

# PRACTICAL WIRELESS

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20p

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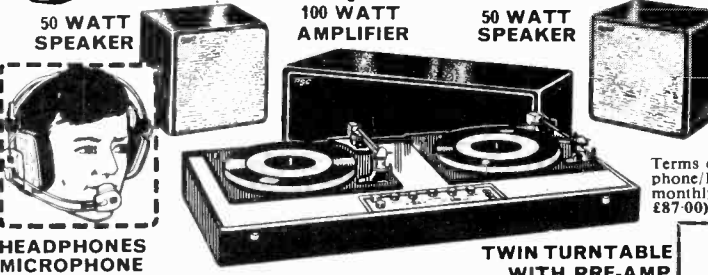
**Loudhailer  
and Siren**



The  
**'MUSIC MAKER'**



# RSC GROUP/DISCO UNITS



## PACKAGE OFFER

- Units listed below  
 (a) 100W POWER AMPLIFIER  
 (b) PAIR OF HI-FI HEAD-  
 PHONES  
 (c) MATCHING DYNAMIC  
 'MIKE' (attached  
 to headphones)  
 (d) PAIR 50 WATT SPEAKERS  
 Black Rexine covered  
 Cabinets

Size approx. £72-85  
 18" x 18" x 8"  
 (a)(b)(c)&(d) Carr. £1-25

Terms on Amps, Speakers and Head-  
 phone/Mike. Deposit £15 and 18  
 monthly payments of £4-00 (Total  
 £87-00).

# RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25  
 Mk.III turntables and Sonotone or  
 Acos Cartridges with diamond styli.  
 Separate Vol. controls for each  
 turntable. Also MONITORING  
 FACILITIES, plus Treble and Bass  
 Controls. Separate input for 'Mike'  
 with vol. control switch. Black  
 Rexine covered Cabinet with lid.  
 See illus. on left  
 Carr. £1-25  
 Or Dep. £13-25 and  
 9 mthly pymts £8-88  
 (Total £76-17) or Dep. £15 and 18  
 mthly payments £3-62 (Total £80-16).

£67-10

## TWIN TURNTABLE WITH PRE-AMP.

## R.S.C. COLUMN SPEAKERS

All types 15 Ohms covered in Rexine and Vynair  
 TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN  
**TYPE C312 30-40 WATTS** Fitted two exceptionally efficient, low feedback howl char-  
 acteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £8 and 9  
 m'thly payments £2-22 (Total £22-98) Carr. 50p.  
**TYPE C4100 100 WATTS** inc. four 12" 50 watt speakers for conserva-  
 tive rating. Extra heavy construction. Size approx. 58 x 16 x 10" Acoustically  
 filled and pressurised. Terms: Dep. £11 and 12 mthly. pyts. £5-18 (Total £78-16).

## IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

**TYPE C4125 50 WATTS** Fitted four 12" 11,000 line 15 watt  
 speakers: Overall size approx. 66 x 14 x 9 1/2 in  
 Terms: Dep. £4 and 9 monthly pay-  
 ments £3-37 (Total £34-33) Carr. 75p. £31

£65 Carr. £1

## R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

Highly sensitive. Push-Pull high output, Hum level -70dB. Response  
 ±3dB 30-20,000 c/s. All high grade components. Valves EF86  
 EF86, ECC83, EL34, EL34, GZ34. Separate Bass and Treble  
 Controls. Sensitivity 36 millivolts. For High Impedance micro-  
 phones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Func-  
 tions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram,  
 and Pick-up etc. for mixing purposes, 200-250v. 60 cfs A.C. mains. For 3 and 15 ohm  
 speakers. Twin-handled perforated cover £1-90. 12 MONTHS' GUARANTEE. Carr. 65p  
**TERMS: Deposit £4 and 9 monthly payments of £2-10 (Total £22-90). Send S.A.E. for leaflet.**

£19-75

## LINEAR T40/60D 50W GROUP/DISCO AMPLIFIER

- ★ FULL MONITORING FACILITIES
- ★ Individual Bass and Treble controls
- ★ Twin Jack output sockets for speakers
- ★ Input sockets for medium or high impedance Microphones or Guitar P.Us and Crystal or Ceramic Gram. P.Us
- ★ Frequency response 30-20,000 Hz.
- ★ Output overload protection plus doubling tuning



£49-50 Carr. free

Simulated black  
 rexine, plastic bonded  
 metal case. Also  
 stocked Linear  
 T80/100D £89-75



## FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.

Solid state. 4 Separately controlled inputs Plus master vol.  
 control. Ind. Bass and Treble Controls. Protective circuit to  
 guard against damage from accidental shorts. Output for  
 Speaker/3 to 30 ohms. Size 17" x 7" x 7 1/4" 200-250v. A.C.  
 mains. Output 50 watts music rating.  
 Or deposit £7-25 and 9 monthly pay-  
 ments £3-55. Total £39-20.

£34-95 Carr. 75p.

## FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE  
 High flux ceramic magnets. ALL CARRIAGE FREE.

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt 14,000 gauss 8/15Ω	15" 60 Watt 14,000 gauss 8/15Ω	12" 50 Watt 13,000 gauss 15Ω
£22-95	£12-90	£10-90
Dep. £6 and 9 mthly payments £2-20 (Total £25-80)	Dep. £3-30 and 9 mthly payments. £1-30 (Total £15).	Dep. £2 and 9 monthly pay- ments £1-20 (Total £12-80)

FOR BASS GUITAR, ELECT. ORGAN, ETC.

## FANE SPEAKERS 'POP' 25/2 12 in. 25 WATT

Dual Cone 15 Ω (for uses  
 other than Bass Guitar or  
 Electronic Organ). Carr. free

£6-75

Or Dep. £1-25 and 9  
 mthly payments 75p  
 (Total £8-00).

## GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER PR. FANE POP 25/2 25W L/SPEAKERS Terms: Deposit £6.50 and 9 monthly payments of £4.92 (Total £50.78)	£34-95 £13-50 £48-45	PACKAGE PRICE £45 £1
F.A.L. PHASE 50 MK.III AMPLIFIER PR. FANE POP 50 L/SPEAKERS Terms: Deposit £10 and 9 monthly payments of £5-87 (Total £58.33)	£34-95 £21-80 £56-75	PACKAGE PRICE £52 £1
F.A.L. PHASE 50 MK.III AMPLIFIER PAIR L12/25 25W L/S in cabinets Terms: Deposit £10 and 9 monthly payments of £5-88 (Total £62-92)	£34-95 £23-80 £58-85	PACKAGE PRICE £56 £1-25
LINEAR T40/60D AMPLIFIER PAIR L12/25 L/S in cabinets Terms: Deposit £9-95 and 9 monthly payments of £7-87 (Total £78-98)	£49-50 £23-80 £73-40	PACKAGE PRICE £69-95 £1-50
F.A.L. PHASE 100 AMPLIFIER 4 FANE POP 50 L/SPEAKERS Terms: Deposit £15-95 and 9 monthly payments of £10-78 (Total £112-52)	£61-95 £43-80 £105-55	PACKAGE PRICE £99-95 £2

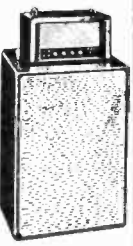
## HIGH QUALITY LOUDSPEAKER UNITS

ALL TWO TONE REXINE AND VYNAIR FINISH  
 L125 50 WATT Fitted pair of 12" 50  
 watt high flux speakers for conservative  
 rating. Impedance 8-15 ohms. Carr. £1-50  
 Or deposit £4-50 and 9 monthly payts. of £3-70. Total £27-80

L12/25 12" 25 WATT 10,000 lines 15 ohms. Carr. 50p.	L13 13" x 8" 10 Watt 10,000 lines 3 or 15 ohms. State imped- ance required. Carr. 40p
£11-95	£5-25

## RSC BASS-REGENT 50 WATT AMPLIFIER

A powerful high quality all-purpose  
 unit for lead, rhythm, bass guitar,  
 vocalists, gram, radio, tape. Peak  
 Output rating. Loudspeaker unit  
 optional horizontal or vertical  
 mounting.  
 ★ Two extra heavy duty 12in. 50w L'spkrs.  
 ★ Four Jack inputs and two Volume  
 Controls for instant use of up to four pick-ups  
 or "mikes". Bass and Treble controls.  
 Credit Terms: Deposit £15 and 9 monthly  
 pyts of £8-25 Carr. £65 for  
 (Total £71-25) £2 S.A.E. for  
 leaflet.



## RSC GP30 HI-FI AMPLIFIER

For Guitar, Vocal or  
 Instrumental Group  
 A 4 input, 2 vol. control Hi-Fi  
 30 watt unit with Separate  
 Bass and Treble controls.  
 Current valves. Peak output  
 rating. Strong Rexine covered  
 cabinet with handles. Attractive  
 black/gold P.V.C. facia.  
 Non indicator. For 200-250v. A.C. mains.  
 For 3 or 15 ohm speakers. Send S.A.E. for  
 leaflet. Terms: Deposit £4-40 and 9 monthly  
 payments of £2-45 (Total £26-45).



£23-50 Carr. 65p

## \* CREDIT TERMS AVAILABLE ON PURCHASES OVER £8 (Kits Excepted) INTEREST CHARGES REFUNDED ON CREDIT SALES Settled in 3 months

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- BIRMINGHAM 30/31 Great Western Arcade, Tel. 021-236 1279 (Closed Wed.).
- DERBY 26 Osbaston Rd., The Spot (Closed Wed.). Tel. 41361
- DARLINGTON 18 Priestgate (Closed Wed) Tel. 68043
- EDINBURGH 101 Lothian Rd. (Closed Wed.). Tel. 229 9501
- GLASGOW 326 Argyle St. (Closed Tues.). Tel. 248 4158
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### GIANT POWER MULTI-WAVEBAND BROADCAST RECEIVER

WITH 3 in 1 AC/DC POWER SUPPLY SYSTEM  
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Tune into the world with this amazing world radio. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 230-240 volt domestic mains supply. 14 Transistors; 9 diodes; thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the 8 WAVEBANDS. Complete with Hi-Fi earphone for personal listening. Frequency ranges: Long wave 150-350Kcs. Medium 353-1605Kcs. Waves 1.6-4.5Mcs. Short Wave 12-24Mcs. FM/VHF 88-108Mcs. Aircraft 108-135 Mcs. PUBLIC SERVICE BANDS 135-174Mcs. Fully guaranteed.

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Type No.	Description	Price each
CD4001AE	Quad 2 input NOR gate	72p
CD4009AE	Hex. buffer — inverting type	£1.56
CD4011AE	Quad 2 input NAND gate	72p
CD4012AE	Dual 4 input NAND gate	£1.16
CD4013AE	Dual "D" Flip-Flop	£1.48
CD4015AE	Dual 4 stage Shift Register	£3.90
CD4017AE	Decade Counter/Divider with Decimal outputs	£3.90
CD4018AE	Presetable divide by "N" Counter	£3.90
CD4020AE	14 Stage Ripple Binary Counter/Divider	£4.34
CD4024AE	7 Stage Counter (Buffered Reset)	£2.78

Order as "COSMOS" + Type No.

**INTEGRATED CIRCUIT SOCKETS**

These low cost sockets are moulded in Makrolon with Phosphor Bronze contacts, silver plated.

Type No.	Description	Price
DRD7	14 pin Dual in Line	14p each
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Type No.	Description	Price
TI112	GA source optically coupled to NPN transistor giving high DC transfer ratio with high electrical isolation of 1.5kV.	£2.00 each

**RECTIFIERS — MEDIUM CURRENT**

Plastic cased rectifiers with 3A current capability. Miniature size and axial leads make them particularly useful for Printed circuitry.

Type No.	If (Amps)	PIV	Price
1N5400	3 A	50	14p each
1N5404	3 A	400	18p each
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**WEBCOR TC 144**  
Push Button Cassette Tape  
Recorders value £17.  
Tip top quality and  
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**HYDRA 8 TRACK**  
Cartridge Stereo Record/  
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Record Player, Battery  
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Really superior finish **£1-99**

**AJAX SENATOR MK. II**  
Big Med./Long Radios.  
Six approx. 12" x 8" x 3½".  
Takes big batteries  
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## ★ TAPE ★

We offer you fully tensilised polyester/mylar  
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range recording characteristics as top grade  
tapes. Quality control manufacture. They are  
truly worth a few more coppers than acetate,  
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Standard Play		Long Play	
3in. 150ft.	12p	3in. 225ft.	13p
4in. 300ft.	22½p	4in. 450ft.	27p
5in. 600ft.	45p	5in. 900ft.	52½p
5½in. 900ft.	52p	5½in. 1,200ft.	65p
7in. 1,200ft.	62½p	7in. 1,800ft.	92½p
Double Play		Triple Play	
3in. 300ft.	20p	4in. 900ft.	65p
4in. 600ft.	40p	5in. 1,800ft.	£1-12½
5in. 1,200ft.	75p	5½in. 2,400ft.	£1-70
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7in. 2,400ft.	£1-35	Quadruple Play	
		3in. 600ft.	42½p

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Post Free loss 5% on three reels.

Quantity and Trade enquiries invited.

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### KG-620 4½ VTMV KIT ★ NEW!

#### SPECIFICATIONS

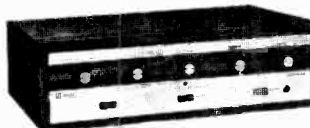


Ranges: 0-1-5-5-15-50-150-500-  
1,500V full scale; with optional  
High-Voltage Probe, to 25,000V.  
Accuracy: ±3% Of full scale  
reading.  
Input Resistance: 11 megohms  
(1 meg in probe) up to 1,500V.  
Ranges (rms): 0-1-5-5-15-50-  
150-500-1,500V full scale (p-p);  
0-4-2-14-42-140-420-1,400-  
4,200V full scale.  
Decibels: -10 to +65 in 7  
ranges.

Response: ±1dB, 30Hz to  
3MHz; ±3dB, 30Hz to 5MHz;  
with optional H.F. Probe, to  
250MHz.  
Accuracy: ±5% of full scale  
reading.  
Ranges: 0-1,000-10,000-100,000-  
ohms; 0-1-10-100-1,000 meg-  
ohms.  
Centre Scales: 10, 100, 1,000,  
10,000, 100,000 ohms; 1 and 10  
megohms.  
Battery: 1½V size D2.

Recommended List Price £18-27½: **£9-95** Assembled Price **£12-90** (RR Price £30)

### KG-865 50 Watt Stereo Amplifier Chassis



#### DE-LUXE FEATURES

All Silicon Transistors for Sta-  
bility, Cleaner Sound ● Extremely  
Wide Power Bandwidth and  
Frequency Response ● 50W IHF  
Power Output ● Specially Selected  
Low-Noise Foam Transistors  
● Two Printed Circuit Boards  
for Fast Easy Assembly ● Con-  
venient Front-Panel Stereo Head-  
phone Track ● Teak-Finished Ex-  
truded Aluminium Front Panel ●  
Two a.c. Convenience Outlets.

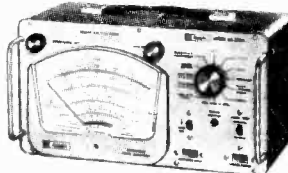
Output: 50W IHF, 25W per channel; 34W  
continuous sine wave ● Response: ±1dB, 18 to  
30,000Hz ● Output Impedances: 4 through 16 ohms,  
plus stereo headphones ● IM Distortion: under 1%  
at 60Hz and 7,000Hz mixed 4:1 at rated power  
● Input Sensitivity, Magnetic Phono, 5mV;  
Tuner and Auxiliary, 500mV ● Power Require-  
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Our Price **£29**

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Tune-up and trouble-shoot any car,  
perform actual road tests

It's several testers in one... do all this

Set Engine Idle and Automatic Trans-  
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of Point Surfaces ● Detect Distributor  
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Regulators ● Check Generators for  
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Find Poor or Open Earth Circuits ●  
Detect Variation in Dwell Angle.



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Stockists of Leak, Quad, Sansui, Goodman, Teleton, Tripletone, Linear, Rogers, Pioneer, Ferrograph, Wharfedale, etc., etc.  
Post: 1 lb. 7p; 1 lb. 15p; 2 lb. 20p; 10 lb. 35p; 14 lb. 45p; 22 lb. 65p. **CALLERS** a very wide range of electronic components await  
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Including variable condensers i.f. coils,  
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3lbs (post 24p)..... 50p  
7lbs (post 35p)..... 90p  
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**100 MIXED RESISTORS** Wide range, all  
good values ½W-2 Watt 35p, 200 for 65p,  
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**100 MIXED CONDENSERS** Ceramic, Poly-  
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sizes 49p, 200 for 85p, 500 for £1-85.

**100 MIXED HI-STABS** Instrument types  
1% to 5%, big selection **45p**

**100 MINIATURE HIGH STABS** Wide  
range of good values **50p**

**100 ½W 1% MICRO HIGH STABS** **60p**

**25 MIXED POTS** L/SW W/SW Preset  
Tandem, snip at **50p**

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HI-FI CENTRE" ★  
★ QUEEN STREET ★  
ARUNDEL  
Tel. Arundel 882299

★ BRIGHTON ★  
HI-FI CENTRE  
★ 6 QUEENS ROAD ★  
Tel. Brighton 23975

★ PORTSMOUTH ★  
HI-FI CENTRE  
★ 350-2 FRATTON RD. ★  
Tel. P'mouth 22034

★ "SOUTHAMPTON ★  
HI-FI CENTRE" ★  
★ 77 EAST STREET ★  
SOUTHAMPTON  
Tel. So'ton 281

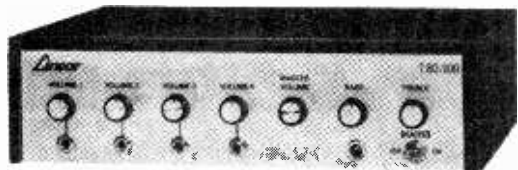
# LINEAR

## AMPLIFIERS FOR GUITAR PICK-UPS GRAM PICK-UPS RADIO or TAPE

OVERLOAD PROTECTION INCORPORATED. SOLID STATE CIRCUITRY

Suitable for application of Loudspeakers impedances between 8 and 30 ohms. Combinations not to measure less than 6 ohms across both speaker output jacks simultaneously.

The Amplifier cover is made of rigid plastic, bonded metal on the top and two sides. Finished in Black to suitably contrast with anodised metal control panel. Size approx. 14" x 4 1/2" x 9 1/2".



## GENERAL PURPOSE AMPLIFIER

Model T80/100 70 - 100 Watts Output Power

Four individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'.

Compact size, robust construction. Ideal for clubs, hotels, restaurants, schools etc.

Inputs for almost any type of microphone

Rec. Retail Price

**£69.75**

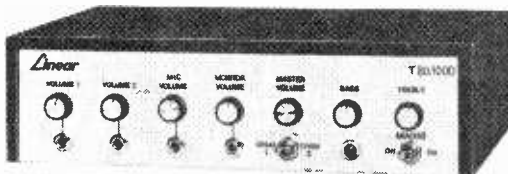
## GENERAL PURPOSE GROUP/DISCO AMPLIFIER Model T80/100D

70 - 100 Watts Output Power

Three individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'.

Compact size. Robust construction. Ideal for discotheques, clubs, hotels, schools, etc. Inputs for most types of microphones. Facilities for head-phone monitoring with changeover switch from input (1) to input (2).

Rec. Retail Price  
**£69.75**



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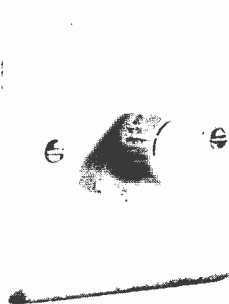
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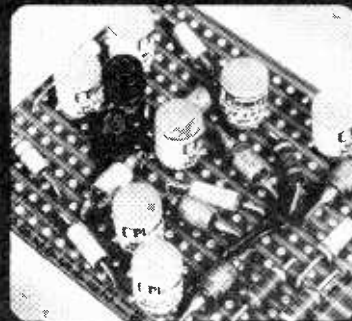
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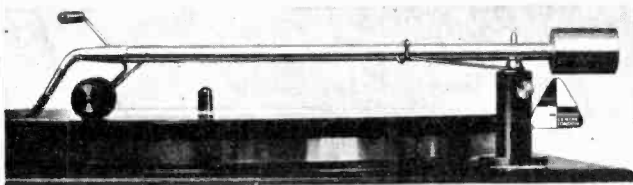
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# Bib®

# HI-FI ACCESSORIES

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## GROOV-KLEEN modern automatic record cleaners – now a choice of models



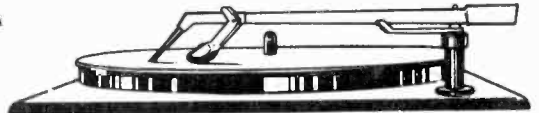
**The popular priced Model 50 GROOV-KLEEN** has all the features of the Model 42 but is made in high quality plastic. The base is finished in matt black and the cranked arm is white.

**Model 50 £1.26**

### The de-luxe Model 42 GROOV-KLEEN

- Removes and collects dust without using liquid.
- Improves reproduction.
- Reduces record & stylus wear. Counterweight ensures lightweight tracking.
- Operates silently.
- Armrest incorporated.
- Beautifully finished in Chrome, bright anodised Aluminium & shiny black.

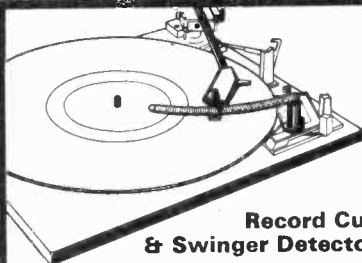
**Model 42 £1.95**



### NEW! HI-FI Stereo Test Cassette

How to get the best Stereo and Mono reproduction and recording. Devised by Bib. Recorded by Decca. Includes channel identification, balance control, speaker phasing, adjusting record volume controls, reducing tape hiss and eliminating hum, wow and flutter, and sounds you can record yourself. 523 musicians · 6 Symphony Orchestras · D'O'lyv Carte Opera Co. · Grand Organ · Brass Band 6 individual instruments.

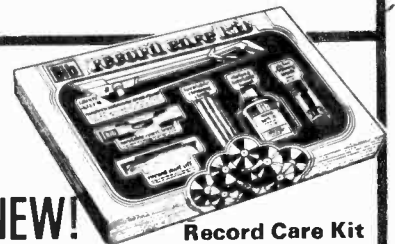
**Ref 53 £2.25**



### Record Cue & Swinger Detector

Identifies selected items on records. Fitted easily to all turntable decks. Scale clear of records, cannot touch pick-up cartridge. Detects swingers for improved reproduction when rectified.

Patent No 2460/72. **Ref 47 £1.45**



### NEW! Record Care Kit

Ideal gift. Contains GROOV-KLEEN in sparkling all-chrome finish, Record Dust Off, Spirit Level, Stylus & Turntable Cleaner.

**Ref 43 £2.49**

### Cassette Head Cleaning Tape

For all cassette machines. Removes oxide and dirt from heads. Packed in plastic "library" case.

**Ref 31 57p**



Packed in attractive bubble pack, without "library" case.

**Ref 31a 47p**

### 8 Track Cartridge Tape Head Cleaner

Maintains tape heads in clean condition. Recommended use after every 5 hours playing. Complete with dust cover.

**Ref 41 99p**



### 1/4" Recording Tape Splicer

Fitted with clamps for holding tape for diagonal or butt splices. On non-slip base, complete with tape cutter and instructions.

**Model 20 £1.24**



### Cassette Tape Recorder Care Kit

To clean tape heads safely and easily, and for joining and editing tapes precisely. Packed in plastic box.

**Ref 26A £2.10**

### Tape Editing Kits—in Wallets

Tape splicer, cutter, marker, splicing tape. Reel or cassette labels. For 1/4" tape.

**Ref 23 £1.40**

(for cassettes)

**Ref 24 £1.56**

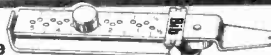


### Stylus Balance

Precision built. Calibrated. Measures stylus pressure within 1/4 gramme. In plastic container.

**Ref 32A**

**£1.45**



### Other Lines include:

Item	Ref	Price
<b>Record Care</b>		
Indexa Record	A	£1.58½
Stylus & Turntable Cleaning Kit	B	38p
Record & Stylus Cleaning Kit	36A	25p
Record Sleeve Protectors	44	44p
Spirit Level	46	56p
Record Dust-Off	48	20p
Roller & Brush for Ref 42	42S	18p
2 Self-adhesive Bases and Cleaning Brush for Models 42 and 50	42P	15p
Pad Base Sticker and Brush for Model 50	50S	20p
<b>Tape Care</b>		
Tape Head Cleaning Kit	J	54p
Recording Tape Cutters	M	20p
1/4" Tape Splicer	Model 21	£9.00
Cassette Title Labels (Pack of 108)	T/5	39p
Cassette Salvage Kit	29	46p
Splicing Tape	33	26p
Cassette Case	34	£1.34
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Cassette Wallet	39	58p
Cassette Re-Record Kit	54	44p
Cassette Hub Clips	57	26p
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Hi-Fi Cable & Flex Ties	D/2	20p
Hi-Fi Solder Pack	37	15p
Hi-Fi Cleaner	P	28p
Wire Stripper De Luxe Model	9	75p
Hi-Fi Maintenance Electrical Kit	C4	72p

Available from good audio shops. If unobtainable send direct plus 20p p & p for amounts up to £3. Over £3 postage free UK only.

### HI-FI Stereo Hints and Tips

How to make the most of your equipment by John Borwick BSc., Technical Editor of "The Gramophone". 48 Pages of useful information with 54 invaluable reference charts and illustrations for Hi-Fi enthusiasts.

**Ref 56 32p**

2nd Edition completely revised



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

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

Total building cost

**£8.50**

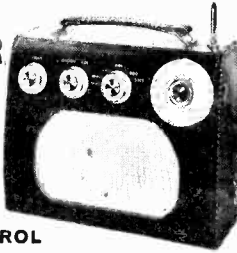
P. P. & Ins. 50p

(Overseas P. & P. £1)



## ROAMER EIGHT Mk I

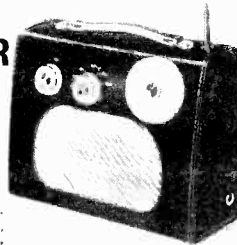
**NOW WITH VARIABLE TONE CONTROL**



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

**Total building cost £6.98** P. P. & (Overseas P. & P. £1) Ins. 45p.

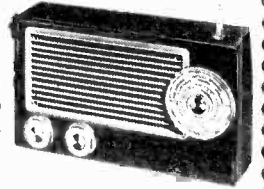
## ROAMER SEVEN MK IV



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

**Total building costs £5.98** P. P. & (Overseas P. & P. £1) Ins. 45p.

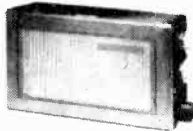
## ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3, Trawler band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages - 6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9" x 5 1/2" x 2 1/2in. approx. Easy build plans and parts price list 15p (FREE with parts).

**Total building costs £3.98** P. P. & (Overseas P. & P. £1) Ins. 30p.

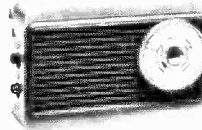
## POCKET FIVE



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

**Total building costs £2.29** P. P. & (Overseas P. & P. 63p) Ins. 23p.

## TRANSONA FIVE

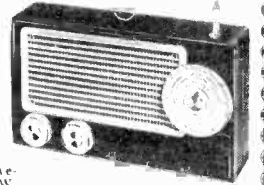


**5 TRANSISTORS AND 2 DIODES**

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage - 5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 9 1/2" x 4 1/2" x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts).

**Total building costs £2.50** P. P. & (Overseas P. & P. 63p) Ins. 24p.

## TRANS EIGHT



**8 TRANSISTORS and 3 DIODES**

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

**Total building costs £4.48** P. P. & (Overseas P. & P. £1) Ins. 32p.

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

**COMPONENTS INCLUDE:**  
Tuning Condenser; 2 Volume Controls; 2 Slider Switches; 3 inch Speaker; Terminal Strip; Ferrite Rod Aerial; 3 Plugs and Sockets; Battery Clips; 4 Tag Boards; Balanced Arrangement Unit; 10 Transistors; 4 Diodes; Resistors; Capacitors; Three 47 Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.

**All parts including Case and Plans £5.50** P. P. & (Overseas P. & P. £1) Ins. 32p.



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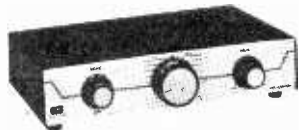




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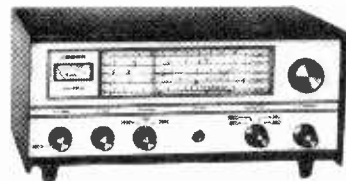


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The PR40 R.F. Preselector is the solid state version of the world famous PR30 which it now supercedes. It employs Silicon "N" Channel FET (Field Effect Transistor) front end, followed by silicon NPN Broad Band R.F. Amp., and will substantially improve receiver performance over the range 1.5 to 35 MHz, providing a considerable increase in gain up to an overall average of 30 dB, with improved image rejection and noise ratio. Supplied complete with co-ax plug (less standard 9 volt PP6 Battery), 12 months Guarantee... £8.90 Carriage 30p.

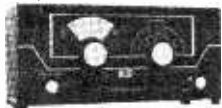


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The CODAR CR70A is an outstanding general coverage communication receiver, ideal for the keen S.W.L. It tunes from 540 metres medium through to 10 metres with no gaps. Covers shipping, coastguard and distress frequencies, all six amateur bands 160-10 metres, International broadcast, Met. stations etc. etc. giving world-wide reception. Exclusive features include Air-spaced CODAR-COIL Hi-"Q" Aerial input, illuminated Meter and Slide Rule Scale, Two Speed vernier tuning, Switched B.F.O. for CW/SSB signals. Separate output for Tape recorder. Ready to plug in to 200/240 volts A.C. it only needs your aerial and a 2/3 ohm loudspeaker to bring the world to your finger tips. 12 months full guarantee.

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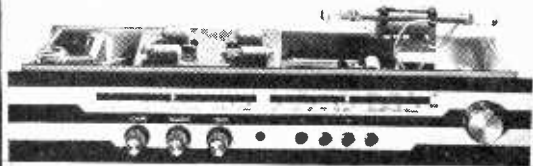
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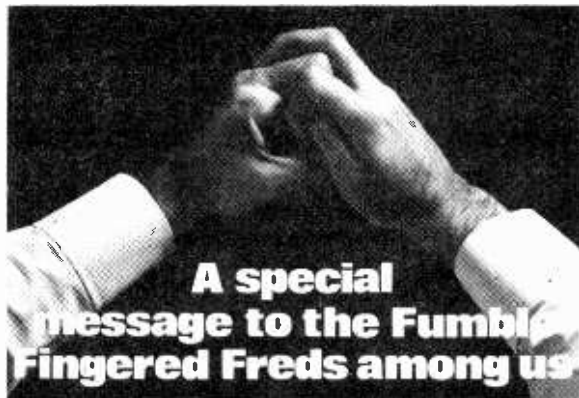
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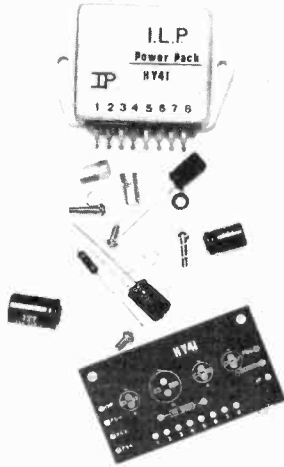


**STEPHENSPEAKERS,**  
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# ILP. (Electronics) Ltd

## THE HY41



The HY41 supersedes the popular HY40 introduced by ILP last year. This highly improved module achieves true High Fidelity with a dramatic reduction in distortion (typically 0.05% at 1KHz into 8 ohms!) and is electronically and mechanically compatible with the HY40.

With this important improvement the HY41 retains all of the quality characteristics found in the earlier version and P.C. board, Resistor, Capacitors, Hardware Mountings and comprehensive manual are included in the basic kit. No further components are required to construct a complete power amplifier of extremely high performance sufficiently versatile to provide power not merely for Hi-Fi but also for public address systems and industry.

The free manual gives a full circuit diagram of the HY41 and its various applications including a complete stereo amplifier.

Like its predecessor the HY41 is based on conventional and proven circuit techniques developed over recent years.

**OUTPUT POWER:** British Rating 40 WATTS PEAK, 20 watts

R.M.S. continuous.

**LOAD IMPEDANCE:** 4-16 ohms.

**INPUT IMPEDANCE:** 30K ohms at 1KHz.

**VOLTAGE GAIN:** 30db at 1KHz

**TOTAL HARMONIC DISTORTION:** less than 0.15% (typical 0.05%) at 1KHz.

**FREQUENCY RESPONSE:** 5Hz-50KHz  $\pm$  1db.

**SUPPLY VOLTAGE:**  $\pm$  22.5volts D.C.

**SUPPLY CURRENT:** 0.8 amps maximum.

**PRICE:** inc. comprehensive manual, P.C. board, five extra components and P. & P.:-  
**MONO: £4.90**      **STEREO: £9.80**

## UNIQUE HYBRID PRE-AMPLIFIER

The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an integrated pre-amplifier circuit.

Supplied with the HY5 are two stabilizing capacitors and by the addition of volume, treble and bass potentiometers it is ready for use.

Internally the HY5 provides equalization for almost every conceivable input, the desired function is achieved by use of a multi-way switch or by direct interconnection.

Two distinctive features of the HY5 are its inbuilt stabilization circuit, allowing it to be run off any unregulated power supply from 16-25 Volts and a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo pre-amplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY41 and PSU45 forms a completely intergrated system.

### INPUTS

Magnetic Pick-up (within  $\pm$ 1db RIAA curve) 2mV. 47K  $\Omega$

Tape Replay (external components to suit head). 4mV. 47K  $\Omega$

Microphone (flat) 10mV. 47K  $\Omega$

Ceramic Pick-up (equalized and compensatable) 20-2000mV. variable.

Tuner (flat) 250mV. 100K  $\Omega$

Auxiliary 1 250mV. 47K  $\Omega$

Auxiliary 2 2-20mV. 100K  $\Omega$

### OUTPUTS

Main Pre-amp output 500mV.

Direct tape output 120mV.

### ACTIVE TONE CONTROLS (Bexendall)

Treble  $\pm$  12db.

Bass  $\pm$  12db.

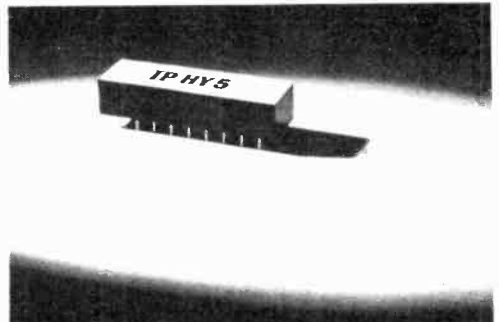
### INTERNAL STABILIZATION

Enables the HY5 to share an unregulated supply with the Power Amplifier.

### SUPPLY VOLTAGE

16-25 volts

**PRICE:** MONO: £3.60      **STEREO: £7.20**



### SUPPLY CURRENT

6mA approx.

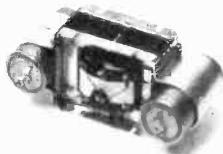
### OVERLOAD CAPABILITY

better than 26db on most sensitive input infinite on tuner and auxl.

**OUTPUT NOISE VOLTAGE:** 0.5mV.

## POWER SUPPLY PSU45

The versatile P.S.U.45 is designed to supply your HY41's +HY5's in stereo or mono format.



### Specification

Input: 200-240 Volts.

Output:  $\pm$  22.5 Volts at 2 amps.

Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

**PRICE: £4.50 inc. P. & P.**

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT

CANTERBURY 63218



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

special introductory offer **£2.50**

First time marketed in England, this exciting electronic instrument the "Decoytronic" is the one responsible for starting the electronic fish-rage in the U.S.A. just recently. Uses ingenious double-action method of attracting all kinds of fish from hundreds and hundreds of feet away... saltwater or freshwater. Why this device is so fantastically successful is because it actually imitates the sound of sea insects milling about the surface. These sound waves spread out hundreds of feet in all directions. Although this peculiar sonic frequency won't sound like much to you—to all the fish in the area it's their dinner bell! But that's not all... *electroluminescence neon tubes cunningly flicker intermittently*, penetrating the area for hundreds of feet around, at a frequency fish are unable to resist. The fish mistake this flickering glimmer for light, and the electroluminescence glow given off by Plankton... a favourite delicacy of most fish!!! All you do is switch on, lower into the water (it's completely water resistant) allow around 5 minutes—then start reeling 'em in. We'll bet you won't be able to reel 'em in fast enough. Self-contained batteries last ages—costs pennies. Kit of all parts including special easy as a.b.c. directions only **£2.50 + 25p. P. & P.** (Parts available separately).

**BUILD 5 RADIO AND ELECTRONIC PROJECTS**

ONLY **£2.45**



Amazing Radio Construction set. Become a radio expert for **£2.45**. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box **45p** extra as illus. (if required) (parts available separately) no soldering necessary. Send **£2.45 + 20p p. & p.**

**SOOTHE YOUR NERVES RELAX WITH THIS AMAZING RELAXATRON**

**CUTS OUT NOISE POLLUTION SOOTHES YOUR NERVES!**—The RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 10 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components: nuts, screws, wire, etc. **£2.75 + 25p p. & p.** (Parts available separately).



ONLY **£2.25**

**ELECTRONIC ORGAN**

ONLY **£3.25**



Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. **SELLS LIKE HOT CAKES**. Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc. You have the thrill and excitement of building it together with the pleasure of playing a real, live portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, simple as ABC to make. **Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.** ONLY **£3.25 + 25p. p. & p.** for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making yourself, finish with an exciting gift for someone.

**TREASURE LOCATOR MODULE**

ONLY **£4.50**



**FULLY TRANSlTORISED METAL DETECTOR MODULE.** Uses PP3 battery and phones. Put it in a case, screw a handle on and you **HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC.** So sensitive it will detect certain objects buried **SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN. Send only **£4.50 + 30p** carriage for kit (High quality Danish Stethoscope headphones **£2.75** extra if required).



the amazing "Phototron" **SOUND OPERATED FLASH**

ONLY **£4.50**

Take flash pictures at the exact instant of the bursting of a balloon. A champagne cork leaving the bottle. The split second a hammer strikes a light bulb. *The mind boggles at the possibilities of the "Phototron"...* the only limit is your imagination. Now that inexpensive flash guns are on the market in quantity, it has made possible, with the help of electronics the production of a wide variety of exciting photography effects, once strictly limited to the professionals. The duration of an electronically produced flash is extremely brief and normally measured in Milliseconds. Now, providing the camera shutter is left open in a dark or subdued light, it is the timing of the flash that determines what is imprinted on the film—not necessarily anything done by the camera. As electronic flash guns are fired by making a switched connection then it becomes obvious that one of the latest Silicon Controlled Rectifiers can be used. If we make this S.C.R. operate by sound (with variable sensitivity control for soft/loud sounds) some real "way out" photography effects can be captured forever on film. Easily built in a couple of hours or so, the "Phototron" is fully solid state, uses self contained PP3 battery. No soldering necessary using our special terminal board (pat. Applied for). All parts including special pictorial step-by-step plans, transistors, microphone, S.C.R., potentiometers, switches, test lamp, case, nuts, screws, etc. etc. ONLY **£4.50 + 25p P. & P.** Made up must be worth at least **£10** (parts available separately).

Eavesdrop on the exciting world of Aircraft Communications—

**V.H.F. AIRCRAFT BAND CONVERTER ONLY £2.85**



**Listen in to AIRLINES, PRIVATE PLANES, JET-PLANES, Eavesdrop on the latest Billion Controlled Rectifiers can be used. If we make this S.C.R. operate by sound (with variable sensitivity control for soft/loud sounds) some real "way out" photography effects can be captured forever on film. Easily built in a couple of hours or so, the "Phototron" is fully solid state, uses self contained PP3 battery. No soldering necessary using our special terminal board (pat. Applied for). All parts including special pictorial step-by-step plans, transistors, microphone, S.C.R., potentiometers, switches, test lamp, case, nuts, screws, etc. etc. ONLY £4.50 + 25p P. & P. Made up must be worth at least £10 (parts available separately).**

Use standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). **NO CONNECTIONS WHATSOEVER NEEDED.** SEND ONLY **£2.85 + 20p. p. & p.** for kit including case, nuts, screws, wire, etc. etc. (Parts available separately).

