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A precision instrument—supplied with standard 3/16″ (4.75 mm) diameter, detachable copper chisel-face bit*.
Standard temp. 360°c at 23 watts.
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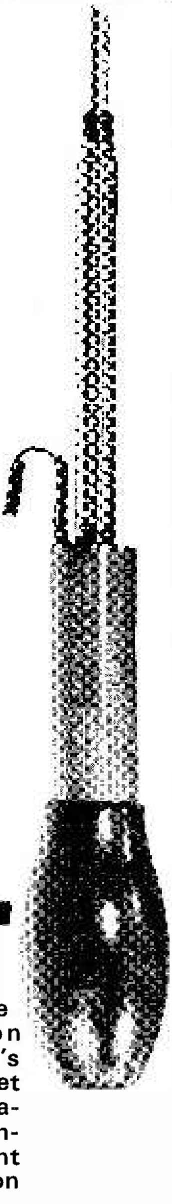

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B 38 $\frac{1}{8}$″ — 3.2 mm CHISEL FACE

B 14 $\frac{3}{32}$″ — 2.4 mm CHISEL FACE

B 24 $\frac{3}{16}$″ — 4.75 mm SCREWDRIVER FACE

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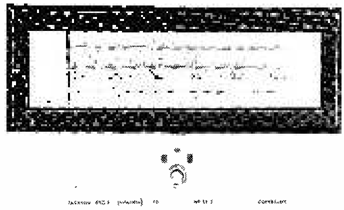

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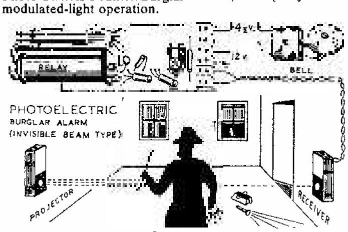

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Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks, Infa-red filter, projector lamp holder, building plans, etc. Price **19/6**. Postage and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/-; Air Mail 8/-.

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Versatile Invisible-beam, Relay-less, Steady-light Photo-Switch, Burglar Alarm, Door Opener, Counter, etc., for the Experimenter.
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CONTENTS: 2 Lenses, Infra-red Filter, Lampholder, Bracket, Plans, etc. Everything (except plywood) to build 1 miniature invisible beam projector and photocell receiver for use with Junior Photoelectric Kit.
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Send a S.A.E. for full details, a brief description and Photographs of all Kits and all 52 Radio, Electronic and Photoelectric Projects Assembled.

TMK METER KITS

These meter kits by TMK offer the unique opportunity of building a really first-class precision multimeter at a worthwhile saving in cost. The cabinet is supplied with the meter scale and movement and the range selector in position. The highest quality components and 1% tolerance resistors are used throughout. Supplied complete with full constructional, circuit and operating instructions

MODEL 200

20,000 O.P.V. Multimeter. Features 24 measurement ranges with mirror scale.

Large 3 2in meter. Full scale accuracy: DCV and current: ±2%. ACV: ±3%, resistance ±3%. Special 0·6V DC range for transistor circuit measurements.

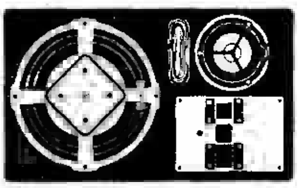
SPECIFICATION

● DCV: 0–0·6–6–30–120–600–1,200V at 20K/OPV. ● ACV: 0–6–30–120–600–1,200V at 10K/OPV. ● DC Current: 0–6 0–6–600mA. ● Resistance: 0–10–K 100K–1M—10M/ohms (58–580–5·8K–58K at mid-scale). ● Capacitance: 0·002–0·2μF (AC 6V range). ● Decibels —20 to +63dB. ● Output: 0·05μF blocking capacitor. Uses two 1·5V (U7 type) batteries. Black bakelite cabinet. Size 5¾ 3¾ 1⅞in. Complete with test leads.

KIT PRICE **ONLY 92/-** Post 3/6

WHARFEDALE

UNIT 3 SPEAKER KIT



3in tweeter uses new Wharfedale "AcoustiPrene" dome diaphragm. Crossover unit crossover freq. 1,750Hz. ALL accessories, acoustic wadding, mounting bolts, wire, etc., are supplied, you provide the cabinet to suit your needs. 8in. Bass/Mid. range speaker employing a powerful magnet assembly with diecast chassis and Flexiprene roll surround. The Wharfedale Unit 3 speaker kit can be constructed by anybody and with a suitable cabinet will provide a highly sophisticated system giving true Hi-Fi reproduction from 40–17,000Hz. Impedance 4/8 ohms. Max. power handling 15W.

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UNIT 4 SPEAKER KIT

2 speakers (12in. Bass and 3in Treble) to give full range, balanced reproduction Frequency response of 45–17,000Hz when housed in suitable cabinet. Superior 4-element crossover unit ensures optimum performance from each speaker.

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UNIT 5 MONITOR SYSTEM KIT

3 speakers (12in Bass, 5in M.-R. unit, 1in Treble) give clean, smooth performance. Frequency response of 40–20,000Hz when housed in suitable cabinet. Unique mechanical electrical 6 element crossover unit.

£23.10 each Post 7/6 **£42.10** per pair Post 15/-

TTC HEADPHONES

MODEL G-IIII

Yet another outstanding TTC product which gives you exceptional value plus super quality. These stereo phones use two 3in low imp. high flux density dynamic reproducers. Freq. Res. 25-15,000Hz. Fitted with foam cushioned adjustable earpads for super listening comfort. Imp. 8 ohms, matching 16 ohms. Max. input 0·5W. Complete with 36in shielded grey cable. Pearl grey finish with double spring headband.

