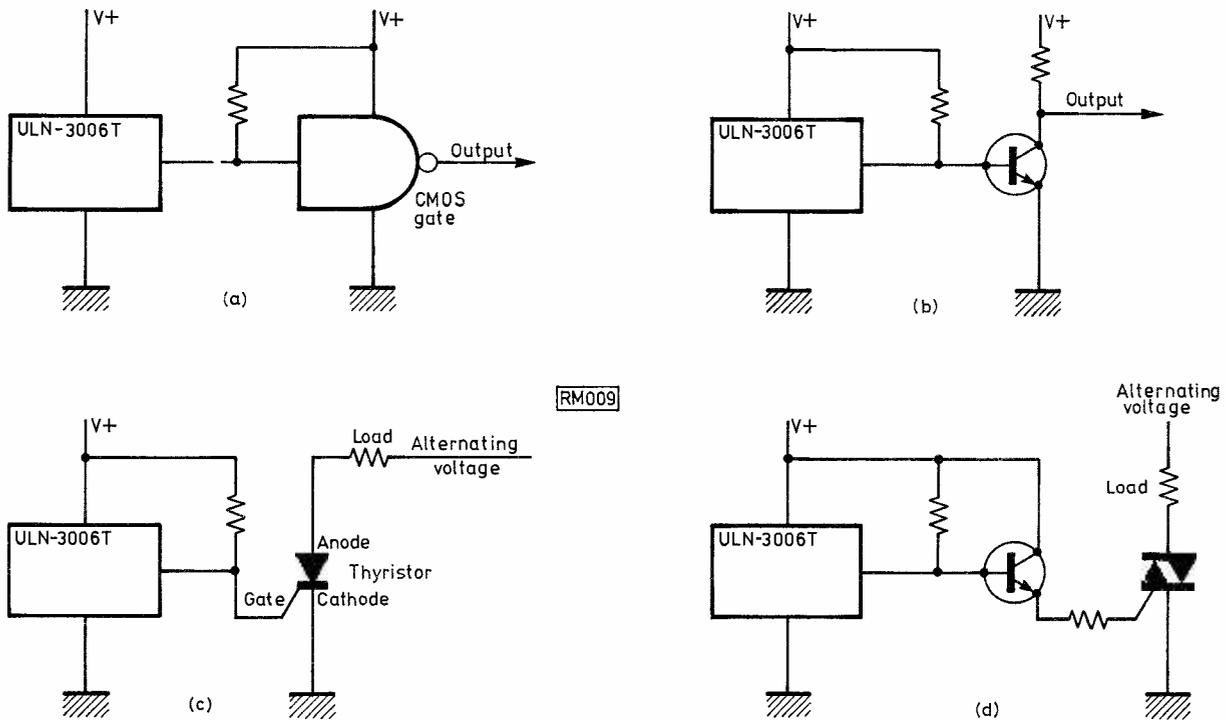


Fig. 6: Suitable circuits in which the ULN-3006T is used to drive (a) a CMOS gate, (b) an NPN transistor, (c) a thyristor, and (d) a triac.

If the magnet is not on the centre line of the body of the ULN-3006T, the maximum distance at which it will cause the circuit to switch to the low output voltage state becomes smaller. This effect is shown in Fig. 7 for distances of 1/10 to 1/100 of an inch between the magnet and the device.

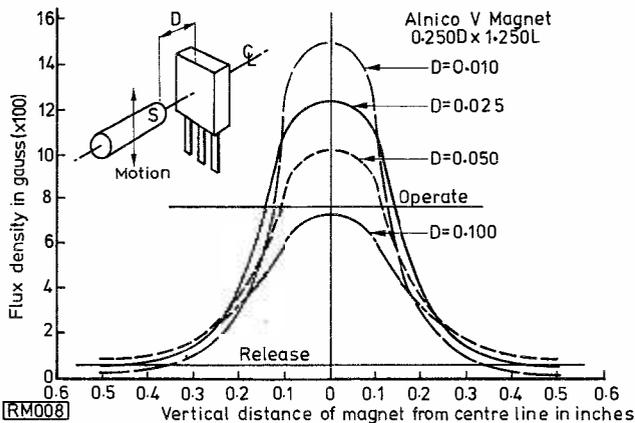


Fig. 7: Variation of magnetic field required for switching with distance from magnet, and with distance from the centre line.

The output from the ULN-3006T can be used to drive COS/MOS logic gates, transistors, thyristors, triacs and other devices. Some typical basic circuits are shown in Fig. 6.

The ULN-3006T is available from Phoenix Electronics (Solent) Ltd., 46 Osborne Road, Southsea, Portsmouth, Hants PO5 3LT at £2.50; this price includes VAT, but 20p must be added for post and packing to UK addresses.

## BINDERS FOR PW

Keep your copies together  
Keep them clean  
with the  
PW Easi-Binder

*The Easi-Binder is attractively bound with the title blocked in gold on the spine with the current (or last) volume number and year. For any previous volume numbers please advise year and volume and a separate set of gold transfer figures will be supplied.*

**£2.85 inclusive of VAT and post and packaging from: Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London, SE1 0PF.**  
(Overseas orders please add 60p).

# BATTERY STATE INDICATOR

W. MOONEY G3VZU

When equipment is supplied from an internal battery its performance, calibration and output level are often unsatisfactory below a certain supply voltage. Some form of battery condition indicator can therefore help. The indicator described here consists of a small Veroboard circuit driving a panel mounted LED whose state reflects the battery condition. The LED has three possible states as follows:—(1) LED on, indicating an adequate supply voltage, (2) LED flashing at 2Hz, indicating that supply has dropped to a pre-set critical range, and (3) LED off, indicating that the supply voltage is too low for satisfactory operation.

All this information can be gleaned from a single panel mounted LED and this is driven by an operational amplifier.

The circuit takes up little space and can be added to almost any piece of equipment, where the LED will probably replace an existing indicator, or if not a suitable hole can be drilled. Two small board mounted pre-sets are used to make adjustments up to 12 volts, the current requirement being about 5mA.

## The Circuit

Several discrete circuits which would give the required action were considered, however these had unpredictable change-over levels or were too costly using many transistors and lacked "style". The use of a moving coil meter for this application is electrically the easiest solution. Unfortunately, such meters are very expensive and must be designed into the equipment taking up considerable panel space, a valuable commodity on modern equipment. The 741 op-amp circuit shown in Fig. 1 was eventually chosen.

Power for the circuit is supplied from the equipment being monitored, and the indicator will normally be wired between the circuit side of the on/off switch

and the common supply line. Positive or negative earth circuits can be accommodated by wiring up the indicator as appropriate. Both inputs to the op-amp are used. The potential of the non-inverting input is held steady at the stabilising voltage of the Zener diode D1. The resistor R2 has practically no effect on the DC conditions due to the high input impedance; the non-inverting input will therefore be the reference voltage across D1, i.e. 3-5V. The inverting input is supplied from the pre-set potential divider VR1 and the circuit DC gain is set by VR2 and R3. The indicator LED is driven by the IC1 output at pin 6, R4 limiting the current drawn for LED protection and current economy. Since the 741 IC output can fall to about 2.5V min. but will rise to almost the supply voltage, the LED must be connected to the positive supply line as shown in Fig. 1 rather than to the negative otherwise it will still glow slightly when a low output (LED off) condition is required.

Normally the voltage of the inverting input at pin 2, will be higher than that on the non-inverting input and thus the output, pin 6, will be at its lowest possible level with the LED alight. As the supply voltage drops, a voltage range will be reached when the potential of the inverting input will approach, reach parity, and finally become lower than the reference voltage on the non-inverting input. Over this range the IC will sweep through its transfer characteristic and the output will finally limit at its highest value causing the LED to extinguish.

Whilst the IC is between its upper and lower saturation limits, the circuit will act as a high gain amplifier and will oscillate at a frequency primarily governed by the values of C2 and R2. The output is a square wave and the LED will flash on and off. The range of supply voltage over which the circuit is in the oscillating mode is governed by the gain and hence the flashing range is set by VR2. With VR2 at its minimum resistance setting the gain is at a maximum

*continued on page 856*

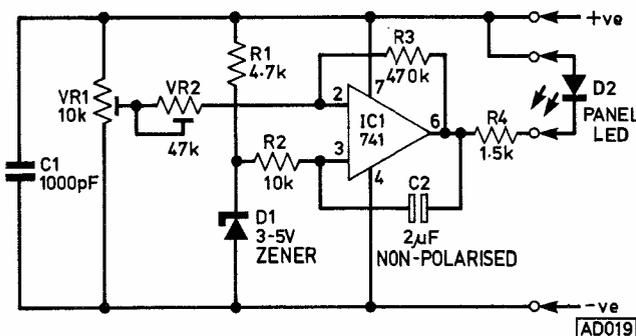


Fig. 1: Circuit diagram of the Battery State Indicator.

## ★ components

### Resistors

R1 4.7kΩ R2 10kΩ R3 470kΩ R4 1.5kΩ  
All  $\frac{1}{4}$  or  $\frac{1}{2}$ W carbon film  
VR1 10kΩ VR2 47kΩ Both linear, pre-sets

### Capacitors

C1 1000pF disc ceramic C2 2µF 50V non-polarised  
(Electrovalue type EX50)

### Semiconductors

D1 Zener diode 3 to 5V 400mW D2 LED TIL209 with clip  
IC1 741

# ON THE AIR



by Eric Dowdeswell G4AR

I must begin with an apology for not having wished all my contributors and readers a VERY HAPPY NEW YEAR which I should have done in the last issue! Only excuse is the lead time required for copy and the fact that the "January" issue comes out at the beginning of December! Anyway, have a successful year, with plenty of DX. There certainly shouldn't be any dearth of it on the 10m and 15m bands according to the reports coming in and it can only get better as we climb the somewhat unpredictable curve of the new sunspot cycle.

As I have said before, the newcomers to these two bands just don't know what they are in for! 10m especially will be a knockover and even the worst of receivers will be copying the DX! Apart from sensitivity the most important characteristic of a 10m set will be selectivity!

So far this month there is more news from the clubs than from individuals, so let's press on with that. New Secretary of the Edinburgh DARC is **Tom Melvin** GM8MJV of 17 Dundas Crescent, Eskbank, Dalkeith, Midlothian. Coming events run from Slow-scan to RTTY, not to mention skittles, so write to Tom for more info. Incidentally, Tom, tell the Editor of your Newsletter that info on your meeting place and addresses of Committee members would not be out of place in following issues!

The AGM of the Wessex AR Group revealed a membership of 82 plus 12 postal members, which sounds pretty healthy to me! A suggestion that membership should be limited was not the view of the majority of members present, however. **Geoff Cole** G4EMN of 6 St. Anthony's Road, Bournemouth remains Secretary and meetings take place in the Club room at the Dolphin Hotel, Holdenhurst Road, at 8 pm. You might read this in time to get to a talk on RTTY by G3VPC on February 3rd and you shouldn't miss H. H. Journeaux on Vintage Radio Equipment on February 17th.

**D. Lively** G3KII will be glad to meet newcomers to the Cheltenham AR Association at The Old Bakery, Chester Walk, off Clarence Street, at 8 pm on the first Thursday of any month, plus the third Friday, a New Year innovation. On to Wales where the Blackwood DARS has elected **Steve Cole** GW4GLE "Entertainments Secretary". From 10 Llanthewy Road, Newport, he tells me that club night is on Fridays at Oakdale Community, Near Blackwood, Gwent, with GW8LJJ presenting "Construction Techniques" on 10 February. A "special" will be G3IOR on "Oscar 7" on the 24th with part two of this tape/slide show on March 3rd. The club is well-equipped with gear for the HF and VHF bands and if you feel like having a go at the RAE there is a class running now. GW3KYA on Blackwood 225 825 can give up-to-the-minute info on club activities.

From Leamington Spa, **Nick Smith** A9050 reports buying a Codar CR70A, which, with a 120ft wire, has been mainly operational on 15m, 20m and 80m so far. **Neil Braeman** G4FUP took time off from operating to tell me how much he enjoys being on the air. He has a Panda Cub plus a Collins TCS12 receiver on the HF bands on CW, "I'm proud to say", but admits to using "fone on 2m with someone else's rig!" He comments on the "rubbish and pointless QSO's" on this band but I wonder if it is any different on the HF bands! Next project is an RTTY set-up and already bits and pieces are littered around the shack!

**Steve Roberts** writes from Mississauga in Ontario, Canada concerning my remarks on "strange calls", in the November issue, inferring that they came from the Citizens Band. He points out that the introduction of 40 channels this year to the band over there has caused the price of the old 23-channel transceivers to drop to around \$50! Then he remarks, most strangely that "the serious SSB operator had to go to the illegal use of a linear amplifier"! Not to mention the illegal "sliders", presumably meaning VFO's. Steve cites cases where he has found his CB gear of real use but as I have pointed out before, over here a licence is readily available for those that have a genuine need. Steve says he is not electrically minded so does not feel able to take an amateur licence exam. It would be worth making the effort OM!

**D. W. Waddell** in Herne Bay, Kent, tried a pre-selector in front of his lovely FRG7! I don't know what Yaesu would say, if they knew! Fortunately the p-s has now been dumped in favour of an ATU which I'm sure is much more worthwhile. D.W.W. wonders when the "experts" get their DX on the 80m and 160m bands. Very briefly, between dusk and dawn! But listen an hour or so before and after this period if only to get the feel of the bands.

More club news! The Silverthorn RC has its HQ and club stations G3SRA and G8CSA at Friday Hill House, Simmons Lane, Chingford, London E4 and Hon. Sec. is **Chris Hoare** G4AJA of 41 Lynton Road, South Chingford, London E4 9EA. Chris together with Colin G4EZQ and Ted G8NPF have been /P on 160m recently, usually on Saturday or Sunday evenings, with a TX using the SL600 series of ICs feeding into a 2N5591 PA, mainly on SSB. Long wires have been slung up with the help of a cross-bow! Oh, yes, club meetings are at 7.30 on Fridays so do go along if you live around that part of London.

Well, that is the sum total of information to hand and I can only presume that there is more knocking around the system somewhere. I'm sure that all you chaps and girls haven't stopped listening! Let's hope that all the radios that Father Christmas will have been distributing will soon increase the flow of reports!

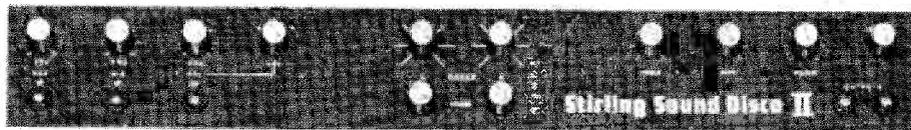
## Log extracts

**D. W. Waddell:**— 80m EP2TY JY9DI U18KAG UL7KBN 20m FP8DG TUZEF 15m C5AAD KG6RT PJ9CG 5T5JD 7P8AR 9L1SL/A 10m C5AT CE6EZ CW0A FG7BA FM0FC HH2MC TU2GM

**N. Smith:**— 20m VR2XL 15m SV1DH

# More power per £ from **Stirling Sound**

**READY BUILT**



**OR BASIC MODULES**

## 4 CHANNEL MIXER/CONTROL UNIT & POWER SUPPLY (READY BUILT OR IN D.I.Y. MODULAR FORM FOR EASY BUILDING)

By designing and manufacturing in our own Essex factory and selling direct to YOU the customer, we believe we have produced just about the best values ever in mixer/control equipment. You can buy the Disco 2 Unit assembled, tested and ready to connect up and use at once, or build your own unit using Stirling Sound Basic Modules. Either way you stand to save—and look at the advantages you get—sensibly arranged controls (on the built unit), proper DJ/PA facilities and RELIABILITY. Credit facilities can be considered.

- **INPUTS**—Left deck, right deck, mic. and aux.
- **INPUT IMPEDANCE**—47K ohms
- **POWER SOURCE**—220-240V. A.C. Mains
- **CONTROLS**—Mains on/off, master volume, bass  $\pm 15$ db, treble  $\pm 15$ db, L and R mixing, L and R motor switches, selector switch for P.F.L. (Pre-Fade Listening), headphone volume, mic. vol., aux. vol., LED indicators on mains and decks on/off switches.
- **HEADPHONE AMPLIFIER**—Powerful 2 watts into 8 ohms; separate vol. control.
- **TERMINATIONS**—Five  $\frac{1}{2}$ " jack sockets—2 input, 2 output, headphones.
- **SIZE**—23 $\frac{1}{2}$ " x 3 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ " max. depth to rear (plus separate power unit). Panel in matt black with controls sensibly grouped for easy handling.

Built, tested and guaranteed.

# £39.95

POST FREE in UK and INC. V.A.T.

Kit of basic modules less power pack, five  $\frac{1}{2}$ " jack sockets, and 3 mains switches, but with front panel

# £21.00

POST FREE in UK and INC. V.A.T.

Suggested Stirling Sound power amps with heat sinks and power supply units—140PH £18. 160PH £22. 1100PH £26.75.

### READY BUILT

(Prices inc. V.A.T. but NOT cost of carriage)

#### SOUND-LIGHT UNITS

SSTL 3/250B—3 channels, 250w. each **£23.95**  
SSTL 3/1000B—3 ch., 1000w. each **£23.95**

#### INTEGRATED POWER AMPS

In strongly made metal cases, complete  
POWER AMP 40—40 watts r.m.s./4 ohms, 2 ch. mixer **£43.00**

POWER AMP 60—60w.r.m.s./4 ohms, 2 ch. mixer **£48.00**  
POWER AMP 100—100w.r.m.s./4 ohms, 4 ch. mixer **£85**  
100 watt SLAVE AMP. **£50.00**

#### LOUDSPEAKERS

Disco 25—25 w.r.m.s. in cabinet; 20' lead **£23.95**  
Disco 50—50 w.r.m.s. in cabinet; 20' lead **£39.95**  
Disco 100—100 w.r.m.s. in cabinet; 20' lead **£64.95**  
Ampower 50—50w. slave amp. & speaker in cabinet **£60.00**  
Ampower 100—100w. slave amp & speaker in cabinet **£80.00**

#### COMPLETE DISCO

with Disco 2 console and Ampower 50 **£155.00**  
with Disco 2 console and 2 Ampower 50s **£210.00**  
with Disco 2 console & 1 Ampower 100 **£175.00**  
with Disco 2 console & two Ampower 100s **£250.00**

Carriage in U.K. please add for Sound Light Units **£1.00**, Power Amps 40 & 60 **£1.50**, Power Amp. 100 & 100w. slave amp Disco 25 & 50 **£2.00**, Ampower 50 and 100, Disco Console **£5.00**. Complete discos **£10**.

EVERYTHING RIGOROUSLY TESTED AND GUARANTEED

### BASIC MODULES

For constructors wishing to build systems to their own requirements. As their description implies, these modules

will require control knobs, etc. Each module is supplied assembled and tested on its own PCB.

SSB4 Phase splitter (for two SS.105s) in bridge formation **£2.75**  
SS104/2 Two channel mixer stage **£3.75**  
SS104/4 Four channel, mixer stage **£7.00**

SS.DTM Output control stage Master vol., 30db variation on treble and on bass; 3mV in for 2V out, 18V working voltage **£6.75**

SSTL 3/250 Sound/light, 3 channels, 250w. ea. **£9.25**  
SSTL 3/1000 Sound/light, 3 ch. 1000w. each **£11.5**

### POWER AMPS.

Ready assembled on P.C.B.s., tested and guaranteed. Easy to connect. With instructions. Output ratings quoted  $\pm 1$ db

SS.103 1 C., amp, 3 watts R.M.S. using 20V/8  $\Omega$  or 14V/4  $\Omega$ . Input 100mV. **£2.85**  
SS.103-3 Stereo version of above, 2 I.C.s **£3.00**  
SS.105 5 watts R.M.S. into 3  $\Omega$  using 13-5V. Sensitivity—30mV. 3 $\frac{1}{2}$ " x 2" x 1". **£3.95**  
SS.110 100 watts R.M.S. into 4  $\Omega$  using 24V. Sensitivity—60mV. 3 $\frac{1}{2}$ " x 2" x 1". **£4.65**  
Designed and recommended particularly for running from 12 volt car battery.  
SS.120 20 watts R.M.S. into 4  $\Omega$  using 34V. Sensitivity—80mV. 3 $\frac{1}{2}$ " x 2" x 1". **£3.15**  
SS.140 40 watts R.M.S. into 4  $\Omega$  using 45V. Sensitivity—300mV. Distortion typically 0-1%. 5" x 3 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ ". **£8.50**  
SS.160 64 watts R.M.S. into 4  $\Omega$  using 50V. Sensitivity—350mV. Distortion typically 0-1%. 5" x 3 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ ". **£8.50**  
SS.1100 100 watts R.M.S. into 4  $\Omega$  using 70V/2A. Input sensitivity—500mV. Distortion at half-power, typically 0-1%. 5" x 3 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ ". **£10.50**  
HS. 160 Multi-finned heatsink for SS.140 or SS.160. **75p**  
HS.1100 Ditto for SS.1100 **£1.50**

### POWER SUPPLIES

Every Stirling Sound Power Unit is tested and guaranteed under working conditions before despatch. All units except SS.312 include a stabilised low voltage take-off point (13-15V) for pre-amp, tone control, radio tuner, etc. Outputs quoted are minimal unloaded ratings.

	Recommended for Power Amp	
SS.312	12V/1A	S.S.105 <b>£6.60</b>
SS.318	18V/1A	SS.103/103-3 <b>£8.95</b>
SS.324	24V/1A	SS.110 <b>£7.65</b>
SS.334	34V/2A	SS.120 <b>£8.75</b>
SS.345	45V/2A	SS.140 <b>£10.75</b>
SS.350	50V/2A	SS.125 <b>£11.75</b>
SS.360	60V/2A	SS.160 <b>£12.75</b>
SS.370	70V/2A	SS.1100 <b>£14.75</b>
SS.310/50	Stabilised power supply unit with variable output from 10V to 50V/2A. Short circuit protected	<b>£17.75</b>
SS.300	Power stabilising unit variable from 10 to 50V/8A for adding to unbalanced supply units	<b>£5.50</b>

SEND NOW FOR FREE CATALOGUE SHEETS. TRADE ENQUIRIES INVITED.

### CONTROL/PRE-AMPS.

■ **UNIT ONE**  
Combined stereo pre-amp & active tone control unit. 50mV in for 200mV out, 10-16V operation. Bass  $\pm 15$ dB; Treble  $\pm 15$ dB. Balance control; Volume control. Ceramic P.U., radio or tape inputs. WITH FREE CONTROL PANEL FASCIA **£9.00**

■ **UNIT TWO**  
Controls as UNIT ONE but for magnetic cartridge input. R.I.A.A. corrected. 5mV in for 200mV out. WITH FREE CONTROL PANEL FASCIA **£12.43**

■ **CONTROL PANEL FASCIA** for above **50p**

■ **SS.100**  
Basic active stereo tone control module to provide  $\pm 15$ dB on bass at 30Hz and on treble at 10KHz **£3.00**

■ **SS.101**  
Stereo pre-amp suitable for ceramics, tape, radio, etc. **£2.75**

■ **SS.102**  
Stereo pre-amp for mag. pick-ups.

STIRLING SOUND PRODUCTS ARE MADE IN OUR OWN ESSEX FACTORY AND SOLD DIRECT TO YOU THE CUSTOMER

### MAIL ORDERS

Dept. PW.3,  
37 VANGUARD WAY, SHOEBURYNESSE,  
ESSEX. Telephone (03708) 5543

### SHOP & SHOWROOMS

220-224 West Road, Westcliff-on-Sea  
Tel. Southend (0702) 351048

WHEN ORDERING  
All goods sent post-free in U.K. (except certain heavy ready-built items) and ALL INCLUDE V.A.T. Prices subject to alteration without notice. E. & O.E. S.A.E. with enquiries, please.

ACCESS OR BARCLAYCARD—Just tell us your No.

To STIRLING SOUND, 37 VANGUARD WAY, SHOEBURYNESSE, ESSEX.

Please send .....

(or as list attached) for which I enclose £.....

NAME.....

ADDRESS .....

PW.3

# Stirling Sound

# 15-240 Watts!

## HY5

Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

**FEATURES:** Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

**APPLICATIONS:** Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

**SPECIFICATIONS:**

**INPUTS:** Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 4-7k $\Omega$  at 1kHz.

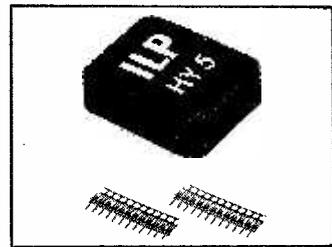
**OUTPUTS:** Tape 100mV; Main output 500mV R.M.S.

**ACTIVE TONE CONTROLS:** Treble  $\pm$  12dB at 10kHz; Bass  $\pm$  at 100Hz.

**DISTORTION:** 0.1% at 1kHz. Signal/Noise Ratio 65dB.

**OVERLOAD:** 38dB on Magnetic Pick-up. **SUPPLY VOLTAGE**  $\pm$  16-50V.

Price  $\pounds$  22 + 65p VAT P&P free.



## HY30

15 Watts into 8 $\Omega$

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

**FEATURES:** Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

**APPLICATIONS:** Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator

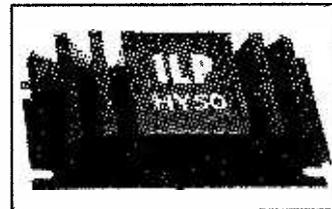
**SPECIFICATIONS:**

**OUTPUT POWER** 15W R.M.S. into 8 $\Omega$ ; **DISTORTION** 0.1% at 1-5W.

**INPUT SENSITIVITY** 500mV. **FREQUENCY RESPONSE** 10Hz-16kHz—3dB.

**SUPPLY VOLTAGE**  $\pm$  18V.

Price  $\pounds$  22 + 65p VAT P&P free.



## HY50

25 Watts into 8 $\Omega$

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

**FEATURES:** Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

**APPLICATIONS:** Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

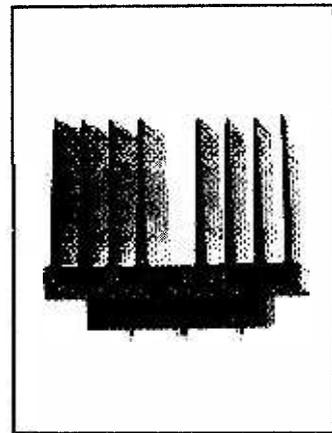
**SPECIFICATIONS:**

**OUTPUT POWER** 25W RMS into 8 $\Omega$  **LOAD IMPEDANCE** 4-16 $\Omega$  **DISTORTION** 0.04% at 25W

at 1kHz **SIGNAL/NOISE RATIO** 75dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.