**FIND BURIED TREASURE!**

**Transistorised Treasure Locator**



ONLY **£2.85**

This fully portable transistorised metal locator detects all tracks—down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FIND GOLD, SILVER COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** Extremely sensitive will signal presence of certain objects buried several feet below ground. No knowledge of radio or electronics required. Can be built with ease in one short evening by anybody from nine years of age upwards, with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes case, nuts, screws, wire, etc. ONLY **£2.85 + 25p. p. & p.** (Sectional handle as illustrated **85p.** extra). Parts available separately. Made up looks worth **£15.**

**INGENIOUS ELECTRONIC SLEEP INDUCER**

ONLY **£3.25**



Do you wake up in the night and can't get off to sleep again? Would you like to be gently soothed off to a slumber each every night? Then build this ingenious electronic sleep inducer. **It even stops by itself so you don't have to worry about it being on all night!** The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until eventually ceases altogether, the effect it has on people is amazingly very similar to hypnosis. All transistor. No knowledge of electronics or radio needed. Step-by-step instructions included. No soldering necessary. Kit includes case, nuts, wire, screws, etc. SEND **£3.25 + 25p p. & p.** (Parts available separately).

**SHORTWAVE TRANSISTOR RADIO**



ONLY **£2.75**

Anyone from 9 years up can follow the step-by-step, easy ABC, fully illustrated instructions. No soldering necessary. Kit includes transistors logged on rod aerial in 30 mins.—**RUSSIA, AFRICA, USA, SWITZERLAND, ETC.** Experience thrills of world wide news, sport, music, etc. **Eavesdrop on unusual broadcasts.** Uses PP3 battery. Size only 3" x 4 1/2" x 1 1/2" ONLY **£2.75 + 20p p. & p.** Kit includes instructions, etc. (Parts available separately).

**UNIQUE RADIO FOR BEDROOM OR OFFICE** No batteries, no electricity. **ONLY £1.70** never wears out



Tune in your favourite programmes or the news, or sports in the Office or in your bedroom. Uses sensitive, germanium diode originally evolved from Wartime radar. Never buy a battery. Never use electricity. Never replace. Covers all medium waves. Clear beautiful tone. Size 4 1/2" x 2 1/2" x 1 1/2" in beautiful case. **ONLY 7 CONNECTIONS AND IT'S WORKING.** No soldering necessary. **CAN BE BUILT ALMOST BLINDFOLD IN UNDER 15 MINUTES!** Ideal for absolute beginner from 8 years of age upwards. **SPECIAL PRICE TO CLEAR STOCKS OF COMPONENTS, ONLY £1.70 + 20p. P. & P.** for all parts including beautiful case, germanium semi-conductor, tuning condenser, personal phone, wire, nuts screws. **SIMPLE AS A.B.C. INSTRUCTIONS** (Parts available separately).

**"READ PEOPLE'S MINDS"—TEST THEIR NERVES—BEAT THEM AT CARDS, ETC. WITH THIS ASTONISHING ELECTRONIC BRAIN BOX ONLY £2.87**

With this "Brain-box" you will be able to perform mind-boggling feats. **THE MIND READING DEVICE** will make people who have "telepathic" powers. **THE AMAZING CARD TRICK UNIT** completely mystifies and baffles from one to six people. You correctly "guess" the two cards each person has selected at random from a pack they themselves shuffled. **THE ELECTRONICS NERVES TESTER** puts your friends to a very lively test. It gives out fail and finish signals (the winner is the person with lowest number of fail signals). **Can be adjusted from the weakest to strongest person.** **THE ELECTRONIC MAZE** tests the mental ability of the player because it uses a maze with an electronic twist to it. You can change the maze pathways in seconds to prevent the maze becoming too stale after lots of use. Completely safe and foolproof. Size 18" x 12" x 6" (Max.). You can play all these games and more beside after building the "Brain box". No soldering, you get pictorial, easy as a.b.c. step-by-step simple instructions. **ONLY £2.87 + 35p. p. & p.** for all parts including chassis, switches, styus, signalling lights, wire, nuts, screws, etc. etc. Use standard battery. Presentation Box 35p. extra as illus. if reqd. (PARTS AVAILABLE SEPARATELY) FULL OPERATING DIRECTIONS WITH EACH OF THE PROJECTS.



**AMAZING MAGIC MUSIC BOX**

make electronic music waving your hands about **only £2.75**



Everyone's heard the weird, wonderful, but beautiful music used in Science Fiction Films, Horror Films etc., also on Radio and Television. This unearthly, eerie music is almost always produced by a little known electronic device measuring only a few inches... called a Therenin. All you have to do is switch on your radio (almost any type will do) and place the Therenin close by. Switch on the Therenin and proceed to wave your hands mysteriously in the air like a magician. The most fantastic musical sounds are then produced, and with a little practice people can learn to play all the well known tunes. Apart from its musical value, its small size allows it to be used to best advantage at parties, gatherings of friends etc., where it attracts tremendous interest. Provides hours and hours of pleasure to young and old. Uses standard PP3 battery which lasts ages. The 3 Transistor circuit, though fairly advanced is simple to build with our pictorial step-by-step plans. No soldering necessary. Easy built in an hour or so using our special terminal board (Pat. Applied For). All parts including nuts, bolts, case etc., **ONLY £2.75 + 25p P. & P.** (Parts available separately).

**INGENIOUS ELECTRONIC SINGING & WARBLING CANARY** **only £4.50**



Actually whistles & warbles like a real live Canary! Amazing circuitry faithfully repeats the bird's magnificent song. Just switch on and leave it—blasting down scale for some seconds, suddenly breaking into a delightful warble, then several seconds later shutting off for a second or two—only to start automatically again in a few seconds. People listen to the delightful song all day and never get bored! Relax, as the sweetest nerve-soothing music, the bird's song, is played over and over. Easy built in an hour or so to young and old alike. Standard self-contained battery lasts for ages. No soldering necessary. All parts including joy to you with special pictorial step-by-step plans. No soldering necessary. Easy built in an hour or so using our special terminal board (Pat. Applied For). All parts including nuts, bolts, case etc., **ONLY £4.50 + 25p P. & P.** (Parts available separately).

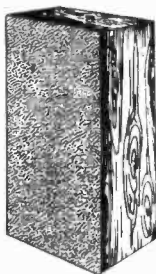
## BROADWAY ELECTRONICS

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LONDON S.W.17 01-672 3984  
(Nr. Tooting Broadway Underground Station)  
(Closed all Wednesday)

### THE SHELLEY

Size 21 x 11 x 6 1/2 in.

An extremely elegant speaker system made of 12mm. chipboard covered with black leathercloth with mottled Vynair front. This unique system uses three ex-TV speakers. Will handle 10 watts and will match 8 ohms impedance. A real bargain at £5.15 plus 70p. British Isles.



### CARTRIDGES—Stereo

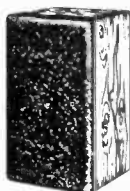
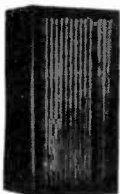
Sonotone 9TA H/C Diamond £2.40. Ronette S105 Medium Output, £1.40. S106 High Output £1.40. Acos GP93/1 Sapphire, £1.90. GP94 1 Sapphire, £2. Japanese equivalent to B.S.R. TC8s, £1.75. P. & P. 7np on each.

### CARTRIDGES—Mono

GP.91 Stereo Compatible £1.25. Acos GP67/2 will replace Collaro and Garrard Mono cartridges, 95np. B.S.R. TC8H Jap. equivalent £1.25. P. & P. 7np.

### FARRA-DAY

5 1/2" x 11" x 4 1/2" covered in White, Green or Black rexine or Teak cloth with Silver coloured metal front 3ohm ex. tv speaker. £2.90 P & P 25p



### ELF

An extension speaker of quality; 9 x 5 1/2 x 3 1/2 in. veneered in natural teak with smart gold and mottled Vynair front 3 ohm ex-TV speaker. The baffle is half inch thick. A real bargain at £1.92 1/2. Post and packing. 37 1/2p.

### SPEAKER MATCHING TRANSFORMERS

3, 7, 15 ohms, 8 watt, 70np. P. & P. 17np.

### HI-FI STEREO HEADPHONES

Padded ear cushions seal out room noise. Perfect coupling between reproducer and ears assure full response impedance 8 ohms. frequency range 30-15,000 Hz 6ft. cord and standard stereo plug. Only £2.57 1/2. P. & P. 27 1/2p.



### STEREO HEADPHONE JUNCTION BOX

Simple unit connects direct to amplifier and speakers to give attenuated headphone output has 3 position switch to give headphones only, speakers only, speakers and headphones. Only £1.50. P. & P. 13p.



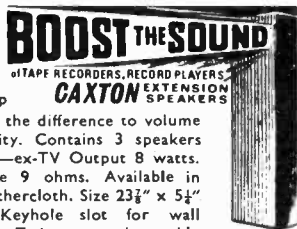
### VYNAIR

Widths from 50 to 54 in., 75np yd. off roll. P. & P. 10np, 1/2 yard 40np. P. & P. 10np. Send 5np stamps for samples.

£3.15

P. & P. 61p

Makes all the difference to volume and quality. Contains 3 speakers in series—ex-TV Output 8 watts. Impedance 9 ohms. Available in black leathercloth. Size 23 1/2" x 5 1/2" x 5 1/2". Keyhole slot for wall mounting. Twin connecting cable 12yds., 35p min.



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### for fast, easy reliable soldering

Ersin Multicore Solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.

### IDEAL FOR HOME CONSTRUCTORS



Size 1 cartons all at 25p each in 40/60, 60/40, or Savbit alloys in 7 gauges.

### EASY-TO-USE DISPENSERS



Size 5 (Savbit) 18swg, 18p (illustrated)

Size 19A (60/40 alloy) 18swg, 18p

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NEW!

Model 3A. Strips insulation from cable or flex without nicking wire. 4 different settings, 4 & 6 BA spanner ends, ground cutting edges Price 32p. Also available, de luxe Model 8. Price 58p.

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# SAXON ENTERTAINMENTS.

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

## SA25-SA35-SA100

LOW-PRICED AUDIO MODULES  
FOR DOMESTIC & COMMERCIAL USE



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

**SA25 £2.95** carr. free

25 WATTS RMS. 7 transistors 7 diodes

**SA35 £4.45** carr. free

35 WATTS RMS. 7 transistors 7 diodes

**SA100 £10.90** carr. free

100 WATTS RMS. 11 transistors 6 diodes

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

### BRIEF SPEC. FOR ALL THREE MODULES

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

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

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

Stab PS45	Stabilized module for 2 SA25's or two SA35's	£3.50 carr. free
MT45	Transformer for above, heavy duty	£2.85 carr. 20p
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PU70	Unstabilized supply for one or two SA100	£6.75 carr. 40p
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ALL MODULES ARE BUILT ON  
GLASS FIBRE P.C. BOARD

## OTHER SAXON PRODUCTS. . .

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

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

### SPECIFICATION

Power output	120 watts into 8 ohms
Freq. response	30-30,000 Hz $\pm$ 2dB
Input sensitivity	200 mV into 10K
Construction	Fibreglass board
Size	8" x 4" x 4" (5" with supply)

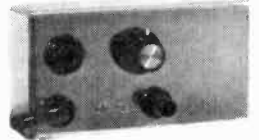
Low distortion parallel push-pull output stage.



### SINGLE CHANNEL SOUND/LIGHT CONVERTER

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

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



**£8.90** carr. free

### THREE CHANNEL SOUND TO LIGHT UNIT

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

**£19.75** carr. 30p

### SAXON STEREO CONTROL UNIT



**£15.80** carr. 30p  
MONO VERSION £6.50 carr. 20p  
(As illustrated left S.A.E. details 9 volt operation)  
Outputs up to 1 volt RMS

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

### COMPLETE AMPLIFIERS

The CSE 100. £34.90 carr. free

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



The SAXON 100 £48.50 carr. free



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

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12" 25 watt 8/15 ohms £4.95 carr. 30p. 15" 50W.8/15 ohm £14.50 carr. 50p.  
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TRADE & EXPORT enquiries invited.

# RTVC THE

## THE FABULOUSLY SUCCESSFUL VISCOUNT III AUDIO £52 complete

14 + 14 watts r.m.s. 40Hz to 40kHz  $\pm 3$ dB. Total distortion at 10 watts at 1kHz -0.1%

This is real value for money! We have designed 2 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For both systems we have chosen the famous Garrard SP25 Mk. III deck which comes with fitted magnetic cartridge, simulated teak plinth and tinted acrylic dust cover. The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

### SPEAKERS

**Duo Type II** Size approx. 17in. x 10 $\frac{1}{2}$ in. x 6 $\frac{1}{2}$ in. Drive unit 13in. x 8in. with parasitic tweeter. Max. power 10 watts, 8 ohms. Simulated Teak cabinet. £14 pair + £2 p&p.

**Duo Type III** Size approx. 23 $\frac{1}{2}$ in. x 11 $\frac{1}{2}$ in. x 9 $\frac{1}{2}$ in. Drive unit 13 $\frac{1}{2}$ in. x 8 $\frac{1}{2}$ in. with H.F. speaker. Max power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32 pair + £3 p&p.

### SPECIFICATION R101

14 watts per channel into 3 to 4 ohms. (suitable 3-15 ohms). Total distortion @ 10W @ 1kHz 0.1%. P.U.1. (for ceramic cartridges) 150mV into 3 Meg. P.U.2. (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within  $\pm 1$ dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal-to-noise ratio: (all controls at max) -P.U.1. and radio -65dB, P.U.2 -58dB. Cross talk better than -35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13 $\frac{1}{2}$  x 9in. x 3 $\frac{1}{2}$ in.

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### PRICES: SYSTEM 1

Viscount III R101 amplifier	£22.00+90p p&p
2 x Duo Type II speakers	£14.00+£2 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23.00+£1.50 p&p
<b>Total</b>	<b>£59.00</b>

Available complete for only £52 + £3.50 p&p

### PRICES: SYSTEM 2

Viscount R101 amplifier	£22.00+90p p&p
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The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale for easy reading at night. Chassis size is: 7in. wide, 2in. high and 4 1/2 in. deep (excluding front panel, etc.).

- ★ Circuit diagram and comprehensive instructions 50p, free with parts.
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Price only £7.00 + 50p p&p. 8 ohm speaker with baffle and fixing strips £1.50 post free if bought with kit + 25p p&p.

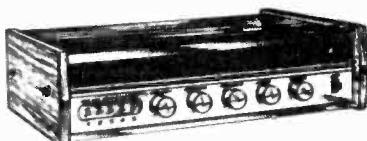
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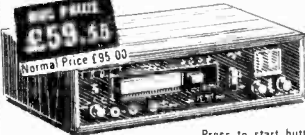
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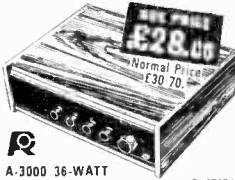
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The A-3000 looks as good as it sounds! Giving you a big performance this superb audio amplifier has a full range of facilities on the front and rear panels. On the front - all the controls you're ever likely to need plus a headphone socket. On the rear - signal inputs, speaker outputs and a line fuse for circuit protection. Specifications: 18 watts rms per channel into 8 ohms; Frequency response 20-35,000 Hz (-2db) Inputs Magnetic, Ceramic, Tuner, Tape, Aux. Tape Play. Size: 345mm x 300mm x 130mm.

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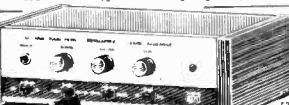


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**OLSON RA-310 AM/FM/MPX STEREO TUNER**  
This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also the RA-310 costs £10.00 less than the normal retail value and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands FM 87-108 MHz; AM: 525-1605 kHz. FM Sensitivities: FM 3µV, AM 250µV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11 1/2" wide, 4" high, 7 1/2" deep.

**REALISTIC SA-100B 6-WATT STEREO AMPLIFIER**

Here's a fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide, 3" high x 5 1/2" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out (mono/stereo, phono) tuner and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz. ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

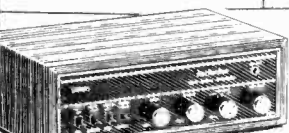


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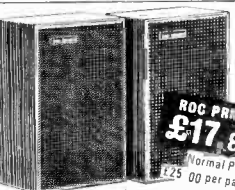
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**OLSON AM-395 40-WATT STEREO AMPLIFIER**  
An ideal unit for your new stereo separate system. It is more than £10.00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got out puts for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3.0mV RIAA, crystal phono 180mV; tape 160mV; tuner 160mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well - sounds even better!



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These will do justice to your amplifier - and to your pocket. At only £16.40 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range, 40 to 19,000 Hz. Size 14" high, 9" wide, 6 1/2" deep.

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**OLSON AM-400 4 WATT STEREO AMPLIFIER**  
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**ROC PRICE**  
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This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units an 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s. into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10 1/2" x 7 1/2" x 8 1/2". Exactly right for matching the most modern decors.

**ROC PRICE**  
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**PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16**  
This is one of the lowest priced stereo tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received - that's the time to switch to 'Stereo!' The SSA-16 has all the facilities you'd expect to find on tuners costing twice as much - separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz; AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output, 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4 1/2" high, 8" deep.

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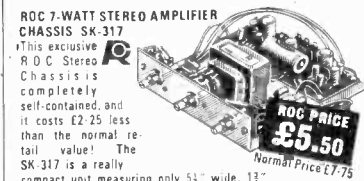
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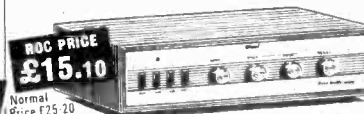
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**ROC PRICE**  
**£5.50**  
Normal Price £7.75



**OLSON AM-372 16-WATT STEREO AMPLIFIER**  
Here's a really good amplifier at a really down-to-earth price - nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you - reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12 1/2" wide, 3 1/2" high, 7 1/2" deep.

**ROC PRICE**  
**£15.10**  
Normal Price £25.20

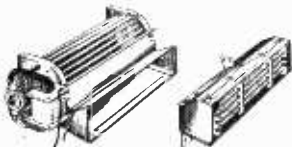
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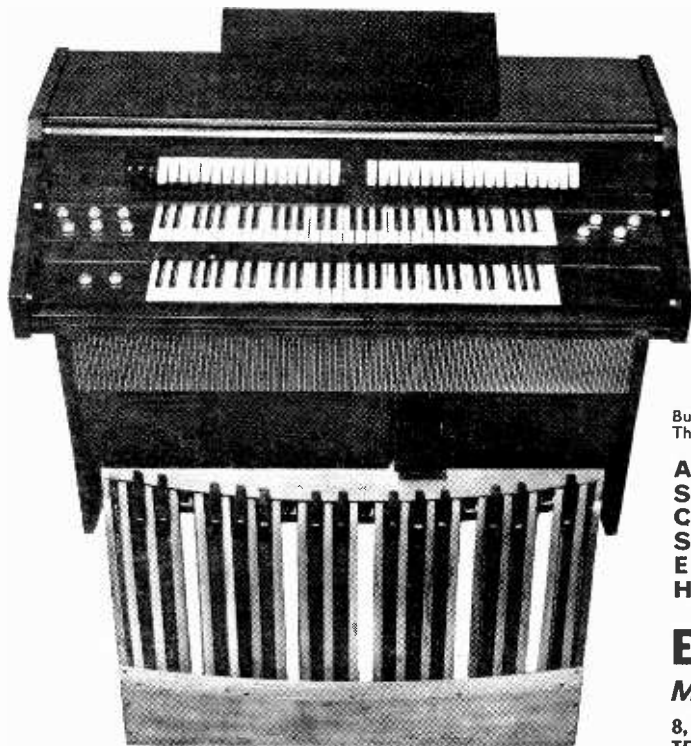
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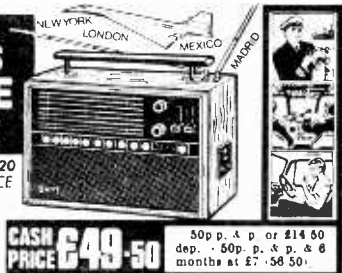
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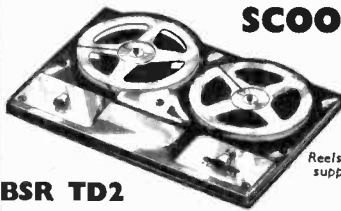


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# PRACTICAL WIRELESS

VOL 48 NO 8

Issue 790

DECEMBER 1972

## Happy Anniversaries

If you have been orbiting in space, trekking across the Gobi Desert or drifting down the Amazon for the past few months, it is possible that the news of the great event about to be celebrated has not filtered through. Otherwise, you will be aware that this month the BBC notches up the 50th Anniversary of broadcasting in the UK.

Special programmes are being broadcast on radio and television, exhibitions are being mounted by the BBC and others, the Post Office has issued a special set of postage stamps, the IEE is staging a series of lectures. After such a welter of words, pictures and sounds, what is there left to say? Not a lot, really, except for Practical Wireless to add its tribute to all those on the engineering, programme and administrative sides, who over the past 50 years have made a contribution towards what is still (despite its lovable faults) the best broadcasting service in the world.

But while we are indulging in flag-waving, let us not forget the unsung heroes who have also played a part in the development of broadcasting—the component makers, the set makers, the performers, the backroom boys and those overlooked but staunch martyrs, the listeners themselves!

There is yet another group who, collectively, deserve a modest pat on the back—our colleagues, past and present, who presumably through some inherited defect (or sheer masochism) decided to devote their life to the career of technical journalism! In the early days of broadcasting, and even before it, the technical journals generated and sustained the interest in the subject. The famous magazines of the day, such as *Popular Wireless*, *Wireless Magazine* and *Amateur Wireless* have long been but memories, but three of the pioneer publications are still with us—*Wireless World*, *Practical Wireless* and *Television* (which started life as *Practical Television* as early as 1934).

At the risk of being dubbed chauvinistic, this seems to be the right occasion to mention (with a becoming blush) that during the BBC festive season of celebrating their 50th Anniversary, readers may like to raise a flag or two in recognition of the fact that this year *Practical Wireless* is a contender in the Anniversary Stakes, having now reached its 40th birthday—a period of time during which, like the famous Windmill, we never closed!

W. N. STEVENS—*Editor*.

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## COMPETITION

WIN A HEATHKIT 'SCOPE 721

THE JANUARY ISSUE WILL BE  
PUBLISHED ON DECEMBER 1st

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## Bristol '73

The Bristol Group of the R.S.G.B. are now privileged to announce their plans for participation in the 1973 anniversary celebrations of the granting of the Royal Charter to the City and County of Bristol.

One aspect will be the operation of an amateur radio exhibition station on the S.S. *Great Britain*, now being restored in dry dock at Bristol.

The Ministry of Posts and Telecommunications, as the licensing authority, has agreed to the special call sign "GB2GB" for a station to be operated from the vessel and will permit the station to be operated by persons holding current Amateur (Sound) Licences A who visit the vessel during the month of August, 1973.

The general public will hear contacts being made with amateur radio stations, both local and long distance, and information will be available from the operators on the hobby of amateur radio and the role it plays in promoting international understanding.

With the co-operation of the S.S. *Great Britain* Project, receiving tests already carried out from the vessel have indicated that the site is suitable for reception and therefore transmission is not considered to present any problems.

It is anticipated that the station will make contacts with stations in other Bristols and the cities of Hanover and Bordeaux. Contact will also be attempted with amateur radio stations in the Falkland Islands where the vessel lay in Sparrow Cove for many years.

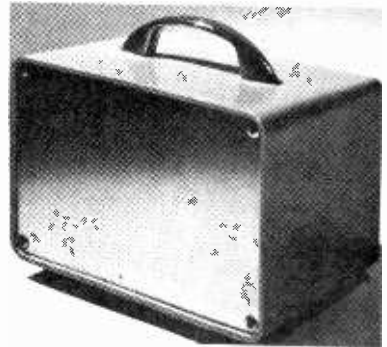
Specially designed cards depicting the S.S. *Great Britain* will be sent to amateur radio stations contacting GB2GB and these are being donated by a famous firm of Bristol wine merchants who have also agreed to present cases of sherry as awards in a Bristol Amateur Radio Activity Contest to be held in 1973, details of which will be announced in a few months' time.

As 1973 is also the Diamond Jubilee of the Radio Society of Great Britain, local members are pleased to announce that a convention will be held at a local hotel. This is to be on the 26th May, 1973, and details are now being planned.

It is hoped that these events—GB2GB on the S.S. *Great Britain*, and radio contest, and the convention, will make 1973 a memorable year for Bristol and radio amateurs.

Further gen from G. Mather G3GKA, 8 Hills Close, Keynsham, Bristol.

## The "Elf"



West Hyde announce the Contil "ELF". Only 6in. x 4in. x 4in., they are offered at five cases for £6 including postage and packing. (£1.25 ea. + 10p p.p.)

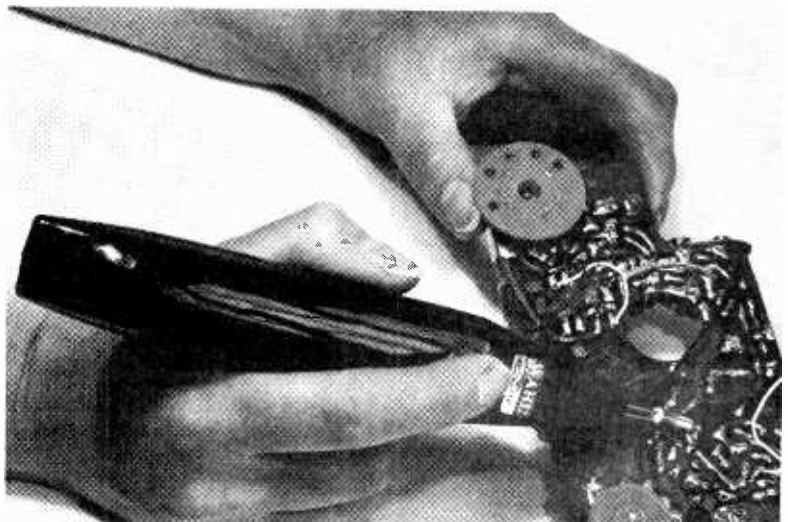
Glass polyester dough moulded in grey or blue, the price includes a chromium plated handle, an aluminium chassis, a protectively coated aluminium front panel and four fitted feet.

Two printed circuit boards can be fitted in the slots provided internally, making the case ideal for the increasing number of applications requiring miniature cases, in step with the firm's well known policy this tough smart little case is available by return of post. West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Northwood, Middx.

## Portable rechargeable soldering iron

Soldering with the new 8in. long portable, lightweight soldering iron—which is rechargeable and can be used far from a power source—launched by the Van Dusen Aircraft Supplies Company in the UK and Europe. The "Iso-Tip" soldering iron, weighing less than 6 ounces, has been designed to handle, with speed and efficiency, every industrial or domestic soldering requirement. Price of unit and stand is £8.75. Van Dusen Aircraft Supplies Co., Oxford Airport, Kidlington, Oxford.

Picture shows the iron in use.



## Pictures on the phone

EMI has entered the facsimile communications market with a document transceiver for sending clear, accurate copies of documents in minutes to anywhere in the world. Known as the EMifax HF146, this compact, desk-top system transmits and receives any type of document up to A4 size (220 x 305 mm), including invoices, lists, graphs, sketches and handwritten notes, over public or private telephone networks.

A unique cost-saving advantage of the EMifax machine is that normal office stationery is used for reproducing transmitted copies, eliminating the need for expensive coated papers which create both cost and supply problems. The document transceiver is priced at £900. Leasing and rental facilities are also available.



## A quick NIP

NIP Electronics, mentioned in our October News . . . pages have asked us to say that two of the readers who have written to them asking for information on NIP-E-BOARDS omitted to give their full addresses.

If they would please communicate with NIP again, giving their full addresses, they will be pleased to supply the items they require.

The readers are: Mr. A. M. Coppin, 128 Fernside Avenue and Mr. Christopher Jones of Coventry.

NIP Electronics, P.O. Box 11, St. Albans, Hertfordshire.

## Texan Reprints

Reprints of the "Texan" 20+20W Stereo Amplifier are now available.

They may be obtained by sending 35p (30p + 5p postage/packing) to *Practical Wireless Editorial, Fleetway House, Farringdon Street, London, EC4A 4AD*

## Paramo Handyvice

Latest addition to the Paramo range of tools is a new design of vice. The vice is manufactured from die cast high strength aluminium alloy, designed to give comparable strength to the standard cast iron product, but with considerable savings in weight.

The vice is available in three forms, a 3in. fixed base mechanics vice (HV1), a 3in. swivel base mechanics vice (HV2), a 3in. swivel base mechanics vice with table clamp (HV3).

The vice is finished in hammer blue enamel with chrome plated moving parts. It is supplied with hardened file cut steel jaws and a steel anvil for light metal forming. On the swivel base versions a simple single handed locking lever enables the vices to be swivelled through 360°.

Prices are: HV1, £2.45; HV2, £2.95; HV3 (illustrated), £3.45.—*F. Parramore & Sons (1924) Ltd., Caledonian Works, Chapeltown, Sheffield, Yorkshire.*



## Disc car aerial



A new car radio aerial is being introduced by Valan Electricals to complement their wide range of conventional aerials.

Named the Valan Disc Aerial, it combines the function of an aerial with that of the road tax licence holder or a club card holder, and is fitted on the windscreen.

It can be fitted in minutes by anyone. The fitting instructions are simple and are on the reverse of the pack. It works equally well in all makes of car and commercial vehicles.

The recommended retail price is £1.20. The Valan Disc Aerial is available from Halfords and leading garage and accessory shops. *Valan Electricals, 1034 Yardley Wood Road, Birmingham B14 4BW.*

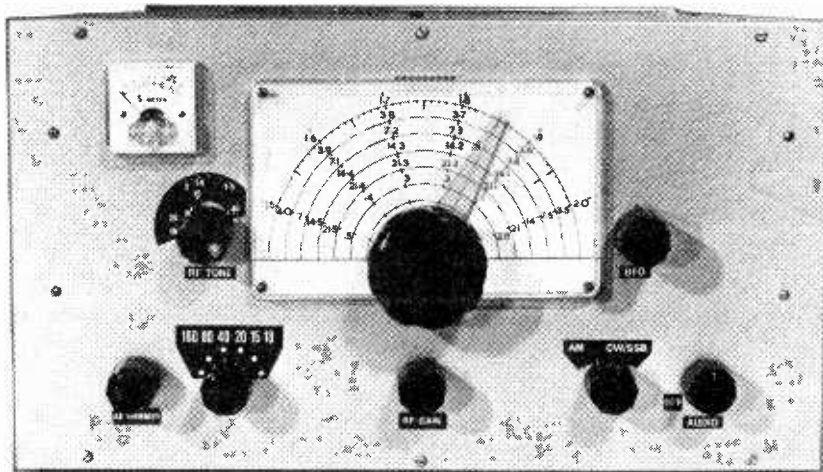
## QSL from the BBC

This month there will be an opportunity for listeners to the BBC World Service programme, World Radio Club, to possess one of the BBC's QSL cards verifying reception of the Club's 50th Anniversary Edition.

There are 12,000 members of the Club, spread all over the world. The programme is broadcast on Thursdays at 1330, Fridays at 2345, and Sundays at 0815 GMT in the World Service. Any member who reports accurately on reception of the Anniversary Edition on November 9th, 10th or 12th will be able to receive this QSL.

If you are not a member, write to World Radio Club, BBC, Bush House, London.

# AMATEUR BANDS RECEIVER



1.8-30MHz • AM-CW-SSB • BANDSWITCHED • EASY CALIBRATION

## PART 1

F. G. RAYER G30GR

**T**HIS receiver possesses high stability coupled with excellent sensitivity, selectivity and adequate bandwidth covering the Amateur bands from 10 to 160metres. On all bands, except 80m, the receiver employs double conversion with a crystal controlled first oscillator. It is easy to tune and to hold a.m., c.w. or s.s.b. signals on all bands.

Those who may not be familiar with the method of operation of this type of receiver should find the block diagram of Fig. 1 helpful in conjunction with the description that follows.

## CIRCUIT

Referring to Fig. 1 stage (1) is an r.f. amplifier followed by the first mixer (2) both working on all bands except 80m. Each Amateur band, except 80m, employs a crystal (3) chosen so that the output of the mixer (2) falls in the range 3.5 to 4MHz whatever the band in use. This tuning range 3.5 to 4MHz is covered by the tunable r.f./i.f. amplifier (4) and is followed by the second mixer and tunable oscillator (5) forming the tunable i.f. part of the receiver on all bands, except 80m. On 80m signals fall in the range 3.5 to 4MHz and are switched to stage (4).

The output frequency of the second mixer (5) is 455kHz which goes to the crystal filter (6) which is a bandpass filter with 2kHz crystal separation. When using a single filter for a.m., c.w. and s.s.b. this is about the highest degree of selectivity which can be tolerated without excessive cutting of the sidebands of a.m. signals.

Stages (7) and (8) are 455kHz i.f. amplifiers followed by the a.m. diode detector (9), its output going to the a.f. amplifier and output stages (10) and (11) and thence to the speaker. For c.w. and s.s.b. reception the beat frequency oscillator (12) and product detector (13) are switched into circuit. Both tunable oscillators (5) and (12) are fed from a voltage regulated source (14).

As the first i.f. is 3.5 to 4MHz the second channel interference, which can be troublesome on the h.f. bands with a lower i.f., is virtually eliminated. The

use of a crystal controlled oscillator also gives an enormous improvement in overall stability.

The tuning coverage of each band is a constant 500kHz with fixed 100kHz calibration points which completely eliminates any calibration problems on the h.f. bands. One disadvantage is that because the 10m band is so wide only a small portion of it can be covered but this can be overcome by providing two or more 500kHz sections with very little extra circuitry, as explained later.

## CONVERSION FREQUENCIES

As stated the tunable i.f. covers 3.5 to 4MHz and is calibrated at 100kHz intervals. The crystal frequency for the 160m band is 5.5MHz the difference or signal frequency selected by stages (1) and (2) thus extending from 1.5 to 2MHz (5.5-3.5 and 5.5-4). In this case the oscillator frequency is on the high side of the tunable i.f.

Band	Crystal	Calibration MHz							
		3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
80	None	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
160	5.5	2.0	1.9	1.8	1.7	1.6	1.5		
40	11	7.5	7.4	7.3	7.2	7.1	7.0		
20	10.5	14.0	14.1	14.2	14.3	14.4	14.5		
15	17.5	21.0	21.1	21.2	21.3	21.4	21.5		
10	24.5	28.0	28.1	28.2	28.3	28.4	28.5		

For 40m an 11MHz crystal is used giving coverage of 7 to 7.5MHz the crystal again being on the high side. Crystal frequencies for the remaining bands are shown in the accompanying table and it will be noted that they are all below the signal frequency. Calibration points are shown, the direction being reversed on 160 and 40m because these crystals are above the signal frequency.

Since stages (1) and (2) cover 28 to 30MHz three 500kHz segments can be obtained by simply selecting the appropriate crystal with a three way switch, crystals on 25 and 25.5MHz adding bands 28.5 to 29MHz and 29 to 29.5MHz.



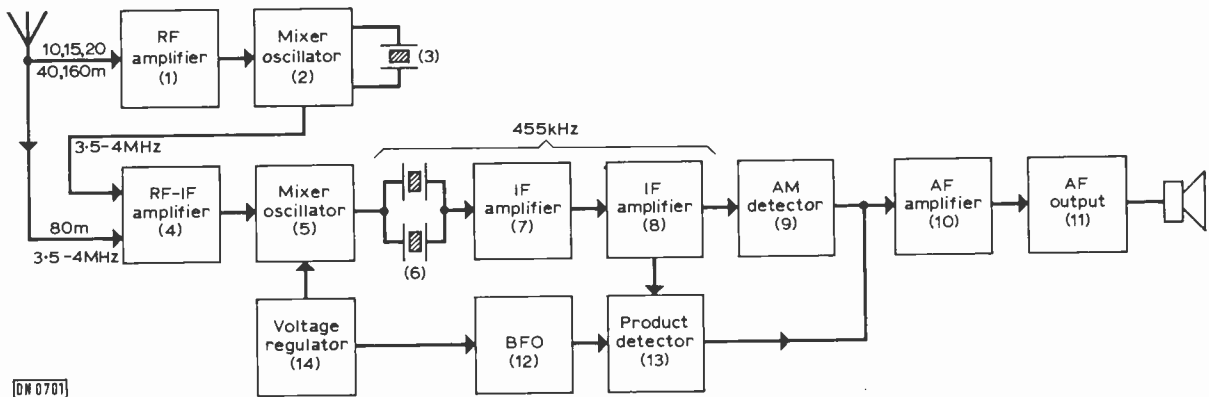


Fig. 1: Block diagram to illustrate the function of each stage in a double conversion communications receiver.

## PROGRESSIVE CONSTRUCTION

The constructional work involved is naturally not simple but it can be carried out and tested in sections. This method has much to recommend it as the location of a wiring fault or error is then much easier. The audio stages together with the power supply can be wired and tested with a pick-up or audio oscillator as a signal source. Stages (4) and (5) with one i.f. stage and the a.m. detector can be added thus forming a complete 80m receiver.

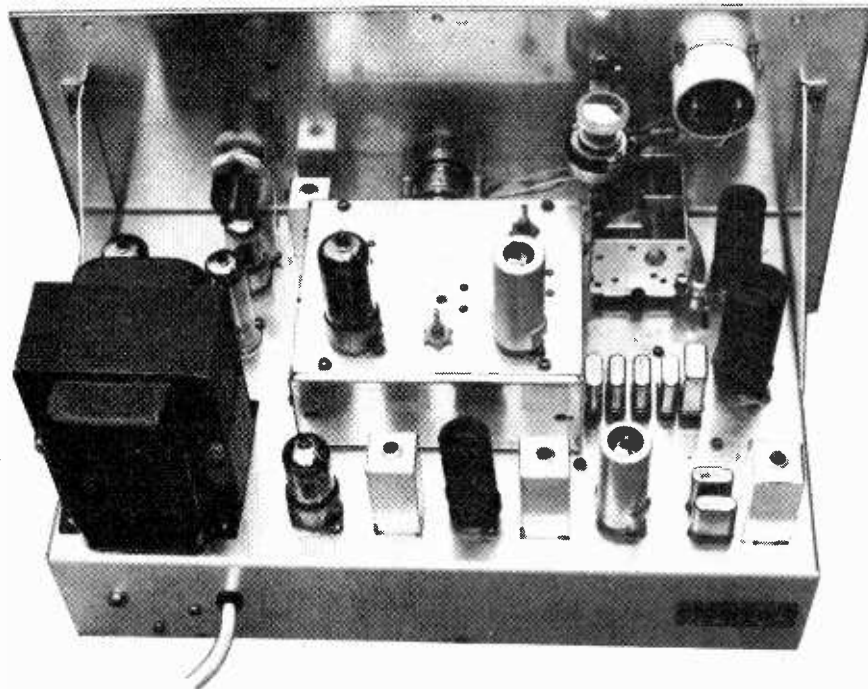
Next the additional i.f. stage and filter together with the b.f.o. and product detector will provide additional selectivity and c.w. and s.s.b. facilities. Stages (1) and (2) should then be wired for one additional band and checked after which the other bands can be added one by one. This general plan will be followed in the articles that follow.

## AF/POWER SUPPLY

In Fig. 2D showing this part of the circuit VR1 is the usual audio volume control, followed by a 2-stage amplifier, the output section of the ECL86 providing about 3 watts of audio. An output jack connected to the secondary of the speaker transformer T1 permits the use of phones or an external speaker automatically silencing the phones. This facility can be useful when operating the receiver with a transmitter.

