PRACTICAL WIRELESS

MAY 1973

20p

8 PAGE SUPPLEMENT

EXTRA INSIDE

SIMPLE PROJECTS FOR THE HOME

PLUS ALL THE REGULAR FEATURES

PRACTICAL WIRELESS

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MAY 1973

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

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● NEWS & COMMENT

● CONSTRUCTIONAL

● OTHER FEATURES

★ SUPPLEMENT Extra eight centre pages

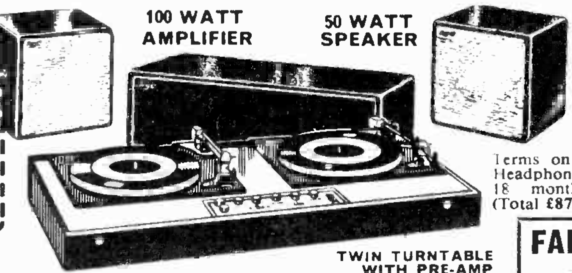
SIMPLE PROJECTS FOR THE HOME
Two Tone Door "Bell"; Intercom Amplifier; Water Level Detector; Tape Tuner; Radio Alarm Clock; Lamp Dimmer; Baby Alarm; Light Powered Radio

RSC GROUP/DISCO UNITS

50 WATT SPEAKER

100 WATT AMPLIFIER

50 WATT SPEAKER



HEADPHONES MICROPHONE

TWIN TURNTABLE WITH PRE-AMP

PACKAGE OFFER
Units listed below
(a) 100w POWER AMPLIFIER
(b) PAIR OF HI-FI HEADPHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to headphones)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets
Size approx. 18" × 18" × 8"
(a)(b)(c)&(d) **£72·85** Carr. £1·25
Terms on Amplifier, Speakers and Headphone/Mike. Deposit £15 and 18 monthly payments of £4·00 (Total £87·00).

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. see illus. on left
Carr. £1·25
Or Dep. £13·25 and 9 mthly pymts £6·88 (Total £75·17) or Dep. £15 and 18 mthly payments £3·62 (Total £80·16). ***£67·10**

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair
TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C132 30-40 WATTS Fitted two exceptionally efficient, low feedback howl characteristic high flux 13" x 8" 20 watt speakers. Terms; Dep. £3 and 9 m'thly payments £2·22 (Total £22·98) Carr. 50p. **£19·95**

TYPE C412S 50 WATTS Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56 × 14 × 9in Terms: Dep. £4 and 9 monthly payments £3·37 (Total £34·33) Carr. 75p **£31**

TYPE C4100 100 WATTS inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58 × 16 × 10" Acoustically filled and pressurised. Terms: Dep. £11 and 12 mthly. pyts. £5·18 (Total £73.16). **£65** Carr. £1

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

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

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

Highly sensitive. Push-Pull high output, Hum level −70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86 EF86, ECC83, EL34, EL34, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. for mixing purposes. 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Twin-handled perforated cover £1·90. 12 MONTHS' GUARANTEE. Carr. 65p **£19·75**
TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

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Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). Carr. free **£6·75** or Dep. £1·25 and 9 mthly payments 75p (Total £8·00).

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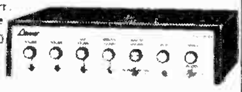
★ Individual Bass and Treble controls
★ Twin jack output sockets for speakers
★ Input sockets for medium or high impedance Microphones or Guitar P.Us and Crystal or Ceramic Gram. P.Us
★ Frequency response 30-20,000 Hz.
★ Output overload protection plus double fusing

£49·50 Carr. free
Or Deposit £7·50 and 9 monthly payments £5·37 (Total £55·83)



FRONT PANEL (Jack inputs) Gram, Gram, Microphone/Guitar P.U.; plus monitoring socket.
CONTROLS Vol. (1) (2) (3) and (4). Bass, Treble, Master Vol., Monitor Selection Switch Gram (1) or (2). Mains Switch.

Simulated black rexine, plastic bonded metal case.
ALSO STOCKED-LINEAR T80/100D £69·75

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PR. FANE POP 25/2 25W L/SPEAKERS	£13·50	
Terms: Deposit £6.50 and 9 monthly payments of £4.92 (Total £50.78)	£48·45	£45 carr. £1
F.A.L. PHASE 50 MK.III AMPLIFIER	£34·95	PACKAGE PRICE
PR. FANE POP 50 L/SPEAKERS	£21·80	
Terms: Deposit £10 and 9 monthly payments of £5·37 (Total £58.33)	£56·75	£52 carr. £1
F.A.L. PHASE 50 MK.III AMPLIFIER	£34·95	PACKAGE PRICE
PAIR L12/25 25W L/S in cabinets	£23·90	
Terms: Deposit £10 and 9 monthly payments of £5·88 (Total £62·92)	£58·85	£56 carr. £1·25
F.A.L. PHASE 100 AMPLIFIER	£61·95	PACKAGE PRICE
4 FANE POP 50 L/SPEAKERS	£43·60	
Terms: Deposit £15·95 and 9 monthly payments of £10·73 (Total £112·52)	£105·55	£99·95 carr. £2

FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.

Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3 to 30 ohms. Size 17" × 7" × 7½" 200-250v. A.C. mains. Output 50 watts music rating.
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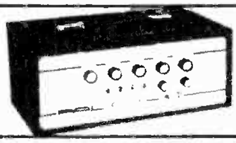

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L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£34·50**
Or deposit £5·50 and 9 monthly payts. of £3·70. Total £38·80

L12/20 12" 20-25 WATT 13,000 lines 15 ohms. Carr. 50p. **£11·95**

L13 13" × 8" 10 Watt 10,000 lines 3 or 15 ohms. State impedance required. Carr 40p **£5·25**

RSC PHANTOM '50'

Combined 50W Amplifier and 12in. Loudspeaker.

For Lead Guitar, Mic., Gram, Radio, Tape (Not for use with Bass instruments). Inc. 3 inputs and 2 vol. controls plus Treble, Bass and Presence. Output Jack for additional 15 ohm Speaker. Attractively finished in black with silver-finished fascia and trimmings. Compact size. Fitted carrying handle.
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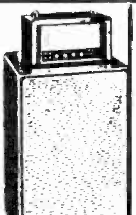
CREDIT TERMS AVAILABLE ON PURCHASES OVER £8 (Kits Excepted) INTEREST CHARGES REFUNDED ON CREDIT SALES Settled in 3 months

VAT FOR INFORMATION ON PRICES MARKED WITH * SEE OPPOSITE PAGE

RSC BASS-REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit either horizontal or vertical mounting.
★ Two extra heavy duty 12in. 50w Loudspeakers.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls. Send S.A.E. for leaflet.
Credit Terms: Deposit £15 & 9 monthly payments of £6·25. (Total £71·25.) Carr. £2 **£65**

RSC GP30 HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group

A 4 input. 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/silver P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £4·40 and 9 monthly payments of £2·45 (Total £26·45). **£23·50** Carr. 65p

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Tel: Pudsey (09735) 77631.
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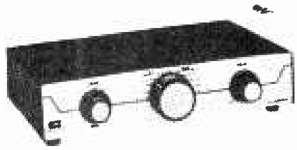
CODAR

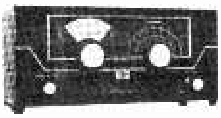
AMATEUR RADIO EQUIPMENT



P.R.40

SOLID STATE R.F. PRESELECTOR

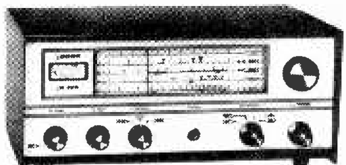
The PR40 R.F. Preselector is the solid state version of the world famous PR30 which it now supercedes.
It employs Silicon "N" Channel FET (Field Effect Transistor) front end, followed by silicon NPN Broad Band R.F. Amp., and will substantially improve receiver performance over the range 1·5 to 35 MHz, providing a considerable increase in gain up to an overall average of 30 dB, with improved image rejection and noise ratio.
Supplied complete with co-ax plug (less standard 9 volt PP6 Battery), 12 months Guarantee . . .



MULTIBAND—6

SOLID STATE SHORT WAVE RECEIVER KIT

All transistor T.R.F. Receiver tunes 550 KHz to 30 MHz (540 to 10 metres) complete coverage—no gaps. Medium waves—Trawlers—Ship/Shore Telephone—All Six Amateur Bands 160–10 metres—International Broadcast from Australia, Far East, Russia, USA etc. using 4 miniature plug in Coils.
Hi-Gain FET Regen. Det./AF/AF Module giving full loudspeaker output to any external 2/3 ohm speaker. Receives AM/CW/SSB.
Separate Electrical Bandspread, Calibrated Main Tuning.
A Quality CODAR-KIT with 12 months Guarantee. No technical knowledge required, simple to build, printed circuit and Pictorial Instruction Manual, fully detailed step by step.
Complete Kit with 4 Coils (less standard PP6 battery).
Stamp brings illustrated leaflets.



CR70A

COMMUNICATION RECEIVER

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

Complete ready built.

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NOTE: These CODAR Receivers meet the B.R.E.M.A. specification for Communication Receivers. Some portable receivers being advertised as Communication Receivers do not meet these requirements.

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2N3055 npn silicon power **60p**
AC153K pnp germanium low power **32p**
AC176K npn germanium low power **32p**
AD161 npn germanium medium power **42p**
AD162 pnp germanium medium power **40p**
AF139 pnp germanium UHF **33p**
BCN 107 **13p**; BC108 **12p**; BC109 **13p**; } npn
BC167 **10p**; BC168 **9p**; BC169 **10p**
BC177 **15p**; BC178 **14p**; BC179 **15p**; } pnp
BC257 **9p**; BC258 **8p**; BC259 **9p**
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BD135 npn med power **30p**
BD136 pnp med power **30p**
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OA90, OA91, OA95 each **6p**
OA200 **9p**; OA202 **10p**
Other semiconductors
AC128 **17p**; AF117 **35p**
BFY51 **19p**

Full lists and technical data will be found in Catalogue No. 6.

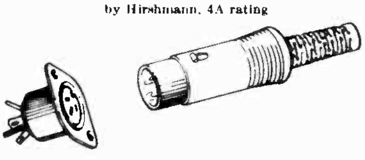
SIEMENS' THYRISTORS

0·8A 400V **56p**, 600V **70p**
3A 400V **60p**, 600V **88p**

ZENER DIODES full range E24 values: 400mW: 2·7V to 36V, **14p each**; 1W: 6·8V to 82V, **21p each**; 1·5W: 4·7V to 75V, **48p each.** Clip to increase 1·5W rating to 3 watts (type 266F) **4p.**

DIN PLUGS & SOCKETS

by Hirshmann. 4A rating

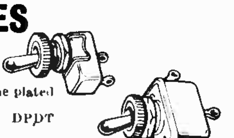


2 way LS—socket **10p**; plug **12p**. 3 way scr. socket **10p**; plug **12p**. 5 way scr. socket **12p**; plug **15p**.

TRANSISTOR ACCESSORIES

To3 cover **7p**
Heat sinks 1°C/w, type 6W1, undrilled **60p**

SWITCHES

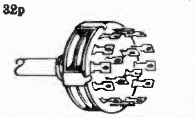


1011C SPST toggle **20p**:
409 DPDT toggle **29p**. (These are chrome plated 2·5A rating)
7201 Sub-miniature DPDT 250V a.c/2A **48p**

ROTARY SWITCHES

Radiospares Miniature Maka-switch (in assembly kit form)
Shaft **48p**.
Wafers, MBB-2P5W, 1P11W; BBM-1P12W, 2P6W, 3P4W, 4P3W, 6P2W, each, **32p**

WAVECHANGE SWITCHES



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

ELECTROLYTIC CAPACITORS

AXIAL LEAD

Rated voltage: / Capacity µF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47							7p	7p
1·0						7p		7p
2·2					7p		7p	7p
4·7				7p		7p	7p	7p
10			7p		7p	7p	7p	7p
22			7p	7p		7p	7p	8p
47	7p		7p	7p	7p	7p	8p	12p
100	7p	7p	7p	7p	7p	8p	12p	18p
220	7p	7p	7p	8p	9p	10p	17p	26p
470	7p	8p	9p	9p	12p	17p	24p	41p
1000	9p	12p	12p	17p	20p	23p	40p	
2200	14p	16p	22p	25p	36p	40p		
4700	23p	26p	37p	40p				
10,000	37p	40p						

Polycarbonate —5% Tolerance

250V up to 0·1µF: 100V/0·1µF and above.
0·01; 0·012; 0·015; 0·018; 0·022; 0·027; 0·033; 0·047; 0·056; each **4p.** 0·068; 0·082; 0·1; 0·12; 0·15 each **4p.** 0·18; 0·22; each **5p.**
0·27; 0·33; **6p.** 0·39 **7p.** 0·47 **8p.** 0·56 **10p.** 0·68 **11p.** 1µF **13p.**

SILVERED MICA non-polarised capacitors in 34 values from 2·2 pF to 680 pF, each **6p**

RESISTORS 10%, 5%, 2%

Code	*Power*	*Tolerance*	*Range*	*Values available*	*1 to 9*	*10 to 99* (see note below)	*100 up*
C	1/20W	5%	82 Ω–220K Ω	E12	9	8	7·5
C	1/8W	5%	4·7 Ω–470K Ω	E24	1	0·9	0·75 nett
C	1/4W	10%	4·7 Ω–10M Ω	E12	1	0·9	0·75 nett
C	1/2W	5%	4·7 Ω–10M Ω	E24	1·2	1	0·8 nett
C	1W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·6 nett
MO	1/2W	2%	10 Ω–1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12	7	7	6
WW	3W	5%	1 Ω–10K Ω	E12	7	7	6
WW	7W	5%	1 Ω–10K Ω	E12	9	9	8

Codes: C—carbon film, high stability, low noise.
MO—metal oxide, Electrosil TR5, ultra low noise.
WW—wire wound, Plessey.

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

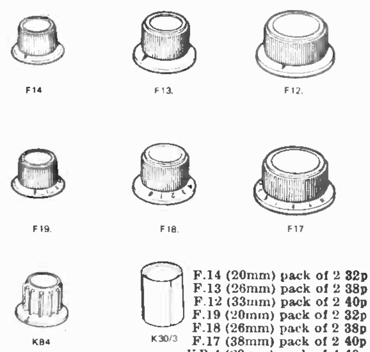
Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

★ Please remember to add V.A.T. to your order if it is going to reach us after March 31.

EVERYTHING BRAND NEW, GUARANTEED TO MAKERS SPEC. NO SECONDS OR REJECTS

KNOBS

All grub screw fitting for ¼" shafts. Black. For other types—see Catalogue No. 6, P.54



F.14 (20mm) pack of 2 **32p**
F.13 (26mm) pack of 2 **38p**
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K.30/3 (17mm) aluminium, each **24p**

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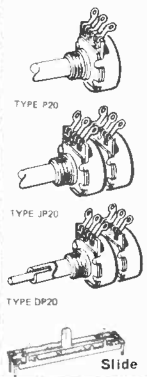

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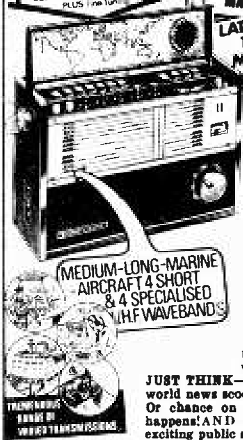

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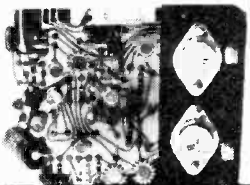

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Freq. response	15-40.000 Hz ± 1dB
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Loads	4 to 16 ohms
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Noise	Better than −75 dB
Supply voltage	25-45 volts SA25/35 40-70 volts SA100
Size	4½" x 4" x 1" (SA100) 4" x 3" x 1" (SA25/SA35)

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

POWER SUPPLIES FOR THE SA25/35 & SA100 AUDIO MODULES

PU45	Unstabilized supply for 2 SA25/35	£4·90
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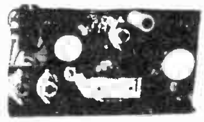
Featuring a rugged class A driver stage, this module will run from all our mixers, etc., and most other makes of mixer. It delivers 120 watts into an eight ohm load and employs 4 T03 can (115 watt) output transistors.



SPECIFICATION

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

Low distortion parallel push-pull output stage.

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

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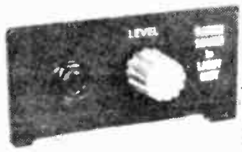
This compact and reliable unit operates from amplifiers with outputs from 5-100 watts. Does not impose a heavy load on the amplifier, or, if connected in the wrong polarity, cause any damage, as with some units.

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



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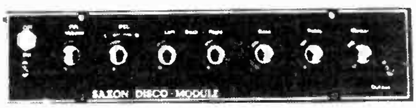
Handling the total of 3000 watt (3kw) this unit is unique for its price in that not only bass, middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads, etc. Supplied in Tough Steel case for free mounting or panel fixing. Fully guaranteed. **£19·75** carr. 30p

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



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

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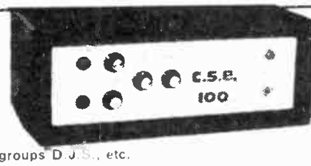

The SAXON 100 £48·50 carr. free

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EMPIRE 909E/X	12·03	7·95
EMPIRE 90EE/X	9·36	6·20
SHURE M3DM	Sp. Price	3·60
SHURE M44-G	Sp. Price	4·60
SHURE M44-7	Sp. Price	4·20
SHURE M-44C	Sp. Price	4·60
SHURE M44E	Sp. Price	4·60
SHURE M55E	Sp. Price	5·30
SHURE M75G	Sp. Price	7·90
SHURE M75-6 (S)	Sp. Price	4·95
SHURE M75-6	Sp. Price	7·10
SHURE M75EJ	Sp. Price	8·25
SHURE M75ED	Sp. Price	10·10
SHURE M75E/95G	Sp. Price	12·15
SHURE M91ED	Sp. Price	9·50
SHURE V15-11	Sp. Price	24·95
*SONOTONE 9TAHC Diam/Saph	3·53	1·30

Cartridges listed are magnetic—except those starred which are ceramic

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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 WB4 Base	5·28	3·90
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GARRARD SPC4 Cover	4·13	3·00
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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	43·56	34·95
MOTORBOARDS only	5·51	4·00
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HPS 7A bass and treble controls	15·35	10·90
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AKAI ASE22	13·09	7·95
AKG K180	30·80	18·70
AKG K60	16·50	9·90
AKG 100	8·80	5·50
AKG 120	11·00	4·95
KOSS HV1	22·00	17·60
KOSS ESP-9 Electrostatic	75·90	58·25
KOSS ESP-6 Electrostatic	49·50	38·50
KOSS K2 plus 2 Quadrafone	49·50	39·95
KOSS PRO 5 L/C	33·00	26·50
KOSS PRO-4AA	30·80	23·25
KOSS KO-727B	18·15	13·75
KOSS 747	22·00	16·50
KOSS K-711	11·00	8·50
KOSS K6	13·75	10·50
KOSS K6/LC (with volume control)	15·40	11·60
KOSS K6/LCQ Quadrafone	22·00	18·75
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PIONEER SE 30A	13·86	9·25
PIONEER SE 20A	8·67	5·50
PIONEER SEL 20	11·58	7·50
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C90	1·08	0·55
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SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
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DANSETTE 4005	67·73	43·95
DECCA SOUND 613	Sp. Price	47·50
DECCA SOUND 614	Sp. Price	51·95
DECCA COMPACT 2 with radio	Sp. Price	72·95
DECCA 403	Sp. Price	40·95
FERGUSON 3450 B with Radio (new Model)	75·35	55·95
FERGUSON 3451 B with Radio (new Model)	101·42	75·95
FERGUSON 3454	39·34	29·95
FIDELITY UA1 Music Master with Radio	95·52	66·95
FIDELITY UA2 Music Master	40·98	27·95
FIDELITY Stereo Nine	Sp. Price	21·95
FIDELITY UA3 incl. stereo radio	59·73	41·95
G.E.C. 2810	74·89	52·95
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HMV 2451	115·64	85·95
HMV 2452	62·57	47·95
HMV 2455	165·89	122·95
I.T.T. 1025 with 662 speakers	45·72	33·95
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AKAI CR81	102·89	75·95
AKAI CR81D	84·10	61·95
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FERROGRAPH 722/724 Dolby	305·80	258·95
FERROGRAPH 722H Dolby	316·80	268·95
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GROSVENOR 8-track record, play-back deck	51·15	36·95
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GRUNDIG TK 121 (twin-track)	53·09	37·95
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AKAI CS35 Stereo incl. Speakers	105·71	77·95
AKAI GXC 400 tape deck	89·74	65·95
AKAI GXC 40	105·71	75·95
AKAI GXC 40T recorder, tuner/amplifier	157·40	116·95
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AKAI GXC 46 Dolby tape recorder	143·30	106·95
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FERGUSON 3257	53·51	37·95
FERGUSON 3257/7 speakers for above	15·15	11·25
GEC CR200 AM/FM Cassette/Radio, Battery/Mains with slide controls	Sp. Price	32·95
GRUNDIG C210 Battery/Mains	46·00	34·95
HARVARD Elite Cassette/AM/FM Radio (battery/mains)	Sp. Price	21·50
JVC Nivico 9420 LS with AM/FM radio, battery/mains	57·84	38·95
JVC Nivico 1710 Radio/Cassette, AM/FM	Sp. Price	34·95
PHILIPS 2202/2203	22·59	16·50
PHILIPS 2204 battery/mains	28·25	21·95
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30FL1	·59	EBF89	·27	EF184	·27	PCC189	·46	PY82	·23	W77	·42
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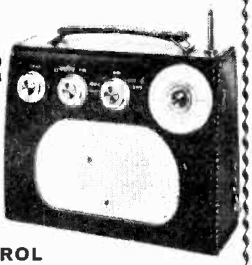

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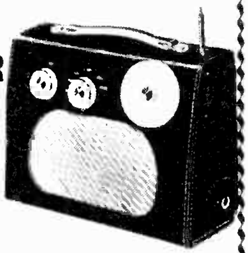

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 33p extra.

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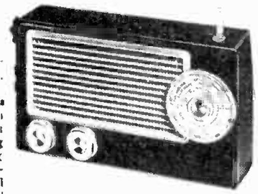

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler, band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 25p (FREE with parts).

Total building costs £4·38 P. P. & Ins. 31p
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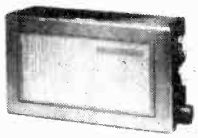
POCKET FIVE



3 Tunable Wavebands. MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1¼ × 3½in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs £2·50 P. P. & Ins. 24p
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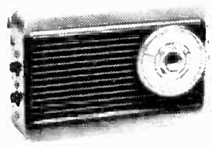
TRANSONA FIVE



5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6¼ × 4¼ × 1¼in. Easy build plans and parts price list 10p (FREE with parts).

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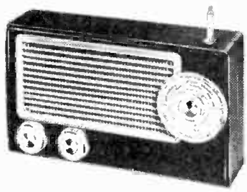
TRANS EIGHT



8 TRANSISTORS and 3 DIODES

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

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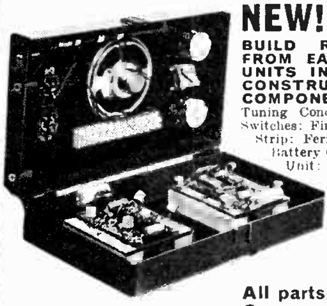

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PW 53

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Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
AC107	22	AD161	36½	BC145	49½	BD133	71½	BF182	44	MAT120	21	2G308	38½	2N2148	62½	2N3053	18½	2N4059	11
AC113	22	AD162	36½	BC147	11	BD135	44	BF183	44	MAT121	22	2G309	38½	2N2160	66	2N3054	50½	2N4060	13
AC115	25½	AD161 &		BC148	11	BD136	44	BF184	27½	MPF102	46	2G339	22	2N2192	38½	2N3055	55	2N4061	13
AC117K	22	AD162 (MP)		BC149	13	BD137	49½	BF185	33	MPF104	40½	2G339A	17½	2N2193	38½	2N3391	15½	2N4062	13
AC122	13		60½	BC150	20	BD138	55	BF188	44	MPF105	40½	2G344	20	2N2194	38½	2N3391A	17½	2N4284	18½
AC125	18½	ADT140	55	BC151	22	BD139	60½	BF194	13	OC19	38½	2G345	17½	2N2217	24	2N3392	15½	2N4285	18½
AC126	18½	AF114	26½	BC152	18½	BD140	66	BF195	13	OC20	69½	2G371	17½	2N2218	22	2N3393	15½	2N4286	18½
AC127	18½	AF115	26½	BC153	31	BD155	88	BF196	15½	OC22	42	2G371B	13	2N2219	22	2N3394	15½	2N4287	18½
AC128	18½	AF116	26½	BC154	33	BD175	66	BF197	15½	OC23	46	2G373	18½	2N2220	24	2N3395	18½	2N4288	18½
AC132	15½	AF117	26½	BC157	20	BD176	66	BF200	49½	OC24	61½	2G374	18½	2N2221	22	2N3402	23	2N4289	18½
AC134	15½	AF118	38½	BC158	13	BD177	71½	BF222	1·04½	OC25	42	2G377	33	2N2222	22	2N3403	23	2N4290	18½
AC137	15½	AF124	33	BC159	13	BD178	71½	BF257	49½	OC26	27½	2G378	17½	2N2368	18½	2N3404	31	2N4291	18½
AC141	15½	AF125	27½	BC160	49½	BD179	77	BF258	66	OC28	55	2G381	17½	2N2369	15½	2N3405	46	2N4292	18½
AC141K	18½	AF126	31	BC161	55	BD180	77	BF259	93½	OC29	55	2G382	17½	2N2369A	15½	2N3414	16½	2N4293	18½
AC142	15½	AF127	31	BC167	13	BD185	71½	BF262	60½	OC35	46	2G401	33	2N2411	26½	2N3415	16½	2N5172	13
AC142K	18½	AF139	33	BC168	13	BD186	71½	BF263	60½	OC36	55	2G414	33	2N2412	26½	2N3416	31	2N5457	35
AC151	16½	AF178	33	BC169	13	BD187	77	BF270	38½	OC41	22	2G417	27½	2N2646	51½	2N3417	31	2N5458	35
AC154	22	AF179	55	BC170	13	BD138	77	BF271	33	OC42	26½	2N388	38½	2N2711	23	2N3525	82½	2N5459	44
AC155	22	AF180	55	BC171	15½	BD139	82½	BF272	88	OC44	16½	2N388A	60½	2N2712	23	2N3646	10	2S301	55
AC156	22	AF181	49½	BC172	15½	BD190	82½	BF273	38½	OC45	14	2N404	22	2N2714	23	2N3702	11	2S302A	46
AC157	26½	AF186	49½	BC173	15½	BD195	93½	BF274	38½	OC70	11	2N404A	31	2M2904	18½	2N3703	11	2S302	46
AC165	22	AF239	40½	BC174	15½	BD196	93½	BFW10	66	OC71	11	2N524	46	2N2904A	23	2N3704	12	2S303	60½
AC166	22	AL102	71½	BC175	24	BD197	99	BFX29	30	OC72	15½	2N527	54	2N2905	22	2N3705	11	2S304	77
AC167	22	AL103	71½	BC177	21	BD198	99	BFX84	24	OC74	15½	2N598	46	2N2905A	23	2N3706	10	2S305	92½
AC168	26½	ASY26	27½	BC178	21	BD199	1·04½	BFX85	33	OC75	16½	2N599	49½	2N2906	16½	2N3707	12	2S306	92½
AC169	15½	ASY27	33	BC179	21	BD200	1·04½	BFX86	24	OC76	16½	2N696	14	2N2906A	20	2N3708	7½	2S307	92½
AC176	22	ASY28	27½	BC180	26½	BD205	88	BFX87	26½	OC77	27½	2N697	14½	2N2907	22	2N3709	10	2S321	61½
AC177	26½	ASY29	27½	BC181	26½	BD206	88	BFX88	24	OC81	16½	2N698	26½	2N2907A	24	2N3710	10	2S322	46
AC178	31	ASY50	27½	BC182	11	BD207	1·04½	BFY50	22	OC81D	16½	2N699	38½	2N2923	15½	2N3711	10	2S322A	46
AC179	31	ASY51	27½	BC182L	11	BD208	1·04½	BFY51	22	OC82	16½	2N706	9	2N2924	15½	2N3819	31	2S323	61½
AC180	18½	ASY52	27½	BC183	11	BDY20	1·10	BFY52	22	OC82D	16½	2N706A	10	2N2925	15½	2N3820	55	2S324	77
AC180K	22	ASY54	27½	BC183L	11	BF115	26½	BFY53	18½	OC83	22	2N708	13	2N2926(G)	14	2N3821	38½	2S325	77
AC181	18½	ASY55	27½	BC184	13	BF117	49½	BPX25	93½	OC84	22	2N711	33	2N2926(Y)	12	2N3823	31	2S326	77
AC181K	22	ASY56	27½	BC184L	13	BF118	77	BSX19	16½	OC139	22	2N717	38½	2N2926(O)	11	2N3903	31	2S327	77
AC187	24	ASY57	27½	BC186	31	BF119	77	BSX20	16½	OC140	22	2N718	26½	2N2926(R)	11	2N3904	33	2S701	46
AC187K	22	ASY58	27½	BC187	31	BF121	49½	BSY25	16½	OC169	27½	2N718A	55	2N2926(B)	11	2N3905	31	40361	44
AC188	24	ASZ21	44	BC207	12	BF123	55	BSY26	16½	OC170	27½	2N726	31	2N3010	77	2N3906	30	40362	49½
AC188K	22	BC107	10	BC208	12	BF125	49½	BSY27	16½	OC171	27½	2N727	31	2N3011	15½	2N4058	13		
ACY17	27½	BC108	10	BC209	13	BF127	55	BSY28	16½	OC200	27½	2N743	22						
ACY18	22	BC109	11	BC212L	12	BF152	60½	BSY29	16½	OC201	31	2N744	22						
ACY19	22	BC113	11	BC213L	12	BF153	49½	BSY38	20	OC202	31	2N914	15½						
ACY20	22	BC114	16½	BC214L	15½	BF154	49½	BSY39	20	OC203	27½	2N918	33						
ACY21	22	BC115	16½	BC225	27½	BF155	77	BSY40	31	OC204	27½	2N929	23						
ACY22	17½	BC116	16½	BC226	38½	BF156	53	BSY41	31	OC205	38½	2N930	23						
ACY27	19½	BC117	16½	BCY30	26½	BF157	60½	BSY95	14	OC309	44	2N1131	22						
ACY28	21	BC118	11	BCY31	28½	BF158	60½	BSY95A	14	OCP71	47½	2N1132	24						
ACY29	38½	BC119	33	BCY32	33	BF159	66	Bu105	2·20	ORP12	47½	2N1302	15½						
ACY30	31	BC120	88	BCY33	24	BF160	44	C111E	55	ORP60	44	2N1303	15½						
ACY31	31	BC125	13	BCY34	27½	BF162	44	C400	33	ORP61	44	2N1304	18½						
ACY34	23	BC126	20	BCY70	15½	BF163	44	C407	27½	P346A	22	2N1305	18½						
ACY35	23	BC132	13	BCY71	20	BF164	44	C424	22	P397	46	2N1306	23						
ACY36	31	BC134	20	BCY72	15½	BF165	44	C425	55	ST140	14	2N1307	23						
ACY40	18½	BC135	13	BCZ10	22	BF167	24	C426	38½	ST141	18½	2N1308	25½						
ACY41	19½	BC136	16½	BCZ11	27½	BF173	24	C428	22	TIS43	33	2N1309	25½						
ACY44	38½	BC137	16½	BCX12	27½	BF176	38½	C441	33	UT46	30	2N1613	22						
AD130	42	BC139	44	BD121	66	BF177	38½	C442	33	2G301	21	2N1711	22						
AD140	53	BC140	33	BD123	71½	BF178	33	C444	38½	2G302	21	2N1889	35						
AD142	53	BC141	33	BD124	66	BF179	33	C450	24	2G303	21	2N1890	49½						
AD143	42	BC142	33	BD131	55	BF180	33	MAT100	21	2G304	26½	2N1893	40½						
AD149	55	BC143	33	BD132	66	BF181	33	MAT101	22	2G306	44	2N2147	79						

DIODES AND RECTIFIERS

AA119	9	BY133	23	OA70	7½
AA120	9	BY164	55	OA79	7½
AA129	9	BYX38/30	46	OA81	7½
AAY30	10	BYZ10	38½	OA85	10
AAZ13	11	BYZ11	33	OA90	6½
BA100	11	BYZ12	33	OA91	6½
BA116	23	BYZ13	27½	OA95	7½
BA126	24	BYZ16	44	OA200	6½
BA148	15½	BYZ17	38½	OA202	7½
BA154	13	BYZ18	38½	SD10	5½
BA155	15½	BYZ19	31	SD19	5½
BA156	14½	CG62		1N34	7½
BY100	16½	(OA91 Eq.)	5½	1N34A	7½
BY101	13	CG651		1N914	6½
BY105	18½	(OA70-OA79		1N916	6½
BY114	18	Eq.)	6½	1N414B	6½
BY126	15½	OA5	38½	1S021	11
BY127	16½	OA5SL	23	1S951	6½
BY128	16½	OA10	38½		
BY130	17½	OA47	7½		

Cut these 3 pages out and keep for reference

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx. count by weight	0·55
C 2	200	Capacitors mixed values approx. count by weight	0·55
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C 5	5	Pieces assorted Ferrite Rods	0·55
C 6	2	Tuning Gangs, MW/LW VHF	0·55
C 7	1	Pack Wire 50 metres assorted colours	0·55
C 8	10	Reed Switches	0·55
C 9	3	Micro Switches	0·55
C10	15	Assorted Pots & Pre-Sets	0·55
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Types	0·55
C12	40	Paper Condensers preferred types mixed values	0·55
C13	20	Electrolytics Trans. types	0·55
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C19	3	Relays 6—24V Operating	0·55
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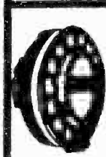

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Each Kit contains two Amplifier Modules, 3 watts RMS, two loudspeakers, 15 ohms, the pre-amplifier, transformer, power supply module, front panel and other accessories, as well as an illustrated stage-by-stage instruction booklet designed for the beginner. Further details available on request.

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SN7427	0·50	0·46	0·44	SN7492	0·74	0·71	0·64	SN74181	£6·05	£5·50	£5·23
SN7428	0·77	0·72	0·66	SN7493	0·74	0·71	0·64	SN74182	£2·20	£1·98	£1·76
SN7430	0·17	0·16	0·13	SN7494	0·85	0·82	0·75	SN74184	£3·85	£3·58	£3·30
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SN7448	£1·10	£1·07	£1·05	SN74123	£3·08	£2·97	£2·86	5V. & μA7812 12V. £1·76 each			

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Type No.	Price 1–24	25–99	100 up
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BP 702C—SL702C	69½p	55p	49½p
BP 702—72702	58½p	49½p	44p
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BP 709P—μA709C	39½p	37½p	33p
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BP 741—72741	55p	50p	45p
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TAA 293	99p	82½p	77p
TAA 350	£1·87p	£1·74p	£1·65p

S.G.S. EA1000 £2·89½p

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

Type	Price 1	25	100+
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BP933	14p	13p	12p
BP935	14p	13p	12p
BP936	14p	13p	12p
BP944	14p	13p	12p
BP945	27½p	26½p	24p
BP946	13p	12p	11p
BP948	27½p	26½p	24p
BP951	71½p	66p	60½p
BP962	13p	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.

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Epoxy TO-5 case	Price each 1–24	25–99	100 up
uL900 Buffer	38p	36p	29p
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Date and Circuits Booklet for IC's Price 8p.

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

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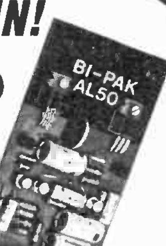

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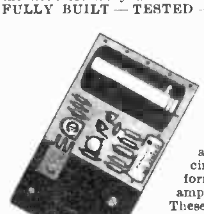
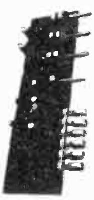


AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 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 ± 1dB
Harmonic Distortion	better than 0·1%
Inputs : 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 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 × 82mm × 35mm

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220-240 Volts or 100-120 Volts

Model X25

The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with it's truly remarkable heat-capacity will easily "out-solder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8".

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

Totally enclosed element in ceramic and steel shaft Bits do not "freeze" and can easily be removed

PRICE: £1.75 (rec. retail)

Suitable for production work and as a general purpose iron

Model CCN

220 volts or 240 volts

The 15 watt miniature model CCN. also has negligible leakage. Test voltage 4000v. 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 1/16"

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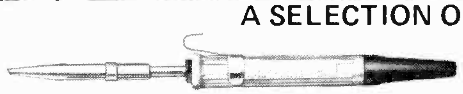
OR Fitted with triple-coated, (iron, nickel and Chromium) bit 1/8"

PRICE: £1.95 (rec. retail)

A SELECTION OF OTHER SOLDERING EQUIPMENT.



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)

MODEL CN2

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

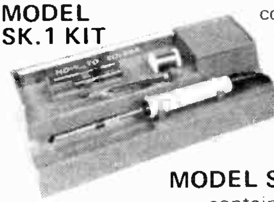
PRICE. £1.70 (rec. retail)

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)

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.

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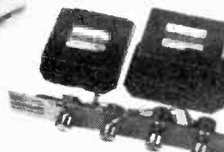

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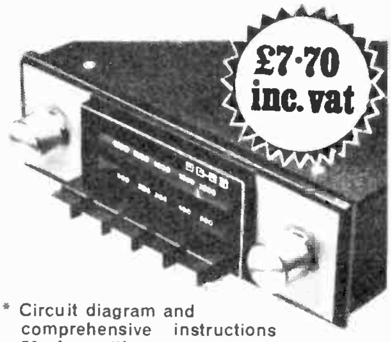

The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles. It covers the full medium and long wave bands. It is permeability tuned and sturdily constructed. Output is a full 2·5 watts into an 8ohms speaker. But the Tourist PB will operate into any loudspeaker from 8 to 15 ohms.
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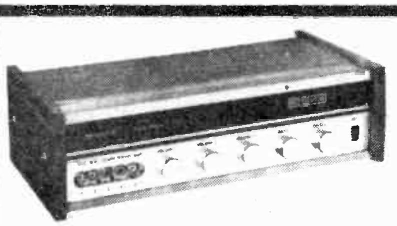

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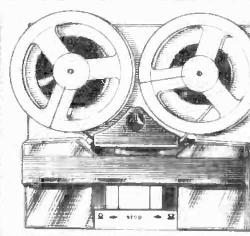
£31·35 (inc. VAT)



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Suitable 3 speed tap deck, less heads. Cater up to 7ins. spools. Unuse but store soiled hence no warranty.

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* Denotes VAT has been absorbed in the price without increase on VISCOUNT audio systems.

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PRICES: SYSTEM 1

Viscount III R 101 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£15·40 + £2·20 p & p
Garrard SP25 Mk.III with MAG. cartridge plinth & cover	£25·00 + £1·75 p & p
total	£64·60

Available complete for only **£52*** + £3·50 p. & p.

PRICES: SYSTEM 2

Vicount R 101 amplifier	£24·20 + £1 p & p
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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VISCOUNT III AUDIO STILL ONLY £52*
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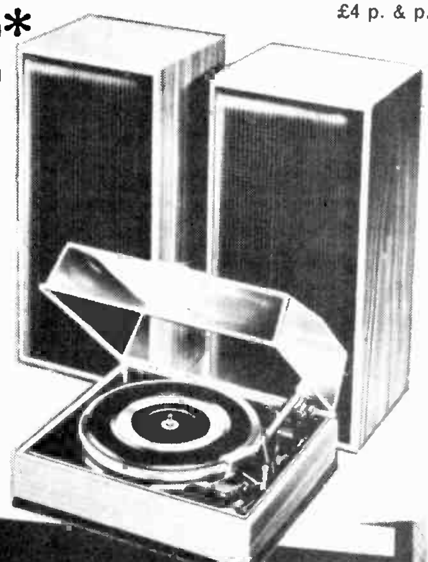

14 + 14w. r.m.s. 40Hz to 40kHz ± 3dB. Total distortion at 10w. at 1kHz – 0·1%. This is real value for money! We have designed 2 systems and the heart of them both is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect, transistors) are incorporated on 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.

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The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

SPEAKERS: Duo Type II Size approx. 17in. × 10½in. × 6½in. Drive unit 13in. × 8in. with parasitic tweeter. Max. power 10 watts ohms. Simulated Teak cabinet. £15·40 a pair (inc. VAT), £3·30 p. and p. Duo Type III Size approx. 23½in. × 11½in. × 9½in. Drive unit 13½in. 8½in. with H.F. speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20KHz. Teak veneer cabinet.
SPECIFICATION R101: 14 watts per channel into 3 to 4 ohms (suitable 3–15 ohms.) Total distortion @ 10W 1kHz @ 0·1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within idB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. Signal-to-noise ratio: (all controls at max.)—P.U.I. and radio — 65dB, P.U.2 — 58dB. Cross talk better than — 35dB on all inputs. Size approx. 13½in. × 9in. × 3½in. Send S.A.E. for fully illustrated brochure. 12 month's written guarantee.

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SUPPORT SERVICE

WHY did you buy this copy of *Practical Wireless?* Were you influenced by advanced publicity or advertising; are you a regular reader with a devotion to follow our activities month by month; or are you one of many thousands who pick up this magazine to seek guidance on what makes radio and electronics tick? It has been said that people read *Practical Wireless* to learn something about the subject. After all, it is a technical field that demands some education and understanding and it is really this aspect that makes most people read.

To supplement professional career requirements there is a growing band of people who are bank clerks, clergymen, accountants, businessmen, as well as students and technicians who are seeking part time courses on the practical side of radio and electronics. Some colleges are able to offer facilities, subject to minimum class size, but we have heard of cases where they cannot find enough qualified engineers who are willing to spend extra time in the evenings to instruct these students. It is a pity because it often means that a course has to be dropped because of this.