**SUPPLY VOLTAGE**  $\pm$  25V **SIZE** 105 50 25mm

Price  $\pounds$  26 + 85p VAT P&P free



## HY120

60 Watts into 8 $\Omega$

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

**FEATURES:** Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components

**APPLICATIONS:** Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

**SPECIFICATIONS:**

**INPUT SENSITIVITY** 500mV.

**OUTPUT POWER** 60W RMS into 8 $\Omega$  **LOAD IMPEDANCE** 4-16 $\Omega$  **DISTORTION** 0.04% at 60W

at 1kHz **SIGNAL/NOISE RATIO** 90dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

$\pm$  35V

**SIZE** 114 50 85mm

Price  $\pounds$  15.84 +  $\pounds$  27 VAT P&P free.

## HY200

120 Watts into 8 $\Omega$

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

**APPLICATIONS:** Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

**SPECIFICATIONS:**

**INPUT SENSITIVITY** 500mV

**OUTPUT POWER** 120W RMS into 8 $\Omega$  **LOAD IMPEDANCE** 4-16 $\Omega$  **DISTORTION** 0.05% at 100W

at 1kHz **SIGNAL/NOISE RATIO** 96dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

$\pm$  45V

**SIZE** 114 50 85mm

Price  $\pounds$  23.32 +  $\pounds$  21.87 VAT P&P free.

## HY400

240 Watts into 4 $\Omega$

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 $\Omega$ ! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—No external components.

**APPLICATIONS:** Public address—Disco—Power slave—Industrial

**SPECIFICATIONS:**

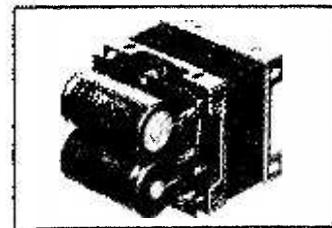
**OUTPUT POWER** 240W RMS into 4 $\Omega$  **LOAD IMPEDANCE** 4-16 $\Omega$  **DISTORTION** 0.1% at 240W

at 1kHz **SIGNAL NOISE RATIO** 94dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

$\pm$  45V

**INPUT SENSITIVITY** 500mV **SIZE** 114 100 85mm

Price  $\pounds$  32.17 +  $\pounds$  22.57 VAT P&P free.



## POWER SUPPLIES

PSU36 suitable for two HY30's  $\pounds$  25.22 plus 65p VAT. P/P free.

PSU50 suitable for two HY50's  $\pounds$  26.82 plus 85p VAT. P/P free.

PSU70 suitable for two HY120's  $\pounds$  213.75 plus  $\pounds$  21.19 VAT. P/P free.

PSU90 suitable for one HY200  $\pounds$  12.65 plus  $\pounds$  21.01 VAT. P/P free.

PSU100  $\pounds$  23.10 +  $\pounds$  21.85 VAT.

B1  $\pounds$  20.48 +  $\pounds$  20.06 VAT.

TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

I.L.P. ELECTRONICS LTD., GROSSLAND HOUSE, NACKINGTON, CANTERBURY, KENT, CT4 7AD.

**I.L.P. ELECTRONICS LTD.,**  
GROSSLAND HOUSE, NACKINGTON,  
CANTERBURY, KENT, CT4 7AD.

Please Supply \_\_\_\_\_  
Total Purchase Price \_\_\_\_\_  
I Enclose Cheque  Postal Orders  Money Order   
Please debit my Access account  Barclaycard account   
Account number \_\_\_\_\_  
Name and Address \_\_\_\_\_  
Signature \_\_\_\_\_

# BROADCAST BANDS

## SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

The Austrian Short Wave "Panorama", which can be heard on 6155kHz, 9725, 15355 and 17770 at 1805 on Sundays, is holding a DX Trophy competition during the first three months of 1978. The idea is to log broadcasting stations in half-hour blocks. Every contestant will receive a diploma stating his score and the highest scorer will receive a DX Trophy, suitably engraved. Full details can be obtained by sending a SAE (in the UK) to Jonathan Marks, 12 South Bailey, Durham DH1 3EE or direct to DX Trophy, Austrian SW Panorama, Austrian SW Service, A-1136 Vienna, Austria.

"Now is the time of year when one can start looking for rare birds from the other side of the world. One of the most elusive is Radio New Zealand, which I have managed to hear during the past four winters" writes John Godwin from Rugeley in Staffordshire. John recommends the 25m band transmission of the Pacific Islands service which is on 11780kHz from 0530 until 0715 and on 11820 from 0730 until 1030, up to March 5th, 1978. The power is 7.2kW. Radio New Zealand is also on 11960 and 15130 from 1800 to 2215, on 17710 from 2230 to 0520, on 15380 from 2300 to 0345 and on 15130 from 0400 to 0715. DX reports, which should be accompanied by two International Reply Coupons, should go to Radio New Zealand, PO Box 2092, Wellington, NZ.

A 1957 Ferguson 391T receiver and 40ft long wire were used by thirteen-year-old Andrew Brade of Stone (Staffs) to pull in an interesting log of DX. Radio Uganda was heard signing-off in English on 9515kHz at 2105, Radio Cyprus on 7195 signing-on in Greek to the UK at 2215, Sri Lanka in English on 11795 at 1500 and the Voice of Greece on 11730 starting a programme in Greek at 1230. Andrew has been looking for Radio Veritas, Philippines on 11725 between 1400 and 1500 and he wonders if the station has changed frequency. Radio Veritas (PO Box 939, Manila, Philippines) has been logged on 11955kHz at 1425 by Philip Grainger of South Shields using a Trio 9R59DS receiver and long wire antenna. Philip would be interested in hearing from anyone who would be prepared to help him start a DX club in his area. Letters should go direct to 26 Beattie St, South Shields, Tyne and Wear.

"Please recommend an International SW Broadcasting frequency book that gives the stations, frequencies, transmission times, etc", asks Van Ommen Kloeke (EI3CM) from Arklow in Ireland. A similar request comes from R. J. Bedall of Cheam in Surrey who has a Sony ICF-5900 which pulls in plenty of stations. He wants to know who they are and where to write for a QSL. The *World Radio and TV Handbook*, published annually in Denmark, lists all known broadcasting stations on the long, medium, short and FM bands with the exception of some low power locals on the MWs. TV stations are also listed. There is a section for each country which gives the hours of transmission, addresses and QSL information and AM broadcasting stations are listed separately in frequency order. The 1977 edition cost £5. The 1978 edition is expected out in February and it can be ordered through booksellers or by post from the Modern Book Company, 19-21 Praed St, London W2 1NP, who advertise in *PW*.

Reader Bill Iball, who has been a SWL since the mid 1930s now has a Yaesu Muse FRG7 communications receiver and he would like to compare notes on aerials and the general performance of this receiver with other DXers. Write to Bill at "Garswood", 53 Winstanley Rd, Billinge,

Wigan WN5 7XE. Stations heard with the FRG7 and end-fed 50ft aerial were Radio Globo, Brazil on 11805kHz, Radio Club Pernambuco, Brazil on 11865, Radio Australia on 6005, Radio South Africa on 4810, USSR (Kalinin listed) on 4860, Benin Republic on 4870, Conakry, Guinea on 4910 and Radio Malaysia, Sarawak on 5005. No times are given but the 60m logging would be after dark and Brazil on the 25m band probably around 2100.

"I am not a regular DXer but I do enjoy a bit of knob twiddling between listening to the amateurs" says Christopher Silk who lives at Leigh-on-Sea in Essex. Using an Eddystone 740 and a 20ft vertical aerial with 60ft of co-ax feeder he pulled in Radio Australia on 7240kHz at 1500. Reception continued until 1555 when an intermittent signal damaged reception. The transmission on 7240 is beamed on 325° to the Pacific Islands but the bearing also covers Europe on the short route across Asia.

Twelve-year-old Chris Howles who is a regular reader of *PW* recently took up SW DXing as a hobby and he bought a Vega 206 receiver. He added a 30ft long wire to an old VHF TV aerial and with this set-up heard Radio Australia at 0900 on 21570kHz in the 13m band, Radio Canada International at 1655 on 15325, All-India Radio at 2020 on 9590, Baghdad at 2010 on 9635 and the Voice of Turkey at 2200 on 9515. Chris is puzzled why the 13m, 16m and 19m bands go blank after about 1930 hours. The reason is that signals on these bands pass through the ionosphere after dark instead of returning to earth. The ionosphere is maintained by ultra violet radiation from the sun and its strength and hence its ability to return the higher frequencies is at a maximum on the sunlit side of the earth. On any particular path the frequencies in use will be higher during the day than at night.

Frequencies will also be higher for long distance (low angle) than short distance (high angle) communication. From the DXer's point of view this means that during the day, the highest frequencies will be in use for long distance and lower frequencies for short distance reception. After dark, the higher frequency bands are dead; long range reception is now found on lower frequencies while short range reception moves to the Tropical Bands (the 75m band in Europe) or to the medium waves.

A Trio 9R59DS receiver and long wire aerial are in use at Braintree in Essex by R. Guest who heard Radio Australia on 11740kHz at 0640, on 21570 at 0800 and on 6035 at 2100, KWTR Guam on 9640 at 1330, Havana, Cuba on 17885 at 2055, Nigeria on 15120 at 0800 and Spain on 6100 at 2030 (there is a DX programme in English on this frequency at 2215 on Sundays). From the International Short Wave Club comes news of programmes in English from Radio 4VEH Cap Haiti on 9770kHz and 11835 between 2230 and 0030, from Sri Lanka over 11955, 15120 and 17850 between 1845 and 1940, from Taiwan on 9600 from 2130 to 2230 (reports to 53 Jen A Rd, Sec 3, Taipei, Taiwan) and from Benin on 4870 (60m) from 2015 to 2030 (reports to PP 366, Cotonou, Benin).

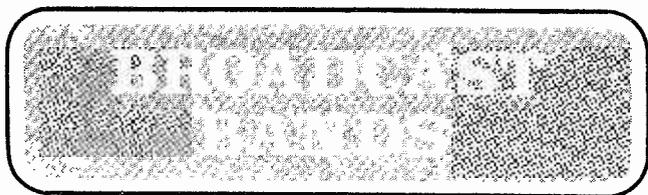
An old Ever-Ready radio of uncertain age works "incredibly well" for P. Gatehouse of Buckingham. All-India Radio came in on 9525kHz at 2230, Radio Canada on 11945 at 2039, Radio Israel on 7412 in English at 2330. On Sundays there is a DX programme from 2000 to 2030 and the station address is PO Box 1082, Jerusalem, Israel.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

**AMATEUR BANDS** Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

**MEDIUM and SW BANDS** Charles Molloy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands must be kept separate.

**VHF BANDS** Ron Ham BR515744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.



## MEDIUM WAVE DX

by Charles Molloy G8BUS

The mystery surrounding the CJON Radio Network has now been cleared up by **Ian Rennison** of Horsham in Sussex. CJON on 930 is no more. It has a new callsign (CJYQ), the address of the station is PO Box 6180, St John's Newfoundland and the slogan used over the air is "Q Radio". The callsigns of the rest of the network have also been changed. CJOX on 610kHz is now CKYQ South Coast, CJNW 670 is now CHYQ Bonavista Estuary, CJCN 680 is now CIYQ Central Newfoundland and CJCR 1350 is now CFYQ Gander. Ian, who uses a MW loop, differential amplifier, Trio 9R59D receiver, audio notch filter and the PW CMOS crystal calibrator, reports hearing a new CBC outlet on 750kHz relaying CBN (640) and that CFBC Saint John N.B. on 930 has now become prominent on this channel in place of CJYQ. All very confusing!

A Trio 9R59DS and a 36in loop are in use at Steyning, Sussex by **Alf Cosham** who reports hearing CKVO Clarendville Newfoundland on 710kHz at 2330, WINS New York on 1010 at 0710 and WNEW also in New York on 1130 at 0705. The CJYQ frequency (930) seems dead at Alf's QTH and reports from other DXers suggest that CJYQ (ex CJON) may no longer be the strongest, most consistent and earliest North American to be heard in the UK. Stations seem to come and go on the medium waves. CBA Moncton N.B. at one time was a solid signal every night on 1070 after Paris closed down, while others, such as CBH in Halifax on 860, WMEX Boston on 1510 and WKBW Buffalo 1520 which used to be reported regularly are now inconspicuous. It is interesting to speculate why this should be. Interference is probably one cause but the explanation that appeals most to the writer is the thought of the Chief Engineer, tired of answering reports from DXers, who adjusts his aerial system so that more signal goes into the service area and less goes out to distant lands and to eavesdropping DXers!

At the moment CKVO on 710kHz and WINS on 1010 are the stations to look for around midnight, if you have never heard North America on the medium waves. WINS has its studios in New York City but the transmitter is in New Jersey and the directional aerials boost the signal to the north east, towards New York and also to the DXer in Europe.

More North American DX from **David Sidebottom** who lives in Fleetwood and uses a Realistic DX160 receiver with an 80ft longwire aerial. Some of the stations heard by him between 0030 and 0200 are VOXM St John's on 590kHz, WHDH Boston on 850, CJCH Halifax on 920, CHER in Sydney on 950, CHNS Halifax on 960, CBY Corner Brook 990, WHN New York on 1050, CBA Moncton 1070, WCAU Philadelphia 1210 and WVOJ Jacksonville in Florida on 1320. "Q Radio" on 930 was also heard mixed with CFBC. **Robin Harvey** writes again from Halesworth to say that he now has a Trio 9R59DS communications receiver and he is set to do some serious DXing. He has been unable to hear MEBO2 which has not been transmitting on 773kHz recently nor has he been able to locate the Voice of Peace on 1540. The latter has changed frequency to 1538 which is occupied also by the 700kW outlet at Mainflingen in West Germany and it will be very difficult to hear the "V of P" on this channel in the UK.

"I would like to know if readers ever write to you about hearing DX on the long waves" asks **Peter Ramsey** of Stevenson in Ayrshire. Occasionally, is the answer, and it

is a pity that more DXers do not try this band. The main obstacle to DXing on the LWs is interference from the line timebase of TV receivers which appears as a buzz at intervals of about 15kHz. This trouble disappears after midnight, when it is worth tuning around the band for weak signals. Asiatic Russia, Turkey, Iceland, Algeria, Morocco, Romania, Sweden, Norway, Finland and Mongolia are to be found on the long waves. A good outdoor aerial is an advantage but a transistor portable with internal aerial can perform very well as its directional aerial will cut down static and QRM.

A report of Asiatic DX on the medium waves comes from our regular reporter **Harold Emblem** who DXes in Mirfield with an Eddystone 730 receiver and loop. Radio Pakistan's outlet at Quetta was heard on 750kHz, Astrakhan USSR on 791, Novosibirsk in Siberia on 1025, Saransk on 1061 with local identification. Also logged were Conakry, Guinea on 1403 which is on the air all night and EAJ28 Radio Tarasa in Spain on 1412.

"What kind of ATU (Aerial Tuning Unit) must I use with a loop?" asks **Raphael M. F. de Witte** who lives at Whitley Bay. An ATU is used to match a long wire to a receiver and it is not suitable for use with a loop as it would act as an aerial itself, pick up signals and therefore mask the loop's null. Even if it were placed inside a screened box it would still give trouble as the type in general use is electrically unbalanced and would upset the operation of the loop.

"Is it possible to receive local radio stations from other parts of the UK?" enquires **C. J. Roe** of Warwick who says he is something of a novice regarding radio. The best type of receiver for this sort of DXing is the ordinary transistor portable with its internal directional aerial. Tune in a station on a portable, rotate the receiver without tilting it and two positions will be found where the station disappears or drops to a very weak signal. This ability to null-out stations can be put to good use when searching for local radio stations as most of the channels in use are shared. Try after dark on 755kHz, 854, 998, 1034, 1106, 1115, 1457, 1484, 1502, 1520, 1546 and 1594 for BBC locals and on 989kHz, 998, 1025, 1151, 1169, 1277 and 1546 for IBA outlets.

"Long time no hear" writes **Ralph Newman** from Reading who has not been idle, though. He has been doing a "few mods" to his homebrew receiver and he now has a really good 8-element ceramic IF filter to sort out the QRM. Highlights from his log are Nigeria on 945kHz with identification at 2357, CBM Montreal on 940, WHN New York on 1050 at 0018, WCAU Philadelphia on 1210 at 0024, WOKO Albany NY (5kW) on 1460 at 0025 and WQXR in New York City on 1560 at 0030. WINS was heard at 0745 in the morning until its carrier finally went out as a heterodyne with 1007kHz at 0810. The fadeout of the sky wave from WINS would be caused by the reforming of the "D" layer in the ionosphere due to the action of ultra violet radiation from the rising sun. The "D" layer absorbs MW signals, but Lopik in Holland on 1007kHz would still be heard via the ground wave.

---

PLEASE MENTION  
PRACTICAL WIRELESS  
WHEN REPLYING TO  
ADVERTISEMENTS

---

# VHF BANDS

by Ron Ham BRS15744

**Gordon Goodyer** BRS 37345 of Petworth, has purchased an Eagle SR550 amateur bands receiver and finds it very good on both the 20m and 10m bands and the long scale between 28 and 30MHz makes it an ideal tunable IF amplifier for his 2m converter. Around midday on December 4th Gordon heard an EI on 2m SSB during the RSGB Fixed Station contest and, according to the grapevine, a GM was also heard in the south, which is not surprising because conditions were right for a tropospheric opening. The atmospheric pressure rose sharply from 30.1in at midday on December 1st to 30.4in by midday on the 3rd and was falling rapidly throughout the 4th. The first sign of a lift came at 0248 on the 3rd when signals from GW mobiles, through the Bristol Channel repeater, were opening the squelch on my receiver.

At 1454 I received a 53 signal from GB3SUT on 70cm, and a picture from the IBA transmitter at Lichfield on Ch.8, 189MHz. A dipole aerial was used to feed each receiver. By 1054 on the 4th, repeater signals were strong and I heard GW8MVA working a French station through GB3BC. The AP continued to fall for the next few days reaching a low of 29.2in at 0400 on the 8th which meant very bad weather over much of the UK and very poor VHF conditions. Later in the day the AP began to rise and by midday on the 12th it was back above 30.0in rising to 30.5in on the 14th bringing back good VHF conditions.

At 2020 on the 12th **Dave Butler** G4ASR London, worked F6DJF Paris, on 2m SSB and was called by an HB9 whose signal suddenly disappeared into the noise; one of those VHF annoyances! Dave has an excellent VHF record; recently, while staying at the Lizard, he worked more than 1300 stations from 16 countries on 2m and 9 on 70cm. His best DX on 2m is Liechtenstein and Switzerland on 70cm. During the opening last September, Dave noticed that many south coast amateurs were able to work into Holland yet he could not hear the Dutch stations although he could easily work into Spain from his location at the Lizard. From his many aerial experiments Dave has found that his VHF Quad is by far the best of his equipment.

**Alan Baker** G4GNX Newhaven, noticed a lift during the evening of the 13th when he heard G3ZIG Norfolk, work a GM on 2m SSB and on the 14th he heard signals from GB3BC right along the south coast to Rottingdean. Also on the 14th **Lee Reynolds** G8LCK London, worked stations via the 2m repeaters in Birmingham, Bristol, Buxton, Dover, Four Marks, Martlesham Heath and Belgium, ON00V, all with 2.5W. **Roy Bannister** G8LXR Lancing, heard French stations on 2m CW on both the 14th and 15th several of those repeater signals were operating the squelch on my receiver and during the early evening of the 15th, **Alf Lee** G4DQS Brighton, worked a French station via the Normandy repeater FZ3THF on R4. Frequently on these two days signals were heard from both GB3SUT and GB3EM on 70cm.

Congratulations are due to our readers **Roy Bannister** G8LXR and **Barry Ainsworth** G8HYN who went together to North Foreland and passed their Morse tests. Roy now has the call sign G4GPX and Barry is G4GPW.

**Brian Oddy** G3FEX Storrington and **J. A. Tipping** G8JXE Brighton, have been carrying out tests between Devils Dyke, a high spot Nr Brighton, and Storrington on 23cm. Both stations are using Microwave Modules con-

verters into their respective receivers and they have been experimenting with a variety of aerials, including a 4ft home-brew dish, a J-Beams 15/15 slot and Brian's 16in dish which he used back in 1962 when he held a record for a 104 mile QSO on 1296MHz. Readers wishing to take part in these tests, which take place on most Saturday mornings, should write to G3FEX, QTHR.

The Haywards Heath ARC held its inaugural meeting on November 17th which was attended by 12 people including two, in an advisory capacity, from the Crawley ARC. The meeting elected **Alec Parsons** G8MDP chairman, **Andy Mephram** G4CBZ secretary, and **Chris Stagg** G8MZO treasurer. At present the club is very much VHF orientated and future meetings, where new members are welcome, will be held monthly at the Liverpool Hotel, opposite Haywards Heath Station; for further information phone Andy Mephram, H.H. 57609.

A period of solar activity began on December 1st and was dying down on the 16th, during which time **Cmdr Henry Hatfield**, Sevenoaks, **John Smith**, Rudgwick, and myself recorded many individual bursts of solar radio noise, and noise storm conditions prevailed on the 10th, 11th and 12th. On the 4th, Henry, using his spectrohelioscope, located the cause of the noise when he identified two sunspot groups, 16 filaments and 4 plages on the sun's disc. As usual this solar activity disturbed the normal path of many radio signals.

Between 1720 and 1920 on the 2nd, **John Branegan**, Saline, Fife, observed an aurora borealis both optically and by radio. John sent me a fine drawing of the event, which I will pass on to G2FKZ, and he described it as pale pearly-grey and white and the pattern was fluctuating in a few seconds. While this natural phenomenon continued, John received signals from five Continental FM stations, between 88 and 92MHz; 6 GMs, 1 GI, and a PA0 on 2m and several beacons including DL0PR, LA4VHF, GB3ANG, GI, NEE, VHF and CTC, all being reflected from the changing auroral display. The BBC World Service reported ionospheric disturbances on December 1, 2, 6, 12 and 13 and during the evening of the 12th, **Alan Baker** reported that the HF bands were unusually noisy.

No doubt this solar activity was responsible for the variable conditions on 10m. I heard signals from the Bahrain beacon A9XC on the 12th, the Mauritius beacon 3B8MS on the 1st and 11th, the Cyprus beacon 5B4CY on November 22, 24, 29, December 9, 11, 12, 13 and 17 while **Nigel Golds** BRS 36910 West Chiltington, Sussex, received a 599 signal from the German beacon DL0IGI at 0800 on the 10th and **Ralph Cathles** G3NDF Great Bookham, heard DL0IGI during the morning of the 13th in addition to signals from the Bermuda beacon VP9BA 28.165MHz. Both Nigel and myself heard signals from Europe, Italy, Russia and north and south America during the 10m contest on the 10th and 11th.

**Anthony Mann**, Applecross, Australia, says that there was "a most intense opening" during the evening of November 13th when he heard signals on 10m from A9XC, 5B4CY, 3B8MS and from amateurs in Europe and the UK as far north as Scotland. Anthony noted a lot of sporadic-E activity between November 6th and 20th.

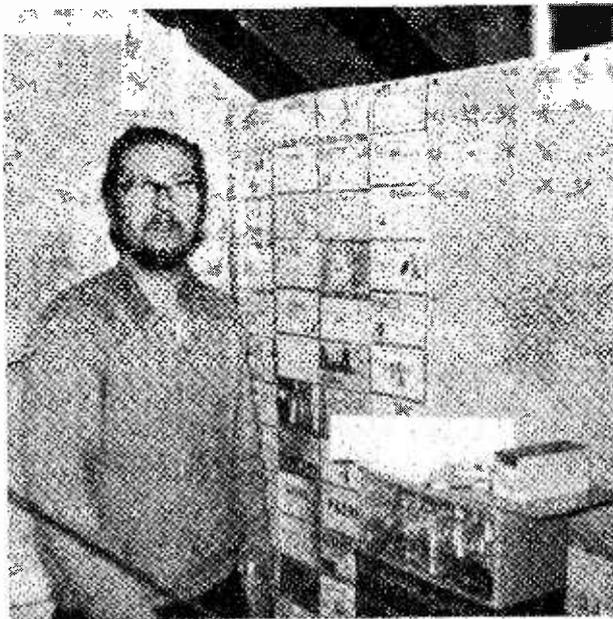
From his DX TV observations he reports Malaysia's Network 1, Ch.E2 and E3 in West Malaysia, came in on three occasions and during one of these he also received East Malaysia's Network 3 on Ch.E2. On November 13th and 18th he received pictures from New Zealand on 45.25MHz and says "November 17th was a very good day for all of us". At the time Malaysia was being received in Perth, 2000 miles east in Sydney, Band 1 and 2 stations in the far north of Queensland were being received by friend **Robert Copeman**.

Thank you all for your interesting reports. Don't forget the RSGB 144/432MHz Open and SWL contest on March 4th/5th and the 70MHz Open contest on March 19th; good luck if you compete and I will look forward to hearing from you after the events.

# VHF PERSONALITY

**ALAN BAKER**

by *Ron Ham*



Alan Baker G8LGQ an electronics engineer from Newhaven, Sussex, is a familiar name to the readers of my VHF column in this journal. According to his father, Alan showed signs of becoming an engineer at the age of three when he played with a pair of pliers and eventually put them across the mains! At the age of six his favourite toy was a crystal set, with the headphones in a pudding basin to increase the audio gain. On leaving Redhill Technical College at 16, Alan began work as a telephone engineer with the GPO and later became a TV service engineer with a private firm in the Kingston area. He was married in 1967 and in 1969 his technical ability took him into the field of public address and the specialised recording of folk music.

In 1975 Ralph Cathles G3NDF loaned him a Hallicrafters Super Sky rider receiver and it was hearing the W's on 20m that convinced him that it was time to take up amateur radio and by February 1976 he was sporting the call sign G8LGQ. Immediately he began exploring the 2m band with a Pye Cambridge which was later replaced with a Yaesu rig.

As a committee member of the Sussex repeater group Alan was involved with the installation of GB3BR, the Brighton repeater on 70cm, and as an enthusiastic mobile operator with an IC22A in his car, he has worked much DX through many of the British Isles and Continental repeaters. His constructional projects include a VHF linear, a frequency counter and a 3-manual theatre organ complete with pit and lift! Alan is a member of the Mid-Sussex Amateur Radio Society and the RSGB, and in May 1977 at the age of 30, he was elected chairman of the newly-formed Brighton and District Radio Society.