The mains transformer T2 and rectifiers D1 and D2 supply 250V for the triode anode, pentode screen grid and earlier stages of the receiver. The OA2 voltage regulator provides a stabilised 150V supply for the tunable i.f. oscillator and beat frequency oscillator.

If T2 is not as listed, the h.t. voltage may be



Rear view of the completed receiver with the tunable IF amplifier in its own screened box on top of the chassis with the five crystals for the first mixer stage to the right. The two crystals at the bottom right are part of the fixed IF amplifier.

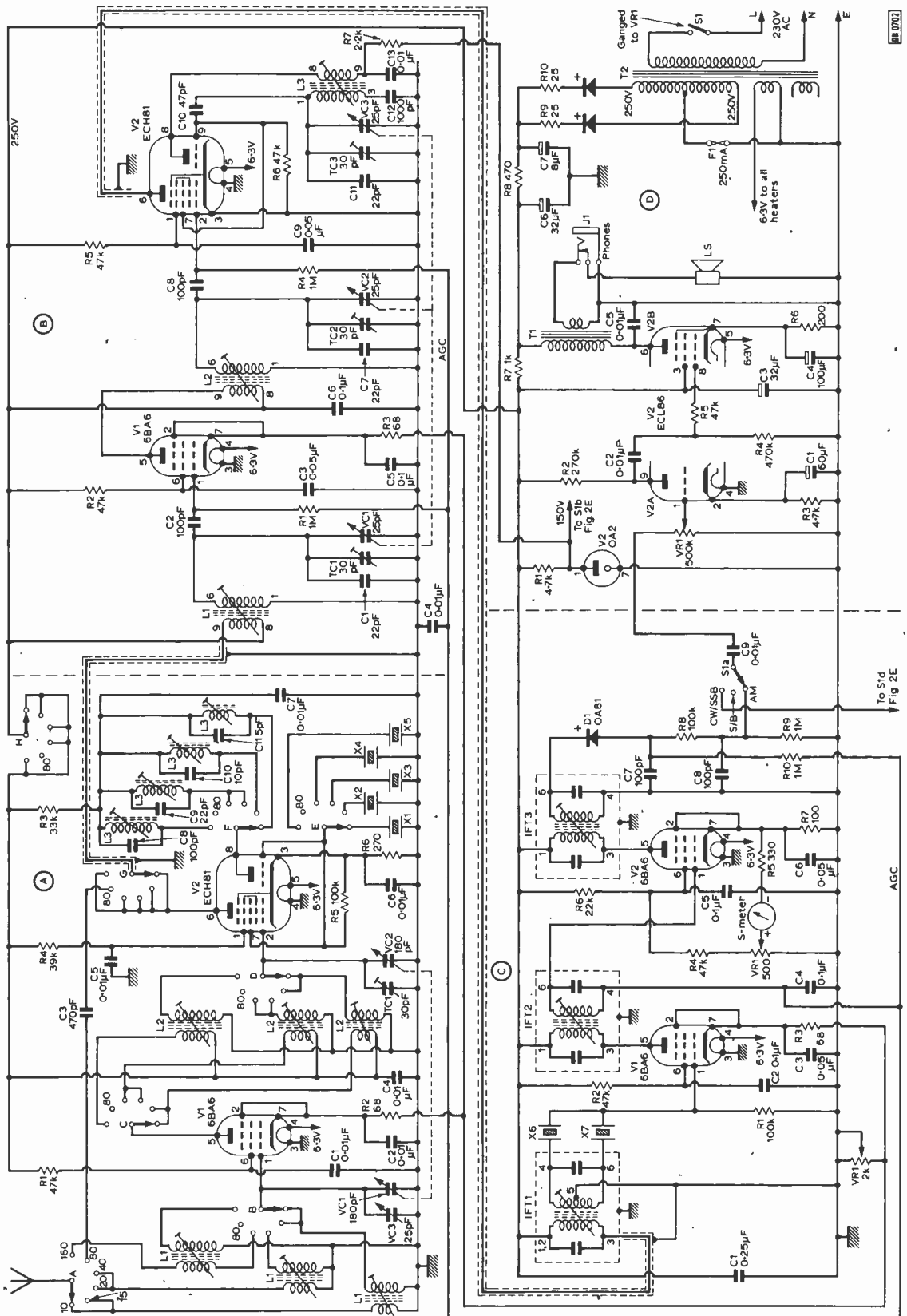


Fig. 2A-B-C-D. Complete circuit diagram of the receiver with the exception of the b.f.o. product detector shown on the next page, Fig. 2E.

different. This has little effect on most stages of the receiver, but if it is found that the OA2 is extinguished or nearly so, with the receiver on any band other than 80m and with no aerial connected and the r.f. gain control at maximum gain, then the h.t. is too low. It is then in order to reduce R7 or R8, or both, to obtain about 250V.

Leads to VR1 run against the chassis and need not be screened but R5 should be soldered directly to pin 8 of the ECL86. A 250mA fuse is placed in a holder on the inside of the chassis, and is in the h.t. circuit from T2 to earth.

The heaters require about 3A and are run from the 6.3V 4A winding of T2. If a transformer is fitted which has two 6.3V windings, rated at less than 3A, use one heater winding to supply some heaters and a separate circuit from the other heater winding to the remaining heaters.

The a.f. amplifier and power supply can be checked by connecting a pick-up, audio signal generator or other source of a.f. to the top of VR1. A 3Ω speaker is connected to or plugged into J1.

## IF STAGES

Fig. 2C is the circuit of this section of the receiver which operates at 455kHz. IFT1 is an intermediate frequency transformer with a centre-tapped secondary the centre tap being earthed. Balanced output in opposite phase, from pins 4 and 6, go to the two crystals X6 and X7, which have a frequency separation of about 2kHz. This pass-band can readily be modified, as described later. It is, however, a reasonable degree of fixed selectivity for all general amateur band purposes and avoids the need for an adjustable phasing capacitor.

Valves V1 and V2 are the two i.f. stages at 455kHz both receiving bias from the a.g.c. line (which also passes to some earlier stages). The manual gain control VR1 adjusts the cathode bias of the first i.f. stage.

Diode D1 provides bias for the a.g.c. line and also operates as the a.m. detector.

Switch S1a is one pole of a 3-way switch, and when in the "AM" position feeds audio via C9 to the volume control.

When S1a is in the "CW/SSB" position, audio signals are fed from the product detector, Fig. 2E. The central position of S1 is for "Standby" when h.t. is removed from several stages.

## S-METER

Incoming i.f. signals produce negative bias at diode D1, Fig. 2C, fed through R10 and the secondary of i.f.t.2 to V2 control grid. This moves negative with increased signal strength, the current through R7 and R6 falls, so that the screen of V2 becomes more positive, and the cathode more negative. With no signal, potentiometer VR2 allows the circuit to be balanced so that no voltage is present across the S-Meter. Incoming signals cause the meter reading to rise in proportion to the signal strength. R5 reduces the meter sensitivity to a suitable level.

If a steady signal is present, from a transmission or a signal generator, all i.f.t. or other adjustments can be directed towards obtaining the best meter reading. This also applies to any external adjustments, such as to an aerial tuner or to the aerial-earth system.

## CRYSTAL FILTER

With the i.f.t.'s aligned at 455kHz, crystal X6 was 454kHz and X7 was 456kHz but it is not necessary that X6 and X7 have exactly 2kHz separation. The specified i.f.t.'s are 465kHz types but they tune easily to 455kHz.

If one crystal only is used, and the other replaced by a 15pF variable phasing capacitor, a sharply resonant peak can be obtained together with a rejection notch which can be moved across the i.f. pass-band. A filter of this type was described in the December 1971 issue of *Practical Wireless* and is excellent for c.w. in particular.

The lead from the mixer pin 6, Fig. 2B, to pin 3 of i.f.t.1 is screened right up to the i.f.t., otherwise stray coupling round the filter will degrade results.

If an accurately calibrated signal generator is available, set it midway between the crystal frequencies and inject at pin 1 of V2, Fig. 2C, adjusting the

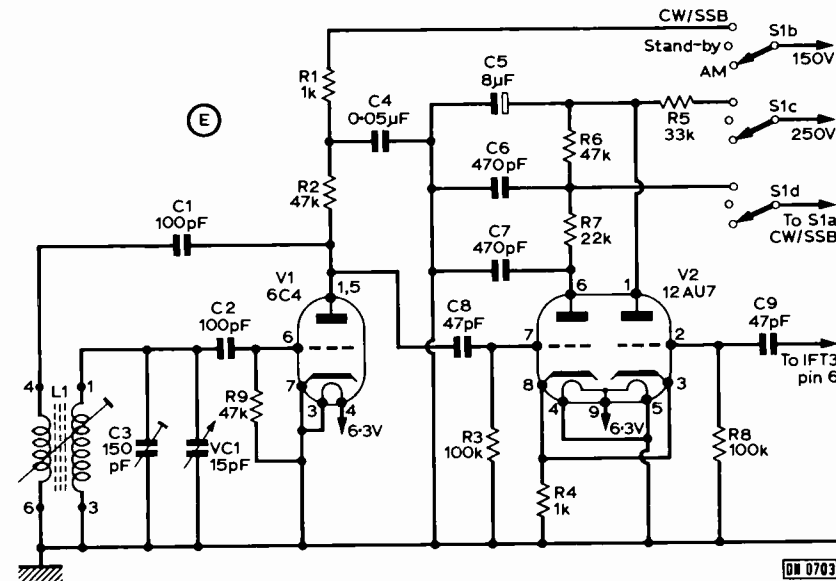


Fig. 2E: Circuit of the b.f.o. product detector, the addition of this unit to the receiver permitting the reception of c.w. and s.s.b. signals. The frequency of the b.f.o. is variable from the front panel to accommodate upper or lower sideband signals.

# ★ components list

## 1ST. RF, MIXER/OSCILLATOR (FIG. 2A)

### Resistors

R1 47kΩ 1W R3 33kΩ 1W R5 100kΩ ½W  
R2 68Ω ½W R4 39kΩ 1W R6 270Ω ½W

### Capacitors

C1 0.01μF Disc 350VW C7 0.01μF Disc 350VW  
C2 0.01μF Disc 350VW C8 100pF SM  
C3 470pF Mica C9 22pF SM  
C4 0.01μF Disc 350VW C10 10pF SM  
C5 0.01μF Disc 350VW C11 5pF SM  
C6 0.01μF Disc 350VW TC1 30pF trimmer  
VC1-2 2 x 180pF (Jackson L2)  
VC3 25pF midget variable (Jackson C804)

### Valves

V1 6BA6 V2 ECH81

### Miscellaneous

Valveholders B7G (1) skirted, B9A (1) skirted.  
Formers (7) see text. Crystals X1-5 Type HC6U (see text) with holders. Bandswitch sections A-H, comprising 4 wafers each 2 pole 6 way. Universal chassis flanged members, 6 x 2in. (1), 5 x 2in. (2) (Home Radio).

## TUNABLE IF AMPLIFIER (FIG. 2B)

### Resistors

R1 1MΩ ½W R4 1MΩ ½W R7 2.2kΩ 1W  
R2 47kΩ ½W R5 47kΩ 1W  
R3 68Ω ½W R6 47kΩ ½W

### Capacitors

C1 22pF SM C8 100pF SM  
C2 100pF SM C9 0.05μF 350VW  
C3 0.05μF 350VW C10 47pF SM  
C4 0.01μF 350VW C11 22pF SM  
C5 0.1μF 350VW C12 1000pF SM  
C6 0.1μF 350VW C13 0.01μF 350VW  
C7 22pF SM TC1-2-3 30pF trimmer  
VC1-2-3 3 x 25pF (Jackson 003)

### Valves

V1 6BA6 V2 ECH81

### Inductors

L1 Blue Range 3 L2 Yellow Range 3 L3 Red Range 3  
(All Denco, miniature, valve type)

### Miscellaneous

Universal chassis flanged members, 5 x 2in. (2), 4 x 2in. (2), flat plate 5 x 4in. (1) (Home Radio). Cabinet 15 x 9 x 8in. Type W, chassis 13 x 8 x 2½in. Type K, brackets 4 x 4in. Type C (2) (H. L. Smith). Dial and drive, Type DL6 and ball drive Type 4511 (Home Radio). If not available use combined Jackson dial and drive Type 4103/A.

## FIXED IF AMPLIFIER (FIG. 2C)

### Resistors

R1 100kΩ ½W R5 330Ω ½W R9 1MΩ ½W  
R2 47kΩ 1W R6 22kΩ 1W R10 1MΩ ½W  
R3 68Ω ½W R7 100kΩ ½W VR1 2kΩ linear WW  
R4 47kΩ 1W R8 100kΩ ½W VR2 500Ω WW pre-set

### Capacitors

C1 0.25μF 350VW C6 0.05μF  
C2 0.1μF 350 VV C7 100pF mica  
C3 0.05μF 350VW C8 100pF mica  
C4 0.1μF 350VW C9 0.01μF 350VW  
C5 0.1μF 350VW

### Valves

V1 6BA6 V2 6BA6

### Inductors

IFT1 IFT/11/465CT IFT2 IFT/11/465  
IFT3 IFT/11/465 (All Denco)

### Miscellaneous

Crystals X6/7 Type HC6U with holders (see text). Valveholders B7G (2) skirted. Diode D1, OA81. Switch S1a-d, 4 pole 3 way wafer switch. S meter, 1mA f.s.d.

## AUDIO AMPLIFIER/POWER SUPPLY (FIG. 2D)

### Resistors

R1 4.7kΩ 3W R4 470kΩ ½W R7 1kΩ 3W  
R2 270kΩ ½W R5 47kΩ ½W R8 470Ω 5W  
R3 4.7kΩ ½W R6 180Ω ½W R9 25Ω ½W  
R10 25Ω ½W  
VR1 500kΩ log. pot. with switch, S1

### Capacitors

C1 60μF 6VW C5 0.01μF 350VW  
C2 0.01μF 350VW C6 32μF 450VW  
C3 32μF 350VW C7 8μF 450VW  
C4 100μF 15VW

### Valves

V1 ECL86 V2 OA2 (150V)

### Miscellaneous

Valveholders B7G (1), B9A (1). D1-2 silicon rectifiers 800 p.i.v. 1A. Closed circuit jack. Fuse 250mA and holder. T1, output transformer Type TO46 (Home Radio). T2, mains transformer Parmeko P2931 or similar (Home Radio) see text.

## BFO/PRODUCT DETECTOR (FIG. 2E)

### Resistors

R1 1kΩ ½W R4 1kΩ ½W R7 22kΩ ½W  
R2 47kΩ ½W R5 33kΩ ½W R8 100kΩ ½W  
R3 100kΩ ½W R6 47kΩ ½W R9 47kΩ ½W

### Capacitors

C1 100pF SM C6 470pF mica  
C2 100pF SM C7 470pF mica  
C3 150pF SM C8 47pF SM  
C4 0.05μF 350VW C9 47pF SM  
C5 8μF 350VW VC1 15pF variable

### Valves

V1 6C4 V2 12AU7

### Miscellaneous

L1, b.f.o. coil (Denco BFO2/465).  
Valveholders B7G (1), B9A (1).

cores of i.f.t.3 for best output. Repeat with i.f.t.2, with the signal applied at pin 1 of V1 The signal can then be taken to the second mixer grid and i.f.t.1 aligned.

Assuming no generator is available, tune in any strong, stable signal. It will probably be found that

there are two responses, one is relatively broad and arises from the i.f.t.'s while the other is sharper and may be much weaker if the i.f.t.'s are not tuned near to the crystal frequencies. Tune the signal in at the sharper response position which places it in the

*continued on page 738*

# Three new stereo kits from Heath

From Heath (Gloucester) Ltd has come an excitingly new line of high-performance stereo equipment - the Heathkit 1214 series. You get advanced specifications, fabulous sound reproduction and immaculate design concepts at reasonable prices.

What is more, you can build all the units yourself from our step-by-step construction manuals, get a great sense of achievement plus the satisfaction of having top-quality Hi-Fidelity equipment at money-saving prices.

Check over the facts and the figures:

First the **AR-1214 Tuner Amplifier**: 50 watts IHF power (15 watts RMS per channel) 2-integrated circuits in the IF giving selectivity better than 60 dB; 2-ceramic IF filters and one phase-locked multiplex demodulator integrated circuit add up to a 35 dB typical channel separation with less than 0.5% distortion; a pre-assembled FM tuner unit which provides better than 2  $\mu$ V sensitivity with

a 2 dB capture ratio; the phono pre-amplifier uses integrated circuitry and, of course, the world famous Heath 'Black Magic' panel lighting gives a suitably sophisticated finishing touch.

Kit K/AR-1214 AM/FM Stereo Tuner Amplifier £69.80. Carr.: 80p.

**The AJ-1214 Tuner** (separate) specifications follow that of the AR-1214. The most dramatic are: FM sensitivity, less than 2  $\mu$ V. FM selectivity, 60 dB. Stereo separation, 35 dB minimum. AM sensitivity, less than 100  $\mu$ V per metre. AM selectivity, greater than 40 dB.

Like the AR-1214 it features a single-knob flywheel for AM/FM, FM-stereo tuning, push-button mode control and an adjustable ferrite rod antenna for AM reception.

Kit K/AJ-1214 AM/FM Stereo Tuner £39.60. Carr.: 40p.

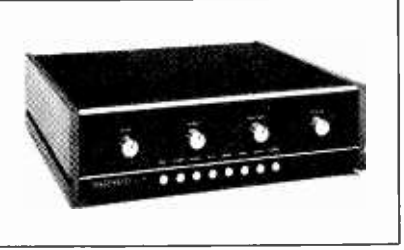
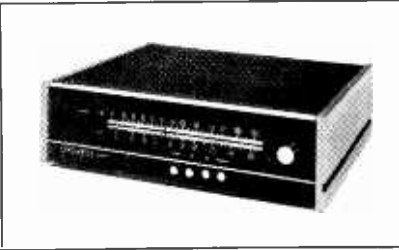
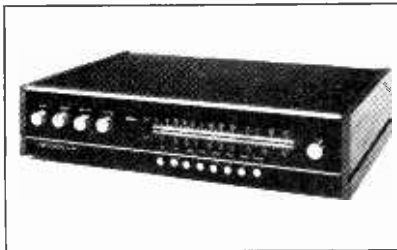
**The AA-1214 Stereo Amplifier** gives 25 watts per channel. All the

circuitry is on 2-printed circuit boards. A single wiring harness takes care of point-to-point connections. The 15 watts RMS power per channel into 8 ohms is more than enough power to drive most speaker systems. You'll find input jacks for phono, tape and tuner inputs along with a tape monitor socket. Should you also be thinking of 4-channel adaptation, the AA-1214 stereo amplifier is worthy of serious consideration.

Kit K/AA-1214 Stereo Amplifier £41.40. Carr.: 40p.

Incidentally, our customer advisory service is here to serve and/or advise you before, during and after your kit assembly. That's our firm guarantee for your successful enjoyment. You simply can't go wrong buying from Heath.

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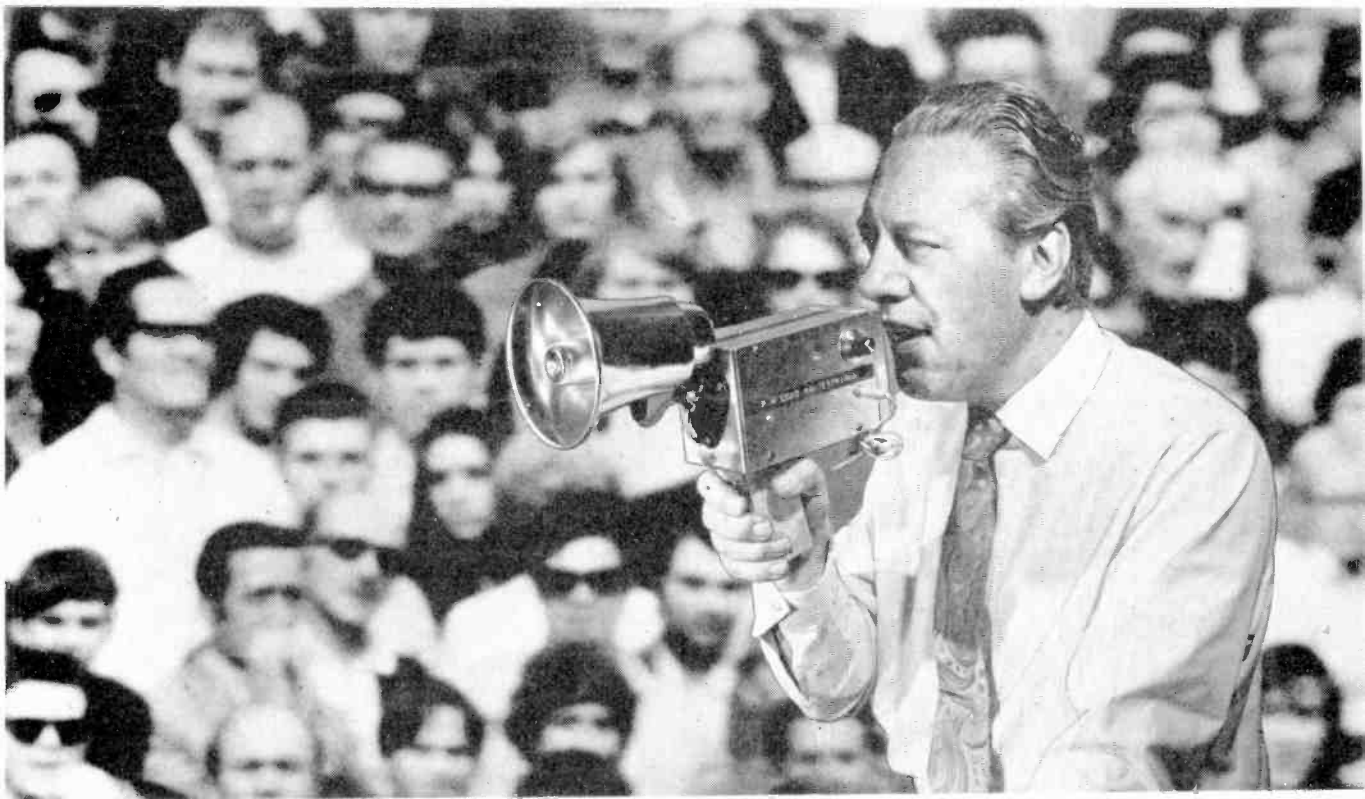
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The loudhailer with siren described in this article has an output power of 3 to 4 watts on speech and is battery operated by eight 1.5V cells (U11 or equivalent) providing a total of 12V. The siren sound can be produced at about the same power output and is pitched at around 250Hz to achieve maximum carrying range. The loudhailer can be hand held by its pistol grip type handle or can be self standing for use with a detachable microphone (see right). The main hailer on-off button is a rocker type switch mounted on the front of the pistol grip handle. This permits easy intermittent operation when the hailer is hand held but can be used in a continuous 'on' position when the hailer is used self-standing.

## The circuit

This is shown in Fig. 1 and consists of a microphone preamplifier Tr1, which drives the PC5+ power amplifier via S1 and the volume control VR1. The siren generator Tr2/Tr3 is simply a multivibrator



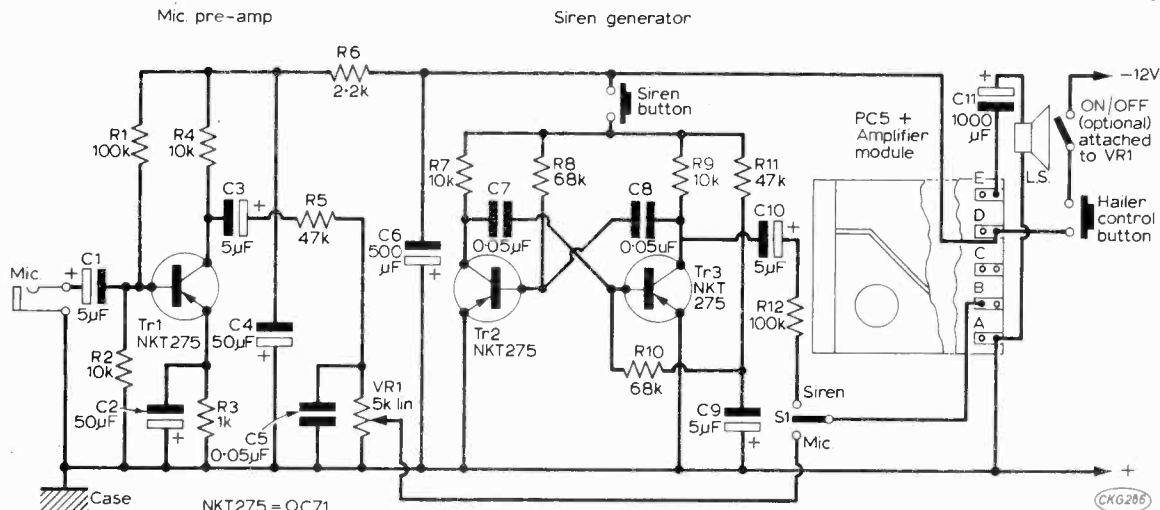
*The loudhailer need not be hand held and can be rested as shown with the speaker adjusted to face forwards.*

with a charge up circuit (C9/R11) that supplies a slowly increasing potential to the base of Tr3. This introduces a slight rise of pitch as the siren is switched on, resulting in a somewhat distinctive sound. The output of the siren is taken to the PC5+ power amplifier via S1.

The power amplifier provides some 3 to 4 watts of power output to an 8Ω speaker and is a printed circuit assembly made by Newmarket Transistors. It was chosen because of its small dimensions which,

in turn, permitted the use of a case for the hailer of only 6 x 4 x 3ins but yet still large enough to accommodate the microphone preamplifier, the siren generator, the battery cells and the power amplifier itself.

Note that the 12V supply has both an on-off switch and the rocker switch (hailer control button) in series to the negative supply rail to the amplifier. The on-off switch is optional but could be used merely as a safety precaution against the rocker switch being left



## ★ components list

### Resistors

R1 100kΩ	R7 10kΩ
R2 10kΩ	R8 68kΩ
R3 1kΩ	R9 10kΩ
R4 10kΩ	R10 68kΩ
R5 47kΩ	R11 47kΩ
R6 2·2kΩ	R12 100kΩ

All resistors ½W, 5 per cent tolerance  
VR1 5k log. pot with switch

### Capacitors

C1 5μF	C7 0·05μF
C2 50μF	C8 0·05μF
C3 5μF	C9 5μF
C4 50μF	C10 5μF
C5 0·05μF	C11 1000μF
C6 500μF	

All electrolytic capacitors should have a working voltage of at least 15V

### Transistors

Tr1, Tr2, Tr3 Newmarket type NKT275

### Miscellaneous

Power Amplifier	Newmarket type PC5+
Loudspeaker	Eagle type HDA5
Microphone	Eagle type CM10 (lapel)
Microphone Socket	Eagle type PJM3
Rocker Switch	Home Radio WS201/Bulgin SIB825
Mic/Siren Switch	Miniature slide type
Siren Switch	Small toggle type
Case	Home Radio Universal Chassis Parts: CU157(2); CU144 (2); CU146 (2)

### Sundries

Plain circuit board; Aluminium angle; 16 or 18 s.w.g. aluminium for pistol grip; Stand-off pillars.

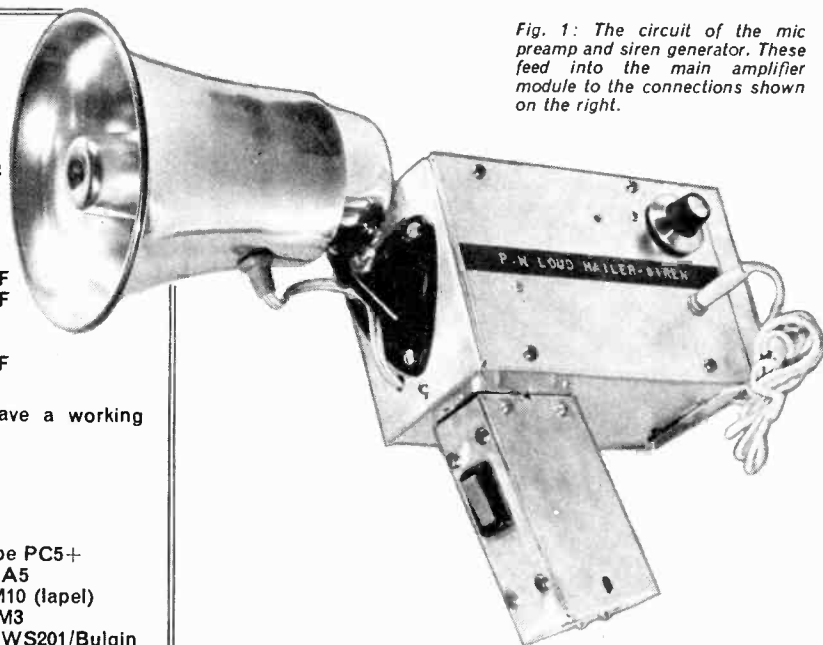


Fig. 1: The circuit of the mic preamp and siren generator. These feed into the main amplifier module to the connections shown on the right.

on. The siren button may be a small toggle switch on a press (self release) button type switch. (See components list regarding suitable rocker switch and self release button switch).

## Construction

The 6 x 4 x 3inch case was constructed from Home Radio Universal Chassis parts (see components list). The loudspeaker is an Eagle type PA speaker



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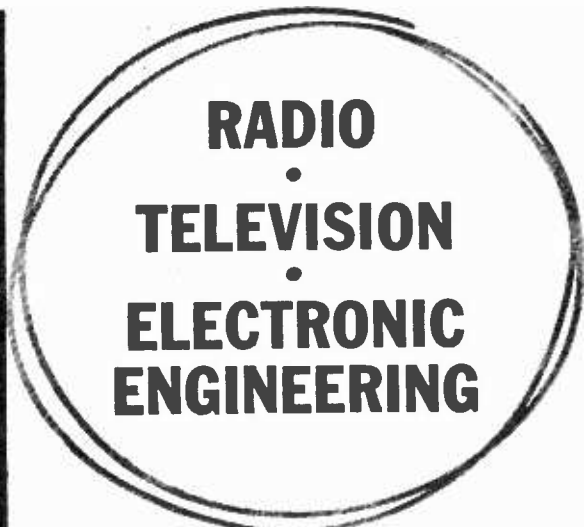
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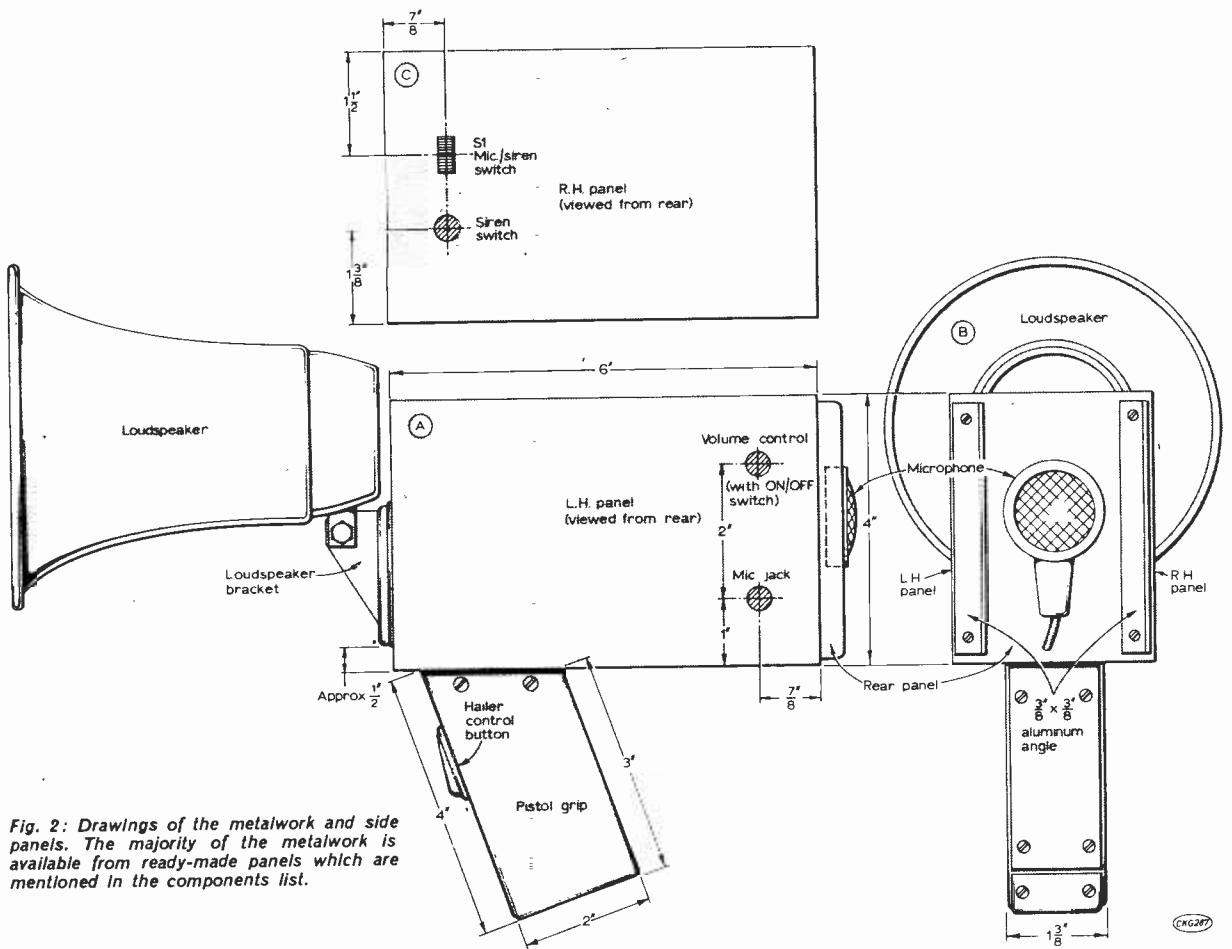


Fig. 2: Drawings of the metalwork and side panels. The majority of the metalwork is available from ready-made panels which are mentioned in the components list.

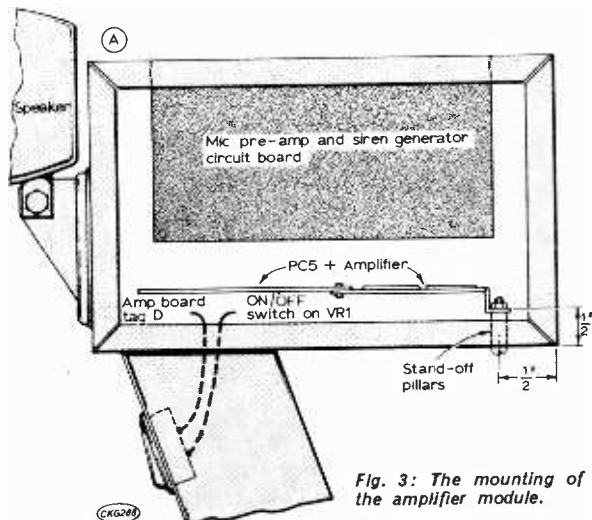
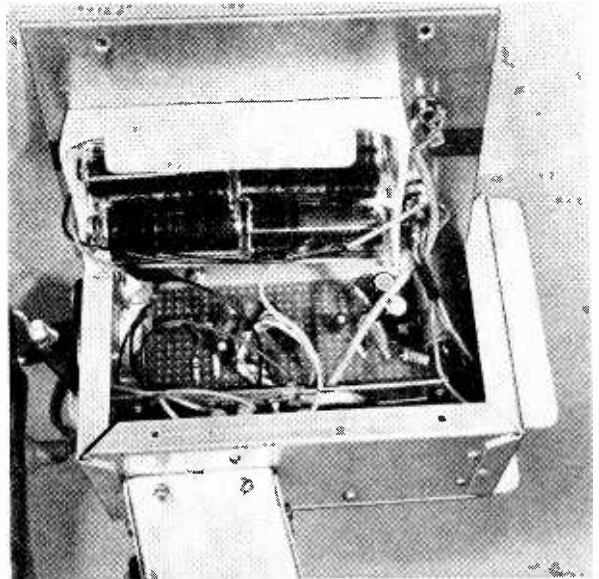


Fig. 3: The mounting of the amplifier module.



One of the side panels unscrewed. The components board can be seen clearly while at the extreme bottom is the main amplifier module. One of the battery holders can also be seen; there is another on the other side panel.

type HDA5 which is supplied complete with fixing bracket and is mounted on the front end of the case as in Fig. 2a. The rear end of the case is fitted with two aluminium angle pieces as in Fig. 2b which allow the unit to stand evenly when used self-standing. The pistol grip is hollow, being made from aluminium to the dimensions given in Fig. 2a and b and which, in turn, is secured centrally to the underside of the case. The hailer control rocker switch is mounted on the front of the pistol grip as in Fig. 2a.

The mic/siren switch S1 and the siren control button (or switch) is mounted on the right hand panel of the case (looking from the rear end) whilst the volume control (with integral on-off switch) and

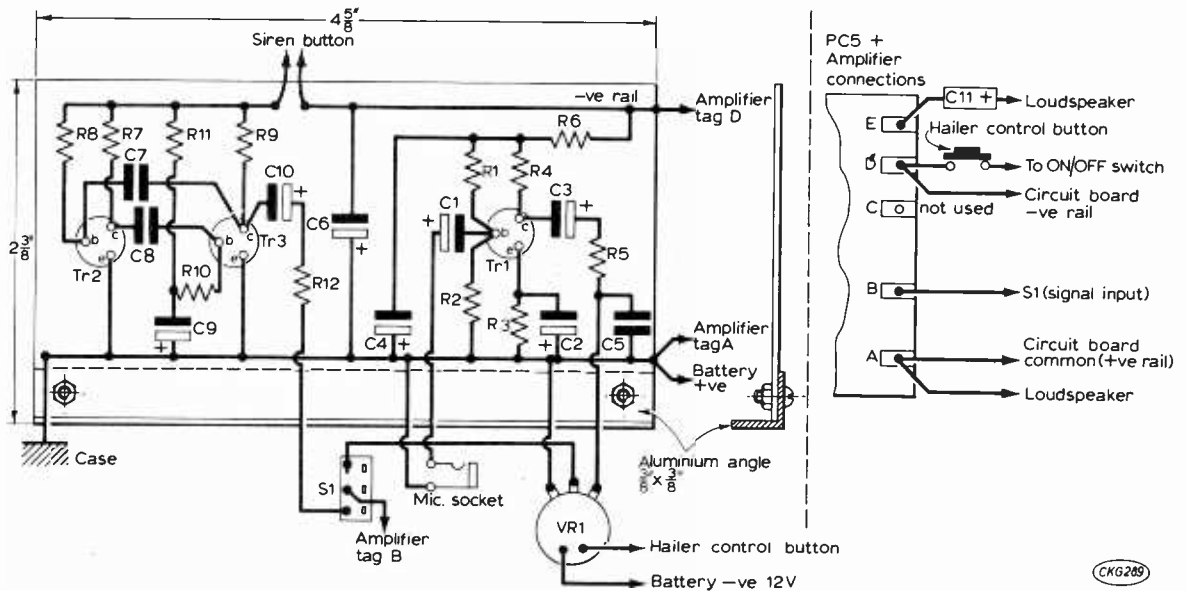
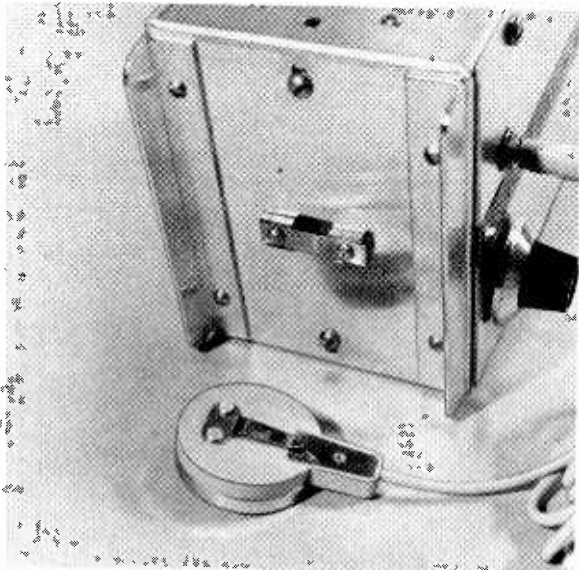


Fig. 4: The component layout and wiring. The connections to the module are shown on the right.



