

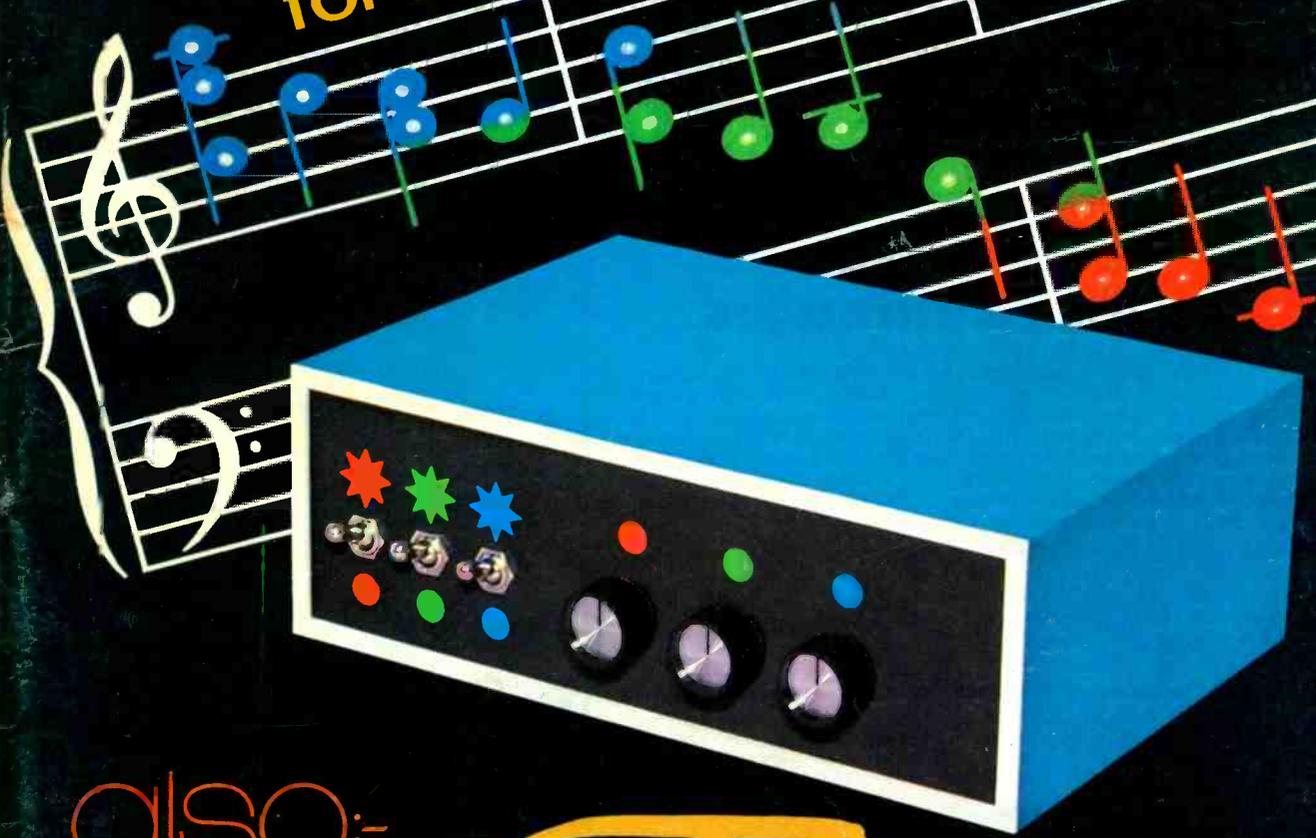
# PRACTICAL WIRELESS

JUNE  
1974

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for the discotheque



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# PRACTICAL WIRELESS

VOL. 50 NO. 2

ISSUE 808

JUNE 1974

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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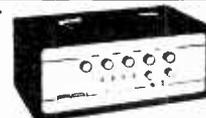
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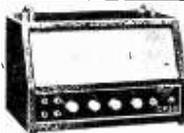
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709c	TO99	35p	799c	TO99	35p
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725c	TO99	85p	799c	TO99	35p
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12 16, 20, 24, 30v or 12-0-12v or 15-0-15v.			
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MT112	1	£1.80	30p
MT73	2	£2.96	36p
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## Resistors

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± watt 5% carbon	1p
1 watt 10% carbon	21p
range 10 ohms to 4.7 megohms.	
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	150µF 81p	
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	470µF 8p	
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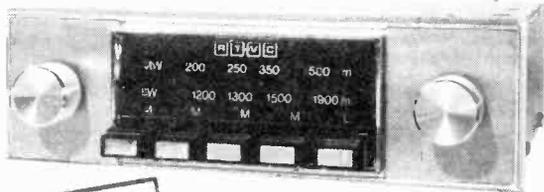


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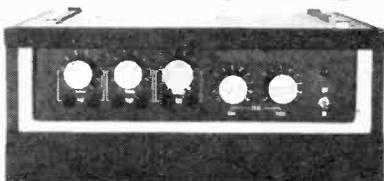
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### DISCO 50



#### 45 WATT R.M.S. MONO DISCOTHEQUE AMPLIFIER

Ideal for Disco Work. Output Power: 45 watts R.M.S. Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K. Size: 19 1/2" x 10 1/2" x 8ins. approx. Amplifier £27.50 + £1.50 p. & p

Special Offer: Disco 50 plus two 15" E.M.I. speakers type 14A/780 (as illustrated on opposite page). Complete £57.00 + £4.00 p & p.

# COMPLETE\* STEREO SYSTEM



**£51.00**

**40 Watt Amplifier.**  
Viscount III - R102 now 20 watts per channel. System I includes.  
Viscount III amplifier - volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.

**Specification**  
20 watts per channel into 8 ohms.  
Total distortion @ 10W @ 1kHz 0.1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K, equalised within -1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power).  
Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB @ -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.) -58dB.  
Crosstalk better than 35dB on all inputs.  
Overload characteristics better than 26dB on all inputs. Size approx. 13½" x 9" x 3½".

**Garrard SP25 deck**, with magnetic cartridge, de luxe plinth and hinged cover.

**Two Duo Type II matched speakers** - Enclosure size approx. 17½" x 10½" x 6" in simulated teak. Drive unit 13" x 8" with parasitic tweeter

**Complete System £51.00**

**£69.00**

**System II**  
Viscount III amplifier (As System I)  
Garrard SP. 25 (As System I)  
**Two Duo Type IIA matched speakers** - Enclosure size approx. 31" x 13" x 11½". Finished in teak veneer. Drive units approx. 13½" x 8½" with 3½" HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

**Complete System £69.00**

**PRICES: SYSTEM 1**  
Viscount III R 102 amplifier £24.20 + £1 p & p  
2 Duo Type II speakers £14.00 + £2.20 p & p  
Garrard SP25 with  
MAG cartridge de luxe plinth  
and hinged cover £21.00 + £1.75 p & p.  
**total £59.20**

Available complete for only **£51.00 + £3.50 p. & p.**

**PRICES: SYSTEM 2**  
Viscount R102 amplifier £24.20 + £1.00 p & p  
2 Duo Type IIA speakers £39.00 + £4.00 p & p.  
Garrard SP25 with  
MAG cartridge de luxe plinth  
and hinged cover £21.00 + £1.75 p & p.  
**total £84.20**

Available complete for only **£69.00 + £4 p & p.**

# EMI SPEAKERS AT FANTASTIC REDUCTIONS

**THE ULTIMATE COMPLETE SPEAKER SYSTEM**  
EMI LE 315 listed price **£86.00**



A professional standard five way speaker system with enclosure giving top quality performance.

**Enclosure Dimensions**  
approx. (3ft. x 2ft. x 1ft.)

**Drive Units**  
Hand built - 15" diameter bass with 3" voice coil, - two 5" diameter Mid Range units, - two 3½" HF units, plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment

**Power Handling**  
Continuous rating 35 W rms. Peak power rating 70 W.

**Frequency Response**  
20 Hz 20,000 Hz. Imp. 8 ohms.

**Our price £45.00 + £3.50 p. & p.**



**15" 14A/780 BASS UNIT**

Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. Flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3" voice coil.

**Recommended retail price £40.80.**

**OUR PRICE £18.70 + £1.50 p & p + £1.50 p & p Special Offer.**

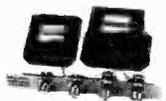


**950 KIT**

Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.

Huge 19" x 14" (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame. The four 10,000 gauss tweeters, each 3½" dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2", others 0.5". Recommended list price £44.00.

**OUR PRICE £19.50**



## BUILD YOUR OWN STEREO AMPLIFIER\*

For the man who wants to design his own stereo - here's your chance to start, with Unisound - pre-amp, power amplifier and control panel. No soldering - just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only.

**£7.64 + 55p. p & p**



## 8 TRACK CARTRIDGE PLAYER\*

Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21.

Technical specification Mains input, 240V. Output sensitivity 125mV. Comparable unit sold elsewhere at £24.00 approx.

**Yours for only £10.95 + 90p. p & p**



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**NO OVERSEAS ORDERS**

103

# BI-PRE-PAK

## AUDIO BARGAINS

STEREO



DECODER  
**£4.95**

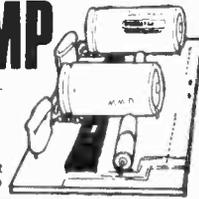
incl. P. & P. and V.A.T.

Ready built unit, ready for connection to the I.F. stages of existing FM Radio or Tuner. A tell take light can be connected. The Unit is a small printed circuit, no further alignment necessary. L.E.D. is recommended as the indicating light. Suitable device available from us at 36 $\frac{1}{2}$ p. Instructions included.

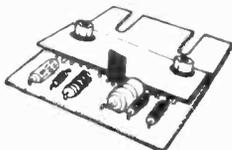
## 3 W.R.M.S.I.C. AMP

only **£1.65** incl. P. & P. and VAT  
Order Code I.C.A. 1

on P.C. Board with all components  
or 2 on one board for £2.86  
Order Code 1.C.A.1/S  
These amps. are supplied with a free booklet  
on connecting up, specifications and easy to  
build projects using the I.C.A.1



## 5W & 10W AMPS



**5W ONLY £1.98**  
**10W ONLY £2.49**

incl. P. & P. and VAT

These matchbox size amplifiers have an exceptionally good tone and quality for the price. They are only 2 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ ". The 5W amp will run from a 12V car battery making it very suitable for portable voice reinforcement such as public functions. Two amplifiers are ideal for stereo. Complete connection details and treble, bass, volume and balance control circuit diagrams are supplied with each unit. Discounts are available for quantity orders. More details on request. Cheapest in the UK. Built and tested.

## Now available for 5 & 10W AMPS

Pre-assembled printed circuit boards 2" x 3" available in stereo only, will fit 15 edge connector.

**Stereo Pre-Amp 1 (Pre 1).** This unit is for use with low gain crystal or ceramic pick-up cartridges. **£1.21**

**Stereo Pre-Amp 2 (Pre 2).** This unit is for use with magnetic pick-up cartridges. **£1.69**

**Stereo Tone Control (STC).** This unit is an active tone control board and when used with the right potentiometers will give bass and treble boost and cut. **£1.21**

Instruction leaflet supplied with all units. Post and packing and VAT included in prices.

I enclose £..... for..... Decoders,  
3W Amps/..... 5W Amps..... 10W Amps.....  
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Stereo Tone Controls.....  
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Address.....

**BI-PRE-PAK**  
Co. Regn. No. B20919

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Westcliff-on-Sea, Essex SS0 9DF.  
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# TRANSFORMERS

## SAFETY MAINS ISOLATING TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	£	P & P
07	20	1 8	7.0 x 6.0 x 6.0	2.55	30
149	60	3 12	9.9 x 7.7 x 8.6	3.79	36
150	100	5 8	9.9 x 8.9 x 8.6	4.17	52
151	200	8 0	12.1 x 9.3 x 10.2	7.09	52
152	250	13 12	12.1 x 11.8 x 10.2	9.25	67
153	350	15 0	14.0 x 10.8 x 11.8	12.32	82
154	500	19 8	14.0 x 13.4 x 11.8	17.87	..
155	750	29 0	17.2 x 14.0 x 14.0	24.31	..
156	1000	38 0	17.2 x 16.6 x 14.0	29.87	..
158	2000	60 0	21.6 x 15.3 x 18.1	49.25	..

PLEASE NOTE  
NEW ADDRESS  
AS BELOW

## AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	Auto Taps	£	P & P
113	20	1 0	5.8 x 5.1 x 4.5	0-115-210-240	1.34	22
64	75	2 4	7.4 x 6.7 x 6.1	0-115-210-240	2.64	30
4	150	3 4	8.9 x 7.7 x 7.7	0-115-200-220-240	3.18	36
46	300	6 4	9.9 x 9.6 x 8.6	..	6.19	52
67	500	12 8	12.1 x 11.8 x 10.2	..	9.20	67
84	1000	19 8	14.0 x 13.4 x 14.3	..	16.71	82
93	1500	30 4	14.0 x 15.9 x 14.3	..	24.19	..
95	2000	32 0	17.2 x 16.6 x 14.0	..	31.57	..
73	3000	40 0	21.6 x 13.4 x 18.1	..	39.17	..

## CASED AUTO TRANSFORMERS

115V 500W enclosed transformer, with mains lead and two 115V outlet sockets. £9.49. P & P 67p. 20 Watt version £2.02 P & P7p

## TRANSFORMERS

### PRIMARY 240-250 VOLTS 12 AND OR 24 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Windings	£	P & P
111	0.5	0.25	4 8	0.12V at 0.25A x 2	1.34	22
71	1.0	0.5	4 8	0.12V at 0.5A x 2	2.58	22
71	2 1	1 2	7.0 x 6.4 x 6.1	0.12V at 1A x 2	2.09	22
18	4 2	2 12	8.3 x 7.7 x 7.0	0.12V at 2A x 2	2.95	30
70	6 3	3 8	8.9 x 8.0 x 7.7	0.12V at 3A x 2	3.52	42
108	8 4	5 8	9.9 x 8.9 x 8.6	0.12V at 4A x 2	3.96	52
72	10 5	6 4	9.9 x 9.6 x 8.6	0.12V at 5A x 2	4.67	52
116	12 6	6 12	9.9 x 10.2 x 8.6	0.12V at 5A x 2	5.61	52
17	16 8	8 12	12.1 x 9.9 x 10.2	0.12V at 8A x 2	7.22	52
115	20 10	11 8	14.0 x 9.6 x 11.8	0.12V at 10A x 2	9.20	67
187	30 15	15 8	14.0 x 12.1 x 11.8	0.12V at 15A x 2	16.94	82
226	60 30	32 0	17.2 x 15.3 x 14.0	0.12V at 30A x 2	31.28	..

### 30 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P
112	0.5	1 4	6.1 x 5.8 x 4.8	0-12-15-20-24-30V	1.56	22
79	1 0	2 4	7.0 x 6.7 x 6.1	..	2.11	36
3	2 0	3 4	8.9 x 7.7 x 7.7	..	3.18	36
20	3 0	4 8	9.9 x 8.3 x 8.6	..	3.96	42
21	4 0	6 4	9.9 x 9.6 x 8.6	..	4.67	52
51	5 0	6 12	12.1 x 8.6 x 10.2	..	5.83	52
117	6 0	8 0	12.1 x 9.3 x 10.2	..	6.94	52
88	8 0	12 0	12.1 x 11.8 x 10.2	..	9.00	67
89	10 0	13 12	14.0 x 10.2 x 11.8	..	11.36	..

### 50 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P
102	0.5	1 12	7.0 x 6.4 x 6.1	0-19-25-33-40-50V	2.09	30
103	1 0	2 12	8.3 x 7.4 x 7.0	..	3.08	36
104	2 0	5 8	9.9 x 8.9 x 8.6	..	4.26	42
105	3 0	6 12	9.9 x 10.2 x 8.6	..	5.79	52
106	4 0	10 0	12.1 x 10.5 x 10.2	..	7.62	52
107	6 0	12 0	14.0 x 10.2 x 11.8	..	11.38	67
118	8 0	18 0	14.0 x 12.7 x 11.8	..	12.40	97
119	10 0	25 0	17.2 x 12.7 x 14.0	..	18.62	..

### 60 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P
124	0.5	2 4	7.0 x 6.7 x 6.1	0-24-30-40-48-60	2.12	36
126	1 0	3 4	7.7 x 7.7	..	2.97	36
127	2 0	6 4	9.9 x 9.6 x 8.6	..	4.67	42
125	3 0	8 12	12.1 x 9.9 x 10.2	..	7.11	52
123	4 0	13 12	12.1 x 11.8 x 10.2	..	9.20	67
40	5 0	12 00	14.0 x 10.2 x 11.8	..	10.83	87
120	6 0	15 8	14.0 x 12.1 x 11.8	..	13.35	82
121	8 0	25 00	14.0 x 14.7 x 11.8	..	15.01	..
122	10 0	35 0	17.2 x 12.7 x 14.0	..	22.10	..
189	12 0	29 00	17.2 x 14.0 x 14.0	..	24.74	..

## MINIATURE TRANSFORMERS WITH SCREENS P & P

Ref. No.	VA	Weight	Size cm.	VOLTS	£	P & P
238	200	2	2.8x2.6x2.0	3-0-3	1.44	10
212	1A 1A	1	4 6:1x5.8x4.8	0-6-0-6	1.67	22
13	100	4	3.9x2.6x2.9	9-0-9	1.23	10
235	330,330	1	4 4.8x2.9x3.5	0-9-0-9	1.67	10
207	500,500	1	6 6:1x5.4x4.8	0-8-9-0-8-9	2.23	22
208	1A 1A	1	7 7.0x6.4x6.1	0-8-9-0-8-9	3.00	30
236	200,200	4	4 4.8x2.9x3.5	0-15-0-15	1.67	10
214	300,300	1	4 6:1x5.8x4.8	0-20-0-20	1.76	22
221	700 (D.C.)	1	8 7.0x6:1x6:1	20-12-0-12-20	1.55	30
206	1A, 1A	2	12 8:3x7:7x7:0	0-15-20, 0-15-20	4.05	36
203	500,500	2	4 8:3x7:0x7:0	0-15-27, 0-15-27	3.10	38
204	1A, 1A	3	4 8:9x7:7x7:7	0-15-27, 0-15-27	3.15	38

PLEASE ADD 10% FOR V.A.T.  
INCLUDING P. & P.

**BARRIE electronics**

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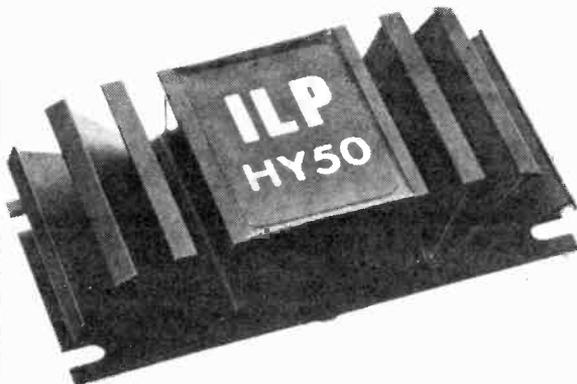
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**I.L.P. (Electronics) Ltd**

## SECOND GENERATION 25 WATT HYBRID



A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices. We have now finally reduced the modular amplifier to a simple input/output device requiring only the addition of a basic unstabilized (split line) power supply. The HY50 takes medium power modules to their logical conclusion by incorporating with it a heatsink, which is designed in special high conductivity alloy, sufficient for normal audio use without additional chassis sinking. All this without significantly increasing the size of the module comparable in size to a packet of 'King-size' cigarettes.

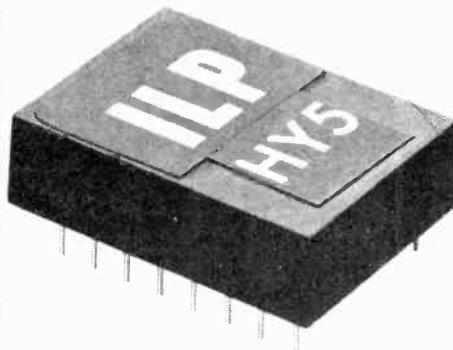
Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

<b>OUTPUT POWER:</b>	<b>SPEC.</b>
<b>LOAD IMPEDANCE:</b>	25 watts RMS, 50 watts peak music power
<b>INPUT SENSITIVITY:</b>	4-16Ω into 8Ω
<b>INPUT IMPEDANCE:</b>	Odb (0-775 volts RMS)
<b>TOTAL HARMONIC DISTORTION:</b>	47KΩ
<b>SIGNAL/NOISE RATIO:</b>	Less than 0.1% at 25 watts typically 0.05 better than 75db
<b>FREQUENCY RESPONSE:</b>	10Hz-50KHz ± 1db
<b>SUPPLY VOLTAGE:</b>	± 25 volts
<b>SIZE:</b>	105 x 50 x 25 mm

Price £5.80 mono, £11.60 stereo

Price inclusive of VAT & P & P

## NEW HY5 PRE-AMPLIFIER



Unchallenged for two years, the HY5, our unique multifunction preamplifier/tone hybrid, has been brought into line with the advancements in our power hybrids.

Like the HY50, the new HY5 has no external components & has been redesigned to run off a split power-line with improvements in signal/noise, overload, capability & reduced distortion. The output has been increased to match the power module (Odb), and to share the same power supply. Overall size is reduced by the use of a new thin film circuitry while the device still retains all the functions of the earlier device.

When combined with the HY50 & power supply only potentiometers are required to complete a simple mono amplifier with input & output facilities expected to be found on HI-FI amplifiers.

The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.

<b>INPUTS</b>	<b>SPEC.</b>
Magnetic Pick-up 3mV (within 1db RIAA curve)	
Ceramic Pick-up up to 3mV	
Microphone 10mV	
Tuner 250mV	
Auxiliary 3-100mV	
Input Impedance 47kΩ 1kHz	

**OUTPUTS**  
Tape 100mV.  
Main output, Odb (0-775volts)

**ACTIVE TONE CONTROLS**

Treble ± 12db at 10kHz

Bass ± 12db at 100Hz

**OVERLOAD CAPABILITY** (equalization stage) 40db on most sensitive input

**OUTPUT NOISE LEVEL** (below 10mV magnetic input) 68db

**DISTORTION** 0-05% at 1kHz

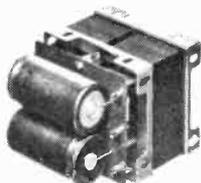
**SUPPLY VOLTAGE** ± 16-25 volts

**SUPPLY CURRENT** 15mA

Price £4.85 mono, £9.70 stereo

Price inclusive of VAT & P & P

## POWER SUPPLY PSU50



The new PSU50 has a low profile look being only 2½ inches high and can be used for either mono or stereo systems.

**SPEC.**  
**OUTPUT VOLTAGE** ± 25 volts  
**INPUT VOLTAGE** 210-240 volts  
**SIZE** L. 70, D. 90, H. 60 mm

Price £5.23  
Price inclusive of VAT & P & P

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Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

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AMPLIFIERS	£
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KSA 1000 10 + 10 watt Mk. II	32.00
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Tripletone	
Hi-Fi 77 7 + 7 watt Mk. II	35.00
Hi-Fi 1818 18 + 18 watt Mk. II	39.95
Teleton SAQ307 8 + 8 watt	27.00
Rotel RA 211	37.00
Rotel Tuner/Amp. RX150A	59.00
SANBU models in stock.	
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BSR MP60/RS5H	11.00
Connoisseur BD1 Kit	11.00
BD2 Chassis	29.50
SAU2 Pick-up Arm	12.25
SCU1 Cartridge	4.95
<b>RECORD DECK PACKAGES</b>	
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SP25 Mk.III/G800 C. & P.	18.50
AP76/G800 C. & P.	30.00
Plinth & Cover for Garrard	
SP25/2025TC	3.95
<b>SPEAKER BARGAINS</b>	
EMI 13" x 8" 3, 8 or 15 ohm	
Plain	2.15
with Co-Axial Tweeter	2.30
Twin Tweeter	3.95
Type 350 8 ohm or 15 ohm, 20 watt	
6 1/2" 8 ohm, 10 watt	2.85
8" 8 ohm, 10 watt	3.90
12" 8 ohm, 20 watt	5.75
8" x 5" C/Mag. 5 watt	1.40
8" x 5" Dualcone 8 ohm	
10 watt	2.70

FANE 7" x 4" 3 or 8 ohm	1.15
8" Dualcone 8 ohm	2.50
CELESTION 8" 15 ohm	1.75
ADASTRA 10" 8 or 15 ohm, 10 watt	3.25
<b>BAKER GROUP 25</b>	
12" 8 or 15 ohm, 25 watt	7.75
3" 8 ohm, 5 watt C/Mag.	80
2 1/2" 8 ohm or 64 ohm	80
ELAC 8" 8ohm Dualcone	2.35
10" 8ohm Dualcone, 10watt	3.45
<b>SELECTION OF GOODMAN AND WHARFEDALE SPEAKERS ALSO AVAILABLE.</b>	
<b>KIT FORM CABINETS - TEAK VENEER</b>	
12 x 12 x 6 with 8", 8" x 5", or 6 1/2" and 3 1/2" outout	2.75
17 x 10 x 9 with 8" or 13" x 8" outout	8.95
18 x 11 x 9 with 13" x 8" out out for EMI 350	4.80
<b>TWEETER &amp; CROSSOVER</b>	
EMI 3 1/2" 3 or 8 ohm C/Mag.	1.10
Cone Tweeter 8 or 15 ohm, 10 watt	2.50
Cone Tweeter 8 ohm, 3 watt	1.50
Horn Tweeter 8 ohm, 20 watt	5.95
Domie Tweeter 8 ohm, 30 watt	4.95
Crossovers CN23 (3 ohm), CN28 (8 ohm), CN216 (18 ohm)	1.15
<b>CARTRIDGES</b>	
ACOS GP91/28C or GP91/38C Stereo comp.	1.05
GP93/1 Stereo crys.	1.35
GP93/1 Stereo crys.	1.75
GP95/1	1.35
GP96/1	1.75
GP101	.75
GP104	1.65
<b>SONOTONE</b>	
9TA1C Stereo ceramic, diam.	1.80
9TA1C/G Slim fit, stereo cer. diam.	1.80
19-T1 Stereo crystal	.85
BSR SC5M Stereo ceramic	2.25

5X5H Stereo crystal	£1.65
5X5M Stereo crystal	1.65
X5H Mono/stereo	1.30
X5M Mono/stereo	1.30
GOLDRING G800	3.85
G850	2.95
G800E	7.50
AUDIO Technica AT-55	1.75
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D. Diamond	1.25
GOLDRING G800 G850 G800E	1.95
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<b>MICROPHONES</b>	
CM20 Crystal Hand	.60
CM70 Planet stick metal, switch crystal	1.70
DM180 Dynamic uni-dir, ball metal	4.00
UD130 50K/600 ohm, uni-dir, ball metal	5.65
TW206	5.90
CONDENSER MIKE 600 ohm, uni-dir.	7.90
Cassette STICK MIKE with R. Control on/off switch (2.5 & 3.5 min J/Ply)	1.45
MIKE MIXERS Mono.	4.10
Mono/stereo de luxe	5.50
<b>CASSETTES</b>	
Type Low noise	Phil. Mem- Am- pex
C45	50p 50p 45p
C60	85p 85p 85p
C90	45p 69p 75p
C120	55p 105p 110p
Cassette Head Cleaner	.45
BIB Stereo Test Cassette	1.65
AMPEX Head Cleaner De-magnetiser	1.65
<b>PLASTIC LIBRARY CASES for 5" Reels 20p, 5 1/2" Reels 25p, 7" Reels 30p.</b>	
<b>CASSETTE CASES</b>	
TAPES Stnd. L.P. D.P.	
5" 55p 65p 80p	
5 1/2" 65p 75p 21.00	
7" 80p £1.05 £1.40	

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Credit Terms for Callers

**BUDGET SPEAKER SYSTEMS**

- Pr. of 10 watt 8ohm 2 speaker system in deluxe teak veneer cabinet 18" x 11" x 9" wired, inc. plugs. £25.00 per pair.
- Pr. of 20 watt 8ohm 2 speaker system freq. response 50c.p.s. to 17,000c.p.s. Teak veneer cab. 21 1/2" x 13" x 9" with 12ft. cable and plugs. £29.95 per pair.

<b>AKAI TAPE DECK</b>	
4000DS Tape	99.95
GXC40B Cassette	83.00
<b>HEADPHONES</b>	
AMSTRAD HP85A	4.95
ROTEL	4.90
430	6.20
700	8.95
AKAI ASE 115	5.75
ARE 20	7.95
KOSS K7II (Black or Red)	9.93
K6	11.95
K6LC (with Vol. control)	13.25
K0727B	15.75
K0747	19.50
HVI	19.80
PROAAA	28.95
PROSLC	28.75
ESP6	42.75
<b>LEESSON ELECTROSTATIC</b>	19.50
Mono/stereo super de luxe 8-16Ω	2.75
Headphone Adaptor	2.50
Curly Ex, Lead 20ft.	1.10
<b>IN-CAR ENTERTAINMENT SECTION</b>	
Car Cassette Stereo Player and Two Speakers	20.95
Car 8-track Stereo Player and Two Speakers	16.80
Pair of Car Stereo Speakers	3.85
Pair of Car Stereo Speakers (Door Mounting)	3.95

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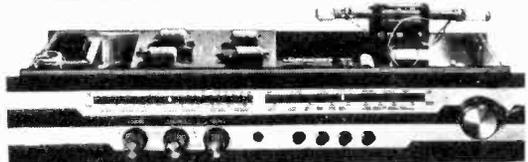
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The uncabineted system is ideal as an economical replacement for an outdated chassis. Stereo Amplifier for Stereo/Mono record reproduction. Tuner with medium, long and short wavebands provides Worldwide coverage, even the weakest continental stations can be received with superb clarity. Push button band selection, 10 watts total output. Frequency response 25-18000 Hz.

**LATEST BSR STEREO/MONO RECORD CHANGER** plays all types of 7in., 10in., and 12in. Mono or Stereo records. Manual or automatic play.

**TWIN ELLIPTICAL SPEAKERS** These low impedance, permanent magnet units have been specially selected to provide the fullest range of audio reproduction.

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All individually boxed and guaranteed. Full trade discounts to bona fide companies. Price and availability lists on application.

## EXPRESS POSTAGE

5p for 1 Valve.  
Each additional Valve add 2p.

DM70	0.63	EF80	0.46	PC86	0.75	PL84	0.66	30C15/	1.05
DY61	0.86	EF83	1.09	PC88	0.75	PL504	0.88	PCF800	1.00
DY86/7	0.45	EF85	0.43	PC907	0.46	PL508	1.05	30C17	1.00
DY802	0.45	EF86	0.90	PC900	0.56	PL509	1.55	30C18/	
EABC80	1.00	EF89	0.81	PC984	0.52	PL802	0.98	PCF805	0.90
EB91	0.88	EF91	1.80	PC988	0.80	PL803	0.86	30F5/PF818	
EC81	0.75	EF92	1.40	PC989	0.65	PL804	0.50	1.10	
EF80	0.60	EF95	1.85	PC989	0.65	PL805	0.50	30FL1/	
EF83	0.62	EF98	0.60	PC989	0.65	PL806	0.50	PCF800	0.75
EC89	0.58	EF184	0.80	PC989	0.65	PL807	0.50	30FL2	0.75
EC88	0.77	EL34	0.95	PCF201	0.87	PL808	1.00	30FL12	1.05
ECC81	0.45	EL36	1.08	PCF201	0.87	PL809	1.00	30FL14	0.85
ECC82	0.43	EL81	0.90	PCF201	0.87	PL810	1.00	30L1/PC894	
ECC83	0.45	EL84	0.47	PCF201	0.87	PL811	1.00	0.52	
ECC84	0.55	EL86	0.55	PCF201	0.87	PL812	1.00	1.05	
ECC85	0.58	EL88	0.85	PCF201	0.87	PL813	1.00	0.90	
ECC86	0.75	EL90	0.60	PCF201	0.87	PL814	1.00	1.80	
ECC89	0.71	EL91	1.81	PCF201	0.87	PL815	1.00	1.05	
ECC90	0.58	EL92	1.80	PCF201	0.87	PL816	1.00	1.05	
ECC92	0.78	EM84	1.18	PCF201	0.87	PL817	1.00	1.00	
ECF86	0.71	EM87	1.18	PCF201	0.87	PL818	1.00	1.00	
ECH81	1.00	EY81	0.83	PCF201	0.87	PL819	1.00	1.00	
ECH83	1.00	EY86/87	0.83	PCF201	0.87	PL820	1.00	0.95	
ECH84	0.78	EY89	0.64	PCF201	0.87	PL821	1.00	0.95	
ECL80	0.58	EZ80	0.51	PL81	0.75	6F23/EF812	1.00	1.20	
ECL82	0.61	EZ81	0.40	PL81A	0.78	30C11/PCF80	1.00	1.25	
ECL83	0.68	GY501	0.90	PL82	0.50	30C11/PCF80	1.00	1.25	
ECL86	0.68	GZ34	0.78	PL83	0.98	30C11/PCF80	1.00	1.25	

# NEW VALVES

Individually boxed and guaranteed but of European or other origin at greatly reduced prices. Quotations for any valve not listed. Send SAE for lists.

SP41	3.00	GJ6	0.30
SP61	0.75	GJ7M	0.45
T41	1.00	GJ7G	0.40
U14	1.00	GK6GT	0.70
U25	0.95	GK7M	0.45
U26	0.85	GK7G	0.70
U181	0.75	GK8M	0.70
UABC80	0.40	GK8G	0.45
UAF42	0.75	GK25	0.75
UBC41	0.75	GL6G	0.55
UBC81	0.45	GQ7M	0.50
UBF80	0.40	GQ7G	0.50
UBF89	0.40	8SL7GT	0.48
UCH85	0.45	88N7GT	0.48
UCH42	0.75	88Q7GT	0.50
UCH81	0.40	8U5G	0.75
UCH82	0.45	8V8G	0.40
UCH83	0.70	8V9GT	0.45
UF41	0.75	6X7M	0.45
UF89	0.40	6X5G	0.40
UL41	0.85	6X5GT	0.45
UL84	0.48	7B6	0.75
UY41	0.48	7B7	0.70
UY85	0.40	7C5	1.30
VR105-30	0.40	7C6	0.75
VR150-30	0.40	7H7	0.70
OA2	0.40	7R7	0.75
OB2	0.40	787	2.25
IR5	0.45	7Y4	0.75
IR6	0.80	12AT6	0.40
IT4	0.40	12AT7	0.40
384	0.40	12A7G	0.45
3V4	0.70	12A7U	0.38
5R4GY	0.80	12AX7	0.38
5U4G	0.40	12BA6	0.45
5V4G	0.50	12BE6	0.50
5Y3GT	0.45	30C1	1.00
5Z4G	0.45	30C15	1.05
6J30L2	0.90	30C17	1.10
6AK5	0.40	30C18	0.90
6AM5	0.90	30F5	1.10
6AQ5	0.45	30FL1	0.80
6B7G	0.95	30FL2	0.70
6AT6	1.45	30FL4	0.90
6AU6	0.80	30L15	1.05
6BA6	0.28	30L17	0.95
6BE6	0.35	30P4MR	1.80
6BH6	0.75	30P12	1.05
6B36	0.55	30P19	1.00
6C7A	0.65	30PL1	0.95
6C8G	1.00	30PL13	1.20
6C9	0.35	30PL14	1.25
6D6G	1.30	35W4	0.50
6E6G	1.40	80Z4GT	0.70
6F25	1.00	80CDDG	1.20
6F23	1.05	807	0.50
6F25	1.00	813 ITT	2.18
6F28	1.00	813 USSR	
6J5M	0.85		25.75
6J5G	0.45		1.00

# TRANSISTORS-INTEGRATED CIRCUITS

## EXPRESS POSTAGE

3p for first Transistor.  
for each additional add 1p.

AA119	0.7	BD132	0.50
AA213	0.10	BF115	0.22
AA215	0.10	BF167	0.25
AC107	0.85	BF173	0.28
AC126	0.25	BF179	0.33
AC127	0.25	BF180	0.35
AC128	0.20	BF181	0.35
AC176	0.25	BF194	0.13
AC187	0.20	BF195	0.13
AC188	0.20	BF197	0.12
AC191	0.22	BFY52	0.20
AC199	0.65	BF861	0.25
AD140	0.60	BF898	0.25
AD149	0.50	BFX29	0.28
AD161	0.39	BFX88	0.22
AD162	0.39	BFY50	0.20
AF115	0.25	BFY51	0.20
AF116	0.25	BFY52	0.20
AF177	0.20	BFY59	0.81
AF186	0.40	BY100	0.15
AF239	0.44	BY126	0.14
ABY27	0.30	BY127	0.15
ABY28	0.25	BZX61 series	
BA102	0.25		0.20
BA115	0.10	BZY88 series	
BC107	0.12		0.10
BC108	0.12	CR81-05	0.30
BC109	0.12	CR81-40	0.45
BC113	0.16	CR83-05	0.40
BC117	0.21	CR83-40	0.55
BC143	0.30	MJE340	0.50
BC147	0.12	MJE379	0.88
BC148	0.10	MJE380	0.85
BC169C	0.14	MJE2955	1.10
BC182	0.12	MJE3055	0.75
BC182L	0.12	MFP102	0.40
BC184L	0.13	MFP103	0.38
BCY32	1.20	MFP104	0.35
BCY33	0.38	MFP105	0.48
BCY34	0.45	NK7404	0.80
BCY70	0.15	OA5	0.80
BCY71	0.20	OA10	0.40
BCY72	0.15	OA79	0.10
BCZ11	0.65	OA81	0.10
BD121	1.00	OA91	0.7
BD124	0.80	OA920	0.05
BD131	0.45	OA202	0.10

All transistors, I.C.'s offered are new and branded. Manufactured by Mullard, Texas, RCA, Ferranti, Motorola, ITT, Fairchild, Lucas, etc. Quantity discounts on application. Send SAE for full lists.

OC16	1.00	ZTX501	0.15	2N2904	0.20
OC20	2.00	ZTX503	0.18	2N2904A	0.25
OC23	1.25	ZTX531	0.25	2N2905	0.32
OC25	0.40	ZTX552	0.18	2N2905A	0.25
OC28	0.70	1N914	0.08	2N2906	0.20
OC35	0.55	1N4001	0.6	2N2926	0.10
OC36	0.65	1N4002	0.7	2N3053	0.20
OC42	0.40	1N4003	0.8	2N3055	0.80
OC44	0.18	1N4004	0.8	2N3823	0.80
OC45	0.18	1N4005	0.10	2N3614	0.59
OC72	0.25	1N4006	0.12	2N3615	0.27
OC76	0.30	1N4009	0.08	2N3703	0.12
OC77	0.55	1N4148	0.06	2N3704	0.14
OC81	0.28	18921	0.07	2N3705	0.12
OC81D	0.28	182033	0.20	2N3706	0.10
OC81Z	0.45	182051A	0.10	2N3707	0.13
OC82	0.25	182100	0.20	2N3708	0.27
OC140	0.65	183010	0.25	2N3709	0.10
OC170	0.25	2N696	0.15	2N3710	0.11
OC171	0.30	2N697	0.15	2N3711	0.11
OC200	0.55	2N706	0.10	2N3819	0.85
OC201	0.80	2N706A	0.12	2N3820	0.60
OC202	0.90	2N1131	0.25	2N3823	0.60
OC203	0.55	2N1306	0.25	2N3903	0.13
OCPT1	0.00	1N3102	0.18	2N3904	0.20
ORP12	0.55	2N1303	0.18	2N3905	0.25
ORP60	0.45	2N1304	0.22	2N3906	0.18
ORP65	0.20	2N1305	0.22	2N4058	0.15
ORP66	0.20	2N1306	0.22	2N4059	0.10
TIC44	0.29	2N1306	0.28	2N4060	0.13
TIL226D	1.50	2N1307	0.28	2N4061	0.13
TIL209	0.25	2N1308	0.28	2N4062	0.14
TIC44	0.29	2N1309	0.30	2N4289	0.20
ZTX107	0.12	2N1613	0.20	2N4289	0.20
ZTX108	0.10	2N1614	0.45	3N141	0.81
ZTX300	0.14	2N2147	0.75	40380	0.40
ZTX301	0.10	2N2180	1.00	40381	0.45
ZTX302	0.20	2N2369A	1.18	40862	0.40
ZTX304	0.24	2N2646	0.50	40430	0.95

SN7400	0.26	SN7425	0.37	SN7473	0.44	SN74107	0.51	SN74157	1.09
SN7401	0.20	SN7427	0.37	SN7474	0.48	SN74110	0.57	SN74170	2.98
SN7402	0.20	SN7428	0.43	SN7475	0.58	SN74111	0.88	SN74174	1.80
SN7403	0.20	SN7430	0.20	SN7476	0.45	SN74118	1.00	SN74176	1.29
SN7404	0.20	SN7432	0.37	SN7480	0.80	SN74119	1.92	SN74178	1.44
SN7405	0.20	SN7433	0.43	SN7482	0.87	SN74121	0.67	SN74190	2.30
SN7406	0.40	SN7437	0.43	SN7483	1.20	SN74122	0.80	SN74191	2.30
SN7407	0.40	SN7438	0.43	SN7484	1.00	SN74123	1.44	SN74192	2.30
SN7408	0.25	SN7440	0.20	SN7486	0.50	SN74141	1.00	SN74193	2.30
SN7409	0.33	SN7441AN		SN7490	0.75	SN74146	1.44	SN74194	1.72
SN7410	0.20			SN7491	1.10	SN74150	2.30	SN74195	1.44
SN7411	0.28	SN7442	0.85	SN7491AN		SN74151	1.15	SN74196	1.58
SN7412	0.28	SN7450	0.20	SN7492	0.75	SN74154	2.30	SN74197	1.58
SN7413	0.30	SN7451	0.20	SN7493	0.75	SN74155	1.15	SN74198	3.16
SN7416	0.30	SN7453	0.20	SN7494	0.85	SN74156	1.15	SN74199	2.88
SN7417	0.80	SN7454	0.20	SN7495	0.85				
SN7420	0.20	SN7480	0.20	SN7496	1.00				
SN7422	0.28	SN7470	0.33	SN7497	4.32				
SN7423	0.40	SN7472	0.38	SN74100	2.18				

DIL SOCKETS 14 pin 15p  
16 pin 17p

# VAT

10% to be added to all orders including POSTAGE!

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● OSCILLOSCOPE TUBE TYPE VCR 139A  
Price £8.00 p & p 25p

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# ALL OUR PRICES INCLUDE V.A.T.

## BSR HI-FI AUTOCHANGER STEREO AND MONO

Plays 12", 10" or 7" records  
Auto or Manual. A high  
quality unit backed by BSR  
reliability with 18 months'  
guarantee. AC 200/250V.  
Size 18 1/2 x 11in.



Above motor board 31in.  
Below motor board 31in.  
With STEREO and MONO XTAL £6-75 Post 35p.

## PORTABLE PLAYER CABINET

Modern design. Size 18" x 15" x 7" Black rexine  
covered. Silver front grille. Padded Lid. Chrome  
fittings. Motor board cut for above BSR deck. £4-50  
Post 45p.

## 4 TRANSISTOR MONO AMPLIFIER

Powerful 8 watt output. 15 ohm. AC mains operated with  
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switch with knobs. Ready made on printed circuit board.  
Fused inputs and outputs. Famous make.  
Size 9in. wide x 4in. deep x 3in. high.  
Suitable 7" x 4" speaker, £1. £5-95 Post 25p

## BSR JUNIOR SINGLE PLAYER

Heavy duty 4-speed motor with  
separate pick-up arm fitted  
LP/78 turnover motor £4-95  
compatible cartridge.