In the latter half of 1977 he polished up his morse code and passed the test at North Foreland in November. In just less than two years Alan Baker mastered the art of working DX on the 2m band and now intends to do the same on the HF bands with his new call sign G4GNX.

## BATTERY STATE INDICATOR

*continued from page 849*

and hence the supply voltage range over which oscillation takes place is very narrow, about 0.1V.

### Construction and Component Selection

The Zener diode D1 should ideally give good stabilisation at a low current and can be simply checked by connection to a variable voltage supply with a 4.7kohms series resistor whilst monitoring its voltage with a multimeter. Selection of the Zener in this way is merely a refinement however, as in several indicator circuits lashed up so far all diodes were off the shelf and worked well. The actual Zener voltage is not critical, so a device anywhere between 3V and 5V will be suitable. The LED type is also non-critical except that it should have a suitable mounting clip.

The circuit is best fabricated on a small piece of Veroboard which can be located inside equipment where space permits. A suitable layout is shown in Fig. 2. Four Veropins are soldered in place at the board edge for connection to equipment being monitored.

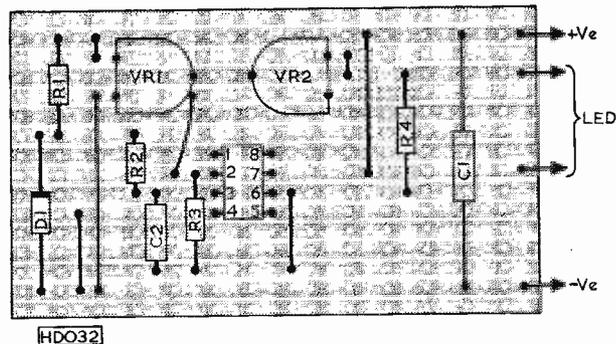


Fig. 2: A suggested Veroboard layout.

### Setting Up

This is a simple matter and is best carried out as follows. Connect the circuit to a variable voltage supply, monitoring the current drain, which should be about 5mA at 9V. Set the supply voltage to the value at which you want the LED to start flashing, say 7V, and adjust VR1 until oscillation begins. With VR2 in its minimum resistance position, the LED will flash between 7V and 6.9V.

This small range will be adequate for low current equipment when the battery voltage drops slowly e.g. a low distortion oscillator taking about 15mA from a PP9 battery, where it is convenient to take the onset of flashing as the "change battery" point. The flashing LED will attract attention if the equipment is being used when the battery voltage drops.

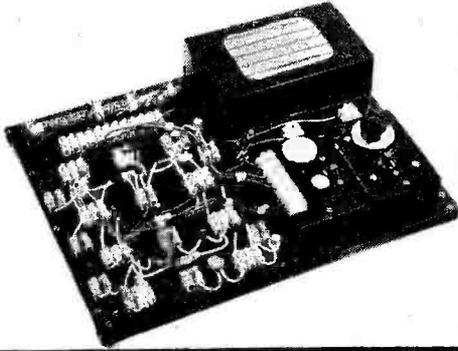
If when switched on after a period of little use the LED does not light, the battery voltage is too low, probably due to normal deterioration. Increasing the value of VR2 will increase the flashing range over wide limits. A small degree of interaction between the two presets is inevitable. For monitoring higher supply voltages than 12V the LED series resistor will need to be increased in order to keep the current at a safe and economic level.

# RADIO EXCHANGE LTD.

## NEW ELECTRONIC MASTER KIT

WITH SPECIAL MULTI-BAND V.H.F. TUNER MODULE TO CONSTRUCT. A completely Solderless Electronic Construction Kit, with ready drilled Bakelite Panels, Nuts, Bolts, Wood Screws etc. Also in the kit: Transistors, Capacitors, Resistors, Pots, Switches, Wire, Sleeving, Knobs, Dials, 5" x 3" Loudspeaker and Speaker Case, Crystal Earpiece, etc. Also ready wound Coils and Ferrite Rod Aerial. These are the Projects you can build with the components supplied with the kit, together with comprehensive Instruction Manual Pictorial and Circuit Diagrams.

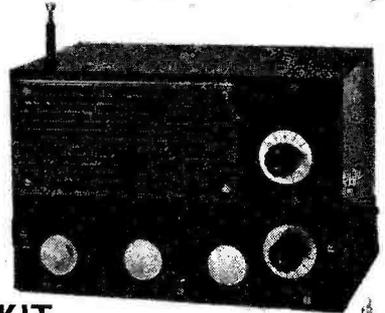
**PROJECTS:** V.H.F. Tuner Module ★ A.M. Tuner Module ★ M.W. L.W. Diode Radio ★ Six Transistor MultiBand V.H.F. Earpiece Radio ★ One Transistor M.W. L.W. Radio ★ Two Transistor Metronome with variable beat control ★ Three Transistor and Diode Radio M.W. L.W. ★ Four Transistor Push Pull Amplifier ★ Eight Transistor MultiBand V.H.F. Loudspeaker Receiver ★ Variable A.F. Oscillator ★ Jiffy MultiTester ★ Four Transistor and Diode M.W. L.W. Radio. ★ A.F. R.F. Signal Injector ★ Five Transistor Push Pull Amplifier ★ Sensitive Hearing Aid Amplifier ★ Three Transistor and Diode Short Wave Radio ★ Signal Tracer ★ Three Transistor Push Pull Amplifier ★ One Transistor Class A Output Stage to drive Loudspeaker ★ Sensitive Transistor Pre-Amp ★ Transistor Tester ★ Sensitive Three Transistor Regenerative Radio ★ Four Transistor M.W. L.W. and Diode Tuner ★ Five Transistor M.W. L.W. Trawler Band Regenerative Radio ★ Five Transistor V.H.F. MultiBand Tuner ★ Three Transistor Code Practice Oscillator ★ Five Transistor Regenerative Short Wave Radio ★ Four Transistor and two Diodes M.W. L.W. Loudspeaker Radio ★ Seven Transistor M.W. L.W. Radio with Loudspeaker Push Pull output ★ One Transistor Home Broadcaster. **£14.99 + P & P £1.10**



## NEW ROAMER TEN MODEL R.K.3

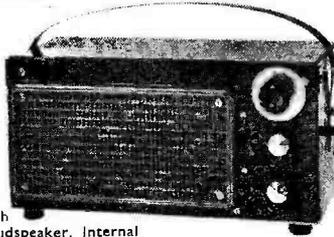
**MULTIBAND V.H.F. AND A.M. RECEIVER. 13 TRANSISTORS AND FIVE DIODES. QUALITY 5" x 3" LOUDSPEAKER.** WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W. Three Short Wave Bands S.W.1, S.W.2, S.W.3 and Trawler Band, Built-in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push-Pull output using 600mW Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Negative Feedback circuit and SPECIAL POWER BOOSTER SOCKET AND RESISTOR, to virtually double gain if required. Powered by P.P.9—9 volt Battery.

Complete kit of parts including carrying strap. **£14.79 + P & P £1.10**  
Building Instructions and operating Manuals.



## NEW MODEL R.K.1

MultiBand A.M. Receiver. M. W. L. W. Trawler Band and Three Short Wave Bands. Seven Transistors and Four Diodes. Push Pull Output stage. 5" x 3" Loudspeaker. Internal Ferrite Rod Aerial. Kit includes all parts to build it up including Carrying Strap, Rubber Feet and ready-drilled Panels. Comprehensive instruction Manual for stage by stage construction. Uses P.P.9 Nine Volt Battery.

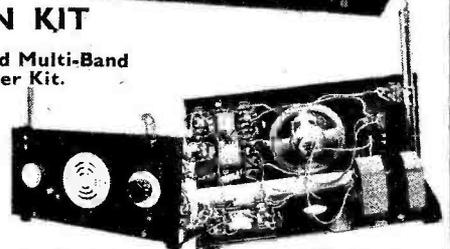


**£8.99 + P & P 90p**

## ELECTRONIC CONSTRUCTION KIT

### E.C.K. 2 Self Contained Multi-Band V.H.F. Receiver Kit.

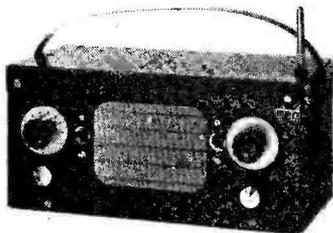
8 transistors and 3 diodes. Push pull output. 3in. loudspeaker, gain control, 7 section chrome plated telescopic aerial V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit)



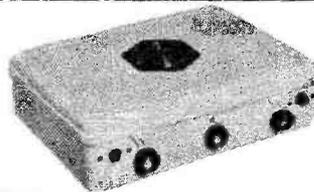
Complete kit of parts **£7.95 + P & P and Ins. 90p**

## NEW MODEL R.K.2

MW, LW and Air Band Receiver. Eight Transistors and Four Diodes. 3" Loudspeaker, Telescopic Aerial, Internal Ferrite Rod Aerial. Complete with Carrying Strap, and ready-drilled Panels and all components necessary for construction. A sensitive Receiver with the additional luxury of an Air Band section to pick up Aircraft from many miles away. Full Instruction Manual enables stage by stage construction. Uses P.P.9 Nine Volt Battery.



**£9.99 + P & P £1.10**



## EDU-KIT MAJOR COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER

Complete kit of parts including construction plans  
Total building costs **£9.99 + P & P and Ins. £1.10**

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN—PNP
- 4 Transistor Push Pull Amplifier
- 24 Resistors
- Earpiece
- Mica Baseboard
- 2 Slider Switches
- 1 Tuning Condenser
- 10 Transistors
- 3 12-way Connectors
- 1 Tuning Condenser
- 3 Knobs
- Ready Wound MW/LW/SW Coils
- 5" x 3" Loudspeaker
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker Radio MW/LW
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- 21 Capacitors
- 12-way Connectors
- 2 Volume Controls
- 3 Knobs
- Ready Wound MW/LW/SW Coils
- 6t yards of wire
- 1 yard of sleeving, etc.

## E.V.6.

Build this exciting new design. 6 Transistors and 2 diodes. MW/LW. Powered by 9V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in. loudspeaker. Attractive case with red speaker grille. Size 9in. x 5½in. x 2½in. approx. All parts including Case and Plans.

Total Building Costs **£5.95 + P & P and ins. 90p**



## V.H.F. AIR CONVERTER KIT

Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the VHF band and operating as shown in the instructions supplied free with all parts.

Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc. All parts including case and plans

**£4.95 + P & P and Ins. 60p**



**To: RADIO EXCHANGE LTD**  
61A High Street, Bedford MK40 1SA

Tel.: 0234 52367 **REG NO. 788372**

- Callers side entrance "Lavells" Shop.
- Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.

Enclose £..... for.....

Name .....

Address .....

..... PW378

**ALL PRICES INCLUDE VAT**

# RST VALVE MAIL ORDER CO.

## CLIMAX HOUSE, FALLSBROOK ROAD, LONDON SW16 6ED

### SPECIAL EXPRESS MAIL ORDER SERVICE

#### SEMICONDUCTORS

AA119 0.20	AA930 0.13	AA932 0.15	AA933 0.25	AA935 0.31	AA937 0.28	AC107 0.75	AC125 0.30	AC126 0.25	AC127 0.25	AC128 0.25	AC141 0.20	AC141K 0.30	AC142 0.20	AC142K 0.25	AC176 0.25	AC187 0.25	AC188 0.25	AC197 0.65	AC198 0.65	AC199 0.65	AC200 0.65	AC201 0.65	AC202 0.65	AD149 0.70	AD181 0.75	AD182 0.75	AF106 0.45	AF114 0.45	AF115 0.25	AF116 0.25	AF117 0.25	AF139 0.40	AF186 1.50	AF239 0.45	AF711 2.75	AF712 2.75	ASV26 0.45	ASV27 0.50	ASV28 1.25	ASV29 1.25	ASV30 0.75	ASZ21 1.50	AU110 1.70	AU113 1.70	AU114 1.70	BA148 0.15	BA154 0.10	BA155 0.12	BA156 0.13	BAW62 0.05	BAX13 0.07	BAX16 0.07	BC107 0.12	BC108 0.12	BC109 0.13	BC113 0.15	BC114 0.18	BC115 0.19	BC116 0.19	BC117 0.22	BC118 0.16	BC125 0.18	BC126 0.18	BC135 0.15	BC136 0.19	BC137 0.16	BC140 0.10	BC149 0.13	BC157 0.12	BC158 0.11	BC159 0.13	BC167 0.13	BC170 0.16	BC171 0.14	BC172 0.13	BC173 0.15	BC177 0.19	BC178 0.18	BC179 0.20	BC182 0.11	BC183 0.11	BC184 0.12	BC212 0.14	BC213 0.14	BC214 0.17	BC237 0.17	BC238 0.12	BC301 0.45	BC303 0.60	BC307 0.22	BC309 0.18	BC322 0.20	BC328 0.18	BC337 0.19	BC338 0.18	BC339 0.18	BC340 0.18	BC341 1.00	BC342 1.00	BC343 0.32	BC358 0.22	BC370 0.18	BC371 0.22	BF014 0.12	BF195 0.11	BF196 0.13	BF197 0.14	BF200 0.32	BF224 0.28	BF244 0.35	BF257 0.37	BF258 0.42	BF259 0.45	BF336 0.50	BF337 0.53	BF338 0.55	BF351 0.25	BF358 0.55	BF359 0.55	BF361 0.25	BF368 0.42	BF369 0.45	BF370 0.45	BF371 0.45	BF372 0.45	BF373 0.39	BF377 0.38	BF378 0.45	BF379 0.48	BF380 0.45	BF381 0.45	BF382 0.45	BF383 0.45	BF384 0.38	BF385 0.37	BF404 0.12	BF405 0.11	BF406 0.13	BF407 0.14	BF408 0.15	BF409 0.16	BF410 0.17	BF411 0.18	BF412 0.19	BF413 0.20	BF414 0.21	BF415 0.22	BF416 0.23	BF417 0.24	BF418 0.25	BF419 0.26	BF420 0.27	BF421 0.28	BF422 0.29	BF423 0.30	BF424 0.31	BF425 0.32	BF426 0.33	BF427 0.34	BF428 0.35	BF429 0.36	BF430 0.37	BF431 0.38	BF432 0.39	BF433 0.40	BF434 0.41	BF435 0.42	BF436 0.43	BF437 0.44	BF438 0.45	BF439 0.46	BF440 0.47	BF441 0.48	BF442 0.49	BF443 0.50	BF444 0.51	BF445 0.52	BF446 0.53	BF447 0.54	BF448 0.55	BF449 0.56	BF450 0.57	BF451 0.58	BF452 0.59	BF453 0.60	BF454 0.61	BF455 0.62	BF456 0.63	BF457 0.64	BF458 0.65	BF459 0.66	BF460 0.67	BF461 0.68	BF462 0.69	BF463 0.70	BF464 0.71	BF465 0.72	BF466 0.73	BF467 0.74	BF468 0.75	BF469 0.76	BF470 0.77	BF471 0.78	BF472 0.79	BF473 0.80	BF474 0.81	BF475 0.82	BF476 0.83	BF477 0.84	BF478 0.85	BF479 0.86	BF480 0.87	BF481 0.88	BF482 0.89	BF483 0.90	BF484 0.91	BF485 0.92	BF486 0.93	BF487 0.94	BF488 0.95	BF489 0.96	BF490 0.97	BF491 0.98	BF492 0.99	BF493 1.00	BF494 1.01	BF495 1.02	BF496 1.03	BF497 1.04	BF498 1.05	BF499 1.06	BF500 1.07	BF501 1.08	BF502 1.09	BF503 1.10	BF504 1.11	BF505 1.12	BF506 1.13	BF507 1.14	BF508 1.15	BF509 1.16	BF510 1.17	BF511 1.18	BF512 1.19	BF513 1.20	BF514 1.21	BF515 1.22	BF516 1.23	BF517 1.24	BF518 1.25	BF519 1.26	BF520 1.27	BF521 1.28	BF522 1.29	BF523 1.30	BF524 1.31	BF525 1.32	BF526 1.33	BF527 1.34	BF528 1.35	BF529 1.36	BF530 1.37	BF531 1.38	BF532 1.39	BF533 1.40	BF534 1.41	BF535 1.42	BF536 1.43	BF537 1.44	BF538 1.45	BF539 1.46	BF540 1.47	BF541 1.48	BF542 1.49	BF543 1.50	BF544 1.51	BF545 1.52	BF546 1.53	BF547 1.54	BF548 1.55	BF549 1.56	BF550 1.57	BF551 1.58	BF552 1.59	BF553 1.60	BF554 1.61	BF555 1.62	BF556 1.63	BF557 1.64	BF558 1.65	BF559 1.66	BF560 1.67	BF561 1.68	BF562 1.69	BF563 1.70	BF564 1.71	BF565 1.72	BF566 1.73	BF567 1.74	BF568 1.75	BF569 1.76	BF570 1.77	BF571 1.78	BF572 1.79	BF573 1.80	BF574 1.81	BF575 1.82	BF576 1.83	BF577 1.84	BF578 1.85	BF579 1.86	BF580 1.87	BF581 1.88	BF582 1.89	BF583 1.90	BF584 1.91	BF585 1.92	BF586 1.93	BF587 1.94	BF588 1.95	BF589 1.96	BF590 1.97	BF591 1.98	BF592 1.99	BF593 2.00	BF594 2.01	BF595 2.02	BF596 2.03	BF597 2.04	BF598 2.05	BF599 2.06	BF600 2.07	BF601 2.08	BF602 2.09	BF603 2.10	BF604 2.11	BF605 2.12	BF606 2.13	BF607 2.14	BF608 2.15	BF609 2.16	BF610 2.17	BF611 2.18	BF612 2.19	BF613 2.20	BF614 2.21	BF615 2.22	BF616 2.23	BF617 2.24	BF618 2.25	BF619 2.26	BF620 2.27	BF621 2.28	BF622 2.29	BF623 2.30	BF624 2.31	BF625 2.32	BF626 2.33	BF627 2.34	BF628 2.35	BF629 2.36	BF630 2.37	BF631 2.38	BF632 2.39	BF633 2.40	BF634 2.41	BF635 2.42	BF636 2.43	BF637 2.44	BF638 2.45	BF639 2.46	BF640 2.47	BF641 2.48	BF642 2.49	BF643 2.50	BF644 2.51	BF645 2.52	BF646 2.53	BF647 2.54	BF648 2.55	BF649 2.56	BF650 2.57	BF651 2.58	BF652 2.59	BF653 2.60	BF654 2.61	BF655 2.62	BF656 2.63	BF657 2.64	BF658 2.65	BF659 2.66	BF660 2.67	BF661 2.68	BF662 2.69	BF663 2.70	BF664 2.71	BF665 2.72	BF666 2.73	BF667 2.74	BF668 2.75	BF669 2.76	BF670 2.77	BF671 2.78	BF672 2.79	BF673 2.80	BF674 2.81	BF675 2.82	BF676 2.83	BF677 2.84	BF678 2.85	BF679 2.86	BF680 2.87	BF681 2.88	BF682 2.89	BF683 2.90	BF684 2.91	BF685 2.92	BF686 2.93	BF687 2.94	BF688 2.95	BF689 2.96	BF690 2.97	BF691 2.98	BF692 2.99	BF693 3.00	BF694 3.01	BF695 3.02	BF696 3.03	BF697 3.04	BF698 3.05	BF699 3.06	BF700 3.07	BF701 3.08	BF702 3.09	BF703 3.10	BF704 3.11	BF705 3.12	BF706 3.13	BF707 3.14	BF708 3.15	BF709 3.16	BF710 3.17	BF711 3.18	BF712 3.19	BF713 3.20	BF714 3.21	BF715 3.22	BF716 3.23	BF717 3.24	BF718 3.25	BF719 3.26	BF720 3.27	BF721 3.28	BF722 3.29	BF723 3.30	BF724 3.31	BF725 3.32	BF726 3.33	BF727 3.34	BF728 3.35	BF729 3.36	BF730 3.37	BF731 3.38	BF732 3.39	BF733 3.40	BF734 3.41	BF735 3.42	BF736 3.43	BF737 3.44	BF738 3.45	BF739 3.46	BF740 3.47	BF741 3.48	BF742 3.49	BF743 3.50	BF744 3.51	BF745 3.52	BF746 3.53	BF747 3.54	BF748 3.55	BF749 3.56	BF750 3.57	BF751 3.58	BF752 3.59	BF753 3.60	BF754 3.61	BF755 3.62	BF756 3.63	BF757 3.64	BF758 3.65	BF759 3.66	BF760 3.67	BF761 3.68	BF762 3.69	BF763 3.70	BF764 3.71	BF765 3.72	BF766 3.73	BF767 3.74	BF768 3.75	BF769 3.76	BF770 3.77	BF771 3.78	BF772 3.79	BF773 3.80	BF774 3.81	BF775 3.82	BF776 3.83	BF777 3.84	BF778 3.85	BF779 3.86	BF780 3.87	BF781 3.88	BF782 3.89	BF783 3.90	BF784 3.91	BF785 3.92	BF786 3.93	BF787 3.94	BF788 3.95	BF789 3.96	BF790 3.97	BF791 3.98	BF792 3.99	BF793 4.00	BF794 4.01	BF795 4.02	BF796 4.03	BF797 4.04	BF798 4.05	BF799 4.06	BF800 4.07	BF801 4.08	BF802 4.09	BF803 4.10	BF804 4.11	BF805 4.12	BF806 4.13	BF807 4.14	BF808 4.15	BF809 4.16	BF810 4.17	BF811 4.18	BF812 4.19	BF813 4.20	BF814 4.21	BF815 4.22	BF816 4.23	BF817 4.24	BF818 4.25	BF819 4.26	BF820 4.27	BF821 4.28	BF822 4.29	BF823 4.30	BF824 4.31	BF825 4.32	BF826 4.33	BF827 4.34	BF828 4.35	BF829 4.36	BF830 4.37	BF831 4.38	BF832 4.39	BF833 4.40	BF834 4.41	BF835 4.42	BF836 4.43	BF837 4.44	BF838 4.45	BF839 4.46	BF840 4.47	BF841 4.48	BF842 4.49	BF843 4.50	BF844 4.51	BF845 4.52	BF846 4.53	BF847 4.54	BF848 4.55	BF849 4.56	BF850 4.57	BF851 4.58	BF852 4.59	BF853 4.60	BF854 4.61	BF855 4.62	BF856 4.63	BF857 4.64	BF858 4.65	BF859 4.66	BF860 4.67	BF861 4.68	BF862 4.69	BF863 4.70	BF864 4.71	BF865 4.72	BF866 4.73	BF867 4.74	BF868 4.75	BF869 4.76	BF870 4.77	BF871 4.78	BF872 4.79	BF873 4.80	BF874 4.81	BF875 4.82	BF876 4.83	BF877 4.84	BF878 4.85	BF879 4.86	BF880 4.87	BF881 4.88	BF882 4.89	BF883 4.90	BF884 4.91	BF885 4.92	BF886 4.93	BF887 4.94	BF888 4.95	BF889 4.96	BF890 4.97	BF891 4.98	BF892 4.99	BF893 5.00	BF894 5.01	BF895 5.02	BF896 5.03	BF897 5.04	BF898 5.05	BF899 5.06	BF900 5.07	BF901 5.08	BF902 5.09	BF903 5.10	BF904 5.11	BF905 5.12	BF906 5.13	BF907 5.14	BF908 5.15	BF909 5.16	BF910 5.17	BF911 5.18	BF912 5.19	BF913 5.20	BF914 5.21	BF915 5.22	BF916 5.23	BF917 5.24	BF918 5.25	BF919 5.26	BF920 5.27	BF921 5.28	BF922 5.29	BF923 5.30	BF924 5.31	BF925 5.32	BF926 5.33	BF927 5.34	BF928 5.35	BF929 5.36	BF930 5.37	BF931 5.38	BF932 5.39	BF933 5.40	BF934 5.41	BF935 5.42	BF936 5.43	BF937 5.44	BF938 5.45	BF939 5.46	BF940 5.47	BF941 5.48	BF942 5.49	BF943 5.50	BF944 5.51	BF945 5.52	BF946 5.53	BF947 5.54	BF948 5.55	BF949 5.56	BF950 5.57	BF951 5.58	BF952 5.59	BF953 5.60	BF954 5.61	BF955 5.62	BF956 5.63	BF957 5.64	BF958 5.65	BF959 5.66	BF960 5.67	BF961 5.68	BF962 5.69	BF963 5.70	BF964 5.71	BF965 5.72	BF966 5.73	BF967 5.74	BF968 5.75	BF969 5.76	BF970 5.77	BF971 5.78	BF972 5.79	BF973 5.80	BF974 5.81	BF975 5.82	BF976 5.83	BF977 5.84	BF978 5.85	BF979 5.86	BF980 5.87	BF981 5.88	BF982 5.89	BF983 5.90	BF984 5.91	BF985 5.92	BF986 5.93	BF987 5.94	BF988 5.95	BF989 5.96	BF990 5.97	BF991 5.98	BF992 5.99	BF993 6.00	BF994 6.01	BF995 6.02	BF996 6.03	BF997 6.04	BF998 6.05	BF999 6.06	BF1000 6.07	BF1001 6.08	BF1002 6.09	BF1003 6.10	BF1004 6.11	BF1005 6.12	BF1006 6.13	BF1007 6.14	BF1008 6.15	BF1009 6.16	BF1010 6.17	BF1011 6.18	BF1012 6.19	BF1013 6.20	BF1014 6.21	BF1015 6.22	BF1016 6.23	BF1017 6.24	BF1018 6.25	BF1019 6.26	BF1020 6.27	BF1021 6.28	BF1022 6.29	BF1023 6.30	BF1024 6.31	BF1025 6.32	BF1026 6.33	BF1027 6.34	BF1028 6.35	BF1029 6.36	BF1030 6.37	BF1031 6.38	BF1032 6.39	BF1033 6.40	BF1034 6.41	BF1035 6.42	BF1036 6.43	BF1037 6.44	BF1038 6.45	BF1039 6.46	BF1040 6.47	BF1041 6.48	BF1042 6.49	BF1043 6.50	BF1044 6.51	BF1045 6.52	BF1046 6.53	BF1047 6.54	BF1048 6.55	BF1049 6.56	BF1050 6.57	BF1051 6.58	BF1052 6.59	BF1053 6.60	BF1054 6.61	BF1055 6.62	BF1056 6.63	BF1057 6.64	BF1058 6.65	BF1059 6.66	BF1060 6.67	BF1061 6.68	BF1062 6.69	BF1063 6.70	BF1064 6.71	BF1065 6.72	BF1066 6.73	BF1067 6.74	BF1068 6.75	BF1069 6.76	BF1070 6.77	BF1071 6.78	BF1072 6.79	BF1073 6.80	BF1074 6.81	BF1075 6.82	BF1076 6.83	BF
------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	-------------	------------	-------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	----

**FANTASTIC  
GOLDRING  
SAVINGS**

**GOLDRING G103  
Belt Drive Turntable**

Famous name turntable slashed to near half price. Complete with plinth, cover and leads. Accepts any standard cartridge (not included)

FULL 12 MONTH GUARANTEE

OUR PRICE  
**£29.95**

R.R.P. £54 (+p/p & Ins £2.50)



SAVE  
OVER £24

**Build your own  
GOLDRING CK2  
Belt Drive Turntable**

Beautifully engineered unit from the famous Goldring company, comes complete with instructions and all necessary parts. Ready to incorporate into your design plinth and cover. The pleasure of assembling your own deck.