For operation as a loudhailer, the microphone is fitted to the small clip shown.

microphone socket, are mounted on the left hand panel (looking from rear end). The positions of these components are shown in Figs. 2a and 2c. The microphone used for the prototype was an Eagle label type CM10 which is fitted with a screened lead and miniature jack plug and also has a small clip on the back. It can therefore, be clipped onto the rear of the hailer as shown in Fig. 2b. The support for the microphone clip is simply a small brass strip about 1/4 in. wide bolted onto the rear panel but raised about 1/8 in. by spacers. Any small crystal microphone can be used with the loudhailer.

The loudspeaker leads are taken into the case and thence to the amplifier through a hole in the front panel. Before attaching the pistol grip, fit a pair of wires to the rocker switch long enough to go through into the case and thence to a) the on-off switch and b) to tag D on the PC5+ power amplifier.

The position of the microphone preamplifier and siren generator circuit board is shown in Fig. 3. It is mounted slightly off centre within the case to be clear of the battery boxes when they are in situ. The PC5+ amplifier is mounted as shown in Fig. 3 centrally and at the bottom of the case but is raised up on stand-off pillars by about 1/2 in.

The battery boxes (Eagle type BH411) are mounted one on each side panel (see photograph) and in the positions shown so as to be clear of both the circuit board and power amplifier when the panels are fitted. Changing batteries means only removing each side panel.

Layout and wiring of the circuit board containing the microphone preamplifier and the siren generator is shown in Fig. 4. The plain 0.15 in. matrix circuit board is mounted on a piece of aluminium angle which, in turn, is secured to the upper panel of the case. Connections to the mic/siren switch S1, the mic socket, the volume control (VR1) and to the power amplifier etc., are all shown in Fig. 4.

## Checking out

Current consumption should be about 10 to 12mA with no signals and can be checked with a meter in series with the 12V negative lead from the battery. With the hailer switched to 'mic', adjust the volume control so that no feedback occurs i.e., no howling due to sound from the speaker coming back to the microphone. The supply current should rise to about 100mA or a little over on speech peaks. With the switch S1 to 'siren', operate the siren button (or switch). The sound should rise slightly in pitch once it starts but if left on will stay at constant pitch. Intermittent use of the siren button should produce a sound with a slight 'whoop' pitched at about 250Hz (around middle C). The current consumption of the hailer will rise to around 100mA when the siren is operated.

These tests should be made with the side panels open to ensure that operation is satisfactory. Make sure that when the side panels are fitted (with the battery boxes now inside) that no short circuits occur which is quite possible as there is little space between the circuit board and battery containers etc.

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# Transistors in Transmitter PA STAGES

R. DOWLING C.Eng MIEE G3NKH

THERE has been no shortage, in recent years, of designs for transistorised transmitters. In the majority of cases, however, the transmitters have been running at inputs of maybe a fraction of a watt. In some cases, modulation appears to have been something of an afterthought. Often, emitter or base modulation has been used in a desperate attempt to obtain the magical 100% modulation—the reason being, one suspects, that the more familiar high-level modulation has not been found to give the desired results.

The purpose of this article is to try to clear away some of the misconceptions surrounding the transistor power amplifier stage, and to outline the way in which amplitude modulation may most effectively be achieved.

## THE BASIC CIRCUIT

Fig. 1 shows the basic circuit arrangement for valve and transistor p.a. stages. Superficially, the circuits look very similar, but there are some important differences. First, one must remember that, unlike valves, transistors are current-operated devices. This means that there is no point at all in feeding a huge signal into the base of a p.a. transistor in an attempt to run it at high power. All that one is likely to achieve is the destruction of the transistor as the result of excessive reverse base-emitter potential.

What the base really requires is current, and this can only be achieved if the driver stage can supply adequate power at the correct impedance to match into the p.a. This brings us to the second important difference between valve and transistor p.a.'s. Being current devices, the latter operate at much lower input and output impedances, typically under 20ohms. One must therefore pay careful attention to the problem of matching the transistor accurately to the load it is to feed.

## CLASS C OPERATION

In any Class C p.a. stage, we are basically trying to switch the stage into conduction for only a brief portion (typically 140°) of the signal cycle. The resulting burst of current causes the p.a. tank circuit to ring at a frequency determined by the LC of the tuned circuit, the oscillations being fed to the aerial via either a link coupling or some form of pi-network.

In a valve p.a. it is necessary to provide a negative bias on the grid in order to restrict conduction to the desired 140°, but the situation with transistors is (for once!) much simpler as a transistor will not conduct at all in the absence of an input signal. This immediately provides Class B operation, but there

is a further bonus in that owing to the existence of the base-emitter diode the input signal has to exceed a certain minimum value (approximately 0.6V for silicon transistors) before conduction begins at all. This is ideal, as it means that Class C operation can be achieved with transistors with no special bias arrangements whatsoever. All we need to do is feed a signal with a positive excursion something in excess of 0.6V between base and emitter of the p.a., from a driver stage capable of supplying adequate base current to give the desired mean collector current.

As a guide, a well-designed p.a. stage will provide a power gain of up to 17dB (approximately 15 times). Thus, a 10watt transmitter running at 70% efficiency will require a drive power of at least half a watt.

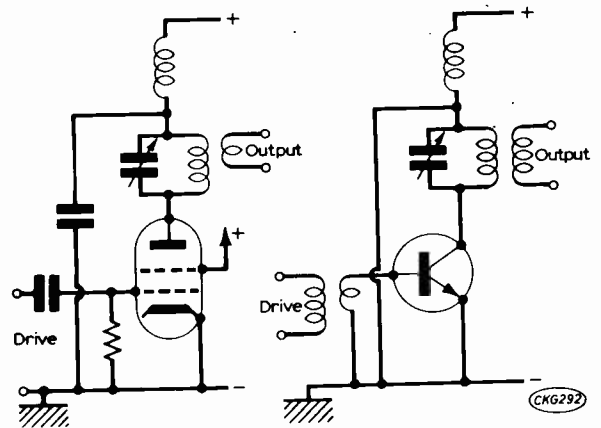


Fig. 1: Circuits illustrating the similarity in valve and transistor p.a. stages.

## MATCHING

With valve transmitters, it has become almost standard practice to use a pi-network to match the p.a. to a 75ohm aerial system. The same principles apply to transistor p.a.'s but owing to the lower impedances involved component values can become somewhat inconvenient at the lower frequencies. For this reason, a tapped p.a. tank coil is often used, as a worked example will illustrate.

Assuming a p.a. efficiency of 70%, the approximate p.a. output impedance can be calculated from:

$$R_{pa} = \frac{V_c}{2I_c} \text{ ohms}$$

where  $V_c$  is the collector voltage and  $I_c$  is the collector current.

Thus, a p.a. with a collector voltage of 20V and a d.c. input of 0.5A will present an output impedance of

$$\frac{20}{2 \times 0.5} = 20\text{ohms}$$

The problem is now one of matching the 20ohm p.a. to the 75ohm aerial system. As mentioned earlier, the most suitable technique consists of initially converting the low p.a. impedance to a more convenient value by means of a tapped p.a. coil, and then transforming down to aerial impedance by means of a link coupling. In this way, a reasonable working Q can be obtained with components of a more sensible value than would have been necessary for a pi-network.

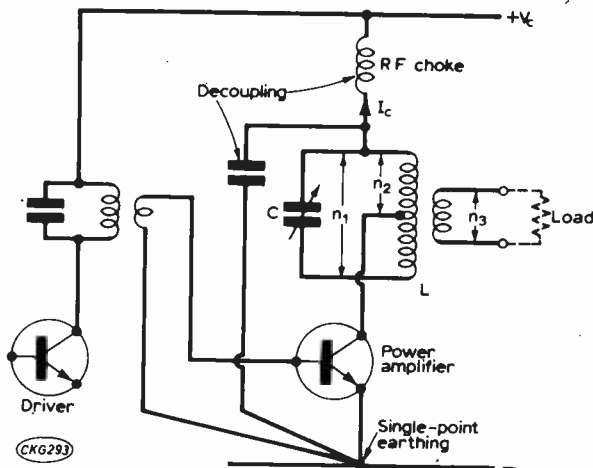


Fig. 2: Typical transistor p.a. stage and the matching problems involved.

The general arrangement is shown in Fig. 2. To establish a starting point in our calculations, we begin by assuming a convenient value for the tuning capacitor C. The value of L is then given in the normal way by:

$$L(\mu\text{H}) = \frac{25,000}{f^2 \times C}$$

where f is frequency (MHz) and C is tuning capacitance (pF).

We next decide on the required operating Q. As with valve p.a.'s, this is usually somewhere between 5 and 15 as a compromise between harmonic suppression and tuned circuit loss. Now, Q is given by:

$$Q = \frac{\pi \times f \times C \times R}{500,000}$$

where R is the effective shunt resistance across the tuned circuit. From this, we can obtain an expression for R:

$$R = \frac{500,000 \times Q}{\pi \times f \times C} \text{ohms}$$

Thus, in order to obtain the required operating conditions, the p.a. output resistance must be transformed to look like this shunt resistance R.

*Example:* Suppose our p.a. is to work at 2MHz and we choose C=500pF as a convenient value for the tuning capacitance. Hence,

$$L(\mu\text{H}) = \frac{25,000}{2^2 \times 500} = 12.5\mu\text{H}$$

If we now choose an operating Q of 10, the effective shunt resistance R will need to be:

$$\frac{500,000 \times Q}{\pi \times f \times C} = \frac{500,000 \times 10}{\pi \times 2 \times 500} = 1,590\text{ohms}$$

It is now necessary to determine the turns ratio for the tapped p.a. coil. This is given by:

$$\frac{n_1}{n_2} = \sqrt{\frac{R}{R_{pa}}}$$

Thus if in our example 30 turns were required to give the required inductance of 12.5μH, n<sub>2</sub> could be obtained from:

$$\frac{30}{n_2} = \sqrt{\frac{1590}{20}}$$

from which n<sub>2</sub> = Approx. 3<sup>1</sup>/<sub>2</sub> turns.

The number of turns required for the aerial link coupling can now be calculated in a similar manner from:

$$\frac{n_1}{n_3} = \sqrt{\frac{R}{R_{ae}}}$$

For a 75ohm aerial system, the above example would therefore require a value for n<sub>3</sub> given by:

$$\frac{30}{n_3} = \sqrt{\frac{1590}{75}}$$

from which n<sub>3</sub> = Approx. 6<sup>1</sup>/<sub>2</sub> turns.

It is vital that the p.a. stage be adequately decoupled. This can be accomplished by means of an r.f. choke and decoupling capacitor as shown. The impedance of the choke should be no more than ten to fifteen times the p.a. output impedance, to discourage low frequency parasitics.

## MODULATION

Undoubtedly the best way to modulate a transistor transmitter is by collector modulation of the p.a. and driver stages. The audio power required will be equal to half the p.a. input power; that is, 5watts for a 10watt p.a.

'Efficiency' modulation systems modulating emitter or base of the p.a. with only a few milliwatts of audio can give satisfactory results if carefully set up, but even at their best will never have the 'talk-power' of a high-level modulated system. This is a matter of fundamental fact, not of design.

## MODULATOR MATCHING

In order to effectively modulate any p.a., it is essential that it be correctly matched to the modulator. The calculations are very simple. A transistor p.a. with a collector voltage of V<sub>c</sub> volts and a collector current of I<sub>c</sub> amperes will present a

load to the modulator of  $\frac{V_c}{I_c}$  ohms. If we call this

load impedance R<sub>p</sub> it can be correctly matched to a modulator of output impedance R<sub>m</sub> by means of a modulation transformer with a turns ratio:

$$\frac{N_1}{N_2} = \sqrt{\frac{R_p}{R_m}}$$



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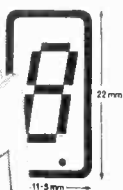
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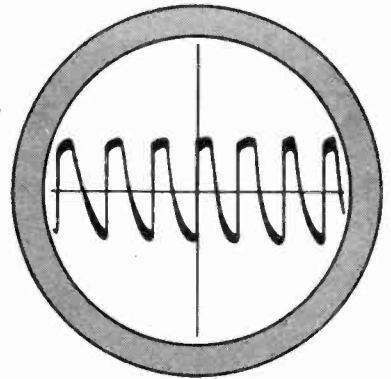
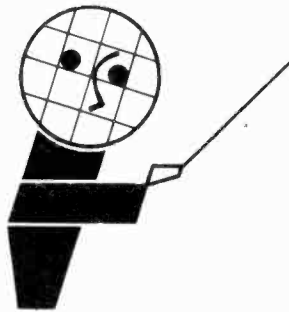
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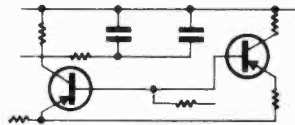
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**Example:**—Suppose we wish to modulate a p.a. having a collector voltage of 20volts and a collector current of 0.5 amperes by means of a modulator with an output impedance of 1000ohms. From the formula, the modulator load  $R_p$  will be

$$\frac{20}{0.5} = 40 \text{ ohms}$$

To match this to a modulator output impedance of 1000ohms, we shall require a modulation transformer with a turns ratio:

$$\frac{N_1}{N_2} = \sqrt{\frac{40}{1000}} = \frac{1}{5}$$

i.e. a step-up ratio of 1:5 between the p.a. and the modulator. The general arrangement is shown in Fig. 3.

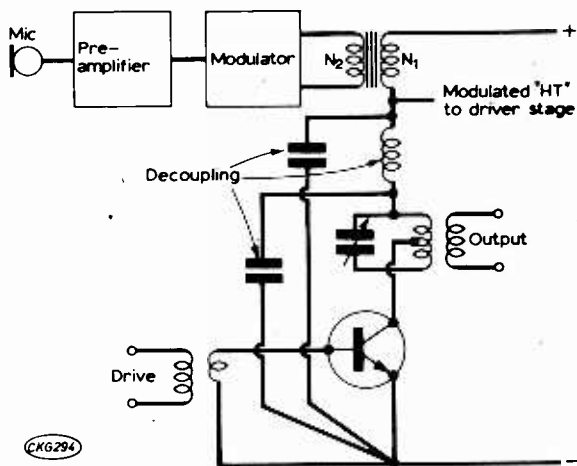


Fig. 3: Circuit showing how the use of formulae given in the text can ensure correct matching between the p.a. and the modulator.

It is not possible, because of internal feedback, to fully modulate a transistor transmitter by means of collector modulation of the p.a. alone. For this reason, it has become established practice for the driver stage also to be collector modulated to a depth best determined by practical tests.

## CHOICE OF TRANSISTORS

This article would not be complete without a brief survey of suitable p.a. transistors available for amateur use at a reasonable cost.

When selecting a type of transistor to meet a particular requirement, there are a number of important parameters to bear in mind.

The first of these is transition frequency  $f_T$ . This is the frequency at which the forward current gain in common emitter mode  $h_{FE}$  (also known as  $\beta$ ) has dropped to unity. But more important, it is also the gain-bandwidth product for the transistor: a transistor with an  $f_T$  of 200MHz will have a gain of 100 at 2MHz and 50 at 4MHz.

From this one might conclude that one should aim for as high an  $f_T$  as possible, but in practice this can result in excessive low-frequency gain and consequent instability. It is therefore best to select a transistor with an  $f_T$  no more than ten to fifteen times higher than the proposed operating frequency.

Another important transistor parameter is its total dissipation  $P_{tot}$ . A Class C p.a. stage is generally no more than 70 per cent efficient, the remaining 30 per cent of input power is wasted as heat which must be adequately dissipated by the transistor and its heat sink if the device is to remain within the temperature limits stipulated by the manufacturer.

Finally, it tends to be expensive to pay too little attention to the manufacturer's 'absolute maximum' voltage and current ratings (the writer speaks from rueful experience!). A p.a. fed from a 12volt supply will have a peak r.f. voltage on its collector of up to 24volts on c.w. and up to 48volts on a.m. A valve p.a. will withstand a fair degree of overload without complaining, but the risk is not worth taking with transistors. It is therefore good sense to choose a transistor with a collector-emitter voltage rating at least three times the proposed supply voltage for c.w. and at least six times the proposed supply voltage for a.m.

A list of readily available transistors suitable for amateur p.a. use is given in the accompanying table.

$P_{tot}$ (W)		$f_T$ (MHz)	$V_{CBM}$ (V)	$V_{CEM}$ (V)	$I_{CM}$ (A)
3	2N1893	50	120	80	0.5
	2N1613	60	75	30	0.5
	2N1711	70	75	30	0.5
4	2N4030	100	-60	-60	1.0
	2N4031	100	-80	-80	1.0
	2N4032	150	-60	-60	1.0
	2N4033	150	-80	-80	1.0
5	2N3053	100	60	40	0.7
	BSY81	100	40	18	1.0
	BSY83	100	80	35	1.0
	BSY85	110	120	64	1.0
	BSY84	120	80	35	1.0
	BSY82	120	40	18	1.0
	BSY86	130	120	64	1.0
2N3866	700	55	30	0.4	
11.5	BD106A	100	36	36	2.5
	BD106B	100	36	36	2.5
	BD106C	100	64	64	2.5
	BD106D	100	64	64	2.5
15	BD124	60	70	45	4.0
45	BD123	85	90	60	5.0
	BD121	95	60	35	5.0

## CONCLUSIONS

The writer concludes with a few recommendations which are the outcome of considerable experimentation and not a few traumatic experiences.

**DO**...bring up the voltage and drive to a transistor p.a. gradually to avoid any possible overloads.

**DO**...use single point earthing.

**DO**...keep leads short. There are high circulating currents in a transistor p.a. and stray inductance from over-long leads can ruin performance.

**DO NOT**...over-drive a transistor p.a. with voltage.

**DO NOT**...forget to decouple the stage properly.  
**DO NOT**...run the p.a. even slightly off-tune or without a proper load. ■

# TAKE 20

JULIAN ANDERSON

**A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.**

**T**HERE are several occasions when audio signals have to be mixed; public address systems frequently have several sources such as a microphone, tape recorder and record player and of course pop groups need an audio mixing facility to bring all the sources together before feeding the main amplifier. Some audio mixers are very complex and sophisticated in that they will handle signals varying from the tiny output from a tape head to more than half a volt produced by a crystal pickup and, as well as providing a mixing system, they equalise the inputs. It is more common however that the signals needing to be added together are of roughly the same level and to mix these is fairly simple as can be seen from the circuit in Fig. 1.

This circuit has facilities for three inputs, two medium level and one high level. One important feature of a mixer is that the level of each of the sources can be controlled individually and so a potentiometer is needed for each. If we simply connected the sliders of the pots together there would be considerable interaction between them. For instance, if one of the pots was set at minimum the slider would be at virtually chassis potential and thus the wanted signals would also be shorted. This interaction can be reduced to negligible proportions by inserting a resistor in series with each slider before taking them all to a common point; in our circuit these are represented by R2, R3 and R4.

The adding of the signals in this way does, however, cut down the level considerably, so much so that the combined signals need amplifying to recover the level and so Tr1 is necessary. In fact this not only recovers the gain but amplifies the signal by about 20 times.

The high level input is that marked in Fig. 1 as A and this will handle signals of more than 1V without causing distortion. The signal available across VR1 is only one seventh that of the input using the 68kΩ resistor shown but the value of R1 can be altered to suit the particular requirements. Inputs B and C do not have any initial attenuation and will handle signals up to about 150mV without trouble. For this input the output is nearly 3V which is more than sufficient and in most cases will be far too much; few amplifiers need more than 600mV. Working backwards, we shall then find that this amplifier stage will give 600mV out for inputs of 30mV. There is no minimum level at which it will work and signals of 1mV could be mixed, though of course the output would then be only about 20mV.

Three inputs have been shown but the final number is up to the constructor. Only two may be required, in which case one can be left out but several more can be added simply by duplicating Input A or or one of the others.

No separate power supply is shown as the mixer will usually be powered from the main amplifier

## No. 43 AUDIO MIXER

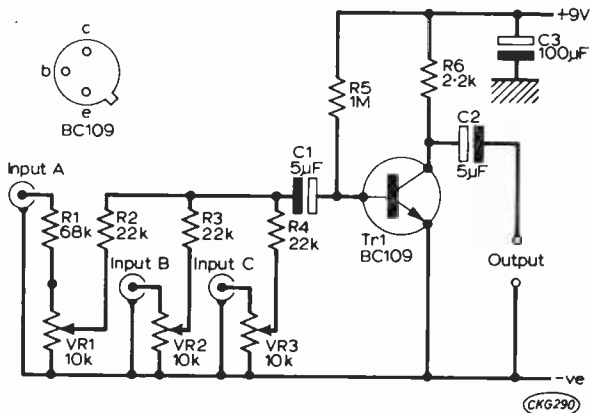


Fig. 1: Circuit of the audio mixer providing for three inputs.

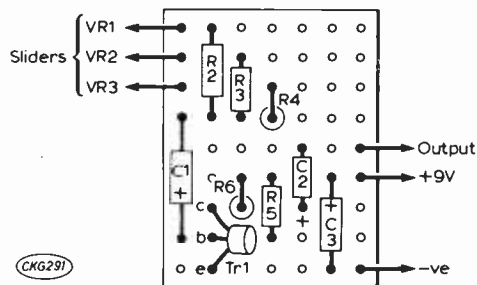


Fig. 2: A suggested component layout; no breaks in the conductor strips are necessary.

### ★ components list

Components list		
R1	68kΩ 5% 1/4W	1p
R2	22kΩ 5% 1/4W	1p
R3	22kΩ 5% 1/4W	1p
R4	22kΩ 5% 1/4W	1p
R5	1MΩ, 5% 1/4W	1p
R6	2.2kΩ 5% 1/4W	1p
VR1	10kΩ log. pot.	12p
VR2	10kΩ log. pot.	12p
VR3	10kΩ log. pot.	12p
C1	5μF, 12V min.	5p
C2	5μF, 12V min.	5p
C3	100μF, 12V min.	6p
Tr1	BC109	12p
		70p

Prices are those recently advertised and may have changed. No allowance is made for minimum order costs or for postage and packing and these points should be checked carefully before ordering.

but it will work from a 9V battery and, since the current drain is tiny, a PP3 type may be used.

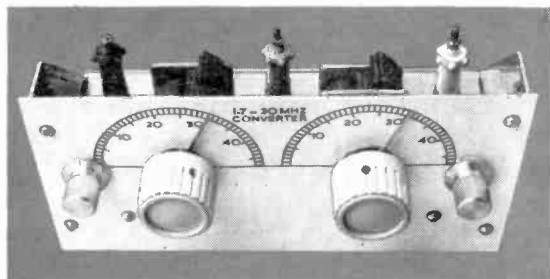
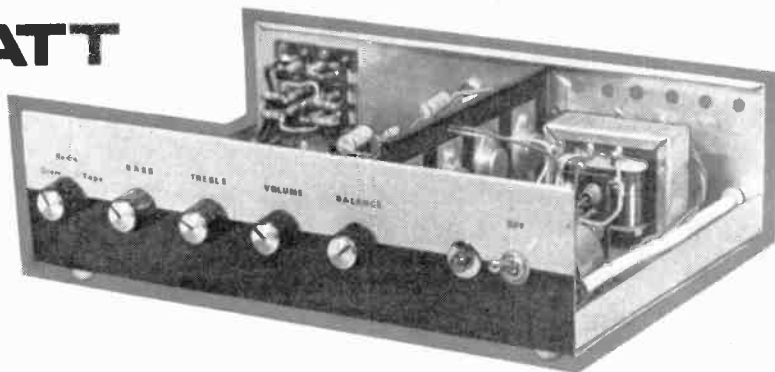
The components may be built in any convenient form but for those using Veroboard a layout diagram is shown in Fig. 2; no breaks are necessary in the conductor strips.

# IN NEXT MONTH'S

# PRACTICAL WIRELESS

## STEREO AMPLIFIER 10+10 WATT

Five years ago W. Cameron described his "Low Cost Hi-Fi" system in P.W.—and a rip-roaring success it was too! Now the same author describes the Mk II. The amplifier uses conventional wiring (for those who hate p.c. boards) and has an output very conservatively rated at 10W per channel. All the usual facilities are provided including inputs for magnetic and ceramic pickups, radio and tape, all with the correct equalisation, of course.

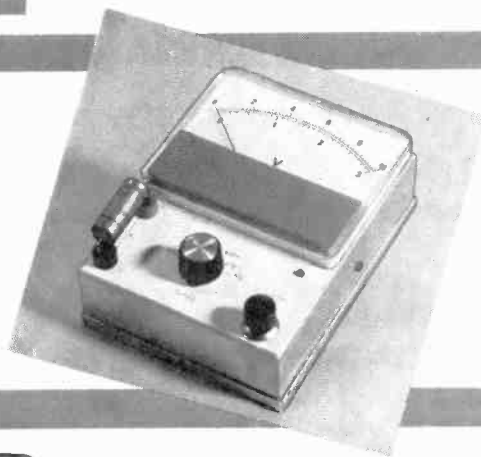


## Short Wave Converter

Do you sometimes wish that you could receive short wave stations on your domestic radio instead of being confined to the medium and long wavebands? This simple three transistor unit will convert that radio into an efficient receiver for the short wave bands, capable of world-wide reception. Full information is given for the construction and alignment of the converter.

## LINEAR CAPACITANCE METER

A highly accurate, easy-to-use unit giving a linear readout. At the low end 1pF corresponds to half a scale division, yet the circuit will measure up to 10 $\mu$ F. Convenient to use? Just connect a capacitor, select the right scale and press the button. Complex? A couple of i.c.'s and a handful of other components... even using a large scale meter the cost is only about £6.

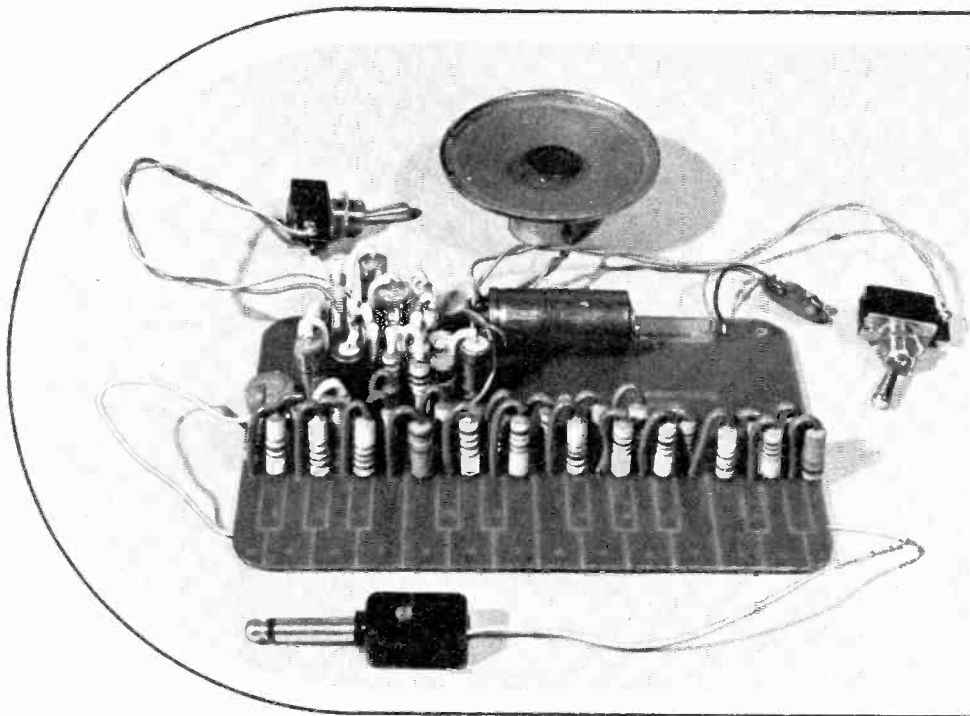


**LAST CHANCE**

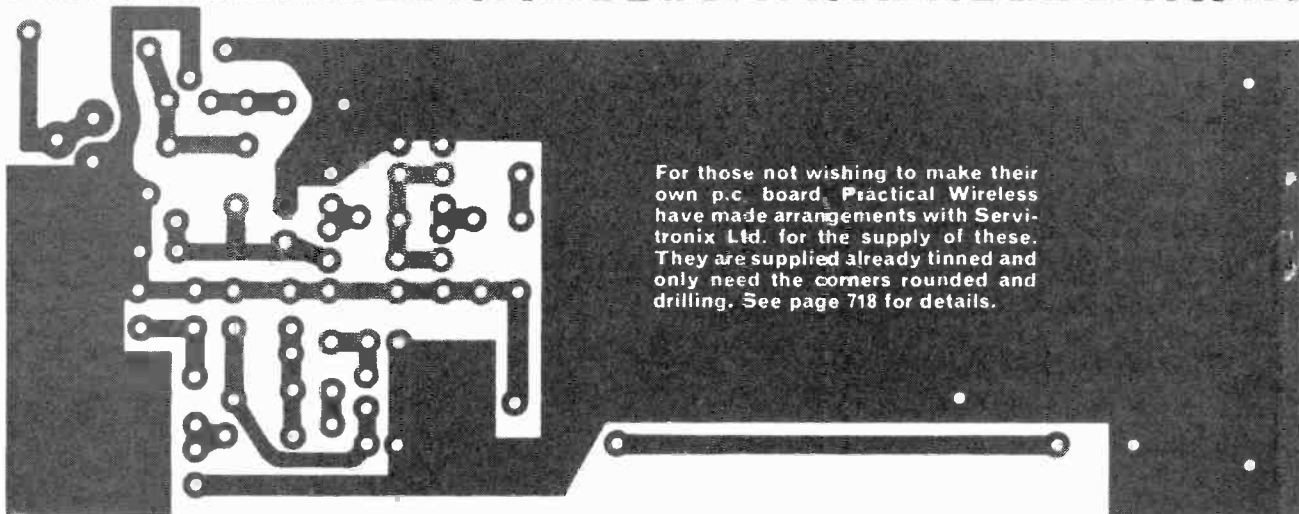
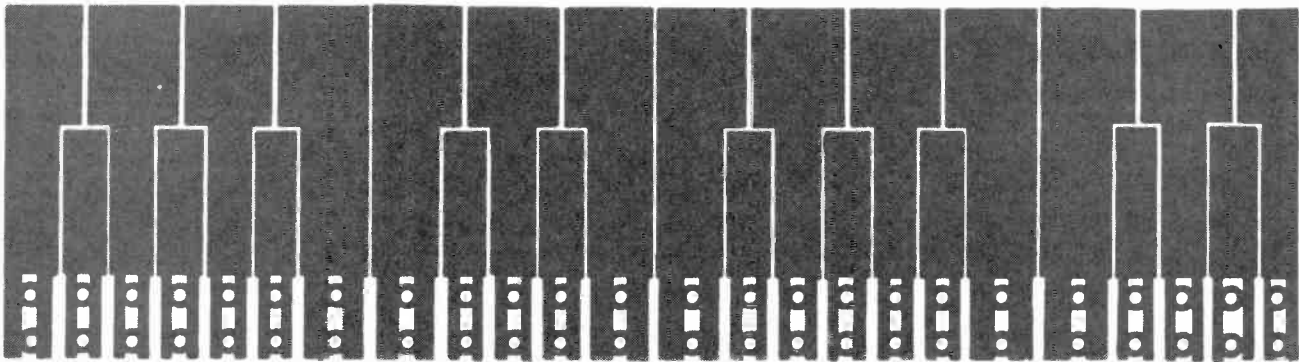
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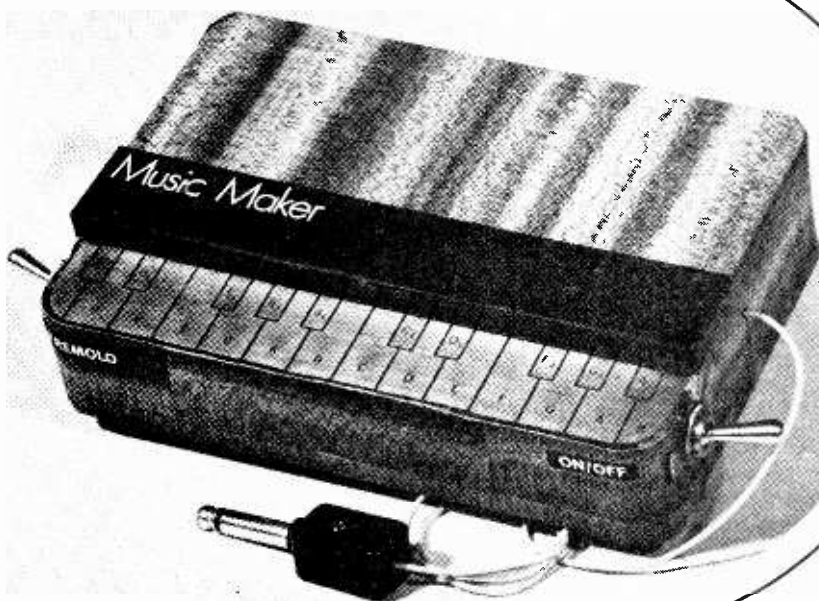
For those not wishing to make their own p.c. board, Practical Wireless have made arrangements with Servitronix Ltd. for the supply of these. They are supplied already tinned and only need the corners rounded and drilling. See page 718 for details.

*Full size pattern of the p.c. board layout. This drawing may be cut out for those wishing to make their own boards; as this page backs onto details of next month's features, your copy will not be spoilt.*

Maker

ronic

D. SMITH



**T**HE Music Maker electronic organ was originally conceived as a toy for the author's young daughter but, after the rigours of field trials of the kind that young children seem to be so well endowed to inflict, it was realised that the organ was more than just a toy.

It turned out to be a very robust and reliable musical instrument, very simple to construct and economic in both manufacture and battery consumption.

The complete instrument is housed in a plastic sandwich box, measuring 6<sup>7</sup>/<sub>8</sub>in. x 4<sup>5</sup>/<sub>8</sub>in. x 1<sup>5</sup>/<sub>8</sub>in. of the type offered for sale in most large chain stores for just a few pence. For those who are unable to obtain this, special arrangements have been made for the supply of this; see overleaf.

The organ is monophonic and played with a probe on a printed circuit keyboard laid out in conventional manner. The keyboard covers two full octaves, centred around middle C, including sharps and flats and gives sufficient notation to play almost any tune.

The notes, although not exactly the correct frequencies are close enough to pass the scrutiny of all but the trained musical ear. The accuracy of the notes was checked on a frequency meter and errors of no more than 10Hz were found in the worst case.

The organ may be built without the tremolo circuit, if even greater simplicity is desired, but it is a very worthwhile addition.

### circuit description

The circuit diagram is shown in Fig. 1. The notes are generated by a relaxation oscillator Tr1 which is a unijunction transistor. The frequency of the notes is determined by C1 and R7 to R30. Tr2 is a simple audio amplifier feeding the output pair Tr3 and Tr4.

### ★ components list

#### Resistors

R1	100Ω	R20	1.5kΩ
R2	15kΩ	R21	1.5kΩ
R3	1kΩ	R22	1.5kΩ
R4	1.5kΩ	R23	1.3kΩ
R5	10kΩ	R24	1.2kΩ
R6	10kΩ	R25	1.2kΩ
R7	3kΩ	R26	1.1kΩ
R8	3kΩ	R27	1.1kΩ
R9	2.7kΩ	R28	1kΩ
R10	2.7kΩ	R29	910Ω
R11	2.7kΩ	R30	10kΩ
R12	2.7kΩ	R31	8.2kΩ
R13	2kΩ	R32	6.8kΩ
R14	2kΩ	R33	4.7kΩ
R15	2kΩ	R34	1kΩ
R16	2kΩ	R35	82kΩ
R17	2kΩ	R36	10kΩ
R18	1.8kΩ	R37	4.7kΩ
R19	1.8kΩ		

All resistors  $\frac{1}{4}$  or  $\frac{1}{2}$ W, 5 per cent types.

See note below on the supply of component packs.

VR1 5kΩ lin. skeleton preset pot.

#### Capacitors

C1	0.05μF	C6	100μF 12V min.
C2	0.22μF	C7	250μF 12V min.
C3	5μF 12V min.	C8	2.5μF 12V min.
C4	25μF 12V min.	C9	2.5μF 12V min.
C5	100μF 12V min.	C10	2.5μF 12V min.

C8-C10 may be 2.2μF

#### Semiconductors

Tr1	2N2646 or UT46	Tr4	AC127
Tr2	OC71	Tr5	AC128
Tr3	AC128		

#### Miscellaneous

Case: Plastic lunch box, see overleaf; LS1 30-80Ω loudspeaker, miniature type, preferably 3in. but 2 $\frac{1}{2}$ in. or 2 $\frac{1}{4}$ in. will suffice. SW1, SW2: On-off toggle switches; Probe, see text; PP3 battery.

The output stage has not been designed for quality but cross-over distortion is not important. The prime consideration here is low battery consumption. The quiescent current is only a few milliamps, giving long battery life.

The circuit diagram for the tremolo oscillator is shown enclosed on the circuit diagram. It consists of a simple oscillator working on the principle that a 180° phase change occurs through the feedback capacitors C8 to C10, applying positive feedback from the collector to the base of Tr5, thus forming a low frequency oscillator.

The output of the tremolo circuit is mixed with the output of the note generator at the base of Tr2 when the switch SW2 is made.

The output power is quite sufficient to allow the organ to be heard in an average sized room and no volume control was considered necessary.

### circuit board construction

The printed circuit board is shown full-size on page 716. (For those not wishing to make their own boards, arrangements have been made for the supply of these.) Firstly, the board is cut to size and the corners shaped to fit the case. After checking that the board will fit the case easily, it is then etched and drilled. The components are then soldered in, starting from R1, C1 and Tr1 and progressively through each component shown on the circuit diagram as far as the loudspeaker.

Many small transistor speakers have a 6BA tapped hole in the permanent magnet keep at the back of the cone. The speaker may be fixed to the printed circuit board by a 6BA bolt, screwed into this hole. If the speaker does not have this hole, the magnet

### special facilities for practical wireless readers

Arrangements have been made for the supply of the following component packs:

Pack 1 Printed circuit board .. .. .	80p
Pack 2 Plastic box .. .. .	25p
Pack 3 Set of scale resistors (R7-R29) .. .. .	21p
Pack 4 Complete set of resistors (R1-R37) .. .. .	35p

Total cost of Packs 1, 2 and 4 .. .. . £1.35  
 Total cost of Packs 1, 2 and 3 .. .. . £1.20

All prices are inclusive of postage etc.

Available from: SERVITRONIX LTD., 26 Killarney Road, Wandsworth, London SW18 2DX (Mail order only).

Personal shoppers: 572 Kingston Road, Raynes Park, London, S.W.20

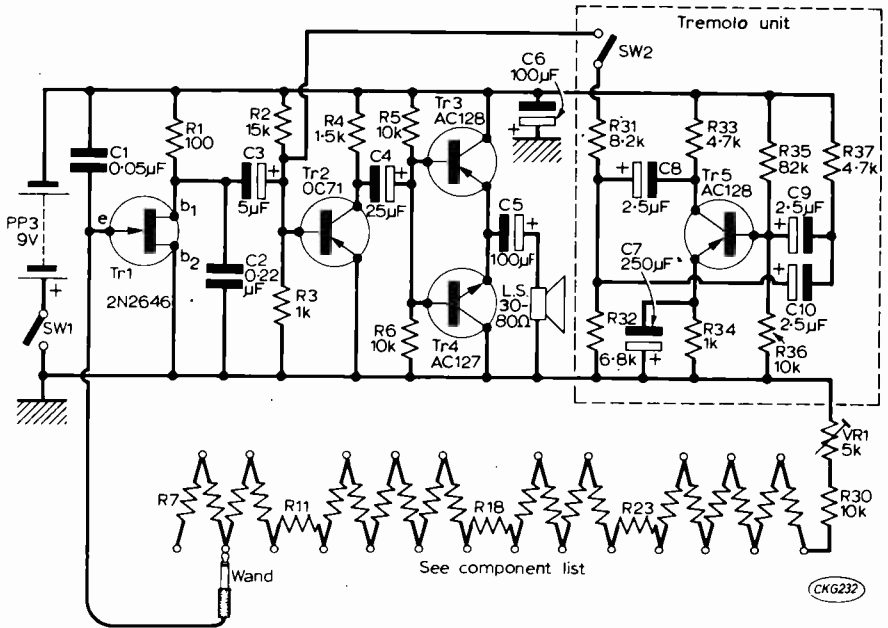


Fig. 1: The complete circuit of the Music Maker. The tremolo section, which is optional, is shown inside the dotted box. See the components list for the values of the note resistors.

can be glued to the board.