ONLY **63/-** Post 3/6

USA MADE CASSETTES

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C60	7/6 each post 1/-	35/- post 2/-	65/- post 3/-
C90	12/6 each post 1/-	57/6 post 2/-	115/- post 3/-
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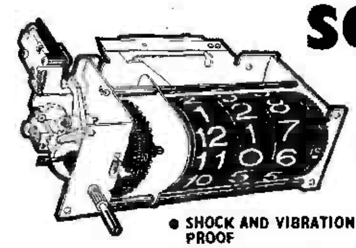
EXCLUSIVE

DIGITAL CLOCK SCOOP!



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This unique **DIGITAL CLOCK** is now available **EXCLUSIVELY FROM LASKY'S** in chassis form for you to mount in any housing that you choose.
All settings are achieved by two dual-concentric controls at the front including: ON-OFF-AUTO and AUTO ALARM. "sleep" switch. 10 minute division "click" set alarm (up to 12 hour delay). time adjustment. Ultra simple mechanism and high quality manufacture guarantee reliable operation and long life.
The sleep switch will automatically turn off any appliance—radio, TV, light etc. at any pre-set time up to 60 min. and in conjunction with the AUTO setting will switch on the appliance again next morning.
The clock measures 4½W x 1⅞H x 3½D (overall from front of drum to back of switch). SPEC: 210/240V AC, 50Hz operation; switch rating 250V, 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS.**

LASKY'S PRICE **£6.19.6** Post 3/6

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Audio Development

AD-309K

PRECISION PICK-UP ARM COMPLETE WITH AD-76K MAGNETIC CARTRIDGE

The new AUDIO DEVELOPMENT precision counter-balanced pick-up arm—ready fitted with the outstanding AD-76K magnetic cartridge is constructed of brass throughout, heavily chromeplated; uses needle and miniature ballrace bearings; both coarse and fine balance adjustment is provided. The fixed head has standard ½in. mounting centres and is finished in black enamel with chrome lifting spur. Completely wired, with all fixing nuts and washers. Arm rest also supplied. Tech. details: Overall length 285mm; needle to pivot length 223mm; offset angle 24°; overhang 10mm. Requires single 7/16in dia. mounting hole.

LASKY'S PRICE **£9.19.6** POST 3/6

AUDIO DEVELOPMENT AD-76K

Stereo Magnetic Cartridge. Frequency response: 20-20,000Hz. Output: 5mV. Stylus: Diamond LP. Tracking force: 2 gms·0·5 gm. Replacement stylus type Y.960S 51/6.

90/- Post Free

AUDIO DEVELOPMENT AD-96K

Stereo Magnetic Cartridge. Frequency response: 20-20,000Hz. Output: 5mV. Stylus: Diamond LP. Tracking force: 2 gns. Replacement stylus type JS.P1 41/-, post free.

£5.18.6 Post Free

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The 1970 edition of Lasky's Audio-Tronics catalogue is available FREE on request. Packed with 1000's of items for the Radio and Hi-Fi enthusiast, Electronics Hobbyist, Servicemen and Communications Ham. Covers every aspect of Hi-Fi (including Laskys budget Stereo Systems and Package Deals) Tape recording and Audio accessories plus Lasky's amazing money saving vouchers worth over £25. **SEND TODAY.** *Send your name, address and 1/- for post and inclusion of your name on our regular mailing list*

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£9.10. plus 7/6 p. & p.

Controls: Selector switch Tape speed equalisation switch (3¾ and 7½ i.p.s.). Volume. Treble. Bass. 2 position scratch filter and 2 position rumble filter.

Specification: Sensitivities for 10 watt output at 1KHz into 3 ohms. *Tape head:* 3mV(at 3¾ i.p.s.). *Mag.P.U.:* 2mV. *Cer. P.U.* 80mV. *Tuner* 100mV. *Aux.:* 100mV *Tape/Rec. output:* Equalisation for each input is correct to within ± 2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone control range* Bass ± 13dB at 60Hz. Treble ± 14dB at 15KHz. *Total distortion:* (for 10 watt output) < 1.5%. *Signal noise:* ≮ —60dB. A.C. mains 200-250v. Built and tested. Size 12½in long. 4½in deep. 2¾in high. Teak finished case.

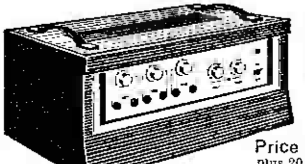
THE DUO SPEAKER SYSTEM

Similar in design to those on the previous page the 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:—

Impedance 3, 8 or 10 ohms (please state requirement). It incorporates Goodmans high flux 6in x 4in speaker and 2½in speaker. Teak finish 12in x 6¾in x 5¼in. 4 guineas each. 7/6 p. & p.

50 WATT AMPLIFIER



A.C. Mains 200-250V

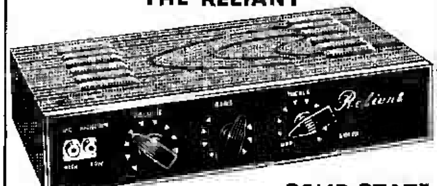
Price **£28.10**
plus 20/- p. & p.

