

# PRACTICAL WIRELESS

JUNE  
1973

20p

**FREE:**  
**COMPETITION**

**FOUR DIGITAL MULTIMETERS  
WORTH £200 TO BE WON**

## STEREO HEADPHONES REMOTE CONTROL UNIT



**ALSO:**

**SIMPLE MEDIUM WAVE RECEIVER**

**REPLACES POWER FOR YOUR TR RADIO**

# The X25

## Why two shafts?

220-240 Volts or 100-120 Volts.

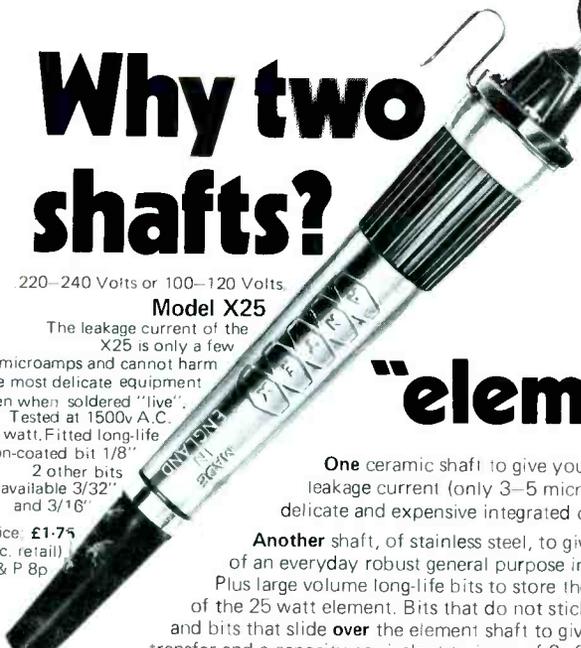
### Model X25

The leakage current of the X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live".

Tested at 1500v A.C. 25 watt. Fitted long-life iron-coated bit 1/8"

2 other bits available 3/32" and 3/16"

Price: £1-75 (rec. retail) P & P 8p



## "elementary"

One ceramic shaft to give you near-perfect insulation and negligible leakage current (only 3-5 microamps) so that you can safely solder delicate and expensive integrated circuits and transistors, even when "live"

Another shaft, of stainless steel, to give you the strength required of an everyday robust general purpose iron. Plus large volume long-life bits to store the enormous heat-capacity of the 25 watt element. Bits that do not stick (no screws or pins) and bits that slide over the element shaft to give you efficient heat transfer and a capacity equivalent to irons of 2-3 times the wattage.



### MODEL CCN

220 volts or 240 volts. The 15 watt miniature model CCN also has negligible leakage.

Test voltage 400v. A.C. Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32". 4 other bits available 1/8", 3/16", 1/4" and 3/64".

PRICE: £1-80 (rec. retail) OR Fitted with triple-coated, iron nickel and Chromium bit 1/8". PRICE: £1-95 (rec. retail). P&P 5p



### MODEL MES.KIT

Battery-operated 12v. 25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet with booklet "How to Solder"

PRICE: £1-95 (rec. retail). P&P 12p

### MODEL G

18 watt miniature iron, fitted with long life iron-coated bit 3/32". Voltages 240, 220 or 110.

PRICE: £1-83 (rec. retail). P&P 5p



All prices mentioned are exclusive of V.A.T.



### MODEL SK.1 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE: £2-75 (rec. retail). P&P 12p

### MODEL CN

Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 3/64", to 3/16". Voltages 240, 220, 110, 50 or 24.

PRICE: £1-70 (rec. retail). P&P 5p

### MODEL CN2

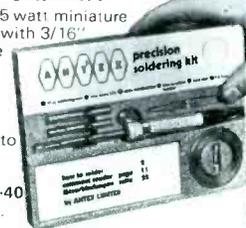
Miniature 15 watt soldering iron fitted with nickel plated bit 3/32". Voltages 240 or 220.

PRICE: £1-70 (rec. retail). P&P 5p

### MODEL SK.2 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, and "How to Solder" booklet.

PRICE: £2-40 (rec. retail). P&P 8p



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PW6

# PRACTICAL WIRELESS

VOL. 49 NO. 2

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JUNE 1973

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We regret that we are unable to supply back numbers of Practical Wireless. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of Practical Wireless and Television only can be published in our CQ Column.

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We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.

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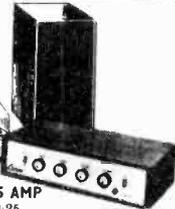


GARRARD 2025

R.S.C. A55  
LOUDSPEAKERS



LINEAR 505 AMP



Individual Rec. Retail Prices:  
LINEAR 505 5 + 6 Watt Amplifier £19.25  
GARRARD 2025 Autochanger + K540A Cartridge £13.44  
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GOLDRING GL72 Trans-  
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GOLDRING G380  
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with Roll-over Cover  
Pair R.S.C. MONARCH  
LOUDSPEAKERS  
R.S.C. SUPER 30  
MK III AMPLIFIER

Total value of individual items  
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'SUPER 30' AMP

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Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db.



Treble Control ± 13db. Selector switch for P.U. or Tape/Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs.  
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PLEASE STATE IMPEDANCE WHEN ORDERING  
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350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a. **£1-81**  
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a. **£2-45**  
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300-0-300v. 130mA, 6.3v. 4a., c.t. 6.3v. 1a. **£2-85**  
Suitable for Mullard 510 Amplifier **£2-85**  
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0-10/120v. 200-230-250v. 50-80 watts **£1-25, 150 watts, £2-10**  
250-250v. 50-80 watts **£2-40**  
**OUTPUT TRANSFORMERS**  
Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 55p  
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω 95p  
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Push-Pull 15-18 watts, sectionally wound **£2-20**  
6L6, K T66, etc. for 3 or 15 Ω **£2-20**  
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All 6/12v. D.C. output. Max. A.C. input 15v.  
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## R.S.C. MKIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET

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R.S.C. STEREO FM III TUNER. in cabinet

Visually matches Super 30 Mk. III **£37-50**

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**£42-50**

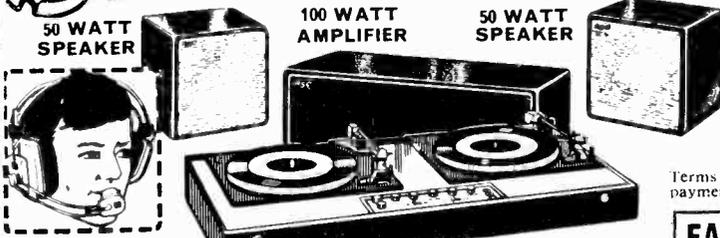
## 'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

- ★ Moderate size only 25 x 14 x 10 in. approx.
- ★ Response 30-20,000 c.p.s. Impedance 15 ohms
- ★ Performance comparable with units costing considerably more Carr. 65p



Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet.  
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★ FULL MONITORING FACILITIES  
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★ Twin jack output sockets for speakers  
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★ Output overload protection plus double fusing  
FRONT PANEL (Jack inputs) Gram, Microphone/Guitar P.U., plus monitoring socket.  
CONTROLS 5 Vol. (1) (2) (3) and (4). Bass, Treble, Master Vol., Monitor Selection Switch (Gram (1) or (2), Mains Switch).

**£54.45** Carr. free  
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Simulated black rexine, plastic bonded metal case. ALSO STOCKED-LINEAR T80/100D £76.72

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Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3 to 30 ohms. Size 17" x 7" x 7". 200-250V. A.C. mains. Output 60 watts music rating. Or deposit £7.25 & 9 monthly payments £3.92. Total £42.55. **£37.95** Carr. 82p.

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## PACKAGE OFFER

- Units listed below  
(a) 100w POWER AMPLIFIER  
(b) PAIR OF HI-FI HEAD- PHONES  
(c) MATCHING DYNAMIC 'MIKE' (attached to h' phone)  
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(e) RSC TDI DISCO CONSOLE
- (a) (b) (c) (d) & (e) **£145** (Carr. £2.50)

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Incorporating twin Garrard SP25 Mk.III turntables and Sonolone or Accor Cartridges with diamond stylus. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid. See illustration on left. Or Dep. £10 and 9 mthly pymts £6.80 (Total £71.20) Carr. £1.50 **£63.26**

Terms Deposit £30 and 18 monthly payments of £8.00 (Total £174.00).

## FANE ULTRA HIGH POWER LOUDSPEAKERS

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

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt 14,000 gauss 8/15Ω	15" 60 Watt 14,000 gauss 8/15Ω	12" 50 Watt 13,000 gauss 15Ω
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Dep. £8 and 9 monthly payments £2.45 (Total £28.05)	Dep. £3.30 and 9 monthly payments. £1.43 (Total £16.17)	Dep. £2 and 9 monthly payments £1.33 (Total £13.97)

PAIR SUITABLE ALL PURPOSES FOR BASS GUITAR, ELECT. ORGAN, ETC.

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Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). Carr. free **£7.43** or Dep. £1.25 and 9 monthly payments 83p (Total £28.72).

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# COMET Hi-Fi discount warehouses



	Rec. Price	Retail Price	Comet Price
<b>STEREO AMPLIFIERS</b>			
AKAI AA5200	£ 87.45	£ 94.95	£ 84.95
AKAI AA5500	109.45	89.95	89.95
AKAI AA5800	164.45	121.95	121.95
ALBA UA 700	41.72	27.95	27.95
ALPHA 212 by Highgate	41.53	25.95	25.95
AMSTRAD IC 2000	50.88	30.95	30.95
AMSTRAD Integra 4000	39.05	23.95	23.95
ARMSTRONG 521	64.90	48.50	48.50
FERRROGRAPH F307 Mk. II (cased)	74.80	49.95	49.95
GLIXOR MW3000, 15 watts RMS per channel	54.45	25.95	25.95
GOODWIN RH 25 25	65.95	49.95	49.95
JVC Nivico VN 300	63.80	52.95	52.95
JVC Nivico MCA 104Z	93.50	74.95	74.95
MCA 105E	143.55	119.95	119.95
MCA V5E/VN550	97.90	81.95	81.95
MCA V9E/VN880	162.80	136.95	136.95
KELETRON KSA 700 Mk. II	31.10	20.95	20.95
KELETRON KSA 1500 Mk. II	45.10	27.95	27.95
LEAK Delta 30 (cased)	76.69	51.95	51.95
LEAK DELTA 70 (cased)	43.45	26.95	26.95
METROSOUND ST20E	77.00	50.95	50.95
METROSOUND ST60	119.90	98.95	98.95
PHILIPS RH521	101.81	35.95	35.95
PIONEER SA500A	155.03	85.95	85.95
SA600A	139.21	99.95	99.95
SA1000	171.40	107.95	107.95
QL600A Quadraphonic Converter	130.85	93.95	93.95
QD 210 Quadraphonic decoder	47.14	32.95	32.95
QA 800A Quadraphonic Sp. Price	159.95	114.95	114.95
QC800A Pre-amp. Sp. Price	135.95	135.95	135.95
QM800A Pow. amp. Sp. Price	135.95	135.95	135.95
Reverberation 202w	60.45	43.50	43.50
RANK ROTEL 210	38.39	28.50	28.50
RANK ROTEL 310	57.20	39.95	39.95
RANK ROTEL 610	86.35	56.95	56.95
RANK ROTEL RA 810	116.05	83.50	83.50
RANK ROTEL RA 1210	141.90	101.95	101.95
ROGERS Ravensbourne	77.00	59.50	59.50
Ravensbourne (cased)	82.50	64.95	64.95
SINCLAIR 2000	38.50	27.75	27.75
3000	49.50	34.95	34.95
PROJECT 605	32.95	23.75	23.75
SOLARVOX 20, 10 watts RMS per channel	43.95	26.95	26.95
SOLARVOX 30, 15 watts RMS per channel	51.65	35.95	35.95
SOLARVOX MA801 2 x 8 watts RMS plus MATRIX 4 channel	56.52	42.95	42.95
TANDBERG TA300	76.89	59.95	59.95
TANDBERG TA300M	87.45	72.50	72.50
WHARFEDALE Linton amplifier	71.50	50.95	50.95
All take both ceramic and magnetic cartridges.			

	Rec. Price	Retail Price	Comet Price
<b>TUNER/AMPLIFIERS</b>			
AKAI AA8030	130.54	96.95	96.95
AKAI AA8090	178.07	131.95	131.95
AKAI AS8100S Quadraphonic	243.85	181.95	181.95
AKAI AA8500	233.98	166.95	166.95
AKAI 6300	129.21	74.95	74.95
ARENA 2600	105.29	55.95	55.95
<b>AUTOMATIC RADIO CHX 9912</b>			
AM/FM: MPX stereo tuner/amplifier with built-in stereo cassette recorder	107.25	49.95	49.95
GOODMANS Module 80, 35w. RMS Module 80 Compact	87.55	66.95	66.95
Module 90	158.16	119.95	119.95
Module 110 FM/MW/LW/SW/100w. RMS	112.04	85.95	85.95
GOODMANS M4000 Compact	130.86	99.95	99.95
JVC Nivico 4MM 1000 Quadraphonic	230.65	175.95	175.95
JVC Nivico VR 5500/5501 AM/FM	159.16	124.95	124.95
VR 5521L AM/FM and SEA	93.68	75.95	75.95
VR 5521L AM/FM and SEA	164.75	135.95	135.95
4VR 5414 Quadraphonic	219.77	179.95	179.95
KYOTO 1000 AM/FM Tuner/Amplifier with built-in Stereo Cassette Recorder. Complete with two speakers and two microphones	79.90	57.95	57.95
LEAK Delta 75	163.83	123.95	123.95
PHILIPS RH 720	202.41	154.95	154.95
PIONEER SX525	134.86	92.95	92.95
SX828	184.72	128.95	128.95
SX828	222.39	152.95	152.95
SX727	285.21	196.95	196.95
OX 4000 Quadraphonic	216.81	159.95	159.95
OX 8000 Quadraphonic	289.76	190.95	190.95
ROTEL RX 150A	65.68	47.95	47.95
ROTEL RX 200A	84.10	61.95	61.95
ROTEL RX 400A	101.01	74.95	74.95
ROTEL RX 600A	140.01	103.95	103.95
ROTEL RX 800A	178.07	131.95	131.95
ROTEL RX 154A Quadraphonic	121.86	89.95	89.95
SOLARVOX TAM 105 2 x 5 watts RMS AM/FM Multiplex comp. with 2 speakers and featuring Matrix 4 channel	37.06	29.75	29.75
TANDBERG TR200 MPX	99.79	83.95	83.95

	Rec. Price	Retail Price	Comet Price
<b>TUNERS/AMPLIFIERS—continued</b>			
TANDBERG TR1000 FM MPX (teak)	146.86	124.95	124.95
TANDBERG TR1000 AM/FM MPX	159.09	133.95	133.95
TELETON CR55	116.63	64.95	64.95
WHARFEDALE LINTON WE40 AM/FM MPX	107.65	81.95	81.95
All the above take magnetic cartridges except Kyoto 1000 which takes ceramic only. All include MPX Stereo Decoder			

	Rec. Price	Retail Price	Comet Price
<b>TURNABLES</b>			
CONNOISSEUR BD1 Kit	12.65	10.50	10.50
CONNOISSEUR BD2 Chassis	31.02	24.95	24.95
CONNOISSEUR BD2 P/C/SAU2	39.16	32.25	32.25
GARRARD SP25 Mk. III	15.25	9.25	9.25
GARRARD 40B	12.85	9.50	9.50
GARRARD SL65B	18.78	12.95	12.95
GARRARD SL95B	46.40	30.60	30.60
GARRARD 401	40.43	27.50	27.50
GARRARD SL72B	30.73	20.25	20.25
GARRARD AP76	26.82	16.95	16.95
GARRARD Zero 100A	51.57	37.25	37.25
GARRARD Zero 100S	47.44	34.25	34.25
GOLDRING G101P/C	28.05	19.50	19.50
GOLDRING GL27 Chassis	29.70	20.25	20.25
GOLDRING GL72P	38.61	26.50	26.50
GOLDRING GL75	39.60	26.50	26.50
GOLDRING GL75P	48.84	33.50	33.50
GOLDRING GL85P/Cover	82.50	55.50	55.50
JVC Delta	65.07	49.95	49.95
JVC Nivico SRP 473 Quadraphonic including plinth and cover	65.88	52.95	52.95
MCDONALD MP60	13.96	9.25	9.25
MCDONALD 610	17.71	12.25	12.25
MCDONALD HT70	19.49	13.50	13.50
PHILIPS GA212 Electronic	64.95	50.95	50.95
PIONEER PL12D with base and cover	47.19	32.50	32.50
PIONEER PL161 with base and cover	170.53	114.95	114.95
THORENS TD125 Mk. II	77.00	82.95	82.95
THORENS TD125AB	109.04	77.95	77.95
THORENS TD 125AB Mk. II with TP 16 arm	116.05	95.50	95.50
THORENS TD 160/c including base and cover	65.04	53.50	53.50
WHARFEDALE Linton	35.11	25.95	25.95

The following Turntables are complete with base, plinth, plastic cover and cartridge. Fully wired and ready for use. All at special prices.

GARRARD SP25 Mk. III with Goldring G800 Special Price 17.50

MCDONALD MP60 with Goldring G800 Special Price 17.25

MCDONALD MP60 with SHURE M 44/7 Special Price 18.25

MCDONALD HT70 with Goldring G800 Special Price 24.25

GARRARD AP76 with Goldring G800 Special Price 25.95

GARRARD AP76 with Shure M55E Special Price 28.95

GARRARD AP76 with Shure M75EJ Special Price 31.25

GARRARD 2025/C with Sonotone 8TAHC Special Price 12.10

GOLDRING GL75 with G800 Special Price 36.95

GOODMANS TD100 with G800E 71.09 48.95

	Rec. Price	Retail Price	Comet Price
<b>SPEAKERS</b>			
AKAI SW 155	70.95	50.95	50.95
AMSTRAD ACOUSTA 1500 (pair)	44.00	25.95	25.95
AMSTRAD ACOUSTA 2500 (pair)	55.00	32.95	32.95
AMSTRAD 138 (pair) Teak	28.60	15.50	15.50
B and W Model 70	175.45	125.95	125.95
B and W DM4	65.99	46.95	46.95
B and W D5 (pair)	55.99	41.95	41.95
CELESTION COUNTY (pair)	46.13	34.50	34.50
Dillon 120 (pair)	52.80	37.95	37.95
Dillon 15	35.20	25.50	25.50
Dillon 25	71.50	51.50	51.50
Dillon 44	59.40	42.95	42.95
Dillon 66	108.90	78.95	78.95
FERRROGRAPH S1 inc. stand	104.50	75.95	75.95
GOODMANS Minister (pair)	46.33	34.95	34.95
Havant (pair)	53.77	38.50	38.50
Magister	72.19	46.75	46.75
Double Maxim (pair)	63.45	45.95	45.95
Mezzo 3	59.27	26.95	26.95
Magnum K2	50.82	34.95	34.95
Goodwood	60.50	41.95	41.95
Dimension 8	79.68	54.95	54.95
DIN 20 NT Kit (pair)	22.95	16.50	16.50
KELETRON S4 (pair)	22.86	14.50	14.50
KSB (pair)	28.16	17.95	17.95
KSB (pair)	36.30	23.50	23.50
KS10 (pair)	46.86	30.50	30.50
KS15 (pair)	69.85	44.95	44.95
KS20 (pair)	78.76	50.95	50.95

	Rec. Price	Retail Price	Comet Price
<b>SPEAKERS</b>			
LEAK 150 (pair)	46.82	35.95	35.95
LEAK 250 (pair)	60.85	46.50	46.50
LEAK 600	54.45	38.50	38.50
METROSOUND HFS 103 (pair)	27.50	19.95	19.95
Duplex 15	23.65	16.95	16.95
Duplex 25	35.20	26.95	26.95
PIONEER CS53	61.60	42.95	42.95
SINCLAIR Q16	51.39	34.95	34.95
TANDBERG Tan 7	8.47	6.20	6.20
Tan 11 (pair)	27.78	22.25	22.25
Tan 12 (pair)	37.66	29.95	29.95
TL 25 Teak (pair)	52.25	42.95	42.95
TL 50 Teak (pair)	67.32	55.50	55.50
TELETON 8000 (pair)	74.80	58.75	58.75
THORPE GRENVILLE TG100 (pair)	19.87	11.50	11.50
TG200 (pair)	31.85	19.50	19.50
TG300 (pair)	46.15	28.50	28.50
WHARFEDALE Denton Mark II (pair)	61.55	34.50	34.50
Linton Mark II (pair)	39.32	27.50	27.50
Triton III (pair)	48.68	34.50	34.50
Milton Mark II	60.85	42.50	42.50
Dovedale 3 Mark II	38.50	26.95	26.95
Rosedale	52.25	35.95	35.95
Unit 12 speaker kit (pair)	75.90	52.95	52.95
Unit 4 speaker kit (pair)	23.40	16.50	16.50
Unit 5 speaker kit (pair)	41.80	24.95	24.95
Unit 5 speaker kit (pair)	60.50	42.50	42.50

	Rec. Price	Retail Price	Comet Price
<b>PICK UP ARMS AND HEADS</b>			
AUDIO Technica AT 1005 Mk. II	17.85	12.95	12.95
AUDIO Technica L2 Lifts	2.46	1.90	1.90
CONNOISSEUR SAU2	13.86	11.25	11.25
GOLDRING Lenco L75	13.00	9.95	9.95
GOLDRING Lenco L69	9.90	6.25	6.25
GOLDRING PH6 Head Shell for 69/75	2.81	1.90	1.90
GOLDRING PH7 Head Shell for 85	3.47	2.40	2.40
GOLDRING PH8 Head Shell for 101	0.92	0.70	0.70
SME 3009 ser 11 Improved	34.65	25.95	25.95
SME 3009-S2 ser 11 Improved	37.95	28.95	28.95
SME S2 Head Shell	2.77	1.90	1.90

	Rec. Price	Retail Price	Comet Price
<b>CHASSIS SPEAKERS</b>			
GOODMANS Twin-axiom 8	8.58	6.25	6.25
Twin Axium 10	9.47	6.90	6.90
Axiom 401	19.45	13.95	13.95
Axiom 8P	5.17	3.75	3.75
Axiom 10P	5.62	4.10	4.10
Axiom 12P	14.30	10.40	10.40
Axiom 15P	23.10	16.50	16.50
Axiom 18P	39.27	27.95	27.95
Axiom 100 40 watts din.	13.20	9.50	9.50
ARU 172	4.95	3.60	3.60
Axent 100	7.59	5.40	5.40
Mixax 850	14.95	9.60	9.60
Attenuator	1.10	0.75	0.75
Crossover network XQ/950	8.55	5.95	5.95
WHARFEDALE 8 in. Bronze/RS/DD	4.44	3.20	3.20
Super 8/RS/DD	7.95	5.75	5.75
Super 10/RS/DD	13.11	9.45	9.45

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	Rec. Retail Price	Comet Price
<b>BASES AND COVERS</b>		
CONNOISSEUR Plinth BD1	5-28	4 30
CONNOISSEUR Cover	3-96	3 20
CONNOISSEUR P.U. Mount Board	0 88	0 70
GARRARD WB1 Base	3-56	2 70
GARRARD W4 Base	5-28	3 90
GARRARD SPC1 Cover	3 47	2 60
GARRARD SPC4 Cover	4 13	3 00
Special Offer of Base and Cover to fit GARRARD SP25, SL35, SL65B and 3500	Sp. Price	2 50
Special offer of base and cover to fit McDONALD MP60 and 610	Sp. Price	3 50
GOLDRING Plinth 75	9 24	6 40
GOLDRING Plinth 72	8 91	6 20
GOLDRING Covers for 72P	4 46	3 10
Cover for 75P De Luxe	4 95	3 40
Cover for 85P	6 60	4 60
THORENS TX 25 (for TD125AB)	8 25	6 40
THORENS TX11 Cover	4 18	3 40
SME Plinth System 2000 with motor-board	43 58	34 95
MOTORBOARDS only	5 51	4 00
SME P1 Spacer	0 92	0 70

	Rec. Retail Price	Comet Price
<b>TUNERS</b>		
AKAI 1550 AM/FM/MPX/FET	84 10	61 95
AKAI AT580 AM/FM/MPX/MOS FET	131 09	96 95
AMSTRAD Multiplex 3000 FM	37 90	26 95
ARMSTRONG M8 Decoder	10 45	7 75
*DULCI FMT 7M	23 16	14 90
JVC Nivico MCT V5E/VT500 AM/FM	80 96	62 95
JVC Nivico MCT V7E AM/FM	115 25	94 95
LEAK Delta FM	74 43	52 95
LEAK Delta AM/FM	83 79	62 25
METRO SOUND FMS 20	51 70	36 95
PHILIPS RH 620	45 66	33 50
PHILIPS RH 621	103 06	78 80
PIONEER TX500 AM/FM	72 47	48 95
PIONEER TX500 AM/FM	100 35	68 95
RANK ROTEL 320	55 91	39 95
RANK ROTEL 620	87 86	62 95
ROGERS Ravensbourne In Teak Case	61 05	44 95
SINCLAIR 2000	42 44	28 95
3000	42 44	28 95
Project 60 Tuner (stereo)	23 57	16 95
All above Tuners are complete with MPX Stereo Decoder except where starred.		

	Rec. Retail Price	Comet Price
<b>HEADPHONES</b>		
AKAI ASE22	13 09	7 95
AKG K180	30 80	18 70
AKG K60	16 50	9 90
AKG 100	8 80	5 50
AMSTRAD HPSSA	8 25	4 40
HPS6A with volume control	11 77	7 40
HPS 7A bass and treble controls	15 35	10 90
KOSS HV1	22 00	17 40
KOSS ESP-9 Electrostatic	75 90	58 25
KOSS ESP-6 Electrostatic	49 50	39 95
KOSS K2 plus 2 Quadrafone	49 50	39 95
KOSS PRO 5 L/C	33 00	26 50
KOSS PRO-4A	30 80	23 25
KOSS KO-727B	18 15	13 50
KOSS 747	22 00	16 50
KOSS K-711	11 00	8 50
KOSS K6/LC (with volume control)	15 40	10 50
KOSS K6/LC Quadrafone	22 00	18 75
PIONEER SE 50	24 09	14 50
PIONEER SE 30A	13 86	8 25
PIONEER SE 20A	8 67	5 50
PIONEER SEL 20	11 58	7 50
PIONEER SEL 40	19 17	12 50
SOUND MD806	7 15	3 10
WHARFEDALE DD1	13 75	8 75
WHARFEDALE Isodynamic	21 95	16 50

	Rec. Retail Price	Comet Price
<b>BLANK TAPES</b>		
SCOTCH DYNARANGE CASSETTES		
C60	0 77	0 40
C90	1 08	0 55
C120	1 63	0 80
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1 20	0 75
C90	1 54	1 00
SCOTCH CASSETTE HEAD CLEANER	0 61	0 40
SCOTCH Low Noise 8-TRACK BLANK CARTRIDGES		
40 mins.	1 65	0 99
90 mins.	1 98	1 20
MAGCASS 8-track 80 mins.	Sp. Price	0 75
SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
5" L.P. 900	2 02	1 25
5 1/2" L.P. 1200	2 37	1 45
7" L.P. 1800	3 18	1 99
SCOTCH HI-FI DYNARANGE DOUBLE PLAY		
5" D.P. 1200	2 50	1 55
5 1/2" D.P. 1800	3 41	2 15
7" D.P. 2400	4 37	2 75
Tapes, cassettes and 8T cartridges, 1-9 items 5p per order. Packs of ten post free.		

	Rec. Retail Price	Comet Price
<b>HI-FI STEREO SYSTEMS—COMPLETE</b>		
BUSH A1005	66 25	48 95
BUSH 1008 with radio	89 06	67 95
DANSETTE 4005	67 73	47 95
DANSETTE 4020	45 50	29 95
DECCA SOUND 613	63 95	48 95
DECCA COMPACT 2 with radio	96 03	75 95
DECCA COMPACT 3 with radio	127 09	99 95
DECCA 403	54 45	42 95
FERGUSON 3450 B with Radio (new Model)	75 40	58 95
FERGUSON 3451 B with Radio (new Model)	101 50	79 95
FERGUSON 3454	39 95	30 95
FIDELITY UA1 Music Master with Radio	94 81	67 95
FIDELITY UA2 Music Master	41 23	28 95
FIDELITY UA3 incl. stereo radio	59 73	43 95
FIDELITY Stereo Nine	Sp. Price	22 95
G.E.C. 2810	74 89	56 95
GROSVENOR MPX 8400 AM/FM/MPX Tuner/Amplifier, magnetic input, built-in 8-track cartridge player with speakers	65 75	38 95
HMV 2451	115 70	89 95
HMV 2452	62 57	48 95
HMV 2455	165 90	129 95
I.T.T. 1025 KB with 662 speakers	45 65	35 95
I.T.T. 2250 KB with 659 speakers and radio	136 83	105 95
PHILIPS 808	99 53	72 95
PHILIPS 825	46 92	34 95
PHILIPS 826	71 09	49 95
PHILIPS 835 with radio	65 88	46 50
PHILIPS 836 with radio	90 05	65 95
ULTRA 6027	54 55	42 95
ULTRA 6450 B (new model) with radio	75 40	58 95
ULTRA 6451	75 40	58 95
ULTRA 5455	39 20	28 95
ULTRA 5454	36 80	28 95

	Rec. Retail Price	Comet Price
<b>TAPE RECORDERS</b>		
AKAI 1721L	93 87	66 95
AKAI 4000 DS	93 50	68 95
AKAI X201D	168 30	123 95
AKAI X1810	215 18	159 95
AKAI GX221D	215 18	159 95
AKAI GX1900D	224 57	166 95
AKAI GX370D	328 95	244 95

	Rec. Retail Price	Comet Price
<b>TAPE RECORDERS—continued</b>		
AKAI CR80D 8-track stereo tape deck	79 90	53 95
AKAI CR80 8-track stereo recorder	117 02	68 95
AKAI CR80DSS Quadraphonic	149 88	109 95
AKAI CR80T 8-track stereo recorder and tuner amplifier	140 78	84 95
AKAI CR81T 8-track cartridge stereo recorder and tuner amplifier	145 65	107 95
AKAI CR81	102 89	75 95
AKAI CR81D	84 10	61 95
FERGUSON 3258 4-track	66 85	47 00
FERROGRAPH 702/704 Dolby	267 30	226 95
FERROGRAPH 722/724 Dolby	278 30	235 95
FERROGRAPH 722H Dolby	305 80	258 95
FERROGRAPH 702/704	316 80	268 95
FERROGRAPH 702/704	220 00	167 95
FERROGRAPH 722/724	258 50	194 95
FIDELITY Braemar 4-track	32 64	18 50
GROSVENOR RP 9008-track record, play-back deck		
GRUNDIG TK 121 (twin-track)	51 15	36 95
GRUNDIG TK 141 (4-track)	54 27	38 95
GRUNDIG TK 147 (4-track auto)	58 60	43 95
GRUNDIG TK 148 (4-track auto 2 speed)	92 87	72 95
GRUNDIG TK 246 4-track stereo deck	69 89	53 95
GRUNDIG TK 3200 Hi-Fi (Battery)	126 78	94 95
MARCONI 4248 4-track, 2 speed	135 15	99 95
PHILIPS 4307 4-track	49 66	35 95
PHILIPS 4308 De Luxe 4-track	47 40	33 95
PHILIPS 4416 4-track stereo recorder	55 92	39 95
PHILIPS 4418 4-track stereo	137 46	99 95
TANDBERG 3341X 4-track stereo deck	189 59	137 95
TANDBERG 901X 4-track stereo	122 11	102 95
TANDBERG 6041X 4-track stereo	187 62	153 95
TANDBERG 9021X 2-track stereo deck	216 20	182 95
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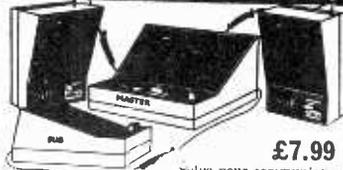
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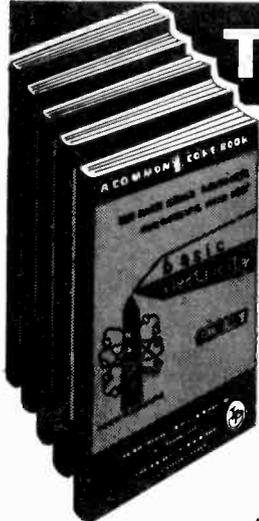
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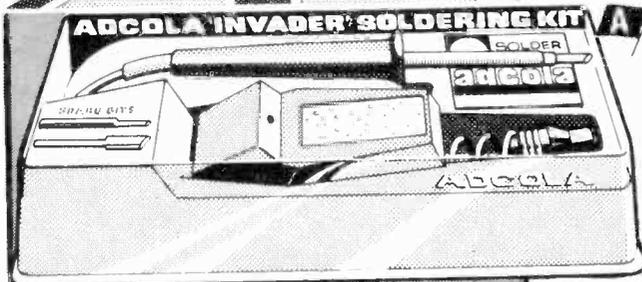
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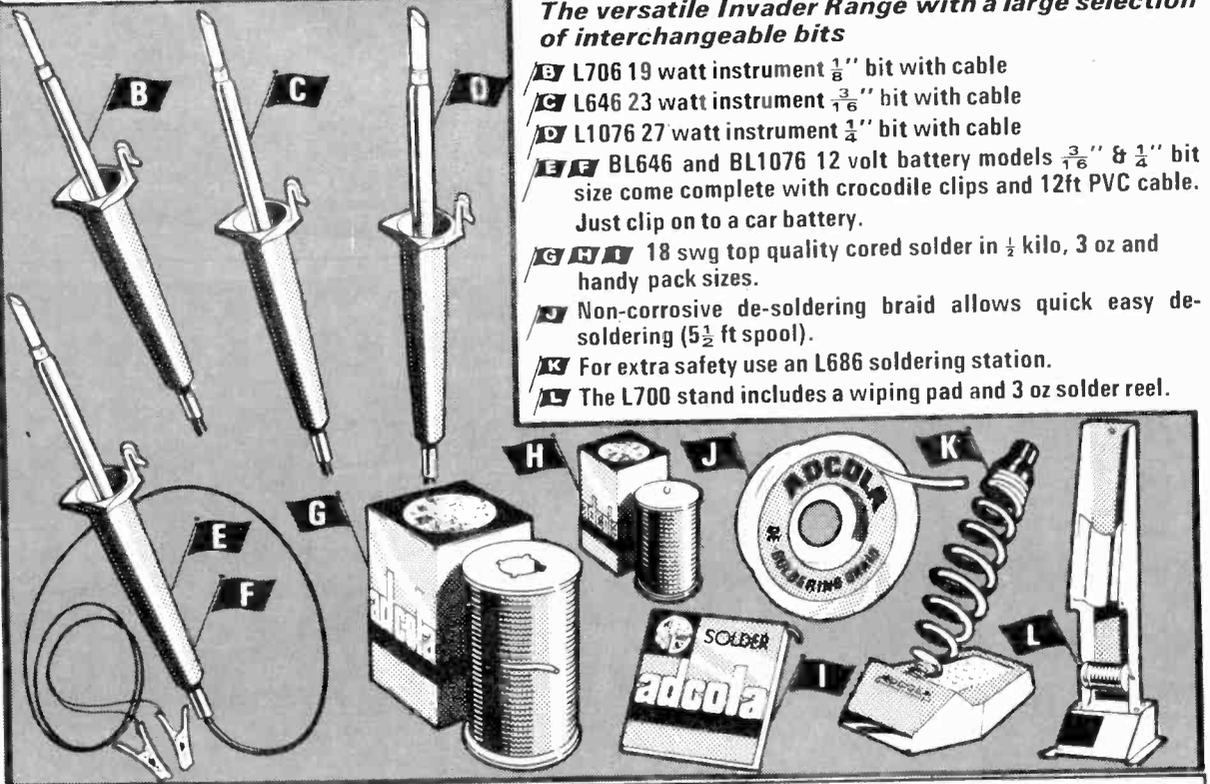
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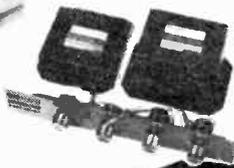


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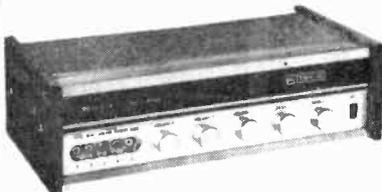
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\* Fully retractable & lockable car aerial £1.37 post paid.

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## RELIANT Mk IV AN ELEGANT 20 WATTS MONO AMPLIFIER FOR ONLY £13.50 (inc. VAT). IDEAL FOR YOUR DISCO.

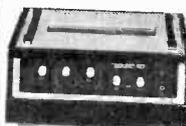
\*5 Electrically Mixed inputs. \*3 Individual Mixing controls. \*Separate bass and treble controls common to all 5 inputs. \*Mixer employing F.E.T. (Field Effect Transistors). \*Solid State Circuitry. \*Attractive Styling INPUTS 1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV Inputs. 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.) All 250mV sensitivity. Output 20 watts into 8 ohms (suitable for 15 ohms).

£13.50 p & p 60p

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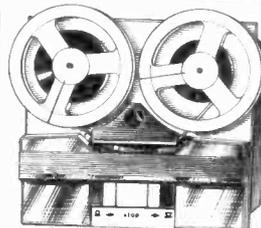
## SOUND 50

(Sine Wave) Frequency



45 WATT MONO AMPLIFIER. Ideal for Disco Work. Output Power: 45 watts R.M.S. 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: 19½ x 10½ x 8ins. Amplifier £31.35 plus £1.65 p. and p.

£31.35 (inc. VAT)



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Suitable 3 speed tape deck, less heads. Caters up to 7ins. spools. Unused but store soiled hence no warranty. plus 60p packing & 50p post

£8.80

All prices include VAT

**20 watts per channel RMS**

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20 + 20w. r.m.s. 40Hz to 40kHz ± 3dB. Total distortion at 10w. at 1kHz - 0.1%. This is real value for money! We have designed 2 systems and the heart of them both is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect, transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder.

For both systems we have chosen the famous Garrard SP25 Mk. III deck, with fitted magnetic cartridge, which comes complete with simulated teak plinth and tinted acrylic cover.

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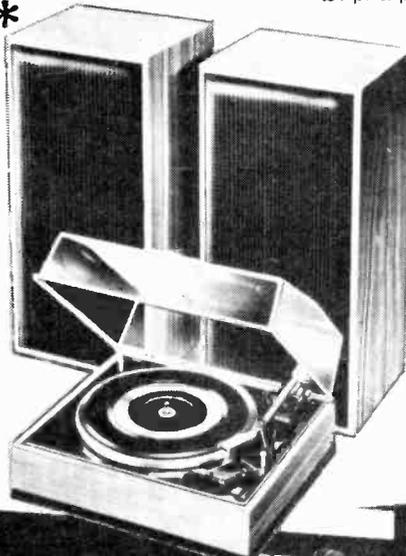


**PRICES: SYSTEM 1**  
Viscount III R 102 amplifier £24.20 + £1 p & p  
2 Duo Type II speakers £15.40 + £2.20 p & p  
Garrard SP25 Mk. III with  
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total £64.60

Available complete for only **£52 +**  
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2 Duo Type III speakers £35.20 + £3.30 p & p  
Garrard SP25 Mk. III with  
MAG. cartridge plinth & cover £25.00 + £1.75 p & p  
total £84.40

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**SPEAKERS:** Duo Type II Size approx. 17in. x 10½in. x 6½in. Drive unit 13in. x 8in. with parasitic tweeter. Max. power 10 watts 8 ohms. Simulated Teak cabinet. £15.40 a pair (inc. VAT), £2.20 p. and p. Duo Type III Size approx. 23½in. x 11½in. x 9½in. Drive unit 13½in. x 8½in. with H.F. speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20KHz. Teak veneer cabinet. £35.20 a pair (inc. VAT) + £3.30 p. & p.  
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**CAPACITORS:** Electrolytic, Miniature axial lead.  
63V: uF: 1, 1.5, 2, 2.3, 4, 7, 6, 8, 10, 15, 22, 47 all at 6p each.  
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160V d.c. uf: 0.1, 0.15 4p, 0.22 5p, 0.33 6p, 0.47 7p, 0.68 10p, 1uf 13p.  
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400 d.c. uf: 0.01, 0.015, 0.022 3p each, 0.033, 0.047 4p each. 250 d.c. uf: 0.068, 0.1, 0.15 4p, 0.22, 0.33 5p, 0.47 7p, 0.68 10p, 1uf 11p.