At this stage the circuit may be tested by injecting an audio frequency signal at C4 (to prove the output stage) and C3 (to prove the audio amp.). If everything is satisfactory, the audio signal will be heard clearly from the speaker.

The relaxation oscillator may be tested by temporarily connecting a 15kΩ resistor from the 'e' of Tr1 to the positive rail and a note should be heard from the speaker. The keyboard components R7 to R30 and VR1 may then be fitted and the scales tried.

It should be mentioned at this stage that the values of some of the resistors R7 to R29 are not normal 10 per cent preferred values, but are 5 per cent or better types and the closer one adheres to the values stated, the closer the notes will be to the desired frequency. Since some of these values fall in the less common E24 series, special arrangements have been made to supply a kit of the scale resistors.

It was found, on the prototype, that the keyboard

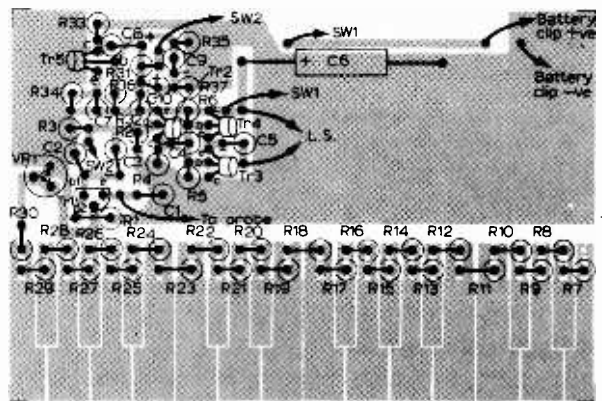
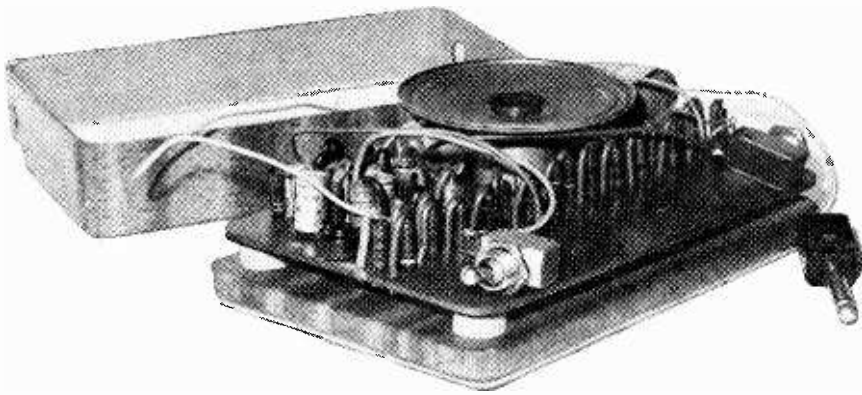


Fig. 2: The component layout on the p.c. board. This is viewed from the components side.





A view of the completed prototype.

must be polished with metal polish before playing because once the surface becomes tarnished the notes change, due to the increased resistance of the copper oxide coating. Several alternatives are possible, either the keyboard may be silver plated or, if the constructor is a soldering expert, the keyboard may be tinned. The ready-made p.c. board which is available is already tinned.

### case construction

Next the case is cut as shown in Fig. 3. The best method of cutting the case is with the tip of a hot soldering iron, keeping well within the actual line of cut to allow for the shrinking effect as the plastic melts. After cutting, the edges should be cleaned up with a sharp penknife and finally sandpapered to a clean edge.

It is recommended that the speaker hole be cut first so that the constructor may get some practice before attempting the more difficult keyboard slot.

The printed circuit board fixing bolts are put through the case next, and held by means of nuts inside. The speaker hole can be covered with cloth fret and the case may be covered with Vinyl or similar decorative covering. The printed circuit board is then placed inside and fitted on the mounting screws.

The switches SW1 and SW2 may then be fixed

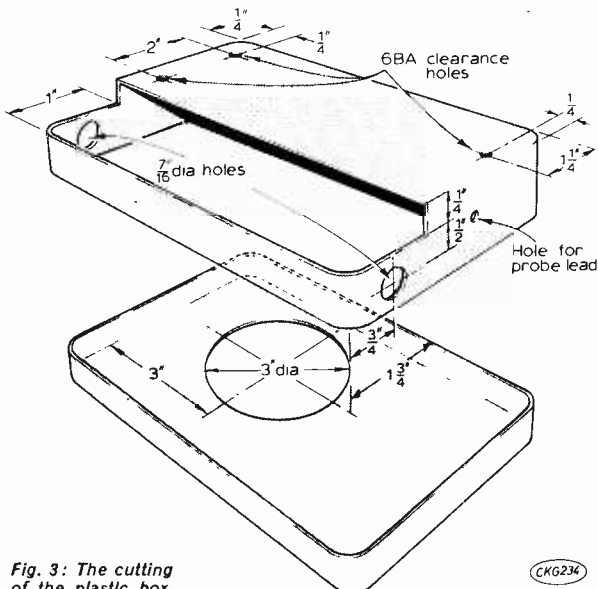
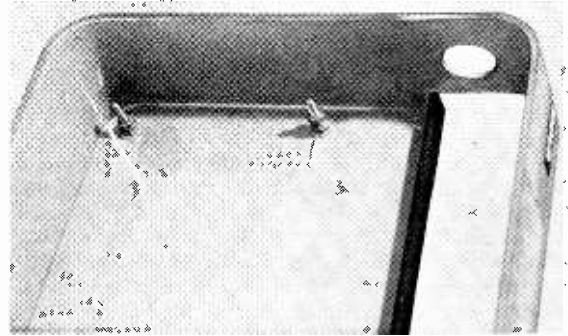


Fig. 3: The cutting of the plastic box.



Inside of the case showing the hole for one of the switches and the mounting screws for the p.c. board.



The case used for the prototype—the black escutcheon can be made from cardboard covered with black, self-adhesive plastic.

and the probe lead passed through the hole in the case and the probe connected. The author used a telephone jack plug for the probe, but it may be made from a variety of items.

Finally the battery is fitted and the probe is held on middle C. VR1 should then be adjusted until the note corresponds to the correct sound; the rest of the notes should then be correct. If R7 to R29 are replaced by skeleton presets, then all the notes will have to be tuned individually, starting with the highest one because the tuning of the higher notes will upset the ones below it.

# practically wireless

commentary by

# HENRY

No. 94

“Psychological  
Pservice”

**H**AVE you ever suffered from mice in your bottom drawer, moths in the cambric and half the local pigeon population perching on your aerial?

You have my sympathy. You can even have my telephone number if you require a quick consultancy service in getting rid of birdies on the f.m. band, rumbles on your autochanger or the depredations of the dreaded alum-worm in your electrolytics.

Some things never age. And Henry is convinced by recent experiences that the problems and vicissitudes of servicing will never change, whatever the ‘tomorrow men’ may predict about modules, and multi-chips, or ‘potent ethos determinants’. I do not need to invent these terms. The foregoing is a quote from Jonathan Benthall’s review of *Science and Technology in Art Today*, by Brian Porter.

I remember the intense castigation I received when, as a humble field engineer, I dared to contribute to print the criticism of the first ever ‘module-type’ television receiver. The several printed circuit boards, according to the maker, would be supplied as immediate replacement spares, and no on-the-spot servicing would be needed.

Henry predicted that engineers would soon circumvent the system

by their innate curiosity. They would find that certain components caused common faults and find it as easy to change these as nip back to the workshop for a new PC board. Which, in the event, is precisely as happened. In no time at all, the prevalence of common faults had caused a shortage of those printed circuit panels where the troubles most often took effect. And most of the problems we had with that particular set and its immediate successors were not with the printed circuit boards at all, but externals like volume controls.

Henry cannot share Mr. Benthall’s regard of computer technology as art, but begins to see what he means when he describes the relevance of error factors. So much art is accidental: so much science is an inspired leap of one step after a determined plod up five hundred. So many of the radio receivers we have seen come off the production lines—computer controlled?—bear the marks of artistic error. Servicing them calls for some of the inspiration of the artist.

The psychology of service comes into it when you have to tackle those strange innovations under the critical gaze of the owner. A discreet tap with the hammer is not to be recommended, and a fierce tug in unstrategic places can result in two separate halves with a mass of disconnected wires. Instead, one holds it wisely to one’s ear, give a twiddle to any visible knobs, shakes it gently, frowns and declares: ‘Rather tricky I’m afraid. This is a bench job.’

Depending on his previous experience and the snobbery of modern tech-owning, the reception by the owner of this advice will either be a glow of self-importance or the suspicion of price-rigging. Trouble is, these contretemps are inevitable. No service engineer can keep up with



A fierce tug in strategic places . . .

all the models, nor even all the advances in general trends of technology. And as for the horror of having to order spares—this is where the psychology of service really sorts the professional from the chap round the corner who dabbles in wireless—and who will probably, eventually, do a much better job.

Here, again, the computer has taken over. The philosophy of the pro is to replace C195 with part number XV5600071008 as recommended in the service manual. He is not concerned that C195 is a 1KpF ceramic, available from umpteen makers and a dozen surplus factors under a multitude of names. Superset Ltd., say item XYZ, so that is what he orders, and the receiver sits on the shelf while the part is airlifted from Japan.

But computers are almost human. In fact, take a quote from Benthall’s last few lines in the computer section of his book:

‘So far, the constraints of working with the computer so dominate anything done with it that they actually appear to oppose the advances of the artist. It is as if the computer were some creature of great sexual attractiveness whose actual anatomy remains elusive, frigid and unexplored.’ Henry felt that way when they invented tights. But that’s another story . . . !



Mice in your bottom drawer.

# FREE COMPETITION

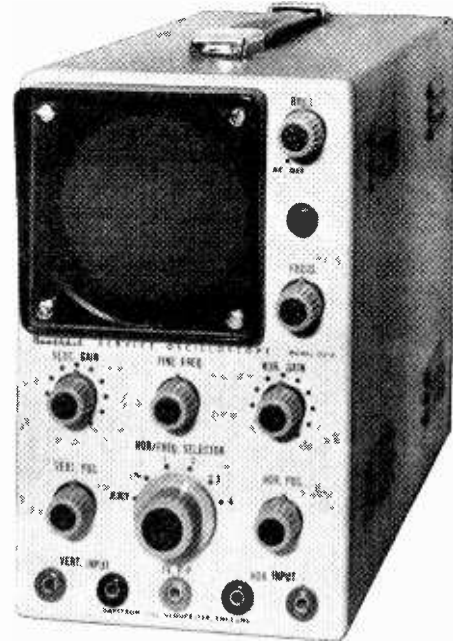
Organised by Practical Wireless and Heath (Gloucester) Ltd.

In this free competition you have two opportunities of winning a Heathkit 3in. portable oscilloscope kit! Our exciting competition will be repeated in the January issue of Practical Wireless, so save this month's coupon until next month's appears and post your two different attempts in the same envelope.

The Heathkit General Purpose Oscilloscope Kit K/OS-2 is a dependable, well-rated design, ideal for the hobby constructor. The small size and light weight make it ideal for the 'shack' while the wide range of facilities make it extremely versatile.

The low price of £29.50 for the kit plus 80p postage and packing (when ordered direct from the Gloucester factory) is an added attraction and of course, coming from Heathkit, the instructions for both assembly and operation are clear and precise, leaving nothing to chance. Even if you already own a 'scope, the OS-2 makes an excellent portable, back-up unit. Just consider the specification: Y Bandwidth from 2Hz to 3MHz; Time base 20Hz-200kHz Automatic sync; P.C. board construction; small size, 12in x 7½in x 5in; Switched ext/int Y plate connections; Sensitivity 250mV peak-to-peak per cm.

# 10 'Scopes to be Won!



## HOW TO ENTER:

Listed below are eight important features of the Heathkit OS-2 oscilloscope. All you have to do is place them in what you consider to be their order of importance to the average Practical Wireless reader. For example, if you think *Portability* is most important of all, write D in the box marked 1st on your entry coupon. The key letter of your second choice goes into the box marked 2nd, and so on for all eight. Complete the coupon, all in ink or ball-point pen, with your full name and address, then post in a sealed envelope to: PRACTICAL WIRELESS 'SCOPE COMPETITION, 16 GARRICK STREET, LONDON WC2E 9PR to arrive not later than Wednesday, February 14th, 1973, the closing date. **REMEMBER:** The competition will be repeated next month, so you can keep the first coupon until then, if you wish, and send both attempts together.

### RULES

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

Every accepted entry will be examined and the prizes, as described, will be awarded to the ten entrants who, in the opinion of an expert panel of judges, and in any one attempt, have shown the most skill and judgment in listing the eight features in order of importance.

In the event of a tie or ties for any of the prizes, a further eliminating test will be conducted by post between the tying competitors to determine such winners.

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

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

The competition is open to all readers in Great Britain, Northern Ireland, and the Channel Isles except employees (and their families) of IPC Magazines, the printers of Practical Wireless, and Heath (Gloucester) Ltd., all of whom are ineligible.

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



- A Good frequency response.
- B Simple controls.
- C Timebase in four ranges.
- D Portability.
- E Calibrating source.
- J Automatic lock-in synchronisation.
- K Switched Ext/Int Y plate connections.
- L Low price.

### FREE ENTRY COUPON

PRACTICAL WIRELESS  
'Scope Competition

1

1st	
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4th	
5th	
6th	
7th	
8th	

My order of importance for the eight points is given on the left. I agree to the rules as final and legally binding.

(Signed)  
Mr./Mrs./Miss .....

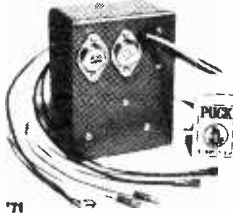
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EBF89	12p	30P4	12p	PL81	17p
ECC82	12p	PC97	17p	PY81	15p
EC180	7p	PCF86	17p	PY800	15p
EF80	12p	PC84	7p	PY82	7p
EF85	12p	PCF80	7p	PY33	22p
EF183	12p	PC89	12p	U191	17p
EF184	12p	PCL85	22p	6F23	17p
EY88	17p	PCL82	17p	30PL1	22p
30PL13	20p	PCL86	17p	30PL2	20p
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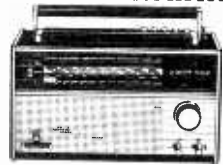
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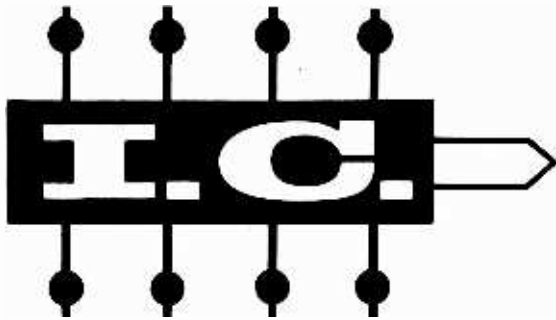
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# OF THE MONTH

L.A.J. IRELAND

Number 34

Westinghouse Hyreg AR1 Power Regulator

**I**N general, anyone whose interest in electronics begins with radio and communications is inclined to think primarily in those terms, maybe extended a little to cover audio and data processing. All else tends to be dismissed as electrical engineering. It is similar with integrated circuits. Application to radio, TV and computers is just about the limit. It comes as something of a surprise, then, to be dealing with an integrated circuit—even if it is a thick film hybrid—designed for power control at ratings of up to 2.5 kW., and operating off the mains. That, however, happens to be our topic for this month, the Hyreg type AR1 power regulator, manufactured by Westinghouse and available from Best Electronics (Slough) Ltd., of Michaelmas House, Salt Hill, Bath Road, Slough, Bucks.

## Applications

Applications may be domestic—to regulate an electric heater or keep a kettle just on the boil; to dim the lights for an evening at home or for the local hall when films are on, or a show is presented; to set the speed of an electric drill; anywhere, in fact, where it would be an advantage to control a high powered device with the same convenience as the volume of a radio. It will by now be clear that silicon controlled rectifiers are involved, or to be more precise, a triac, consisting of two s.c.r.'s with a common gate for triggering conduction, and capable of use on a.c. circuits.

It will be remembered by those who have followed this column for a long time that the application of triacs was discussed once before, when the very useful G.E.(USA.) range of triggering circuits was

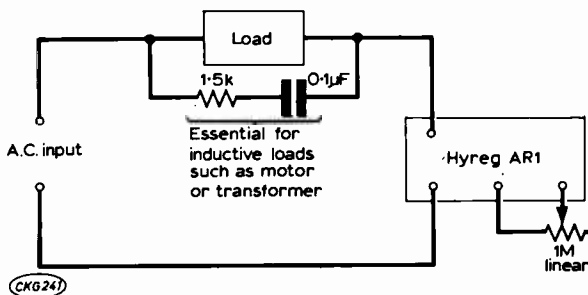
featured. In the present case, however, the triac itself, together with the triggering components, is incorporated in the hybrid assembly. All these items are then bonded to a ceramic substrate of high thermal conductivity and electrical resistivity. The assembly is potted in epoxy, with the ceramic in good thermal contact with a metal base plate.

In use, only three external components are required, and if the load is purely resistive, such as tungsten lighting or a kettle or bar-type electric heater, this can be reduced to one, a variable resistor, as shown. The unit is mounted on a heat sink with thermal contact established with the metal base plate of the regulator. Due to the properties of the ceramic, however, this plate and the attached heat sink are fully insulated and protected.

It is suggested, however, that the variable resistor should be of the type with a plastic operating spindle, or a solid plastic knob used, for safety in the case of component failure, or accidental reversal of the connections to the mains. The fraction of the power dissipated in the load compared with that drawn directly from the mains is linearly dependent on the setting of the variable resistor. For zero resistance, the power delivered to the load is 100% dropping to zero when the resistance rises to some 800k $\Omega$ . It is clear, therefore, that if the application is for lighting, for example, a 1M $\Omega$  linear variable resistance will control the illumination, from total darkness to full power.

One cautionary note must be sounded, however, about devices employing small a.c. motors. Most such motors, including those generally used to drive cooling fans, are of the induction or squirrel cage type. Such synchronous motors operate at a single speed or not at all. It follows therefore that it is impossible to regulate the speed of such motors with a triac device. Rather, at a particular point such a motor simply stops; and as the operating temperature of the motor, or of other components, if it is driving a fan, will then rapidly rise, damage may result. If it is intended to use this device in a system incorporating an electric motor, first check that the motor is of the type using brushes, i.e. non-synchronous. If used with a fan heater, for example, ensure that the fan receives the full mains voltage at all times, while the regulator controls only the power dissipated in the heating element.

The AR1/250-10 (250V r.m.s. 10A r.m.s.) costs £5.87 inc. p/p with present delivery of 6 to 8 weeks. ■



A potentiometer is all that is required for full power control.

**H**AVE you ever wanted to find out the value of an unmarked capacitor or wondered which was the primary and secondary of a transformer?

The value of a resistor can often be found easily by using a multimeter but how many of us possess one which can accurately measure  $1\Omega$  or, at the other extreme,  $2M\Omega$ ? Capacitors are less easy to measure and an a.c. source is usually required and, the world being the way it is, capacitors tend to have their values erased more easily than most components. Inductors present another problem;

# UNIVERSAL BRIDGE

HALVOR MOORSHEAD

granted that this facility is rarely required for most of us but when you *have* to know, what do you do?

The Wheatstone Bridge is the answer; it will rapidly give answers to all the above. In the circuit used here, the values of the components can be read directly off the scale.

## THE THEORY

Look at the circuit arrangement in Fig. 1. An audio note (at any reasonable level and frequency, it doesn't affect the operation) is applied across the network made up from VR1,  $C_a$  and  $C_b$  with headphones connected between the slider of VR1 and the common junction of the capacitors.

Assume that  $C_a$  and  $C_b$  are of the same value; they will then each have the same reactance at the audio frequency and therefore the signal level between E and F will be half that between E and D.

If the slider of VR1 is at its central position, then the resistance A-B will equal that between B-C and half the applied voltage will appear at the slider. Thus the signal level at B and F are the same: what will be heard in the phones? Nothing of course; since there is no voltage difference across them, no current can flow and so they remain silent. In this state, the Bridge, for that is what this network is called, is in balance and the null position has been achieved.

If the slider of VR1 is at any other position there will be a voltage difference and an audio note will be heard in the phones.

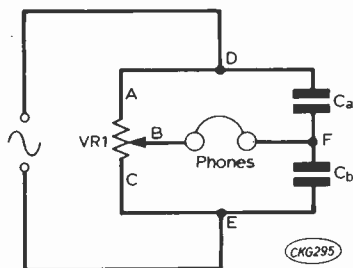


Fig. 1: The Wheatstone Bridge which forms the basis of this project. A full explanation of the theory is given in the text.



Now if  $C_b$  is one tenth the value of  $C_a$ , its reactance will be ten times greater and we shall only get a null when the resistance B-C is ten times greater than A-B. If we make  $C_a$  a standard, we shall obviously be able to find out the value of  $C_b$  as long as we know the relationship between the two parts of the track of VR1.

We have dealt with capacitors but the same applies to resistors and inductors with only one difference. The reactance of both of these is directly proportional to their values—in other words the higher their value, the more resistance they exhibit. With capacitors the reverse is true, the higher the value, the lower the reactance and so two scales are needed for the pot, one a mirror image of the other.

## THE CIRCUIT

To operate the bridge we require an audio source, a set of standards and also something to detect the null. Headphones are pretty good but they have to be quite sensitive to detect the setting of VR1 which corresponds to the maximum null and so an amplifier is used. In addition to feeding headphones, a cheap meter is also used which will give a visual rather than an audible indication.

The complete circuit is shown in Fig. 2. The audio frequency generator to drive the bridge is represented by Tr1 and the associated components. This is a phase-shift oscillator which provides a pretty good sine wave. R1 and R2 provide the base bias while C2, C3 and C4 together with R3 and R4 take part of the signal from the collector and invert it by  $180^\circ$ , converting it from a negative to a positive feedback and thus sustaining oscillation. As we have already mentioned, the actual frequency of operation is not important but the values given operate at about 700Hz. This frequency can be altered slightly by modifying the value of R4 but only by plus or minus 50 per cent ( $4.7k\Omega$  to  $15k\Omega$ ). A transformer is included in the collector of Tr1; this is a transistor output transformer type LT700 which is widely available. This has a tap on the primary but this is not required for our purposes. The metal case of the transformer should be connected to the negative line. The secondary of T1 drives the bridge and it will be seen that this part of the circuit is isolated

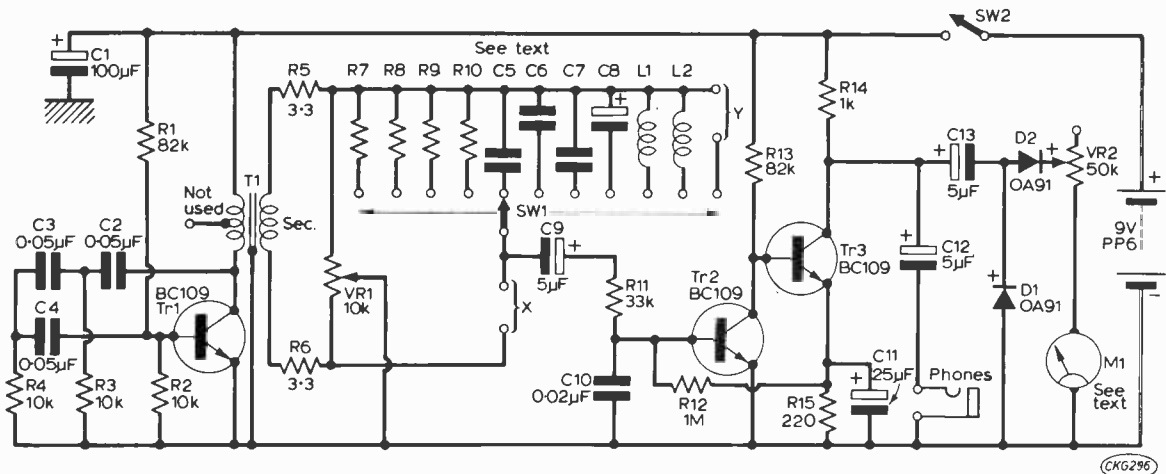


Fig. 2: Complete circuit of the Universal Bridge; the accuracy of the finished unit will depend on the tolerance of the standards and the care taken in calibration.

### TEST VOLTAGES

	Emitter	Base	Collector
Tr1	0V	0.5V	7.5V
Tr2	0V	0.25V	1.2V
Tr3	1V	1.2V	3.4V

Note: Measured on Avo 8 (20,000 ohms per volt) on 10V range, battery voltage on load reading 8.5V. The above voltages should only be regarded as a guide.

from the audio oscillator. Two low value resistors are shown wired in series with the secondary; these do not really affect the circuit but prevent a complete short-circuit of the secondary if very low value resistance components need to be compared. If the secondary is short-circuited, the oscillator may cease to function.

The bridge potentiometer is represented by VR1 which has its slider taken to the negative line. This pot should be a high quality component and should of course have a linear track. A wire-wound component is to be preferred although not essential (the prototype shown uses a standard carbon track pot).

The standard components in the bridge circuit are represented by R7-R10, C5-C8 and L1, L2; these are selected by SW1. SW1 is also able to select an external pair of terminals (marked Y) for matching purposes.

The component to be measured on the bridge is connected across the terminals marked X.

The audio signal, indicating an imbalance in the bridge, will appear between chassis and the junction of the standard and unknown component and a d.c. blocking capacitor C9 takes this output to the amplifier. R11 is included to minimise the loading that the amplifier presents to the bridge. C10 bypasses any high frequencies to chassis and is necessary to prevent r.f. pickup since the amplifier has a very high gain.

The amplifier stage is made up from Tr2 and Tr3 with their associated components and is a fairly conventional arrangement. The use of BC109 transistors ensures considerable amplification of the input. The bias for Tr2 base is provided from the emitter of Tr3; this helps to stabilise the circuit and also takes up any variation in the parameters of the

### ★ components list

#### Resistors

R1 82kΩ	R9 100kΩ
R2 10kΩ	R10 10MΩ
R3 10kΩ	R11 33kΩ
R4 10kΩ	R12 1MΩ
R5 3.3Ω	R13 82kΩ
R6 3.3Ω	R14 1kΩ
R7 10Ω	R15 220Ω
R8 1kΩ	

Resistors  $\frac{1}{2}$ W, 5 per cent except R7-R10, see text  
 VR1 10kΩ lin. pot. see text  
 VR2 50kΩ lin. pot. carbon track

#### Capacitors

C1 100µF 12V min.	C8 10µF 12V—see text
C2 0.05µF ceramic	C9 5µF 12V min.
C3 0.05µF ceramic	C10 0.02µF ceramic
C4 0.05µF ceramic	C11 25µF 12V min.
C5 10pF see text	C12 5µF 12V min.
C6 1000pF see text	C13 5µF 12V min.
C7 0.01µF see text	

#### Semiconductors

Tr1 BC109	D1 OA91
Tr2 BC109	D2 OA91
Tr3 BC109	

#### Miscellaneous

T1 Transistor output transformer, Eagle type LT700  
 SW1 1-pole, 12-way rotary switch  
 SW2 On-off, miniature toggle switch  
 M1 Recording level meter—see text  
 Jack socket; 4 off R.S. Components (Radiospares);  
 Slim Insulated Terminals, 4mm or similar; Vero-board, 0.15in. matrix, 12 x 16 holes; PP6 battery;  
 Battery clip; Case: 'Elf' type, available from West Hyde. Developments Ltd., Ryefield Crescent, Northwood, Middx., HA6 1NN. Price: £1.25 plus 10p postage. L1, CH4/A 10mH choke, L2 100µH choke, wire ends, available from Repanco Ltd., 203-265 Foleshill Road, Coventry, the price of each is 50p including postage.

transistors.

The amplified audio signal appears at the collector of Tr3 and is connected via C12 to the headphone socket. Any type of phones can be connected to this

point—even the low  $8\Omega$  types that are now common; the effect on the meter part of the circuit is marginal. The output is also connected to the meter circuit through C13 which rectifies the a.f. and applies it to the meter. D1 provides the d.c. bias necessary for correct operation of D2. Since the variation of signal strength applied to this circuit is far more than any meter could sensibly handle, a sensitivity control is fitted. This is simply a variable resistor in series with the meter M1.

When the audio signal is at minimum, the meter will be showing the minimum reading and since we are not interested in calibration, only in noting the minimum deflection, a very simple and inexpensive meter may be used here. The most suitable type is a recording level meter; these come in a variety of shapes and sizes but most have a sensitivity of about  $200\mu\text{A}$  and cost between 50p and £1. Suitable types are listed in the catalogues of the large mail order component suppliers.

The current drain of the prototype was measured at about 10mA and a PP3 or PP6 type battery may be used; the low consumption should ensure a long battery life.

SW2 is a separate on-off switch and C1 decouples the positive line. The table shows the transistor voltages measured on the prototype; these may be of help if difficulty is experienced in getting the circuit to operate.

## CONSTRUCTION

The circuit can, of course, be built into any type of case but the one chosen for the prototype is a very convenient size and looks very attractive. The main body of the case is made from thick plastic and the front panel from aluminium with mounting screws provided. An internal chassis is also provided but this is not required for our purposes. Bearing in mind the attractive appearance of the case the price, £1.25, is not expensive; details of the supplier are given in the components list. All the components are fitted to the front panel and the drilling and cutting of this is shown in Fig. 3. The front panel is supplied

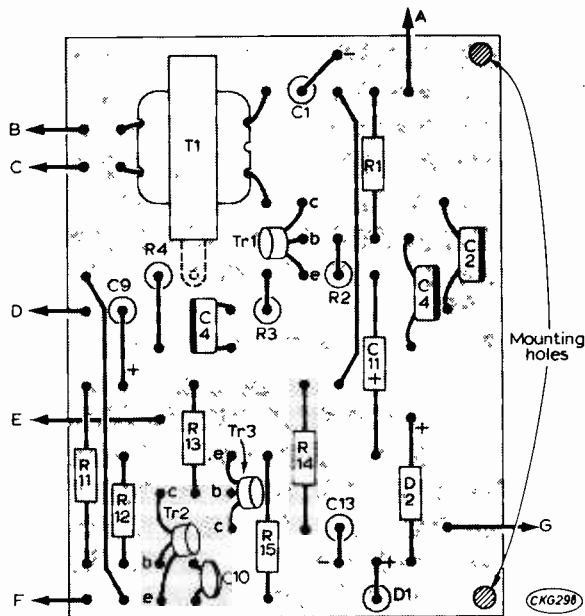


Fig. 4: The majority of the components are mounted on a small piece of Veroboard as shown. Certain of the conductor strips should be broken.

with a protective plastic sheet and this is best left on while the marking is done to prevent scratching but it should be removed before the actual drilling starts. The meter cut out is shown for the type used in the prototype but other types may vary and so this dimension may have to be worked out separately. The holes are of two diameters,  $\frac{3}{8}\text{in}$  and  $\frac{1}{4}\text{in}$ . Two holes are not shown on this diagram; these are for the component board mounting bracket. These are best sited to suit the type of bracket used; they will lie to the right of the VR1 hole.

The majority of the components are fitted to a piece of Veroboard with a 0.15in. matrix. The layout for this is shown in Fig. 4. Three chassis and two positive lines are used, these are connected by link

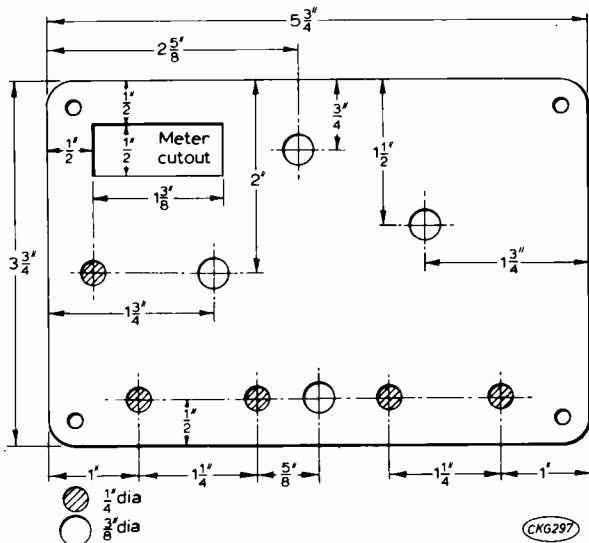
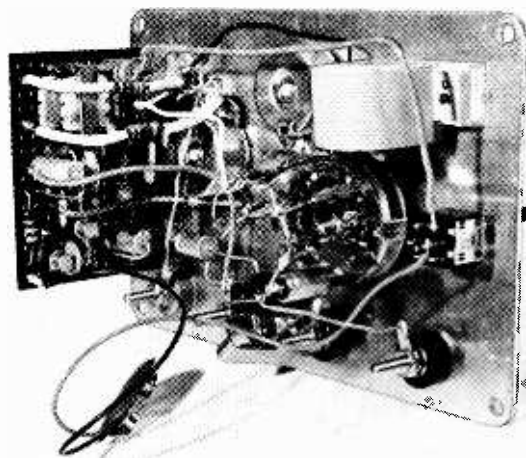


Fig. 3: The front panel, which is supplied with the case, should be drilled and cut as shown.



All the components are mounted on the front panel. The wiring, especially around VR1, should be short and straight.



wires as shown. The transformer T1 is fitted with two tabs which are rather larger than the holes in the board, but by slightly enlarging these with a drill the tabs may be pushed through the board and on one side bent over and soldered to the adjacent strip. The upper tag should be soldered to the upper strip. It is important that both sides are soldered to the correct strip as the upper strip must be at chassis' potential for the connection for C1. Take-off pins are connected at various points, these are marked A-G and correspond with similar letters in Fig. 5.

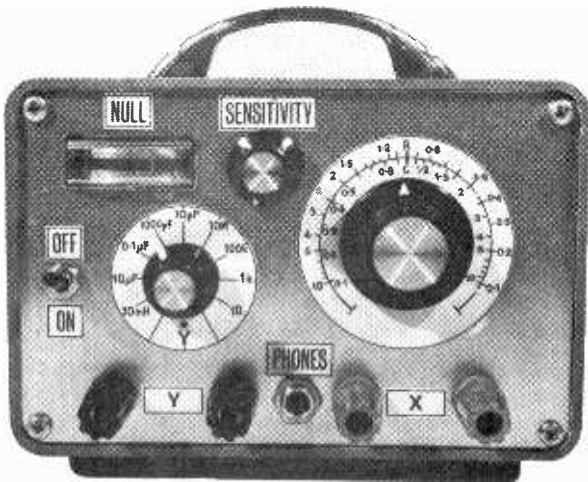
Several breaks are necessary in the copper conductor strip but these are clearly shown in the diagram.

Figure 5 shows the remaining wiring. The component board should be fitted to an aluminium angle bracket which in turn should be fitted to the front panel. A solder tag can be fitted under one of these mounting screws to act as the main chassis connection.

The standard components are wired directly to the switch SW1 and a common wire connects one side of these together; the photograph should make this clear.

To minimise the capacity of the wiring, all connections from and to SW1 and VR1 should be as short as possible and good stout wire should be used; it may look less attractive but will improve the performance of the unit.

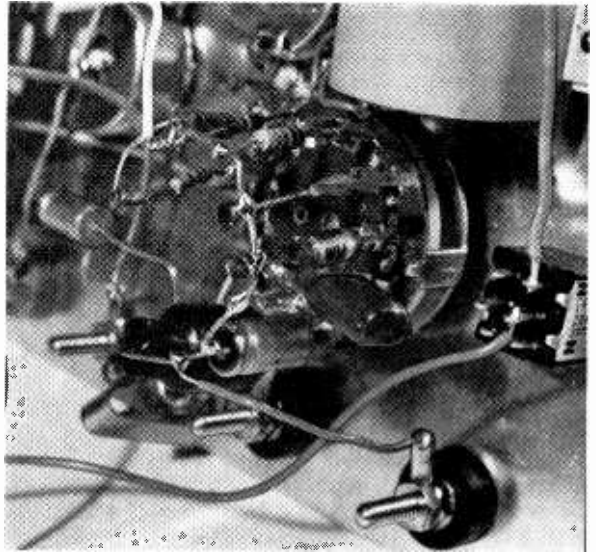
The only component not on the front panel is the battery. This fits into the main body of the case and should be held in some form of clip to prevent it moving around.



Using the recommended case, and taking care over the labelling of the controls, the finished unit can look quite professional.

## CHOICE OF STANDARDS

The accuracy of the unit depends on two factors: the quality of the standards and the care taken in calibration. One per cent resistors are available although they are hard to find. Two per cent types are not all that expensive and should be quite adequate; Home Radio list these in their catalogue at 5p each. One per cent capacitors are available from a number of suppliers including Electrovalue Ltd., though C9, 10µF, costs a small fortune in this tolerance. However, it is highly unlikely that high accuracy is needed on this range.



Close-up of the reference components showing how these are wired directly to the switch.

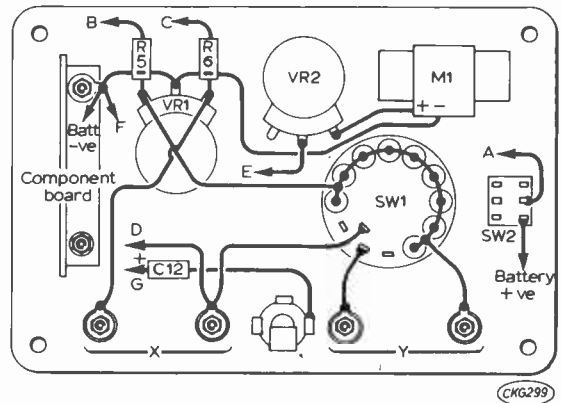


Fig. 5: Wiring of the controls. The letters match up with those on the main component board.

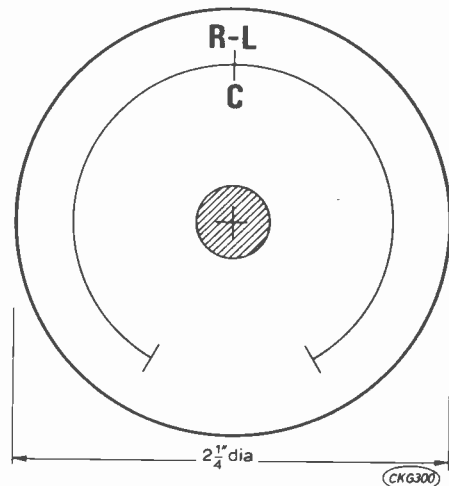


Fig. 6: This scale may be cut out and calibrated as described in the text.

The inductors chosen for the circuit are a matter of choice. The author only included two in the prototype, a 10mH and a 100 $\mu$ H. Arrangements have been made with Repanco Ltd., for the supply of these 5 per cent tolerance inductors, details are given in the components list. This will allow measurement within reasonable accuracy of inductors lying within the range 1mH to 10 $\mu$ H. Lower inductances can be measured but the accuracy below this must be suspect because of strays in the circuit.

The matter of standards must be left up to the reader. Many people may be content using 5 per cent components throughout and certainly little usefulness will be lost.