An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

TECHNICAL SPECIFICATIONS

3 electronically mixed channels, with 2 inputs per channel, enables the use of 6 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES.** Channels 1 and 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars. Channels 3 and 4 300mV at 1m. Suitable for most high output instruments (gram, tuner, organ, etc). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS.** Bass Boost +12dB at 60Hz. Bass Cut—13dB at 60Hz. Treble Boost +11dB at 15 KHz. Treble Cut —12dB at 15 KHz. With bass and treble controls central—3dB points are 30 Hz and 20 KHz. **POWER OUTPUT**: For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sine wave 38.5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3.2% at 1KHz. Total distortion at 20 watts 0.15% at 1KHz. Output to match into 8 or 15 ohms speaker system. **NEGATIVE FEEDBACK** 20dB at 1KHz. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES** adjustable from 200-250V A.C. 50-60Hz. A protective fuse is located at the rear of the unit. Output-impedance 3, 8 and 15 ohms.

THE RELIANT



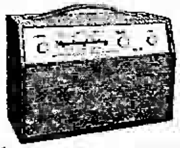
SOLID-STATE GENERAL PURPOSE AMPLIFIER

SPECIFICATIONS

Output—10 watts. Output impedance—3 to 4 ohms
Inputs—1. -xtal mic 10mV **Tone Controls**—Treble control range ±12dB at 10KHz.
2. -gram/radio 250mV. Bass control range ±13dB at 100Hz.
Frequency Response—(with tone controls central) Minus 3dB points at 20Hz and 40KHz. **Signal to Noise Ratio**—better than —60dB. **Transistors**—4 silicon Planar type and 3 Germanium type. Mains input—220/250V. A.C. Size of chassis— 10¼in x 4¾in x 2½in. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control from gram. and mike. Built and tested.

RELIANT Mk. I
As above less teak case
£6.10 plus 7/6 P. & P.

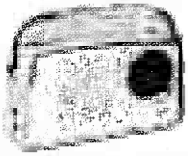
RELIANT Mk. II
In teak finished case
£7.5 plus 7/6 P. & P.



The ELEGANT SEVEN Mk. III (350mW Output)

7-transistor fully-tunable M.W.—L.W. superhet portable Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.
MAINS POWER PACK KIT: 9/6 extra.

Price **£5.5.0** plus 7/6 P. & P.
Circuit 2/6 FREE WITH PARTS



The DORSET (600mW Output)

Price **£5.5.0**
plus 7/6 P. & P.
Circuit 2/6
FREE WITH PARTS

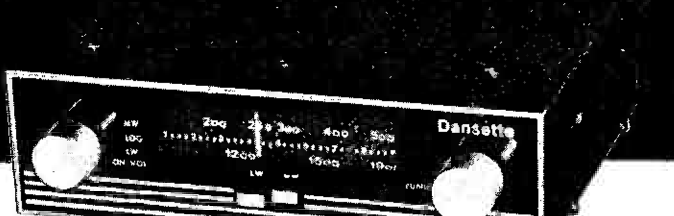
7-transistor fully tunable M.W.—L.W. superhet portable—with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in.
MAINS POWER PACK KIT: 9/6 extra

QUALITY MAINS TRANSFORMER

Input 240 volts. OUTPUT (All RMS values) 4 windings of 11.5 volts connected in series total 46 volts at 4.5 amps (conservatively rated). The following combinations may be used. 1.23-0-23 volts. 2.46 volts.
Both of these above voltages are commonly used in medium to high powered transistor amplifiers, power supplies, etc.

Price 35/- plus 7/6 P. & P.

LIQUIDATED STOCK
DANSETTE
TOURISTE MK3 CAR RADIO



Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1 MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts.

Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in. deep.

Originally sold complete for £15.4.6.

SET OF PARTS £6.6.0 plus 7/6 P. & P.
Circuit diagram 2/6. Free with parts

Speaker, baffle and fixing kit 25/- extra plus 4/- P. & P.
Postage free when ordered with parts.

See top of previous page for address

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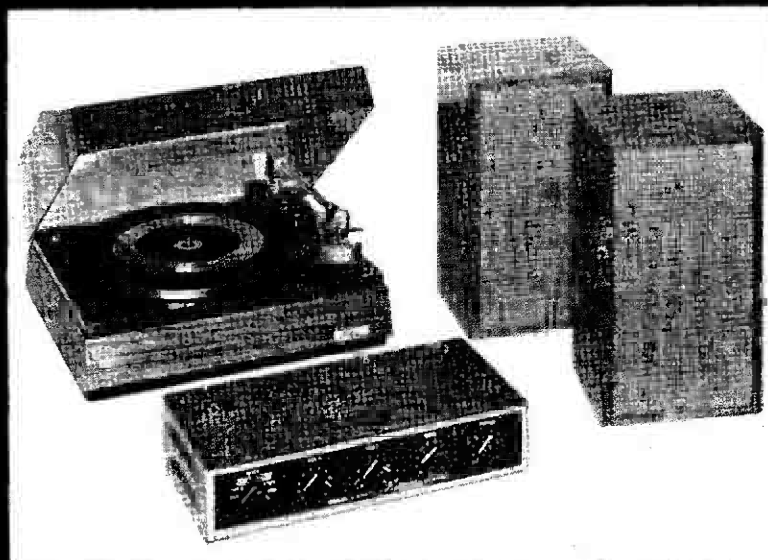
Complete Stereo System £41

WITH VISCOUNT F.E.T. FIELD EFFECT TRANSISTORS AMPLIFIER



This superb stereo system is a real price break through. It comprises the VISCOUNT F.E.T. Mk I amplifier on which full details are given below, the famous Garrard SP 25 Mk II (including teak veneer base and transparent cover) with diamond cartridge or 2025 TC and the very successful DUO type 2 speakers. Measuring 17½in x 10¾in x 6¼in, the Duo type 2 speakers are beautifully finished in teak veneer with matching vynair grills. They incorporate a 10½in x 6½in drive unit and high frequency speaker, both of which are of 3 ohms impedance. The Duo speaker system is also available separately at £6.6.0 each, plus 15/- p. & p.