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5K-2M, log or lin Single gang W/Switch 24p.  
Knobs: Pointer Knob 8p. Aluminium 10p.

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Single Gang, 10K-100K, log or linear 35p  
Dual Gang, 10K-100K, log or linear 50p  
Knob for above 10p

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0-25W HORZ & VERT 5p  
0-1W VERT 3p

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SLIDE SWIT D.P. 1A 10p  
TOGGLE S.P.S.T. 18p  
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AC127	12p	BC108	8p	BF196	22p	OC70	11p
AC128	12p	BC109	8p	BFY51	22p	OC71	11p
AD161	30p	BC147	10p	BFY52	22p	2N2926R	9p
AD162	30p	BC148	10p	OC26	40p	2N2926G	9p
AF114	12p	BC149	10p	OC28	40p	2N2926V	9p
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Matrix	Matrix	PLAIN	Matrix	DC POWER SUPPLY
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2½in x 3½in	20p	18p	17in x 2½in	Current 500mA
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**MAINS TRANSFORMERS ALL POST 25p each**

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3 amp. 5, 8 and 18 v. £1.00; Ditto 5 amp. £1.20  
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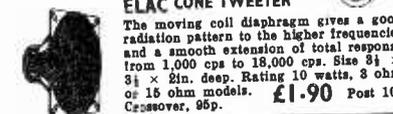
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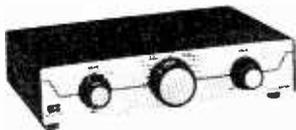
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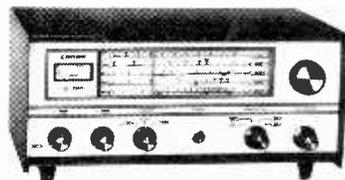


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100	0-28	0-37	0-52	0-52	0-55	0-64	0-70
200	0-39	0-41	0-54	0-54	0-63	0-67	0-83
400	0-48	0-52	0-62	0-62	0-74	0-83	1-03
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100	0-04	0-07	0-06	0-15	0-18	0-26
200	0-06	0-10	0-07	0-16	0-22	0-27
400	0-07	0-15	0-08	0-22	0-30	0-41
600	0-08	0-18	0-11	0-26	0-38	0-50
800	0-11	0-19	0-12	0-28	0-41	0-61
1000	0-12	0-28	0-16	0-33	0-51	0-70
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UIC03	=12 x 7403	0-55	UIC60	=12 x 7450	0-55	UIC92	=5 x 7492	0-55
UIC04	=12 x 7404	0-55	UIC61	=12 x 7461	0-55	UIC93	=5 x 7493	0-55
UIC05	=12 x 7405	0-55	UIC63	=12 x 7453	0-55	UIC94	=5 x 7494	0-55
UIC06	=8 x 7406	0-55	UIC64	=12 x 7464	0-55	UIC95	=5 x 7495	0-55
UIC07	=8 x 7407	0-55	UIC60	=12 x 7460	0-55	UIC96	=5 x 7496	0-55
UIC10	=12 x 7410	0-55	UIC70	=8 x 7470	0-55	UIC100	=5 x 74100	0-55
UIC13	=8 x 7413	0-55	UIC72	=8 x 7472	0-55	UIC101	=5 x 74101	0-55
UIC20	=12 x 7420	0-55	UIC73	=8 x 7473	0-55	UIC141	=5 x 74141	0-55
UIC30	=12 x 7430	0-55	UIC74	=8 x 7474	0-55	UIC151	=5 x 74151	0-55
UIC40	=12 x 7440	0-55	UIC75	=8 x 7475	0-55	UIC154	=5 x 74154	0-55
UIC41	=5 x 7441	0-55	UIC76	=8 x 7476	0-55	UIC193	=5 x 74193	0-55
UIC42	=5 x 7442	0-55	UIC80	=5 x 7480	0-55	UIC199	=5 x 74199	0-55
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SN7402	0-17	0-16	0-13	SN7453	0-17	0-16	0-13	SN74150	0-30	0-27	0-25
SN7403	0-17	0-16	0-13	SN7454	0-17	0-16	0-13	SN74151	0-10	0-10	0-09
SN7404	0-17	0-16	0-13	SN7454	0-17	0-16	0-13	SN74152	0-10	0-10	0-09
SN7405	0-17	0-16	0-13	SN7460	0-17	0-16	0-13	SN74153	0-10	0-10	0-09
SN7406	0-17	0-16	0-13	SN7470	0-32	0-29	0-27	SN74154	0-10	0-10	0-09
SN7407	0-39	0-34	0-31	SN7472	0-32	0-29	0-27	SN74155	0-10	0-10	0-09
SN7408	0-20	0-19	0-18	SN7473	0-41	0-39	0-35	SN74156	0-10	0-10	0-09
SN7409	0-20	0-19	0-18	SN7474	0-41	0-39	0-35	SN74157	0-10	0-10	0-09
SN7410	0-17	0-16	0-13	SN7475	0-50	0-48	0-46	SN74160	0-10	0-10	0-09
SN7411	0-17	0-16	0-13	SN7476	0-44	0-43	0-42	SN74161	0-10	0-10	0-09
SN7425	0-39	0-34	0-31	SN7480	0-74	0-71	0-64	SN74162	0-10	0-10	0-09
SN7413	0-32	0-29	0-27	SN7481	0-32	0-27	0-21	SN74163	0-10	0-10	0-09
SN7416	0-48	0-44	0-42	SN7482	0-96	0-95	0-94	SN74164	0-10	0-10	0-09
SN7417	0-48	0-44	0-42	SN7484	0-10	0-10	0-09	SN74165	0-10	0-10	0-09
SN7420	0-17	0-16	0-13	SN7485	0-36	0-34	0-33	SN74175	0-10	0-10	0-09
SN7422	0-55	0-50	0-48	SN7489	0-05	0-05	0-05	SN74176	0-10	0-10	0-09
SN7423	0-55	0-50	0-48	SN7490	0-74	0-71	0-64	SN74177	0-10	0-10	0-09
SN7425	0-55	0-50	0-48	SN7491	0-10	0-10	0-09	SN74180	0-10	0-10	0-09
SN7426	0-50	0-46	0-44	SN7492	0-74	0-71	0-64	SN74181	0-10	0-10	0-09
SN7427	0-50	0-46	0-44	SN7493	0-74	0-71	0-64	SN74182	0-10	0-10	0-09
SN7428	0-77	0-72	0-68	SN7494	0-85	0-82	0-75	SN74183	0-10	0-10	0-09
SN7430	0-17	0-16	0-13	SN7495	0-85	0-82	0-75	SN74190	0-10	0-10	0-09
SN7432	0-50	0-46	0-44	SN7496	0-96	0-93	0-88	SN74191	0-10	0-10	0-09
SN7433	0-32	0-29	0-27	SN7497	0-96	0-93	0-88	SN74192	0-10	0-10	0-09
SN7437	0-71	0-68	0-66	SN74100	0-10	0-10	0-09	SN74193	0-10	0-10	0-09
SN7438	0-71	0-68	0-66	SN74101	0-10	0-10	0-09	SN74194	0-10	0-10	0-09
SN7440	0-17	0-16	0-13	SN74105	0-10	0-10	0-09	SN74195	0-10	0-10	0-09
SN7441	0-74	0-71	0-64	SN74107	0-44	0-42	0-40	SN74196	0-10	0-10	0-09
SN7442	0-74	0-71	0-64	SN74110	0-61	0-59	0-55	SN74197	0-10	0-10	0-09
SN7443	0-10	0-08	0-07	SN74111	0-38	0-27	0-21	SN74198	0-10	0-10	0-09
SN7444	0-43	0-38	0-32	SN74118	0-10	0-10	0-09	SN74199	0-10	0-10	0-09
SN7445	0-10	0-08	0-07	SN74119	0-49	0-38	0-31	SN74199	0-10	0-10	0-09
SN7446	0-17	0-16	0-13	SN74121	0-44	0-41	0-38	Terminal Pos Volt Reg. TO-3			
SN7447	0-10	0-07	0-05	SN74122	0-54	0-43	0-31	Plastic O/P 1.5 Amps. $\mu$ A7805			
SN7448	0-10	0-07	0-05	SN74123	0-83	0-72	0-60	5V. & $\mu$ A7812 12V. $\pm$ 1.76 each			



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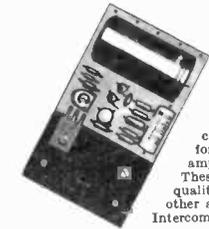
## THE AL50

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Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.P. amplification needs.  
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AP80 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:—Disco Systems, Public Address, Intercom Units, etc. Handbook available. 10p **PRICE £3.25**

TRANSFORMER BMT80 £2.14½ p. & p. 27½p.

## 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 $\pm$ 1dB
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.U.	1.5 mV into 50K $\Omega$
All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within $\pm$ 1dB. from 20Hz to 20KHz.	
Bass Control	$\pm$ 15dB at 20Hz
Treble Control	$\pm$ 15dB at 20KHz
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

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

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## LINEAR I.C.'s—FULL SPEC.

Type No.	1-24	25-99	100 up
BP 201C—SL201C	89p	58½p	49½p
BP701C—SL701C	89p	55p	49½p
BP 702C—SL702C	89p	55p	49½p
BP 702—72702	58p	49½p	44p
BP709—72709	38p	37p	33p
BP 709P— $\mu$ A709C	39p	37p	33p
BP 710—72710	48p	46p	44p
BP 711— $\mu$ A711	49p	47p	44p
BP 741—72741	55p	50p	45p
$\mu$ A705C	31p	28p	28½p
TA A 263	77p	66p	60p
TA A 293	99p	82p	77p
TAA 350	£1.87p	£1.74p	£1.65p

G.S.S. EA1000 £2.89½p

## ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C.'s

Type	Price	25	100+
BP930	13p	12p	11p
BP932	14p	13p	12p
BP933	14p	13p	12p
BP935	14p	13p	12p
BP936	14p	13p	12p
BP944	14p	13p	12p
BP945	27½p	26p	24p
BP946	18p	17p	11p
BP948	27½p	26p	24p
BP951	7½p	6p	60p
BP962	18p	12p	11p
BP9093	44p	42p	38½p
BP9094	44p	42p	38½p
BP9097	44p	42p	38½p
BP9099	44p	42p	38½p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

## NUMERICAL INDICATOR TUBES



MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2.3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1.87	£1.70	£1.09

All indicators 0.9 + Decimal point. All side viewing. Full data for all types available on request.

## RTL MICROLOGIC CIRCUITS

	Price each
Epoxy TO-5 case	1-24 25-99 100 up
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## DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C.'s. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1-24	25-99	100up.
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T80 16 " "	38½p	35p	33p

## LOW COST NO.

BF8 14	16p	14p	12p
BF8 16	17p	15p	13p

# SUMMER SEASON

**N**OT so very many years ago there was much controversy over the invasion by small transistor radios on the beaches of popular British holiday resorts. There is no doubt they can, if not used with discretion, be an intrusion to the enjoyment of other people's relaxation. As a result it is now unlawful to cause a nuisance by allowing radios to be operated in public places.

Since May is generally regarded as the opening of the holiday season we thought that readers will want to look into the possibilities of taking away a small radio or perhaps a cassette player. In this issue, therefore, we have offered a design for a simple TRF receiver for the medium wave band. This is no ordinary MW receiver; it has been designed so that stations beyond the 200 metre mark stand a good chance of being heard.

In spite of certain limitations of the TRF there is no doubt that most people who start building their own radio usually choose this type because of its relative simplicity compared with superhets.

But the problem really is that the TRF is only as good as the aerial-earth system used and the locality in which you wish to listen in. On the other hand, the larger and more expensive superhet can be taken virtually anywhere.

There is a rapidly growing trend to incorporate a cassette recorder in the same case as the radio and this makes sense from a commercial as well as user aspect. So far these are all imported; the U.K. market has grown from about 30,000 in 1970 to almost 400,000 in 1972. Examples of this and other radio and hi-fi equipment recently announced are shown in our special pictorial feature on page 148.

If your holiday turns out to be a wet one, or if you want to save batteries, you can use a small mains power supply unit. It is worth having a regulated supply and in this issue we show you how to make one.

Although the summer months tend to discourage indoor activities, *Practical Wireless* continues to provide some superb designs that you cannot afford to miss. Among these in the coming months will be projects for musicians, amateur radio constructors, f.m. experimenters, audio addicts, pop radio listeners, and equipment testers. As back numbers are not available, we recommend advance orders to avoid disappointment.

Finally, don't forget to have a go in our competition this month; you could win a digital multimeter and a year's supply of new projects, designs, features and promotions in 12 free issues of *Practical Wireless*.

M. A. COLWELL—Editor

The July issue on sale 1st June, will include a tremolo generator for guitars and organs, an experimental f.m. receiver with extended tuning range, a digital i.c. process timer, an article about magnetic amplifiers and a variable frequency oscillator for the 3-band transmitter in this issue. Also watch out for first details of articles specially devised for beginners, plus the extra features and regular news and comment pages.

Further details on page 143.

## NEWS...

### Mobile rally diary

**May 6**—The Tulip Time Rally is being held at Sunfleet on the A16 four miles north of Spalding. All information can be obtained from R. Harrison, G3VPR, 38 Park Avenue, Spalding, Lincs.

**May 13**—South Leicestershire Mobile Rally will be held at Westfield Activity Centre Rosemary Way, Hinckley. Talk-in stations will be manned by G3ZOP/A (Top Band) G8CGW/A on 2m a.m./f.m. and G3WPB/A on 2m s.s.b. Contact for further gen is J. Elliott G8CGW, 92 Hinckley Road, Barwell, Leicester.

**May 20**—The Radio Amateur Invalid Bedfast Club will be having their rally at the Fairground, Broadlands Estate, Romsey, Hampshire. This will be held in conjunction with the Southampton Group. All information from Mrs. Frances Woolley, G3LWY, Woodclose, Penselwood, Wincanton, Somerset.

**May 20**—Otley Radio Society are holding their Northern Mobile Rally at Moor Grange School, Ring Road, Leeds. Many stalls and refreshments etc. Contact is D. G. Mott, 17 Newall Carr Road, Otley, Yorkshire.

**May 27**—The Hull and District Mobile Rally will be at Bishop Burton, near Beverley, Yorkshire. All the information can be obtained from L. D. Colley, G3AGX, 13 Ferry Road, Wawne, Nr. Hull, HU7 5XU.

**May 27**—The Maidstone Mobile Rally will be held at the YMCA Sports Centre, Melrose Close. Talk-in stations will be GB3YSC on 2, 4, 80 and 160m. Further information from A. S. Walter, G3WXL, 4 Oak Farm Gardens, Headcorn, Kent.

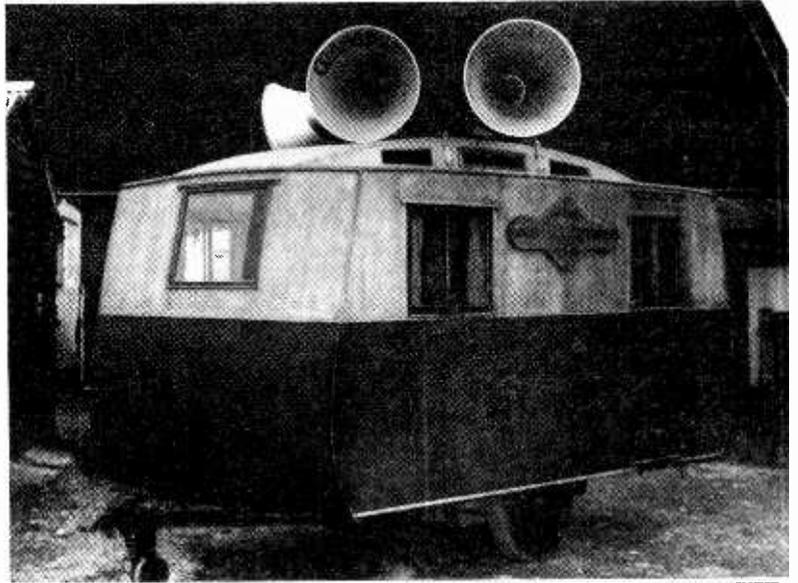
**June 10**—Elvaston Castle Mobile Rally. This fourth annual event will be held in the grounds of the Castle Country Park, just off the B5010 south-east of Derby. A bring-and-buy sale is one of the main attractions and talk-in stations will be operating on 2m, 4m and Top Band by G3EEO and G3ZBL. Further gen may be obtained from I. Cage, G8GBV, 25 Petersham Drive, Alvaston, Derby, DE2 0JU.

### Good old days at Sound '73

**I**N 1927 the Bedford public address engineer Cecil Clarabut purchased a caravan to tow behind his motor car for his public address work. The van and car travelled to many events in the Bedfordshire area for almost thirty years and according to the records this van and car were last used in June 1958. Since then they have been stored at Mr Clarabut's premises in Bedford and lain idle until Tuesday 6th March this year when the tyres were pumped up, the dust brushed off, a few squirts of oil were given in the appropriate places and it was possible to tow the caravan from Bedford to Harrow for preparation for the Sound 73 Exhibition.

The equipment inside is obviously not as old as the van itself, although the rack dates from the mid 1940's. The 78 record players are probably from the same era, and it is understood that the amplifiers were modernised in 1947 to take the new Reslo VMC microphones. The horn speakers which fitted to the roof rack were manufactured by Goodmans.

Mr Clarabut is selling his premises for re-development and plans to reduce his activities in the audio world. He has therefore kindly donated this caravan and its equipment to the Association of Public Address Engineers' collection and at present the Association's Secretariat is looking for a suitable museum to house this caravan.



### Home Radio

The latest issue of this catalogue covers more components than ever. It's a "new look" edition with larger format. If readers would like a copy it is available from Home Radio (Components) Ltd., 240 London Road, Mitcham, Surrey, CR4 3HD. The price is 75p (post paid) or 55p to callers.

### Quadraphonic sound

**R**EPORTS are coming in from America and Japan of increasing favour towards discrete four-channel stereo (CD-4), although currently there are in Japan more matrix Sansui QS discs available than any other. JVC-Nivico have opened a record cutting plant in Los Angeles for CD-4 records. The influence of recording companies in America, and presumably in the U.K., together with recommendations for broadcasting, will decide on the ultimate system (or systems) to be generally promoted.

Mr. C. B. Wood, Head of Engineering Information at the BBC, implied in a statement recently that the BBC were likely to take a long time before deciding on their choice of quadraphonic sound, especially when stereo broadcasting, now using p.c.m., has reached a high standard.

### Northern Radio Societies Convention

**T**HIS year, the Northern Radio Societies Association Annual Convention will be held at The Forum Halls, Wythenshawe, Manchester, on Sunday, May 6, from 11 a.m. to 6 p.m.

This is a new venue for the convention, on the south side of Manchester, a few minutes from the M56 Motorway and with good access from the centre of Manchester.

The convention will take the same form as in previous years with member societies competing for the G3AYD trophy awarded to the stand giving the best presentation of some aspect of amateur radio.

Talk-in stations will be operating on 2, 4 and 160m and the main station will operate on all h.f. bands using call GB2NRS.

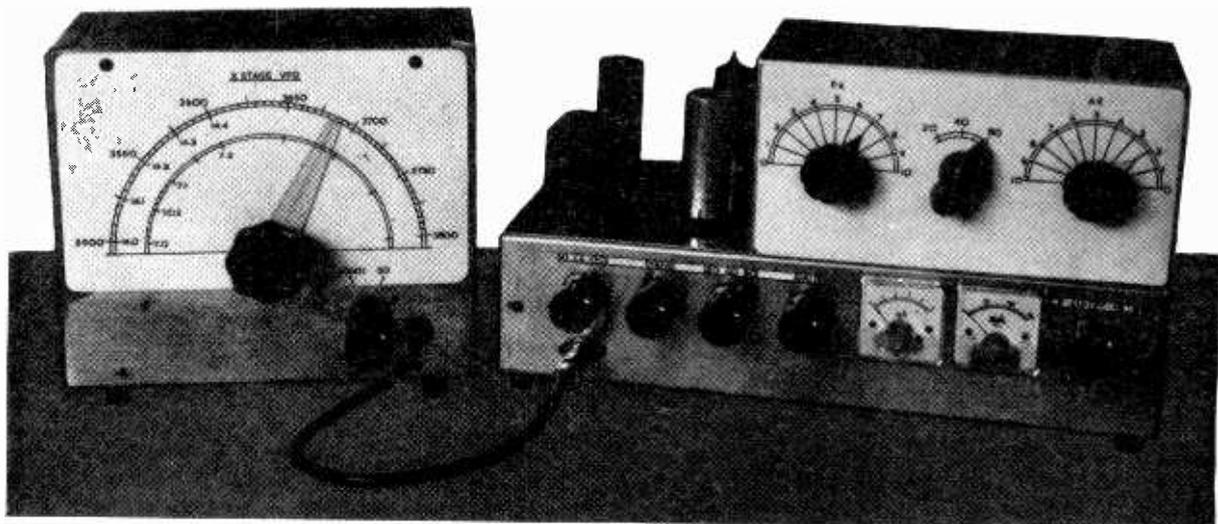
The usual raffle will be organised with tickets on sale during the day.

Further information is obtainable from *Peter Taylor G8BCG*, 2 Columbia Avenue, Gorton, Manchester M18 7LG.

### Screwdriver standard

**T**O provide an authoritative specification for the adequate design of insulated screwdrivers—and for the benefit of purchasers—the British Standards Institution has published BS 2559 *Screwdrivers: Part 3: 1972 Insulated screwdrivers*.

The Standard covers the materials and thickness of the insulation suitable for the tools specified in other parts of BS 2559, and gives a test which utilises a potential of 5kV.



# 3-BAND TRANSMITTER

PART 1

F. G. RAYER G30GR

**T**HE transmitter described here is of particularly simple construction, being fully enclosed and screened without the use of a cabinet. It covers three bands, 20, 40 and 80 metres and runs about 25 watts input for AM, screen-grid modulated, and about 50 watts CW. Crystal control is used and a single crystal may permit working on two or three bands. There are two crystal holders, with a switch to select them, so a few crystals can give a useful number of working frequencies. Since a variable frequency oscillator is often wanted in addition to crystal control a suitable plug-in VFO is also described. This does not require any changes to be made to the transmitter.

## CIRCUIT DESIGN

Fig. 1 is the circuit, a 5763 being used as a crystal oscillator or buffer-multiplier. Switch S1 selects either crystal, or VFO input, and the valve anode circuit L1 can be tuned to the crystal frequency, or to a harmonic.

This type of oscillator works well and gives a good output on harmonic frequencies. For example, 1750-1900kHz crystals may be used for 3.5-3.8MHz, as well as 3.5-3.8MHz crystals. Similarly, those 80m band crystals which fall in the 40m band on their second harmonic, may be used for both 80m and 40m, while 3.5MHz band and 7MHz band crystals may be employed for 14MHz working, as well as on their fundamental frequencies.

L1 is tapped and switched for the required band and tuned by VC1. VR1 allows output of this stage to be adjusted. C3 is in parallel with the RF choke when V1 is used with the VFO.

The power amplifier, a 6146, runs at an input of 50 watts which is easily within the ratings of this valve. Since grid current provides bias and is very important, a 5mA meter is permanently connected in the grid circuit. The second meter indicates PA

anode current. This method is easier in practice than having a single meter, with switch.

The PA tank circuit L3 is designed to match into a 75ohm load, so dipoles and other conventional aerials may be used.

In the modulator V3, a 6BR7, is a high-gain audio amplifier for a crystal microphone and VR2 is a pre-set audio gain control. Using an ECL82, V4a is a further audio stage and V4b the screen-grid modulator. With screen-grid modulation the input to the PA is reduced to about 25 watts, when the transmitter is capable of giving a good signal, well modulated.

A single control switch S4 has four positions, "Net" puts HT on the oscillator (and VFO, if in use) so that the transmitter can be tuned for correct PA grid current and the working frequency located with a receiver. The "Off" position takes HT off all stages. The "AM" position places HT on the PA, and the screen-grid voltage from the modulator. In the "CW" position, the PA SG voltage is raised and taken from the modulated line. The keying is carried out in the cathodes of the 5763 and 6146.

Though a screen-grid modulator does not have the power of a high level anode and screen modulator, the method avoids the need for a large modulation transformer and can work out very satisfactorily.

Power units are separate, which may allow existing supplies to be used. The oscillator and modulator require about 60mA to 80mA at about 250V so a receiver type power pack is satisfactory.

The 500V high voltage supply is used for the PA only. With an AM input of 50mA and CW input of 100mA this will provide inputs of 25 watts and 50 watts. The PA has been run successfully with 400V and even lower voltages but a fairly high voltage here is useful with SG modulation. The PA maximum listed input ratings are 110mA anode current at 750V, but these have not been used in the present transmitter.

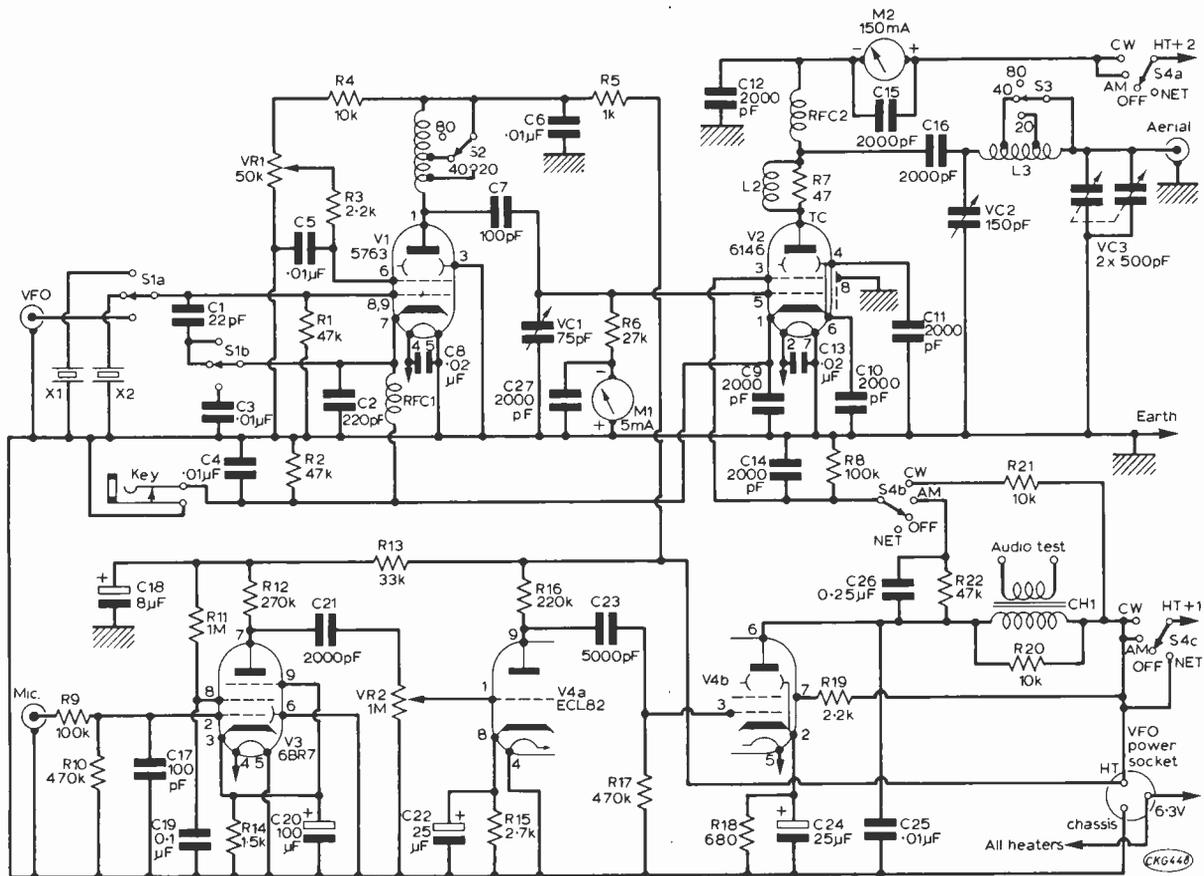
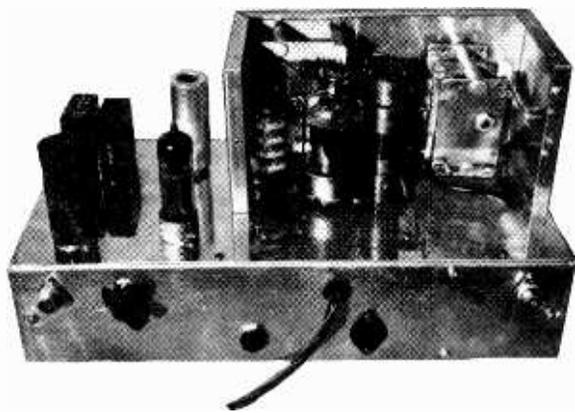


Fig. 1: Complete circuit of the transmitter and modulator.

## CHASSIS CONSTRUCTION

The transmitter is built on an enclosed chassis with the PA stage as a closed screening box. This both screens and protects against possible contact with HT circuits the equipment being intended for use in this form, with no other cabinet.

The flanged PA box can be obtained ready-formed. It is 4in. high, 4½in. deep, and 8in. wide, and has flanges at top, back and bottom. It is bolted to the 13 x 6in. chassis as in Fig. 2, which also shows positions of the valveholders. Six holes are punched round V2 for ventilation.



Rear chassis view with part of power amplifier screening removed.

Capacitors VC2 and VC3 are bolted to the front of the box. Their rotor contacts are connected together with stout wire and to a tag held with one of the bolts securing V2 holder.

A tag strip holds C12 and RFC2. A well-insulated lead from C12 runs against the chassis and passes through a hole directly over the 150mA meter negative terminal.

A co-axial lead runs from VC3 through the chassis to the aerial socket.

Fig. 3 shows all wiring, etc., under the chassis. Heater, power and audio circuit leads run against the chassis with adequately insulated wire used for the high voltage circuits.

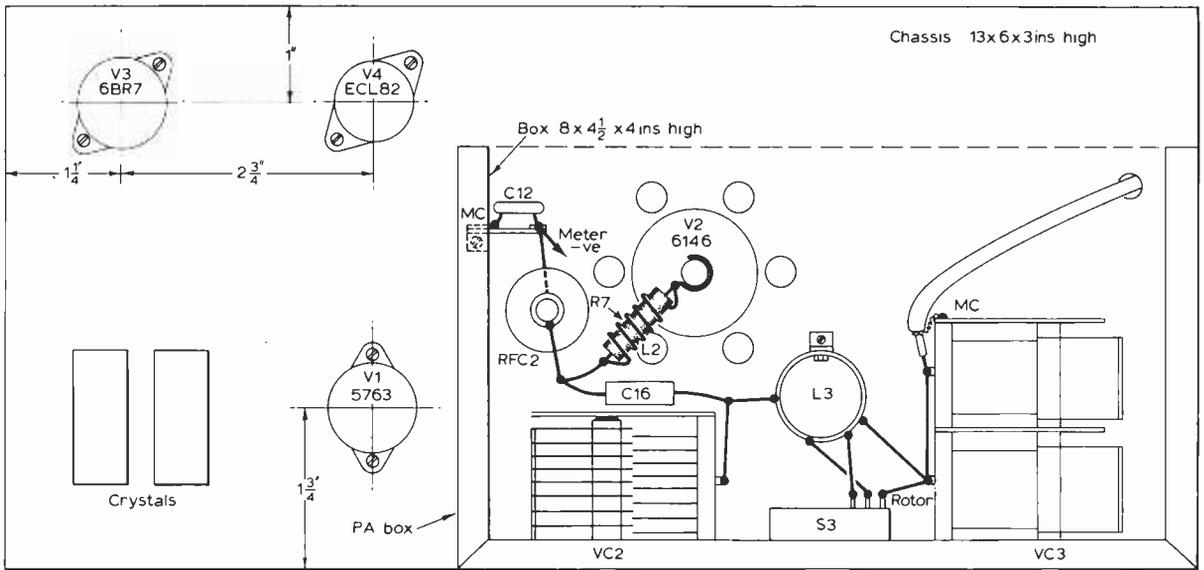
When wiring S1, use one pole to select each crystal holder, and the adjacent VFO input socket. The other pole places C1 from grid to cathode, when the stage is used as a crystal oscillator.

By-pass capacitors in the RF circuits must be connected with very short leads, especially around V2. These are all disc ceramics and since they may be obtained cheaply it may be noted that the actual values used are not too important.

When wiring V3 in particular, keep R9, R10, C17 and grid leads short and against the chassis, and clear of the heater circuit, or hum may be caused.

The chassis listed has flanges at the bottom which allow a flat plate 13 x 6in. or perforated metal of the same size to be attached with self-tapping screws, for screening and protection. A plate should have a number of ventilation holes punched in it.

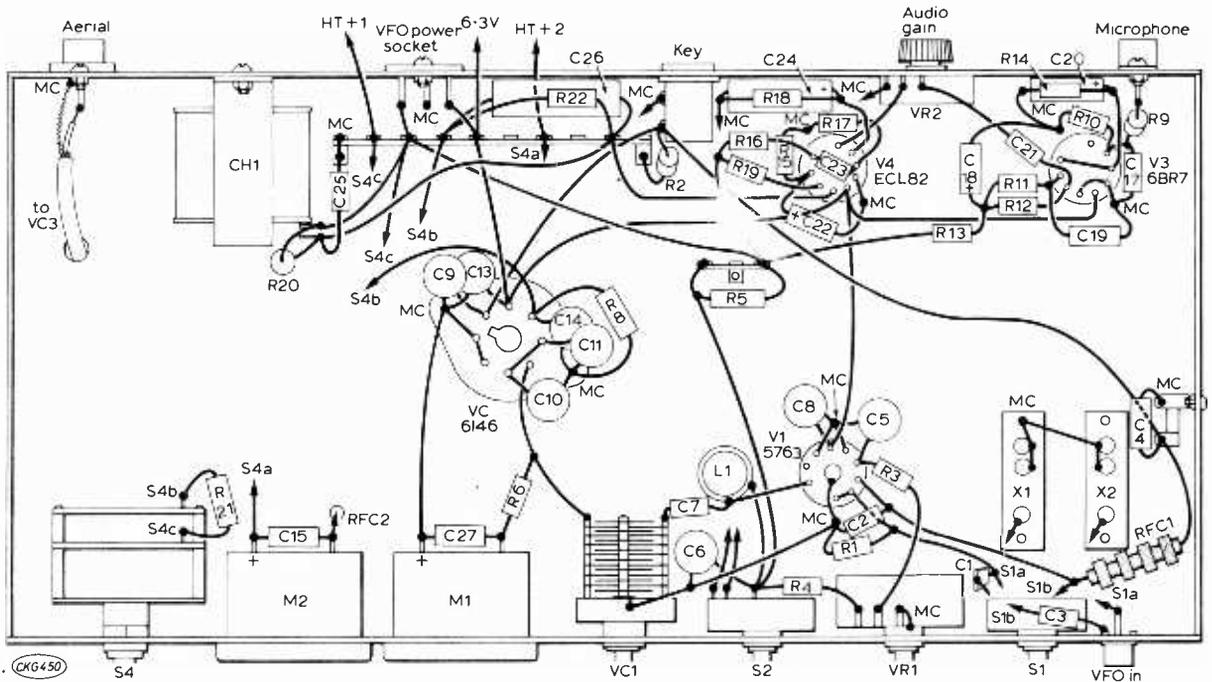
To allow circulation of air, the transmitter is



CKG443

▲ Fig. 2: Component layout on top of the chassis with drilling details.

▼ Fig. 3: Under-chassis wiring information and placement of the smaller components.



CKG450

raised on four rubber feet, attached with bolts to the plate or bottom.

Tag strips are used to support various small components and to anchor the power supply leads, which pass out through a grommet at the back. A 3-way socket is required for the VFO power supply with a 3-pin plug wired to match.

The key jack has closing contacts which complete the cathode circuit to chassis when no plug is inserted. With the key plugged in, it has to be held closed or locked down while tuning up.

Fig. 4 shows connections to the function switch S4. S4a applies HT in the AM and CW positions while S4b switches the screen-grid from R21 to R22. S4c completes the low voltage HT circuit.

## INDUCTORS

The parasitic choke L2 is five turns of 18swg wire, spaced to occupy about  $\frac{3}{4}$  in. length and about  $\frac{3}{8}$  in. inside diameter. All connections here should be stout and short.

## ★ components list

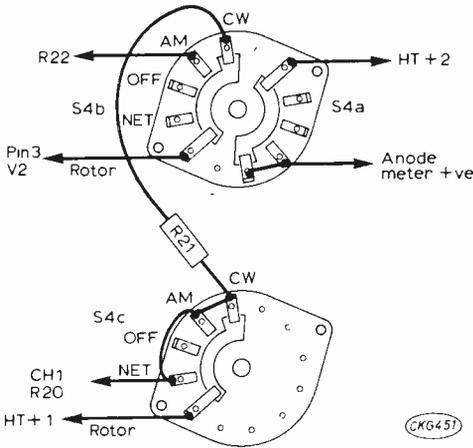


Fig. 4. Wiring of the two wafer switches constituting the function switch S4.

L3 is wound on a 1 in. diameter paxolin tube  $3\frac{1}{4}$  in. long, as in Fig. 5. The  $11\frac{1}{2}$  turn and 13 turn sections are of 20swg wire, wound slightly spaced (20 turns per inch). The 21 turn section is close-wound with 22swg wire, a space of  $\frac{1}{8}$  in. being left between sections.

The switch, coil and taps are so placed that short, direct leads are possible. The spaced windings were made by smearing the tube with adhesive and winding simultaneously with 20swg and 26swg wire, close-wound. The 26swg wire was afterwards unwound. This coil was found to give the same RF output from the transmitter on 14MHz and 7MHz as on 3.5MHz. If other coils are used, there must be sufficient clearance between the winding and metal parts, including the chassis.

After wiring is completed the PA box can be closed with a piece of perforated metal, held with self-tapping screws to the box and chassis.

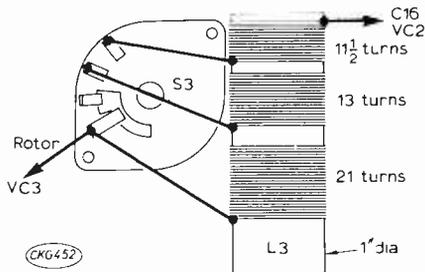


Fig 5: Winding details for the power amplifier coil L3.

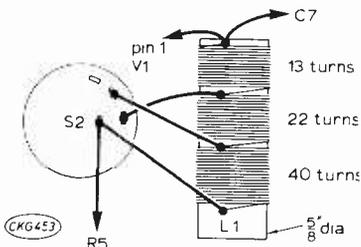


Fig. 6: The driver output coil L1 is wound as shown above.

### Resistors

R1 47kΩ ½W	R9 100kΩ ½W	R17 470kΩ ½W
R2 47kΩ 1W	R10 470kΩ ½W	R18 680Ω 1W
R3 2.2kΩ ½W	R11 1MΩ ½W	R19 2.2kΩ ½W
R4 10kΩ 1W	R12 270kΩ ½W	R20 10kΩ 1W
R5 1kΩ 1W	R13 33kΩ ½W	R21 10kΩ 2W
R6 27kΩ 1W	R14 1.5kΩ ½W	R22 47kΩ 1W
R7 47Ω 1W	R15 2.7kΩ ½W	
R8 100kΩ 1W	R16 220kΩ ½W	All 10%

VR1 50kΩ 1W linear potentiometer

VR2 1MΩ log. potentiometer

### Capacitors

C1 22pF SM	C15 2000pF 350V D. Cer
C2 220pF SM	C16 2000pF 1kV Mica
C3 0.01μF 350V D. Cer	C17 100pF SM
C4 0.01μF 350V D. Cer	C18 8μF 350V
C5 0.01μF 350V D. Cer	C19 0.1μF 350V
C6 0.01μF 350V D. Cer	C20 100μF 6V
C7 100pF SM	C21 2000pF 350V
C8 0.02μF 350V D. Cer	C22 25μF 6V
C9 2000pF 350V D. Cer	C23 5000pF 350V
C10 2000pF 350V D. Cer	C24 25μF 50V
C11 2000pF 350V D. Cer	C25 0.01μF 1kV Tubular
C12 2000pF 1kV D. Cer	C26 0.25μF 350V Tub.
C13 0.02μF 350V D. Cer	C27 2000pF 350V D. Cer
C14 2000pF 1kV D. Cer	

SM=Silver Mica D. Cer=Disc Ceramic

VC1 75pF variable

VC2 150pF variable 600V

VC3 500+500pF variable

### Valves

V1 5763

V2 6146

V3 6BR7

V4 ECL82

### Chassis

Universal chassis sides	13 x 3 in. (2)	} (Home Radio)
Universal chassis sides	6 x 3 in. (2)	
Flat plates	13 x 6 in. (2)	
PA Box.	8 x 4½ x 4 in. (Type P chassis, H. L. Smith)	
Perforated metal	9 x 8 in.	