## CALIBRATION

A blank calibration scale is shown in Fig. 6. This can be cut out and stuck onto the front panel, the null position is already marked. For calibration a source of close tolerance components is required and the remarks made above apply. However, as we are only interested in one set of markings, this can be done using the cheapest components—resistors. The best range on which to calibrate is probably the 1k $\Omega$  one and a set of resistors with their values ranging between 100 $\Omega$  and 10k $\Omega$  will be needed. Points can be obtained by interpolation if only a few components are used. Alternatively, if a highly accurate test meter is available (one with an individually calibrated scale) a variable resistor can be adjusted on this and then used for the calibration. There are several ways of approaching this problem and the above points are only a guide. However, once calibrated, the scale will hold good for all values of resistance, capacitance and inductance as long as the standards are accurate.

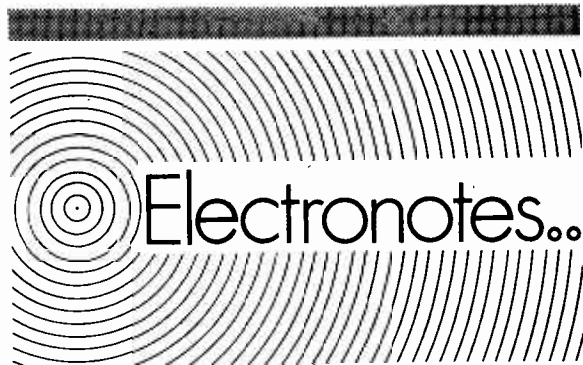
For matching two components the internal standards are not used. The two components are fitted to X and Y and their similarity compared, if they are the same the null will appear at the 1:1 setting right at the top. ■

# MAXWELL

by G8DSH



"I think it needs a plug change and its valves ground in!"



S. GINSBERG

SOMETIME back, comment was made in this column about miniature lasers. Some will have wondered about the applications of these devices while others, perhaps, even doubted the existence of such midget marvels.

It will be of interest, therefore, that small lasers are available in this country from a company in Edgware. These are colourfully described as "Hip Pocket He-Ne Lasers". Ratings of one, three and 10mW are available and the power supply allows operation from 230V a.c. or 12V d.c. Dare our imagination picture a man from Mars reaching for the "sky" on the commands of a Space Sheriff on whose hip hangs a 45MW laser? Jesse James would turn in his grave!

Before anyone ridicules the laser as just a novelty, they should consider the latest application by the Dutch electronics giant Philips. The Eindhoven laboratories use one in their latest system of video recording.

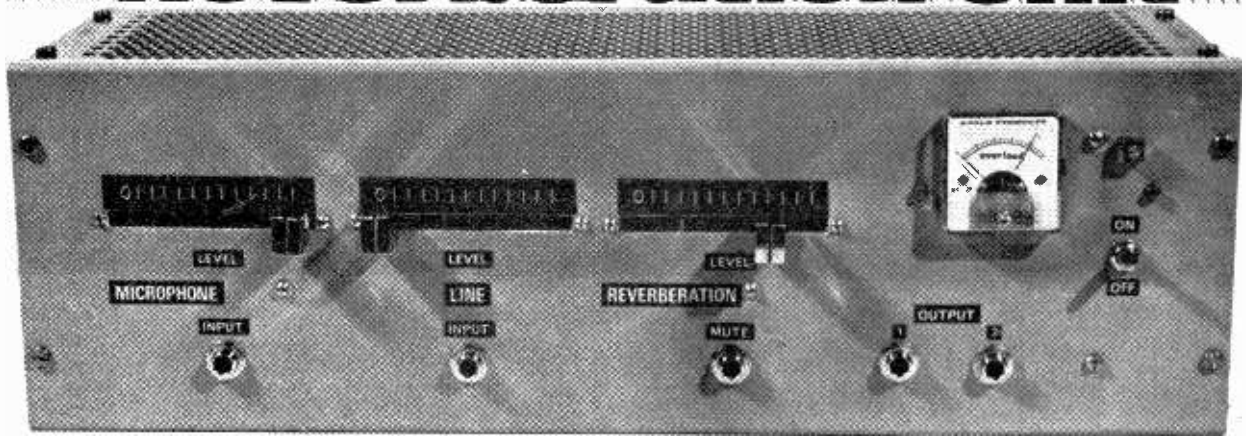
The reflection from a minute spot of light generated by a miniature laser is used to obtain a signal from a video LP. A 45 minute colour television programme can be recorded on a normal LP sized disc. This amounts to something like recording 50,000 separate frames or individual pictures.

Since there is no direct physical contact with the pick-up head, wear is almost non-existent. However, one sees scratches as a problem and, more importantly, dust and/or dirt in the groove will throw up as noise in the system.

New electronic products flood the market every week. From amongst the current list is an interesting new IC. It is believed to be the first IC timer commercially available. Designated the 555 its applications include a timer which will cover intervals from fractions of a second to one hour, frequency divider, frequency modulator and missing pulse detector.

Another interesting newcomer is the range of epoxy-coated inductors. This IR-4 Series extends from 0.015 $\mu$ H to 240 $\mu$ H which is a very useful coverage. The devices are small, wire-ended and colour coded. The smaller ones in the range might be mistaken for resistors by the unwary. Self-resonant frequencies go from 5.9MHz to 525MHz. Weight is only 0.65 grammes maximum and size of the largest is 0.45in. by 0.2in. with an overall length of almost 3in. (including the length of the wire end leads). Looks as though it won't be long before nobody bothers to wind coils. Old timers in radio will be saddened and doubtless harbour fond nostalgic memories of winding 100 turns of 24s.w.g. on a cardboard toilet roll former in order to receive 2LO.

# Reverberation Unit



F.C. JUDD

## PART TWO

CONNECTIONS to each of the panel mounted components are given in Fig. 11. Note that the slider control connections are numbered as follows—1 is the earth connection, 2 is the slider and 3 is the signal input. They must be wired this way to obtain the logarithmic performance of the potentiometer.

The layout and wiring of the circuit board is shown in Fig. 12. Note also that the leads coupling the spring line unit to the circuit board have to be screened and connected to the unit itself by means of phono plugs.

Construction of the power supply is shown in Fig. 13 in which details are also given regarding the size of the chassis etc. The capacitor C13 and the bridge rectifier BR1 are mounted on a small piece of circuit board elevated from the chassis on stand-off pillars.

## Checking out and Performance

The overall performance of the finished reverb unit is given in the specification table given last month.

The supply rail current at the negative 18V point (see circuit) should be approximately 15mA with no

signal and with the reverb control off. The no-signal current of the reverb driver amplifier only should, if possible, be checked by connecting a meter in series with the negative supply rail at the starred point shown in Fig. 2. The pre-set PR1 should be adjusted until the standing current is about 10mA. Otherwise set PR1 to mid position.

With signals, and with the reverb control VR3 at max, the current to the driver amplifier should rise to not more than 100mA on speech peaks. A higher current indicates overload.

## The Overload Meter

The overload meter will read only with reverb on and on strong signals may show full scale deflection. This is well beyond the point of overload at which distortion from the reverb amplifier circuit will be high. The meter used in the prototype is an Eagle type MR2P with a 50 $\mu$ A movement and calibrated 0-10. For the prototype reverb unit the figures on the meter scale were erased leaving only the scale itself. The overload point is marked (in red ink) at what was division 8 as shown in Fig. 14. In normal use the input signal should always be adjusted so that with full reverb the overload meter never quite reads to the overload mark.

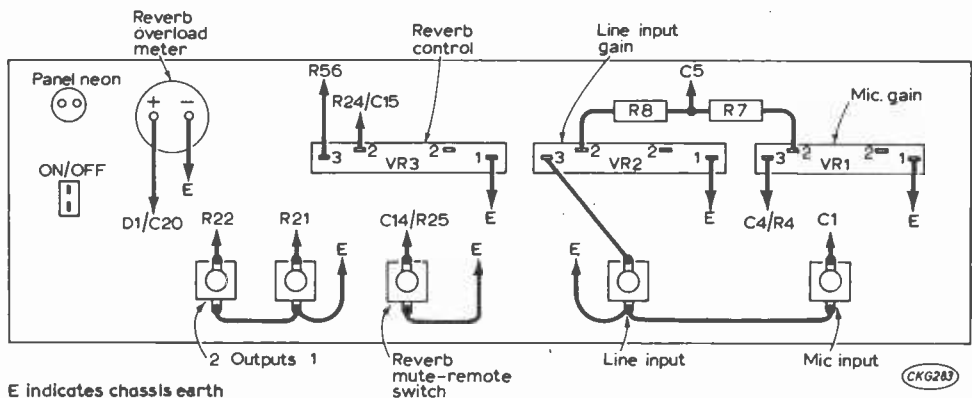


Fig. 11: The wiring of the front panel components.

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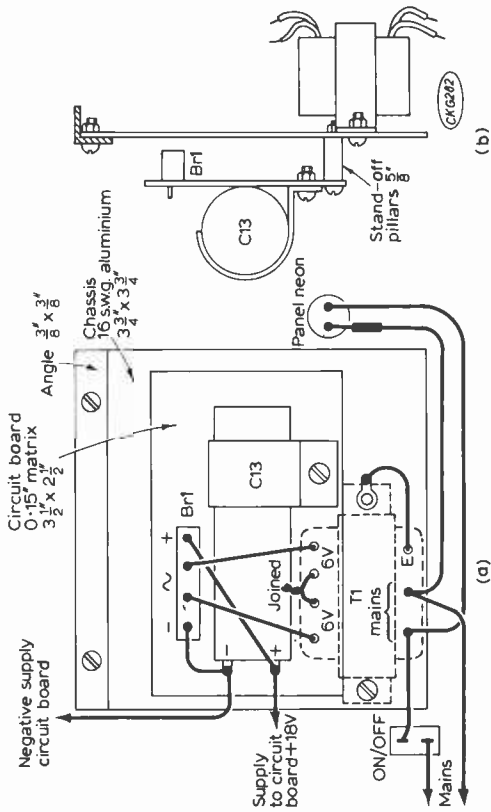
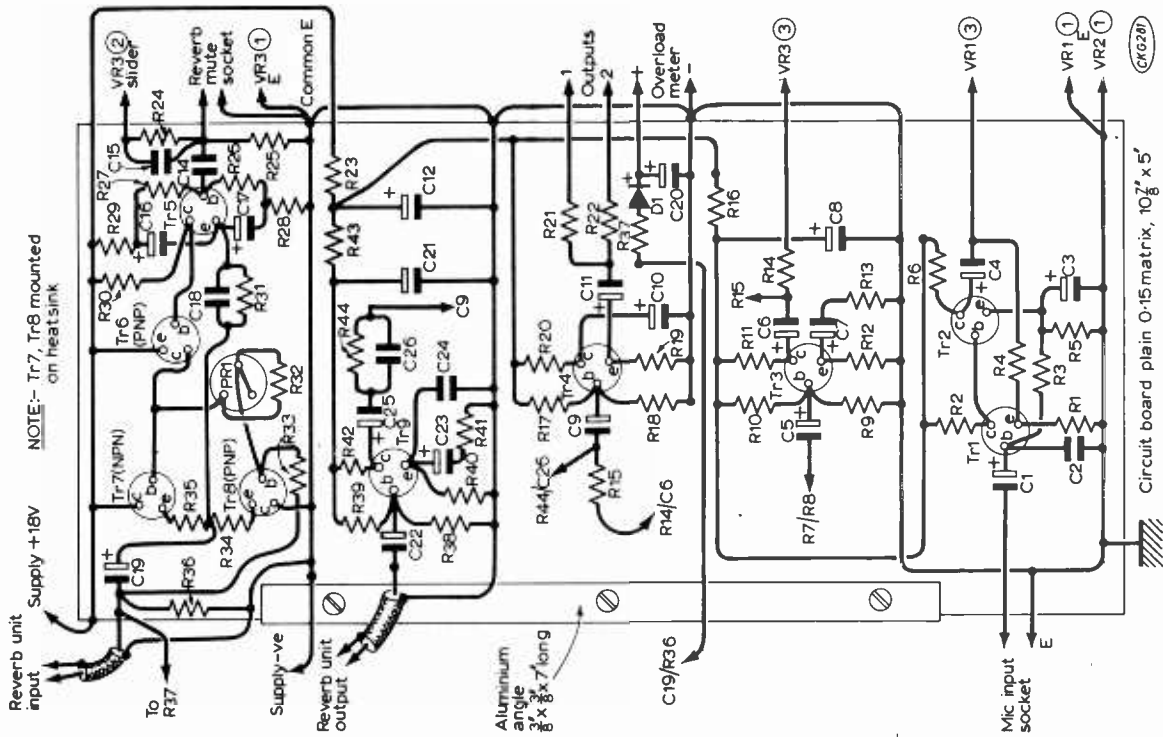
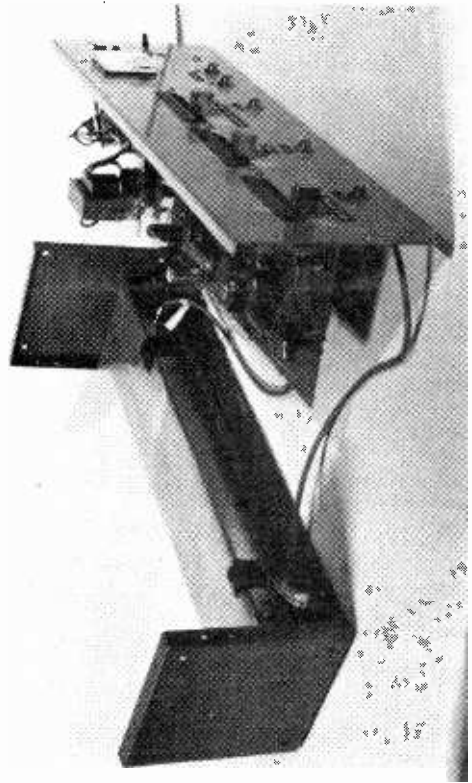


Fig. 12 (left): The wiring of the main component board. The siting of this can be seen from the photograph below.

Fig. 13 (above): The wiring and construction of the power supply on its own small sub-chassis.



A view of the prototype. The main component board and power supply sub-chassis can be seen behind the front panel and fixed to it.

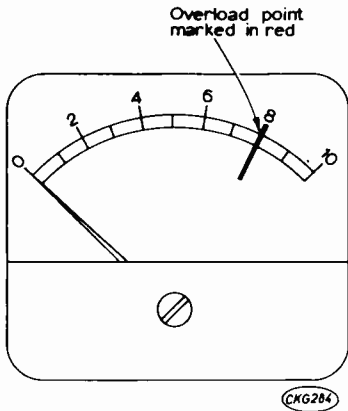


Fig. 14: The overload meter can be marked as shown. The plastic cover can easily be removed to do this.

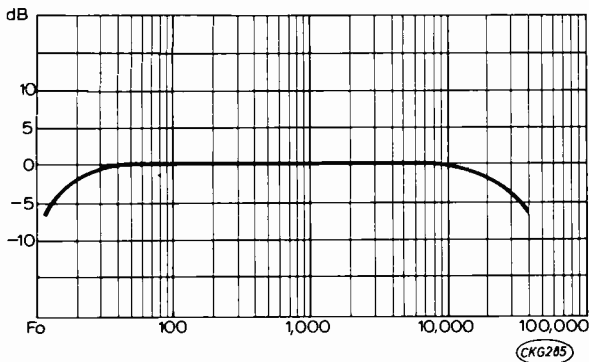


Fig. 15: The overall frequency response of the reverb unit from either input but with no reverb included.

## Frequency Response

The overall frequency response for through signals (i.e., with reverb 'Off'), is shown in Fig. 15. The frequency responses of the spring line driver amplifier and its output amplifier can be checked against the responses shown in Figs. 3 and 4 respectively. For checking the response of the line driver amplifier, connect an audio signal generator at the junction of R14 and VR3 and set VR3 at maximum. Input signal should be not greater than about 20mV. Check the response at the output with an audio voltmeter between C19/R36 and chassis and with the line unit disconnected. Check the response of the spring line output amplifier Tr9 with an audio signal generator connected to C22 and with line unit output plug connected. Input signal should not be greater than about 5mV. Check the response with an audio voltmeter connected between C9/R15 and chassis.

## Reverb Mute

The socket marked "Reverb Mute" (external remote switch) as in Fig. 2, is optional but can be used for remote control by means of a switch on the end of a screened lead. When the switch is closed signals feeding the reverb driver amplifier are short circuited to chassis. ■

# THE Medium Wave Column

**G**EOFFREY DRIVER who lives in Woodham, Surrey has been active on the medium waves and he reports reception of Tenerife, Canary Islands on 620kHz after 2300hrs; Radio Andorra 701kHz in both French and Spanish from 2030hrs until midnight; Radio Portugal 755kHz in English at 2300hrs with "DX Magazine" on the last Monday of the month; Algiers 890kHz in English at 0300hrs; Bissau, Portuguese Guinea with a good signal on 1070kHz after midnight.

During the winter months North American medium wave stations are often heard in the U.K. before midnight and sometimes they are audible as early as 2300hrs. This is the hour when a number of Europeans close down for the night leaving a few spaces for the DX to be heard. North Americans operate on channels spaced 10kHz apart and all of them are allocated identifying call letters which they use frequently. Listen on 710kHz at 2305hrs after Cairo 2 signs-off, for CJOX which is located in Grand Bank, Newfoundland. This is a commercially owned station and it carries the "CJON Radio Service" programme. On 1070kHz, Paris closes down at 2300hrs leaving the frequency clear for CBA, a 50kW outlet of the Canadian Broadcasting Corporation situated in Moncton, New Brunswick. CBA relays the CBC Radio Network and it identifies locally on the hour and the half hour. Propagation is variable on the North American path but when conditions are favourable CJOX and CBA should be heard by 2330hrs. Others to listen for between 2330hrs and midnight, are WHDH Boston on 850kHz; CJON St John's, Newfoundland on 930kHz; CBM Montreal on 940kHz; CHER Sydney, Nova Scotia 950kHz; WINS New York City on 1010kHz; WNEW 1130kHz also in NYC; CKEC 1320kHz in New Glasgow, Nova Scotia.

A list of North American loggings made in the UK since 1962 and covering nearly 400 different stations, is currently being distributed by the Medium Wave Circle to its members. This club, which is now in its 19th year, deals exclusively with DXing on the medium waves. Its bulletin "Medium Wave News" appears 8 times a year and contains up-to-date information about the medium waves, loggings of DX, a verification section and articles on MW DXing. Further information about the MWC is obtainable from Ken Brownless, 7 The Avenue, Clifton, York YO3 6AS.

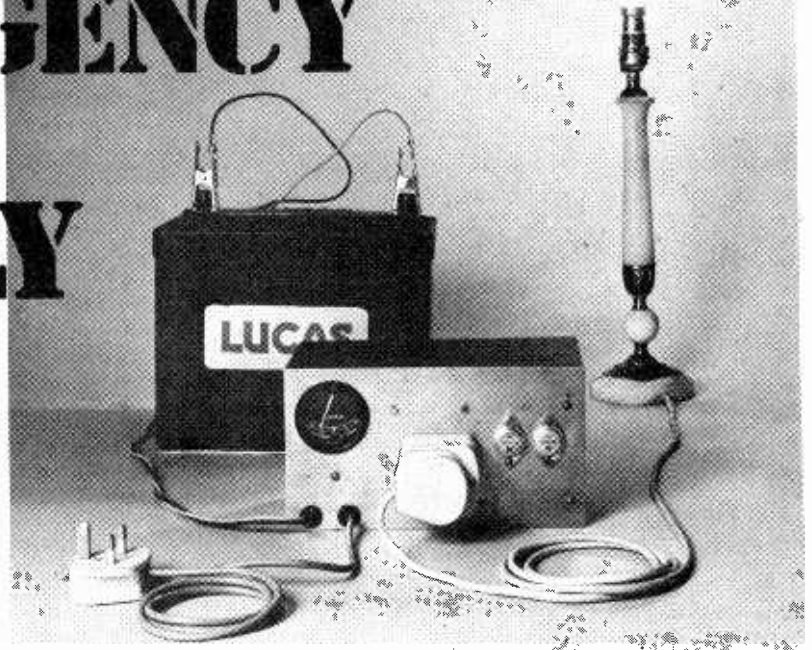
S. N. Gaythorpe of Cranbrook, Kent asks if it is possible to hear Bermuda on the medium waves. Bermuda has 3 medium wave stations; ZFBI on 960kHz; ZBM1 on 1230kHz and ZBM2 on 1340kHz and all have been heard in the UK. There is no short wave broadcasting in Bermuda and consequently this is a "medium waves only" DX country. Try on 1230kHz after midnight for ZBM1, and log this rare DX country.

Please send logs and information about the medium waves to the author at 132 Segars Lane, Southport PR8 3JG.

# AUTOMATIC EMERGENCY 250V SUPPLY

Within the last two years there have been two electricity supply emergencies and, at the time of going to press, there is a possibility of another. This unit will save you the indignity of spending yet another spell 'blacked-out'.

S.SOAR



THE unit described here was developed during the power crisis of February 1972 and was primarily intended as a standby emergency lighting unit, although since the restoration of normal power the device has had considerable use, both as a battery charger and as a portable power supply in garage and caravan. The power output is sufficient to operate a small electric drill or an inspection lamp.

## Circuit Description

The unit has two modes of operation, with a 12V accumulator and 240V mains connected, the unit is a charger capable of delivering up to 12A, this charge rate falls to approximately 1.5A with the battery fully charged. An auxiliary socket on the unit provides a 240V mains output.

In the event of the mains supply being interrupted, the unit automatically switches over and power is taken from the battery and by inverter action is delivered to the auxiliary socket at 240V thus maintaining the supply. When the mains supply is restored, the unit again switches automatically to its charging condi-

## Specification

	As a Charger	As an Inverter
Input	240V mains	12V battery
Output	12V, 12A d.c. to battery	240V, 50Hz square wave, up to 150W

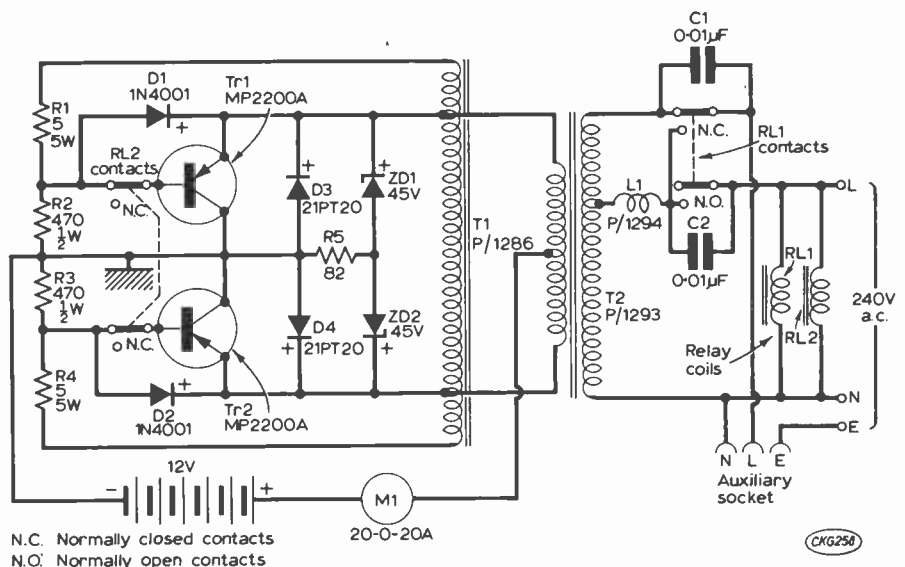


Fig. 1: The complete circuit on the combined charger/inverter. This will give up to 150W at 240V, 50Hz. See text for a description of the operation.

tion and the battery is restored to its fully charged state.

Since the inverter output is a square wave, it is not ideally suitable as a supply for equipment such as a television receiver, however, satisfactory performance has been achieved with slightly reduced picture size and tolerable interference on sound.

#### As a Charger

With the mains supply connected, relays RL1 and RL2 are energised, transistor bases are isolated and mains supply is connected directly to the auxiliary socket and to the output transformer secondary via choke L1. Rectifiers D3 and D4 supply full wave rectified current to charge the battery. Ballast choke L1 limits the charging current to a safe maximum of around 12A with a flat battery, this charge rate decreasing as the battery potential rises.

#### As an Inverter

With the mains supply interrupted, the relays de-energise, the transistor bases are connected and the output socket is connected directly to the secondary of the output transformer. The unit now operates as an inverter.

Referring to Fig. 1, assume Tr1 to be conducting, then transformer action (T1) holds Tr2 off (+ve on base) and Tr1 on (-ve on base) magnetic flux in the transformer core (T1) increases uniformly and current is substantially constant. However, as the flux density in the core approaches saturation, current increases rapidly in an attempt to maintain the rate of flux increase constant. Base drive on Tr1 is limited by R1 and the gain of the transistor falls with increased collector current, these two factors result in Tr1 coming out of its saturated state and collector current can increase no further, flux cannot increase

and base drive falls causing a further reduction in collector current. Falling flux causes Tr2 to become biased on and the collector current increases rapidly and Tr2 is switched hard on, this completes one cycle.

Frequency of operation is determined by the time taken for the transformer core to saturate, suitable choice of core and windings results in an operating frequency of approximately 50Hz.

The transistors are protected against reverse bias by diodes D1 and D2, and ZD1 and ZD2 clip voltage switching transients to a safe level.

#### Construction

Since the power transistors are connected in common collector, these devices should be fixed directly to the chassis, 16 s.w.g. aluminium was used on the prototype. Transformers, relay and choke are also bolted directly to the chassis, and if rectifiers with anode studs are used, these can also be fixed directly to chassis. Other components should be mounted on insulated tag strips. It is advisable to have all low voltage components on one side of the output transformer (i.e. primary winding side) and all mains voltage components on the other side (i.e. secondary side). ■

### ★ components list

#### Resistors

R1	5Ω	5W	R4	5Ω	5W
R2	470Ω	½W	R5	82Ω	1W
R3	470Ω	½W			

#### Semiconductors

Tr1	MP2200A	D3	20A 100V p.i.v. rectifier (e.g. 21PT20)
Tr2	MP2200A	D4	20A 100V p.i.v. rectifier (e.g. 21PT20)
D1	1N4001	ZD1	45V 1W zener, e.g. 1S3045
D2	1N4001	ZD2	45V 1W zener, e.g. 1S3045

Tr1 and Tr2 are available from Jermyn Industries, Vestry Estate, Sevenoaks, Kent. D3 and D4, 21PT20, are International Rectifier types. ZD1 and ZD2 are available from Quarndon Electronics, Slack Lane, Derby.

#### Transformers, Coils and Relays

RL1	2-pole changeover with 240V a.c. coil
RL2	2-pole changeover with 240V a.c. coil
T1	Driver transformer type P/1286
T2	Output transformer type P/1293
L1	Ballast Choke type P/1294

T1, T2 and L1 are available from Magtor Limited, 68 Dale Street, Manchester; a complete kit of these costs £6.65 plus 50p postage.

#### Miscellaneous

C1, C2, 0.01μF 600V; M1, Ammeter with centre zero, 20-0-20A or similar (Car types are suitable).

# TELEVISION

## DECEMBER ISSUE

### EHT SYSTEMS FOR TV SETS

A lot of confusion seems to be present about the nature of the e.h.t. pulse, the stabilisation of the e.h.t. voltage and the different characteristics of half-wave and multiplier systems. This month we are taking a close look at this department, for both monochrome and colour set use.

### UHF PREAMPLIFIER

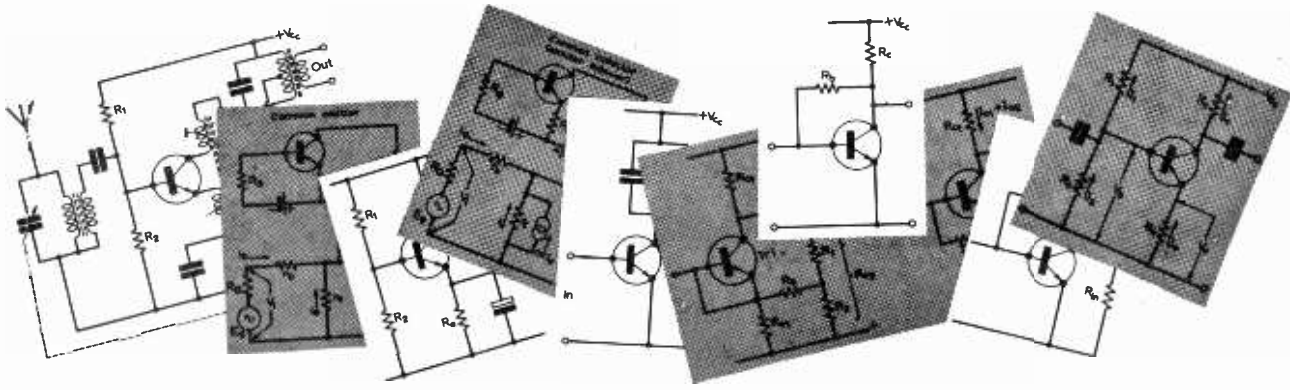
Full constructional details of a simple u.h.f. aerial preamplifier which has given excellent results for both fringe area and DX use. Several prototypes have been tried out and the stability is so good that they can be cascaded.

### SERVICING THE PYE 368 CHASSIS

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# TRANSISTOR CIRCUITRY for beginners

## PART 13

H.W. HELLYER & MICHAEL HOLLIER

### Minimum noise

We have already stated that our principal aim is as good a signal swing as we can afford provided that we do not thereby increase the noise in the circuit. With any transistor type, some noise is generated, but this can be aggravated tremendously by collector currents and also by the source resistance seen by the transistor—and, as might be expected, the optimum conditions alter with frequency.

A digression here, for colleague Mike feels strongly on this subject, having been too often caught with unsuitable replacements. Transistors with the same code number but made by different firms can have widely odd noise performances, as we have found when using them for laboratory equipment.

To find the optimum operating conditions under which our chosen transistor is to be used, we must turn to the graphs of noise figures quoted by the maker. These indicate a typical noise level expected at a selected collector current, with a selected source resistance 'seen' by the transistor base. But the quotes are at one single frequency. In practice we find conditions vary widely—a whole family of curves is really needed for optimum choice—and is seldom available, even from our old friends Mullard, who kindly acknowledged our quotes while pointing out an omission, in a letter from L. W. Owers in the October issue of *PW*. Very few firms, including Mullard, give figures that allow us to optimise for the whole audio band—in fact, they seem to think the world ceases revolving below 100Hz, giving data at 1kHz and 10kHz, generally. More noise is generated at low frequencies than high, and the higher the operating current, the higher the noise level.

We have decided upon a collector current of 80 microamps for Tr1 and the graphs, such as are available, would indicate that a source resistance of between 5 and 20kΩ would be best for low noise. We shall aim at the lower figure.

The base of Tr1 will 'see' the resistance formed by the virtual earth (see Fig. 62) shunted by the series input resistor plus whatever the impedance

may be of the device that is feeding the circuit. The inset of Fig. 64 should give us some idea.

The virtual earth resistance can be calculated from  $R_v = \frac{R_b}{G_o}$  so  $R_b$  becomes 500kΩ, or, in prac-

tice, a 470kΩ, 5% component. The voltage across this resistor is the Tr2 emitter voltage less the base voltage of Tr1, or 9.303V and the current through this resistor will be around 19.8 microamps (remember we are ignoring the very small  $I_{b1}$ ).

The current through R2 will, of course, be the same. So we come to a preferred value of 39kΩ. I shall not insult you with the details of the workings after 11 plodding articles of preparation . . .

We now have a working circuit with a low input resistance of around 5kΩ. And we insert R3 into the base 'feed' circuit of Tr1. This does two things: first, it raises the input resistance—that is, the resistance the source will 'see'; second, it gives us some control of the gain of this circuit. Remember, closed loop gain is equal to  $R_b$  divided by R, which is, in this particular configuration,  $R_1 + R_3$ . To get a theoretical gain of 20, for example, R3 would have to be 23.5kΩ (preferred value, 22kΩ).

$$G_c = \frac{R_1}{R_3} = \frac{470k\Omega}{22k\Omega} = 21.3613$$

### Coupling

As for that input and output coupling. We found, in practice, great care had to be taken. In fact, we built the circuit and had some very strange figures before remembering that the feedback was both a.c. and d.c. conscious. So the input capacitor serves a double function; that of blocking the d.c. from previous stages (and to previous stages) and coupling the signal to the stage which we are designing.

Now the problem is that it must be of a sufficiently large value to present a short-circuit, or as near this as may be, to the frequencies over which our amplifier has to work. In the practical case, something like 200μF is in order. One reason that







care is needed here is again to reduce that bother—noise. If we make short-circuit and open-circuit input tests while measuring the residual noise at the output, we find there are some amazingly variant readings. A practical tip, for those who get fun from building their own hook-ups, is to load the circuit, at the actual input point, with the input impedance you want the circuit to 'see'. You may be surprised at the difference from abstract theory which your eventual readings reveal!

## Measurement

We have talked glibly about open-loop gain,  $G_o$ , but given no clues as to its measurement. This is no easy task—you see, if you disconnect the feedback to measure open-loop gain the first transistor bias goes adrift, and the measurements mean nothing.

We must take into account the a.c. feedback as well as the d.c., and here there is a gag which is worth recounting. A network can be made up temporarily, and inserted in place of the feedback resistor, which maintains the essential d.c. conditions, but effectively ties the a.c. feedback down to chassis. Fig. 65(a) shows a simple, three resistor

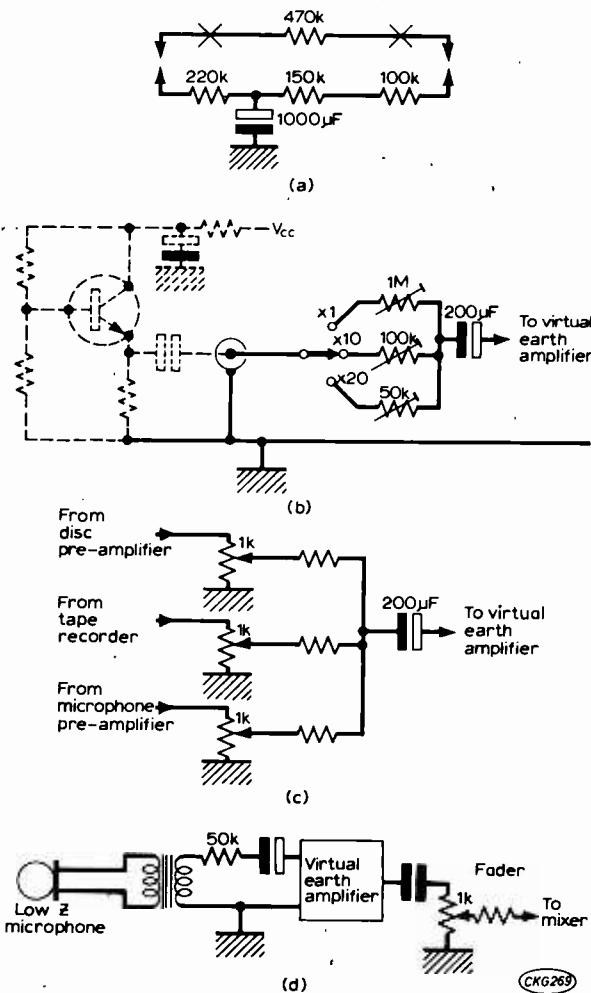


Fig. 65. (a) Substituting the feedback resistor with a decoupled network enables the gain to be measured more accurately. (b) Input for a variable gain pre-amplifier. An emitter follower, shown dotted, may be needed to effect matching. (c) Mixing facilities. (d) Microphone pre-amplifier.

and one-capacitor network, chosen so that the resistive values are approximately as  $R1$  in Fig 64, but the large electrolytic capacitor acts as a complete shunt to any a.c. in which we might be interested. As Mike says, this may be of academic interest, but is worth a mention.

Of greater than academic interest is the capacitor shown dotted across the feedback resistor in Fig. 64. It has been said too often—which does not stop me from saying it again—that the wider one opens the window, the more the dirt blows in. Being interpreted, the wider our bandwidth, the more likelihood is there of our little amplifier getting upset by extraneous influences, like Auntie switching on the vacuum cleaner.

Without joining the argument that can set the hi-fi world by its ears; one group of contenders arguing for an almost infinite bandwidth and the inclusion of filters, the other for a 'tailored bandwidth', we can say here that the ease of making our frequency response roll off in a controlled manner at the top end appeals to us. Without that capacitor, our frequency response of the built amplifier (made up in a Norman Rose AB9 box with co-axial terminations, for complete screening) was within  $+0-3\text{dB}$  at  $78\text{kHz}$  and at  $150\text{kHz}$ , we were still only  $8.2\text{dB}$  down.

At the bottom end, incidentally, we were  $-0.1\text{dB}$  at  $40\text{Hz}$  and  $-0.8\text{dB}$  at  $15\text{Hz}$ , which is negligible.

Shunting the feedback resistor with  $22\text{pF}$  gave us  $-3\text{dB}$  points at  $20\text{kHz}$  and  $-6\text{dB}$  points (complying with DIN 45 500, in case anyone wanted to argue!) at  $31\text{kHz}$ . Under these conditions, the broadband residual noise was  $0.13\text{mV}$  with an open-circuited input,  $990$  microvolts with a short-circuited input. As clipping took us to slightly over  $6$  volts (for a  $410\text{mV}$  input), our signal-to-noise ratio, unweighted, could be said to be  $20 \log 10^{-6} : 0.0001$ , taking a figure of  $0.1\text{mV}$  as a typical residual noise measurement. A rather impressive (who said impossible?)  $95.5\text{dB}$ .

Effective input noise is the output noise with input short-circuited divided by the gain. Our measured gain at a typical  $10\text{mV}$  input was only  $14.7$ , not as much as we had expected, but accounted for most likely by component spreads and the second transistor, which happened to be an odd type we had handy. You can always select with great care for precision, as we said earlier, but it is great fun to 'suck it and see'. So in the practical instance, we can say our effective input noise is  $68$  microvolts. This now becomes the limiting factor for any use to which we are going to put such a device. I think you will agree that in the present case the limitation is hardly exclusive.

## Application

A few of the possible applications were hinted at previously. Without wasting any more space on design data, take a look at the three sub-circuits of Fig. 65 (b), (c) and (d). First we see a way of altering the input resistor, precisely, by 'presets', so that we get a variable gain pre-amplifier, as might be useful for an oscilloscope. The problem here may be an alteration of input impedance, and it is a good idea to precede the virtual earth pre-amplifier with an emitter follower stage, which gives, you will remember, a reasonably high input impedance and a low output impedance (providing the necessary low source our device wants to 'see'.)

Let's suppose we want to use the virtual earth pre-amplifier as an input stage for a mixer, where there are several odd sources that may be used separately or simultaneously, and where the action of one must not interfere with that of another. As any amateur disc-jockey will tell you, a very practical problem. In Fig. 65(c) we get the inputs from the sources taken to low value potentiometers and from there we can feed up to three R3 resistors to the virtual earth point, this time using our coupling capacitor to follow the resistors, for effective isolation. By juggling resistor values, with a little experiment, we can again get our levels somewhere the same, and use a master gain control later in the circuit, where its operation at a higher signal level will not introduce unwanted noise, etc.

Of course, there is always the microphone pre-amplifier, as in (d), where we want a bit more gain prior to a mixer stage. The transformer is a low/high or medium/high type and is best mounted in the overall screened box that houses the virtual earth amplifier.