## GARRARD DECCA HI-FI DECK

Single play Stereo/  
Mono Deram  
transcription  
head and arm.  
Four speeds.  
10in. turntable.  
Anti-rumble filter.  
Bias compensation.  
Laboratory motor.



SPECIAL PRICE £18-50 Post 25p Ideal for  
Disco-Deck

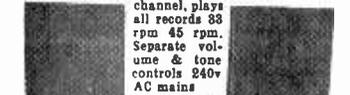
## METAL PLINTH AND PLASTIC COVER

Cut out for most Garrard or B.S.R.  
Most will play with cover in position.  
12 1/2 x 14 1/2 x 7 1/2in. £4-95  
Covered in black leatherette. Post 45p

ALSO AVAILABLE IN SOLID NATURAL MAHOGANY  
WAX POLISHED FINISH—£6-95

## COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 12 1/2 x 10 x 3 1/2in. Player  
unit clips to loudspeakers making it extremely compact.  
Overall size only 13 1/2 x 10 x 8 1/2in. 8 watts per  
channel, plays all records 33  
rpm 45 rpm. Separate vol-  
ume & tone  
controls 240V  
AC mains



Attractive  
Teak finish  
Weight 13lbs. Bargain Price  
£25  
85p carriage

## SPECIAL OFFER! SMITH'S CLOCKWORK 15 AMP TIME SWITCH 0-60 MINUTES

Single pole two-way Surface mounting  
with fixing screws. Will replace existing  
wall switch to give light for return home,  
garage, automatic anti-burglar lights etc. Variable knob  
Turn on or off at full or intermediate settings.  
Fully insulated. Makers last list price £4-50. Brand new and  
fully guaranteed. OUR PRICE £1-65 Post 25p.



BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2 1/2in sides  
6 x 4in 45p; 8 x 6in 53p; 10 x 7in 65p; 12 x 8in 85p;  
14 x 9in 90p; 16 x 6in 90p; 12 x 3in 50p; 16 x 10in £1.  
ALUMINIUM BOXES 3 x 3 x 3 in. 60p. 4 x 4 in. 70p.  
6 x 4 x 4 in. 80p. 9 x 4 x 4 in. £1. 12 x 4 x 4 in. £1-30.  
ALUMINIUM PANELS 18 s.w.g. 6 x 4in 12p; 8 x 6in 18p;  
14 x 3in 20p; 10 x 7in 24p; 12 x 5in 25p; 12 x 8in 34p;  
16 x 6in 34p; 14 x 9in 40p; 12 x 12in 47p; 16 x 10in 60p.  
PAXOLIN PANEL 10 x 8in 20p.

1 1/2inch DIAMETER WAVECHANGING SWITCHES. 25p.  
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way, 25p each.  
1 p. 1-2-way, or 4 p. 2-way, or 4 p. 3-way, 25p.

TOGGLE SWITCHES. 18p; dp. 22p; dp. dt. 22p.  
Sub-miniature, sp. 33p; dp. 40p; dp. dt. 50p.

R.C.S. STABILISED POWER PACK KITS  
All parts and instructions with Zener Diode. Printed Circuit  
Bridge Rectifiers and Double Wound Mains Transformer.  
Input 200/240V a.c. Output voltages available 6 or 9 or 12  
or 15 or 18 or 20V dc. at 100mA or less.  
PLEASE STATE VOLTAGE REQUIRED. £2-20 Post 20p

R.C.S. GENERAL PURPOSE TRANSISTOR  
PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape P.U., Guitar, etc. Can be used with  
Battery 9-12v. or H.T. line 200-300V. D.C. operation. Size  
1 1/4" x 1 1/4" x 1". Response 26 c.p.s. to 25 Kc/s. 26 db gain.  
Can be used with valve or transistor equipment. 99p Post  
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NEW TUBULAR ELECTROLYTICS		CAN TYPES	
2/350V 14p	250/25V 14p	16 + 16 + 16/376V 45p	
4/350V 14p	500/25V 20p	40 + 40/300V 50p	
8/450V 18p	1000/25V 35p	60 + 100/850V 85p	
16/450V 22p	1000/50V 47p	32 + 32/850V 20p	
32/500V 50p	8 + 8/450V 22p	32 + 32/450V 60p	
25/25V 10p	8 + 16/450V 35p	350 + 50/325V 55p	
50/50V 10p	16 + 16/450V 40p	100 + 50 + 50/350V 55p	
100/25V 10p	32 + 32/350V 40p	32 + 32 + 32/850V 65p	

LOW VOLTAGE ELECTROLYTICS.  
1, 2, 4, 6, 8, 15, 25, 30, 50, 100, 200mF 15V 10p.  
500mF 15V 15p; 25V 20p; 50V 30p.  
1000mF 12V 20p; 25V 35p; 50V 47p; 100V 70p.  
2000mF 6V 25p; 25V 42p; 50V 57p.  
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.  
5000mF 6V 25p; 12V 42p; 25V 70p; 50V 85p; 50V 95p.  
CERAMIC 1pF to 0.01mF, 4p. Silver Mica 2 to 5000pF, 4p.  
PAPER 350V-0.1 4p; 0-5 18p; 1mF 15p; 5mF 150V 15p.  
500V-0.001 to 0.05 4p; 0.1 6p; 0.25 8p; 0.47 25p.  
SILVER MICA. Close tolerance 1%. 2-2-600pF 8p; 650-  
2-200pF 10p; 2-700-5-800pF 20p; 6-300pF-0.01, mfd 30p each.  
TWIN GANG. "0-0" 208pF + 176pF, 75p.  
Slow motion drive 385pF + 365pF with 22pF + 25pF, 60p;  
500pF standard 85p.  
SHORT WAVE SINGLE. 10pF, 30p; 25pF, 55p; 50pF, 55p.

SHORT WAVE SINGLE GANG. Precision Silver Plated  
Gaugable Tuning Condensers. 50p each  
Values up to 100pF.  
Section Couplers supplied FREE with two or more gangs.

NEON PANEL INDICATORS. 250V AC/DC Amber, 20p.  
RESISTORS. 1/4 w., 1/2 w., 1 w., 2 w., 5 w., 10 w., 10 Ohm to 10M.  
HIGH STABILITY. 1/4 w., 2%, 10 Ohms to 6 meg., 10p.  
Ditto 5%. Preferred values 10 Ohms to 10 meg. 4p.  
WIRE-WOUND RESISTORS. 5 watt, 10 watt, 15 watt,  
10 Ohms to 100K, 10p each; 2w 0.5 Ohm to 8.2 Ohms 10p.  
TAPE OSCILLATOR COIL. Valve type, 35p.  
FERRITE ROD 8" x 1/2" 20p; 6" x 1/2" 20p; 3" x 1/2" 10p.

## MAINS TRANSFORMERS ALL POST 25p each

Esq. MT12 12-0-12v 50MA £2-50  
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800-0-800 v. 120 mA. 6-3 v. 4 a. C.T. 6-3 v. 2 a. £4-25  
MINIATURE 200 v. 20 mA. 6-3 v. 1 a. 2 1/2 x 2 1/2 x 2in. 75p  
MIDGET 220 v. 45 mA. 6-3 v. 2 a. 2 1/2 x 2 1/2 x 2in. 90p  
HEATER TRANS. 6-3 v. 2a. 60p  
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs  
at 2 amp, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £3-00  
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2 amp, 6, 8, 10, 12, 15, 18, 20, 24, 30, 36, 40, 48, 60 £4-00  
5 amp, 6, 8, 10, 12, 15, 18, 20, 24, 30, 36, 40, 48, 60 £9-75  
5, 8 and 13 v. 5 amp. £1-20. 3 amp. 3, 5, 8, 10, 13 and  
6-0-6 v. £1-30. Ditto 5 amp. £1-60. 6-0-6 v. 500 mA 90p.  
6 v. 1 amp 85p. 12 v. 300 mA 75p. 12 v. 500 mA 85p.  
12 v. 750 mA 95p. 40v. 1 amp £1-75.  
AUTO TRANSFORMERS. 115v to 230v or 230v to 115v.  
150w. £3-00; 500w. £6-25; 750w. £10; 1000w. £15.  
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BATTERY CHARGERS. Ready built with leads and clips  
1 1/2 amp. £2; 4 amp. £4; 5 amp. £4-50.  
FULL WAVE BRIDGE CHARGE RECTIFIERS:  
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watts. Insulated terminals. Varnish impregnated. Fully  
enclosed in steel case with fixing lugs. £10 Carr.  
Famous make. (Value £19) OUR PRICE £10 50p  
Can be used as 800 watt auto transformers 240-110V.

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115 volt TAPE DECK £2-50 Post 50p.

## VOLUME CONTROLS 80 Ohm Coax 5p. rd.

Long spindles. Midget Size  
5 K. Ohms to 2 Meg. LOG or  
L/S 15p. D.T. 25p.  
STEREO L/S 55p. D.T. 75p.  
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## BRITISH AERIALITE AERIAL-AIR SPACED 40 YD. £2-60 Post 25p.

FRINGE LOSS 10p per  
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Wirewound controls 1 1/2in. diam. 3 watts, 10 Ohms to 100K  
British made with long spindles 1/2in. dia 45p ea.

HELICAL POT 10k LIN List £3. Bargain 75p.

DUAL CONCENTRIC POT 500k LOG + 500k LIN D.P.  
switch. Inner spindle 3 1/2in; outer spindle 2 1/2in. 75p.

Wirewound controls 1 1/2in. diam. 3 watts, 10 Ohms to 100K  
British made with long spindles 1/2in. dia 45p ea.

HELICAL POT 10k LIN List £3. Bargain 75p.

DUAL CONCENTRIC POT 500k LOG + 500k LIN D.P.  
switch. Inner spindle 3 1/2in; outer spindle 2 1/2in. 75p.

Wirewound controls 1 1/2in. diam. 3 watts, 10 Ohms to 100K  
British made with long spindles 1/2in. dia 45p ea.

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switch. Inner spindle 3 1/2in; outer spindle 2 1/2in. 75p.

## E.M.I. 13 1/2 x 8 in. SPEAKER SALE!

With twin tweeters.  
And crossover. 10  
watt. State 3 or 8 or  
15 Ohm. As illustrated. Post 25p  
£4-50



With flared tweeter cone and ceramic  
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Flux 10,000 gauss.  
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8 Ohm, 10 watt. Large ceramic magnet.  
Special Rubber cone. Mounted on  
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## ELAC CONE TWEETER

The moving coil diaphragm gives a good  
radiation pattern to the higher frequencies  
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from 1,000 cps to 18,000 cps. Size 5 1/2 x  
3 1/2 in. deep. Rating 10 watt, 3 Ohm.  
Crossover £1-25  
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## GOODMANS 8 in. WOOFER

8 Ohm 12 watt. Deep cone.  
Heavy ceramic magnet. Bass  
resonance 35 cps. Frequency  
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Ideal bass unit for £3-75  
Hi-Fi systems



LOUDSPEAKERS P.M. 3 OHMS. 7 x 4in. £1-25; 6in. £1-50;  
8 x 5in. £1-60; 8in. £1-75; 10 x 6in. £1-90; 10in. £2-00.  
SPECIAL OFFER LOUDSPEAKERS! All Brand New.  
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3in. 15 Ohm. 3 1/2in; 5in; 6 x 4in; 5in x 3in; 7 x 4in; 8 x 5in.  
25 Ohm. 2 1/2in; 3in; 3in; 6 x 4in; 3in. 35 Ohm. 2in; 3in; 5in.  
8 Ohm. 3 1/2in. £1 EACH

RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in.  
diameter 4W £2-50, 10in. diameter 5W £2-60; Post 25p.  
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SPEAKER COVERING MATERIALS. Samples Large S.A.E.  
Horn Tweeter 2-18Kc/s. 2-18Kc/s. 2-18Kc/s. 2-18Kc/s.  
De Luxe Horn Tweeters 2-18 Kc/s. 15W. 8 Ohm £2-50.  
TWO-WAY 3,000 c.p.s. CROSS OVERS 3, 8 or 15 Ohm £1-25

TWO-WAY CROSSOVER NETWORK 3,000 c/s  
With variable tweeter attenuator giving accurate high/low  
frequency balance. Mounted on panel 5 1/2in. x 4in. with  
control knob, tweeter and woofer leads and input £3-75 Post  
terminals. Suitable for 3 to 8 Ohm impedance. 80p

## ELECTRO MAGNETIC PENDULUM MECHANISM

1-6v d.c. operation over 250 hrs. continuous on SP3 battery.  
Fully adjustable swing and speed. Ideal displays teaching  
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2 Stage Triode Pentode valve. 3 watts 3 Ohm output. Volume  
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£4-50. Post 25p.

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P50/1AC-40p. RASW 85p.  
P50/2CC-40p. OPT1 85p.  
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Printed Circuit 60p. Twin Gang 75p.

## COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p

OUTLET BOXES. SURFACE MOUNTING 25p.  
BALANCED TWIN RIBBON FEEDER 800 Ohms, 5p. rd.  
JACK SOCKET S4. open-circuit 14p. closed circuit 25p;  
Horn Lead Socket 45p. Phone Plug 5p. Phone Socket 5p.  
DIN SOCKETS S4. Chrome 20p; 3-5mm Chrome 12p. DIN  
SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS  
Lead 3-pin 15p; 5-pin 15p. DIN PLUGS 3-pin 15p; 5-pin 25p.  
VALVE HOLDERS 5p; CERAMIC 10p; CANS 5p.

## BRITISH FM/VHF TUNING HEART

88 to 108 Mc/s British made. 2 Transistors  
ready aligned—requires 10.7  
Mc/s IF. Complete with tuning gang.  
Connections supplied but some  
technical experience essential.  
Our Price  
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**E.M.I. WOOFER AND TWEETER KIT**

THE PAIR. Post 25p. (Available separately.)  
**£6-75** Woofer £5-25; Tweeter £1-50.

Comprising a fine example of a Woofer 10 1/2 x 6 1/2 in. with a massive Ceramic Magnet. 440s. Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3 1/2 in. square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

Impedance Standard 8 ohms  
 Maximum power 12 watts  
 Useful Response 25 to 18,000 cps  
 Bass Resonance 45 cps

SUITABLE ENCLOSURE 20 x 13 x 9 in. MODERN DESIGN. TEAK WOOD FINISH.

**£10-50** Post 45p



**8in. or 10in. ELAC HI-FI SPEAKER**

Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts **£3-75**  
 10in. 12 watts



**TEAK VENEER HI-FI SPEAKER CABINETS Fluted Wood Fronts**

MODEL "A". 20 x 13 x 9 in. For 12in. dia. **£10-50** Post 45p  
 10in. speaker.

MODEL "B". 16 x 10 x 9 in. For 13 x 8in. or **£6-60** Post 35p  
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MODEL "B2" ditto. Triangular corner version.

MODEL "C". 16 x 8 x 6 in. For 8 x 6in. **£5** Post 25p  
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LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft.



**BARGAIN AM TUNER.** Medium Wave. Transistor Superhet **£4-95**  
 Ferrite aerial. 9 volt.

**BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER.** Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£4-50**

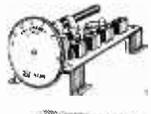
STEREO VERSION OF ABOVE **£5-95**.

**BARGAIN FM TUNER.** 88-108 Mc/s Six Transistor. 9 volt. Printed circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 x 5 x 4 in. **£12-85**

**BARGAIN FM TUNER.** **£8-85**  
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**BARGAIN 3 WATT AMPLIFIER.** 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£4-50**

**THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER.** Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leadset S.A.E. **£3-50** Post 20p



**BAKER MAJOR 12" £9-90**



30-14,600 c/s. 12in. double cone woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£12-50**

Please state 3 or 8 or 15 ohms. Post Free

**BAKER "BIG SOUND" SPEAKERS**

Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass Resonance 55 cps.

GROUP "25" **£8-80**  
 12in. 25 watt 3, 8 or 15 ohms. Post Free

GROUP "35" **£9-90**  
 12in. 35 watt 3, 8 or 15 ohms. Post Free

GROUP "50" **£22-00**  
 15in. 50 watt 8 or 15 ohms.

GROUP 50/12in. **£17-60**  
 50 watt 8 or 15 ohms



**MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER**

All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. Guaranteed. Details SAE.



**£49** Carr. £1-00

**CALLERS ONLY! DE LUXE 100 WATT AMPLIFIER CHASSIS**

7 valve version. 4 input 10 wide range controls. For mikes, Discos, Organs, Guitars, etc. 4, 8 & 15 ohm loudspeakers matching 289-00.

**QUALITY LOUDSPEAKER ENCLOSURE**

Teak veneered 1/2 inch thick wood cabinet. Size 18 1/2 in x 18 1/2 in x 8 in. Weight 28lbs. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for a 6 1/2 inch Woofer. Price £7-50 Carr. 50p. Rosewood Version £8-50. Carr. 50p.

**SPECIAL OFFER**

100 Ohm 90 watt Rheostat 2 1/2 in diam. Ceramic Former. Screw Terminals 1/4 in. diam. spindle. 95p. Post 25p.

**SPECIAL OFFER**

8 inch Panel Meter 50 Microamp, unusual scale require recalibrating. £1-75 post 25p.

**REVERSIBLE 4 POLE MOTOR**

1,400 r.p.m. Reversible 42 Watt. spindle 1 1/2" x 7/32", size 3 1/2" x 3". As illustrated, 240v. AC mains. **£2-25** Post 25p

**E.M.I. GRAM MOTOR**

120v. or 240v. A.C. 2,400 rpm. 2-pole 70mA. Size 2 1/2 x 2 1/2 x 2 1/2 in. **£1-00** Post 25p.

**BAKER HI-FI SPEAKERS HIGH QUALITY - BRITISH MADE**

**REGENT 12in. 15 watts**

An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver. Bass Resonance 45cps Flux Density 12,000gauss Useful response 45-13,000cps 3 or 8 or 15 ohm models.

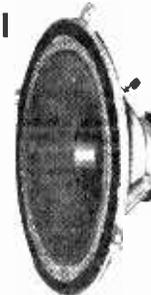
**£8-80** Post Free



**DE-LUXE Mk II 12in 15 watts**

Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone. Bass Resonance 30cps Flux Density 14,000gauss Useful response 25-18,000cps 8 or 15 ohms models.

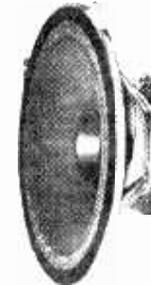
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**SUPERB 12in. 20 watts**

A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register. Bass Resonance 25cps Flux Density 16,500gauss Useful response 20-17,000cps 8 or 15 ohms models.

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**AUDITORIUM 12in. 25 watts**

A full range reproducer for high power, Electric Guitars, public address, multi-speaker systems, electronic organs. Ideal for Hi-Fi and Discobothèques. Bass Resonance 35cps Flux Density 15,000gauss Useful response 25-18,000cps 8 or 15 ohms models.

**£15-40** Post Free



**AUDITORIUM 15in. 35 watts**

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discobothèques, Electronic instruments and the home. Bass Resonance 35cps Flux Density 15,000gauss Useful response 20-14,000cps 8 or 15 ohms models.

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Hi-Fi Enclosure Manual containing 20 plans, designs, crossover data and cubic tables. 42p. Post Free.

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OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10 1/2 x 2 1/2 x 1/4 in. Operating voltage 200/250V, a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photocopyers and print drying equipment.

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½W 5% 4E7 to 2M2 then 10% to 10M

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Unit 'A' Rs, Cs, S/C's £1-20  
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## New Product CASED AUTO TRANSFORMERS

240 Volt Mains to 115 Volts, smart steel-cased units coated in tough resin, fitted with power lead, fuse and 115 Volt American type socket up to 500VA. above 500VA cable entry.

VA (Watts)	Price	Post
200 "	£5-58	£0-38
500 "	£9-50	£0-67
1000 "	£15-82	£0-82
2000 "	£29-70	£1-60

20V A version £10-30  
uncoated, no fuse £2-52

## POWER UNIT Type A125

Supplying 6 or 9 Volt DC at 200 mA.

In moulded case forming a 2 pin 5 A mains plug.

2 metric output lead with 4-way multiplug giving 2.1 and 2.5 mm sockets and 3.5 mm plugs.

Price £2-25. Post 10p.



## POWER UNIT Type P1076

Output switched 3, 4.5, 6, 7.5, 9 and 12 Volts at 500mA D.C. Operates from 240 V. mains, suitable for Radios, Tape Recorders, Record Players, etc. Size 7.5 x 6.0 x 14.0 cm. Price £3-85. Post 25p.

## MAINS KEYNECTOR

The safe, quick, connector for electrical appliances, 13 Amp rating, fused, will connect a number of appliances quickly and safely to the mains, ideal for testing, demonstrating, window displays, etc. Warning Light, interlocked to prevent connecting when live. Trade Price: £2-95. Post 25p.



## PANEL METERS 2" & 4"

Modern Wide View Face. Moving Coil. Wired for illumination (lamps extra).

50 mA 1250 ohms  
1 mA 170 ohms  
VU 5250 ohms (with Detector)  
Face Size 60 x 45 x 40mm (2")  
110 x 82 x 43mm (4")

PRICE: 2" £2-95 4" £3-95 + POST 10p

# TRANSFORMERS

## SAFETY ISOLATING

Prim. 120/240V. Sec. 120/240V. Centre Tap with Screen.

VA (watts)	Ref. No.	Price	P & P
		Cased	Open
60	149	—	£ 3-74 0-38
100	150	—	4-18 0-52
200	151	£ 9-48	7-48 0-62
250	152	12-05	9-57 0-65
350	153	14-00	11-44 0-80
500	154	15-80	13-20 1-00
1000	156	30-70	27-46 1-20
2000	158	60-95	55-44
3000	159	79-53	72-49

## 12 & 24 Volts Prim. 200-240V.

Amps	Ref. No.	Price	P & P
0-3	0-15	242	1-34 0-22
0-5	0-25	111	1-34 0-22
1	0-5	213	1-59 0-22
2	1	71	2-08 0-22
4	2	18	2-75 0-38
6	3	70	3-58 0-42
8	4	108	3-88 0-52
10	5	72	4-87 0-52
12	6	116	5-87 0-52
16	8	17	6-84 0-52
20	10	115	10-23 0-69
30	15	187	13-75 0-97
40	20	232	19-26 1-00
60	30	226	22-52 1-10

## 30 Volts

Prim. 200-240V. Sec. 12, 15, 20, 24, 30V.

Amps	Ref. No.	Price	P & P
0-5	112	£1 58	£0-22
1	79	2-20	0-38
2	3	3-19	0-38
3	20	3-98	0-42
4	21	4-88	0-52
5	51	5-80	0-52
6	117	6-83	0-52
8	88	9-00	0-67
10	89	10-00	0-67

## AUTO TRANSFORMERS (Open)

VA (Watts)	Ref. No.	Price	Post
Tapped at 115, 220, 240 Volts			
20	113	£1 32	22p
75	64	£2-83	30p
Tapped at 115, 200, 220, 240 Volts			
150	4	£3-25	39p
200	65	£3-98	40p
300	66	£4-64	62p
500	67	£5-03	67p
1000	84	£13-50	82p
2000	95	£25-30	£1-00
3000	73	£33-00	£1-20

PLEASE ADD 10% FOR V.A.T.

## 50 Volts

Prim. 200-240V. Sec. 19, 25, 33, 40, 50V.

Amps	Ref. No.	Price	P & P
0-5	102	£2-11	£0-30
1	103	3-08	0-38
2	104	4-29	0-42
3	105	5-77	0-52
4	106	7-43	0-52
6	107	11-00	0-67
8	118	14-19	0-97
10	119	17-80	0-97

## 60 Volts

Prim. 200-240V. Sec. 24, 30, 40, 48, 60V.

Amps	Ref. No.	Price	P & P
0-5	124	£2-10	£0-38
1	126	2-97	0-38
2	127	5-77	0-42
3	125	7-15	0-62
4	123	9-35	0-67
5	40	11-55	0-67
6	120	13-57	0-82
8	131	16-00	1-00
10	122	19-40	1-00
12	189	21-62	1-10

## MINIATURE AND EQUIPMENT

Prim. 240V with screen. Volts

Sec. 1	Sec. 2	Milliamperes	Ref. No.	Price	P & P
3-0-3	—	200	—	238	1-23 0-10
0-6	0-6	500	500	234	1-30 0-10
0-6	0-6	1000	1000	212	1-68 0-22
0-9-0-9	—	100	—	13	1-23 0-10
0-9	0-9	330	330	235	1-43 0-22
0-9-9	—	500	500	207	2-28 0-30
0-8-9	0-8-9	1000	1000	208	3-03 0-10
15-0-15	—	40	—	240	1-23 0-10
0-15	0-15	200	200	236	1-30 0-10
20-0-20	—	30	—	241	1-23 0-10
0-20	0-20	150	150	237	1-30 0-10
0-15-20	0-15-20	500	500	205	2-97 0-38
0-20	0-20	300	300	214	1-78 0-22
0-20	—	3500	NO SCREEN	1116	3-00 0-40
20-12-0-12-20	—	700 (D/C)	—	221	1-55 0-30
0-15-20	0-15-20	1000	1000	206	3-80 0-38
0-15-27	0-15-27	500	500	203	3-08 0-38
0-15-27	0-15-27	1000	1000	204	2-24 0-38

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One Amp	Two Amp	Four Amp	Six Amp
50 P.I.V. 25p	50 P.I.V. 35p	100 P.I.V. 55p	50 P.I.V. 65p
100 P.I.V. 25p	100 P.I.V. 40p	200 P.I.V. 58p	100 P.I.V. 70p
200 P.I.V. 28p	200 P.I.V. 45p	400 P.I.V. 65p	200 P.I.V. 80p
600 P.I.V. 30p	400 P.I.V. 50p	600 P.I.V. 75p	400 P.I.V. 90p

ADD 10p P & P PER ORDER

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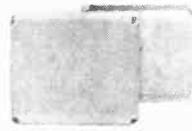
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Wall Thickness: 1/4"

Weight: 1 1/2 ozs

Price: £1-50. Post 15p.



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Suitable BCD decoder driver 7447 £1 15  
3015G showing + or - & 1 & dec. pt. £1 20

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1000mF/25V 28p 1000/50 41p  
5000/100 £2 91 2000/50 57p  
5000mF/25V 62p 5000/50 £1 18

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Radial leads for P.C.B. mounting. Working voltage 250V d.c.  
0.01, 0.015, 0.022, 0.033, 0.047 ea. 3p  
0.068, 0.1, 0.15 ea. 4p  
0.22, 5p; 0.33 7p; 0.47 8p; 0.68 11p; 1.0 14p;  
1.5 21p; 2.2 24p

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Working voltage 500V d.c.  
Values in pFs—2.2 to 820 in 32 stages ea. 6p  
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4700, 5000 15p; 6800 20p; 8200, 10,000 25p

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0.1, 0.22, 0.47, 1.0 mF/35V ea. 13p  
2.2/16V, 2.2/35V, 4.7/16V, 10/6.3 ea. 13p  
4.7/35V, 10/16V, 22/6.3V ea. 16p  
10/25V, 22/16V, 47/6.3V 100/3V ea. 18p

#### POLYCARBONATE

Type B432540 Working Voltage—250V  
Values in mF:  
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0.018; 0.022; 0.027; 0.033; 0.039; 0.047; 0.056  
0.068; 0.082; 0.1 ea. 4p

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In 26 values from 22pf to 6800pF, each, 2p

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ROTARY, CARBON TRACK. Double wipers for good contact and long working life.

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P.20 SINGLE log. 4.7Kohms to 2.2megohms, ea. 14p  
JP.20 DUAL GANG lin. 4.7Kohms to 2.2megohms, ea. 48p  
JP.20 DUAL GANG log. 4.7Kohms to 2.2megohms, ea. 48p  
JP.20 DUAL GANG Log/antilog 10K, 22K, 47K, 1 megohm only ea. 48p  
JP.20 DUAL GANG antilog 10K only 48p  
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2-circuit unswitched S1/SS 12p  
2-circuit /2 break contacts S1/BB 15p  
3-circuit unswitched (Not GPO) S3/SS 17p  
3-circuit with 3 break contacts S3/BBB 20p  
2 circuit with chrome nut and black/white/red/green or grey unswitched S5/SS 16p  
with 2 break contacts S5/BB 20p  
Miniature 3.5mm 2-circuit, (black) 2 br. cont S6/BB 9p

### Plugs

2 circuit screened top entry P1 24p  
side entry SEP1 30p  
Line socket mono 231 40p  
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3 circuit unscreened, bl/grey/wh. P4 38p  
2 circuit, unscreened, bl/wh/red/bl/grn/grn P2 18p  
3 circuit screen top entry P3 53p  
side entry SEP3 55p  
Miniature 3.5mm 2-circuit screened P5 13p  
Min. 3.5mm 2-circ. unscrend. various colours P6 10p

## EV CATALOGUE 2nd printing

112 pages, thousands of items; illustrations; diagrams; much useful technical information. The 2nd printing of this catalogue has been updated as much as possible on prices. It costs only 25p post free and includes a refund voucher for 25p for spending when ordering goods list value £5 or more.

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### RESISTORS

Code	Watts	Ohms	1 to 9	10 to 99	100 up
C	1/3	4.7-470K	1-3	1-1	0.8 nett
C	1/2	4.7-10M	1-3	1-1	0.9 nett
C	3/4	4.7-10M	1-5	1-2	0.9 nett
C	1	4.7-10M	3-2	2-5	1.9 nett
MO	1/2	10-1M	4	3-3	2.3 nett
WW	1	0.22-3.9	9	9	8
WW	3	1-10K	7	7	6
WW	7	1-10K	9	9	6

### Codes:

C = carbon film, high stability, low noise.  
MO = metal oxide, Electrofil TR5, ultra low noise.  
WW = wire wound, Plessey.

Values: All E12 except C 1/3W, C 1/2W, and MO 1/2W.  
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.  
E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

### Tolerances:

5% except WW 10% ±0.05% below 10Ω and MO 1/2W 2%.

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order.) Prices for 100 up in units of 100 only.

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0.47	—	—	—	—	—	—	11p	8p
1.0	—	—	—	—	—	—	—	8p
2.2	—	—	—	—	11p	—	—	8p
4.7	—	—	—	11p	—	—	—	8p
10	—	—	—	—	—	8p	9p	8p
22	—	—	—	—	—	—	8p	10p
47	8p	—	—	—	8p	8p	8p	10p
100	8p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	18p	23p	26p	37p	41p	—	—
4,700	26p	30p	39p	44p	58p	—	—	—
10,000	42p	46p	—	—	—	—	—	—

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Impedance  
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Gauss 14,000  
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50-15,000 Hz  
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12" 100 Watt 3" Pole Diam.

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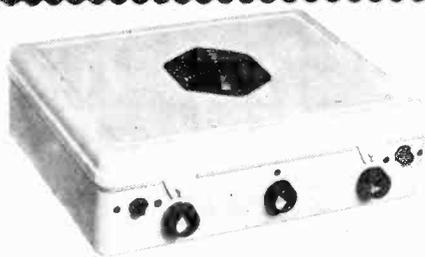
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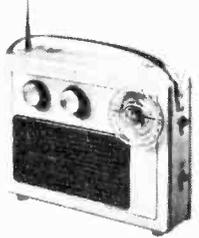
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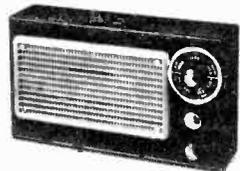


WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors, 9 Tuneable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors, 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9 1/2" x 7" x 2 1/2" approx. Parts Price List and Plans 30p (Free with parts).

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**Total Building Costs** **£2-73** P P & Ins. 30p  
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(Overseas P & P £1-25)

E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 15p. Free with parts.

**Total Building Costs** **£3-60** P P & Ins. 30p  
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E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans 20p. Free with parts. Overseas P & P £1-05.

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(+ 10% VAT 40p)

## ROAMER EIGHT Mk I

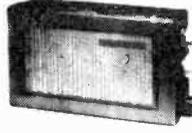


NOW WITH VARIABLE TONE CONTROL

7 Tuneable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt ferrite magnet loudspeaker. 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 4 in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

**Total building costs** **£6-98** P P & Ins. 47p  
(Overseas P & P £1-85) (+ 10% VAT 69p)

## POCKET FIVE



3 Tuneable wavebands. M.W. L.W. and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive black and gold case. Size 5 1/2" x 1 1/2" x 3 1/4" approx. Plans and Parts Price List 15p (Free with parts).

**Total Building Costs** **£2-28** P P & Ins. 26p  
(+ 10% VAT 22p)  
(Overseas P & P £1-25)



## TRANSONA FIVE

Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List 15p (Free with parts).

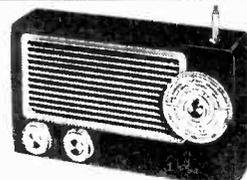
**Total Building Costs** **£2-50** P P & Ins. 26p  
(+ 10% VAT 25p) (Overseas P & P £1-25)

## TRANS EIGHT

8 TRANSISTORS and 3 DIODES

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

**Total building costs** **£4-48** P P & Ins. 33p  
(+ 10% VAT 44p)  
(Overseas P & P £1-25)



## ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 Tuneable Wavebands: MW, LW, SW1, SW2, 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 1/2 in. approx. Plans and parts price list 25p (FREE with parts).

**Total building costs** **£3-98** (Overseas P & P £1-85)  
(+ 10% VAT 39p)

## ROAMER TEN



WITH VHF INCLUDING AIRCRAFT  
10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 9 Tuneable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Latest 4" 2 watt ferrite magnet loudspeaker.

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

**Total building costs** **£8-50** P P & Ins. 52p  
(Overseas P & P £1-85) (+ 10% VAT 85p)



## "EDU-KIT"

Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include:  
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone 3" Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three 1/2" 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.  
Parts price list and plans 25p (FREE with parts).

**Total building costs** **£5-50** P P & Ins. 33p  
(Overseas P & P £1-85) (+ 10% VAT 55p)

## RADIO EXCHANGE LTD

★ Callers side entrance "Lavells" shop.  
★ Open 10-1, 2.30-4.30, Mon.-Fri. 9-12 Sat.

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Tel.: 0284 52867. Reg. No. 788372.

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# The largest selection

## EX COMPUTER BOARDS

Packed with transistors, diodes, capacitors and resistors—COMPONENT VALUE £1.50, 3 for ONLY 55p + p & p 30p

**SPECIAL ONE.** As above PLUS Power Transistors ONLY 55p each + p & p 15p

## STABILISED POWER MODULES

Complete with circuit diagrams, etc. 99p each + p & p 15p

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## FIBRE-GLASS PRINTED CIRCUIT BOARDS

16½ x 4" approx. 2 for 55p

## DECON-DALO 33PC Marker

Etch resistant printed circuit marker pen 90p each

## VEROBOARDS

Packs containing approx., 50sq. ins. various sizes, all -1 matric 55p

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RF Chokes  
CH1. 2.5mH 25p CH2. 5.0mH 25p  
CH3. 7.5mH 25p CH4. 10mH 25p  
CH5. 1.5mH 25p

## COILS

DRX1 Crystal set 11p DRR2 Dual range 45p

## COIL FORMERS & CORES

NORMAN 1" Cores & Formers 7p  
1" Cores & Formers 8p

## SWITCHES

DP/DT Toggle 25p SP/ST Toggle 18p

## FUSES

1½ and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1.5A, 2A  
QUICK-BLOW 4p ea. ANTI-SURGE 5p ea.

## EARPHONES

Crystal 2.5mm plug 33p  
Crystal 3.5mm plug 33p  
8 ohms 2.5mm plug 22p  
8 ohms 3.5mm plug 22p

## DYNAMIC MICROPHONES

B1223. 200 ohms plus on/off switch and 2.5mm and 3.5mm plugs £1.60

## 3-WAY STEREO HEADPHONE JUNCTION BOX

H1012 £1.87

## 2-WAY CROSSOVER NETWORK

K4007. 80 ohms Imp. Insertion loss 3dB £1.21

## CAR STEREO SPEAKERS

(Angled) £3.85 per pair.

## BI-PAK

CATALOGUE AND LISTS  
Send S.A.E. and 10p.

## INSTRUMENT CASES



(Black Vinyl covered)

No.	Length	Width	Height	Price
BV1	8"	5½"	2"	90p
BV2	11"	6"	3"	£1.20

## ALUMINIUM BOXES

BA1	5½"	2½"	1½"	42p
BA2	4"	4"	1½"	41p
BA3	4"	2½"	1½"	41p
BA4	5½"	4"	1½"	47p
BA5	4"	2½"	2"	41p
BA6	3"	2"	1"	34p
BA7	7"	5"	2½"	66p
BA8	8"	6"	3"	84p
BA9	6"	4"	2"	54p

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18 BALDOCK ST., WARE, Herts. (A10)

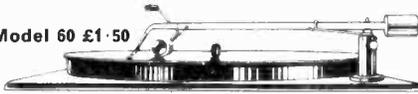
Open Mon.—Thurs. 9.15–6 p.m. Sat. 9.15–5.30. Late Night Shopping until 7 Fri. Tel. 61593

## BIB HI-FI ACCESSORIES

### De Luxe Groov-Kleen

Model 42 £1.84

Chrome Finish Model 60 £1.50



Ref. 36A. Record/Styleus Cleaning Kit 28p

Ref. 43. Record Care Kit £2.35

Ref. 31. Cassette Head Cleaner 54p

Ref. 32. Tape editing Kit £1.54

Model 9. Wire Stripper/Cutter 88p

Ref. P. Hi-Fi Cleaner 31p

Ref. 32A. Styleus Balance £1.36

Ref. J. Tape Head Cleaning Kit 51p

Ref. 34. Cassette Case £1.27

Ref. 56. Hi-Fi Stereo Hints & Tips 82p

## ANTEX SOLDERING IRONS

X25. 25 watt £1.93

CCN 240. 15 watt £2.15

Model G. 18 watt £2.15

SK2. Soldering Kit £2.86

STANDS: ST1 £1.21. ST2 77p

BOLDER: 18SWG Multicore 7oz 82p

22SWG 7oz 82p. 18SWG 22rt 28p

22SWG Tube 22p

## ANTEX BITS AND ELEMENTS

Bits No.

102 For model CN240 3/32" 38p

104 For model CN240 3/16" 38p

1100 For model CN240 3/32" 38p

1101 For model CN240 3/8" 38p

1102 For model CCN240 1" 38p

1020 For model G240 3/32" 38p

1021 For model G240 1/8" 38p

1022 For model G240 3/16" 38p

50 For model X25 3/32" 38p

51 For model X25 1/8" 38p

52 For model X25 3/16" 38p

## ELEMENTS

ECN 240 £1.16 ECCN 240 £1.32

EG 240 £1.16 EX 25 £1.16

## ANTEX HEAT SINKS 10p

V.A.T. included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

## NEW COMPONENT PAK BARGAINS

Pack

C1 250 Resistors mixed values approx. count by weight 0.55

C2 200 Capacitors mixed values approx. count by weight 0.55

C3 50 Precision Resistors 1%, 2% mixed values 0.55

C4 75 1/4 W Resistors mixed preferred values 0.55

C5 5 Pieces assorted Ferrite Rods 0.55

C6 2 Tuning Gangs, MW/LW VHF 0.55

C7 1 Pack Wire 50 metres assorted colours 0.55

C 8 10 Reed Switches 0.55

C 9 3 Micro Switches 0.55

C10 15 Assorted Pots & Pre-Sets 0.55

C11 5 Jack Sockets 3 x 3.5m 2 x Standard Switch Type 0.55

C12 40 Paper Condensers preferred types mixed values 0.55

C13 20 Electrolytics Trans. types 0.55

C14 1 Pack assorted Hardware—Nuts/Bolts, Grommets etc. 0.55

C15 4 Mains Slide Switches 0.55

C16 20 Assorted Tag strips & Panels 0.55

C17 10 Assorted Control Knobs 0.55

C18 4 Rotary Wave Change Switches 0.55

C19 3 Relays 6–24V Operating 0.55

C20 4 Sheets Copper Laminate approx. 10" x 7" 0.55

## PLUGS AND SOCKETS

### SOCKETS

PS 35 DIN 2 Pin (Speaker) 0-06

PS 36 DIN 3 Pin 0-10

PS 37 DIN 5 Pin 180° 0-10

PS 38 DIN 5 Pin 240° 0-10

PS 39 Jack 2.5mm Switched 0-09

PS 40 Jack 3.5mm Switched 0-10

PS 41 Jack 1" Switched 0-17

PS 42 Jack Stereo Switched 0-26

PS 43 Phono Single 0-06

PS 44 Phono Double 0-10

PS 45 Car Aerial 0-09

PS 46 Co-Axial Surface 0-09

PS 47 Co-Axial Flush 0-14

### INLINE SOCKETS

PS 21 D.I.N. 2 Pin (Speaker) 0-13

PS 22 D.I.N. 3 Pin 0-17

PS 23 D.I.N. 5 Pin 180° 0-17

PS 24 D.I.N. 5 Pin 240° 0-17

PS 25 Jack 2.5mm Plastic 0-10

PS 26 Jack 3.5mm Plastic 0-12

PS 27 Jack 1" Plastic 0-24

PS 28 Jack 1" Screened 0-28

PS 29 Jack Stereo Plastic 0-22

PS 30 Jack Stereo Screened 0-32

PS 31 Phono Screened 0-14

PS 32 Car Aerial 0-15

PS 33 Co-Axial 0-17

### PLUGS

PS 1 D.I.N. 2 Pin (Speaker) 0-11

PS 2 D.I.N. 3 Pin 0-12

PS 3 D.I.N. 4 Pin 0-15

PS 4 D.I.N. 5 Pin 180° 0-14

PS 5 D.I.N. 5 Pin 240° 0-15

PS 6 D.I.N. 6 Pin 0-15

PS 7 S.I.N. 7 Pin 0-15

PS 8 Jack 2.5mm Screened 0-10

PS 9 Jack 3.5mm Plastic 0-09

PS 10 Jack 3.5mm Screened 0-12

PS 11 Jack 1" Plastic 0-13

PS 12 Jack 1" Screened 0-18

PS 13 Jack Stereo Screened 0-29

PS 14 Phono 0-06

PS 15 Car Aerial 0-15

PS 16 Co-Axial 0-10

### CABLES

CP 1 Single Lapped Screen 0-06

CP 2 Twin Common Screen 0-08

CP 3 Stereo Screened 0-08

CP 4 Four Core Common Screen 0-23

CP 5 Four Core Individually Screened 0-30

CP 6 Microphone Fully Braided Cable 0-10

CP 7 Three Core Mains Cable 0-07

CP 8 Twin Oval Mains Cable 0-08

CP 9 Speaker Cable 0-04

CP 10 Low Loss Co-Axial 0-10

### CARBON POTENTIOMETERS

Log and Lin

47K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M

VC 1 Single Less Switch 0-14

VC 2 Single D.P. Switch 0-26

VC 3 Tandem Less Switch 0-28

VC 4 1K Lin Less Switch 0-14

VC 5 100K Log anti-Log 0-44

### HORIZONTAL CARBON PRESETS

0-1 watt 0-08 each

100, 220, 470, 1K, 2.2K, 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4.7M

## WORLD SCOOP

### JUMBO SEMICONDUCTOR PAK

Transistors—Germ. and Silicon Rectifiers—Diodes—Triacs—Thyristors—I.C.'s and Zeners ALL NEW AND CODED.