So we come back to magazines; *Practical Wireless* is used in schools and colleges to a great extent because it provides an excellent support service to instructors, many of whom cannot always find sufficient time in addition to their everyday jobs to make full preparation for classes. *Practical Wireless* is a leader because its articles and designs are "down-to-earth" and, in spite of competition from elsewhere, we still offer the greatest constructional project support to instructors, technicians and engineers, while encouraging the confidence of newcomers.

This month we have rubber-stamped this policy by giving you for the first time a unique supplement containing eight extra straightforward constructional projects for the home, attractively presented with abundant illustrations and a full colour cover picture. To make it easier for you to find this supplement and worthwhile to keep for reference, we have printed it on a pleasant shade of "apple-green" coloured paper—another first for *Practical Wireless.*

Don't let this divert your curiosity too far from our other usual features because you will also find much more to interest you in this issue. For the benefit of quick and easy reference you will also find our contents list just inside the front cover, together with information on many aspects of our service. And watch out for next month's issue too for more special attractions, some of which are mentioned in this issue.

M. A. COLWELL—*Editor*

The June issue, on sale May 4th, will include a new easy competition to win a Digital Multimeter, a special feature on what to look for when buying Hi-Fi Equipment, and "Special Valves in Electronics", plus the usual abundance of constructional projects.

Further details on page 48.

NEWS...

B.R.C. change their name

BRITISH Radio Corporation Limited announced on the 1st April that it has changed its name to Thorn Consumer Electronics Limited. It continues to manufacture and market audio and TV products under the Ferguson, HMV, Ultra and Marconiphone brands and remains a wholly-owned subsidiary of Thorn Electrical Industries Ltd.

VAT

To the best of our knowledge, the prices quoted in this issue were correct at the time of going to press.

As from April 1st, 1973, there is no purchase tax but a large number of goods carry Value Added Tax.

The "N.F.A.C."

THE National Federation of Aerial Contractors Limited is making an attempt to "clean up" the aerial contracting industry.

The Ministry of Posts and Telecommunications listed 55,000 complaints of bad reception in their recent annual report. Out of 32 listed causes of complaints, the largest numbers were for "inefficient aerial installations" and the N.F.A.C. feels that it can help this state of affairs by alerting the consumer and all who employ aerial contractors that there are in existence a very large number of "Rooftop Racketeers".

Plans currently being considered by the Federation include random inspections of members' installations and a system whereby new companies applying for membership will have their work inspected in addition to the trade references that are already required. A special Standards Committee will hear reports of faulty workmanship.

By this system, the N.F.A.C. hopes to assist in narrowing the field of consumer complaints and possibly convince dealers that they mean to play their part in cleaning up the aerial contracting industry.

NEWS... NEWS... NEWS...

Mullard film on I.C. design

MULLARD Ltd. have announced a new 16mm colour film lasting 18 minutes. It's called *The Computer-Aided Design of Integrated Circuits* and is available on free loan from the Mullard Film Library, 269 Kingston Road, Merton Park, London, SW19 3NR.

The film, which was shot mainly on location at the Mullard semiconductor plant at Southampton, describes in detail the use of the computer and its peripheral equipment in such functions as IC design and layout, mask-making and testing at every stage of production.

Tandberg in the jungle

SERGEANT J. Murtagh of the Royal Signals is seen in the picture using a Tandberg Series 11 portable tape recorder. This machine and a TP4-1 portable radio accompanied a recent British Trans-Americas expedition which took in 18,000 gruelling miles from Alaska to the tip of South America. The purpose of the journey was to survey a road through the uncrossed 300 miles of swamp and jungle bordering the Panama canal which blocks the Pan American highway system.

During the trip, the expedition kept in touch with the outside world with the TP4-1 receiver, picking up BBC news broadcasts and weather reports.

In the jungle and swamps, the electrical equipment was carried in man-packs or by ponies and although it was partially immersed in water, rolled on several times by the ponies and carried through thick mud, it continued to function without a fault.

Sgt. Murtagh of the Royal Signals.

Signals "piped" through waveguide

THE core of a system which, when fully implemented, will transmit 300,000 phone conversations or 200 colour TV signals at the same time through a waveguide "pipe" is now operating at the GEC-Marconi works at Great Baddow.

This equipment will be used by Post Office engineers in a field trial system to be installed between the Post Office Research Station at Martlesham, Suffolk and a Post Office site at Wickham Market, 15 kilometres away.

The new "pipe" is a 50mm diameter circular waveguide capable of supporting signals throughout the frequency band from about 32 to 110GHz. The photograph shows 32-50GHz channel separating filters and band-branching assembly.

Texan reprints

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

They may be obtained by sending 35p (30p+5p) postage/packing to "Texan" Reprint, c/o *Chief Cashier, Practical Wireless Tower House, Southampton Street, London WC2E 9QX.*

World Radio Club

FURTHER to the item on the World Radio Club in the March issue, we have been informed by the programme Producer that an extra broadcast in the BBC World Service will be made each week at 20.30 GMT on Thursdays.

The midday edition has now been moved to 13·30 GMT on Wednesdays. The other Friday and Sunday transmissions remain unaltered. *BBC, Bush House, P.O. Box 76, Strand, London WC2B 4PH.*

Some S.E.R.T. meetings

THE Society of Electronic and Radio Technicians, Faraday House, 8-10 Charing Cross Road, London, W.C.2. will be holding the following meetings:

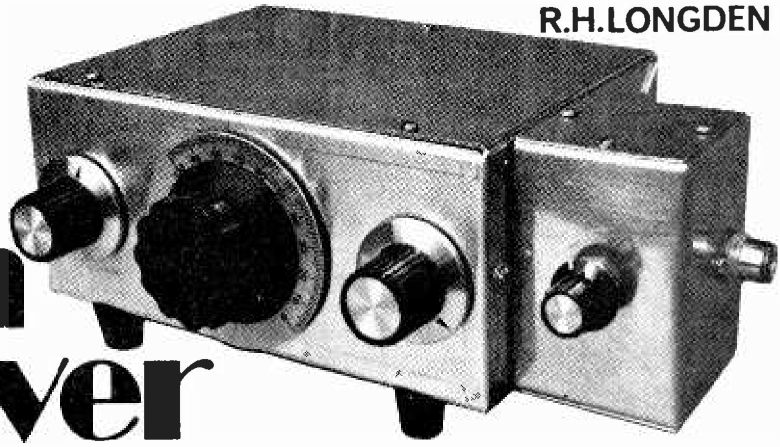
April 11: "Test Equipment" by B. Ellison from Tektronix. Venue is The Conference Theatre, I.B.A., 70 Brompton Road, London, S.W.3 and the lecture commences at 7·00 p.m.

April 5: "Colour TV Forum and Exhibition". This will be held in the Byng Kendrick Suite, University of Aston, Birmingham, commencing at 7.00 p.m.

April 24: "The CVC5 Colour Receiver" by A. E. Thomas from ITT. This will be held in the Cleveland Scientific Institution, Corporation Road, Middlesborough. Meeting starts at 7.30 p.m.

VHF Regen Receiver

R.H.LONGDEN



THIS is a self-contained receiver which may be used over the range 115-150MHz, or 140-190MHz, according to the coil fitted. It was actually found to maintain good efficiency even up to 210MHz. A vertical telescopic aerial or improved aerial system will provide reception on the internal speaker, an outlet being present for headphones when required. An optional preamplifier is also described.

The receiver has a superregenerative detector, which is a great advantage from the point of view of simplicity. This type of detector is highly sensitive, and it should be possible to copy a signal of under 1μV. There is also only one tuned circuit, so no alignment or ganging difficulties arise. The bands include the 2-metre amateur band (144-146MHz). In terms of sensitivity, most signals which can be well received with the simpler type of converter-communications receiver combination can also be received satisfactorily with this receiver.

A disadvantage sometimes encountered with this type of receiver is tricky tuning and hand-capacity effects. These do not arise here, due to sound construction and a metal case and so actual use of the receiver is easy.

Circuit Details

Fig. 1 is the circuit, employing a junction f.e.t. in the first stage. The rod or other aerial is coupled by L1, and L2 is tuned by VC1. The network R2, C4, R3 and C5 gives a suitable quench frequency and regeneration is controlled by VR1. To modify the tuning range, L2 only need be changed.

A three-stage audio amplifier assembled on a separate circuit board follows. Tr2 is the first audio amplifier, Tr3 the driver, and Tr4/5 the output pair, operating a small speaker in the case. The outlet takes a jack plug for an external speaker or phones, if wanted, and VR2 is the volume or audio gain control. R12 is a small pre-set potentiometer, which allows working conditions for the output pair to be suitably adjusted.

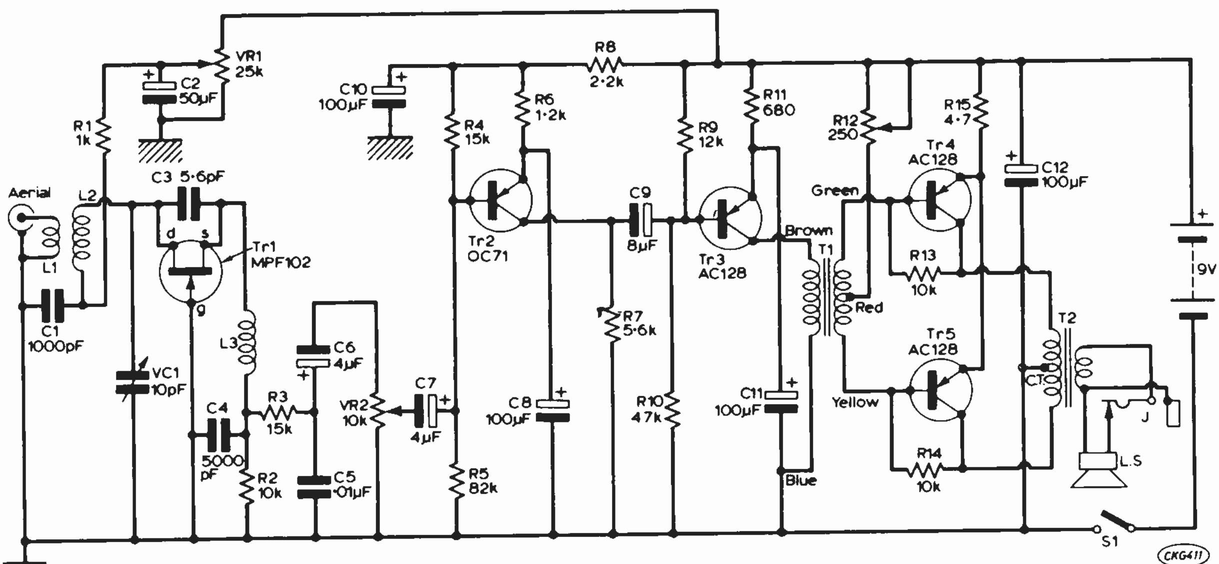


Fig. 1 : Circuit of the main receiver. The circuit of the pre-amplifier is shown in Fig. 4. The heading photograph shows the two units bolted together.

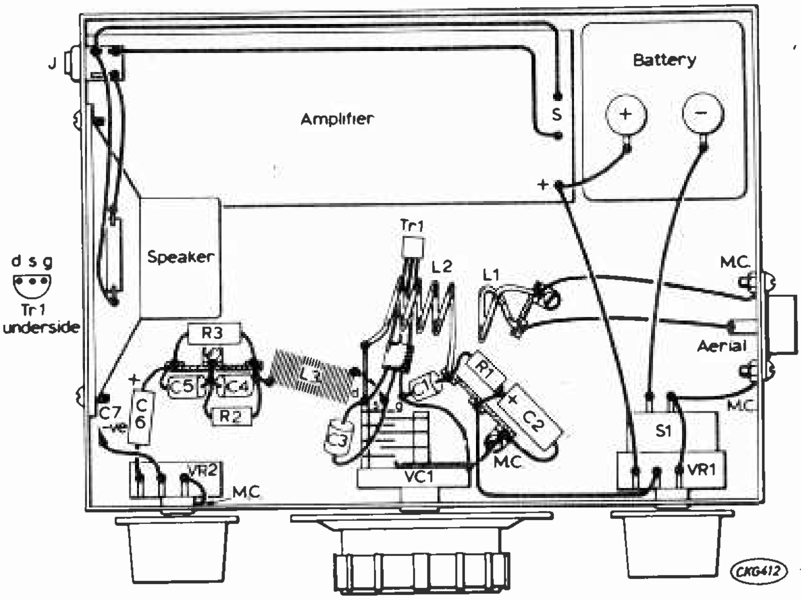
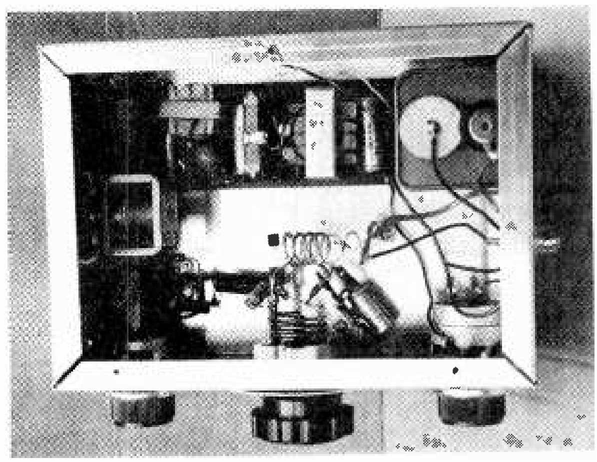


Fig. 2: Layout of the main components and audio amplifier board within the cabinet. When the preamplifier is fitted the coaxial aerial socket is removed and used on the preamplifier box.



Photograph looking into the top of the receiver which may help when locating components as in Fig. 2 above.

Cabinet Construction

Flanged universal chassis members 7 x 3in form the front and back, and similar parts 5 x 3in are the sides. The top and bottom are 7 x 5in flat plates.

The front member is drilled for VC1, VR1 and VR2, as in Fig. 2. Also punch or drill holes for a co-axial socket on the right hand side, or for an insulated terminal or socket, if a co-axial feeder is not required here.

An opening is cut in the left member for the speaker, taking care that this will clear the amplifier and other parts. Perforated zinc or expanded metal is placed over the aperture, and the speaker is bolted on. The jack outlet is placed as shown.

The four flanged members are then assembled by bolts through the holes present in them. Four holes are drilled in one 7 x 5in plate, these are marked through so that the flanges can be drilled to suit. The case bottom can then be attached. Two rubber feet were placed on the front bolts, to raise the front of the receiver slightly.

It is easier to assemble the receiver if the sides and back are left off until later. When all construction is finished, the top 7 x 5in flat plate is fixed with four self-tapping screws.

Detector Stage

This is wired as in Fig. 2. A 3-lead holder is used for Tr1. This avoids possible damage from heating while soldering, and also allows the transistor to be changed, if necessary. The MPF102 is listed as having a top frequency of 200MHz. Some were found to perform satisfactorily at well above this, but others, not up to specification, would only operate at relatively low frequencies.

The holder *drain* tag is soldered directly to the lower fixed plates pillar of VC1. The leads of C3 are cut short, and this item is soldered from the *source* tag, to the top pillar of VC1. A stout wire is also soldered to this pillar, projecting back about ½in so that L2 can be changed without unsoldering other items.

A stout lead from the *gate* tag goes to the moving plates contact of VC1, just clearing the moving plates. The tag strip holding R1 and C2 is raised on a long bolt, so that wires from C1 are as short as possible. A wire projects upwards about ½in to take the other end of L2.

L1 is a single turn of insulated wire. Coupling can be adjusted by rotating this small tag strip slightly on its fixing bolt, but it is not very critical.

L3 is self-supporting, and is 30 turns of 26swg enamelled wire, wound on a ¼in diameter object which is afterwards removed. Turns are closewound. One end is soldered to the tag supporting R2, C4 and R3, and the other end is soldered to the source tag of Tr1 holder.

The potentiometers and other parts can then be wired as in Fig. 2. A lead will run from VR2 under the speaker to the input pin of the audio amplifier.

Audio Amplifier

This is assembled on Veroboard 5 x 1¾in, as in Fig. 3. First drill two holes for the chassis bolts, position the board in the case, and mark and drill matching holes in the metal bottom. Tags held with the bolts form earthing points, Fig. 3. The bolts are $\frac{1}{2}$in long, so that extra nuts hold the assembly clear of the metal case, lock-nuts underneath securing the amplifier. A piece of card $5 \times 1\frac{3}{4}$in may be put between the amplifier and case bottom, though shorts to the metal will not arise if joints are kept close to the board.

Coils

These are self-supporting, wound with 18swg, 20-swg or other stout wire, with spaced turns. A coil having 4 turns, $\frac{1}{2}$in outside diameter, and $\frac{7}{8}$in long, was found to tune 115-150MHz. This is suitable for 2 metre reception.

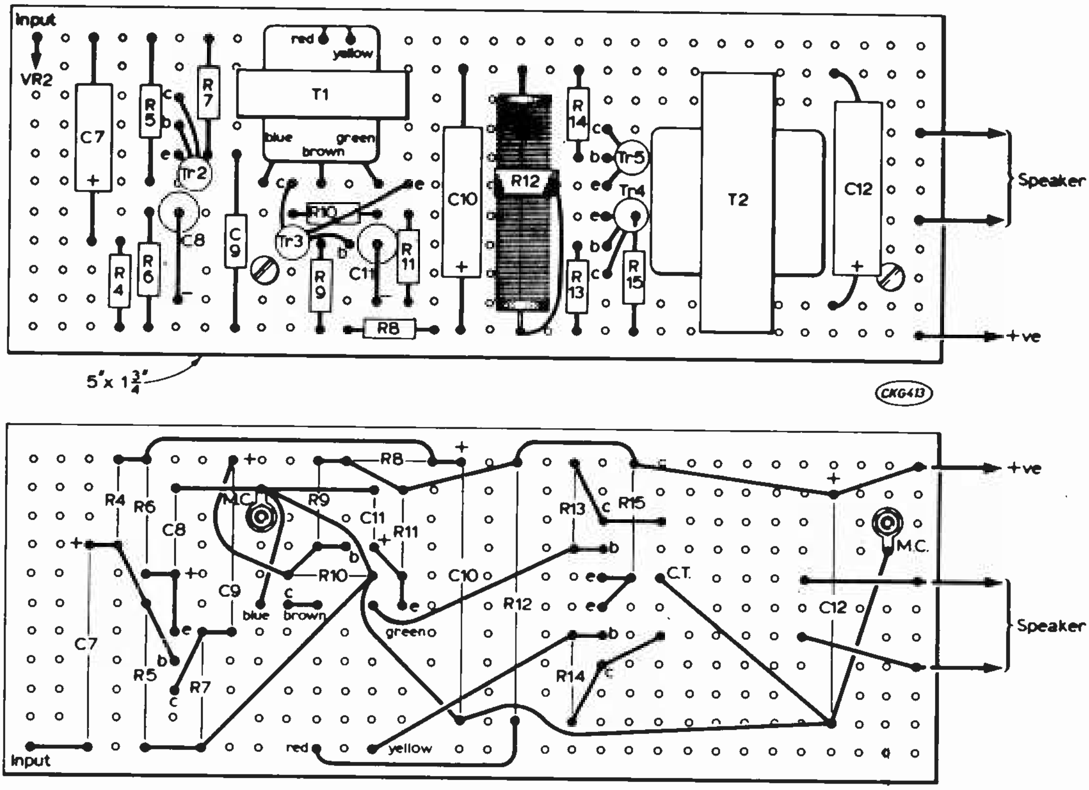


Fig. 3: Diagrams of the component layout and wiring of the audio amplifier board.

Take care to fit the electrolytic capacitors as indicated. With a unit of this kind, it is helpful to place black 1mm sleeving on the negative line leads, and red sleeving on positive leads. With another colour for other wiring, it will be easy to check connections if this should prove necessary.

The amplifier may be tested before fixing it. Place the slider of R12 at about the central position. Connect the speaker and a 9V battery, negative to one of the chassis tags. Either place a meter in one battery lead and move the slider of R12 for a current of 10mA, or adjust R12 to place just enough resistance in circuit for speech to sound normal. If R12 is at a very low value, current drawn will be small but cross-over distortion will be present.

For this test, input can be from any convenient source; a signal generator, diode tuner, pick-up, or from the first stage of the completed receiver. If VR2 is not in circuit, avoid overloading the amplifier by the test signal.

The amplifier is fitted as shown, negative return being through the metal case. Connect the speaker leads and amplifier to the jack so that the contacts which open silence the speaker, when phones or an external speaker are in use.

A coil $\frac{1}{2}$in long and $\frac{7}{16}$in in diameter, having three turns, tuned 192-150MHz, while a similar coil having two turns allowed 216MHz to be reached.

Stray circuit capacitances and the length of connecting leads influence the frequencies tuned. The frequency can be raised by reducing the number of turns, or by stretching the coil to separate turns, or by reducing the overall diameter.

Operating notes

When VR1 is advanced, a position should be found where a strong hiss begins. This is roughly the correct setting for VR1, though it will be found that further slight adjustment may be helpful, depending on the strength of the signal tuned in.

The hiss should cease when any signal of sufficient strength is tuned in, provided VR1 has not been turned too far. VR2 adjusts volume in the usual way, and can probably be advanced about half way, for the internal speaker.

If superregeneration is impossible on some part of the band, move L1 a little further from L12. This

★ components list

Resistors

R1	1kΩ	R9	12kΩ
R2	10kΩ	R10	47kΩ
R3	15kΩ	R11	680Ω
R4	15kΩ	R12	250Ω miniature slide pot.
R5	82kΩ	R13	10kΩ
R6	1·2kΩ	R14	10kΩ
R7	5·6kΩ	R15	4·7Ω All ¼W, 5%
R8	2·2kΩ		

VR1 25kΩ linear pot. with switch
VR2 10kΩ log. pot.

Capacitors

C1	1000pF disc ceramic	C7	4μF 4V
C2	50μF 10V	C8	100μF 10V
C3	5·6pF	C9	8μF 6V
C4	5000pF	C10	100μF 10V
C5	0·01μF	C11	100μF 10V
C6	4μF 4V	C12	100μF 10V

VC1 10pF variable Jackson C804

Transistors

Tr1	MPF102	Tr3	AC128
Tr2	OC71	Tr4/5	2xAC128

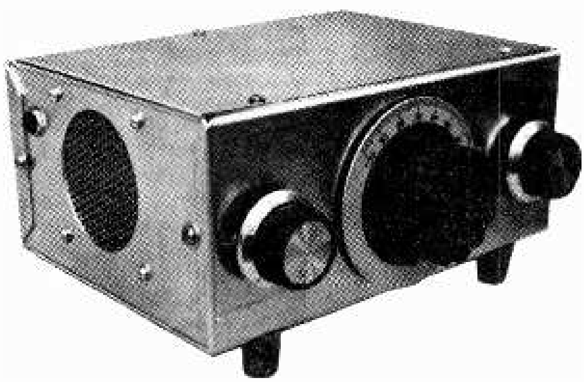
Miscellaneous

Case: Two 5x3in. and two 7x3in. flanged universal chassis members, and two 5x7in. flat plates (Home Radio, Mitcham); KN2 2¾in. dial and knob (Home Radio); Two 1in. knobs; tag strips, etc.; T1 Osmor driver transformer; T2 Output transformer, 2xAC128 type to 2/3 ohms; 2½in. 3Ω speaker; Jack socket with break contacts; 3-lead transistor holder, co-axial socket.

is not critical, but tight coupling will tend to prevent regeneration, while very loose coupling will reduce signal strength.

Aerials

There is room for considerable experiment here. Some local transmissions (range about 10 miles) were received with about 6in of wire projecting from the socket, which shows how sensitive this type of circuit can be.



This view of the receiver shows the positioning of the internal loudspeaker and the socket for an external loudspeaker or headphones.

With a telescopic aerial extending to three feet, a considerable number of transmissions were received, including amateurs over 50 miles away. This aerial performed poorly with the receiver and aerial near a metal window, but was better in the centre of a downstairs room, and even better in an upstairs room. Reducing the length to about two feet made almost no difference, and sliding the sections up and down did not give any notably best or critical resonant length.

Best results of all on 2 metres were obtained with a dipole made from ¼in aluminium tubing, 38½in overall, with a centre co-axial feeder. This aerial was mounted out of doors on a light pole. A long or lossy feeder would tend to lose much of the advantage such an aerial can give.

The angle and slope (polarisation) of all these aerials had some influence on results. No doubt an improved VHF aerial would increase signal strength, but some means of rotating it would be needed, and this was not felt justified.

Pre-amplifier

The receiver has high sensitivity, but in some circumstances there are advantages to be obtained by adding an r.f. stage. This stage will materially reduce radiation from the superregenerative detector, and also help isolate the aerial to avoid dead spot or damping effects on some frequencies. In fact, these are the most important advantages, and much gain must not be expected from the r.f. stage at frequencies over 150MHz or so.

Fig. 4 is the circuit, the f.e.t. being used in a grounded-gate arrangement which does not need neutralising. L1 is peaked by the small capacitor VC1. Tuning is flat, and needs no adjustment over a small band.

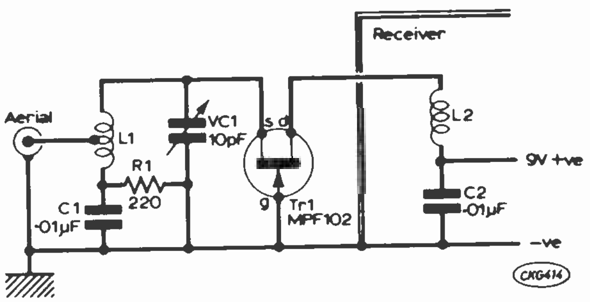


Fig. 4: Circuit of the pre-amplifier and connections to the input circuit of the main receiver.

The f.e.t. drain circuit is to the coupling loop L2, which was originally used for aerial coupling in the receiver. Alternatively, a broadly resonant winding can be used here, resulting in better gain over a narrow band of frequencies.

Cabinet

The box is 3 x 2 x 2in and is bolted on the metal side of the receiver case. It is made from a flat piece of aluminium 7 x 2in and one 7 x 3in flanged "universal chassis" member.

The long flanges are cut 2in from each end, a 90° piece being removed. A piece of wood about

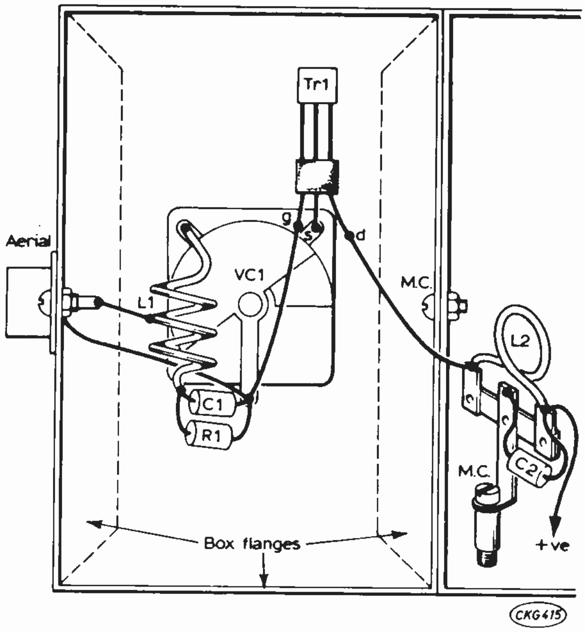


Fig. 5: Positioning of the few components within the preamplifier box.

3 x 2in and ½in or so thick is then placed between the flanges, and another piece of wood is placed level with this, and the whole gripped tightly in a vice. The 7 x 3in member is then bent into a 3 x 2 x 2in box, with the flanges inwards. Fig. 5 shows this part from behind. The front is drilled for VC1, and one side for the co-axial or other aerial socket. Three holes are also drilled in the other side, to match up with the holes which are exposed when the co-axial socket is removed from the receiver.

The 7 x 2in piece is bent at 2in from each end, in the same manner, so will fit on to enclose the box. It is held with a number of self-tapping screws.

Pre-amplifier Wiring

The transistor holder (or transistor) is soldered directly to VC1, as in Fig. 5. All leads are as short as possible.

L1 is wound with 18 or 20swg copper wire, and is similar to the coil in the receiver, but will generally have to be stretched somewhat, or have about one less turn. If maximum volume is with VC1 fully open, this shows that L1 should be changed, by removing a turn, spacing turns further apart, or winding a new coil of smaller diameter.

The position of the aerial tapping depends somewhat on the use of a co-axial fed dipole or similar aerial, or a short vertical rod type aerial. This tapping can usually be about one-quarter to one-third the total number of turns from the C1 (earthed) end.

Two bolts fix the r.f. stage to the side of the receiver, and a lead from Tr1 drain passes through the original aerial socket hole to L2.

★ components list

R1 220Ω ¼W, 5%
C1 0·01µF
C2 0·01µF
VC1 10pF or similar miniature variable, or pre-set.
Tr1 MPF102 Holder optional

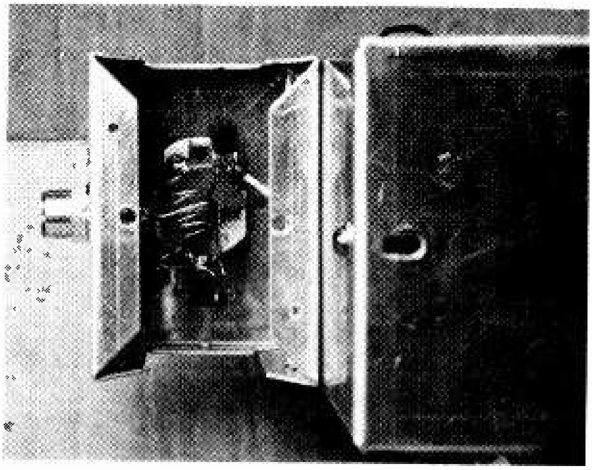
Universal Chassis flanged side 7x3in. (Home Radio)
Aluminium 7x2in.
Knob, tag-strip, etc.

The components listed above for the pre-amplifier are additional to those required for the main receiver.

Receiver Changes

The tag strip holding L2 is replaced by one having two insulated tags. A lead from one tag is run to a positive pin on the a.f. amplifier and C2 is connected from this tag to the chassis tag, as in Fig. 5. The drain lead is taken to the other tag.

L2 is one turn of insulated wire, positioned near the detector coil. Coupling is adjusted for best regeneration, by bending the loop L2 to adjust the distance to the detector coil, as with the original circuit.



Rear view of the completed pre-amplifier bolted to the receiver.

It was found that results were better with coupling in one phase. To check for this, twist L2 180°, to change its sense with relation to the detector coil.

As mentioned, L2 can be resonant over a narrow band. This increases gain, but makes it a little more troublesome to change coils or cover a wide band of frequencies. If this method is to be tried, wind L2 with one or two extra turns, compared with the detector coil, using insulated wire to avoid shorts. It is then necessary to stretch or compress L2, or change the number of turns, until it is found to peak up signals in the wanted frequency range. The resonant effect is quite flat, but these adjustments, and the degree of coupling with the detector coil, and position of the aerial tapping, can make quite a difference to reception. ■

Because superregenerative receivers are notorious for their radiation it is strongly recommended that the pre-amplifier be fitted as an essential part of the receiver. Complete screening, as described by the author, is very important.

SPECIAL PRODUCT REPORT

FETRONS ...

FETRONS

THE field effect transistor (FET) is currently being used in the front end of a.f. and r.f. circuits, as well as being developed into simplified forms of logic circuitry for micro-miniature applications such as wrist watches and pocket calculators. Aside from the manufacturers of such luxury items, our attention is turned here to more domestic matters such as television receivers, radio transmitters and receivers. Where thermionic valves are still being used, there is some reluctance to effect a total conversion to semiconductor techniques. We can have the best of both worlds because we can now replace valves in some circumstances with direct equivalent improved performance transistors. Particular areas of application also include unattended relay stations, and telecommunications terminals, as well as domestic receivers.

TRIODE EQUIVALENT

These transistors, called "fetrons," have emerged from the military applications stable and are being made available for other applications, although very little is generally known about the performance so far. The fetron is basically an arrangement of two n-channel field effect transistors (Fig. 1) connected to provide the equivalent working characteristics of a triode valve but with a much better frequency response at both ends of the spectrum. This is because the fetron has an extremely low channel resistance and inter-electrode capacitance. Furthermore, since there are no heaters, operation is immediate on switch-on.

OTHER FEATURES

The life of the fetron is likely to be much greater than the thermionic valve under normal working conditions and the degradation of operational characteristics is minimal. Other important features include a higher amplification factor (almost ten times that of a valve) and a lower noise figure. Since no heaters are used, power requirements are simplified to just one high tension supply.

PENTODE CHARACTERISTIC

Both the thermionic valve and the FET are voltage controlled devices, hence design equations are virtually the same. Although the pentode anode voltage-current characteristics are similar to the drain characteristics of the fetron, the latter are more clearly defined at the cut-off region or "knee" and exhibit stable current drain for various drive conditions (Fig. 2).

Since the main purpose of the fetron is to act as a direct replacement for the triode valve, it is essential that it should withstand high voltages and have a matched gm. The single junction FET cannot do this, but when two specially selected FETs are cascaded the problem is overcome. It is also possible to reduce the Miller (gate to source capacitance) effect by using a low capacitance, small signal, high gm FET at the input circuit, coupled with a high voltage output FET.

With the arrangement shown in Fig. 1, the output FET acts as a voltage dropper for the input FET and the Miller effect capacitance of each is in series. The output impedance is also greater than in a valve pentode, resulting in the excellent characteristics shown in Fig. 2. Since the input gate circuit is effectively a reversed bias junction, it presents a very high resistance load to the signal source.

Fig. 3 shows the transfer characteristic of a fetron which has been made

Fig. 1: Basic arrangement of two field effect transistors in one package to form a fetron, and the symbol of the 6AK5 valve.

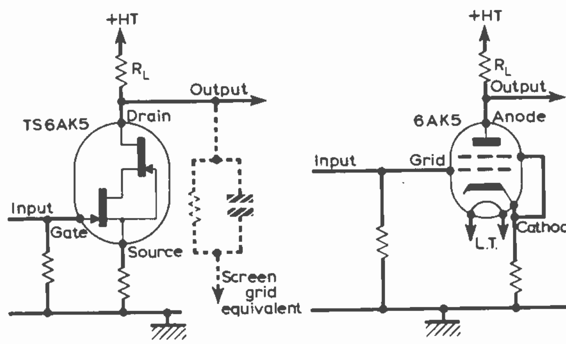


TABLE 1:

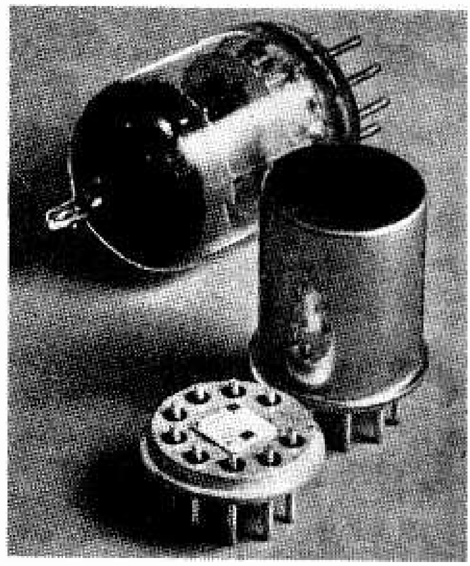
TYPICAL PENTODE DEVICE CHARACTERISTICS— Rk=200 Ω, Eb=120V

PARAMETER	6AK5	TS6AK5
Plate voltage breakdown	350V	350V
Plate resistance	0·5MΩ	5·0MΩ
Transconductance	5,000μmhos	4,500μmhos
Plate current (Rk=200Ω)	7·5mA	7·0mA
Grid voltage for Ib=10μA	−8·5V	−5·0V
Amplification factor	2,500	22,500
Input capacitance	4·0pF	6·5pF
Output capacitance	0·02pF	0·02pF
Useful frequency limit	400MHz	600MHz

TABLE 2:

TYPICAL TRIODE DEVICE CHARACTERISTICS (EACH SIDE)—Rk=2—70 Ω, Eb=130V

PARAMETER	12AT7	TS12AT7
Plate voltage breakdown	400+V	350V
Plate resistance	15kΩ	250kΩ
Transconductance	4,000μmhos	3,000μmhos
Plate current (Rk=240Ω)	5·0mA	9·0mA
Grid voltage for Ib=l10μA	−7·0V	−7·0V
Amplification factor	60	750
Input capacitance	2·2pF	25pF
Output capacitance	1·5pF	3·5pF



up from selected FETs to approximate closely that of a particular valve (shown dotted) operating within the same limits. If special requirements include partial operation beyond this FET cut-off then clearly a more appropriate FET device must be selected for this, perhaps providing a higher current for the same control voltage. The gm or transconductance ratio of the fetron gives a true square law property with consequent harmonic distortion figures of an extremely low order. In fact, harmonics beyond second order are claimed to be negligible.

Although the simulation of the "screen grid" principle can be effected within the fetron package, the similarity of the transfer curves to those of a pentode must not be taken as an assumption that the fetron is an ideal replacement for the pentode, even though the noise figure may be lower. The fetron has a markedly improved performance over the triode due to square law operation.

POWER REQUIREMENTS

Power supplies can be greatly simplified: first by the elimination of low voltage lines; secondly by the use of less stringent h.t. regulation. Current requirements are similar to or slightly higher than for a triode, but surge currents of up to about 1,000 times can be tolerated. Due to the lack of heating requirements the fetron will operate at more confortable temperatures around 65°C. The case is ruggedised by using a deep-drawn steel cap welded to a large diameter header, using the same pin arrangement for connections.

Fetrons that have been made so far include replacements for the 6EW6, 6JC6, 6AK5 and 12AT7 but with ready made FET junctions currently available it is expected that the majority of common types can be simulated. More familiar types such as 6V6 and 6AQ5 are next on the list. The type number given to fetrons consists of the equivalent valve number but prefixed TS. Hence the fetron for replacing the 12AT7 is TS12AT7.

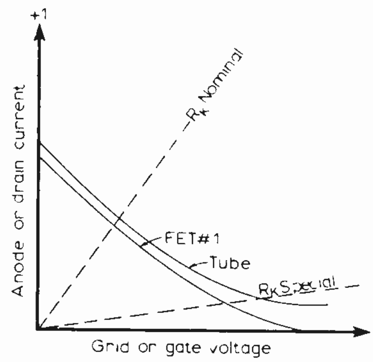


Fig. 3: Transfer characteristic of a fetron compared with a valve.

The manufacturer who has announced these activities in fetrons is the American company Teledyne Semiconductors, who are selling in the U.K. via the distributors GDS Sales Ltd. of Slough. Prices are higher than for valves but this is offset by the long term performance advantages described. GDS Sales quotes £8 for the TS12AT7 and £6·50 for the TS6AK5 for orders of 1 to 99, these being the first available in the U.K. Although this price is high the long term advantages of reliability and performance are compensatory. Small orders for these devices are being handled by the subsidiary company *Best Electronics (Slough) Ltd, Michaelmas House, Salt Hill, Bath Road, Slough, Bucks, SL1 3UZ.*

Elsewhere in this issue we are taking a closer look at some of the valves that still have a unique role to play in radio and electronics. Look out for our special feature "Special Valves for Communications".

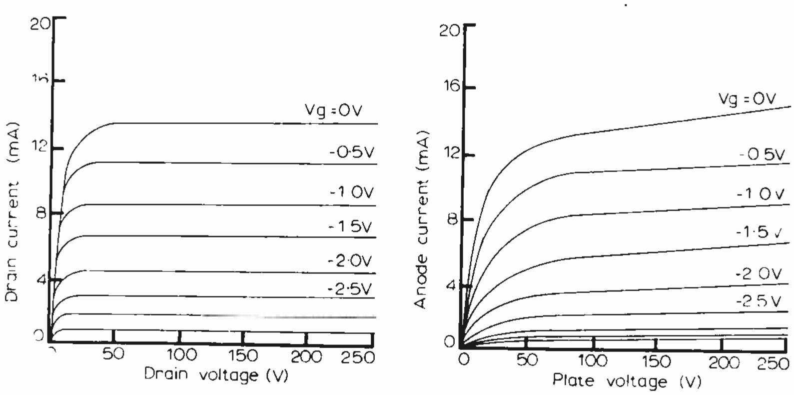


Fig. 2: Comparison of output drain characteristics with those of the 6AK5 anode.