Complete stereo system £41 plus £2.10. p. & p.

The Viscount F.E.T. Mk I **£14.5** plus 7/6 p. & p.

High fidelity transistor stereo amplifier employing field effect transistors. With this feature and accompanying guaranteed specifications below, the Viscount F.E.T. vastly surpasses amplifiers costing far more.

Specification—Output per channel 10 watts r.m.s. Frequency bandwidth 20 Hz to 20 kHz + 1db at 1 watt. Total distortion at 1 kHz at 9 watts 0.5% Input sensitivities CER. P.U. 100mV into 3 meg ohms. Tuner 100mV into 100K ohms. Tape 100mV into 100K ohms. Overload Factor Better than 26db. Signal to noise ratio—70db on all inputs (with vol. max). Controls—6 position selector switch (3 pos. stereo and 3 pos. mono). Separate volume controls for left and right channels. Bass ± 14db at 60 Hz. Treble (with D.P.S. on off) ± 12 db at 10 KHz. Tape recording output sockets on each channel. Size 12¼in . 6in . 2¾in. in teak-finished case. BUILT & TESTED.

MkII (MAG P.U.) £15.15 plus 10/- p. & p.
Specification same as Mk. 1, but with the following inputs. Mag. P.U. CER. P.U. Tuner. Spec. on Mag. P.U. 3mV at 1 kHz input impedance 47K. Fully equalised to within ±1db RIAA. Signal to noise ratio—65db (vol. max).

The £29-10-0 Stereo system

The Duetto is a good quality stereo amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.

SPECIFICATION—
R.M.S. power output 3 watts per channel into 10 ohms speakers.

INPUT SENSITIVITY. Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.

CONTROLS: 4-position selector switch (2 pos. mono and 2 pos stereo) dual ganged volume control.

TONE CONTROL Treble lift and cut Separate on off switch. A preset balance control.

Duetto integrated transistor stereo Amp.	£9.10.0 + 7/6 p&p.
Garrard Changer from	£7,19.6 + 7/6 p&p.
Cover and teak finish plinth	£4.15.0 + 7/6 p&p.
Duo Type I speakers (see opp. page)	ea. £4. 4.0 + 7/6 p&p.
The above items purchased together	£29.10.0 + £1,10 p&p.

This MONTH'S Best Buy . . .

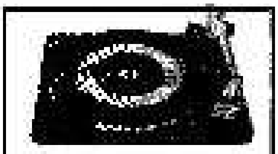
AKG K50 Dynamic Stereo headphones

Complete with spare ear muffs.

(Total value £10/8/0d.) Our Price **£5.18.** + 4/6 p. & p.

Available only from us at this price. Due to entire purchase of manufacturer's remaining stock this fantastic offer is open only while stocks last.

★ High-fidelity reproduction due to broad frequency response (20-20,000Hz) ★ Substantially increased stereo effect ★ Headphones fit the head gently and do not shift ★ Earpieces fit ears snugly (Cardanic suspension) ★ Tone quality superior to conventional loudspeakers. Only expensive studio loudspeakers can match the reproduction quality of the K50. ★ Music can be reproduced at concert hall volume (!), preserving the lower bass notes and brilliant treble tones without causing any strain to the listener.

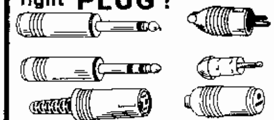


GARRARD SP25 mk II £10.19.6 *Plus 10/- carriage*

Normal price £15.11.4

Single record playing unit. Features include cue and pause and automatic pick up return and switch off.
Wired with mains cable and 5ft twin screened stereo cable. 5 pin plug. 10/6 extra.
AP75 Complete with base and cover £25 plus 15/- carriage

Having trouble getting the right PLUG?



Pack 107 5 Pin Din	4/-d.
Pack 108 3 Pin Din	3/6d.
Pack 135 ¼" Jack	5/-d.
Pack 130 ¼" Jack Stereo	9/6d.
Pack 103 Loudspeaker Plug	3/-d.
Pack 100 Phono Plug	1/3d.
Pack 230 3 pin Socket	4/6d.
Pack 236 5 pin Socket	6/-d.
Pack 234 Loudspeaker Socket	6/-d.

Special express delivery 6d. per unit postage. S.A.E. for list of plugs, sockets, drive belts, ready-made leads etc.

PLINTH and COVER £5.5.

Unbeatable Value *plus 10/- p. & p.*

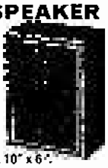
Suitable for AT60; SP25; 3000; 2500; 3500. Superb finish. Spindle can be left in position with cover on. Cover of neutral smoke tint perspex.
Also available for AP75; SL99; SL75 **£6.17.6** plus 10/- carr.

Replacement Stereo DIAMOND STYLI

8TA 9TA 9TAHC GP91 ST4 ST9 EV26 GC8 others on request **15/-** each p. & p. 1/6

Countdown SPEAKER

Teak Cabinet



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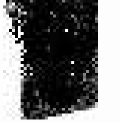
A speaker of outstanding specifications and technical merit. Solid teak cabinet size: 14" x 10" x 6". Originally designed for use with our Countdown stereo budget system but now available separately.

EMI 20w MATCHED SPEAKER SET 350



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13.5" x 8.125" eliptical woofer coupled to a coaxially mounted 3.125" high frequency choke and condenser dividing network. The high frequency unit has a critically curved cone and also uses a high flux ceramic magnet.