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20 Boards packed with Semiconductors and other Electronic Components. Each board approx. size 8" x 7". All known type nos and easily recognisable.

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OUR SPECIAL PRICE 8 for £1

## LOW COST CAPACITORS

01UF 400v. 3p. each  
500UF 50v. Elect. 10p each

## RECORD STORAGE/CARRY CASES

7" EP. 18½" x 7" x 8". (50 records) £2.10  
12" LP. 13½" x 7½" x 13½". (50 records) £2.95

## CASSETTE CASES

Holds 12. 10" x 3½" x 5". Lock & Handle. £1.90

## 8-TRACK CARTRIDGE CASES

Holds 14. 13" x 5" x 6". Lock & Handle. £1.95  
Holds 24. 13½" x 8" x 5½". Lock & Handle. £2.70

COLOURS: Red, Black and Tan—Please state preference.

## REPANCO TRANSFORMERS

240v. Primary. Secondary voltages available from selected tapings 4v, 7v, 8v, 10v, 14v, 15v, 17v, 19v, 21v, 25v, 31v, 33v, 40, 50 and 26v-0-25v.

Type	Amps.	Price	P & P
MT50/1	1	£1.98	30p
MT50/1	1	£2.42	35p
MT50/2	2	£3.30	40p

## CARTRIDGES

ACOS GP91-18C. 280mV at 1.2cm/sec £1.16  
ACOS GP93-1. 280mV at 1cm/sec £1.65  
ACOS GP96-1. 100mV at 1cm/sec £2.65

TTC J-2005. Crystal/Hi Output 95p

TTC J-20 10C Crystal/Hi Output Compatible £1.10

TTC J-200 CS Stereo/Hi Output £1.60

TTC J-2105 Ceramix/Med. Output £1.64

## CARBON FILM RESISTORS

The E12 Range of Carbon Film Resistors, 1/8th watt available in PAKS of 50 pieces, assorted into the following groups:—

R1 50 Mixed 100 ohms–820 ohms 40p

R2 50 Mixed 1K ohms–8.2K ohms 40p

R3 50 Mixed 10K ohms–82K ohms 40p

R4 50 Mixed 100K ohms–1 Meg. ohms 40p

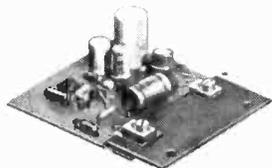
THESE ARE UNBEATABLE PRICES—LESS THAN 1p EACH INCL. V.A.T.

## BI-PAK SUPERIOR QUALITY LOW-NOISE CASSETTES

# -the lowest prices!

## BI-PAK QUALITY COMES TO AUDIO!

### AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S. The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	$P_o = 3 \text{ WATTS}$ $f = 1 \text{ kHz}$	0-25%
LOAD IMPEDANCE	—	8-16 $\Omega$
INPUT IMPEDANCE	$f = 1 \text{ kHz}$	100 k $\Omega$
FREQUENCY RESPONSE $\pm 3 \text{ dB}$	$P_o = 2 \text{ WATTS}$	50 Hz-25 kHz
SENSITIVITY for RATED O/P	$V_s = 25 \text{ V}$ , $R_L = 8 \Omega$ $f = 1 \text{ kHz}$	75 mV RMS
DIMENSIONS	—	3" x 2 1/4" x 1 1/2"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. ( $R_L = 8 \Omega$ $f = 1 \text{ kHz}$ )	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

#### AUDIO AMPLIFIER MODULES

AL 10. 3 watts RMS	£2 19
AL 20. 5 watts RMS	£2 59
AL 30. 10 watts RMS	£3 01

#### POWER SUPPLIES

PS 12. (Use with AL10 & AL20)	88p
SPM 80. (Use with also AL30 & AL50)	£3 25
FRONT PANELS SP 12 with Knobs	£1 10

#### PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20)	£4 35
PA 100. (Use with AL30 & AL50)	£13 15

#### TRANSFORMERS

T461 (Use with AL10)	£1 28 P & P 15p
T538 (Use with AL20)	£1 93 P & P 15p
BMT80 (Use with AL30 & AL50)	£2 15 P & P 25p

#### PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with Ceramic cartridges while the auxiliary input will suit most Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm x 84mm x 35mm.

Frequency response—  
20Hz-50KHz (-3dB)  
Bass control—  
 $\pm 12 \text{ dB}$  at 60Hz  
Treble control—  
 $\pm 14 \text{ dB}$  at 14KHz  
\*Input 1 Impedance—  
1 Meg. ohm  
Sensitivity 300mV  
†Input 2 Impedance—  
30 K ohms  
Sensitivity 4mV

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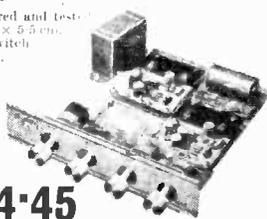
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ALL PRICES INCLUDE V.A.T.

### The STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm x 14 cm x 5.5 cm. This compact unit comes complete with on/off switch, volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control  $\pm 12 \text{ dB}$  at 60Hz typically 0.25% at 1 watt. Treble con.  $\pm 14 \text{ dB}$  at 14kHz.



£14.45

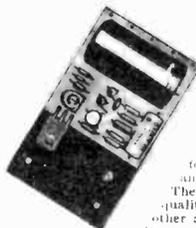
### NOW WE GIVE YOU 50w PEAK (25w R.M.S.) THERMAL PROTECTION! The NEW AL60 Hi-Fi Audio Amplifier FOR ONLY £3.95



- Max Heat Sink temp. 90°C.
- Frequency Response 20Hz to 100KHz
- 0-1% Distortion
- Distortion better than 1% at 1KHz
- Supply voltage 10-35 volts
- Thermal Feedback
- Latest Design Improvements
- Load—3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm x 105mm x 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

### STABILISED POWER MODULE SPM80



SPM80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1.5 amps at 35 volts. Size: 63mm x 105mm x 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disc Systems, Public Address Intercom Units, etc. Handbook available 10p. PRICE £3.25

TRANSFORMER BMT80 £2.15 p. & p. 28p

### STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages. Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.



#### SPECIFICATION

Frequency Response 20Hz-20KHz  $\pm 1 \text{ dB}$   
Harmonic Distortion better than 0.1%  
Inputs: 1. Tape Head 1-25 mV into 50K  $\Omega$   
2. Radio, Tuner 35 mV into 50K  $\Omega$   
3. Magnetic P.L. 1-5 mV into 50K  $\Omega$   
All input voltages are for an output of 250mV. Tape and P.L. input—equal to RIAA curve within  $\pm 1 \text{ dB}$  from 20Hz to 20KHz.  
Bass Control  $\pm 15 \text{ dB}$  at 20Hz  
Treble Control  $\pm 15 \text{ dB}$  at 30 KHz  
Filters: Rumble (High Pass) 100Hz  
Scratch (Low Pass) 8KHz  
Signal/Noise Ratio better than -65dB  
Input overload -26dB  
Supply -35 volts at 20mA  
Dimensions 292mm x 82mm x 35mm

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £25.30 FREE p. & p.

Giro-No. 388-7006

Please send all orders direct to warehouse and despatch department

# BI-PAK

P.O. BOX 6, WARE - HERTS

Postage and packing add 11p. Overseas add extra for airmail.

Minimum order 55p. Cash with order please.

Guaranteed Satisfaction or Money Back

# COMPONENTS 'FREEZE'

**N**OW that we have a good idea of what effects the 1974 Budget will have, the time is right for a reappraisal of our spending. There are, as always, two sides to the coin—the reader who may also be a constructor and therefore component buyer; the advertiser or component supplier, usually doing his best to satisfy a demand or looking for a new sales line.

Where shortage of cash and credit may well seriously affect the sales of commercial equipment, the devotee will look more towards cutting his costs by "doing-it" himself. There are, however, some areas that claim buoyant interest and of late this has been in the "ICE" (in-car entertainment) sector in particular.

## IN-CAR ENTERTAINMENT

In this issue of Practical Wireless we are publishing two articles on ICE, one on commercial equipment, the other as a technical appraisal. In this latter one we show you a first class design that has been made and is now touring the country in the designer's car.

Of course this particular design was conceived before anyone really believed that the industrial situation was so serious. Here we have an example where energetic investigations to find readily available components for it may have been frustrated. Alas, there is now, not only a shortage of steel and other materials, but price increases are imminent.

We could not in all honesty, commit readers knowingly to become victims of this situation through a popular published project without warning. In particular there are problems in getting the push button tuner head, and other items used by the author; current output is concentrated on long standing orders with commercial manufacturers.

Even so, these difficulties do not deter us completely from publishing an otherwise excellent design for its own sake. We know that British ingenuity will come to the rescue as it so often does. Many of you will have old car radios that need up-dating. In most cases the tuner head mechanism may still be serviceable. Unfortunately we cannot tell you if yours is suitable; we can only suggest that you look into it thoroughly or ask a knowledgeable friend for advice.

## COMPONENT SUPPLIES

Readers will probably have read or heard about other component shortages from some manufacturers, coupled with long delivery times and reorganised or rationalised stock holding. At retail level this is now being felt, although most of our advertisers may still boast large stocks. It all depends really on whether they have what you want at the right price.

We hear a great deal about the "information and communication rift" between suppliers and customers. On the one hand there are those suppliers who do not keep customers fully informed about delays, so aggravating customer relations and creating unnecessary complaints; on the other hand there are those constructors who do not make out their orders in a clear and concise manner, and often pose irrelevant questions or fail to send adequate money to cover VAT and carriage charges.

To solve all these problems to everyone's satisfaction is almost impossible with the limited resources

at our disposal. What we can do is to help inform readers through the magazine.

## BUYER'S GUIDE

We are planning to launch a special supplementary operation in the autumn aimed to provide readers with details of product lines and trading terms or retail component outlets. To carry any measure of value to both parties we need your help. However, there are limitations and we cannot hope to please everyone.

We shall be adding to our normal October issue an extra centre pull-out section which will contain information on components, components suppliers and trading terms. Unfortunately this has to be limited in size, so we shall be including further sections in the following three issues. You will be able to collate all these sections to form a valuable "Buyer's Guide" reference book which you will always want to keep handy.

## INVITATION

Component suppliers in the retail sector, who sell through shops or by mail order, are invited to submit catalogues or price lists of components only that they always carry in stock or are likely to have in stock regularly by the end of 1974. Trading terms must be included stating minimum order charge (if applicable), carriage and packing terms and quantity discount arrangements (if any). Any non-availability or waiting time in excess of one month for items listed should be indicated. The closing date for sending information to us is 17th June.

We regret that we cannot entertain telephone queries in respect of this operation. All correspondence should be addressed to "P.W. Electronic Components Buyer's Guide", Practical Wireless, Fleetway House, Farringdon Street, London EC4A 4AD.

Component suppliers will be pleased to learn that extra space is being made available for inclusion of their own personal announcements in the booklet, offering a permanent record to all readers. Special publicity support is being organised so that the best advantage will be taken to circulate this information among a larger audience.

Full details of the advertisers' announcements facility are available from our Advertisement Manager and bookings for space (no matter how small) should be made by the 1st July for the October issue section and by 1st August for all subsequent sections.

In undertaking this exercise we are confident that this Buyer's Guide will be welcomed by all readers. To make sure you do not miss out, we recommend you order your copies of Practical Wireless now.

M. A. COLWELL—Editor

**Next month: FIRST AGAIN, this time with TELE-TENNIS. You have probably seen the slot-machine version—see ours in the July issue and make one yourself. Also included are a 4-band portable radio, a wide-band high quality amplifier for audio and radio applications, advance details of new projects. Further details on page 139.**

**HOW!**

**T**HE womenfolk of the Navajo Indian tribe were sitting round the camp fire one balmy, summer evening. One woman, who was sitting on a deer skin, had a son who weighed 140lb. Another woman sitting on a buffalo skin had a son who weighed 160lb. A third woman, who herself weighed a staggering total of 300lb, was sitting on a hippopotamus skin.

What mathematical theorem does this remind you of and why? \*Answer at foot of page.

The aforementioned was extracted from the April issue of *The Cornish Link*, the official magazine of the Cornish Radio Amateur Club. Club call is G4CRC.

Subscription to the C.R.A.C. is £1.25 per annum. All enquiries should be addressed to the club p.r.o., Bill Locke G3NKE, "Hillside," Kehelland, Camborne, Cornwall (Tel. Camborne 2419). Sheila Locke, G3NKE's xyl, is Editor of the *Cornish Link*.

The C.R.A.C. annual mobile rally will be held on July 21st, 1974 on the campus of the Cornwall Technical College, Pool, Redruth. Prospective exhibitors may obtain further information and stand details from Bill Locke.

**Going Back**

**W**e have received a letter from Roger Goodman, who wanted some information on the instrument we included in our November 1973 issue (page 667). He says he would like to express his thanks to "Going Back" for the help he received in providing information on his "linesman detector". He received 21 replies and would like to sincerely thank those people who wrote to him, from Adrian Moss, aged 10, to a 71 year-old radio amateur.

\*Pythagoras. Because the squaw on the hippopotamus was equal to the sons of the squaws on the other two hides. Hi!

**The Source of Sound**

A feature at this year's Ideal Home Exhibition was a pavilion which showed, in sound and vision, the development of sound recording from early wax discs. Five room-settings were on view, dating from 1920 to the present. Our picture shows the 1930's setting.

**Weekend Course**

**W**HAT now looks massive and dominant in our society, only 50 years ago was tentative and experimental.

The beginnings of radio lie deep in the past; indeed one could look back thousands of years to those persons whose curiosity was aroused by small amber beads becoming attracted after polishing. This was investigated by Gilbert in experiments with "electricity" shown to Queen Elizabeth I. There followed the discoveries of Ampere and Volta, Faraday, Maxwell, Hertz and Marconi, which prepared the world for what was to be one of the great revelations of all time—the means of communication by radio broadcasting.

The weekend course will range from the early inventions and inventors of wireless and television to reminiscences of Savoy Hill, while not too technical language will describe Radio and Television studios. The social impact of the growth of broadcasting will be reviewed and its reflection on programming.

The weekend is enlivened with

demonstration and illustration, using working exhibits and archive recordings — Marconi — Reith — Nellie Melba, leaning heavily on the tradition of Information — Education — and Entertainment. Antiquities will be on working display, a crystal set of 1920—the pre-broadcasting era and "fireworks" in the form of a replica of Marconi's spark transmitter and receiver. Modern high power equipment will be used for transmission and reception throughout the world, during the weekend, under the callsign GB2HF.

The weekend will begin on Friday 7th June (evening) in an amenable social atmosphere, cultivated in a comfortably furnished guest house and will be led by Mr. Ralph Barrett, C.Eng. MIEE, MIERE.

Further details may be obtained by telephoning 01-203-3381.

**SORRY WE ARE LATE!**

We apologise for the late appearance of Practical Wireless. The delay has been caused by an industrial dispute in the printing industry.



RICHARD COLLIN

**T**HE first car radio receivers were essentially mains-type valve receivers with a special power supply. The 12 volt DC battery voltage was 'chopped' by a mechanical vibrator into a rough AC which was applied to a special type of power transformer, followed by considerable smoothing circuits. These receivers were very bulky and produced a large amount of noise from the vibrator. So much, in fact, that in many designs the power supply was separate to allow mounting outside the passenger compartment. These receivers were produced for almost 30 years until the transistor arrived on the scene.

Initially, only one transistor was used in the output stage. This led to a significant simplification of the receiver. Valves were still used in the earlier stages, although they were specially designed to operate with a 12 volt 'HT' rail, the receivers being known as 'hybrid' sets. The more expensive 'hybrid' receivers used a transistor driver stage and two power devices in a push-pull transformer output circuit. Up to 5 watts output could be provided into a 3 ohm loudspeaker.

The fully transistorised car receiver did not appear until high-frequency transistors became available at an economic price, when the car receiver underwent a complete change in design and the efficiency increased considerably. The old valve receivers consumed about 40 watts of power (3.5A at 12V) whilst the present generation of receivers require only 12W (1A at 12V). This reduction of heat output allowed more effective screening and helped to reduce size, the average car radio now measuring 7in x 2in x 4in deep, approximately.

## CIRCUITRY

Fig. 1 is an example of the circuit of a modern car radio which, in general, is fairly standard, but there are some special considerations. The RF stages must be high gain and the AGC must be fast acting. The oscillator stages must have very low drift and the whole set must operate successfully over a wide temperature range. In addition, the power supply circuits must effectively filter out the spikes and

transients and whistles produced by the car electrical system. Allowance also has to be made for connection to either negative or positive chassis cars.

## AERIAL INPUT CIRCUITS

A car radio aerial invariably has a high value of capacitance resulting from the screened feeder that is used to minimise interference pick-up and the input circuits have to accommodate this. A pre-set capacitor (C5, Fig. 1) is provided to balance out the feeder capacitance. This is adjusted once and for all with the receiver finally installed in the car. The normal procedure is to 'trim' for maximum sound output whilst tuned to a weak signal on the high frequency part of the MW band. A similar function is provided by C1 on the LW band.

The tuned circuits (AE, RF and OSC) are provided by a ganged permeability tuner. L2 tunes the aerial circuit and L3 is a loading coil, switched into circuit on LW.

To achieve the high gain necessary in a car receiver a tuned RF stage is used. Transistor Tr1 is a conventional amplifier with AGC applied to the base circuit, via R2/R14, and a tuned circuit, L4, C10/C12 providing coupling to the next stage. L4 is also part of the permeability tuner. This is switched out of circuit on LW. The signal from the RF circuit is fed into the base of Tr2, the mixer oscillator stage.

The oscillator circuit is provided by L6 in conjunction with C16-18 on MW plus C20/L5 on LW. The reason for using C17 and C18 (200pF plus 220pF) instead of just one single capacitor is to provide temperature drift compensation. In the receiver shown C18 is an NTC capacitor with a coefficient of  $-1500\text{ppm}$ . This compensates for any drift in the value of L6 and maintains an essentially stable oscillator frequency from  $-20^{\circ}\text{C}$  to over  $50^{\circ}\text{C}$ .

The IF output is taken from Tr2 collector via IFT1 primary L7. The primary is capacitively coupled via C23 to the secondary L8 which feeds directly into the base of Tr3 the IF amplifier. The amplified IF is applied to the detector diode D4 via IFT2. AGC is developed by D2, D3 and fed back to the RF stage.

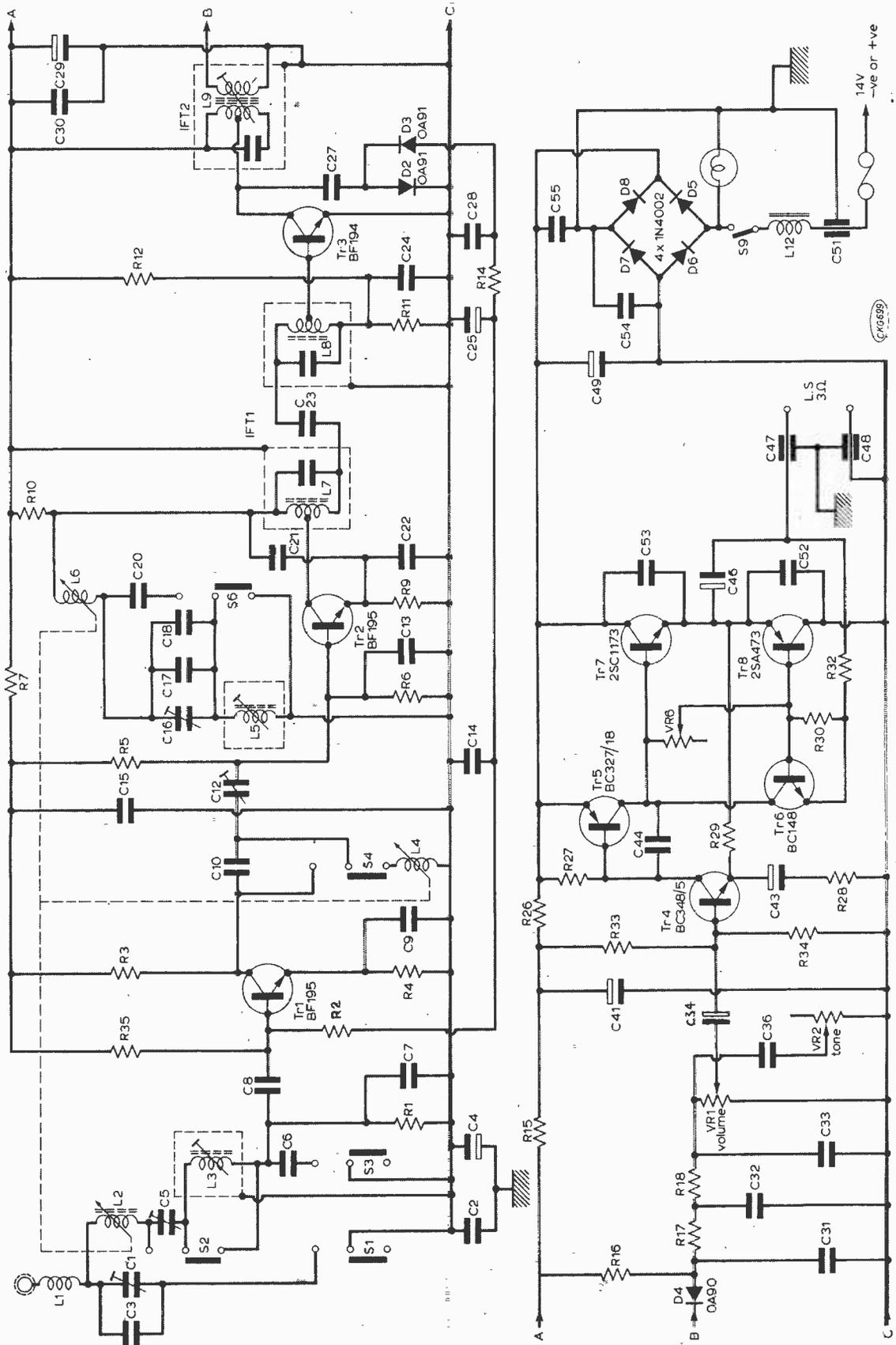


Fig. 1. Circuit diagram of a typical modern car radio. Its operation is described in the text.

Bias is applied to D4 via R16 to improve signal quality at low output levels.

C31, R17, C32, R18 and C33 provide filtering for the signal. VR1 is the volume control and VR2 provides top-cut tone control in conjunction with C36. Transistors Tr4 to Tr8 form a conventional audio amplifier providing 5W output into a 3Ω load with a fully charged battery (14.4V).

Capacitors C53, C52 and the feed-through types C47, C48 and C51 provide RF filtering of the DC supply. LF smoothing is effected by L12 and C49. An interesting feature is the use of separate diodes D5-D8 which form a bridge rectifier, allowing connection to cars with either negative or positive chassis. An important feature of this design is the method by which the RF earth of the radio is DC isolated from chassis by C2 and C4, but connected to the car chassis by either D6 or D7 depending on the battery polarity.

## RECENT TRENDS

The advent of low cost, high performance integrated circuits has recently brought further simplification to car receivers. The audio stages have been replaced by a power IC producing 4 watts output from the detector signal at the volume control. More recently complete AM subsystem IC's have appeared and these allow integration of the RF and IF stages so that it is now possible to produce a car radio with just two integrated circuits.

### EXPERIMENTAL TWO-IC CAR RADIO

<b>Battery Supply:</b>	12-16V, positive or negative chassis.
<b>Power Output:</b>	3.5W/4Ω or 4W/3Ω.
<b>Tuning Range:</b>	MW 185-577 metres. LW 1000-2000 metres.
<b>Temperature Range:</b>	-20°C to 60°C.
<b>Active Devices:</b>	RF CA3123E RF-IF—OSC—AGC. SGS TBA810AS Audio

In the following pages a two-IC 4W car radio built by the author is described, the radio having been in use very successfully for over four months. It must be stressed that anyone wishing to build a similar receiver should ensure that they can obtain the permeability tuner unit before they begin work as these are not readily available to the home constructor.

A full circuit board layout and circuit description is given but the chassis work is left to the individual as it consists of little more than an aluminium surround with top and bottom plates.

## CIRCUIT DESCRIPTION

The circuitry is shown in Figs. 2 and 3. The whip aerial is coupled via an RF choke, L1, into the RF amplifier by a conventional car radio tuned input circuit consisting of L2 and capacitors C3, C4, C5 and R1. C3 is a preset capacitor which is adjusted only after the receiver is finally installed in the car. Its purpose is to balance out the capacitance of the aerial feeder and provide optimum power transfer into the RF stage. On LW, C1 and C2 perform a

## ★ components list

### Resistors

R1 2.2kΩ	R5 150kΩ	R9 100Ω
R2 1.2kΩ	R6 1.2kΩ	R10 1Ω
R3 3.3kΩ	R7 100kΩ	VR1 10kΩ log*
R4 330Ω	R8 27Ω	VR2 22kΩ log*

Resistors  $\frac{1}{2}$  or  $\frac{1}{4}$ W 10%

\* concentric controls, ganged with S5, long bush

### Capacitors

C1 390pf ceramic	C21 0.01μF
C2 30/140pf pre-set	C22 0.047μF
C3 "	C23 180pF ceramic
C4 47pF ceramic	C24 0.047μF
C5 1500pF "	C25 0.1μF
C6 0.047μF	C26 470μF 6V
C7 470μF 10V	C27 0.0047μF ceramic
C8 0.1μF	C28 1500pF "
C9 10μF 16V	C29 0.1μF
C10 47μF 16V	C30 100μF 16V
C11 390pF ceramic	C31 1000μF 25V
C12 180pF "	C32 0.1μF
C13 470pF "	C33 1000μF 25V
C14 30/140pF pre-set	C34 1000μF 25V
C15 180pF ceramic*	C35 0.1μF
C16 120pF polystyrenet	C36 } 1000pF feedthrough
C17 0.015μF	C37 }
C18 10μF 16V	C38 }
C19 56pF ceramic	C39 100μF 16V
C20 0.0047μF "	C40 0.1μF

\* temp. coeff.—47ppm

† —150ppm

### Inductors

L1 6μH RFC	L3 Toko YXNS 6A139BA
L2 } Tuner, see note	L6 Toko YXNS 6A140HM
L4 }	L7 see text
L5 }	
IFT1 Toko YHCS/1A/590R	
IFT2 Toko YHCS/1A/589R	
IFT3 Toko YHCS/111 00/AC2	

### Semiconductors

D1 OA90	IC1 CA3123E (RCA)
D2/5 50V 1.5A bridge	IC2 TBA810AS (SGS/ATES)

### Miscellaneous

S1 to S4 are ganged. In the prototype a 6 pole change-over was used. For a manually tuned set the switch can be a 'push-on push-off' type. With a push-button set this switch is operated by the buttons changing from MW to LW automatically, in which case the return spring and lock must be removed from the switch. S5, on/off switch, is part of VR1/2 assembly. LP1, 14V LES bulb and holder. F1, In-line fuseholder and fuse 1.5A.

similar function while a loading coil L3 is also switched into circuit.

The RF stage is gain controlled by a frequency counter AGC circuit which allows control of the AGC response by selection of the coupling capacitor, C19. The output of the RF stage is coupled to the mixer stage by a further tuned circuit L4, C11, C12 and C13. On the LW the circuit is untuned and L4 switched out of circuit.

The oscillator stage is tuned by L5 together with C14, C15 and C16. On LW a further loading coil, L6, is switched into circuit. Because of the temperature range experienced within a car, extra care has to be taken in the design of the oscillator circuit. Temperature stability is provided by using three tuning

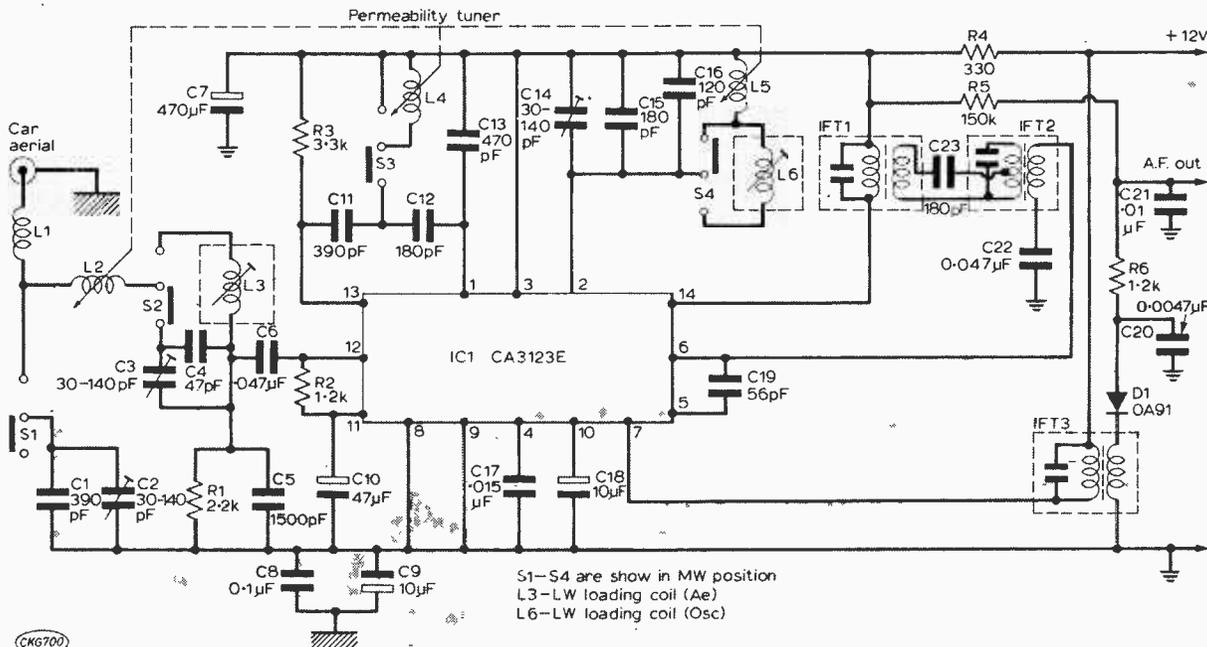
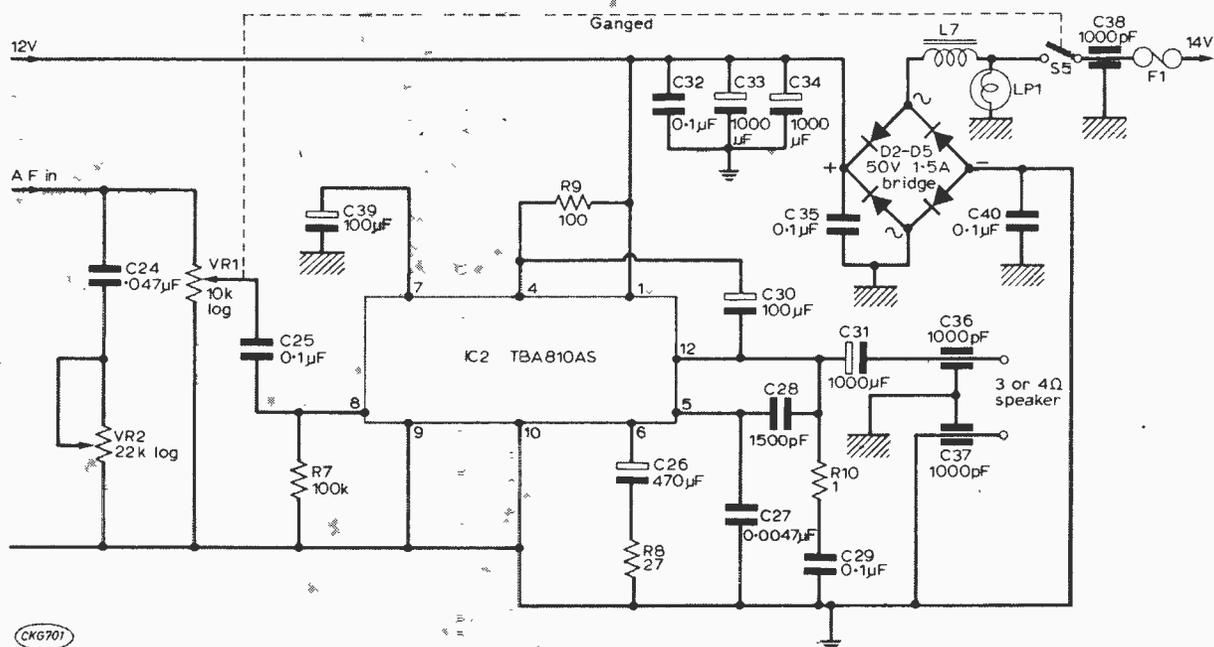


Fig. 2, above, RF section of the experimental car radio with the audio section, Fig. 3, below.

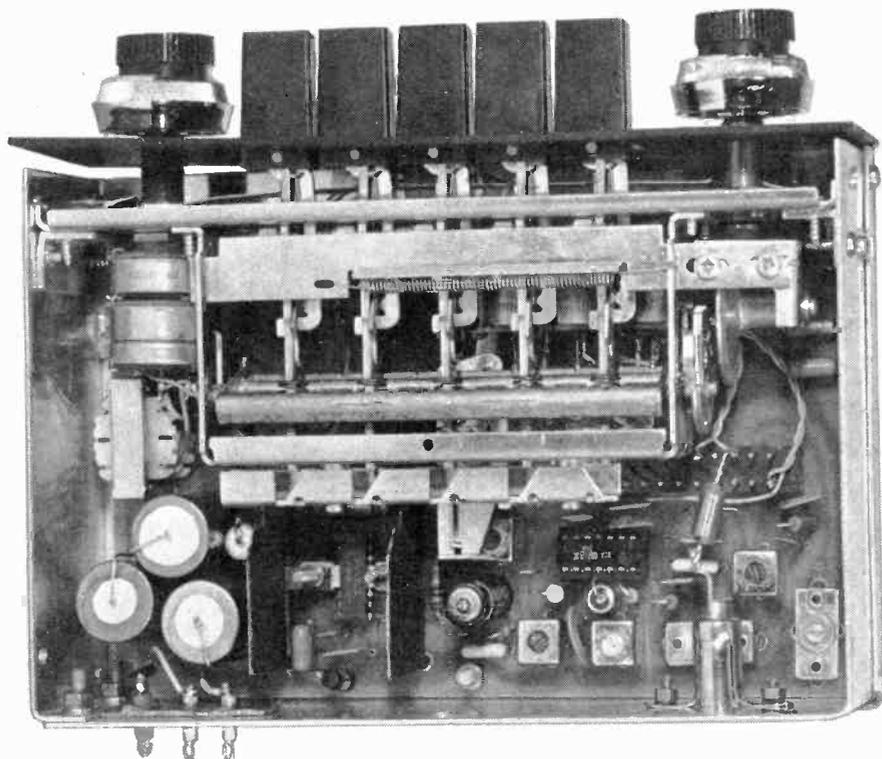
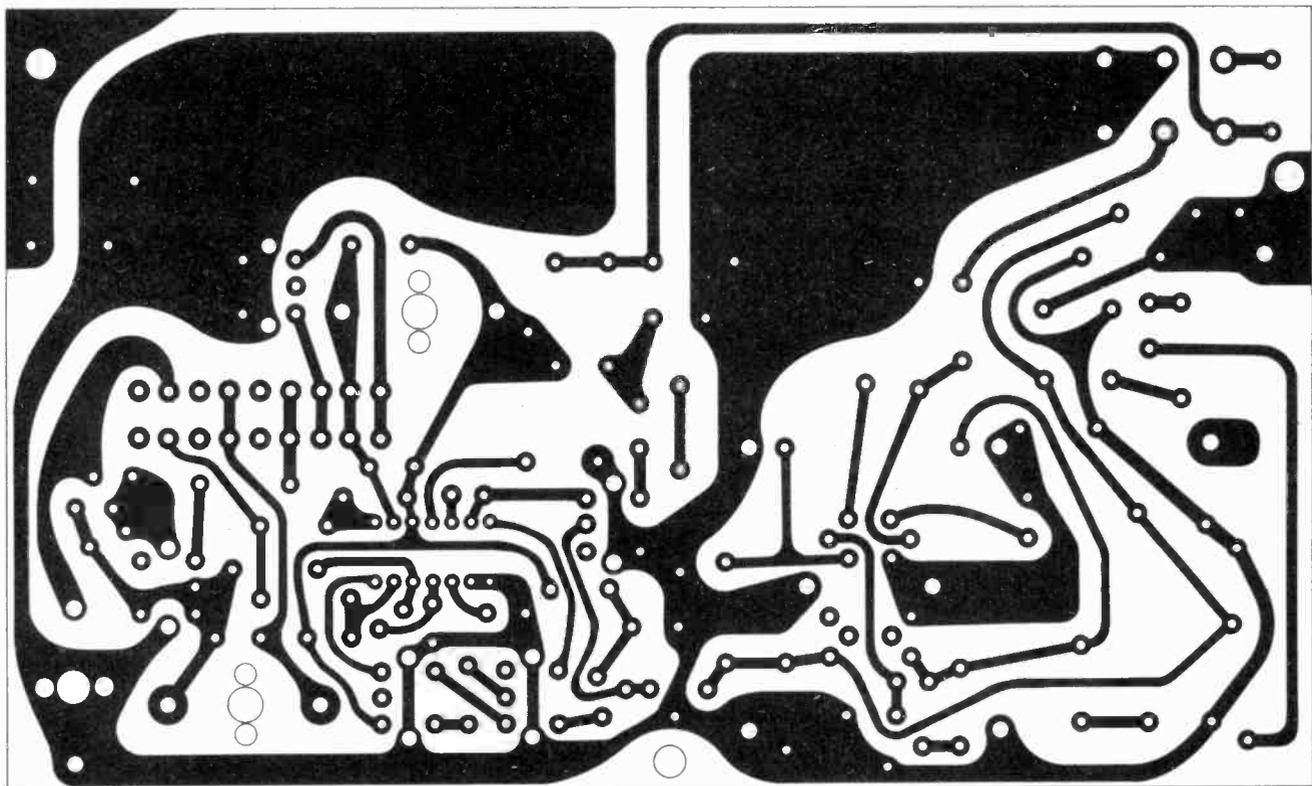


capacitors with specific negative temperature coefficients to compensate for any positive drift in the values of L5 and L6. The three main tuning inductors L2, L4 and L5 are ganged together in a complete permeability tuner which can have push-button facilities and automatic waveband switching.

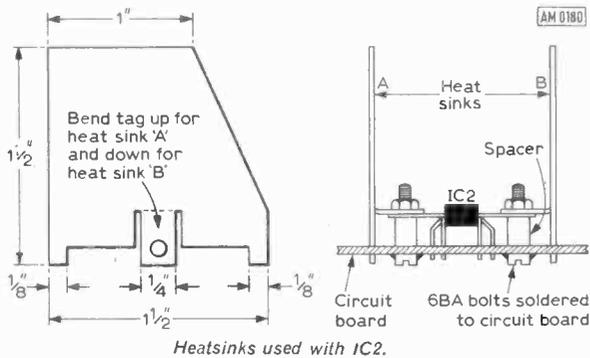
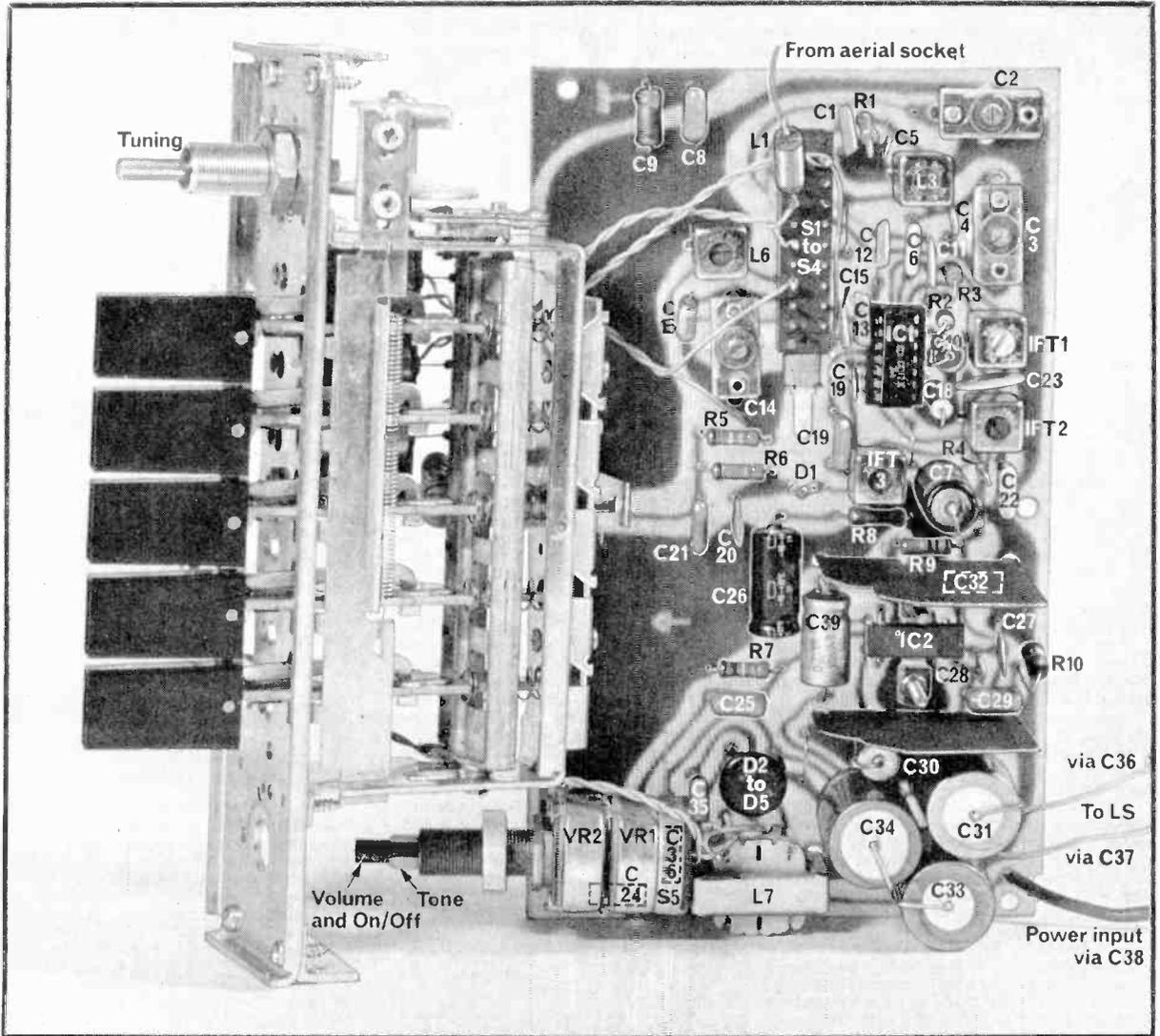
The IF output (470kHz) is taken from the mixer and coupled to the IF amplifier via a double tuned arrangement IFT1 and IFT2. After amplification the signal is fed to the detector diode via IFT3. The detected audio output is developed across the detector load formed by the volume control VR1. Capacitors C20 and C21 provide filtering in conjunction with R6.

Top-cut tone control is provided by VR2 and C24. The gain of the audio amplifier is set by C26 and R8 which form a potential divider with the feedback resistor in the IC. Capacitors C27 and C28 determine the top frequency roll-off characteristic. A Zobel network (R10, C29) is effectively connected across the loudspeaker load which thus always appears essentially resistive to the output devices in the IC, protecting them from transients that could occur across inductive loads.