## Power supply

Finally, this month, having again not kept my promise to lead us on to tone controls, although a careful perusal of the foregoing will have seen the trend our thoughts are taking, we have a brief look at the proposed power supply for this and other projects. This was knocked up easily in an hour and needs no particular layout finesse, nor screening. It uses any convenient transformer that can give between 24 and 33 volts—not really safe to exceed 33.6V—and the rectifiers are easily obtained types with minimum requirements of peak-inverse voltage

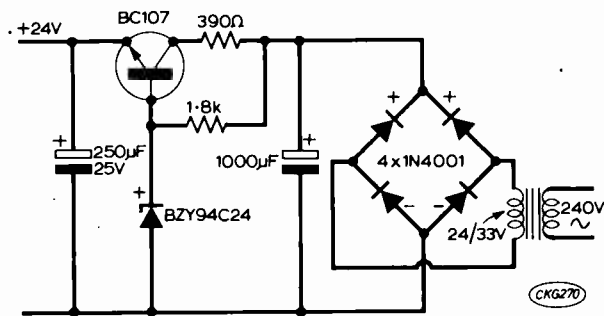


Fig. 66. A practical power supply, suitable for use with the circuits described.

50V and handling capacity 200mA. We used a REC 60 because it happened to be there, but four 1N4001's would have done. The particular requirement is the zener diode, which must be a 24 volt type, such as shown, and components can be half-watt types, with the biggest problem the mounting of the two large capacitors. Note that this zener operates in the reverse to the breakdown mode, i.e., it is set to regulate, with cathode to positive. This 24 volt output, with the 2kΩ resistor (or 2.2kΩ, if you have no 2kΩ version available) drops to the needed 20 volts for our amplifier.

TO BE CONTINUED

## AMATEUR BANDS RECEIVER

—continued from page 698

crystal pass-band. Adjustment of any of the i.f.t. cores should then bring about a great increase in signal strength as they are shifted into the crystal pass-band. The i.f.t.'s are all finally peaked in this way, signal strength being reduced by VR1 as necessary.

When the i.f. amplifier is aligned in this way, a very steep sided response should be obtained. If X6 and X7 are removed and a 100pF capacitor plugged into one holder, general selectivity will still be very good, but there should be a very noticeable reduction in sharpness of tuning and noise will increase due to the broader pass-band.

## MODIFICATIONS

As the idea of construction in stages is to obtain fully working circuits as quickly and easily as possible, the i.f. section can be simplified initially then modified to the full circuit.

The S-Meter circuit can be omitted completely at first and fitted later.

IFT1 and V1, Fig. 2C may be omitted and mixer pin 6 taken to pin 3 on i.f.t.2 or V1 and i.f.t.2 may be omitted and the crystals or secondary of i.f.t.1 may be temporarily connected to pin 1 of V2.

When the tunable first i.f. section is constructed, the receiver can be employed for the 3.5-4MHz band only. The receiver cannot be used on other bands until the crystal controlled first conversion section is completed.

With some valves i.f. instability occurred with VR1 at maximum gain. This was cured by placing a 2.2kΩ resistor between pin 2 of i.f.t.1 and h.t., with a 0.25μF capacitor from pin 2 to chassis.

## TUNABLE FIRST IF AMPLIFIER

This has two stages, Fig. 2B, and is constructed in a screened box to minimise pick-up of unwanted signals. Coverage is 3.5MHz to 4MHz, with a little to spare at the extreme positions of the 3-gang capacitor VC1, VC2 and VC3.

V1 operates as an r.f. amplifier on the 3.5-3.8MHz band and as first i.f. on the other ranges. The gain of this stage is also controlled by VR1. AGC bias is applied to both stages via R1 and R4 (it is not good practice to apply a.g.c. to a frequency changer of this type—Ed).

The oscillator section of the mixer-oscillator V2 is run from the 150V stabilised h.t. supply. Input to L1 is via a screened lead and a similar screened lead runs from V2 to the 455kHz i.f. amplifier.

The box is 5×4×2in. deep, with the valves on top and all other parts, including VC1/2/3, inside. This box is made from a 5×4in. flat plate, to which are bolted two 4×2in. and two 5×2in. "universal chassis" flanged members. It is easier to leave the sides and back off the box until wiring is completed.

TO BE CONTINUED

Next month we shall cover the construction and alignment of the tunable IF amplifier and give full information on the BFO/Product Detector and RF/1st Mixer stages to enable the receiver to be completed.

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B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, mixed types large and small	50p
B99	200	Mixed Capacitors. Approx. quantity, counted by weight	50p
H4	250	Mixed Resistors. Approx. quantity counted by weight	50p
H7	40	Wirewound Resistors. Mixed types and values.	50p
H39	10	Integrated Circuits. 6 Gates BMC 962, 4 Flip Flops BMC 945	50p
H9	2	OC71 Light Sensitive Photo Transistor	50p
H40	20	BFY50/2, 2N696, 2N1613 NPN Silicon uncoated TO-5	50p
H28	20	OC200/1/2/3 PNP Silicon uncoated TO-5 can	50p
H30	20	1 Watt Zener Diodes. Mixed Voltages 6.8 - 43V.	50p
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked.	50p
H38	30	Short Lead Transistors, NPN Silicon Planar types.	50p

## UNMARKED UNTESTED PAKS

B66	150	Germanium Diodes Min. glass type	50p
B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	50	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1, 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
H17	20	3 amp. Silicon Stud Rectifiers, mixed volts	50p
H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
H16	15	Experimenters' Pak of Integrated Circuits. Data supplied	50p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	50p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	50p

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AC126	0-15	OC140	0-15
AC127	0-17	OC170	0-23
AC128	0-15	OC171	0-23
AC176	0-20	OC200	0-25
AC177	0-20	OC201	0-25
AF239	0-30	2N1302-3	0-15
AF186	0-20	2N1304-5	0-17
AF139	0-30	2N1306-7	0-20
BC154	0-20	2N1308-9	0-22
BC107	0-10	2N3819FET	0-40
BC108	0-10	2N4416FET	0-23
BC109	0-10	2N3823FET	0-30
BC148	0-10	Power Transistors	
BC169	0-12	OC20	0-40
BF194	0-15	OC23	0-25
BF274	0-20	OC25	0-25
BFY50	0-15	OC26	0-25
BSY25	0-13	OC28	0-30
BSY26	0-13	OC35	0-25
BSY27	0-13	OC36	0-37
BSY28	0-13	AD149	0-35
BSY29	0-13	AUY10	0-75
BSY95A	0-10	25034	0-25
OC41	0-15	2N3055	0-40
OC44	0-13	Diodes	
OC45	0-10	AA42	0-10
OC71	0-10	OA95	0-07
OC72	0-10	OA79	0-07
OC81	0-13	OA81	0-07
OC81D	0-13	OA95	0-07
OC83	0-18	IN914	0-04

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90W PNP	25p	23p	21p

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Ex. 2/4-input Buffer	BMC932	12p	11p 10p
2/4-input Expander	BMC933	12p	11p 10p
Hex. Inverter	BMC934	12p	11p 10p
Hex. Inverter	BMC935	12p	11p 10p
Hex. Inverter	BMC936	12p	11p 10p
Hex. Inverter	BMC937	12p	11p 10p
Decade Counter	BMC938	25p	23p 21p
Div. by 16 Counter	BMC939	25p	23p 21p
Hex. Inverter	BMC940	12p	11p 10p
Type D Flip Flop	BMC941	12p	11p 10p
Ex. 2/4-input Power	BMC942	12p	11p 10p
Clocked Flip Flop	BMC943	20p	18p 16p
Quad Inverter	BMC944	11p	10p 9p
Clocked Flip Flop	BMC945	20p	18p 16p
Quad Inverter	BMC946	11p	10p 9p
Pulsed Trig. Binary	BMC947	12p	11p 10p
Monostable Multivib.	BMC948	12p	11p 10p
Dual J/K Flip Flop	BMC949	12p	11p 10p
Dual J/K Flip Flop	BMC950	20p	18p 16p
Dual J/K Flip Flop	BMC951	20p	18p 16p
Dual J/K Flip Flop	BMC952	20p	18p 16p
Quad. 2-input Power	BMC953	12p	11p 10p
2/4-input Gate	BMC954	12p	11p 10p
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# SHORT WAVES

## MONTHLY NEWS FOR DX LISTENERS

### THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

**A**LTHOUGH a great deal of pleasure can be obtained from simply listening to Broadcast stations many listeners take the hobby a step further and collect QSL cards from all over the world.

A QSL card is a verification from the station that the listener did, in fact, hear their broadcast. QSL cards are issued as a reply to reception reports from the listener after the details have been checked against the station log.

The majority of stations are very glad to receive reports from listeners as a well prepared report tells the station how well its transmissions are getting through. The subject for this month is the preparation of reception reports which are helpful to the station.

The first essential of a good reception report is the name and address of the reporter, without this the station does not know where the reception occurred and is unable to send a reply. The technical information should be given in the following manner:—

#### RECEPTION REPORT

I received your broadcast on ..... (date), on a frequency of .....kHz, and listened to it from ..... to ..... hours G.M.T.

The receiver used was a ..... (TRF/Superhet etc.) with ..... (Number) Valves/Transistors, made by ..... model number .....

The aerial was an interior/exterior one, ..... metres high and ..... metres long of the ..... type.

Reception was ..... in the SINPO code, i.e.: "S" Signal Strength ....., "I" Interference ....., "N" Noise ....., "P" Propagation ....., "O" Overall Merit ....., The broadcast was in the ..... language and the programme details were as follows .....

I hope that this report is of use to your Engineers and trust that you will be able to verify that my report is correct. If so, will you please send me your QSL card, or verification letter, in reply to this report. I enclose an International Reply Coupon to cover your postage costs.

I hope that I shall have the pleasure of hearing your station in the future and look forward to sending you further reports on your transmission.

Yours sincerely,

.....

The SINPO code mentioned in the above specimen report may be new to some readers so I will give details of this method of assessing reception.

The "P" in the SINPO code stands for Propagation but is probably easier to understand if we refer to it as Fading.

Rating	1	2	3	4	5
S	Barely Audible	Poor	Fair	Good	Excellent
I	Extreme	Severe	Moderate	Slight	Nil
N	"	"	"	"	"
P	"	"	"	"	"
O	Unusable	Poor	Fair	Good	Excellent

Reception of BBC Radio One on 247 metres in the medium wave band can usually be rated as 55555 but the transmissions are sometimes affected by slight interference which reduces the rating to 54554. Radio Luxembourg on 208 metres is usually subject to severe fading and slight interference giving a rating of 54522.

The overall Merit figure is a very subjective rating and takes into account the other four figures, it would however be unusual to have an overall merit figure which is greater than the lowest of the other four. To use the above example some listeners would rate Radio Luxembourg as 54523, others would take the average of the first four figures as the "O" rating. In this case Luxembourg would rate 54524, which is incorrect since reception with severe fading cannot be classed as good.

The first log this month comes from **Michael Berry** of Dewsbury in Yorkshire who used his Eddy-stone EB35 receiver and 20 foot horizontal wire in the loft to hear:

- 3227 ELWA, Liberia, vernacular at 2010.
- 4890 R. Diff. Venezuela, Spanish at 0100.
- 11795 ETLF, Ethiopia in Malagache at 0330.
- 15105 R. Rural, Brazil, Portuguese at 2125.
- 15155 R. Diff. de Sao Paulo, Portuguese, 2235.
- 15170 ELWA, Liberia in French at 2000.
- 15445 R. Nacional de Brazilia, English at 2130.

**Nigel Knowlman** of Cullompton in Devon has sent in another log using his Lafayette HA-600A with an inverted 'L' antenna to hear:

- 11720 Radio Tashkent, USSR, at 1405.
- 11815 TWR, Bonaire noted at 0040.
- 11850 Radio Vilnius, USSR at 2245.
- 15185 WINB, USA in English at 2215.
- 15195 R. Ankara, Turkey in English at 2200.
- 17855 NHK, Japan, news in English at 0705.
- 17920 Radio Cairo in English at 1415.

**A. P. Turner** of Eastbourne, Sussex has a Peto-Scott H-25, 5-valve domestic superhet receiver and a 65 foot long wire which enabled him to hear:

- 6040 VOA with news at 1917.
- 7100 R. Tirana, Albania in English at 2223.
- 7245 R. Austria, news in English at 0907.
- 11805 R. Pakistan in English at 1830.
- 15245 RSA, South Africa in English at 1608.
- 17810 R. Kuwait, news in English at 1738.

Reports should arrive by the 15th. of the month and be addressed to me at 59 Windrush, Highworth, Swindon, Wiltshire. Please note the new address.

# SHORT WAVES

**D**OUTBLESS many will not be pursuing the noble art of Amateur Radio on November 5 but will usefully employ the time to honour (?) Guy Fawkes for his near miss. However, that does leave another twenty nine days in which to make up for lost time.

One thought is the topband transatlantics. Quite a few signals have been received, not merely from across the pond but from other countries/continents also. A session around 0600 hours might be worth a try although most 160 metre stalwarts are just as liable to be putting out a slow CQ in c.w. in the evenings too. Many d.x. stations are trying their hands at topband using s.s.b. and this band should make an interesting playground for the more seriously minded s.w.l. during the long winter evenings ahead.

Intruders in the Amateur bands are pests who have no moral or legal right to be there. The R.S.G.B. keep an intruder watch and this relies heavily upon reports received. Any s.w.l. with reasonable equipment is welcome to assist, but reports must be accurate. If you have a single conversion superhet, for example, you must ensure that it is not an image signal you are hearing which is, in fact, outside the band.

It's funny callsign time again. Queries flood in about those using a letter followed by two numbers. Not a postal code for Hong Kong, just a new prefix time—again! Bangladesh is apparently active and the call sign here begins S21 (sounds like the wash-room in a Government building). Just in case you think I've picked out an odd one, how about C21 for Nauru. Don't be fooled though, the latter have also been known to use a C29 prefix too.

**Paul Genner** (Liverpool) writes in with news of activity from Vietnam which must surely be a rare one for anyone to bag. Callsign is XV5AC and no band given but 20 and/or 15 would be a safe bet. Paul also mentions that anyone wanting to add Willis Island to their list should look out for VK9ZB who will set sail in December from Willis. Quick, while there is yet time.

**John Tirrall** (Bognor) tells the amazing tale of a W7 reported to be putting up a 40 (forty) element beam for 28MHz and will feed the brute on generous helpings of r.f.—a kilowatt no less. Those who hear nothing on ten metres could make it a red letter day. (Perhaps a red aerial day with all that power coming in).

Talking of ten metres, with the decline of the sunspot activity count this band is perhaps one of the most interesting. Readers might consider erecting a simple ground plane antenna especially for this band. The elements are only just over 8 feet in length and even a vertical dipole might be dangled down the side of the house. Feed in the centre with 75Ω coax as for a horizontal dipole and your in business. Watch that your receiver isn't one which is to be nurtured on 300Ω feed though or you'll have a mismatch.

## THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz ● Times in GMT

Times to listen are always a dangerous thing to predict with any degree of dogma since some bright soul always hears half the world at the very opposite times to those you have predicted. However, according to the JDG crystal ball, afternoons and evenings appear favourite for 21 and 14MHz which are still the most popular listening bands if logs received are any indication. Hopefully, adventurous s.w.l.s will venture forth into regions such as 3.5MHz and 7MHz during the coming months as conditions improve.

**Alan Smith** (Nelson), JR310, a.t.u. and 60ft. end fed is one who braved 3.5MHz to get s.s.b. scalps from; HK1NR, KZ5JF, K3JH, PY1HA, SP9FMA, VE1ARH, VE1IE, VE1XI, VO1BT, VO1CV, W1PSK, W3MFW, XE1IJJ, YN1FI, ZL2BT, ZM4PG, 6Y5AR.

Up on 21MHz Alan bagged; CR6QA, CR7LE, CR8BF, DU1BOB, DU2EL, EP2JW, ET3USA, FP8DH, HS4AGN, HS4AGZ, JA1HIV, JA2DX, JA3BLC, JA4FDZ, JA6FBQ, JA7MFA, JA8QX, JA9EFQ, JA0GRR, KA6MH, KH6KHD, KP4DDO, LU1ACO, SV0WW, SV1GP, TJ1DF, VE1AM, VE3AUM, VS6AD, W8EX, W9ADW, XV5AC, ZS1J, ZS2MI, ZS3AK, ZS4LW, ZS5OE, ZS6OF, 4S7AB, 4S7PB, 4Z4EF, 4Z4LK, 5B4KP, 5N2ESH, 6W8YL, 6Y5GB.

**Paul Russell** (High Wycombe), went to West Norfolk for a holiday. With him went a Sentinal converter, UR-1A receiver as a tuneable i.f. (4.6MHz) and a 5-element yagi which posed transport problems on the way there, especially on the London Underground. Rewards for these sterling efforts included 144MHz signals from; F5VA, F6AGV, F6NM, G2AKQ, G3BN, G3CZA, G3DAH, G3OXV, G3PMH/P, G3POI, G3SRT/A, G3TTV, G3UJK, G3WW, G3XIX, G3ZYC, G4ARD/P, G8DYK, GW4ABR/P, P0HVA, PA0VJ, PA0VZL.

**William Fereday** (Aston-on-Trent) uses an R107 and bent 50ft long wire (Oh—bold). Twenty metre tweets from; JA1QZY, JA2PJC, VK3AHI, VK3RZ, VK5FH, W6BMP, W6BT, YN3NPF, 9V1QT.

**Roger Dixon** (Skipton), PR30, CX203 receiver and 100ft. long wire end fed sent in a log for ten metres (bless you). Stations bagged include; CE3AGU, LU4DCO, TU2DO and 9J2KY. Who says there's nothing up there?

**Glyn Fisher** (Oakham) landed a number of EU stations on 7MHz. Among these were signals of the s.s.b. type from VK2AVA, VK5PB and VK7GK. Gear is a Westminster radiogram and a 50ft. endfed.

Well worth a listen is the 1.8MHz contest on November 11-12. There is also a Czechoslovakian contest on the 12th. The Czech stations are often in evidence on topband but if you want to log stations from further afield, try the CQ WW d.x. c.w. contest on November 25-26.

Logs, in alphabetical order please to arrive by the 15th of the month to 12 Cross Way, Harpenden, Herts.





## Christmas Presents a Problem!

We can take it for granted that she will be buying you the very thing you've set your heart on, so let's concentrate on that superb present you are so generously thinking of buying her! Simple—as everybody knows, today's finest range of radio and electronic components is to be found in the Home Radio Components Catalogue. You could buy her a copy, so that she can pick out just what she wants. On second thoughts, that might complicate matters. Better make the choice yourself. After all, you want it to be a surprise for her on Christmas morn! Moreover, you'll both have the Home Radio Components Catalogue and can spend many hours together, browsing through it. The Catalogue is crammed full with details of 8,000 items, of which about 1,500

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# LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

## In the post

As a purchaser, in a small way of components advertised in *P.W.* I have sometimes been amazed at the varying rates of postage charged for parcels to N.Z. I therefore wrote to the Post Office, London to find out the reason.

I enclose copies of my letter and the reply.

I am sure that the advertisers are trying to act in our best interests. It is no advantage to them to pay out extra postage, but it's our money they're using!—**C. J. Christie** (Whangarei, New Zealand).

### LETTER TO GPO:

I should be grateful for your advice in the following problem.

I am a hobbyist meddler in things electronic and from time to time I make purchases of equipment from England.

Postage on parcels varies so much—for example: (1) Six hearing-aid inserts (1 oz.) Liversedge, 5p. (2) One integrated circuit (1 oz.) Sevenoaks, 61<sup>1</sup>/<sub>2</sub>p. (3) Resistance wire (7 ozs.) Croydon, 7<sup>1</sup>/<sub>2</sub>p. (4) Loudspeakers (3 lb.) Liversedge, £1.23. (5) Five tape cassettes from London, 75p.

All these goods have been marked "surface mail"—not registered.

I don't object to waiting a couple of months for goods sent sea-mail but I must confess to being mystified by the postages quoted.

Can you advise the most economical rate in general terms for the sort of equipment I am buying please?

### REPLY FROM POST OFFICE:

We were interested to see the rates that were charged on the packets you have been receiving. Items 1 and 2, the hearing aids and integrated circuit, weighing one ounce each, should have been sent by the Letter Post at the Commonwealth Rate of 2 new pence (3p from 1 July 1971). There was no service operating in March 1971, surface or air, by which the charges you mention of 5p and 61<sup>1</sup>/<sub>2</sub>p could have been correctly made for these items. Although they were sent a long time ago, if you still have their

wrappings we will gladly investigate how the charges were raised. Item 3 was sent by the Small Packet service, and although you have not given us a date for the packet, the charge of 1s 6d was almost certainly correct. Item 4, the radio speakers weighing 3 lb would have been sent by the Surface Parcel Post Service for £1.15p.

The most economical service available for the sort of goods you have been receiving, including the tape cassettes, is undoubtedly the Small Packet service. This provides a cheap rate for lightweight goods (up to 2 lbs in the case of New Zealand). Small packets must be packed so that they can be easily examined without breaking any seal, and should not contain any letters or personal correspondence, although an invoice is permissible. The words 'Small Packet' should be marked on the top left hand corner. In this service a packet of cassettes weighing, say, 14 oz can be sent for 15p.

I enclose various leaflets showing our current charges and a photocopy of the Small Packet regulations taken from the current edition of the Post Office Guide. I am sure you will find the Small Packet service meets your needs.

## Radio fags



I enclose the photo of a packet which once held ESS-O-ESS cigarettes as I thought you might like to reproduce it in your magazine.

Whereas countless cigarette brand designs are based on ideas to do with the sea there may be few that have anything to do with radio. The only item apart from this that I know of is Wire-less Mixture tobacco.

I do not know when the packet was introduced but this brand was on sale in 1939 at 3d for 6, also 12 for 6d and 3 for 1<sup>1</sup>/<sub>2</sub>d. It was to disappear during the next ten years as it is not included in the 1949 retail price lists. Gallaher Ltd. are now the proprietors of Cope's brands.

One of my achievements is getting something into the Guinness Book of Records concerning wireless. I sent them an obituary from a newspaper called "the forgotten inventor." This resulted in the inclusion of details of the world's first advertised broadcast by Sir Aubrey Fessenden.—**W. Humphries** (Suffolk).

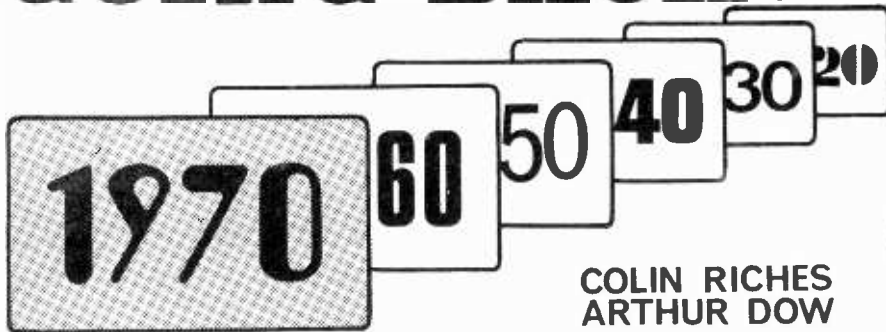
## She saw the light

One day a dear old lady came into our shop and asked if we could sell her a light bulb for her "loo". Upon asking what wattage she wanted she replied that she had not any idea. I then asked her to bring her old bulb into the shop so that I might try to read the wattage. At this suggestion she stepped back in surprise and flatly refused to do this. When asked the reason for her attitude she replied, "Young man, if I take the old bulb out without putting a new one in straight away, all the electricity will fall out of the socket and I'll have a big bill to pay next quarter".

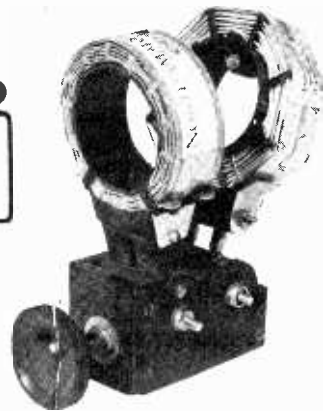
It took me several minutes to explain to her that this was not the case and she went away with a new 25W bulb in her bag which we gave her as a prize for being our 'customer of the month'.—**C. Scott**, (Edinburgh).

We are glad to hear that the lady went away a happy customer. If any readers have amusing stories like this, we'll be glad to consider them for our "Letters" pages—Editor.

# GOING BACK...

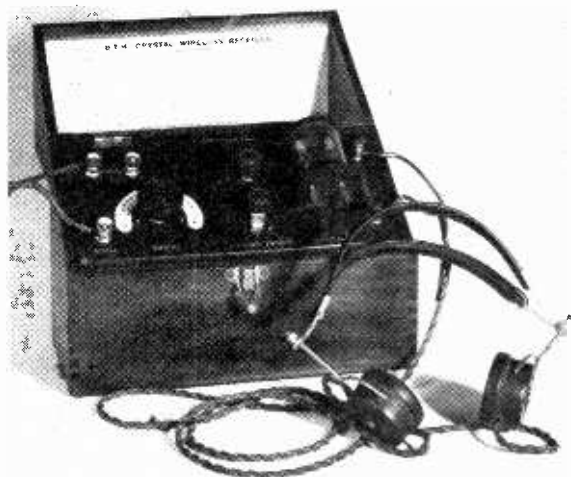


COLIN RICHES  
ARTHUR DOW



**F**IFTY years ago British broadcasting was born in an ex-army hut near Chelmsford in Essex, when on 14th February 1922 a group of Marconi engineers began a series of regular experimental transmissions. Every Tuesday evening from a rigged-up transmitter, call sign 2MT Writtle, or more affectionately to its listeners, Two Emma Tock, they transmitted programmes whose original purpose was entirely technical. Shortly afterwards, in May, another transmitter, later to be even better known, was opened up by the company at Marconi House in the Strand in London. This was the famous 2LO station that provided the foundation from which the British Broadcasting Company grew after its formation on 14th November of the same year.

Two Emma Tock provided the first regular broadcasting service in this country, and incidentally broadcasting's first audience, an audience which in its enthusiasm for the pioneering programmes, generated the original demand for public service broadcasting. The 2MT transmitter was set up for use in a series of experiments designed to establish the effective range of a wireless telephony transmitter. At the same time a number of radio amateurs were appearing, largely young ex-service men who had learnt about radio during the 1914-18 war, who had put together their own receiving sets, and who wanted transmissions to receive. Earlier experiments with entertainment, as when Dame Nellie Melba and later Lauritz Melchior, the Danish tenor, had broadcast from a makeshift studio in Chelmsford in 1920, had shown that there was a potential for wireless telephony outside official communication and naviga-

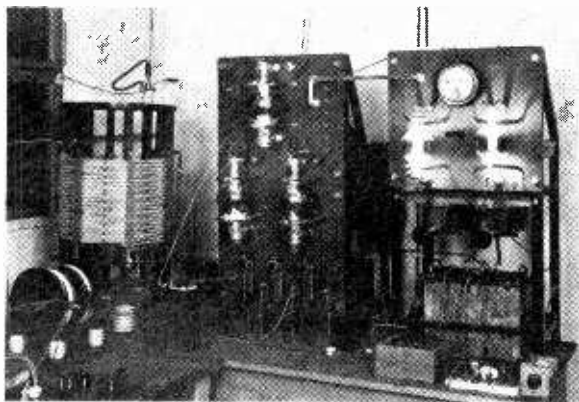


A B.T.H. crystal receiver of 1923 vintage.

tion usage, but the official attitude had been discouraging, and the duty of granting licences for transmitters was the preserve of the Postmaster General. Government was unwilling to consider licences for more than a token number of even technical transmissions.

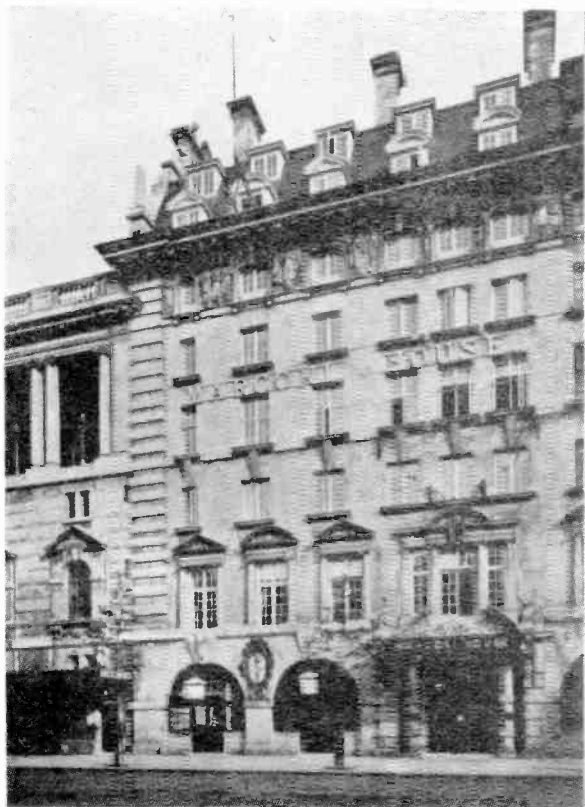
2MT was finally granted an experimental licence to transmit early in 1922, though the permission was hedged about with many restrictions. But for half an hour on Tuesday evenings, experiments were to be allowed, though even then with three-minute breaks in every ten, to ensure that no interference with "legitimate services" was being perpetrated.

2MT opened regular broadcasts officially on behalf of the amateurs who needed a source against which they could calibrate their receivers, and to begin with its programmes were not very much more interesting than early 1920 transmissions made before the government clamp-down, when W. T. Ditcham read from Bradshaw's railway timetable, but the enthusiasm and gaiety of the young Marconi engineers who ran it very soon turned it into a half-hour's entertainment in its own right. The names of those men read like a roll-call of some of the great names in broadcasting. In charge of the project was Captain P. P. Eckersley, who later went to the new British Broadcasting Company as its first chief engineer. It was his infectious and spontaneous humour which gave 2MT its unique flavour; he was



The 2MT transmitter at Writtle from which the first regular broadcast transmissions in this country began on Feb. 14th, 1922.

# PICTURES TO BRING BACK MEMORIES . . .



"Marconi House" main entrance from the Strand (taken 1912).



The "Television Toppers" view a 23in screen. The largest at the 1953 Radio Show.



The "Roving Eye", taken in 1954.



Jean Metcalf, compère of "Family Favourites" (1954).



BBC camera used for televising the "Victory Parade". Seen here with Windmill Girls (1946).

not only the first engineer in charge, he was also the first of the true radio entertainers, with a gift for ad-libbing that constantly alarmed those of a less adventurous disposition who worked with and around him. Others in the team were Noel Ashbridge, later Sir Noel, who was the BBC's first technical director, till his retirement in 1952, R. T. B. Wynn, a later chief engineer of the BBC and B. N. MacLarty, who became head of the BBC's Design and Installation team before he returned to Marconi's in 1947 as Engineer in Chief.

By contrast, Marconi's 2LO station, granted its licence in May, began a rather staid existence, a happy coincidence for the pioneers of 2MT, as it gave them an opportunity to provide skits and lampoons which were much appreciated by their listeners. 2LO operated on conditions of restricted timing, at first even no music, and low power, beginning with 100 watts, later raised to 1½kW. Its programmes had each to be individually licensed by the PMG, and were limited to private occasions often for charity, at which Marconi engineers installed the receiving apparatus and operated it. Each programme was notified to listeners by postcard by means of a special mailing list kept by The Marconi Company, and most of them consisted of polite light music.

The 2LO station transmitter was designed by Captain H. J. Round, installed by C. S. Franklin and run by A. R. Burrows who eventually became the much-loved Uncle Arthur of the BBC. Among the many papers in the Marconi archives which tell the story of the birth of British Broadcasting, not the least interesting is Arthur Burrows' letter requesting permission to recruit a young man of particular quality to compere the station's programmes, a young man with "technical tendencies . . . . grace of manner . . . . and an excellent telephone voice." Many of Burrows' requirements were couched in terser terms and it was his organisational skill and foresight that shaped the studio techniques which are still the basis of modern broadcasting.

By this time many wireless societies had been formed and more and more the demand for radio receivers was being felt. In the United States since 1919 "wireless" had become fashionable, but with no constitutional control of the use of wavelengths, chaos reigned in a commercially sponsored free-for-all. The British Government, seeking a way from the dilemma posed by popular demand on the one hand and a justifiable reluctance to allow free access to the air on the other, set up the Wireless Sub-Committee of the Imperial Communications Committee in April of 1922. After consideration, their recommendation to set up a single broadcasting company was accepted and in November 1922 the British Broadcasting Company was formed from six commercially interested companies with £100,000 share capital.

The six companies were The Marconi Company, the Metropolitan Vickers Co., the Western Electric Co., the British Thomson-Houston Co., the Radio Communication Co., and the General Electric Co., and on its formation on 14th November a Broadcasting Committee of the founder members took over the responsibility of running 2LO.

2MT Writtle continued to transmit until the following January, when it finally closed down.



Our favourite "dumb blonde"—Sabrina shown during rehearsals for Arthur Askey's "Before Your Very Eyes" show (1955).

We would like to thank the Marconi Company, the BBC, the Science Museum and readers whose help in compiling this article has really been appreciated.



**CAR/PORTABLE RADIO.** October 1972  
Readers experiencing difficulty in obtaining the oscillator coil L3 (Osmor PW/01) can use the Denco coil Type TOC1 using the following connections:— Pin 1 to C3 and R3, Pin 2 to the positive line, Pin 3 to S1b, Pin 4 to IFT1, Pin 5 to Tr1 collector and Pin 6 to Tr1 emitter. (Denco Ltd., 357 Old Road, Clacton-on-Sea, Essex).

**INTERCOMM CALLING SYSTEM.** October 1972  
There is an error regarding the wiring around the secondary of T2. The loudspeaker is connected in series with the wire from pin 5 of SW1 to the positive line; the speaker is not connected directly to the top of the secondary of T2.

**DX'ers A.F. PROCESSING UNIT.** July 1972  
In Fig. 4 a break in the conductor strip should be shown at 30-g.

**I.C. AUTO PARKING LIGHT.** September 1972  
It has been brought to our attention that a single parking light is no longer sufficient; all four parking lights are necessary. This does not of course invalidate the circuit.



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Complete kit of Semiconductors £6.30  
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AA213	10p	BC142	21p	BF180	35p	OA91	7p
AC107	34p	BC143	23p	BF184	20p	OA95	7p
AC126	25p	BC147	12p	BF185	20p	OA200	7p
AC127	25p	BC148	10p	BF194	15p	OA202	10p
AC128	25p	BC149	12p	BF195	15p	OA2223	45p
AC141K	25p	BC152	20p	BF196	15p	OA2230	45p
AC142K	18p	BC153	20p	BF197	15p	OC28	65p
AC153	25p	BC157	15p	BF200	35p	OC35	50p
AC153K	25p	BC158	12p	BF222	35p	OC36	65p
AC175K	36p	BC159	15p	BF224J	15p	OC44	15p
AC176	25p	BC170	15p	BF256L	30p	OC45	15p
AC176K	20p	BC171	15p	BF256LC	34p	OC70	15p
AC187	25p	BC171A	17p	BF536A	37p	OC71	11p
AC187K	25p	BC177B	23p	BFW17A	£1.22	OC74	25p
AC188K	25p	BC177B	23p	BFX37	30p	OC75	23p
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AC194K	27p	BC179	20p	BFX85	25p	R2008	£3.5
ACY20	20p	BC182L	10p	BFY50	20p	R2009	£2.5
ACY21	20p	BC182LB	10p	BFY51	20p	R2010	£2.5
ACY22	12p	BC183	10p	BFY52	20p	SP8385	£1.0
AD143	45p	BC183L	10p	BFY90	55p	TA-A700	£2.4
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AF124	25p	BC212	10p	BY126	15p	TBA530	£1.8
AF126	20p	BC212L	12p	BY127	15p	TBA540	£1.8
AF127	20p	BC212LA	13p	BY147	£1.04	TBA540	£1.8
AF139	30p	BC213L	12p	BY164	35p	TBA550	£3.0
AF179	25p	BC214	15p	BZY98 ser 9	9.5p	TBA550Q	£3.0
AF178	55p	BC214L	15p	BZY98 ser 9	9.5p	TBA570Q	£1.2
AF170	60p	BC250B	14p	BR100	26p	TBA750	£1.4
AF239	40p	BC261	16p	BRC4443	90p	TBA750Q	£1.4
ASZ17	50p	BC268	11p	BRY39	30p	TIC46	40p
BA102	30p	BC308A	17p	EI222	40p	TIP29A	50p
BA145	15p	BC317	20p	E5024	40p	TIS60M/61M37p	24p
BA148	15p	BCY21	96p	GET102	30p	TIS61	20p
BA154	9p	BCY31	40p	GET103	25p	TIS91	17p
BA155	10p	BCY42	30p	IS921	15p	2N404	15p
BA163	90p	BCY70	15p	IS923	15p	2N697	12p
BAX12	12p	BCY71	20p	ME0404	11p	2N706	9p
BAW63	36p	BCY72	15p	ME0412	15p	2N708	12p
BAW65	36p	BCY89	97p	ME0413	12p	2N753	10p
BAW67	35p	BD115	75p	ME0462	19p	2N919	45p
BB105	37p	BD124	80p	ME2002	8p	2N920	42p
BBY20	37p	BD131	75p	ME4003	12p	2N1302	17p
BC107	10p	BD132	80p	ME4102	10p	2N1304	21p
BC107B	12p	BD135	75p	ME4104	8p	2N1306	24p
BC108	10p	BD175	44p	ME6002	12p	2N1307	24p
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BC113	15p	BF123	30p	ME8003	13p	2N3054	50p
BC116	20p	BF125	25p	MEF104	34p	2N3055	55p
BC117	20p	BF127	30p	MEL11	30p	IN914	6p
BC119	30p	BF153	20p	MP8112	34p	IN916	10p
BC121	25p	BF154	20p	MP8113	40p	IN4148	6p
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TRANSISTORISED F.M. tuner head with A.M. gang, slow motion drive. 88—108Mcs, with circuit diagram. £2.10p.

B.F.W. 10 Fet. New (unmarked) 5 for £1.00p.

**SPECIAL OFFERS** of Unmarked Tested Power Transistors.  
2N3055 Silicon NPN 30p each 4 for £1.  
2N3054 Silicon 20p each 3 for 50p.  
Plastic 40 Watt NPN 25 Volt 20p each 3 for 50p.

## P-C BOARDS (not computer panels).

- 1 off 6 transistors single wave band
- 1 off 4 transistor audio
- 1 off 3 transistor £1.50 the three.

Encapsulated bridge rectifier (itt usd 3 3mdh) 100 PIV 2 amps. 50p each.

Transistor F.M. Stereo Multiplex Decoder. Size: 5 1/2" x 2 1/2" x 1 1/2". As used in well known British stereo units with circuit. £3.75.

GARRARD SP25 MK. II less Cartridge. £10.50.

10 VOLUME CONTROLS consisting of 2 off each. 100K log. ganged L S—20K log. ganged L/S 470K log. D.P Switch—10K lin. L S—50K lin. L S. £1.25.

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12 PLASTIC KNOBS. Chrome and Gold, 3 types—4 off each—spring clip £1.25.

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WB122  
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### TAPE HEADS

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

### I R.P.M. MOTOR

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

### DRILL CONTROLLER NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1.50 plus 15p post and insurance. Made up model also available. £2.25 plus 15p post & p.



### MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2 1/2 x 2 x 2 in. £1.50 each.

### HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of 1 degree. Complete kit with power pack £5.50.

### AUTO-ELECTRIC CAR AERIAL

With dashboard control switch fully extendable to 40in. or fully retractable. Suitable for 12v. positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £5.75 plus 25p post and insurance.



### WATERPROOF HEATING ELEMENT

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

### MULTI-SPEED MOTOR

Replacement in many well-known food mixers. Six speeds are available—800, 850 and 1100 r.p.m. either either or both of the nylon sockets (where the beaters of the food mixer normally go) and 8,000, 12,000 & 15,000 r.p.m. (ideal polishing speeds) from the main drive shaft. This drive shaft is 3 in. diameter and approximately 1 in. long. A further point about this motor is that being 230/240v. AC-DC series wound its speed may be further controlled with the use of our Thyristor controller. This is a very powerful and useful motor size approx. 2 in. dia. x 5 in. long, mains 230/240v. Price 85p plus 25p postage and insurance, 12 or more post free.