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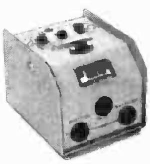

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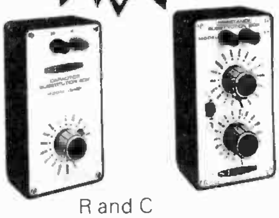

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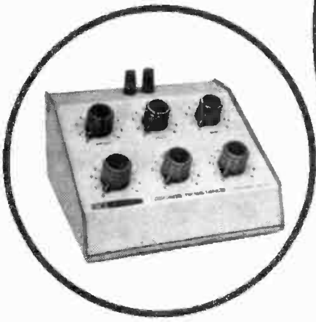

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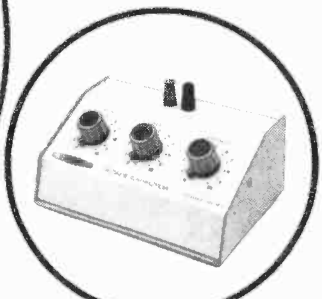

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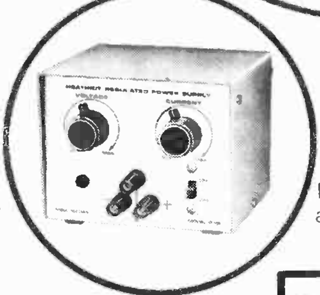

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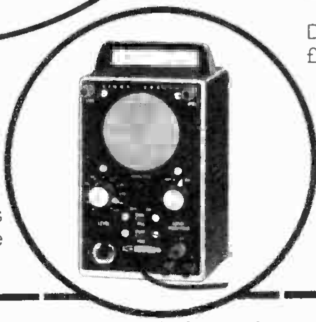

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BC182L	0·12
BC183	0·09
BC183L	0·09
BC184	0·11
BC184L	0·11
BC186	0·25
BC187	0·26
BC204	0·11
BC205	0·10
BC206	0·11
BC207	0·10
BC208	0·09
BC209	0·10
BC211	0·30
BC212K	0·10
BC212L	0·16
BC214L	0·23
BC236	0·16
BC237	0·09
BC238	0·09
BC239	0·09
BC251	0·20
BC252	0·18
BC253	0·23
BC257	0·09
BC258	0·09
BC259	0·13
BC261	0·20
BC262	0·18
BC263	0·23
BC300	0·42
BC301	0·34
BC302	0·27
BC303	0·54
BC304	0·43

BC307	0·10
BC307A	0·10
BC307VI	0·10
BC308	0·09
BC308A	0·09
BC308B	0·09
BC309	0·10
BC309A	0·10
BC309B	0·10
BC313	0·30
BC327	0·24
BC328	0·22
BC337	0·19
BC338	0·19
BCY30	0·35
BCY31	0·40
BCY32	0·60
BCY32	0·75
BCY33	0·34
BCY34	0·35
BCY38	0·40
BCY39	1·05
BCY40	0·50
BCY42	0·15
BCY43	0·15
BCY58	0·21
BCY59	0·22
BCY66	0·66
BCY67	0·94
BCY70	0·17
BCY71	0·22
BCY72	0·13
BCY87	3·47
BCY88	2·40
BCY89	0·80
BCZ10	0·85
BCZ11	0·50
BD115	0·75
BD116	0·75
BD121	0·75
BD123	0·82
BD124	0·67
BD130	0·57
BD131	0·40
BD132	0·50
BD135	0·48
BD136	0·49
BD137	0·55
BD138	0·63
BD139	0·71
BD140	0·83
BDY10	1·35
BDY11	1·50
BDY17	1·50
BDY18	1·75
BDY19	1·97
BDY20	0·92
BDY38	0·65
BDY60	0·90
BDY61	0·85
BDY62	0·75
BF115	0·23
BF117	0·43
BF119	0·58
BF121	0·25
BF123	0·27
BF125	0·25
BF127	0·27
BF152	0·20
BF153	0·29
BF154	0·16
BF158	0·15
BF159	0·27
BF160	0·23
BF161	0·35
BF163	0·20
BF166	0·35
BF167	0·18
BF173	0·19
BF177	0·25
BF178	0·25
BF179	0·30
BF180	0·35
BF181	0·32
BF182	0·30
BF183	0·40
BF184	0·17
BF185	0·17
BF194	0·14
BF195	0·15
BF196	0·15
BF197	0·15
BF198	0·15
BF199	0·18
BF200	0·35
BF224J	0·14
BF225J	0·19
BF257	0·22
BF238	0·22
BF244	0·16
BF245	0·33
BF246	0·48
BF247	0·49
BF254	0·14
BF255	0·15
BF257	0·41
BF258	0·46
BF259	0·48
BF261	0·23
BF264	1·45
BF270	0·25

BF271	0·21
BF272	0·53
BF273	0·25
BF274	0·28
BF457	0·53
BF458	0·65
BF459	0·57
BF821	2·10
BF821A	2·30
BF828	0·92
BF861	0·27
BF898	0·28
BFW10	0·61
BFW11	0·61
BFW15	0·35
BFX13	0·23
BFX29	0·25
BFX30	0·25
BFX37	0·30
BFX44	0·33
BFX63	2·48
BFX68	0·30
BFX84	0·24
BFX85	0·29
BFX86	0·24
BFX87	0·25
BFX88	0·20
BFX89	0·45
BFY10	0·35
BFY11	0·45
BFY17	0·90
BFY18	0·25
BFY19	0·25
BFY20	0·50
BFY29	0·40
BFY37	0·20
BFY41	0·42
BFY43	0·62
BFY50	0·16
BFY51	0·18
VFY52	0·16
BFY53	0·15
BFY56	0·34
BFY64	0·41
BFY75	0·40
BFY76	0·22
BFY77	0·24
BFY78	0·36
BFY90	0·60
BRY39	0·30
BSX19	0·13
BSX20	0·14
BSX21	0·20
BSX26	0·34
BSX27	0·34
BSX28	0·25
BSX29	0·47
BSX30	0·68
BSX59	0·78
BSX60	0·54
BSX61	0·42
BSX76	0·15
BSX77	0·20
ASX78	0·25
BSW70	0·28
BSY24	0·20
BSY25	0·15
BSY26	0·20
BSY27	0·15
BSY28	0·15
BSY38	0·15
BSY39	0·15
BSY51	0·25
BSY52	0·25
BSY53	0·25
BSY54	0·30
BSY56	0·79
BSY65	0·15
BSY78	0·40
BSY79	0·40
BSY790	0·45
BSY95A	0·09
BU104	1·42
BU105	2·25
C111	0·58
D40N3	0·62
GET111	0·45
GET113	0·20
GET114	0·20
GET115	0·50
GET119	0·35
GET120	0·25
GET535	0·20
GET536	0·20
GET538	0·20
GET873	0·12
GET880	0·30
GET883	0·20
GET887	0·20
GET890	0·22
GET895	0·25

RETURN OF POST SERVICE

Post & Packing 13p per order. Europe 25p. Commonwealth (Air) 65p (MIN.) Matching charge (audio transistors only) 15p. extra per pair. Prices subject to stock availability.

TTL. LOGIC I.C. NEW PRICES

	1-24 £p	25+ £p		1-24 £p	25+ £p		1-24 £p	25+ £p
SN7400	0·20	0·18	SN7428	0·50	0·41	SN7460	0·20	0·18
SN7401	0·20	0·18	SN7430	0·20	0·18	SN7470	0·30	0·26
SN7402	0·20	0·18	SN7432	0·48	0·42	SN7472	0·30	0·25
SN7403	0·20	0·18	SN7433	0 71	0·62	SN7473	0·40	0·34
SN7404	0·20	0·18	SN7437	0·52	0·45	SN7474	0·40	0·34
SN7405	0·20	0·18	SN7438	0·52	0·45	SN7475	0·45	0·35
SN7406	0·30	0·24	SN7439	0·52	0·45	SN7476	0·44	0·39
SN7407	0·56	0·48	SN7440	0·20	0·18	SN7480	0·75	0·70
SN7408	0·20	0·18	SN7441AN	0·75	0·72	SN7481	1·25	1·07
SN7409	0·20	0·18	SN7442	0·79	0·68	SN7482	0·87	0·81
SN7410	0·20	0·18	SN7443	1·04	0·88	SN7483	1·00	0·82
SN7411	0·22	0·20	SN7444	1·04	0 88	SN7484	0·95	0·85
SN7412	0·42	0·36	SN7445	1·85	1 70	SN7485	2·50	2·30
SN7413	0·30	0·27	SN7446	2·00	1·60	SN7486	0·45	0·40
SN7416	0·45	0·40	SN7447	1 30	1·20	SN7488	12·40	11·80
SN7417	0·45	0·40	SN7448	1·04	0·92	SN7489	4·97	4·40
SN7420	0·20	0·18	SN7449	Price to be announced shortly		SN7490	0·80	0·75
SN7421	0·22	0·20				SN7491	1·20	1·06
SN7422	0·42	0·42	SN7450	0·20	0·18	SN7492	0·75	0·70
SN7423	0·52	0 45	SN7451	0·20	0·18	SN7493	0·75	0·70
SN7425	0·48	0·42	SN7452	0·20	0·18	SN7494	0·84	0·80
SN7426	0 32	0·28	SN7453	0·20	0·18	SN7495	0·80	0·74
SN7427	0·48	0·42	SN7454	0·20	0·18	SN7496	1·00	0·90

SUB-MIN ELECTROLYTIC

Axial lead — 6p each

Values (µF/V). 6·64/64; 1/40; 1 6/25. 2 5/16; 2·2/63; 4·7/16; 4·7/25; 6·4/6 4. 6 4/25; 10/16; 10/25; 10/64; 12 5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 40/16; 50/6·4; 50/25. 50/40. 64/10; 80/16; 80/25; 100/6 4. 125/10; 125/16; 200/10.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	8p	9p	10p	11p	12p	15p	20p	—
3A	15p	17p	20p	22½p	25p	27p	30p	35p
6A		--	25p	30p	32½p	35p	-	--
10A	30p	35p	40p	47p	56p	66p	75p	
15A	36p	45p	48p	55p	65p	75p	87p	
35A	70p	80p	90p	£1·00	£1·40	£1·70	£2·75	—

1 amp and 3 amp are plastic encapsulation.

DIODES & RECTIFIERS

IN34A	10p	AA119	7p	BAX16	12½p	FST3/4	22½p
IN914	7p	AA129	15p	BAY18	17½p	OA5	17p
IN916	7p	AAZ13	12p	BAY31	7p	OA10	20p
IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
IS940	5p	BA154	12p	BYZ12	30p	OA202	10p
		BAX13	5p	BYZ13	25p	TIV307	50p

OPTOELECTRONICS

MINITRON 3015F 7-SEGMENT INDICATOR (16 PIN DIL) £2·00
May be driven by SN7447

TIL 209 LIGHT EMITTING DIODE. Made by TEXAS INST. (Red). 35p

B9900 PHOTORESISTOR 38p

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	0.15 Matrix	0.1 Matrix
2½ × 3¾in	18p	25p
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3¾ × 5in	32p	31p
5 × 17in (Plain)	82p	

Vero Pins (Bag of 36) 22p
Vero Cutter 45p
Pin insertion Tools (·1 and ·15 matrix) at 58p.

"SCORPIO" CAP DISCHARGE IGNITION SYSTEM

(As published in P.E. November 1971)

Complete kit £10·00

P. & P. 50p.

SLIDE POTENTIOMETERS

58 mm, TRACK
SINGLE GANGED, LOG or LIN 1k to 1M. 40p each.
TWIN GANGED, LOG or LIN 1k to 500k 60p each

All Prices Exclusive of V.A.T.

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2·5 watt 5% (up to 270 ohms only), 7p
5 watt 5% (up to 8·2k Ω only), 9p
10 watt 5% (up to 26k Ω only), 10p

POTENTIOMETERS

Carbon:
Log. or Lin., less switch, 16p
Log. or Lin., with switch, 27p
Wire-wound Pots (3W), 38p
Twin Ganged Stereo Pots, Log. or Lin. 43p.

PRESETS (CARBON)

0·1 Watt 6p
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6–9V STABILISED SUPPLY

J. ROWLEY

THIS inexpensive unit will enable cassette recorders, portable radios, portable record players and the like requiring 6 to 9V to be run from a 12V car battery, in or out of the car. This not only saves their internal batteries but ensures that they run at peak efficiency.

CIRCUIT

In the basic circuit, Fig. 1, the reference voltage is determined by a zener diode ZD which controls the output voltage. Tr1, a power transistor, takes a small current from the zener diode, amplifies it, and feeds the resulting current to the output circuit.

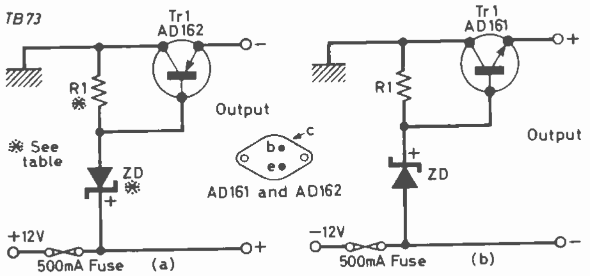


Fig. 1: Basic stabilising circuits for a) negative and (b) positive "earth".

With the output circuit left open Tr1 remains off, but as soon as a load is connected the current will increase until the voltage at the output is a little less than that of the zener diode. If for any reason the output voltage increases the voltage across Tr1's base-emitter decreases causing the collector current to drop. Conversely, if the output voltage decreases the base-emitter voltage will increase, raising the collector current. The overall effect being that the output voltage will remain constant despite varying load currents.

OVERLOAD

Although the basic circuit will work quite satisfactory, if the output leads are accidentally shorted together a heavy current will flow which may damage the transistor before the fuse can blow. To insure against this the circuit can be modified to the form shown in Fig. 2. Here, no matter what the load, even a short circuit, no more than 330mA will flow. Under normal loads the voltage across R2 will be less than the 500mV or so required to start Tr2 conducting, so the circuit will work as in Fig. 1.

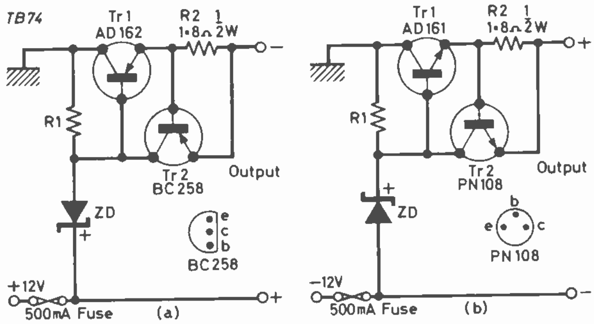


Fig. 2: Protected circuits for negative or positive "earth".

However when the current exceeds 280mA this will no longer obtain and Tr2 will start to draw current from the zener diode. At first this will have no effect, but if the voltage across R2 increases further Tr2 will draw more and more current until finally the zener will stop conducting, thus enabling the output voltage to fall to a level where no more than 330mA flows.

Output Voltage	ZD (400mW)	R1 (⅛W)
6V	6·2V	680Ω
7·3V	7·5V	390Ω
9V	9·1V	220Ω

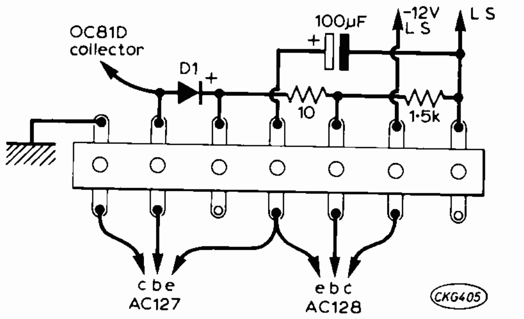
CONSTRUCTION

The unit is built into an aluminium box approx. 3×2×2in. (Type AB12) the power transistor being bolted to the box after applying silicone grease. The few components are connected directly to the pins of the power transistor. Since the quiescent current is only about 13mA no on-off switch is fitted. ■

TWO VERSATILE TRANSISTOR AMPLIFIERS

C. E. MILLER

As an independent service engineer one is often called on to repair car radios whose age, or foreign origin, make it difficult, if not impossible, to obtain spares. Quite often there is a burnt-out output or driver transformer which would normally result in the set involved being scrapped. To avoid this it has been possible, over a period of time, to evolve two output stages which employ no transformers or "difficult" components. The transistors used are easily obtained and cheap. In fact, one aspect of the design was to take advantage of the ex-computer panels now widely on sale, which contain large numbers of suitable transistors, etc.

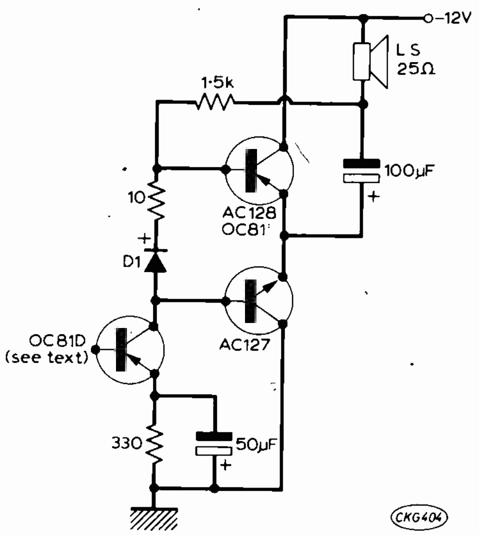


Suggested layout of Circuit No. 1 using a tag strip.

CIRCUIT No.1

The first design is intended to take the place of the relatively low-powered output stage used by several firms in hybrid car radios. A typical set employed two "12 volt h.t." valves and three transistors, an OC81d driving a pair of OC81's. The original OC81d is retained, but with a slightly different emitter resistor, and feeds directly into a complementary pair, AC127 and AC128.

The actual construction is so simple that it may be done on a seven-way tag strip. It will usually be possible to use the heat sinks previously fitted to the OC81's. The sole drawback, if such it be, is that the loudspeaker has to be changed to a high impedance type.

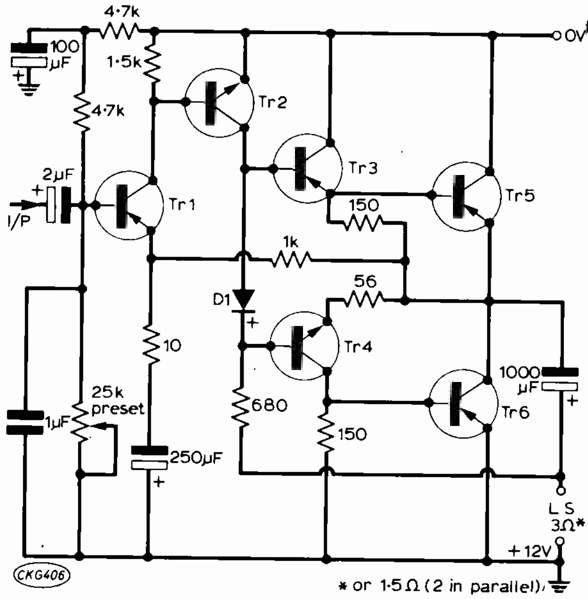


Two transistor output stage added to existing OC81D stage in receiver.

CIRCUIT No.2

It was to provide more power than the AC127/128's could give, and also to avoid having to use special loudspeakers, that the second circuit was evolved. It consists of an amplifier, a driver, and a complementary stage, which in turn drives the output transistors. In this circuit the computer panels really came into their own. Those used contained mainly 2G302's (p.n.p.), 2N1091's (n.p.n.), OC23's (p.n.p. output) and OA10 diodes. There were also some anonymous devices which looked, and behaved, like OC81's. The alternatives for the various transistors, etc., in the design are as follows:—

Tr1. AC128, OC81, 2G302.
Tr2. AC127, AC176, 2N1091.
D1. AA119, OA10, AC128 with base/collector strapped.
Tr3, as Tr1.
Tr4, as Tr2.
Tr5, Tr6. AD149, OC23. (Etc.—any large output type).



Higher powered output stage of Circuit 2.

As a final construction point, the output transistors should be mounted on a piece of aluminium of some 30 sq. in. This may conveniently be shaped to act as a screen for the rest of the amplifier. The prototype was deliberately mounted in the worst possible place, in a confined space close to the vehicle heater, but no overheating has been observed. ■

practically wireless commentary by HENRY

No. 99

Age cannot wither them

WHERE wireless engineers foregather, talk inevitably veers toward: 'I remember . . . '

It is either a model with such idiosyncracies that a catalogue of 'common faults' would have called for an appendix to the service manual, a manufacturer whose crass perfidy extended to an invoice before the goods arrived—or worse, so long afterwards that one had to guess at the cost of the spares before one dared complete the repair—or a customer.

But my subject today is not so much the trials and tribulations of the working engineer as this 'harking back' tendency we all evince, once we converse with fellows of like mind. Go to a meeting of the RSGB, the SERT, the BARTG or even your local Gramophone Society and before the last strains of the demonstration or mutters of the lecture have died away, everybody is avidly recounting his or her personal experiences.

. . . a donkey-driven gramophone.

Watching two members of the Royal Television Society taking coffee last week reminded me of Ralph Richardson and John Gielgud in the Royal Court Theatre production of *Home*. Parallel tracks of reminiscence, meeting rarely at some way-station. From the few words I caught in that BBC Hospitality Room, member A was waffling on about videotape while the other had some bee in his bonnet about phase-lock loop and pulse-code-modulation.

Henry was dying to know how Mr. B allied the two subjects, but couldn't find out because the charming production assistant he was trying to chat up with his memories of Marconi would insist on relating her opinions of Arthur Negus every time I had to pause for breath.

All this is brought on by hearing about the Fetron.

The Fetron is a genuine solid state substitute, mounted in a case like a valve, with pin formation and characteristics of the valve it is meant to replace.

You can read the ins and outs of it in the "Special Product Report" elsewhere in this issue, if it grips your curiosity like it did mine. Suffice it to say on this page that all those "everlasting" relay stations, built around valves designed to run forever, could not die without putting up a fight first.

Use of the Fetron saves major circuit modification when a valve-change is needed. Ain't science wunnerful?

Trouble is, Henry took a look at the types available and found there listed the dear old 12AT7. Now the TS12AT7 sounds a good idea until you remember some of those old 'universal' radiograms, and one or two series-heatered television sets that used them.

What happens if you plug in a Fetron? Have they made a resistive heater 'bridge', or do we have to solder a resistor across the socket? And, if we do, shouldn't there be a thermistor provided? Should we not also protect the h.t. line because the Fetron is operative immediately?

So many questions . . . reminds Henry of that unfortunate chap in an electronics magazine who offered a simpler way of getting over some stabiliser problems. Only snag was, somebody had to remember to turn the control back to zero after use unless the next chap along blew the thing up—you know, the way your loudspeaker creases when you have left the amplifier gain up high and a 'friend' flicks your stylus!

Well, the upshot of this poor chap's sensible economy was that

. . . and the inevitable happened.

electronic geniuses wrote in, both calling him gormless and detailing complicated protection circuits that would automatically switch off, from any given function. I wonder if Mrs. Mary W. would like one built into every TV?

I remember one TV we could never switch 'Off' because the maker had fitted too-substantial suppressors across the contacts.

We all tend to hark back. You should see the glee with which Colin Riches unearths a donkey-driven gramophone. At the wedding of a friend's daughter, hardly out of her teens, one of the speakers, Marketing Director of a worldwide Telecommunications company, had to remind the reception that his first acquaintance with the charming Sally was when she sat in his lap—at eighteen months—and the inevitable happened.

He might, at least, have reminded them of the days when he was hawking cheap radios round the council estates. It is just as funny a story. Remind me to tell it to you, one day . . .

Special Valves

PART 1 COMMUNICATION TYPES

M.K.TITMAN B.Sc(Eng), C.Eng, MIEE.

THERMIONIC devices still have a wide range of applications in modern electronic circuits and, despite the semiconductor takeover, they remain essential components in a variety of applications from high power r.f. amplifiers to electro-optical transducers.

The requirement for valves for u.h.f. and s.h.f. has led to the development of special techniques. The following valves were all developed from the necessity to exploit new ways to enable communication systems to use the wide bandwidths available at u.h.f. and microwave frequencies. The principles used are mathematically complex but their operation can be readily understood.

DISC SEAL VALVES

The form of construction used for both triode and tetrode configurations is illustrated in Fig. 1. The structure consists of a thimble-like cathode, spaced from a parallel wire grid further separated from a disc anode. The structures are very rigidly held by the ceramic space discs and because of the annular configuration co-axial input and output terminations can be used. The advantage of this system is that high power operation with reasonable efficiency in the GHz region is possible.

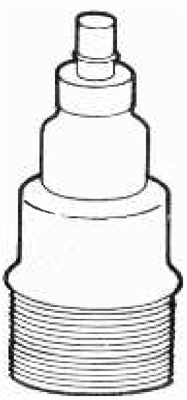
Disc seal triodes are used for amplifier and oscillator applications from 0·5GHz to 4GHz frequencies, at power levels of 1W to 600W. Typical values of g_m are 6mA/V to 25mA/V. At lower power levels (<25W) the envelope is designed for convection cooling but forced air cooling is used for the higher power levels. Examples of this valve type are the ES157 at 2W, and TDO4-20 at 12W.

KLYSTRONS

Klystrons are also essentially microwave valves which operate as oscillators in the frequency range from u.h.f. to more than 100GHz. Generally they are available for discrete commercial frequencies such as 6, 7, 8 or 9GHz and mechanical tuning by micrometer adjustment is possible.

The klystron consists of a cavity (or for power devices, multiple cavities) through which a stream of electrons is beamed from a normal electron gun assembly, as shown in Fig. 2. The electrons are velocity modulated by a field produced by a toroidal modulating structure known as a rhumbatron. The electrons therefore become bunched in regions of high electron density and rarified in low density regions, as they travel through a further section known as the drift space. Consequently if critical frequencies are utilised the bunching allows resonant oscillation to occur in a mode controlled by the rhumbatron.

Power levels for high frequencies are in the region of 1kW with special u.h.f. power devices operating at 460 to 1000MHz at levels of 20kW. The electronic tuning range for such devices is from 30 to 100MHz,



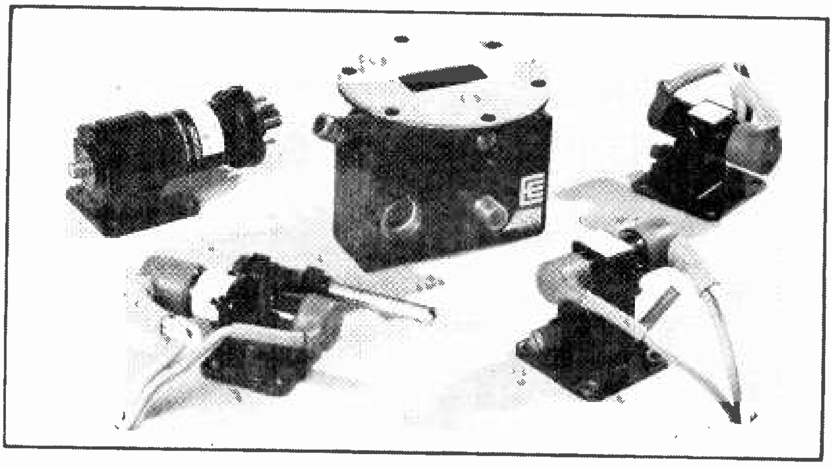


Fig. 1: at left, shows the general configuration of a disc seal valve. The picture shows a collection of oscillator klystrons, the centre one being used in communications relay equipment. The others are used in radar local oscillators.

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AF186	40p
AF239	50p
AF279	55p
ASY26	25p
ASY27	30p
ASY28	22p
ASY29	30p
BA138	15p
BAX16	8p
BB103	16p
BB104	28p
BB105	32p
BC107	10p
BC107/BC177	24p
BC108	10p
BC108/BC178	23p
BC109	10p
BC109/BC179	24p
BC109C	11p
BC140	30p
BC147	10p
BC148	9p
BC149	10p
BC157	12p
BC158	11p
BC159	12p
BC147/157	22p
BC148/158	20p
BC149/159	22p
BC167	11p
BC168	10p
BC169	11p
BC169C	12p
BC177	14p
BC178	13p
BC179	14p
BC182	10p
BC182L	10p
BC183	9p
BC183L	10p
BC184	13p
BC184L	12p
BC212	12p
BC212L	12p
BC238	10p
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BZY88C9V1	13p
BZY88C10V	13p
BZY88C11V	13p
BZY88C12V	13p
BZY88C13V	13p
BZY88C15V	13p
BZY88C16V	13p
BZY88C18V	13p
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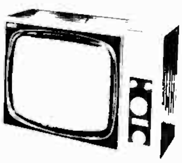

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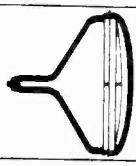

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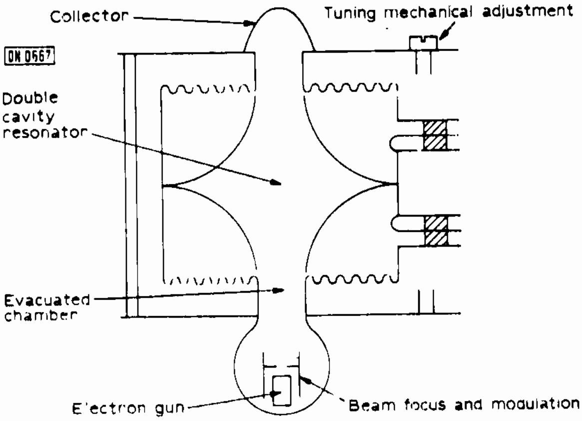


Fig. 2: Internal arrangement of a klystron valve.

whilst the mechanical range is considerably more. Typical device types are the KS6, 7, 9 family and YK1010 to 1090. Most of these utilise waveguide outputs but some have coaxial probes. The higher power devices require forced air cooling, whilst the u.h.f. power units need a cooling water supply.

TRAVELLING WAVE TUBES

These are microwave power amplifier valves used extensively in communication systems particularly for microwave links. The basic construction is shown in Fig. 3 and consists of an electron gun assembly, a modulating helix structure and a collector electrode. The electron gun forms a narrow electron beam focused by means of the grid and anode. The beam passes along the axis of an accurately formed helix structure and is continually focussed by a magnet system. The modulating microwave frequency is passed along the helix and travels at approximately the same speed as electrons in the beam. Thus the r.f. field produces an electric field which velocity modulates the electron beam as it travels along the helix axis. After modulation the electron beam bombards the collector electrode which is often water cooled.

For low power valves the helix is of wire but for power devices a ring bar structure is used. As the helix is in a long glass envelope, heat dissipation is by radiation and thus the power is limited, especially since the mechanical helix structure must be very accurate. For very high power devices a ring-bar helix system is used and is a development of the cross-wound opposite band helix system. Where very high power is necessary the ring bar structure is supported by annular beryllium insulators of high thermal conductivity.

Travelling wave tubes are very efficient microwave amplifiers which produce amplitude modulated output signals. The frequency range is determined by the mechanical structure and the helix in particular and, for the simple helix, it is roughly an octave about the centre frequencies from 1 to 9GHz.

Power levels for continuous operation are usually 1 to 10W but kilowatts are possible while operation in pulsed modes can result in peak power levels in the megawatt region. The band-width at high power levels is usually reduced to as low at 10% or 400MHz at 4GHz.

Both forward and backward wound helices are used and typical gains in the X band are in the region of 30 to 40dB, with noise factors of 20 to 28dB. Generally they are designed to fit into special mountings which incorporate the permanent magnet systems. The input and output are usually taken directly from waveguide connections, with the forward wave tubes operating as amplifiers and the backward wave tubes as oscillators. Typical forward wave types are LB4-20 and 30, at 4GHz and LB6-15 to 25 at 6GHz, with backward wave oscillators like the YH1100 and BA16.

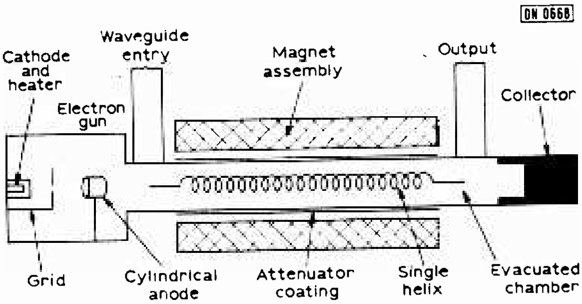
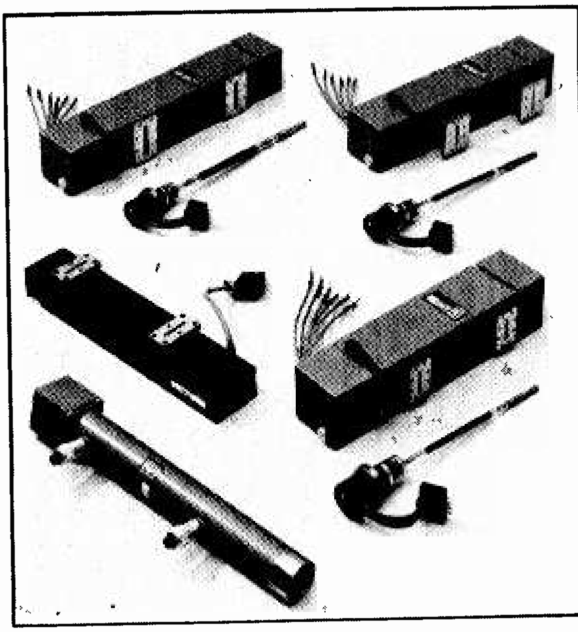


Fig. 3: Diagram to illustrate the construction of a travelling wave tube.

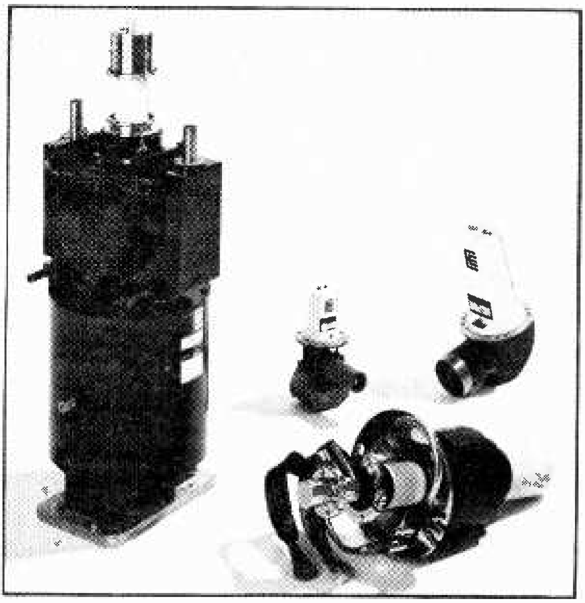
MAGNETRONS

These are essentially high efficiency oscillator valves and are used for producing fixed frequency, fixed amplitude oscillations and, in a pulsed mode, are widely used in radar equipment. The normal frequency is in the X band (5·2 to 10·9GHz) although other bands are covered.

The magnetron, as illustrated in Fig. 4, consists of one or more very carefully machined cylindrical cavities with a cathode adjacent to the cylinder and formed of a thin wire. A permanent magnet provides



A selection of travelling wave tubes used for communications in the S, C and X-bands. Three are replaceable types, shown beside their mounts.



In this collection of magnetrons the large one is an L-band 2·3MW tunable pulse magnetron intended for high power surveillance radar. In the foreground is a 25kW CW model for industrial use. The remaining two magnetrons are rated at 50kW and 900kW pulse operation in the S-band.

a magnetic flux at right angles to the cylinder and thus at right angles to the electric field formed by the diode. Electrons released from the cathode travel in a circular path and at a given frequency just graze the anode. The oscillation frequency is determined by the physical characteristic of the cylinder and therefore is often fixed. Slight tuning is however provided with some magnetrons.

Continuous-wave magnetrons are available in the frequency range 8 to 9·5GHz at power levels of 6W to 20W. Typical operating conditions are Va=1kV, Ia=50mA, Vh=6·3 and Ih starting at 1A. Typical types are JPT 9-01 and JPG 8-01.

Pulsed magnetrons are designed for short pulse durations in the region 1 to 5μs for X band devices at approximately 9GHz. Power outputs range from 25W to 50kW with devices such as JPT9-02 and YJ1050. The lower frequency 1·25GHz (L Band) and 5·5GHz (C Band) devices operate at higher power levels up to 1,000kW.

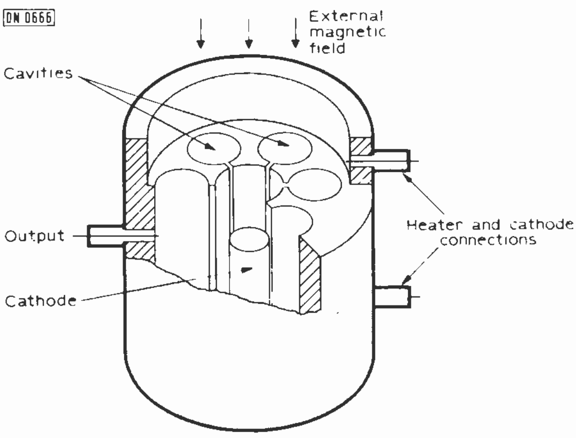


Fig. 4: General arrangement of a multiple cavity magnetron.

FUTURE TRENDS

Although trends continue towards the use of semiconductor devices, the power transmitter valve at all frequencies cannot yet be replaced directly. Thus power valves at all frequencies are still of very considerable use and development continues to improve all these designs.

A trend which undoubtedly will continue is the replacement of high power microwave transmitters by low power solid state components such as varactor chains. This has been made possible by improved receiver and aerial design.

We are indebted to the English Electric Valve Co. of Chelmsford for permission to reproduce the photographs in this article.

TO BE CONTINUED

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I.C. OF THE MONTH

L.A.J. IRELAND

Number 37 — SGS NE555 Precision Timer

A highly stable timing device, type NE555, recently released by SGS, is the topic for this month's article. It allows precision timing from microseconds to hours with a mere handful of components; its uses however are not limited solely to the timing field as it can also find wide application in such diverse spheres as pulse generation, frequency division, pulse-width modulation, etc., to mention but a few. Such versatility coupled with low cost should make it an attractive i.c. to the amateur experimenter and a few of its more interesting features and applications will be outlined in the following notes.

Applications

A block diagram of the NE555 is shown in Fig. 1 and the first application to be considered is its use as an accurate timer, Fig. 2. The timing period is set by one additional resistor capacitor network with additional terminals allowing control over the triggering and resetting of the device. The external

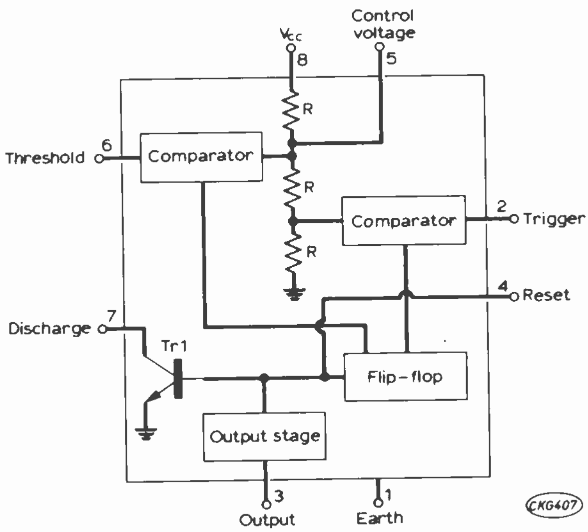


Fig. 1: Block diagram of the NE555 timing device.

capacitor connected between pin 7 and earth is initially held discharged by the short circuit path of the saturated transistor Tr1. When a negative trigger pulse is applied to pin 2 the flip-flop changes state and biases off Tr1 thereby allowing C1 to charge via R1. The time constant associated with R1C1 determines the rate at which C1 charges and when its voltage reaches $\frac{2}{3}V_{cc}$ the threshold comparator

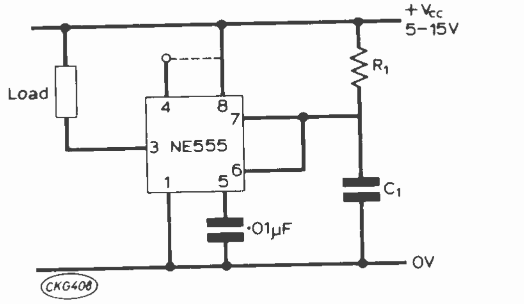


Fig. 2: Typical application of the NE555. The values of R1 and C1 for a delay of 1 second would be 1MΩ and 1μF.

resets the flip-flop and discharges C1 in addition to providing an output pulse at pin 3. One of the great advantages of this type of circuit is that the timing rate, for all practical purposes, is independent of the supply voltage. Timing periods from as short as 1 microsecond to as long as 1 hour may be obtained with this rather simple arrangement.

Multivibrator

Another interesting application of the NE555 is obtained when pins 2 and 6 are joined together as illustrated in Fig. 3. Here the device is operated as

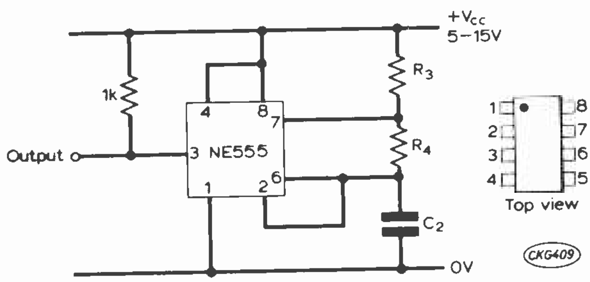


Fig. 3: In this circuit the NE555 is used as a free-running multivibrator.

a free-running multivibrator with the frequency and duty-cycle set by the R3-R4-C2 arrangement. The combined value of R3 and R4 in conjunction with C2 determines the frequency while the duty cycle is set by the ratio R3/R4. As the transistors fabricated in the silicon chip are of the highest quality excellent square waves are obtained from the output at pin 3. Once again, in this arrangement the operating frequency is independent of the power supply voltage.

Pulse-width modulator

The final application of the NE555 to be considered is its use as a pulse-width modulator. Here an external square wave generator's output is connected to pin 2 with the modulating signal applied to pin 5 as indicated in Fig. 4. (Incidentally, another NE555 operated in the astable mode will function quite well

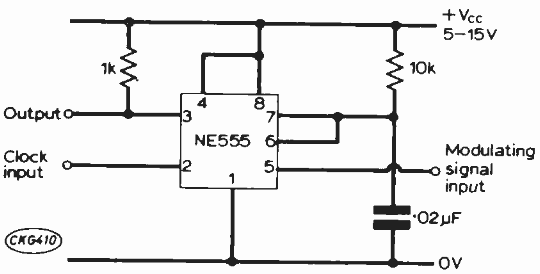


Fig. 4: Yet another application is as a pulse-width modulator.

as the clock generator.) As the control voltage on pin 5 increases, it affects the threshold voltage of the comparator resulting in an increase of the pulse width. The exact opposite occurs as the modulating voltage decreases so the output train of pulses obtained at pin 3 has a frequency identical to the clock input frequency with the pulse width controlled by the modulating signal.

A few of the more interesting applications of the NE555 i.c. have been reviewed in this article and further uses of the device are left to the ingenuity of the experimenter. The NE555 is available from Quarndon Electronics Ltd., Slack Lane, Derby.

Improving VHF Radio April PW

Although our information was taken from a normally reliable valve and transistor manual the connections for the BF200 transistor in Fig. 6 were incorrect. They should read, clockwise from the tag: emitter, base, collector and shield.