Capacitor C31 is sufficiently large to provide a lower bass limit of -3dB at 40Hz. Capacitors C36, C37 and C38 are ceramic feedthrough types used to further suppress RF interference by decoupling



*At the top is shown the full size layout of the PCB. The photograph above shows the PCB and the tuner unit. The photograph at the top of the next page is of the PCB with component locations. The copper areas below are showing through the board.*



the loudspeaker lines and the power input. The main smoothing is provided by the 1.5mH choke L7 and C32, C33, C34 and C35. These components greatly attenuate interference produced by charging and ignition circuits. Diodes D2-D5 form a bridge rectifier and provide automatic polarity correction, regardless of which battery pole is connected to the radio case. The earth rail is isolated from the chassis at DC by capacitors C8, C9, which have negligible

impedance at RF so that the circuit is effectively earthed to the case.

Basically any three coil ganged permeability coil assembly designed for transistor car radio can be utilized. The type used by the author was an S. Bird type ΔW160. Probably the easiest way of obtaining a tuner is to order this as a replacement part via a radio dealer or car radio service agent. Either a push-button unit or coil pack only can be used. In the latter case it will be necessary to rig up some form of drive cord and scale pointer.

### THE IGNITION CHOKE

Any small choke with an inductance of between 1.5 and 4mH will suffice. The winding should be less than 0.5Ω and able to carry approximately 1A DC. The author wound his own using a miniature transformer core found in the junk box, the winding being 100 turns 18swg enamelled copper wire.

The Toko IFT's are obtainable from Ambit International, 37 High Street, Brentwood, Essex as well as the TBA810AS which costs £1.50 inc. The CA3123E costs £1.98 inc. from Electronic Component Supplies, Thames Avenue, Windsor, Berks.

# IN-CAR ENTERTAINMENT

COLIN RICHES

In-car entertainment or ICE as it is popularly referred to, is a booming business and it does not matter whether you drive an 'old banger' or a gleaming Jensen, music on the move adds pleasure to your leisure.

In this article, I have chosen a selection of ICE units currently available. In some cases, I have quoted manufacturers' recommended prices, but if readers scout around, they will find some very efficient ICE items at quite reasonable discount prices.

Should readers require any additional information, they should write to the manufacturers concerned.

**PHILIPS** The RN712 plays stereo cassettes. It receives stereo radio programmes and long/medium waves. It records in mono from either radio or microphone and it costs £177.50. One can console oneself over the price however, by working out how much a separate tape recorder, stereo tape player, stereo tuner-amplifier and m.w./l.w. receiver would cost if they were purchased individually.

The RN712 must, without doubt, be classified as one of the most sophisticated in-car units on the market and it has a list of features as intriguing as Aladdin's cave.

Reception of f.m. signals is generally difficult in cars because the multiplex signal is extremely sensitive to interference. Philips have introduced an "I.A.C." circuit to overcome this problem.

The Interference Absorption Circuit (I.A.C.) operates on f.m., radio record and mono microphone functions. For the technical, it cuts off the interfering pulses on the audio signal by keeping constant the instantaneous value of this signal from the point just prior to the pulse becoming active until after it has passed on. Operation is limited to 50% of signal time as this cuts distortion which may occur from the absorption of too many interference pulses.

This unit will be featured in a Special Product Report in a future issue. Philips Ltd., Century House, Shaftesbury Avenue, London, WC2H 8AS.



**AIWA** The Aiwa TP-1042 stereo cassette player starts playing when a cassette is inserted and switches off, ejecting the cassette when the tape ends. The amplifier employs all silicon transistors and controls are provided for balance, tone, volume, fast forward wind and fast rewind. Johnsons of Hendon Ltd., Radlett Road, Colney Street, St. Albans, Herts., AL2 2EA.



**EAGLE** A very useful item from Eagle International is the FF.21 4-channel car stereo adaptor. It converts and synthesises an existing car stereo system with the addition of two extra loudspeakers. Any 8-track tape player, cassette player or f.m. multiplex receiver can be used with this unit, allowing 4-channel stereo to be enjoyed in the car.

The FF.21 we tested proved to be very effective. After making a few simple connections, the switch on the unit is turned to the '2 ch' position and the two front slider volume controls are set at maximum. The car stereo is then switched on with its controls set as usual. The 'rear speaker' control on the FF.21 is then turned anti-clockwise and the switch set to the '4 ch' position. The rear speaker control is then slowly turned clockwise and the full 4-channel effect is obtained. Eagle International, Precision Centre, Heather Park Drive, Wembley, HA0 1SU.



**PYE** Model 2253 is an auto-reverse cassette car player. Automatic track switching at the end of the tape is achieved by reversal of the tape running direction. Insertion of a cassette automatically switches on the unit and an illuminated indicator shows the direction of the tape travel. This unit can be fitted to cars of either polarity—a protection diode being fitted to prevent 'blowing up the works'.

When we tested the 2253 with the 'wick' turned right up, the current drawn was 1A. Wow and flutter is quoted as less than 0.3% and frequency response as 40Hz to 10kHz. Output power is 3.5W per channel. Normal fast wind and rewind facilities are provided and we found a C60 cassette rewound in 64 seconds.

We have had this unit in constant use over the last few months and it has performed without any troubles whatsoever. It is very thoughtfully designed and has excellent tonal quality. Recommended retail price, inclusive of VAT is £44.21. Pye Limited, P.O. Box 49, Cambridge.



**MUSITAPES** Model 8159 is an 8-track stereo cartridge player with a long and medium wave receiver. The control on the left is for on/off, volume and track change with a separate tone control. The knob on the right controls radio tuning and channel balance.

Output power is quoted as 10W and frequency response 30-10,000Hz. Speaker impedance is 4-8 ohms. Recommended retail price is £58 plus VAT. Musitapes (Wholesale) Limited, 402 Edgware Road, London, W2 1ED.



**SANYO** The FT 8006E is an 8-track stereo cartridge player combined with a m.w./l.w. and f.m. receiver. It has rotary on/off, volume, tone, tuning and balance controls and push-button waveband selection and track change. Output power is 6W per channel and frequency response is quoted as 30-10,000Hz. Operation is on 12V negative earth vehicles only. Recommended retail price, including VAT is £64.75. Sanyo Marubeni UK Limited, Bushey Mill Lane, Watford, Herts.



**HARRY MOSS** Apart from marketing a good range of in-car equipment, this firm also supplies a 12V d.c. unit, operated from the mains and including speakers, that can be used to work car-type 8-track players and radios in the home.

One of their receivers which caught my eye was the 344 stereo cassette player and a.m./f.m. receiver. Output is 7W per channel and the circuit includes 2 i.c.'s, 28 transistors and 10 diodes. A fast-forward button for tape is provided and there is an indicator light to show when the radio is receiving a stereo programme. Harry Moss (London) Limited, 424 Kingston Road, London, SW20 8LJ.



**JAVELIN** The Javelin Continental PU612A is a m.w./l.w. receiver and an 8-track stereo tape player. It's a very neat looking unit which performs very well. The controls are easy to operate and an illuminated indicator shows which track the tape is playing at any given time. Output is 5W per channel and the price, excluding VAT is £67. Javelin Electronics Limited, 137-149 Goswell Road, London, EC1V 7EY.



**HEATHKIT** The CR9502 comes from the famous Heathkit stable and covers long and medium waves. Output power is 4.5W and a special circuit allows the unit to be connected to both positive and negative earth vehicles without re-wiring or changing any components.

The circuit embodies two integrated circuits and sensitivity is quoted as 8µV on medium waves and 30µV on long waves.

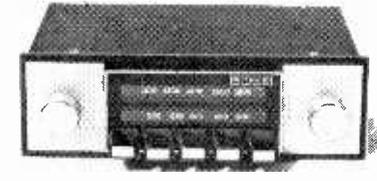
This kit comes complete with fully comprehensive and lavishly illustrated instruction manual and costs £19.80.

We will be including a Special Product Report on this receiver kit in a future issue. Heath (Gloucester) Limited, Gloucester, GL2 6EE.



**R & TV COMPONENTS** The 'Tourist' comes in kit form at £6.60. It has 2.5W output and an i.c. output stage. It also employs a pre-assembled 3-stage i.f. module. We built up one of these kits from the instructions supplied and found it to work very efficiently. The ability to solder on a printed circuit board however is essential and we would not recommend the absolute beginner to tackle this one.

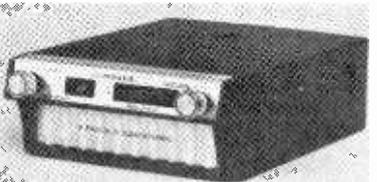
Radio & TV Components Ltd., 21 High Street, Acton, London, W3 6NG.



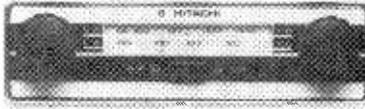
**SHARP** This stereo radio is designated AR/953. It employs a.g.c. and a.f.c. in the circuit and covers f.m. and medium waves. Output power is 5W per channel and recommended retail price £49.95 including VAT. Sharp Electronics (UK) Ltd., 48 Derby St., Manchester, M8 8HN.



**PIONEER** This Pioneer TP222 is a mini-sized 8-track stereo cartridge player designed to be fitted under the dashboard. The circuit employs 4 i.c.'s and 1 diode. Output is 3.5W per channel and frequency response is said to be 40Hz to 10kHz, wow and flutter less than 0.3% and S/N ratio more than 45dB. Price is £31.46 plus VAT and speakers are extra. Autocar Electrical Equipment Co. Ltd., 1 Chantry Road Industrial Estate, Kempston, Bedford.



**HITACHI** The WM702 retails at £17.90 (VAT paid) and covers l.w. and m.w. Output is 3W and speaker impedance 8 ohms. The circuit includes 7 transistors and 2 diodes. Supply voltage is 6/12V either positive or negative earth. This radio comes complete with brackets and mounting screws. Hitachi Sales (UK) Ltd., New Century House, Coronation Road, Park Royal, London, NW10 7QN.



**BOSCH** I have chosen the Blaupunkt ACR 845 from an excellent range of in-car equipment ranging in price from £30 to £300. This unit is an 8-track stereo cartridge player which plays back on 2 (stereo) or 4 (quadraphonic) channels.

Front panel controls include a tape 'head tuner' which compensates for discrepancies in track position between tapes, and slider controls for front and rear volume. The ACR 845 comes complete with fitting kit and four speakers and costs £83.50 including VAT. Bosch Limited, Rhodes Way, Watford, WD2 4LB.



**RADIOMOBILE** The 308 CSR is a long/medium wave radio and stereo cassette player. The cassette ejects automatically at the end of play and within 10 seconds if the unit is switched off with cassette in position. Coming complete with two speakers, and fixing kit, recommended price is £67.95 inc. VAT. Radiomobile Ltd., North Circular Road, London, N.W.2.



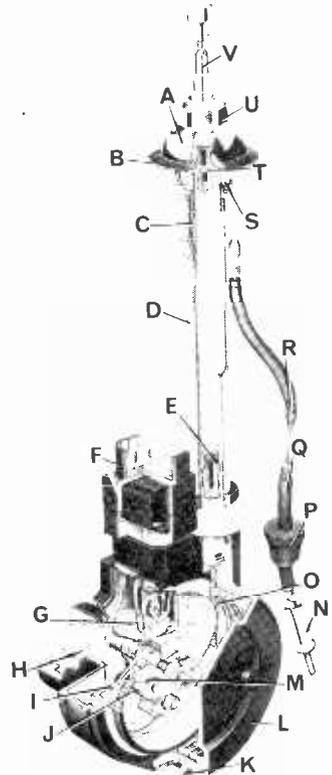
**GRUNDIG** This is the WK 2503 medium/long wave receiver in presentation pack which includes fitting kit, speaker and baffle and suppression components. Output is said to be 5/7W, and circuit has tuned r.f. stage and 3-stage a.g.c. A socket is supplied for tape recorder connection. Price is £39.85. Grundig Ltd., Newlands Park, London, S.E.26.



**PHILIPS** have introduced a range of electric car radio aerials. They are compact, lightweight and corrosion resistant. There are three models: the Standard, Automatic and De-Luxe Automatic and the prices, including VAT, are £13.50, £15.50 and £18 respectively.

An important feature of these aerials is the use of a small efficient motor claimed to give superior lift capability with a power consumption of only 600mA. A 12-month guarantee is also included and this covers free aerial replacement.

On the picture, (A) is brass/chromed dome, (B) plastic seal, (C) injected plastic insulation, (D) metal screening tube, (E) sprung slides ensuring good contact between rods, (F) plug-in relay operates AE from radio on/off switch, (G) limit switch cuts motor at end of rod travel, (H) motor, (I) water-resistant compartment, (J) nylon gears, (K) drain hole, (L) nylon casing, (M) ball bearing clutch, (N) sprung leaves ensure tight fit, (O) tooth drive cable, (P) grommet, (Q) correct capacity cable, (R) screening, (S) earthing bar, (T) serrated edge gives good contact with car, (U) mounting nut, (V) stainless steel rods.



**MEMOREX** The tape used to test some of the cassette machines in this article was the new Memorex MRX2 Oxide. It is claimed to have a distinct 2dB advantage over many competitive brands especially at high frequencies. It comes in C30, C45, C60 C90 and C120 sizes.



# understanding

# DISTORTION

PART 1

A. FOORD

THE gain of an amplifier is usually stated as a single number, either as a ratio or in decibels.

Although this is adequate for most practical purposes it does imply perfect linearity, or no distortion. In an ideal amplifier, where  $V$  is the input,  $A$  is the gain, and  $V_{out}$  is the output:—

$$V_{out} = AV$$

However, since practical amplifiers are not linear the input/output transfer characteristics will always be curved. The standard form usually assumed for this non-linear function is:—

$$V_{out} = A_1V + A_2V^2 + A_3V^3 + \dots A_nV^n$$

If we consider only two terms for this expansion and allow  $V$  to become the instantaneous voltage of a sine wave, we have:—

$$V_{out} = A_1V \sin \omega t + A_2V^2 \sin^2 \omega t$$

The second term may be expanded so that the result becomes:—

$$V_{out} = A_1V \sin \omega t + \frac{A_2}{2} \times V^2 (1 - \cos 2\omega t)$$

The output from the amplifier now contains an unwanted second harmonic whose amplitude depends

on the square of the input level and the co-efficient  $A_2$ . This means that if the input level is doubled we produce four times the amount of second harmonic distortion which is one reason why distortion increases rapidly with signal level. Similarly the third term in the original series will produce distortion with a strong third harmonic content.

Fig. 1 shows a typical transfer characteristic for an amplifier, with the resulting output signal. If the transfer characteristic for an amplifier is known then the distortion can be calculated by a graphical method. However, this approach is only feasible for a considerably non-linear transfer characteristic and in practice harmonic distortion has to be measured by electronic methods.

This simplified explanation shows what happens when a single frequency is amplified by an amplifier. In a practical system two or more signals are applied simultaneously to any amplifier. If this contains a non-linear element then mixing occurs. This produces not only fundamentals and harmonics of the signals, but also the sum and difference frequencies of the signals themselves and their harmonics. These sum and difference frequency components are called intermodulation products. For audio applications intermodulation measurements are probably more valuable than harmonic distortion measurements, although both are normally quoted.

## Effects of Non-linearity

Since audio amplifiers are used for the transmission of music and speech any distortion causes a loss in quality. In music all harmonics up to and including the 6th will "harmonise" with the fundamental, while higher order harmonics may become disagreeable. In general, intermodulation distortion is more noticeable since the products are not harmonically related to the original signals. Although harmonic and intermodulation distortion must in theory be related through the shape of the transfer characteristic, there is no direct and convenient relationship in practice.

## Measurement of Non-linearity

Rather than try to measure small deviations in the linearity of the amplifier transfer characteristics it is much simpler, and more sensitive, to measure the effects of non-linearity. Naturally the effects to measure are harmonic distortion using a single signal, and intermodulation distortion using two signals. In spectrum analysis the amplitude of each component is measured individually. This demands elaborate

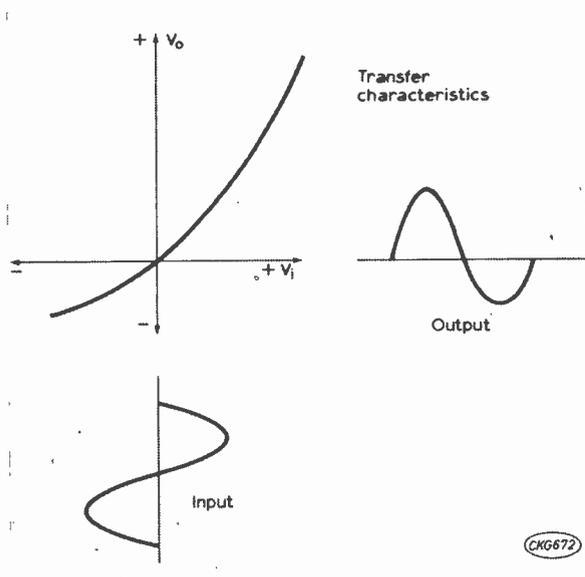


Fig. 1: The generation of distortion by amplifier non-linearity.

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test equipment but gives detailed information on the distortion mechanisms for design work. The other standard measurement methods give no indication of the relative amplitudes of the various components, and are therefore more suitable for routine testing.

## Causes of Non-linearity

There are many causes of non-linearity, and include:—

- 1 The inherent curvature of the amplifier transfer characteristics.
- 2 Mismatch between halves of push-pull stages, which causes an excessive even harmonic distortion for class A and AB stages.
- 3 Cross-over distortion in class B push-pull stages, which may produce an increase in percentage distortion as the signal amplitude is reduced.

## Spectrum Analysis

In spectrum analysis the amplitude of each individual frequency component of a waveform is measured separately, and these components can be summed to calculate a total harmonic distortion factor if required. This instrument is called a spectrum (or wave) analyser or a frequency selective voltmeter. It can be designed on two different principles, but is essentially a narrow band filter which can be tuned over any part of the audio band. It can be used to measure harmonic distortion as shown in Fig. 2.

The bandwidth of the filter is very narrow, perhaps 3Hz, so that it is possible to measure the amplitude of any selected harmonic without measuring an unwanted harmonic or the fundamental. If for example the fundamental were 1V and the amplifier output had a 2nd harmonic content of 0.01%, then the analyser has to measure a 0.1mV signal at 2kHz without reading the 1V fundamental. This 80dB dynamic range illustrates the complexity, and hence cost, of this technique.

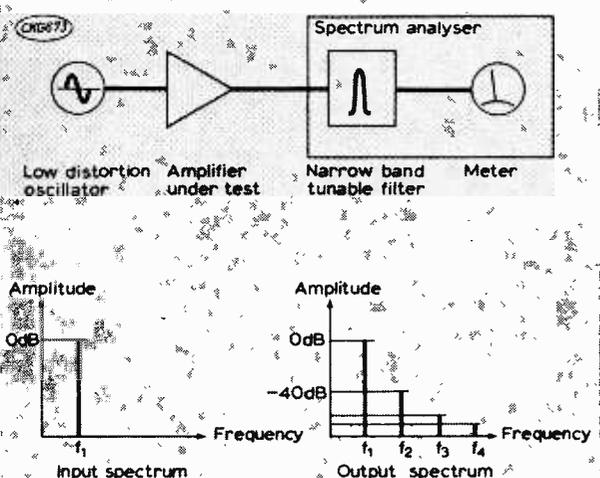


Fig. 2: Harmonic distortion measurement by spectrum analysis.

A low distortion input signal is applied to the amplifier under test, and the spectrum analyser is used to measure the amplitudes of the fundamental and each harmonic in turn. This measurement can be made either in absolute terms, or as shown in the

figure, in relative terms. If a single figure is required for total harmonic distortion the terms can be summed on an RMS basis. Then total harmonic distortion D% is given by:—

$$D = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2}}{V_1} \times 100\%$$

For example, if:

- $V_1 = 1V$  (Fundamental)
- $V_2 = 0.1mV$  (2nd Harmonic)
- $V_3 = 0.3mV$  (3rd Harmonic)
- $V_4 = 0.1mV$  (4th Harmonic)

Then:—

$$D = \frac{\sqrt{0.1^2 + 0.3^2 + 0.1^2}}{1000} \times 100\% = 0.033\%$$

A similar arrangement can be used to measure intermodulation products, as shown in Fig. 3. To simulate actual operating conditions the two frequencies and their relative levels can be varied, producing an infinite variety of test conditions! In instrumentation applications these values would be chosen to represent particular test requirements, but for audio applications two standard methods may be used.

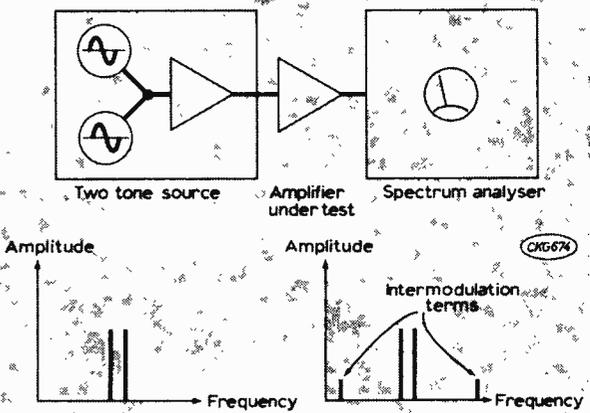


Fig. 3: Intermodulation measurement by spectrum analysis.

One advantage of two frequency intermodulation distortion measurements is that the test signals need not have a low HARMONIC distortion content if suitable frequencies are used. For example if signals of 1.1kHz and 900Hz are used, then possible intermodulation terms are:—

- $A + B = 1100 + 900 = 2kHz$
- $A - B = 1100 - 900 = 200Hz$
- $A + 2B = 1100 + 1800 = 2.9kHz$
- $A - 2B = 1100 - 1800 = 700Hz$
- etc
- etc

The harmonic distortion terms inherent in the two sources will be

- 2A 2.2kHz and 2B 1.8kHz
- 3A 3.3kHz and 3B 2.7kHz
- 4A 4.4kHz and 4B 3.6kHz
- etc
- etc

These harmonic distortion terms are well separated from the intermodulation terms, allowing them to be distinguished on the spectrum analyser.

## Distortion Factor Meter

If a plot of total harmonic distortion against frequency is required for several different amplifier power levels then it is laborious to use a spectrum analyser and calculate the results. The distortion factor meter is designed to make such measurements quickly and simply, but cannot indicate the individual distortion components. The basic block diagram is shown in Fig. 4.

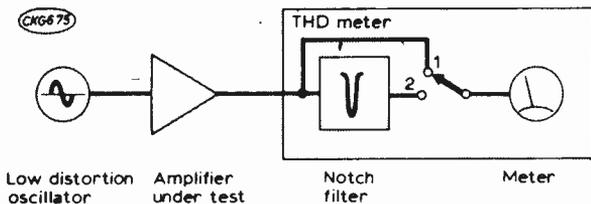


Fig. 4: Total harmonic distortion measurement.

The fundamental is eliminated by a narrow band rejection filter and the total harmonic content of the residue measured. The narrow band filter may be a bridged or parallel T or a Wein bridge and can be tuned over the audio band. When the switch is in position 1 the fundamental plus distortion is measured, while in position 2 the distortion only is measured. Then the THD is given by:

$$\text{THD} = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \dots}}{\sqrt{V_1^2 + V_2^2 + V_3^2 + V_4^2 + \dots}} \times 100\%$$

In normal audio equipment the distortion is low (less than 1%) and this expression approximates to the previous equation:

$$\text{THD} = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \dots}}{V_1} \times 100\%$$

This assumes that the final detector and meter measures a true RMS value. In practice such meters are expensive, and either an average or pseudo-RMS reading meter may be used. A pseudo-RMS reading meter uses diodes or other non-linear elements to give a reading which is approximately correct for waveforms with a high harmonic content such as a squarewave or noise. When an average reading meter is used the difference between this and the correct RMS reading is less than 1 part in 100 even for distortions of up to 14% and may be ignored. However true RMS reading meters are important for some other applications.

## CCIF Intermodulation Measurement

As previously discussed the main advantage of the two frequency methods of intermodulation measurement is that a very low distortion source may not be required. There are methods to CCIF (Comite Consultatif International Telephonique) and SMPTE (Society of Motion Picture and Television Engineers) standards. The two methods may give widely differing results and it is revealing to use them both in performance measurements. For the CCIF measurement the test signal consists of two sinewaves of equal amplitude but close together in frequency. The basic block diagram is shown in Fig. 5.

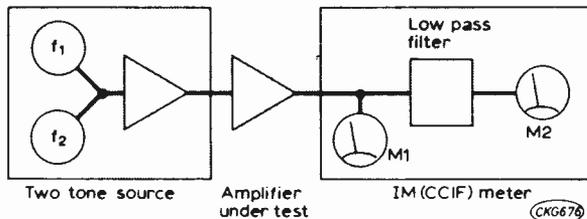


Fig. 5: Intermodulation distortion measurement (CCIF standards).

Two frequencies (perhaps 1.1kHz and 900Hz) are summed and applied to the amplifier under test. The low pass filter removes all the odd order intermodulation products,  $(2f_1 - f_2)$ ,  $(3f_1 - 2f_2)$ , etc, and the sum components,  $(f_1 + f_2)$ ,  $(2f_1 + f_2)$ , etc. The even order intermodulation products,  $(f_1 - f_2)$ ,  $2(f_1 - f_2)$ ,  $3(f_1 - f_2)$ , etc, are indicated on a peak reading meter M2. This is compared with the peak reading on M1 for the input signal and the IM distortion calculated:—

$$\text{IM (CCIF)} = \frac{M2}{M1} \times 100\%$$

Although this technique only indicates an intermodulation distortion figure obtained by measuring certain even order components it is still useful for routine testing.

## SMPTE Intermodulation Measurement

In the SMPTE method two tones widely separated in frequency are used, with the amplitude of the low frequency  $f_1$  being four times that of the high frequency  $f_2$ . Typical frequencies would be 1kHz and 10kHz. When this two tone signal is amplified by a non-linear system the intermodulation will produce sidebands symmetrically spaced about  $f_2$ . For example,  $(f_2 \pm f_1)$ ,  $(f_2 \pm 2f_1)$ , etc. The basic block diagram is shown in Fig. 6.

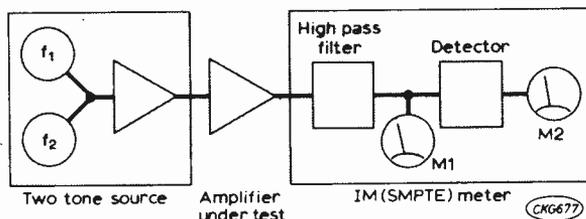


Fig. 6: Intermodulation distortion measurement (SMPTE standards).

In the measurement the low frequency tone  $f_1$  is removed by a high pass filter, leaving an amplitude modulated waveform at a carrier frequency of  $f_2$  which is detected and indicated on M2. The intermodulation distortion is given by the conventional expression for modulation depth.

$$\text{IM (SMPTE)} = \frac{\text{sidebands level}}{\text{carrier level}} = \frac{M2}{M1} \times 100\%$$

## Practical Information

When measurements are made on an amplifier using the techniques discussed it is found that there is no simple rule for comparing the different results, and each technique has its own advantages and disadvantages. Most published amplifier specifications

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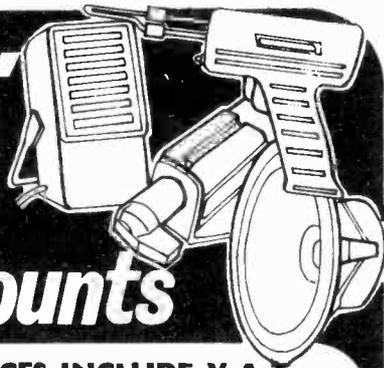
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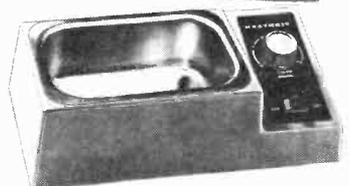
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give the total harmonic distortion curves for various power levels, but intermodulation methods are valuable for very low distortion levels (less than 0.25%). In general for intermodulation measurements the peak to peak input voltage should be the same as for simple harmonic distortion measurements, and all the frequencies involved should be within the pass band of the amplifier under the test.

Naturally the test signals should be combined in a way which does not introduce any intermodulation, the virtual earth summing amplifier is ideal, and the measuring instrumentation itself should be above reproach from a distortion and noise viewpoint.

## Basic Causes and Cures

In a class B push-pull amplifier one output transistor conducts for one half of the cycle, and the other transistor conducts for the other half of the cycle. This gives an improved efficiency over a class A amplifier and is extensively used in audio power stages. However, due to the 0.6V base to emitter potential required for each transistor there is a region of input voltage around 0V where the output voltage is very small.

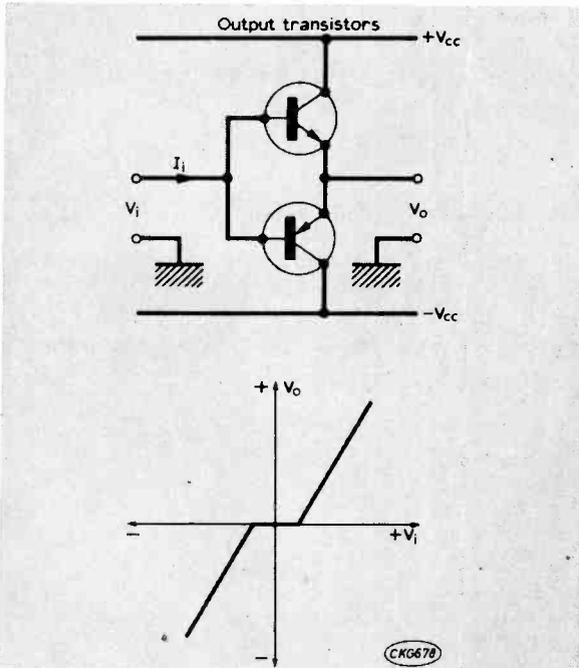


Fig. 7: Distortion production in complementary class B emitter follower power amplifier output stage.

As shown in Fig. 7 this produces considerable crossover distortion and a reduction of gain in this region. The main problem in audio power amplifier design is the reduction of crossover distortion without degrading the thermal stability of the output stage, and many articles have been written on this aspect. The simplest remedy is to enclose the class B output stage within a negative feedback loop to reduce this distortion, as shown in Fig. 8.

The loop gain "forces" the input voltage of the output stage so that this non-linear transition is as rapid as possible. This arrangement has several disadvantages. Firstly, the amount of feedback needed is considerable and, secondly, the distortion has a high harmonic content so that the frequency

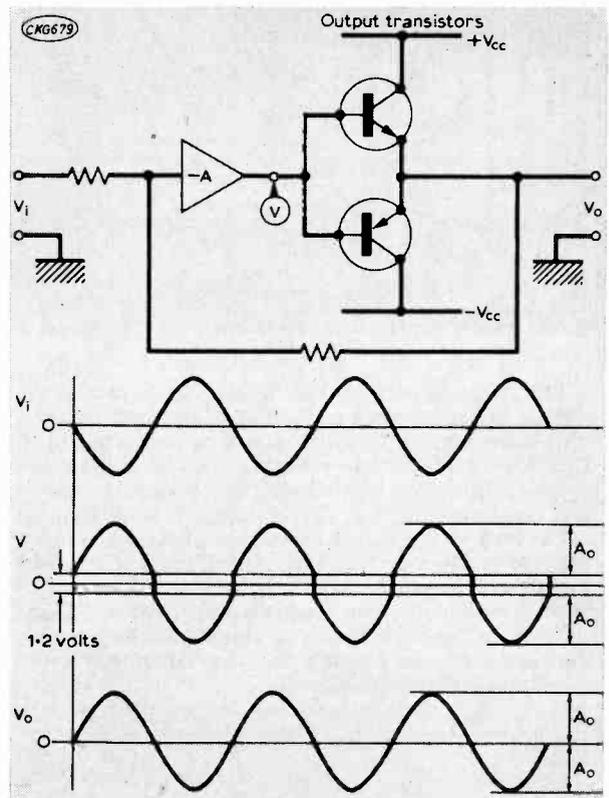


Fig. 8: Reduction of distortion of output stage by overall negative feedback.

response around the loop has to be maintained far outside the audio band. If an amplifier had 2% distortion without feedback, and its gain were reduced by 26dB, we would now expect the distortion to be reduced to 0.1%.

For a conservatively designed system this would be correct in practice, and at low levels. However at high signal levels the slope of the input/output gain characteristics will change. It can be shown that although the 2nd harmonic distortion may be reduced, the 3rd and higher order distortions may be INCREASED by the feedback around the loop. The net result might be that the amplifier might actually need 35dB of feedback to reduce the THD to 0.1%. Clearly, it is important to reduce the distortion to an absolute minimum BEFORE applying overall feedback.

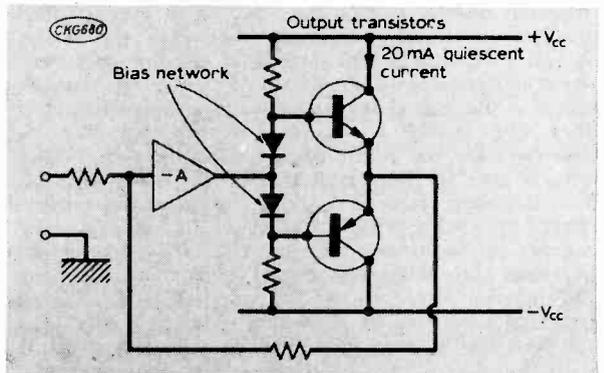


Fig. 9: Distortion reduction in class B output stage by means of a small quiescent current.

# TELEVISION

## IN THE JUNE ISSUE

### THE VLP SYSTEM

The Philips video long play disc system at present under development offers a reasonable cost home colour video playback system. The discs themselves are similar to conventional gramophone LP records and can be mass-pressed in the same way. The whole system has many ingenious features, from the way in which the full PAL signal plus sound is impressed on the disc as a modulated pattern of pits and scanned for playback by a laser to the signal encoding and automatic control techniques used.

### PYE COLOUR RECEIVER FAULTS

Paul Soanes describes various fault conditions commonly experienced in the Pye group's 691, 693 and 697 single-standard colour chassis.

### IC IF PREAMPLIFIER

Lack of gain in an i.f. strip can be overcome by adding a preamplifier between the tuner unit and the i.f. strip. The problem can occur when a different type of tuner unit is being used or a set is being assembled from various surplus units. The preamplifier to be described uses a  $\mu$ A703C i.c. and was designed for use in a colour receiver.

### SERVICING TV RECEIVERS

The next chassis to be dealt with by Les Lawry-Johns is the Philips 300 series single-standard monochrome chassis.

### PLUS ALL THE REGULAR FEATURES

*Details of the June issue are subject to the current national situation at time of going to press.*

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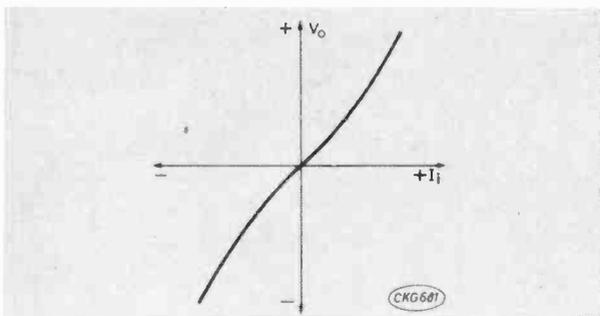


Fig. 10: A plot of output voltage against input current for the output stage of Fig. 7.

The basic circuit of Fig. 8 can be improved by biasing the transistors so that each conducts slightly even when there is no input signal, as shown in Fig. 9. This is very effective in reducing crossover distortion but may introduce the danger of thermal runaway. One treatment has the driver stage directly coupled to the load at low signal levels, but allows the output stage to conduct only at high signal levels. This gives a high efficiency but needs a special driver transformer. Another proposal adds a non-linear resistance network in the base circuit of complementary output transistors to compensate for the non-linear input impedance at low signal levels.

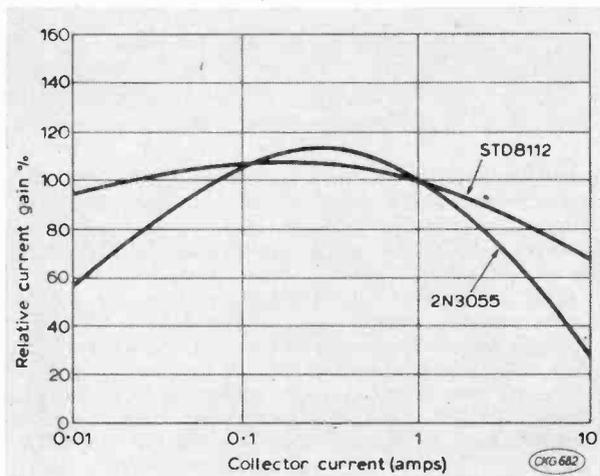


Fig. 11: The beta dropout characteristics for two transistor types.

However since a transistor is essentially a current operated device, the output voltage of Fig. 7 more closely reproduces the input CURRENT, as shown in Fig. 10. There is still a residual non-linearity near the crossover due to the decrease in  $\beta$  at low current levels in the output transistors, and also non-linearity over the whole transfer characteristics due to changes over the whole region. The popular 2N3055 type is poor in this respect, with the triple diffused planar power transistor giving an improved performance at a price. This is illustrated in Fig. 11.

Since the input impedance of the output transistors becomes high when the input voltage is near zero, the current drive must be supplied from a high impedance source. At each zero crossing the transistor drive can more readily step the necessary 1.2V. If suitable precautions are observed then thermal stability is not impaired.

**To be continued**

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BC147	10p	2N2646	45p	IN4005	8p
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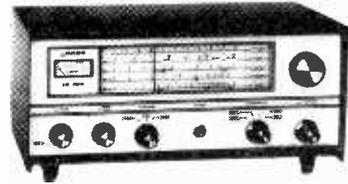
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# station SEPARATOR

N. GRAHAM

WITH the onslaught of local radio stations, BBC and IBA, to the medium wave band some form of frequency separation may be required in some areas. The writer decided to make something more compatible with the living room than the now famous PW frame aerial. Consequently it was decided to try a ferrite rod aerial as a possible solution. Of course, if the radio is a transistor one then it will almost certainly have an internal ferrite rod aerial so the set can be rotated to eliminate unwanted stations.

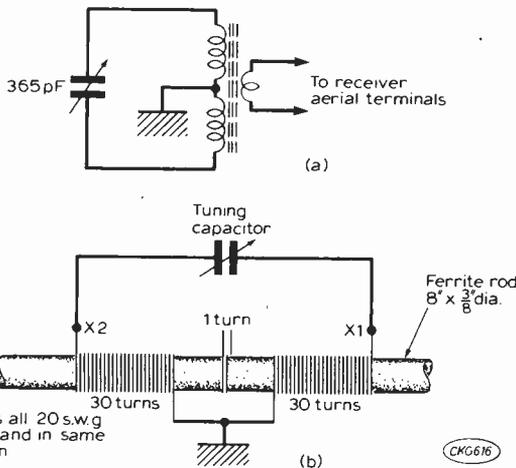


Fig. 1(a): Prototype circuit for medium waves only. (b) shows construction of circuit using a ferrite rod.

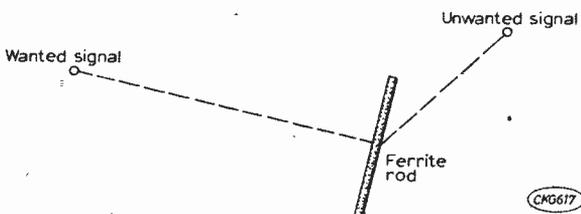


Fig. 2: The ferrite rod aerial has a broad maximum pick-up at right angles to its axis and a very sharp minimum off each end.

Results proved exciting and the circuit shown in Fig. 1a was effective in separating stations having only a small front-to-back angle, Fig. 2. It occurred to the writer to add another winding to the rod to cover the long wave band, Fig. 3. Going a step further another coil was added for the short wave bands, Fig. 4, according to the table. When fixing this coil on the rod tune to the highest frequency and slide the coil along the rod for maximum signal.

At this point thoughts turned to the possibility of switching the coils and producing an aerial tuning unit (ATU). The tuning capacitor can be changed for a two-gang capacitor and connected as in Fig. 5, using an external aerial.

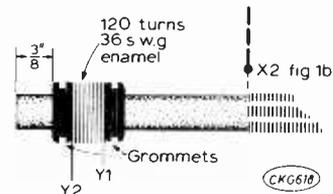


Fig. 3: Construction of the long wave coil on one end of the ferrite rod.

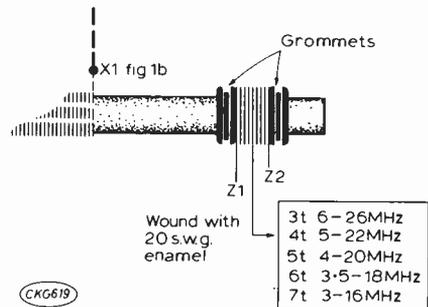


Fig. 4: The short wave coil at the other end of the rod, the number of turns depending upon the tuning range required.

## Construction

Construction is simple, as shown in Fig. 1b and Figs. 3/4, the rod being mounted in a plastic or wooden case. The case must not be of metal, which would screen the rod aerial. First make the single turn link at the centre of the rod, holding it down with polystyrene cement or plastic insulating tape.

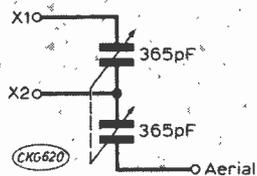


Fig. 5: When an external aerial is used the single tuning capacitor is replaced by a two-gang unit.

Next wind on the two 30-turn coils either side of the link and join their inner ends together and take them to earth. The outer end of each coil can be held with cement or under a grommet chosen to be a good fit on the rod. Do not be tempted to use more than one turn for the link. It may increase the signal transfer but will reduce selectivity. Add the short wave and long wave coils if these are required, Fig. 6.

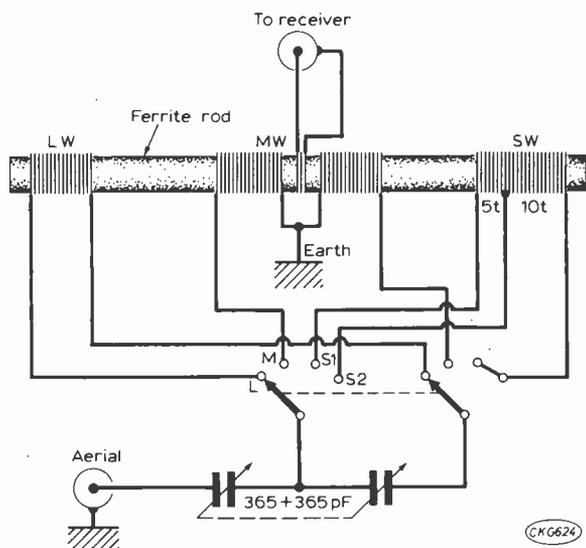
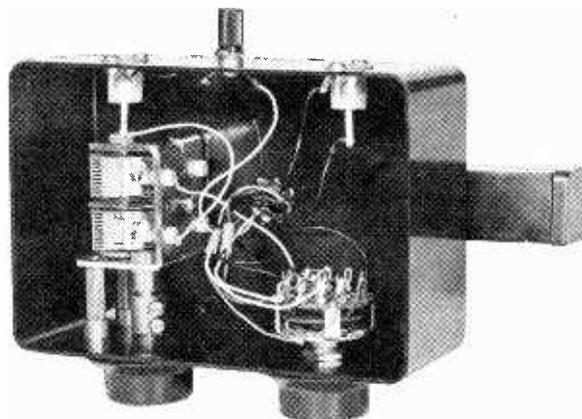


Fig. 6: The complete circuit as finally adopted. Complete short wave coverage is obtained with one tapped coil and range switch.