### Switches

S1 2 pole 3 way

S2 1 pole 3 way

S3 1 pole 3 way

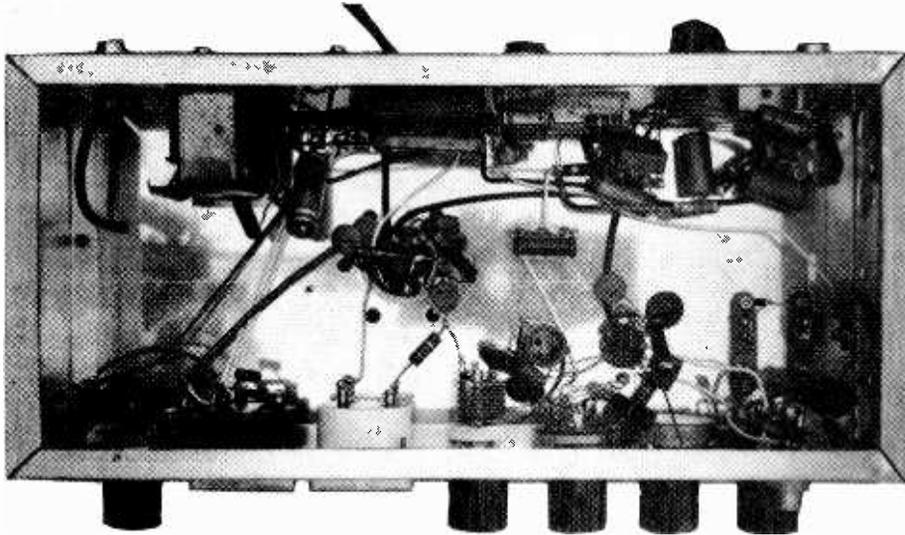
S4 3 pole 4 way (2 wafers)

### Miscellaneous

RFC1, 2.5mH 60mA. RFC2, Denco RFC9A 250mA. M1, 5mA miniature meter. M2, 150mA miniature meter. Key socket. Co-axial sockets for microphone, aerial and VFO. CH1, pentode speaker transformer. Valveholders, B9A (3) with two screens. Valveholder, octal (1). Crystal holders (2). Crystals as required (Senator Crystals, 36 Valleyfield Rd., London, SW16). Knobs, rubber feet. VFO power socket, 3 way).

The driver coil L1 is wound on a  $\frac{5}{8}$  in. diameter paxolin tube 2 in. long, as in Fig. 6. The 13 turn and 22 turn sections are of 28swg enamelled wire and the 40 turn section of 32swg enamelled wire. A space of  $\frac{1}{8}$  in. is left between sections, as shown.

With a coil wound in this way it was found impossible to tune to incorrect harmonics with VC1, when doubling. However, when putting any transmitter into use for the first time it is wise to check with an absorption meter, when multiplying from a lower frequency, to be sure the wanted harmonic is obtained.



*This view underneath the chassis will help when wiring up from Fig. 3.*

## AUDIO TEST

As the choke CH1 is the primary of a speaker type transformer, it is worth while testing the audio section with V3 and V4 only in place. Connect a speaker temporarily to the secondary. VR2 is turned up from zero until normal speech in the crystal microphone gives good loudspeaker volume. Feedback of sound from the loudspeaker to the microphone will cause howling.

Audio may also be checked by listening to the signal with a receiver, having the RF and IF gain near zero and the aerial disconnected. Another method is to connect headphones to a crystal diode and few turns of insulated wire, and bring this loop towards L3 when the transmitter is working into an artificial load or the aerial.

## PA OPERATION

With V1 and V2 in place, the function switch should never be turned to AM or CW unless some 2mA or so of grid current has been found on "NET." The equipment should not be operated with HT on the screen of V2 and not on the anode (i.e., by having HT2 disconnected).

With a crystal in circuit tune VC1 for maximum grid current. VC1 will be nearly closed for 80m, half closed for 40m and well open for 20m, S2 being in the appropriate position in each case.

Adjust VR1 so that grid current is about 2mA. It will be found that VR1 needs to be nearly at zero when working on the same frequency as that of the crystal, but has to be advanced considerably when L1 is tuned to a multiple of the crystal frequency.

L1 and L3 are always switched to the same band, so that V2 operates straight through at the same frequency since doubling in this stage is not recommended.

For an initial test, plug a 40 watt household lamp into the aerial socket, or clip it across VC3. Close VC2 and VC3 (to avoid doubling). Switch to "NET" and tune for 2mA grid current, as described. Switch to AM and open VC2 so that the anode current dip is found. Open VC3 a little, meanwhile re-tuning

with VC2 for the dip. This increases input and output and the operation is continued until the wanted input is obtained. The lamp should light with increasing brilliance as this is done.

With the switch at CW, input rises considerably and the PA must not be left off tune. The PA can be tuned initially in the AM position, even when CW is required, because the lower screen voltage helps to keep the anode current down.

When using a transmitter with screen-grid modulation the PA must be loaded so that the anode current dip, shown by the anode meter, is quite flat. If not, speech quality, as reported by a station in the usual way, will deteriorate considerably. With an average crystal microphone, VR2 can first be tried about one-third from the zero position. Excess audio will cause over modulation and distortion.

## CRYSTALS

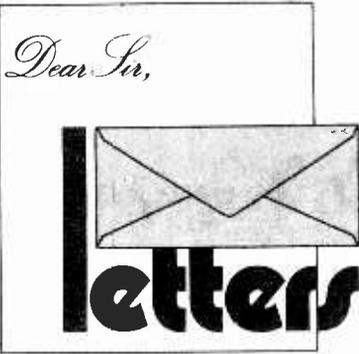
Surplus crystals may be used, and it is worth noting that the choice of frequency may determine whether a given crystal can be used in only one band, or two bands. For example, a 3520kHz crystal can be used on 80m, and also on 40m, because it doubles to 7040kHz. But a 3560kHz crystal doubles to 7120kHz which is outside the 40m band.

It will be noticed that all 40m band crystals can be used for both 40m and 20m. On the other hand, crystals of higher frequency than 7.1MHz cannot be used for 40m, but may still be used for 20m where they fall in this band.

The choice of crystals may also depend on the requirement to work CW or AM.

Attempting to use too high a crystal harmonic results in insufficient PA grid current. It was found that 160m crystals were satisfactory for 80m and 40m. Various 80m crystals gave over 5mA on 80 and 40M, and 2mA on 20m, while 40m crystals give nearly 5mA on 40m and 20m. As expected, 160m crystals do not furnish enough drive on 20m.

**PART 2, next month, will deal with the design and construction of a matching variable frequency oscillator.**



## VAT

I was rather puzzled by the letter from Alan Secker A.C.A. on Value Added Tax.

Of particular interest was his "nutshell" in paragraph (a) in which he stated that orders received after 31st March 1973 would have to be accompanied by 10% for the VAT over and above list prices. Surely this is not so, as I understood that VAT was to replace purchase tax, and as purchase tax was already on the listed items (until they had been reassessed for VAT) one would, in effect, be paying tax on tax!—**J. I. McCartney** (*Littleover, Derby*).

[The term "list price" is usually expressed as the retail value of goods excluding tax. For further information on VAT, see the Leader article in April's issue of Practical Wireless]—Editor.

## A "go" at the locals

I read with interest the letter in the March issue from Mr. Redhouse (BEC Radio London) replying to correspondence from myself and Mr. J. Manners. There was no reference to either advice to my customers or to the volume of sales . . . As to the rest of the letter, I would like to raise the following points.

Perhaps no-one did quarrel openly with the idea of making the network services available on v.h.f., though why this should be due to "limited resources" baffles me. As the sole authorised broadcasting service in the UK for so many years, the BBC demeans itself and its audience by this excuse. The BBC has also ensured the continuing use of a.m. by making its most popular radio channel available only on m.w., except for a couple of hours at

night and when—perish the thought—it is being relayed by local radio.

Has the BBC really "demolished" its regional structure to make room for commercial broadcasting? According to an IBA leaflet, their stations will have sole use of only 1151kHz. They will share 1546kHz with the BBC. The greatest benefit from the recent wavelength changes would appear to be felt by continental listeners to the BBC's external services.

Radio Stoke, my local radio station, will have been on the air for some 146 hours in the current week (February 3rd-9th). Of this time, it will have relayed 83 hours of Radios 2 and 4. The remaining 63 hours of truly local origin will have contained 10½ hours of repeats. There are no local programmes after 8.30 p.m. at the latest; it has been known for Radio 2 to be relayed from 5.00 p.m. on Sundays. When is a carbon copy not a carbon copy? For the answer to this, tune in tomorrow at 2.00 p.m., go slowly up and down the m.w. band and in between sighing for the erstwhile Radios 390, 270, Caroline, London, etc. *et al* count how many stations are broadcasting "Woman's Hour".—**C. E. Miller** (*Uttoxeter*).

## Knob Twiddlers Unite!



As the new season of mobile rallies approaches, may I suggest to Top Band talk-in station operators that instead of random tuning a specific frequency be announced in advance. Three advantages are apparent.

The first, and by far the most important, is improved road safety. Knob twiddling is very dangerous while driving. The second would be that mobiles not requiring talk-in facilities could arrange nets with friends in advance without fear of causing interference to the talk-in station. Finally, there would be a far better chance of the talk-in station hearing "distress" calls from distant, and not so distant mobiles. **D. Matthews, G3ZZP/M** (*London EC2Y 8BR*).

# 'SCOPE COMPETITION RESULT

## THE PRACTICAL WIRELESS 'SCOPE COMPETITION WAS A FANTASTIC SUCCESS

Ten prizewinners have each received the portable oscilloscope kit.

These kits, offered as prizes in the "Scope Competition", published in our December 1972 and January 1973 issues, are obviously even more desirable than we had anticipated—we were inundated with entries!

Having considered them all, the judges decided that the best attempt received was that submitted by J. Boraston, of Filton, Bristol, who had listed the features of the prize 'scopes in the following order:

1st-A; 2nd-J; 3rd-L; 4th-K; 5th-E; 6th-C; 7th-B; 8th-D.

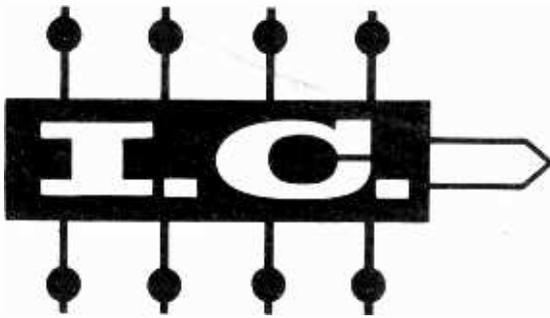
### OTHER WINNERS

The nine next best entries according to the judges were sent by:

G. Abrams, Aylesbury;  
J. D. Bower, Hull;  
M. Brookland, Cuckfield;  
P. J. Dick, Edinburgh;  
D. M. Haig, Abingdon;  
D. Kan, Southsea;  
M. E. Randle, Walsall;  
J. Summers, Peterhead;  
G. A. Towill, Portsmouth.

These ten readers each receive a 3in. portable oscilloscope kit—the K/OS-2 by Heathkit.

**NOW TRY YOUR HAND AT THE NEW COMPETITION ON PAGE 147 OF THIS ISSUE.**



# OF THE MONTH

L.A.J. IRELAND

Number 38

Toshiba TA7117P Quadraphonic Decoder

ANYONE who has recently returned from the United States may have brought home some of the new quadraphonic records which have begun to catch on in a big way on that side of the Atlantic, and no doubt will shortly become freely available here, so this month's article reviews a new linear i.c. recently released by Toshiba, type TA7117P, which is capable of decoding such records to give four channel stereo sound. It is probably only a matter of time before four channel matrixed sound appears on standard l.p.'s especially now that many of the teething problems, associated particularly with the compatibility of ordinary stereo records and four channel records, have been ironed out.

joint Columbia-Sony venture produced a four channel record which was capable of being played through existing stereo equipment and by means of an adapter placed between the pick-up and main amplifiers true quadraphonic sound could be reproduced. The four channel information is embedded in the groove of the record with the LF (left front) and RF (right front) information cut into the left and right hand 45° grooves. The LB (left back) and RB (right back) information is cut in a clockwise and counterclockwise helix and all the information is transformed into a single complex stylus movement with the various components subsequently separated by the matrix decoder.

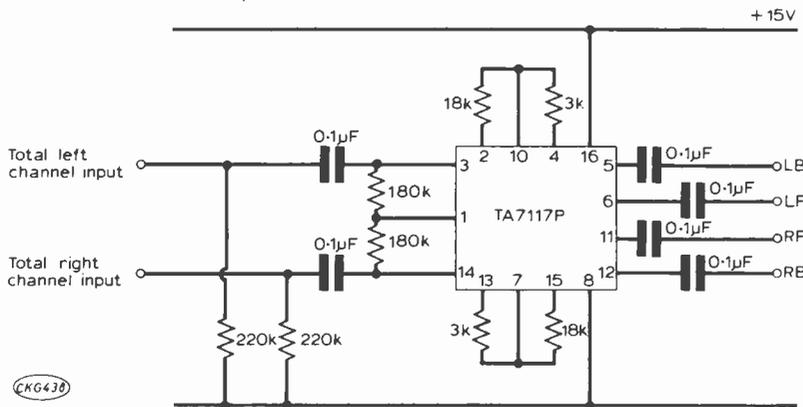


Fig. 1. As can be seen from this diagram few discrete components are needed to provide a complete quadraphonic decoder using the TA7117P. Separate amplifiers and speakers are required for each channel.

## Quadraphonics Briefly

Quadraphonic sound is not new; it was first mooted back in the early sixties and in fact a number of experimental four channel tapes were on the market at that time. However, the idea failed to catch on, as the public demand for such tapes was very poor. Before any real impact could be made on the home market, it was necessary for the major recording companies to make an all-out drive to develop and push the sales of quadraphonic records. In 1970 Dynaco, an American firm, introduced a quasi-quadraphonic decoder that would give a type of four channel sound from existing stereo records, and the idea began to catch on. At about the same time a

## Practicalities

Few external components are needed with the TA7117P i.c., as is shown in Fig. 1. Channel separation is controlled by the values of the resistor network connected between pins 2 and 4, 13 and 15. The i.c. itself is housed in a 16 lead dual-in-line package.

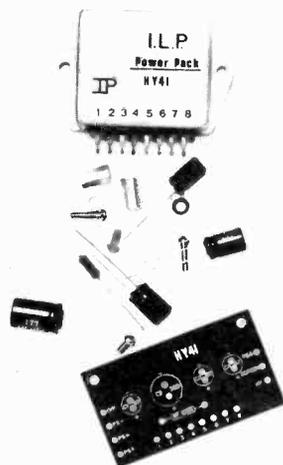
The following are the electrical characteristics of the TA7117P:—Input Impedance 3MΩ, Output Impedance 7kΩ, Current Drain 15mA, Voltage Gain 10dB and Distortion less than 0.1% for an input signal of 100mV.

The unit is available from Erie Electronics Ltd., South Denes, Great Yarmouth.



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

**THE HY41**



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

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

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

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

**OUTPUT POWER:** British Rating 40 WATTS PEAK, 20 watts R.M.S. continuous.

**LOAD IMPEDANCE:** 4-16 ohms.  
**INPUT IMPEDANCE:** 30K ohms at 1KHz.  
**VOLTAGE GAIN:** 30db at 1KHz

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

**FREQUENCY RESPONSE:** 5Hz-50KHz  $\pm$  1db  
**SUPPLY VOLTAGE:** + 22.5volts D.C.  
**SUPPLY CURRENT:** 0.8 amps maximum.

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

**UNIQUE HYBRID PRE-AMPLIFIER**

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

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

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

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

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

**INPUTS**

Magnetic Pick-up (within  $\pm$ 1db RIAA curve) 2mV, 47K  $\Omega$   
Tape Replay (external components to suit head), 4mV, 47K  $\Omega$   
Microphone (flat) 10mV, 47K  $\Omega$   
Ceramic Pick-up (equalized and compensatable) 20-2000mV, variable.  
Tuner (flat) 250mV, 100K  $\Omega$   
Auxiliary 1 250mV, 47K  $\Omega$   
Auxiliary 2 2-20mV, 100K  $\Omega$

**OUTPUTS**

Main Pre-amp output 500mV.  
Direct tape output 120mV.

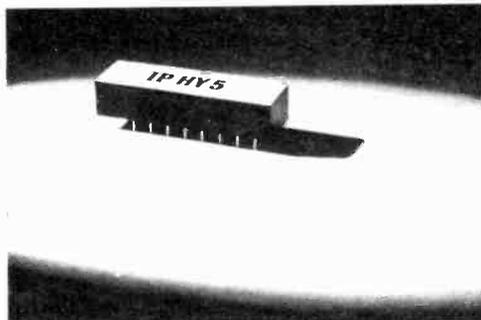
**ACTIVE TONE CONTROLS** (Bexendall)  
Treble  $\pm$  12db.  
Bass  $\pm$  12db.

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

**SUPPLY VOLTAGE**

16-25 volts

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



**SUPPLY CURRENT**

6mA approx.

**OVERLOAD CAPABILITY**

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

**OUTPUT NOISE VOLTAGE:** 0.5mV.

**POWER SUPPLY PSU45**

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



**Specification**

Input: 200-240 Volts.  
Output:  $\pm$  22.5 Volts at 2 amps.  
Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

**PRICE:** £4.50 inc. P. & P.

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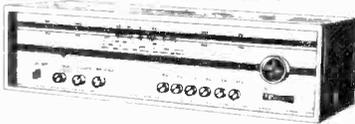


Credit terms £5.00 deposit plus £2.00 p. & p. followed by 12 payments of £4.80. Total Credit Terms £62.60 SEND £7.00 TODAY.

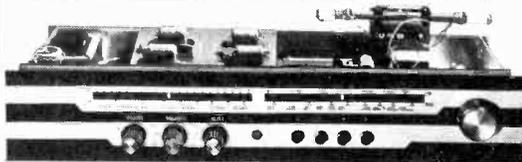
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**THE AVON AUDIO SYSTEM**

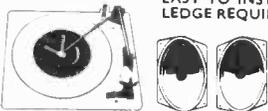


The uncabineted system is ideal as an economical replacement for an outdated chassis. The Stereo Tuner Amplifier with medium, long and short wavebands provides Worldwide coverage, even the weakest continental stations can be received with superb clarity. Push button band selection, 10 watts total output.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

**BSR 4 SPEED STEREO/MONO RECORD CHANGER** plays all types or 7in., 10in., and 12in. Mono or Stereo records. Manual or automatic play.

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As above. Complete with all accessories. £25.00, Carr. £1.50. Many other oscilloscopes available.

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# REGULATED POWER

## for your Transistor Radio

J. N. WATT

A compact unit that enables a battery driven transistor radio to run from the mains supply. It incorporates a series voltage regulator to give a constant supply voltage even when driving the varying load of a Class B output stage.

THE simple unit described here was constructed by the author for an elderly relative, whose battery radio, although extremely useful for outdoor use in fine weather, did use up batteries at an alarming (and expensive!) rate when left on for long periods of indoor use. For such service, a mains power supply is the obvious answer, but the design of a suitable one is not quite so straightforward as it might at first seem.

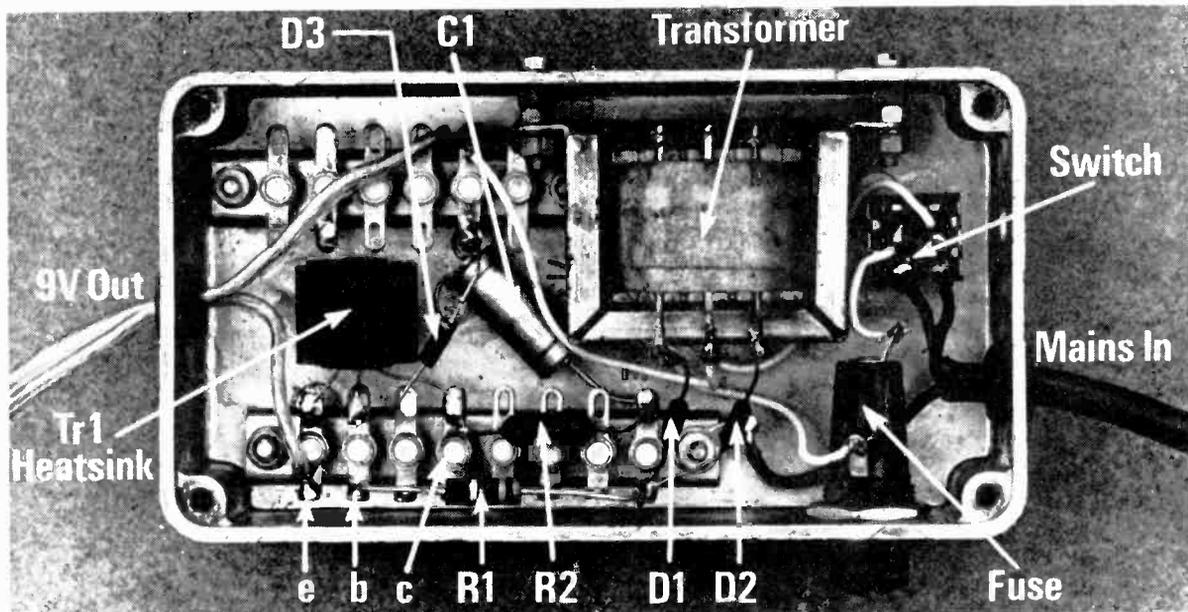
Most battery driven transistor radios employ a Class B output stage; the current requirements of such a stage can vary from a few milliamps when there is no sound output to perhaps 40mA on peaks. Addition of, say, 10mA for the other stages in the radio results in a requirement varying from about 12/15mA to 55mA or so, and the employment of a simple, unregulated supply will lead to large undesirable voltage fluctuations.

To overcome this objection, a series regulator is incorporated, which has that advantage of requiring

a low power zener diode, the power handling being undertaken by the series transistor. The more conventional shunt regulator (conventional at such current levels, that is) would not only call for the use of a larger and more expensive zener diode but, additionally, since the maximum load current would then be diverted to the zener when not required by the load itself, there would be a continuous drain on the transformer of about 60mA—greater than its maximum rating. It is under such conditions of greatly varying load current that series regulators show up best.

### Design

Fig. 1 shows the circuit. A 12-0-12V transformer and a conventional twin rectifier produce about 18 volts across C1 when no current is being drawn by the load. The base of Tr1 is held at 5.6V relative to the positive supply rail, by zener diode D3 and hence the negative output is at about 6 volts, since there is about 0.4V across the base-emitter junction of Tr1. With only a few milliamps load current, most of the excess voltage is dropped across Tr1, and R2 has little effect. When the load current rises to about 50mA however, R2 drops more of the excess voltage and this, along with the reduction in voltage across



Every component in the power supply can be clearly identified in this photograph.

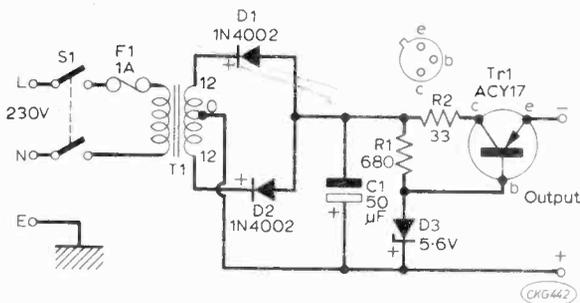


Fig. 1: Circuit diagram of 9V regulated power unit.

C1 due to the higher current causing voltage loss in the transformer windings, means less voltage drop across Tr1. Thus, at times when Tr1 is passing more current it has less voltage across it, so keeping its dissipation low.

The output is not absolutely constant, however, due to the method of feeding the zener diode, D3. The voltage across C1 is, as mentioned previously, 18 volts when no load current is drawn but falls to 11 volts at an output current of 50mA; this means that a variable current flows through D3 and hence its zener voltage is not quite constant, so resulting in a similar change of output voltage. The amount of such change is small, and of no consequence in this application.

## Construction

Practical construction of the power supply will depend to a large extent on individual circumstances. In the author's case, there was not room for the power supply to be built inside the radio itself but it was found that the smallest size of Eddystone die-cast box, 4¼ x 2¼ x 1in., was just deep enough to accommodate the transformer mounted on its side, leaving ample room for the remainder of the components, as the photograph shows. Provided that care is taken from a safety point of view, there is no reason why any form of construction found to be convenient should not be employed.

Since the transistor is operating in a closed environment, a small push-on heat sink was fitted to obviate any overheating which might otherwise be caused by lack of ventilation.

The type of connection used to take power to the radio will depend on the original method of connecting the batteries. In the case of the radio mentioned in the first paragraph, four U2s were fitted, so the twin lead from these was cut and a small two way battery plug and socket wired in. A compatible fitting was connected to the leads from the power supply so that either mains or battery operation was possible, by swapping connections. It is essential to observe polarity when wiring up such arrangements.

## ★ components list

R1 680Ω ½W	Tr1 ACY17
R2 33Ω 3W wirewound	S1 D.P. on-off toggle
C1 50μF 25V	D3 Zener 5.6V 250mW
D1/2 1N4002	T1 12-0-12V 50mA

F1, fuse 1A with holder. Diecast box, type 7134P (Eddystone). Heatsink type TO5. Tag strips.

Later, the running of another radio, with a 9 volt battery, from a second mains supply was required and in this case the battery fitted, a PP3, had a two way connector in place of terminals. Accordingly, the mains power unit was fitted with a mating two way connector identical to that on a PP3, observing polarity of course.

For 9 volt operation the zener diode D3 was changed to one of 8.2V rating; this resulted in an output of about 8.6V which equates with that from a 9 volt battery after a moderate amount of use. The fitting of a 9.1V zener might have given an output voltage that was rather too high for a radio designed to operate efficiently on 9 volts.

# TELEVISION

## JUNE ISSUE

### THE PIL TUBE

One of the most significant developments for some time in colour television is RCA's Precision-in-Line tube which is to be produced in the UK by Thorn (Mazda). This tube has a shadowmask with slits instead of dots, giving increased brightness. The major step forward however is that by using inline guns with a specially designed toroidal scanning yoke the need for dynamic convergence adjustments has been completely eliminated. In fact the coils are attached to the tube and if necessary both must be replaced together. Setting up is almost as simple as with a monochrome set therefore.

### TACKLING FIELD FAILURE

Field timebase failure is the most common TV set fault. If changing the valve doesn't do the trick just how do you find where the fault lies? This month we describe practical methods of field timebase testing.

### REVERSE AND FORWARD AGC

The application of a.g.c. depends on the characteristics of the devices—valves and transistors—to which it is applied. With transistors there are two opposite techniques of a.g.c.—forward and reverse. The precise mechanisms, not too well known, will be explained this month.

### TV RECEIVER SERVICING

One of the first modern UK-produced portable TV chassis was the BRC 1580 chassis: this month Les Lawry-Johns describes the chassis and what goes wrong with it.

### TEST REPORT

The next article in this series reports on the Nombrex RC bridge which E. M. Bristol has found to be a useful workshop aid.

PLUS ALL THE REGULAR FEATURES

# ON SALE MAY 21

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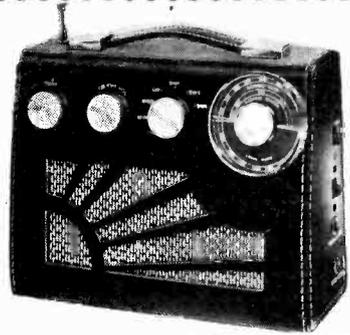
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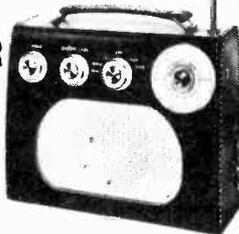
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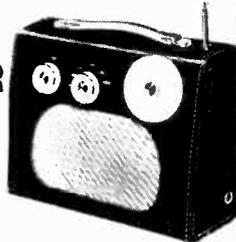
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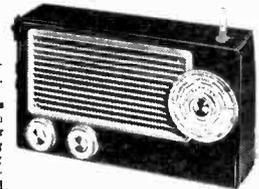
## ROAMER SEVEN MK IV



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## ROAMER SIX



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Total building costs **£4.38** P.P. & (Overseas P. & P. £1.05) Ins. 31p

## POCKET FIVE



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

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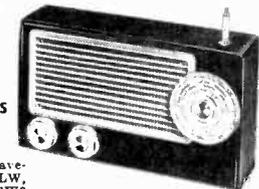


5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs **£2.75** P.P. & (Overseas P. & P. 65p) Ins. 26p

## TRANS EIGHT



8 TRANSISTORS and 3 DIODES

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

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3A4	40	6C6	35	6K8G	40	10F1	75	25L6GT	50	85A2	50	DK22	45	EC83	£1.00	EM84	55	PC88	50	PY82	35	UCB88	40	
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2N1132	25	2N3819	35	BC109	10	MJ5E3055	87	OA2224	45	OC84	25	7406	20	7422	20	7484	20	7492	75	74124	£1.00
2N1305	25	2N3904	20	AF117	35	GTJ7M	37	OA2224	45	OC84	25	7407	20	7423	20	7485	20	7493	75	74125	£1.00
2N2147	75	AAZ12	20	AF117	35	GTJ7M	37	OA2241	25	OC170	25	7408	20	7425	20	7486	20	7494	80	74126	£1.00
2N2160	60	AC126	20	BFY60	30	NKT223	33	OA2242	25	OC171	30	7409	20	7426	20	7487	20	7495	80	74127	£1.00
2N2218	20	AC127	25	BFY61	30	NKT251	24	OC35	50	OCP71	97	7410	20	7428	20	7488	20	7496	80	74128	£1.00

Integrated Circuits		7430		20 7474		40 74100		£2.50 74157		£1.90	
		7432	42	7475	55	74107	50	74170	50	74174	£2.00
		7433	70	7476	45	74110	80	74174	£2.00		
		7434	85	7482	85	7483	85	7484	85	7485	85
		7435	85	7486	85	7487	85	7488	85	7489	85
		7436	85	7489	85	7490	85	7491	85	7492	85
		7437	85	7490	85	7491	85	7492	85	7493	85
		7438	85	7491	85	7492	85	7493	85	7494	85
		7439	85	7492	85	7493	85	7494	85	7495	85
		7440	85	7493	85	7494	85	7495	85	7496	85
		7441	85	7494	85	7495	85	7496	85	7497	85
		7442	85	7495	85	7496	85	7497	85	7498	85
		7443	85	7496	85	7497	85	7498	85	7499	85
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# PRODUCTION LINES

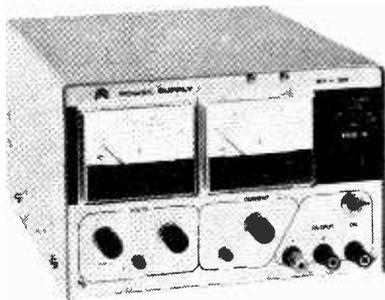
colin riches

## BENCH P.S.U.

Model B1-30 is a bench power supply marketed by Elliott Relays. It has separate meters for output voltage and current and a switch on the unit enables interruption of the output so that voltage and current can be set or altered with the load disconnected.

Output voltage is 0-30V. Line stabilisation is better than 0.01% + 1mV for a 10% change in input voltage and load regulation is such that a change from minimum to maximum load will not alter the output voltage by more than 0.05% + 3mV. Output ripple is less than 1mV.

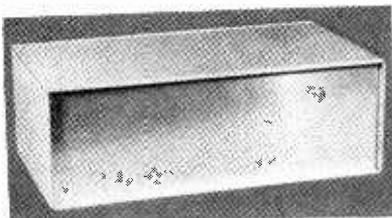
Price of the unit is £35 and further gen can be obtained from *Elliott Relays, 70 Dudden Hill Lane, London, N.W.10.*



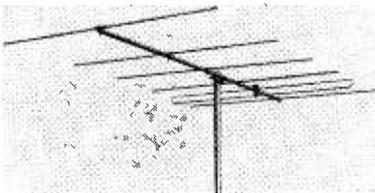
## EQUIPMENT HOUSING

These cabinets, distributed by Norman Rose Limited are supplied packed flat in robust cartons.

The design of the cabinets is such that they are ideal for housing test gear, amplifiers, transmitting gear, etc., and they can be assembled in a few minutes without using any tools. The panels simply slot together and "trim strips" lock them in position.



## THE "STEREOBEAMS"



J. Beam Aerials Ltd., have launched their new range of "Stereobeam" aerials for both stereo and mono reception. There is a wide choice of models from a dipole to a six-element array.

Each aerial's folded dipole construction incorporates the patented "inverse balun"—a feature providing elimination of pick-up on downlead, reduction of interference and distortion from multi-path reception, reactance compensation to give wide bandwidth and equal performance on all f.m. stations.

The aerial illustrated is the Model SBM6 (8.5dB) priced at £6.95p. Further details on the "Stereobeams" may be obtained from *J. Beam Aerials Ltd., Rothersthorpe Crescent, Northampton.*

Assembly instructions read as follows:

1. Place bottom panel on a working surface and slide the two panels over the upturned end pieces.
2. Place the front and rear panels in position and lock on to the bottom panel with two of the trim strips.
3. Place the top panel in position, the down-turned end pieces engaging in the side panels. Lock to front and rear panels with trim slips.
4. Position self adhesive feet.

All panels are detachable, the top, bottom and side panels being of plastic-coated leather-textured steel.

The cabinet can be dismantled by easing off the trim strips and removing the appropriate panels.

## THE VARISPEECH

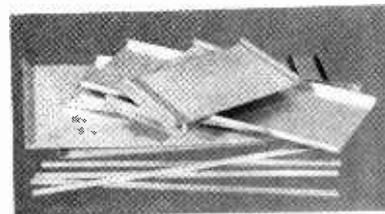
F. W. O. Bauch Ltd. have announced the "Varispeech", a unit which offers precise time control for recordings. It is suitable for language and speech study, timing speeches, conference recordings, transcription, dictation and any use where there is a requirement to accommodate a given script to a given time.

Frequency distortion is introduced on a conventional recorder if recording and playback speeds are altered but the Varispeech offers time compression or expansion without distortion and can, therefore, be used to synchronise a given script to any situation. The operating principle is to convert the voice signal, which is recorded in analogue form on a normal cassette, to a digital equivalent. A special-purpose computer then converts this digital signal to a second digital format with or without time compression/expansion. Re-conversion to analogue form restores the original speech without loss of intelligibility. The record/playback electronics are discrete solid state and the p.s.u. and servo control are 100% integrated TTL and MOS LSI. Further details may be obtained from: *F. W. O. Bauch Ltd., 49 Theobald Street, Boreham Wood, Herts. WD6 4RZ.*



Cabinets come in three sizes: the MC1 (8 x 3 x 9 7/8 in.) costing £3.40; the MC3 (17 x 4 1/2 x 9 7/8 in.) at £4.40 and the MC4 (17 x 6 x 9 7/8 in.)—shown in pictures—costing £4.60.

Norman Rose only distribute to the trade but if you send a s.a.e. to them at *8 St. Chad's Place, Grays Inn Road, London, WC1X 9HJ*, they will let you know the name and address of your nearest stockist.



# TAKE 20

JULIAN ANDERSON

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

LIE detectors can be very sophisticated devices, and whilst they are far from infallible, they give a pretty good indication whether someone is telling the truth or not. The principles involved vary but one of them makes use of the fact that when a person is under tension, as they are when they are lying, the perspiration glands start working. Such an effect is easily measurable using a very simple electronic circuit, Fig. 1.

## The Circuit

The circuit is primarily one for measuring a change in resistance. A sensor is used which comprises a small piece of Veroboard of a size suitable for holding in the palm of the hand. Alternate strips of this are wired together as shown in the diagram: When the board is held in the hand with the copper side next to the skin, the resistance will appear across the strips and affect the circuit; it is not essential that every part of the board is in contact with the skin.

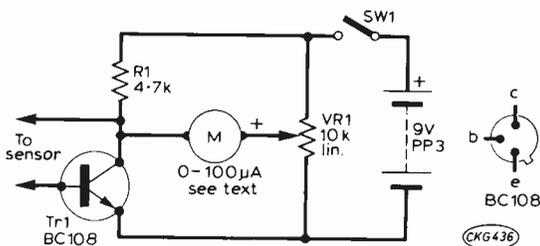


Fig. 1. Simple circuit of the lie detector.

The resistance of the skin is thus transferred to the collector/base circuit of the transistor and it will start to conduct. The transistor is in a bridge circuit. With the sensor held in the hand and with the "subject" not lying, a particular resistance will appear across the transistor and the bridge can be balanced using VR1. By 'balancing the bridge' we mean adjusting VR1 so that the voltages at the collector of the transistor and at the slider of the potentiometer are the same and no current flows through the meter.

## In Operation

When the subject is asked a series of innocent questions, the needle of the meter will remain fairly steady; it may wander about a bit but not to any great extent. When the subject is asked a question

## No. 49 LIE DETECTOR

which they lie to, the skin will sweat, the resistance between the Veroboard strips will fall, the transistor will pass more current, upsetting the bridge and causing the needle to rise.

Simple though it is, it *does* work, but unless tried reasonably seriously, results may seem a little inconclusive. Asking obvious questions and deliberately lying will not work. "Do you live at No. 4 Green Street?" . . . "No, at No. 5" . . . even if it is a lie will cause little deflection as the subject is not under tension. Just what questions you ask is a matter between you and the person under interrogation. Be careful however, it is easy to cause offence; asking young ladies about their lovelife cannot be recommended and you are likely to become very unpopular if you try this sort of thing. As we have said before, the circuit is *not* infallible and should not be regarded too seriously but, if you select your questions carefully, it makes a good party trick.

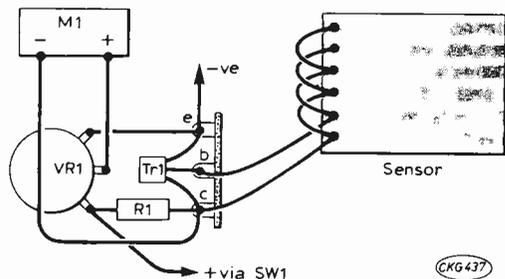


Fig. 2. Author's layout of lie detector using a piece of tagstrip.

## Construction

A suggested layout is shown in Fig. 2. The meter used can have a sensitivity of anything between 100 $\mu$ A and 1mA; to keep within our budget one of the recording level meters has to be used, which are available from a number of suppliers as well as that mentioned in the components list but the price should be similar.

## ★ components list

R1	4.7k $\Omega$ $\frac{1}{4}$ W, 5%	1p
VR1	10k $\Omega$ linear pot	12p
Tr1	BC108	12p
SW1	On-off switch	5p
M1	100 $\mu$ A meter, type V150 (Henry's Radio)	70p

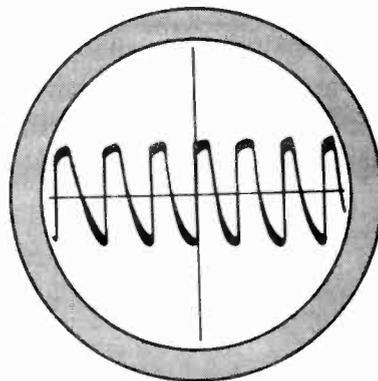
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Prices are those at time of going to press and may have changed. VAT, minimum order costs and postage etc., are not included, and these points should be checked carefully before ordering.