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Diamond styli **95/-** *plus 2/6 p. & p.*

Today's value £6. Stylus replacement can be carried out without removing cartridge. Fully guaranteed.

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Ronette 105 Stereo cartridge (Sapphire 78 Diamond LP) 25/- 2/6 p. & p.

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AF116	3/-	OA81	1/6	OC71	2/3	OC171	2/3
*AF117	4/-	OA85	1/6	OC72	2/3	OC202	4/6
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Replacements for BSR TC8LP, TC8/S and TC8LP/STEREO: COLLARO "O"; RONETTE BF40LP; GARRARD GC2LP and GC8LP: ACOS GP65/67: all at **7/6** each (1/-) ACOS GP73 and GP91; BSR ST4 (ST3, ST5), ST8 (ST9); SONOTONE 8TA, 9TA and 9TAHC; PHILIPS AG3306, 3060, (3063, 3066, 3301, 3302, 3304), all at **15/-** (1/-).
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SAPPHIRE all the above 7/6 types only, also ACOS GP37 at **3/3** each (1/-). ACOS GP91 at **7/6** (1/-). No other types at present, and no 78 rpm available in any type.

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All fitted Styli and Standard fittings, Mono GP67/2, 15/-. ●Stereo compatible—Mono which also plays Stereo records monaurally with min. wear, **GP91/SC, 21/-**. ●latest Stereo **GP93, 24/6**. ●Ceramic Stereo, top quality for expensive outfits, **GP94, 38/6**. ●Sonotone stereo 9TAHC diamond fitted cartridge **55/-** (all at 1/-). More diamond types in list.
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TRANSISTORISED AMPLIFIER, 3 watt. 9V operation, **45/6** (1/6).
Extra High Torque **MINI-MOTOR,** 4½ to 12V, 1½ × ⅞in. **5/-** (1/-) 9,000 r.p.m.
SUBSTITUTION BOXES. Capacitance **25/6** (1/6). Resistance **32/6** (1/6). Both full range and complete. Full details in list.
TEST PRODS: Flexible, unbreakable 24in. Red and Black leads, thin 4½in. prods, 1¼in. plugs **4/9** (1/-). **CROC. CLIPS:** Plated with screw, or with red/black hndles, **6d.** each, 5/- doz. (1/-).

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Finest quality British Mylar. **STANDARD:** 5in. 600ft. **7/3** 5¾in. 900ft **10/-**, 7in 1200ft. **11/3. LONG PLAY** 5in. 900ft **10/-**, 5¾in. 1200ft. **11/3**, 7in. 1800ft. **18/-** (1/3 reel). Still the finest quality and value obtainable.

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DYNAMIC: Cream hand/table **15/6** (1/6). **MS10** 50K Ω, 34 + pin. with Base. Adaptor **37/6** (2/6). **MS11,** similar but fixed on flexible Swan neck to switch-fitted base **42/6** (2/6).
CARDIOD DYNAMIC OMNI-DIRECTIONAL: Highly successful "BALL" type, 209, 50K/600 ohms imp., **£5.17.6** "Non-directional ball", switch cord adaptor—DM160—**£3.17.6** (both these types 5/-).
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SPEAKERS 12in. round, fitted Tweeter, 6W. 3 or 15 Ω (state which), **37/6** (5/6); or for stereo, **80/-** per pair (charges paid), 2½in. 3 Ω **7/6** (1/-); Limited quantity powerful 2½in. PM transistor replacement speaker, high ohms, excellent **5/9** (1/-). **HEADPHONES:** Stereo Dyn 8-16 Ω **63/-** (3/-). **EARPIECES** with lead and min. jack plug, magnetic **1/9**. Crystal **4/9** (up to 3 for 1/- on either). State if 2.5 mm. of 3.5mm, plug required. (Crystal 3.5mm. only)
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For Portables & F.M. Sets—4-section 6½-23", ¾" sliding threaded base, needs ¼" hole **4/-**
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DISAPPEARING, with swivel and sliding threaded socket, fixing nut on bottom section—
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10-section 7¾–56½, ⅜" dia, **15/9**
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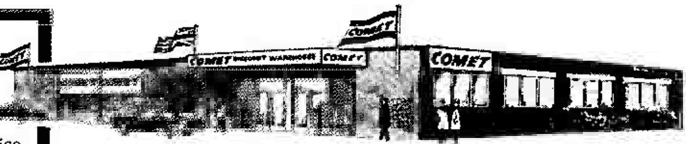

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	Rec. Retail Price	Comet Price
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ARMSTRONG 521	£52 0 0	£42 19 6
DULCI 207	£25 0 0	£17 0 0
DULCI 207M	£30 0 0	£20 19 0
GOODMANS Maxamp ..	£54 0 0	£44 19 6
LEAK Stereo 30 Plus ..	£53 0 0	£43 19 6
LEAK Stereo 30 Plus in teak case	£59 10 0	£47 19 6
LEAK Stereo 70	£65 0 0	£52 19 6
LEAK Stereo 70 in teak case	£71 10 0	£56 19 6
LINEAR LT.66	£18 18 0	£15 19 6
METRO SOUND ST 20 ..	£32 0 0	£25 19 6
PHILIPS RH 591	£73 0 0	£55 19 6
PHILIPS RH 590	£49 0 0	£37 12 6
PHILIPS RH 580	£26 0 0	£19 19 6
PIONEER SA500	£62 1 11	£45 0 0
PIONEER SA700	£98 0 0	£74 19 6
PIONEER SA900	£134 2 0	£99 19 6
PIONEER Reverberation..	£45 9 11	£35 19 6
QUAD 33 Pre-amplifier ..	£43 0 0	£38 19 6
QUAD 303 Main Amplifier	£55 0 0	£48 19 6
ROGERS Ravensbourne ..	£59 10 0	£46 19 6
ROGERS Ravensbourne (cased)	£64 0 0	£49 19 6
ROGERS Ravensbrook ..	£44 0 0	£36 19 6
ROGERS Ravensbrook (cased)	£49 0 0	£39 19 6
SINCLAIR 2000	£30 9 0	£24 19 6
TELETON 203E	£28 7 6	£19 19 6
TRUVOX TSA, 200 ..	£54 12 0	£34 19 6