Receiver Matching Unit

F. G. RAYER

AN end-connected wire of random length is often used as a short wave aerial and this can, in fact, give good results if reasonably high and clear of earthed objects. At some frequencies, when the aerial length is a half wave or multiple of a half wave, the end impedance at the receiver can be very high, over 1000 ohms. At the other frequencies (a quarter wave or odd number of quarter waves) the impedance is low, probably under 50 ohms. Therefore, for an efficient transfer of energy from the aerial to the receiver at all fre-

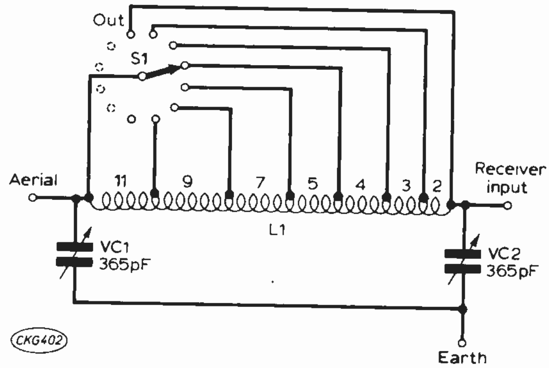


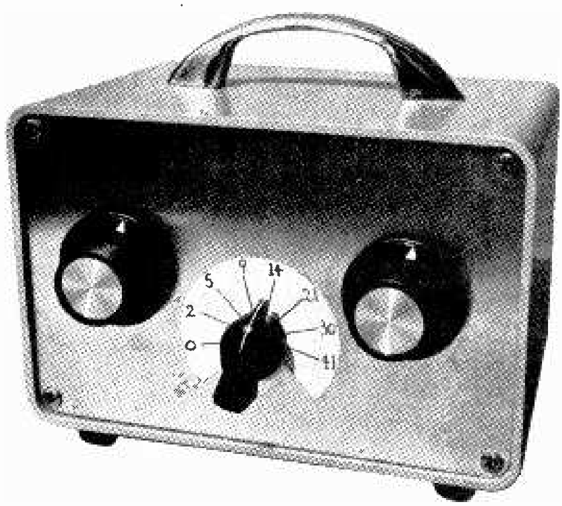
Fig. 1: above, shows the circuit of the receiver matching unit. When switched to "Out" the two variable capacitors should be turned to minimum capacity.

quencies, some matching device is needed. The one described here covers about 3·5MHz to 30MHz, and it is over this range that such an accessory is most likely to prove useful.

THE PI NETWORK

In the circuit, Fig. 1, the tapped inductor L1 has a variable input capacitor VC1 and variable output capacitor VC2. A 12 position rotary switch S1 allows turns to be selected as follows—0, 2, 5, 9, 14, 21, 30, and 41, the last four positions remaining unused. This switch and adjustment of VC1 and VC2 allows a wide range of aerials to be matched to the receiver.

Many communications receivers have a nominal aerial input impedance of about 75 ohms while others, and especially some popular older models, are 600 ohms. On some frequencies the aerial may chance to match the receiver. The Receiver Matching Unit will then give no improvement in signal strength, but can be left in circuit by setting VC1



and VC2 at minimum and the switch at "O".

At other frequencies the switch is progressively rotated to bring more turns into circuit, each time adjusting VC1 and VC2 for best results. This is merely a matter of peaking the matching unit controls for best volume, or best S-meter reading. Where the mis-match is bad, quite a significant improvement should be had. If peaking the signal by ear, switch off the receiver a.g.c. or choose a weak signal or adjust for maximum general noise picked up by the aerial.

capacitors. Solid dielectric components are not recommended. A value of 350pF or so is useful for the lower frequencies, but for the h.f. bands only 200pF or even 150pF capacitors may be suitable, if to hand.

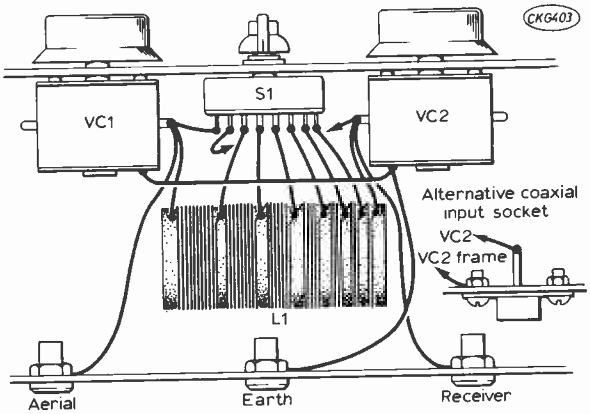
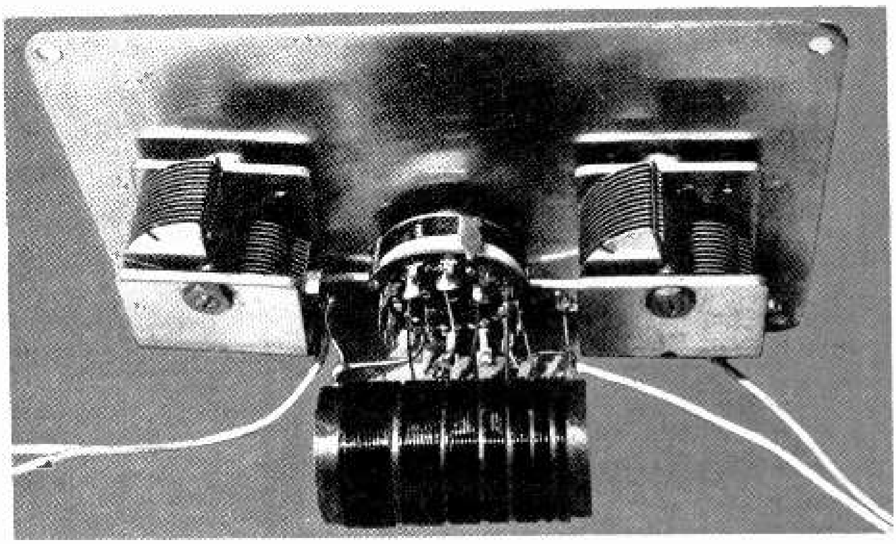


Fig. 2: Wiring diagram of the matching unit. Unused positions on the switch have been ignored.

Fig. 2 shows construction, the coil being supported by its leads. The plastic case used was 6×4×4in. but had no removable back, so flying leads were left just long enough to reach Aerial, Receiver, and Earth terminals fitted at the rear. Communication receivers often have a 75 ohm co-axial aerial input socket when a co-axial socket can be fitted to the

The photograph, right, shows the author's prototype unit. The multiple leadouts from the coil are sufficient to hold it firmly on the switch.



The coil is wound with 22 s.w.g. enamelled wire on a paxolin tube 1in. in diameter and about 2in. long. Anchor the wire through small holes near one end. Wind 2 turns side by side, and twist a small loop. Leave a space of about $\frac{1}{16}$in. and wind 3 turns, making a further loop. Continue in this way, adding 4, 5, 7, 9 and 11 turns, with a small space between each section. Scrape all the loops and solder on leads for the switch.

Solder the leads to the switch so that the first position shorts the whole coil, subsequent positions leaving 2 turns, 5 turns, 9 turns, and so on, in circuit, position 8 having no connection so that the whole coil is in use.

VC1 and VC2 are each 365pF miniature air-spaced

back of the matching unit. The inner conductor of the co-axial lead to the receiver will be the aerial lead, and the outer braiding will act as the earth connection no earth being needed on the unit.

The switch has a scale showing the number of turns in circuit. The lowest frequency reached depends on the aerial and receiver, but can extend down to 1·5MHz in some cases. On some ranges, the unit is useful in reducing second channel interference. If a numbered dial is fitted to each capacitor a very useful chart can be made up showing dial readings and switch positions for the various amateur and short wave broadcast bands, which will considerably shorten the time taken to tune the unit to any particular frequency. ■

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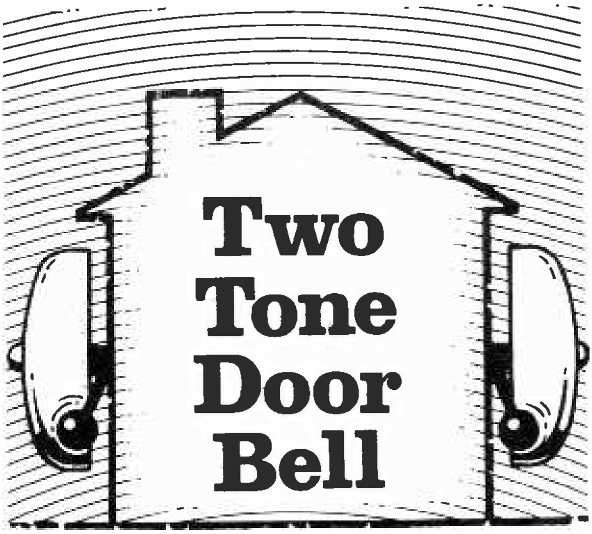


Two Tone Door Bell

This oscillator produces a pleasing tone, different in frequency for either of two doors. By using a suitable centre-tapped transformer T1, the collector circuit of each transistor can drive the base of the other transistor.

Assembly is on a perforated srbp board and wired as in Fig. 2. This board is fitted in the speaker cabinet or to a flat speaker panel fitted across the corner of the room.

One push-button switch is wired to A, and the other to B. The return leads of both switches go the common terminal C. When one switch is operated both R1 and R2 are in circuit, while with the second push R2 only is present. Wires A-C can run to the front door, and B-C to the back door.

The note can be altered by changing the resistance of R1 or R2 or the capacitance of C1, C2 or C3.

Connections for OC81, NKT271: collector wire nearest spot, then base, emitter. ●

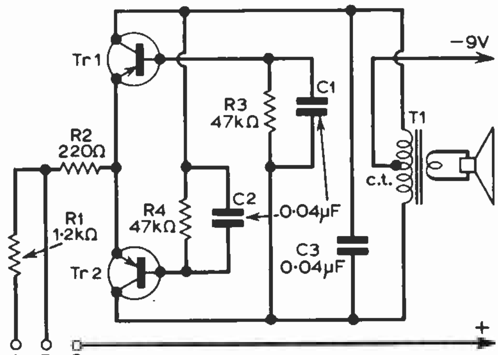


Fig. 1: Circuit diagram

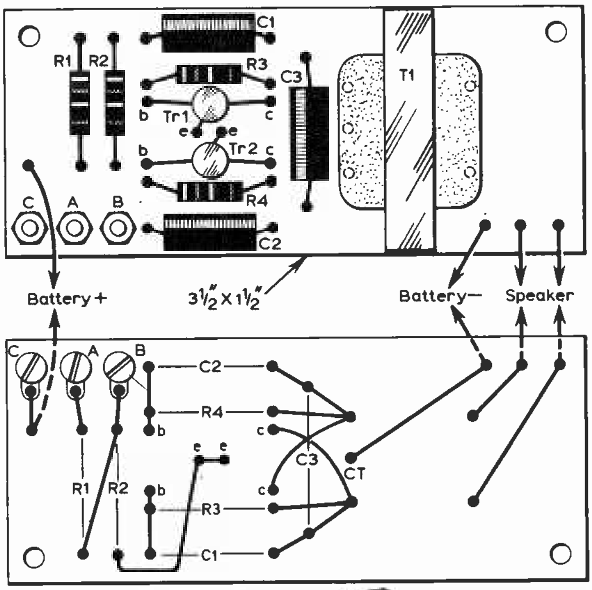
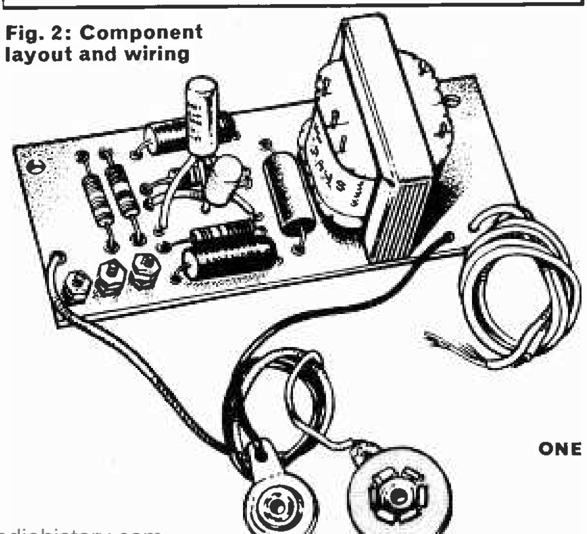
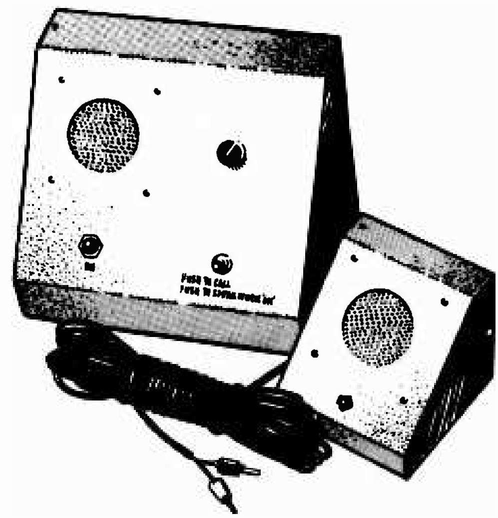


Fig. 2: Component layout and wiring



components

R1	resistor 1·2kΩ ±10% ¼w
R2	resistor 220Ω ±10% ¼w
R3	resistor 47kΩ ±10% ¼w
R4	resistor 47kΩ ±10% ¼w
C1	capacitor 0·047μF polyester
C2	capacitor 0·047μF polyester
C3	capacitor 0·047μF polyester
Tr1	transistor OC81 or NKT271
Tr2	transistor OC81 or NKT271
T1	transformer 9·2:1 CT primary, type T/T7 Repanco
	Loudspeaker 3Ω 5in. and wooden board 12in. × 9in.
	Battery 9V type PP6 or PP9 with connectors
	Perforated srbp component board
	Nuts and bolts 6BA, soldering tags, pvc wire



Ready-made amplifier module used to give press-button calling and communication in both directions. Fig. 1 is the complete circuit.

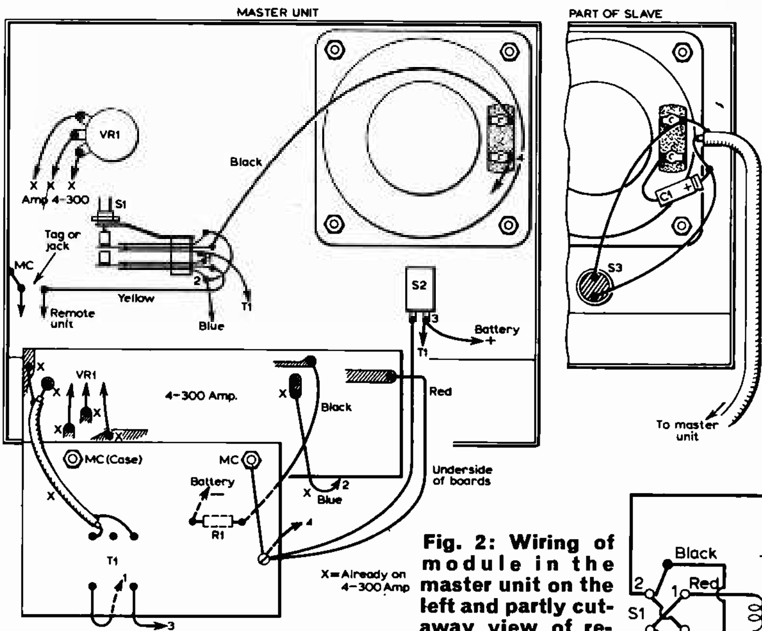


Fig. 2: Wiring of module in the master unit on the left and partly cut-away view of remote unit

S1 is the "push-to-call and push-to-speak" switch. When it is pressed, the circuit is completed in such a way as to cause an audio tone (R1 limits current in this condition). S2 switches the unit on so that the master position may speak to the remote position, or vice versa. S3 at the remote unit causes a tone at the master unit, to gain attention.

At the master unit, press S1 a few times to gain attention, then close S2, with S1 released to listen. Press S1 again to speak. Switch off with S2 when contact is finished. At the remote unit, press S3 a few times to call master unit and await reply. VR1 is set to a suitable volume level, and is ready wired to the 4-300 unit.

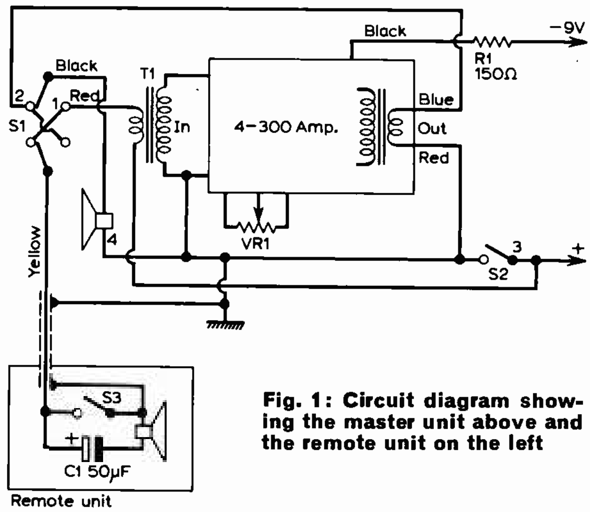


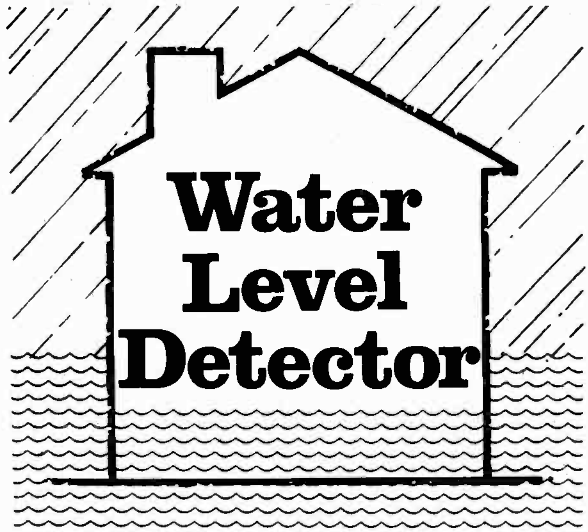
Fig. 1: Circuit diagram showing the master unit above and the remote unit on the left

components

R1	resistor 150Ω ±10% ¼ watt
VR1	potentiometer supplied with amplifier module
C1	capacitor 50μF 12V electrolytic
T1	transformer 9·2:1 CT primary, type T/T7 Repanco
S1	2-pole, changeover spring loaded push button, type S746 with S768 operator, or type S415 Bulgin
S2	single-pole, on-off toggle switch
S3	single-pole, on-off push button
	Loudspeakers 3Ω 2½in. or 3½in.
	Battery 9V type PP6 or PP9 and connectors
	Amplifier module type 4-300
	Component board srbp 3½in. × 2½in.
	Case 8in. × 6in. × 6in. (Master unit)
	Case 4in. × 4in. × 4in. (Remote unit)
	PVC connecting wire and knob
	Nuts and bolts 6BA and 4BA
	Soldering tags 6BA

Numbers 1 to 4 in Fig. 1 refer to connection points 1 to 4 in Fig. 2. Fig. 2 shows the master unit. Two 6BA bolts secure the 4-300 amplifier and also the srbp board for T1 and R1. Solder coloured leads to S1 as indicated before fitting this item. Input and output circuits and T1 are

continued on page three



Water Level Detector

A sensor, on the end of twin flexible lead, can be placed in a water tank, swimming pool, bath or wash-boiler. A buzzer sounds when the water level reaches the sensor.

The minimum battery current drain is about 0·3mA; rises to about 400mA when water reaches the sensor.

Fig. 1 shows the circuit. The presence of water shorts the sensor probe and allows base current to flow through R1, resulting in a collector current of about 40–50mA to close the relay. The buzzer sounds until the sensor is removed from the water, or the device is switched off.

Fig. 2 shows all wiring, in a case made from aluminium. The tag strip (shown detached) is mounted vertically in the adjacent corner of the case. Space is left for a flat 3-cell 4·5 volt battery.

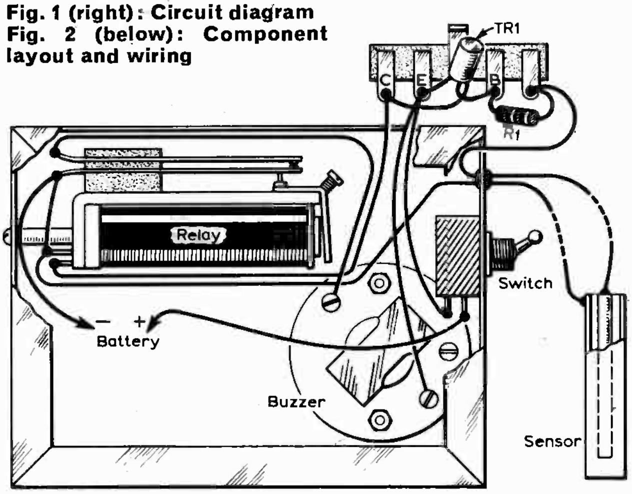
components

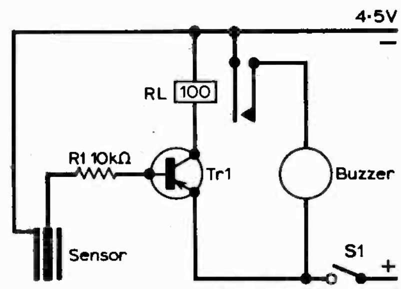
R1	resistor 10kΩ ±10% ½ watt
Tr1	transistor OC76 or any high gain pnp type
S1	single-pole, on-off switch
RLA	relay 100Ω coil, single-pole on-off contacts, 3-6V operation
	Battery 4½ to 6V depending on relay obtained
	Buzzer 4½ to 6V
	Sensor probe (see text)
	Case 6in. × 4in. × 2in. aluminium box or chassis with lid.

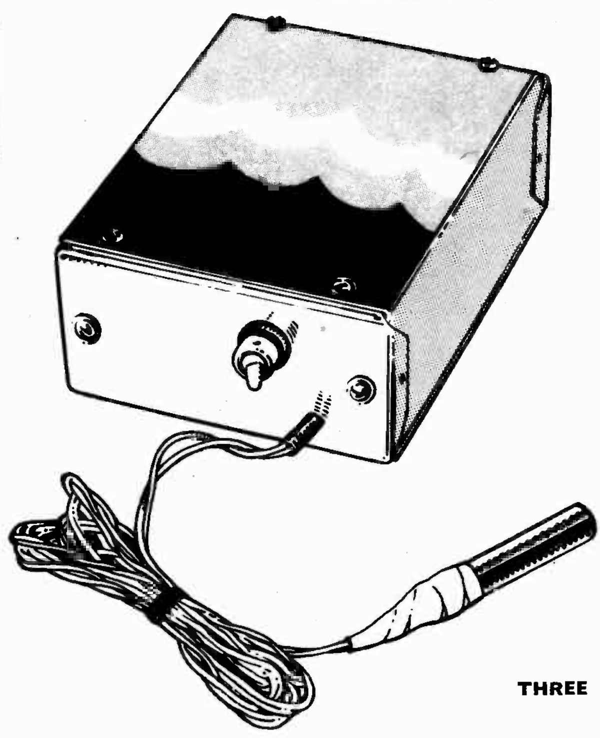
The sensor is made in coaxial form to avoid any accidental short (and wrong indication) by metal items. It has an outer metal tube about 2in. long by ⅜in. diameter, with a slightly shorter internal pin (actually a length of 4BA threaded rod). The inside part is fixed by a tight binding of insulating tape, or by an insulated sleeve. The sleeve and pin must not touch. Several feet of thin twin flex are soldered on, the sensor inner part going to R1.

An alternative probe can be a coaxial plug as used for TV aerial wire, although it must be kept free from corrosion. ●

Fig. 1 (right): Circuit diagram
Fig. 2 (below): Component layout and wiring







INTERCOM AMPLIFIER

continued from page two

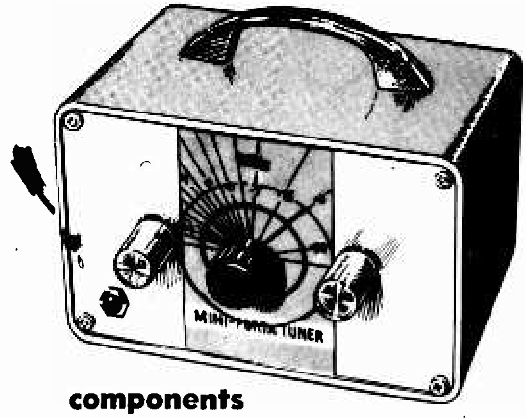
positioned to avoid feedback which would cause instability. In addition to VR1, the 4-300 has a preset sensitivity control, which can be left at about the middle of its travel.

Easy connecting of a remote unit lead can be by a jack plug and socket, the outer conductor being the common positive return. Do not connect or disconnect while battery is switched on.

The equipment will operate as a baby alarm by placing the remote unit near the cot and closing S2.

Connections to the 4-300 amplifier module are shown in Fig. 2, indicating appropriate copper pads used for connections. MC indicates connection made to the metal case by soldering tags. S1 does not necessarily need to resemble that shown in Fig. 2 but can be any style with the operation as in components list. ●

Tape Tuner



This portable medium wave tuner gives an output for a tape recorder or amplifier.

Note that the AA119 diode has a *black* mark to denote plus polarity; wrong polarity here will upset avc action. Components are positioned as in Fig. 2 and wired as shown in grey. The perforated srbp board is bolted to the metal bracket carrying VR1, VC1/2 and S1. MC is the metal case connection.

A bracket, srbp strip, and strip of card wrapped round the rod and drawn tight with a

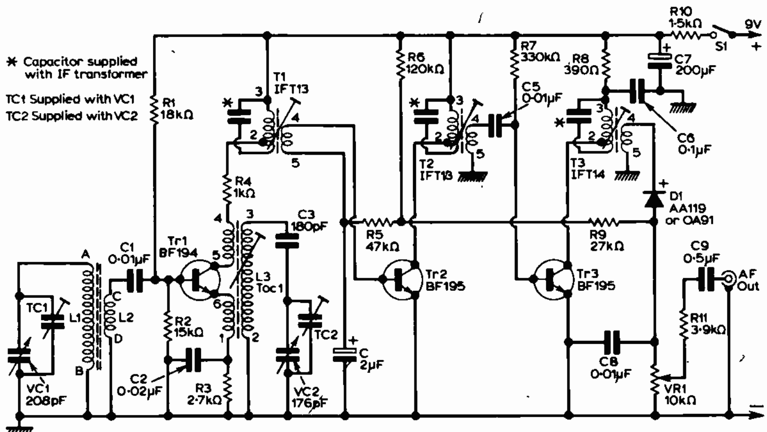


Fig. 1: Circuit diagram of the tuner

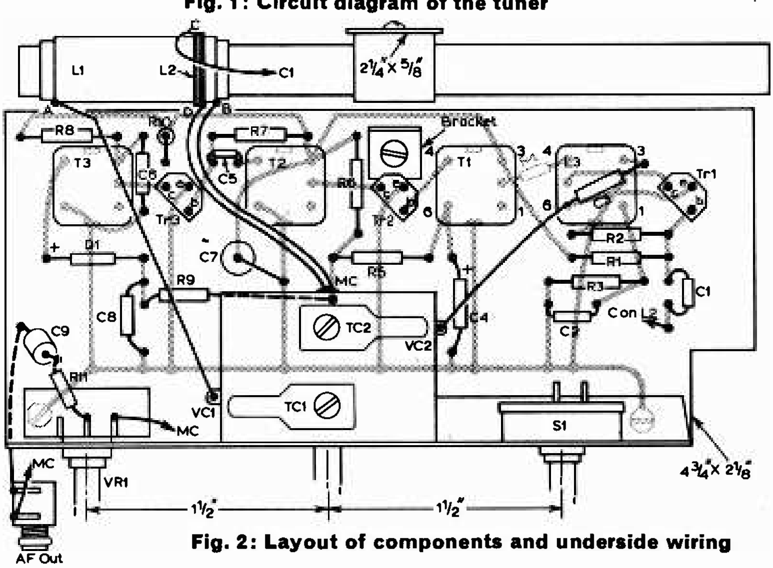


Fig. 2: Layout of components and underside wiring

components

Resistors

R1	18kΩ	R7	330kΩ
R2	15kΩ	R8	390Ω
R3	2·7kΩ	R9	27kΩ
R4	1kΩ	R10	1·5kΩ
R5	47kΩ	R11	3·9kΩ
R6	120kΩ		

All resistors ±10% ¼ watt

Potentiometer
VR1 10kΩ log.

Diode
D1 AA119 or OA91

Capacitors
C1 0·01μF mica or ceramic
C2 0·02μF mica or ceramic
C3 180μF mica or ceramic
C4 2μF electrolytic
C5 0·01μF mica or ceramic
C6 0·1μF polyester
C7 200μF 9V electrolytic
C8 0·01μF polyester
C9 0·5μF polyester
(Note: C9 not required if used only with IC-12 audio amplifier)

Variable Capacitors
VC1 & VC2 208+ 176pF with trimmers type 00 Jackson (slow motion optional)

Preset Trimmers
TC1, TC2 fitted to VC1, 2

Transistors
Tr1 BF194 Tr2 BF195 Tr3 BF195

Coils
L1, L2 Medium wave ferrite rod aerial coil type MW/FR5 Denco
L3 Oscillator coil type TOC1 Denco

Transformers
T1 I.F. transformer type IFT13 Denco
T2 I.F. transformer type IFT13 Denco
T3 I.F. transformer type IFT14 Denco

Switch
S1 Single-pole, on-off toggle switch

Miscellaneous
Perforated srbp, 0·15in. matrix 4¾in. x 2⅛in.
Control panel and bracket 4¾in. x 2in. aluminium
Nuts and bolts 6BA, pvc wire
Case, insulated, of wood or plastic

Radio Alarm Clock

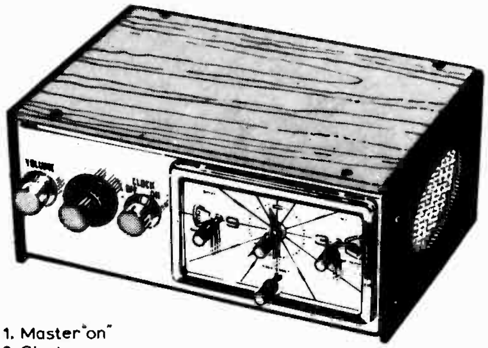
This radio alarm is designed to awaken you at a preset time set on the clock movement, and to switch off automatically if required.

Use the "Tape Tuner" (page four of this supplement) with an integrated circuit audio amplifier. The synchronous clock runs from 250V a.c. mains and is supplied with contacts which are set by a front mounted control. A second control sets the duration, then automatically switching off. (A minute timer ringer is also provided, but is not used in this circuit.)

The master or programming switch, which is arranged as in Fig. 1 and shown in two views in Fig. 2, allows the radio to be switched on irrespective of the clock settings, or switched off separately, giving complete freedom of operation without any need to change clock settings.

components

Tape tuner as described on page four of Supplement
Amplifier i.c. type "Super IC12" with heat sink (Sinclair)
Electric programmer clock as illustrated with switch contacts glass and bezel (various advertisers)
Loudspeaker 8Ω to match IC12
Switch single pole, 3-way to select operation
Connection block, 3-way for mains connection
Fabric or expanded aluminium speaker grille
Case approx. 10in × 7in. × 4½in.



A mains connector joins mains leads and clock leads.

The i.c. amplifier is mounted on brackets. The whole unit is powered by a PP9 9V battery. A mains unit could be fitted instead and several proprietary brands can be purchased or the reader can make his own. All units can be mounted in a suitable wooden case. ●

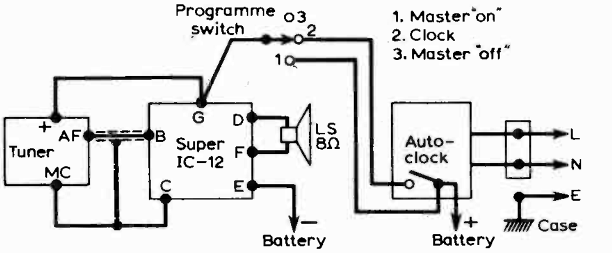
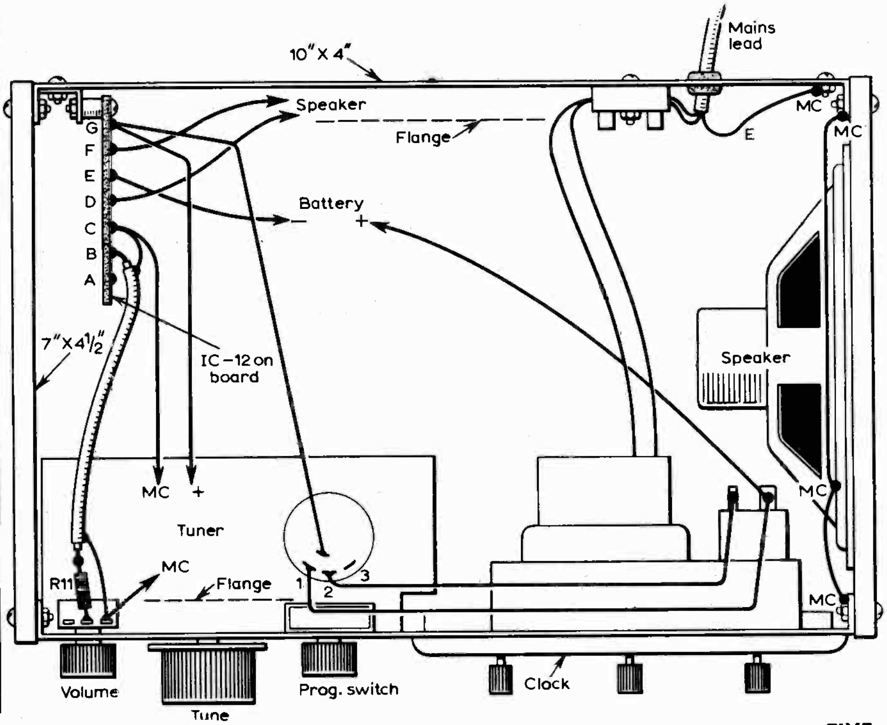


Fig. 1 (left): Circuit diagram
Fig. 2 (below): Component layout and wiring (the programme switch is shown twice for wiring detail)

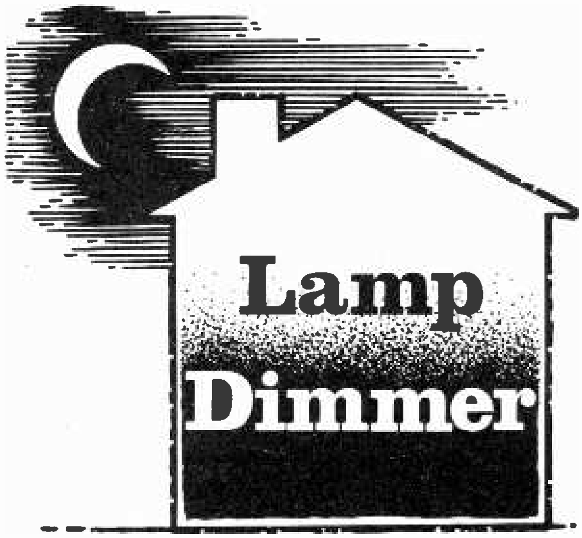


TAPE TUNER
continued from page four

nut and bolt hold the ferrite rod aerial.

The i.f. transformers T1, T2, T3 are pre-aligned but the effect of slight core adjustment can be tried. Adjust TC1 and TC2 at the high frequency (200 metres) end of the band, and the core of L3 (if necesary). The position of L1/L2 on the ferrite rod is adjusted at the low frequency end of the band.

Note that the specified case is insulated material, not metal to avoid screening the ferrite rod aerial. Audio output should be heard on high impedance phones connected to the output jack socket. The output is of high impedance and should be fed into the high impedance input of a tape recorder via screened cable (but see also the Radio Alarm Clock). Transistor connections as indicated by top view in Fig. 2.●



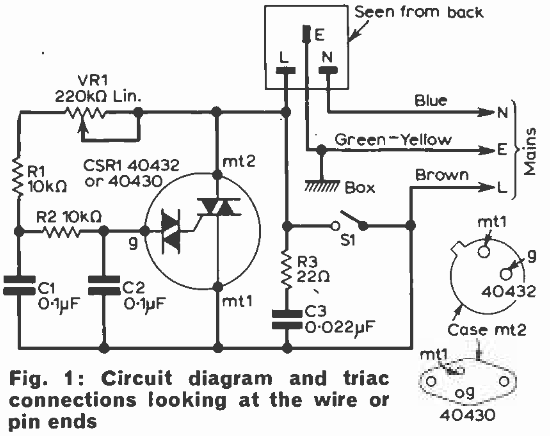


Fig. 1: Circuit diagram and triac connections looking at the wire or pin ends

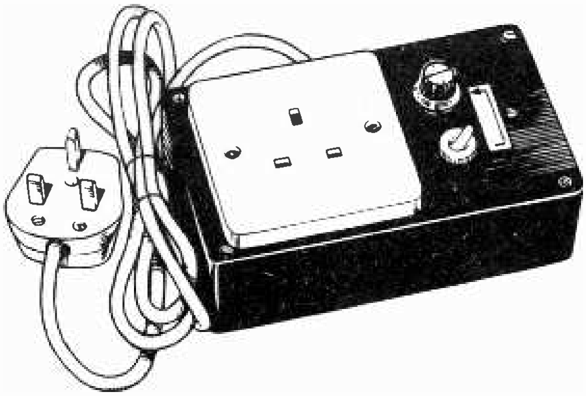
This lamp dimmer is constructed in an electrical switch box. The 40432 triac is rated at 0·5A without a heat sink, or 1A with the type 5F clip-on heat sink shown. With 240V a.c. mains, this is suitable for lamp loads of 120 watts and 240 watts respectively. An alternative triac type 40430 can also be used.

The dimmer can be fitted in place of an ordinary lamp switch. With the portable unit shown, the dimmer box and a 13A type outlet are assembled in a larger box. A table or standard lamp can be plugged into it, or it can be used for heat control of a soldering iron. This unit is not rated for power drills and is not suitable for them nor for fluorescent lamps.

Fig. 1 is the circuit, with wiring to integral 13A type outlet. The metal box, Fig. 2, provides screening. Complete closure by a metal plate was not found necessary. The triac case is connected, via a soldering tag bolted to the heat sink or case, to VR1. It must be insulated from the box and any other metal part. Flexible leads to VR1 and S1 allow these to be positioned in the front holes.

Assure proper earthing is maintained right up to any appliance controlled by the unit. The mains plug is fitted with a 3A fuse.

Triac connections shown in diagram. ●



components

R1	resistor 10kΩ ±10% ½ watt
R2	resistor 10kΩ ±10% ½ watt
R3	resistor 22Ω ±10% ½ watt
VR1	potentiometer 250kΩ linear
C1	capacitor 0·1μF 1,000V d.c. or 300V a.c.
C2	capacitor 0·1μF 1,000V d.c. or 300V a.c.
C3	capacitor 0·022μF 1,000V d.c. or 300V a.c.
CSR1	triac type 40432 with heat sink clip type 5F or triac type 40430
S1	Single-pole, on-off toggle switch 250V a.c.
	Metal electrical switch box 2¾in. × 2¾in. × 1⅜in. or 6¼in. × 3¼in. × 2in. with 13A mains socket
	Tag strip 8-way, knob, pvc wire, rubber grommet

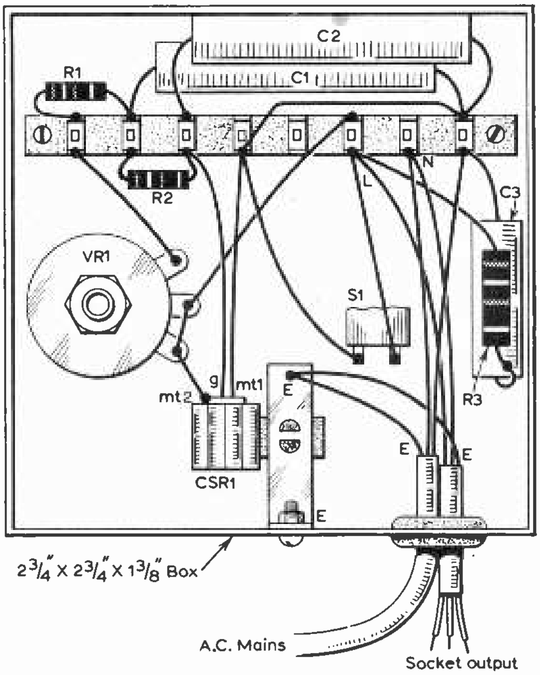


Fig. 2: Component layout and wiring

The input transducer is a small loudspeaker, followed by Tr1 and Tr2 as amplifiers. VR1 is a sensitivity control, allowing adjustment of the sound level at which the unit operates.

All components except the speaker and VR1 are mounted on the perforated srbp board in Fig. 2. Underside wiring is shown in grey. Points A, B and C carry connecting wires to VR1. Wires A and C are connected so that sensitivity increases as the control knob is rotated from the "off" position in the usual way. The case is an aluminium box or chassis.

Test by connecting a meter to the output terminals. A brief pulse of current is indicated when switching on, due to C5. The reading should then remain at zero, rising to 100-250mA while snapping the fingers or speaking quietly.

Place the unit adjacent to the source of sound. Where extraneous sounds may operate the unit, reduce sensitivity by turning back VR1 just enough to avoid this.

Twin bell wire or a long twin flexible lead run from the output terminals to the bell or relay. A diode 1N4148 should also be connected across the output terminals to suppress back e.m.f. through Tr4; diode plus to collector.

Connections for OC71, OC81: Collector nearest spot, then base, emitter. ●

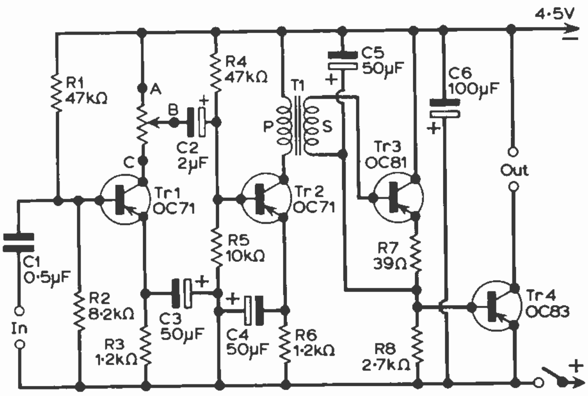


Fig. 1: Circuit diagram of the amplifier

components

Resistors

R1	47kΩ	R5	10kΩ
R2	8·2kΩ	R6	1·2kΩ
R3	1·2kΩ	R7	39Ω
R4	47kΩ	R8	2·7kΩ

All ±5% ¼W

Potentiometer

VR1 5kΩ with switch S1 attached

Capacitors

C1	0·5µF polyester	C4	50µF 6V electrolytic
C2	2µF 6V electrolytic	C5	50µF 6V electrolytic
C3	50µF 6V electrolytic	C6	100µF 6V electrolytic

Transistors

Tr1	OC71	Tr3	OC81
Tr2	OC71	Tr4	OC83

Transformer

T1 9·2:1, CT primary, type T/T7 Repanco

Miscellaneous

Miniature 40 ohm speaker
Perforated srbp board 4in. × 2½in.
Screw terminals or sockets
Case, aluminium or wood, 10in. × 4in. × 3in.