## In use

If the receiver has an S-meter peak the wanted signal and then rotate the rod to eliminate the unwanted signal at the same time keeping the circuit tuned using the unit's tuning capacitor. A point will be found where the wanted signal level is acceptable, consistent with minimum unwanted signal. If the receiver has a manual RF gain control keep the gain as low as possible to prevent the signal operating the automatic gain control which would tend to negate any adjustments made.



The tuning unit is contained in a plastic box, the ferrite rod being mounted in the square plastic tube which swivels on top of the box.

It was found necessary to use a reduction drive on the tuning capacitor as the point at which an unwanted signal could be eliminated was quite critical. ■

# PW TECHNICROSS PUZZLE No. 4 Solution

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10	D	A	T	E	M	E	D	S												
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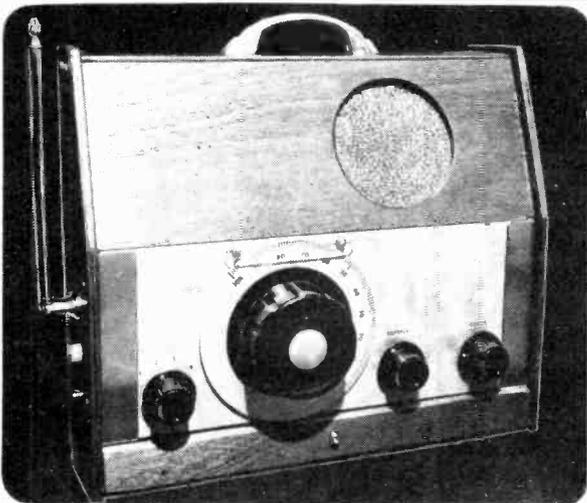
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for the disco

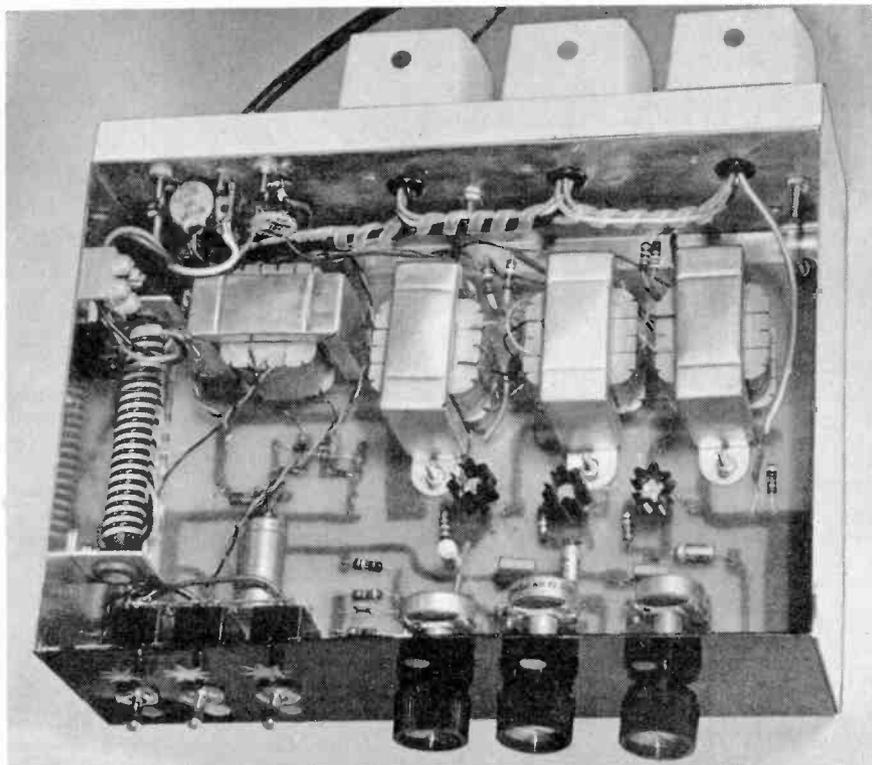
**T**O-DAY, many young electronics enthusiasts are involved with discos of one sort or another. For most of these some sort of light show is required. The unit described here will flash, in time with the music, three independent lamps, (or sets of lamps) up to 250 watts per channel. One lamp responds to bass, one to middle, and the other to treble. Also provided is a facility to turn any of the lamps on full, or off completely. The channels are identified as follows—Red for bass, Green for middle and Blue for treble.

## AF CIRCUITRY

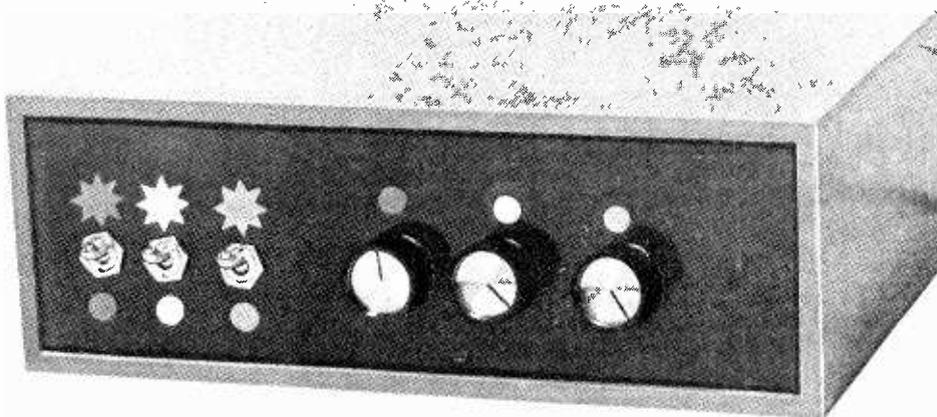
The audio input is applied to the filter network which divides it into treble, middle and bass. The signal levels in the three channels are controlled

by VR1, VR2 and VR3 respectively. A master control is not required as the filter network, being entirely passive, cannot be overloaded. Each filter is based on simple tone control networks which favour the appropriate frequency range. The separation of treble, middle and bass is not complete, but is sufficient for this application.

The following description applies to the Blue channel, the others are similar. The separated signal is passed through capacitor C8 to the base of Tr1. This transistor is biased by R4 and normally draws about 100mA, so a small heatsink is required. The 6.3V winding of T2 forms the collector load, whilst the 240V winding goes to the SCR. Note this carefully. The change in collector current induces a large voltage across the mains winding and this is used to trigger the SCR.



*This view shows the component layout. The SCRs shown here are in TO66 packages and are not widely available. A stud-mounted version is specified in the components list.*



The power supply for the transistors comes from T1 via a standard rectifier arrangement and gives about 18V DC on load.

## SCR OPERATION

Without wishing to go too deeply into the theory of silicon controlled rectifiers (SCRs), some explanation of their operation may be helpful here. Normally an SCR will block current from both directions. However, when triggered by a positive voltage on the gate it conducts like a diode until the current through it is reduced to zero. With 50Hz AC mains the current reaches zero one hundred times every second, so there is no problem in turning the SCR off.

To trigger the SCR a current above a certain level has to flow through the gate and also, in this circuit, through R5, D5 and T2. If R5 is too small, the leakage through the SCR from the cathode will trigger the device and the lamp will glow. The value of R5 is therefore chosen so that this just fails to happen. This value depends entirely on the individual SCR and was found to lie between 47kΩ and 180kΩ for one batch tested, averaging about 150kΩ.

In most cases use of a preferred value resistor will be satisfactory. Occasionally it may be necessary to use the next higher value and connect a second resistor of 1MΩ in parallel to achieve the desired effect. If R5 is too large, the Blue channel will be insensitive.

When an audio signal appears at the secondary of T2 it will be superimposed on the mains frequency voltage applied to the gate of SCR1. At some stage the two voltages will add and the resultant increase in gate current will trigger the SCR. Having fired, it will remain in conduction until the end of that mains half-cycle. The abruptness of the switching is smoothed out by the thermal delay of the lamp filament and so the overall effect is flashing in time with the music.

## MAINS WIRING

The mains input is via a three core lead as a good earth is essential both for safety and for interference suppression reasons. The output is via three 13A sockets. The earth of these must be connected to the mains input earth.

When any of the switches is in the Bypass position

full power is applied to the lamp in question. With all three switches in the Bypass position the transformer T1 is switched off, thus removing the power supply from the transistors. If double pole switches are used, the poles should be connected in parallel.

To avoid shorts, hum loops, etc., the input circuit is not earthed except via R1 and C2, the static drain and spike suppression components. When connected to an amplifier the earth follows through from the amplifier.

## INTERFERENCE SUPPRESSION

In the switching circuit used here the SCRs are firing at random points during the AC mains cycle. The resulting voltage transients can cause considerable interference to nearby radio and TV reception

## ★ components list

### Resistors

R1 4.7MΩ	R6 5.6kΩ	R11 1kΩ
R2 10Ω 2W	R7 22kΩ	R12 22kΩ
R3 47kΩ	R8 See text	R13 See text
R4 22kΩ	R9 3.9kΩ	All ½W 10% carbon except R2
R5 See text	R10 47kΩ	VR3 100kΩ log
VR1 100kΩ log	VR2 10kΩ log	

### Capacitors

C1 1000μF	25V	C8 4μF 25V
C2 47pF		C9 0.1μF
C3 0.047μF	250VAC	C10 0.047μF
C4 0.047μF	250VAC	C11 4μF 25V
C5 0.1μF	250VAC	C12 0.047μF
C6 0.033μF		C13 10μF 25V
C7 0.047μF		

### Semiconductors

T1—T3 BFY52
D1—D4 1N4002
D5—D7 OA81
SCR1—SCR3 CRS 3/40AF

### Miscellaneous

T1 240V: 12V 1A, T2—T4 240V: 6V 2A Both types from RSC (Hi-Fi Centres) Ltd.; S1—S3 SPCO 250V 3A; SK1—SK3; L1 see text; Heatsinks for T1-3

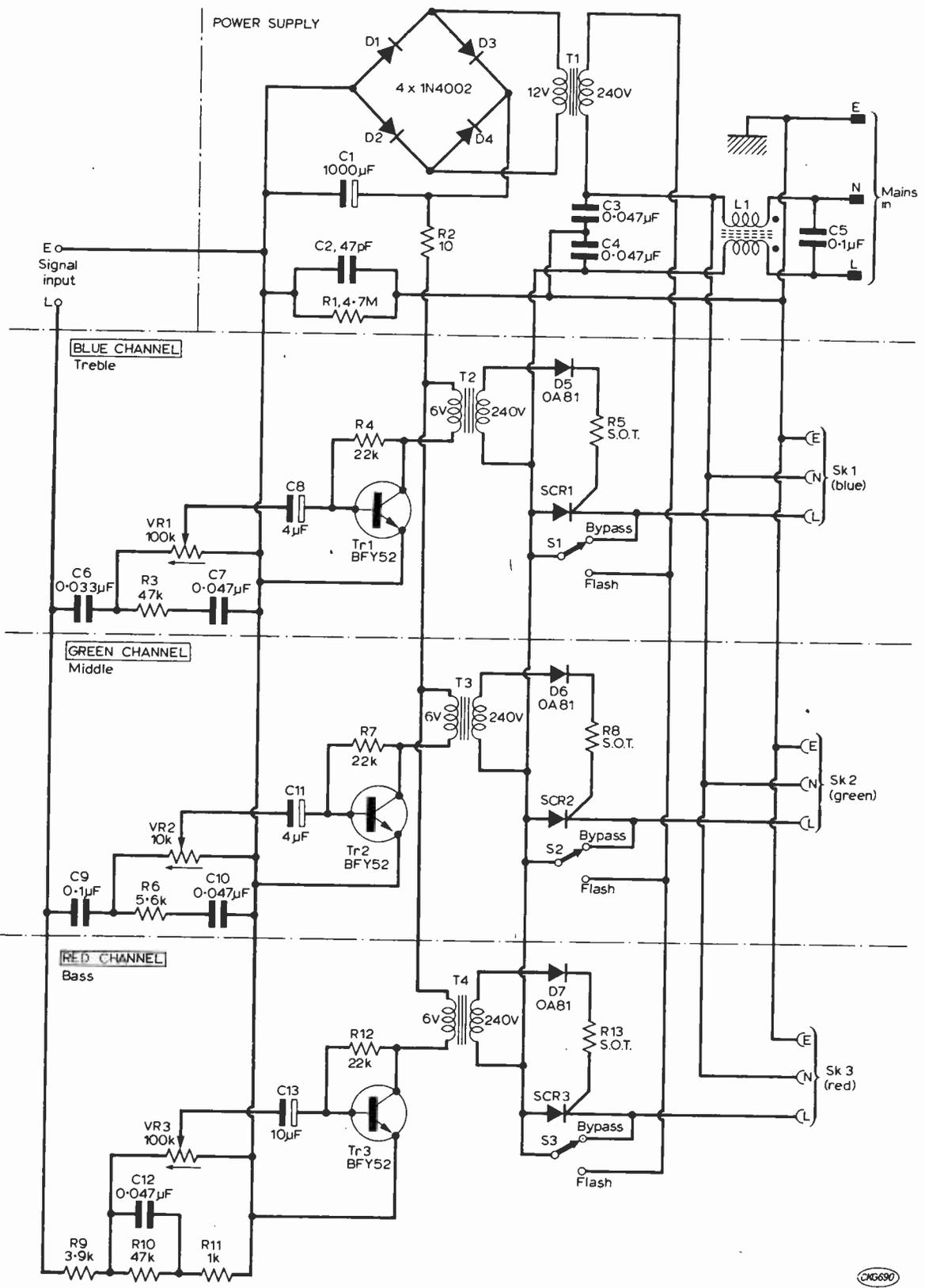


Fig. 1: Circuit diagram of the converter. The mains input should be via a suitably fused plug.

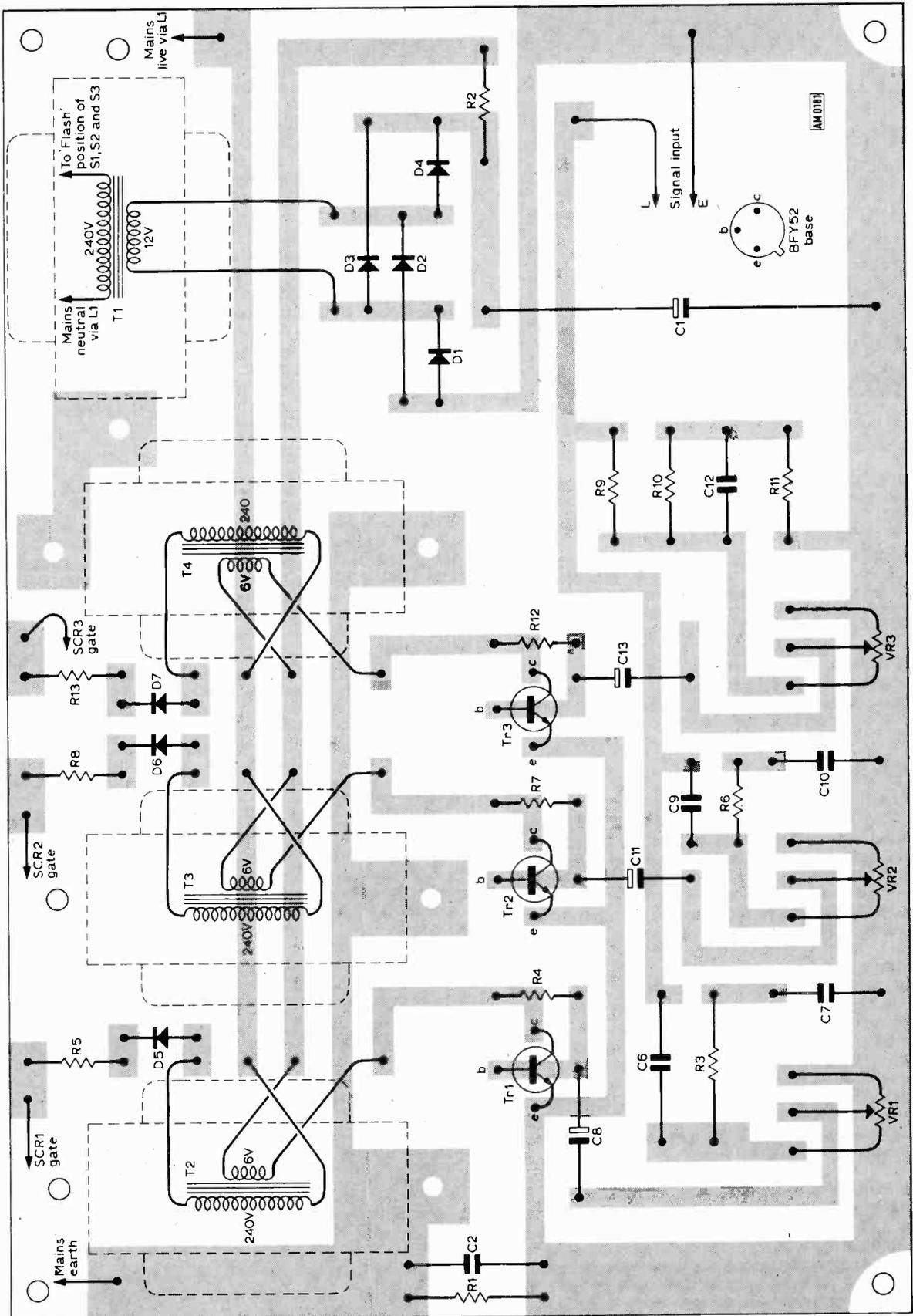
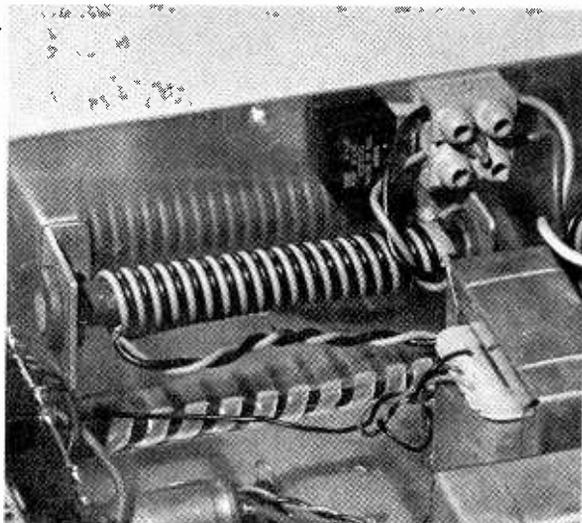


Fig. 2. Full size layout of the printed circuit board seen from the copper side with skeleton view of components.



Choke L1 is mounted on the left-hand end of the box using grommets and aluminium-angle feet.

and even to audio amplifiers. It is therefore essential to incorporate some form of suppression, which in this unit comprises C3, C4, C5 and L1, a bifilar-wound ferrite cored choke. Winding data for L1 is given later in the article.

As load currents are increased it becomes more and more difficult to obtain adequate suppression whilst keeping the filter circuits simple and inexpensive. The limit of 250W per channel is set for this reason.

The length of leads between the unit and the lamps also has quite an effect on the interference problem. These leads should be kept as short as possible—preferably not much over a couple of yards.

## CONSTRUCTION

In the interests of reliability the unit was built on a printed circuit board housed in a 10×7×3in. aluminium box. The PCB should be mounted on spacers giving adequate clearance between the metal box and the printed tracks carrying mains potential.

The SCRs and switches are mounted on the box, the potentiometers are mounted on the circuit board. The three 13A sockets are fixed to a length of plywood which is bolted to the back of the box and provides a safety cover over the SCR anode studs. The ply must be recessed to clear the studs, otherwise leakage may occur via the wood with consequent risk of shock.

All four transformers are small enough to bolt direct to the PCB, though this should preferably be of fibre-glass to take their weight safely.

Exact drilling details are not given for the PCB because the layout may have to be changed slightly to allow for variation in component size, especially C1. However, plenty of room is available on the board.

The SCRs are mounted using insulating kits and silicone grease. The anode leads are soldered to a busbar joining solder tags which are placed on the bolts holding the SCRs.

The mains wiring must be done very carefully, using wire of adequate gauge. The mains filter choke L1 is wound on a  $\frac{3}{8}$ in. diameter ferrite rod 4in. long.

Each winding is 20 turns of 14/0·0076in. or 16/0·2mm pvc insulated wire, requiring a length of about 36in. including flying leads. The two windings are put on together so that the turns of one are between the turns of the other. Capacitor C4 must be mounted as close as possible to the SCR anodes.

When construction is complete the values for R5, R8 and R13 can be determined by test. It is suggested that Veropins are fitted to the circuit board in these positions, and the resistors soldered across them. In this way it is easier to experiment with different values.

Presets are unsuitable for R5, R8 and R13. Because of the voltages involved, small sparks from slider to track cause pitting. It is in order to use a preset initially to determine R5 etc., but it should be replaced by a fixed resistor afterwards.

Any channel may be omitted if desired. No other modifications are needed if this is done. Just omit the appropriate parts.

Finally a sleeve of  $\frac{1}{4}$ in. ply was made to go round the box and fixed to it by four self-tapping screws, which also secure the four rubber feet.

## OPERATION

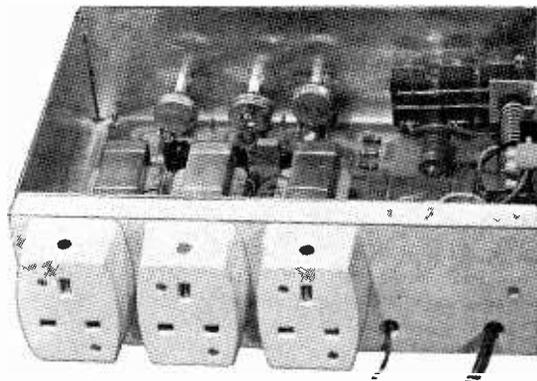
Turn all three controls to minimum, and all three switches to Bypass. Connect to amplifier and mains. Plug in 3 lamps, each should come on as it is plugged in. Set each switch to Flash, the appropriate lamp should then go out. With all three switches in the Flash position, play a record and advance each control until the corresponding lamp just flashes. Overloading spoils the effect.

The input to the unit comes from across one of the speakers. For good operation 2VAC or more is needed, but negligible power is taken. This represents slightly over 1W and should present no problem in any disco. Adjustments to volume, tone, etc. on the amplifier will probably mean that the controls for the lights need readjusting.

A domestic sound system operating at normal listening levels will probably not provide adequate drive for this unit.

The lights should be wired to a standard 13 amp plug, fitted with a 3 amp fuse, in the conventional way. All metal parts must be earthed.

Any lamps may be used but banks consisting of many low wattage bulbs, as opposed to 250 watt spotlights, flash better. The effect is improved by colours. ■



Input and output connections are at the rear. The live SCR studs are protected by the socket mounting block.

# TAKE 20

DAVID ANDREWS

## No. 60 LIGHT CONTROLLED OSCILLATOR

A series of simple transistor projects, using not more than twenty components.

THIS is a very simple project that employs a voltage controlled oscillator. Admittedly not a very sophisticated oscillator nor any guarantee of a well definable law relating voltage to frequency but the principle is so simple that it may prove an interesting sound source to electronic music experimenters. This application uses the output voltage from a photo-resistive cell/resistor combination (PCC1 and VR1) to control the frequency of the signal.

### Circuit

Tr1 and Tr2 are the active members of a fairly conventional free-running multivibrator; C2 and C3 form the timing element for one half of the cycle but the usual timing resistor from the base of Tr2 has been replaced by a resistor and Tr3, Fig. 1. Tr3 acts as an emitter follower and sets the potential at the top end of R2. It is this potential that governs the rate at which the voltage at the base of Tr2 rises, controlling the time of the other half of the multivibrator's cycle. The higher the potential at the top end of R2 the higher the frequency of the oscillator. This potential MUST, however, be greater than 600mV otherwise no oscillation will occur. This potential is controlled via the base of Tr3; any input voltage in the range of 1.2V to 4.5V on the base of this transistor will effect frequency control.

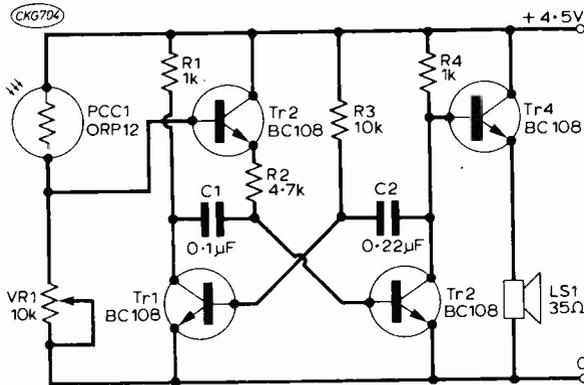


Fig. 1: Circuit of light controlled oscillator.

The lower portion of this range gives an exponential relationship between voltage and frequency but the law tends to linearise at the top end. In this application the control voltage is taken from the junction of PCC1 and VR1; the potentiometer being used to set the input to respond to any range of ambient lighting. Any shadow falling on the cell will reduce the frequency. This could be caused by persons passing the detector or, with care, the hands could be

used to control the shading and thus produce a "Theremin" type of music.

### Alternative Inputs

There is no reason why other sources of input voltage should not be used provided that they fall in the correct range and comes from a source impedance not greater than 100kΩ. Note that only one half of the multivibrator's waveform is controlled hence it is not possible to maintain unity mark/space ratio. This could be effected, together with a wider range of frequency sweep, if the Tr3/R2 combination was repeated on the other side of the astable. The same voltage source could be used to drive both halves or, alternatively, two independent non-interacting voltage sources could be used for different effects.

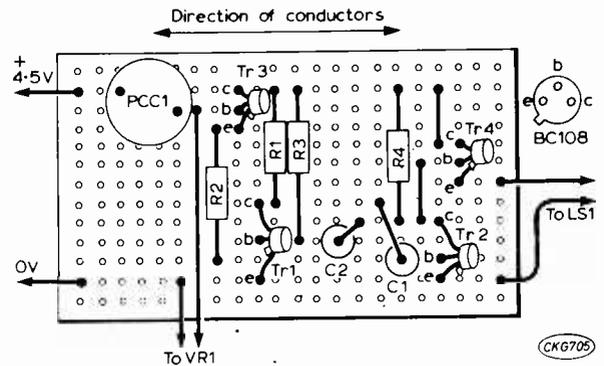


Fig. 2: Author's layout of circuit shown in Fig. 1.

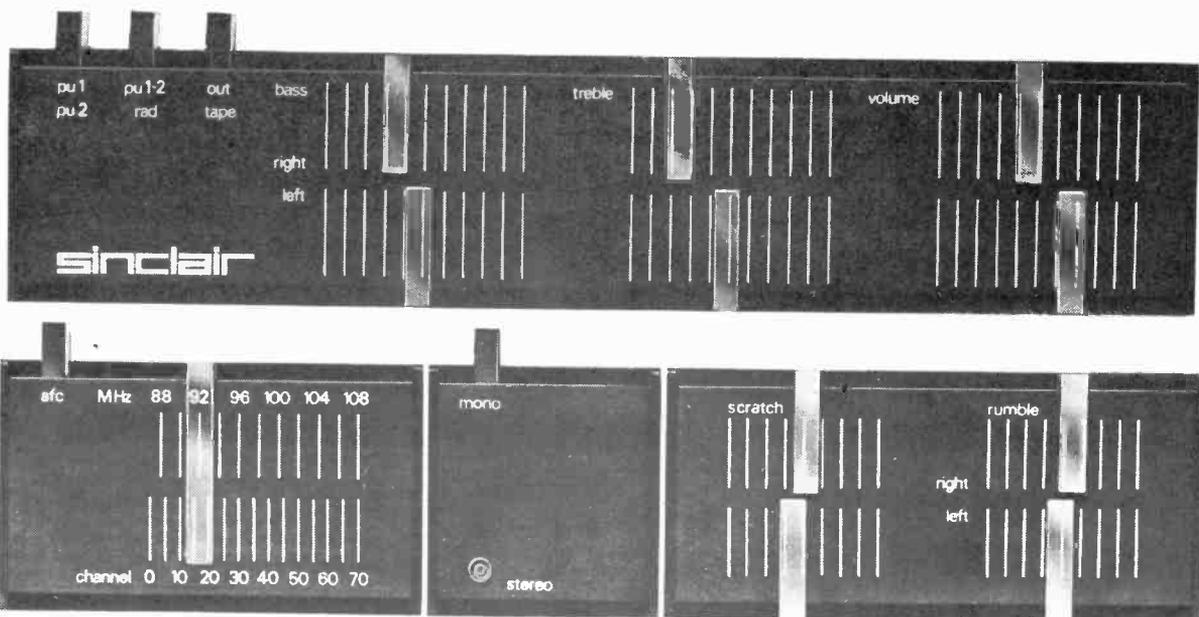
A suitable layout of the unit on veroboard is shown in Fig. 2. VR1 could be mounted at the left end of the board provided the copper rails were broken to prevent short circuits. Finally, the board could be fitted in a box with a suitable aperture for the light to reach the photo cell, together with the battery.

### ★ components list

R1	1kΩ 1/4W	PCC1	ORP12
R2	4.7kΩ	Tr1	BC108
R3	10kΩ	Tr2	BC108
R4	1kΩ	Tr3	BC108
C1	0.1µF	Tr4	BC108
C2	0.22µF	LS1	35 ohm (min)
VR1	10kΩ pot.		

# Sinclair Project 80

exciting



only  $\frac{3}{4}$ " deep x 2" high

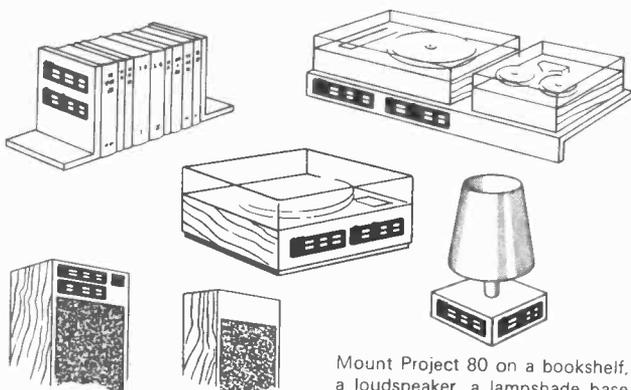
Living with hi-fi takes on new meaning with Sinclair Project 80. The electronics of these revolutionary new modules are all contained within elegantly designed matching cases no more than three-quarters of an inch deep. They are designed for mounting on any appropriate flat surface by means of 6BA bolts extending from the rear of each module and which pass through suitably drilled holes. Connections are taken away out of sight in a similar manner. The possibilities opened up by Project 80 are endless – superb hi-fi systems can be installed in ways hitherto only dreamed about and never before made practical. No more cutting out and shaping to put modules in position. A few holes drilled with the aid of templates supplied and the job is done. Now you need never again be faced with problems of keeping the hi-fi from clashing with carefully thought-out furnishing schemes. (That will surely please wives!) Slider controls have been introduced in place of knobs and all modules in the range incorporate new up-dated circuitry with emphasis on performance standards and built-in protection against overload and shorting. The aim was to re-think modular construction completely – to make it infinitely more versatile, even simpler and more reliable – the result – Project 80 – another triumph for Sinclair, and the most exciting construction modules ever.

the slimmest, most elegant hi-fi modules ever made

## Typical Project 80 applications

System	The Units to use	Units cost
Simple battery record player	Z.40	£5 45 +54p V.A.T.
Mains powered record player	Z.40, PZ.5	£10 43 +£1.04 V.A.T.
30W. RMS continuous sine wave stereo amp.	2 x Z.40s, Stereo 80; PZ.6	£30 83 +£3.08 V.A.T.
50W (8 Ω) RMS continuous sine wave de luxe stereo amp	2 x Z.60s, Stereo 80; PZ.8	£33 83 +£3.38 V.A.T.
Indoor P.A.	Z.60, PZ.8	£14 93 +£1 49 V.A.T.

Project 80 FM tuner, decoder, and A.F.U. may be added as required



Mount Project 80 on a bookshelf, a loudspeaker, a lampshade base a false wall with two Q.16 loudspeakers... almost anywhere.

# new thinking in modular hi-fi

## Stereo 80 pre-amplifier and control unit



- For P.U., radio and tape
- Tape monitoring switch
- Simplest ever fixing

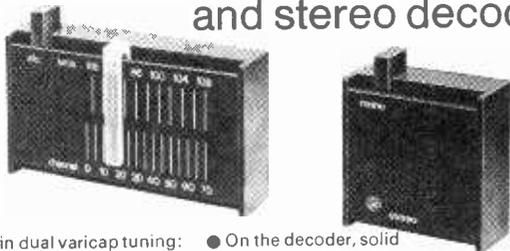
Each channel has its own separate tone and volume controls operated by sliders, enabling ideal environmental matching to be obtained. A virtual earth input stage forms part of the up-dated circuitry that ensures the finest possible quality from all signal sources. Generous overload margins are allowed on all inputs. Clear instructions with template are supplied.

### TECHNICAL SPECIFICATIONS

Size - 260 x 50 x 20mm (10 1/4 x 2 x 3/4 ins)  
 Finish - Black with white indicators and transparent sliders  
 Inputs - Magnetic pick-up 3mV RIAA corrected; Ceramic pick-up 300mV  
 Radio 300mV; Tape 30mV  
 Signal/noise ratio - 60dB  
 Frequency range - 20Hz to 15KHz ± 1dB, 10Hz to 25KHz ± 3dB  
 Power requirements - 20 to 35 volts  
 Outputs - 100mV + AB monitoring for tape  
 Controls - Press button for tape, radio and P.U. Sliders for volume, bass (+ 12dB to - 14dB at 100Hz) treble (+ 11dB to - 12dB at 10KHz)

R.R.P. £11.95 + £1.19 V.A.T.

## Project 80 FM tuner and stereo decoder



- Twin dual varicap tuning: 4 pole ceramic filter: switchable A.F.C.
- On the decoder, solid state stereo indicating beacon.

Making the Project 80 F.M. tuner and decoder available separately gives a wider choice of systems and saves money where stereo reception may not be required. The tuner is a triumph of electronic design and assures excellent performance. The decoder gives a 40dB channel separation with 150mV output per channel. Both units may be used with other than Project 80 systems.

### TECHNICAL SPECIFICATIONS OF TUNER

Size - 85 x 50 x 20mm (3 1/2 x 2 x 3/4 ins)  
 Tuning range - 87.5 to 108 MHz  
 Detector - I.C. balanced coincidence for good A.M. rejection  
 One I.C. equal to 26 transistors  
 Distortion - 0.2% at 1 KHz for 30% modulation  
 4 pole ceramic filter in I.F. section  
 Aerial impedance - 75 Ω or 240-300 Ω  
 Sensitivity - 4 microvolts for 30dB quieting  
 Output - 300 mV for 30% modulation  
 Power requirements - 23 to 33 volts

### DECODER

Size - 47 x 50 x 20mm (1 7/8 x 2 x 3/4 ins)  
 One-19 transistor I.C.

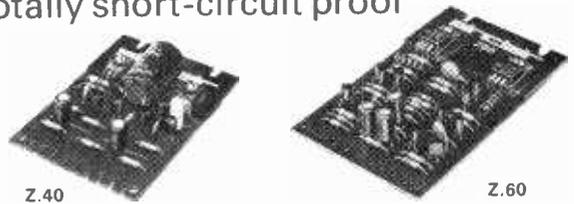
R.R.P. £11.95 + £1.19 V.A.T.

R.R.P. £7.45 + 0.74 V.A.T.

## Guarantee

If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair appointed stockists also offer this guarantee. Should any defect arise in normal use, we will service it without charge.

## Z.40 & Z.60 power amplifiers totally short-circuit proof



Z.40

Z.60

Intended for use in Project 80 installations, these modules readily adapt to an even wider range of applications. Both incorporate built-in protection against short circuiting and risk of damage from mis-use is greatly reduced.

### Z.40 TECHNICAL SPECIFICATIONS

Size - 55 x 80 x 20mm (2 1/4 x 3 1/8 x 3/4 ins) 9 transistors  
 Input sensitivity - 100mV  
 Output - 15 watts RMS continuous into 8 Ω (35V)  
 Frequency response - 10Hz - 100KHz ± 1dB  
 Signal/noise ratio - 64dB  
 Distortion - at 10 watts into 8 Ω less than 0.1%  
 Power requirements - 12 to 35 volts

### Z.60 TECHNICAL SPECIFICATIONS

Size - 55 x 98 x 15mm (2 1/4 x 3 7/8 x 3/4 ins) 12 transistors  
 Input sensitivity - 100-250mV  
 Output - 25 watts RMS continuous into 8 Ω (45V).  
 Distortion - typically 0.03%  
 Frequency response - 10Hz to more than 200KHz ± 1dB  
 Signal/noise ratio - better than 70dB  
 Built-in protection against transient overload and short circuiting  
 Load impedance - 4 Ω min, max. safe on open circuit

Z.40 R.R.P. £5.45 + 0.54 V.A.T. Z.60 R.R.P. £6.95 + 0.69 V.A.T.

## Project 80 active filter unit

Makes a highly desirable part of any worthwhile system where inputs may be from record, radio or tape. As with Stereo 80, separate controls applied to each channel make it easier to obtain ideal stereo balance.



### TECHNICAL SPECIFICATIONS

Size - 108 x 50 x 20mm (4 1/4 x 2 x 3/4 ins)  
 Voltage gain - minus 0.2dB  
 Frequency response - 36Hz to 22KHz controls minimum  
 Distortion - at 1 KHz - 0.03% using 30V supply  
 HF cut off (scratch) - 22KHz to 5-5KHz, 12dB/oct. slope  
 L.F. cut off (rumble) - 28dB at 20Hz, 9dB/oct slope

- For scratch and rumble control
- Transistorised active circuitry

R.R.P. £6.95 + 0.69 V.A.T.

## Power supply units

### PZ.8

Stabilised. Re-entrant current limiting makes damage from overload or even direct shorting impossible. Normal working voltage (adjustable) 45V.



R.R.P. £7.98 + 0.79p V.A.T.  
 Without mains transformer

PZ.5 30V un stabilised  
 R.R.P. £4.98 + 0.49p V.A.T.

PZ.6 35V, stabilised  
 R.R.P. £7.98 + 0.79p V.A.T.

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Please send post paid

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# EXPERIMENTAL WORKSHOP

M. J. HUGHES M.A.

## LEARNING BY PRACTICAL PROJECT STEPS

### PART 8—POTENTIAL DIVIDER BIASING & GROUNDED BASE AMPLIFIERS

ONE often wishes to have a fairly simple grounded emitter amplifier stage that gives reasonably well defined gain and at the same time will work with transistors having a fairly wide spread of  $h_{FE}$ . The feedback bias method of controlling the working point of the output is one technique but the quiescent output voltage (typically mid-rail) is still dependent on the  $h_{FE}$  of the device in question. It was shown last month, that we can define the gain of a stage very accurately by using two transistors and associated negative feedback, but sometimes this is too sophisticated a circuit for simple applications.

A very commonly used method of biasing is to use the *potential divide* method; this has the advantage of being less dependent on  $h_{FE}$  and at the same time allows us to tailor the signal gain of the stage by using negative feedback. It is not as predictable a circuit as the two transistor version we saw previously but nevertheless is frequently used by designers.

#### Biasing

The basic potential divide biasing method is shown in Fig. 59. R1 and R2 between them set the bias but R4 is also a very important component because it helps stabilise the quiescent output voltage. Let's see how this is done. To arrive at component values we must first decide what we need as a quiescent output and what current we want to flow in the collector circuit of the transistor ( $I_C$ ). As a rule of thumb one should aim for a collector current that is at least ten times higher than the current that needs to be drawn from this circuit to power another stage. At the moment we have not given ourselves any specification in that direction so it need not bother us too much. If we specify a mid-rail output of 4.5V and a collector current of about 0.1mA the value of R3 has to be  $\frac{4.5}{0.1}$  k $\Omega$ . In practice we have made it 39k $\Omega$  so the voltage at A (provided we do everything else right) will be slightly higher than mid-rail but this is no hardship!

We must now turn our attention to how we generate the necessary base current to control 0.1mA of collector current; this is where R1, R2 and R4 come in. Base current is that which flows between points B and C. This is going to be part of the current flowing down R1 and will go through the base emitter junction to add to any collector current already flowing through R4. We now rely very much on the fact that we can predict, fairly accurately, that there will always be a potential difference of 600mV between points B and C (this is the forward voltage drop across a silicon pn junction); also we hope that the transistor we use will have a fairly high  $h_{FE}$  so that when the base current adds to the collector current through R4 it will make insignificant contribution to voltage changes at point C. Provided  $h_{FE}$  is 200 or more the increase in current through R4 caused by this will be less than 0.5%.

In practice we usually try to select a value for R4 that will give us a quiescent potential at C of about 1V. Assuming our original quiescent collector current is *all* that flows through it (i.e. ignoring base current) its value works out at  $\frac{1}{0.1}$  k $\Omega$  to 10k $\Omega$ .

We can now say that the potential at B will be 600mV more positive than the 1V at C (i.e. +1.6V). It is now a simple matter to calculate the values for R1 and R2 provided that we set ourselves the criterion that the total current flowing down the chain of R1 with R2 should be four or five times our desired base current. If we say 5 times  $I_b$  flows down R1 then only 4 times  $I_b$  will flow down R2 (because one unit of  $I_b$  is extracted at point B to feed the transistor's base emitter circuit). If we assume  $h_{FE}$  to be approximately 200 we can expect a base current requirement of  $\frac{I_C}{h_{FE}} = \frac{0.1}{200} = 0.0005\text{mA}$  (don't worry about whether the  $h_{FE}$  is exactly this in practice for the moment).

Having assumed this we can now work out the theoretical values for R1 and R2. We know that the potential at B is +1.6V hence if five times  $I_b$  flows through R1 the resistor should have a value of  $\frac{9-1.6}{5 \times 0.0005}$  k $\Omega$  = approx. 3,000k $\Omega$  (or to a near approxi-

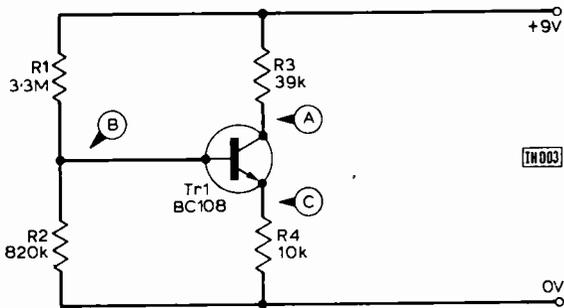


Fig. 59: The values of the bias resistors, R1 and R2, are usually chosen to set point A at a mid-rail voltage.

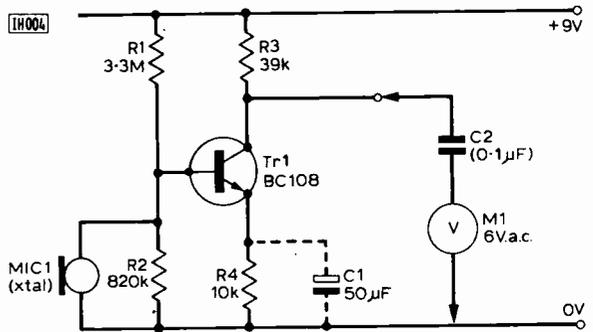


Fig. 61: The small current injected into the base/emitter circuit by the microphone produces an amplified signal at Tr1's collector. Negative feedback has to be suppressed by capacitor C1. Some a.c. multimeters might incorporate the d.c. blocking capacitor C2.