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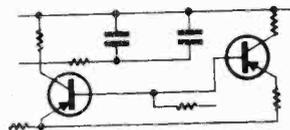
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OB2	.25	6BQ7A	.38	6Q7G	.45	12SH7	.15	50L6GT	.45	EABC80	.29	EF86	.25	KT41	.98	PL82	.28	UY85	.28	AC157	.22	BCY12	.55	OA73	.10
IA3	.23	6BR8	.63	6Q7M	.63	12SH7	.43	85A2	.43	EAC91	.38	EF89	.23	KT44	1.00	PL83	.80	U10	.45	AC157	.28	BCY33	.22	OA79	.10
1A7GT	.32	6H87	1.25	6R7G	.35	14H7	.48	85A3	.40	EAF42	.48	EF91	.17	KT66	.80	PL84	.28	U15/14	.88	AC165	.28	BCY34	.42	OC21	.42
1B3GT	.35	6BW6	.72	6R7M	.55	14S7	.75	90C2	.70	EB34	.20	EF92	.28	KT81	2.00	PL504/500		U19	1.78	AC166	.28	BCY35	.25	OA85	.09
1H5GT	.33	6BW7	.50	6SA7M	.35	19AQ5	.24	150B2	.58	EB91	.10	EF97	.55	KTW81	.63			U22	.39	AC168	.42	BCY39	.28	OA90	.14
1L4	.13	6BZ6	.31	68C7GT	.33	19G6	.50	807	.59	EB41	.48	EF98	.65	KTW82	.68	PL608	.90	U25	.72	AC169	.36	BCZ11	.42	OA91	.10
1NSGT	.27	6CB6A	.28	68H7	.33	20D4	1.06	5702	.80	EB81	.29	EF84	.24	MHLD6	.75	PM84	.81	U26	.64	AC176	.61	BF168	.32	OA95	.10
1R5	.26	6C4	.28	68I7	.53	20P1	.65	5763	.60	EBF80	.30	EL35	1.00	P61	.40	PY80	.33	U281	.72	AC177	.67	BF159	.22	OA200	.10
1B4	.22	6C9	.73	68J7	.35	20L1	.98	7475	.70	EBF83	.38	EL36	.44	PAB80	.32	PY81	.24	U301	.64	AC178	.22	BF173	.28	OA209	.11
1U4	.29	6CD6G	1.08	68K7GT	.33	20P1	.50	AC/PEN	.98	EBP39	.26	EL37	.74	PC88	.44	PY82	.28	U403	.67	AC179	.21	BF180	.33	OC23	.42
1U5	.48	6CGR8A	1.00	68Q7GT	.38	20P3	.78	AC/PEN	.98	EBL21	.60	EL38	.44	PC96	.58	PY88	.31	U801	.76	ACY21	.21	BF185	.44	OC25	.42
2D21	.35	6CH6	.55	6U4GT	.60	20P4	.88	DD	.88	EC86	.59	EL180	.21	PC90	.29	PY90	.31	VP23	.40	ACY22	.17	BF194	.17	OC28	.66
2OK5	.50	6CL6	.43	6V6G	.17	20P6	1.00	AC/PEN	.98	EC88	.58	EM80	.37	PC98	.44	SP61	.75	W29	.60	AF115	.17	BV210	.28	OC74	.25
3A4	.25	6CM7	.50	6V6GT	.27	25A6G	.29	AC/TH1	.50	EC92	.84	EM81	.87	PCF84	.40	TH233	.98	X65	.50	AF117	.21	BV211	.28	OC77	.12
3D6	.19	6CU5	.30	6X4	.29	25L6G	.20	AT/P	.98	EC93	1.50	EM83	.75	PCF86	.44	TH233	.98	X66	.50	AF121	.33	BV212	.28	OC78	.12
3Q4	.88	6CW4	.63	6XS6T	.25	25Y9G	.48	AL60	.78	EC98	.85	EM85	1.00	PCF89	.26	UCC85	.38	2N2147	.94	AF180	.53	GT113	.22	OC81D	.17
3Q5GT	.35	6DE7	.63	6B8G	.58	25Z4G	.28	ATP4	.40	EC90	.40	EM87	.49	PCF90	.26	UCC85	.38	2N2147	.94	AF180	.53	GT113	.22	OC81D	.17
384	.23	6DT6A	.50	7B7	.32	25Z5	.40	AZ1	.40	EC81	.18	EM87	.49	PCF92	.60	UCC85	.38	2N2147	.94	AF180	.53	GT113	.22	OC81D	.17
4CB6	.50	6EW6	.55	7H7	.28	25Z6G	.43	AZ31	.46	EC82	.19	EY61	.35	PCF94	.40	SP61	.75	W29	.60	AF115	.17	BV211	.28	OC74	.25
5CG8	.50	6E5	.55	7R7	.65	30A5	.44	AZ41	.53	EC93	.21	EY81	.85	PCF96	.44	SP61	.75	W29	.60	AF115	.17	BV211	.28	OC74	.25
5U4G	.80	6FG6	.35	7Z4	.59	30C17	.74	CV53	.39	EC94	.65	EM85	1.00	PCF98	.26	UCC85	.38	2N2147	.94	AF180	.53	GT113	.22	OC81D	.17
5V4G	.33	6F13	.33	8R9W6	.50	30C18	.69	CY1C	.53	EC95	.82	EY84	.50	PCF98	.26	UCC85	.38	2N2147	.94	AF180	.53	GT113	.22	OC81D	.17
5Y3GT	.30	6F14	.40	9D7	.78	30P1	.61	CY31	.29	EC98	.19	EY87/8	.27	PCF80/85		UC92	.55	2N2927	.25	AF186	.61	GT118	.27	OC82	.12
5Z4G	.33	6F18	.45	10C2	.49	30P1L2	.75	DAF91	.20	EC90	1.00	EY88	.40	PCF80/85		UC92	.55	2N2927	.25	AF186	.61	GT118	.27	OC82	.12
5Z4GT	.38	6F23	.65	10D7	.50	30P1L2	.75	DAF96	.33	EC90	.27	EZ41	.42	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6/50L2	.55	6F24	.68	10F1	.75	30P1L3	.67	DC90	.60	EC92	.25	EZ80	.19	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6A8C	.33	6F25	.51	10F9	.45	30P1L3	.67	DF91	.14	ECF86	.44	EZ81	.20	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AC7	.15	6F28	.60	10F18	.35	30P1L4	.68	DF96	.34	ECF84	.64	EZ81	.20	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AG5	.25	6F32	.15	10LD11	.53	30L15	.55	DH76	.28			EZ81	.20	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AH6	.50	6GH8A	.50	10P13	.54	30L17	.65	DK40	.55	EH21	2.10	GZ32	.75	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AJ5	.75	6K5	.50	10P14	1.08	30P4MR	.95	DK92	.49	ECH35	.50	GZ34	.47	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AK5	.25	6G7	.50	12A6	.63	30P12	.69	DK96	.43	ECH42	.57	GZ37	.67	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AK6	.30	6HGT	.15	12A6C	.40	30P19		DL96	.35	ECH83	.38	HAB80	.44	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AM8A	.60	6J5G	.19	12A6E	.40	30P19		DL96	.35	ECH83	.38	HAB80	.44	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AN8	.49	6J5GT	.29	12A6E	.48	30P1L1	.57	DM2	.28	EC91	.25	HL23DD	.40	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AQ5	.21	6J6	.18	12A76	.23	30P1L3	.86	DM71	.50	ECL80	.28	HL41DD	.98	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AR5	.30	6J7G	.24	12A76	.28	30P1L4	.80	DY87/6	.22	ECL82	.28	HL41DD	.98	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AT6	.18	6J7M	.38	12A76	.28	30P1L5	.87	DY80	.29	ECL83	.52	HVR2	.58	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AU6	.19	6J78A	.50	12B46	.30	35A3	.48	E80CC	1.65	ECL84	.52	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AV6	.28	6K7G	.12	12B6E	.30	35D5	.70	E80F	1.20	ECL85	.84	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AW8A	.54	6K8G	.33	12BH7	.27	35L6GT	.42	E83F	1.20	ECL86	.58	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6AX4	.39	6L1	.98	13J7GT	.33	35W4	.23	E88CC	.60	EP29	.58	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6B8G	.13	6L6GT	.50	12K5	.50	35Z4GT	.24	E92CC	.40	EP40	.58	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6BA6	.19	6L7	.38	12K7GT	.34	35Z5GT	.20	E180T	.90	EP41	.58	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6BC5	.50	6L18	.44	12Q7GT	.28	69C5	.32	E182CC1	.90	EP42	.58	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6BE6	.20	6L19	1.38	12R07	.35	50CD8G		E1148	.53	EP73	.75	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28
6BH6	.43	6LD20	.48	12R07	.25	E17		EA50	.27	EP80	.21	HVR2A	.53	PCF86	.40	UC94	.33	2N2913	.48	BA102	.50	GT573	.47	OC84	.28

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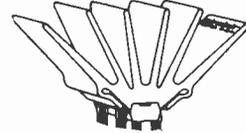
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### S-DECS AND T-DECS

# Special Valves

## PART 2 VISUAL OUTPUT VALVES

M.K.TITMAN B. Sc(Eng), C. Eng, M.I.E.E.

**T**HIS section deals with valves which provide visual outputs from electrical signals, using the principles of thermionic devices. It includes such cathode ray tubes as those used for oscilloscopes, television, radar sets, data display and level indicators.

### THE BASIC STRUCTURE

The cathode ray tube utilises an electron gun assembly to produce a focused electron beam as shown in Fig. 5. This beam is used to bombard a phosphor-coated screen which fluoresces emitting light at the point of bombardment. Various phosphors can be used to give different characteristics of colour and image retentivity and are consequently specifically chosen for the designed application.

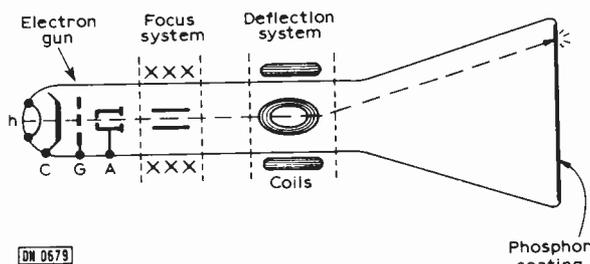


Fig. 5: General arrangement of a CRT using electromagnetic deflection.

The beam direction can be moved by either electrostatic or electromagnetic deflector systems to produce a movable point of light as required. Therefore, by sequential scanning, complex electrical signals can provide visual outputs.

### OSCILLOSCOPE TUBES

One of the most important uses of c.r.t.'s is in oscilloscopes where an electrical signal is visually displayed. Since these are essentially test and measuring instruments the tubes used are designed to give linear responses and simplicity of access to the deflection system. For this reason electrostatic deflection plates are used and for safety the anode is earthed which allows the plates to be safely accessible.

The X axis plates are usually internally driven by a ramp generator with switched speeds to give the desired time base. Similarly the Y axis plates are fed via an attenuator/amplifier system from the signal

input, to give a visual display of signal amplitude variations with time.

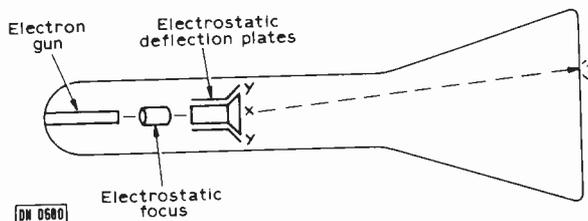


Fig. 6: Oscilloscope CRT with electrostatic deflection by means of the X and Y plates.

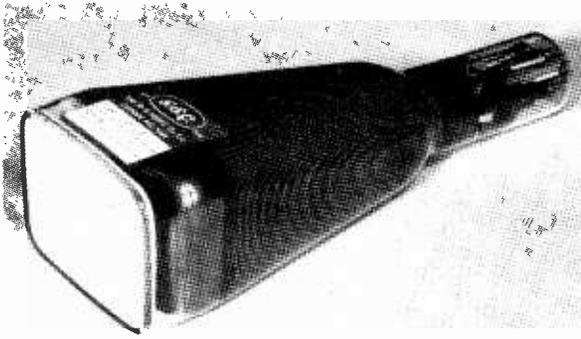
Most modern oscilloscope tubes, such as that shown in Fig. 6 utilise a green phosphor screen but a wide range of colours is available. Such phosphors generally have a short to medium persistence, whereas very long persistence can be achieved using orange phosphors and very short using blue or purple-blue colours. Many tubes use double beam systems in which the beam is split by an electrostatic plate and independently deflected by separate sets of X-Y plates. In addition, other types are available with dual electron gun assemblies and in some, four separate display traces can be achieved in a single tube.

Screen sizes vary from 1in. for monitor tubes to 6in. in diameter. Modern types are also available with rectangular faces. Precision tubes incorporate internal screen gratitudes to eliminate parallax errors. High brightness types also utilise metallising on the phosphor to increase tube life and reduce burning of the tube face coating.

Final anode voltages are commonly 1 to 3kV for general purpose types but up to 20kV for special purpose, fast response tubes. Typical deflection sensitivities are 10 to 40V/cm for Y plates and 15 to 60V/cm for X plates.

### TELEVISION TUBES (MONOCHROME)

These are large screen area c.r.t.'s which use an electromagnetic scan system of four scan coils in two planes. Generally the focusing of the beam is by means of a small ring permanent magnet located on the neck of the tube before the scan coils, but modern tubes often use electrostatic focusing. Most modern television tubes utilise wide angle (110°) deflection and the electrical deflection waveform compensates for the deflection de-focusing. The phosphor used gives an essentially black and white image.



The Marconi-Osram Valve Company's 1400A single gun oscilloscope tube has a flat face with a display area of  $10 \times 8$  cm. The maximum final anode voltage is 4kV.

Typical operating parameters are: 10kV to 20kV screen potential; 400V to 500V for the anode potential; 0 to 400V focus anode; -50 to -100V grid potential for beam extinction.

Television tubes are generally designated using the Pro-electron code in which the first letter A stands for domestic television picture tube. The next figures indicate the screen diagonal dimension in cms. The final letter is W for monochrome and X for colour tubes. Commonly used tubes are the A59-23W/R and A47-26W/R which are 23in. and 19in. tubes respectively. High performance studio monitor tubes include such types as M21-12W (8½in.) and M36-11W (14in.).

## TELEVISION TUBES (COLOUR)

Colour television tubes using the shadow mask principle, have three separate electron gun assemblies all contained in a 90° deflection c.r.t. The electron guns use electrostatic focusing and are set 120° apart with their axis tilted with respect to the screen. The individual beams are aimed through holes in the mask at their respective phosphor dots which are of three primary colours—red, green and blue. The alignment of these beams is dependent upon an external purity magnet and the deflection coil assembly. It is critical and requires the use of magnetic shielding around the tube neck, since it is affected by even weak magnetic fields—such as the earth's magnetic field.

The electron beams converge and form a spot which by suitable mixing can give the required colour. Convergence is achieved by physical movement of the permanent magnets in the convergence assembly and centring by passing d.c. through the deflection coils. Dynamic convergence is achieved by the addition of parabolic waveforms to separate secondary windings in the deflection system.

The colour television tubes available are in the range 11in. to 26in. with their designations in the Pro-electron coding as for monochrome tubes. Typical types are A49-11X (19in.) and A63-120X (25in.).

## RADAR TUBES

The earliest radar devices used ordinary c.r.t.'s and measured times for the return of a pulse to determine distance. Modern radar sets use special radar

tubes with electromagnetic scan coils which generate a scanning beam from the centre of the tube to the edge. The scan line revolves in synchronism with the rotating aerial and thus an effective picture is built up.

Such tubes are known as Plan Position Indicator tubes (P.P.I.) and are available in a wide range of sizes although typically in the region 8in. to 24in. diameter. The phosphor is specially chosen for its retentivity since the scan rate is usually fairly slow and thus orange displays are common.

The rear port tube is currently being developed to overcome the difficulties attendant upon the use of graticules, electronic mapping or frontal projection to superimpose static information on the display. The map, co-ordinate, scale or other information can be slide projected on to the screen through a window on the rear of the tube. This is superimposed on the radar trace to give additional information.

## LEVEL INDICATOR TUBES

Commonly known as "magic eye" indicators these valves are thermionic devices in which the anode is coated with a fluorescent material. Electrons are beamed past the grid electrode and bombard the anode producing a visible sweep. The basic structure is shown in Fig. 7 and in this case the electron beam bombards the circular anode. With no input the beam width is restricted to form a pencil line but with maximum input a wide band appears, as illustrated.

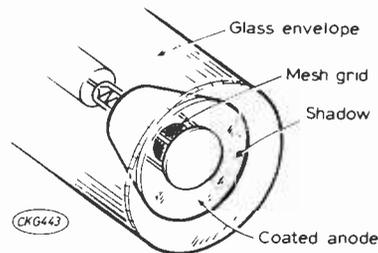


Fig. 7: Sketch of the electrode assembly of a typical "magic eye" level indicator.

END VIEW OF MAGIC EYE

This form of level indication is widely used for the less critical indication required for general purpose tape recorders and radio tuning indicators. Many different anode shapes are used with side and end viewed anodes. The valves generally fit standard valve holders and operate at normal anode voltages of 100V to 300V. grid - 10V.



The 700J projection CRT is designed for use with high brightness head-up radar displays and requires an anode voltage of 15kV. This tube is also a M-O Valve Co. product.

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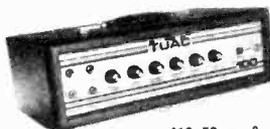


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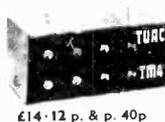
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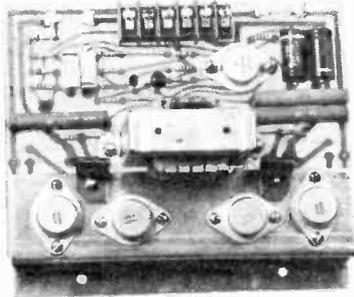
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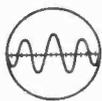
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## NUMICATORS

Numicators have now superseded dekatrons for the display of numerical information but they can be used only as display devices. A typical side view numicator is shown in Fig. 8. The numerical shaped cathodes are stacked one behind the other and separately connected to the wire outlets. The common mesh anode is connected through a resistor to the positive supply. The cathodes are earthed by means of semiconductor switches and the glow forms in the immediate vicinity of the shortened cathode. Consequently a count display can be obtained by suitable decimal outputs from a decade counter.

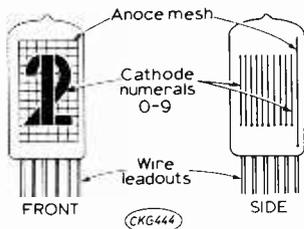


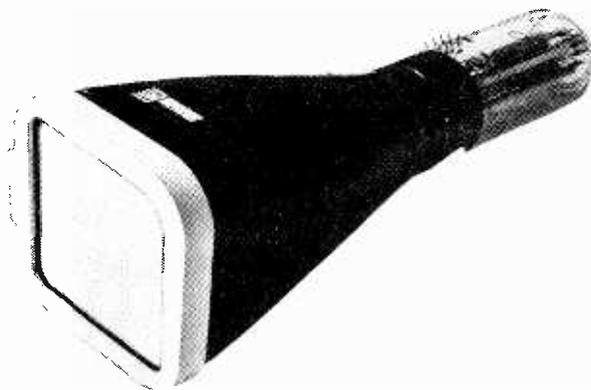
Fig. 8: Illustration of the construction of a numicator tube.

Such digital indicator devices give fairly clear, high intensity, large size numerals and are still widely used in modern digital equipment. Very often the displays incorporate red filters to give a cleaner visual indication and both side and end view configurations are available. In addition to numbers other information displays are available.

## CHARGE STORAGE TUBES

These are similar in shape and construction to cathode ray tubes but embody additional electrode structures to store charges. They are used in a wide range of applications such as TV camera valves, scan charge tubes, storage c.r.t.'s and image intensifiers. Generally they are not mass produced and consequently expensive.

Charge storage tubes rely upon a target electrode structure located in an evacuated c.r.t. The target is of insulating material which stores charge on its surface and the flow of this charge is limited by its



This E716A direct-view storage CRT is manufactured by the English Electric Valve Company has a viewing area of  $10 \times 10$  cm. Because of its good deflection sensitivities it is particularly suitable for compact transistorised equipment. The normal storage time is from less than one second to several minutes but this can be extended to several days!

surface resistivity which is exceptionally high. The charge itself is generated by photon bombardment in the case of visual to electrical TV camera tubes or alternatively by electron beams which are scanned across the target. This procedure of imprinting a non-conductive target with stored charge is known as writing and the retention as storage.

The mechanism by which the charge is removed is known as reading and is achieved by means of electron beam scanning of the target. The actual output signal is derived from this beam usually by examining the received beam current and generally the effect of this beam is to remove the stored charge to the neutral no charge condition.

## TV CAMERA TUBES

The **Image Orthicon** is the ultimate commercial development of the original studio quality camera tube which began in the form of the Emitron tube shown in Fig. 9. Here, photon bombardment produces a charge depending upon the focussed light intensity and this is sequentially read by the scanned electron beam current. The metal plate receives the capacitively induced signal which is then combined with the scan pulse information to give the complete video-signal.

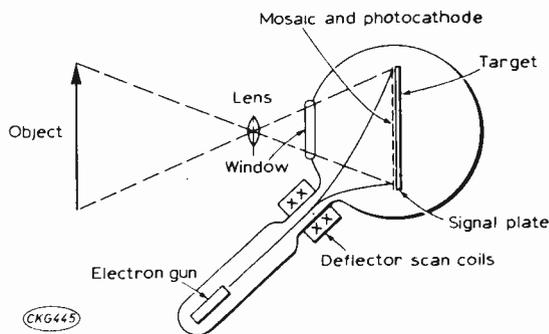


Fig. 9: General layout of the original Emitron TV camera tube.

The image orthicon whose structure is illustrated in Fig. 10 consists of a plain glass high purity optical aperture through which the externally mounted lens focus the object on to a photo-sensitive mosaic screen. The target consists of a very thin glass sheet and fine metal mesh supported in a wire ring. In modern tubes the glass is coated with a metallic oxide such as vanadium or titanium. Electrons are emitted from the photosensitive mosaic and travel to the target to form a charge image corresponding to the light image.

The target is scanned by an electron beam which is slowed down by the field produced by the walls of the tube and the wire mesh. Thus secondary emission electrons are minimised. The beam neutralises the target charge and the remaining electrons are returned to an electron multiplier dynode chain near the electron gun. This gives a very large signal amplification and in consequence this camera tube is very sensitive.

It is widely used in professional studio equipment since the picture is of high quality. Most cameras are equipped with these and the most popular size is 4 1/2 in. diameter. Until recently the major drawback to the use of this tube was its short working

life, as a result of which it was usually hired and after use returned for target or gun replacement. However improved target materials have contributed to a dramatic increase in operating life.

The **Vidicon** is now by far the most widely used camera tube largely because of its simplified construction and operation and hence distinct price advantage. A typical vidicon consists of a photoconductive layer deposited on to a conductive signal plate on the inner surface of the glass faceplate. The electron beam scans the target and results in effective connection of the signal plate through the photo-conductive semiconductor layer. In the absence of light this side of the photoconductive surface achieves cathode potential because of the high resistance but the impingement of light reduces the resistance and discharges the surface.

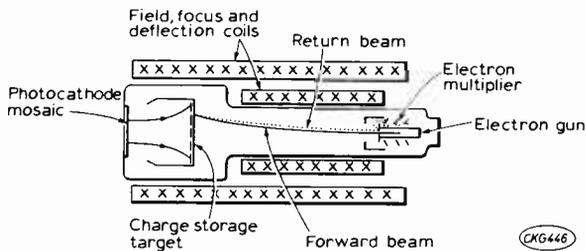


Fig. 10: The image orthicon tube incorporates an electron multiplier assembly.

When the charge is restored by the scanning beam, a current flows in the load resistance connected to the signal plate. This output is dependent upon the rate of discharge as well as time and is thus dependent upon illumination and scan. However, since the charge can only be restored by the beam, there can be a delay on the return of high-lighted areas which results in image retention. Until recently this was a serious problem since bright moving objects were blurred, but this has now largely been overcome by the introduction of the **Plumbicon** tube.

The advent of the **Plumbicon** has now resulted in the acceptance of this tube for studio work. Because of its relatively small size and considerably simpler operation, it is increasingly used for colour television cameras. Similarly it has always been used for closed circuit television and outside broadcasts.

## IMAGE INTENSIFIER AND CONVERTOR TUBES

These are tubes designed to increase the brightness of images by electronic multiplication. They are used in order to obtain acceptable visual images of objects which have poor illumination levels. As such they are incorporated in starlight viewers or infra-red viewers. Another application is the storage and amplification of extremely fast events such as sparks etc. which occur only for times of  $10^{-3}$  to  $10^{-6}$  seconds duration.

Generally multi-storage elements are used, with each stage giving a gain of 30 to 80 and overall gains of  $10^6$  are possible. A variety of phosphors are used, none of which have a sensitivity corresponding to the human eye. Consequently they do not visually appear as bright normal pictures.

Several types of construction and principles are used, all of which involve photocathodes which emit secondary electrons which travel through a uniform field space. Further gain is achieved either by focussing on secondary emission devices or photocathode and phosphor boundaries or by using fibre optically coupled assemblies.

The tubes operate with supplies in the region of 10 to 45kV and usually involve a slight reduction in image size. The photocathode material is caesium on oxidised silver and typical screen sizes are 0.5in. with a resolution of greater than 10,000 lines per inch.

## THERMOVISION CAMERAS

These are essentially radiation detectors in which the infra-red radiation is beamed by means of scanning mirrors on to a detector. Generally the detector is of indium antimonide and this provides the electrical signal. The signal is amplified and transferred together with the mirror scan synchronisation pulses to form a television-like picture on a c.r.t.

A very limited number of these devices are commercially available and needless to say the price is correspondingly high. Generally they are difficult to use since the response is not easily interpreted, however they are very useful for the detection of hot spots at fault positions.

## ELECTRON MICROSCOPES

These are very expensive specialist devices used for very large magnification factors of minute objects. In effect they consist of accurate electronic lenses in which the electrons replace light. The potentials used are high ( $>60\text{kV}$ ) and the magnification factor achieved by focusing the electromagnetic or electrostatic lenses can be as high as 200,000

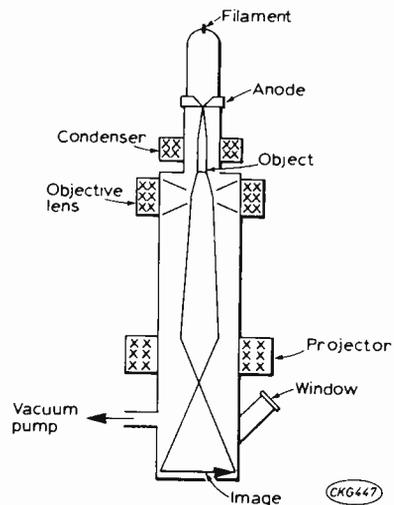


Fig. 11: In the electron microscope electron beams can be focused in the same way as light beams in conventional microscopes.

The construction is diagrammatically illustrated in Fig. 11 and shows the focused electron beam passing through the object. The chamber is evacuated during each operation and the magnified image is recorded on photographic film.

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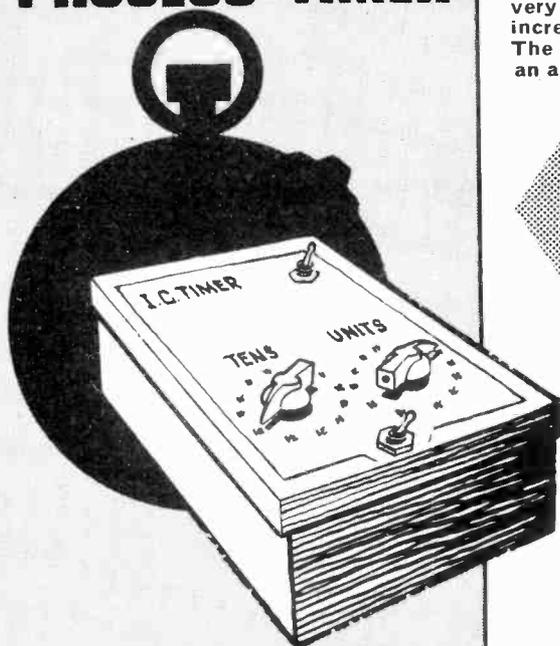
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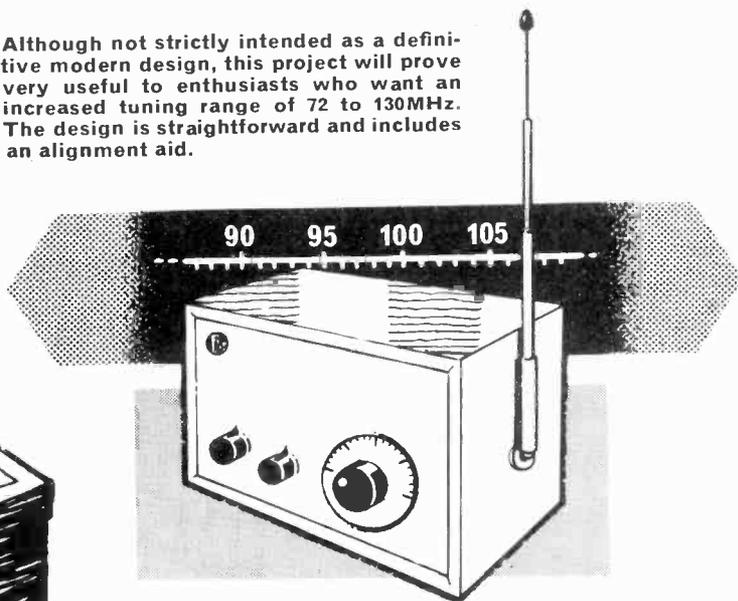
## 0-99 seconds PROCESS TIMER



For all those operations requiring set timing, such as photographic processing, delayed switching, telephone call unit timing and tape editing, this inexpensive unit uses low cost i.c.s. to provide a very accurate switching timer with two ranges.

## EXTRA BANDS FM RECEIVER

Although not strictly intended as a definitive modern design, this project will prove very useful to enthusiasts who want an increased tuning range of 72 to 130MHz. The design is straightforward and includes an alignment aid.



**MANY OTHER CONSTRUCTIONAL  
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# STEREO HEADPHONES REMOTE CONTROL UNIT

N. PICKLES

WHILE a great deal of pleasure can be derived from listening to stereo through conventional loudspeakers, it is often more enjoyable and practical, particularly late at night, to use stereo headphones. One of the disadvantages, however, is the usual need to position oneself adjacent to the amplifier for the obvious purpose of using its controls.

It is the opinion of the author that once the conventional bass and treble tone controls have been set to suit one's taste, it is unnecessary to re-adjust them for each record played. This, of course, is assuming that the records being played are all of similar quality. Volume and balance are however

in more frequent need of adjustment and a unit facilitating this from a remote seating position is extremely useful.

The unit to be described contains volume controls for left and right channels and an overall balance control. Also included is a balance meter to monitor the balance of the output of the stereo amplifier and the unit is so designed to allow it to be used as a balance meter without any power supply or headphones connected.

A switch is provided on the unit to select between normal listening and listening via a network which provides some degree of cross-talk between the left and right channels. The idea behind this is that when one listens to stereo from loudspeakers, the sounds received by, say, the left ear constitute a mixture of left and right signals; the same applies for the right ear. It is the balance of these two "views" that forms a stereo image.

However, when one uses stereo headphones the left ear can only hear the signals emanating from the left channel and a corresponding degree of discrimination exists for the right ear. Therefore, strictly speaking, a correct stereo image is not formed aurally. Thus some degree of "crosstalk" between left and right is necessary. This need only be noticeable at mid-frequencies, at round about 1kHz where the ear is most sensitive. The network included performs this function and the effect of this is to shift some of the signals into the centre of the image.

## Circuit

The circuit, Fig. 1, shows the network and the components forming the balance meter circuit. The two resistors R1 and R4 provide attenuation for the headphones from the amplifier loudspeaker outlet. With the resistors included the unit can be fed directly from the speaker outlet of the amplifier, but if an amplifier including an attenuated headphones outlet is used then these resistors can be reduced in value or even omitted. Balance and volume adjustment are provided by VR1, VR2/3.

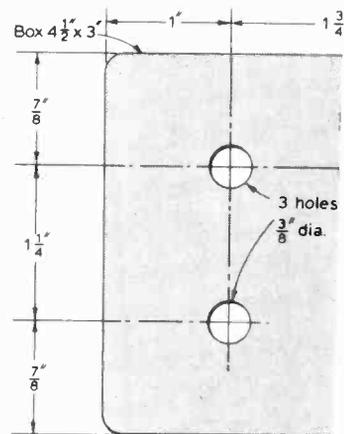
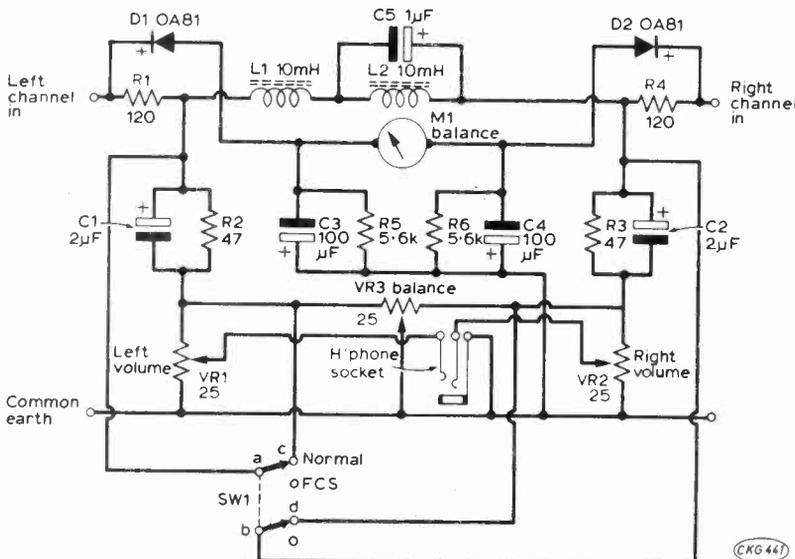


Fig. 1: (left) shows the complete circuit; Fig. 2: (above) gives the positions of the verobloc components being mounted on the o



## ★ components list

### Resistors

R1 120Ω	R4 120Ω	VR1 25Ω
R2 47Ω	R5 5.6kΩ	VR2 25Ω
R3 47Ω	R6 5.6kΩ	VR3 25Ω
All ½W 5%.		All wirewound pots.

### Capacitors

C1 2μF	} All 12VW electrolytics
C2 2μF	
C3 100μF	
C4 100μF	
C5 1μF	

### Miscellaneous

M1, stereo balance meter, 100μA (G. W. Smith). L1, L2, 10mH (Repanco CH4). D1, D2, diodes OA81 or OA79. SW1, double pole changeover, slide switch. Plastic box 4½ x 3 x 1½ in, see text. Veroboard 3 x 2 in. 0.15 in. matrix. Grommet. 3-core cable. Stereo phone plug and socket. Knobs.

In the normal mode the switch SW1 connects the attenuated signals directly to the volume and balance controls. When the signals are switched through the crosstalk circuit (FCS) the signals are channelled through L1, L2, C1, C2, and C5, R2 and R3. Capacitors C1 and C2 shunted by R2 and R3, although not affecting normal sounds, do provide slight attenuation of any mains hum and generally frequencies below 40-50Hz, but with bass notes as encountered in music the effect is largely negligible. Looking at the balance meter circuitry, the arrangement of C3, C4, R5 and R6 is largely a standard circuit, these components providing a path to earth of comparatively low impedance to high frequencies.

## Construction

A plastic box, about 4½ x 5 x 1½ in., as used in the prototype, should be obtainable from any good radio parts shop but if difficulty is experienced a plastic soap dish of the type with a clip-on lid can be used. A metal case can be used but then care must be taken to ensure that the underneath of the veroboard is clear of the case bottom.

Drilling details for the box lid are given in Fig. 2. An easy way of cutting the thin plastic is by means of a hot thin knife blade later finishing off the holes with a smooth file after the plastic has hardened. This method is preferred to drilling which can lead to a split box.

The balance meter, two volume controls, slide switch SW1 and the balance control are mounted on the lid and the remainder of the components on a small piece of 0.15 in. veroboard approx. 3 x 2 in. or eight strips of 15 holes. The board, Fig. 3, is fixed to the box by a single bolt with a spacing nut between the board and the case.

VR1, VR2 and VR3 are flat, miniature, wirewound

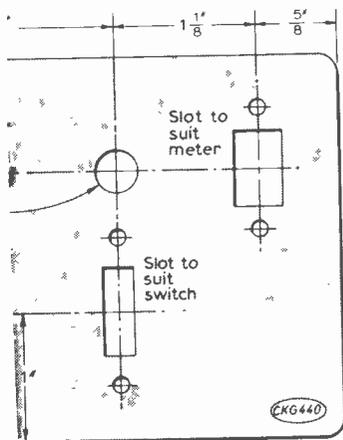
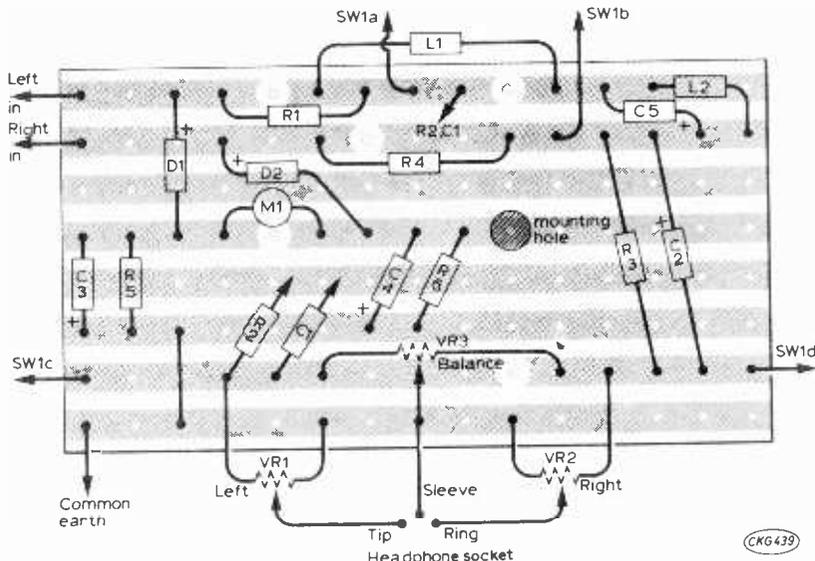
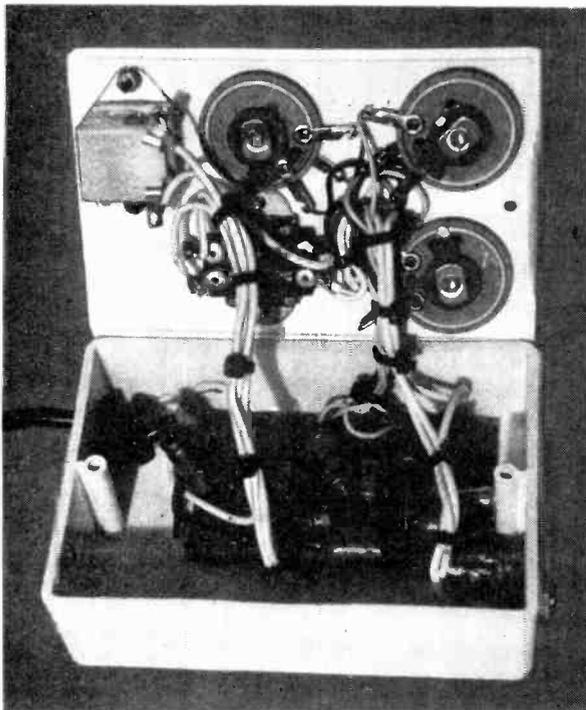


Fig. 2. Layout of the stereo headphone unit. The various holes and slots in the box lid. Fig. 3 shows the layout from the copper rail side, the veroboard side, in the positions shown.