This alarm gives a warning by means of a bell, buzzer or lamp, so it can be used as a baby alarm, or as an extension for a door-bell or telephone bell. As it is sound operated, no direct connection is necessary to a telephone or other equipment.

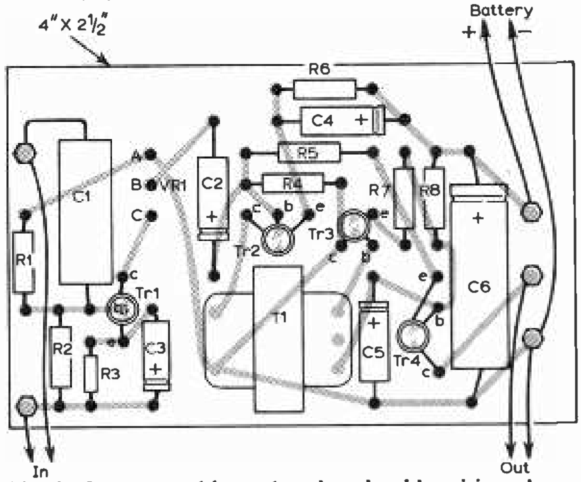
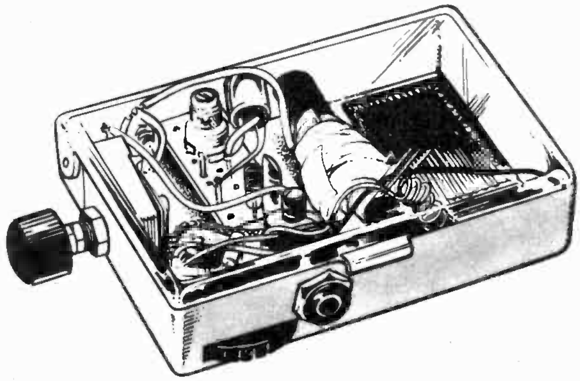


Fig. 2: Component layout and underside wiring shown grey

Light Powered Radio



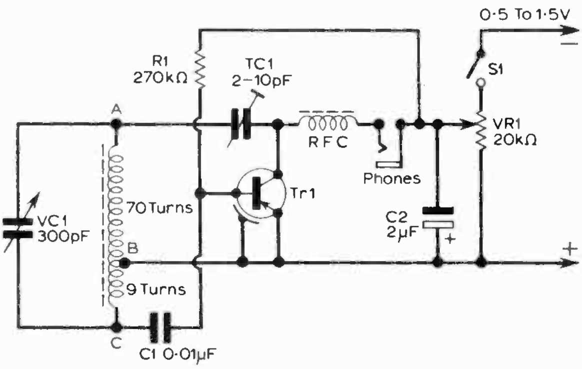


Fig. 1: Circuit diagram

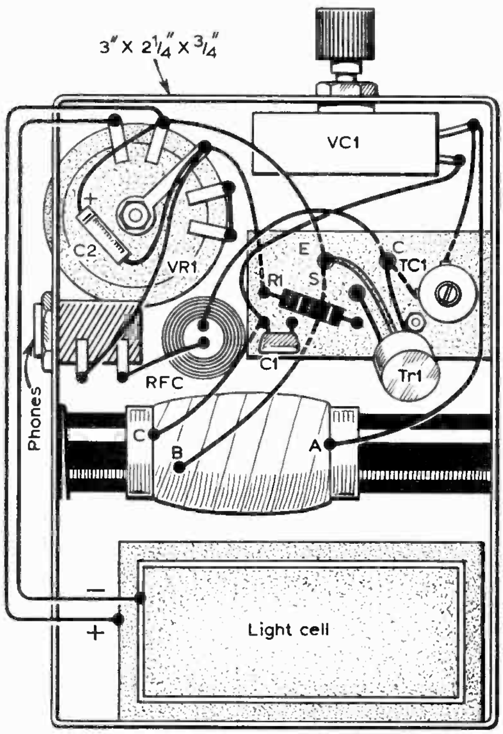


Fig. 2: Component layout and wiring

components

R1	resistor 270Ω ±10% ¼ watt
VR1	potentiometer 20kΩ miniature edge control with switch S1
C1	capacitor 0·1μF low voltage
C2	capacitor 2μF 6V or higher electrolytic
VC1	variable capacitor 300pF mica dielectric
TC1	trimmer capacitor 2-10pF screw driver control
Tr1	transistor AF117 or similar pnp type
RFC	R.F. cored choke 5mH
	Ferrite rod ⅜in. diameter, 2in. long
	Wire 26 s.w.g. enamelled copper wire for tuning coil
	Phones high impedance with jack plug and socket
	Solar cell 0·5volt or dry cell 1·5V
	Component board 1⅛in. × ⅝in. and box
	PVC connecting wire

Simple regenerative receiver providing headphone reception of local medium wave stations only. Power derived from a mercury cell when energised from daylight or good artificial light. A 1·5 volt dry cell can be used instead.

Tuned circuit consists of 79 turns of 26 s.w.g. enamelled copper wire (A to C) close wound on ferrite rod ⅜in. diameter, in parallel with small tuning capacitor VC1. This coil has a tapping (B) nine turns from one end (C). Trimmer capacitor TC1 controls regeneration and is set so that oscillation is just possible with VR1 near maximum voltage setting when using a single 0·5V solar cell.

Tuning coil is wound on thin card or thick paper tube so that it can be moved along ferrite rod for best reception. A few feet of flexible wire aerial connected at A may help reception. Phones should be high impedance 2,000 ohms or more and connected via jack socket on box. Small components are mounted on perforated srbp board and wired underneath. Keep wires short. Minimum recommended box size 3in. x 2¼in. x ¾in. Connections for AF711: collector wire nearest spot, then screen, base, emitter. ●

COMPONENT SUPPLIES

Components should be readily available from several of our advertisers including the following: Arrow Electronics, Chromasonic Electronics, Electrokit, Electrovalue, Henry's Radio, Home Radio (Components), A. Marshall & Son, Trannies, J. Bull (Electrical) and others.

Sub-standard, unmarked or other components that are not as specified in components lists cannot be guaranteed as suitable substitutes. Constructors should satisfy themselves before buying.

TRICOLOUR

Mood Lighting System

PART TWO **JUREK BUDEK***

THE *P.W. Tricolour* provides a versatile but straightforward form of colour lighting effect that is much improved on earlier designs, due largely to the use of the principle of zero voltage switching. Last month's article explained how this was done so now it is time to do the construction and see the results.

Construction

In the *P.W. Tricolour* lighting system, the bass frequencies are 'presented' by the red lamps, middle frequencies by the green lamps and treble frequencies by the blue lamps. The control unit referred to in the following text is the *P.W. Tricolour* filter and control unit.

The construction of the control unit is not complicated if care is taken to follow the drawings and assembly notes. Before connecting any mains supply to any unit, double-check all wiring against the circuit diagrams (last month) and wiring diagrams, making quite sure that all thyristors, triacs and diodes are correctly connected.

It is recommended that sockets are used for mounting the integrated circuits. *Do* not solder the I.C.'s directly to the printed circuit board.

Assemble the eight way socket to the back panel in such a manner that when plug is inserted the five core cable to the lamps leads horizontally away from the fuse assembly.

The lights output socket is a Bulgin type P552 and the plug to fit this (for the lamps unit lead) is a Bulgin P551.

Attach the fuse holders, rubber grommets and speaker socket to the back panel. Assemble the components on to the printed circuit board, making sure that no accidental solder bridges occur across adjacent copper pads. The heat sink for the triacs is "live" and should not be connected to, or allowed to come in contact with, any metal part except the triac mountings, which are also the connections to their "main terminal 2". For safety connect this, the "zero" voltage indicated on the mains transformer, to the neutral terminal of the mains, and connect the control unit chassis to earth on the mains plug.

Insert the rubber grommet for the l.e.d. lamp indicator into the front panel. Switches S1, S2, S3 and S4 are as used in the Texan amplifier.

The mains switch shown on the front panel uses detachable connecting clips, but any suitably rated mains switch is suitable. The front panel is mounted on the front of the chassis frame with spacers so that clearance of the control fixing nuts provides a neat and uncluttered appearance to the panel. The assembly

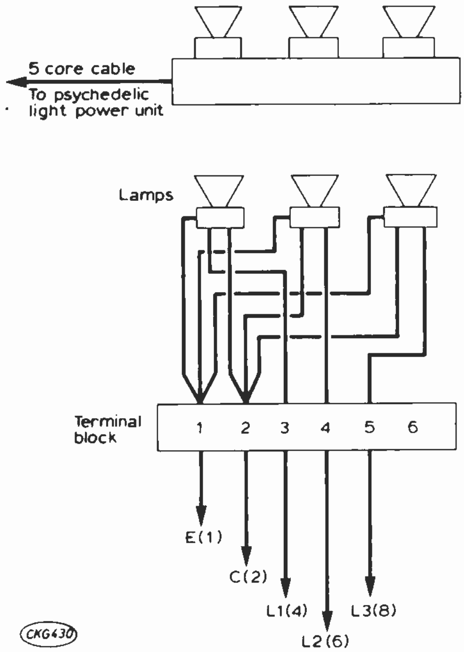


Fig. 13: The simplest arrangement in which one control unit drives three lamps, each 100 to 150 watts. E represents the earth or chassis connection via tag 1 on the Bulgin 8 pin plug/socket arrangement. The figures in parenthesis are the pin numbers. C is the common lead to the lamps—which is the 240V live lead. L1, L2 and L3 are the leads to the respective lamps shown as LP1, LP2 and LP3 (Fig. 12 last month).

* *TEXAS INSTRUMENTS LIMITED*

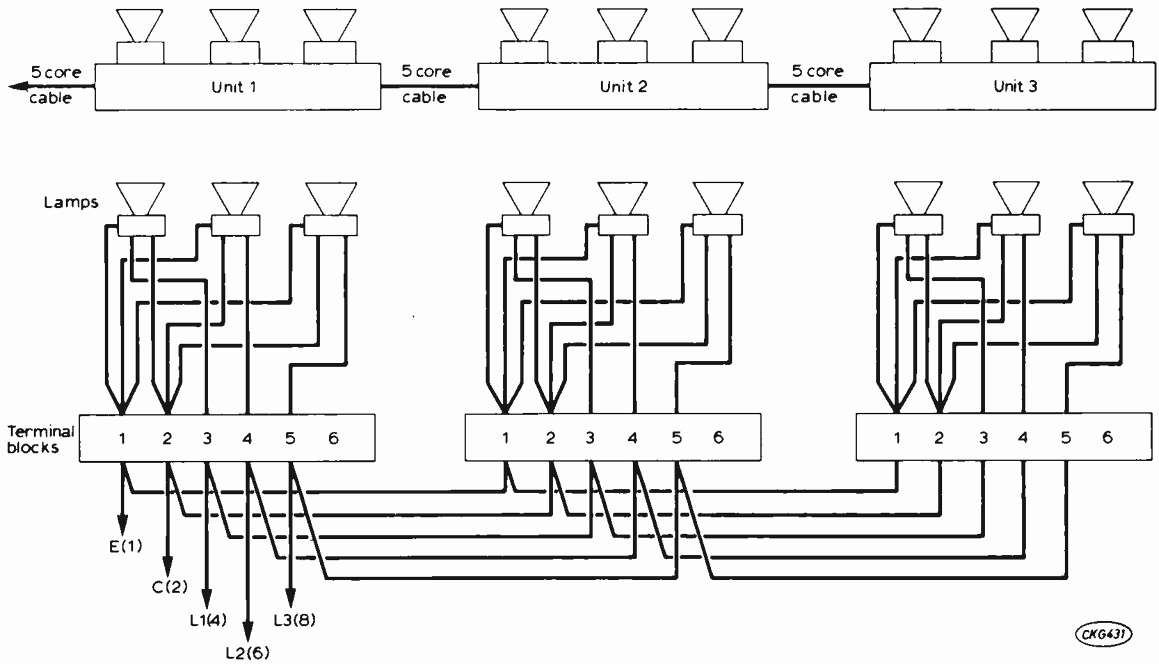


Fig. 14: Three banks of lamps, each 100w maximum, driven from one control unit.

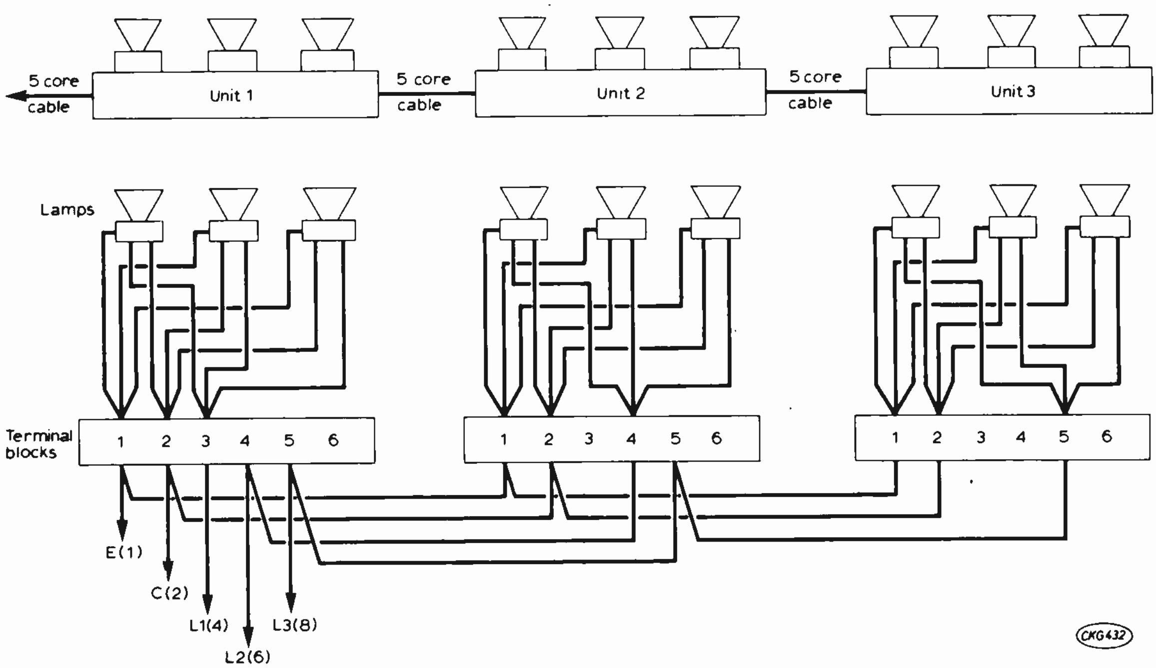


Fig. 15: Three banks of lamps, each 100W maximum, controlled by one frequency range.

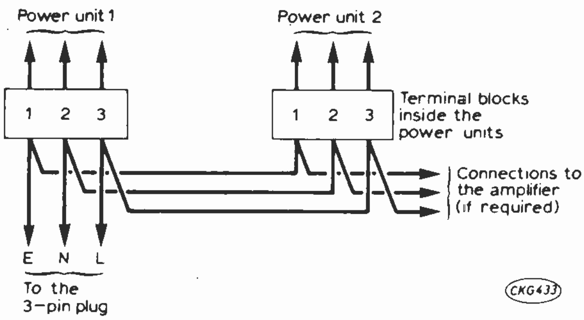


Fig. 16: Mains terminal block connections when using two control units.

uses 6BA nuts and bolts.

The three triacs and their associated heat sink uses 4BA nuts and bolts.

Fuses FS1, FS2 and FS3 are in the bass (red lamp), middle (green lamp) and treble (blue lamp) circuits respectively.

Unit Arrangement

The equipment consists of two units. One unit contains the control for the psychedelic lights, the filter circuits and the necessary power supply. It is advisable, but not essential, that this unit is located near to the 13A power socket and amplifier. The second unit is mobile and consists of three colour lamps mounted on a panel with a five core flexible cable attached to it. This unit can be hung on the wall, left on the table, or placed in some other convenient position.

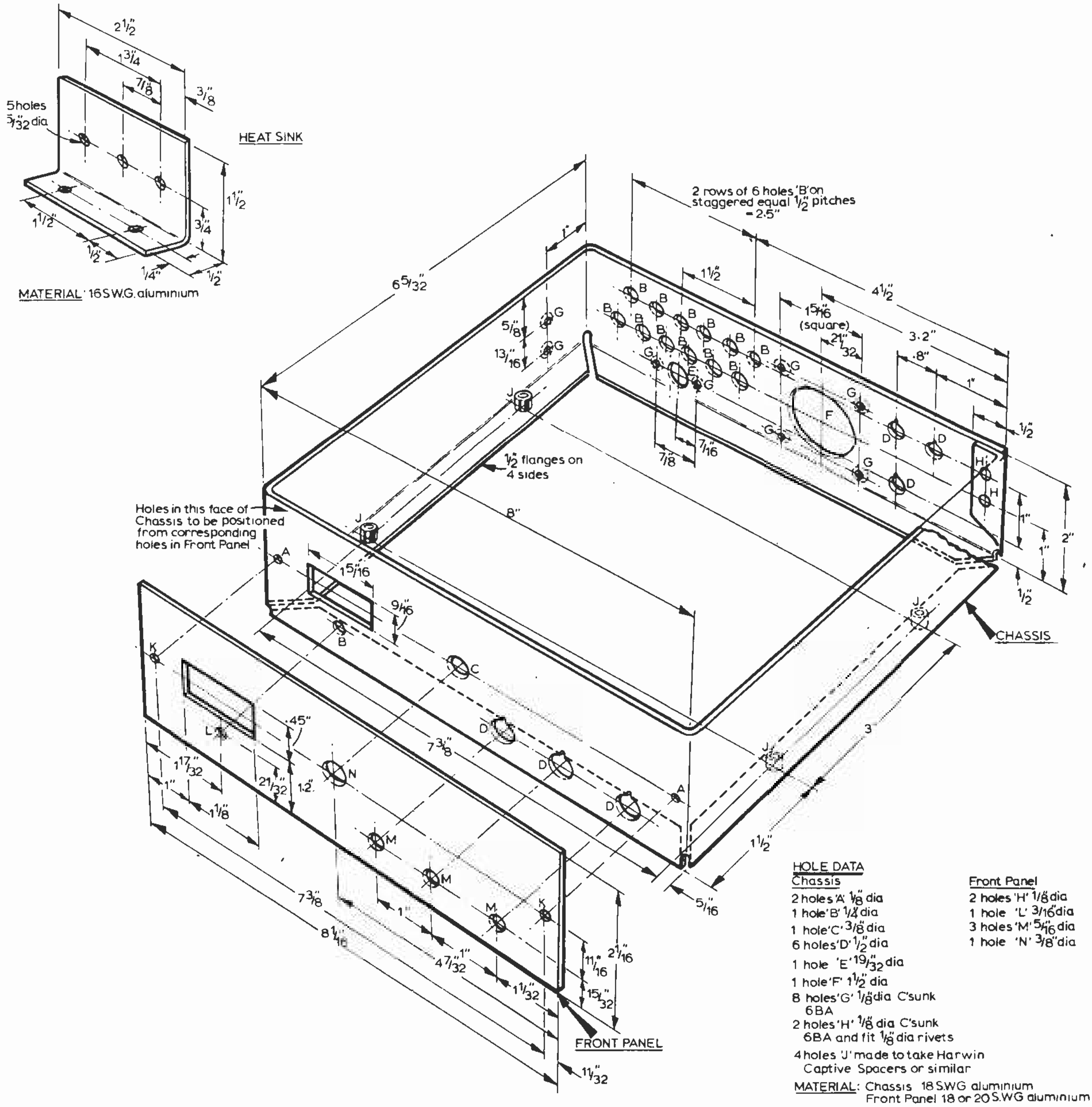
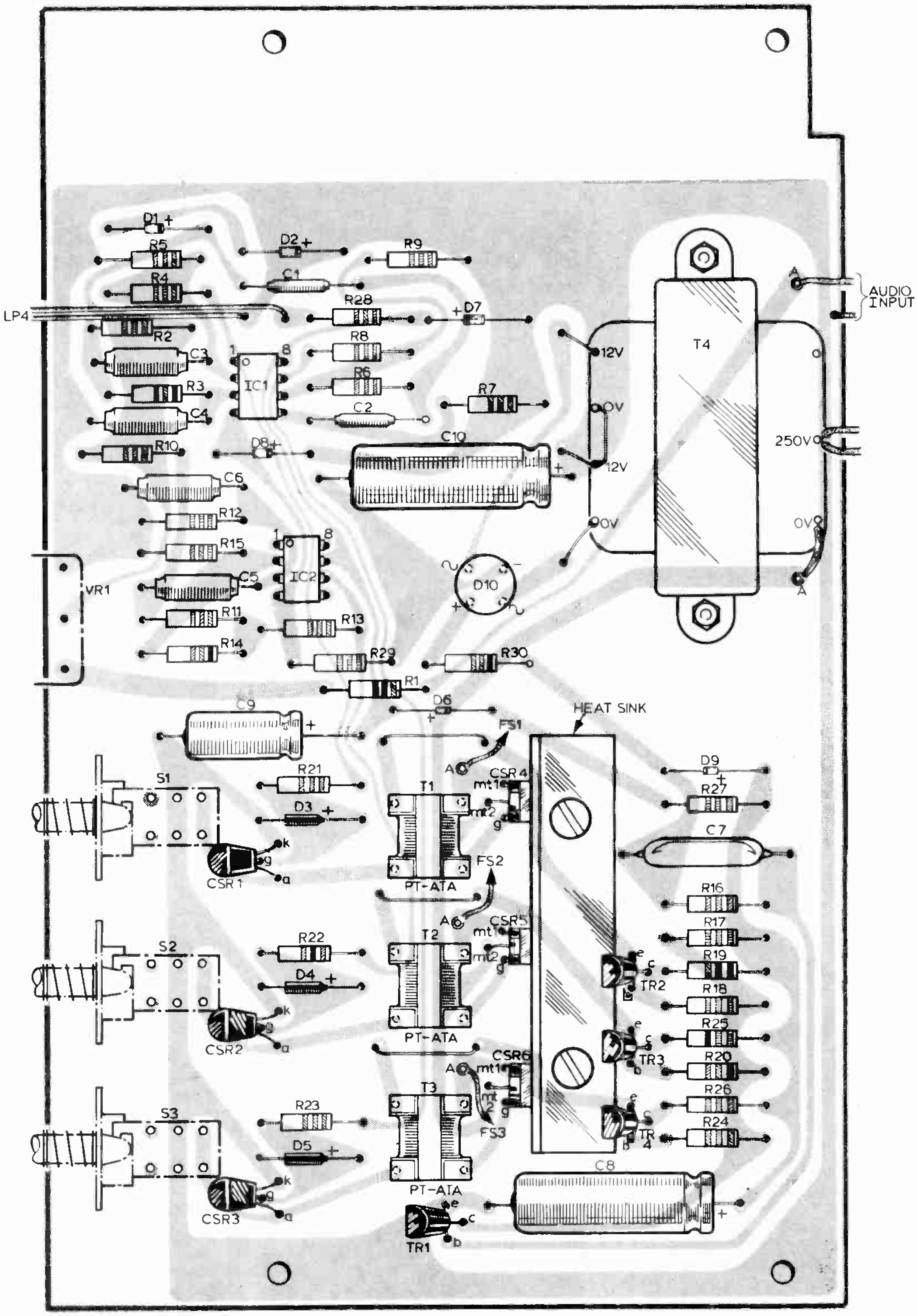
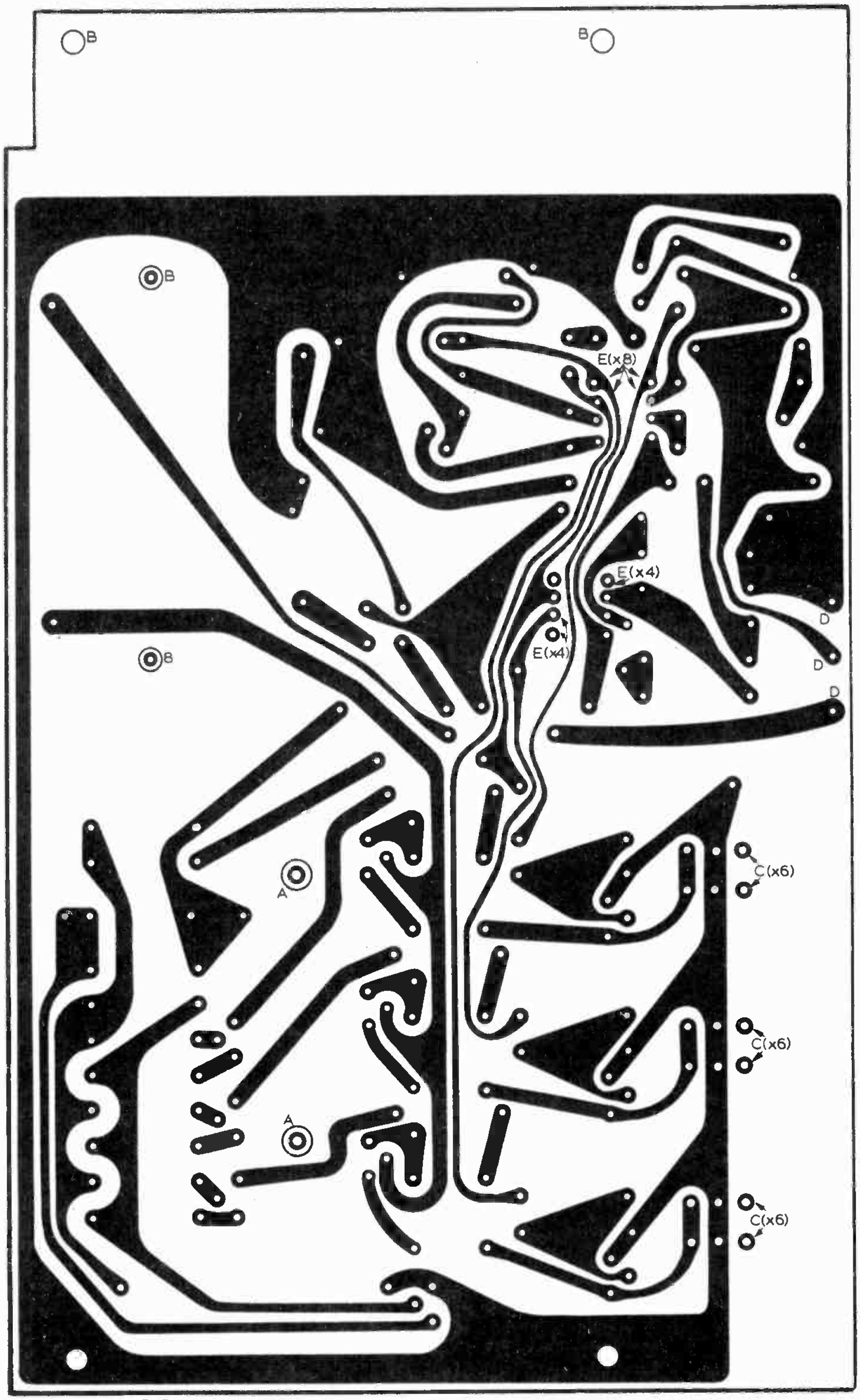


Fig. 17: Details of chassis construction and drilling with the heat sink shown top left, front panel left.



◎ Indicates solder pins in 5 positions A

Fig. 18 : Component layout and wiring to the printed circuit board. It will be observed that there are two leads from the 250V tag on T4. One lead is the live (L) lead from the mains terminal block. The other lead goes to tag 2 on the lights output socket.



HOLE DATA
2 holes 'A' 5/32" dia
6 holes 'B' 1/8" dia
18 holes 'C' 1.3mm dia
3 holes 'D' 1.8mm dia
16 holes 'E' 1/32" dia
All other holes 1.0mm dia

Fig 19: Full size pattern and drilling positions of the printed circuit board.

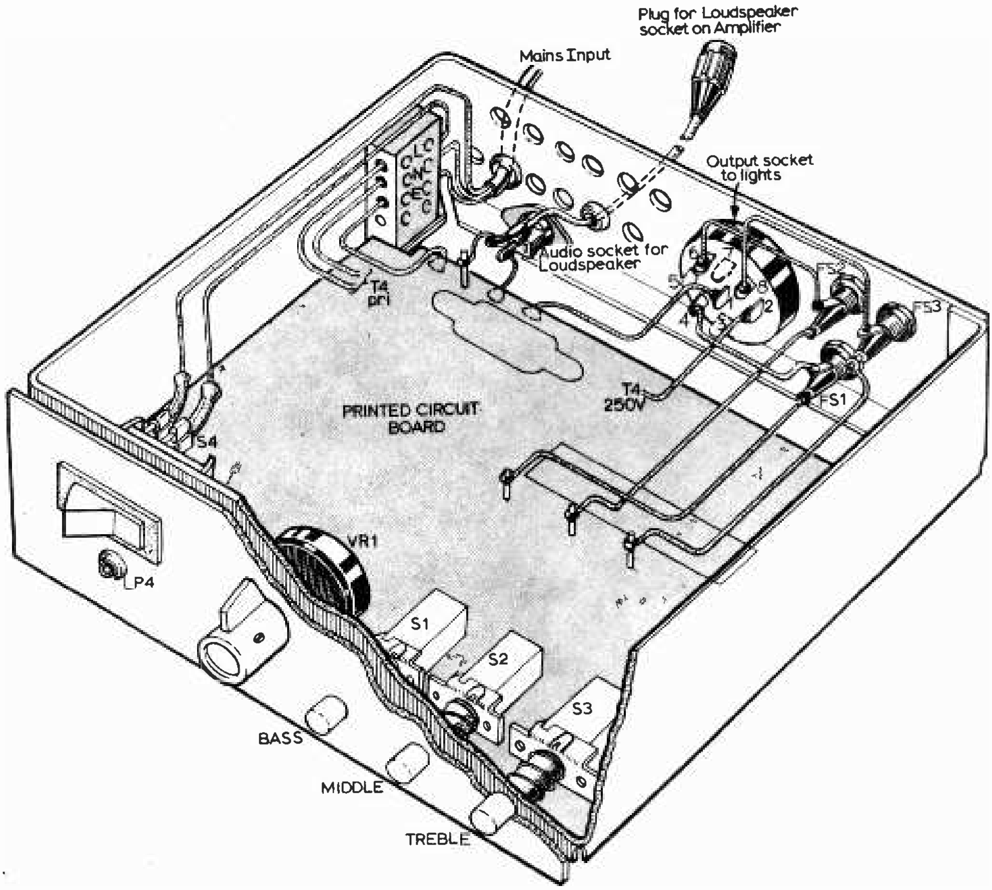


Fig. 20: Wiring of chassis mounted components to the printed circuit board. Tag 1 on the lights output socket goes to chassis (and mains earth). The live lead (L) from the mains terminal block goes to the 250V tag on T4 transformer.

The power control unit is capable of supplying three of these lamp units in parallel, each with its three coloured 100 watt lamps, i.e. a total power capability of 3×300 watts. Each lamp unit has a six way terminal block for interconnecting as shown in the diagrams.

Fig. 13 shows the connections for a single lamp unit. The five core cable is terminated with a plug suitable for connecting to the control unit. The figures in brackets show the pin numbers on the plug used. Connected thus, the three lamps will flash in accordance with frequency ranges present in the music.

Fig. 14 shows a triple unit arrangement, where each unit is connected in the same way as shown in Fig. 13. Here, however, the overall light level is increased and flexibility of lamp positioning is allowed, each lamp unit maintaining its three frequency range response.

A great deal of experimentation of lamp arrangement is worthwhile to achieve the best effect to suit your room and music. Fig. 15 gives another arrangement, using three lamp units, which is basically similar to that shown in Fig. 14, except that here each lamp unit will flash according to one frequency range.

The interconnections between speaker, amplifier and control units are also straightforward. Simply connect the speaker's DIN plug into the control unit and then plug in the cable from the control unit, now terminated with a DIN plug, into the amplifier. This should be done while all power is switched off. The amplifier should be connected via the control unit to a suitable loudspeaker before switching on.

The arrangement for a stereo system is very simple. Two control units and two lamp sets are required. A three core cable from a 13A socket is connected to the terminal board of control unit 1. From the same terminal board the second three core cable is connected to control unit 2 as shown in Fig. 16.

The advantage of this arrangement is obvious, i.e. only one 13A plug is used for both control units. If required, the power supply to the amplifier can also be taken from the terminal board of control unit 2 as shown in Fig. 16, thus achieving further simplification.

The interconnections between the control units, amplifier and speakers are similar to that described for the mono system but duplicated. Connect one speaker DIN plug into control unit 1 and then plug in the cable from it into the amplifier socket. This is repeated for the second speaker and control unit.

The effectiveness of the association of the light and music can be further improved if the lamps are placed near the speaker from which they are actuated. It is extremely effective when standing each lamp unit on or behind each speaker cabinet and projecting the lights up the walls behind.

The printed circuit board shown in this issue is for the zero voltage control version of the *P.W. Tricolour* only. A different printed circuit board, alternative components and slight alterations to the metalwork will be required for the version with lamp dimming facilities.

TO BE CONTINUED


Discoscene
500

PRODUCTION LINES

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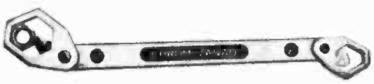
ADJUSTABLE SPANNER

The picture shows a self-adjusting spanner sultable for all nut sizes from $\frac{7}{16}$in. to $\frac{13}{16}$in. A.F.

The end of the tool is placed over the nut and turned until the "tongue" of the spanner locks onto the nut.

It is constructed from chrome-vanadium steel and weighs 5½ ozs. Finish is either matt (£1·49) or polished (£1·79). *Thunder Screw Anchors Ltd., Victoria Way, Burgess Hill, Sussex, RH15 9NF.*

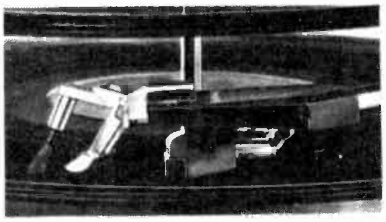


TUAC EQUIPMENT

Tuac Ltd., are marketing a new range of ready-assembled modules and complete units. They are a "waa-waa" unit, fuzz box, disco "auto fade", octave doubler and a phase-splitter.

Leaflets which are issued in conjunction with Tuac kits can be obtained on receipt of a 3p stamp from: *Transistor Universal Amplification, Co. Ltd., 163 Mitcham Road, London, SW17 9PG.*

AUTO GROOVE-KLEEN



If you have an autochanger record playing unit, you have not been able up to now, to use a groove-cleaning brush to remove the dust and dirt from the records.

Bib seem to have solved this problem with their model 45 unit which just sticks onto the cartridge housing. Obviously to avoid any increase in stylus weight, the tone-arm should be re-balanced or the calibration control reduced by two grammes.

Due to the design, the velvet shoe and brush will not drag across the record when the tone arm moves from the end of one record to the outside of the record stack.

After the records have been played, the velvet shoe can be lifted off for cleaning with the separate brush supplied.

The price of this unit is 98p plus tax. *Bib Sales, P.O. Box 78, Hemel Hempstead Herts.*

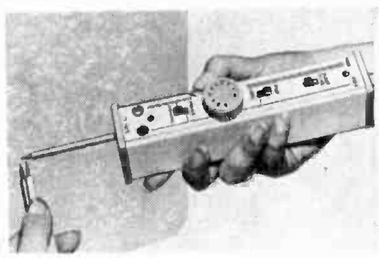
GUIDE TO SEMICONDUCTORS

Motorola Semiconductors Ltd. have published a "master selection guide". It Includes in its 150 pages brief technical details of 17 diode familles from 4-layer to zener, hybrid circuits, microwave devices, optoelectronic components, rectifiers, triacs, diodes, linear Integrated circuits and much more than we can describe here. The guide, which is free of charge, may be obtained from *Motorola Semiconductors Ltd., York House, Empire Way, Wembley Middlesex.*

TRANSISTOR TESTER

Transistor tester type TT169 has been announced by Avo. It is designed for GO/NO-GO in-circuit testing of p.n.p. and n.p.n. signal or power transistors. The tester is battery operated and small enough to be held in the hand. Front panel lights show whether a device is faulty or OK.

The TT169 comes with all the necessary leads and connector in a plastic case. The price is £17·50 plus VAT and readers may obtain them from the usual retailers and distributors. *Avo Limited, Avocet House, Dover, Kent.*

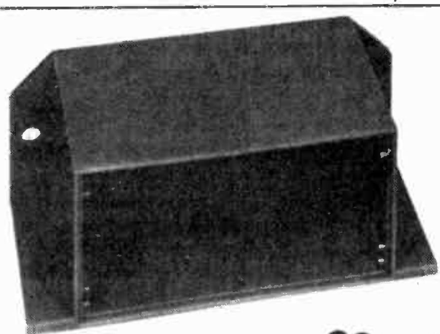


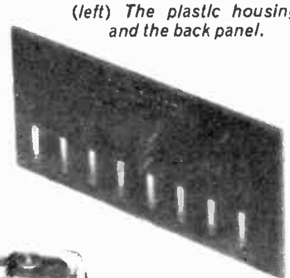
COMPONENT HOUSING TYPE LK8

Logikontrol Ltd., announce a compact component housing. It is made from high impact polystyrene and measures 90 x 50 x 37m.m. and at 25·4m.m. to the inch, you can work it out for yourselves! The internal volume is 10c.c. and it has facility for 2 printed circuit boards on which the components can be mounted.

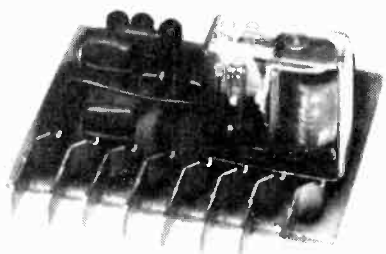
Printed circuit connections and a snap-fit lid eliminate the need for a special plug and socket.

These units which are available in five different colours may be obtained from large component suppliers or in quantities of 10 upwards from Logikontrol direct, the 10 off price being 22p each. *Logikontrol Ltd., 17 Little Edward Street, London, NW1 4AT.*





(left) The plastic housing and the back panel.



(right) A component board which can be slotted into the housing

160–80 metre CONVERTER

R.A. PENFOLD

THIS is a simple device which is easy to construct and which when placed ahead of a medium wave receiver will enable it to cover the 80 and 160 metre amateur bands. The unit is self contained, and is housed in a diecast box measuring $4\frac{3}{4}$in × $3\frac{3}{4}$in × $2\frac{5}{32}$in. An external long wire aerial and an earth are required.

Only two transistors are used, including a field-effect type in the mixer stage. Frequency stability is excellent as the oscillator is crystal controlled.

Heterodyne Principle

What is required of the converter is to receive a signal in either the 160 or 80 metre band and change this signal to a frequency which lies in the MW band. This can be achieved by heterodyning.

This is a process in which two signals are mixed to produce at the output, (a) the original two frequencies, (b) the sum of the two, and (c) the difference between the two. By the use of tuned circuits in the output, whichever of the two new frequencies produced is required can be selected.

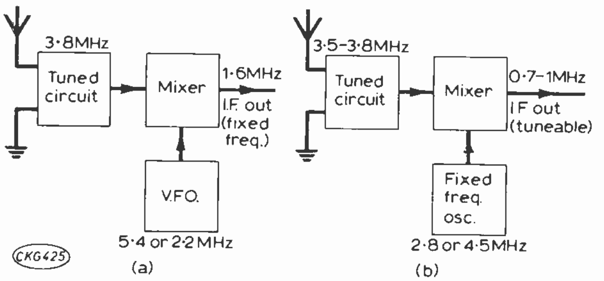


Fig. 1: Diagrams showing methods of converting a signal to a fixed or variable intermediate frequency.

The manner in which this process can be used in a converter is shown in Fig. 1. In the type of converter shown in Fig. 1a, the circuit is arranged so that the frequency to which the tuned circuit at the input is tuned is different from the operating frequency of the oscillator by the i.f. The tuning capacitors for the aerial tuned circuit and the oscillator would be ganged.

An example is given in the diagram of how a 3·8MHz signal is converted to a 1·6MHz i.f. There are two oscillator frequencies which will allow this (3·8 − 1·6 = 2·2MHz, or 3·8 + 1·6 = 5·4MHz). In this type of converter the receiver is tuned to the i.f., and the tuning is carried out on the converter.

A second type of converter is shown in Fig. 1b. This type is often used in 2 and 4 metre VHF amateur band converters. This time the tuning is carried out on the receiver, the oscillator on the converter being at a fixed frequency. The aerial tuned circuit should either be a broadband unit i.e. resonant over the entire band which is to be tuned, or should be tuneable over this range. Again there are two possible oscillator frequencies (3·8 − 1 = 2·8MHz, 3·5 − 0·7 = 2·8MHz, 3·8 + 0·7 = 4·5MHz, 3·5 + 1 = 4·5MHz).

This type of converter has the advantage that the oscillator can be crystal controlled, simplifying alignment and giving very good stability. This type is also very much more simple and inexpensive. The system does have drawbacks as discussed later but the author's converter, which is of this type, has proved very successful.

Practical Circuit

A circuit diagram of the converter is shown in Fig. 2. Tr2 is operated as a Pierce oscillator the crystal being used on its parallel resonant frequency. The primary winding of the oscillator r.f. transformer, L5, forms the collector load for Tr2. R2 biases the transistor, C3—C5 produce a centre tap on the crystal, this centre tap being earthed.