TUNERS

	Rec. Retail Price	Comet Price
ARENA F211	£39 10 0	£33 19 6
ARMSTRONG 523 AM/FM	£52 9 0	£44 19 6
ARMSTRONG 524 FM ..	£40 4 6	£34 19 6
ARMSTRONG M8 decoder	£9 10 0	£7 19 6
DULCI FMT.7FM	£22 1 0	£17 19 6
DULCI FMT.7S Stereo ..	£31 0 0	£25 5 0
GOODMANS Stereomax	£82 10 5	£71 19 6
LEAK Stereofetic Chassis	£59 18 0	£53 19 6
LEAK Stereofetic in teak case	£67 3 6	£59 16 6
PHILIPS RH 690	£39 0 0	£31 19 6
PIONEER TX500 AM/FM ..	£77 18 9	£63 19 6
PIONEER TX900 AM/FM ..	£153 13 10	£125 0 0
QUAD Stereo FM	£51 0 0	£39 19 6
ROGERS Ravensbourne ..	£61 17 9	£49 19 6
ROGERS Ravensbrook ..	£45 0 2	£39 19 6
ROGERS Ravensbrook (cased)	£51 5 3	£42 19 6
SINCLAIR 2000	£26 14 6	£19 4 6
TRUVOX FM 200/1C ..	£60 11 10	£39 19 6

All above tuners are complete with MPX stereo decoder

TUNER/AMPLIFIERS

	Rec. Retail Price	Comet Price
ARENA 2400..	£90 6 0	£71 19 6
ARENA 2600 Stereo AM/FM	£111 6 0	£94 0 0
ARENA 2700 Stereo ..	£105 0 0	£85 0 0
ARENA T1500F	£72 9 0	£59 19 6
ARENA T9000	£303 9 0	£258 0 0
ARMSTRONG 525 ..	£87 16 9	£66 19 6
ARMSTRONG 526 ..	£98 15 6	£79 19 6
ARMSTRONG M8 decoder	£9 10 0	£7 19 6
GOODMANS 3000 ..	£77 14 7	£66 19 6
PHILIPS RH781	£74 19 6	£54 19 6
PHILIPS RH790	£125 0 0	£101 19 6
PHILIPS RH691	£83 0 0	£70 10 6
PIONEER KX330 AM/FM/SW	£78 12 4	£62 19 6
PIONEER SX770 AM/FM ..	£160 8 6	£129 19 6
PIONEER SX990 AM/FM ..	£194 14 8	£155 0 0
TELETON F.2000	£51 0 0	£37 19 6
TELETON 7ATI	£133 0 0	£85 0 0
TELETON R4200	£51 15 0	£42 19 6
TELETON CR/10T	£39 0 0	£29 19 6
TELETON TF550	£74 0 0	£56 19 6

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CARTRIDGES ALL MAKES STOCKED AT DISCOUNT PRICES

PICKUP ARMS

	Rec. Retail Price	Comet Price
GOLDRING Lenco L75 ..	£12 6 6	£10 10 0
GOLDRING Lenco L69 ..	£9 5 9	£7 0 0
SME 3009 with S2 shell ..	£31 6 3	£25 19 6
SME 3012 with S2 shell ..	£33 7 3	£28 19 6

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TURNTABLES

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GARRARD SP25, fully wired with Goldring G800 magnetic cartridge, complete with base, plinth and cover	Special price	£20 19 6
GARRARD SP.25 Mk II ..	£15 11 4	£10 19 6
GARRARD AP.75 ..	£23 16 0	£17 19 6
GARRARD SL.55	£13 17 9	£11 12 6
GARRARD SL.65B ..	£18 6 5	£14 9 6
GARRARD SL.75B ..	£35 12 4	£28 19 6
GARRARD SL.95B ..	£45 9 1	£37 19 6
GARRARD 401	£31 14 2	£26 10 0
GARRARD SL.72B ..	£30 2 0	£24 19 6
GARRARD 3500 with GKS Cartridge	£15 15 0	£11 19 6
GOLDRING GL69 ..	£25 1 6	£21 5 0
GOLDRING 69P	£33 11 9	£28 19 6
GOLDRING GL.75 ..	£36 8 2	£29 18 6
GOLDRING 75P	£46 18 8	£38 19 6
GOLDRING Covers for 69P and 75P	£4 4 3	£3 8 0
GOODMANS 3025 ..	£37 14 9	£32 19 6
PHILIPS 228	£18 19 6	£16 19 6
PHILIPS GA146	£29 19 6	£24 16 6
PHILIPS 217	£32 0 9	£27 6 0
PHILIPS 202 Electronic ..	£64 0 0	£54 0 0
THORENS TD.125 ..	£75 17 8	£59 19 6
THORENS 125AB	£120 3 11	£99 19 6
THORENS 150A Mk II ..	£43 12 7	£32 19 6
THORENS 150AB Mk II ..	£47 8 7	£40 19 6
THORENS TD.124/11 ..	£46 15 10	£39 19 6

Bases, plinths, and covers stocked.