CKG439



The circuit board is mounted inside the box, the various controls and meter being fitted to the lid.

pots, widely available as "extension speaker volume controls". Standard size pots will require a larger box than that specified here. Single flex is used to wire the panel components to the board, as shown in the photograph. A rubber grommet was used for neatness at the cable entry hole. The cable must be long enough to comfortably reach between the stereo amplifier and the listening point.

More than one set of headphones can be used provided attention is paid to the impedance of the extra sets. Too low impedance will cause a loss of volume which may not be acceptable. If more headphone sockets are fitted they should be wired in parallel.

Component values are by no means critical and there is room for improvement here. Variation of the network values can provide some interesting effects.



#### APPARATUS REQUIRED

- ...Wanted, kit or built, Heathkit, stereo control unit model USE-1.—E. H. Smith 84 Westgate, Louth, Lincs.
- ...P. S. U. for TX (ADM. Patt No. 100337) made by Rees Mace Marine Ltd.—L. Brown, 46 Massey Road, Gloucester.
- ...Wanted; new or used B12B base.—A. J. Collinge, 87 Iveagh Gardens, Crumblin Road, Dublin 12.
- ...Wanted LP head (red) for Deccalcan.—J. F. Glavin, North Lodge, Northlands, Salthill, Chichester, Sussex.
- ...Cossor Radio Model 522 or 523 with or without cabinet. Working or not. Price please.—A. G. Foster, 44 Warwick Road, Luton, Beds.
- ...Wanted a 13 pole wafer switch for a tape recorder B.S.R. Challenge. 10 pole one side, 3 pole opposite side.—J. Rowsell, 65 Ayresome Park Road, Middlebrough, Yorks.
- ...Wanted a set of coils to suit a B34 communications receiver, range 150kHz—30MHz.—H. I. Street, 11 Green Farm End, Kineton, Warwicks.
- ...Can anyone supply new or s/h a replacement transformer for a Cossor 1035 Mk III (Parmeko 1KA30219)—M. J. Pickering, 19 The Meadows, Newby, Scarborough.
- ...3 or 4 dust cores for L.F. coils & Crystal phasing capacitor for a Canadian Vancouver radio laboratories model 250.—F. J. Stephenson, 34 Pinfold Lane, Scartho, Grimsby, Lincolnshire.
- ...Wanted coil packs for national HRO-MXS receiver state price and details.—B. Gale, 4 Rosebery Avenue, St. Werburghs, Bristol 2. BS2 9TN
- ...Wanted—Three Mullard LA11 or LA2002 pot cores, also Amateur tape recording magazine, January 1962 and November 1962—Prices to.—R. Cambell, 17 Highfield Avenue, Thundersley, Benfleet, Essex. SS7 1RY.
- ...the address of any retailer who stocks obsolete valves. I need an EBL31 Mullard.—G. C. Leake, 71 Bants Terrace, Northampton, NN5 6AW

#### EXCHANGE:

- ... "The Technique of Building" by E. G. Warland, 367 pages in Mint Condition. Wanted Cossor Scope Manual 1035 MkIII in readable condition. J. Hornes, 91 Saturn Way, Hemel Hempstead, Herts.
- ...P. W. Oct. 1971 for Jan. 1972.—D. Morrell, Maidwell Hall, Northampton.
- ...Osmon Signal Generator. Boxed. Mint Condition. "Take Twenty" complete series 1—30, Plus 30p post. S.A.E. first instance.—W. L. Brunsden, 28 Meadfoot Road, Wallasey Wirral, Cheshire.
- ...Collins TCS Transmitter, coverage 160-80-40 metres, large power supply, also very large and heavy, no operating manual, for TW mobile Topband receiver.—P. Jenkins, 30 Gainsborough Road, North Finchley, London, N12, 8AG.
- ...B40B receiver, above average, aligned last year. Modified for SSB. A real cracker. I want a good multimeter, or would sell.—M. Dickson, 32 Culliford Way, Littlemoor, Weymouth.
- ...5 (five) 4CX250B's: Four new, one used but OK, for Comm Type RX.—B. K. Arnott, 49 Blenheim Drive, Bicester, Oxon.
- ...Eddystone S670 "Marine Receiver" for any Transmitting gear or sell.—D. McQuillan, Milden Cottage, North Road, Kelly, Fife.

#### INFORMATION WANTED

- ...any mods to extend frequency range of R1132A 100/124MHz to include 144MHz—D. McKenzie, 19, Manse Road, Ardersyer, Inverness.
- ...lend or give the instruction booklet for the Murphy Radio type A34 (its number is 12656) or as much information as possible concerning valves etc. on this receiver.—S. Thackery, 9 Dale Close, Fritchley, Derbyshire, DE5 2HZ.
- ...wanted any circuit for a transistorised C. R. Oscilloscope or Feb 72 copy of P.W.—P. Ducker, 50, Cheshire Road, Leicester.
- ...Ferguson Radio 204BVX manual, service sheet or circuit required. Buy or borrow. All replies answered.—A. Nicholls, 8 Findlay Place, Swanage, Dorset.
- ...Info on Indicator unit 266 fitted with CRT VCR97 and used with receiver type 3645.—D. J. Rockliffe, 42, Hollybrow, Selly Oak, Birmingham, 29.
- ...Info or circuit diagram of the Cossor 339A scope.—R. Williams, 34, Gwydir Road, Llandudno, North Wales.
- ...any circuit diagram and component list of metal locators.—J. Martins, Av. Almirant E Reis, 238-60E Lisboa, 1, Portugal.
- ...Information wanted circuit details of RCA wavemeter type TE149.—E. Kilner, Spennythorne, Cokes Lane, Chalfont St. Giles, Bucks.
- ...wanted circuit diagram, handbook or manual for TR10 JR-60RX (buy or borrow).—R. Thomas, 13 Northways, Porthcawl, Glam.
- ...circuits of the following wanted: RF units 25, 26 and RX52, also any info on Rx No. 46159 type.—T. Richards, 52 Cookson St., Liverpool, L1 5EU.
- ...details on the Ex-Service Tx.Rx. B44 mark 3 conversion to make tunable from 60-95MHz, will buy or loan manual.—A. C. Norfolk, 24 Hornsby Crescent, Scunthorpe, Lincs.
- ...can you supply me with information or a circuit for the R1155 radio set etc.—A. J. Rudd, Quellerina, 13 Distington Park, Distington, Nr Workington, Cumberland.
- ...any info on S.T.CR4187 set, manual and/or circuit to buy or copy.—T. Eyre, Battersea Court, University of Surrey, Guildford, Surrey.
- ...circuit or manual and S meter and mains mods. for R209, Rx. J McMillan, Derby Hall University, Nottingham.—J. E. McMillan, 202 Tudor Drive, Kingston, Surrey.
- ...wanted P.W.'s wallchart circuit building blocks, also any info. on the Taylor type 20A circuit analyser.—Mr. J. Nolan, 274 Packington Square, London, N1, 7UH.
- ...Info. wanted on ex-government RG42C receiver (1235), also borrow or buy information booklet on Sinclair X10 amplifier.—G. Winterburn, 40 Priestsills Road, Hinckley, Leics.
- ...V.T.V.M. CT54. Mico-Vac., Philips Tape recorder EL3527. B.S.R. tape recorder "Majestic"—J. Moore, 7 Newcastle Road, Liverpool, L15 9HP.
- ...circuitry and maker's name of the silicon transistors used throughout in the "Peak Sound" Englefield 840A, amplifier 1971.—Mr. W. Wodhams, 13 Wallasey Crescent, Ickenham, Uxbridge, Middlesex.
- ...School-Boy requires loan of Handbook and/or instruction or Manual sheet for Hallcrafters Model S-108 receiver.—G. Knox, 252 Lode Lane, Solihull, Warwicks.
- ...Info. on Old 17 set and has anyone modified the R209 II to mains operation, and does this eliminate the "Buzzing" interference on Range II top band 1.8 to 2.0 meg.—K. F. Best, 17 Chapelow Close, Groes-y-Celliog, Cwmbran, Mon. S. Wales.
- ...Info. wanted on where I can obtain a blueprint for a stereo pre-amp, with bass, treble, balance and volume control and its own power supply.—H. W. Verce, 49 Lowestoft Road, Wymering, Portsmouth, Hants.
- ...Info. on servicing and operating information of the Honor Tube Tester.—R. Decamps, P.O. Box 24, 2800 Maline, Belgium.
- ...Info. on power supply and the circuit of a Valve Voltmeter, Model CT54 (an ex. Navy Job).—J. R. Owen, 40 Kingslea Road, Withington, Manchester, M20 90A.
- ...any info. on "Electra", they make P.A. system loudspeakers.—S. C. Davies, 12 Hamilton Grove, Peel Common, Gosport, Hants.
- ...Wanted: manual or circuit diagram for Pye Reporter Radio telephone.—P. Jenkins, 30 Gainsborough Road, North Finchley, London, N12 8AG.



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Before sealing, copy out on the outside back of the envelope the eight key letters in exactly the same order as they appear on the completed coupon. Do not enclose any correspondence or matter other than your coupon.

The Sinclair DM1 Multimeter has been designed to fill a need for constructors who find analogue multimeters in some way limited, while offering a digital readout and higher accuracy, where previous digital multimeters have so far been expensive.

The normal retail price at £49 represents good value and you will find that you will always have a need for such an instrument to measure a.c. or d.c. volts from 1mV to 1,000V; current from 1µA a.c. 1nA d.c. to 1A; d.c. resistance up to 1MΩ. The very high input resistance makes this instrument ideal for almost any circuit using transistors, i.c.s. or valves. A full report appeared in the March 1973 issue only of Practical Wireless.

### RULES

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

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

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

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

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

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

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

- A** Light, portable and easy to handle
- B** Easy readability from number tubes with decimal point
- C** Probe lead stowing facility
- D** Accuracy of better than 1%
- E** Very high input resistance up to 1,000MΩ
- J** A.C. and D.C. current measuring capability
- K** Price/performance ratio competitive with moving coil multimeter
- L** Voltage measurement from 1mV to 1,000V A.C. or D.C.

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2nd	
3rd	
4th	
5th	
6th	
7th	
8th	

CUT ALONG THIS LINE

# DOMESTIC RADIO AND HI-FI EQUIPMENT TO LOOK OUT FOR

## SONEX Pictorial Plus

**I**n spite of some pessimistic mutterings expressed in various quarters on the future of quadrasonic sound, there is no doubt that there is increased confidence in its viability. Several manufacturers, exhibiting at Sonex in the new venue, Excelsior Hotel, London Airport, show that in order to be able to sell four-channel it must be of high quality.

The characteristic "wait-and-see" of the British Trade will not be able to hold out much longer, especially as there are now being made and imported quad recordings based on matrix coding systems SQ and QS. Some manufacturers have wisely chosen to cater for both these systems and the discrete four-channel

system generally known as CD-4 (See News . . . page). Space does not permit an exhaustive treatment of the exhibition, but we have shown here some highlights that are worthy of consideration. Some of the main features are given and prices shown where known. It is stressed that all specifications are quoted and are in no way intended as a basis of transaction under the Trades Descriptions Act. Full details are usually available from manufacturers or agents. E.M.I. Crown and ITT were not at Sonex. The quad SQ system originates from CBS of America; QS from Sansui; discrete CD-4 from Victor Company of Japan. *The Midlands and North have their own special exhibitions.*

### CASSETTE RECORDER CC 9201 WITH RADIO CC 9301 (BASF)



Battery mains portable for chromium dioxide (automatic switch) or ferric oxide tape, wow and flutter less than 0.3%, signal/noise ratio better than 45dB (50dB with Cr02) Amplifier 1.5W (CC9201) and 2.5W (CC9301). Radio in 99301 has a.m./f.m. bands.

CC 9201 is £55; CC 9301 £75.  
BASF United Kingdom Ltd.,  
Knightsbridge House, 197  
Knightsbridge, London, SW7.

### FM TUNER 624 (Armstrong)

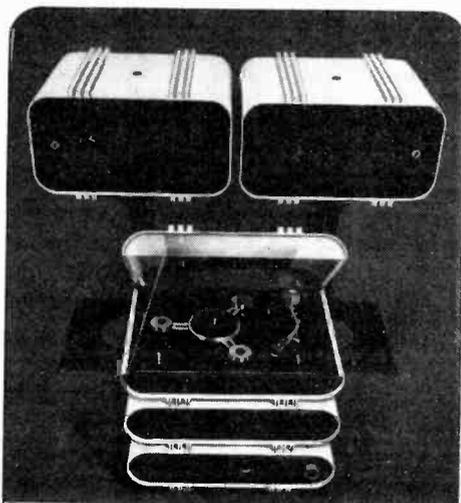
Varicap diode tuning, dual gate fets, ceramic filters, integrated circuit phase lock loop stereo decoder. Six preset stations and variable control. Preset station frequency meter and tuning meter for centre-zero tuning or field strength monitor. Switched a.f.c. and local/distant mode. Sensitivity 1mV for 30dB signal/noise. Distortion less than 0.2%. Signal/noise ratio at 100µV 65dB. Price: £59.40 inc. VAT.



Armstrong  
Audio Ltd.,  
Writers Road, London, N7 0RZ.

### AM/FM TUNER 623 (Armstrong)

Single scale variable a.m. tuning without band switching; preset stations also available. Continuous coverage 145 to 1,625kHz. Sensitivity on a.m. 250µV ferrite rod or 25µV external aerial. FM section as for 624. Recommended retail price £79.20 including VAT. Also available stereo receiver (illustrated) 626 a.m./f.m. £132 including VAT.



### SCIENTELEC MULTIPLE UNIT

This interlocking system comprises: transcription unit 33 $\frac{1}{3}$ /45 r.p.m. Wow and flutter 0.15%. Rumble: 54dB. Amplifier: 2 x 40W. Bass/treble cut filters. Tuner: input-75/300Ω with 1µV for 24dB sensitivity. Less than 0.5% distortion, amplified a.f.c. and squelch cct. Speakers: 8in. and 3in. (45Hz to 20kHz). 4Ω.—Sinclair (SSB) Ltd., 34A Beddington Lane, Croydon.

### PICK-UP ARM LUSTRE GST1 (Acos)

Imported Japanese high quality pick-up arm with counter-balance, bias compensation and preset

adjustable base slide for optimum positioning. This easy to set up arm has an integral lift arm and cue lever, anti-skating adjustment, height adjustment and two headshells for interchange of two cartridge types. Price £24.51 plus VAT.

Cosmocord Ltd., Eleanor Cross Road, Waltham Cross, Herts.



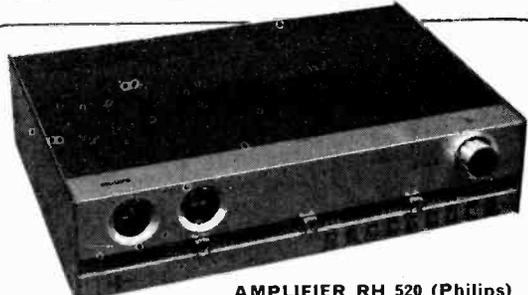


**CASSETTE RECORDER STUDIO 60 (ITT)**

Battery/mains portable recorder for chromium dioxide or ferric oxide tape. Fast forward/rewind, start/stop and pause controls. 1W amplifier. Automatic motor cut-out and warning light when tape ends. Recommended retail price £38.95 plus VAT. ITT Consumer Products (UK) Ltd., Maidstone Road, Sidcup, Kent, DA14 5HT.

**STEREO AMPLIFIER 1515 & QUAD DECODER SQ1500 (E.M.I.)**

The 15+15W amplifier has a quoted distortion of less than 0.2% at full power at 8ohms. Conventional controls plus power outlets of full stereo system and outlets for disc and tape mechanisms. Quad decoder for SQ four-channel recordings to CBS specification. Retail prices: Amplifier 1515 £46.50; Decoder SQ1500 £30, both inc. VAT. E.M.I. Pathe Division, E.M.I. Sound & Vision Equipment Ltd., 252 Blyth Road, Hayes, Middlesex.



**AMPLIFIER RH 520 (Philips)**

Successor to the 590, this 2 x 15W r.m.s. amplifier conforms to DIN 45500 Standard. It has switchable "Stereo-4" quadrasonic facility, rumble and scratch filters, slider controls, headphone socket, power meters. Recommended retail price £85 including VAT. Philips Electrical Ltd., Century House, Shaftesbury Avenue, London WC2H 8AS.

**RADIO/HI-FI UNIT RS 252 (Siemens)**

Complete system (less speakers) in one cabinet includes PE 3015 transcription turntable with pickup safety lock operated by push-rod near centre spindle; prevents pickup being moved over turntable without a record in position. Shure magnetic cartridge type M75D, 2 x 25W r.m.s. amplifier, radio tuner a.m./f.m. reception, six preset tuners on f.m., slider controls, quadrasonic sound facility. Interconti Electronics Ltd., Albany House, Petty France, London, S.W.1.



**QUADRAPHONIC HEADPHONES SH870Q (Crown)**

Four-channel phones of low impedance (4 to 16 ohms) for an input of 0.2W maximum per channel. Frequency range 20Hz to 14,000Hz. Recommended retail price £15.95 plus VAT. Crown Radio Co. Ltd., 128 Shoreditch High Street, London, E1 6JE.

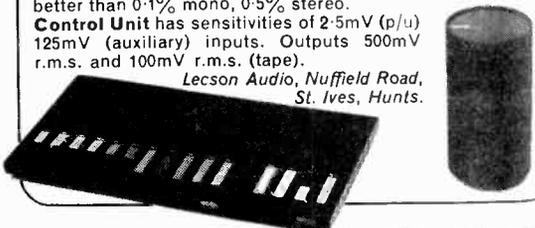


**POWER AMPLIFIER AP1, AP2 (Right) FM TUNER TF1 (Centre) CONTROL UNIT AC1 (Left)**

Cylindrical housing power amplifier with up to 50W per channel into 4 or 8 ohms (AP1) or 70W (AP2). Distortion rated at less than 0.02% at 50W. Input sensitivity 500mV for 35W into 8 ohms. FM tuner sensitivity 1.5µV for 30dB quieting. Signal/noise ratio better than 60dB. Distortion better than 0.1% mono, 0.5% stereo.

Control Unit has sensitivities of 2.5mV (p/u) 125mV (auxiliary) inputs. Outputs 500mV r.m.s. and 100mV r.m.s. (tape).

Lescon Audio, Nuffield Road, St. Ives, Hunts.

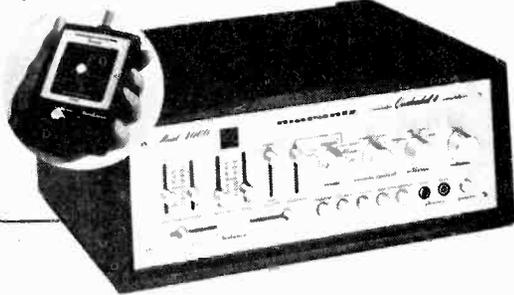


**QUADRADIAL-4 AMPLIFIER MODEL 4060 (Marantz)**

New equipment designed to provide for synthesised 4-channel sound of matrix-encoded disc or f.m. broadcast programmes. 4 x 15W r.m.s. amplifiers, mode switch for mono on four channels, discrete 4-channel, vari-matrix synthesised 4-channel or enhanced stereo, SQ matrix 4-channel.

**QUADRADIAL-4 REMOTE CONTROL (Marantz)**

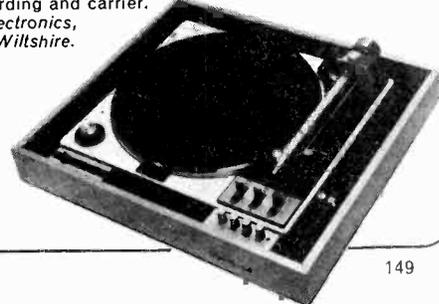
Includes four-channel balance control joystick, master volume, loudness switch. Pyser-Britex (Swift) Ltd., Fircroft Way, Edenbridge, Kent.



**4-CHANNEL PLAYER QZ100S (Garrard)**

Both this turntable unit and its companion, the QSP25 Mk. 3, are now available with Q prefix to cater for quadrasonic sound. Capable of playing discrete four-channel and two-channel discs or, by using the built-in matrix decoder, they can provide enhanced four-channel output from two-channel recordings. High quality magnetic pickup on the QZ100S has frequency range 20 to 50,000Hz to reproduce CD-4 recording and carrier.

Plessey Electronics, Swindon, Wiltshire.



# HOTLINES

## ON RECENT DEVELOPMENTS

### FLAT C.R.T.

**T**HE search for a flat, thin cathode ray tube continues. Many ingenious ideas have been put forward, but many have had to be shelved simply because of cost compared to the c.r.t. This is particularly so in the case of television screens. Could it be that the solutions to date have sought to be too clever? An American company has come up with a solution which is extremely simple, it works, and the cost is not prohibitive.

Basically, the system is based on the principle that if a spot of oil, turpentine, etc is dabbed onto the roughened side of a sheet of frosted glass, the affected spot will become transparent.

Imagine two sheets of glass. The rear one is blackened. The front sheet is frosted, the rough side facing the blacked sheet. Between the two sheets is a reservoir of liquid and the glass is thus transparent or clear all over. All that is necessary is some form of matrix to "address" this "cell". This could be a fine mesh of conductors laid down onto the roughened surface of the front plate—a very fine pattern of lines in the x and y axis—rather like finely ruled graph paper squares.

Action of the device is simple. When power is fed to two electrodes, the point at which they meet will heat and vaporise the liquid, causing a white opaque spot to appear.

The speed at which all this can happen is, in present models, between 1-10mS. Note: this is quite adequate for television applications where the frame speed is about 30 per second. Turn off time is about 10mS.

Various liquids are under investigation. Trichlorethylene, for example, requires 50V at about 2W of power to control each square centimetre of display area. Compared directly to the c.r.t. for TV applications this "picture frame cell" uses more power but at a lower voltage. Because the surface is completely flat, barrel and pin-cushion distortion are eliminated. By utilising low vapour pressure liquids, it should be possible to increase efficiency.

The idea could also be used for a form of storage tube display. The addressing matrix could be used to boil off the liquid in the selected

"trace" areas leaving those areas dry and thus standing out against the transparent surrounding areas. The boiled-off vapour would be returned to a reservoir via suitable ports where it would condense back to a liquid. This liquid in the reservoir could, in turn, be heated and allowed to re-condense over the entire surface of the cell, thus clearing the display ready for the next trace.

Perhaps thin, flat-screen television is nearer than we think, and the Japanese are known to be working on some pretty cute ideas.

### I.C. SOUND EFFECT

Electronic organs are popular and circuitry has appeared in many journals. One very nice asset is a Leslie Speaker cabinet which contains a drum which rotates in front of a loudspeaker. This sort of f.m. gives an effect of vibrato and chorus. The more sophisticated home organs have a Leslie Speaker built-in to the organ itself.

A German company has now produced an IC which could replace the entire Leslie System. It has the advantage, besides an obvious tremendous reduction in size, of having no moving parts; no motor noise, nothing to rotate. The IC, designated TCA350, achieves the effect by introducing a delay time. The actual electronics of the system is too complex to deal with here, but the TCA350 contains some 185 field effect transistors and complementary capacitors. Another application could be to use this IC to replace glass delay lines.

### MONO CHIP INDUCTORS

Little things please little minds so we're told, but sometimes it's not that cynically simple. Cramping a few thousand semiconductors into a dual in-line package is a common occurrence today, but what of the devices which are very difficult to integrate? Items such as tuned circuits are a problem. However, solutions are on the way, in the form of subminiature inductors or "coils".

Described as monolithic chip inductors, these minute devices are made by stacking U-shaped conductor patterns which have been screened onto a special ferrite tape. The U-shaped patterns are stacked

such that when the individual ends of each U are connected to the U's above and below, a continuous "coil" pattern is achieved. When this has been done, the complete stack is "fired" resulting in a monolithic structure.

It sounds simple; but it isn't. First a special high-permittivity ferrite has to be carefully bonded with a plasticiser to make the tape which is typically about 1.8 thou. (1thou  $\frac{1}{1000}$  inch).

Again when the tiny tapes are stacked, holes must be drilled through the stack to enable the ends of each U-pattern to be connected. The entire coil is only 0.08in<sup>3</sup>.

Another snag is the d.c. resistance of the "windings". If this is too high, the Q of the coil will be lowered and the tuned circuit would tune far too broadly. The favourite metal, Platinum, was found to give a resultant inductor with far too great a resistivity. Gold and Silver, other immediate candidates, have melting points which are much too low to be of use with many ferrites. One company overcame this by developing a special ferrite material which could be fired at under 900°C.

In their tiny 0.08inch cubes, these miniature marvels, called Magna Chips, have been produced with Q ratings of from 20 to 50 with inductance values in the range 0.1 to 6 $\mu$ H. Perhaps transformers are a possible future development, particularly r.f. types. At present, the upper limit appears to be around 50MHz.

### GOT A TEMPERATURE?

If you're worried about getting too hot under the collar, you need a Hot Spot temperature recorder/indicator. These devices look like a transistor (there are other mountings) about 0.18inch in diameter. They have a particular temperature rating which you specify on ordering and the present range covers from 100°F to 350°F in 10°F steps. If one of these devices is exposed to its rated temperature it immediately turns from bright silver to black.

*Ginsberg*

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BC177 21p; BC178 19p; BC179 21p  
BC257 12p; BC258 11p; BC259 13p  
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BD136 pnp med power 38p  
**DIODES**  
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OA200 9p; OA202 10p  
Other semiconductors  
AC128 17p; AP117 35p  
BFY51 19p

Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

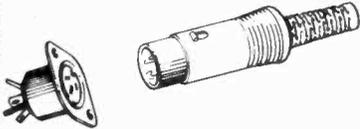
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0-8A 400V 85p, 600V 80p  
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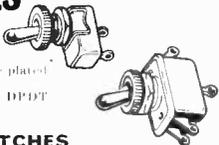
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To3 cover 7p  
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7201 Sub-miniature DPDT 260V a.c./2A 48p

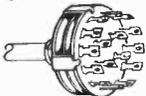


### ROTARY SWITCHES

Radiospares Miniature Maki-switch (in assembly kit form) Shaft 48p  
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### WAVECHANGE SWITCHES

1P12W, 2P6W, 3P4W, 4P3W, each 24p



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2.2				7p	7p	7p	7p
4.7			7p	7p	7p	7p	7p
10			7p	7p	7p	7p	7p
22			7p	7p	7p	7p	7p
47	7p		7p	7p	7p	7p	7p
100	7p	7p	7p	7p	8p	12p	18p
220	7p	7p	7p	8p	9p	10p	17p
470	7p	8p	8p	8p	12p	17p	24p
1000	8p	12p	12p	17p	20p	28p	40p
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4700	23p	26p	37p	40p			
10,000	37p	40p					

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Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99	100 up
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C	1/8W	5%	4.7Ω-470K Ω	E24	1		0.75
C	1/4W	10%	4.7Ω-10M Ω	E12	1		0.75
C	1/2W	5%	4.7Ω-10M Ω	E24	1.2		0.8
C	1W	10%	4.7Ω-10M Ω	E12	2.5		1.6
MO	1/2W		10Ω-1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0.22Ω-3.9 Ω	E12	7	7	6
WW	3W	5%	1Ω-10K Ω	E12	7	7	6
WW	7W	5%	1Ω-10K Ω	E12	9	9	8

Codes: C—carbon film, high stability, low noise.  
MO—metal oxide, Electrosl TR.5, ultra low noise.  
WW—wire wound, Pleseey.

Values:  
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.  
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

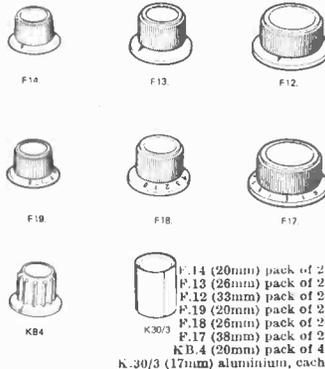
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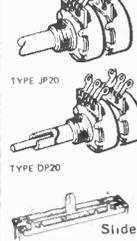
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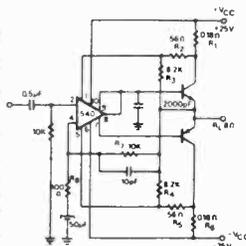
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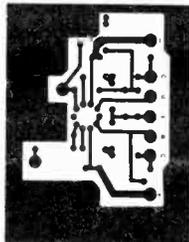
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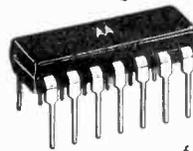
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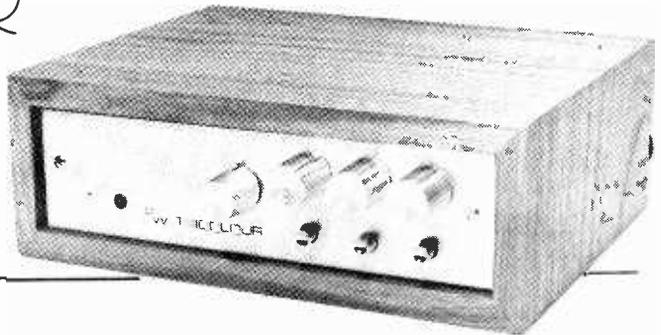


# TRICOLOUR

## Mood Lighting System

PART THREE

JUREK BUDEK\*



THE P.W. Tricolour described in parts 1 and 2 dealt with a design which utilised zero voltage control and the printed circuit board, components and metalwork was specifically designed for that purpose.

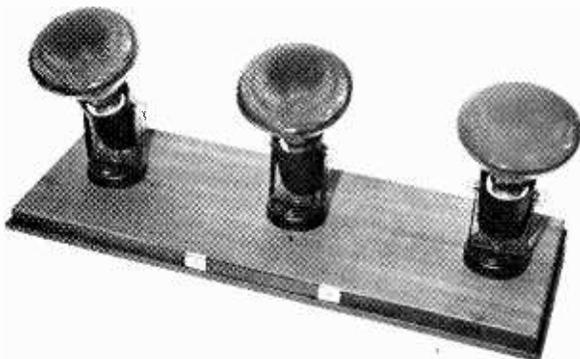
Part 3 deals with the lamp dimming version of the P.W. Tricolour which requires a different printed circuit board, component changes and modified metalwork. To avoid any confusion we will refer to this design as 'Mk II'. The Mk II printed circuit board however has been designed to accommodate either the lamp dimming or zero voltage control designs. Each design has its basic differences and these can be ascertained by reference to the circuitry.

The filter circuit as shown in Fig. 9 part 1 remains identical for each design. The Mk II metalwork is similar in many respects to the original design, but will be reproduced in its entirety for the sake of completeness.

### Light Dimming

The light intensity is varied by controlling the input voltage to the lamps. This is achieved by using the same solid state devices, triacs, as in the zero voltage switching design described in parts 1 and 2 in this series of articles (April, May 1973).

Fig. 21 shows some of the voltage waveforms obtained by moving the gate pulses in time with respect to the input voltage and thus controlling the load voltage.



Photograph shows the lamps unit that is used with the P.W. Tricolour

The formulae given below gives the relationship between the output r.m.s. (root mean square) voltage, a function of delay angle ' $\gamma$ '.

$$V_{r.m.s.} = E_{r.m.s.} \sqrt{2 \sqrt{\frac{1}{2\pi} (\pi - \gamma + \frac{\sin 2\gamma}{2})}}$$

Where E.r.m.s. = 240V (supply voltage)

Taking the supply voltage as 100, the above formulae can be modified to give the results as a percentage of the supply voltage.

$$V_{r.m.s.} = 100 \cdot \sqrt{2 \sqrt{\frac{1}{2\pi} (\pi - \gamma + \frac{\sin 2\alpha}{2})}} \text{ per cent}$$

Fig. 22, drawn from the above formulae, shows the percentage reduction of the output r.m.s. voltage as a function of delay angle ' $\gamma$ '.

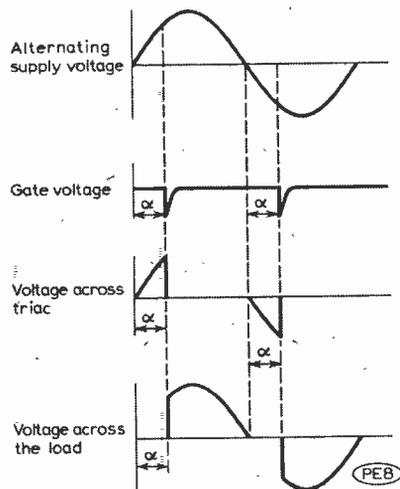


Fig. 21 : Some of the triac voltage waveforms obtained by moving the gate pulses in time with respect to the input voltage.

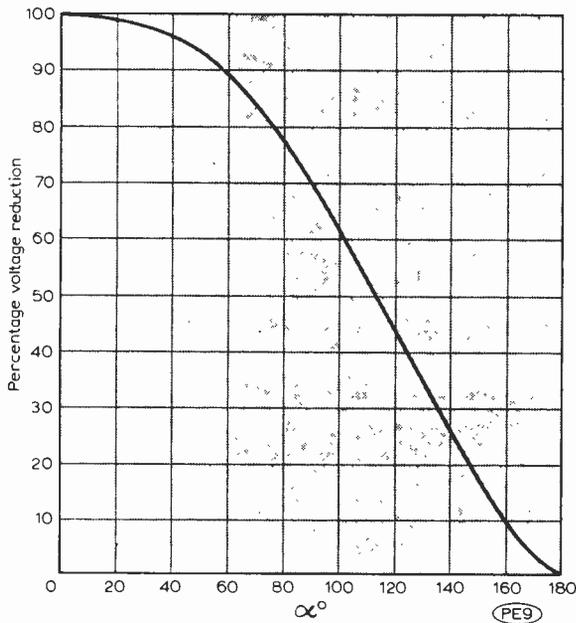


Fig. 22: Graph showing the percentage reduction of the output r.m.s. voltage as a function of the delay angle  $\alpha$

There are various circuits for controlling the gating of a triac and thus the power in the load. One of the simplest ways is to employ an unijunction transistor (u.j.t.).

Unijunction transistor trigger circuits are usually based on the simple relaxation oscillator as shown in Fig. 23.

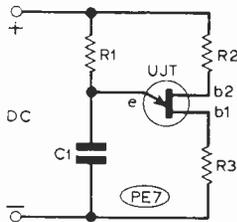


Fig. 23: Circuit shows simple unijunction relaxation oscillator.

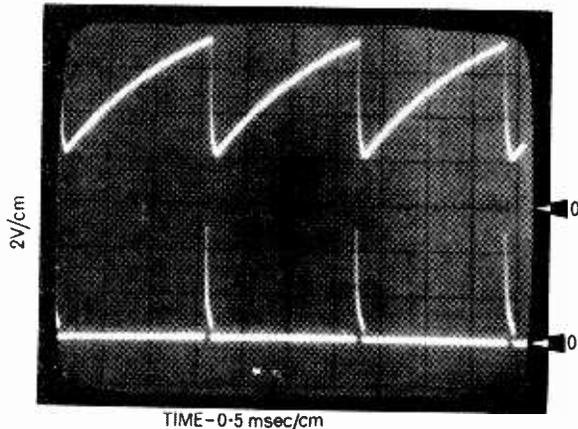


Fig. 24: Voltage waveforms relating to Fig. 23 (see text). Photograph not to scale.

Resistor R1 and capacitor C1 form the timing network. On application of a d.c. voltage capacitor C1 will charge up exponentially at a rate (time constant) determined by resistor R1 and its own value until the peak point voltage of the u.j.t. emitter is reached. At this time the u.j.t. turns on discharging capacitor C1 through the base resistor R3 (i.e. with a time constant  $C1 \times R3$  where  $R3 \ll R1$ ). Then the process repeats, resulting in a train of pulses across resistor R3. Fig. 24 illustrates the voltage waveforms across capacitor C1 (upper trace) and the voltage pulses across resistor R3 (lower trace). The values of components for this oscillogram were:

D.C. supply	—	10V
R1	—	15 $\Omega$
R2	—	270 $\Omega$
R3	—	100 $\Omega$
C1	—	0.1 $\mu$ F

Synchronisation to the mains is achieved by using the circuit as shown in Fig. 25.

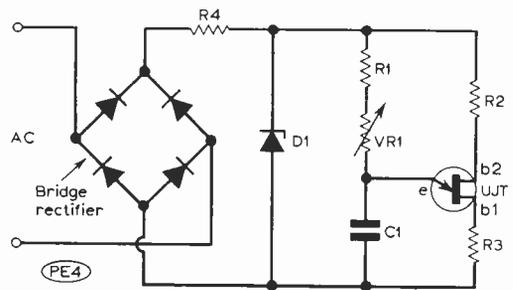


Fig. 25: Mains synchronisation of the unijunction oscillator.

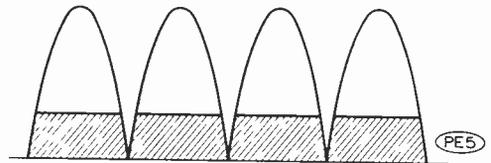


Fig. 26: Waveform related to Fig. 25, see text.

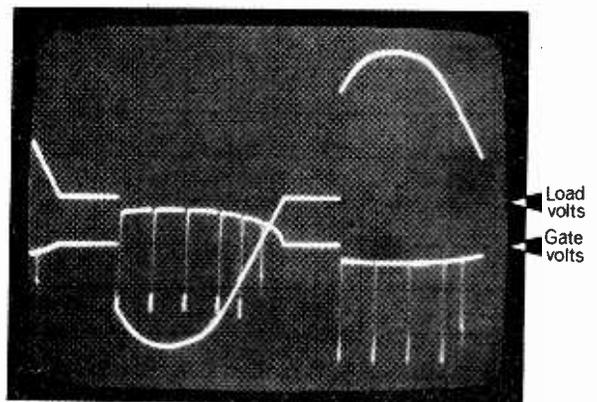
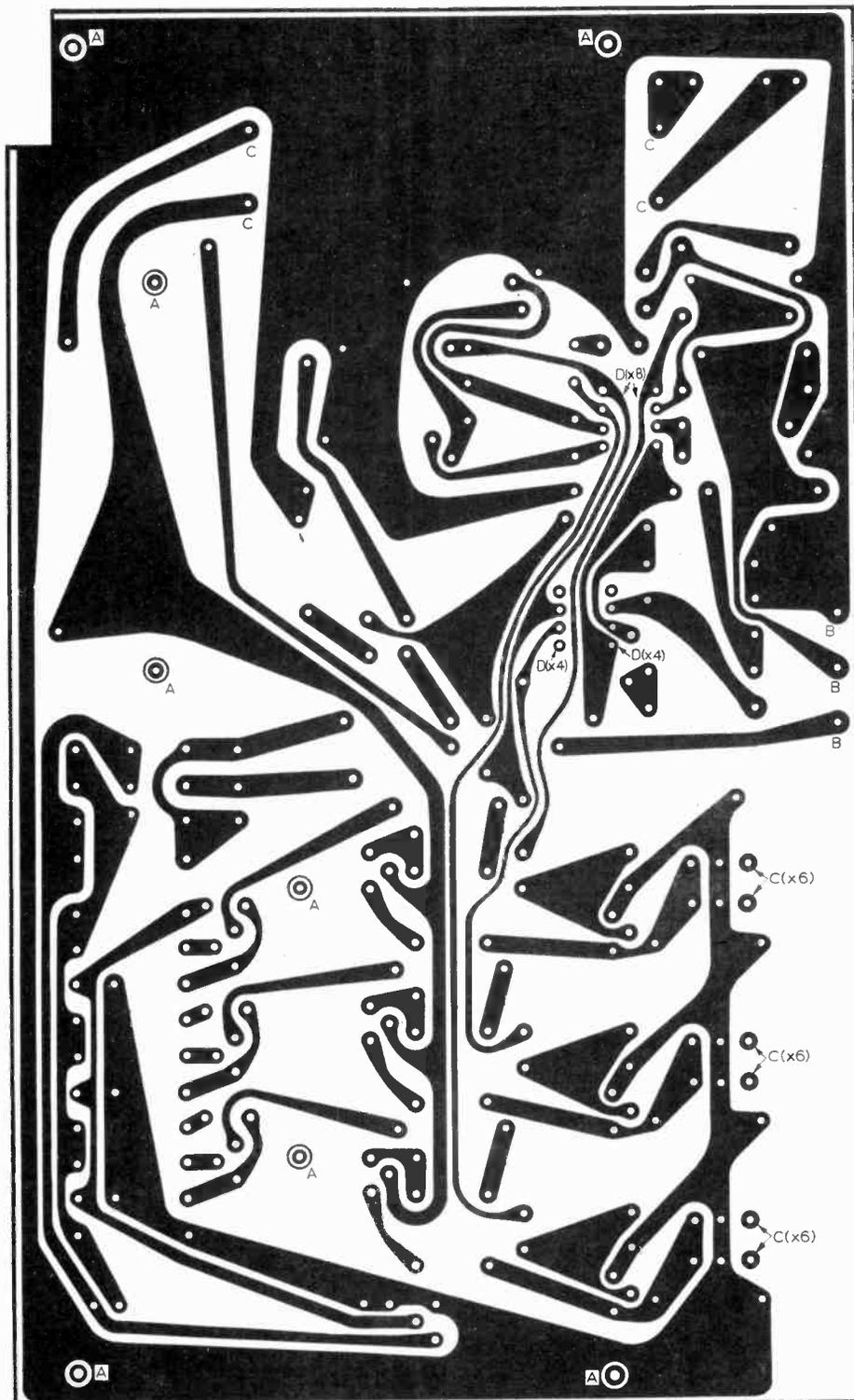


Fig. 27: Triac gate voltage pulses and corresponding voltage waveform across the load.