Tr1 is the f.e.t. mixer stage. L1 is the aerial input coupling winding and L2 the aerial tuned winding. This can be tuned over the range 70-230 metres by VC1. Tr1 is used in the common-source mode, source bias being provided by R1 and C1 is its decoupling capacitor. Tr1's source and R1 are connected via the

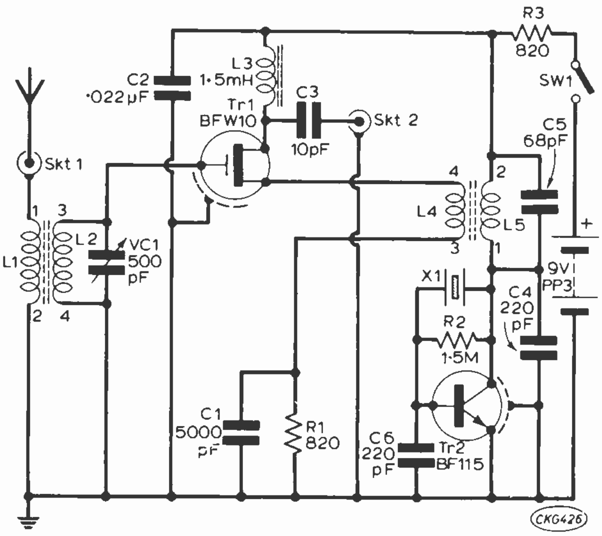


Fig. 2: Complete circuit of the converter unit.

secondary winding on the transformer, L4. The voltage across L4 modulates Tr1's drain and source voltages and thus mixes the oscillator signal and the input signal. A small r.f. choke, L3, forms the drain load for Tr1, the mixed output being coupled to the receiver via C3.

SW1 is the on-off switch, and R3 reduces the 9V supply to the required level. C2 is the supply decoupling capacitor.

The crystal frequency is chosen so that it can be used to convert signals in both the 80 and 160 metre bands to the MW band, the desired band being selected by tuning VC1—L2 to the correct frequency. Using a 2·8MHz crystal the 80 metre band will be converted to 0·7 – 1MHz (3·8 – 2·8 = 1, 3·5 – 2·8 = 0·7), and the 160 metre band will be converted to 0·8 – 1MHz (2·8 – 1·8 = 1, 2·8 – 2 = 0·8).

It is not essential for the crystal to operate exactly on 2·8MHz, as if it is a little either side of this frequency the converter will still operate but the tuning range on the receiver over which the amateur bands are covered will be slightly altered. A 2·794MHz crystal was used on the prototype.

Construction

The circuit is housed in an STC diecast box. The wiring is broken into two sections, a 5-way tagstrip on which the oscillator is constructed, and a 6-way tagstrip on which the mixer is built.

Diagrams illustrating the wiring of these two tagstrips are shown in Fig. 3 (mixer) and Fig. 4 (osc.). These two diagrams also show all other wiring of the converter. All the wiring is quite straightforward and should present no difficulty, even to a beginner. The only point which should be noted is that the screen lead of Tr1 is too short to reach to the appropriate tag unless a short piece of insulated wire is used to lengthen it.

Figure 5 shows the interior layout of the unit and also gives details of the mounting bracket of the crystal. This bracket is constructed from 18-22 swg sheet aluminium. The two tagstrips are mounted by $\frac{1}{2}$in 6BA bolts, a stand-off insulator $\frac{1}{4}$ to $\frac{3}{8}$in long being used to hold them clear of the sides of the case.

The battery is held in place by being trapped between the front, and rear of the case. A pad of expanded polystyrene, foam rubber or a similar material should be glued to the rear of the case where the battery would otherwise come into contact with it. This is to make it fit more firmly and to insulate the battery terminals from the case.

★ components list

Resistors
R1 820Ω
R2 1·5MΩ All $\frac{1}{4}$W, 5 per cent types
R3 820Ω

Capacitors
C1 5000pF
C2 0·022μF polystyrene etc.
C3 10pF ceramic or silver mica
C4 220pF polystyrene or silver mica
C5 68pF polystyrene or silver mica
C6 220pF polystyrene or silver mica

Semiconductors
Tr1 BFW10 or similar f.e.t.
Tr2 BF115

Miscellaneous
L1/2 Repanco RA3; L3 miniature r.f. choke, about 1·5mH; L4/5 Repanco RO3; SW1, on-off switch; STC diecast box, size 2 ($4\frac{3}{4}$ x $3\frac{3}{4}$ x 2 $\frac{5}{32}$in.); HC6U crystal, about 2·8MHz with holder (see text) (Henry's Radio); 1-off each 5-way and 6-way tag strip; 2-off coax sockets; Knob; Battery and clip.

As supplied, the exterior finish of the diecast box is rather rough and dirty. If the case is to be painted it will be necessary to thoroughly clean it first with a scouring pad. If preferred it can be cleaned in this way, and then polished to a bright natural finish.

Using the Converter

An external aerial is required; this merely consists of a length of wire which is mounted as high as possible and is as long as possible. An earth of some sort is essential for the correct operation of the circuit, although this does not necessarily have to be a very efficient one. The prototype is fitted with coaxial sockets for the aerial, earth and output connections.

Ideally the converter should be used in conjunction with a broadcast receiver which requires an external aerial. The receiver and the converter are connected by a short screened cable. In this way there is a minimum of interference picked up on the MW band directly by the receiver.

It was found possible to use the converter with an

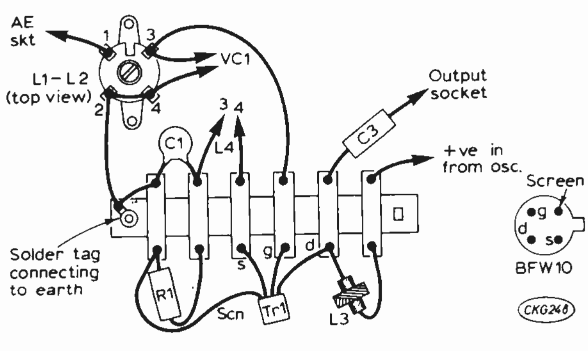


Fig. 3: Method of wiring the mixer stage components.

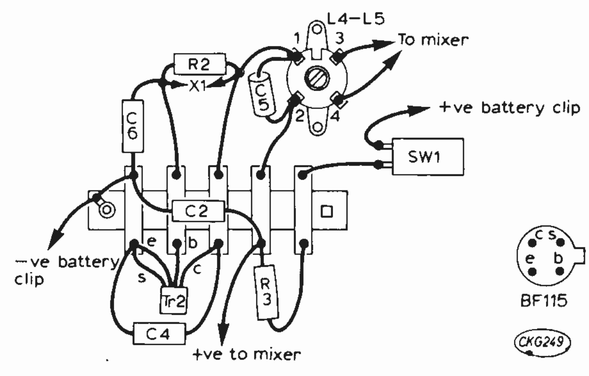


Fig. 4: Tagstrip construction of the oscillator stage.

ordinary transistor receiver. C3 should be removed, and a piece of wire connected in its place. It is then merely necessary to take a short lead from the converters output socket, and to place this alongside the receiver's ferrite aerial.

In this way it was found possible to receive a number of amateur stations on both the 80 and 160 metre bands. MW stations received directly by the receiver can prove bothersome, especially after dark.

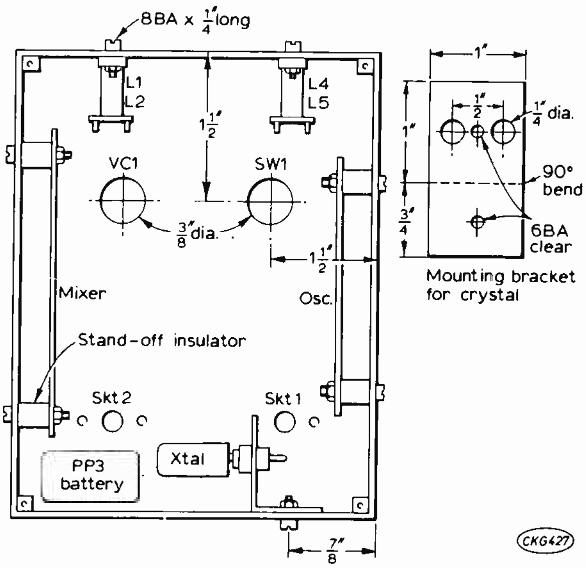


Fig. 5: Layout of components and tagstrips inside the die-cast box.

Operating the controls on the converter is very simple, as there are only two. SW1 is the on-off switch. VC1 tunes the converter to the desired band. With this control turned almost fully anti-clockwise it should be found possible to tune the 80 metre band and with it turned almost fully clockwise it should be possible to tune 160 metres.

With VC1 approximately adjusted in this way, it should be possible to receive a few signals. VC1 can then be peaked for maximum sensitivity. A simple dial can be marked around the control knob of VC1 showing the areas over which the amateur bands are tuned.

Results

Using the converter with a 132ft. longwire aerial at about 20ft., in conjunction with a 6 transistor MW portable receiver, a large number of amateur stations have been heard. The 160 metre band is of course used mainly for local working, and a.m. is still used to a certain extent. Stations up to about 50 miles distant have been received on this band without too much difficulty.

Due to its simplicity, the circuit does have one drawback. Top Band is not only used for amateur transmissions but also for maritime ones. These transmissions are fairly powerful and occasionally when tuning the 80 metre band transmissions from ships in the nearby Thames estuary did break through. Conversely, a local amateur using a powerful SSB transmitter on 80 metres did tend to break through on the 160 metre band. ■

ON THE AIR

BROADCAST BANDS

SHORT WAVE RECEIVER CHOICE

by MALCOLM CONNAH

By far the largest portion of my mailbag consists of lettters from readers asking my advice on the choice of a receiver. I have often said that this is a very difficult subject on which to give advice, partly because the letters give very little information and partly because "one man's meat is another man's poison".

In order to assist the less technically minded reader to select a receiver to meet his requirements I am going to devote this article to discussing the various features of receivers which are important for good short wave reception.

1. Frequency Coverage: The most common type of receiver is the General Coverage Receiver. This type of receiver usually tunes from 540kHz to 30MHz in four bands. One of these bands covers the medium wave band leaving three bands of short wave coverage.

Due to the number of stations on the bands it is very desirable to have a separate bandspread, or fine tuning, control. This control has the effect of expanding a small portion of the tuning scale making it much easier to tune in a particular station. The much-advertised transistor portable receivers are usually lacking in this respect.

An alternative method of frequency coverage is found in the more expensive receivers which have a number of bands each covering 500kHz of the spectrum. These receivers usually cover the Amateur bands only but can be ordered with coverage of the Broadcast bands. The tuning of these receivers is so fine that a separate bandspread control is not required.

In general the listener must ensure that the receiver covers the bands in which he is interested and that the tuning can be finely controlled.

2. Number of Conversions: The number of conversions that a receiver has is the number of different i.f.'s (Intermediate Frequencies) that it has. The normal single conversion receiver has a single i.f. usually in the range 455-470kHz, although 1·6MHz is sometimes used. The double conversion receiver has two different i.f.'s. In general, the more i.f.'s a receiver has, the better the selectivity and image rejection will be.

3. RF Stages: Some of the simpler receivers available have no r.f. stage and the signal is passed from the aerial to the mixer stage directly. The addition of an r.f. stage will increase the sensitivity of the receiver and also improve the image rejection of a single conversion set. As mentioned last month this problem can be overcome by adding a preselector between the aerial and the receiver.

4. Operating Modes: The Broadcast Bands listener is usually only interested in amplitude modulated (a.m.) signals and this mode of operation is, therefore, essential. If the set is also to be used for reception of Amateurs provision should be made for code (c.w.) reception, this also allows reception of single sideband (s.s.b.) transmissions. However, the provision of a product detector gives much better s.s.b. reception. If the provision also exists for manual selection of the upper or lower sideband this facility can be used during the reception of a.m. signals to avoid interference and fading effects.

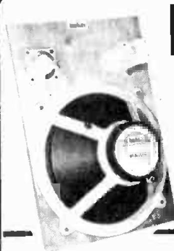
5. Selectivity: The selectivity of a receiver is its ability to separate stations on adjacent frequencies. It is extremely useful to have the facility of varying the selectivity of the receiver. When interference is heavy a narrow selectivity can be used to cut out the interference. Mechanical or crystal filters help to improve the selectivity of a receiver.

6. Stability: It is essential for a good receiver to be stable in operation. With some valve receivers the heating effects involved caused frequency drift and other annoying effects. The introduction of transistors and, in particular, field-effect transistors has greatly improved the situation due to the low heating effects associated with these devices.

7. Valves vs. Transistors: Apart from improving stability, as mentioned above, transistors have many advantages in communication receivers. They have a longer life, require simpler power supplies and are low cost. The benefits of this are that transistor receivers tend to be smaller, lighter in weight, less expensive and also have the option of being operated from an external battery.

8. Automatic Volume or Gain Control (a.v.c. or a.g.c.) Almost every receiver has some form of a.v.c. or a.g.c. which adjusts the gain of the receiver to compensate for changes in signal strength. A receiver with variable a.v.c. or a.g.c. is to be preferred as the optimum setting can then be used.

9. Extras: Most receivers have various extras of which the following are the most useful. (a) The provision of a headphone socket. (b) An aerial trimmer to match the aerial to the set. (c) A signal strength meter (S-meter) to assist with tuning. (d) A crystal calibrator to check the dial accuracy. (e) A noise limiter which should be variable if possible. (f) A notch filter to reduce hetrodynes.



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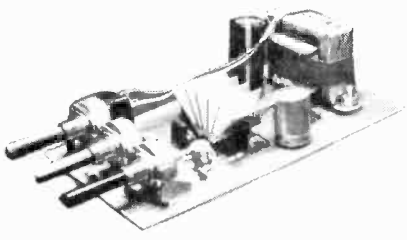

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ON THE AIR

COMMERCIAL RADIO

by CHARLES MOLLOY

COMMERCIAL radio in the UK has come a step nearer with the start of medium wave tests in the London area by the Independent Broadcasting Authority. **Kevin Peel** (Hornchurch Essex) has heard the IBA on 557kHz with transmissions of music and announcements stating that the tests were being made by the IBA for an indefinite time. The choice of frequency is a surprise as the two IBA London stations are expected to be on 1151kHz (London News) and 1546kHz (London Entertainment). The first regular broadcasts from the IBA are scheduled to start this year with the opening of the London stations to be followed in 1974 by others in the provinces.

Harold Emblem (Mirfield, Yorkshire) has logged a number of medium wave stations in the Persian Gulf area between 0230hrs and 0300hrs GMT. He reports Kuwait on 539kHz; Tabriz, Iran on 645kHz; Bagdad 760kHz; 'The Voice of the Arab Emirates' Dubai 1250kHz with an Arabic religious programme followed by pop music at 0300hrs; Teheran 1325kHz; Kuwait 1345kHz. Harold mentions that Kuwait 539kHz can be heard during the evening under Budapest, which uses the same frequency. Baghdad on 760kHz is also audible in the evening.

Commercial radio is well established in Spain where several chains of low power locals operate alongside the government owned Radio Nacional Espana networks. The commercial stations are allocated call signs and about 150 of these outlets can be found all over the band. Those most frequently heard in the UK are EAJ5 Radio Sevilla on 809kHz; EAJ1 Radio Barcelona on 827kHz; EAJ2 Radio Espana (Madrid) 917kHz; EAJ29 Radio Intercontinental 953kHz; EAJ8 R. San Sebastian 1025kHz; EFE14 La Voz de Madrid 1097kHz; EAJ15 Radio Reloj (Barcelona) 1124kHz; EFJ43 Radio Juventud Bilbao 1133kHz; ECS11 Radio Centro Madrid 1385kHz; EAJ20 Radio Sabadell 1475kHz; EFE25 La Voz de Calabria 1570kHz. The common channels 1106kHz, 1133kHz, 1394kHz, 1412kHz, 1430kHz, 1475kHz, 1502kHz, 1520kHz and 1570kHz are crowded with stations. They sign-off for the night from 2300hrs GMT onwards and at this time the DXer can hear one station after another dominate a channel only to close down and leave the frequency free for a weaker occupant. Many a rare catch can be had at this time.

L. J. Hook asks for information about the MW Command receiver. Also known as the BC946 it was part of the ARC5 aircraft communications equipment used in the last war. It performs very well on the medium waves but it does require some modification as it was designed to work from a 28 volt aircraft supply.

IBA ON VHF

by SIMON DAVID

THIS new v.h.f. section will be a regular feature giving news and views on transmissions usually found on the 88 to 108MHz dial, but may be extended to include related topics. VHF is generally taken to include transmissions between 30 and 300-MHz, i.e. below 10 metres, but since this area is also covered in David Gibson's Short Wave column, this section has been specially started to provide some information more appropriate to broadcasting.

Since f.m. broadcasts began in the U.K. on a regular basis, it has been continually predicted that the medium wave band was due for banishment. This has not come about however and the medium wave is in fact still being exploited. What is expected is that the new Independent Broadcasting Authority Stations will use the upper reaches of the f.m. dial for stereo programmes, but will not necessarily use the same transmitters as the BBC. Receivers within close proximity of a BBC transmitter and collecting signals of around 100μV may find that they will be able to pick up a 20mV signal from the local IBA station.

One of the main headaches is expected to come from cross modulation effects due to emergency services being tuned in close to the commercial channels. This will undoubtedly result in a number of semi-redundant old tuners, although there is no fear of upsetting their present usefulness for BBC programmes. Whether politics come into this we are not too sure, but it is strange how the commercial side of broadcasting frequently has to accept second rate operational conditions.

In order to help find space for the new IBA commercial radio stations, the BBC will be nudging its local stations along the v.h.f. tuning scale a little, changing the operating frequencies of Radios London, Medway, Oxford, Brighton, Bristol, Leicester, Nottingham, Stoke, Humberside, and Sheffield. These adjustments are expected later this year when the appropriate details should be given in the local Press and *Radio Times*.

The new station at Carlisle is still expected to "appear" on 95·6MHz, but it looks as if Swaledale will be "lost" for want of a suitable site for a relay station.

Although some way off yet, it is not a bad idea to look into the needs and possibilities of incorporating very sharp rejection filters to suppress adjacent local transmitters. The use of a field effect transistor at the front end will also help to reduce cross modulation effects. Several tuners have automatic gain control and since this would not be helpful in this situation it is worth incorporating a switch so that it can be cut out of service as necessary.

Furthermore, the mixer stage design becomes critical and the noise generated here must be at a very low level. This will mean that the r.f. circuit will not have such a high gain as in the past but this can be made up by increasing the gain through the i.f. stages.

The use of phase-lock integrated decoders will provide tuners with lower distortion and better frequency response, both of which have become necessary for good stereo reception.

We shall always be pleased to hear of readers' experiences of v.h.f. reception, especially those who listen in to continental stations. Please be brief and confine your letters to stations received, aerial and tuner used and the effect of interfering transmissions.

ON THE AIR

SHORT WAVES

by DAVID GIBSON, G3JDG

THIS month's postbag has been conspicuous by the very marked absence of 14MHz logs. It seems that the twenty-metre-only addicts are as dead as their band these days. Meanwhile, back at the eighty-metre ranch it's been a right merry r.f. square dance. The amount of DX on eighty has been quite remarkable with west coast W stations romping in at times. In fact, stations further down the globe have also put in an almost regular appearance on this band; Mexico, Brazil and Argentine, etc. Some real goodies have put in an appearance for the persistent enthusiast. Callsigns like DU1EJ and VS6DO have shown that your reciever dial need not read above 4MHz in order to log some rewarding DX signals both on phone and c.w.

News from VE land. An enthusiastic band of Canadian Amateurs are building a large ocean-going trimaran. Their object is to put the 40 most "wanted" countries on the air. I will pass on information about their ports of call as soon as I hear.

Great hopes that an Amateur station will be allowed on Clipperton Island. Callsign to listen for will probably be FO8C. Anyone heard the station reported to be located in the Spanish Sahara yet?

Time to pass on to some queries, curses and comments. **Michael Green** (Cheshire) uses a UR1A. The drawing of his antenna system bears a harrowing resemblance to the national grid. (Bet he's the only s.w.l who tunes topband in rubber gloves and wellies). Michael queries queer callsigns heard in the wee small hours on 80 metres s.s.b.; Rudolph, Scrooge, Virgin Mary and Snowman. Michael's problem is simply, "How do I QSL them?" (Perhaps the nearest Asylum is licensed?).

Letter from a long, long way off bears the signature of **Lindsay Pennell** and the post mark Hong Kong (Ah, those were the days, Chow Mein butties and cocoa on the Kowloon ferry). Lindsay wonders why so few G s.w.l.s hear the Hong Kong throng signing VS6. There are some 40 licensed Amateurs many of them being very active into Europe. Confess now, you're all logging VS6's and not telling your Auntie David.

Simon Baines (Hitchin) reports a number of W stations including W5NMA, heard on forty metres s.s.b. Gear is a five-vale receiver, transistor b.f.o. and 30ft of wire end fed.

M. Harrison (Derby) sends in a log of numerous G stations heard on topband. Incidentally, a good non-G to listen for on 1·8MHz is W1BB/1 whose stalwart support and interest in topband is well known all over the world. It is interesting to note that PY1DVG has been heard on 1·8MHz.

Kevin Smith is thirteen summers old and lives in Brighton. (Wish I was and did.) Whereas most boys of 13 are the proud possessors of pieces of string and marbles, Kevin settles for a CR100 and a 215ft long wire end fed. His best areas on topband were: DL8PC, GI3GRD, GM4BBL, GW3ZQN all on s.s.b., and OK1ATP on c.w. His log for 28MHz reads: CN8BF, CN8CF, CR4BS, CR7AF, CR7IZ, CT2AT, ET3USF, ET3USP, KV4CF, ST2SA, VP2LAF, WB4WOI/P, ZE4JW, ZS6AD, 4Z4ME, 6W8DL, 7Q7RM, 9G1HE, 9H4D, 9J2AY, 9J2DT all s.s.b.

Best times for listening on eighty metres are from midnight to around 0300 hours according to **Alan Smith** (Lancs). He bemoans the Lids who test incessantly by blowing into the mike (it's unhygienic but they can't touch you for it). Alan has a JR31), 60ft end fed and an a.t.u. Heard on eighty: EP2TW, K1UAT, K2LQA, KP4AN, KV4CI, PY4BTK, VE1ADV, VP2LI, VP7ND, W1GEY, W2BXA, W3WGH, W4AG, ZB2CF, ZS1MH, ZS3GH, 9H1CW, 9V1RE. A cheap day excursion to 14MHz s.s.b. raised: EP2ES, HZ1AB, KG6JBE, KL7HFA, KX6BQ, LU1DAC, MP4TEE, VE1ASJ, VE3MO, VK3ADR, YK1AA, ZL1KN, ZL1WE, ZL2AVE, ZL2BQC, ZL3QN.

David Sharred (Birmingham) had a quick tour of eighty metres. Main listening times were "after my paper-round", and the gear is a CR150/2 with a V-shaped antenna (60ft each leg). Goodies bagged on 3·5MHz: CN8BF, JY1, K5PFL, KV4AM, OA6NCT, PI1ROS, VE3CDP/W9, W2HCW, W4MYA, W9QLD, WA5JMK, WB4MCI/P4, ZK2BO, ZL4BT, ZL4KF, ZS3GH, 3A2EG, 5U7AX. On twenty metres David's best were VK5RN and VK6XO.

Where are all you v.h.f. types hiding? No logs at all for lonely little 70MHz and only one for 144MHz. **Michael Prescott** (Lancs.) uses a Roamer 10 receiver and a two metre dipole. He reports signals from the following: G3AHD/A, G3PVC, G3VIM, G3XIM, G3VME, G8EYO/A, G8ESU, G8GYS, G8VLE and G8XDL. Well done Michael, you've kept the v.h.f. flag flying—just.

For the contest and Rally enthusiasts, April is a busy, busy month. Jottings from my Events diary read: April 1, White Rose Mobile Rally at Leeds; 1, WAB phone contest (l.f.); 8, WAB c.w. l.f. contest; 8, eighty metre QRP (low power) contest; 15, four metre portable contest (no excuse now for not sending in a log); 21-22, Bermuda contest (phone); 29, Rugby DF qualifying round; May 5-6, two metre and 70cm open contest (another chance for the v.h.f. s.w.ls to shine); 5-6, Bermuda contest (c.w.); 6, Spalding Tulip Time Mobile Rally.

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 Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4 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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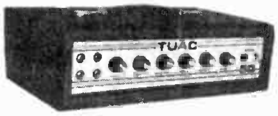

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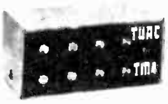

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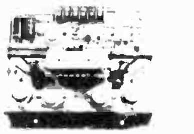

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3Q4	50	6BW7	80	6K8G	40	10F1	75	25L6GT	50	85A2	50
3Q5	50	6C4	33	6K8GT	50	10F3	90	25Y5	65	150B2	60
3S4	35	6C5G	35	6K25	75	10F9	60	25Z4	30	150C4	60
3V4	48	6C6	25	6L6G	50	10F18	50	25Z5GT	55	801	60
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DAF91	30	EBL31	£1·50	EL34	50	N78	£1·50	PL500	80	U403	60
DAF96	45	EC90	33	EL41	60	N108	£1·50	PL504	80	U404	60
DCC90	£1·35	ECC81	35	EL42	65	OA2	38	PL508	90	U801	£1·18
DF33	55	ECC82	30	EL84	25	OC3	38	PL509	£1·60	UABC80	40
DF70	45	ECC83	30	EL95	35	OZ4	40	PL802	95	UAF42	55
DF91	30	ECC84	30	ELL80	£1·00	PC86	60	PX4	£2·50	UBC41	50
DF92	20	ECC85	40	EM80	45	PC88	60	PX25	£2·50	UBC81	40
DF96	45	ECC88	40	EM81	60	PC97	50	PY33	63	UBF80	40
DH77	35	ECH21	63	EM84	35	PCC84	40	PY81	30	UBF89	35
DK32	45	ECH35	£1·00	EY51	40	PCC89	50	PY82	35	UCC84	43
DK91	40	ECH42	75	EY86	40	PCC189	55	PY83	38	UCC85	40
DK92	55	ECH81	30	EZ35	40	PCF80	30	PY500	£1·00	UCF80	55
DK96	50	ECH83	45	EZ40	50	PCF82	35	PY800	40	UCH42	70
DL66	£1·25	ECL80	45	EZ41	50	PCF84	60	PY801	50	UCH81	40
DL92	35	ECL82	35	EZ80	27	PCF86	60	R2	75	UCL82	35
DL93	40	ECL83	70	EZ81	29	PCF801	50	R19	50	UCL83	60
DL94	48	ECL86	40	GY501	80	PCF802	50	S130	£1·75	UF41	60
DL95	50	ECLL800	£2·25	GZ30	40	PCF805	80	SP4	50	UF89	40
DL96	45	EF9	75	GZ32	48	PCF806	70	SP41	£3·00	UL41	65
DM70	45	EF37A	£1·20	GZ34	60	PCF808	85	SP61	75	UL84	40
DY86	33	EF39	60	HN309	£1·50	PCL82	35	STV280/80	£10·00	UM80	30
DY87	38	EF41	65	KT36	£1·00	PCL83	65	SU25	£1·00	UU9	50
E88CC	65	EF50	25	KT61	£1·75	PCL84	45	SU2150	75	UY21	50
EA50	20	EF52	£1·25	KT66	£2·05	PCL85	40	T41	£1·00	UY41	48
EABC80	35	EF80	25	KT81	£1·75	PCL86	45	TDD4	80	UY85	40
EAF42	55	EF85	35	KT81(7C5)	£1·13	PD500	£1·30	U10	75	VMP4G	85
EB91	20	EF86	30	KT88	£2·25	PENA4	£1·00	U14	75	VP4B	£1·25
EBC33	50	EF89	28	KTW61	£1·75	PENB4	£1·00	U19	£3·00	VR105/30	38
EBC41	55	EF91	33	KTZ41	50	PEN45	75	U25	80	VR150/30	35
EBC90	35	EF92	35	ML4	88	PEN46	40	U26	80	VU111	75
EBF80	40	EF98	75	ML6	40	PL36	55	U78	35	VU120	£1·00
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EBL1	£1·00	EL32	50	MX40	63	PL83	45	U301	63	Y63	£1·25
EBL21	60	EL33	£1·75			PL84	40			Z759ON	£3·50

Transistors

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1S113	25	2N2369A	15	ACY20	20	BZY88	15	OA70	10	OC45	12
1S202	23	2N2444	£1·91	ACY39	50	CRS1-40	47	OA71	10	OC57	60
2G302	22	2N2646	45	AD140	50	DD003	15	OA81	08	OC58	60
2G371	22	2N2904	20	AD149	50	GET102	30	OA85	12	OC59	65
2N404	20	2N2926	10	AD161	37	GET882	25	OA91	07	OC71	12
2N697	15	2N3055	75	AF115	25	GJ7M	37	OA211	30	OC72	20
2N706	10	2N3702	10	AF117	25	KS100A	20	OAZ201	50	OC81	20
2N1132	25	2N3819	35	ASY26	25	MJE520	37	OAZ207	47	OC81D	20
2N1305	22	AAZ12	30	BC107	10	MJE2955	£1·37	OAZ210	32	OC82	25
2N2147	75	AC126	20	BC108	10	MJE3055	87	OAZ222	45	OC82D	20
2N2160	60	AC127	25	BC109	10	NKT212	27	OAZ224	45	OC84	25
2N2218	20			EC169C	15	NKT214	15	OAZ241	22	OC170	25
				BF898	28	NKT223	33	OAZ242	23	OC171	30
				BFY50	22	NKT251	24	OAZ246	23	OC200	40
				BFY51	20			OC35	50	OCP71	97

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7402	20	7413	30	7433	70	7476	45	74110	80	74174	£2·00
7403	20	7416	30	7437	65	7480	80	74111	£1·45	74175	£1·35
7404	20	7417	30	7438	65	7482	87	74118	£1·00	74176	£1·60
7405	20	7420	20	7440	20	7483	£1·00	74119	£1·90	74190	£1·95
7406	30	7422	48	7441AN	75	7484	90	74121	60	74191	£1·95
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7410	20	7428	50	7453	20	7492	75	74145	£1·50	74195	£1·85
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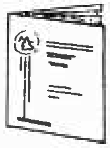

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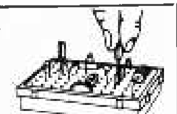

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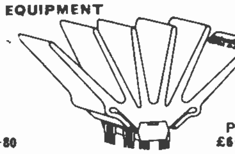

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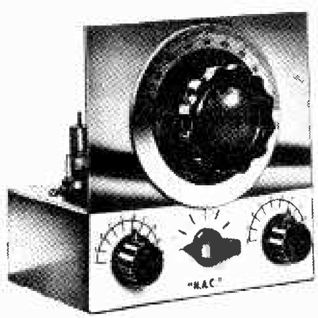

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TAKE 20

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The unijunction transistor bears little resemblance to the conventional transistor; it doesn't amplify, has only limited use and doesn't even have a collector. The connections are to an emitter, base 1 and base 2. In fact the best thing that the unijunction is good for is as a relaxation oscillator, as in Fig. 1.

Operation

When a voltage is applied to the circuit, the capacitor C1 starts to charge up through R1 and VR1. Initially the emitter of Tr1 will be at negative potential but as the capacitor charges, the voltage at this point rises. When it reaches a certain point, b_1 and b_2 are virtually short circuited and current will pass through R2, R3 and Tr1. At the same time C1 will be discharged through R3 and the device will become open circuit again. The same process will start all over again so that a series of pulses appears across R3 via C2. Since the output will be a series of pulses whose rise and fall times are very rapid, only a low value capacitor is necessary despite the low value of R3. The output will be in the form of a positive-going pulse; if a negative-going pulse is required this capacitor should be connected to b_2. A sawtooth waveform is available from the emitter but it should only be connected to a high impedance load otherwise the operation of the relaxation oscillator will be affected.

The frequency of the pulses depends on the relationship of the resistance made up from VR1 and R1 and the capacitor C1. Resistor R1 limits the current through the emitter so that it cannot be connected directly to the positive line; this would cause damage to the device.

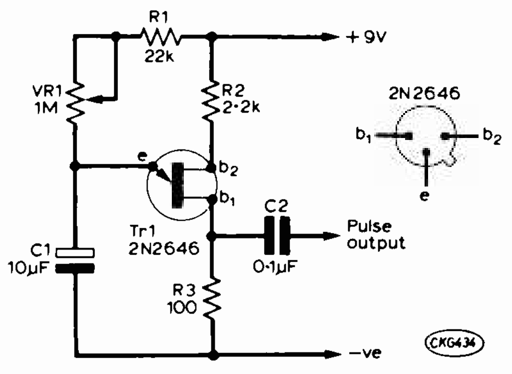

Fig. 1: Circuit and suggested valves for the pulse generator.

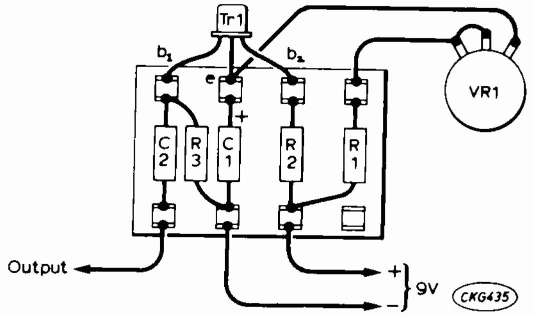

Fig. 2: Practical layout of components on a piece of tagboard.

Experimenting

There is room for experiment here; C1 can be altered in value from 500µF down to 0·01µF. The high value will produce pulses with very long intervals; it is difficult to say how long as the natural leakage through the electrolytic will play a major role. If a low leakage device is used the time interval can be a minute or more. Using the low value capacitors the pulses could extend to ultrasonic frequencies.

★ components list

R1	22kΩ ¼W, 5 per cent	1p
R2	2·2kΩ ,,	1p
R3	100Ω ,,	1p
VR1	1MΩ linear pot	12p
C1	10µF 12V	5p
C2	0·1µF mylar, etc.	4p
Tr1	2N2646	40p
		64p

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

Modifications

The output can be taken to an amplifier to act as a metronome. In fact if only a low level output is required, a high impedance loudspeaker (50Ω to 80Ω) can take the place of R3; in this case of course C2 will not be needed.

A suggested layout is shown in Fig. 2 making use of a small piece of tag board; this is far from critical and almost any layout may be used. ■

HOTLINES

ON RECENT DEVELOPMENTS

Do you ever have that feeling that you are being watched? Well, maybe you are at that and have been for the past 13,000 years. A theory has been put forward that we are getting intelligent messages from space. To be more precise, from an interstellar "thingy" which is buzzing round the earth—probably in an orbit which is similar to that of the moon. (Good gracious, Holmes).

LONG WAY ROUND

Before you rush out and wave your hanky at the sky, hear what the experts have done about it. It is all tied in with things called long-delayed echoes. These were observed as far back as 1928. A transmitter using 15kW on 9550kHz was radiating its Morse signal which in turn was being received by a number of receiving stations. A Morse signal was being sent and received almost instantaneously. Now a signal can go two ways—direct to the receiver by the shortest route and also in the opposite direction. This latter signal can quite easily travel right round the world before it is received by our receiver. Thus two signals are heard; the direct one, and the one which goes the "long" way round. The latter takes about one seventh of a second and is heard as an "echo" of the direct signal which, because it travels direct (therefore less distance) arrives almost instantaneously i.e., with negligible delay.

So far so good. But imagine the effect on the minds of the listeners when other echoes were heard—not delayed by one seventh of a second but at various intervals varying from about three seconds to 15 seconds! These long-delayed echoes were also noticed independently at other times, on other dates, by different receiving stations listening to a different transmitter and on a different frequency.

Then, someone plotted a graph of one of these echo sequences and another piece of the intrigueing jigsaw came to light. The plotted points bore a striking likeness to the constellation Bootis. Other echo sequences were plotted and produced patterns which were clearly identifiable with other constellations.

The hypothesis has been put that the long-delayed echoes are being returned to Earth from a space probe; a probe which arrived from the Bootis constellation 13,000 years ago. Moreover, the probe was sent to search for evidence of intelligent life in the form of radio transmissions.

People who are in doubt about the validity of all this should bear in mind that all the evidence so far corroborates this hypothesis. So closely, in fact, that EMI engineers are to set up a high-power transmitter and high gain antenna (probably around 144MHz) in order to put the hypothesis to the test. Are they just being starry-eyed? I do not think so.

ERNIE

Apart from driving the fastest milk cart in the west, Ernie has achieved fame in other ways. For example, he painstakingly avoids selecting *your* premium bond number every month without a single complaint or grumble. To date, his selections have paid happy punters prizes amounting to some £350 million—none of which has yet reached your scribe!

So it is with ageing joy and renewed hope that I report a new Ernie who will produce the monthly list of prize-winners in under three hours. The old Ernie used to take ten days to complete the same task.

Before we non-winners get too elated, let us examine what we are up against. Just what (or who) is Ernie and how does he choose winners?

First, Ernie comes from Ernie Harrison, Managing Director of Racal, whose idea it was. Ernie himself (the number picker) has been described as the most advanced electronic system in the world for generating numbers in a completely random fashion. How does he/it go about the task?

The first job is to monitor the noise level of a pair of zener diodes (actually, a pair for each digit). Each "pair" noise is amplified and then compared with a reference voltage. Because of the nature of noise there are peaks, and each time one of these exceeds the set reference level it is counted and used in the production of a digit.

Once a complete digit is generated it is safely entrusted to the memory of a computer. Here, it is checked to see if it is eligible. If it is, then it will be stored in the computer's memory, if it is not, it will be discarded.

Ernie presses on until the memory or store has 60 numbers in its care. These are then "written" onto magnetic tape and this is then "played" to another computer for checking and finally linking the lucky numbers to the bondholders' names and addresses.

I am already making the most careful measurement of the noise generated by a pair of zener diodes—well, you never know.

TRANSISTORISED TED?

How about an electronic government, a big computer tucked away beneath Parliament in a Guy Fawkes-proof vault? Maybe not yet, but in America the computer has managed to secure itself a small governmental foothold.

The House of Representatives is to vote by computer. Problem has been the 435-name list of members and the time wasted in correcting attendance errors. Other little hitches like finding a vote recorded from a member who wasn't even there were also proving annoying. The mind boggles.

The new system means that each member has a small plastic "card". He can use this card to vote at any one of some 50 stations located at various points about the House. Behind the Speaker's seat is a score-board which gives the latest updated score on how the voting is going. Electronic voting is reckoned to save at least 50 per cent of the time previously taken for such a task. The computer will also give written records of votes simultaneously plus an instant breakdown of these into States or Parties as required.

Look out members of Parliament—you might be replaced by a pair of zener diodes one day—they're cheaper, smaller and generate less noise!

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H30	20	1 Watt Zener Diodes. Mixed Voltages 6.8 – 43V.	50p
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H39	10	Integrated Circuits. 6 Gates BMC 962, 4 Flip Flops BMC 945	50p
H40	20	BFY50/2, 2N696, 2N1613 NPN Silicon uncoded TO-5	50p
H41	2	Sil Power transistors comp pair BD131/132	50p

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B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
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B86	100	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
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H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
H16	15	Experimenters' Pak of Integrated Circuits. Data supplied	50p
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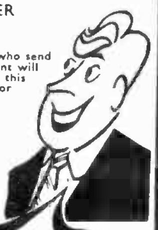

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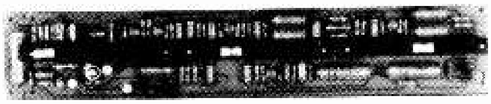

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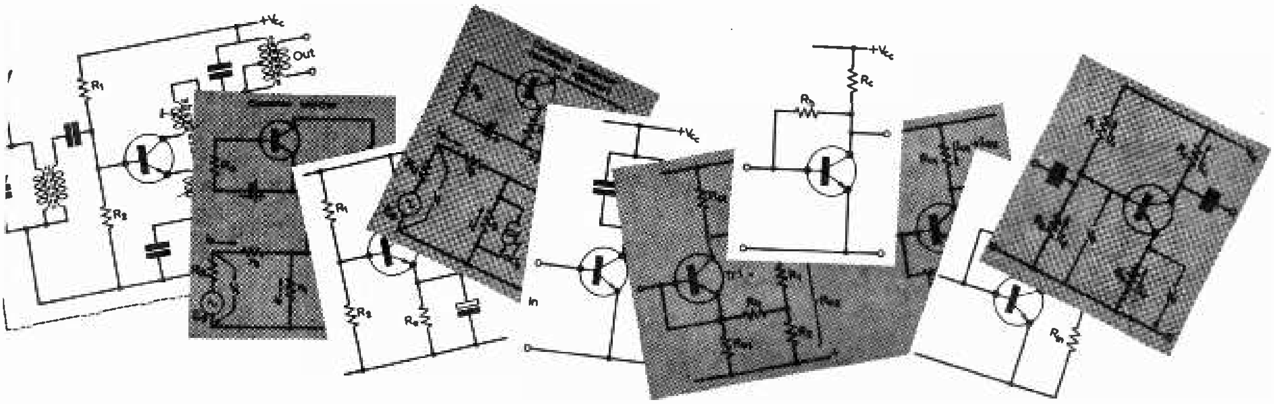


TRANSISTOR CIRCUITRY for beginners

PART 16

H.W. HELLYER & MICHAEL HOLLIER

Practicalities

A BC109 is chosen to give an open-loop gain of 260, with an input of about 30mV at 1kHz. We shall aim to keep this level constant for further tests. Connecting the two resistors of Fig. 76 to the input, we have the virtual earth type of circuitry. This has been discussed at some length in previous articles. It can now be simpified to the triangle of Fig. 77,

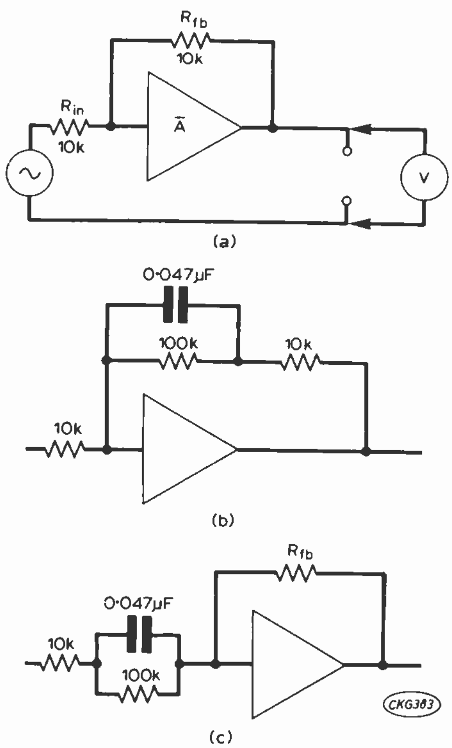


Fig. 77: (a) Simplified representation, with the symbols denoting an inverting amplifier. (b) a frequency-dependent development, and (c) the bass cut variation, with the frequency-selective portion before the feedback loop.

the input shown conventionally at the blunt end; the output at the sharp end (i.e., the 'arrow' points the way the signal is going). Fig. 77 is a simplified diagram, the letter A within its triangle denoting that it is an amplifier.