SPEAKERS

	Rec. Retail Price	Comet Price
ARENA HT 27	£18 18 0	£13 19 6
ARENA HT 28	£17 17 0	£12 19 6
ARENA HT 21	£10 10 0	£9 5 0
ARENA HT 7	£19 19 0	£17 0 0
ARENA HT 10	£22 1 0	£18 19 6
ARENA HT 20	£32 11 0	£26 19 6
ARENA HT 26	£78 15 0	£65 19 6
B & W DM3	£63 0 0	£53 6 0
B & W P2H	£94 10 0	£79 0 0
B & W DM1	£32 0 0	£25 19 6
CELESTION Ditton 10 ..	£21 3 2	£17 5 0
CELESTION Ditton 15 ..	£29 0 0	£22 10 0
CELESTION Ditton 25 ..	£59 17 0	£49 0 0
DULCI AS 3	£8 8 0	£6 19 6
GOODMANS Majesta ..	£57 0 0	£48 19 6
GOODMANS Maxim ..	£20 7 9	£16 19 6
GOODMANS Mezzo II ..	£30 18 0	£23 10 0
GOODMANS Magnum-K	£40 2 0	£29 19 6
GOODMANS Marimba ..	£24 0 1	£19 19 6
GOODMANS Mambo ..	£22 5 6	£17 19 6
GOODMANS 3005 (pair)	£25 0 0	£21 0 0
KEF Celesta	£29 0 0	£22 10 0
KEF Concord	£43 10 0	£33 19 6
KEF Concerto	£53 10 0	£44 19 6
KEF Cresta	£22 3 4	£19 19 6
LEAK Sandwich	£45 10 0	£34 19 6
LEAK Mini-Sandwich ..	£29 15 0	£22 19 6
LOWTHER Acousta (with PM6)	£45 10 0	£38 7 6
LOWTHER Acousta (with PM7)	£53 0 0	£45 19 6
LOWTHER Ideal Baffle ..	£35 10 0	£29 17 6
QUAD Electrostatic ..	£66 0 0	£52 19 6
PHILIPS RH 481	£11 0 0	£9 2 6
PHILIPS RH 482	£18 0 0	£14 19 6

WHARFEDALE Speakers

	Rec. Retail Price	Comet Price
Airedale	£69 10 0	£57 14 0
Denton	£19 0 0	£14 19 6
Super Linton	£22 10 0	£18 10 0
Melton	£29 10 0	£22 19 6
Dovedale 3	£39 10 0	£29 16 6
Rosedale	£59 10 0	£48 19 6
WHARFEDALE UNIT 3 Speaker Kit	£11 19 6	£9 19 6
WHARFEDALE UNIT 4 Speaker Kit	£16 0 0	£13 10 0
WHARFEDALE UNIT 5 Speaker Kit	£23 10 0	£19 19 6

CHASSIS SPEAKERS

	Rec. Retail Price	Comet Price
GOODMANS Axiette 8 ..	£7 2 1	£5 13 6
GOODMANS Twinaxiette 8	£8 0 7	£6 8 0
GOODMANS Axiom 10 ..	£8 8 0	£6 14 0
GOODMANS Axiom 201	£12 10 0	£9 7 6
GOODMANS Axiom 301	£17 18 0	£13 8 6
GOODMANS Audiom 51	£11 6 0	£8 9 6
GOODMANS Audiom 61	£16 7 0	£12 5 6
GOODMANS Audiom 81	£27 12 0	£20 14 0
GOODMANS Audiom 91	£31 5 0	£23 8 6
GOODMANS Audiom 91/100	£34 17 0	£26 2 9
GOODMANS ARU 180 ..	£3 17 8	£2 18 6
GOODMANS ARU 280 ..	£3 17 8	£2 18 6
GOODMANS ARU 480 ..	£5 8 5	£4 1 3
GOODMANS ARU 172 ..	£3 17 8	£2 18 6
GOODMANS Trebax 100	£7 9 0	£5 11 6
GOODMANS Trebax 5K/20KL	£8 8 0	£6 6 0
GOODMANS Midax ..	£11 4 0	£8 8 0
GOODMANS Attenuator..	£3 1 4	£2 6 0
GOODMANS Crossover Networks XO/950/5000 ..	£8 8 7	£6 6 0
GOODMANS Crossover Networks XO/950 ..	£6 7 9	£4 15 9
GOODMANS Crossover Networks XO/5000	£2 6 0	£1 14 6
WHARFEDALE 8 inch Bronze/RS/DD	£4 8 0	£3 13 6
WHARFEDALE Super 8/RS/DD	£7 12 0	£6 6 0
WHARFEDALE Super 10/RS/DD	£12 14 0	£10 10 0
WHARFEDALE WMT 1 Matching Transformer ..	16 9	13 6