(Plinth, cover and cartridge not included).

Usually sold for £54.95 with plinth and cover.

Call in or send cheque, P.O., M.O., Access, Barclaycard, Diners Club or American Express Number.



ONLY  
**£16.95**

(+ p.p & Ins. £1.75)

ALL PRICES  
INC. VAT

**Sonic Sound Audio**

248/250 TOTTENHAM COURT ROAD, LONDON W1. TEL: 01-637 1908

THE COMMUNICATIONS RECEIVER THAT  
HAS IT ALL ...



**FRG-7**

The finest general-coverage synthesised communications receiver on the market, now available in two versions

**ANALOGUE**

**DIGITAL**

★ **£162.00** inc. VAT ★ **£223.00** inc. VAT ★

Also available from us with special 2m converter and accessories, all for just an extra **£17.00**

★

Phone for details of current stocks—new and secondhand—and opening hours

★

**AMATEUR RADIO EXCHANGE**

2 Northfield Road, Ealing, London, W.13. Tel: 01-579 5311

Easy terms up to 3 years

Credit Sales by Telephone

Securicor Delivery

**The  
latest kit  
innovation!  
from Sparkrite**

the quickest fitting

**CLIP ON**

capacitive discharge

electronic ignition

in KIT FORM

Introductory

**SPECIAL OFFER**

£2 OFF Kit



- Smoother running
- Instant all-weather starting
- Continual peak performance
- Longer coil/battery/plug life
- Improved acceleration/top speeds
- Optimum fuel consumption

Sparkrite X4 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 1/3 mins.

Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). The circuit incorporates a voltage regulated output for greatly improved cold starting. The circuit includes built in static timing light, systems function light, and security changeover switch. All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

**THE KIT COMPRISES EVERYTHING NEEDED**

Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, bolts and silicon grease. Full instructions to assemble kit neg. or pos. earth and fully illustrated installation instructions.

NOTE—Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.35 inc. VAT, post & packing.

Electronics Design Associates, Dept. PW3  
82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 614791

Name .....

Address .....

Phone your order with Access or Barclaycard

Inc. V.A.T. and P.P.

QUANTITY REQD.

X4 KIT £14.95	£12.95	
TACHS PULSE SLAVE UNIT	£3.35	
Access or Barclaycard no.		

I enclose cheque/PO's for

£

Cheque No.

Send SAE if brochure only required.

# SLIM JIM

2 METRE OMNI AERIAL  
TYPE SJ2

- ★ Low angle radiation
- ★ Designer approved
- ★ Precision built
- ★ Solid alloy rod
- ★ Machined fittings
- ★ Integral mast clamp
- ★ Low S.W.R.
- ★ £15.50 + £1 pp inc. VAT

Send stamp for details or order direct from:

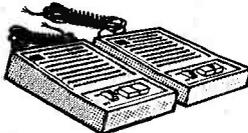
**T & T ELECTRONICS**  
Green Hayes, Surlingham Lane  
Rockland St. Mary, Norwich  
Norfolk NR14 7HH

or from our stockists:

**THANET ELECTRONICS**  
143 Reculver Road, Beltinge  
Herne Bay, Kent CT6 6PL

Trade enquiries welcomed

## MAINS INTERCOM



**NO BATTERIES NO WIRES ONLY**  
**£29.99**  
PER PAIR + VAT 88-75

The modern way of instant 2-way communication. Supplied with 3-core wire. Just plug into power socket. Ready for use. Crystal clear communications from room to room. Range 1/2 mile on the same mains phase. On/off switch. Volume control. Useful as inter-office intercom, between office and warehouse in sisters and in homes. P. & P. 99p.

## 4-STATION INTERCOM



**£19.95**  
+ V.A.T. £1-60

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in robust plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospitals and Offices. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 6ft. A Battery and other accessories. P. & P. 99p.

## NEW! AMERICAN TYPE CRADLE TELEPHONE AMPLIFIER



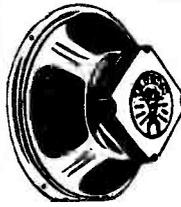
**ONLY £14.95**  
+VAT £1.20

Latest transistorised Telephone Amplifier with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume, conversation recording model at £19.95 + V.A.T. £1.95. P. & P. 89p.

10-day price refund guarantee on all items.  
**WEST LONDON DIRECT SUPPLIES (WVW)**  
189 KENSINGTON HIGH STREET, LONDON, W8  
01-887 5548

# Sonic

HI-FI DISCOUNT CENTRES



## DISCOUNT SPEAKERS

Imp 8 or 15Ω as app.

Guarantees:  
TITAN 5 years  
FANE 2 years  
OTHERS 1 year  
**ALL PRICES INC. VAT**

Prices correct at 8.1.78

### HI-FI TYPES

	List/Value	Sonic Price
5" FANE 501 Mid or Full range	Sp. Price	£4.95
8" x 5" 15w Various makes	Sp. Price	£3.35
8" A.F. Model 80 Dual Cone	Sp. Price	£3.95
8" A.F. Model 83 Dual Cone	Sp. Price	£6.95
FANE 805	Sp. Price	£3.95
FANE 804	Sp. Price	£4.95
FANE 801 Dual Cone	Sp. Price	£7.95
FANE 8" 808T Dual Cone	Sp. Price	£3.95
FANE 8" 807TP	Sp. Price	£4.75
WH/FEDALE L/TON 3XP Kit Pr.	£60.70	£44.95*
10" DENTON 2XP KIT Pair	£39.15	£27.95*
10" GLENDALE 3XP KIT	£82.44	£59.95*
8" FANE MODE ONE KIT	Sp. Price Pair	£19.99
10" ELAC Model 10RM	Sp. Price	£3.85
12" FANE 121/15LR 20w	Sp. Price	£7.95

### GROUP/DISCO TYPES

12" TITAN T12/45 45w	£15.80	£10.95
12" TITAN T12/60A 60w	£22.50	£12.95
12" TITAN T12/100A 100w	£36.00	£22.95
12" CELESTION G12M	£16.50	£12.95
12" CELESTION G12H 30w	£22.00	£11.95
12" CELESTION G12/50 50w	£25.75	£17.50
12" GOODMAN'S 12 PD	Sp. Price	£18.95
12" GOODMAN'S 12 PG	Sp. Price	£17.95
12" FANE 'SPECIALIST' P.A. 80	£26.95	£17.95
12" " DISCO 80	£28.95	£18.95
12" " DISCO 100	£30.95	£20.95
12" " GUITAR 80L	£26.95	£17.95
12" " GUITAR 80B	£27.95	£18.95
12" FANE CRESCENDO 12A 8Ω	£57.35	£39.95
12" FANE " 12A 15Ω	£57.35	£35.95
12" FANE " 12L 8Ω	£59.95	£41.95
12" FANE " 15Ω	£59.95	£38.95
12" FANE " 12 BASS 8Ω	£56.70	£39.95
12" FANE " 15Ω	£56.70	£35.95
15" TITAN T15/60 60w	£26.00	£18.95
15" TITAN T15/70 70w	£28.00	£19.95
15" TITAN T15/100 100w	£41.00	£28.95
15" FANE 'SPECIALIST' BASS 85	£39.95	£29.95
15" " BASS 100	£42.00	£31.50
15" GOODMAN'S 15P	Sp. Price	£23.95
15" CELESTION G15C	£36.00	£24.95
15" FANE CRESCENDO 15/100A 80Ω	£72.95	£49.95
15" FANE " 15Ω	£72.95	£44.95
15" FANE CRESCENDO BASS	£76.00	£49.95
15" " 15/100LT	£74.69	£49.95
15" " 15/160 160w	£95.00	£65.95
15" " 15/125A	£95.00	£69.95
15" " COLOSSUS 200w	£108.00	£69.95
15" TITAN T15/100 100w	£47.00	£35.95
18" GOODMAN'S 18P	Sp. Price	£39.95
18" CELESTION G18C	£53.00	£39.95
18" FANE CRESCENDO 18A	£101.95	£69.95
18" FANE CRESCENDO BASS	£89.95	£59.95
18" " COLOSSUS' 200w	£115.00	£69.95

### HORN UNITS

	(Carr. 75p)	
CELESTION MH1000 25w	£17.00	£13.75
FANE 910 MK II 50w	£17.75	£10.99
" 920 100w	£59.95	£42.45
" 143 50w	£7.95	£4.95
" 173 50w	£11.75	£6.79
" 1104 50-70w	£16.95	£9.75

### HIGH POWER 'CROSS-OVERS'

FANE HPX1R or HPX2R Carr. 35p £3.25 £2.25

### ADD-ON HIGH FREQUENCY UNITS

F.A.L. 'Add-on' Carr. £1	£51.84	£35.95
TITAN T1H 70w Carr. £1	£33.00	£23.95
TITAN TS2H 100w Carr. £1	£33.00	£23.95
TITAN T2H Carr. £1	£39.00	£26.95

### EXTRA SPECIAL MAIL ORDER OFFER TITAN TA/50A 50w AMPLIFIER



High sensitivity. Multi purpose three ind. controlled inputs.

Controls: Bass, Treble & Presence. Robust, well styled compact cabinet. Black Vynide covered. Attractive Black/Silver Fascia. 12 months Guarantee. Carr £1 **£39.95**

Also for personal shoppers only

**AMPS, TTABLES, JINGLE MACHINES, DISCO CONSOLES, LIGHTING, CABINETS, CREDIT TERMS AVAILABLE** orders £20 over

Phone orders accepted from Access & Barclay card holders. Branches at

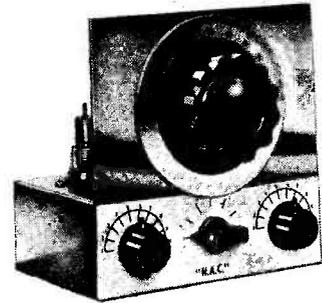
403 SAUCHIEHALL STREET  
Tel: 141 332 0700 **GLASGOW**

24 NEWGATE SHOPPING CENTRE  
**NEWCASTLE**

Tel: 0632 25168  
Mail Orders & Export enquiries to NEWCASTLE Branch. Add 60p carr. on Hi-Fi spkrs. or kits. Otherwise add 95p (12" spkr.) £1.50 (15") £2.50 (18")

## H.A.C. SHORT-WAVE KITS

WORLD-WIDE RECEPTION



Famous for over 35 years for Short-Wave Equipment of quality. "H.A.C." were the Original suppliers of Short-Wave Receiver Kits for the amateur constructor. Special offer AR8 valves—70p each.

1978 "DX" RECEIVER Mark III Complete kit—Price £9.00 (incl. p. & p. and V.A.T.). Customer who sent us five QSL cards, one from each continent writes: "Other countries of interest which I have heard are Korea, Japan, Sri Lanka, Liberia and many others. I was very surprised at the simplicity of the set, compared to its efficiency." This kit is ready to assemble and contains all genuine short-wave components, drilled chassis, valve, accessories and full instructions. Full range of other S.W. kits, including the famous model "K plus" (illustrated above). All orders despatched within 7 days. Send now for free descriptive catalogue of kits and components.

SORRY, NO CATALOGUES WITHOUT S.A.E.

"H.A.C." SHORT-WAVE PRODUCTS  
P.O. Box No. 16, 10 Windmill Lane  
Lewes Road, East Grinstead, West  
Sussex RH19 3SZ

## VALVE BARGAINS

Any 5-64p, 10-£1.20, 50-£5.00. Your choice from the list below.

ECC82, EF80, EF183, EF184, EH90, PCF80, PCF802, PCL82, PCL84, PCL85, PCL86, PCL805, PL504, PY81/800, PY88, 30PL14, 6F28, PFL200.

Colour Valves—PL508, PL509, PL519, PY500/A. All tested. 35p each.

Aerial Splitters—2 way, 75 OHMS, Inside Type, £1.50.

## AERIAL BOOSTERS

Aerial boosters can produce remarkable improvements on the picture and sound, in fringe or difficult areas.

B11—For TH stereo and standard VHF/FM radio.

B12—For the older VHF television—Please state channel numbers.

B45—For Mono or colour this covers the complete UHF Television band.

All boosters are complete with battery with Co-ax plugs and sockets. Next to the set fitting. **£4.20**

### 100—C280/1 CAPACITORS

Values from .01uF to 1.5uF, 250v/w. Price £1.50 (mixed packs).

### 100—ELECTROLYTICS

From 1uF to above 500uF. Mixed voltages. Price £2.00 (mixed packs).

All prices include VAT. P&P 30p per order. Please send uncrossed P.O. or cheques for returning if we are out of stock of capacitor bargain packs. Exports welcome at cost.

## ELECTRONIC MAILORDER LTD.

62 BRIDGE STREET, RAMSBOTTOM,  
BURY, LANCs.  
TEL: RAMS (070 682) 3036

### MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £14.00.



### ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30°C. Special snip this month £3.00.



### WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts and instructions to make. £3.75.



### MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts. Ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 (2 types) for £1.00.



### RADIO STETHOSCOPE

Easiest way to fault find, traces, signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Kit comprises transistors and parts including probe tube and twin stetho-set. £3.95.



### MULTISPEED MOTORS

Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is 3/8" diameter and approximately 1 1/2" long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2" dia. x 5" long. Price £2.00.



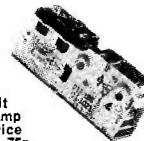
### RECTANGULAR HOT PLATE

Aluminium panel with ridged top and angled underneath to strengthen it. This is approx. 10" x 4 1/2" of flat plate. Beneath plate is 100w element and sensor switch which will maintain the surface of the plate just too hot to touch. With leads and tages. This is ideal if you are making up a food warmer or for an airing cupboard, etc. Price £1.03.



### HUMIDITY SWITCH

American made by Ranco, their type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp at 250v A.C. Overall size of the device approx. 3 1/2" long, 1 1/2" wide and 1 1/2" deep. 75p.



### 8 POWERFUL BATTERY MOTORS

For models, Meccanos, drills, remote control planes, boats, etc. £2.



### PP3/PP9 REPLACEMENT MAINS UNIT

Japanese made in plastic container with leads size 2" x 1 1/4" x 1 1/4", this is ideal to power a calculator or radio, it has a full wave rectified and smoothed output of 9 volts suitable for a loading of up to 100mA. £2.53.



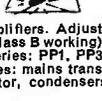
### SWITCH TRIGGER MATS

Wiring dig, supplied for complete house protection—Keep Those Robbers Away! 13" x 10" — £2.10  
24" x 18" — £2.60



### MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer, resistor, smoothing and load resistor, condensers and instructions. Real snip at only £1.95.



### SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £9.95.



### DRILL CONTROLLER

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. £3.45  
Made up model £1.00 extra



### MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output £1.50 including Post and VAT.  
Model 1172 1W, power output £1.85  
Model EP9000 4 watt power output £2.90  
EP 9001 twin channel or stereo pre-amp. £2.90



### SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £1.90—crystal earphone 55p.



### BREAKDOWN PARCEL

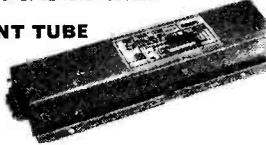
Four unused, made for computer units containing most useful components, and these components unlike those from most computer panels, have wire ends of usable length. The transistors for instance have leads over 1" long—the diodes have approx. 3/4" leads.



List of the major components is as follows—17 assorted transistors—38 assorted diodes—60 assorted resistors and condensers—4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which were made to receive these units). The price of this four unit parcel is £1 including VAT and post (considerably less than value of the transistors or diodes alone). DON'T MISS THIS SPLENDID OFFER.

### FLOUORESCENT TUBE INVERTOR

For camping—car repairing—emergency lighting from a 12v battery you can't beat fluorescent lighting, it will offer plenty of well distributed light and is economical. We offer inverter 12v 13 watt miniature tube for only £3.75 with tube and tube holders as well.



### THIS MONTH'S SNIP

is a miniature sealed relay 12v dc. operated with two sets of change over contacts. The unique feature of this relay is its heavy lead out wires. These provide adequate support and therefore the relay needs no fixing; on the other hand there is a fixing bolt protruding through one side so if you wish you can fix the relay and use its very strong lead outs to secure circuit components—an expensive relay; but we are offering it for only 87p each. Don't miss this exceptional bargain!



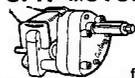
### EXTRACTOR FAN

Ex computers—made by Woods of Colchester, ideal for fixing through panel—reasonably quiet running—very powerful 2500 rpm. Choice of two sizes 5" or 6 1/2" dia. £5 and £6.



### SPIT MOTOR WITH CARTER G/BOX

Probably one of the best spit motors made. Originally intended to be used in very high priced cookers, however this can be put to plenty of other uses, for instance your garden barbecue or to drive a tumbler for stone polishing; in fact there are no ends to its uses. Normal mains operation. £4.32.



### HONEYWELL P.B. MICRO SWITCH

1-2 or 3 10 amp 250v changeover micro-switch thru panel mounting by cock nuts 1 1/2" dia black knob 1 switch 40p 2 switch 55p, 3 switch 70p.



### LATCHING RELAY

by Guardian Electric, mains operated it is in fact two relays mounted on a metal base plate. The relays being mounted in such a way to ensure that when one closes the other opens and vice versa thus when closed relay A would remain locked until manually released or electrically released by energising relay B. Each relay has 2 sets of 10 amp changeover contacts. Should be ideal for burglar alarms and similar applications £2.11.

### TERMS:

Cash with order—prices include VAT and carriage unless stated but orders under £6 must add 50p to offset packing, etc. BULK ENQUIRIES WELCOMED. Phone 01-688 1833.

### IT'S FREE

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

**FM Tuner and decoder**, two very well made (Japan) units, nice clear dial, excellent reproduction £9.95 the pair £1.25 VAT.

**12 Volt Heavy Duty Relay**, plug in type has three pairs of 10 amp changeover contacts. A transparent dust cover, price £1 + 8p, suitable 11 pin base 27p + VAT 2p.

**4 Changeover Mains Relay**, upright mounting with perspex type dust cover, the really interesting feature is 4 sets of 10 amps changeover contacts price £1.82 + VAT 12p.

**12 Volt Pump**. Designed we believe as a bilge pump, this is 12 volt A.C./D.C. motor coupled by a long enclosed shaft to a submersible pump. Suitable for water or most any fluids. Price £11.70.

**Just arrived**. Fruit machines, working order very impressive choice of several but very heavy so you must collect. £50.

**High Load 24 Hour Clock Switch**, made by the famous AEG Company for normal mains but with clockwork reserve has load capacity of 80 amps at 240v 50hz. Therefore suitable for dealing with large loads of say shop lighting, water heating, storage heaters, etc., etc. Has triggers for on and off once per 24 hours but extra triggers will be available. Price £1.50 per pair. Size of clock approximately 8" x 5" x 5", totally enclosed but has lift up flap for ease of altering switching times. Price, new and unused £10.65 or used but guaranteed o.k. £6.50.

**Enclosed 24 Hour Clock**, with contacts for breaking 10-12 amps at 240v. This one has two sets of on/off per 24 hours, price £7.00.

**Smiths 24 hr. Timers—Heart only**, with over-ride similar to those used in the auto set, etc. £4.75 + VAT 33p. Diff. but in grey plastic wall mounting case, with leads ready for attaching to plug and socket, price £6.95.

**Light Dimmer**, our timer module with small mods makes an excellent light dimmer. Contains a 4 amp 400V SCR so it should be suitable for loads approaching 1kw. Price of module with variable resistor and instructions £2.25.

**Push Pull Solenoids**, mains operated solenoids which will push as well as or instead of pull. Very heavy duty estimate this at 20lbs push or pull 1 1/2" x 3 1/2" x 4" made Magnetic Devices Co. £7.50.

### MINI-MULTI TESTER

Amazing, deluxe pocket size precision moving coil instrument. Jewelled bearings—1000 opv—mirrored scale. 11 instant ranges measure—DC volts 10, 50, 250, 1000 AC volts 10, 50, 250, 1000 DC amps 0-1 mA and 0-100 mA Continuity and resistance 0-150K ohms. Complete with insulated probes, leads, battery, circuit diagram and instructions. Unbelievable value only £5.50p.



### FREE

Amps ranges kit enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one send £1.50p.

**Flat Reed Switches**, for stacking greater quantity in confined space. Price 50p each VAT 4p.

**Single Ended Types** for jobs where it is not easy to bring a load to each end 75p each. All these switches are normally open but can be biased to a normally closed position by fitting a magnet adjacent. The reed switch would then be opened by a magnet of opposite polarity being brought up to it.

**Ceramic Magnets** suitable for operating reed switches, central fixing hole, 10 for £1.

**Music Centre Transformer** 12-0-12 at 1 amp and 9 volt at 1/2 amp. Normal primary, upright mounting, impregnated and varnished for quiet operation. Price £2.95. Post 54p.

**Extension Speakers** 8 ohm 4.5 watts handling power. We have 5 or 6 different models in stock, cheapest being the Partytime at £3.95 each, again only really a bargain for callers as postage is £1.50 per speaker.

**T.V. Monitor**, an item for callers, believed to be in good working order, switchable thro' 405-525 & 625. 21" tube line systems, normal controls, volume, brightness, contrast, width, etc. Price £16.20, 12" model £18, suitable for conversion into special purpose scope, etc.

**Auto transformers** for working American tools and equipment, completely enclosed in sheet metal case with American type flat output socket made for computer so obviously first-class. 500 watts. With carrying handle, offered at about half price only £15 + 30p, carriage £2 + 15p. These may be £29.50 or £5.48.

### TANGENTIAL HEATER UNIT

A most efficient and quiet running blower-heater by Solatron—same type as is fitted to many famous name heaters—Comprises mains induction motor—long turbo fan—split 2kw heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct onto base of say kitchen unit—price £4.95 post £1.50 control switch to give 2kw, 1kw, cold blow or off available 60p extra.



3KW MODEL  
£5.95  
+ £1.50 P. & P.

**J. BULL (ELECTRICAL) LTD**  
(Dept. PW), 103 TAMWORTH RD.  
CROYDON CR9 1SG

**EASY BUILD SPEAKER DIY KITS**  
Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak-simulate enclosures, two EMI 13" x 8" (approx.) woofers, two tweeters and a pair of matching crossovers. Supplied complete with an easy-to-follow circuit diagram, and crossover components.

**STEREO PAIR** Input 15 watts rms, 30 watts peak, each unit. Cabinet size 20" x 11" x 9 1/2" (approx.). **£2800** + p & p £5.50

**SPEAKERS AVAILABLE WITHOUT CABINETS.** It's the units which we supply with the enclosures illustrated. Size 13" x 8" (approx.) woofer, (EMI), 2 1/2" app. **£1700** per tweeter, and matching crossover components. stereo pair Power handling 15 watts rms, 30 watts peak. + p & p £3.40

**20 x 20 WATT STEREO AMPLIFIER** **£2990**  
Superb Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack p & p £2.50

**30 x 30 WATT AMPLIFIER KIT** Specially designed by RT-VC for the experienced constructor, complete in every detail. Same facilities as Viscount IV amplifier. 60 + 60 peak. p & p £2.50 **£2900**  
**NOW AVAILABLE** fully built and tested. **£3500** p & p £2.50

**FREE** To cash or cheque personal shoppers A 4 channel Stereo Adaptor to all buyers of the Viscount 20 x 20 **£2990** Available separately **£395** Amplifier at + £1.00 p & p.

**45 WATT MONO DISCO AMP** **£3500** p & p £2.50  
Size approx. 13 1/2" x 5 1/2" x 6 1/2"  
45 watts rms, 90 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

**70 & 100 WATT MONO DISCO AMP** **£57**  
Size approx. 14" x 4" x 10 1/2"  
Brushed aluminium fascia and rotary controls. Five vertical slide controls - master volume, tape level, mic level. Deck level, PLUS INTER-DECK FAOER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre-fade level control **£57** (PFL) lets YOU hear next disc before fading **140 watt peak** it in. VU meter monitors output level. **100 watt** p & p **£4.00**  
Output 100 watts RMS 200 watts peak. **100 watt** **£65**

**COMPACT FOR TOP VALUE** These infinite baffle enclosures come to you ready mitted and professionally finished. Each cabinet measures approx. per stereo pair 12" x 9" x 5" deep, and is in wood simulate. **£850** Complete with two 8" (approx.) speakers for maximum power handling of 7 watts. 8Ω. + p & p £2.20

**SPEAKERS** Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak. 18 1/2" x 13 1/2" x 7 1/2" (approx.). Duo III, 20 watts rms, 40 watts peak. 27" x 13" x 11 1/2" approx. Duo IIb **£17** p & p £6.50 Duo III **£52** p & p £7.50

**DECCA 20 WATTS STEREO SPEAKER** stereo pair This matching loudspeaker system is hand made, kit comprises of two 8" diameter approx. base drive unit, with heavy die cast chassis laminated cones with rolled P.V.C. surrounds, two 3 1/2" diameter approx. domed tweeters complete with crossover networks. 8Ω. **£4.00** p & p **£20.00**

**ADD-ON STEREO CASSETTE TAPE DECK KIT** Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record/replay electronics with twin V.U. meters and level control for mating with mechanism. Specifications: Sensitivity - Mic. 0.85 mV/α 20K OHMS; Din, 40mV α 40K OHMS; Output - 300mV RMS per channel/α 1KHz from 2K OHMS source; Cross Talk - -30db; Tape Counter - 3 Digit- Resettable; Frequency Response - 40Hz - 8KHz ± 6db; Deck Motor - 9 Volt DC with electronic speed regulations; Key Functions - Record, Rewind, Mains Transformer **£1995** Fast Forward, Play, Stop & Eject. **£2.50** + £1 p & p & n **£2.50** Opt. extras: Mains Transformer to suite **£2.50** + £1 p & p.