Previously you will have noted reference to an 'inverter'. By this, is meant that the input is 180° antiphase to the output. In Fig. 77, we see a bar over the A, denoting an inverter. For the benefit of old-timers like me, this can be regarded as exactly parallel to valve technology: a positive-going waveform at the grid produces a negative-going waveform at the anode.

If previous articles have been followed, it will be noted that the closed loop gain, which is the circuit gain calculated after feedback has been applied, is derived from the formula: $G_c = R_{fb}/R_{in}$.

If we now make R_{in} equal to 10kΩ and R_{fb} also 10kΩ, the closed loop gain is unity, i.e., 10/10. In practice, we shall measure 0·8 rather than 1. If, with R_{in} at 10kΩ and R_{fb} at 100kΩ, giving a theoretical gain of 10, we were again to measure, we should find the answer more like 7·7. Carrying this experiment a little further—and please do not merely take our word for this; try it and see for yourself—we find that with R_{in} at 100kΩ and feedback resistors varying between 10kΩ and 1MΩ, the closed loop gain varies between 0·1, via 0·98 (at 100kΩ) and 5·8. Which only goes to prove that the actual gain is always less than calculated, and, secondly, the lower the circuit impedance, the greater the error.

Practically, therefore, it would seem that our circuit was not the best. But, as it is typical of the majority of commercial designs, we make no apology. It has to be remembered that the tone control circuitry does not have to contribute a lot of gain. We do not normally need a gain at any frequency of more than 'times 10', plus a stage gain of around 4, and so a maximum gain of about 40. Refinements will be added, never fear . . .

Reverting to Fig. 77(a) and making R_{in} 10kΩ, with a similar value for R_{fb}, we obtain a gain of 0·98, and the virtual earth point is at the junction of the two resistors. If we insert a resistor as shown at

Fig. 77(b) we reduce the gain somewhat, 0·96, but let's return to that later, the important point being that we can arrange the gain that we require by choice of R_{in} and R_{fb}.

Here I part with Mike and assert that many modern circuits are resolved and arranged (rather than designed) by what are euphemistically called 'empirical methods'; more cynically described as 'hit or miss'. With the basis of existing circuits and a mass of mathematics that go to support them, the modern designer takes for granted the previous researches, and builds upon them. Exceptions, like John Linsley Hood, who question every fact and do their own research, are as rare as gold nuggets in a leadmine.

All of which digression leads me to Fig. 77(b). Here we have R_{in} at 10kΩ with a similar feedback resistor R_{fb} in series with a 0·047μF capacitor (itself, practically, paralleled by 100kΩ). The impedance of the feedback network can, if you want to be meticulous, be calculated at any point in the frequency range.

This is all very fine, but, in practice, we can say that at very high frequencies the capacitor will be an effective short-circuit. In these circumstances, the circuit becomes effectively R_{in}/R_{fb} having unity gain. Lowering the frequency raises the reactance X_c until it eventually becomes an open-circuit, and, in comparison with the 100kΩ previously mentioned, the gain will be nearly 11. Theory gives us 110/10, practice a little less, hence my question-begging formula. We shall settle for a gain of around 20dB, which is ten times the input voltage.

In the frequency range that C is effective we will have an impedance change in the feedback network giving us a slope of 6dB/octave. At frequencies below where unity gain is produced, the slope will flatten, so that further reduction of frequency does not change the output from unity gain. At frequencies above where the effective R_{fb} is 110kΩ, i.e., for a theoretical gain of x11, the curve again flattens. The transitions from slope to flat are not sudden and our dotted curves show the practical results obtained.

Turnover

Reference has already been made to f_t, and by this we mean the turnover frequency, (in the case of Fig. 75 we have two turnover points, at 3dB positive or negative position on the curve, depending on the way the calculations are carried out, as should become apparent).

The f_t points can be calculated from the formula $f_t = \frac{1}{2\pi CR}$ where the frequency is in hertz; the

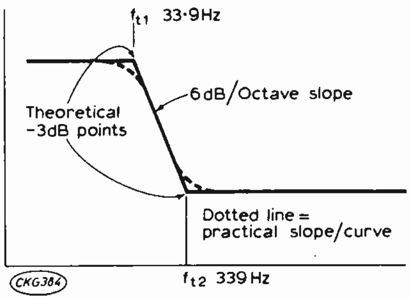


Fig. 78: The bass lift curve in theory (solid line) and in practice (dotted line).

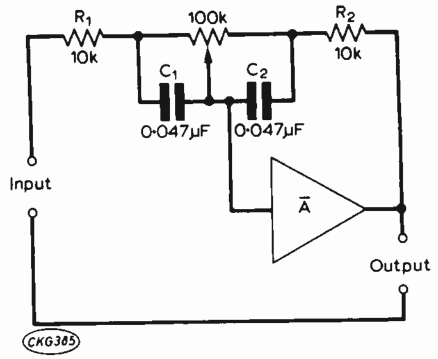


Fig. 79: A combined bass lift and cut circuit.

constant 2π can be taken as 6·28, C is in farads and R in ohms. Taking the component values of Fig. 77(b), we obtain a lower frequency turnover point of 33·9Hz while the upper frequency turnover point works out to 339Hz.

In practice, of course, the points are not definite. The plotted curve, as can be shown later, follows rather the dotted than the hard line of Fig. 78. Plotting the curve obtained from a 'hook-up' replica of Fig. 76, we get the actual curve of Fig. 78, from a generator with a 600Ω source impedance, and reading across the 'open' output with a high impedance valve-voltmeter. (Amendment, please: our habit these days is to use the battery-powered millivoltmeter so the use of the term 'valve-voltmeter' is mostly a matter of habit—although we certainly continue to use our old faithful instruments where the low value of hum and noise will not prove an embarrassment.)

One of the reasons for the smoothing of a theoretical curve is, of course, that other circuit considerations take effect. In theory, we take the two extremes, when the 0·047μF capacitor is in parallel with the 100kΩ resistor and the 10kΩ resistor is not effective, and when the capacitor is in series with the 10kΩ resistor, the effect of the 100kΩ resistor then being ignored. In practice, of course, it cannot be ignored: its real effect is to modify our 10kΩ to 9kΩ under these circumstances.

Taking the worked theoretical examples:

$$f_t = \frac{1}{2\pi CR} = \frac{10^6}{6{\cdot}28 \times 0{\cdot}047} \times 10\text{k}\Omega \quad \ldots\ldots\ldots\ldots (1)$$

$$\text{and } \frac{10^6}{6{\cdot}28 \times 0{\cdot}047} \times 100\text{k}\Omega \quad \ldots\ldots\ldots\ldots (2)$$

(1) = 339Hz and (2) = 33·9Hz

These figures agree very nearly with our practical measurements, This, from the curve of Fig. 78., gives us our Bass Lift circuit.

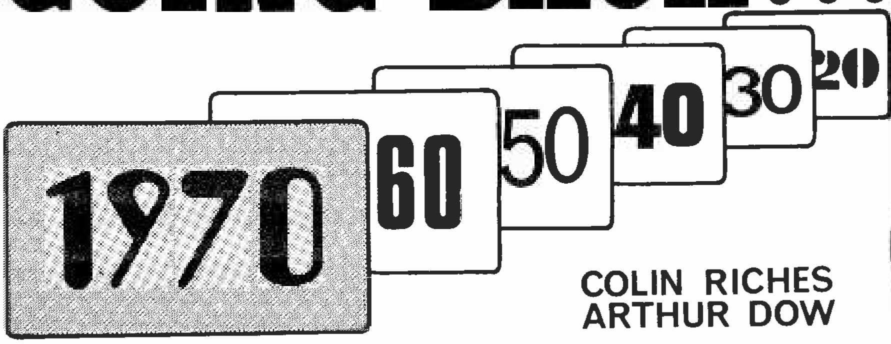
Bass cut

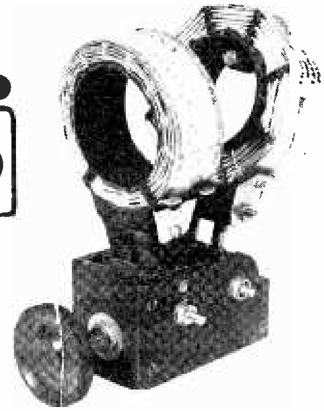
If we now reverse the networks R_{in} and R_{fb} as depicted in Fig. 77(c), we get an inverse of the previous curve. That is to say, we get bass cut instead of bass lift, because the feedback is now resistive, while the input circuit, up to the 'virtual earth point', is frequency-dependent.

Combining both these circuits, as in Fig. 79, we get bass cut and lift according to the position of the slider of the control. With the slider on the left, C1 is effectively short-circuited and we are left with

—continued on page 76

GOING BACK...





COLIN RICHES
ARTHUR DOW

QUITE a large number of letters addressed to us involve queries or seek information on the date or origin of bits and pieces of old wireless equipment or valves. So this month we thought that we would try to give some very broad indications of the form of construction and appearance of domestic wireless sets at the interesting stage of their development. This should enable readers to date a piece of apparatus, if called upon to express an opinion, or if an interesting bit of gear is found in a junkshop.

History

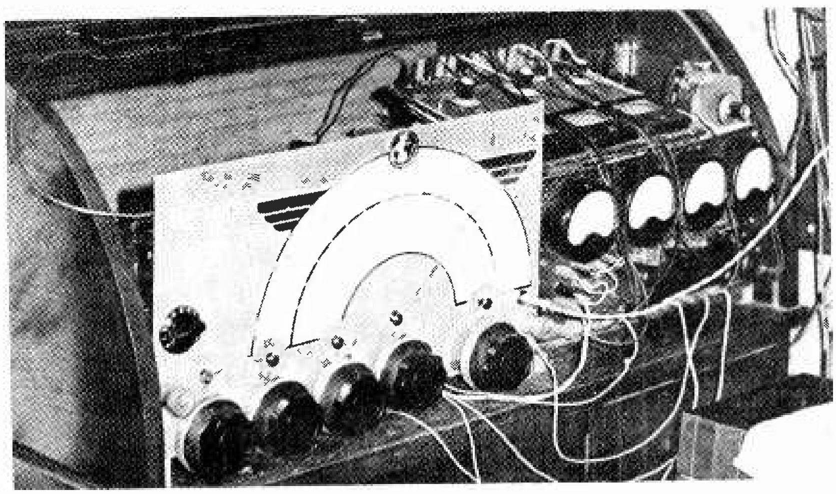
From the turn of the century when Marconi was experimenting with the first tuned spark transmitter, until 1922 when the first official broadcast was made and valve circuits had been developed to the extent that they were no longer regarded as freak, the amount of equipment produced was comparatively small and that which remains is mostly in safe hands.

Once broadcasting had begun the boom in home constructed receivers got under way very rapidly since there were few commercial receivers available at that time. It is this period from about 1922 until the mid-30's that is probably of most interest to those who specialise in collecting vintage wireless equipment and with which we will concern ourselves here.

Components

There were many firms supplying components such as coils and holders, tuning condensers, audio transformers and valves as well as ebonite panels and associated hardware. Basket-wound or wave-wound coils were frequently home-made and plugged into holders which were adjustable from the panel to vary the coupling between the coils. Resistors looked like cartridge fuses and were pushed in to clips. The grid-leak was often changed to suit the 'softness'' of the detector valve or it might be a panel-mounted variable resistance.

'Spaghetti' resistors had the resistance wire wound on a flexible core and looked like a piece of string with end tags. These could be connected directly between terminals of components. Most components such as audio transformers, valveholders and condensers etc. had terminals, usually 6BA, often with a soldering tag. Sets of this period were characterised by the great effort that went into the wiring up.



We don't want to start an argument but we think that Mr. A. Rea of Hull could be our oldest reader, at 80 years plus. Wireless is still his hobby and he is very proud of the John Scott-Taggart ST900, shown above, built many years ago, probably about 1937. He can feed the output of the receiver into a tape recorder or into a valved amplifier using a pair of PX25's which feeds no less than five loudspeakers around the place.

Square sectioned copper wire was common, always arranged with neat corners or angles and straight parallel runs and neat loops under the terminals. The need for short, direct wiring was not appreciated then, and indeed, was probably of little importance where only medium and long waves were concerned and stage gains were very low.

Construction

Such receivers were built on a wooden baseboard to which the components were fixed with woodscrews and an ebonite panel was fixed to one edge of the board. Along the back edge was a row of terminals, mounted on a strip of ebonite, for connecting the set to the accumulator, high tension battery, grid bias battery, aerial and earth and headphones or speakers. Incidentally, the cabinets for these sets were also given a great deal of attention and often were works of art in themselves to ensure that they fitted in with the rest of the furniture. Indeed, the receiver was often built in to an existing piece of furniture. The panels of sets of this period were a mass of knobs and controls with possibly a rheostat for each filament, variable grid-leaks, tuning condensers for each stage, coil coupling controls and reaction controls. Later, when shorter wavelengths were in use, metal panels were employed in order to prevent 'hand capacity' effects which upset the rather critical tuning.

Valves

Valves can be dated fairly accurately from a study of their physical characteristics. At the beginning of the period we are discussing, say 1922-24, the Marconi-Osram R valve was common along with the Mullard ORA and the Cossor P1 all of which were bright emitters with tungsten filaments. Generally they had a metal sleeve base and a pinch on top of the glass envelope, formed during the evacuation process. 1924-25 saw the introduction of the dull emitter valves using oxide-coated filaments such as the MO DE5, Mullard DO6 and the Cossor WR1. These valves still had the pinch on top but the bases were the more familiar moulded type.

Between 1925 and 1927 saw the advent of the now famous Mullard PM range of valves which were dull emitters with filament voltages from two to six volts. The pinch was now concealed in the base of the valve thus eliminating a very vulnerable feature of the older valves.

The first 'mains' type valves emerged in 1927 with the heaters, usually four volts, being run from a mains transformer instead of accumulators or batteries. In the early 30's r.f. type valves appeared with sprayed-on metallic coating for screening purposes and the glass envelopes, especially for the audio amplifier valves, developed a waisted section at the top of the envelopes intended to support the mica discs of the electrode assembly and thus reduce any tendency to microphony.

For those that are really interested in these old radios there is no finer pastime than trying to get one of them to work even if it means using equivalent modern components as replacements for faulty parts. Our CQ column is open to those readers who wish to appeal to other readers for old components if it is felt that only a 100% genuine vintage receiver is acceptable.

TRANSISTOR CIRCUITRY FOR BEGINNERS—

continued from page 72

the effective bass lift circuit of Fig. 77(b). With the slider to its right we get the alternative condition, with C2 short-circuited and the bass cut circuit of Fig. 77(c).

Balance

Take the case of the slider at its middle position. Then, the input and output circuits are identical and balanced. That word, BALANCED is important. It is the basis of the Baxandall tone control circuit—one of the most elegant solutions to an audio problem yet posed, and not to be under-rated. In the full circuit, the impedance change with the slider control moved (a change in frequency-dependence, looked at in the basic way of our approach) is exactly balanced with the movement of the slider in the other

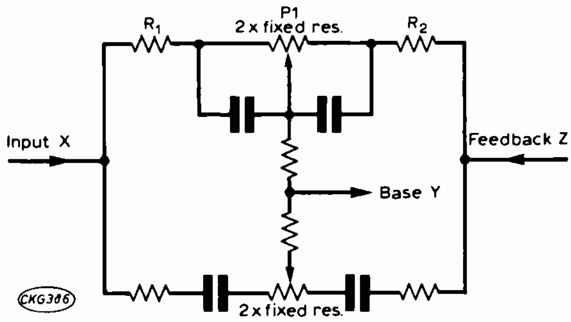


Fig. 80: The eventual network to be inserted in the feedback loop, giving bass and treble lift and cut.

section of the ganged potentiometer. It remains only that the ganged potentiometers themselves shall be within at least 1dB of linearity.

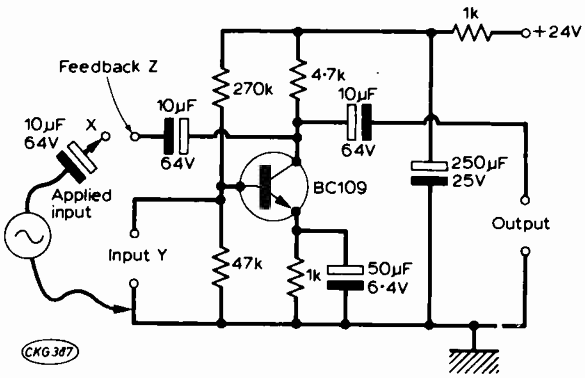


Fig. 81: The basic amplifier circuit over which the feedback is applied.

From the simple experiments we have already carried out, we know that when the input resistance, R_{in} is equal to the feedback resistance R_{fb}, then the theoretical gain is unity. In practice, findings are not far removed from the theoretical. At intermediate positions of the sliders, we shall get variations from the theoretical norm, between maximum bass and maximum cut.

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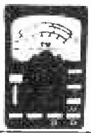

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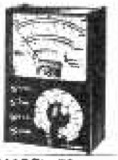

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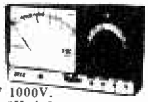

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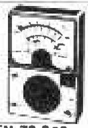

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20k Ω/Volt D.C. 8k Ω/Volt AC. Mirror scale. ·6/3/12/30/120/600 V D.C. 3/30/120/600 V A.C. 50/600μA/60/600 mA. 10/100K/1 Meg/10 Meg Ω −20 to +46db. **£6·97.** P. & P. 12p.

TMK MODEL TW-50K

46 ranges, mirror scale, 50K/Vol. D.C. 5K/Volt A.C. D.C.: Volts ·125, ·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1000V, A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: −20 to +81·5db **£8·50.** P. & P. 17p.

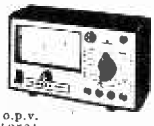
MODEL TE-200

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 +62db. **£3·95.** P. & P. 15p.

MODEL 500

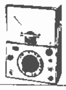
30,000 O.P.V. with overload protection mirror scale 0/ 5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω
£8·87. Post paid.

MODEL K228A



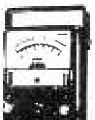
Taut band suspension. Overload protection. Polarity reversing switch. 30,000 o.p.v. 0 / ·5 / 2·5 / 15 / 50 / 250/ 500 / 1000 / 2500V. D.C. 0 / 15 / 50 / 150 / 500 / 1000V. A.C. 0 / 50μA / 5 / 50 / 150 / 500mA / 5A D.C. 0 / 3K / 300K / 3 meg. **£8·95.** Post 20p.

HIOKI MODEL 750X



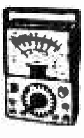
50,000 o.p.v. 43 ranges 0–0·3 to 1,200v D.C. 0–3 to 1,200v A.C. 0–30μA/300mA. 0–3K/30 meg ohms. − 10 to + 17dB. **£8·97.** Post 20p.

HT100B4 MULTI-METER



Features A.C. current ranges. 100,000 o.p.v. Mirror Scale, Overload protection.
0/·5/2·5/10/50/250/500/1000 V D.C.
0/2·5/10/50/250/1000 V. A.C.
0/10/250μA/2·5/25/250 MA/10 Amp. D.C.
10 Amp A.C. 0/20K/200K/2 MEG/20 MEG. − 20 +62db.
£12·50. P. & P. 25p.

HIOKO MODEL 700X

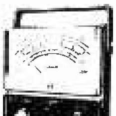


100,000 O.P.V. Overload protection. Mirror scale. ·3/·6/1·2/1·5/3/6/12/30/60/120/300/600/1200V DC
1·5/3/6/12/30/60/150/300/600/1200 V. A.C.
15/30μA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm −20 to +63dB. **£13·50.** P. & P. 20p.

370 WTR MULTI-METER

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

MODEL C-7080 EN

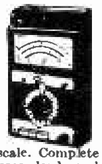


Giant 6" mirror scale. 20,000 o.p.v. 0 / ·25 / 1 / 2·5 / 10 / 50 / 250 / 1000 / 5000V. D.C. 0 / 2·5 / 10 / 50 / 250 / 1000 / 5000V. A.C. 0 / 50μA / 1 / 10 / 100 / 500mA / 10 amp. D.C. 0 / 2K / 200K / 20 meg — 20 to + 50 dB. **£13·95.** Post 35p.

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 100wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE **£5·97.** P. & P. 25p

U4312 MULTIMETER



Extremely sturdy instrument for general electrical use. 667 o.p.v.
0/·3/1·5/7·5/30/60/150/300/600/900 VDC and 75mV.
0/·3/1·5/7·5/30/60/150/300 600/900 VAC.
0/300μA/1·5/6/15/60/150 600MA/1·5/6 AMP. D.C.
0/1·5/6/15/60/150/600MA/1·5/6 AMP. AC.
0/200 Ω/3K/30K Ω.
Accuracy DC 1·5%. AC 1·5%.
Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. **£9·50** plus P. & P. 25p.

Selected TEST EQUIPMENT

FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and ICO. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads.
£7·50. Post 20p.

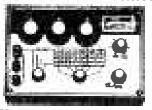
TE-16A TRANSISTORISED SIGNAL GENERATOR

5 ranges 400kHz–30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¼ × 3¼in. Complete with instructions and leads. **£7·97.** Post 25p.

Model S-100TR MULTIMETER/ TRANSISTOR TESTER

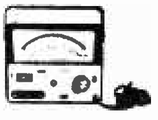
100,000 o.p.v. mirror scale/ overload protection. 0/·12/·6/3/12/30/120/600 V DC. 0/6/30/120/600. V AC. 0/12/600μA/ 12/300mA/12 AMP DC. 0/10 K/1 MEG/100MEG. −20 to +50db. 0·01–·2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. **£13·50.** P/P 25p.

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



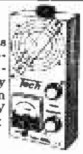
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω 11·1 meg Ω 6 Ranges ±1% L.1 μ H − 111 HENRYS 6 Ranges 2 − % C.10pF ±1110mFd 6 Ranges ± 2%. TURNS RATIO 1 : 1/1000–1 : 1/100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7⅜ × 5 × 2in. **£20.** P. & P. 25p.

MODEL 449A IN CIRCUIT TRANSISTOR TESTER



Checks true A.C. beta in / out. Checks Icbo. Checks diodes in / out. Checks SCR, etc. Beta HI 10 – 500. LO 2 – 50. Icbo 0–5000μA. 220/240 V A.C. operation
£17·50. Post 25p.

MODEL TE.15 GRID DIP METER



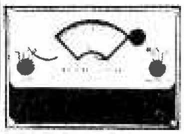
Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440Kc/s–280Mc/s in 6 coils. 500μA Meter. 9V battery operation. Size 180 × 80 × 40mm.
£12·50. Post 20p.

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

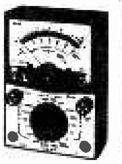
BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Sine 18 × 200,000 Hz; Square 18 × 50,000 Hz



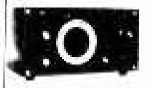
Output max. + 10 dB. (10 K ohms) Operation internal batteries Attractive 2-tone case 7¼" × 5" × 2". Price **£17·50.** Carr. 17½p.

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

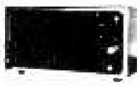


Range 19–220,000Hz Sine Wave 19–100,000 Hz Square Wave. Output Sine or Square wave 10v. P. to P. Size 180 × 90 × 90mm. Operation 220/240v. A.C.
£17·50. Post 37p.

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. ·3-25; Preset triggered sweep 1-3,000usec.; free running 20-200,000Hz in nine ranges. Calibrator pips. 220 × 360 × 430mm. 115-230V. AC operation.
£39·00. Carr. paid.

MODEL AT201 DECADE ATTENUATOR

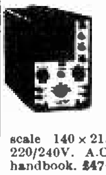


Frequency range 0–200KHz. Attenuator 0–111db, 0·1db step. Impedance 600 ohms. Max. input power 30dbm. Size 180 × 90 × 55mm.
£12·50. Post 37p.

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. **£2·12½**; H.V. **£2·50.**

TO-3 PORTABLE OSCILLOSCOPE



3in. tube, Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5cps–800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. **£47·50.** Carr. 50p.

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 / 750mV / 1·5 / 3 / 7·5 / 15 / 30 / 75 / 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.

RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

5 mc/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. × 4in. C.R.T. Calibrated triggered sweep from ·2 u/sec. to 100 milli-sec. per cm. Free running time base 50 c/s-1 mc/s. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual
£87. Carr. Paid.

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MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. P. & P. Up to £1 12p, £1-£2 17p, £2-£3 22p. Over £3 post free. C.O.D. 25p extra.

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ALL valves guaranteed

6J5GT	25p
6J6	20p
6J7G	35p
6J7M	40p
5K6GT	56p
6K7	32p
6K7G	20p
6K8GT	40p
6K25	70p
6SA7	40p
6SA7GT	32p
6SC7GT	25p
6SG7	35p
6SJ7	37p
6SJ7GT	32p
6SK7	40p
6SL7GT	32p
6SN7GT	32p
6SQ7	39p
6SQ7GT	35p
6V6G	17p
6V6GT	40p
6X4	30p
6X5G	30p
6X5GT	37p
6Y6G	60p
6-30L2	80p
6Z4	36p
7B7	45p
7Y4	60p
9D6	37p
11E2	£2 80
12AT6	30p
12AT7	30p
12AU7	29p
12AV6	38p
12AX7	30p
12BA6	37p
12BE6	40p
12BH7	27p
12C8	32p
12E1	£2·70
12K5	55p
12K7GT	40p
12K8GT	45p
12Q7GT	35p
12SG7	35p
14S7	75p
19AQ5	40p

19G3	£4·25
19G6	£1·50
19H4	£5·00
20P4	£1·00
25L6GT	40p
30C15	70p
30C17	80p
30C18	70p
30F5	80p
30FL1	75p
30FL12	£1·15
30FL13	50p
30FL14	83p
30L15	80p
30L17	80p
30P12	80p
30P19	77p
30PL1	75p
30PL13	92p
30PL14	90p
35L6GT	50p
35W4	35p
35Z4GT	45p
50C5	50p
50CD6G	60p
50EH5	60p
75	40p
76	40p
78	40p
80	50p
723A/B	£7 00
803	£3 25
805	£12·00
807	50p
813	£4·00
832A	£3·00
866A	80p
931A	£4·00
954	40p
955	25p
956	20p
957	30p
991	40p
2051	55p
5933	£1·12
6057	50p
6060	50p
6064	45p

6065	65p
6080	£1·50
6146	£1·75
8020	£2·25
9001	20p
9002	25p
9003	50p
9004	15p
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88J	£9·00
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TR1143 TRANSMITTER RECEIVER 100/126 mcs. Price £12·00 Carriage £1·50.
H.F. TRANSCEIVER TR26 Brand new £15·00 Carriage £1·50.
SCR 522 RECEIVERS—no valves. £2·50 carriage 50p.
RS METERS 0-8 amp. 2¼" (U.S.A.) £2·25 Carriage 15p.
METERS Full List of our very large stock of meters on request.

TEXAS INTEGRATED CIRCUIT SN 76131N Stereo pre-amp £0·65. **VACUUM CONDENSERS** 12, 50, 55pF each 20,000v. £1·50. P. & P. 20p. **4, 5 and 8 bank 25 way uniselectors**, 24V, guaranteed perfect, £3·75; £4·50; £6·87 respectively. **MODULATION TRANSFORMERS** made by **COLLINS**. Freq. resp. 200-5000 CPS; Pri. 6000zCT 3000 TV Sec. 60000z 3000 TV Audio power 20W. £1·25. Post and packing 25p.

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This is your opportunity to train as a television and radio engineer on our full-time Two-Year College Diploma Course specially designed to cover the examinations of the City and Guilds Radio, Television and Electronics Technicians' Certificate. Full theoretical and practical instruction on all types of modern receivers—including the latest colour sets. Minimum entrance requirements are Senior Cambridge or 'O' Level, or equivalent in Mathematics and English.

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Manufacturers of Capacitor Discharge Ignition Systems

PRESENT

THE HIGHWAYMAN

Performance Comparison	"Highwayman"	Standard
Input Voltage	12 volts	12 volts
Output voltage	Higher than 30,000	10-18,000
Operating Limit	4-15 volts	8-15 volts
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CB Resistance Limit	25 ohms	0·2 ohms

COMPLETELY SHOCKPROOF 1 YR'S GUARANTEE £9·90 plus 35p P. & P.

ADVISE VEHICLE MODEL, POLARITY, TACHOMETER. TACHO COMPENSATOR MAY BE REQUIRED £1·60.

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AUTOMATIC EMERGENCY SUPPLY

250v 50Hz—150 watt Inverter. Full kit of parts excluding meter. Circuit as appeared in December P.W. Complete kit—£16·95 + 80p P. & P.

OTHER INVERTERS AVAILABLE IN KIT FORM

150 Watt—£13·50 + 60p P. & P.
300 Watt—£17·90 + 85p P. & P.
75 Watt—£7·80 + 60p P. & P.
40 Watt—£5·20 + 40p P. & P.
25 Watt—£2·60 + 20p P. & P.

All above operate from 12v. battery and give 250v.-50Hz. Output. 24 volt types are also available, alternative outputs or taps can be supplied. Transformers and/or Transistors can be supplied separately.

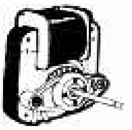
SPECIAL OFFER

12v. Fluorescent lights, suitable for tents, caravans, houses or secondary lighting for factories, hotels, etc. 12 inch—8 watt—£3·40 post paid. 21 inch—13 watt—£4·20 post paid. Large discounts available for quantities.

TEXAN AMPLIFIER

Fibre glass P.C. board—£2·00 + 10p P. & P.
Transformer—£4·00 + 30p P. & P.
Other components including Teak Cabinet—£24·00 + Postage.

ASTRO ELECTRONICS
6, BARNES ROAD, CHESTERFIELD, DERBYSHIRE



MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **65p.** Postage 20p for first one then 10p for each one ordered.

MUSIC ON TAPE

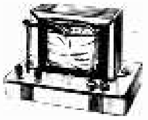
A further buy enables us to offer these at an even lower price—namely **65p** each or 5 for **£2·50.** Send for list of titles. We can't repeat when sold out.

BALANCED ARMATURE UNIT

500 ohm, operates as speaker or microphone, so useful in intercom or similar circuits, **33p** each, **£3·50** doz.

CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system, **38p** each or 10 for **£3·42.**



12 VOLT 1½ AMP POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mF smoothing. Price **£2·00,** plus 20p post & packing.

Heavy Duty Mains Power Pack. Output voltage adjustable from 15-40V in steps — maximum load 250W—that is from 6 amp at 40V to 15amp at 15V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage adjustment is very quick—simply interchange push on leads. Silicon rectifiers and smoothing by 3,000mF. Price **£5·75** plus 65p post.

MAINS RELAY BARGAIN

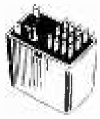
Special this month are some single, double and treble pole change-over relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Unused. Size approx. 1½" × 1". Open construction.

Single pole **25p** each 10 for **£2·25**
Treble pole **35p** each 10 for **£3·15**

DOOR INTERCOM

Know who is calling and speak to them without leaving bed or chair. Outfit comprises microphone with call push button, connectors and master intercom. Simply plugs together. Originally sold at £10. Special snip price **£3·50** plus 20p postage.

TYPE 25 RELAYS



These are miniature relays. Size approx. 1 3/16th in. high × 1⅛ in. wide × ⅞ in. deep, 4 change over silver/gold contacts. Contact rating lamp 100v. D.C. Fitted with a plastic cover. Coil operates approx. 250Mv. D.C. Available with the following coils:
28 ohm for 1·2·5v. 45 ohm for 4·7·5v. 52 ohm for 4·9-6v. 90 ohm for 5·5-11·5v. 130 ohm for 10-15v. 530 ohm for 17-36v. 1250 ohm for 27-44v. 2500 ohm for 31-65v. 5800 ohm for 27-44v. **75p** each, 10 for **£6·75.** Also one with 16,500 ohm coil but this has only 2 heavy duty change-over gold contacts. Price **85p.**

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **20p** each **£1·80** for ten, your assortment.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:
Miniature, 1" long × approximately ⅛" diameter. Will make and break up to ½A up to 300V. Price **13p** each, **£1·20** dozen.
Standard, 2" long × $\frac{3}{16}$" diameter. This will break currents of up to 1A, voltage up to 250V. Price **10p** each, **90p** per dozen.
Flat. Flat type, 2" long, just over $\frac{3}{16}$ thick, flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1A 200V. Price **30p** each **£3** per dozen.
Small ceramic magnets to operate these reed switches **9p** each, **90p** dozen.
Dry Reed Relays. Solenoids on moulded bobbins within magnetic shields—printed circuit, or panel mounting.

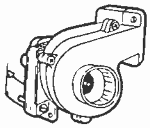
Ref.	*Coil Resistance*	*Reed Switches*	*Price*
71005	2 K	1 normally open	**25p**
81916	5 K	1 normally open 1 normally closed	**75p**
05003	4 K	1 normally open	**25p**
62040	1500 & 500 ohms	1 normally open	**35p**

Multiple Reed Relay. Ref. 53001. Contains 13 normally open reeds within a solenoid. Operates on 600 mW. Coil resistance 9K ohms. Price **£1·95** each.
Multiple Reed Relay. Ref. 631. 2 normally open 1 normally closed coil resistance 30 ohms. Price **75p.**

MULLARD AUDIO AMPLIFIERS

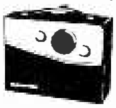
All in module form, each ready built complete with heat sinks and connection tags, data supplied.
Model 1153 500mW power output **65p.**
Model 1172 750mW power output **85p.**
Model EP9000 4 watt power output **£1·65.**
EP9001 twin channel or stereo pre amp. **£1·60**
10% discount if 10 or more ordered.

CENTRIFUGAL BLOWER



Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quiet running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½" × 4½" × 4". When mounted by flange, air is blown into the equipment but to suck air out, mount it from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering etc., etc. A real bargain at **£1·85.**

GOOD COMPANION I.C. VERSION



We can now offer these again in I.C. version using Ferranti ZN414 and Mullard AF Module 1172. Cabinet size approx. 11in. wide × 8in. high × 3in. deep. Complete assembly instructions—Excellent tone wood cabinet **£5·75** + 25p post & ins.

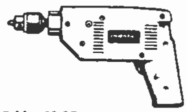
MIGHTY MIDGET

Probably the tiniest possible radio, as described in Practical Wireless, January '73. All electronic parts **£2** post paid.

THIS MONTH'S SNIP

10 AMP DIMMER/CONTROLLER

For the control of lighting of stage or studio or portable equipment in workshops etc. This has socket outlets each controlled by 5 AMP Solid State regulator. Also fitted with master switch fuse and neon indicator and terminating with 6 feet of flex. Overall length 17in. 3½in. x 1½in. deep. £7·50, plus 25p P. & P.



PORTABLE ELECTRIC DRILL

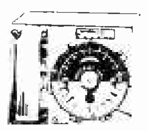
Very superior quality made by a famous Dutch Toolmaker. Model No. ASM 830. 300w – 2 speed 2200/3000. With ⅜" chuck and chuck key, also separate side handle and hammer facility for dealing with concrete, etc. An equivalent British made drill would cost £15·00. **£9·95**—similar model but without the hammer attachment **£7·95.** Have either model on approval for 7 days.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp. sockets in metal box to take standard 13 amp. fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2·25** plus 20p post and ins.

CAPACITOR DISCHARGE CAR IGNITION

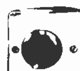
This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version (*Practical Wireless*, June). Price **£5·95** plus 20p post. When ordering please state whether for positive or negative systems. De-luxe model including printed circuit board etc. **£6·95.**



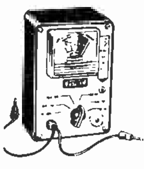
24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. Two completely adjustable time periods per 24 hours, 5A changeover contacts will switch circuit on or off during these periods. **£2·50** post and ins. 25p. Additional time contacts **60p** pair.

THYRISTOR LIGHT DIMMER



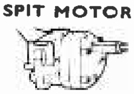
For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price **£2·95,** plus 20p post and insurance. Industrial model 5A **£3.**



BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3⅜" × 6¼" × 2" with leads and prods. Price **£2·25** plus 20p postage.

SPIT MOTOR



200-250v Induction Motor, driving a carter gear box with 1½" of output drive shaft running at 5 revs per minute. Intended for roasting chickens, also suitable for driving models—windmills, coloured disc lighting effect, etc. etc. **£1·85** plus 20p post and insurance.

DRILL CONTROLLER

NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·50.** 13p post and p. Made up model also available. **£2·50.**

MAINS TRANSISTOR POWER PACK

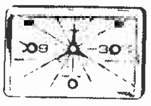
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip only **£1.**

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc.
24" × 18" **£1·40**
13" × 10" **£1·00**

PP3 BATTERY CHARGER

Almost 3 times the life can be obtained from PP3 battery if you re-charge it from the mains—this ready to use charger with instructions only **50p.**



15A ELECTRICAL PROGRAMMER

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

BAKELITE INSTRUMENT CASE

Size approx. 6¼" × 3½" × 2" deep with brass inserts in four corners. This is a very strong case suitable to house instruments and special rigs, etc. Price **45p** each. Fixolin lid **10p** extra.

TELEPHONES

Complete as illustrated. Save your legs, time and temper, simply by putting in some telephones. Ex. G.P.O. not new — but guaranteed in good condition and serviceable. Supplied with diagram and instructions showing how to connect. Price **£1** each + 50p post or 2 for **£2·50** post paid. Also available separately, dials and handsets **50p** each + 20p post

RADIO ALARM CLOCK, LAMP DIMMER, INTERCOM-AMPLIFIER, LIGHT POWERED RADIO, BABY ALARM, TWO TONE DOOR BELL, TAPE TUNER, WATER LEVEL DETECTOR. To receive kits for these and other projects featured in this issue send S.A.E. for PW Kits List.

ROCKER SWITCH

13 amp self-fixing into an oblong hole. Size approximately 1" × ⅜" **8p** each, 10 for **72p.**

SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in × ⅜in rated 250V lamp. **6p** each. 10 for **54p.** 100 for **£5·10.** 500 for **£24.** Ditto as above but for printed circuit **5p** each. 10 for **45p.** 100 for **£4·25.**
Sub Miniature Slide Switch. DPDT 19mm (¾in approx.) between fixing centres. **18p** each or 10 for **£1·08.** SP Change over spring return 250v 1 amp. **10p.**

SPRING COIL LEADS

as fitted to telephones, 4 core **15p** each, 10 for **£1·35.** 3 core **10p** each 10 for **90p.**

V.A.T. Please add V.A.T. 10% on total order after April 1st.

TERMS: 10% discount if ten of an item ordered, send postage where quoted—other terms, post free if order for these over **£6·00** otherwise add **20p.**

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.) 7 Park Street, Croydon CRO 1YD

Callers to: 102/3 Tamworth Road, CROYDON

BSR LATEST SUPERSLIM
STEREO & MONO

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 18½ × 11½in. Above motor board 3¼in. Below motor board 2½in.

with STEREO and MONO XTAL **£8·25** Post 25p

ANOTHER RCS BARGAIN!
4 TRANSISTOR MONO AMPLIFIER

Powerful 3 watts output, 15 ohm. AC mains operated with transformer. 3-Controls, volume, treble, bass and On/Off switch with knobs. Ready made on printed circuit board. Fused inputs and outputs. Famous make,

Size 8" wide × 4" deep × 3" high.
Price £5·95 post 25p.

Suitable 7" × 4" Speaker £1·00.

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made, tested. Printed circuit. 3 watts output. Tone and volume controls. Complete with output valve and rectifier, two knobs, and high performance loudspeaker. Double wound fully isolated mains transformer. A.C. mains 200/250V. Response 50-12,000 cps. Sensitivity 300mV. **£4** Post 25p

BSR SINGLE PLAYER

Heavy duty 4-speed motor with separate pick-up arm fitted LP 78 stereo compatible cartridge. **£5·50** Post 25p

HI-FI PICK UP CARTRIDGES.
Stereo/Mono 9TA £2 50; GP94 £2·50; GP93 £2.
Sapphire Mono GP91 £1·50; Powerpoint LP/78 60p.

GARRARD DECCA DISCO DECK

Single play Stereo/Mono Deram transcription head and arm. Four speeds. 10½in. turntable. Anti-rumble filter. Bias compensation. Laboratory motor.

SPECIAL PRICE **£18·50** Post 25p

METAL PLINTH AND PLASTIC COVER

Cut out for most Garrard or B.S.R. Most will play with cover in position. 12½ × 14½ × 7½in. Covered in black leatherette. **£4·95** Post 35p

ALSO AVAILABLE IN SOLID NATURAL MAHOGANY WAX POLISHED FINISH—AT SAME PRICE

SPECIAL OFFER!
SMITH'S CLOCKWORK 15 AMP TIME SWITCH

Single pole two-way Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights etc. Variable knob Turn on or off at full or intermediate settings. Two types available 0 to 60 minutes or 0 to 6 hours. Fully insulated. Makers last list price £4·50. Brand new and fully guaranteed.

OUR PRICE **£1·50** P. & P. 15p or £3 pair. (STATE TYPE A OR B WHEN ORDERING.)

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides. 6 × 4in. 45p; 8 × 6in. 53p; 10 × 7in. 65p; 12 × 8in. 85p; 14 × 9in. 90p; 16 × 6in. 90p; 12 × 3in. 50p; 16 × 10in. £1.

ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 9p; 8 × 6in. 15p; 14 × 3in. 16p; 10 × 7in. 19p; 12 × 5in. 20p; 12 × 8in. 28p; 16 × 6in. 28p; 14 × 9in. 34p; 12 × 12in. 40p; 16 × 10in. 50p.

RADIO BOOKS (Post 3p)

Handbook of transistor equivalents	40p
Handbook of Simple Transistor Circuits	35p
Master colour code folder	15p
Boys' book of crystal sets and simple circuits	18p
Universal gram motor speed indicator	8p
High fidelity loudspeaker enclosures	40p
Practical Stereo handbook	30p
Sound and Loudspeaker Manual	50p
Coil design and construction manual	30p
Radio, TV and electronics data book	25p
Handbook of tested Transistor Circuits	40p
38 Practical Tested Diode Circuits	35p
Hi Fi, PA and Disco Amplifier Design	75p
Practical Transistor Novelty Circuits	40p
Resistor colour code disc calculator	10p
Engineers' and Machinists' reference tables	20p
TV fault finding	50p

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit. Bridge Rectifiers and Double Wound Mains Transformer. Input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. Size 3½ × 1½ × 1¼in. **£2·20** Post 15p

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

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12v. or H.T. line 200-300v. D.C. operation. Size 1½" × 1½" × ½". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **99p**

MAINS TRANSFORMERS
ALL POST 25p each

Eagle MT12 12-0-12v 90p
250-0-250 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a. £2·50
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300-0-300 v. 120 mA., 6·3 v. 4 a. C.T.; 6·3 v. 2 a. £3·25
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GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp., 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £2·25
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5 amp., 5, 8 and 13V .... £1·20
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Primary 0-110-240v. Secondary 0-240v. 3 amps. 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make. (Value £19) OUR PRICE **£10** Carr. 50p
Can be used as 800 watt auto transformers 240-110V.

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	50+50/350V	35p
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8/450V	14p	1000/25V	35p	32+32/250V	18p
16/450V	15p	1000/50V	47p	32+32/450V	33p
32/450V	20p	8+8/450V	18p	350+50/325V	50p
25/25V	10p	8+16/450V	20p	32+32+32/350V	43p
50/50V	10p	16+16/450V	25p	100+50+50/350V	48p
100/25V	10p	32+32/350V	25p		

LOW VOLTAGE ELECTROLYTICS.
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500mF 12V 15p; 25V 20p; 50V 30p.
1000mF 12V 17p; 25V 35p; 50V 47p; 100V 70p.
2000mF 6V 25p; 25V 42p; 50V 57p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.

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SILVER MICA. Close tolerance 1%. 2·2-500pF 8p; 560-2,200pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p each.
TWIN GANG. "0-0" 208pF+176pF, 65p; Slow motion drive 365pF+365pF with 25pF+25pF, 50p; 500pF standard 45p; small 3-gang 500pF £1·60.
SHORT WAVE SINGLE. 10pF, 30p; 25pF, 55p; 50pF, 55p.

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

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RESISTORS. ¼ w., ½ w., 1 w., 20%, 1p; 2 w. 5p. 10 Ω to 10M.
HIGH STABILITY. ½ w. 2% 10 ohms to 6 meg., 10p. Ditto 5%, Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS. 5 watt, 10 watt, 15 watt, 10 ohms to 100K, 10p each; 2w 0·5 ohm to 8·2 ohms 10p.
TAPE OSCILLATOR COIL. Valve type, 35p.

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RA2W Ferrite Aerial	72p	Spare Cores	3p
Osc. P50/1AC	33p	Driver Trans. LFDT4	58p
I.F. P50/2CC 470 kc/s	36p	Printed Circuit, PCA1	58p
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P51/1 or P51/2	36p	Weyrad Booklet	10p
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Mullard Ferrite Rod 8 × ⅜in. 20p. 6 × ⅜in. 20p.

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Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P, Transistor 25p

80 Ohm Coax 4p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2.
FRINGE LOW LOSS Ideal 625 and colour. **10p** per yd

1½inch DIAMETER WAVECHANGE SWITCHES, 25p. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way, 25p each. 1 p.1 2-way, or 4 p. 2-way, or 4 p. 3-way, 25p.
TOGGLE SWITCHES, sp. 14p; dp. 22p; dp. dt. 22p. Sub-miniature, sp. 30p; dp. 37p; dp. dt. 45p.

E.M.I. 13½ × 8 in. SPEAKER SALE!

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

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·75** Post 25p

TEAK CABINET 16 × 10 × 9in. Modern Design **£5·50** Post 25p

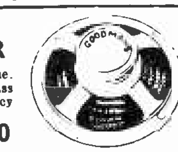
GOODMANS 6½in. HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosure Systems, etc. **£4**
Suitable cabinet 12 × 8 × 6 £4·00.
Suitable Tweeter £2·00.

ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watt, 3 ohm or 15 ohm models. **£1·90** Post 10p
Crossover 95p.

GOODMANS 8 in. WOOFER



8 ohm 12 watt. Deep cone. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps. **£4·50**

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1 25; 6½in. £1·50; 8 × 5in. £1·60; 8in. £1·75; 10 × 6in. £1·90; 10in. £2·00.
SPECIAL OFFER! 80 ohm, 2½ in. 2¾in. 35 ohm, 2in.; 3in; 5in. 25 ohm, 2½in. dia.; 3in. dia; 15 ohm. 3½in. dia.; 5in. /6 × 4in.; 7 × 4in.; 8 × 5in **£1** EACH TYPE
3 ohm, 2½in, 2¾in., 3½in., 5in. dia. (6 × 4in., 8 ohm, £1·50).
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. diameter 4 watt; 10in. diameter 5 watt; 12in. diameter 6 watt, 3 or 8 or 15 ohm models £2·20 each. Post 15p.
SPEAKER COVERING MATERIALS. Samples Large S.A.E.
Horn Tweeters 2-16Kc/s, 8W 8 ohm or 15 ohm £1·95.
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TWO-WAY 3,000 c.p.s. CROSSOVERS 3, 8 or 15 ohm 95p.

FM/VHF TUNING HEART

88 to 108 M/CS British made. 2 Transistors ready aligned—requires 10·7 M/CS IF. Complete with tuning gang. Connections supplied but some technical experience essential.
OUR PRICE **£3·95**

VALVE OUTPUT TRANS. 25p.
MIKE TRANS. mv metal 100-1 £1·25.
5 WATT MULTI RATIO. 3, 8 and 15 ohms, 80p.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt .... £9·50 100 watt .... £12·50

STEREO / MONO HEADPHONES

New Model with new type slider volume controls. Stereo / Mono switch. 8 ohms. £10.
High Quality with tweeters and volume controls. 8 ohm. £7.
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HEADPHONE JUNCTION BOX with switch £1·75.
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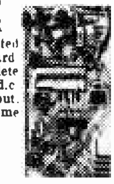
EAR PIECES. Crystal. 25p.
Magnetic. 8 ohms. 18p.
Magnetic. 250 ohms. 23p.
ACOS. 1000 ohms. 53p.

BRITISH MADE STEREO MULTIPLEX DECODER



Brand New. 7 transistors plus integrated circuit. Fibre glass printed circuit board Size 2½ × 6½ × ⅞in. Pre-aligned. Complete with stereo beacon indicator. 12V d.c operation. 400mV output for 100µV input. Full instructions for any FM Tuner. Some technical experience essential. **£6·50** Post 15p

DIPOLE LOFT AERIAL £1·50.
CABLE 4p yard.

COAXIAL PLUG 10p, PANEL SOCKETS 10p, LINE 18p. OUTLET BOXES, SURFACE OR FLUSH 25p.
BALANCED TWIN RIBBON FEEDER 300 ohms, 5p yd.
JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p
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E.M.I. WOOFER AND TWEETER KIT

£5·75 THE PAIR. Post 25p. (Available separately. Woofer £4 25; Tweeter £1 90).

Comprising a fine example of a Woofer 10¾ · 6¼in. with a massive Ceramic Magnet. 44oz. Gauss 13.000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3½in. square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

Impedance Standard	8 ohms
Maximum power	12 watts
Useful Response	35 to 18.000 cps
Bass Resonance	45 cps

SUITABLE ENCLOSURE 20 · 13 · 9in. MODERN DESIGN. TEAK WOOD FINISH. **£9·90** Post 25p

BAKER 12in. MAJOR £10

Post 25p

30-14.500 c.p.s.. 12in. double cone. woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14.000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

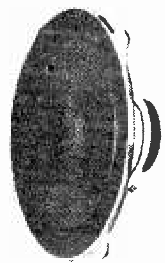
Module kit. 30-17,000 c.p.s. with tweeter. crossover. baffle and instructions. **£12·50** Post 25p

BAKER HI-FI SPEAKERS

HIGH QUALITY — BRITISH MADE

REGENT

12in. 15 watts



An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio. Amplifier. Hi-Fi or Television receiver.

Bass Resonance	45cps
Flux Density	12.000gauss
Useful response	45-13.000cps

3 or 8 or 15 ohm models.

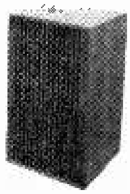
£8 Post 25p

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

Dual cone plasticised roll surround. Large ceramic magnet. 50 16.000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts. 10in. model. 12 watts music power. **£3·75** Post 25p

TEAK VENEER SPEAKER CABINET

Fluted Wood Front



MODEL "A" 20 · 13 · 9in. For 12in. dia. or 10in. speaker. **£9** Post 25p

MODEL "B". 16 · 10 · 9in. For 13 · 8in. or 8in. speaker. **£5** Post 25p

MODEL "C". 16 · 8 · 6in. For 8 · 5in. or 6in. speaker. **£4** Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide. 15p ft.

BAKER "BIG SOUND" SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13.000 cps. Bass Resonance 55 cps.

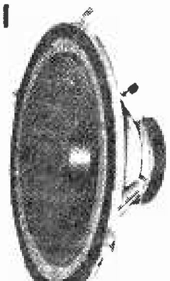
GROUP "25" 12in. 25 watt 3. 8 or 15 ohms. **£8·80** Post 25p

GROUP "35" 12in. 35 watt 3. 8 or 15 ohms. **£9·90** Post 25p

GROUP "50" 15in. 50 watt 8 or 15 ohms **£22** Post 25p

DE-LUXE Mk II

12in 15 watts



Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.

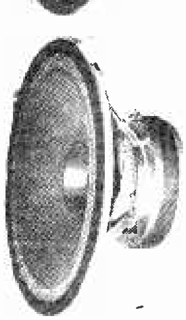
Bass Resonance	30cps
Flux Density	14.000gauss
Useful response	25-16,000cps

8 or 15 ohms models.

£10 Post 25p

SUPERB

12in. 20 watts



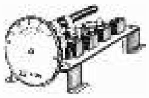
A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.

Bass Resonance	25cps
Flux Density	16.500gauss
Useful response	20-17.000cps

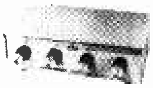
8 or 15 ohms models.

£15 Post 25p

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



BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone. records. tape and tuner with separate controls into single output. 9 volt battery operated. **£3·95**



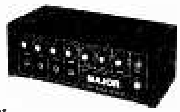
STEREO VERSION OF ABOVE £5.85

BARGAIN FM TUNER. 88-108 Mc/s Six Transistor. 9 volt. Printed circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 · 5 · 4in. **£14·85**

BARGAIN FM TUNER. As above less cabinet. **£9·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built. with volume control 9 volt battery operated. **£4·50**

MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

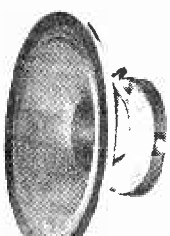


4 inputs speech and music 4-way mixing. Response 10 30,000 cps. Matches loudspeakers 8/15ohm. A.C. 200/250V. Separate Treble and Bass controls Guaranteed. Details S.A.E. **£49** Post Free

CALLERS ONLY: DE-LUXE 100 WATT AMPLIFIER CHASSIS. 7 Valve version. 4 inputs. 10 wide range controls. For Mikes. Discos. Organs. Guitars. etc. 4. 8 and 15 ohm matching. **£55**

AUDITORIUM

12in. 25 watts



A full range reproducer for high power. Electric Guitars. public address. multi-speaker systems. electric organs Ideal for Hi-Fi and Discotheques.

Bass Resonance	35cps
Flux Density	15.000gauss
Useful response	25-16.000cps

8 or 15 ohms models.

£14 Post 25p

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes. and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£2·50** Post 15p

Q MAX CHASSIS CUTTERS

A die, punch and Allen Screw

3/8in. Round	68p	15/16in. Round	98p	Key "B" for above	8 p
7/16in. Round	75p	1in. Round	98p	2in. Round	£2·05
Key "T" for above	5p	1 1/16in. Round	98p	2 3/32in. Round	£2 30
1/2in. Round	83p	1 1/8in. Round	98p	Key "C" for above	12p
9/16in. Round	83p	1 3/16in. Round	£1 05	2 1/2in. Round	£4 10
5/8in. Round	83p	1 7/32in. Round	£1 05	2 3/4in. Round	£5·25
11/16in. Round	88p	1 1/4in. Round	£1 05	3in. Round	£8 10
3/4in. Round	88p	1 5/16in. Round	£1·10	Key "E" for above	18p
13/16in Round	90p	1 3/8in. Round	£1·10	1in. Square with key	£1 93
7/8in. Round	90p	1 1/2in. Round	£1·25		
Key "A" for above	5p	1 5/8in. Round	£1·43		
		1 3/4in. Round	£1 50		

WAFER THIN HEATING ELEMENTS

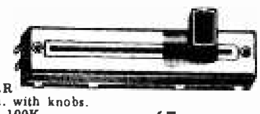
OFFERING 1001 USES for every type of heating and drying applications in the home. garage. greenhouse. factory (available in manufacturing quantities). Approx. size 10½ · 8½ · 1/16in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photocopiers and print drying equipment.

Ideal for home handymen and experimenters. Suitable for Heating Pads. Food Warmers. Convector Heaters. etc. Must be clamped between two sheets of metal or asbestos. etc.. to make efficient clothes dryers. towel rails ideal for airing cupboards. Ideal for anti-frost device for the garage preventing frozen radiators or acting as oil sump heater. Use in the greenhouse for seed raising and plant protection. Invaluable aid for bird houses. incubators. etc.. etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1 50)

ALL POST PAID Discounts for quantity

SLIDER VOLUME CONTROLS



Mono LOG or LINEAR Size 3¼ · ½ · ⅜in. with knobs. 5K. 10K. 25K. 50K. 100K. 250K. 500K. 1 MEG. 2 MEG. **65p** EACH

E.M.I. TAPE MOTORS. 120 volts AC each. 1,200 r.p.m. 4 pole or 2 in series 240 volts AC. Size 3½ · 2½ · 2¼in. (illustrated). Post 15p. **£1**

BALFOUR GRAM. MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 50mA. Spindle ⅜ · 3/20. Size 2½ · 2½ · 1½in. Post 15p **85p**

E.M.I. GRAM. MOTORS. 120V or 240V AC. 2,400 r.p.m. 2-pole 70mA. Spindle ¼ · 3/16in. Size 2½ · 2½ · 2¼in. **£1** Post 15p

AUDITORIUM

15in. 35 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address. Discotheques. Electronic instruments and the home hi-fi.

Bass Resonance	35cps
Flux Density	15.000gauss
Useful response	20-14.000cps

8 or 15 ohms models.

£20 Post 25p

Hi-Fi Enclosure Manual containing 20 plans designs. crossover data and cubic tables. 12p Post Free.

ALL PRICES INCLUDE VAT

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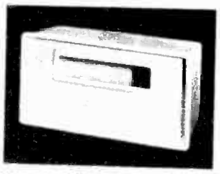
P/P 10p. Price list S.A.E. (Saturday callers welcome)
ALL PRICES INCLUDE VAT

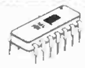
£19·50 ELECTRONIC DIGITAL CLOCK

(For complete kit of parts including case.)



This 4 digit 24 hour clock is available to readers at this special price for 1 month only. Parts would normally cost over £25. Kit of parts includes twelve IC's, indicators, and a smart white plastic case.

74 Series TTL



	1	25		1	25		1	25		1	25
SN7400	16p	15p	SN7423	55p	50p	SN7450	16p	15p	SN7489	6·05p	5·85p
SN7401	16p	15p	SN7425	55p	50p	SN7451	16p	15p	SN7490	74p	72p
SN7402	16p	15p	SN7427	49p	46p	SN7453	16p	15p	SN7491	1·10p	1·04p
SN7403	16p	15p	SN7428	77p	72p	SN7454	16p	15p	SN7492	74p	72p
SN7404	16p	15p	SN7430	16p	15p	SN7460	16p	15p	SN7493	74p	72p
SN7405	16p	15p	SN7432	49p	46p	SN7470	33p	29p	SN7494	85p	72p
SN7406	38p	35p	SN7433	94p	82p	SN7472	33p	29p	SN7495	85p	72p
SN7407	38p	35p	SN7437	72p	69p	SN7473	41p	39p	SN7496	95p	92p
SN7408	20p	18p	SN7438	72p	69p	SN7474	41p	38p	SN74100	1·80p	1·75p
SN7409	20p	18p	SN7440	16p	15p	SN7475	50p	47p	SN74104	1·09p	1·08p
SN7410	17p	15p	SN7441	74p	70p	SN7476	44p	43p	SN74105	1·09p	1·06p
SN7411	27p	25p	SN7442	74p	70p	SN7480	73p	70p	SN74107	44p	42p
SN7412	38p	35p	SN7443	1·43p	1·37p	SN7481	1·32p	1·26p	SN74110	61p	59p
SN7413	32p	29p	SN7444	1·43p	1·37p	SN7482	97p	95p	SN74111	1·37p	1·27p
SN7416	47p	43p	SN7445	2·00p	1·92p	SN7403	1·20p	1·15p	SN74118	1·10p	1·05p
SN7417	47p	43p	SN7446	1·07p	1·02p	SN7484	1·10p	1·05p	SN74119	1·47p	1·37p
SN7420	16p	15p	SN7447	1·10p	1·03p	SN7485	3·96p	3·85p	SN74121	44p	41p
SN7422	55p	50p	SN7448	1·10p	1·03p	SN7486	36p	35p	SN74122	1·54p	1·43p

* Devices may be mixed to qualify for Price Breaks
* 100 Plus less 10% off 25 plus break

Linear Integrated Circuits

301	DIL	50p	723c	DIL	99p
301	TO99	55p	723c	TO99	95p
301	8 PIN DIL	46p	741c	8 PIN DIL	38p
301A	DIL	69p	741c	14 PIN DIL	39p
301A	TO99	69p	741c	TO99	41p
301A	8 PIN DIL	66p	747c	DIL	46p
307	DIL	69p	748c	DIL	39p
307	TO99	69p	748c	TO99	41p
307	8 PIN DIL	66p	1437	DIL	1·27p
308	TO99	6·45p	1458	TO99	1·27p
308A	TO99	6·40p	3046	DIL	84p
709c	DIL	35p	7503	DIL	1·27p
709c	TO99	31p			

Transistors

AC107	16p	BC138	36p	BF260	29p	OC44	14p
AC126	14p	BC142	33p	BF329	18p	OC45	14p
AC127	13p	BC143	33p	BF330	18p	OC70	23p
AC128	13p	BC144	30p	BF390	37p	OC71	14p
AC142K	22p	BC145	26p	BFX84	28p	OC72	14p
AC141K	20p	BC147	9p	BFX85	35p	OC81	14p
AC176	15p	BC148	9p	BFX86	22p	OC83	22p
AC187	13p	BC149	9p	BFX87	28p	OC84	28p
AC187K	20p	BC153	16p	BFX88	26p	TIP29A	53p
AC188	13p	BC154	17p	BFY50	21p	TIP30A	64p
AC188K	20p	BC157	13p	BFY51	17p	TIP31A	64p
ACY17	24p	BC158	12p	BFY52	17p	TIP32A	73p
ACY18	21p	BC159	14p	BFY64	39p	TIP33	£1·05
ACY19	25p	BC167	13p	BFY90	72p	TIP34A	
ACY20	22p	BC168	11p	BSX20	19p		£1·54
ACY21	23p	BC169	11p	C407	22p	TIP35A	
ACY22	18p	BC177	15p	C426	33p		£2·53
ACY39	68p	BC179	15p	C428	31p	TIP36A	
AD140	40p	BC182L	9p	C450	17p		£3·19
AD142	44p	BC183L	9p	MP8111	35p	TIP41A	79p
AD143	39p	BC184L	9p	MP8112	42p	TIP42A	91p
AD149	38p	BC186	33p	MP8113	35p	2N706	13p
AD150	60p	BC212L	11p	MP8121	33p	2N930	23p
AD161	29p	BC213L	11p	MP8122	44p	2N1131	22p
AD162	29p	BC214L	11p	MP8123	50p	2N1132	28p
AD M/P	50p	BC258	9p	NKT211	28p	2N1613	22p
AF114	14p	BC259	9p	NKT212	28p	2N1711	26p
AF115	14p	BC267	14p	NKT214	25p	2N2904	40p
AF116	14p	BC268	15p	NKT217	55p	2N2904A	
AF117	14p	BC300	40p	NKT261	23p		44p
AF118	92p	BC301	32p	NKT271	20p	2N2905	46p
AF124	27p	BC302	30p	NKT274	20p	2N2924	18p
AF139	39p	BC303	50p	NKT275	25p	2N2926	10p
AF239	41p	BC304	40p	NKT403	71p	2N3053	26p
AL100	77p	BCY70	17p	NKT405	83p	2N3054	55p
AL102	66p	BCY71	37p	NKY603F		2N3055	52p
AL103	55p	BCY72	17p		66p	2N3405	44p
ASY26	31p	BD123	66p	NKT613G		2N3663	57p
ASY27	40p	BD130	50p		33p	2N3702	9p
AU103	99p	BD131	68p	NKT674	26p	2N3703	9p
AU110	£1·10	BD132	90p	NKT677G		2N3704	9p
AU111	77p	BD135	42p		24p	2N3705	9p
BC107	9p	BD136	50p	NKT713	32p	2N3706	9p
BC108	9p	BD141	£1·87	NKT773	27p	2N3707	9p
BC109	9p	BD142	50p	OC19	55p	2N3708	9p
BC113	15½p	BF159	33p	OC20	55p	2N3709	9p
BC116	16p	BF173	29p	OC23	33p	2N3710	9p
BC125	16p	BF177	28p	OC25	28p	2N3711	9p
BC126	25p	BF178	29p	OC28	33p	2N3794	17p
BC132	16p	BF179	35p	OC29	33p	2N3819	28p
BC134	16p	BF194	15p	OC35	38p	40361	50p
BC135	16p	BF195	17p	OC36	38p	40362	50p
BC137	16p	BF244	27p	OC41	14p	40636	50p

Diodes & Rectifiers

IN914	8p
IN916	8p
IN4148	8p
IS44	10p
IN4007	22p
IS113	17p
IS120	17p
IS121	15p
IS130	9p
IS131	11p
IS132	13p
IS920	8p
IS922	9p
IS923	13p
IS940	6p
AA119	11p
AA129	11p
AAZ13	11p
AAZ15	14p
AAZ17	14p
BA100	16p
BA102	25p
BA115	8p
BA144	14p
BA145	22p
BA154	14p
BAX13	14p
BAX16	14p
BAY18	19p
BAY31	9p
BY100	19p
BY126	16p
BY127	19p
BYX10	24p
OA5	19p
OA9	11p
OA10	24p
OA47	9p
OA70	8p
OA73	11p
OA79	8p
OA81	9p
OA85	11p
OA90	8p
OA91	8p
OA95	8p
OA200	11p

Electrolytic Capacitors

4 VOLT

47μF	6½p
100μF	6½p
220μF	6½p
330μF	6½p
1000μF	13p
4700μF	29p

6 3 VOLT

33μF	6½p
68μF	6½p
150μF	6½p
470μF	11p
680μF	13p
1500μF	18p
2200μF	18p
3300μF	26p

10 VOLT

22μF	6½p
47μF	6½p
100μF	6½p
220μF	8p
330μF	10p
470μF	10p
1000μF	11p
1500μF	20p
2200μF	24p

16 VOLT

15μF	6½p
33μF	6½p
68μF	6½p
150μF	8p
220μF	9p
680μF	17p
1000μF	17p
1500μF	25p
2000μF	43p

25 VOLT

10μF	6½p
22μF	6½p
47μF	6½p
100μF	8p
150μF	8p
220μF	10p
470μF	13p
680μF	20p
1000μF	22p
2200μF	39p
5000μF	68p

40 VOLT

6·8μF	6½p
15μF	6½p
33μF	6½p

40 VOLT

47μF	6½p
100μF	9p
150μF	10p
220μF	11p
470μF	19p
680μF	25p
1000μF	25p
2200μF	44p

63 VOLT

1μF	6½p
2·2μF	6½p
4·7μF	6½p
6·8μF	6½p
10μF	6½p
22μF	6½p
68μF	10p
100μF	11p
150μF	13p
220μF	19p
330μF	22p
470μF	26p
1000μF	44p

MULLARD POLYESTER'S

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·22μF, 3½p. 0·33μF, 0·047μF, 0·068μF, 4p. 0·1μF, 4½p 0·15μF, 0·22μF, 5½p. 0·33μF, 7p. 0·47μF, 9½p. 0·68μF, 12p. 1·0μF, 14p. 1·5μF, 22p. 2·2μF, 27p

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, 2½p. 0·0068μF, 0·01μF, 0·015μF 0·022μF, 0·033μF, 3½p. 0·047μF. 0·068μF, 0·1μF, 4½p. 0·15μF, 6½p. 0·22μF, 8½p. 0·33μF, 12p. 0·47μF, 14p.

160V: 0·01μF, 0·015μF, 0·22μF, 0·033μF, 0·047μF, 0·068μF, 3p. 0·1μF 3½p. 0·15μF, 4½p. 0·22μF, 5½p. 0·33μF, 6½p. 0·47μF, 8½p. 0·68μF, 12p. 1·0μF, 14½p.

VOLUME CONTROLS

Potentiometers
Carbon track 500 Ω to 2·2M Ω
Log or Linear
Single **13p.** Dual gang (stereo) **44p**
Single type with D.P. switch **13p extra.**

SLIDE POTENTIOMETERS

58mm, TRACK
SINGLE GANGED, LOG or LIN 1k to 1M.
45p each
TWIN GANGED, LOG or LIN 1k to 500k.
66p each.

CARBON SKELETON PRESETS

Small high quality type (linear only).
All valves 100-5 meg ohms.
·1 watt 5½p each
·2·5 watt 6½p each

VEROBOARD

	0·15 Matrix	0·1 Matrix
2½in × 3¾in	19p	26p
2½in × 5in	28p	28p
3¾in × 3¾in	28p	28p
3¾in × 5in	33p	32p
5in × 17in (plain)	94p	—

Vero Pins (bag of 36), **22p**
Vero cutter, **50p**; Pin insertion Tools (0·1 and 0·15 matrix) at **61p.**

SLIDE SWITCH

SPST **11p** each. D.P.D.T. **13p** each.

MINIATURE NEON LAMPS

240V or 110V 1–4 **5p**, 5 plus **4½p** each.

MINITRON DIGITAL INDICATOR TYPE 3015F

Reads 0–9 and decimals
(Data Sheet on request)
ONLY £1 50
16 DIL Socket 33p
Driven by 7447 £1·05

RECTIFIERS

P.I.V.	1 AMP	1·5 AMP
50	IN4001 4½p	PL4001 8p
100	IN4002 4½p	PL4002 9p
200	IN4003 5½p	PL4003 10p
400	IN4004 6½p	PL4004 10p
600	IN4005 8p	PL4005 13p
800	IN4006 9p	PL4006 15p
1000	IN4007 10p	PL4007 20p

BRIDGE RECTIFIERS

P.I.V.	1 AMP	2 AMP	5 AMP	10 AMP
50	33p	53p	£1·76p	£2·20p
100	35p	57p	—	—
200	37p	60p	£1·98p	£2·31p
400	40p	64p	£2·15p	£2·42p
600	44p	66p	£2·42p	£2·75p
800	49p	—	—	—

THYRISTORS

PIV	50	100	200	300	400
1 Amp	28	25	41	44	53
3 Amps	44	50	60	—	66
7 Amps	—	96	1·01	—	1·24

RESISTORS

¼ watt 5% carbon 1p each
½ watt 10% carbon 1p each
1 watt 10% carbon 2½p each
Range 10 ohms to 4·7 meg.
½ watt m/o 2% **3p** each
Range 10 – 1 meg ohms

BARGAIN PACKS

Unmarked Packs

Pack of 25 IN4148 **55p**

Pack of 10
BC108 **55p**
BC107 **55p**
(Plastic can)

Pack of 10 Plastic BC109 **55p**

Pack of 10
BC169 **55p**
(unmarked) but tested

2N2646 (unmarked) **33p each**

Pack of 10
2N2926G **55p**
unbranded but tested

Unmarked but fully tested 2N3055
1–9 **33p**
10 plus **27p**

FULLY MARKED TYPES

AD161, AD162 M/P
1–9 **59p**
10 plus **53p**

BC107–BC108 BC109
1–9 **9p**
10–99 **8p**
100 plus **6½p**

BC 182L-3-4-212-4
1–9 **9p**
10 plus **8p**

AC127 or AC128
1–9 **13p**
10 plus **12p**
100 plus **11p**

ZENER DIODES

400 M/W 5%
Miniature
BZY 88 Range

All voltages
3·3 – 33 Volt
9p each

1 watt 5%

All voltages
6·8 – 200 Volts
14p each

10 watt 5%

All Voltages
7·5 – 100 Volts
51p each

Sinclair Project 60

Now—the Z.50 Mk.2

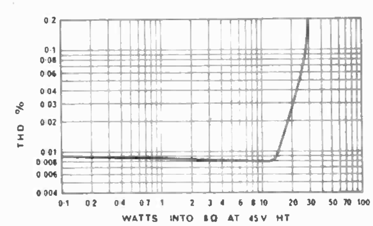
with built-in automatic transient overload protection

When originally introduced, the Sinclair Z.50 proved how it was possible to design and produce a popularly priced modular power amplifier having characteristics to challenge the world's costliest amplifiers. Many thousands of Z.50's are now giving excellent service day in, day out. But we have also learned that constructors do not always use their Z.50's ideally. That is why we have introduced modifications whereby risk of damage through mis-use is greatly reduced and performance further enhanced. The Z.50 Mk.2 has improved thermal stability, more accurately regulated D.C. limiting to ensure more symetrical output voltage swing and clipping and still less distortion at lower power. Z.50 Mk.2 is compatible with all other Project 60 modules, and may be incorporated to advantage in existing systems. Eleven silicon epitaxial planar transistors are now used, two more than in the original Z.50; circuitry has been re-designed, making this versatile high performance amplifier better than ever.

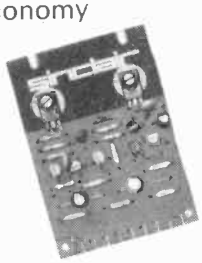
with free manual
£5.48

Brilliant new technical specifications

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



Z.30 the power amplifier for quality and economy



with free manual
£4.48

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 (3⅛ x 2¼ x ½) Z.30, Z.50 and Z.50 MK.2 modules are compatible and interchangeable.

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 de luxe 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.

Guarantee

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

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

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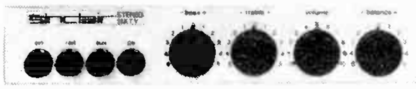
SINCLAIR RADIONICS LTD., R.O. London Road, St. Ives, Huntingdonshire, PE17 4HJ (Phone St. Ives 4311) Reg. No. 699483 England

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

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

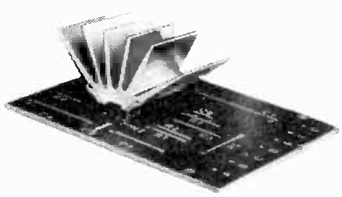
Project 60 Stereo F.M. Tuner

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 stero decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz. **Sensitivity:** 7µV for lock-in over full deviation. **Squelch level:** Typically 20µV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10Hz – 15KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2µV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum. **Operating voltage:** 25–30VDC. **Indicators:** Stereo on; tuning. **Size:** 93 x 40 x 207mm.

Built and tested. Post free. **£25**

Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC make possible. It is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak), 6–8Ω. **Frequency Response:** 5Hz to 100KHz ±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0·1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 × 45 × 28mm including pins and heat sink.

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual.
£2.98 Post free

Power Supply Units The new PZ.8 Mk.3

The most reliable power supply unit ever made available to constructors. Brilliant circuitry makes failure from over load and even direct shorting of the output impossible. This is due to an ingenious re-entrant current limiting principle which, as far as we know has never before been available in any comparable unit outside the most expensive laboratory equipment. Ripple and residual noise have been reduced to the point of almost total elimination. This is, of course, the perfect unit for Project 60 assemblies, particularly where the new Z.50 MK.2 amplifiers are used. Nominal working voltage – 45.

PZ.8 Mk.3—£7.98
(Mains transformer, if required) £5.98
PZ.5 30v. unstabilised
(not suitable for Project 60 tuner) £4.98
PZ.6 35v. stabilised
(not suitable for IC 12) £7.98

Project 605

the easy way to buy and build Project 60 without soldering

Project 605 in one pack contains: one PZ.5, two Z.30's, one Stereo 60 and one Masterlink, which has input sockets and output components grouped on a single module and all necessary leads cut to length and fitted with clips to plug straight on to the modules thus eliminating all soldering.

Complete with comprehensive manual, post free **£29.95**
All you need for a superb 30 watt high fidelity stereo amplifier

Order form

Please send ____________________

I enclose cash/cheque/money order.

Name ____________________

Address ____________________

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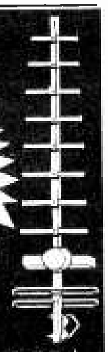

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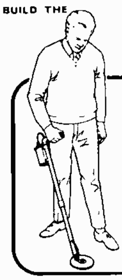

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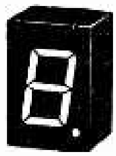

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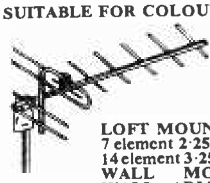

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6AQ6	0.70
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6BN6	0.60
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6BW6	0.90
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6BX6	0.25
6BZ6	0.45
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6C5GT	0.55
6CB6	0.40
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6CG7	0.60
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CY31	0.50
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DK92	0.70
DK96	0.60
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DY51	0.55
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ECL83	0.70
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EF37A	1.00
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EF41	0.65
EF42	0.70
EF80	0.30
EF85	0.35
EF86	0.30
EF89	0.28
EF91	0.37
EF92	0.35

EF95	0.40
EF97	0.65
EF98	0.75
EF183	0.30
EF184	0.35
EF804	1.25
EK90	0.82
EL34	0.50
EL36	0.50
EL37	1.70
EL41	0.75
EL81	0.55
EL83	0.50
EL84	0.25
EL85	0.43
EL86	0.40
EL90	0.42
EL360	1.15
EL821	0.60
EL822	1.40
ELL80	0.75
EM34	1.00
EM71	0.80
EM80	0.45
EM81	0.60
EM83	0.50
EM84	0.35
EM85	1.00
EM87	0.70
EN91	0.40
EY51	0.40
EY80	0.75
EY81	0.40
EY83	0.55
EY86	0.40
EY87	0.43
EY88	0.43
EZ40	0.50
EZ41	0.75
EZ80	0.28
EZ81	0.29
GT1C	3.00
GY501	0.70
GZ30	0.45
GZ31	0.40

GZ32	0.50
GZ33	0.75
GZ34	0.60
HABC80	0.55
HK90	0.50
KT66	2.35
KT88	2·25
N78	1·60
PABC80	0.40
PC86	0.60
PC88	0.60
PC92	0.05
PC97	0.50
PC900	0.48
PCC84	0.40
PCC85	0.40
PCC88	0.55
PCC89	0.55
PCC189	0.60
PCC805	0.95
PCC806	0.95
PCF80	0.30
PCF82	0.35
PCF84	0.60
PCF86	0.60
PCF87	1·10
PCF801	0.50
PCF802	0.50
PCF805	0.90
PCF806	0.75
PCF808	0.90
PCH200	0.70
PCL81	0.50
PCL82	0.35
PCL83	0.65
PCL84	0.45
PCL86	0.45
PCL88	1.25
PCL200	0.75
PCL800	1.10
PCL801	0.95
PCL805	0.50
PD500	1.30
PF86	0.70

PF818	1.00
PFL200	0.65
PL33	0.40
PL36	0.55
PL81	0.50
PL82	0.45
PL83	0.45
PL84	0.40
PL302	0.95
PL504	0.75
PL508	0.90
PL509	1.10
PL801	1.00
PL802	0·95
PM84	0.60
PY31	0.35
PY33	0.63
PY80	0.40
PY81	0.30
PY82	0.35
PY83	0.38
PY88	0.40
PY800	0.47
PY801	0.50
PZ30	0.38
QQV02-6	2.25
QQV03-10	1.25
QQV03-20A	5.25
TT21	3.40
TT22	3.50
U18/20	0.75
U25	0.85
U26	0.85
U31	0.70
U37	6.50
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U78	0.40
U191	0.75
U201	0.50
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U282	0.55

U301	0.55
U403	0.70
U404	0.70
U801	0.80
UABC80	0.40
UAF41	0.70
UAF42	0.60
UB41	0·65
UBC41	0.55
UBC81	0.45
UBF80	0.40
UBF89	0.40
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UBL21	0.70
UC92	0.45
UCC85	0.45
UCF80	0.70
UCH21	0.60
UCH42	0.70
UCH81	0.40
UCL81	0.60
UCL82	0.35
UCL83	0.65
UF9	0.65
UF11	0.60
UF41	0.65
UF42	0.65
UF43	0.65
UF80	0.35
UF85	0.40
UF89	0.40
UL41	0·65
UL84	0.43
UM84	0.30
UY1N	0.50
UY11	1.00
UY41	0.48
UY82	0.50
UY85	0.40
W729	0.75
Y63	0·75
Z759	3.00
Z803U	1.35

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2N696	0.15
2N697	0.15
2N698	0.30
2N705	0.70
2N706	0.10
2N708	0.15
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2N3707	0.12
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2N3710	0.10
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2S746	0.25
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AC125	0.30
AC126	0.20
AC127	0.17

AC128	0.15
AC132	0.35
AC153	0.20
AC154	0.15
AC157	0.17
AC169	0.10
AC176	0.17
AC187	0.25
AC188	0.25
ACY17	0.25
ACY18	0.20
ACY19	0.25
ACY20	0.20
ACY21	0.20
ACY22	0.10
AD140	0.50
AD149	0.45
AD161	0.35
AD162	0.35
ADZ11	1.25
ADZ12	1.25
AF114	0.17
AF115	0.17
AF116	0.17
AF117	0.17
AF118	0.30
AF125	0.20
AF127	0.20
AF180	0.35
AF181	0.35
AF186	0.40
AF239	0.36
AFZ11	0.45
AFZ12	1.00
ASY26	0.25
ASY27	0.30
ASY28	0.25
ASY29	0.30
ASY54	0.25
ASZ15	0.70
ASZ16	0.70
ASZ17	0.75
ASZ18	0.75
ASZ20	0.25
ASZ21	0.40
AUY10	1·00
BC107	0.10
BC108	0.10
BC109	0.10
BC113	0.10
BC118	0.20
BC134	0.20
BC147	0.10
BC148	0.10
BC149	0.12
BC152	0.15
BC158	0.15
BC175	0.20
BC186	0.25
BCY30	0.25
BCY31	0.30
BCY33	0.25
BCY34	0.30
BCY72	0.15
BCZ10	0.30
BCZ11	0.40

BD121	0.65
BD123	0.80
BD124	0.60
BD131	0.75
BD132	0.80
BF115	0.20
BF167	0.18
BF173	0.20
BF179	0.30
BF180	0.30
BF181	0.30
BF184	0.20
BF185	0.20
BF194	0.14
BF195	0.14
BF196	0.12
BF197	0.12
BF200	0.35
BFW87	0.25
BFW88	0.20
BFW89	0.20
BFW91	0.20
BFX88	0.20
BFY17	0.40
BFY19	0.25
BFY50	0.20
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BSY95A	0.12
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OC71	0.12
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OC75	0.15
OC76	0.15
OC78	0.25
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OC81	0.20
OC81D	0.20
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OC139	0.30
OC140	0.35
OC141	0.60
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OC171	0.25
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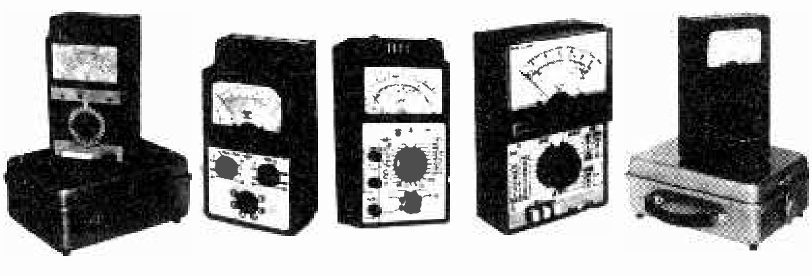
OC203	0.40
OC204	0.40



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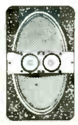

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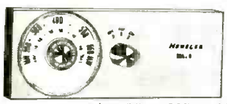

Uses Mullard Module. Slow motion tuning. Built in battery. Ferrite aerial. Overall size 7" x 2¾" x 3¼". TOTAL COST TO BUILD £4·85, Post 15p. All parts sold separately. Leaflet No. 6

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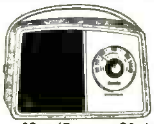

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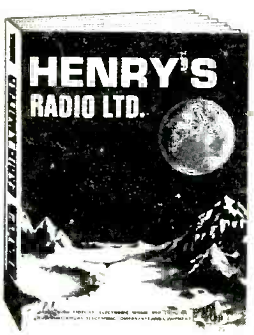

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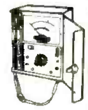

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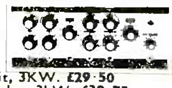

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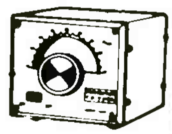

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