**HOLE DATA**  
 8 holes A  $\frac{5}{32}$ " dia      16 holes D  $\frac{1}{32}$ " dia  
 3 holes B 1.8mm dia      All other holes 1.0mm  
 22 holes C 1.3mm dia

Fig. 28: The Mk II printed circuit board for the PW Tricolour. This is shown full size—copper foil side. The respective layouts for zero voltage switching and lamp dimming will be given next month.

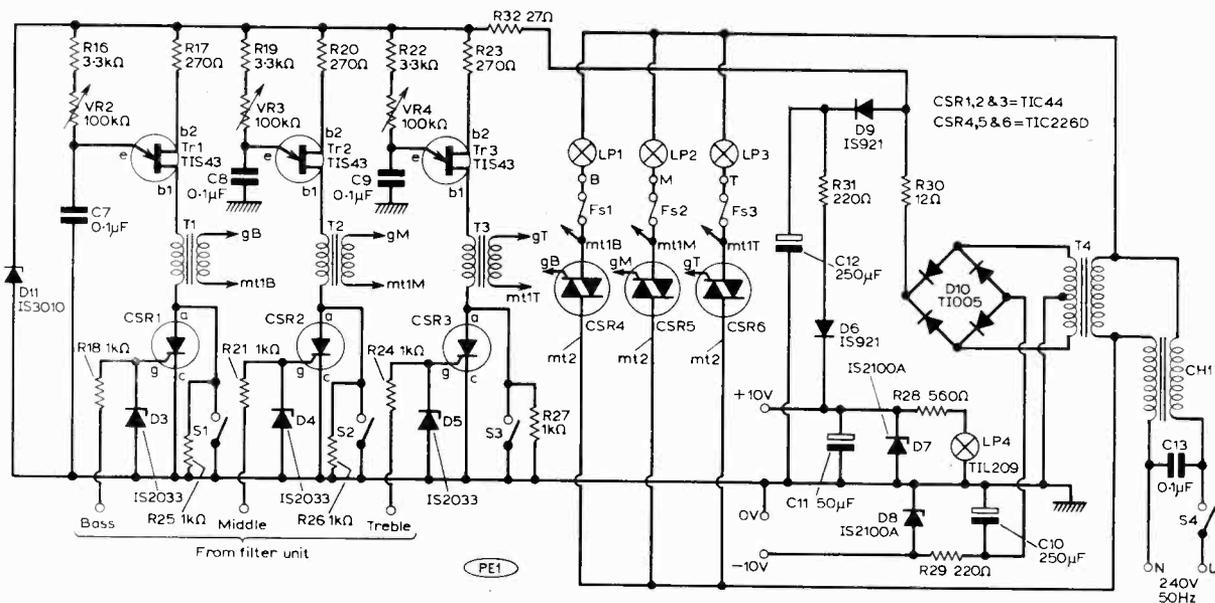


Fig. 29: Circuit showing the P.W. Tricolour lamp dimming control unit. The associated filter unit is exactly as described in Part 1 of this series (April 1973 P.W.)

## ★ components list

### Resistors

R16	3.3kΩ
R17	270Ω
R18	1kΩ
R19	3.3kΩ
R20	270Ω
R21	1kΩ
R22	3.3kΩ
R23	270Ω
R24	1kΩ
R25	1kΩ
R26	1kΩ
R27	1kΩ
R28	560Ω
R29	220Ω
R30	12Ω ½W
R31	220Ω
R32	27Ω

All 10% ½W unless otherwise specified

### Capacitors

C7	0.1μF
C8	0.1μF
C9	0.1μF
C10	250μF 25V electrolytic
C11	50μF 25V electrolytic
C12	250μF 25V electrolytic
C13	0.1μF 250V a.c. wkg.

### Transformers

T1	Pulse transformer, type PT-ATA ITT Ltd.
T2	
T3	
T4	Miniature mains transformer, 240V primary, 0-12V, 0-12V r.m.s. 6VA type 12V, R. S. Components Ltd.

### Semiconductors

Tr1	TIS43
Tr2	TIS43
Tr3	TIS43
D3	IS2033
D4	IS2033
D5	IS2033
D6	IS921
D7	IS2100A
D8	IS2100A
D9	IS921
D10	T1005 Bridge rectifier
D11	IS3010
CSR1	TIC44
CSR2	TIC44
CSR3	TIC44
CSR4	TIC226D
CSR5	TIC226D
CSR6	TIC226D

Texas Instruments Ltd.

### Miscellaneous

VR1, VR2, VR3	100kΩ linear potentiometer
FS1, FS2, FS3	5A fuses and panel mounting holders
LP1, LP2, LP3	Colour flood lamps, 240V 100W
LP4	TIL209 indicator lamp, Texas
S1, S2, S3	Push on-push off switches
S4	Single pole mains on-off switch
CH1	Filter choke, Tunewell Transformers type J.B.1
SK1	Lamps socket, Bulgin type P552
PL1	Lamps plug, Bulgin type P551 (fitted to lead from lamps unit)

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MT45	Transformer for above, heavy duty	£2-85 carr. 20p
MT30	Transformer for unstabilized supply complete with rectifier diodes mounted	£3-50 carr. 20p
PS70	Stabilized supply module for one or two SA100's	£4-90 carr. free
MT70	Transformer for PS70	£4-90 carr. 40p

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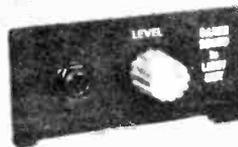


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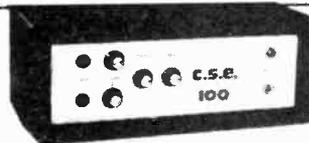
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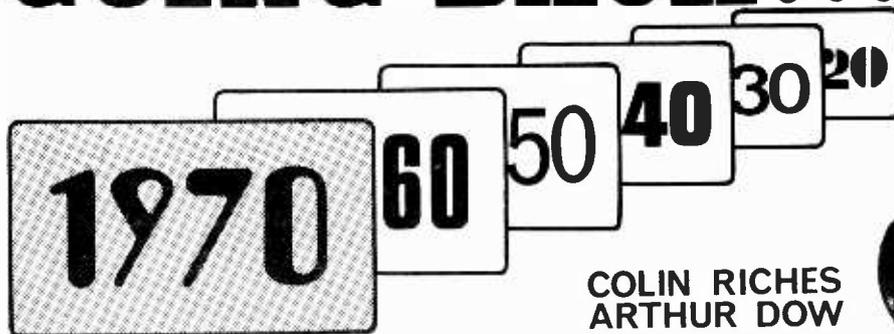
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1T4	-14	DAF91	-21	ECC85	-31	EL84	-20	PCF802	-38	U191	-84
384	-28	DAF96	-35	ECH35	-48	EM80	-35	PCF805	-55	U251	-60
3V5	-48	DF91	-14	ECH42	-68	EM81	-85	PCL82	-28	U329	-65
6B0L2	-48	DF96	-19	ECH81	-28	EM84	-30	PCL83	-53	U801	-73
6AT6	-18	DH77	-05	ECL80	-27	EY86	-27	PCL84	-31	UABC80	-89
6AQ5	-21	DK91	-25	ECL82	-27	EZ80	-19	PCL85	-31	UBF89	-28
6BW7	-48	DK96	-43	ECL86	-32	EZ81	-21	PCL86	-35	UCO85	-82
6F1	-57	DL82	-26	EF39	-43	KT61	-63	PFL200	-45	UCH42	-56
6F23	-64	DL84	-48	EF41	-56	KT66	-75	PL36	-45	UCH81	-28
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30C15	-66	DY802	-28	EF89	-24	PC97	-34	PL84	-28	UL41	-82
30C17	-73	EABC80	-28	EF91	-12	PC900	-28	PL500	-56	UL84	-27
30C18	-65	EBC33	-43	EF92	-28	PC84	-27	PL504	-56	UY41	-37
30F5	-60	EB41	-47	EF183	-25	PCC89	-41	PY81	-23	UY85	-22
30FL1	-59	EBF89	-27	EF184	-27	PCC89	-46	PY82	-23	W77	-42
30FL14	-68	ECC81	-15	EH90	-33	PCF80	-25	PY800	-80	Z77	-18

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# GOING BACK...



COLIN RICHES  
ARTHUR DOW



**M**r. Paul Godfrey has sent us some excellent photographs of a vintage wireless. He discovered it at an auction in Great Yarmouth and is wondering if anyone can help him identify the manufacturer and the rough age of the set.

The exterior bears no maker's name but a great many of the components bear the name "Saxon Radio, Blackpool." The wiring is somewhat untidy for the standard of the day and Mr. Godfrey wonders if the wireless may have been made up from a kit.

Three of the valves are made by Tungstram of Hungary and the fourth is a Marconi valve that appears to have been adapted somewhat to fit the holder.

The speaker has been spoilt by a "tatty" coat of paint which has in all probability obscured the name of the manufacturer but he thinks this could be removed to allow it to be re-painted or sprayed properly. So, if anyone can help, you can contact Paul Godfrey at 59 North Quay, Great Yarmouth, Norfolk.

**It's all on record!**

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**T**HIS excellent gramophone record, produced by the BBC contains no less than 127 separate items combined together to give a masterpiece of sound broadcasting history. The double album covers such milestones as P. P. Eckersley's, "This is Two Emma Toc Writtle calling", with the unmistakable rolling of the 'R's' in Writtle. The opening of Savoy Hill in 1923 is covered and the historic broadcast of the opening of Tutankhamun's tomb by Dr. Howard Carter and the General Strike news announcement of 1926 are all featured. H. G. Wells gives a talk on communications and King George V gives the first ever Christmas Message from Sandringham in 1932.

Side 1 of the record covers 1922-1932, Side 2, 1933 to 1939, side 3, 1940 to 1945 and side 4, 1946 to 1972.

Some of the tracks on side 2 are nostalgic reminders of our favourite programmes—In Town Tonight, Bandwaggon, etc. The death of George V is announced by Sir John Reith (21/1/36). The invasion of Poland and the outbreak of war with Neville Chamberlain's announcement on 3/9/39 are recorded.

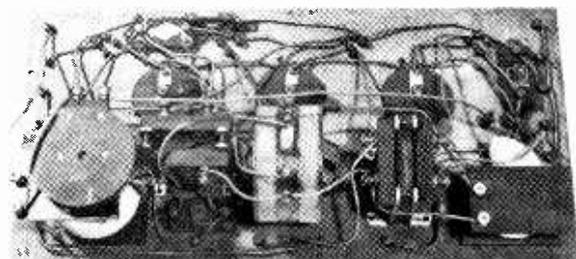
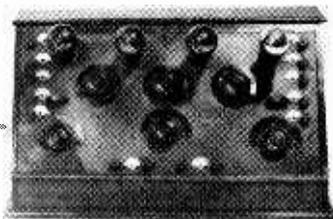
Side 3 starts with Churchill's "Fall of France" speech and voices that were to become so familiar to us all in those years of trouble and strife bring back nostalgic memories. Frank Phillips, Vera Lynn, Alvar Lidell, Tommy Handley, Jack Warner, Freddy Grisewood, John Snagge and Richard Dimpleby all add their voices to the recordings.

Side 4 starts with the 1947 F.A. Cup Final between Charlton and Burnley when the ball burst. There are excerpts from "Take it from Here", 20 Questions, The Goon Show and others. The events of Yuri Gagarin in space and President Kennedy's assassination bring us into the sixties and the final track is the memorial service in Westminster Abbey for Lord Reith (22/7/71) with the lament "Flowers of the Forest" played on bagpipes by Pipe Major Thomas Anderson.

We cannot praise this album too highly. It is a record that should be in the collection of anyone who has gained enjoyment from listening to BBC programmes over the years. We have only been able to mention a few of the fascinating tracks and to do full justice to this memorable record we recommend that you listen to this nostalgic document. Price £3.99 from your local record dealer.



Mr. Godfrey's receiver and horn speaker.



Under-chassis wiring of the above receiver



## SHORT WAVE DX by MALCOLM CONNAH

**T**HE first news this month is of an interesting venture by several young readers of this column. They are attempting to form a DX Club for younger listeners.

The name of the club is the **Youth DX-Club International** and the first copy of their magazine arrived on my desk this week. The magazine contains many interesting features including an article on antenna construction and an equipment review. The majority of the articles are aimed at helping the young DXer.

The present membership of the club is composed of 14 and 15 year olds. I have no further information at present but hope to publish more details next month.

### DX News

**GREECE:** The Hellenic National Radio Institute has been heard on the new frequency of 21610 from 1420 to 1500 with a strong signal.

**SWEDEN:** The new, 500kW, transmitters of Radio Sweden at Karlsburg are now on the air. Due to technical difficulties the output has been reduced, for the time being, to 150kW. It is hoped that these problems will soon be overcome.

**URUGUAY:** Radio El Espectador, Montevideo is reported to be active again on 11835kHz and has been heard from 1100 to 0300.

The last three items are courtesy of Sweden Calling DXers which, by the way, has just celebrated its 25th. anniversary.

### Readers' Logs

The first log comes from the team of **Simon Wormleighton** and **J. P. Fletcher** at Rendcomb College, Cirencester. The equipment used in their station is an HRO receiver with 8 metre folded dipole and an Astrad Altair receiver with an 80 foot long-wire. Stations logged include:

- 5920 R. Kiev, Ukraine in English at 1950.
- 9560 R. Japan with news in English at 1000.
- 9570 R. Australia in English at 0700.
- 9655 R. Damascus, Syria. Nx. in English, 2030.
- 9695 RSA, South Africa, English at 2400.

- 10050 Voice of Vietnam, Hanoi at 1705.
- 11770 BBC, Atlantic Relay in English at 1700.
- 21500 AFRTS, Washington in English at 1500.

**Paul Beeson** of Bexleyheath caught his father in the act of throwing away a 1947 Murphy type TA92, 6 valve Domestic receiver. Having rescued the set he performed a few minor repairs, added a 100 foot long-wire and obtained the following results:

- 9560 All India Radio in English at 1830.
- 9565 Voice of America, Tangier, at 1730.
- 9580 Warsaw Radio, Poland, news at 2240.
- 9605 R. Bucharest, Rumania at 2020.
- 9645 Armed Forces & Int. Ser., R. Canada, 2055.
- 9690 R. New York World Wide at 2300.
- 9700 IBRA Radio, Lisbon, English at 2015.
- 9830 Voice of Vietnam, Hanoi at 1610.

**Richard Witney** of Black Notley, near Braintree has used his Skywood CX203 and inverted 'L' antenna to hear:

- 5965 Voice of America, Wooferton, at 0545.
- 9760 Voice of Vietnam, Hanoi.
- 11720 RAE, Argentina in English at 2345.
- 15140 Voice of Vietnam, via R. Havana, Cuba, 2115.
- 15435 R. Tanzania in English at 1900.
- 17710 NHK, Japan in English at 0802.

**John McFadden** of Belfast has just received a Trio 9R59DS receiver and using an indoor loop antenna he heard the following stations during the first five days:

- 9550 R. Lebanon, Beirut in English at 0245.
- 9570 R. Australia with news at 0715.
- 9745 R. Baghdad, Iraq in English at 1930.
- 11650 R. Bangladesh, news in English at 1720.
- 11710 RAE, Argentina in English at 2305.
- 11720 R. Nacional, Brazil in English at 2255.
- 11770 R. Afghanistan in English at 1820.
- 11800 Voice of Turkey in English at 2215.
- 11930 WBS, Grenada, Sports commentary at 2055.
- 11955 FEBA, Seychelles in English at 1800.

**Ian Gordon** of Birmingham has a Codar CR70A receiver and uses a central heating radiator as an aerial which must be an unusual feature on the Birmingham skyline. Stations logged include:

- 6125 R. Canada with DX news at 0730.
- 9550 R. Finland in English at 1425.
- 9695 RSA, South Africa at 2110.
- 9710 RAI, Italy, s/on in English at 1935.
- 9745 R. Baghdad, Iraq in English at 2000.
- 9912 All India Radio, Delhi at 2210.
- 17755 HCJB, Quito, Ecuador at 1940.
- 21485 Voice of America, Bethany at 1930.

I hope to answer all those letters which raised specific queries in the near future. Please remember that all queries should be accompanied by a stamped addressed envelope.

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## MEDIUM WAVE FROM AFRICA by CHARLES MOLLOY

**M**EDIUM WAVE stations in North and West Africa are worth listening for after dark at this time of year. From Algeria, Ain Beida is on 533kHz with Arabic programming and Tipaza is on 251kHz on the Long Waves. This station can be found between Kalundborg 245kHz and Lahti, Finland on 255kHz, it has a power of 1500kW and is heard all over Europe with its French programming. From nearby Tunisia the Arabic programme on 962kHz is usually conspicuous by 2200hrs GMT. From 2300hrs onwards when European interference begins to subside, listen for Dakar, Senegal on 764kHz, which often features a programme of African music with announcements in French until it signs-off at 2345hrs. Enugu, Nigeria is a weakish signal on 1320kHz with news in English before it closes down at 2305hrs GMT. Conakry, Guinea is usually a strong signal on 1403kHz with African style music. Bissau, Portuguese Guinea is often strong on 1070kHz with pop music and Portuguese announcements. There are two stations at Funchal on the island of Madeira that can be logged when conditions are good for reception from this area.

## VHF/FM FROM EUROPE by SIMON DAVID

**I**HAVE received an interesting letter (passed on to me by the Editor) from Mr R. B. Callwood who writes from Munich, West Germany. He says that a popular station there is *Austria-3* which transmits from Vienna about 200 miles away to the east.

The most interesting point is that *Austria-3* broadcasts in stereo from 6 a.m. each morning to 4 a.m. the next morning. This makes British stereo services look rather mean by comparison. Mr Callwood moved into a new apartment block that has a Hirschmann communal aerial. Not being satisfied with the aerial's sense of direction he dangled a wire dipole over the balcony of his apartment. More decibels came pouring in but it was still very noisy on stereo signals.

Still not content that the Pioneer SX-626 receiver was running flat out, he made up the f.m. preamplifier from the April issue of *P.W.* and is now receiving *Austria-3* in stereo loud and clear.

It is not difficult for the BBC to pick up and relay *ORTF* programmes from France, especially when they "cheat" a little by going to the cliffs at Folkestone.

At least they thought it would be easy to pick up Boulogne 27 miles across the water but ran into trouble with transmission reflections from Wrotham on an adjacent frequency only 30 miles North West. They were obliged to find Lille (100 miles) to avoid trouble. "France Musique" is the usual stereo channel and from Lille comes in on 88.7MHz.

It is an interesting fact that "France Musique" is the "bread and butter" stereo music channel for some listeners in South West England and the Channel Islands. Is that a sign of *joie de vivre*, Vive le Common Market or just plain inadequacy of British stereo broadcasts? The French are now urging the

CSA99 is on 1331kHz with a power of 10kW and can be heard with station identification at 2350hrs followed by news in Portuguese and close-down at 0005hrs. CSB91 with 1kW on 1529kHz is a weaker signal but is on a clear channel after Vatican Radio signs-off at 2200hrs. Try around 2330hrs for a fluttery signal with local or pop music until it goes off the air at midnight.

Back on the mainland Azilal, Morocco can be found on 209kHz on the long waves, in French but with some interference from Kiev, while the Voice of Morocco in Tangiers transmits with 200kW on 1232kHz with Arabic programming until midnight. For the night owl there is Kinshasa in the Republic of Zaire (Congo) which is on the air all night on 692kHz, a frequency which it shares with an East German outlet but it is fairly easy to separate the two with a medium wave loop aerial.

**John McFadden** (Belfast) has been trying the medium waves with his Ekco transistor portable. Although using only the internal ferrite aerial he heard Radio Blackburn on 854kHz; Radio Merseyside on 1484kHz and Radio Bristol on 1546kHz, all during the daytime. After dark he logged the following broadcasts in English:—BBC World Service on 1295kHz at 1700hrs; AFN Frankfurt on 872kHz at 1730hrs; Radio Berlin International 1511kHz at 1815hrs; Radio Tirana, Albania 1394kHz at 2030hrs; Vatican Radio 1529kHz at 2055hrs; Radio Moscow 1493kHz at 2115hrs; Trans World Radio, Montecarlo 1466kHz at 2230hrs; Warsaw Radio 1502kHz at 2230hrs; Radio Sweden 1178kHz at 2250hrs and Radio Portugal at 2300hrs.

expansion of British stereo to supplement what they claim to be inadequate service over there.

France Musique boasts 70 stereophonic transmitters operating at fixed hours each day; for reception in the south of England the best stations to find will be Boulogne 89.4MHz, Lille 88.7MHz, Caen 95.6MHz, Rennes 89.9MHz, Cherbourg 92.35MHz. These stations radiate sufficiently to receive stereo here although there may be a good deal of noise about. Details are published in *La Semaine Radio Télé* and *Le Figaro* (weekend edition). You should switch off the a.f.c. on your set if you don't want to lock on to the BBC.

My feelings go out to readers in other parts of the country who cannot yet receive stereo at home from the BBC. In particular, Scottish listeners always seem to get the "donkey's tail" in broadcasting and, since I have a yen for my compatriots over the border (I'm no Sassenach!), perhaps we Southerners should toss a metaphorical caber at the policy makers.

The BBC has issued a statement regarding the stereo pilot tone it uses. As a result of confusion over mixed stereo/mono broadcasts the BBC has adopted the following policy:

1. During stereo (or mixed) programmes the pilot tone will be transmitted and is indicated by the stereo lamp if fitted.
2. During wholly monophonic programmes of substantial duration the pilot tone will not be transmitted. This procedure applies to all BBC v.h.f. broadcasts; the Midlands and North Radio-3 transmitters will be so arranged at a later date.

We shall always be pleased to hear of readers' experiences of VHF/FM reception, especially those who listen in to continental stations. Please state stations received, aerial and tuner used.



## SHORT WAVES

by **DAVID GIBSON, G3JDG**

**M**Y remarks in previous episodes regarding four metres (or 70MHz) appear to have struck a few nails on the head. A large number of letters said naughty words (or were they new callsigns) and made suggestions which, although both ingenious and original, I found physically impossible.

**H. Brown** (Eastwood, Essex) suggests that one answer would be to make 70MHz available to the G8 stations. This is a very good idea. All it needs is an effort from the G8s to learn c.w. and get a "full" Amateur Licence—the ball is really back in our court! Is it worth learning c.w. to save 70MHz? If we don't none of us will be using it!

**Barry Crowley** (Crawley, Sussex) offers useful comment. He reckons that after a 70MHz station has called CQ, the CQ caller tunes up and down the band once and, hearing nothing, closes down or migrates to other bands. Barry says that on one occasion on the mobile channel (70.26MHz) he heard four mobiles, all within working distance, calling CQ one after the other in the space of 15 minutes. Barry's solution is a simple one—patience.

Stations logged by Barry on 70MHz using an AR88D, nuvistor converter and 4 ele. yagi at 40ft include: G2DN, G6HB, G6HD, G3-KSU, NKS/M, OUX, RAE, TR, TIR, VHR, XOG, XSZ/M, XIG, UPS/M, YVR/M, ZHA/M, ZLO/M, ZQX, ZRR, ZYR, G4ARO.

Unwanted signals on 3.5MHz look out. The Northumbria Radio Club is after you. They (like the rest of us) have had enough of the deliberate interference on the 80 metre Amateur Band—and they're doing something about it. How about everyone giving the Northumbria R.C. a little help? Please, have a listen on eighty for intruders and assorted unwanted interference. When you find one, log all the info. you can i.e., a rough d.f. bearing would be very useful, frequency, time in BST (or whatever, but specify) and the type of QRM—carrier only, some LID tapping a microphone, etc. Address for all this info. is **W. Ricalton G4ADD**, 4 South Road, Longhorsley, Morpeth, Northumberland.

A few tasty morsels for the DX fanatics to drool over. Fanning Island should see Amateur activity later this year and a KP6 callsign will (hopefully) be heard from Palmyra Island. Topband DX types will be delighted with the news that both G3RGB and G3SZA worked VK3CZ on 160 metres. Also, GW3YGH had a natter with VK6HD. Well, what do you hear on topband these days?

News has arrived that there is a S.E. Asian DX net on 7.075MHz; listen Tuesday/Friday at 1400hrs. (Go on, have the afternoon off work, your boss will understand).

**Mike Prescott** (Warrington, Lancs) reckons there's only one station in Bhutan now; A51PN. Watch out in case some expedition turns up, this could double the number of stations! The VE1 prefix for Prince Edward Island is now C11. Apparently, the province years ago.

## Contests

Contests in May are: May 5-6, two metre and seventy cms open; 5-6, Bermuda c.w. contest; 5-6, OZ-CCA c.w. contest; 6, 70cm fixed contest; 12-13, Jubilee phone contest; 12-13 Russian c.w. contest; 19-20, Jubilee c.w. contest; 20, S. Manchester DF qualifying round; 27, two metre portable contest; June 2-3, National Field Day.

## Logs

**L. Tarassenko** (Dorchester, Dorset) opens the logs for this month with a little piece entitled "Heard on Eighty Metres". This work was played on a G3JDG receiver (modified) (how dare you Sir?), accompanied by an a.t.u. and a "W3DZZ dipole". Squirts of s.s.b. from: CN8BDO, CT3AR, EA6BJ, EA6BT, FC2WS, HB0AWQ, KP4AN, KV4CI, KZ5JF, M1I, OH0MA, VO1FJ, VP2LI, W1TAT, WA2HSU, W4RQ, W5PWW, ZL3GS, 3A2EE, 4W1AF, 4Z4EF, 6W8DY, 9H5D.

**Stephen Glover** (Castleford, Yorks, neat handwriting) has a 9R59DS and a poor 30ft. aerial (wonder what a rich aerial is like?) Savoured on 80m s.s.b.: CN8BF, ET3USF, FP8DH, JX5EN, KP4AN, KV4FZ, OD5LX, OD5BA, OY5NS, OY7BA, PZ2OA, VP2SAF, VP7ND, W2PV, YA1OS, ZS2MI, 9H4KN. On 20 metres s.s.b.: CR6AB, KV4CL, OA2WC, OD54D, VK2WC, VK6VW, 4X4BL, 9H4KN, 9V1QQ.

St. Peter-in-the-wood is where **Roger Sarre** lurks. It is located at Guernsey in the Channel Islands. Fellow lurkers include an HRO and a 30ft. end fed. Results of combined lurks: CN8BF, CN8GG, CR7IC, EP2BI, KP4AN, OD5GC, VE1ADV, VEIAM, VO1FN, VP2L1, ZB2CF, ZC4EJ, 4X4BL, 4X4UF, 4Z4DX, 7X0GM, 9H5C all 3.5MHz s.s.b. An h.f. lurk revealed: CN8CG, CT2AK, CR3RY, CR6FW, CR7IZ, EA8GK, EL2DT, EL8G, EP2TC, FP8AA, HC2PY, HI8LC, KP4BAJ, K6RMM, KV4AD, LU8EDN, ST2SA, SV1BS, W4D1W/P/VP7, XT2AC, ZD3D, ZD3X, 4Z4MO, 5B4AC, 5N2AAN, 6W8AL, 9E3USA all s.s.b. on 15 metres.

### BROADCAST BANDS

Short Wave Reports by 15th of the month to **Malcolm Connah**, 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

Medium Waves 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

#### Short Wave/VHF

Logs in alphabetical order please by 15th of the month to **David Gibson**, G3JDG, 12 Cross Way, Harpenden, Hertfordshire.

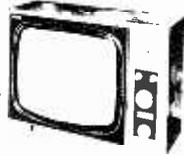


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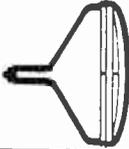
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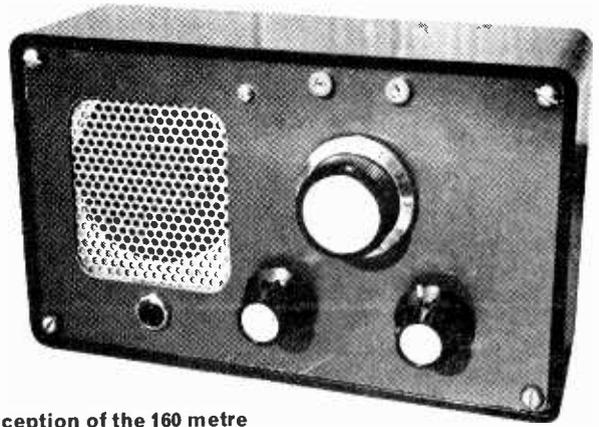
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The receiver described here covers the usual medium wave band of about 500kHz to 1.6MHz and in addition has a high frequency bandspread range covering 1.5MHz to 2.15MHz. This includes those transmissions at the h.f. end of the MW range and the 1.8MHz to 2.0MHz band, so the receiver will give reception of 160 metre amateurs, as well as shipping and other signals. There is provision for adding an external aerial if wanted and for using headphones.

## RECEIVER CIRCUIT

SW1 (see Fig. 1), is a 3-pole 3-way switch, one position giving "Off." L1 is the ferrite rod winding

which is tuned by VC1a and VC1b which are in parallel for MW reception. For the higher frequency range, SW1 disconnects VC1a and C1 is in series with VC1b, resulting in a coverage of about 1.5MHz to 2.15MHz with the full swing of VC1b.

VC1 is a readily available ganged capacitor. It is possible to obtain h.f. bandspread by using a 365pF or similar capacitor in the VC1b position, VC1a being omitted and C1 being 30pF, but this has the disadvantage that most of the frequency coverage is then compressed into a quite small part of the rotation of VC1b, giving cramped tuning at the h.f. end of this band. This arises from the tuning "law" achieved with fixed and variable capacitors in series, and a much more even spread of frequencies across the dial is obtained by having a small value for VC1b.

L2 is the base coupling winding, and L3 is for an external aerial, when used. A to F are pins on the circuit board for leads to other items. Tr1 acts as r.f. amplifier. TC1 is a pre-set adjusted for suitable feedback to L1, and the potentiometer VR1 controls

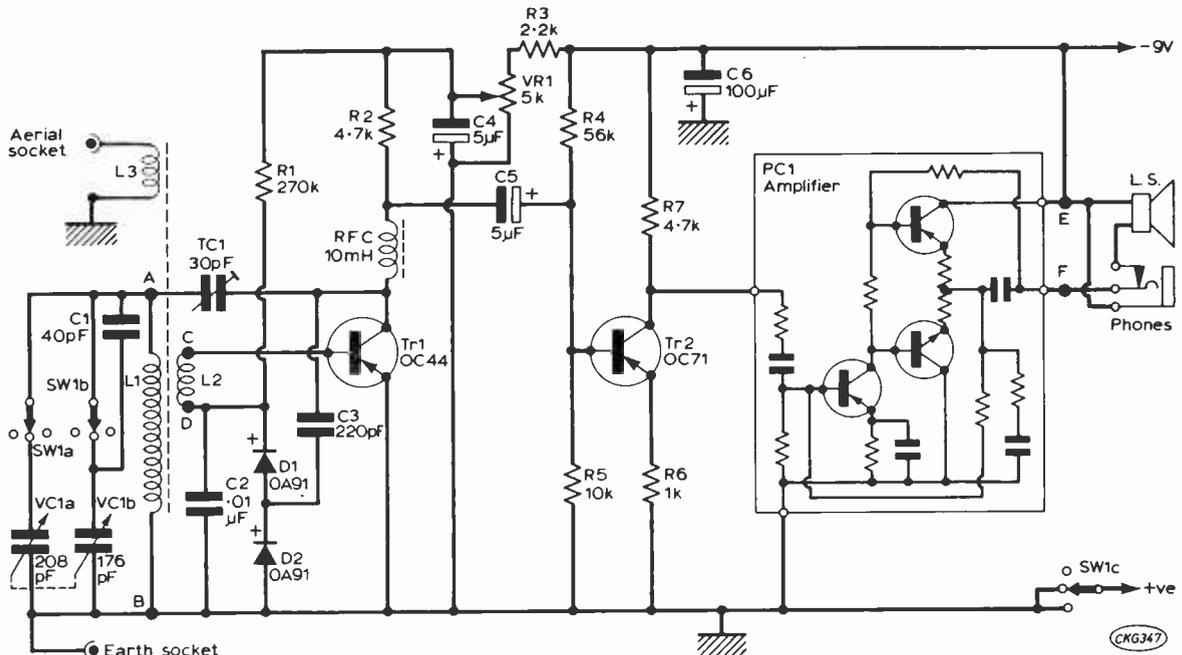


Fig. 1: The circuit of the receiver. Tr1 acts as both an r.f. and a.f. reflexed stage, Tr2 as an audio pre-amplifier and the three transistors in the PC1 package as the audio output stage.

regeneration. Demodulation is by diodes D1 and D2 and audio signals pass through L2 to Tr1, which is a reflexed amplifier with a.f. output developed across R2 and thus reaching the base of Tr2.

Tr2 is followed by the PC1 package. This is a 3-transistor medium gain amplifier of the directly coupled transformerless complementary symmetry type. The NPN-PNP output pair provide about 125mW for a 40Ω or similar speaker. Results are also satisfactory with a 30Ω to 80Ω speaker and the output can instead be taken to phones. Inserting the phone plug disconnects the speaker. The use of this amplifier considerably simplifies construction. It has only four external connections—positive line, negative line, audio input, and output to the speaker.

The whole receiver with speaker is constructed entirely on a panel and perforated board, for easy testing out of its case.

## FERRITE AERIAL

Wind a strip of paper 1½in wide on the rod, and secure with a little adhesive, leaving the tube free to slide on the rod. Beginning at the SW1 end, Fig. 2, wind 65 turns of 26s.w.g. enamelled wire side by side for L1, finishing at the chassis end. The ends can be fixed with adhesive or tape. The whole winding should not be painted with adhesive, and turns should not be so tight that the tube and winding cannot be moved on the rod.

A very small space (say ¼in.) is left and L2 is wound in the same direction, beginning with the end to go to pin D. L2 has 6 turns of 34s.w.g. enamelled wire. L3 is similarly wound on a strip of paper about ¾in. long and has 25 turns of 34s.w.g. wire.

The rod is mounted on a strip of paxolin 1¾in. x ¾in. which is secured to the panel by a small bracket. A strip of card or other material passes

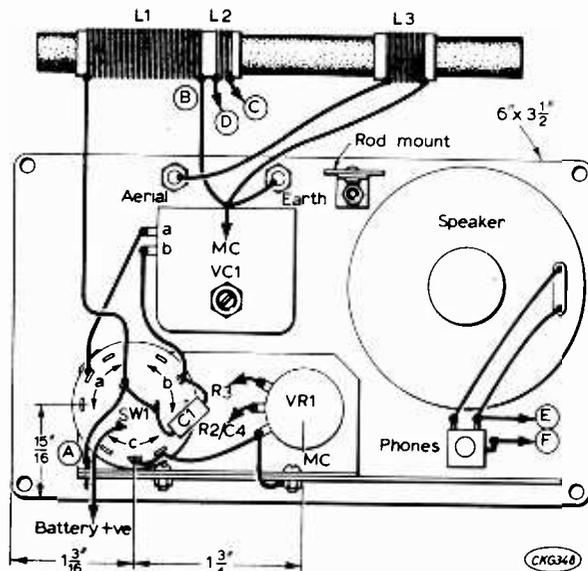


Fig. 2: The component wiring on the reverse of the front panel, together with details of the coil connections.

round the rod and is clamped with a 6BA bolt also through the paxolin.

## PANEL

This is 6in. x 3½in. for the case listed, but could be changed to suit a plastic lunch box or other case. Holes are drilled to locate the switch and VR1 as in Fig. 2.

A round hole may be cut to match the speaker cone, and the speaker can be placed behind gauze or other suitable fabric or perforated metal. If a rectangular hole is made, this can be about 2½in. x 1¾in. Gauze is then cemented on, followed by a piece of stout card with an aperture to match the speaker cone.

The speaker is fixed with adhesive or with screws through fixing lugs if these are present. The phone jack is immediately below, as in Fig. 2.

VC1 requires a ½in. clearance hole, and three holes for 4BA bolts. Drilling positions can be accurately marked by passing a piece of paper over the spindle, and piercing through this, using it as a template. The 4BA bolts must only project the thickness of the capacitor frame behind the panel.

L3 is connected to small sockets for aerial and earth, as in Fig. 2.

## CIRCUIT BOARD

A piece of aluminium about 3in. x 1½in. is drilled to match the panel holes for the switch and VR1, Fig. 2, and has a flange which is bolted to the circuit board, Fig. 3. The completed board is thus held by the bushes of the switch and VR1, when wiring is finished.

Figure 3 shows both the top and bottom of the board. A Veropin is inserted at A, for the connection to SW1. Pin B is the earth return for the tuning capacitor and L1.

Pin C is for lead C from L2, and for Tr1 base, Fig. 3. Pin D is the other end of L2.

Pins E and F are connected to the speaker, one

## ★ components list

### Resistors

R1 270kΩ—see text	R5 10kΩ
R2 4.7kΩ	R6 1kΩ
R3 2.2kΩ	R7 4.7kΩ
R4 56kΩ	All ±w 10%
VR1 small 5kΩ log pot.	

### Capacitors

C1 40pF silver mica
C2 0.01μF
C3 220pF
C4 5μF 10V min.
C5 5μF 10V min.
C6 100μF 12V
VC1 208/176pF, Jackson 00
TC1 30pF miniature trimmer

### Miscellaneous

- L1/L2/L3 see text. 5 x ½in. ferrite rod.
- Tr1 OC44
- Tr2 OC71
- PC1 Newmarket package amplifier.
- 2in. or 2½in. speaker, about 30-60Ω.
- RFC 10mH miniature cored choke.
- D1 OA91
- D2 OA91
- 3-pole 3-way small rotary switch.
- Veroboard, pins, etc.
- 6 x 3½ x 2in. case.
- Knobs, two small sockets, jack socket (switched).

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Individual prices of these are: 2 track record playback heads 50p each. 4 track record playback heads 75p each. Brass heads are also available separately 2 track 17p - 4 track 28p.

**1 R.P.H. MOTOR**

Made by the famous Smiths Company. 240v 50 cycle mains working. Ideal motor to drive clock mechanisms. Price £1-10p each or 10 for £9-90

**MULTI-SPEED MOTOR.**

Six speeds are available 500,850 and 1,100 r.p.m. And 8,000, 12,000 and 15,000 r.p.m. Shaft 1/4" diameter and approx. 1 1/2" long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2" dia. x 3" long. Price 97p plus 23p post and insurance.



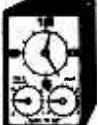
**MAINS OPERATED CONTACTOR**

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2 1/2" x 2 1/2" x 1 1/2". £1-65 each.



**TELESCOPIC AERIAL**

For portable, car radio or transmitter. Chrome plated six sections, extends from 7 1/2 to 47in. Hole in bottom for GBA screw. 42p. KNUCKLED MODEL FOR P.M. 55p.