### ISA ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio, ping and kettle boiling as you awake—switch on lights to ward off intruders—have a warm house to come home to. All these many other things you can do if you invest in an electrical programmer. Clock or timer with 15 amp. on/off switch. Switch on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jigger. A beautiful unit. Price £1.95 + 20p p & p with glass front chrome bezel 75p extra.

### 0-8 AMMETER

2in. square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price 80p each. 10 for £8.40.



### NUMERICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Elvac XV. 3. Price £1.45 each. 10 for £13.

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

#0078 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 20p per yard.

### LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by 1/2in. thick. Rated at 800 MW, wire ended. 43p with circuit. Also ORP 12 light cell 45p.

### BAKELITE INSTRUMENT CASE

Size approx. 6 1/2 x 3 1/2 x 2" deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price 45p each.



## MULLARD 4 + 4 UNILEX AMPLIFIER



We demonstrate these daily and almost always a sale results; it really is a cracking amplifier. Only Mullard with their know how could have made it possible at this low price. SPEC: Mains operated. 4 watts music or speech per channel. Double wired power supply eliminates cross talk. Harmonic distortion less than 2%. Frequency response 50Hz-16KHz. Input suitable for pick-up tuner or microphone. 6 month guarantee. Only £8.95 + 30p postage and insurance.

### THYRISTOR LIGHT DIMMER

For any lamp up to 200w. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price £2.95 + 20p post and insurance.



### TANGENTIAL HEATER UNITS

This heater unit is the very latest type, most efficient, and quiet running. Is a fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2k.W. element and 1k.W. element allowing switching 1, 2 and 3k.W. and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. £3.50. 2k.W. Model as above except 2 kilowatts £2.50. Don't miss this. Control Switch 35p. P. & P. 40p



### DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 5 feet of flex cable. Wired up ready to work, £2.25 plus 25p P. & I.



### THIS MONTH'S SNIP

#### BATTERY MOTORS

A bargain parcel of 7 motors for £1. Some small as large as a postage stamp and only 1/4" thick, largest is 1 1/4 x 1 1/4" dia. Some work off 1 1/2v. some as high as 18v. These motors are used in racing cars, power toys, etc. The largest is so powerful that it will drive a Mini drill, model lathe, or similar. This is a 4 pole motor, optimum working 16.5v. but very powerful even as low as 4 1/2v. Don't miss this wonderful snip.



#### REPEATING TIME SWITCH

1 or 2 on/off per 24 hours. Repeats until re-programmed. Switches up to 15 amp. Switching time completely adjustable through 24 hours. Precision made with 24 hour dial. Miniature—will fit into 2ins. cube. Mains operated clock but switch may be isolated for switching battery sets. Ideal for: shop window lighting, anti-theft devices, central heating control and many other automatic processes. Price with instructions £2.50 each plus 20p post and insurance.

#### STANDARD WAFER SWITCHES

Standard size 1 1/4" wafer—silver-plated 5-amp contact standard 1/4" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
3 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
4 poles	40p	40p	40p	70p	70p	70p	70p	70p	70p
5 poles	40p	40p	70p	70p	85p	85p	85p	85p	1.20
6 poles	40p	70p	70p	70p	85p	85p	85p	85p	1.20
7 poles	70p	70p	70p	85p	1.20	1.20	1.20	1.20	1.95
8 poles	70p	70p	70p	85p	1.20	1.20	1.20	1.20	1.95
9 poles	70p	70p	85p	85p	1.45	1.45	1.45	1.45	2.45
10 poles	70p	70p	85p	1.20	1.45	1.45	1.45	1.45	2.70
11 poles	70p	85p	85p	1.20	1.70	1.70	1.70	1.70	2.95
12 poles	70p	85p	85p	1.20	1.70	1.70	1.70	2.20	2.95

#### MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500m watt power output 75p. Model 1172 750m watt power output 85p. Model EP9000 4 watt power output £1.45. 10% discount if 10 or more ordered.



#### 13 AMP TWIN GANG SOCKETS

Offered at less than wholesale price your opportunity to replace those dangerous adaptors—brown bakelite fush mounting—standard fitting. Unswitched 20p each, separately switched 30p each. Separately switched and with neon on/off indicators 45p each. Less 10% ten or more + 20p postage if order under £5.00

#### 50 MICRO AMPMETER

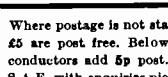
Square, panel mounting type. £2.

#### INTEGRATED CIRCUIT DIAGRAM

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

#### MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10-7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 85p each. 10 for £7.85. 100 for £62.50p. With connection dig.



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

### MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 80p each £1.80 for ten, your assortment.



### TOGGLE SWITCH

3 amp. 250v. with fixing ring 7p each, 75p doz.

### ROCKER SWITCH

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



Slide Switch. 2-pole changeover panel mounting by No 6 B.A. screws. Size approx. 1in x 1in rated 250V lamp. 6p each, 10 for 54p, 100 for £5.10, 500 for £24.

### MICRO SWITCH

5A changeover contact. 8p each. £1 doz. 15 amp Model 10p each or £1.05 doz.



### NEED A SPECIAL SWITCH?

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



### PRESSURE SWITCH

Containing a 15 amp. change over switch operated by a diaphragm which in turn is operated by air pressure through a small metal tube. The operating pressure is adjustable but is set to operate in approx. 10 in. of water. These are quite low pressure devices and can in fact be operated simply by blowing into the inlet tube. Original use was for washing machines to turn off water when tub has reached correct level but no doubt has many other applications. £1.50 each.



### SWITCHES ???

We could fill this whole page with all the switches we have so if you can't see the one you want send for our switch list.

### TIMED "ON" SWITCHES

Made by Smiths for washing machines, etc. Centre spindle closes double pole 15 amp switch directly if it is turned. A full 360° turn or only a part turn winds the clockwork mechanism and keeps the switch closed until the spindle returns to the "off" position. A dial therefore could be fitted to indicate hours and minutes and the switch on period could be set quite accurately. 3 models available—90 minutes, 120 minutes and 360 minutes. Price 95p each. Metal clud pointer knob 15p. Suitable relay to make the switch "on" instead of "off" 85p.

### LEVER SWITCH—Ref. H52/4

Ideal for intercom or similar. Pressing the lever down operates 6 pairs of change-over contacts, pressing the lever up operates 4 pairs of change-over contacts. The switch is spring loaded and normally returns to the off or centre position. Size approximately 1 1/2" long x 2 1/2" deep x 1" thick. 40p each.

### 5 PUSH BUTTON SWITCHES

Mains, suitable for audio or R.F. Each switch rated at 250v. 15 amps. 1st (black push button) closes 2 circuits, 2nd (white push button) operates one change-over, 3rd (white push button) operates one change-over, 4th (white push button) opens one circuit. Note: all depressed buttons remain down until cleared by the 5th (red button). Further note: It is a relatively easy job to alter the position of the tags thus making the switches suit your circuit. Fitted with 3 white, 1 red and 1 black button. 30p each or 10 for £2.70.

### PUSH OPERATED MICROSWITCH

Change-over contacts, spring return when plunger released. Also fitted with lamp holder to take Lilliput lamp in plunger; fixing is by locknut, through 1" hole. Price 25p each or 10 for £2.25.

### 22-POSITION SOLENOID OPERATED STUD SWITCH

Mains operated, each current pulse to switch solenoid moves switch arm through one position on to the next contact stud—current to release solenoid brings back switch arm to position one. These are ex-equipment but in good working order. Any not so would be replaced. Price 50p each.

### SNAP ACTION SLIDE SWITCH

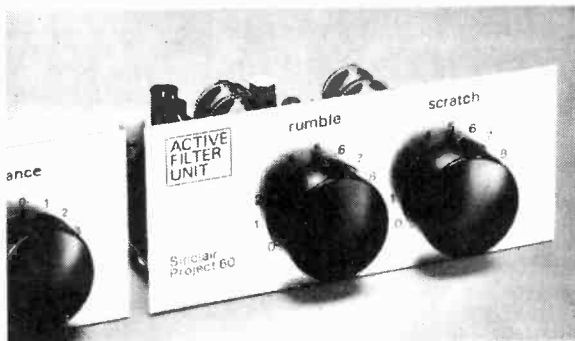
Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 5p each, 10 for 45p.



**NOTE: All items subject to 10% discount on quantities of 10 or more**

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# Sinclair Project 60



## Active Filter Unit (A.F.U.)

Built and tested post free  
**£5.98**

The value of an efficient filtering system cannot be over emphasized in these days of very high quality reproduction since there are so often occasions where its use can mean the difference between comfortable and uncomfortable listening. On the low pass side the Sinclair A.F.U. will effectively reduce hiss from radio or tape, cut out heterodyne whistles on A.M. reception, greatly reduce record surface noise and other imperfections; on the high-pass side it will cut out motor rumble and other spurious low frequency intrusion. The unit is for use between pre-amp (including tape pre-amps) and power amplifiers, and operates in two sections, both stereo. The cut-off frequencies are continuously variable, and since attenuation in the rejection band is rapid (12dB/octave) there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is as easy to mount as the stereo 60 pre-amp/control unit which it matches in styling, along with the Stereo FM Tuner.

### SPECIFICATIONS

The A.F.U. employs two Sallen and Key type active filter stages, one rumble (high pass) and one scratch (low pass). The two stages use complementary transistors to minimise distortion.

**Supply voltage:** 15 to 35 volts. Current 3mA maximum.

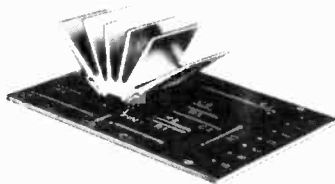
**Gain at 1kHz:** Filters flat 0.98 (—0.2 dB)

**HF cut off:** (—3dB) variable from 28 kHz to 5 kHz at 12 dB/octave.

**LF cut off:** (—3dB) variable from 25Hz to 100Hz at 12dB/octave.

**Distortion:** at 1kHz (35 volt supply) 0.02% at rated output.

## Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC. make possible. It is the equivalent of a 22 tran-

sistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

### SPECIFICATIONS

**Output power:** 6 watts RMS continuous (12 watts peak), 6—8Ω. **Frequency Response:** 5Hz to 100KHz ±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0.1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 x 45 x 28mm including pins and heat sink.

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual.

**£2.98** Post free

## Project 605



The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5 two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

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Everything you need to assemble a superb 30 watt high fidelity stereo amplifier without having to solder.

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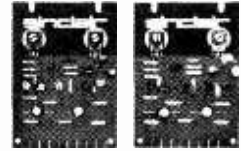
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## Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual **Z.30 £4.48** **Z.50 £5.48**

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and are intended for use principally with other units in the Project 60 range. Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

**SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications).— Power Outputs:**  
**Z.30** 15 watts R.M.S. into 8 ohms using 35 volts 20 watts R.M.S. into 3 ohms using 30 volts.  
**Z.50** 40 watts R.M.S. into 3 ohms using 40 volts 30 watts R.M.S. into 8 ohms using 50 volts.  
**Frequency response:** 30 to 300,000Hz : 1dB **Distortion:** 0.02% into 8 ohms. **Signal to noise ratio:** better than 70dB unweighted. **Input sensitivity:** 250mV into 100 Kohms (for 15w into 8Ω). For speakers from 3 to 15 ohms impedance **Size:** 14 x 80 x 57mm.



## Stereo 60 Pre-amp/control unit

Built, tested and guaranteed **£9.98**

Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

**SPECIFICATIONS—Input sensitivities:** Radio — up to 3mV. Mag. p.u. 3mV correct to R.I.A.A. curve : 1dB 20 to 25,000 Hz Ceramic p.u. — up to 3mV Aux — up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB **Channel matching:** within 1dB **Tone controls:** TREBLE : 12 to —12dB at 10KHz BASS : 12 to —12dB at 100Hz **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.



## Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

**SPECIFICATIONS—Number of transistors:** 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** Typically 20μV **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10Hz — 15KHz ( : 1dB) **Total harmonic distortion:** 0.15% for 30% modulation **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB **Output voltage:** 2 x 150mV R.M.S. maximum **Operating voltage:** 25–30VDC **Indicators:** Stereo on, tuning **Size:** 93 x 40 x 207mm.



## Power Supply Units

Designed specifically for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 or PZ.8 where a stabilised supply is essential.

**PZ.5 30 volts un stabilised £4.98**  
**PZ.6 35 volts stabilised £7.98**  
**PZ.8 45 volts stabilised £7.98**  
 (less mains transformer)  
**PZ.8 mains transformer £5.98**

### Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	<b>Z.30</b>	Crystal P.U., 12V battery volume control, etc.	<b>£4.48</b>
Mains powered record player	<b>Z.30, PZ.5</b>	Crystal or ceramic P.U. volume control, etc.	<b>£9.45</b>
12W RMS continuous sine wave stereo amp for average needs	<b>2 x Z.30s, Stereo 60; PZ.5</b>	Crystal, ceramic or mag P.U., F.M. Tuner, etc.	<b>£23.90</b>
25W RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	<b>2 x Z.30s, Stereo 60; PZ.6</b>	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	<b>£26.90</b>
80W. (3 ohms) RMS continuous sine wave deluxe stereo amplifier. (60W. RMS into 8 ohms)	<b>2 x Z.50s, Stereo 60; PZ.8, mains transformer</b>	As above	<b>£34.88</b>
Indoor P.A.	<b>Z.50, PZ.8, mains transformer</b>	Mic., guitar, speakers, etc., controls	<b>£19.43</b>

F.M. Stereo Tuner (**£25**) & A.F.U. (**£5.98**) may be added as required.



## Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

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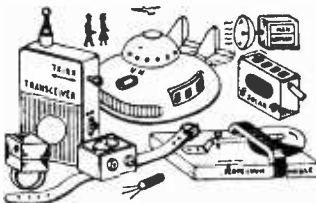
**Valve List EX Equipment.** All Valves Tested on our Mullard Valve Tester before Despatched. 3 Months' Guarantee on all Valves. Single Valves Post 3p over Post Paid.

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EF80	8p	PCL83	12p	6BW7	10p
EF85	12p	PCL84	12p	6U4	10p
EF89	12p	PL36	17p	20P1	20p
ECC81	10p	PL81	17p	20P3	10p
ECC82	12p	PY81	8p	20D1	10p
ECL80	8p	PY82	8p	30F5	10p
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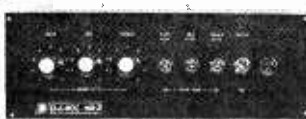


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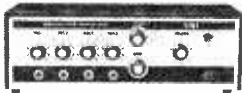
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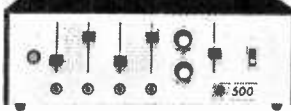
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### SPECIFICATION

Frequency Response	50-20,000 Hz ± 3db (10dB Bass Boost at 10 Hz)	50 watts R.M.S. <b>£58-95</b>
Signal/Noise Ratio	better than =50db.	70 watts R.M.S. <b>£67-50</b>
Harmonic Distortion	less than 1%	100 watts R.M.S. <b>£79-00</b>
Speaker Impedance	8-16 ohms.	
Inputs: Mic 1 & 2	5mV at 50K ohms (50 or 600 ohm to order)	
Aux 3 & 4	100mV at 1 meg ohm.	
Size (all models)	15 1/2" x 5" x 6".	

## DISCO MINI

Hardly larger than a suitcase yet contains all the necessary features for a high quality mobile unit. The pre-amp has separate tone controls for both mic. and decks, and each input has its own individual volume controls and inputs, plus the addition of a cross fade for deck to deck sound transfer. A built in P.F.L. system for cueing, together with mic-over-ride facility are standard on all units. Response 20-20,000 Hz. Mic. input 5mV. 50K. Output 1 volt.  
McDonald M.P.60 Turntables are used with high quality ceramic cartridges, and each deck has its own individual cut out switch fitted. This unit is suitable for Discos or Clubs having a power amplifier, or for use with the "Discmaster" 100 watt power amplifier as above. Size 32" x 20" x 8". **£98-50**.



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100μA	...\$3-40	300V. D.C.	...\$2-85
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100μA	...\$3-40	300V. D.C.	...\$3-10
100-0-100μA	...\$3-30	1 amp. D.C.	...\$3-10
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500μA	...\$3-20	300V. A.C.	...\$3-10
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1mA	...\$3-10	VU Meter	...\$3-95
1-0-1mA	...\$3-10	1 amp. A.C.*	...\$3-10
5mA	...\$3-10	5 amp. A.C.*	...\$3-10
10mA	...\$3-10	10 amp. A.C.*	...\$3-10
		30 amp. A.C.*	...\$3-10

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50μA	...\$3-40	20V. D.C.	...\$2-20
50-0-50μA	...\$2-85	50V. D.C.	...\$2-20
100μA	...\$2-85	300V. D.C.	...\$2-20
100-0-100μA	...\$2-75	1 amp. D.C.	...\$2-20
500μA	...\$2-55	5V. A.C.	...\$2-30
1mA	...\$2-55	5 Meter 1mA	...\$2-30
5mA	...\$2-55	S Meter 1mA	...\$2-30
10mA	...\$2-55	VU Meter	...\$2-50
50mA	...\$2-55	1 amp. A.C.*	...\$2-30
100mA	...\$2-55	5 amp. A.C.*	...\$2-30
500mA	...\$2-55	10 amp. A.C.*	...\$2-30
1 amp.	...\$2-55	20 amp. A.C.*	...\$2-30
5 amp.	...\$2-55	30 amp. A.C.*	...\$2-30

### Type MR.65P. 3 1/4in. x 3 1/4in. fronts.

50μA	...\$3-70	20V. D.C.	...\$2-40
50-0-50μA	...\$3-00	50V. D.C.	...\$2-40
100μA	...\$3-00	300V. D.C.	...\$2-40
100-0-100μA	...\$2-90	1 amp. D.C.	...\$2-40
200μA	...\$2-90	5V. A.C.	...\$2-55
500μA	...\$2-90	50V. A.C.	...\$2-55
500-0-500μA	...\$2-40	150V. A.C.	...\$2-55
1mA	...\$2-40	300V. A.C.	...\$2-55
5mA	...\$2-40	500V. A.C.	...\$2-55
10mA	...\$2-40	S Meter 1mA	...\$2-90
50mA	...\$2-40	VU Meter	...\$2-70
100mA	...\$2-40	50mA A.C.*	...\$2-40
500mA	...\$2-40	100mA A.C.*	...\$2-40
1 amp.	...\$2-40	200mA A.C.*	...\$2-40
5 amp.	...\$2-40	500mA A.C.*	...\$2-40
10 amp.	...\$2-40	1 amp. A.C.*	...\$2-40
15 amp.	...\$2-40	5 amp. A.C.*	...\$2-40
20 amp.	...\$2-40	10 amp. A.C.*	...\$2-40
30 amp.	...\$2-40	20 amp. A.C.*	...\$2-40
50 amp.	...\$2-40	30 amp. A.C.*	...\$2-40
5V. D.C.	...\$2-40		

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50-0-50μA	...\$5-10		
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16V. d.c.	...\$4-85		

### Type MR.85P. 1 21/32in. square fronts.

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500mA	...\$1-75	1 amp.	...\$1-75
5 amp.	...\$1-75	2 amp.	...\$1-75
10 amp.	...\$1-75	5 amp.	...\$1-75
3V. D.C.	...\$1-75	10 amp.	...\$1-75
10V. D.C.	...\$1-75	3V. D.C.	...\$1-75
15V. D.C.	...\$1-75	10V. D.C.	...\$1-75
20V. D.C.	...\$1-75	15V. D.C.	...\$1-75
50V. D.C.	...\$1-75	20V. D.C.	...\$1-75
100V. D.C.	...\$1-75	50V. D.C.	...\$1-75
10V. D.C.	...\$1-75	100V. D.C.	...\$1-75
15V. D.C.	...\$1-75	500V. D.C.	...\$1-75
30V. D.C.	...\$1-75	300V. D.C.	...\$1-75
500V. D.C.	...\$1-75	500V. D.C.	...\$1-75
750V. D.C.	...\$1-75	750V. D.C.	...\$1-75
1V. A.C.	...\$1-85	1V. A.C.	...\$1-85
5mA	...\$1-85	5mA	...\$1-85
10mA	...\$1-85	10mA	...\$1-85
20mA	...\$1-85	20mA	...\$1-85
50mA	...\$1-85	50mA	...\$1-85
100mA	...\$1-85	100mA	...\$1-85
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100μA	...\$2-30	20V. D.C.	...\$1-85
100-0-100μA	...\$2-30	50V. D.C.	...\$1-85
200μA	...\$2-30	300V. D.C.	...\$1-85
500μA	...\$1-95	15V. A.C.	...\$2-00
500-0-500μA	...\$1-85	300V. A.C.	...\$2-00
1mA	...\$1-85	S Meter 1mA	...\$2-05
5mA	...\$1-85	VU Meter	...\$2-50
10mA	...\$1-85	1 amp. A.C.*	...\$1-85
50mA	...\$1-85	5 amp. A.C.*	...\$1-85
100mA	...\$1-85	10 amp. A.C.*	...\$1-85
500mA	...\$1-85	20 amp. A.C.*	...\$1-85
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5 amp.	...\$2-15	15 amp.	...\$2-15
15 amp.	...\$2-15	30 amp.	...\$2-15
30 amp.	...\$2-15	50 amp.	...\$2-15
50 amp.	...\$2-15	5V. D.C.	...\$2-15
5V. D.C.	...\$2-15	10V. D.C.	...\$2-15
10V. D.C.	...\$2-15	20V. D.C.	...\$2-15
20V. D.C.	...\$2-15	50V. D.C.	...\$2-15
50V. D.C.	...\$2-15	150V. D.C.	...\$2-15
150V. D.C.	...\$2-15	300V. D.C.	...\$2-15
300V. D.C.	...\$2-20	500V. A.C.*	...\$2-20
500V. A.C.*	...\$2-20	150V. A.C.*	...\$2-20
150V. A.C.*	...\$2-20	300V. A.C.*	...\$2-20
300V. A.C.*	...\$2-20	500mA A.C.*	...\$2-15
500mA A.C.*	...\$2-15	1 amp. A.C.*	...\$2-15
1 amp. A.C.*	...\$2-15	5 amp. A.C.*	...\$2-15
5 amp. A.C.*	...\$2-15	10 amp. A.C.*	...\$2-15
10 amp. A.C.*	...\$2-15	20 amp. A.C.*	...\$2-15
20 amp. A.C.*	...\$2-15	30 amp. A.C.*	...\$2-15
30 amp. A.C.*	...\$2-15	50 amp. A.C.*	...\$2-15
50 amp. A.C.*	...\$2-15	VU Meter	...\$3-40
VU Meter	...\$3-40	100mA	...\$2-15
100mA	...\$2-15	50 MV D.C.	...\$2-40
50 MV D.C.	...\$2-40		
		100 MV D.C.	...\$2-40

25μA	...\$3-85	30V. A.C.*	...\$2-20
50μA	...\$3-00	60V. A.C.*	...\$2-20
50-0-50μA	...\$2-60	150V. A.C.*	...\$2-20
100μA	...\$2-60	300V. A.C.*	...\$2-20
100-0-100μA	...\$2-50	500mA A.C.*	...\$2-15
500μA	...\$2-45	1 amp. A.C.*	...\$2-15
500-0-500μA	...\$2-15	5 amp. A.C.*	...\$2-15
1mA	...\$2-15	10 amp. A.C.*	...\$2-15
1-0-1mA	...\$2-15	20 amp. A.C.*	...\$2-15
5mA	...\$2-15	30 amp. A.C.*	...\$2-15
10mA	...\$2-15	50 amp. A.C.*	...\$2-15
50mA	...\$2-15	VU Meter	...\$3-40
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50, 125, 250, 500, 1,000V.  
P.C. Current: 25, 50IA, 2.5, 5, 25, 50, 250,  
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impedance: 1000 Meg ohm. Measuring cycle:  
1 per second. Adjustment: Automatic zero-  
ing, full scale adjustment against an internal  
reference voltage. Overload: to 100v. D.C.  
Input: Fully floating (3 poles). Input power:  
110-230V. A.C. 50/60 cycles. Overall size:  
6 1/4in. x 2 1/4in. x 8 3/16in. AVAILABLE  
BRAND NEW AND FULLY GUARAN-  
TEED. \$35-50. Carr. 50p.



**TMK MODEL 117 F.E.T. ELECTRONIC  
VOLTMETER**  
Battery operated,  
11 meg input, 26  
ranges. Large 4 1/2"  
mirror scale. Size  
5 1/2" x 4 1/4" x 2 1/8".  
DC VOLTS 0.5-  
1200V. AC VOLTS  
3-300V RMS. 8-0-  
800V P-P. DC CUR-  
RENT 10-122MA.  
Resistance up to 2000K ohm. Decibels  
-20 to +51 db. Complete with leads/instructions.  
\$17-50, P. & P. 20p.

# SEMI-CONDUCTOR TUBE VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors				Integrated Circuits				VALVES																					
2C301	20p	2N3415	22p	2N5458	35p	2C302	20p	2N3416	22p	2N5459	40p	2C303	20p	2N3417	27p	2N5460	45p	FJH111	70p	8N7437	64p	OA2	38p	2S24	30p	EM80	45p		
2C304	20p	2N3418	37p	2N5461	45p	2C305	20p	2N3419	37p	2N5462	50p	2C306	20p	2N3420	42p	2N5463	60p	FJH112	70p	8N7438	64p	OB2	45p	2S25	42p	EM81	60p		
2C307	20p	2N3421	37p	2N5464	55p	2C308	20p	2N3422	42p	2N5465	65p	2C309	20p	2N3423	42p	2N5466	75p	FJH113	70p	8N7439	64p	OZ4	45p	2S26	45p	EM84	35p		
2C310	20p	2N3424	37p	2N5467	85p	2C311	20p	2N3425	42p	2N5468	95p	2C312	20p	2N3426	42p	2N5469	110p	CA3000	180p	FJH114	70p	8N7440	64p	1L4	20p	30C15	80p	EM87	70p
2C313	20p	2N3427	37p	2N5470	110p	2C314	20p	2N3428	42p	2N5471	125p	2C315	20p	2N3429	42p	2N5472	150p	CA3001	285p	FJH115	70p	8N7441	64p	1B5	30p	30C17	40p	EM87	40p
2C316	20p	2N3430	37p	2N5473	135p	2C317	20p	2N3431	42p	2N5474	165p	2C318	20p	2N3432	42p	2N5475	195p	CA3002	825p	FJH116	70p	8N7442	64p	1B5	30p	30C18	80p	EY51	40p
2C319	20p	2N3433	37p	2N5476	165p	2C320	20p	2N3434	42p	2N5477	195p	2C321	20p	2N3435	42p	2N5478	225p	CA3003	125p	FJH117	70p	8N7443	64p	1B5	30p	30C19	80p	EY52	40p
2C322	20p	2N3436	37p	2N5479	195p	2C323	20p	2N3437	42p	2N5480	225p	2C324	20p	2N3438	42p	2N5481	255p	CA3004	175p	FJH118	70p	8N7444	64p	1B5	30p	30C20	80p	EY53	40p
2C325	20p	2N3439	37p	2N5482	225p	2C326	20p	2N3440	42p	2N5483	255p	2C327	20p	2N3441	42p	2N5484	285p	CA3005	225p	FJH119	70p	8N7445	64p	1B5	30p	30C21	80p	EY54	40p
2C330	20p	2N3444	37p	2N5485	255p	2C331	20p	2N3445	42p	2N5486	285p	2C332	20p	2N3446	42p	2N5487	315p	CA3006	275p	FJH120	70p	8N7446	64p	1B5	30p	30C22	80p	EY55	40p
2C333	20p	2N3447	37p	2N5488	285p	2C334	20p	2N3448	42p	2N5489	315p	2C335	20p	2N3449	42p	2N5490	345p	CA3007	325p	FJH121	70p	8N7447	64p	1B5	30p	30C23	80p	EY56	40p
2C336	20p	2N3450	37p	2N5491	315p	2C337	20p	2N3451	42p	2N5492	345p	2C338	20p	2N3452	42p	2N5493	375p	CA3008	375p	FJH122	70p	8N7448	64p	1B5	30p	30C24	80p	EY57	40p
2C339	20p	2N3453	37p	2N5494	345p	2C339A	20p	2N3454	42p	2N5495	375p	2C340	20p	2N3455	42p	2N5496	405p	CA3009	425p	FJH123	70p	8N7449	64p	1B5	30p	30C25	80p	EY58	40p
2C342	20p	2N3456	37p	2N5497	375p	2C341	20p	2N3456	42p	2N5498	405p	2C342	20p	2N3457	42p	2N5499	435p	CA3010	475p	FJH124	70p	8N7450	64p	1B5	30p	30C26	80p	EY59	40p
2C345	20p	2N3459	37p	2N5500	405p	2C343	20p	2N3458	42p	2N5501	435p	2C344	20p	2N3459	42p	2N5502	465p	CA3011	525p	FJH125	70p	8N7451	64p	1B5	30p	30C27	80p	EY60	40p
2C348	20p	2N3462	37p	2N5503	435p	2C345	20p	2N3460	42p	2N5504	465p	2C346	20p	2N3461	42p	2N5505	495p	CA3012	575p	FJH126	70p	8N7452	64p	1B5	30p	30C28	80p	EY61	40p
2C351	20p	2N3465	37p	2N5506	465p	2C347	20p	2N3463	42p	2N5507	495p	2C348	20p	2N3464	42p	2N5508	525p	CA3013	625p	FJH127	70p	8N7453	64p	1B5	30p	30C29	80p	EY62	40p
2C354	20p	2N3468	37p	2N5509	495p	2C349	20p	2N3465	42p	2N5510	525p	2C350	20p	2N3466	42p	2N5511	555p	CA3014	675p	FJH128	70p	8N7454	64p	1B5	30p	30C30	80p	EY63	40p
2C357	20p	2N3471	37p	2N5512	555p	2C351	20p	2N3467	42p	2N5512	555p	2C352	20p	2N3468	42p	2N5513	585p	CA3015	725p	FJH129	70p	8N7455	64p	1B5	30p	30C31	80p	EY64	40p
2C360	20p	2N3474	37p	2N5515	585p	2C353	20p	2N3469	42p	2N5514	585p	2C354	20p	2N3470	42p	2N5515	615p	CA3016	775p	FJH130	70p	8N7456	64p	1B5	30p	30C32	80p	EY65	40p
2C363	20p	2N3477	37p	2N5518	615p	2C355	20p	2N3471	42p	2N5516	615p	2C356	20p	2N3472	42p	2N5517	645p	CA3017	825p	FJH131	70p	8N7457	64p	1B5	30p	30C33	80p	EY66	40p
2C366	20p	2N3480	37p	2N5521	645p	2C357	20p	2N3473	42p	2N5518	645p	2C358	20p	2N3474	42p	2N5519	675p	CA3018	875p	FJH132	70p	8N7458	64p	1B5	30p	30C34	80p	EY67	40p
2C369	20p	2N3483	37p	2N5524	675p	2C359	20p	2N3475	42p	2N5520	675p	2C360	20p	2N3476	42p	2N5521	705p	CA3019	925p	FJH133	70p	8N7459	64p	1B5	30p	30C35	80p	EY68	40p
2C372	20p	2N3486	37p	2N5527	705p	2C361	20p	2N3477	42p	2N5522	705p	2C362	20p	2N3478	42p	2N5523	735p	CA3020	975p	FJH134	70p	8N7460	64p	1B5	30p	30C36	80p	EY69	40p
2C375	20p	2N3489	37p	2N5530	735p	2C363	20p	2N3479	42p	2N5524	735p	2C364	20p	2N3480	42p	2N5525	765p	CA3021	1025p	FJH135	70p	8N7461	64p	1B5	30p	30C37	80p	EY70	40p
2C378	20p	2N3492	37p	2N5533	765p	2C365	20p	2N3481	42p	2N5526	765p	2C366	20p	2N3482	42p	2N5527	795p	CA3022	1075p	FJH136	70p	8N7462	64p	1B5	30p	30C38	80p	EY71	40p
2C381	20p	2N3495	37p	2N5536	795p	2C367	20p	2N3483	42p	2N5528	795p	2C368	20p	2N3484	42p	2N5529	825p	CA3023	1125p	FJH137	70p	8N7463	64p	1B5	30p	30C39	80p	EY72	40p
2C384	20p	2N3498	37p	2N5539	825p	2C369	20p	2N3485	42p	2N5530	825p	2C370	20p	2N3486	42p	2N5531	855p	CA3024	1175p	FJH138	70p	8N7464	64p	1B5	30p	30C40	80p	EY73	40p
2C387	20p	2N3501	37p	2N5542	855p	2C371	20p	2N3487	42p	2N5532	855p	2C372	20p	2N3488	42p	2N5533	885p	CA3025	1225p	FJH139	70p	8N7465	64p	1B5	30p	30C41	80p	EY74	40p
2C390	20p	2N3504	37p	2N5545	885p	2C373	20p	2N3489	42p	2N5534	885p	2C374	20p	2N3490	42p	2N5535	915p	CA3026	1275p	FJH140	70p	8N7466	64p	1B5	30p	30C42	80p	EY75	40p
2C393	20p	2N3507	37p	2N5548	915p	2C375	20p	2N3491	42p	2N5536	915p	2C376	20p	2N3492	42p	2N5537	945p	CA3027	1325p	FJH141	70p	8N7467	64p	1B5	30p	30C43	80p	EY76	40p
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2C399	20p	2N3513	37p	2N5554	975p	2C379	20p	2N3495	42p	2N5540	975p	2C380	20p	2N3496	42p	2N5541	1005p	CA3029	1425p	FJH143	70p	8N7469	64p	1B5	30p	30C45	80p	EY78	40p
2C402	20p	2N3516	37p	2N5557	1005p	2C381	20p	2N3497	42p	2N5542	1005p	2C382	20p	2N3498	42p	2N5543	1035p	CA3030	1475p	FJH144	70p	8N7470	64p	1B5	30p	30C46	80p	EY79	40p
2C405	20p	2N3519	37p	2N5560	1035p	2C383	20p	2N3499	42p	2N5544	1035p	2C384	20p	2N3500	42p	2N5545	1065p	CA3031	1525p	FJH145	70p	8N7471	64p	1B5	30p	30C47	80p	EY80	40p
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2C411	20p	2N3525	37p	2N5566	1095p	2C387	20p	2N3503	42p	2N5548	1095p	2C388	20p	2N3504	42p	2N5549	1125p	CA3033	1625p	FJH147	70p	8N7473	64p	1B5	30p	30C49	80p	EY82	40p
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2C417	20p	2N3531	37p	2N5572	1155p	2C391	20p	2N3507	42p	2N5552	1155p	2C392	20p	2N3508	42p	2N5553	1185p	CA3035	1725p	FJH149	70p	8N7475	64p	1B5	30p	30C51	80p	EY84	40p
2C420	20p	2N3534	37p	2N5575	1185p	2C393	20p	2N3509	42p	2N5554	1185p	2C394	20p	2N3510	42p	2N5555	1215p	CA3036	1775p	FJH150	70p	8N7476	64p	1B5	30p	30C52	80p	EY85	40p
2C423	20p	2N3537	37p	2N5578	1215p	2C395	20p	2N3511	42p	2N5556	1215p	2C396	20p	2N3512	42p	2N5557	1245p	CA3037	1825p	FJH151	70p	8N7477	64p	1B5	30p	30C53	80p	EY86	40p
2C426	20p	2N3540	37p	2N5581	1245p	2C397	20p	2N3513	42p	2N5558	1245p	2C398	20p	2N3514	42p	2N5559	1275p	CA3038	1875p	FJH152	70p	8N7478	64p	1B5	30p	30C54	80p	EY87	40p
2C429	20p	2N3543	37p	2N5584	1275p	2C399	20p	2N3515	42p	2N5560	1275p	2C400	20p	2N3516	42p	2N5561	1305p	CA3039	1925p	FJH153	70p	8N7479	64p	1B5	30p	30C55	80p	EY88	40p
2C432	20p	2N3546	37p	2N5587	1305p	2C401	20p	2N3517	42p	2N5562	1305p	2C402	20p	2N3518	42p	2N5563	1335p	CA3040											

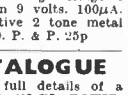
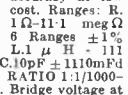
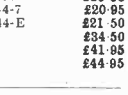
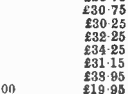
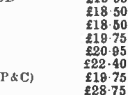
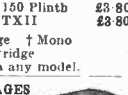
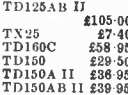
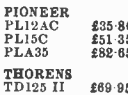
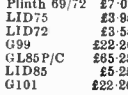
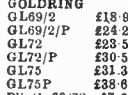


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SAVE UP TO  
33 1/3% OR MORE  
SEND S.A.E. FOR  
DISCOUNT PRICE LISTS  
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## SINCLAIR IC-12

List Price £2.98  
OUR PRICE £1.80  
P. & P. 10p



NS-1600W STEREO A MPLIFIER Exceptional budget price amplifier. All silicon transistor. Handsome Walnut case. Switched input selector, separate balance, volume, treble, bass controls. Output 2x6W RMS. Inputs Mag. Tape, Xtal. Tuner, Tape Out. £14.75. Carr. 37p.

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As used in world famous system. 5" dia. Impedance 4/8 ohms. High flux ceramic magnet. 20 watts rms. Brand new £1.50 Carr. 37p.



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MCA.220 AUTOMATIC VOLTAGE STABILISER Input 88-125 V.A.C. or 175-250V A.C. Output 120V A.C. or 240 VAC 200 VA rating. £11.97. carr. 50p.



## BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Sine 18-200,000 Hz; Square 18-50,000 Hz Output max +10 dB (10 K ohms) Operation internal batteries Attractive 2-tone case 7 1/2" x 5" x 7". Price £17.50. Carr. 17p.

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Project 60 Package offers.  
2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. £15.95 Carr. 37p. Or with PZ8 power supply £18.00 Carr. 37p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. £20.25. Carr. 37p.  
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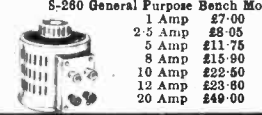
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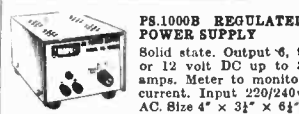


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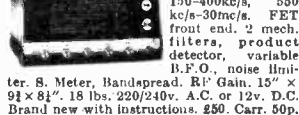
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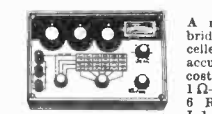
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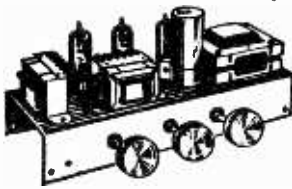
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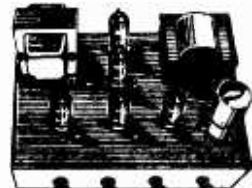
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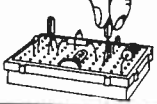
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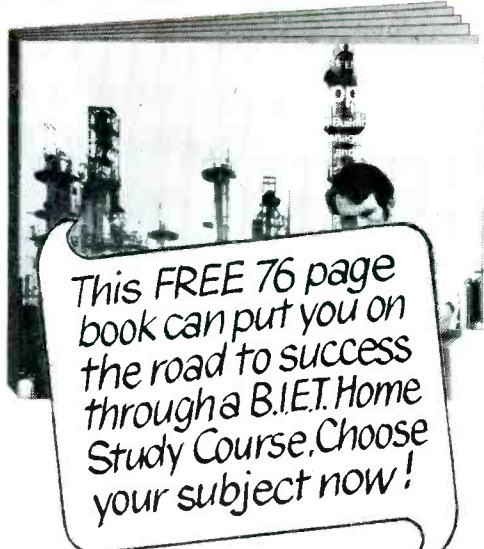
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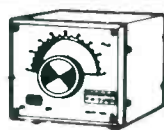
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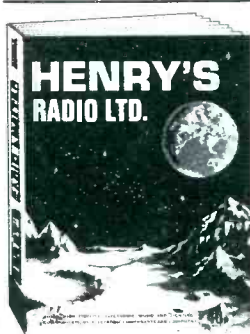
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