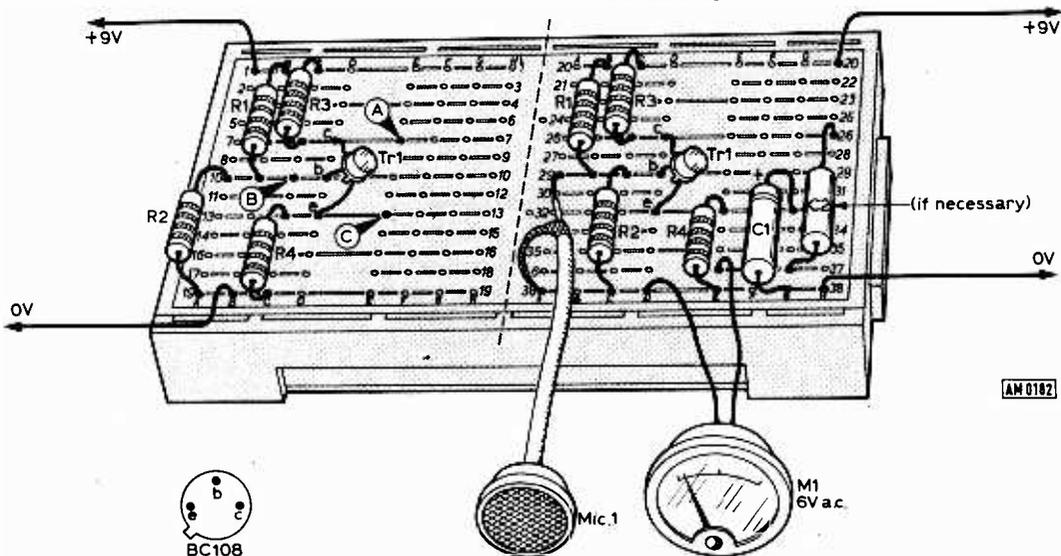


Fig. 60: Layout for Fig. 59.

Fig. 62: Layout for Fig. 61.

mation 3.3MΩ). The voltage drop across R2 is 1.6V and it has four times  $I_b$  flowing through it so its value works out as  $\frac{1.6}{4 \times 0.0005} \text{ k}\Omega = 800 \text{ k}\Omega$  (we have rounded it up to 820kΩ to match the rounding up of R1).

Make up this circuit and using a 20,000Ω per volt meter, measure the potentials at A, B and C and see how near we are to our predicted requirements.

Within reasonable limits the quiescent output level is controlled by the potential at C and the forward voltage drop across the base emitter junction.

The transistor works, to some extent, like an emitter follower; i.e. provided there is sufficient  $h_{FE}$  in the first place (and we have sufficient total current flowing through R1 and R2) the transistor will draw the necessary amount of base current to keep the potential at C 600mV more negative than that at B. If we ensure we have several times the predicted base current flowing through the potential divide resistors then small variations in actual base current drawn will not significantly affect the potential at B. It would, obviously, be better to reduce the values of R1 and R2 to ensure that the standing current was very much higher than  $I_b$  but this is undesirable for some applications. For example if we wish to use a crystal microphone or cartridge as a source of signal for amplification these two resistors act as if they were both connected in parallel

across the source and thus reduce the input impedance of the amplifier with the predictable drop in low frequency response from a high impedance capacitive source.

Why not use a crystal microphone (in the same manner as last month) and measure the a.c. voltage changes at the collector of Tr1—use the circuit and layout for Fig. 61.

At first leave out the capacitor C1 and try the "hum and whistle" test. You will probably see very little signal. The reason for this is that not much of the extra current, supplied by the microphone, is being used to modulate the collector current. The reason is that as soon as you try to inject more current into the base, the potential at the emitter rises to combat it (negative feedback). This negates the effect of the extra base current—in so doing it shows that we have a nice stable biasing system! However this is not particularly desirable when it comes to amplifying a signal so we have to do something about it. As our applied signal is a.c. by nature it will flow through a capacitor so we connect a high value capacitor between the emitter of Tr1 and ground. Any a.c. signal applied to the base will cause maximum a.c. base current to flow and this produces maximum modulation of the quiescent collector current.

Connect C1 into the circuit and try your test again; you should now get a much larger response at the

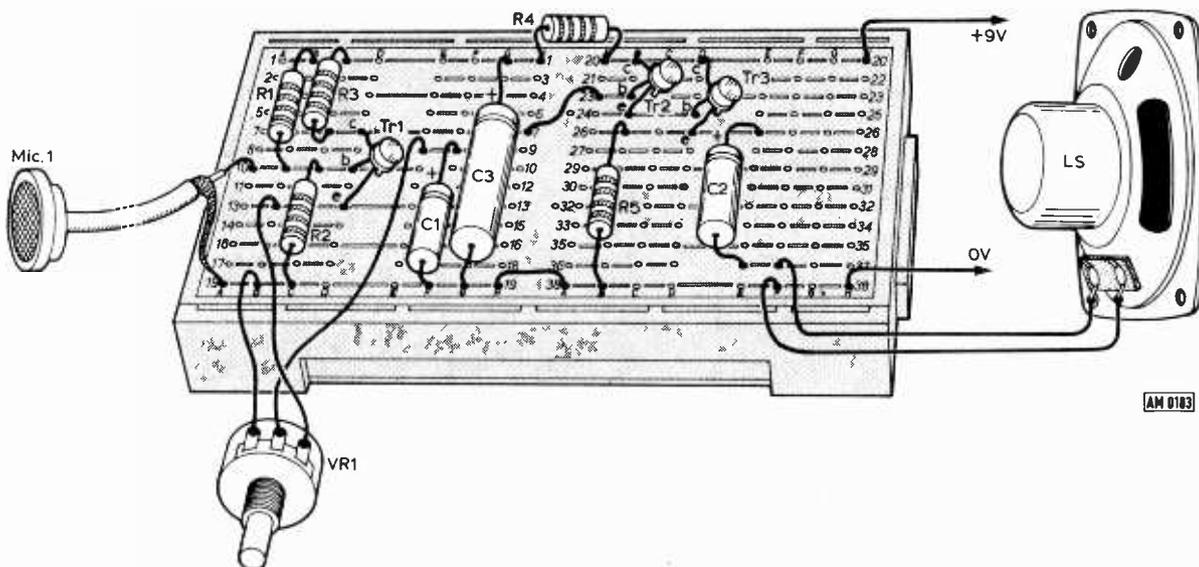


Fig. 64: Layout for Fig. 63.

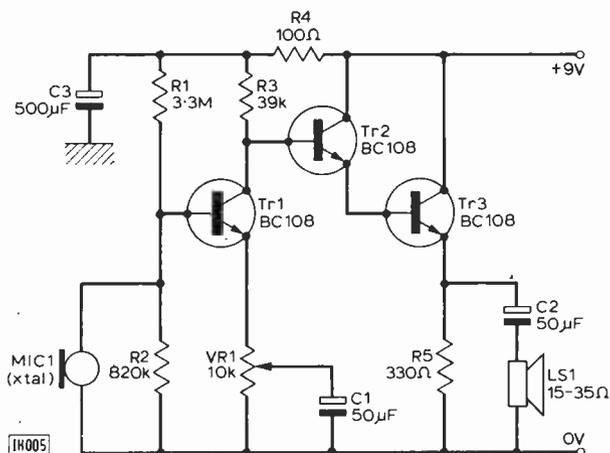


Fig. 63: A simple microphone amplifier (for use as an intercom or baby alarm) using a potential divider biased stage. Volume is controlled by VR1.

collector. We still have negative feedback to d.c. (thus stabilising the bias) but, provided C1 is of high enough a value, we have removed all negative feedback to a.c. We call C1 an emitter by-pass or decoupling capacitor. We obviously get more amplification by including C1 but at the expense of frequency response.

Because we are drawing maximum current from the a.c. source we can say that the input impedance of our amplifier is much less when we reduce the negative feedback; this means that although the amplification at high frequencies increases dramatically it is severely reduced at low frequencies. Usually one has to compromise with the amount of emitter decoupling as shown in Fig. 63. This circuit allows you to apply more or less of the effect of C1 by adjustment of VR1. With the extra power stage you can experiment and hear the difference between high gain and poor frequency response or low gain with better response. Some circuits use the technique of adjustable feedback to control volume, in which case you trade volume for quality.

(TO BE CONTINUED)

## ARE YOU ORDERING COMPONENTS?

During the past few months the components supply situation has undergone significant changes, creating long delivery times and price alterations. Catalogues now available may not carry current prices and availability. We strongly recommend readers to ascertain these points, including V.A.T. and carriage charges before placing orders to avoid disappointment and embarrassing situations arising.

See also the Leader article on page 116.

## CR! CR! CR! CR! CR!

### EXCHANGE

...R209 in perfect working order, exchange for other communication receiver (eg AR88, HRO, CR70A, etc), or sell.—P. J. Kay, 85 Northway, Maghull, Liverpool.

### ISSUES WANTED

...Practical Wireless Sept., Oct., Nov., and Dec. 1971.—R. Vye, 97 Grange Drive, Melton Mowbray, Leicestershire LE13 1EZ.

...Practical Television for March, April and May 1954 on "Simplex TV"—P. Loxdale, 3 Elm Lane, Redland, Bristol.

...Practical Wireless January/February 1973 with details of the W. Cameron 10 + 10W amplifier.—Lawrence French, 181 Thomas Street, Killy, E.C. Dem., Guyana, S.A.

...Series of Practical Wireless required: Vol. 42 Nos. 1, 2, 3, 4, 9, 10, Vol. 43 Nos. 2, 3, 4, 7, 8, 9, 10, 11, 12. Vol. 44 Nos. 1, 2, 3, 4, 5, 6, 7, 8.—Cyril Moriarty, Railway View, Athlone, Eire.

...Practical Wireless October/November 1964 and April and November 1965.—P. J. Bowyer, 204 Bournemouth Park Road, Southend-on-Sea, Essex SS2 5LU.

...Issues of P.W. from May '71—Aug. '71 inclusive.—E. J. Houghton, 42 Southampton Hill, Titchfield, Fareham, Hants.

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...December 1969 Issue of Practical Television.—L. J. Symes, Titchborne Farm, Redlynch, Salisbury, Wilts.

...P. Wireless January and March 1972, July, September, October, December 1971, Also Volume 46.—B. G. Simeon, 5 Penlu Court, Tuckingmill, Camborne, Cornwall.

...Telefunken 'Partner 101', LW/MW/VHF Transistor Radio. Borrow or purchase circuit diagram or any info.—B. Pendry, 3 Rugby Street, Belfast BT7 1PX.

...wanted AR88D Manual to buy or will exchange vintage components.—C. E. Clark, 91 Craven Road, Brighton, Sussex.

# CASSETTE RECORDER AND TUNER AMPLIFIER

PART 4

RICHARD COLLIN



screen is not often connected at both ends as this would cause earth loops. This applies especially to the wiring to the input sockets. To ensure that earth loops are not created by the connection of external apparatus (e.g. gramophone deck or tape recorder) most screens are not connected at the sockets.

Each of the +34V and 0V leads from the PCB's should be taken direct to the tags of 5C3. The negative tag is then earthed to an adjacent chassis-mounted solder tag. This is important so that the power supply and signal earth paths are clearly defined. For the same reason, all screened cables must have an overall insulating sheath.

Failure to follow the wiring routes shown could result in serious hum and instability problems. Any stereo system has critical earth return paths, because any length of wire has a finite resistance. It is possible to generate voltages across this resistance which will be added to the intended input signals. The phase and magnitude of these unwanted voltages can be such that oscillations occur which may be at very high frequencies and therefore inaudible. They can however cause distortion and also lead to failure of transistors. In addition high hum levels can be generated.

## ASSEMBLY AND WIRING

Having constructed the chassis and power supply and made up the five main boards, final assembly can commence. The boards are mounted on to the chassis skeleton frame in the positions shown in the photographs. It is important when bolting the boards into place to make sure that they are totally isolated from the metalwork—transistor mounting bushes make neat insulators for this application. The power amplifier board should be mounted before the heatsink clearance holes in the rear panel are drilled. These holes can then be accurately marked out. It is important that the transistor leads are not strained when the heat sink plate is bolted to the rear panel. A smear of silicone grease should be applied between the plate and the panel to ensure good thermal contact.

Once all boards, switches, potentiometers and sockets are mounted, wiring may commence. Be sure to follow the wiring diagrams exactly. Take particular notice of the screened lead connections. The

## INITIAL TESTS

Having completed all construction and wiring, a further very thorough check of all connections, electrolytic capacitor polarities and component positioning should be made.

Once everything has been checked out, the loudspeakers should be connected, the Volume control set at minimum, the Bass, Balance and Treble set mid-way. Before connecting the mains supply, the

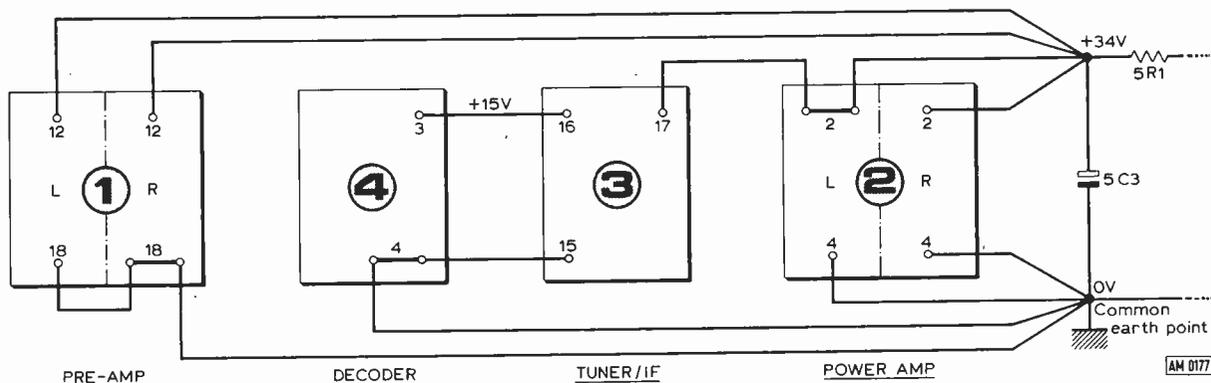
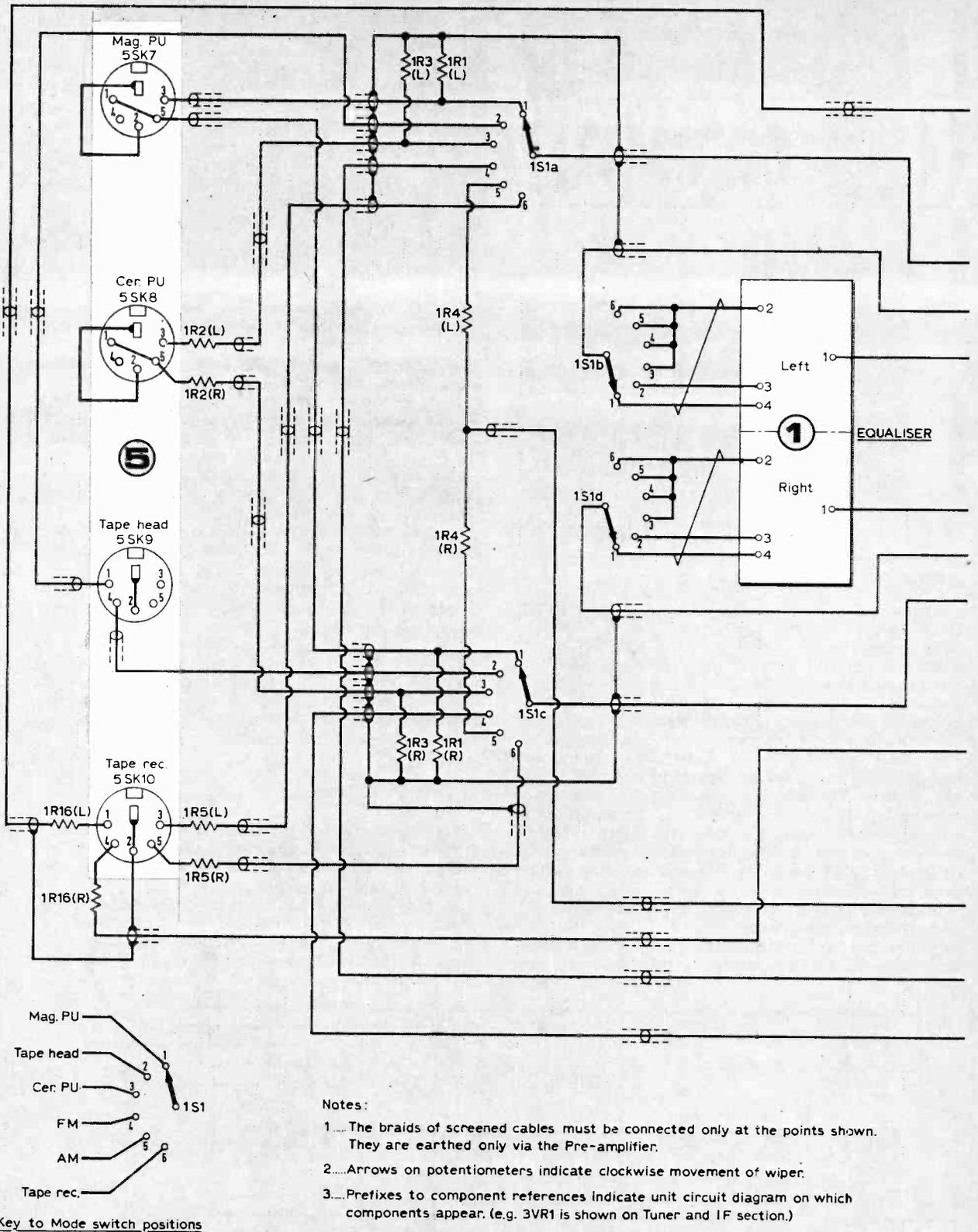
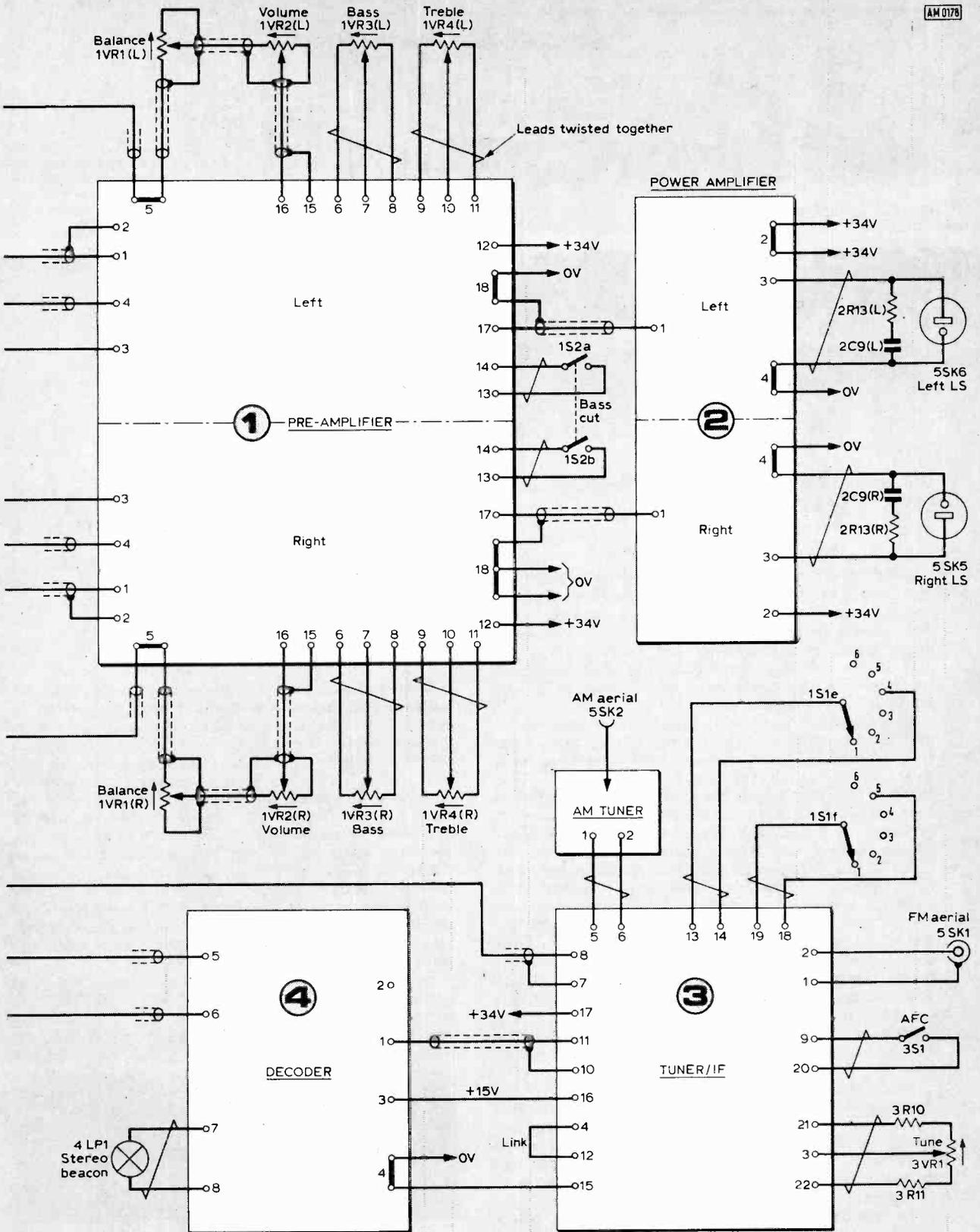
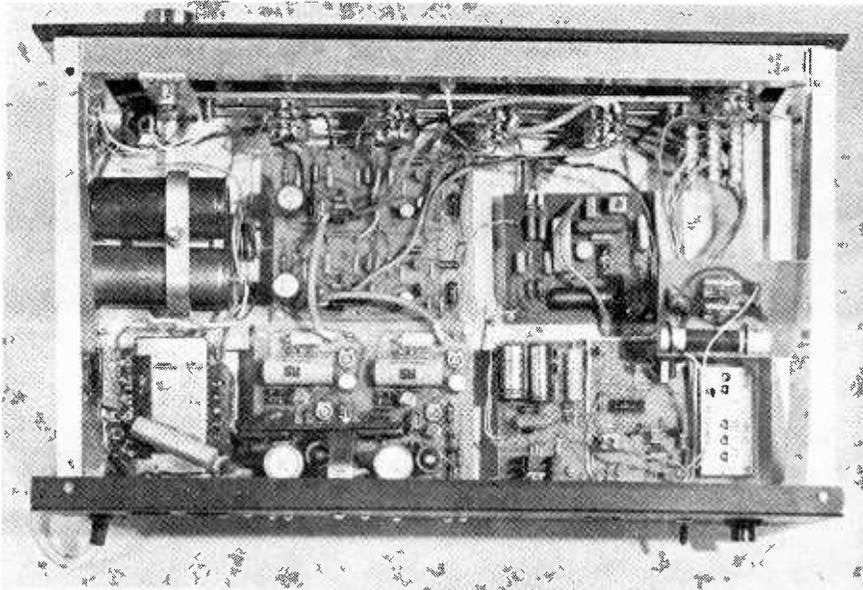


Fig. 20: Wiring diagram of power distribution to PCBs.



**Fig. 21: Overall wiring diagram, excluding power and earthing (see Fig. 20). Screened wire must be used where shown. The Balance, Volume, Bass and Treble potentiometers for the Right and Left channels are each ganged.**





Top view of CRATA showing unit positions with Power Supply at the left. The Pre-Amplifier and Decoder are at the top, Power Amplifier and Tuner/IF at the bottom. The Equaliser board, which is not shown in this photograph, should be mounted near the input selector switch.

two preset resistors on each power amplifier should be set as follows:

- VR1—midway
- VR2—fully anti-clockwise

Connect the mains supply and switch on—a faint hiss should then be audible in each speaker. Measure the HT supply across the smoothing capacitor 5C3. This should be approximately 34V. If the voltage is much lower, then switch off and recheck all wiring and boards for short circuits—check also the power transistors which could have been damaged during lead forming or soldering.

If the voltage is correct, connect a meter (preferably a valve-voltmeter) to the emitter of Tr4 on the left power amplifier. Adjust VR1 (left) so that this voltage is half the HT voltage i.e. 17V. Next the bias for the output stage should be set. This is best carried out using an oscilloscope and sine wave generator. Connect the 'scope' across the left hand speaker socket and feed a 1kHz sine wave into the input of the left power amplifier. Feed in only sufficient signal to produce a low output volume. The output waveform is certain to exhibit crossover distortion (see Fig. 22). Adjust VR2 (left) until the distortion just disappears. If an oscilloscope and signal generator are not available, the bias may be set with a milliammeter. Disconnect one end of R12 and connect the meter (100mA fsd) in series with this resistor. Adjust VR2 (left) so that the current flowing is 10mA. Reconnect R12 and then repeat the entire setting up procedure on the right hand power amplifier.

Next, using a high impedance voltmeter, check the operation of Tr1/2 in the preamplifiers. Measure the voltage on Tr2 collector—it should be about 5V. If the voltage is much different, change the value of R7 until the voltage is correct. Reducing R7 will increase the voltage and vice versa. Check both channels.

To test the preamplifiers and socket wiring, select the Magnetic P.U., Ceramic P.U., Tape head and Tape recorder replay positions in turn, feeding the associated sockets with their respective input signals.

Having ensured that each input is working, select whichever is the most convenient to use and make a more thorough check on the amplifier performance. Check that the Tone controls behave as expected, check the Bass Cut switch (if fitted) and also the action of the Balance control. If a signal generator and oscilloscope are available the operation may, of course, be checked in greater detail.

## TUNER ALIGNMENT

Once satisfied that the audio stages are functioning correctly, select AM Radio. Check that +15V is present at the emitter of 3Tr2. If a selector switch is fitted select the first position. Adjust the appropriate trimming capacitor associated with the ferrite aerial until the desired station is received. Orientate the board for maximum volume, with the complete receiver in the plane in which it will be operating when finally installed. Lock the board into position. Then adjust the trimmer capacitor associated with L2 on the aerial board for maximum volume. Readjust the two trimmers until no further improvement can be obtained. With the multi-station version repeat the procedure for each selector switch position, being careful not to disturb those trimmers already adjusted.

Next select FM Radio. Without a signal, a high background noise is to be expected. Connect an aerial (FM dipole), switch off the AFC and rotate the Tuning control until a station is located. (If using preselected tuning, select any push button

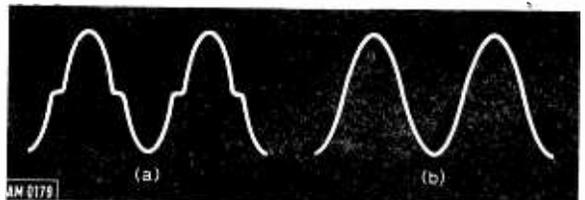


Fig. 22: Output waveform of sine wave  
(a) With crossover distortion.  
(b) With VR2 adjusted for correct bias on output transistors.

and adjust the appropriate preset resistor, having first set the fine tune potentiometer to mid-way). As soon as a signal is located, adjust the core of 3L4 (the FM IF coil) for maximum volume, using an insulated trimming tool. Then select several other stations and recheck the IF coil setting.

## DECODER ADJUSTMENT

Tune to a station broadcasting in stereo. Adjust the decoder oscillator coil L1, again using a proper tool, until the Stereo indicator lamp lights—as it does so the decoder should automatically switch into the stereo mode, making the previous monaural sound image appear to spread out. Continue turning the core until the lamp goes out again and the decoder switches back to mono. The correct tuning point is mid-way between the point where the lamp lights and the point where it goes out again.

Now turn the Tuning until off tune. The lamp should extinguish and the audio become louder and severely distorted. Switch on the AFC—the station should instantly come on tune again and the lamp relight. Switch off the AFC and tune back through the correct point until a distorted signal is again received. Switching on the AFC should again bring the receiver on tune. Finally check that the Stereo lamp does not come on when tuned to a station broadcasting in mono.

To prevent the decoder being triggered by noise or by the 23kHz tone on Radio 4, capacitor 3C20 was added across the audio output of the FM tuner. Too high a capacitance at this point will degrade stereo separation with some samples of the decoder IC. The value fitted should therefore be the minimum consistent with correct operation, i.e. lamp On for stereo and Off for mono broadcasts.

Having completed the alignment, it only remains to check the Tape recorder output. This may be accomplished with an oscilloscope, or a tape recorder set to 'record'. This should respond to the programme being received. The Volume and Tone controls on the equipment will not affect the tape record output.

The equipment is now fully aligned and fully operational. It only remains to mount CRATA into its case.

## ★ Voltage analysis

**Meter** 10kΩ/Vdc—negative lead to OV rail, all readings in volts

**H.T. Supply at 5C3 34V**

**Power Amplifier**  
(each channel)

**Pre Amplifier**  
(each channel)

	e	b	c		e	b	c
Tr1 BC149	*	*	2	Tr1 BC158	17	16	*
Tr2 BC148	*	2	4	Tr2 BC148	17	17.5	18
Tr3 BC149	0	*	5	Tr3 2N6288	0	*	17
				Tr4 2N6288	17	18	34
				Tr5 2N6111	17	17	0

**Tuner & IF**

(a) AM Radio selected

	in	out		e	b	c
IC1 ZN414	1	1.5	Tr1 BC113	0	0.6	0.75
			Tr2 2N6288	15	16	34

(b) FM Radio selected

IC2	Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CA3089E	Reading	2	2	0	0	0	5	5	5	5	5	12	0	2	0	5	0

**NOTE**—The reading on pin 7 (AFC output) varies with tuning.

**Decoder FM Radio selected—tuned to stereo broadcast**

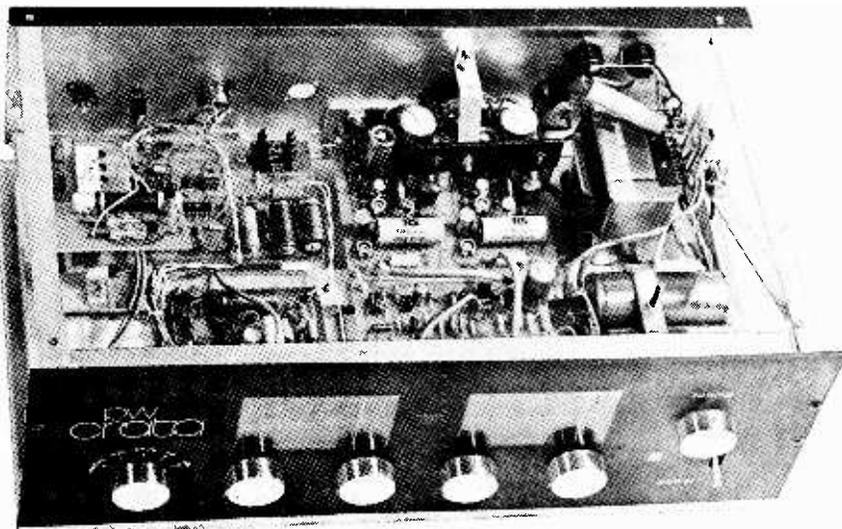
IC1	Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CA3090Q	Reading	2	2	0	0	0	6	1	1	1	10	10	15	0	0	3	5

	e	b	c
Tr1 BC158	15	14.5	15

\* Indicates very low reading due to circuit loading by meter.

## FAULT FINDING

To help with any problems encountered during testing, or with any future service requirements, all transistor and IC terminal voltages are given in the table.



The Power Amplifier heatsink arrangements are visible here. The small pcb on the mains transformer tagboard carries the rectifier assembly.



# Oscilloscope

PART 4

## techniques ALAN AINSLIE

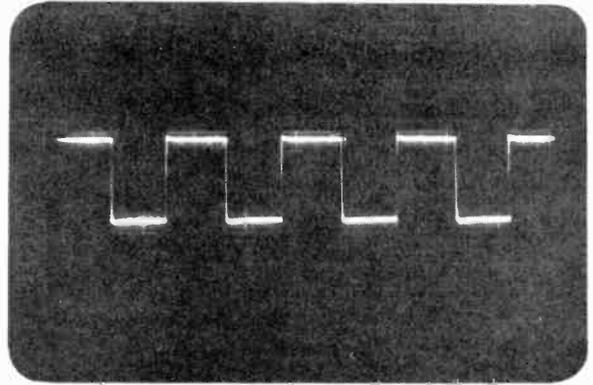
If the switching waveform is not a pure square wave it will tend to blur the trace on the CHOP mode, but on ALT switching takes place during flyback and is of no consequence, unless it is very bad. Beam blanking is often employed to render switching transients unseen and to produce a clearer trace.

When using a dual trace plug-in there are difficulties with timebase triggering, but these will be dealt with later.

Often the dual trace unit has a polarity reversal switch for each beam to reverse the direction of deflection. Also the ALT/CHOP switch besides having positions for CH1 only and CH2 only has a sum position. The deflection in this position is the sum of the signals, or if one channel is inverted, the difference. Hence the dual trace unit can be used as a differential amplifier. However, results are not generally as good as a proper differential plug-in.

The differential plug-in usually has two inputs, one being inverted. A mode switch enables the operator to add the two signals and so anything common to both inputs at the same level is rejected. The degree of rejection is termed the "common mode rejection". Elaborate facilities are provided to optimise the CMR at all attenuator settings and frequencies.

Differential amplifiers are used to investigate balanced signals, investigate phase changes and in the analysis of distortion, as well as for precise balancing methods. The average amateur laboratory can usually manage with a dual trace unit and a bit of common sense.

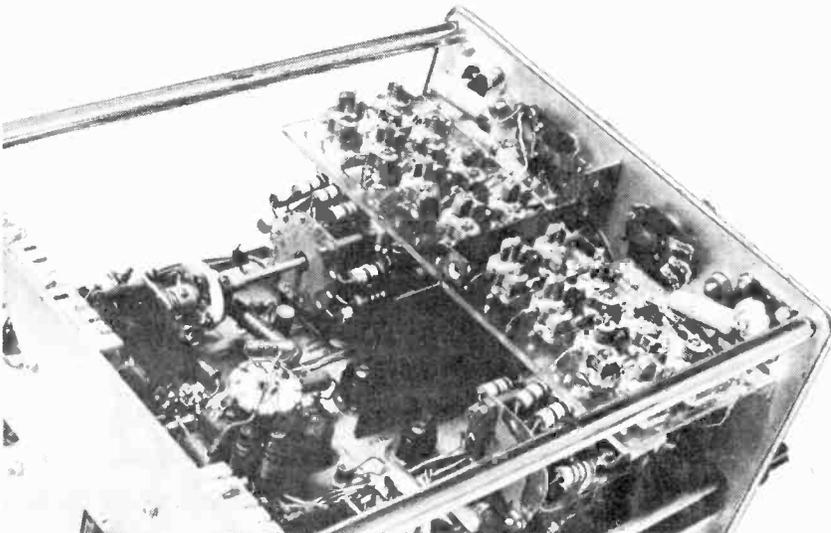


*A 180kHz beam switching waveform. The overshoot and lack of blanking during the switching transients cause the overall trace to lack definition.*

### PROBES

As mentioned earlier the input impedance of a typical scope is perhaps  $1M\Omega$  in parallel with 25pF. When a screened input lead is connected the capacitance would be well over 100pF. At 100pF and 500MHz this is an impedance of a little less than 32 ohms!

Probes have been developed to reduce this capacity to as little as 1 or 2pF. The simplest types are the passive attenuator probes, Fig. 9 shows the arrangement. The resistors  $R_p$  and  $R_y$  are the divider, for a 10:1 probe with  $R_y$  (the input resistance) of  $1M\Omega$



*The inside of a double beam plug-in. The attenuator switches and the associated trimmer capacitors can be clearly seen. Because of the high input impedances screening between the channels is necessary and can be seen between the two attenuators.*

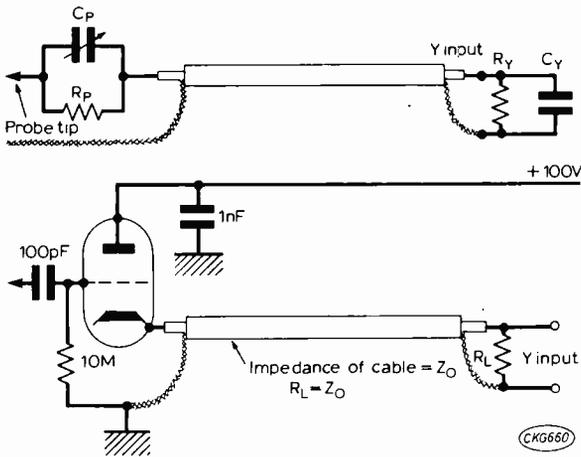


Fig. 9. Two simple probe circuits.

then  $R_p$  would be  $9M\Omega$ .  $C_p$  and  $C_y$  (input capacity) plus the cable capacity form the capacitive divider.  $C_p$  is adjusted on a 1kHz square wave to give a good response. Then:—

$$R_p \times C_p = R_y \times C_y + \text{Cable Capacity}$$

The capacity seen at the probe tip is therefore much less than the capacitance at the scope input and even with several feet of coax a 10:1 probe gives a capacitance of only about 12pF. Higher ratios are available giving even less capacity and are invaluable for serious work.

A passive probe has to be matched to the scope by adjustment of  $C_p$  the series trimmer, which is adjusted to give a good display on a 1kHz square wave as shown in Fig. 10. The effect of slight maladjustment may be thought to be negligible, but Fig. 10 also shows the display of a brief pulse. It can be seen that in order to keep the amplitude calibration accurate at all frequencies the probe must be carefully adjusted.

The second approach, also shown in Fig. 9, is to take the input cathode follower right up to the circuit under test. The capacitance is reduced to only a few pF and there is only a small attenuation (output =  $0.85 \times$  input; sometimes reduced to 0.5 for ease of

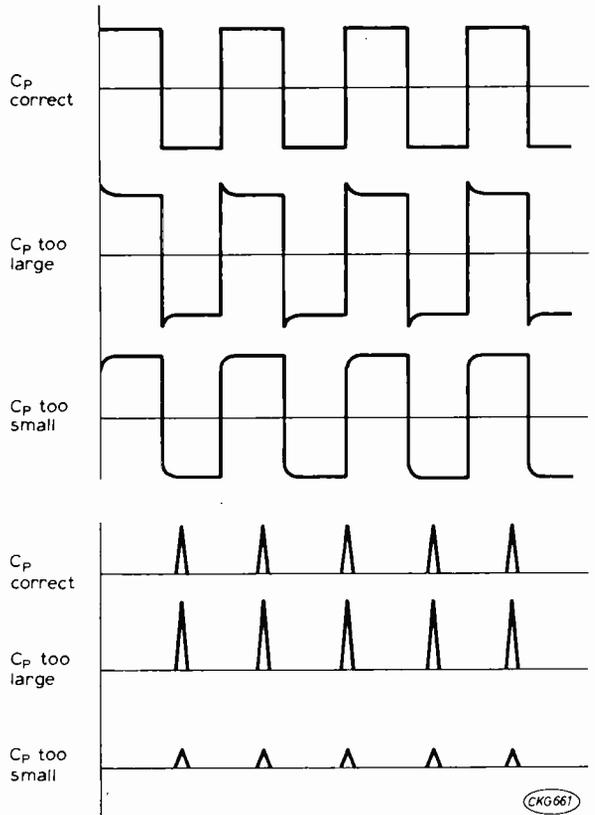
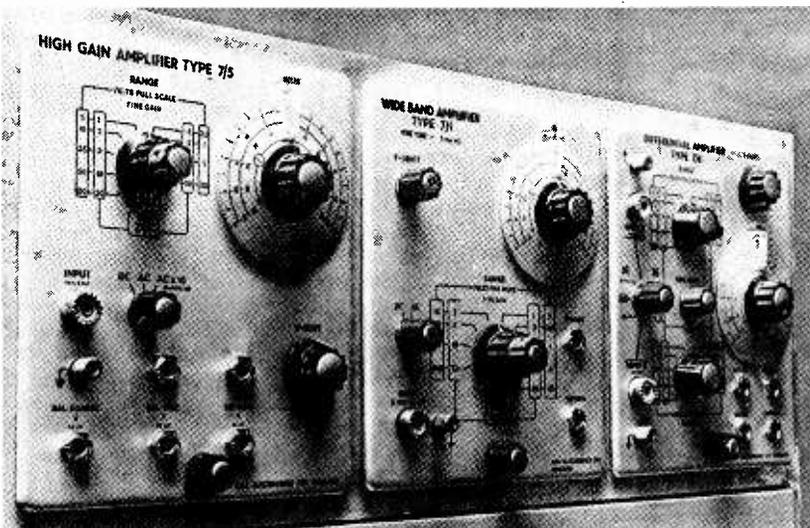


Fig. 10. Effect on square wave of various values of  $C_p$ .

calculations). However the input signal range is limited and attenuators have to be added to the front of the probe. One other major snag is that power has to be fed to the probe along the signal cable. The resistor  $R_L$  is to terminate the cable and prevent reflections.

The cathode follower probe is most useful but tends to be expensive and easily damaged by over-voltage at the input. These two facts alone mean that most amateurs stick to passive probes which virtually never wear out, cannot be blown up, unless you try very hard, and are reasonably priced.



Three amplifiers designed for the EMI WM16 oscilloscope. The wideband unit fully utilises the full main frame bandwidth having a rise time of 5ns. The high gain amplifier has a rise time slightly worse than the wideband unit but has provision for providing 5mV/cm sensitivity at 25MHz bandwidth. The differential unit has a bandwidth of 25MHz and a common mode rejection of 50dB when correctly set up.

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## CALIBRATION

The calibration of the Y deflection system does not usually present a very great problem, the main difficulty being in the adoption of a standard against which the scope is to be set. Usually this standard will be the lab voltmeter if it is known to be correct within a per cent or so and is reliable.

Valve scopes should be run for an hour or more, then the power supply voltages checked and adjusted. After a further hour or so the calibration can be started. In order for non-linearity not to affect the results, signals are applied to give about 75% max. deflection. For example, with the attenuator set to the 5V/cm position (Y shift range 25V) a DC signal of 20V would be used.

The first step is to set the input levels to the main frame amplifier. First a meter is connected between the two balanced inputs and the Y shift adjusted to give zero voltage between them. The drive amplifier balance control (centreing) is then adjusted to centre the trace (timebase free running) on the central graticule line. Then the voltage difference (produced by Y shift control) to deflect, say, 2cm is noted. The gain preset (main frame) is adjusted to bring the sensitivity to the value quoted in the manual (usually 0.1 to 0.5V for 1cm deflection).

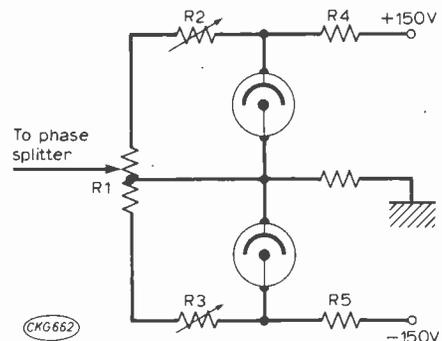


Fig. 11. Circuit for calibrating Y deflection system.

The attention can now be turned to the plug-ins. The first step here is to calibrate the Y shift if necessary. The calibrated shift is set to 0V and the trace centred by the Y shift. A DC input is applied and the calibrated shift adjusted to again centre the trace. The reading on the dial is noted and compared with the applied voltage. Fig. 11 shows the general arrangement of the calibrated shift. The mechanical centre (0V) of the calibrated shift R1 is set so that the resistance between slider and centre tap is zero when the scale indicates 0V. R2 is used to calibrate the negative half of the rotation and R3 is used to calibrate the positive half of the rotation.