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

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	44p	44p							
2 poles	44p	44p							
3 poles	44p	44p							
4 poles	44p	44p							
5 poles	44p	44p							
6 poles	44p	44p							
7 poles	77p	77p							
8 poles	77p	77p							
9 poles	77p	77p							
10 poles	77p	77p							
11 poles	77p	77p							
12 poles	77p	77p							

**THYRISTOR LIGHT DIMMER**

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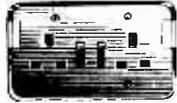
**HORSTMANN 'TIME AND SET' SWITCH**

(A 30 amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip-price: £1-65. p. & ins. 23p.



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Offered at less than wholesale price—your opportunity to replace those dangerous adaptors—brown bakelite flush mounting—standard fitting. Unswitched 22p each, separately switched 33p each. Separately switched less 10% ten or more + 20p postage if order under £5.



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**MULLARD UNILEX** This D.I.Y. Stereo Amplifier is still available complete at £7-70 for the four Mullard Modules, or Modules can be bought separately as follows—4 watt amplifier module (2 required) Mullard Ref. No. E.P.9000—£1-40 each. Pre amp module Mullard Ref. No. E.P.9001—£1-98 each. Power module—Mullard Ref. E.P.9002—£2-33 each. In addition and made to Mullard Specification we offer: Standard Control Unit with escutcheon—£2-75. Knobs—Set of 4—55p. Unit—£2-54 with Set of Knobs—£3p. Mullard Unilex Handbook—£2p.

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Mini Immersion Heater. 350w 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. £1-25. Post and insurance 14p. 12v. car model also available same price. Jug heater £1-75 plus p. & p. 14p.



**MAINS TRANSISTOR POWER PACK**

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: P1, P2, P3, P4, P5, P7, P9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only £1-10 plus 20p postage.

**TREASURE TRACER**

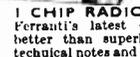
Complete Kit (except wooden battery) to make the metal detector as the circuit in Practical Wireless, August issue. £2-30 plus 20p post and insurance.

**WINDSCREEN WIPER CONTROL**  
Beat dirty roads, drizzle, fog, etc. Kit of parts to make this useful accessory with circuit details £2-50.



**12 VOLT 1 1/2 AMP. POWER PACK**

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mA/t/d smoothing. Price £2-20 plus 20p post & packing.



**1 CHIP RADIO**

Ferranti's latest device ZN414—gives results better than superhet. Supplied complete with technical notes and circuits. £1-85 each, 10 for £12.

**HI-G TUNER COMPONENTS**

For experimenting with the ZN414. KIT NO. 1. Plessey Miniature Tuning Condenser with built-in LW switch and 3" Ferrite slab and litz wound MW coil, 72p. KIT NO. 2. Air spaced tuning condenser 5" ferrite rod litz wound MW and LW coils, 99p. KIT NO. 3. Air spaced TC with slow motor drive 8" ferrite rod, with litz wound LW and MW coils, £1-10. KIT NO. 4. Permeability tuner with fast and slow motion drive and LW loading coils, 50p.

**DRY FILM LUBRICANT**

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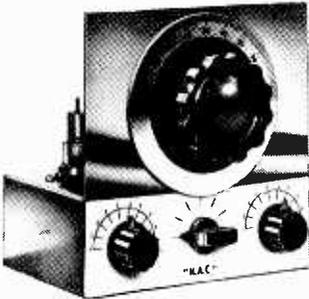
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Output V. & Amps.	Ref. No.	Add 10% V.A.T.	Price P. & P.
12V x 2 250 mA x 2	MT111 CS*	...	£0.91 9p
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12V x 2 3A x 2	MT 70 AT*	...	£2.56 32p
12V x 2 4A x 2	MT 108 AT*	...	£2.92 34p
12V x 2 5A x 2	MT 72 AT*	...	£3.38 42p

Output	Ref. No.	Price P.P.	Output	Ref. No.	Price P.P.
500 mA	MT 112 CI†	1-12 16p	3A	MT 20 AT	2-84 32p
1A	MT 79 AT†	1-55 29p	4A	MT 21 AT	3-10 40p
2A	MT 3 AT	2-28 30p	5A	MT 51 AT	4-31 42p

50 volts. All tapped at 0-19-25-33-40-50V.	60 Volts. All tapped at 0-24-30-40-48-60V.				
500 mA	MT 102 AT†	1-45 24p	3A	MT 105 AT	3-61 41p
1A	MT 103 AT†	2-00 32p	4A	MT 106 AT	3-06 41p
2A	MT 104 AT†	3-10 32p	6A	MT 107 AT	4-47 50p
500 mA	MT 124 AT†	1-46 30p	2A	MT 127 AT	3-16 41p
1A	MT 126 AT†	2-24 32p	3A	MT 125 AT	4-59 41p

Power output	Winding tapped at	Ref. No.	Price P. & P.
20 VA	0-115-210-240	MT 113 CT	20-89 15p
75 VA		MT 61 AT	31-78 30p
150 VA	0-115-200-220-240	MT 4 AT	22-15 32p
200 VA		MT 65 AT	23-06 32p
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C-D Ignition system by R. M. Marston			£2.30 29p

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3-0-3 V.	200 mA	MT 238 CS†	20-89 8p
9-0-9 V.	100 mA	MT 13 CS†	20-91 8p
12-0-12	50 mA	MT 239 CS†	20-91 8p
20-0-20	30 mA	MT 241 CS†	20-91 8p
0-20-20	300 x 2	MT 214 CT†	21-21 16p
0-8-0 x 2	500 mA x 2	MT 207 CT†	21-46 19p
0-15-20 x 2	500 mA x 2	MT 203 AT†	22-12 28p
0-15-27 x 2	500 mA x 2	MT 203 AT†	22-46 29p
0-15-27 x 2	1A x 2	MT 204 AT*	23-48 30p
20-12-0-12-20	700 mA (d.c.)	MT 221 AT*	21-11 26p

AT Indicates open universal fixing with tags; CT is open U-clamp fixing with tags; CS is open U-clamp fixing with P.C. spalls; \* with interwinding screen; † untapped 240V Primary; ‡ Primary tapped at 210-240V. other Primaries tapped at 200-220-240V.

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## HARTLEY 13A D.B. SCOPES

General purpose double beam scope for use on 200/250 mains, band width 100 Kc to 4.5 Mc/s depending on gain settings, time markers, int ext sync., etc. Note these are supplied with C.F. probe, mains lead, front cover, circuit, but are less graticule and test leads. Supplied in used condition but tested prior to dispatch.  
Price £25.30 plus £1.65 carr.

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These well known Rx cover the range 1.5 to 12 Mc/s in 3 bands, i.e. 160, 80 and 40 meter Amateur bands, have good band spread, R.F. gain control or AVC operation, B.F.O. etd. Supplied complete with mains P.U. and Headphones in used cond. Tested and aligned prior to dispatch. Few only.  
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American service type 177-B 115v I/P at 60 watts, will test UX, Octal, Acorn, B7g, Loctal etc. Supplied with inst and test data and circ., also supplied is circ for add on adaptor that will extend range to include B9a, low power Tx types etc. No special parts are required to make this adaptor, supplied in used cond., tested.  
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Moving coil type, with lead and plug. Low res type. Headphones have soft ear pads. New, boxed.  
Price £1.37 plus 30p post.

## SIGNAL GENERATORS TF144G

Marconi sig gens cover range 85Kc to 25 Mc/s, with O/P meter atten. etc., for use on 200/250v mains. Supplied with circ and copy of inst. book. Supplied less leads, tested.  
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Small double ended blower, ratings full O/P 27.5v D.C. at 3-8a 10,000RPM, however, these can be operated on any D.C. voltage from 2 to 27.5 rating on 12v 1-8a. Size outlets 1 1/2 sq., overall size 6" long, 3" dia. These are a very powerful blower and on 12v give considerable air flow. New, boxed, American surplus.  
Price £1.54 plus 25p post.

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Circular scale type, scaled 0 to 200 linear for approx. 135 deg. could be used up to 180 deg. if required. Ex equip. Tested, American surplus.  
Price £1.37 plus 15p post.

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## A. H. SUPPLIES

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Phone 0742 444278

circuit running through the jack contacts, Fig. 1, so that the speaker is not in circuit when a plug is inserted. Pin E is also the battery negative line.

Fit the resistors and other items as in Fig. 3, positioning the leads approximately as shown on the underside of the board. In most places the wire ends are long enough to reach the connecting points. Sleeving is put on wires which may touch other wires or joints.

The transistors can have about  $\frac{3}{8}$  in. of lead above the board. Lengthy heating of the transistor and diode wires should be avoided when soldering. The diodes and polarised capacitors must be put in as shown.

## AF AMPLIFIER

Drill fixing holes to match the holes in the amplifier board. Solder four leads to the four circuit connecting points on the board, and these leads will then come through the Veroboard as in Fig. 3. They are taken to the positive line, pin E (negative line), pin F (speaker) and Tr2 collector and R7. Place extra nuts or washers between the amplifier and Veroboard to act as spacers.

## ASSEMBLY

The bushes of the switch and VR1 can now be put through the panel holes, so that the nuts hold the board as in Fig. 2. Leads C and D (L2) and other connections are cut to length, sleeving is put on where necessary, and wiring is completed as shown.

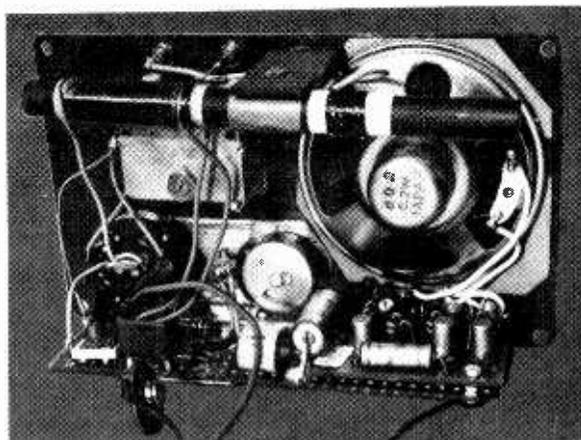
As miniature phone jacks are made in various types, check that connections here are correct. With no plug in, the circuit must run from pins E and F to the speaker. When a plug is inserted, this interrupts the circuit to the speaker and the jack tip is in contact with circuit F so that the phones operate instead. The amplifier ought not to be operated with a load of under 30Ω.

## ADJUSTMENTS

If necessary, band coverage can be modified by moving L1/L2 along the rod. Moving it towards the end of the rod increases the frequency reached with VC1 fully open. This frequency limit can be around 1600 to 1500kHz for MW and 2.2MHz to 2.0MHz for the h.f. range.

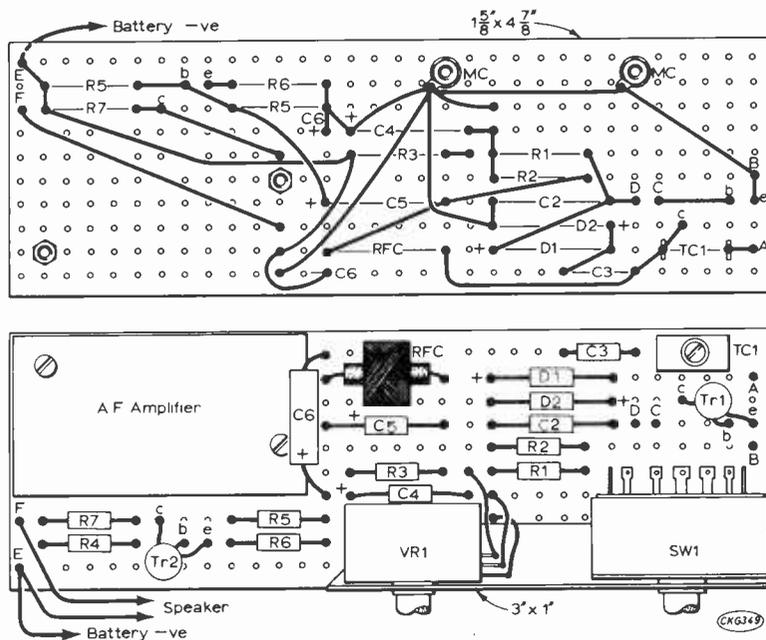
TC1 should only require to be screwed down slightly, so that oscillation can just be secured with VR1 at the l.f. end of the MW band.

VR1 does control volume, but is *not* a volume control, and merely turning it to maximum is unsatisfactory. Instead, it should be advanced slowly from minimum setting until oscillation *just* arises when



A rear view of the prototype.

Fig. 3: The component layout on the circuit board; the top section shows the underside wiring.



tuning through a transmission. It is then backed off very slightly. The setting of VR1 is quite critical for maximum possible sensitivity, and varies with frequency. With optimum adjustment, very many signals can be received.

R1 should be satisfactory at 270kΩ, but as diodes D1 and D2, and Tr1 will vary, the effect of changing R1 may be tried. A value from about 150kΩ to 330kΩ should be satisfactory, and it may be found that some change improves results.

Headphones become useful when listening for weaker signals in the 1.8MHz to 2MHz range, though more powerful signals can be reasonably audible with the speaker.

Reception of amateur and shipping signals will

be greatly improved by an aerial. Also, adding an earth connection can bring about a very useful improvement in signal strength. Even an indoor wire only a few feet long will increase signal pick-up, especially when an earth is available. An outdoor aerial will naturally give more volume, but a very long aerial will tend to result in strong, local signals breaking through. This can be prevented to some extent by placing a small capacitor in series with the aerial lead to the receiver. In all cases the receiver is kept on the point of oscillation for maximum sensitivity and selectivity. For the reception of a.m. signals, oscillation is *just* avoided. To receive c.w., regeneration has to be advanced so that oscillation begins.

## LONG WAVES

If reception of the BBC on 200kHz is required, the simplest method is to shunt L1 with a silver-mica capacitor which will load it to this frequency. In the original receiver, a value of 2000pF, 1 per cent tolerance, was found suitable, and coverage was then about 195kHz to 205kHz with the full swing of VC1 in use. This method is used in some inexpensive receivers. With so much parallel capacitance, very small changes in the inductance of L1 have a considerable influence on frequency. It is thus necessary to slide L1 on the rod, or to make up the parallel capacitance with a pre-set, such as a 1500pF padder with a 1000pF silver mica capacitor in parallel. The padder is then adjusted for 200kHz with VC1 half open, and the latter then allows a narrow band to be covered for correct tuning.

An improved LC ratio is obtained with a LW winding, but this introduces the need for additional switching for L2, for the full advantage to be obtained.

With the 3-way switch, substituting VR1 by a potentiometer with on/off switch allows the third position to give reception of 1500m. Alternatively, a 4-way switch could be fitted here.

The 208/176pF capacitor is produced both with and without an integral reduction drive. The latter is helpful when tuning; if no drive is used the tuning control knob should be of fairly large diameter. ■



Supplement—May 1973

### Tape Tuner

The 2 $\mu$ F capacitor between R5 and chassis is C4 (Fig. 1). Pin 6 on T1-3 is in this case marked as pin 5 (Fig. 2).

### Baby Alarm

T1 has an unused centre tap on the winding connected to Tr3.  
C4+ is connected to R5, Tr4e, C3+.

### Light Powered Radio

In the components list, R1 should be 270k $\Omega$ , C1—0.01 $\mu$ F.

In the text, the mercury cell should be a solar cell and the connections are for transistor AF117. In Fig. 2, Tr1 base should be connected to R1 and C1.

P.W. TRICOLOUR—continued from page 156

The output voltage from the single phase bridge is clipped by a zener diode D1. The shaded part of the sinewave represents the voltage applied to the u.j.t. circuit. The emitter voltage of the u.j.t. drops to zero each time the line voltage crosses zero, so that capacitor C1 is discharged completely to zero every half cycle and charges again at the beginning of a next half cycle at the rate determined by the values of (R1 + VR1) and itself. By varying the resistance of the potentiometer VR1, the charge rate is varied so that the position of the pulses with respect to the supply voltage moves in time.

Fig. 27 shows typical triac gate voltage pulses and the corresponding voltage waveform across the load.

## Lamp Dimming Circuit

The circuit shown in Fig. 24 is basically similar to that of Fig. 12 (part 1). Both the power supply of  $\pm 10V$  for the filter circuit and the mode of controlling the lamps are as before. In fact the only basic differences are the addition of the zener diode D11 and the replacement of the zero voltage switching system by the unijunction transistor circuit. (Filter choke CH1 and capacitor C13 have been added at the input to the circuit for radio frequency interference suppression.)

The unit is suitable for either mono or stereo record playing in the same manner as described earlier. The flashing of the light can be controlled at various light intensity levels by means of the potentiometers corresponding to Bass, Middle and Treble frequencies. Facilities are also provided for 'by passing' the psychedelic control by closing switches S1, S2 and S3 to allow the lamps to be used as ordinary lamp dimmers.

## Radio Interference Suppression

Radio frequency interference problems caused by triac and thyristors phase control can become acute and difficult to suppress to an acceptable level. Many circuits and equipment such as radios, hi-fi amplifiers, etc. are sensitive to these voltage transients and the results are generally unpleasant noises in the speakers and/or causing malfunction of the semiconductor circuits. Each time a triac or thyristor fires in a mainly resistive load, such as lamps, the load current rises in less than a few microseconds from the zero value to its maximum. A frequency analysis of such a step function of current will show an infinite spectrum of energy with the amplitude inversely proportional to frequency. The greatest effect of radio frequency interference is of course, at the peak current, i.e. when the delay angle ' $\alpha$ ' is 90°, and this effect decreases towards '0°' or 180°.

There are two main types of radio frequency interference. One is caused by radiation and the other by conduction through the power leads.

*We stated in the April issue that the author had arranged with Henry's Radio Ltd for the supply of all components. We now understand that the printed circuit board and metalwork as shown in the May 1973 issue will not be available from them.*

TO BE CONTINUED

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SN7404	0.20	0.18	0.16	SN7460	0.20	0.18	0.16	SN74154	2.00	1.75	1.55
SN7405	0.20	0.18	0.16	SN7470	0.30	0.27	0.25	SN74155	1.55	1.47	1.35
SN7406	0.30	0.27	0.25	SN7472	0.30	0.27	0.25	SN74156	1.55	1.47	1.35
SN7407	0.30	0.27	0.25	SN7473	0.40	0.37	0.35	SN74157	1.80	1.70	1.50
SN7408	0.20	0.19	0.18	SN7474	0.40	0.37	0.35	SN74160	2.60	2.40	2.25
SN7409	0.45	0.42	0.35	SN7475	0.55	0.52	0.50	SN74161	2.60	2.40	2.25
SN7410	0.20	0.18	0.16	SN7476	0.45	0.42	0.39	SN74162	3.40	3.25	2.70
SN7411	0.20	0.18	0.16	SN7480	0.80	0.75	0.67	SN74163	3.40	3.25	2.70
SN7412	0.42	0.40	0.35	SN7481	1.25	1.15	1.10	SN74164	2.75	2.50	2.10
SN7413	0.30	0.27	0.25	SN7482	0.87	0.80	0.70	SN74165	4.00	3.50	3.00
SN7416	0.30	0.27	0.25	SN7483	1.00	0.90	0.85	SN74166	4.00	3.50	3.00
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2N467	0.80	2N3704	0.14			ASZ21	0.65	BCY71	0.83	BFY18	0.25
2N491	8.25	2N3705	0.10	40050	0.78	AU103	1.85	BCY73	0.18	BFY19	0.25
2N491	8.25	2N3706	0.09	40050	0.81	BC107	0.14	BCY87	3.47	BFY20	0.50
2N496	0.15	2N3707	0.10	40251	0.83	BC108	0.13	BCY88	3.40	BFY29	0.40
2N497	0.16	2N3708	0.70	40309	0.80	BC109	0.14	BCY89	0.80	BFY37	0.20
2N498	0.25	2N3709	0.09	40310	0.90	BC113	0.13	BCZ10	0.50	BFY43	0.48
2N499	0.25	2N3710	0.12	40313	0.92	BC115	0.15	BD115	0.75	BFY60	0.18
2N706	0.10	2N3711	0.90	40316	0.69	BC116	0.15	BD116	0.75	BFY61	0.18
2N708	0.18	2N3712	0.85	40318	0.69	BC117	0.21	BD124	0.87	BFY66	0.34
2N709	0.88	2N3713	1.08	40329	0.92	BC118	0.11	BD124	0.87	BFY66	0.34
2N709	0.88	2N3714	1.15	40360	0.46	BC119	0.27	BD130	0.87	BFY64	0.41
2N711	0.80	2N3715	1.23	40361	0.46	BC121	0.29	BD132	0.50	BFY76	0.22
2N718	0.21	2N3716	1.80	40362	0.46	BC122	0.29	BD132	0.50	BFY76	0.22
2N718A	0.80	2N3773	2.35	40363	0.88	BC123	0.29	BD132	0.50	BFY76	0.22
2N720	0.50	2N3774	3.38	40369	0.46	BC125	0.15	BD135	0.43	BFY77	0.22
2N721	0.59	2N3775	4.19	40394	0.56	BC126	0.20	BD136	0.49	BFY78	0.36
2N914	0.22	2N3776	5.95	40395	0.56	BC128	0.20	BD137	0.55	BFY90	0.60
2N916	0.17	2N3777	4.84	40406	0.44	BC131	0.11	BD138	0.63	BRY39	0.30
2N918	0.30	2N3778	2.25	40407	0.88	BC132	0.11	BD138	0.63	BRY39	0.30
2N919	0.20	2N3779	3.15	40408	0.50	BC135	0.15	BD140	0.63	BRX20	0.14
2N929	0.14	2N3780	4.90	40409	0.62	BC136	0.15	BD140	0.63	BRX20	0.14
2N930	0.24	2N3781	3.87	40410	0.92	BC137	0.15	BDY10	1.85	BRX21	0.24
2N990	0.20	2N3782	4.84	40411	0.87	BC138	0.20	BDY11	1.80	BRX26	0.80
2N1091	0.24	2N3789	1.78	40414	3.55	BC140	0.84	BDY12	1.50	BRX27	0.84
2N1131	0.20	2N3790	2.20	40438	1.44	BC141	0.89	BDY18	1.75	BRX28	0.85
2N1132	0.20	2N3791	8.05	40467A	0.99	BC142	0.84	BDY18	1.75	BRX28	0.85
2N1202	0.18	2N3792	2.20	40468A	0.44	BC143	0.84	BDY18	1.75	BRX28	0.85
2N1203	0.16	2N3793	1.10	40600	0.99	BC144	0.84	BDY18	1.75	BRX28	0.85
2N1204	0.20	2N3794	1.10	40600	0.99	BC145	0.84	BDY18	1.75	BRX28	0.85
2N1205	0.20	2N3795	1.10	40600	0.99	BC146	0.84	BDY18	1.75	BRX28	0.85
2N1206	0.20	2N3796	1.10	40600	0.99	BC147	0.84	BDY18	1.75	BRX28	0.85
2N1207	0.22	2N3824	0.75	40604	0.56	BC148	0.10	BDY62	0.75	BRX76	0.15
2N1208	0.25	2N3826	0.82	40636	1.10	BC149	0.13	BF116	0.23	BRX77	0.20
2N1209	0.25	2N3854	0.16	40673	0.80	BC153	0.15	BF117	0.48	BRX78	0.25
2N1489	0.90	2N3854A	0.16	AC107	0.85	BC154	0.15	BF119	0.58	BRX79	0.25
2N1507	0.20	2N3855	0.18	AC110	0.18	BC157	0.14	BF121	0.85	BRX79	0.25
2N1613	0.35	2N3856	0.16	AC116	0.18	BC158	0.18	BF123	0.27	BRX79	0.25
2N1637	0.30	2N3856A	0.16	AC117	0.20	BC159	0.14	BF125	0.25	BRX79	0.25
2N1638	0.27	2N3856A	0.16	AC121	0.13	BC160	0.17	BF127	0.27	BRX79	0.25
2N1638	0.27	2N3856A	0.16	AC126	0.85	BC167B	0.87	BF152	0.20	BRX78	0.15
2N1701	1.10	2N3859A	0.16	AC127	0.25	BC168C	0.11	BF154	0.16	BRX39	0.15
2N1702	2.15	2N3859B	0.16	AC128	0.25	BC168C	0.11	BF154	0.16	BRX39	0.15
2N1711	0.12	2N3859A	0.18	AC141K	0.30	BC169B	0.13	BF158	0.15	BRX76	0.25
2N1893	0.34	2N3860	0.16	AC142K	0.25	BC169C	0.13	BF159	0.27	BRX76	0.25
2N2102	0.30	2N3866	0.70	AC151V	0.14	BC170	0.11	BF160	0.28	BRX76	0.25
2N2147	0.70	2N3877	0.25	AC152V	0.17	BC171	0.18	BF161	0.35	BRX76	0.25
2N2148	0.60	2N3877A	0.86	AC153	0.22	BC172	0.11	BF163	0.20	BRX76	0.25
2N2192	0.40	2N3878	1.88	AC153K	0.25	BC182	0.13	BF165	0.35	BRX76	0.25
2N2192A	0.40	2N3878	1.91	AC154	0.20	BC182L	0.12	BF167	0.18	BRX78	0.40
2N2193	0.40	2N3900	0.80	AC176	0.18	BC183	0.09	BF173	0.19	BRX79	0.40
2N2193A	0.42	2N3900A	0.81	AC176K	0.20	BC183L	0.09	BF177	0.25	BRX79	0.40
2N2194	0.27	2N3901	0.38	AC187K	0.20	BC184	0.11	BF178	0.25	BRX96A	0.45
2N2194A	0.30	2N3903	0.20	AC188K	0.28	BC184L	0.11	BF179	0.40	BU104	1.42
2N2195	0.37	2N3904	0.17	ACY17	0.25	BC185	0.09	BF180	0.25	BU105	2.25
2N2196A	0.18	2N3906	0.22	ACY18	0.25	BC187	0.25	BF181	0.82	CI111	0.58
2N2197	0.18	2N3906	0.22	ACY19	0.20	BC204	0.11	BF182	0.80	D40N3	0.82
2N2219	0.87	2N4036	0.93	ACY20	0.20	BC206	0.10	BF182	0.40	GET111	0.65
2N2219A	0.61	2N4037	0.42	ACY21	0.18	BC206	0.11	BF184	0.17	GET113	0.20
2N2220	0.20	2N4058	0.16	ACY22	0.13	BC207	0.10	BF185	0.17	GET114	0.20
2N2221	0.20	2N4059	0.09	ACY28	0.18	BC208	0.09	BF186	0.15	GET115	0.50
2N2221A	0.23	2N4060	0.09	ACY30	0.45	BC209	0.10	BF185	0.15	GET119	0.85
2N2222	0.20	2N4060	0.11	ACY39	0.55	BC211	0.80	BF196	0.15	GET120	0.25
2N2222A	0.41	2N4061	0.11	ACY40	0.17	BC212K	0.10	BF197	0.15	GET120	0.25
2N2368	0.11	2N4062	0.11	ACY41	0.17	BC212L	0.16	BF198	0.15	GET126	0.20
2N2369	0.19	2N4302	0.25	ACY44	0.81	BC214L	0.23	BF199	0.18	GET126	0.20
2N2369A	0.37	2N4303	0.38	AD186V	0.98	BC236	0.16	BF207	0.14	GET126	0.20
2N2646	0.50	2N4913	0.80	AD140	0.50	BC237	0.09	BF224J	0.19	GET127	0.12
2N2647	1.50	2N4914	0.87	AD140	0.55	BC238	0.09	BF225J	0.22	GET180	0.20
2N2711	0.12	2N4915	0.95	AD142	0.50	BC239	0.09	BF227	0.22	GET180	0.20
2N2712	0.12	2N4916	0.20	AD143	0.45	BC251	0.20	BF238	0.22	GET183	0.20
2N2713	0.17	2N4917	0.17	AD149V	0.68	BC252	0.18	BF244	0.18	GET187	0.20
2N2714	0.17	2N4918	0.50	AD149V	1.88	BC253	0.23	BF245	0.48	GET189	0.22
2N2904	0.18	2N4919	0.58	AD150	0.65	BC257	0.08	BF246	0.48	GET189	0.22
2N2904A	0.19	2N4920	0.60	AD161	0.37	BC258	0.09	BF247	0.48	GET189	0.22
2N2905	0.28	2N4921	0.50	AD162	0.87	BC259	0.13	BF254	0.14	TIP29A	0.48
2N2905A	0.23	2N4922	0.55	AD161	0.87	BC261	0.20	BF255	0.15	TIP30A	0.59
2N2906	0.18	2N4923	0.60	AD162	0.89	BC262	0.18	BF257	0.41	TIP31A	0.62
2N2906A	0.23	2N4926	0.90	ADZ11	1.50	BC263	0.23	BF258	0.48	TIP32A	0.74
2N2907	0.18	2N4927	1.00	ADZ12	1.75	BC300	0.48	BF263	0.20	TIP33A	1.01
2N2907A	0.25	2N4928	1.00	AF108R	0.40	BC301	0.34	BF264	1.45	TIP34A	1.51
2N2908	0.12	2N4929	2.28	AF108R	0.40	BC302	0.27	BF261	0.25	TIP35A	2.90
2N2924	0.12	2N4930	2.25	AF114	0.25	BC303	0.54	BF270	0.25	TIP36A	3.70
2N2925	0.12	2N4931	2.70	AF115	0.24	BC304	0.43	BF271	0.21	TIP36A	3.70
2N2926	0.10	2N5172	0.02	AF116	0.25	BC307	0.10	BF272	0.53	TIP41A	0.79
Green	0.10	2N5174	0.22	AF117	0.20	BC307A	0.10	BF273	0.53	TIP42A	0.90
Yellow	0.10	2N5175	0.28	AF118	0.25	BC308	0.09	BF274	0.53	TIP295S	0.98
Orange	0.10	2N5176	0.32	AF119	0.22	BC309	0.09	BF275	0.85	TIP295S	0.98
2N3053	0.31	2N5245	0.48	AF124	0.24	BC308A	0.09	BF458	0.85	TIP295S	0.98
2N3054	0.47	2N5190	0.92	AF125	0.20	BC308B	0.09	BF459	0.85	TIP295S	0.98
2N30											



# MULTIMETERS for EVERY purpose!



**TS60 POCKET MULTIMETER**  
High-precision at low-cost.  
Ranges: D.C. 15V, 150V, 1,000V (10,000 opv). A.C. 15V, 150V, 100V (1,000 opv). D.C. Current 150mA.  
Resistance 100k ohms.  
#1-85. Post 15p.

**MODEL 1092 TESTMETER**

5,000 O.P.V.  
0/3/15/150/300/1200 V.  
D.C. 0/6/30/300/600 V.  
A.C. 0/300μA/300 MA  
0/10K/1 meg  
Decibels -10 to +16db  
\$2-75 each +15p P. & P.



**HIOKI MODEL 720X**  
20,000 O.P.V.  
Overload protection  
5/25/100/500/1000 VDC.  
10/50/250/1000 VAC.  
500μA/250mA. 20K/2 meg  
ohm -5 to +63db.  
\$4-97. P. & P. 15p.

**HIOKI MODEL 730X**  
30,000 O.P.V. Overload protection.  
6/30/60/300/600/1200 VDC. 12/60/120/600/1200 VAC. 60μA/30 mA/300 mA. 2K/200K/2 megohm. -10 to +63db.  
\$2-50. P. & P. 15p.



**KAMODEN 72.200 MULTITESTER**

High sensitivity tester. 200,000 o.p.v. Overload protection. Mirror scale.  
Ranges: 0/-96/-3/3/30/120/600/1200V. D.C. 0/3/12/60/300/11,200V. A.C. 0/6mA/1.2mA/120mA/600mA/12A. D.C. 0/12A/1C. -20 to +63db.  
0/2K/200K/2 meg/200 meg ohms.  
#18-95. Post 30p



**MODEL TE-200**

20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50 μA/250 mA. 0/60K/6 meg Ω -20 to +63db.  
\$2-95. P. & P. 15p.



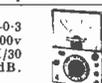
**MODEL 500**

30,000 O.P.V. with overload protection mirror scale. 0/5/25/100/250/500/1,000V. D.C. 0/2/5/10/20/100/250/500/1,000V. A.C. 0/60μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg/60 Meg Ω  
\$2-87. Post paid.



**HIOKI MODEL 750X**

50,000 o.p.v. 43 ranges 0-0.3 to 1,200V. D.C. 0-3 to 1,200V. A.C. 0-30μA/300mA. 0-3K/30 meg ohms. -10 to +17dB.  
\$2-97. Post 20p.



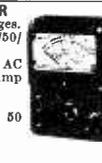
**HT100B4 MULTI-METER**

Features A.C. current ranges. 100,000 o.p.v. Mirror Scale, Overload protection.  
0/5/25/100/250/500/1000 V D.C.  
0/2/5/10/50/250/1000 V. A.C. 0/10/250μA/25/250/250 MA/10 Amp. D.C.  
10 Amp A.C. 0/20K/200K/2MEG/20 MEG. -20 +62db.  
#15-00. P. & P. 25p.



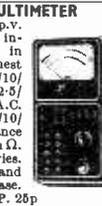
**370 WTR MULTI-METER**

Features A.C. current ranges. 20,000 o.p.v. 0/5/25/100/500/2500 1000 V. D.C. 0/2/5/10/50/250/500/1000V. A.C. 0/50μA/1/10/100mA/10 Amp D.C. 0/100mA/1/10 Amp A.C. 0/5K/50K/500K/5 MEG/50 MEG. -20 +62db.  
#15. P. & P. 25p.



**RUSSIAN 22 RANGE MULTIMETER**

Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2.5/10/50/250/500/1000V. D.C. 2.5/10/50/250/500/1000V. A.C. DC Current 100mA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE \$2-97. P. & P. 25p

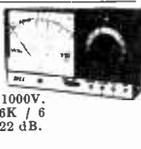


**ROUND SCALE TYPE PENCIL TESTER**

MODEL T.S.48  
Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY \$1-97 P. & P. 15p.

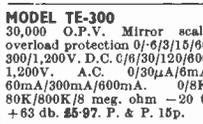
**LT601 MULTIMETER**

New style 20,000 o.p.v. pocket multi-meter. 5/25/50/250/500/2500 V. D.C. 10/50/100/500/1000V. A.C. 50μA/250mA. 6K/6 meg ohms. -20 to +22 dB.  
\$2-75. Post 20p.



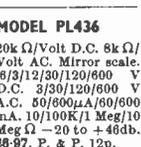
**MODEL TH-12**

20,000 o.p.v. Overload protection. Slide switch selector. Ranges: 0/-25/25/10/50/250/1000V. D.C. 0/10/50/250/1000V. A.C. 0/50μA/25/250mA. D.C. 0/3K/30K/300K/3 meg -20 to +50dB  
\$4-97. Post 15p.



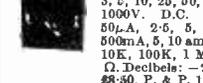
**MODEL TE-300**

30,000 O.P.V. Mirror scale, overload protection 0/6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm -20 to +63 db. \$2-97. P. & P. 15p.



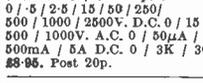
**MODEL PL436**

20k Ω/Volt D.C. 8k Ω/Volt A.C. Mirror scale. 6/3/12/30/120/600 V. D.C. 3/30/120/600 V. A.C. 50/600μA/60/800 mA. 10/100K/1 meg/10 Meg Ω -20 to +43db.  
\$2-97. P. & P. 12p.



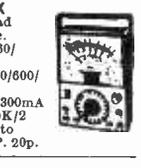
**TMK MODEL TW-50K**

46 ranges, mirror scale, 50K/Volt. D.C. 5K/Volt A.C. D.C.: Volts -125, -25, 1-25, 2-5, 5, 10, 25, 50, 125, 250, 500, 1000V. A.C. Volts: 1-5, 3, 5, 10, 25, 50, 125, 250, 500V. D.C. Current: 25, 50μA, 2-5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: -20 to +81-5db  
\$2-80. P. & P. 17p.



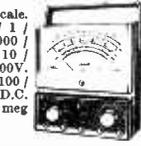
**MODEL K228A**

Taut band suspension. Overload protection. Polarity reversing switch. 30,000 o.p.v. 0/1-5/2-5/15/50/250/500/1000V. D.C. 0/15/50/150/500/1000V. A.C. 0/50μA/5/50/150/500mA/5A. D.C. 0/3K/300K/3 meg. \$2-95. Post 20p.



**HIKOKI MODEL 700X**

100,000 O.P.V. Overload protection. Mirror scale. 3/4/7-2/15/3/6/15/30/60/120/500/600/1200V. D.C. 1-5/3/6/12/30/60/140/300/600/1200 V. A.C. 15/30μA/3/6/30/60/150/300mA 6/12 AMP. DC. 2E/200K/2 Meg/20 Meg ohm -20 to +63dB. #15-50. P. & P. 20p.



**MODEL C-7080 EN**

Giant 6" mirror scale. 20,000 o.p.v. 0/-25/1/2-5/10/50/250/1000/5000V. D.C. 0/5-5/10/50/250/1000/5000V. A.C. 0/50μA/1/10/100/500mA/10 amp. D.C. 0/2K/200K/2 meg -20 to +50 dB.  
#18-95. Post 35p.



**U4312 MULTIMETER**

Extremely sturdy instrument for general electrical use. 687 o.p.v. 0/3/1-5/7-5/30/60/150/300/600/900 VDC and 75mV. 0/3/1-5/7-5/30/60/150/300/600/900 VAC. 0/300μA/1-5/5/15/60/150/600mA/1-5/6 AMP. D.C. 0/1-5/6/15/60/150/600mA/1-5/6 AMP. A.C. 0/200 Ω/3K/30K Ω. Accuracy DC 1%, AC 1-5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. \$2-50 plus P. & P. 25p.

# Selected TEST EQUIPMENT

**FTC-401 TRANSISTOR TESTER**

Full capabilities for measuring A, B and Ico. NFN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads.  
\$7-50. Post 20p.



**TE-16A TRANSISTORISED SIGNAL GENERATOR**

5 ranges 400KHz-30mHz. An inexpensive instrument for the handyman. Operates on 9v. battery. Wide easy to read scale. 800KHz modulation. 5 1/2 x 5 1/2 x 3 1/2 in. Complete with instructions and leads. \$7-97. Post 25p.



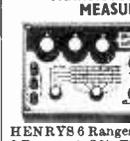
**Model 5-100TR MULTIMETER/TRANSISTOR TESTER**

100,000 o.p.v. mirror scale/overload protection. 0/12/-6/3/12/30/120/600 V DC. 0/6/30/120/600V. A.C. 0/12/600μA/12/300mA/12 AMP. DC. 0/10 K/1 MEG/100MEG. -20 to +50db. 0.01-2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. \$18-50. P/P 25p.



**TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE**

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω 1:1:1 meg Ω 6 Ranges ±1% L.1 μ H - 111 HENRY'S 6 Ranges 2-2% C.10P/1-1110MFD 6 Ranges ±2%. TURN'S RATIO 1:1/1000-1:1/100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA Meter Indication. Attractive 2 tone metal case. Size 7 1/2 x 5 x 2 in. \$20. P. & P. 25p.



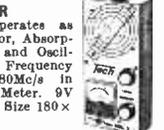
**MODEL 449A IN CIRCUIT TRANSISTOR TESTER**

Checks true A.C. beta In. out. Checks Ico. Checks diodes in / out. Checks SCR, etc. Beta HI 10 - 500, LO 2 - 50. Ico 0-5000μA. 220/240 V. A.C. operation  
\$17-50. Post 25p.



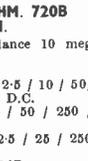
**MODEL TE.15 GRID DIP METER**

Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440Kc/s-280Mc/s in 6 coils. 500μA Meter. 9V battery operation. Size 180 x 80 x 40mm.  
\$15-00. Post 20p.



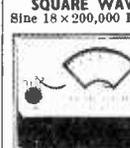
**KAMODEN HM. 720B F.E.T. V.O.M.**

Input impedance 10 meg ohms. Ranges: 0/-25/1/2-5/10/50/250/1000V. D.C. 0/2-5/10/50/250/1000V. A.C. 0/25μA/2-5/25/250 MA D.C. -20 to +62db. 0/5K/50K/500K/5meg/500meg ohms.  
\$14-95. Post 30p



**BELCO AF-54 SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR**

Sine 18 x 200,000 Hz; Square 18 x 50,000 Hz. Output max. 10 dB. (10 K ohms) Operation: Internal batteries. Attractive 2-tone case 7 1/2 x 6 x 2". Price \$17-50. Carr. 17 1/2p.