**CHASSIS RECORD PLAYER DECKS** **BSR BD S 95 TYPE** illus. **£24.95**  
Belt drive turntable unit, 2 speed, semi automatic. p & p **£2.55**  
**BSR MP60 TYPE** Single play record deck less cartridge. p & p **£2.55**  
Cartridges to suit above  
Acos, magnetic stereo **£4.95**  
Ceramic stereo **£1.95**  
BSR automatic record player deck cueing device and stereo ceramic head, p & p **£2.55** **£9.95**

Type II 5T  
BSR MP 60 type, complete with magnetic cartridge, diamond stylus, and de luxe plinth and cover. p & p **£4.50**  
Home 8 Track cartridge player This unit will match with the Viscount IV 9" x 8" x 3 1/2". p & p **£2.50** **£16.50**

**PERSONAL SHOPPERS**  
**STEREO CASSETTE** record/replay fully built P.C. board **£4.95**  
**AM. FM. TUNER** P.C.B. with Mullard L.P. 1186, 1185, 1181 modules. **£9.50**  
**100K** Multiturn Varicap tuning pots, 6 for **£1.00**  
**PAIR STEREO 8 WATT SPEAKERS** 8" base units with 3 1/2" approx. tweeters Size 16 1/2" x 11" x 8 1/2". **£9.95**  
**Plinth & cover** BSR or Gerrard teak finish **£6.00**  
**DECCA** DC1000 Stereo Cassette P.C.B. complete with switch oscillator coils and tape-heads **£2.95**  
**AM. FM. Stereo Multiplex Car Radio/cassette** player in dash fixing Negative earth 5 watts output **£36.00**  
**I.C. Stereo 8 Track to Cassette** adaptor converts, any 8 track player to cassette player. **£18.95**

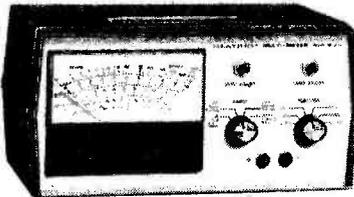
**FOURIST IV CAR RADIO KIT** For the experienced constructor only Output 4 watts into 4 ohms. 12 volts pos or neg (altered internally) **£12.50** p & p **£1.50**  
**FREE TO PERSONAL SHOPPERS** BUYING CAR RADIO KIT worth **£3.00**  
**ELECTROMATE** Rear window heater, modern line element. **£3.00**

All enquiries send stamped addressed envelope.

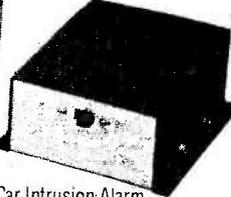
**RTVC**  
323 EDGWARE ROAD, LONDON W2  
21c HIGH STREET, ACTON W3 6NG  
ALL PRICES INCLUDE VAT AT 12 1/2%  
All items subject to availability. Price correct at and subject to change without notice.

Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm, Half day Thursday. ACTON: Mail Order only. No callers. GOODS NOT DESPATCHED OUTSIDE UK

# Over 200 kits in the free Heathkit Catalogue



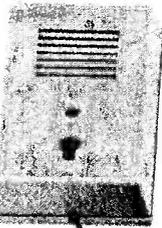
**NEW 4 Function Solid State Multimeter**  
— One of a whole range of test equipment



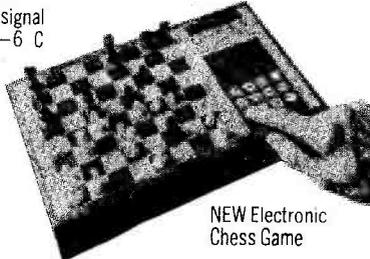
**Car Intrusion Alarm**  
— Gives a distinctive 'yelping' sound-signal the moment your car is tampered with



**NEW Digital Clock**  
— with repeater alarm



**Freezer Alarm** — Gives audible signal if freezer temperature rises to -6 C for any reason



**NEW Electronic Chess Game**

Right now, there's a brand new edition of the Heathkit Catalogue — packed with hundreds of practical and fascinating items which you can build yourself.

**Send for your copy now!**

To Heath (Gloucester) Ltd.  
Department PW-38  
Bristol Road, Gloucester, GL2 6EE.  
Please send a copy of the Heathkit Catalogue. I enclose 11p in stamps to cover postage only.

Name \_\_\_\_\_  
Address \_\_\_\_\_

**Soldering iron offer FREE**

When you receive your catalogue you'll get details of this free offer worth approximately £4.75.

**HEATH**  
**Schlumberger**  
The world's biggest producers of electronic kits.

**ACCESS AND BARCLAY CARD WELCOMED**

There are Heathkit Electronics Centres at 233 Tottenham Court Road, London (01-636 7349) and at Bristol Road, Gloucester (Gloucester 29451).

### MINI CONSOLES

Ideal for small desk control panels and consoles. Moulded in orange, blue, black and grey ABS. Incorporates slots for holding 1.5mm thick pcb's. Aluminium panel sits recessed into front of console and held by screws running into integral brass bushes.

MC 161 x 96 x 58mm £2.12 (1-9) (Includes VAT)  
 MC 215 x 130 x 75mm £2.94 (1-9) (Includes VAT)  
 (Prices include VAT & P.P.)

### ECONOMY QUALITY LED'S

50 for only £5 - 100 for only £9  
 Mixed bags, all sizes, various colours

Full specification LED's also available  
 Red (specify size) 75p per pack  
 Green, Yellow, Orange (specify size) £1.20 per pack  
 Packs contain 5 LED's, mounting clips and data

### TYPE A NEON INDICATORS

Supplied with resistor for 240 Volts operation  
 Held in 8mm hole by plastic bezel  
 150mm wire leads

AA AG AH  
 Red, Amber, Clear, Opal 19p each  
 Green 28p each

### 12 VOLTS MINI HAND DRILL

Ideal for drilling pcb, chassis etc as well as model making. Supplied with 2 collets that accept tools and drills with 3/32" and 0.50" dia shanks. £7.56 (Includes VAT & P.P.)

Stop wasting time soldering  
**The NEW MW BREADBOARD accepts**  
 Transistors, LED's, Diodes, Resistors, Capacitors and all DIL packages with 6 to 40 pins

Includes slot-in Component Support Bracket and has 470 individual sockets, plus Vcc and Ground Bus Strips  
 Price £9.72 (includes VAT & P.P.)

### TYPE MP NEON INDICATOR

Supplied with resistor for 240 Volts operation  
 150mm leads, held in 6.4mm hole by nut

Red, Amber, Clear, Opal 20p each

### SEVEN SEGMENT DISPLAYS

Economy quality Red, yellow and green Only 45p each  
 Common Anode - 0.3" Left Decimal Full specification displays also available as above Red @ 98p each Green and Yellow @ £1.35 each. Data supplied with full spec. displays only.

Quantity quotations on request

P.P. Note Unless included in price add 25p Post & Packing for orders totalling under £10. All prices include VAT and are valid in UK only for 2 months from journal issue date

**Michael Williams Electronics**  
 47 Vicarage Av. Cheadle Hulme, Cheshire SK8 7JP

### SC BOXES

Easily drilled or punched, orange, blue, black and grey ABS. Incorporate slots for holding 1.5mm thick pcb's. Aluminium panel sits recessed into front of the box and held by screws running into integral brass bushes.

SC 85 x 56 x 35mm 97p (1-9) (Includes VAT)  
 SC 111 x 71 x 48mm £1.29 (1-9) (Includes VAT)  
 SC 161 x 96 x 59mm £1.81 (1-9) (Includes VAT)  
 Add 25p per £1 order value for Post & Packing

### 240 VOLTS MINI HAND DRILLS

Ideal for drilling pcb's, chassis etc as well as model making. Supplied with 3 collets that accept tools and drills with 1mm, 2mm and 1/8" dia shanks. £9.72 (includes VAT & P.P.)  
 Accessory tools... 5 Burrs, 1mm, 2mm, 1/8th Drills, 3/32" Collet Price £1.75 (Includes VAT & P.P.)

### RC BOXES ABS and DIECAST

1.5mm pcb slots and close fitting flanged lids. ABS in orange, blue, black or grey colours. Diecast in natural or grey hammertone colour. Lid held by screws running into integral brass bushes.

RC 100x62x25mm	68p	70p	93p
RC 112x62x31mm	79p	94p	1.23
RC 120x65x40mm	88p	1.22	1.59
RC 150x80x50mm	1.03	1.84	2.11
RC 190x110x60mm	1.77	2.53	3.08

Palystyrene version  
 in grey only, no slots, no integral brass bushes  
 RC(P) 112 x 61 x 31mm 61p  
 All prices are 1-9 off, include VAT, but please add 25p per £1 order value for Post & Packing

## BARGAIN PARCELS SAVE POUNDS

Huge quantities of electronic components must be cleared as space required. 1000's of capacitors, resistors, transistors, Ex equipment panels etc. covered in valuable components. No time to sort. Must sell by weight 7 lbs-£4.95; 14lbs-£7.95; 28lbs-£12.00; 56lbs-£20.00; 112lbs-£30.00.

### BARGAIN PACKS

**Handy Packs**  
 4 aluminium boxes 128 x 44 x 38 mm Ideal for signal injectors, etc. £1.00.  
 Self fluxing enamelled copper wire 18 & 22 swg on 2 oz reels, 2 for £1.10.  
 100 miniature red switches ideal for burglar alarms, model railways, etc. £3.30.  
 15 x 2-pole reed relays on board operate at 12 volts £2.45.  
 6 x 6 pole 12 volt reed relays on board £2.45.  
 High quality computer panels smothered in top grade components 5 lbs £4.75. 10 lbs £8.95.

**DE LUXE FIBRE GLASS PRINTED CIRCUIT ETCHING KITS**  
 Includes 150 sq. ins. copper clad 1/4 board, 1 lb ferric chloride, 1 Dalo etch resist pen, abrasive cleaner, 2 mini drill bits, etch tray and instructions/only £5.30.

150 sq. in. fibre glass board £2.00  
 Dalo pen. 90p  
 1 lb ferric chloride to mil spec £1.25

5 lbs ferric chloride to mil spec £5.00  
 Instruction sheet 20p

200 unmarked mixed transistors, lots of interesting types including power. Send 60p for samples £4.50.  
 25 New & marked integrated circuits including 555, 741, 7400, 7480, TBA 800, CD4001, etc. £4.70.  
 BR 101 full spec. 5 for £1.00.  
 TBA 120A 50p each  
 20 mm anti-surge fuses your selection 800MA to 3-15A. 12 for £1.00

**Component Bargains**  
 300 mixed resistors ± & 1 watt £1.00  
 300 modern mixed caps most types £3.30.  
 125 mixed resistors mostly 1 & 2 watt. £1.  
 100 mixed polyester caps £2.20.  
 100 mixed modern miniature ceramic plate caps £2.20.  
 100 mixed electrolytics £2.20.  
 100 mixed wirewounds £2.20.  
 200 printed circuit resistors £1.00.  
 25 mixed pots & presets £1.00.

40p P & P ON ALL ABOVE ITEMS. SEND CHEQUE OR POSTAL ORDER WITH ORDER TO SENTINEL SUPPLY, DEPT PW 20A WADDON ROAD, CROYDON, SURREY 149A BROOKMILL, DEPTFORD, LONDON, SE8

## ORCHARD ELECTRONICS

Service second to none—Try us and see !  
**SUPPLIERS TO U.K.A.E.A., D.O.E., UNIVERSITIES, ETC.**

### FOR A FANTASTIC SERVICE

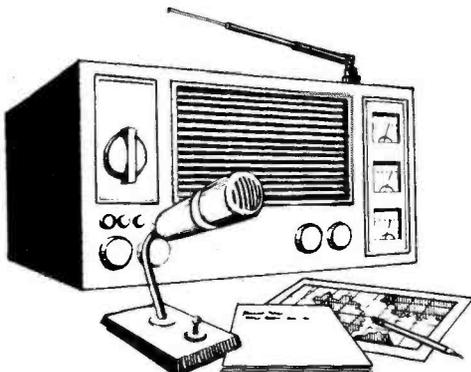
<b>TRANSISTORS</b>	<b>BRIDGES</b>	<b>TTL DIGITAL</b>	7490(A) 0-55 7491 0-75 7492 0-55 7493 0-85 7494 0-85 7495 0-74 7496 0-30 7497 0-30 7498 0-38 7499 0-49 7500 0-80 7501 1-15 7502 1-20 7503 1-20 7504 1-20 7505 1-20 7506 1-20 7507 1-20 7508 1-20 7509 1-20 7510 1-20 7511 1-20 7512 1-20 7513 1-20 7514 1-20 7515 1-20 7516 1-20 7517 1-20 7518 1-20 7519 1-20 7520 1-20 7521 1-20 7522 1-20 7523 1-20 7524 1-20 7525 1-20 7526 1-20 7527 1-20 7528 1-20 7529 1-20 7530 1-20 7531 1-20 7532 1-20 7533 1-20 7534 1-20 7535 1-20 7536 1-20 7537 1-20 7538 1-20 7539 1-20 7540 1-20 7541 1-20 7542 1-20 7543 1-20 7544 1-20 7545 1-20 7546 1-20 7547 1-20 7548 1-20 7549 1-20 7550 1-20	100V 1A 0-28 200V 1A 0-30 400V 1A 0-32 400V 2 1/2A 0-65 7402 0-18 7403 0-18 7404 0-23 7405 0-23 7406 0-23 7407 0-30 7408 0-18 7409 0-18 7410 0-18 7411 0-24 7412 0-25 7413 0-38 7414 0-72 7415 0-94 7416 0-36 7417 0-36 7418 0-20 7419 0-60 7420 0-18 7421 0-18 7422 0-22 7423 0-34 7424 0-34 7425 0-34 7426 0-36 7427 0-32 7428 0-36 7429 0-36 7430 0-18 7431 0-32 7432 0-32 7433 0-32 7434 0-32 7435 0-32 7436 0-32 7437 0-32 7438 0-32 7439 0-32 7440 0-32 7441 0-32 7442 0-32 7443 0-32 7444 0-32 7445 0-32 7446 0-32 7447 0-32 7448 0-32 7449 0-32 7450 0-32	7490(A) 0-55 7491 0-75 7492 0-55 7493 0-85 7494 0-85 7495 0-74 7496 0-30 7497 0-30 7498 0-38 7499 0-49 7500 0-80 7501 1-15 7502 1-20 7503 1-20 7504 1-20 7505 1-20 7506 1-20 7507 1-20 7508 1-20 7509 1-20 7510 1-20 7511 1-20 7512 1-20 7513 1-20 7514 1-20 7515 1-20 7516 1-20 7517 1-20 7518 1-20 7519 1-20 7520 1-20 7521 1-20 7522 1-20 7523 1-20 7524 1-20 7525 1-20 7526 1-20 7527 1-20 7528 1-20 7529 1-20 7530 1-20 7531 1-20 7532 1-20 7533 1-20 7534 1-20 7535 1-20 7536 1-20 7537 1-20 7538 1-20 7539 1-20 7540 1-20 7541 1-20 7542 1-20 7543 1-20 7544 1-20 7545 1-20 7546 1-20 7547 1-20 7548 1-20 7549 1-20 7550 1-20	<b>DISPLAYS</b> DL704 DL707 Comm. An. 0-75
<b>TANTALUM BEAD</b>	<b>PRESET</b>	<b>MIN &amp; SUB-MIN</b>	<b>C/MOS</b>			
15 MFD/35V 13p 47 MFD/35V 13p 1 MFD/35V 13p 6-80 MFD/16V 13p 10 MFD/10V 14p 22 MFD/16V 18p 100 MFD/6V3 20p	7400 0-15 7401 0-25 7402 0-18 7403 0-18 7404 0-23 7405 0-23 7406 0-23 7407 0-30 7408 0-18 7409 0-18 7410 0-18 7411 0-24 7412 0-25 7413 0-38 7414 0-72 7415 0-94 7416 0-36 7417 0-36 7418 0-20 7419 0-60 7420 0-18 7421 0-18 7422 0-22 7423 0-34 7424 0-34 7425 0-34 7426 0-36 7427 0-32 7428 0-36 7429 0-36 7430 0-18 7431 0-32 7432 0-32 7433 0-32 7434 0-32 7435 0-32 7436 0-32 7437 0-32 7438 0-32 7439 0-32 7440 0-32 7441 0-32 7442 0-32 7443 0-32 7444 0-32 7445 0-32 7446 0-32 7447 0-32 7448 0-32 7449 0-32 7450 0-32	100ohm, 220ohm 470ohm, 1K, 2K2, 4K7, 10K, 20K, 50K, 100K, 250K, 470K, 1M. RM2 8p* each.	4000 0-19 5000 0-19 10000 0-19 1500A 1-20 MOT 700 OP P-1K2 8 Ω 200 MW 0-50			
<b>THYRISTORS</b>	<b>ECL 1043/05</b>	<b>RESISTORS</b>	<b>POTENTIOMETERS</b>			
80V 1A 0-25 100V 1A 0-38 TAG 1 100 200V 1A 0-60 TAG 1 200 600V 1A 0-80 TAG 1 600 700V 1A 1-40 BT 106 400V 4A 0-65 C106D1 500V 6 1/2 A 1-85 BT109	VARICAP TUNER £5-00	1/2 WATT 5% 2p* each 10 off value 15p* 20 mixed values 30p*	Lin/Log 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, 2M, 28p* each.			
<b>LED T11 209/0-125"</b>	<b>POST AND PACKING 25p.</b>	<b>DISCOUNTS</b>	<b>ORCHARD ELECTRONICS,</b>			
Red 20p Green 25p Clips for above 3p	VAT* ADD 12% REST 8% £5-5% £10- 7 1/2% £15-10%.	7 1/2% £15-10%.	Orchard House, St Martins St. Wallingford, Oxon O491 35520.			

TTLS by TEXAS		741's		OP. AMPS.		NE531V		MEMORY I.C.s		MPSA12		DIODES		OA202							
7400	14p	7497	290p	74LS00	30p	4001	20p	95p	140p	1702A	EPROM	850p	MPSA12	62p	2N2907A	25p	BY127	12p	IN614	4p	
7401	14p	7410	140p	74LS02	30p	4007	20p	20p	160p	2102-2	RAM	160p	MPSA56	40p	2N2926B	9p	OA47	9p	IN918	7p	
7402	16p	74104	75p	74LS04	30p	4008	115p	115p	150p	2107	RAM	884p	MPSU05	30p	2N3054	65p	OA91	15p	IN4001/2	7p	
7403	16p	74105	75p	74LS08	30p	4009	50p	50p	25p	2112-2	RAM	300p	MPSU56	80p	2N3055	65p	OA85	15p	IN4003/4	7p	
7404	24p	74107	38p	74LS10	32p	4010	60p	60p	25p	8080A	C.P.U.	£18	OC28	140p	2N3442	151p	OA90	9p	IN4005/7	8p	
7405	25p	74109	60p	74LS13	55p	4011	20p	20p	40p	AY-6-1013	UART	600p	OC35/6	140p	2N3643	54p	OA91	9p	IN4148	4p	
7406	40p	74110	80p	74LS20	32p	4012	20p	20p	21p	776	ROM	750p	OC71	32p	2N3844	54p	OA95	9p	IN5401/3	15p	
7407	40p	74111	80p	74LS22	34p	4013	55p	55p	70p	MC1458P	75p		R2088	225p	2N3702/3	14p	OA200	9p	IN5404/7	20p	
7408	22p	74116	210p	74LS27	45p	4014	115p	115p					R2010B	225p	2N2704/5	14p					
7409	22p	74118	160p	74LS30	30p	4015	90p	90p					TIP29A	50p	2N3706/7	14p					
7410	18p	74119	225p	74LS32	34p	4016	50p	50p					TIP29C	60p	2N3708/9	14p					
7411	26p	74120	130p	74LS33	30p	4017	110p	110p					TIP30A	60p	2N3773	320p					
7412	25p	74121	32p	74LS34	30p	4018	110p	110p					TIP30C	72p	2N3819	27p					
7413	40p	74122	52p	74LS37	45p	4019	32p	32p					TIP31A	56p	2N3820	50p					
7414	85p	74123	75p	74LS39	30p	4020	120p	120p					TIP31C	68p	2N3823	70p					
7416	40p	74125	70p	74LS83	120p	4021	115p	115p					TIP32A	83p	2N3866	97p					
7417	40p	74126	65p	74LS85	144p	4022	100p	100p					TIP32C	85p	2N3903/4	22p					
7420	18p	74128	82p	74LS90	80p	4023	22p	22p					TIP33A	97p	2N3905/6	22p					
7421	43p	74132	81p	74LS93	80p	4024	80p	80p					TIP33C	120p	2N4058	19p					
7422	28p	74136	81p	74LS99	80p	4025	22p	22p					TIP34A	124p	2N4060	19p					
7423	38p	74141	85p	74LS107	80p	4026	170p	170p					TIP34C	100p	2N4123/4	22p					
7425	33p	74142	300p	74LS109	80p	4027	170p	170p					TIP35A	243p	2N4125/6	22p					
7426	43p	74145	95p	74LS123	110p	4028	98p	98p					TIP35C	200p	2N4401/3	34p					
7427	40p	74147	205p	74LS138	140p	4029	120p	120p					TIP36A	297p	2N4427	97p					
7428	40p	74148	180p	74LS151	110p	4030	250p	250p					TIP36C	380p	2N4871	60p					
7430	48p	74150	130p	74LS159	100p	4031	130p	130p					TIP41A	70p	2N5179	75p					
7432	37p	74151	81p	74LS159	100p	4032	130p	130p					TIP42A	70p	2N5245	58p					
7433	43p	74153	81p	74LS158	150p	4040	100p	100p					TIP42C	86p	2N5401	62p					
7437	37p	74154	160p	74LS160	180p	4042	90p	90p					TIP2955	76p	2N5457/8	40p					
7438	37p	74155	97p	74LS161	180p	4043	100p	100p					TIP3055	60p	2N5459	40p					
7440	18p	74156	97p	74LS162	180p	4044	100p	100p					T1S43	40p	2N5460	65p					
7441	85p	74157	97p	74LS163	180p	4046	100p	100p					2N696/7	25p	2N5485	45p					
7442	75p	74159	250p	74LS164	180p	4047	100p	100p					2N698	45p	2N6107	70p					
7443	120p	74160	100p	74LS165	225p	4049	55p	55p					2N705/8	22p	2N6227	60p					
7444	120p	74161	100p	74LS173	235p	4050	57p	57p					2N918	43p	2N6247	200p					
7445	97p	74162	100p	74LS174	160p	4051	110p	110p					2N930	19p	2N6254	140p					
7446	108p	74163	100p	74LS175	160p	4054	120p	120p					2N1131/2	25p	2N6292	70p					
7447	75p	74164	120p	74LS181	375p	4055	140p	140p					2N1304/5	22p	3N128	85p					
7448	85p	74165	150p	74LS187	375p	4056	135p	135p					2N1306/7	75p	3N140	95p					
7450	18p	74166	180p	74LS191	200p	4060	85p	85p					2N1613	22p	3N141	22p					
7451	18p	74167	320p	74C		4066	24p	24p					2N1711	22p	3N187	200p					
7453	18p	74170	260p	74C00	25p	4067	24p	24p					2N1893	32p	40360	43p					
7454	18p	74172	750p	74C02	25p	4068	27p	27p					2N2102	60p	40381/2	43p					
7460	18p	74173	190p	74C04	27p	4069	27p	27p					2N2160	120p	40409/10	75p					
7470	38p	74174	120p	74C08	27p	4070	27p	27p					2N2218A	22p	40594	100p					
7472	32p	74175	130p	74C10	27p	4071	27p	27p					2N2219	22p	40594	100p					
7473	38p	74176	130p	74C14	90p	4072	27p	27p					2N2222	22p	40595	110p					
7474	37p	74177	120p	74C22	110p	4073	30p	30p					2N2369	15p	40635	60p					
7475	43p	74180	120p	74C28	230p	4076	170p	170p					2N2484	32p	40636	140p					
7476	37p	74181	324p	74C38	230p	4077	170p	170p					2N2646	52p	40673	90p					
7480	54p	74182	150p	74C73	75p	4081	24p	24p					2N2804A	22p	40841	85p					
7481	108p	74184	250p	74C74	70p	4082	24p	24p					2N2905/A	22p	40872	85p					
7482	90p	74185	190p	74C85	200p	4083	94p	94p					2N2906/A	22p	40872	90p					
7483	88p	74186	990p	74C86	65p	4088	120p	120p													
7484	108p	74189	120p	74C90	90p	14502	180p	180p													
7485	120p	74191	120p	74C93	90p	14503	90p	90p													
7486	36p	74192	100p	74C107	125p	14507	55p	55p													
7489	340p	74193	100p	74C151	260p	14508	30p	30p													
7490	36p	74194	160p	74C157	250p	14510	130p	130p													
7491	90p	74195	110p	74C160	155p	14511	160p	160p													
7492	58p	74196	160p	74C161	155p	14512	120p	120p													
7493	36p	74197	130p	74C162	155p	14515	160p	160p													
7494	90p	74198	250p	74C163	155p	14518	110p	110p													
7495	75p	74199	250p	74C164	140p	14520	110p	110p													
7496	90p	74221	175p	CMOS		14528	130p	130p													
				4000	20p	14560	270p	270p													

VAT INCLUSIVE PRICES. Add 25p P&P—no other extras  
**MAIL ORDER ONLY**  
**TECHNOMATIC LTD**  
 54 Sandhurst Road, London NW9 Tel. 01-204 4333 Tlx 922800

# Electronics. Make a job of it....

Enrol in the BNR & E School and you'll have an entertaining and fascinating hobby. Stick with it and the opportunities and the big money await you, if qualified, in every field of Electronics today. We offer the finest home study training for all subjects in radio, television, etc., especially for the CITY AND GUILDS EXAMS (Technicians' Certificates); the Grad. Brit. I.E.R. Exam; the RADIO AMATEUR'S LICENCE; P.M.G. Certificates; the R.T.E.B. Servicing Certificates; etc. Also courses in Television; Transistors; Radar; Computers; Servo-mechanisms; Mathematics and Practical Transistor Radio course with equipment. We have OVER 20 YEARS' experience in teaching radio subjects and an unbroken record of exam successes. We are the only privately run British home study College specialising in electronics subjects only. Full details will be gladly sent without any obligation.



## Become a Radio Amateur.

Learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence.