When the calibration shift has been set the fine gain control (if fitted) is turned to maximum and the preset gain (usually the phase splitter cathode resistor) is adjusted for the required volts/cm from a DC input producing three-quarters of full deflection. The calibration can be checked by noting the rotation of the calibrated shift for a certain deflection both in a positive and negative direction. It should be noted that the calibrated shift once set is accurate regardless of the settings of the preset gains or the main frame gain.

To be continued

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1A3	.45	6B16	.70	6L7	2.00	12S9T	2.00	50B5G	.45	E1148	.58
1ASGT	.50	6B16	.55	6L1D20	.55	12H87	.45	50C1D6G	1.25	E450	.27
1ATGT	.65	6BQ7A	.55	6N7GT	.60	12J7	.44	50E18E	.55	E476	1.00
1BSGT	.50	6BR7	1.00	6Q7G	.50	12K7	.65	50L6GT	.65	E4BC80	.38
1HSGT	.55	6BR8	.85	6N7GT	.50	14H7	.55	55A2	.60	EAC91	.75
1L4	.20	6B87	1.40	6Q7M	.55	14H7	.55	80A3	1.00	EAF42	.60
1NGGT	.65	6B7W	.60	6R7G	.70	19A95	.50	90C1	.75	EAF801	.75
1R5	.45	6B7W	.65	6R7M	.78	19C05	1.40	90C6	2.40	E134	.35
1S6	.38	6BZ6	.49	68A7	.44	20D4	2.00	150B2	.75	E891	1.15
1U4	.40	6CB8A	.40	68C7GT	.38	20P2	2.75	1515G	.50	EBC41	.65
1U5	.75	6C4	.30	68G7	.44	20L1	.88	807	.50	EBC81	.85
2D21	.40	6C6	.40	68H7	.44	20P3	.80	5702	.80	EBF80	.39
2GK5	.65	6C9	1.25	68J7	.55	20P4	1.00	6057	1.00	EBF83	.48
2X2	.60	6C6D80	1.00	68K7GT	.44	20P5	1.30	6080	1.00	EBF89	.30
2A4	.50	6C6A	.75	68Q7GT	.45	25A8G	.38	6057	1.00	EEL21	2.00
2B6	.40	6C18	.60	6V6G	.17	25L4G	.80	7475	1.00	EC86	.70
3A4	.60	6CL6	.55	6V6GT	.45	25V6G	.70	AC/PEN	.88	EC88	.70
3QSGT	.65	6CL8A	.80	6X4	.40	25Z4G	.38	AC2/PEN	.88	EC92	.45
3B4	.85	6CM7	.75	6X5GT	.40	25Z5	.80	DD	.98	ECC33	1.50
4CB6	.55	6C6U5	.75	7B8	.75	25Z6G	.70	AC6/PEN	.88	ECC35	.95
5C08	.55	6C6W4	1.00	7B7	.70	28B7	1.00	AC7/TH1	.81	ECC40	1.00
5B4GY	.75	6DE7	.75	7H7	.75	30A8	.65	AC10	1.00	ECC48	.44
5U4G	.40	6E18	.60	6V6G	.17	30C15	.60	TF4	.40	ECC92	.92
5V4G	.54	6EW6	.75	7Y4	.85	30C17	.90	AZ1	.60	ECC83	.88
5Y3GT	.45	6E85	1.00	7Z4	.80	30C18	.78	AZ31	.60	ECC84	.80
5Z3	.70	6F1	.70	9D7	.95	30F5	.80	AZ41	.65	ECC85	.38
5Z4G	.35	6F6G	.40	10C2	.65	30FL1	.75	B163	2.00	ECC86	.85
5Z4GT	.45	6F13	.55	10DF7	.55	30FL2	.75	CL33	1.60	ECC88	.44
6J30L2	.80	6F14	.75	10F1	.60	30FL12	1.00	DT1C	1.00	ECC189	.58
6A8B	1.25	6B18A	.75	10F9	.65	30FL13	.85	CV31	.45	ECC80A	.80
6AC7	.49	6F23	.80	10F18	.55	30FL14	.70	DAF91	.30	ECC807	1.00
6AG5	.87	6F24	.85	10LD11	.70	30L15	.75	DAF98	.44	ECF80	.34
6AH6	.60	6P25	1.00	10L13	.70	30L17	.70	DF91	.30	ECF82	.88
6AJ5	.75	6F28	.60	10L14	.2.00	30P4MR	.70	DP96	.44	ECF84	.75
6AK5	.34	6F32	.65	12A8	1.00		1.00	DK40	.70	ECF804	
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6AV6	.58	6J8A	.75	12B17	.50	35D5	.75	E80C	1.05	ECL92	.34
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6B8G	.30	6LI	2.00	12K6	1.00	35Z3	.75	E88CC	1.00	ECL85	.60

ECL85	.40	EZ81	.27	PEN45	.80	UCF80	.65	AA119	.17	BA129	.14	OA70	.17
EF22	1.50	GY601	.75	PEN45DD		UCH212	.00	AA120	.17	BA130	.11	OA73	.17
EF40	.75	GZ52	.54			UCH42	.70	AA129	.17	BA131	.10	OA79	.10
EF42	.55	GZ34	.65	PEN46	.80	UCH81	.80	AAZ13	.20	BC107	.14	OA81	.10
EF73	1.50	GZ37	.87	PEN483D		UCL82	.38	AC107	.17	BC108	.14	OA85	.09
EF80	.28	HABC80	.50	PENDD		UCL83	.55	AC113	.28	BC113	.28	OA90	.14
EF83	.95	HL3DD	.75	4020	2.00	UF41	.70	AC126	.14	BC115	.17	OA91	.10
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EF97	.80	KT41	.98	PL83	.45	UL84	.42	AC166	.28	BCY38	.25	OC25	.48
EF133	.29	KT44	1.00	PL84	.38	UM60	.44	AC166	.28	BCY39	.28	OC36	.47
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EL37	2.50	M61	1.00	PY82	.30	UY91	.70	ACY21	.21	BF185	.44	OC75	.18
EL38	.60	PABC80	.38	PY83	.35	UY231	.80	ACY22	.20	BF194	.17	OC76	.18
EL39	.45	PC85	.60	PY88	.38	UY31	.58	ACY28	.20	BFY50	.25	OC77	.30
EL40	.28	PC88	.80	PY900	.85	UY43	.75	AD140	.40	BFY51	.21	OC78	.17
EL41	.44	PC95	.75	PY500A	.85	UY404	.49	AD150	.50	BY105	.20	OC81	.12
EL42	.38	PC97	.38	UY801	.85	UY801	.85	AD162	.50	BY105	.20	OC81D	.18
EL43	.40	PC90	.45	UY801	.35	UY420	.55	AF106	.55	BY114	.20	OC82	.18
EL44	.40	PC94	.40	PZ30	.48	VP23	.75	AF114	.28	BY116	.17	OC82D	.12
EL45	.45	PC95	.44	QVQ03/10		VP41	.75	AF115	.17	BY127	.20	OC83	.22
EL46	.45	PC98	1.00	QVQ03/10		VP41	.75	AF117	.21	BYZ10	.28	OC84	.28
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EL53	.54	PCF80	.48	UAF42	.60	2N176	.58	AF180	.53	OA5	.31	OC202	.47
EL54	.45	PCF802	.50	UBC41	.53	2N1247	.94	AF186	.81	OA9	.14	OC203	.38
EL55	.40	PCF806	.55	UBC81	.65	2N2297	.25	BA115	.15	OA10	.47	OC204	.38
EL56	.40	PCF807	.38	UBF80	.38	2N2369	.24	BA116	.20	OA47	.11	OC205	.47
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H8/3A	4µF	50V	4p	H7/8A	100µF	35V	6p
H8/4	4-7µF	25V	4p	H7/9	100µF	63V	6p
H8/4A	5µF	64V	4p	H7/9A	125µF	4V	4p
H8/5	5µF	10V	4p	H7/10	125µF	25V	6p
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H8/8A	16µF	16V	4p	H7/13A	200µF	25V	8p
H8/9	20µF	6V	2p	H7/14	220µF	50V	10p
H8/9A	20µF	70V	4p	H7/15	220µF	25V	5p
H8/10	22µF	50V	4p	H7/15A	220µF	35V	10p
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H8/11	25µF	12V	4p	H8/2	250µF	25V	3p
H8/11A	24µF	275V	4p	H8/3A	320µF	2-5V	3p
H8/12	32µF	15V	4p	H8/4	320µF	10V	4p
H8/12A	30µF	10V	4p	H8/4A	330µF	16V	5p
H8/13A	32µF	50V	4p	H8/5	330µF	25V	10p
H8/14	40µF	25V	5p	H8/5A	330µF	35V	15p
H8/14A	40µF	16V	4p	H8/8	470µF	25V	10p
H8/15	47µF	50V	4p	H8/8A	470µF	35V	20p
H8/15A	40µF	35V	4p	H8/9A	400µF	4V	20p
H7/1	50µF	6V	3p				
H7/1A	50µF	10V	4p				
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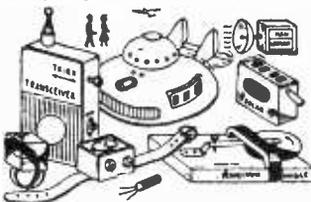
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## BROADCAST BANDS

### SHORT WAVE DX by MALCOLM CONNAH

**W**ITH such a large number of reports this time I think I should start straight away with the contribution from **Ian L. Wadman** of Didcot in Berkshire. Ian has a new Trio 9R-59DS and a 70 foot end-foot antenna. Some concentration on 60 metres produced the following excellent results:

- 4770 ELWA, Liberia in English at 0615.
- 4832 Radio Capital, Costa Rica, Spanish at 0405.
- 4860 R. Maracaibo, Venezuela, Spanish at 0420.
- 4882 R. Commercial, Dominican Rep., music at 0530.
- 4900 R. Juventud, Venezuela, Spanish at 0355.
- 4940 R. Yarucuy, Venezuela, Spanish at 0345.
- 4970 R. Rumbos, Caracas in Spanish at 0455.
- 5030 R. Continente, Venezuela, S/off at 0500.
- 5035 Bangui, Cent. Afr. Rep. with music at 0545.
- 5050 R. Tirana, Home Service at 0340.

The **Rev. W. John Mckae** of Birkenhead has built the 3 Band SW receiver described in the December issue. This combined with a 45 foot indoor aerial and ATU produced the following:

- 5995 VOA, noted in English at 2130.
- 6045 Hilversum, Holland, English at 1045.
- 6065 Radio Sweden in English at 1600.
- 6120 Vatican Radio noted in English at 2100.
- 7260 Monte Carlo, S/off in English at 0845.
- 7310 Radio Vilnius, Lithuania S/off at 2300.
- 7345 R. Prague noted in English at 2200.
- 11815 WYFR noted in English at 2240.
- 15185 R. Finland in English at 1830.
- 21520 Radio Switzerland noted in English at 2125.

**Linford Fevrier** sends in our first report from the West Indies; St. Lucia to be precise; using a Pye valve domestic receiver and 100 foot long wire to hear:

- 6010 R. Sweden in English at 2114.
- 6090 R. Luxembourg in English at 0210.
- 9570 Swiss B.S. in English at 0905.
- 9635 R. Nacional de Colombia, Spanish at 1539.
- 11775 WINB, Red Lion, USA in English at 2130.
- 11855 Broadcasting Service of Saudi Arabia at 1855.
- 11880 Voice of Turkey in English at 2213.
- 11895 R. Senegal in French at 2225.
- 11935 R. Portugal in English at 0208.
- 15190 La Voix de la Revolution Congolaise at 2010.

**Matthew Phillips** of Halstead in Essex is only 12 years of age but this Domestic receiver is 37 years old; using a metal bed frame as an aerial the combination produced the following log:

- 5995 R. Australia in English at 0900.
- 6180 BBC, Cyprus relay at 1730.
- 7210 Red Cross Radio in English at 1730.
- 7245 Austrian Radio noted at 1030.
- 9005 R. Tehran, Iran at 2000.
- 9520 ORTF, Paris noted at 1415.
- 9525 AIR, Delhi in English at 2230.
- 9570 R. Australia noted at 1500.
- 9670 Adventist World Radio at 0930.
- 11710 Radio Kiev, USSR noted at 1930.
- 11730 R. Tashkent, USSR noted at 1400.
- 11765 R. Australia in English at 0645.
- 11770 BBC, Ascension Island relay at 1700.
- 11815 NHK, Japan in English at 0800.
- 11850 R. Norway in English at 0815.
- 11900 RSA, South Africa noted at 1900.
- 11970 Radio Tunis in English at 0900.
- 17825 RSA, South Africa noted at 1600.

**Robin Hookham** of Stretford, Manchester certainly managed to hook'em when he used his Codar Multi-band-6 and 40 foot end-fed antenna to record:

- 4970 R. Rumbos in Spanish at 2345.
- 4980 Ecos del Torbes in Spanish at 0026.
- 5920 R. Kiev, Ukraine noted at 1950.
- 5940 R. Vilnius with Mailbag show at 0047.
- 6130 R. Norway with id. in English at 1900.
- 9545 R. Ghana, 'Africa Worldwide' at 2125.
- 9670 IBRA Radio with religious pgr. at 2015.
- 11720 R. Nacional de Brazil, English at 2312.
- 11805 R. Globo in Portuguese at 2008.
- 11860 R. Canada Int., SW Club at 2148.
- 11880 Voice of Turkey in English at 2203.
- 15130 WYFR with news at 1905.
- 15300 HCJB, Quito, Ecuador 'DX Partyline' at 1944.
- 15410 UN Radio noted at 1921.

Please remember to correct all times to GMT when sending in reports and also remember the new address.

### MEDIUM WAVE DX by CHARLES MOLLOY

**H**AROLD Emblem (Mirfield Yorkshire) has been listening to the Middle East on the medium waves with his Eddystone 730 communications receiver and MW loop antenna. He reports hearing Riyadh, Saudi Arabia on 587kHz; Cairo on 710kHz; Baghdad 760kHz; Tartar, Syria 782kHz; Quazvin, Iran 841kHz; Damman, Saudi Arabia 885kHz; Izmir, Turkey 926kHz; Diyabakir, Turkey 1061kHz; Sharjah, United Arab Emirates 1535kHz. Harold also reports

hearing CSB81 at Santa Maria, Azores on 1570kHz at 2336hrs GMT. Stations in the Middle and Near East can be logged during the evening and after 2300hrs GMT, the time when a number of Europeans sign-off for the night. A sensitive and selective receiver together with a medium wave loop antenna is essential for this type of DXing though a few of the stronger outlets can be heard with simpler equipment. Try for Kuwait on 539kHz; Batra, Egypt on 620kHz; El Beida, Libya on 1124kHz; Tripoli, Libya on 1250kHz and Kuwait on 1345kHz.

**Brendon Rooney** (Glencar, Co. Sligo in Eire) has sent in an excellent log of North American reception. Using a Trio 9R59DS, a Heathkit GR78 transistor communications receiver and a medium wave loop with balanced differential amplifier, he reports hearing CBN St John's in Newfoundland on 640kHz; WOR New York City on 710kHz; WABC also in NYC on 770kHz; WCCO Minneapolis on 830kHz; WHDH Boston on 850kHz; CJON St John's on 930kHz; CBM Montreal 940kHz; CHNS Halifax, Nova Scotia on 960kHz; CBA Moncton, New Brunswick 1070kHz; WBAL Baltimore on 1090kHz; WNEW New York City on 1130kHz; WOWO Fort Wayne, Indiana 1090kHz. Although these stations were heard between 2300hrs and 0200hrs during December it is possible to hear North America on the medium waves in the UK at any time of year provided there is a path of darkness between transmitter and receiver. In June stations can be logged during the hour before sunrise. North Americans broadcast on 'channels' which

are multiples of 10kHz and they are easy to identify as they use their callsigns frequently (prefix C for Canada and W or K for the US.) followed by the name of the city or town where the studios are located.

**Julian Allan** (Hadleigh, Suffolk) has been trying the medium waves with his Audiosonic transistor portable with internal ferrite rod aerial. He reports hearing London Broadcasting on 719kHz (417m); American Forces Network (AFN) Frankfurt on 872kHz (344m); BBC Radio Medway 1034kHz (290m); AFN Munich 1106kHz (271m); Radio Sweden 1178kHz (254.5m) in English at 2245hrs GMT; Radio Tirana, Albania 1394kHz (215.2m); Trans World Radio, Monte Carlo 1466kHz (204.6m). On the long waves Julian has heard Mainflingen, West Germany on 151kHz (1986m); Allouis, France 164kHz (1829m); Luxembourg 236kHz (1271m). Others to look for on the long waves are the Voice of America, Munich 171kHz (1734m); Azilal, Morocco 209kHz (1435m) in Arabic; Tipaza, Algeria 251kHz (1195m) normally in French but in English at 1900hrs GMT; Lahti, Finland 254kHz (1181m).

**Brian Murray** (Edinburgh) has been busy again with his Astrad transistor portable coupled to an old 405-line TV aerial. His log includes CSB2 Lisbon, Portugal on 1034kHz at 0020hrs; Radio Portugal 1061kHz in English at 2300hrs; Radio Denmark also on 1061kHz at 2300hrs; BBC Radio Derby on 1115kHz at 2240hrs and BBC Radio Manchester 1457kHz at 1800hrs, all times being in GMT.

## VHF/FM DXING

by **SIMON DAVID**

**L**AST month I reported on the strange events in January. My Correspondent **E. W. Earnshaw** is now on his way around the world as a sea-going Radio Officer. The reported Turkish station, Radio Ankara news, has been verified by an official at the Turkish Embassy who heard the tape recording made in Newcastle. Other recordings made were of f.m. broadcasts from Russian and Polish origin followed by a Spanish station. I hope this will not deter others reporting more modest DXing achievements.

Openings of a less dramatic nature in February enabled **Roy Patrick** of Derby to pick up Hessischer Rundfunk, Frankfurt on 99MHz. He received a very quick QSL card from them.

**George E. Sykes** is only 50 feet above sea level at Bolton-le-Sands, Lancashire but has a clear view all round. On his AR2000, with an Aerialite 264 and Stolle rotator 15 feet above his garage, he has received local radio stations from Blackburn, Merseyside, Carlisle and Sheffield. He wonders if going upstairs means better results! An unidentified station was picked up on 102MHz, but best reception comes from local mobiles. Kirk O'Shotts, Blaenplwyf and Divis have also been picked up.

**Colin Chatfield** of Camborne, Cornwall has a home made 5-element Yagi feeding a P.W. design preamp and Heathkit FM4-TU tuner. He has received Radio Eirean in English and Gaelic, Radio 4 from Wenvoe and Haverfordwest, BBC radio from North Hessary Tor and ORTF from Brest 97.7MHz.

Finally, anyone in the home counties who heard a foreign station, probably East European, between 97.7 and 98MHz (above LBC) on 23rd March, please

let me know. Reception on my receiver was not good enough to identify it.

Please state the date, frequency and country of origin in all reports; also your receiver and aerial type would be useful.

## Station information

Among the latest information to hand are the following: Perth, BBC Radios 1/2,3 and Radio Scotland are now on 89.0, 91.2, 93.4MHz respectively; Campbeltown BBC services are similarly changed to 88.6, 90.8, 93.0MHz respectively. Listeners with preset push-button receivers will need to alter the tuning of the appropriate channels in these areas.

The IBA station BRMB Radio started broadcasting official programmes on 94.8MHz from Lichfield. VHF transmissions are said to be better here than the alternative medium wave transmissions. The aerial is directional, mounted on the 1,000ft television mast, and beamed towards Birmingham centre. Polarisation is circular to help car radio and portable radio reception.

Piccadilly Radio (IBA) went on the air on 2nd April in the Manchester Area. The transmitter situated at Saddleworth broadcasts on 97.0MHz using a circular polarised directional aerial. The next to follow will be Swansea Sound from Kilvey Hill on 95.1MHz using an omni-directional circular polarised aerial.

Full details of IBA independent radio broadcasts on v.h.f. and medium wave can be obtained by sending a stamped addressed envelope to the *Engineering Information Service, Independent Broadcasting Authority, 70 Brompton Road, London SW3 1EY, or Crauley Court, Winchester, Hampshire SO21 2QA.*

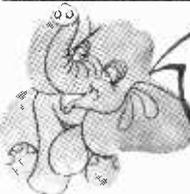
BBC local radio information can be obtained from *Engineering Information Dept., BBC Broadcasting House, London W1A 1AA.*

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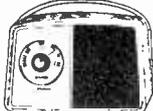
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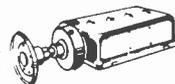


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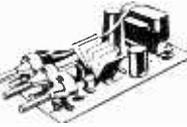
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Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0.1 matrix).  
Sub-miniature 0.1W, 5p each. Miniature 0.25W, 7p each.

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The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector.  
Detector GDI £2. Kit of parts for mains operated detector, including GDI but excluding case, £5.60. Suitable case £1.50. Kit of parts for 12 or 24V battery operation, including GDI and P.C. Board, £7.70. As above for PP9 battery, £5.90.  
NOTE: The battery operated kits incorporate our patented circuit to minimise battery drain. Typically 90mA for 24V.

## PRINTED BOARD MARKER

97p  
Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

## MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 3p. 0.0068μF, 0.01μF, 0.015μF, 0.022μF, 0.033μF, 31p. 0.047μF, 0.068μF, 0.1μF, 5p. 0.15μF, 6p. 0.22μF, 71p. 0.33μF, 11p. 0.47μF, 13p.

160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 3p. 0.1μF, 31p. 0.15μF, 41p. 0.22μF, 5p. 0.33μF, 6p. 0.47μF, 71p. 0.68μF, 11p. 1.0μF, 13p.

## MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 31p. 0.1μF, 4p. 0.15μF, 0.22μF, 5p. 0.33μF, 61p. 0.47μF, 81p. 0.68μF, 11p. 1.0μF, 13p. 1.5μF, 20p. 2.2μF, 24p.

## MYLAR FILM CAPACITORS 100V

0.001μF, 0.002μF, 0.005μF, 0.01μF, 0.02μF, 3p. 0.04μF, 0.05μF, 0.068μF, 0.1μF, 4p.

## CERAMIC DISC CAPACITORS

100pF to 10,000pF, 2p each.

## ELECTROLYTIC CAPACITORS

(μF/V) 1/63, 1.5/63, 2.2/63, 3.3/63, 4.7/63, 6.8/40, 6.8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33/6.3, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6.3, 68/16, 100/4, 100/10, 100/25, 150/6.3, 150/16, 220/4, 220/6.3, 220/16, 330/4, 6p. 47/63, 100/40, 150/25, 220/25, 330/10, 470/6.3, 7p. 68/63, 150/40, 220/40, 330/16, 1000/4, 10p. 470/10, 680/6.3, 11p. 100/63, 150/63, 220/63, 1000/10, 12p. 470.25, 680/16, 1500/6.3, 13p. 470/40, 680/25, 1000/16, 1500/10, 2200/6.3, 18p. 330/63, 680/40, 1000/25, 1500/16, 2200/10, 3300/6.3, 4700/4, 21p.

## SOLID TANTALUM BEAD CAPACITORS

0.1μF 35V	2.2μF 35V	22μF 16V	12p
0.22μF 35V	4.7μF 35V	33μF 10V	
0.47μF 35V	6.8μF 25V	47μF 6.3V	
1.0μF 35V	10μF 25V	100μF 3V	

## VEROBOARD

0.1	0.15
24 x 32	24p 20p
24 x 5	28p 28p
32 x 32	28p 28p
32 x 5	32p 32p
17 x 24	85p 67p
17 x 32	120p 108p
17 x 33 (plain)	76p 52p
17 x 21 (plain)	— 41p
24 x 5 (plain)	— 12p
24 x 32 (plain)	— 11p
Pin insertion tool	62p 62p
Spot face cutter	52p 52p
Pkt. 50 pins	20p 20p

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Standard screened 28p	2.5mm insulated 12p
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Stereo screened 40p	3.5mm screened 18p
Standard socket 20p	2.5mm socket 11p
Stereo socket 30p	3.5mm socket 11p

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Plug 12p. Socket 8p.  
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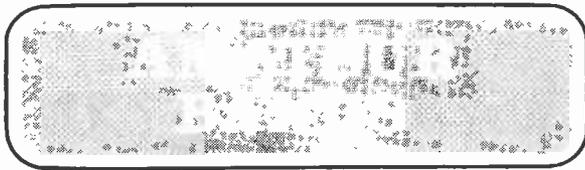
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by Eric Dowdeswell G4AR

**F**IRST, the bad news! Dave Gibson G3JDG, your conductor around the amateur bands for so long, reports that for personal reasons he is no longer able to produce the monthly page. Dave's reports under the heading of 'The Amateur Bands' began in October 1964 and the following month became part of the feature 'On the Short Waves'.

We owe a lot to Dave for keeping us up-to-date on amateur affairs over the years. His humorous, free-and-easy style of writing will be missed. Good luck in the future Dave and thanks a lot, keep in touch.

And now, more bad news! This page is being taken over by yours truly who will endeavour to give you at least as good a service as did JDG. How well I shall succeed remains to be seen. A lot depends upon the number and quality of the reports received so start them rolling to my QTH given below.

## Reporting

A few pointers which will help all round:- letters short, reports accurate and to the point and preferably on a separate sheet of paper and above all, legible! Call signs, in particular, should be in clear block letters but I hope I have enough experience to be able to spot the odd boo-boo. I don't want to hear about those routine QSO's heard on 20m made by fellows using 400W of SSB and a multielement beam. But do tell me all about that unusual call sign, that newly activated country or exotic expedition plus the DX that is really DX when related to the band/power/distance involved.

Reports of QRP work may prove of interest as they may encourage others to try a little less power and more ingenuity and operating know-how to achieve the results they do with high power.

Break for a commercial! As ST2AR in Khartoum, Sudan from 1953 to 67 I worked nearly 300 countries, using homemade equipment and mostly wire aerials, but not one of these QSO's held the same thrill for

me as did the QSO I had a couple of years ago with W1BB on Top Band with a genuine 10W input. In recent times G3XAP has worked all continents with 9W input on this band and now threatens to repeat the performance with 5W, which leaves me gasping! He does have the slippery slope of the sunspot cycle to slide down so others ought to try and emulate him while the going is good. The glow of self-satisfaction attending success has to be appreciated!

## GB Operations

With the proliferation of GB prefixes for use at just about any event that a club secretary cares to dream up their novelty value has decreased to zero. However, there are a couple of calls around that rise about this modern day mediocrity. In the centenary year of the birth of Marconi, GB2MT was operated from Bayswater, London from April 25 to 28 on 15, 20 and 80m SSB. The QTH was the house in which Marconi and his mother lived in 1896/7.

Another event associated with the centenary and taking place over the weekend of June 7/9 is a House Party at Stratford-Upon-Avon where guests will face a programme of films, talks and demonstrations to illustrate the progress of radio communications. GB2HF will be on the air to demonstrate how it is done. QSL's and reports to Ralph Barrett G2FQS (QTHR) or the Bureau, for both stations.

By the time this appears in print you may have heard GB2MT already on April 7 when it was located at the top of the GPO building in St. Martins-le-Grand in London from where Marconi made the first official demonstration of wireless in this country to a second station on the Embankment just half a mile away. QSL as above.

## Deadlines

The deadline for your reports each month is a rather flexible feast since the date, from month to month, when the magazine "goes to bed" can vary by as much as seven days. Aim at the middle of the month but remember that every effort will be made to squeeze in material received after this time. Incidentally, I often wonder if the brief listing of future events is really of any interest. I have a sneaking feeling that anyone with sufficient enthusiasm will have already acquainted himself with the full details from other sources.

Starting off with a nil balance of readers' reports and an aversion to nicking anything from the other scribes the reports on the band conditions must wait until next month. Suffice to say that the sunspot number is dropping more or less as predicted so take the hint and keep an eye on the lower frequency bands for your reports. Cheers for now.

### BROADCAST BANDS

**Short Wave** Reports by 15th of the month to Malcolm Connah, 27 Lismore Road, Highworth, Swindon, Wiltshire, SN6 7HU.

**Medium Wave** Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

**VHF/FM** Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

### AMATEUR BANDS

Logs covering any amateur band/s in band/alphabetical order by the middle of the month to Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashstead, Surrey, KT21 2TW.

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2 1/2in x 5in	26p	23p	13p
3 1/2in x 3 1/2in	26p	23p	—
3 1/2in x 5in	30p	30p	22p
17in x 2 1/2in	82p	63p	45p
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## I.C. SOCKETS



DUAL IN LINE 8 pin 13p, 14 pin 15p, 16 pin 17p, 24 pin 26p, 28 pin 39p, 36 pin 41p, 40 pin 44p.  
ZIG ZAG 14 pin 19p, 16 pin 21p.

## HEAT SINKS

TV2 for TO-66 15p. 5F for TO-5  
TV3 for TO-3 16p. 18F for TO-18



TV4 for TO-126  
TV5 for TO-220

DIP10 2 for SL403D  
DIP14/5 for EA1,000



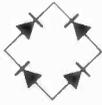
10DN400 4 4Y-1 4



46p

35p

## BRIDGE RECTIFIERS



P.I.V.	1 amp	R.M.S.	2 amp
100V	20p	50V	35p
200V	22p	100V	40p
600V	25p	200V	45p
1000V	38p	400V	50p

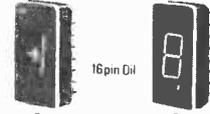
## RECTIFIERS

P.I.V.	1 amp	3 amp
50	1N4001 6p	1N5400 15p
100	1N4002 7p	1N5401 16p
200	1N4003 9p	1N5402 17p
400	1N4004 9p	1N5404 22p
600	1N4005 11p	1N5406 26p
800	1N4006 13p	1N5407 30p
1000	1N4007 16p	1N5408 33p

BY100	16p	BY133	23p
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1/2 watt	Metal Oxide Film	±2%	E12 Series 10Ω to 1MΩ	41p
1 watt	± Cermet Thick Film	±2%	E12 Series 56Ω to 150KΩ	8p
1 watt	Carbon Film	±5%	E24 Series 10Ω to 10MΩ	11p
1 watt	Carbon Composition	±0.5Ω	(2-2Ω) 2.7Ω 3.3Ω 3.9Ω 4.7Ω	41p
1 watt	Carbon Composition	±10%	(5-6Ω) 6.8Ω 8.2Ω	51p
1 watt	Carbon Film	±5%	E12 Series 10Ω to 10MΩ	3p
2 watt	Carbon Film	±5%	E12 Series 10Ω to 10MΩ	6p
2 1/2 watt	Wire Wound	±10%	E12 Series 0.22Ω to 0.47Ω	10p
2 1/2 watt	Wire Wound	±5%	E12 Series 1Ω to 270Ω	10p
5 watt	Wire Wound	±5%	0.5Ω to 8.2KΩ	10p
10 watt	Wire Wound	±5%	0.5Ω to 6.8KΩ	17p
10 watt	Wire Wound	±5%	10KΩ 15KΩ 20KΩ 25KΩ	17p
15 watt	Wire Wound	±5%	10Ω to 6.8KΩ	13p

## TRANSISTORS and DIODES

AC107	16p	ASV26	33p	BCY70	17p	BF181	33p	BU10502	OC171	33p
AC126	13p	BC107	11p	BCY72	17p	BF184	28p	BU10502	TIC44	46p
AC127	13p	BC108	11p	BCZ10	28p	BF185	25p	D13V	53p	TIC226D
AC128	13p	BC109	11p	BCZ11	28p	BF194	15p	MJ4000	£1.97	
AC176	15p	BC114	15p	BD115	74p	BF195	17p	MJ4010	TIP41A	81p
AC187	22p	BC117	22p	BD124	82p	BF196	16p	MJ4010	TIP42A	99p
AC187K	20p	BC147	10p	BD131	55p	BF197	16p	MJE340	TIS43	36p
AC188	22p	BC148	10p	BD132	66p	BF200	32p	MJE340	TIS73	£2.10
AC188K	25p	BC149	10p	BD131Z	66p	BF200	27p	MJE2955	TIS91	33p
ACY19	25p	BC157	13p	BD133	72p	BF244B	27p	MJE2955	TN2977	16p
ACY20	22p	BC158	12p	BD133	72p	BF252	25p	MJE3055	TN3053	19p
AD140	15p	BC159	14p	BD135	42p	BF263	25p	MJE3055	TN3054	51p
AD149	49p	BC168B	11p	BD136	44p	BF272	£1.21	MPPF102	TN3055	52p
AD161	38p	BC169	12p	BD137	50p	BF390	37p	MPPF102	TN3102	24p
AD162	38p	BC171	20p	BD138	55p	BF528	£1.01	MPPF103	TN3103	24p
AD161Z/2p	BC172	17p	BD139	61p	BFV100	66p	MPPF104	TN3104	24p	
AF114	17p	BC174B	35p	BD140	66p	BFV11	67p	MPPF105	TN3105	24p
AF115	17p	BC176	22p	BD201	99p	BFV52	22p	MPPF106	TN3106	24p
AF116	17p	BC178	22p	BD202	41p	BFV59	43p		TN3107	27p
AF117	17p	BC179	24p	BD203	£1.55	BFV59	37p	OC28	TN3108	35p
AF118	92p	BC182L	11p	BD204	41.37	BFV88	26p	OC35	TN3109	35p
AF118	92p	BC183L	12p	BF109	75p	BFV90	22p	OC36	TN3110	35p
AF124	33p	BC184L	12p	BF115	25p	BFV91	22p	OC44	TN3111	35p
AF125	27p	BC187	27p	BF160	25p	BFV92	22p	OC45	TN3112	35p
AF126	27p	BC192L	12p	BF167	24p	BR100	43p	OC71	TN3113	35p
AF127	27p	BC213L	13p	BF173	24p	BRV39	44p	OC72	TN3114	35p
AF139	35p	BC214L	11p	BF177	28p	BSX20	18p	OC75	TN3115	35p
AF172	25p	BC268	15p	BF178	29p	BSX21	22p	OC81	TN3116	35p
AF179	71p	BC327	28p	BF179	33p	BSY95A	14p	OC83	TN3117	35p
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CERAMIC DISC—LOW VOLTAGE—  
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0.1µF, 0.22µF, 6µp.

POLYSTYRENE (160V)—From 10pF to 0.01µF in multiples of 10pF: 15pF, 22pF, 33pF, 47pF and 68pF, 4µp.

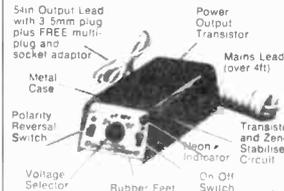
MYLAR PLATE (100V)—1000 PF, 2000pF, 5000pF, 2µp, 0.01µF, 0.02µF, 0.04µF, 0.05µF, 3µp; 0.068µF, 0.1µF, 5p; 0.2µF, 6µp.

MULLARD C280 (250V POLYESTER)  
—0.01µF, 0.015µF, 0.022µF, 0.033µF, 0.047µF, 3µp; 0.068µF, 0.1µF, 0.15µF, 4µp; 0.22µF, 5µp; 0.33µF, 7p; 0.47µF, 9p; 0.68µF, 12p; 1.0µF, 14p; 1.5µF, 22p; 2.2µF, 26p.

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Audio I.C. Leaflet No. 12. FREE (only with I.C.'s—10p separately)

### Pre-Amplifiers

Dual, MC1303L £1-89  
Low Noise Dual, MC1339P £1-29

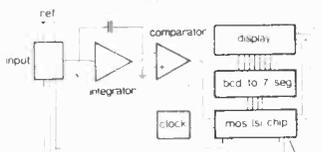
### Amplifiers

250mW. MFC4000A 49p  
1 watt, TAA300 £1-79  
2 watt, LM380 £1-40  
3 watt, SL414 £1-76  
5 watt, TBA800 £1-59  
7 watt, TBA810S £1-70  
15 watt, BHA0002 £3-95  
35 watt driver NE540L £1-32

NEW SL414 pin for pin = SL403D 3 watt £1-76



## 3 1/2 Decade DVM



Supplied with complete data  
All this on a single 16 pin DiL packed MOS LSI Integrated Circuit

**A State-of-the-Art Digital Voltmeter I.C. for only £7-79**

- Maximum Display - or - 1 999V
- Minimum Display - or - 1mV
- Can be scaled up to read 1 999V
- Automatic Polarity Detection
- Dual Ramp Integration
- Automatic Overrange Indication
- Up to 50 readings per second
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### Coil-less Phase-Locked Loop

### I.C. Stereo Decoder

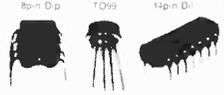
MC1312 decodes CBS. SQ Free leaflet No. 11 gives full circuit and details.  
**Our Price £6-49**

Motorola MC1310, supplied complete with our FREE leaflet No. 11  
**Our Price £3-05**

# QUADRISONICS

Inc. all parts for decoder, inc. Veroboard, V.A.T., P. & P. (Leaflet alone 10p.)

## Linears



709	34p	40p	35p
710	40p	45p	39p
711	35p	45p	39p
723	96p	95p	85p
751	42p	45p	43p
757			92p
748	42p	45p	43p
CA3046	95p	MVR5V(L0005)	£1-65
CA3075	£1-85	MVR12V(L005)	£1-85
CA3082	£1-85	MVR15V(L03P)	£1-85
LM101H	£1-99	NE555	85p
LM201H	£1-15	NE560B	£4-92
LM301	£1-85	NE551B	£4-92
LM307N	66p	NE562B	£4-92
LM308N	£1-45	NE565	£2-80
LM309K	£2-89	NE566	£2-75
LM3900	77p	NE567	£2-80
MC1330	88p	SG3482N	£3-08
MC1350	83p	SL410	£2-89
MC1351	£1-10	TA263	99p
MC1352	£1-10	TA293	99p
MC1357	£1-59	TA310	£1-37
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MC1456CP	£2-42	TA370	£5-15
MC1485	£3-85	TA450	41p
MC1486N	£1-49	TA470	£1-85
MC3401	77p	TA470	£4-49
MFC4010A	81p	TA470	£1-55
MFC4080	78p	TA470	£1-85
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R.F. CHOKES, 0.1µH to 19mH. For full details ask for List No. 5. P & P 5p

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Transistor Range: Series 1T to 5T inclusive Blue, Yellow, Red and White all 44p each.  
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Dual Purpose Range: Series 1 to 7 inc Blue, Yellow, Red and White 44p each.  
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Ferrite Aerials: Medium and Long—state 300pF or 500pF tuning 87p each

## Tuning Gangs



**Type C604**  
5pF 71p 50pF 77p 365pF 83p  
10pF 71p 60pF 83p 365+365pF 99p  
**Type 0**  
15pF 71p 75pF 83p 208 + 176pF with screen and trimmers 99p  
20pF 77p 100pF 85p  
25pF 71p  
P & P all types 10p

## NEW FERRANTI RANGE

### ZN414

The Radio I.C. in a TO18 can. Supplied with our data leaflet No. 10 Giving circuits and component information. (Leaflet alone 10p.)

BFS59	15p	ZTX302	17p	ZTX450	17p	ZS121	10p	ZS272	18p
BFS60	20p	ZTX303	14p	ZTX451	17p	ZS122	13p	ZS274	19p
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BFS97	23p	ZTX311	10p	ZTX502	17p	ZS140	25p		
BFS98	20p	ZTX312	10p	ZTX503	14p	ZS141	43p		
		ZTX313	11p	ZTX504	43p	ZS142	33p		
ZTX107	10p	ZTX314	13p	ZTX510	17p	ZS170	10p		
ZTX108	10p	ZTX320	31p	ZTX530	21p	ZS171	13p		
ZTX109	15p	ZTX330	15p	ZTX531	22p	ZS172	16p		
ZTX212	14p	ZTX331	16p	ZTX550	17p	ZS174	17p		
ZTX213	14p	ZTX341	22p	ZTX551	17p	ZS176	23p		
ZTX214	15p	ZTX382	13p			ZS178	38p		
ZTX300	12p	ZTX383	15p			ZS270	11p		
ZTX301	13p	ZTX384	18p			ZS271	16p		

Our Price  
£1-32

KSO30A  
Zener Series as  
BZY88 Series 11p each.

## ELECTROLYTICS

µF	4V	6.3V	10V	16V	25V	40V	63V	100V	160V	450V
1							61p		81p	15p
1.5							61p		81p	
2.2							61p		81p	
3.3							61p		81p	
4.7							61p		81p	17p (4µF)
6.8							61p	61p	81p	21p
10							61p	61p	81p	24p (16µF)
15							61p	61p	81p	
22							61p	61p	81p	
33							61p	61p	81p	
47							61p	61p	81p	
66	61p	61p	61p	61p	61p	61p	8p			33p (32µF) 25p (50µF) (350V)
100	61p	61p	61p	61p	61p	8p	11p			
150	61p	61p	61p	61p	8p	11p	14p			
220	61p	61p	61p	8p	11p	14p	19p	31p		
330	61p	61p	8p	11p	14p	20p	25p	44p		
470			8p	11p	14p	20p	25p	47p		
680			10p	14p	20p	25p	59p	59p		
1000	13p	14p	19p	22p	25p	44p	79p	79p		
1500		18p	19p	25p						
2200		18p	24p		39p	44p	79p	148p		
3300		26p								
4700										
6800	25p				44p	68p	79p	149p	252p	

## Potentiometers



5kΩ 250kΩ  
10kΩ 500kΩ  
25kΩ 1MΩ  
50kΩ 2MΩ  
100kΩ

Log or lin less switch (and 1kΩ lin) 13p  
Log or lin with switch 26p  
Dual less switch 44p  
Dual with switch 10kΩ, 100kΩ and 1MΩ. Log only 57p



10kΩ Single  
25kΩ Dual  
100kΩ 60p

New Silver and Black Knob 16p

## Presets

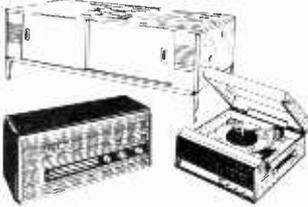
Vertical or Horizontal  
0-1 watt 61p  
100Ω 1kΩ 10kΩ 0-25 watt 71p  
250Ω 2-5kΩ 25kΩ 250kΩ 2-5MΩ  
500Ω 5kΩ 50kΩ 500kΩ 5MΩ  
Cermet Type to 1MΩ only 41p

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A15B	98p	GL23	£1-21
CZ1	161p	R53	£1-49
CZ4	18p	R54	£1-61
CZ13A	18p	VA1005	16p
CZ19	18p	VA1025	16p
E298CD A258	13p	VA1033	16p
E298ED A258	13p	VA1034	16p
E298ED A260	13p	VA1039	16p
E298ED A262	13p	VA1040	16p
E298ED A265	13p	VA1053	16p
E298ED P268	13p	VA1055S	16p
E298Z2 05	13p	VA1056S	16p
E298Z2 06	13p	VA1066S	17p
E299DD P336	14p	VA1067S	19p
E299DD P338	14p	VA1077	19p
E299DD P342	14p	VA1098	21p
E299DD P348	14p	VA1104	31p
GL16	£1-21	VA1107	29p

Other types obtainable upon application

The items below are from the March Supplement to our 1974 Catalogue. You can receive this Catalogue and the next 12 supplements by sending 66p.