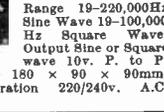
**MODEL L-55 FET V.O.M.**

Input impedance 10 meg ohms 0/3/1-2/6/30/120/600V. D.C. 0/3/12/60/120/600V. A.C. 0/120μA/120mA D.C. 0/1K/100K/10 meg/100 meg ohms  
\$15-97. Post 15p.



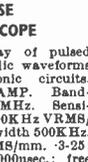
**MODEL MG-100 SINE SQUARE WAVE AUDIO GENERATOR**

Range 19-220,000Hz Sine Wave 19-100,000 Hz Square Wave. Output sine or Square wave 10v. P. to P.C. Size 180 x 90 x 90mm. Operation 220/240v. A.C.  
\$17-50. Post 37p.



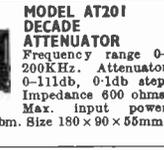
**CI-5 PULSE OSCILLOSCOPE**

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100KHz VRMS/mm. -1.25; HOR. AMP. Bandwidth 500KHz. Sensitivity at 100KHz. V RMS/mm. 0.25; Preset triggered sweep 1-3,000usec.; free running 20-200,000Hz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115-230V. AC operation.  
\$89-00. Carr. paid.



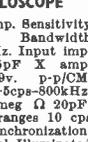
**MODEL AT201 DECADE ATTENUATOR**

Frequency range 0-200KHz. Attenuator 0-111db. 0.1db step. Impedance 600 ohms. Max. input power 30dbm. Size 180 x 90 x 55mm.  
\$12-50. Post 37p.



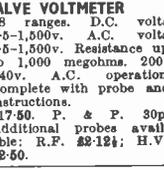
**TO-3 PORTABLE OSCILLOSCOPE**

3in. tube, v amp. Sensitivity 0.1v p-p/cm. Bandwidth 1-5 cps-1.5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0.9v. p-p/cm. Bandwidth 1-5cps-500KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 330 mm. Weight 16lb. 220/240V. A.C. Supplied brand new with handbook. \$47-50. Carr. 60p.



**TE-65 VALVE VOLTMETER**

28 ranges. D.C. volts 1.5-1,500v. A.C. volts 1.5-1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions.  
\$17-50. P. & P. 30p. Additional probes available: R.F. \$2-124; H.V. \$2-50.



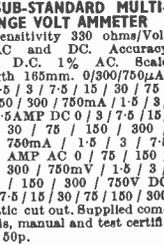
**RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE**

5 mc/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. x 4in. C.R.T. Calibrated triggered sweep from .2 usig. to 100 milli-sec. per cm. Free running time base 50 cps-1 mc/s. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual  
\$27. Carr. Paid.



**MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER**

Sensitivity 330 ohms/Volt AC and DC. Accuracy 5% D.C. 1% AC. Scale length 165mm. 0/300/750μA/1-5/3/7-5/15/30/75/150/300/750mA/1-5/3/7-5AMP DC 0/3/7-5/15/30/75/150/300/750mA/1-5/3/7-5 AMP AC 0/75/150/300/750mA/1-5/3/7-5/150/300/750V DC 0/750mV/1-5/3/7-5/15/30/75/150/300/750V AC. Automatic cut out. Supplied complete with test leads, manual and test certificates. \$49-00. Post 50p.



G. W. SMITH & CO (RADIO) LTD. Also see opposite page and next two pages

### KAMODEN HM.350 TRANSISTOR TESTER

High quality instrument to test Reverse Leaky current and DC current. Amplification factor of NPN, PNP, transistors, diodes, SCR's etc. 4" x 4 1/2" clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. £12.50. Post 30p.



### KAMODEN HMG-500 INSULATION RESISTANCE TESTER

Range 0-1000 Meg-ohms, 500 Volt. Battery operated. Wide range clear meter 4 1/2" x 4". Complete with deluxe carrying case, batteries, instructions. £19.95. Post 30p.



### ARF-300 AF/RF SIGNAL GENERATOR

All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine 1 square 10v P-P. RF 100 KHz to 200 MHz. Output 1v maximum. Operation 220/240v. A.C. Complete with instructions and leads. £29.95. Post 50p.

### HONEYWELL DIGITAL VOLTMETER VT.100

Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt. current and ohms with optional plug in cards. Specifications: Accuracy: ± 0.2, ± 1 digit. Resolution: InV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1.999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 60/60 cycles. Overall size: 6 1/2in. x 2 13/16in. x 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. £85.50. Carr. 50p.



**HAND HELD 2-WAY WALKIE TALKIES**  
Industrial quality in robust metal cases. Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic aerial. Complete carrying cases.  
2 channel £52.50 Pair. Post 60p.  
3 channel £79.50 Pair. Post 60p.  
2 watt. £79.50 Post 60p.  
Licence required for operation in U.K.

### EMI LOUDSPEAKERS

Model 350. 13" x 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. £7.25 each P. & P. 37p.  
Model 450. 13" x 8" with twin tweeter/crossover. 55-13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. £8.62 each. P. & P. 25p.



### SPECIAL OFFER! STEREO SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14 1/2" x 9" x 7 1/2". 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead. £12.95 pr. Carr. 50p.



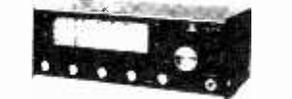
### EA.41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7 1/2" x 3 1/2" x 4 1/2". £5.97. P. & P. 15p.



### UNR-30 RECEIVER

4 Bands covering 550 Kc/s - 30 Mc/s. B.F.O. Built-in Speaker 220/240v A.C. Brand new with instructions. £15.75. Carr. 37p.



### UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 550 Kc/s-30 Mc/s. FET 8 Meter. Variable BFO for 88B, Built-in Speaker, Bandspread, Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12 1/2" x 4 1/2" x 7". Brand new with instructions. £25. Carr. 37p.

### SKYWOOD CX203 COMMUNICATION RECEIVER

Solid state. Coverage on 5 bands 200-420 KHz and 55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning BFO, AVC, ANL, 8" meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v A.C. or 12v D.C. Size 325 x 265 x 150 mm. Complete with instructions and circuit. £32.50. Carr. 50p.



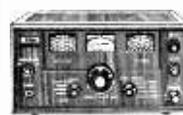
### LAFAYETTE HA-600 SOLID STATE RECEIVER

General coverage 160-400 Kc/s. 550 Kc/s-30 Mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter. 8 Meter, Bandspread, RF Gain. 15" x 9 1/2" x 8 1/2". 18 lbs. 220/240v. A.C. or 12v. D.C. Brand new with instructions. £50. Carr. 50p.



### TRIO 9R59DS COMMUNICATION RECEIVER

4 band covering 160-400 Kc/s. to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. 88B-CW. ANL. Variable BFO. 8 meter. 8sp. bandspread dial. 1F frequency 455 Kc/s. audio output 1.5w. Variable RF and AF gain controls 116/260v. A.C. Size: 7" x 13" x 10". with instruction manual. £49.50. Carr. Paid.



### HA-10 STEREO HEADPHONE AMPLIFIER

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 6MU/100MU. Output 50mW. £6.97. P. & P. 16p.



### 1021 STEREO LISTENING STATION

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6" x 4" x 2 1/2". £2.25. P. & P. 16p.



### MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9 1/2" x 6" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K. £28.97. P. & P. 20p.



# HI-FI EQUIPMENT

## SAVE UP TO 33 1/3% OR MORE

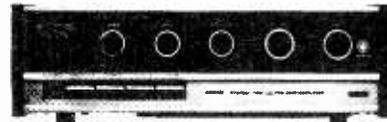
SEND S.A.E. FOR FULL DISCOUNT PRICE LISTS AND PACKAGE OFFERS!



## FANTASTIC OFFER!

### NIKKO TRM 50 STEREO AMPLIFIER

17 + 17 watts rms stereo amplifier with inputs for Magnetic and Crystal phono, Tuner, Tape, Aux and Tape Monitor. Outputs for two pairs of stereo speakers and Tape. Stereo headphone socket. Full range of controls including loudness control, scratch filter, etc. Size 13" x 9 1/2" x 3 1/2". Unrepeatable offer—limited stocks!



List price £50.50  
OUR PRICE  
**£39.95**  
Carriage 50p

### AKAI BARGAINS!



### AAG300 AM/FM STEREO TUNER AMPLIFIER

20 + 20 watts rms. Magnetic, ceramic and tape inputs. FM 88-108 MHz. AM 535-1605 kHz. Dual stereo speaker outputs. Headphone socket. (Rec. List Price £117.46)  
OUR PRICE **£61.95** P & P 75p

### NIKKO TRM.50 SYSTEM



OUR PRICE **£93.95**

NIKKO TRM50 17 + 17 watt rms. stereo amplifier Garrard AP76. plinth & cover. Goldring G800E cartridge, pair of Linton 2 speakers and all leads.

Carr. and Ins. £1.50

### LEAK DELTA 30 SYSTEM



OUR PRICE **£110.50**

Leak Delta 30 stereo amplifier. Goldring GL75, plinth, cover and G800 cartridge. Pair of Leak 150 speakers and all leads.

Carr. and Ins. £1.50

### TELETON SAQ206B SYSTEM



OUR PRICE **£50.95**

Teleton SAQ206B 8 + 8 watt Amplifier, BSR MP60, plinth & cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.

Carr. £1.50

### AKAI AAG300 SYSTEM

20 + 20 watt AM/FM stereo tuner amplifier. Garrard AP76, plinth and cover. G800 cartridge, pair of Mezzo III speakers.  
OUR PRICE **£131.95** Carriage & Pack. £2.00



### WHARFEDALE LINTON SYSTEM

Wharfedale Linton Amplifier, Linton Turntable, pair of Linton 2 speakers and all leads.  
OUR PRICE **£95.95** Carr. and Ins. £1.25



LINTON RECEIVER SYSTEM £125.00. Carr. & Ins. £1.25.

### AMSTRAD 8000 II SYSTEM

Amstrad 8000 II 7 + 7 watt amplifier. BSR MP60, plinth and cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.  
OUR PRICE **£43.50** Carr. £1.00



### B.S.R. TD8S 8-TRACK STEREO TAPE PLAYER DECK

Integrated preamps (output 125 mV) to feed into any stereo amplifier. Automatic and manual programme selector. 4 pole synchronous motor. 210/240 V.  
OUR PRICE **£12.75** Post 50p

G. W. SMITH & CO (RADIO) LTD.  
Also see previous pages and opposite page

## SINCLAIR IC-12

List Price £2.98

**OUR PRICE £1.80**

P. & P. 10p

## SINCLAIR PROJECT GO PACKAGE DEALS

2x230/Stereo 60/PZ5. \$15.85. P. & P. 37p.  
 2x230/Stereo 60/PZ6. \$18.00. P. & P. 37p.  
 2x200/Stereo 60/PZ8. \$20.25. P. & P. 37p.  
 Transformer for PZ5 \$2.97 extra.  
 Active Filter Unit. \$4.46 extra.  
 Pair of Q16 Speakers. \$10.70 extra.  
 Sinclair Project 605. \$20.97. P. & P. 37p.  
 All other Sinclair Products in stock.

### TRANSISTORISED FM TUNER

6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6x4x2In. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108Mc/s. Ready built ready for use. Fantastic value for money. \$5.95. P. & P. 12p. Stereo multiplex adaptors \$4.97.

### AUDIOTRONIC ACR. 3500 CAR RADIO

Manual tuning of Medium and Long waves. 12v pos. or neg. earth. Complete with speaker, mounting brackets and instructions. **OUR PRICE £6.50** P. & P. 50p

### AUDIOTRONIC ACP-8 8 TRACK CAR PLAYER

Attractive black and silver finish. 10V neg. earth. Slider controls for volume, tone and balance. Channel selector button with red pilot lamp. Complete with speakers, mounting brackets and instructions. **ONLY £12.50** P. & P. 40p

**TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET**  
 Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms. \$1.97. P. & P. 15p.

**HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES**  
 Features unique mechanical 2 way units and fitted adjustable lever, controls, 8 ohm impedance 20-20,000cps. Complete with spring lead & stereo jack plug \$7.97. P. & P. 12p.

**TE-1035 STEREO HEADPHONES**  
 Low cost high performance stereo headphones. Foam rubber ear cups. Adjustable head-band. 8 ohm impedance 25-18,000 Hz. With lead and stereo jack plug. ONLY \$1.97. P. & P. 12p.

## ROTEL BARGAINS!

All brand new and guaranteed

RA210 Amp ... £22.50  
 RA310 Amp ... £34.95  
 RA610 Amp ... £51.95  
 RX150 Receiver ... £36.95  
 RX200 Receiver ... £46.50  
 RX400 Receiver ... £57.50  
 P. & P. 50p extra any item.

## ROTEL RA210 SYSTEM

8+8 watt amplifier, BSR MP60, plinth and cover, 0800 cartridge, pair of Medway T139 speakers and all leads.

**OUR PRICE £54.50** Carr. & Ins. £1.25

## ROTEL RX150 SYSTEM

AM/FM 7½ + 7½ watt stereo tuner amplifier, BSR MP 60, plinth and cover, 0800, pair of Denton 2 speakers and all leads.

**OUR PRICE £75.95** Carr. & Ins. £1.25

## MONATONE 6750 SYSTEM

AM/FM 4 + 4 watt stereo tuner amplifier, Garrard 2025 T/C, plinth and cover, stereo cartridge, pair of matching speaker and all leads.

**OUR PRICE £30.50** Carr. £1.00

**SPECIAL OFFER! ROTEL RH700 STEREO HEADPHONES**  
 20-20,000Hz. 8-16 ohm. (List £9.95). **OUR PRICE \$6.75.** P. & P. 25p.

**KOSS SP.3XC STEREO HEADPHONES**  
 Response 10-15,000Hz. Impedance 4-6 ohms. Brand new, boxed & fully guaranteed (List £9.50). **OUR PRICE \$6.50.** P. & P. 25p.

**HOSIDEN DH-02S STEREO HEADPHONES**  
 Wonderful value and excellent performance combined. Adjustable head-band. 8 ohm impedance. 20-12,000 cps. Complete with lead and plug. **ONLY £2.37.** P. & P. 12p.

## AXAI BARGAINS

CASSETTE (P. & P. 50p)

CS86D Deck	£44.95
CS85 Recorder	£57.75
CS85/CS88 Speakers	£67.95
GXC40D Deck	£57.75
GXC40 Recorder	£67.95
GXC40T Deck/Receiver	£101.25
GXC45 Deck	£78.25
GXC46D Dolby Deck	£84.30
GXC46 Recorder	£90.75
GXC60D Deck	£87.65
GXC60D Dolby Deck	£93.40

CARTRIDGE (P. & P. 50p)

CR81 Deck with amps.	£66.20
CR11D Recorder	£54.10
CR81T Recorder/Receiver	£98.70
CR808S 4 channel Recorder	£114.25
CR80DS 4 channel Recorder	£94.95

TAPE (P. & P. 75p)

4000DS Deck	£59.95
4000DS Dust Cover	£8.95
1721 Recorder	£60.35
X5000 Recorder	£82.50
X201D Deck	£108.20
GX220D Deck	£128.95
GX221D Deck	£138.40
GX280D	£196.50
GX370 Deck	£211.50

TAPE/CASSETTE (P. & P. 75p)

GX1900D Deck	£144.50
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TAPE/CARTRIDGE (P. & P. 75p)

X1810D Deck	£138.40
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TAPE/CASSETTE/CARTRIDGE (P. & P. 75p)

X2008D Recorder	£180.75
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MICROPHONES (P. & P. 50p)

ADM. 11 Dynamic (pair)	£7.50
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RECEIVERS (P. & P. 75p)

AA6300 20 + 20 watt	£61.95
AA8030 25 + 25 watt	£92.50
AA8060 40 + 40 watt	£117.50
AA8500 65 + 65 watt	£150.50

## AUDIOTRONIC PROCESS 2 DOLBY SYSTEM NOISE REDUCTION UNIT

Improves the performance of cassette and semi-professional recorders. Reduces tape hiss by 3dB at 600Hz, 6dB at 1200Hz and 10dB for all frequencies above 3000Hz. Controls for input levels and noise reduction on record and replay. 2 meters for Dolby level. Off tape monitoring. Frequency response: 20Hz to 16kHz ± 1dB 18kHz -35dB. Size 161" x 9" x 31". AC 200/260V.

**OUR PRICE £32.50** Carr. 50p.

## LOW NOISE TAPE CASSETTES

Top quality in library cases

	5	10	25
C80	£1.29	£2.53	£5.99
C90	£1.85	£3.62	£8.59
C120	£2.29	£4.48	£10.63

P. & P. Post Free

**TAPE HEAD CLEANER 80p each.**

## VAT 10% VAT

All prices are subject to 10% VAT (10p in the £)

Order with confidence by post - but remember to add 10% VAT (10p in the £) to total value of goods including carriage/packing and send cash with order. PLEASE PRINT NAME & ADDRESS CLEARLY.

## RECORD DECKS

Carriage and Packing 60p

B.S.R. McDONALD

C114 Mini	£3.95
C129 Mono	£5.50
C137	£7.00
510/TPD1	£13.95
610	£9.90
610/TPD1	£14.85
710	£18.20
810	£24.50
710/810 Plinth and cover	£3.35
MP60/G800	£10.95
MP60/TPD1	£12.60
MP60/TPD2	£11.25
HT70	£10.97
HT70/G800	£13.60
HT70/TPD1	£15.95

## GOLDRING

G99	£16.85
G101P/C	£18.85
GL59/2	£15.75
GL72	£17.85
GL72P	£28.20
Plinth 69/72	£5.35
LID 72	£2.70
GL75	£28.75
Plinth 75	£5.35
LID 75	£2.97
GL85P/C	£49.50

## GARRARD

1035T Stereo	£4.95
2025 T Stereo	£6.40
SP25 III	£8.50
SP25 III/Acos	£8.50
GP104 Ceramic	£8.50
SP25/M75-6	£18.90

## PLINTHS & COVERS

Carriage & Packing 50p

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Budget B.S.R.	£2.95
SME 2000 System	£28.40

## RECORD DECK PACKAGES

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Complete units with stereo cartridge ready wired in plinth with cover.

## GARRARD

2025 TC/9TAHCD	£10.65
SP25 III/G800	£16.00
SP25 III/M44E	£16.45
SP25 III/M44-7	£16.10
SP25 III/M56E	£18.90
SP25 III Module/M75-6	£23.50
AP76/G800	£23.95
AP76/G800E	£24.95
AP76/M44E	£24.95
AP76/M56E	£28.65
AP76/M75EJ	£31.75
AP76/M75EJ	£37.85
AP76 Module/M75-6	£28.95
AP96 Module/M75-6	£30.40
ZERO 1008 Module/M93E	£41.85

## B.S.R. McDONALD

210/87M	£8.95
MP60/G800	£15.00
MP60/TPD1/G800	£16.20
MP60/M44-7	£16.75
HT70/TPD1/G800	£18.60

## GOLDRING

G175/G800	£32.25
G175/G800E	£34.95

## GOODMANS

TD100/G800 Teak	£42.95
TD100/G800 White	£44.75

## LEAK

Delta/M75-6	£48.95
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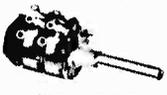
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log or lin less switch (& 1KΩ lin) 12p  
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0.1μF 18v	5p	0.1μF 30v	5p
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1000pf	10p	4700pf	10p
2200pf	10p	10,000pf	10p

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Single	Dual	log
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100	1KΩ	10KΩ	100KΩ	1MΩ
250	2.5KΩ	25KΩ	250KΩ	2.5MΩ
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9 volt operation  
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Matching stereo decoder £4.97  
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**Ceramic - plate**

1.8pf	8.2pf	63V (C333)	
2.2pf	10pf	33pf	120pf
3.3pf	12pf	47pf	150pf
3.9pf	15pf	55pf	180pf
4.7pf	18pf	68pf	220pf
5.6pf	22pf	82pf	270pf
6.8pf	27pf	100pf	330pf

**polystyrene 160V**

10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 88.

**metallised polyester 250V (C280)**

0.1μF	3p	0.68μF	3p	47μF	8p
0.15μF	3p	1μF	4p	68μF	11p
0.22μF	3p	1.5μF	4p	1μF	13p
0.33μF	3p	2.2μF	5p	1.5μF	20p
0.47μF	3p	3.3μF	6p	2.2μF	24p

**metallised polyester 400V (C281)**

0.1μF	4p	0.47μF	6p	22μF	10p
0.15μF	4p	0.68μF	6p	33μF	14p
0.22μF	4p	1μF	7p	47μF	15p
0.33μF	5p	1.5μF	8p		

**silvered mica 1% (-50pf) 500V**

2.2pf-820pf	7p	4.7nF-5600pf	19p
1nF-2.2nF	9p	6800pf-0.1μF	29p
2.7nF-3.6nF	16p		

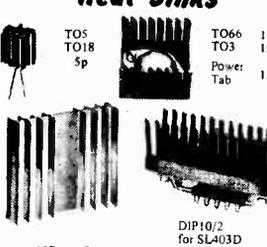
**mixed dielectric 600V**

0.1μF	7p	0.47μF	7p	22μF	16p
0.22μF	7p	0.68μF	8p	47μF	24p
0.33μF	7p	1μF	8p	1μF	33p

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AC127	15p	BC149	10p	BF272	53p	OC170	23p	2N1893	30p	LO36T1	£1.50
AC128	15p	BC157	12p	BFY50	24p	OC171	30p	2N2926 all 10p		LO37T1	
AC176	15p	BC158	10p	BFY51	21p	ZTX107	15p	2N3053	23p	MC1303L	£1.75
AC187	25p	BC159	12p	BRY39	36p	ZTX108	12p	2N3054	50p	MC1350	80p
AC188K	25p	BC169	15p	BSX21	26p	ZTX109	15p	2N3055	48p	MC1350	75p
AC188	25p	BC264	15p	BSY95A	40p	ZTX300	12p	2N3702	12p	MC1351	£1.00
AC188K	25p	BD115	87p	BU106/02	£1.75	ZTX301	15p	2N3703	12p	MC1352	£1.00
ACY20	20p	BD131	70p	MJE340	87p	ZTX302	20p	2N3704	10p	MFC4000B	45p
AD140	40p	BD132	70p	MPP192	40p	ZTX303	20p	2N3705	10p	MFC4010A	55p
AD149	40p	BD133/2M.P		MPP103	37p	ZTX304	25p	2N3706	10p	LM360	£1.45
AD181	80p			MPP104	37p	ZTX341	20p	2N3707	15p	PZ32A	£1.98
AD182	80p			MPP105	40p	ZTX500	15p	2N3708	12p	SL433D	£1.50
AF114	18p	BF160	21p	MPP106	45p	ZTX501	15p	2N3709	12p	TAD100	£1.50
AF115	18p	BF173	20p	OC28	40p	ZTX502	20p	2N3710	12p		
AF116	18p	BF180	25p	OC35	40p	ZTX503	17p	2N3711	12p	μA708C	34p
AF117	17p	BF181	30p	OC44	15p	ZTX504	50p	2N3819	35p	μA710	45p
AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3903	15p	μA723C	95p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3904	17p	μA741C	47p
BC108	10p	BF194	15p	OC72	17p	2N706	12p	2N3905	21p	μA748C	60p
BC109	10p	BF192	15p	OC76	15p	2N708	15p	2N3906	12p		

**mixed dielectric 1000V**

1000pf	6p	6800pf	9p	1μF	12p
2200pf	6p	0.1μF	9p	22μF	22p
3300pf	6p	0.22μF	9p	47μF	30p
4700pf	6p	0.47μF	12p		

**Ceramic**

12KV d.c. 8KV d.c. HI-K 750V.

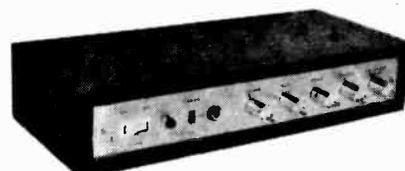
10pf	9p	200pf	9p	1000pf	5p
15pf	9p	220pf	9p	1500pf	5p
22pf	9p	250pf	9p	2000pf	5p
68pf	9p	270pf	9p	3000pf	5p
82pf	9p	300pf	9p	5000pf	5p
100pf	9p	750V DISC	10,000pf	5p	
120pf	9p	470pf	5p	feed-	
140pf	9p	1000pf	5p	through	
150pf	9p	5000pf	5p		
180pf	9p	10,000pf	5p	1000pf	5p

**Veroboard**

Copperclad		Plain
0.1"	0.15"	0.15"
2 1/2" x 1"	6p	6p
2 1/2" x 3 1/2"	20p	16p (9)
2 1/2" x 5"	24p	21p (7)
3 1/2" x 3 1/2"	24p	21p (8)
3 1/2" x 5"	27p	27p (10)
17" x 2 1/2"	67p	50p
17" x 3 1/2"	90p	70p
17" x 5"		75p

Spot-face Cutter 36p  
Pin Insertion Tool 47p  
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20 Watts per channel integrated stereo amplifier developed by engineers of Texas Instruments Ltd. This designer approved kit, has a state-of-the-art specification, including distortion of only 0.09% at 20 Watts into 8 ohms and a bandwidth of 5 - 35,000 at -3db. The semiconductor complement of this superb kit includes no less than 6 integrated circuits, 10 Silicon transistors, 4 rectifiers and 2 zeners. Controls include: bass; treble; volume; balance; on/off; on indicator; headphone sockets; scratch filter; rumble filter; inputs for magnetic phono, tuner, aux. or tape; tape head etc; input; selector; mono/stereo switch.

The construction of this kit was featured in "Practical Wireless" May - Aug. 1972.

**Mullard B Siemens Electrolytics**

CAP μF		VOLTAGE					
		4	6.3	10	25	40	50
1	—	—	—	—	—	—	8p
1.5	—	—	—	—	—	—	6p
2.2	—	—	—	—	—	—	6p
3.3	—	—	—	—	—	—	6p
4.7	—	—	—	—	—	—	6p
6.8	—	—	—	—	—	—	6p
10	—	—	—	—	—	—	6p
15	—	—	—	—	—	—	6p
22	—	—	—	—	—	—	6p
33	—	—	—	—	—	—	6p
47	6p	6p	6p	6p	6p	6p	6p
68	6p	6p	6p	6p	6p	6p	10p
100	6p	6p	6p	6p	6p	6p	12p
150	6p	6p	6p	6p	6p	6p	12p
220	6p	6p	6p	6p	6p	6p	15p
330	6p	6p	6p	6p	6p	6p	21p
470	6p	6p	6p	6p	6p	6p	21p
680	10p	10p	10p	10p	10p	10p	21p
1000	10p	10p	10p	10p	10p	10p	21p
1500	10p	10p	10p	10p	10p	10p	21p
2200	10p	10p	10p	10p	10p	10p	21p
3300	10p	10p	10p	10p	10p	10p	21p
4700	10p	10p	10p	10p	10p	10p	21p

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Including baseplate and screws

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

**Hi-Volt Electrolytics**

1.2	4	8μF	450V	14p	32μF	450V	20p
16μF	450V	15p	50μF	350V	20p		
8	8μF	450 V.W	18p	32 - 32μF	350 V.W	25p	
8	15μF	450 V.W	20p	32 - 32μF	450 V.W	43p	
18	18μF	450 V.W	25p	50	50μF	350 V.W	35p



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★ Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, £145-29. ★ Console—5 octave keyboard with 10 voices, 3 pitches. Keyboard can be split into solo and accompaniment. Vibrato, built in amplifier and speaker £250-93. ★ Console—2 x 4 octave keyboards and 13 note pedal board, 29 voices, Vibrato, Delay Vibrato, Sustain, Reverberation, Percussion, Wah Wah, £406-00. ★ Console—2 x 5 octave keyboards and 32 note pedal board, 32 voices. Vibrato, Delay Vibrato, Sustain, Reverberation, Percussion, 3 Couplers, etc., at £572-55. V.A.T. please add 10%—show separately on order.

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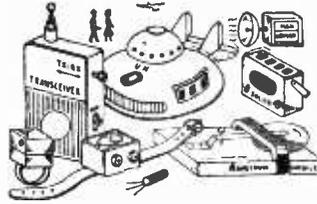
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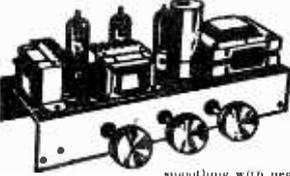
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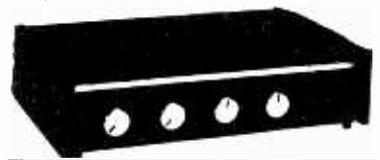
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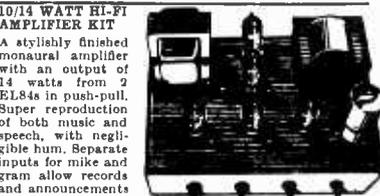
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with free manual  
£5.48

### Z.30 the power amplifier for quality and economy



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The Z.30 provides excellent facilities for the constructor requiring a high fidelity audio system of less power than that available from Z.50's. Using a power supply of 35 volts, Z.30 will deliver 15 watts RMS into 8 ohms, or 20 watts RMS into 3 ohms using 30 volts. Total harmonic distortion is a fantastically low 0.02% at 15 watts into 8 ohms with signal to noise ratio better than 70 dB unweighted. Input sensitivity 250mV into 100K ohms. Size 80 x 57 x 13 mm (3 1/8 x 2 1/4 x 1/2). Z.30, Z.50 and Z.50 MK 2 modules are compatible and interchangeable.

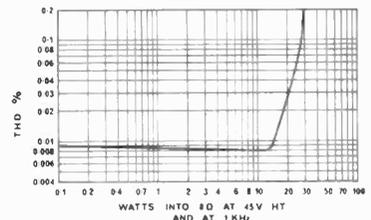
### Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

### Brilliant new technical specifications

Input impedance 100 K $\Omega$   
Input (for 30w into 8 $\Omega$ ) 400mV  
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better  
Distortion 0.02% up to 20W at 8 $\Omega$ . See curve  
Frequency response 10Hz to more than 200 KHz  $\pm$  1dB  
Max. supply voltage 45v (4 $\Omega$  to 8 $\Omega$  speakers) (50v 15 $\Omega$  speakers only)  
Min. supply voltage 9v  
Load impedance – minimum: 4 $\Omega$  at 45v HT  
Load impedance – maximum: safe on open circuit



## Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control, etc.	£4.48
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control, etc.	£9.45
12W. RMS continuous sine wave stereo amp. for average needs	2 x Z.30s, Stereo 60; PZ.5	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	£23.90
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	2 x Z.30s, Stereo 60; PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	£26.90
80W. (3 ohms) RMS continuous sine wave deluxe stereo amplifier. (60W. RMS into 8 ohms)	2 x Z.50s, Stereo 60; PZ.8, mains transformer	As above	£34.88
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£19.43

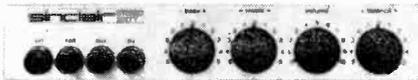
F.M. Stereo Tuner (£25) & A.F.U. (£5.98) may be added as required.

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# the world's most advanced high fidelity modules

## Stereo 60 Pre-amp/control unit



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

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

Built, tested and guaranteed. **£9.98**

## Project 60 Stereo F.M. Tuner

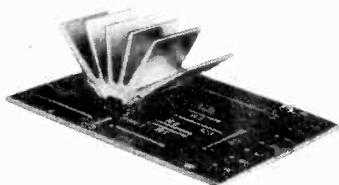


The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an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

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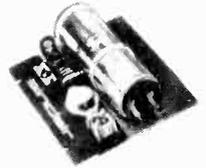
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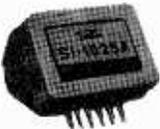
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30L1	0.40	868A	0.85	E180F	0.90	ECC189	0.80
30L15	0.95	868B	0.85	E180F	0.90	ECC189	0.80
30L17	0.95	868C	0.85	E180F	0.90	ECC189	0.80
30P12	1.00	868D	0.85	E180F	0.90	ECC189	0.80
30P19	0.85	868E	0.85	E180F	0.90	ECC189	0.80
30PL1	0.95	868F	0.85	E180F	0.90	ECC189	0.80
30PL11.2	1.10	868G	0.85	E180F	0.90	ECC189	0.80
30PL13.1	1.10	868H	0.85	E180F	0.90	ECC189	0.80
30PL14.2	1.25	868I	0.85	E180F	0.90	ECC189	0.80
30S3	0.80	868J	0.85	E180F	0.90	ECC189	0.80
30S4	0.80	868K	0.85	E180F	0.90	ECC189	0.80
30S5	0.80	868L	0.85	E180F	0.90	ECC189	0.80
30S6	0.80	868M	0.85	E180F	0.90	ECC189	0.80
30S7	0.80	868N	0.85	E180F	0.90	ECC189	0.80
30S8	0.80	868O	0.85	E180F	0.90	ECC189	0.80
30S9	0.80	868P	0.85	E180F	0.90	ECC189	0.80
30S10	0.80	868Q	0.85	E180F	0.90	ECC189	0.80
30S11	0.80	868R	0.85	E180F	0.90	ECC189	0.80
30S12	0.80	868S	0.85	E180F	0.90	ECC189	0.80
30S13	0.80	868T	0.85	E180F	0.90	ECC189	0.80
30S14	0.80	868U	0.85	E180F	0.90	ECC189	0.80
30S15	0.80	868V	0.85	E180F	0.90	ECC189	0.80
30S16	0.80	868W	0.85	E180F	0.90	ECC189	0.80
30S17	0.80	868X	0.85	E180F	0.90	ECC189	0.80
30S18	0.80	868Y	0.85	E180F	0.90	ECC189	0.80
30S19	0.80	868Z	0.85	E180F	0.90	ECC189	0.80
30S20	0.80	868A	0.85	E180F	0.90	ECC189	0.80
30S21	0.80	868B	0.85	E180F	0.90	ECC189	0.80
30S22	0.80	868C	0.85	E180F	0.90	ECC189	0.80
30S23	0.80	868D	0.85	E180F	0.90	ECC189	0.80
30S24	0.80	868E	0.85	E180F	0.90	ECC189	0.80
30S25	0.80	868F	0.85	E180F	0.90	ECC189	0.80
30S26	0.80	868G	0.85	E180F	0.90	ECC189	0.80
30S27	0.80	868H	0.85	E180F	0.90	ECC189	0.80
30S28	0.80	868I	0.85	E180F	0.90	ECC189	0.80
30S29	0.80	868J	0.85	E180F	0.90	ECC189	0.80
30S30	0.80	868K	0.85	E180F	0.90	ECC189	0.80
30S31	0.80	868L	0.85	E180F	0.90	ECC189	0.80
30S32	0.80	868M	0.85	E180F	0.90	ECC189	0.80
30S33	0.80	868N	0.85	E180F	0.90	ECC189	0.80
30S34	0.80	868O	0.85	E180F	0.90	ECC189	0.80
30S35	0.80	868P	0.85	E180F	0.90	ECC189	0.80
30S36	0.80	868Q	0.85	E180F	0.90	ECC189	0.80
30S37	0.80	868R	0.85	E180F	0.90	ECC189	0.80
30S38	0.80	868S	0.85	E180F	0.90	ECC189	0.80
30S39	0.80	868T	0.85	E180F	0.90	ECC189	0.80
30S40	0.80	868U	0.85	E180F	0.90	ECC189	0.80
30S41	0.80	868V	0.85	E180F	0.90	ECC189	0.80
30S42	0.80	868W	0.85	E180F	0.90	ECC189	0.80
30S43	0.80	868X	0.85	E180F	0.90	ECC189	0.80
30S44	0.80	868Y	0.85	E180F	0.90	ECC189	0.80
30S45	0.80	868Z	0.85	E180F	0.90	ECC189	0.80
30S46	0.80	868A	0.85	E180F	0.90	ECC189	0.80
30S47	0.80	868B	0.85	E180F	0.90	ECC189	0.80
30S48	0.80	868C	0.85	E180F	0.90	ECC189	0.80
30S49	0.80	868D	0.85	E180F	0.90	ECC189	0.80
30S50	0.80	868E	0.85	E180F	0.90	ECC189	0.80
30S51	0.80	868F	0.85	E180F	0.90	ECC189	0.80
30S52	0.80	868G	0.85	E180F	0.90	ECC189	0.80
30S53	0.80	868H	0.85	E180F	0.90	ECC189	0.80
30S54	0.80	868I	0.85	E180F	0.90	ECC189	0.80
30S55	0.80	868J	0.85	E180F	0.90	ECC189	0.80
30S56	0.80	868K	0.85	E180F	0.90	ECC189	0.80
30S57	0.80	868L	0.85	E180F	0.90	ECC189	0.80
30S58	0.80	868M	0.85	E180F	0.90	ECC189	0.80
30S59	0.80	868N	0.85	E180F	0.90	ECC189	0.80
30S60	0.80	868O	0.85	E180F	0.90	ECC189	0.80
30S61	0.80	868P	0.85	E180F	0.90	ECC189	0.80
30S62	0.80	868Q	0.85	E180F	0.90	ECC189	0.80
30S63	0.80	868R	0.85	E180F	0.90	ECC189	0.80
30S64	0.80	868S	0.85	E180F	0.90	ECC189	0.80
30S65	0.80	868T	0.85	E180F	0.90	ECC189	0.80
30S66	0.80	868U	0.85	E180F	0.90	ECC189	0.80
30S67	0.80	868V	0.85	E180F	0.90	ECC189	0.80
30S68	0.80	868W	0.85	E180F	0.90	ECC189	0.80
30S69	0.80	868X	0.85	E180F	0.90	ECC189	0.80
30S70	0.80	868Y	0.85	E180F	0.90	ECC189	0.80
30S71	0.80	868Z	0.85	E180F	0.90	ECC189	0.80
30S72	0.80	868A	0.85	E180F	0.90	ECC189	0.80
30S73	0.80	868B	0.85	E180F	0.90	ECC189	0.80
30S74	0.80	868C	0.85	E180F	0.90	ECC189	0.80
30S75	0.80	868D	0.85	E180F	0.90	ECC189	0.80
30S76	0.80	868E	0.85	E180F	0.90	ECC189	0.80
30S77	0.80	868F	0.85	E180F	0.90	ECC189	0.80
30S78	0.80	868G	0.85	E180F	0.90	ECC189	0.80
30S79	0.80	868H	0.85	E180F	0.90	ECC189	0.80
30S80	0.80	868I	0.85	E180F	0.90	ECC189	0.80
30S81	0.80	868J	0.85	E180F	0.90	ECC189	0.80
30S82	0.80	868K	0.85	E180F	0.90	ECC189	0.80
30S83	0.80	868L	0.85	E180F	0.90	ECC189	0.80
30S84	0.80	868M	0.85	E180F	0.90	ECC189	0.80
30S85	0.80	868N	0.85	E180F	0.90	ECC189	0.80
30S86	0.80	868O	0.85	E180F	0.90	ECC189	0.80
30S87	0.80	868P	0.85	E180F	0.90	ECC189	0.80
30S88	0.80	868Q	0.85	E180F	0.90	ECC189	0.80
30S89	0.80	868R	0.85	E180F	0.90	ECC189	0.80
30S90	0.80	868S	0.85	E180F	0.90	ECC189	0.80
30S91	0.80	868T	0.85	E180F	0.90	ECC189	0.80
30S92	0.80	868U	0.85	E180F	0.90	ECC189	0.80
30S93	0.80	868V	0.85	E180F	0.90	ECC189	0.80
30S94	0.80	868W	0.85	E180F	0.90	ECC189	0.80
30S95	0.80	868X	0.85	E180F	0.90	ECC189	0.80
30S96	0.80	868Y	0.85	E180F	0.90	ECC189	0.80
30S97	0.80	868Z	0.85	E180F	0.90		

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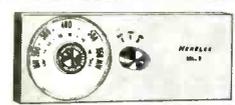
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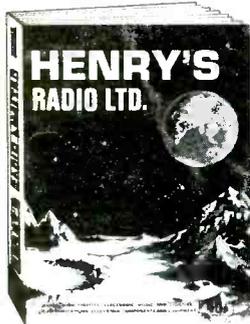


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303 Special offers and bargains store  
All mail to 303 Edgware Road, London W2 1BW

Open - 9 am - 6 pm  
6 days a week  
(309 closed Thursday)  
All stores open all day Saturday