**Free!**

Brochure without obligation to:  
**British National Radio & Electronic School**

P.O. Box 156, Jersey, Channel Islands.

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 Block caps please



# Wilmslow Audio

## THE firm for speakers!

SEND 10P STAMP FOR THE WORLD'S BEST CATALOGUE OF SPEAKERS, DRIVE UNITS, KITS, CROSSOVERS ETC. AND DISCOUNT PRICE LIST.

ATC ● AUDAX ● BAKER ● BOWERS & WILKINS ● CASTLE ● CELESTION ● CHARTWELL COLES ● DALESFORD ● DECCA ● EMI ● EAGLE ● ELAC ● FANE ● GAUSS ● GOODMANS ● HELME ● I.M.F. ● ISOPHON ● JR ● JORDAN WATTS ● KEF ● LEAK ● LOWTHER MCKENZIE ● MONITOR AUDIO ● PEERLESS ● RADFORD ● RAM ● RICHARD ALLAN ● SEAS ● TANNOY ● VIDEOTONE ● WHARFEDALE

## WILMSLOW AUDIO (Dept. P.W.)

SWAN WORKS, BANK SQUARE, WILMSLOW, CHESHIRE SK9 1HF

Discount HiFi Etc. at 5 Swan Street and 10 Swan Street

TEL: WILMSLOW 29599 FOR SPEAKERS  
WILMSLOW 26213 FOR HIFI

# Join the Digital Revolution

Understand the latest developments in calculators, computers, watches, telephones, television, automotive, instrumentation . . .

Each of the 6 volumes of this self-instruction course measures 11½in × 8½in and contains 60 pages packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra, to memories, counters and simple arithmetic circuits, and on to a complete understanding of the design and operation of calculators and computers.

*Design of Digital Systems.*

## £7-10

plus 90p packing and surface post anywhere in the world.

Overseas customers should send for proforma invoice



Quantity discounts available on request. VAT zero rated.

Also available—a more elementary course assuming no prior knowledge except simple arithmetic.

*Digital Computer Logic and Electronics*

In 4 volumes:

## £4-60

plus 90p P. & P.

1. Basic Computer Logic
2. Logical Circuit Elements
3. Designing Circuits to Carry Out Logical Functions
4. Flipflops and Registers

Offer Order both courses for the bargain price **£11-10**, plus 90p P. & P.—a saving of £1-50.

**Designer**

**Manager**

**Enthusiast**

**Scientist**

**Engineer**

**Student**

These courses were written so that you could teach yourself the theory and application of digital logic. Learning by self instruction has the advantages of being quicker and more thorough than classroom learning. You work at your own speed and must respond by answering questions on each new piece of information before proceeding to the next.

**NEW** from Cambridge Learning Enterprises:

**FLOW CHARTS AND ALGORITHMS**—use, design and layout; vital for computing, training, wall charts, etc.

## £2-95

plus 45p P. & P.

**Guarantee**—If you are not entirely satisfied your money will be refunded.

Cambridge Learning Enterprises, Proprietors: Drayridge Ltd. Registered in England No. 1328762.

Reg. Office: Cambridge Learning Enterprises, Unit 7, FREEPOST Rivermill Lodge, St. Ives, Huntingdon, Cambs. PE17 4BR

\*Please send me . . . set(s) of Design of Digital Systems at £8-00 each, P. & P. included

\*or . . . set(s) of Digital Computer Logic and Electronics at £5-50 each, P. & P. included

\*or . . . combined set(s) at £12-00 each, P. & P. included

\*or . . . the Algorithm Writers Guide at £3-40 each, P. & P. included

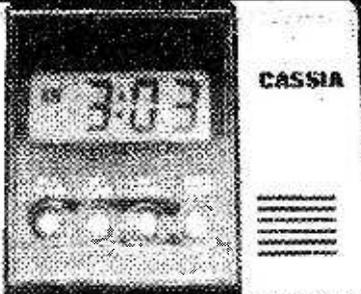
Name .....

Address .....

\*delete as applicable

No need to use a stamp—just print FREEPOST on the envelope.

PW3



CASSIA  
from  
K  
R  
A  
M  
E  
R

Only £19-90 inc. VAT (+ £1 p&p)

### PORTABLE ALARM CLOCK

Use in the home, in offices and travel also would make an excellent car clock

- Computer-type ½" (12-7mm) LCD readout
- Battery operated (2 × AAA cells)
- Minimum one year battery life
- Quartz crystal accuracy
- 100% Solid state circuitry designed for long life and trouble-free operation
- Readout is back lighted for night viewing
- PM indicator in 12 hour format
- Simple time setting procedure. Time zone changes easily made
- Time synchronizing switch for exact time setting
- Clear, pleasant sounding piezo-electric alarm
- Touch-to-activate control bar for drowse function giving extra minute's sleep when activated

Dimensions: 120 × 74 × 19mm (4½" × 1½" × ¾")

Weight: 120 grams (4-5 ounces) including gift box and packing.

Finish: Metal with black inset.

## KRAMER & CO

9 October Place, Holders Hill Road, London NW4 1EJ  
Telex: 858941. ATTN. KRAMER, K7. Tel. 01-203 2473

MAIL ORDER ONLY

Up to 28 days delivery



### NOTICE TO READERS

When replying to Classified Advertisements please ensure:

- That you have clearly stated your requirements.
- That you have enclosed the right remittance.
- That your name and address is written in block capitals, and
- That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

### Receivers and Components

#### TOUCH CONTROLLED LIGHTING KITS

These KITS replace conventional light switches and control 300W of lighting. No mains rewiring required. Insulated Touch Plates. Easy to follow instructions. TSD300K—TOUCHSWITCH & DIMMER combined. ONE touch plate to switch light on or off. Brightness controlled by small knob—£5.20. TS300K—TOUCHSWITCH. TWO touch plates—£4.00. TSA300K—AUTOMATIC. ONE touch plate. Light turns off after preset delay—£4.00.

LD300K—LIGHT DIMMER KIT—£2.80.

400V TRIACS BULK OFFERS		CMOS
Plastic		
3A	BC148	£7/100* 4001 15p
8A	555	£22/100 4011 12p
8A-5A	741	£18/100 4013 55p
12A	8A/400V Triac	£71/100 4015 51p
15A	105p	DL727 dual 0.5" 7 seg. 4016 51p
20A	165p	LED Display £62/50 4017 51p
6.5A with trigger	80p	555 36p (3 for £1) 4040 87p
Diac	21p	741 24p (5 for £1) 4049 26p

CLOCK 1KW APPLIANCE TIMER KIT inc. AV-5-1230, 0-5"  
LED display, triac, switches, box pcbs, etc. £18.25  
AV-5-1230 CLOCK APPLIANCE TIMER IC £2.85  
LM3911 THERMOMETER/TEMPERATURE CONTROL I.C. £1.00

#### QUANTITY DISCOUNTS ON REQUEST

Add 8% (\*12½% VAT + 25p P&P. Mail Order Only to: T.K. ELECTRONICS (PW)  
106 Studley Grange Road, London W7 2LX

**TIRRO ELECTRONICS** the mail order division of Ritro Electronics UK offers a wide range of components for the amateur enthusiast. Large SAE or 20p brings list. Grenfell Place, Maidenhead, Berks. SL6 1HL.

### VALVES

Radio - T.V. - Industrial - Transmitting  
We Dispatch Valves to all parts of the world by return of post, Air or Sea mail, 2700 Types in stock, 1930 to 1976. Obsolete types a speciality. List 20p. Quotation S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves and Projector Lamps.

#### COX RADIO (SUSSEX) LTD.

Dept. P.W. The Parade, East Wittering,  
Sussex PO20 8BN  
West Wittering 2023 (STD Code 024366)

**LOUD SIRENS** 6v D.C. for Burglar Alarms, £1.46 inclusive. GRIMSBY ELECTRONICS, Lambert Road, Humberstone. Large selection components etc. List 10p.

## SMALL ADS

The prepaid rate for classified advertisements is 20 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £6.80 per single column centimetre (minimum 2.5 cms). All cheques, postal orders etc., to be made payable to Practical Wireless and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Wireless, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846)

### CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

- Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.
- The publishers reserve the right to refuse or withdraw any advertisement.
- Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

**GAMMA ENTERPRISES** for transistors, resistors, capacitors, ICs, hardware etc. Large SAE for catalogue. 18 Landale Road, Peterhead, Aberdeenshire AB4 6QP.

### ORCHARD ELECTRONICS

I.C.s TTL, C/Mos. Linear. Capacitors. Resistors. (E12) S/L Rectifiers. Diodes. LED. Thyristors. Xenons. Voltage Reg. DIL Sockets. Bridge Rectifiers. Potentiometers. Presets. Triacs. Diac. Plugs. Sockets. Cable. Vero. Carefully selected range, excellent despatch service. Same day turn round. S.A.E. List. Suppliers to A.E.R.E. U.K.A.E.A. Governments Depts. Schools. Universities. Manufacturers. Accounts opened for trade and amateur. Join the professionals. Phone by 4 p.m. Goods out 1st class by 5 p.m. Try us and prove it!

**ORCHARD ELECTRONICS**  
Flint House, High Street, Wallingford,  
Oxon. Telephone 0491-35529

**TRANSISTORS, Resistors, Caps, Pots, plugs** 7 sockets, zeners, TTL, cable, boxes, all at very good prices. 65 Railway Road, Leigh, Lancs. Telephone Leigh 679575.

#### BRAND NEW COMPONENTS BY RETURN.

Electrolytic capacitors 16V, 25V, 50V.—0.47, 1.0, 2.2, 4.7 & 10mfd.—5p. 22, 47—51p. (50V—8p). 100—7p (50V—8p) 220—8p. (50V—10p) 470—11p. (50V—18p) 1000/18V—15p. 1000/25V—18p. 1000/50V—22p.

Subminiature bead tantalum electrolytics—0.1, 0.22, 0.47, 1.0, 2.2 @ 35V, 4.7/25V—11p. 10/25V—13p. 22/16V, 47/6V, & 100/3V—15p.

Multilayer miniature ceramic E12 series 2% 63V. 10pf. to 47pf.—3p. 56pf. to 330pf.—4p.

Vertical mounting ceramic plate 50V. E12 series 22pf-1000pf. E6 series 1500pf-47000pf.—2p.

Polystyrene E12 series 63V horizontal mounting. 10pf to 10000pf—3p. 1200pf. to 10000pf.—4p.

Multilayer polyester 250V vertical mounting E6 series. 0.01 to 0.1—4p. 0.15, 0.22—5p. 0.33, 0.47—8p. 0.68—11p. 1.0—13p. 1.5—20p. 2.2—22p.

Mylar (Polyester) Film 100V vertical mounting. 0.001, 0.002, 0.005—3p. 0.01, 0.02—4p. 0.04, 0.05—4p.

Miniature resistors Highstab E12 series 5%. Carbon Film 0.25W 12 to 10MΩ. (10% over 1MΩ)—1p. Metal Film 0.125W, 0.25W & 0.5W 10Ω to 2MΩ.—1p. Metal Film 1W. 27Ω to 10MΩ.—2p ea.

1N4148—3p. 1N4002—5p. 1N4006—7p. 1N4007—5p. BC107/3/5, BC147/8/9, BC157/8/9 & BF194 & 197—8p. Fuses 20mm. glass. 1½" glass & 1" ceramic. 21p. Post 10p. (Free over £4.00) Prices inclusive of VAT.

### THE C. R. SUPPLY CO.

127, Chesterfield Rd., Sheffield S8.

### NOSTALGIA VINTAGE RADIO COLLECTING

1920 to 1950

Receivers, valves, components, service data, historical research, books, magazines, repairs and restorations. A complete service for the collector and enthusiast of vintage radio.

S.a.e. with enquiries and for monthly newsheet. Full 1977 catalogue, 70p post paid.

**TUDOR REES** (Vintage Services), 64, Broad Street, Staple Hill, Bristol, BS16 5NL. Tel. Bristol 565472.

### Books and Publications

**SIMPLIFIED TV REPAIRS.** Full repair instructions individual British sets £4.50, request free circuit diagram. Stamp brings details unique. TV Publications (Ause PW), 76 Church Street, Larkhall, Lanarkshire.

### RADIO BOOK SERVICE

50 Projects using IC CA3130 (R. A. Penfold)	£1-05
50 CMOS IC Projects (R. A. Penfold)	£1-05
A Practical Introduction to Digital ICs	£1-05
28 Tested Transistor Projects (R. Torrens)	£1-05
50 Projects using Relays, SCRs & TRIACs (F. G. Rayer)	£1-20
How to build your own Metal & Treasure Locators (F. G. Rayer)	£0-95
Practical Repair & Renovation of Colour TVs (C. F. Miller)	£1-05
Fun & Games with your Electronic Calculator (J. Vine)	£0-85
How to build Advanced Short Wave Receivers (R. A. Penfold)	£1-30
Radio Antenna Handbook for Long Distance Reception	£0-95
50 (Fet) Field Effect Transistor Projects (F. G. Rayer)	£1-35
Service Transistor Radio Receivers	£0-95
Solid State Short Wave Receivers for Beginners	£1-05

PRICES INCLUDE POSTAGE & PACKING... S.A.E. FOR FULL LIST  
4 CHICHESTER COURT, WICKHAM RD, BECKENHAM KENT BR3 2QU

**YOU CAN'T HELP BUT MAKE MONEY.** If you follow the planned and detailed information on how to start your own business rewinding Armatures, set out in the new manual which is profusely illustrated and leads you through easily understood stages of fault diagnosis, taking data, test procedures, laying down new windings, where to obtain work, how to cost jobs etc. NO PREVIOUS ELECTRICAL KNOWLEDGE REQUIRED. Complete instruction manual, £4, plus 50p P&P. CWO. Copper Supplies, 102 Parrswood Road, Withington, Manchester 20. Dept. PWB.

### THE DALESFORD SPEAKER BOOK

by R. F. C. Stephens.

This book is a must for the keen home constructor. Latest technology DUV speaker designs. Contains full plans for infinite baffle and reflex designs for 10-100 watts, also unusual centre-bass system for those who want Hi-Fi to be "Heard and not seen". £1.95 (£2.20 post paid. 5% Overseas)

**VAN KAREN PUBLISHING**  
5 SWAN STREET  
WILMSLOW  
CHESHIRE

**BASIC ELECTRONICS Timesaver Program.** 30-stage speedlearn, easylearn program. Unique Timesaver breadboards, terminals, plans and circuit know-how. Ideal for beginners, students, schools, colleges. Limited period intro-offer £4.75. Money back if not delighted. TECHNOCENTRE, (PW) PO Box 33, 54 Adcott Road, Middlesbrough.

**BOOKS AND MAGAZINES ON RADIO AND TELEVISION:** Catalogue of over 1,000 technical and non-technical out-of-print items. Bampton Books, "Franklyn", Deymans Hill, Tiverton, Devon.

### Radio Receivers

**MULTIBAND RADIOS.** 12 band . . . Marine, Aircraft, LP5B, HP5B, UHF (430/470), SW1/4, MW, LW, FM, RF gain. BFO. £150. GRUNDIG SATERLITT £199. BFO Units, £16.50. SHARP MW/Aircraft, £13. Langtons, High Street, Rocester, Staffordshire. SAE lists.

## Service Sheets

### SERVICE SHEETS — COLOUR TV SERVICE MANUALS

Service Sheets for Mono TV, Radios, Record Players and Tape Recorders 75p. Please send large Stamped Addressed Envelope. We can supply manuals for most makes of Colour Television Receivers by return of post.

**B.R.C. PYE ECKO PHILIPS ITT/KB SONY G.E.C. HITACHI BAIRD ULTRA INVICTA FERGUSON H.M.V. MARCONI AND MANY MORE**

Let us quote you. Please send a Stamped Addressed Envelope for a prompt reply. Also comprehensive T.V. repair manuals by J. M. Court. S.A.E. for details. MAIL ORDER ONLY

#### G. T. TECHNICAL INFORMATION SERVICE

10 DRYDEN CHAMBERS, 119 OXFORD ST., LONDON W1R 1PA

**BELL'S TELEVISION SERVICES** for Service Sheets on Radio, TV, etc., 75p plus S.A.E. Colour TV Service Manuals on request. S.A.E. with enquiries to B.T.S., 190 King's Road, Harrogate, N Yorkshire. Tel: (0423) 55885.

**SERVICE SHEETS** for Radio, Television, Tape Recorders, Stereo, etc. With free fault-finding guide, from 50p and SAE. Catalogue 25p and SAE. **HAMILTON RADIO**, 47 Bohemia Road, St. Leonards, Sussex.

### Electrical

**LIST NO. 28** now ready—Styli illustrated equivalents also cartridges, leads, etc., free for long SAE. Felstead Electronics (PW), Longley Lane, Gatley, Cheadle, Cheshire SK8 4EE.

**TIMESWITCHES. CHEAP TIMESWITCHES.** Sangamo 20 amp reconditioned, guaranteed for one year. Only £5.70. Also electric eyes. Write: J. DONOHOE, 1 Upper Norfolk Street, North Shields, Tyne and Wear.

### Aerials

### G2DYM ANTI-TVI AERIALS

**DO OVERCOME TVI PROBLEMS FOR BOTH THE SWL & TRANSMITTING AMATEUR.** A 12p SAE and 3 x 9p Stamps bring you full details, article on aerials and copies of genuine testimonials from satisfied customers with their names and full addresses.

LAMBDA, WHITEBALL, WELLINGTON, SOMERSET

### For Sale

**NEW ISSUES** of "Practical Wireless" available from April 1974 edition up to date. Price 65p each post free. Bell's Television Services, 190 Kings Road, Harrogate, N. Yorkshire. Tel: (0423) 55885.

### Wanted

**WANTED.** Valves, types PX4 and PX25, new or S/Hand; any quantity. Rees, 64 Broad Street, Staple Hill, Bristol. Tel: 0272 565472.

**SURPLUS???** Turn it into cash, Phone 0491 35529 (Oxon).

**WANTED NEW** Valves, transistors, I.Cs, amplifiers, receivers, televisions (Anything Useful) any quantity. Stan Willetts, 37 High Street, West Bromwich. Tel: 021-553 0186.

**WANTED.** Mains Transformer for Solartron CT436 Oscilloscope. Phone: 0723 870684.

**WANTED.** New Valves, Transistors. Top prices, popular types. Kensington Supplies (C), 367 Kensington Street, Bradford 8, Yorkshire.

**"RADIO AND TELEVISION SERVICING"** books wanted from 1964-65 edition up to date. £3.00 plus postage paid per copy by return of post. Bell's Television Services, 190 Kings Road, Harrogate, N. Yorks. Tel: (0423) 55885.

### LARGE SUPPLIER OF SERVICE SHEETS

All models at 75p PO/Cheques plus s.a.e. Except Colour and Car Radios. Free TV fault finding chart or TV list.

#### C. CARANNA

71 Beaufort Park, London NW11 6BX  
01-458 4882

**SERVICE SHEETS,** Radio TV, etc., 10,000 models. Catalogue, 24p, plus SAE with orders, enquiries. Telray, 154 Brook Street, Preston PR1 7HP.

### Ladders

**LADDERS.** Varnished 20ft 9in extd., £29.72, carr. £2.40. Leaflets. Also alloy ext. up to 62ft 6in. Ladder Centre (WLS2), Halesfield (1) Telford. Tel: 586644. Callers welcome.

### Educational

**GO TO SEA** as a Radio Officer. Write: Principal, Nautical College, Broadwater, Fleetwood FY7 8JZ.

### Miscellaneous

### LOSING DX ?

Maybe the RARE DX is buried under QRM. DIG IT OUT with a Tunable Audio Notch Filter, speaker amplifier, bypassed when off, only £27.50.  
**NOT COVERING 100-500 KHz? EXPLORE this EXCITING DX band** with an LF Converter, antenna tuning, feeds 3.5-4 MHz receiver, only £28.80.

**FIND the RARE DX** with a Crystal Calibrator between your antenna and receiver. 1 MHz, 100, 25 KHz markers to VHF, bypassed when off, only £13.80.

Each easy-assembly kit includes all parts, printed circuit, case, battery etc, instructions, postage, money back assurance, so SEND off NOW.

#### CAMBRIDGE KITS

45(PC) Old School Lane, Milton, Cambridge.

**100 WATT GUITAR/PA/MUSIC Amplifier,** superb treble bass overdrive slimline solid-state 12 months' guarantee, unbeatable offer at £39. Money returned if not absolutely delighted within seven days. Send cheque or P.O. to: **WILLIAMSON AMPLIFICATION**, 62 Thorncliffe Avenue, Dukinfield, Cheshire.

### H. M. ELECTRONICS

276a FULWOOD ROAD, BROOMHILL, SHEFFIELD S10, 3BD.

SEC. CABINETS (illus'd)

METAL CASES  
DRY TRANSFER LETTERING

Send 15p for leaflets (Refundable)  
Trade enquiries invited



**SUPERB INSTRUMENT CASES** by Bazelli, manufactured from P.V.C. faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low 90p, chassis punching facilities at very competitive prices. 400 models to choose from, free literature (stamp would be appreciated). **BAZELLI**, Dept No 25, St. Wilfrid's, Foundry Lane, Halton, Lancaster LA2 6LT.

## RECHARGEABLE BATTERIES

'AA' pcell (HP7) £1.32; Sub 'C' £1.64; 'C' (HP11) £2.43; 'D' (HP2) £3.56; PPs £4.98. Matching chargers £5.33 each except PP3 charger £4.99. Charging holders for 2, 3, 4, 5 or 6 pcells 50p. 'C' & 'D' size holders, 4 cells only 80p. Prices include VAT. Add 10% post package and insurance orders under £20. 5% over £20. SAE for full details plus 75p for 'Nickel Cadmium Power' booklet. 250/12 volt inverters now available. Mail Orders to Dept. PW, SANDWELL PLANT LTD., 201 Monmouth Drive, Sutton Coldfield, West Midlands. Tel: 021-354 9764. Callers to T.L.C., 32 Craven Street, Charing Cross, London WC2.

**IMMEDIATE BY RETURN DELIVERY.** Large range of miniature synchronous motors, many speeds 1 rev per hour to 1 rev per 2 days. £1.10 to £2.50 each. 3 and 4 digit mechanical counters, 45p to 85p. 10 amp micro switches at 20p. SAE for list. **WALES (ELECTRICAL) LTD.**, Queen St., Newton Abbot.

### ENAMELLED COPPER WIRE

swg	1 lb	8oz	4oz	2oz
14-19	2.40	1.20	.60	.30
20-29	2.45	1.60	.82	.39
30-34	2.60	1.70	.89	.64
35-40	2.85	1.90	1.04	.75

Inclusive of p&p and VAT.

SAE brings Catalogue of copper and resistance wires in all coverings.

#### THE SCIENTIFIC WIRE COMPANY

PO Box 30, London E4 9BW

Reg. Office: 22 Coningsby Gardens,

**STABILISED P.S.U.s,** large range of various voltages and currents, available cased or in chassis form. SAE for full particulars and prices. A. BARTON, PW, Highbanks, Newport Road, Sandown, I.W.

### 100 Resistors 75p

±W 5% c/FILM 2.2Ω-2.2M Ω (E12)

10 each of any value

Send stamped envelope for **FREE SAMPLE**

C60 CASSETTES 30p

C90 CASSETTES 45p

All prices include VAT.

Quantity Discounts

50 Units 5%

100 Units 10%

All Cassettes in Plastic Case with Index and Screwed Assembly.

Add postage 10p in £1.

**SALOP ELECTRONICS**

25 WYLE COP.

SHREWSBURY.

Tel. 53286

**OUTSTANDING 2200 HI-FI FM Tuner.** Full coverage 88-102MHz. Varicap tuning. Latest silicon superhet design. Ideal for push button/manual tuning, only £9.95. Unique 3300 stereo class A Amplifier, power 32 watts peak, complete stereo Pre-Amplifier/ 2 Power Amplifiers, all inputs accepted. Only £10.95. 5500 Tuner Amplifier plus specification as above 2. Only £19.95. All equipment built, tested and guaranteed with full instructions. (P&P 50p.) **GREGG ELECTRONICS**, 86-88 Parchmore Road, Thornton Heath, Surrey.

### MORSE CODE TUITION AIDS

Cassette A: 1-12 w.p.m. for amateur radio examination. Cassette B: 12-24 w.p.m. for professional examination preparation.

Morse by light system available. Morse Key and Buzzer Unit for sending practice.

Prices each Cassette (including booklets) £4.50; Morse Key and Buzzer £4.  
Prices include postage etc., Diverseas Airmail £1 extra.

#### MHEL ELECTRONICS (Dept PW)

12 Longshore Way, Milton,

Portsmouth PO4 8LS

**3½ DIGIT DVM MODULE KIT.** Autozero, antipolarity only £37.50. SAE details. M.L.C., 116 College Road, Southwater, Horsham, Sussex.

### SINTEL KITS, COMPONENTS, CMOS etc.

MDT CMOS Databk 3.50 RCA CMOS Databk 5.45  
8800 Appl. Man. £2.95 Z80 Ass. Lang. Prog. Man. 7.50  
NS TTL Databk 2.10  
Best of Byte Vol. 1 11.95 Z80-CPU Man. 5.00

All Items CWO (Books-No VAT) 35p p&p.

Full range in our **FREE CATALOGUE** which will be sent by return. **SINTEL, P.O. BOX 75F**, 208 Cowley Road, Oxford. Tel.: (0865) 49791.

**NEED A HAND?** Kits, projects built to your requirements by professional engineer. K.E.S., 12 Woodside Court, Selbourne Road, Littlehampton, Sussex. Tel: 21858.

**LOW COST ALUMINIUM BOXES** with lids and screws. 3 x 2 x 1, 42p; 4 x 3 x 1½, 49p; 4 x 3 x 2, 56p; 6 x 4 x 2, 62p; 6 x 4 x 3, 72p; 8 x 6 x 2, 97p; 8 x 6 x 3, £1.08; prices include p&p. **HARRISON BROS.**, P.O. Box 55, 22 Milton Road, Westcliff-on-Sea, Essex SS0 7LQ.

**PRINTED CIRCUITS and HARDWARE**

Readily available supplies of Constructors' Hardware. Printed circuit boards, top quality for individual designs. Prompt service. Send 25p for catalogue from:

**RAMAR CONSTRUCTOR SERVICES**  
Masons Road, Stratford-on-Avon, Warwicks  
Tel: 4879

**BURGLAR ALARM SYSTEMS!** 12v siren £5.53, 240v siren £9.61, plastic coated and lettered bell box £5.25. Flush magnetic contact 60p, surface 65p. SAE for price list. C.W.A.S., 11 Denbrook Walk, Bradford BD4 0QS. Bradford 682674. All prices fully inclusive.