**Stereo Radiogram Cabinet.** Long, Low and Medium. Teak veneered with sliding front and tapered legs. Speaker spaces each end. Size approx. 4ft. x 15" x 15". Probably cost over £20 to make. Our Price £29.10 each. Carriage £2 per 200 miles. **Bush Record Player.** Bush Ref. No. SRP 64. Separate bass and treble controls help give this unusually good sound quality. A suitable amplifier/speaker unit converts this to full stereo. Cabinet size 17" x 16 1/2" x 18" deep. Finished in charcoal grey leather cloth. Fully transistorised with 8" speaker. Controls bass, on/off, treble and volume. Socket stereo. Makers recommended price £27.73. Our Price £17.72. A saving of over £8. Post and Insurance £2.

**Erres Table Radio.** Dutch made. Three wavebands (L.M. & S.) Nice size (16 1/2" x 8 1/2" x 5") wooden cabinet with high gloss finish. 6" x 4" speaker gives better than average tone—these radios are very well made from good quality component—and should not be confused with Hong Kong makes. They recently retailed at £18 each and were well worth it. The ones we have are brand new and working but have failed final inspection because either they will work only on mains or only on batteries. It is unlikely that the fault is very much however and we are arranging for a circuit diagram. Price £8.64 plus £1 post and insurance.

**Electric Welder.** Big transformer in metal case with carrying handle and control switch, output through very heavy duty terminals. Output volts 1.9-4.25 volts max. 117 amps—normal mains input socket for optional foot switch. £19.50 plus £2 carriage up to 200 miles. A further £1 for each 100 miles extra.

**24v 8 amp Mains Transformer.** Upright mounting with fixing clamps, standard primary 240/200/195/160—£3.50 plus 30p post and service.

**Mains Transformer.** (6.5v-0-6.5v at 500 mA and 1v at 1 amp). Normal tapped primary. Upright mounting with fixing lugs. £1.00

**Mains Transformer.** (18v-37v-39v-41v at 2 amp or this would function at 18v-0-18v). Primary tapped 110, 115, 127, 200, 220 and 240v selected by labelled plug. Primary screen and multi-tapped. Upright mounting with fixing lugs. £2.85.

**Midget Two Gangs.** Tuning condenser as fitted to many Japanese and Hong Kong radios—probably 30pft each section with 1" spindle with terminals less trimmers. Price 38p. With trimmers 50p. **Ferrite Rods for aerials, etc.** The following type are in stock: Dia 1/4" 4" long 15p, 5" long 18p, Dia 5/16" 5" long 20p, 6" long 25p, 8" long 30p, Dia 3/8" 4" long 20p, 5" long 25p, 6" long 30p, 8" long 40p; Dia 1/2" 6" long 35p; Ferrite Slab 1" long x 1" x 1/8th" 20p.

**Photo Resistor.** Mullard type. This drops its resistance from approx. 250Kohms in dark to only approx. 200 ohms in bright light but it is only quite small, in fact less than 1/2" square with leads coming out of corners on one side. Price 22p.

**0-8 Ammeter.** 2" square, full vision face for flush mounting—moving iron, ideal for charger. 75p each.

**I.F. Transformers.** Tuneable around 465 KC Japanese manufacture as fitted to many Japanese made portable radios. Three sizes available—

**Sub. miniature approx 1 1/2" x 1" x 1" high—Miniature approx 1" x 1" x 1" high—Small approx. 9/16" x 3/16" x 1" and Standard 9/10" x 9/10" x 1". All £1.1p each.**

**12v Power Pack.** "Smooth flow" Double wound mains transformer, full wave rectifier and overload protection. Completely enclosed in plastic case with output terminals and test leads—ideal to operate models, drive motors, charge small batteries etc. Price £2.25.

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**Relay.** Clare Elliot. Sealed and wire ended. 675 ohm coil with two pairs change over contacts. Price £1.85.

**TERMS:—Add 10% V.A.T.** Send postage where quoted—other items post free if order for these items is £6.00, otherwise add 20p.

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Small robust 12 volt Model Makers Motors. NEW 50p each P. & P. 10p.

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250V (Evershed & Vignoles) (not new) with metal box £8.50p each 50p P. & P.

### SPECIAL OFFER

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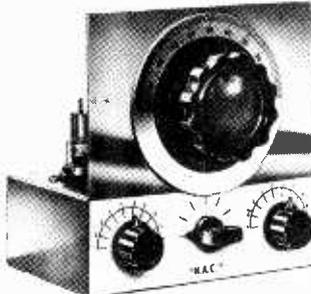
**S.T.C. 12 VOLT (170Ω) RELAYS.** Plug in type with base, dp. dt. As new! 30p each P. & P. 10p. 4 for £1.00 P. & P. 20p.

When in Leeds visit our Walk Round Showroom—near City Square, Queens Hotel. Many BARGAINS FOR SHOP CALLERS. We shall be visiting all the MAJOR RALLIES in the NORTHERN ZONE!

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Complete kit—Price £4.30 (incl. p. & p. & V.A.T.). Customer writes: "Australia, India and America at loud volume."—I have now heard over 300 stations including many Amateurs. I have received 32 Q.S.L. verified reports—from all continents. An amazing one-valver!" This kit contains all genuine short-wave components, drilled chassis, valve, accessories and full instructions. Ready to assemble, and of course, as all our products—fully guaranteed. Full range of other S.W. kits, including the famous model "K plus" (illustrated above). All orders despatched by return. Send now for free descriptive catalogue, of kits & components. Test Report available. **EXCITING COMPETITION for Short-Wave listeners.** Send stamped envelope for details.

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IC radio chip with data £1.20 (23p). Also available kit of extra parts to complete a radio £2.39 (40p). Send sae for free leaflet.

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2 x Z60/Stereo 80/PZ8/Transformer £33.11 (£3.31)

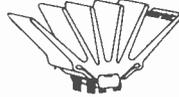


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Send sae for free leaflet on new quadraphonic adapter for use with Project 80 £9.95 (£1.30).

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6W rms power. With 44 page booklet and printed circuit £2.10 (43p)



### DELUXE KIT FOR THE IC12

Includes all parts for the printed circuit and volume, bass and treble controls needed to complete the mono version £1.60 (27p). Stereo model with balance control £3.60 (48p)

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SEND SAE FOR FREE LEAFLET ON KITS

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The most versatile battery eliminator ever offered. Switched output of 3, 4½, 6, 7½, 9 and 12V at 500mA. £4.15 (70p)



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Attractive plastic instrument cases in 4 sizes: 80 x 50 x 30mm 60p (25p) 115 x 65 x 40mm 87p (30p) 155 x 90 x 50mm £1.20 (35p) 210 x 125 x 70mm £1.80 (45p)

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£9.95 (£1.30)  
Complete self contained matrix quadraphonic synthesizer in attractive cabinet. Just feed output of ordinary stereo hi-fi into it and hook up to 4 speakers to obtain the latest experience in sound. Send sae for free leaflet.

## SWANLEY ELECTRONICS

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Please add the sum shown in brackets after the price to cover the cost of post and V.A.T. Official credit orders from schools etc. welcome. No VAT charged on overseas orders.





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WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

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Post and Packing 15p per kit.

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for use with 2 x AF310	£11.45
GP312 Circuit board	£7.50
GP330 Tremolo unit	£3.32
HF61 Diode detector	£2.70
HF65 FM transmitter	£2.87
HF310 FM tuner	£15.81
HF325 Deluxe FM tuner	£24.12
HF330 Decoder (HF310/325)	£9.96
HF380 (with AF) serial amplifier	£4.94
HF395 broadband aerial amp	£1.77
LF380 Quadraphonic device	£11.36
M160 Multi-vibrator	£1.71
M191 V.U. Meter	£4.55
M192 Stereo balance meter	£4.97
M1302 Transistor tester	£8.45
NT10 Stabilised power supply	£5.15
100mA A.C.	£1.45
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
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104 5/16V DC 500mA	£4.50

**Amateur Electronics by Josty Kit**, the professional book for the amateur - covers the subject from basic principles to advanced electronic techniques. Complete with circuit board for AE1 to AE10.

<b>OUR PRICE £3.30</b> (No VAT)	
P&P 25p plus V.A.T.	
AE1 100mW output stage	£1.50
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AE4 Flasher	99p
AE5 Stable multi-vibrator	95p
AE6 Movable multi-vibrator	93p
AE7 RC generator	97p
AE8 Bass filter	90p
AE9 Treble filter	90p
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Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 368 x 222 x 190mm, 8 ohms, 8 watts RMS, 16 watts peak. Complete with Din lead.



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High quality 2 way speaker systems. 25 Watts, 4-8 ohms, 40Hz-18kHz. Size: 560 x 340 x 255mm approx. Wood grain finish with black fronts.



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6 transistor high quality tuner. Size only 153 x 101 x 63mm. 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88-108MHz. Ready built, ready for use. Fantastic value for money.



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Stereo multiplex adapter £5.95 extra.

**ALL PRICES EXCLUDE VAT**

**Also see previous page**

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A new portable bridge offering excellent range and accuracy at low cost. Resistance: 6 ranges 0.1 ohm-11.1 megohms. Inductance: 6 ranges: 1 microhenry-111 henries. Capacity: 6 ranges 10pF-1110 nF. Turns Ratio: 6 ranges: 1:1-1000:1-11100:1. Bridge Voltage at 1,000cps. Operated from 9 volt battery. 100 microamp meter indication. Size 7 1/2 x 5 x 2".

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Frequency range 500kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.

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**TE-200 RF SIGNAL GENERATOR**

Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable RF attenuator audio output. Xtal socket for calibration. 220-240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm.

**OUR PRICE £17.50** P&P 30p

**ARF 300 AF/RF SIGNAL GENERATOR**

All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100kHz. Output Square/Sine wave 10V. P.P. RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

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**MODEL MG100 SINE SQUARE WAVE AUDIO GENERATOR**

Range 19-220,000Hz Sine Wave Output Sine or Square wave 10V p.p. Output size 180 x 90 x 90mm. Operation 220/240V A.C.

**OUR PRICE £19.95** P&P 37p.

**MCA220 Automatic Voltage Stabiliser**

Input 88-125V AC or 175-250V AC. Output 120V AC or 240V AC. 200V/A rating. P&P 50p.

**OUR PRICE £11.97**

**PS1008 Regulated POWER SUPPLY UNIT**

Solid state. Output 6, 9 or 12V DC up to 3 Amp. Meter to monitor current. Input 220/240V AC. Size: 100 x 82 x 159mm.

**OUR PRICE £11.97** P&P 25p

**PS200 Regulated POWER SUPPLY UNIT**

Solid state. Variable output 5-20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.

**OUR PRICE £19.95** P&P 25p

**POWER RHEOSTATS**

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. 1/4" diameter shafts. Bulk quantities available.

**25 WATT** 10/25/50/100/250/500/1000 2500 Ohms **£1.15** P&P 10p

**50 WATT** 10/25/50/100/250/500/1000/2500/5000 Ohms **£1.62** P&P 10p

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**1000 WATTS** **£9.50** P&P 38p

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Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1 1/8" punches complete with gripper and accessories.

**OUR PRICE £3.00** P&P 40p

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Excellent quality at low cost. Input: 230V 50/60Hz. Output 0-260V. MODEL S260 BENCH MOUNTING

**1A** £10.50 **30p**

**2.5A** £12.00 **35p**

**5A** £17.50 **37p**

**8A** £30.35 **50p**

**10A** £33.75 **75p**

**12A** £29.50 **75p**

**20A** £36.00 **125p**

**25A** £95.00 **130p**

**40A** £120.00 **150p**

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**1A** £10.00 **30p**

**2.5A** £12.00 **35p**

**240° Wide Angle 1mA METERS**

**MW 1-6** 60x60mm **£6.50** P&P 15p

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App. 7:1 ratio planetary drive vernier dial. Log scale 0-180 degrees. Blank scales 1-5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. 1/4" diam. shaft.

**OUR PRICE £1.62** P&P 15p



**WALKIE TALKIES**

**SKYFON 100mW**

**OUR PRICE £24.95** per pair

**P302 Two Channel 300mW**

**OUR PRICE £52.50** per pair

**P1003 Three Channel 1 Watt**

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**P&P 50p** per pair

NB. Licence required for use in UK

**RUH6 Reflex Horn Speaker**

Built-in driver unit. Impedance 16 ohms. Power rating 10W. Response 380-7000Hz. Size approx 6" x 6". Weather and shock protected.

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**TRIO 9R590S RECEIVER**



Four bands covering 550kHz to 30 MHz continuous and electrical bandspread on 10, 15, 20, 40, and 80 mtrs. 8 valve plus 7 diode circuit. 4 to 8 ohm output and phone jack. SSB-CW, AM, variable BFO, S Meter and separate band spread dial. IF frequency 445kHz. audio output 1W watt. Variable RF and AF gain controls. 105/250V AC, with instructions.

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**BELTEK W5400 CAR TRANSCIEVER**



Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squelch and channel select. Internal 3" speaker. Complete with dynamic mic. PTT switch, three sets of crystals for 144.48, 144.6 and 145MHz. mounting bracket and instructions. Size: 150 x 70 x 220mm.

**OUR PRICE £75.00** P&P 50p

**HITACHI FLUORESCENT LANTERN L1901**

A portable battery operated lantern ideal for home, motorizing, camping etc. Approx 10" tall. Provides brilliant light from 9 1.5v batteries (not supplied).

**OUR PRICE £7.90** P&P 25p

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Features 24 hour alarm setting, on/off and auto alarm 'sleep' switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V-3 Amp.

**OUR PRICE £5.95** P&P 30p

**KE630 3 Station INTERCOM**

Master and two sub stations. Can be used on desk or wall mounted. Complete with cable and batteries.

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**LH02S STEREO HEADPHONES**

Light weight head-phones with padded ear pieces. 4/16 ohms 20-20,000Hz. Complete with 6' lead and plug.

**OUR PRICE £1.97** P&P 30p

**TE1018 Deluxe Mono High Impedance Headset.**

Sensitive magnetic headset with soft ear pads. Impedance 2,600 ohms (600 ohms DC). Frequency response: 200-4,000Hz.

**OUR PRICE £2.25** P&P 30p

**DH02S STEREO HEADPHONES**

Wonderful value and excellent performance combined. Adjustable head band. Impedance 8 ohms. 20-12,000Hz. Complete with lead and plug.

**OUR PRICE £2.50** P&P 30p

**TE1035 Stereo HEADPHONES**

Low cost with excellent response. Foam rubber ear cups. Adjustable headband. 8 ohms impedance. Frequency response 25Hz-18kHz. Complete with cable and stereo jack plug.

**OUR PRICE £2.60** P&P 30p

**SH80V MONO/STEREO HEADPHONES**

Volume control for each channel. 4/16 ohms impedance. Frequency response 20Hz-18kHz. Complete with 10ft. coiled lead and jack plug.

**OUR PRICE £4.97** P&P 30p

**BH01 HEADSET and Boom Microphone**

Moving coil. Ideal for language teaching, communications etc. Headphone impedance 16 ohms. Microphone impedance 200 ohms.

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Model 350 13 x 8" with single tweeter/crossover. 20-20,000Hz. 15 watts RMS. Available 8 or 15 ohms.

**OUR PRICE £7.50** each P&P 37p

Model 450 13 x 8" with twin tweeter/crossover. 20-20,000Hz. 8 watts RMS. Available 8 or 15 ohms.

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Tannoy 12" DR/8 Bass Speakers 8 ohms 30 watt Heavy duty ideal for Hi-Fi A Group

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Size: 85 x 64mm

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500uA	£3.65
50-0-500uA	£3.75
100-0-100uA	£3.70
1mA	£3.65
5mA	£3.65
10mA	£3.85
50mA	£3.85
100mA	£3.85
500mA	£3.85
1A DC	£3.85
5A DC	£3.85
10A DC	£3.85
5V DC	£3.65

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20V DC £3.65  
300V DC £3.65  
15V AC £3.75  
300V AC £3.75  
VU Meter £3.90



**CLEAR PLASTIC MODEL SW100**  
Size: 100 x 80mm

50uA	£4.60
100uA	£4.50
500uA	£4.30
50-0-500uA	£4.50
100-0-100uA	£4.45
1mA	£4.30
1A DC	£4.30
5A DC	£4.30
20V DC	£4.30
50V DC	£4.30
300V DC	£4.30

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300V AC £4.45  
VU Meter £4.50



**EDGEWISE MODEL PE70**  
Size: 90 x 34mm

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100uA	£4.10
200uA	£4.05
500uA	£3.90
50-0-500uA	£4.10
100-0-100uA	£4.05
1mA	£3.85
300V AC	£3.95
VU Meter	£4.30



**MODEL ED107 EDUCATIONAL METER**  
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.

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100uA	£7.90
50-0-500uA	£7.90
1mA	£7.60
1-0-1mA	£7.60
1A DC	£7.60
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5V DC	£7.60
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50-0-500uA	£5.40
100-0-100uA	£5.35
500-0-500uA	£5.35
1mA	£5.20
1-0-1mA	£5.20
5mA	£5.20
10mA	£5.20
50mA	£5.20
100mA	£5.20
500mA	£5.20
1A DC	£5.20
5A DC	£5.20
15A DC	£5.20
30A DC	£5.20
10V DC	£5.20
20V DC	£5.20
50V DC	£5.20
150V DC	£5.20

300V DC £5.20  
15V AC £5.30  
5A AC £5.30  
S Meter 1mA £5.20  
VU Meter £5.55  
1A AC £5.20  
5A AC £5.20  
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5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mic 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.

**OUR PRICE £8.97** P&P 20p



**ALL PRICES EXCLUDE VAT**

\*Items with asterisk are Moving Iron type, all others are Moving Coil

**CLEAR PLASTIC MODEL SD830**  
Size: 110 x 83mm

50uA	£4.30
100uA	£4.25
200uA	£4.20
500uA	£4.15
50-0-500uA	£4.25
100-0-100uA	£4.20
1mA	£4.15
5mA	£4.10
10mA	£4.10
50mA	£4.10
100mA	£4.10
500mA	£4.10
1A DC	£4.10
5A DC	£4.10
10A DC	£4.10
5V DC	£4.10

10V DC £4.10  
20V DC £4.10  
50V DC £4.10  
300V DC £4.10  
15V AC £4.20  
300V AC £4.20  
VU Meter £4.40



**CLEAR PLASTIC MODEL MR 45P**  
Size: 50 x 50mm

50uA	£3.20
100uA	£3.15
200uA	£3.10
500uA	£3.00
50-0-500uA	£3.15
100-0-100uA	£3.10
500-0-500uA	£2.95
1mA	£2.95
10mA	£2.95
50mA	£2.95
100mA	£2.95
500mA	£2.95
1A DC	£2.95
5A DC	£2.95
10V DC	£2.95
20V DC	£2.95
50V DC	£2.95
300V DC	£2.95
15V AC	£3.05
300V AC	£3.05
VU Meter	£3.40

1A AC £2.95  
5A AC £2.95  
10A AC £2.95  
20A AC £2.95  
30A AC £2.95



**CLEAR PLASTIC MODEL MR 38P**  
Size: 42 x 42mm

50uA	£3.10
100uA	£3.05
200uA	£3.00
500uA	£2.85
50-0-500uA	£3.00
100-0-100uA	£2.80
1mA	£2.80
1-0-1mA	£2.80
2mA	£2.80
5mA	£2.80
10mA	£2.80
20mA	£2.80
50mA	£2.80
100mA	£2.80
150mA	£2.80
200mA	£2.80
300mA	£2.80
500mA	£2.80
1A DC	£2.80
2A DC	£2.80
5A DC	£2.80
10A DC	£2.80
3V DC	£2.80
10V DC	£2.80
15V DC	£2.80

20V DC £2.80  
50V DC £2.80  
100V DC £2.80  
300V DC £2.85  
500V DC £2.85  
750V DC £2.90  
15V AC £2.90  
50V AC £2.90  
150V AC £2.90  
300V AC £2.90  
S Meter 1mA £2.80  
VU Meter £3.20



**CLEAR PLASTIC MODEL SD460**  
Size: 59 x 46mm

50uA	£3.50
100uA	£3.45
200uA	£3.40
500uA	£3.35
50-0-500uA	£3.45
100-0-100uA	£3.40
1mA	£3.30
5mA	£3.30
10mA	£3.30
50mA	£3.30
100mA	£3.30
500mA	£3.30
1A DC	£3.30
5A DC	£3.30
10A DC	£3.30
5V DC	£3.30

10V DC £3.30  
20V DC £3.30  
50V DC £3.30  
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15V AC £3.65  
VU Meter £3.65



POSTAGE & PACKING 15p

**1021 Stereo Listening Station**

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on-off slide switch, stereo headphone socket.

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TYPE	5	10	25
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CR90	£5.32	£10.46	£25.22

**AUDIOTRONIC 8 TRACK CARTRIDGES**

TYPE	Each	5	10
40M	£1.15	£4.00	£7.50
80M	£1.15	£4.00	£10.25

P&P Cassettes 3p. Cartridges 5p each  
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All silicon transistor amplifier operates from magnetic ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 50mV and 100mV. OUTPUT: 50mV per channel.

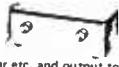
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**EA41 REVERBERATION AMPLIFIER**

Self contained, transistorised, battery operated. Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverb control. Beautiful cabinet. 184 x 77 x 108mm.

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Size: 86 x 78mm

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200uA	£3.80
500uA	£3.75
50-0-500uA	£3.85
100-0-100uA	£3.80
500-0-500uA	£3.70
1mA	£3.70
1-0-1mA	£3.70
5mA	£3.70
10mA	£3.70
50mA	£3.70
100mA	£3.70
500mA	£3.70
1A DC	£3.70
5A DC	£3.70
10A DC	£3.70
15A DC	£3.70
20A DC	£3.80
30A DC	£3.85
40A DC	£3.70
5V DC	£3.70
10V DC	£3.70
15V DC	£3.70
20V DC	£3.70
50V DC	£3.70
150V DC	£3.70

300V DC £3.70  
15V AC £3.80  
30V AC £3.80  
150V AC £3.80  
300V AC £3.80  
500V AC £3.80  
VU Meter 1mA £3.70  
VU Meter £3.70  
1A AC £3.70  
5A AC £3.70  
10A AC £3.70  
20A AC £3.70  
30A AC £3.70  
50mA AC £3.70  
100mA AC £3.70  
200mA AC £3.70  
500mA AC £3.70



**BAKELITE MODEL S80 Enlarged Window**  
Size: 80 x 80mm

50uA	£4.50
100uA	£4.45
500uA	£4.20
50-0-500uA	£4.45
100-0-100uA	£4.40
1mA	£4.40
1A DC	£4.20
5A DC	£4.20
20V DC	£4.20
50V DC	£4.20
300V DC	£4.20
300V AC	£4.30
VU Meter	£4.70

S Meter 1mA £3.50  
VU Meter £3.80  
1A AC £3.30  
5A AC £3.30  
10A AC £3.30  
20A AC £3.30  
30A AC £3.30  
50V AC £3.30  
100V AC £3.30  
300V AC £3.30



**CLEAR PLASTIC MODEL MR 52P**  
Size: 60 x 60mm

50uA	£3.70
100uA	£3.50
500uA	£3.35
50-0-500uA	£3.50
100-0-100uA	£3.45
1mA	£3.30
5mA	£3.30
10mA	£3.30
50mA	£3.30
100mA	£3.30
500mA	£3.30
1A DC	£3.30
5A DC	£3.30
10V DC	£3.30
20V DC	£3.30
50V DC	£3.30
15V AC	£3.40
300V AC	£3.40

S Meter 1mA £3.30  
VU Meter £3.80  
1A AC £3.30  
5A AC £3.30  
10A AC £3.30  
20A AC £3.30  
30A AC £3.30



**BAKELITE MODEL MR 65** Size: 80 x 80mm

25uA	£5.25
50uA	£4.00
100uA	£3.95
500uA	£3.85
50-0-500uA	£3.95
100-0-100uA	£3.90
500-0-500uA	£3.60
1mA	£3.60
1-0-1mA	£3.60
5mA	£3.60
10mA	£3.60
50mA	£3.60
100mA	£3.60
500mA	£3.60
1A DC	£3.60
5A DC	£3.60
10A DC	£3.60
15A DC	£3.60
50A DC	£3.60
5V DC	£3.60
10V DC	£3.60
15V DC	£3.60
20V DC	£3.60
50V DC	£3.60
150V DC	£3.60

300V DC £3.40  
30V AC £3.60  
50V AC £3.60  
150V AC £3.60  
5A AC £3.60  
10A AC £3.60  
20A AC £3.60  
30A AC £3.60  
50A AC £3.60  
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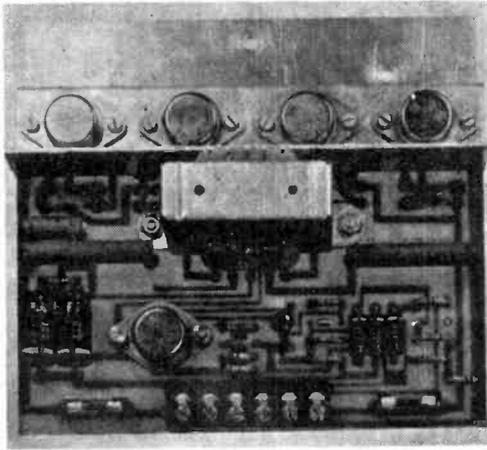
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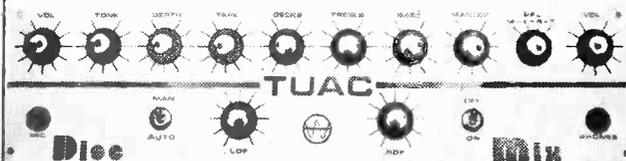
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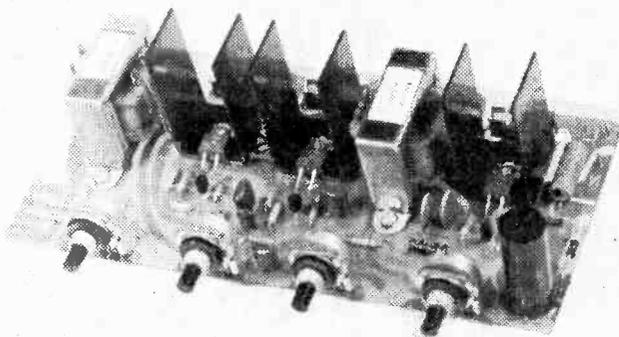
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EB91	20p	EF227	75p	PC88J	55p
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EB91	20p	EF249	75p	PC88F	55p
EB91	20p	EF250	75p	PC88G	55p
EB91	20p	EF251	75p	PC88H	55p
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EB91	20p	EF262	75p	PC88S	55p
EB91	20p	EF263	75p	PC88T	55p
EB91	20p	EF264	75p	PC88U	55p
EB91	20p	EF265	75p	PC88V	55p
EB91	20p	EF266	75p	PC88W	55p
EB91	20p	EF267	75p	PC88X	55p
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EB91	20p	EF287	75p	PC88R	55p
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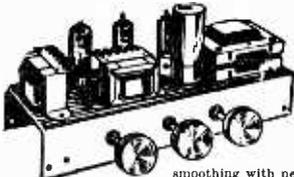
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A.C. mains 200-240 V. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up-2 x ECL86 Triode Pentodes, 1 x E280 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" w x 4" d. Overall height including valves 6". Ready built & tested to a high standard.

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**POWER SUPPLY UNIT 200/240V.** A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7.5v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" x 3 1/2" x 2 1/4". Suitable for Transistor Radion, Tape Recorders, Amplifiers etc. etc. Ready PRICE £5.00 P. & P. 35p. built and tested.

**FEW ONLY!** High grade mains transformer with grain orientated lamination. Primary 200/240 secondary 18.5 volts at 0.6 amps and 4-6 volts at 0-3 amps. Size 2" h x 2 1/2" w x 2" d overall. £1.25 plus 25p P. & P.

**BRAND NEW MULTI-RATIO MAINS TRANSFORMERS.** Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations 0.5-10-15-20-25-30-35-40-60V. half watt at 1 amp, or 10-10-10, 20-20-30, 30-30-30v. at 2 amps full wave. Size 3in. long x 3in. wide x 3in. deep. Price £2.31 P. & P. 40p.

**MAINS TRANSFORMER.** For transistor power supplies. Pri. 200/240V. Sec. 9-0-9 at 500 ma. £1.10. P. & P. 25p. Pri. 200/240V. Sec. 10-0-12 at 1 amp. £1.21. P. & P. 25p. Pri. 200/240V. Sec. 12-0-12 at 2 amp. £1.82. P. & P. 35p.

**HI-GRADE COPPER LAMINATE BOARDS** 8" x 6". Five for 60p plus 30p P. & P.

For personal callers only! Limited number of stereo radiogram chassis, covering LW/MW/FM bands. Mono radio and stereo gram. Overall size approx. 16 1/2" w 6 1/2" h. 8" Depth. 4 watts per channel output. only £18.50.

**GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER** For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300V. Frequency response 15Hz-25KHz. Gain 26dB. Solid encapsulation size 1 1/2" x 1 1/2" x 1/2". Brand new complete with instructions. Price £1.00. P. & P. 15p.

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## SPECIAL BARGAIN OFFER!

Limited number of BSR CI23 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. Brand new. ONLY £8.00 + p. & 60p.

## PRECISION ENGINEERED PLINTHS

Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 2500, 5100, SP25 II and III, SL65B, AT60 etc. or B.S.R. CI09, CI29, A21 etc. Black leatherette finish. Size 12 1/2" x 14 1/2" x 3 1/2" high (approx. 7 1/2" high, including rigid smoked acrylic cover). NOW ONLY £4.95. P. & P. 70p.

**LATEST ACOS GP91/18C** mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1.50. P. & P. 15p.

**SONOTONE STAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. ONLY £2.30 P. & P. 10p.** Also available fitted with twin Diamond T/O stylus for Stereo LP. £2.80. P. & P. 15p.

**LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. £1.98 P. & P. 15p.**

**LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £1.50. P. & P. 15p.**

**QUALITY RECORD PLAYER AMPLIFIER MK. II** A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide x 3in. deep x 6in. high. Ready built and tested. PRICE £5.00. P. & P. 50p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £6.30. P. & P. 60p.

## SPECIAL OFFER ! HI-FI LOUSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tyezan-Vynair front. Size 16" high x 10 1/2" wide x 6" deep. Fitted with E.M.I. Ceramic Magnet 15" x 8" bass unit, two H.F. tweeter units and crossover. Maximum power handling 10 watts. Available 3 or 8 or 15 ohm impedance.

**OUR PRICE £9.25** Carr. 75p  
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## HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide x 3in. deep x 6in. high overall. AC mains 200/240V. Supplied absolutely Brand New completely wired and tested with good quality output transformer. **£3.85**

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**BRAND NEW.** 12in. 15w. J1/D Speakers, 3 or 8 or 15 ohms. State which. Current production by well-known British maker. Now with Hifux ceramic ferrobar magnet assembly £9.90. Guitar models: 25w. £9.90, 35w. £11.00. P. & P. 45p.



## SPECIAL OFFER!

LIMITED NUMBER OF BRAND NEW ELAC 10" TWIN CONE LOUSPEAKERS

With large ceramic magnet and plasticised cone surround. 8 ohm impedance. £3.70. P. & P. 35p.

Also available specification as above but size 10" x 6" £2.70 and size 8" round £2.60. P. & P. 35p.

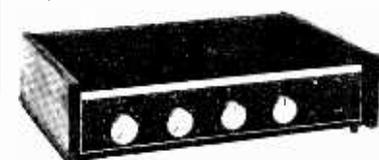
**LIMITED NUMBER** EMI 2 1/2" 8 ohm Tweeters. Mounted on flat bracket size 2 1/2" wide x 7 1/2" long. Ex equipment but new and tested 70p per pair plus 15p P. & P.

12in. "RA" TWIN CONE LOUSPEAKER. 10 watts peak handling. 3 or 8 or 15 ohm (state which) £2.95. P. & P. 35p.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER. Size 11 1/2" x 14 1/2" x 1 1/2" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20KHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only £6.55 each. P. & P. 34p.

**VYNAIR & REXINE SPEAKERS & CABINET FABRICS** app. 5 1/2 in. wide. Our price £1.10 yd. length. P. & P. 15p per yd. (min. 1 yd.). S.A.E. for samples.

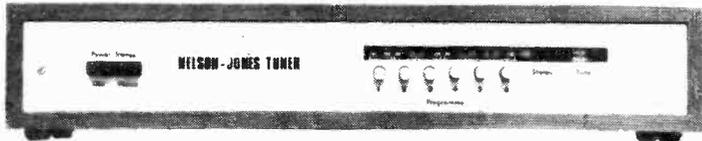
## HARVERSON SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



**NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EVEN EASIER CONSTRUCTION**

A really first-class H.-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, enamel brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response  $\pm$ 3dB 12-20,000 Hz Sensitivity: high quality ready drilled printed circuit board, enamel brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response  $\pm$ 3dB 12-20,000 Hz Sensitivity: high quality ready drilled printed circuit board, enamel brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response  $\pm$ 3dB 12-20,000 Hz Sensitivity: high quality ready drilled printed circuit board, enamel brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. 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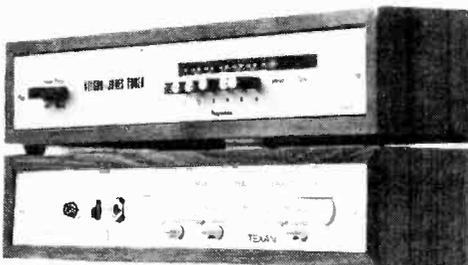
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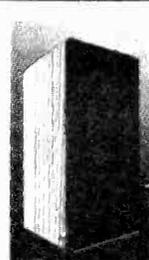
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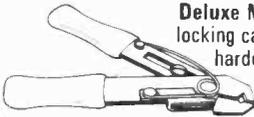
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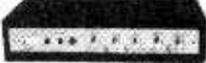
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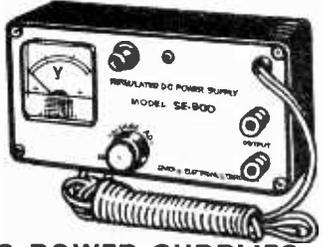


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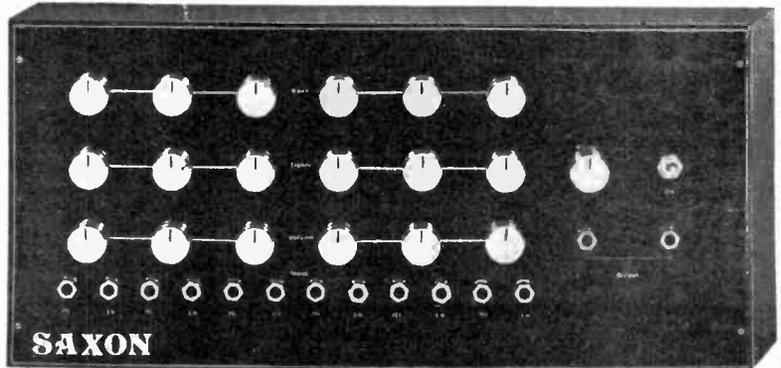


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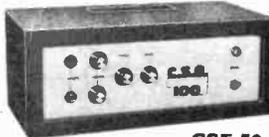


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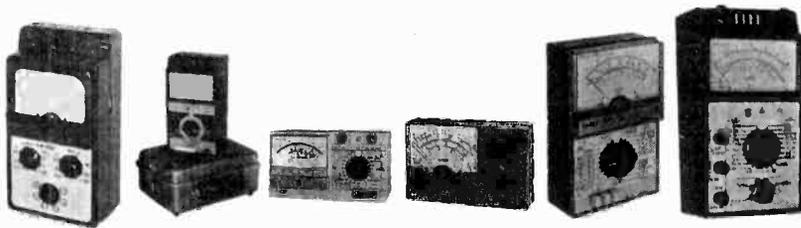
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7402 17p	7428 43p	7474 37p	7421 63p	£1.30	B1/20 28p		
7403 18p	7430 55p	7475 55p	7441 95p	MC1304	B1/60 30p		
7404 18p	7432 37p	7476 37p	7450 95p	£1.60	B2/05 35p		
7405 18p	7433 43p	7480 69p	7459 95p	MFC4000	B2/20 45p		
7406 39p	7437 43p	7481 £1.10	7493 £2.28	TBA800	B2/60 50p		
7407 39p	7438 43p	7482 86p	74194 £1.65	£1.35	B2/100 55p		
7408 21p	7440 18p	7483 £1.10	74196 £1.45	ZN414 £1.15	B4/800 £1.00		
7409 24p	7441 75p	7484 95p			BY122 55p		
7410 18p	7442 28p	7485 £1.87			BY164 34p		
7411 22p	7443 £1.20	7486 38p	709C 35p		WO1 30p		
7412 28p	7444 £1.20	7490 69p	723C 90p		WO6 35p		
7413 28p	7447 £1.30	7491 99p	741C 39p				
7414 60p	7448 £1.18	7492 69p	748C 45p				
7416 35p	7450 18p	7493 69p	CA3046 95p				
7417 35p	7451 18p	7494 80p	CA3075				
7420 18p	7453 17p	7495 80p	CS £1.65				
7422 24p	7454 17p	7498 99p	CA3090				
7423 38p	7460 18p	74104 60p	£4.25				
7425 38p	7470 28p	74105 59p	LM300 £1.70				

**POLYESTER CAPACITORS.** Axial lead type.  
400V: 0.001µF, 0.0015µF, 0.0022µF, 0.0033µF, 0.0047µF, 0.0068µF, 2p; 0.01µF, 0.015µF, 0.022µF, 3p; 0.047µF, 0.068µF, 0.1µF, 0.15µF, 4p; 0.22µF, 7p; 0.33µF, 10p; 0.47µF, 13p; 160V: 0.1µF, 0.15µF, 4p; 0.22µF, 5p; 0.33µF, 6p; 0.47µF, 7p; 0.68µF, 10p; 1µF, 13p.  
**Radial lead P.C. type:**  
250V: 0.01µF, 0.015µF, 0.022µF, 3p; 0.033µF, 0.047µF, 0.068µF, 3p; 0.1µF, 4p; 0.15µF, 4p; 0.22µF, 5p; 0.33µF, 5p; 0.47µF, 7p; 0.68µF, 10p; 1µF, 11p.

**ELECTROLYTIC CAPACITORS.** Miniature axial lead type.  
63V: 1µF, 1.5µF, 2.2µF, 3.3µF, 4µF, 4.7µF, 6.8µF, 10µF, 15µF, 22µF, 47µF, 68µF, 6p each  
40V: 100µF, 6p; 150µF, 25V, 6p; 25V: 220µF, 11p; 470µF, 7p; 1,000µF, 24p.  
16V: 100µF, 1500µF, 16p; 10V: 220µF, 16p.

**CERAMIC CAPACITORS**  
50V d.c. Plaquette body 25mm leads.  
Range: 22pF-10,000pF. Price 2p each.  
0.015µF, 0.022µF, 0.033µF, 0.047µF 3p.

**POTENTIOMETERS Carbon Track**  
0.25W, log and linear values. 12p  
1kΩ-2MΩ Single gang 12p  
5KΩ-2MΩ s/gang w/switch 24p  
2kΩ-2MΩ Dual gang 37p

**SLIDER POTENTIOMETERS**  
0.25 W log and linear values 40p  
10kΩ-100kΩ Single gang 10p  
10kΩ-100kΩ Dual gang 55p

**THRISTERS**  
CRS 1/10 100V 1A 30p  
CRS 1/20 200V 1A 35p  
CRS 1/40 400V 1A 45p  
CRS 1/60 600V 1A 55p  
CRS 3/10 100V 3A 40p  
CRS 3/40 400V 3A 55p  
CRS 3/60 600V 3A 65p

**ALUMINIUM BOXES**  
A7 2 1/2" 5 1/2" 1 1/2" 40p  
A8 4" 4" 1 1/2" 40p  
A9 4" 2 1/2" 1 1/2" 40p  
A10 4" 5 1/2" 1 1/2" 45p

**VEROBOARDS**  
PITCH 0-1 0-15 0-15  
24 x 3 1/2" 22p 16p 12p  
24 x 5" 24p 24p 12p  
3 1/2 x 3 1/2" 24p 24p  
3 1/2 x 5" 28p 27p 21p  
2 1/2 x 17" 80p 60p 45p  
3 1/2 x 17" 105p 84p 65p  
5 x 17" 141p 89p  
Pkt. of 50 pins 20p  
Spot face cutter 42p  
Pin Insertion tool 52p

**MYLAR FILM CAPACITORS**  
100V: 0.001µF, 0.002µF, 0.005µF, 0.01µF, 0.02µF, 0.04µF, 0.05µF, 3p.  
100V: 0.1µF, 0.2µF, 50V: 0.47µF 6p.

**PRESET POTENTIOMETERS**  
0.25W 1kΩ-1MΩ Hor. and Vert. 6p  
0.1W 100Ω-220kΩ Vert. only 4p

**KNOBBS**  
To fit 1/8" shaft unless specified.  
Black Pointer type 6p  
Slim Silvered 10p  
Black 1" with chrome rim 15p  
Slider Pot knob (Black) 10p  
Slider Pot knob (Silvered) 10p

**RESISTORS**  
±W Tol. Range Values 1-9 10-99  
1W 5% 2-2R-10M E12 1p 0.8p  
1W 5% 2-2R-10M E12 1p 0.8p  
4W 10% 1-10 ohm E12 6p

**SWITCHES**  
Toggle SPST 18p  
Toggle DPDT 22p  
Slide 1/4 sub. min. 10p  
Slide 1A 14p  
Push Button 6 pole changeover 35p  
Water 1/12, 2/8, 3/4, 4/3 way 24p each

**JACK PLUGS (CHROME) SOCKETS**  
Standard Screened 12p Standard 12p  
Stereo Screened 30p Stereo 15p  
2.5mm Screened 8p 2.5mm 7p  
3.5mm Screened 10p 3.5mm 7p

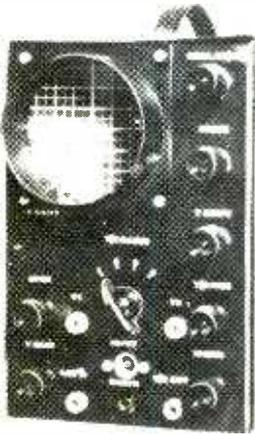
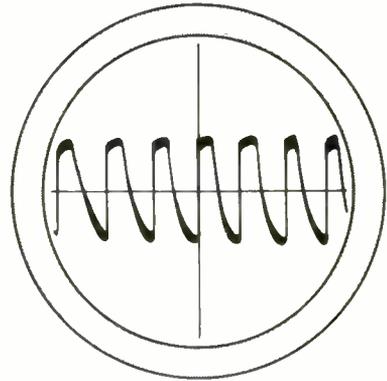
**DIN PLUGS, SOCKETS AND COUPLERS**  
Pins: 2, 3, 4, 5 (180°), 240P, 6, 7  
PLUGS: 12p, SOCKETS, 5p, COUPLERS: 10p

**PHONO PLUGS, SOCKETS & COUPLERS**  
Assorted Coloured Plugs: 5p, COUPLERS: 8p  
SOCKETS Single: 5p, Double: 7p, Triple: 10p

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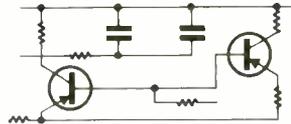
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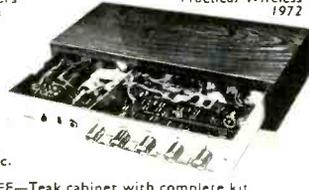


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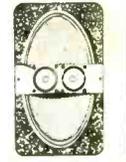
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