**Government Surplus Multicore Cable Pack**

Assorted 2ft to 15ft lengths, 3 to 18 core stranded and colour coded 6-50volt working, P.V.C. Covered. For sample pack of 6 asstd. pieces **PLUS FREE GIFTS** send £2.00 plus 50p P & P to:

**B.B. Supplies, (Dept. PW)**  
125, High Street, Deal, Kent. Tel: 03045 62573.

4T 1½ x ½ 20 ohm D.C. Ideal for microphone or speaker use. 50p each incl P. & P. Quantity discounts available.

**ARMATURE & COIL WINDING ENAMELLED COPPER WIRE**  
Only top quality materials supplied.  
All orders dispatched within 24 hrs.

S.W.G.	1 lb reel	1 lb reel
10 to 18	£2.95	£1.80
20 to 28	£3.15	£1.80
30 to 34	£3.45	£1.90
35 to 40	£3.65	£2.10

All prices are inclusive of P. & P. in U.K.  
**COPPER SUPPLIES, 102 Parrswood Road, Withington, Manchester 20. Tel: 061-445 6753**

**BUILD THE TREASURE TRACER MK III Metal Locator**



- Variable tuning
- Britain's best selling metal locator kit
- Fitted with Faraday shield.
- Speaker and earphone operation
- 4,000 already sold
- Knocks down to only 17in.
- Prebuilt search coil assembly
- Thoroughly professional finish
- As seen on BBC1 and BBC2 TV
- You only need soldering iron, screwdriver, pliers and snips
- Five transistor circuit

Send stamped, addressed envelope for leaflet

Complete kit £15.95 Built & tested £20.95  
Post £1.20 incl P & P Post £1.20 incl P & P  
**MINIKITS ELECTRONICS,**  
44 CLEVELAND ROAD,  
LONDON, E18 2AN (Mail order only)

**EX MINISTRY EQUIPMENT**  
Aerial Rotation Motor units, complete with Remote Position Indicator connectors and Data. Transistor Curve Tracers. DC Motors. 5V DC Stabilised Power Supplies. Thumb Wheel Switches. Ten Turn Potentiometers. DC Milliampmeters. Lever Switches. Seven Segment Gas Displays. Terminal Blocks. 12 Way Cable. 100 Way Cable. 240V Solenoids. Push Buttons. Odd Items of Test Equipment. Aircraft Instruments and Equipment. Lots of Items in Stock. 9" x 3" S.A.E. For List Mail Order Only. Eldun Electronics, 31 Alexander Drive, Timperley, Cheshire, WA15 6NF.

**NOTICE TO READERS**

*Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.*

**ORDER FORM PLEASE WRITE IN BLOCK CAPITALS**

Please insert the advertisement below in the next available issue of Practical Wireless for ..... insertions.

I enclose Cheque/P.O. for £.....

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Practical Wireless).


NAME .....

ADDRESS .....

Send to: Classified Advertisement Manager  
**PRACTICAL WIRELESS,**  
GMG, Classified Advertisement Dept., Rm. 2337,  
King's Reach Tower, Stamford Street,  
London SE1 9LS Telephone 01-261 5846

Rate  
20p per word, minimum 12 words. Box No. 60p extra.

Company registered in England. Registered No. 53826. Registered office: King's Reach Tower, Stamford Street, London SE1 9LS



# WATFORD ELECTRONICS

33/35, CARDIFF ROAD, WATFORD, HERTS, ENGLAND  
MAIL ORDER, CALLERS WELCOME. Tel. Watford 37774

**ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRIES TO COME. P. & P. ADD 30p. TO ALL ORDERS UNDER £10.00. OVERSEAS ORDERS POSTAGE AT COST.**

**VAT** Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 8% to devices marked \*. To the rest add 12%.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground, Nearest Underground Br. Rail Station: Watford High Street. Open Monday to Saturday 9 a.m. - 8 p.m. Ample Free Car Parking space available.

**POLYESTER CAPACITORS:** Axial lead type. (Values are in  $\mu$ F).  
40V: 0-001, 0-0015, 0-0022, 0-0033  $\mu$ F; 0-0047, 0-0068, 0-01, 0-015, 0-018  $\mu$ F; 0-022, 0-033, 0-10, 0-15, 0-22, 0-33, 0-47, 0-68, 1-0, 1-5, 2-2, 3-3, 4-7, 7-5, 10, 15, 20, 25, 30, 33, 40, 45, 50, 60, 75, 100, 150, 200, 250, 300, 330, 400, 450, 500, 600, 750, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7500, 10000, 15000, 20000, 25000, 30000, 40000, 50000, 60000, 75000, 100000, 150000, 200000, 250000, 300000, 400000, 500000, 600000, 750000, 1000000, 1500000, 2000000, 2500000, 3000000, 4000000, 5000000, 6000000, 7500000, 10000000, 15000000, 20000000, 25000000, 30000000, 40000000, 50000000, 60000000, 75000000, 100000000, 150000000, 200000000, 250000000, 300000000, 400000000, 500000000, 600000000, 750000000, 1000000000, 1500000000, 2000000000, 2500000000, 3000000000, 4000000000, 5000000000, 6000000000, 7500000000, 10000000000, 15000000000, 20000000000, 25000000000, 30000000000, 40000000000, 50000000000, 60000000000, 75000000000, 100000000000, 150000000000, 200000000000, 250000000000, 300000000000, 400000000000, 500000000000, 600000000000, 750000000000, 1000000000000, 1500000000000, 2000000000000, 2500000000000, 3000000000000, 4000000000000, 5000000000000, 6000000000000, 7500000000000, 10000000000000, 15000000000000, 20000000000000, 25000000000000, 30000000000000, 40000000000000, 50000000000000, 60000000000000, 75000000000000, 100000000000000, 150000000000000, 200000000000000, 250000000000000, 300000000000000, 400000000000000, 500000000000000, 600000000000000, 750000000000000, 1000000000000000, 1500000000000000, 2000000000000000, 2500000000000000, 3000000000000000, 4000000000000000, 5000000000000000, 6000000000000000, 7500000000000000, 10000000000000000, 15000000000000000, 20000000000000000, 25000000000000000, 30000000000000000, 40000000000000000, 50000000000000000, 60000000000000000, 75000000000000000, 100000000000000000, 150000000000000000, 200000000000000000, 250000000000000000, 300000000000000000, 400000000000000000, 500000000000000000, 600000000000000000, 750000000000000000, 1000000000000000000, 1500000000000000000, 2000000000000000000, 2500000000000000000, 3000000000000000000, 4000000000000000000, 5000000000000000000, 6000000000000000000, 7500000000000000000, 10000000000000000000, 15000000000000000000, 20000000000000000000, 25000000000000000000, 30000000000000000000, 40000000000000000000, 50000000000000000000, 60000000000000000000, 75000000000000000000, 100000000000000000000, 150000000000000000000, 200000000000000000000, 250000000000000000000, 300000000000000000000, 400000000000000000000, 500000000000000000000, 600000000000000000000, 750000000000000000000, 1000000000000000000000, 1500000000000000000000, 2000000000000000000000, 2500000000000000000000, 3000000000000000000000, 4000000000000000000000, 5000000000000000000000, 6000000000000000000000, 7500000000000000000000, 10000000000000000000000, 15000000000000000000000, 20000000000000000000000, 25000000000000000000000, 30000000000000000000000, 40000000000000000000000, 50000000000000000000000, 60000000000000000000000, 75000000000000000000000, 100000000000000000000000, 150000000000000000000000, 200000000000000000000000, 250000000000000000000000, 300000000000000000000000, 400000000000000000000000, 500000000000000000000000, 600000000000000000000000, 750000000000000000000000, 1000000000000000000000000, 1500000000000000000000000, 2000000000000000000000000, 2500000000000000000000000, 3000000000000000000000000, 4000000000000000000000000, 5000000000000000000000000, 6000000000000000000000000, 7500000000000000000000000, 10000000000000000000000000, 15000000000000000000000000, 20000000000000000000000000, 25000000000000000000000000, 30000000000000000000000000, 40000000000000000000000000, 50000000000000000000000000, 60000000000000000000000000, 75000000000000000000000000, 100000000000000000000000000, 150000000000000000000000000, 200000000000000000000000000, 250000000000000000000000000, 300000000000000000000000000, 400000000000000000000000000, 500000000000000000000000000, 600000000000000000000000000, 750000000000000000000000000, 1000000000000000000000000000, 1500000000000000000000000000, 2000000000000000000000000000, 2500000000000000000000000000, 3000000000000000000000000000, 4000000000000000000000000000, 5000000000000000000000000000, 6000000000000000000000000000, 7500000000000000000000000000, 10000000000000000000000000000, 15000000000000000000000000000, 20000000000000000000000000000, 25000000000000000000000000000, 30000000000000000000000000000, 40000000000000000000000000000, 50000000000000000000000000000, 60000000000000000000000000000, 75000000000000000000000000000, 100000000000000000000000000000, 150000000000000000000000000000, 200000000000000000000000000000, 250000000000000000000000000000, 300000000000000000000000000000, 400000000000000000000000000000, 500000000000000000000000000000, 600000000000000000000000000000, 750000000000000000000000000000, 1000000000000000000000000000000, 1500000000000000000000000000000, 2000000000000000000000000000000, 2500000000000000000000000000000, 3000000000000000000000000000000, 4000000000000000000000000000000, 5000000000000000000000000000000, 6000000000000000000000000000000, 7500000000000000000000000000000, 10000000000000000000000000000000, 15000000000000000000000000000000, 20000000000000000000000000000000, 25000000000000000000000000000000, 30000000000000000000000000000000, 40000000000000000000000000000000, 50000000000000000000000000000000, 60000000000000000000000000000000, 75000000000000000000000000000000, 100000000000000000000000000000000, 150000000000000000000000000000000, 200000000000000000000000000000000, 250000000000000000000000000000000, 300000000000000000000000000000000, 400000000000000000000000000000000, 500000000000000000000000000000000, 600000000000000000000000000000000, 750000000000000000000000000000000, 1000000000000000000000000000000000, 1500000000000000000000000000000000, 2000000000000000000000000000000000, 2500000000000000000000000000000000, 3000000000000000000000000000000000, 4000000000000000000000000000000000, 5000000000000000000000000000000000, 6000000000000000000000000000000000, 7500000000000000000000000000000000, 10000000000000000000000000000000000, 15000000000000000000000000000000000, 20000000000000000000000000000000000, 25000000000000000000000000000000000, 30000000000000000000000000000000000, 40000000000000000000000000000000000, 50000000000000000000000000000000000, 60000000000000000000000000000000000, 75000000000000000000000000000000000, 100000000000000000000000000000000000, 150000000000000000000000000000000000, 200000000000000000000000000000000000, 250000000000000000000000000000000000, 300000000000000000000000000000000000, 400000000000000000000000000000000000, 500000000000000000000000000000000000, 600000000000000000000000000000000000, 750000000000000000000000000000000000, 1000000000000000000000000000000000000, 1500000000000000000000000000000000000, 2000000000000000000000000000000000000, 2500000000000000000000000000000000000, 3000000000000000000000000000000000000, 4000000000000000000000000000000000000, 5000000000000000000000000000000000000, 6000000000000000000000000000000000000, 7500000000000000000000000000000000000, 10000000000000000000000000000000000000, 15000000000000000000000000000000000000, 20000000000000000000000000000000000000, 25000000000000000000000000000000000000, 30000000000000000000000000000000000000, 40000000000000000000000000000000000000, 50000000000000000000000000000000000000, 60000000000000000000000000000000000000, 75000000000000000000000000000000000000, 100000000000000000000000000000000000000, 150000000000000000000000000000000000000, 200000000000000000000000000000000000000, 250000000000000000000000000000000000000, 300000000000000000000000000000000000000, 400000000000000000000000000000000000000, 500000000000000000000000000000000000000, 600000000000000000000000000000000000000, 750000000000000000000000000000000000000, 1000000000000000000000000000000000000000, 1500000000000000000000000000000000000000, 2000000000000000000000000000000000000000, 2500000000000000000000000000000000000000, 3000000000000000000000000000000000000000, 4000000000000000000000000000000000000000, 5000000000000000000000000000000000000000, 6000000000000000000000000000000000000000, 7500000000000000000000000000000000000000, 100, 15000000000000000000000000000000000000000, 200, 25000000000000000000000000000000000000000, 300, 400, 500, 600, 75000000000000000000000000000000000000000, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7500, 100, 15000, 200, 25000, 300, 400, 500, 600, 75000, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7500, 100, 15000, 200, 25000, 300, 400, 500, 600, 75000, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7500, 100, 15000, 200, 25000, 300, 400, 500, 600, 75000, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7500, 100, 15000, 200, 25000, 300, 4000000000000

# WATFORD ELECTRONICS

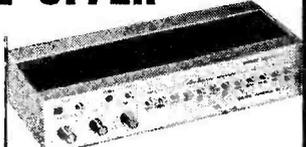
(Continued from opposite side)

DIODES		*BRIDGE RECTIFIERS	SPEAKERS
AA119	15	(plastic case)	8Ω 0-3W
AA215	15	1A/100V	2" x 2" 65
AEY11	60	4Ω 2.5"	2.5 x 3" 58
BA100	10	1A/200V	4Ω 2.5" 65
BY100	24	1A/200V	8Ω 3W 190
BY126	14	1A/400V	8Ω 3W 160
BY127	14	1A/600V	
OA9	75	2A/100V	
OA47	12	2A/200V	
OA70	12	2A/400V	
OA79	12	2A/600V	
OA81	15	4A/100V	
OA85	12	4A/200V	
OA90	6	4A/400V	
OA91	6	4A/600V	
OA95	6	6A/100V	
OA200	9	6A/200V	
QA202	8	6A/400V	
IN914	4	6A/600V	
IN915	5	BY164	
IN4001/2*	6	VM18	
IN4003*	6		
IN4004/5*	7		
IN4006/7*	7		
IN4148	4		
IS44	20		
3A/100V*	18		
3A/400V*	20		
3A/600V*	27		
3A/1000V*	30		
6A/600V	50		
SCR's*		ZENERS	LAMP HOLDERS AND LAMPS*
1A50V	38	Rng:3-3V-33V	LES HOLDER Dome shaped, Red, Blue, Green, Yellow, White
1A100V	42	400mW	LES BULBS 6v and 12v
1A200V	47	1-3W	MES HOLDERS Chrome cover, Red or Amber, Jewelled top
1A400V	52		LES ORMES Batten Holders
1A600V	70		MES BULBS 3-5V 6V 12V
3A50V	38		NEONS Maine, Sealed with Resistor, Sq. Top, Red or Grn. Round Top Red 2"
3A100V	43		Neon Open with leads, 95V AC
3A200V	60		
3A400V	118		
3A600V	120		
5A400V	120		
7A400V	125		
8A400V	150		
BT106	150		
CT106	55		
TIC44	25		
TIC45	45		
2N4444	191		

OPTO ELECTRONICS*		VOLTAGE REGULATORS*	SWITCHES*
LED5 + Clip	7	723 DIL	TOGGLE 2A 250V
TIL209 Red	13	TBA625B	SPST
TIL211 Grn	23	TO3 Can Type	DPST
TIL212 Yellow	27	1A 5V	4 pole on off
0-2" Red	17	1A 12V	SUB-MIN
0-2" Yellow,	21	1A 15V	TOGGLE
Grn, Amber	21	1A 18V	SP changeover
ORP10	40	LM309H	DPDT 6 tags
2N5777	54	LM323K	DPDT C/OFF
OPTO ISOLATORS		ROCKER: (Black)	
TIL111/2	105	LM327N ± 15V	on/off 10A 250V 23
TIL114	110	MVR5	
TIL117	164	MVR12	
		1A -5V	
		2A -12V	

ROTARY		JACK PLUGS		SOCKETS		VEROBOARD* Pitch	
Make your own multiway Switch. Adjustable Stop Shafting Assembly, Accommodates up to 6 Wafers	69	Screened chrome	Plastic body	Open metal	Moulded with break contacts	0-1 (copper clad)	0-15 (plain)
Main Switch DPST to fit Break Before Make Wafers, 1 pole/12 way, 2p/6 way, 3p/4 way, 4p/3 way, 6p/2 way	47	2.5mm 12p	3.5mm 15p	3.5mm 10p	3.5mm 15p	2 1/2 x 3 1/2"	2 1/2 x 3 1/2"
Spacer and Screen	5	MONO 23p	STEREO 31p	4.5mm 13p	4.5mm 18p	3 1/2 x 5"	3 1/2 x 5"
ROTOR: (Adjustable Stop)	41			5.5mm 14p	5.5mm 18p	4 1/2 x 7"	4 1/2 x 7"
1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way	45					4 1/2 x 17"	4 1/2 x 17"
ROTOR: (Main 250V AC, 4 Amp)	21					PKT of 36 pins	PKT of 36 pins
KNOS* fit 1/8" shaft with grub screw contact K2, K8, K12, K15, K16 (push fit)	9					Spot face cutter	Spot face cutter
K1 Black or White pointer type	9					Pin insertion tool	Pin insertion tool
K2 Slim Silvered Plastic	12						
K4 Black serrated. Metal top with Iline Indicator 33mm diam.	22						
K4A As above but 25mm diam.	20						
K5 Black fluted metal top and skirt calibrated 0-10, 37mm diam.	26						
K6 PK2 as K5, pointer on skirt	26						
K7 Black, knurled, tapered. Metal top & skirt. Callb. 0-10, 30mm	25						
K8 Black or silvered for slider pot	10						
K12 Aluminium plastic with Iline Indicator 22mm	16						
K15 Black plastic ribbed body, white indicator line, 15mm diam. tapered coloured insert tops, Red, Blue, Yellow 19mm height.	16						
K16 As above but 23mm diam	20						

# SPECIAL OFFER



**TV GAMES**  
 "Olympic Kit" £20.80\*  
 "Olympic" Colour Kit £28.50\*  
 (p&p insured add 95p)  
 EconoGame Kit £8.99\*  
**COLOUR ADAPTOR** for existing Black and White Games £8.85\*  
 Basic AY-3-8600 B & W Kit includes, PCB, sound and vision Modulators, Resistors and Capacitors. Needs controls. Only £13.98\*  
 (p&p insured add 48p)  
 "Joy Stick" £1.75\*  
 IC AY-3-8500 £4.50\*  
 IC AY-3-8550 £7.50\*  
 IC AY-3-8600 £9.00\*

**RHYTHM GENERATOR**  
 Build this PE (Jan. '78) Easy-build Low cost Rhythm Generator. We are the sole suppliers of the complete Kit including the case, pre drilled printed front panel and the printed Circuit Boards.  
 Complete Kit price incl. VAT £49.95 only (p&p £1).

(TV Games & Rhythm Gen. Demonstration on at our shop).  
**SAE FOR LEAFLET.**

Din		Plugs		Sockets		In line	
2-PIN Loudspeaker	3, 4 & 5 pin Audio	13p	8p	20p			
<b>CO-AXIAL (TV)</b>		14p	14p	14p			
<b>PHONO</b> assorted colours metal screened		10p	8p	2-way 12p	3-way 15p		
<b>BANANA</b> 4mm		10p	10p				
2mm		10p	10p				
1mm		8p	8p				
<b>WANDER</b> 3mm		8p	8p				

# INDEX TO ADVERTISERS

ACE Mailtronic Ltd. ... 805	Fairline Supplies ... 796	Radio Book Services ... 866
Alben Engineering ... 801	G3DYM Aerials & Projects ... 867	Radio Component Specialists ... cover iii
Amateur Radio ... 859	G.T. Information Service ... 867	
Ambit International ... 801	Greenweld Electronics ... 807	
Antiference ... Supp.		
A.P. Electronics ... 804		
Bandridge ... 809	H.A.C. Short-Wave Supplies ... 860	Radio Exchange Ltd. ... 857
Bamber B. ... 802	H.M. Electronics ... 867	Ramar Constructor Services ... 868
Baron Electronics ... 806	Harversons Surplus ... 869	R.S.C. (Hi-Fi) ... 795
Barrie Electronics ... 796	Heathkit ... 862	R.S.T. Valve Mail Order Co. ... 858
B.B. Supplies ... 786	Home Radio ... 794	Radio & T.V. Components Ltd. ... 862
Bently Acoustic Corp. ... 806	I.L.P. Electronics Ltd. ... 803, 852	Saga Ltd. ... 794
B.I.E.T. (C.M. Schools Ltd.) ... 847	Intertex ICS ... 806	Salop Electronics ... 867
Bi-Pak ... 810, 811	Kramar & Co. ... 865	Sandwell Plant Ltd. ... 867
Bi-Pre-Pak Ltd. (Stirling Sound)... 851	Laszar ... 869	Scientific Wire Co., The ... 867
Birkett J. ... 807	Linear Products (Fane Accoustics) ... 794	Selray Book ... 802
British National Radio & Electronics School ... 797, 864	Logic Leisure (Teleplay) ... 804	Sentinel Supplies ... 863
J. Bull (Electrical) Ltd. ... 861	London Aerials (Aerial Services) Supp.	Sintel ... 867
	Lynx Electronics ... 805	Sonic (Hi-Fi) ... 860
		Sonic Sound ... 859
		Southern Valve Co. ... 799
		Swanley Electronics ... 801
Cambridge Kits ... 867	Monolith Electronics ... 799	Technomatic Ltd. ... 864
Cambridge Learning ... 865	Manor Supplies ... 805	T.K. Electronics (Vintage Services) ... 866
Castle Electronics ... 872	Maplin Electronic Supplies ... cover iv	Trampus ... 805
Caranna C. ... 867	A. Marshall (London) Ltd. ... 799	T.T. Electronics ... 860
Chromasonics ... 800	Mhel Electronics ... 867	
Chromatronics ... 808	Minikits Electronics ... 868	Van Karen Publishing ... 866
Continental Specialists ... 798	Moulded Electronics ... 869	Vero Electronics ... 807
Copper Supplies ... 868		
Cox Radio (Sussex) Ltd ... 866		
Crescent Radio Ltd. ... 804	Orchard Electronics ... 863, 866	Watford Electronics ... 870, 871
C.R. Supply Co. ... 866		West London Direct Supplies ... 860
		Wilmslow Audio ... 865
		Williams Micheal ... 863
		Xeroza Radio ... cover ii
Electronics Design Associates ... 859	Partridge Electronics Ltd. ... 847	
Electronic Mail Order ... 860	Precision Petite ... 796	Z & I Aero Services ... 872
Electrovalve ... 799	Progressive Radio ... 872	

Head Office and Warehouse  
44A WESTBOURNE GROVE  
LONDON W2 5SF  
Tel: 727 5641/2/3

# Z & I AERO SERVICES LTD.

Please send all correspondence and Mail-Orders to Head Office

Retail Shop  
85 TOTTENHAM COURT ROAD  
LONDON W1  
Tel: 580 8403  
Open all day Saturday

## A SELECTION FROM OUR STOCKS OF FULLY GUARANTEED FIRST QUALITY VALVES

1B3GT	0-65	6AK6	0-75	6CW4	3-75	12BA6	0-65	ECL80	0-60	EZ80	0-50	PCL805	0-75
1R4	0-50	6AK7	0-85	6CY5	1-00	12BE6	0-80	ECL81	0-75	GY501	0-90	PD510	3-35
1R5	0-50	6AL5	0-40	6CY7	1-00	12BH7A	0-75	ECL82	0-60	GZ30	0-65	PL36	1-10
1S4	0-40	6AM6	0-70	6DQ6B	1-45	12BY7A	0-80	ECL83	1-15	GZ32	0-65	PL81	0-80
1S5	0-40	6AM8	0-70	6DT6	0-80	35W4	0-70	ECL84	0-70	KT66	4-50	PL82	0-55
1T4	0-40	6AN5	2-50	6GH8A	0-80	50C5	1-00	ECL85	0-65	KT88	5-80	PL83	0-50
1U4	0-70	6AN6	0-85	6GK5	0-70	*75C1	0-80	ECL86	0-85	OA2	0-55	PL84	0-75
1U5	0-80	6AQ5	0-85	6J4	1-20	*85A2	0-85	EF80	0-40	OA3	0-75	PL85	0-70
1X2B	1-20	6AR5	0-70	6J5GT	0-80	*90C1	1-20	EF85	0-48	OB2	0-60	PL508	1-30
2CW4	4-50	6AS6	1-00	6J6	0-55	*807	1-00	EF86	0-60	OB3	0-75	PL802	2-80
*2D21	0-80	6AS7G	1-20	6J7	0-80	*811A	3-80	EF92	0-75	OC2	1-40	PY81	0-70
*3-500Z	40-00	6AT6	0-75	6K6GT	0-85	*829B	8-80	EF97	0-70	OC3	0-75	PY82	0-55
*3E29	8-50	6AU6	0-50	6L6GT	0-85	*832A	8-20	EF98	0-90	OD3	0-75	PY83	0-70
3Q4	0-75	6AV6	0-75	6N7GT	0-85	*866A	3-00	EF183	0-70	PABC80	0-45	PY88	0-75
3S4	0-50	6AW8A	0-75	6Q7	0-90	*872A	6-00	EF184	0-70	PBC86	0-85	PY500A	1-30
5AQS	0-75	6AX4GTB	1-00	6S7	0-80	*5763	2-85	EFL200	1-20	PC88	0-85	TT21	7-80
5AT8	0-80	6AX5GT	1-30	65A7	0-80	DAF96	0-60	EH90	0-60	PC92	0-85	TT22	7-80
5T4	0-75	6BA6	0-45	65K7	0-80	DF96	0-60	EL34	0-95	PC95	0-70	U25	1-00
5U4G	0-60	6BE6	0-48	65L7GT	0-70	DK92	1-00	EL36	0-95	PC96	0-50	U26	1-00
5U4GB	0-75	6BF5	0-85	65N7GT	0-70	DL96	0-60	EL81	0-65	PC97	0-95	UABC80	0-58
5U8	0-95	6BF6	0-75	65Q7	0-80	ECC84	0-60	EL82	0-60	PC900	1-00	UBC81	0-60
5V4G	0-60	6BH6	0-85	6V6GT	0-65	ECC85	0-48	EL83	0-60	PCC84	0-50	UBF89	0-60
5X4G	0-80	6BJ6	1-20	6X4	0-60	ECC86	1-25	EL84	0-45	PC885	0-60	UBL21	0-85
5X8	0-90	6BN6	0-80	6X5GT	0-60	ECC88	0-75	EL86	0-75	PCC88	0-65	UCC84	0-75
5Y3GT	0-65	6BQ7A	0-65	12AC6	0-80	ECC89	0-80	EL95	0-70	PC889	0-75	UCC85	0-55
5Z4GT	0-65	6BR8A	1-20	12AD6	0-80	ECC189	0-80	EL504	0-80	PCC189	1-00	UCF80	0-75
6AB4	0-55	6BU8	0-85	12AE6	0-85	ECC80	0-60	EM80	0-65	PCF80	0-65	UCH81	0-65
6AB7	0-60	6BW7	1-00	12AT6	0-60	ECC86	0-80	EM81	0-60	PCF82	0-65	UCL81	0-70
6AC7	0-80	6BZ6	0-65	12AT7	0-50	ECC200	0-90	EM84	0-60	PCF84	0-45	UCL82	0-75
6AF4A	0-80	6BZ7	0-70	12AU6	0-65	ECC201	0-90	EM87	1-00	PCF201	1-10	UCL83	0-80
6AG5	0-65	6C4	0-55	12AU7	0-47	ECCF80	0-95	EY51	0-60	PCF806	1-00	UF85	0-50
6AG7	0-85	6CB6	0-55	12AV6	0-85	ECCF802	0-95	EY81	0-50	PCL81	0-65	UL84	0-85
6AH6	0-95	6CS7	0-85	12AV7	1-00	ECH81	0-55	EY87	0-50	PCL82	0-80	UM80	0-60
6AJ5	0-65	6CU5	1-00	12AX7	0-55	ECH83	0-60	EY88	0-55	PCL84	0-75	UM81	0-75
6AK5	0-55	6CU6	1-00	12AY7	0-85	ECH200	0-80	EY500A	1-50	PCL86	0-85	UM84	0-45

## AC/DC TAUT SUSPENSION MULTIMETERS TYPE U4315



Sensitivity D.C. 20,000 o.p.v.  
Sensitivity A.C. 2,000 o.p.v.  
D.C. Current 50µA-2.5A  
A.C. Current 0.5mA-2.5A  
D.C. Volts 75mV-1000V  
A.C. Volts 1V-1000V  
Resistance 300Ω-500kΩ  
Capacity 0.5µF  
Accuracy 2.5% D.C., 4% A.C.

Price complete with pressed steel carrying case and test leads. £14.95  
Packing & postage + VAT 8% £1.35

VAT is not included. Please add 12½% on all items except those marked with asterisk, on which VAT is 8%. Postage and packing charges are £0.10 per £ subject to a minimum of £0.30.

OUR NEW 1977/1978 CATALOGUE IS NOW READY AND WILL BE SENT ON RECEIPT OF REMITTANCE FOR £0.30

**SEMICONDUCTOR OFFERS ALL FULL SPEC**  
BC212, BC182, BC237, BF197, BC159, ALL 8p each. RCA 2015 TO3 POWER TRANSISTOR (SIM TO 2N3055) 35p.  
AC18 18p. BF200 20p. MOTOROLA MRD 3051 PHOTOTRANSISTORS 35p. N. CHANINEL F.E.T.S. SIMILAR TO 2N5819 18p. MOSFET SIM. TO 40873 3p. 2N140 MOSFETS 50p. M203 DUAL MATCHED PAIRS MOSFETS SINGLE GATE PER P.E.T. 40p. SL301 DUAL MATCHED PAIR SIL. N.P.N. POWER TRANSISTORS FT 300MHz 30p. INTEL 1024 BIT MOS RAMS 95p. MULLARD BB113 TRIPLE VARICAP DIODE 35p. MC1310 STEREO DECODER I.C.S. £1.20. TB8800 I.C. AMPS 90p. CD4051 CMOS 50p. MC100N ST. PREP. SIM. I.C. £1.30. 741 8 PIN D.I.L. 23p. MM5318 CLOCK CHIPS £3.50. 400V 15 amp STUD S.C.R. 75p. 500V 600mA BRIDGE RECS. (EX. EQUIP.) 25p. IN4002 100V 1A DIODES 4p. 14005 800V 1A DIODES 7p. E.H.T. SIL. REC. 18kV 2.5mA, 15mm x 5mm 85p. 7812 12V 1A PLASTIC V. REGS. 95p. MIN. NIXIES IIT 58705T 13 x 6mm FIG SIZE 85p. NIXIES IIT GN19A 13 x 8mm 85p. 0.2" OR 0.125" RED LEDS 12p each. MAN8A 3mm LED DISPLAYS 50p.

**MICROPHONES—GRUNDIG ELECTRET INSERTS WITH BUILT IN F.E.T. PREAMP £1.50. CRYSTAL MIKE INSERTS 37mm 50p. ELECTRET CONDENSER MIKES 1KΩ IMP. WITH STD JACK PLUG £2.85. CASSETTE CONDENSER MIKES WITH 2.5 AND 3.5 JACK PLUGS £2.85. STANDARD CASSETTE MIKES 200 OHM IMP. WITH 2.5 AND 3.5 JACK PLUGS £2.20. P.A. MIKES MOBILE TYPE 50KΩ. THUMB SWITCH £4.20.**

**MORSE KEYS—PLASTIC TYPE 85p. HI-SPED TYPE ALL METAL £2.25. HI-IMP. PHONES 2KΩ £1.65. AERIAL COAX SWITCH 3 POSITION, 3 OUTPUTS, 0-30MHz, 150 watts MAX. USES 20239 SOCKETS £4.95. LOW PASS IN-LINE FILTERS, 30MHz CUT OFF, 50 OHM IMP. £3.30 S.W.R. METER, 50 OHMS IMP. WITH POWER SCALE £19.50. XTAL MARKER GEN. 300KHz STEPS TO 60MHz, SUPPLIED WITH XTAL FOR THIS COVERAGE £7.80.**

**CRYSTALS 300KHz HCBU 40p. 4.43MHz C.T.V. XTALS 45p. 0.1" EDGE CONNECTORS 84 Way 85p. 32 Way 40p.**

**RELAYS—MIN. SEALED RELAYS ALL 4 POLE CHANGE-OVER, 36V (6V DC) 45p. 700Ω (24V AC) 55p. MIN. 220V AC SEALED RELAY 2 POLE C/O 45p. 240V AC SEALED RELAY 3 POLE C/O 5 AMP CONTACTS 1 PIN Base 80p. 12 VOLT 4 POLE N.O. REED RELAY 20p.**

**MOTORS—1.5 TO 6V DC MOTOR 20p. 115V AC MIN. 3 R.P.M. WITH GEARBOX 30p. 240V AC SYNCH. MOTOR 1/8TH R.P.M. 65p. 240V AC SYNCH. MOTOR 1/24TH R.P.M. 65p.**

**BOXES—BLACK A.B.S. PLASTIC WITH BRASS INSERTS AND LID, 75 x 56 x 35mm 40p. 95 x 71 x 35mm 40p. 115 x 95 x 35mm 57p. GREY POTTING BOXES WITH LUGS, 23 x 48 x 23mm 11p. 38 x 52 x 25mm 13p. 60 x 80 x 42mm 28p.**

ORDER ADDRESS:  
**PROGRESSIVE RADIO 31 CHEAPSIDE, LIVERPOOL 2. 051-236 0982**

**TRANSFORMERS—6-0-6v 100mA, 9-0-9v 75mA, 12-0-12v 50 mA 75p each. 12-0-12v 100mA 95p. 12v 500mA 95p. 35v 2A AND 2-5v 2A TOROID £2.75 + 35p P & P. 18v 1 amp RECTIFIED £1.45 + 35p P & P. 25v 2 amp £1.75 + 35p P & P. 0-12-15-20-24-30V 1 amp £3.25 + 35p P & P. 2 amp VERSION £4.45 + 35p P & P. 30-0-30v 1A £3.00 + 35p P & P. 25-0-25v 2A £3.95 + 35p P & P. 100 volt LINE TRANSFORMER 15 watts MAX—0-8-15Ω £1.80 + 35p P & P. 1-1 TRIAC XENON PULSE TRANSFORMER 30p, 6MH 3 amp CHOKES 30p.**

**SWITCHES—MIN. TOGGLE SPST 12 x 6 x mm 54p. 0.1PDT 12 x 6 x 9mm 80p. DPDT CENTRE OFF 12 x 6 x 11 x 5mm 75p. 4P 2W SLIDERS 20p. 6P 3W SLIDERS 30p. DPDT C/O SLIDERS 20p. SPST 10 AMP ROCKERS 12p. R.S. SINGLE POLE C/O PUSH-BUTTONS 45p. ROLLER MICRO SWITCHES 15p. MIN. MICRO SWITCHES 13 x 10 x 4mm 20p. G.P.O. KEYSWITCH ASSY. 3 SWITCHES 2.5 WATT, 12 VOLT, 12 WAY MIN. 35p. MIN. PUSH TO MAKE OR PUSH TO BREAK SWITCHES 16 x 6mm 15p. PLESSEY WINKLER STUD SWITCHES 2 BANK, 1 POLE 30 WAY ADJ. STOP 75p. DE-SOLDERING TOOLS, PLUNGER TYPE £4.95.**

**TAPE HEADS—JAP. CASSETTE MONO 90p. CASSETTE STEREO £3.00. BSR MN180 1 TRACK DUAL IMPED. REC/PLAYBACK 30p. BSR SR90 1 TRACK STEREO REC/PLAYBACK £1.95. TD10 ASSEMBLIES TWO HEADS 1 TRACK REC/PLAYBACK STAGGERED STEREO WITH BUILT IN ERASE PER HEAD £1.20. TAPE HEAD DEMAG 240v AC £1.95.**

**BUZZERS—GPO TYPE 6-12V 30p. MIN. SOLID STATE BUZZERS 8-9-12 OR 24V 15mA 75p. U.H.F. T.V. TRANSISTORISED PUSH BUTTON TUNERS (MIN. VARICAP), NEW AND BOXED £2.50.**

**POT CORES—ADJ. VINKOR 250-370 MICRO H 20p. 260 OR 500 MILLI HENRY CORES 10p each.**  
**METERS—75p. STEREO TUNING METERS 100µA PER MOVEMENT £2.75. GRUNDIG BATT. LEVEL METER 1mA 40 x 40mm £1.10. MIN. LEVEL METER 200µA 25 x 15mm 75p. FERRANTI 1mA PANEL METER 55 x 70mm £2.85. FERRANTI 600µA C.METER £3.95.**

**BOARDS—G.P.O. BOARD WITH 64, BC107 TYPE TRANSISTORS, 2 REED, 1 MERCURY RELAY ETC. £2.00 + 55p P & P. 465KHz I.F. PANELS 6 I.F.T.'s 30p. BOARD WITH 14 12V N.O. REED RELAYS £2.40. BOARD WITH 6V C/O REED RELAY £1.20.**

**AEROSOLS—SERVISOL SWITCH CLEANER + LUBRICANT 8ozs 35p. FREEZER 6ozs 50p. GEAR CLEANER & TARI REMOVER 14ozs 85p.**

**SOLENIDS—240V AC 45p. 12V DC H DUTY 75p. 240V AC LARGE 25lbs PULL 47 TRAVEL £3.25 + 50p P & P. MURATA 40KHz TRANSDUCERS, 15mm DIAM. £2.95 PAIR.**

**CONTACT COOLED SEL. RECS. 12V 750MA 15p. CANNON 50 WAY GOLD INLAY PLUGS & SOCKETS, FREE PLUG—NEW—£1.50 PAIR.**

**POSTAGE—30p UNLESS OTHERWISE SHOWN (EXCEPT POSTAGE REFUNDED WITH ORDER). OVERSEAS POST AT COST. VAT INCLUDED IN ALL PRICES.**

S.A.E. FOR LISTS

## "CASTLE ELECTRONICS"

7, CASTLE STREET, HASTINGS, SUSSEX  
Tel: (0424) 437875

R.C.A. 7163 L.D.R. 1" Dia, Dark Res 2.5M, Light IK, 3 for £2.75.  
Signal Switches 6 Pol C/O 40p, 4 Pol C/O 35p, 2 Pol C/O 30p incl. knob.  
Stereo Slider Controls 10K Log, 250K Lin, 100K Log, 3 1/2" long 40p each.

Ex G.P.O. New Stabilized Power Supplies 250 V.A.C. at 500mA + - 2V £6.00.  
H.F. Ammeters 0-2 Amp 2" Dia. £2.35.

Shure M91-ED Stereo Magnetic Cartridges £15.95.  
Micro Switches 5 Amp 240V Contacts C/O Button Opp 10 for £1.00.

Brand New Ex-WD High Impedance Headphones £2.00 pair.  
1 1/2 Bags of New Electronic Components £1.95.

Stereo Jack Sockets 5 for 75p.  
Thermometers 2" Dia. 70F-160F Chrome Front Bezel. New £1.95.

Reed Switches 1-1/2" IN, 1/4" Dia 500 M/A 250V Contacts 65p doz.  
Photo Diodes 5 for £1.00.

Min High Power Electric Motors with Rev Sw 1 1/2" Long, 1 1/2" Dia. 6-12 VDC German manufacture £1.25.

Nical Cad Cells 5 x 1.2V (=6V) 225M/AH New £1.75; Nical Cad Cells 5 x 1.2V (=6V) 50M/AH New £1.00.

Low Noise Cassettes 10 x C60's £4.00, 10 x C90's £5.00.

ALL PRICES INCLUDE VAT, POST AND PACKING.  
Please send S.A.E. for further details on items listed below.

Over 2,000 New Ex-WD Panel Meters in stock from 75p-£3.50.  
Amtron Electronic Kits, Complete Range in stock (many obsolete kits at half price).

Complete range of Sanwa Multi-Meters in stock. Panel Meters Alps 50µA-50 Amp, 10 MV-500V, Full range. C-Scope Metal Detectors, complete range in stock. Wide range of surplus components.

Published on approximately the 7th of each month by IPC Magazines Limited, Westover House, West Quay Road, POOLE, Dorset BH15 1JG. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (Asia) Ltd.; South Africa—Central News Agency Ltd. Subscriptions INLAND and OVERSEAS £10.60 payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. PRACTICAL WRITERS is sold subject to the following conditions: namely that the Publishers shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Bire where the selling price is subject to V.A.T. and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

# U.K. RETURN OF POST MAIL-ORDER SERVICE ALSO WORLD WIDE EXPORT SERVICE

## R.C.S. 100 watt MIXER/AMPLIFIER ALL VALVE



Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, P.A., where high quality power is required. 6 speaker outputs. A/C mains operated. Slave output. Produced by demand for a quality valve amplifier. Send for details.  
Price **£110** Chassis only **£94** carr. 25

## CASSETTE TAPE TRANSPORT MECHANISM

Complete with mono record/playback and erase heads. Five push buttons, record, play, forward, rewind and pause. Less motor, brand new **£3.50**



## 10" ELAC HI-FI SPEAKER

Large ceramic magnet. Response: 50-18,000 cps. Bass resonance 55 cps. 16 ohm impedance 10 watts. Post 40p

**£4.50**

## TEAK VENEER HI-FI SPEAKER CABINETS

MODEL "A". 20 x 13 x 12in. For 12in. dia. or 10in speaker. **14.50** Post 21.60

MODEL "B" BOOKSHELF For 12 x 8in. or 8in. **£8.50** Post 21

MODEL "C" BOOKSHELF For 8in and tweeter. **£5.95** post 75p

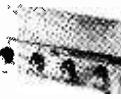
LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft.



## GOODMANS CONE TWEETER

3 1/2in. diam. 18,000 C.P.S. 25 WATTS 8 Ω **£3.25**  
8in. Audax 15 watts £4.95.  
5in. EMI mid range 25.  
10in. 30 watt GOODMANS woofer 4 ohm £10.95.

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. TWO CHANNEL STEREO VERSION OF ABOVE £8.50



BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated or Mains Supply £2.95. **£3.95**

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/240V. Leaflet S.A.E. **£4.95** Post 50p



## WAFER HEATING ELEMENTS

THIN Size 10 1/2 x 8 1/2 x 1/4in. Operating voltage 200/250V a.c. 250W approx. Suitable for Heating Pads, Food Warmers, Convecter Heaters etc. Must be clamped between two sheets of metal or asbestos. **ONLY 40p EACH (FOUR FOR £1.50)**

ALL POST PAID. Discounts for quantity.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2 1/2in. sides 6 x 4in. 70p; 9 x 6in. 90p; 10 x 7in. £1.15; 14 x 9in. £1.50. 16 x 8in. £1.45; 12 x 8in. 87p; 16 x 10in. £1.70. All boxes, many sizes in stock.

## DE LUXE BSR HI-FI AUTOCHANGER

Plays 12in. 10in. or 7in. records Auto or Manual. A high quality unit backed by BSR reliability with 12 months guarantee. A.C. 200/250V. Size 13 1/2 x 11 1/2in. Above motor board 2 1/2in. Below motor board 2 1/2in. With MAGNETIC STEREO CARTRIDGE **£21.50**  
Cueing Device, Bias Compensator, Balanced Arm, All Post 75p OR with Sonotone V100 magnetic cartridge. **£21.50**



### NEW DECKS

BSR MP60/P128 with Goldring G860 magnetic cartridge. **£24.50**  
BSR Budget Autochanger with ceramic cartridge. **£12.95**  
Garrard AP76. Single player less cartridge. **£28.50**  
BSR. P168. Belt drive. Turntable less cartridge. **£27.50**  
Garrard 5300. Autochanger with ceramic cartridge. **£14.95**  
Garrard Minichanger. Plays all size records. Ceramic cartridge. **£9.95**

## BAKER MAJOR 12" £15.00



90-14,500 c/s. 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 Gauss and a total flux of 1,45,000 Maxwells. Bass resonance 40 c/s rated. 25 watts. NOTE: 4 or 8 or 16 ohms must be stated.

### MODULE KIT

30-17,000 c/s with tweeter, crossover, baffle 19 x 12 1/2in. Please state 4 or 8 or 16 ohms. **£19.00** Post £1.60

## BAKER SPEAKERS "BIG SOUND"

Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass resonance 55 cps.

### GROUP "25"

12in. 30 watt 4, 8 or 16 ohms. **£12.00** Post £1

### GROUP "35"

12in. 40 watt 4, 8 or 16 ohms. **£14.00** Post £1

### GROUP "50/12"

12in. 60 watt professional model. 4, 8 or 16 ohms. **£21.00** Post £1.60

### GROUP "50/15"

15in. 75 watt 8 or 16 ohms. **£26.00** Post £1.60

Send for leaflets on Disco, P.A. and Group Gear.

## BAKER 150 WATT QUALITY TRANSISTOR MIXER/AMPLIFIER

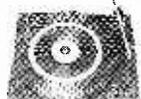
Professional amplifier using advanced circuit design. Ideal for disco, groups, P.A. or musical instruments. 4 inputs: 4 way mixing Master treble, bass and volume controls. 3 speaker output sockets. 4-8-16 ohm. Slave output. A/C mains. Guaranteed. Details S.A.E. **£75** Carr. £1.50

## 100 WATT DISCO AMPLIFIER

MADE BY JENNINGS MUSICAL INSTRUMENTS 4 Speaker outputs volume, treble, bass, controls CAN BE USED AS 100 WATT SLAVE **£59** Carr. £2

## B.S.R. SINGLE PLAYER DECK

3 speed. Plays all size records. Stereo Cartridge. Cueing device, Ideal Disco Deck. **£15.50** Post 75p



DRILL SPEED CONTROLLER/LIGHT DIMMER KIT. Easy to build kit. Will control up to 500 watts AC mains. **£3.25** Post 35p

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high medium or low gain per channel, with volume control and P.C. Board. Can be ganged to make multi-way stereo mixers. **£2.95** Post 35p

## R.C.S. SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three channels. 600 to 1,000 watts each. Will operate from 200W. Cabinet extra £4. Price **£17**

200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw Fitting 75p. Each.

## MAINS TRANSFORMERS

6 VOLT 1 AMP. £1.00 7.5 AMP. £1.40  
12 VOLT 300 MA. £1.00 750 MA. £1.30  
30 VOLT 5 AMP. AND 24 VOLT 2 AMP. G.T. £3.45  
20 VOLT 1 AMP. £2.00 2 AMP. £2.20 20-0-20 VOLT 1 AMP. £2.85  
30 VOLT 1 1/2 AMP. £2.50 40 VOLT 2 AMP. £2.95  
0-20-40-60 VOLT 1 AMP. £3.50 2 x 18 VOLT 6 AMP. 29.

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at:  
2A, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V **25.30**  
1A, 6, 8, 10, 12, 15, 18, 20, 24, 30, 36, 40, 48, 60 **25.30**  
2A, 6, 8, 10, 12, 15, 18, 20, 24, 30, 36, 40, 48, 60 **28.80**  
3A, 6, 8, 10, 12, 15, 18, 20, 24, 30, 36, 40, 48, 60 **£11.00**  
5A, 6, 8, 10, 12, 15, 18, 20, 24, 30, 36, 40, 48, 60 **£14.60**

## R.C.S. BOOKSHELF SPEAKERS

13 x 10 x 6in. 50 to 14,000 cps. 8 watts rms. 8 ohms

**£16 pair** Post £1.30

## BAKER DISCO SPEAKERS HIGH QUALITY—BRITISH MADE 2 x 12" CABINETS

for Disco or PA all fitted with carrying handles and corners. Black vinyl covered. Other cabinets in stock. SAE for leaflet

### 60 WATT R.M.S.

**£52**  
With one horn **£60**  
With two horns **£68** Carr. 25

### 80 WATT R.M.S.

**£56**  
With one horn **£64**  
With two horns **£72** Carr. 25

### 100 WATT R.M.S.

**£69**  
With one horn **£78**  
With two horns **£86** Carr. 25



## SINGLE 12inch CABS COMPLETE

30 WATT R.M.S. **£32. WITH HORN £40.**  
40 WATT R.M.S. **£34. WITH HORN £42.**  
60 WATT R.M.S. **£41. WITH HORN £49.**  
CARR £3 EA.

## "SUPERB HI-FI"

### 12in 25 watts

A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register. Bass Resonance 25cps Flux Density 16,500 gauss Useful response 20-17,000cps 8 or 16 ohms models.

**£22.00** Post £1.60



## "AUDITORIUM"

### 12in. 35 watts

A full range reproducer for high power. Ideal for Hi-Fi and Discotheques. Electric Guitars, public address, multi-speaker systems, electric organs. Bass Resonance 35cps Flux Density 15,000 gauss Useful response 25-16,000cps 8 or 16 ohms models.

**£21.00** Post £1.60



## "AUDITORIUM"

### 15in. 45 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home Hi-Fi. Bass Resonance 35cps Flux Density 15,000 gauss Useful response 20-14,000cps 8 or 16 ohms models.

**£26.00** Post £1.60



Loudspeaker Cabinet Wadding 18in wide, 20p per ft. Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables, 68p.

## E.M.I. 13 1/2 x 8in SPEAKER SALE!

With tweeter. And crossover. 10W. State 8 or 8 ohm. **£7.95** Post 45p

15W model 8 ohms. **£10.50** Post 65p

GOODMANS 20W Woofer Size 12 x 10in 4 ohms. Rubber cone surround. **£9.95** Post 85p



# RADIO COMPONENT SPECIALISTS

Minimum post 30p. Components List 20p. Cash price includes VAT. Access & Barclay cards welcome. Phone your order Tel. 01-684 1665

337 WHITEHORSE ROAD, CROYDON

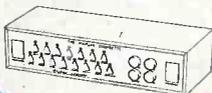
Open 9—6 Wed. 9—1 Sat. 9—5 (Closed for lunch 1.15—2.30)

# MAPLIN

in a modern world of electronics

## THE 'DRUMSETTE' RHYTHM GENERATOR

Organists, pianists, guitarists . . . an automatic drum set to accompany you! Nine highly realistic instruments play fifteen different rhythms. Fifteen rhythm-select touch switches and a touch plate for stop/start without rhythm change gives absolute ease of operation. Build it yourself for under £65 including smart teak-effect cabinet. See it and hear it in our shop! Send for full construction details now :  
MES 49 price 25p



## AUDIO MIXER

A superb stereo audio mixer. It can be equipped with up to 16 input modules of your choice and its performance matches that of the very best tape-recorders and hi-fi equipment. It meets the requirements of professional recording studios, FM radio stations, concert halls and theatres. Full construction details in our catalogue. A component schedule is available on request.



## INTEGRATED CIRCUITS

Over 35 pages in our catalogue devoted to hundreds of useful I.C.s. All with data, pin connections and many with applications circuits and projects to build. Post the coupon now!



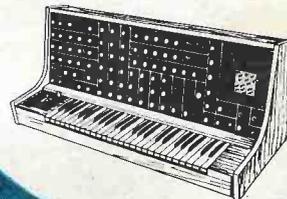
## 10 CHANNEL STEREO GRAPHIC EQUALISER

A new design with no difficult coils to wind, but a specification that puts it in the top-flight hi-fi class. All this for less than £70 including fully punched and printed metalwork and woodwork. Send for our component schedule now.  
Full construction details price 40p.



## SYNTHESISER

The International 4600 Synthesiser. A very comprehensive unit. Over 400 sold. We stock all the parts costing less than £500 including fully punched and printed metalwork and a smart teak cabinet. Far less than half what you'd pay for a ready made synthesiser of equal quality. Specification on request, full construction details in our construction book £1.50



Who says the Maplin Catalogue's worth having?

"in our 'musts' for readers-to-collect list!"—P.E.

"contains . . . just about everything the DIY electronics enthusiast requires"—P.W.

"probably the most comprehensive catalogue we have ever come across"—E.E.

"has been carefully prepared and is very well presented..."—R.E.C.

"make the job of ordering components an easy, accurate and enjoyable pastime"—P.W.

"Only one word describes the publication—superb!"  
E.T.I.

OVER 60,000 COPIES SOLD DON'T MISS OUT!  
SEND 60p NOW

MAPLIN ELECTRONIC SUPPLIES  
P.O. Box 3, RAYLEIGH, ESSEX S86 4LR  
Telephone: Southend (0702) 715155

Shop: 284 London Road,  
Westcliff-on-Sea, Essex.

(Closed on Monday)  
Telephone: Southend  
(0702) 715157

Our bi-monthly newsletter keeps you up to date with latest guaranteed prices—our latest special offers—details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).

POST THIS COUPON NOW  
FOR YOUR COPY OF OUR  
CATALOGUE PRICE 60p

Please rush me a copy of your 216 page catalogue. I enclose 60p, but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 60p refunded immediately.

NAME .....

ADDRESS .....

.....  
.....  
.....