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	Rec. Retail Price	Comet Price
AKAI 150D	£130 2 4	£109 0 0
AKAI X-360	£339 0 0	£284 0 0
AKAI X-360D deck.. ..	£290 0 0	£243 0 0
AKAI 1710	£109 0 0	£85 19 6
AKAI 1800	£158 0 0	£133 0 0
AKAI 1800SD	£199 0 0	£167 0 0
AKAI 4000	£124 18 0	£99 19 6
AKAI 4000 D deck ..	£89 19 5	£72 19 6
ALBA R22 Battery/Mains..	£50 5 0	£29 19 6
BUSH TP 60 Cassette Tape Recorder	£27 15 8	£24 19 6
FERGUSON 3224 Twin Track	£33 14 0	£24 19 6
FERGUSON 3246	£41 14 0	£32 19 6
FERGUSON 3247 4-track ..	£47 1 0	£37 19 6
FERGUSON 3244 Stereo 4-track	£97 18 0	£79 19 6
GRUNDIG C200 Cassette	£37 19 10	£29 19 6
GRUNDIG TK 120 Continental	£39 5 0	£29 19 6
GRUNDIG TK 124 ..	£44 18 0	£34 19 6
GRUNDIG TK 144 ..	£49 19 5	£39 19 6
GRUNDIG 149	£57 12 8	£47 19 6
MARCONI 4218 Stereo tape Recorder	£89 11 2	£69 19 6
PHILIPS 3302 Cassette Tape Recorder	£28 7 0	£21 19 6
PHILIPS 4302 Twin Track Auto.	£35 17 6	£25 19 6
PHILIPS 4307 4-track ..	£49 10 0	£38 19 6
PHILIPS N4404 (4 track stereo)	£83 0 0	£69 19 6
PHILIPS N4407 Stereo ..	£105 0 0	£89 19 6
PHILIPS N4308	£60 10 0	£49 19 6
TELETON FXB 570D Stereo	£52 10 0	£43 19 6
TRUVOX PD 102 Stereo Tape Recorder ..	£114 15 3	£79 0 0

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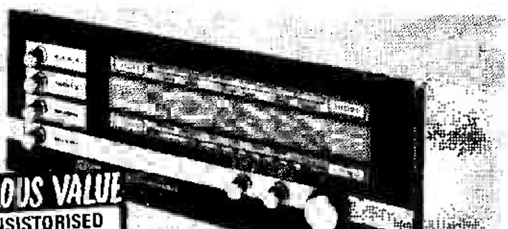

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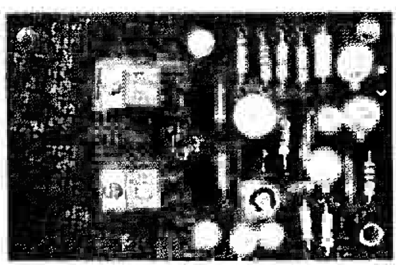

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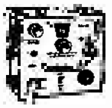
Operation internal batteries Attractive 2-tone case 7½" x 5" x 2". Price £17.10.0. Carr. 3/6.

CLASS D WAVEMETERS



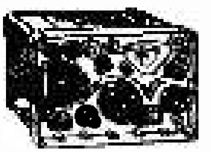
A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.19.6. Carr. 7/6. Or brand new with accessories. £7.19.6. Carr. 7/6.

CLASS D WAVEMETERS No. 2

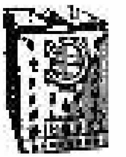
Crystal controlled. 1·2-19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. £12.10.0. Carr. 30/–.

R209 MK II COMMUNICATION RECEIVER

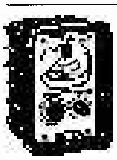
11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier drive, B.F.O. aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked £15.0.0. Carr. 20/–.



TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope. T.B. 2 cps–750 Kc/s. Bandwidth 5.5 Mc/s Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Carriage 30/-



MARCONI T/44/TF956

AF Absorption Wattmeter

1 μ/watt to 6 watts. £20. Carr. 10/–.

SOLARTRON CD 711S2

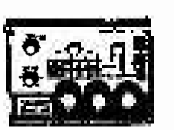
Double Beam Oscilloscopes

D.C. to 9 Mc/s. Perfect order £65. Carr. 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 1.5 cps -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 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £37.10.0. Carr. 10/–.

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



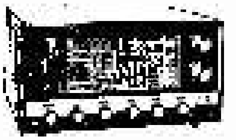
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω–11·1 meg Ω 6 Ranges ±1% L.1 μ H - 111 HENRYS 6 Ranges – 2% C. 10pF ± 1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7½ × 5 × 2in. £20. P. & P. 5/–.

UNR-30 4-BAND COMMUNICATION RECEIVER

Covering 550 Kcs—30 Mc/s. Incorporates BFO. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6. **13 gns.**

TRIO JR.310 New Amateur Band 10–80 Metre Receiver in stock. £77.10.0.

LAFAYETTE SOLID STATE HA600 RECEIVER



5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s-400 Kc/s and 550 Kc/s-30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8½in. Weight 18 lbs. EXCEPTIONAL VALUE. £45. Carr. 10/– S.A.E. for full details.

LAFAYETTE HA-800 SOLID STATE AMATEUR COMMUNICATION RECEIVER

Six bands 3·5–4, 7–7·3, 14–14·35, 21–21 45, 28–29·7, 50–54Mc/s. Dual conversion on all bands. 2 × 455 Kc/s mechanical filters. FET front end, product detector, variable BFO, 100Kc/s crystal calibrator. 'S' Meter. Huge slide rule dial. Operation 230V AC or 12V DC. Size 15 × 9½ × 8½in. Complete with instruction manual. £57.10.0 Carr. Paid. 100Kc/s crystal 39/6 extra.

VARIABLE TRANSFORMERS

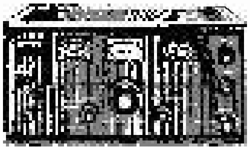
Input 230v. A.C. 50/60 cs.
Output variable 0–260v.

	BENCH MOUNTING			
1 amp	£5.10.0.	8 amp	£14.10.0.
2½ amp	£6.15.0.	10 amp	£18.10.0.
5 amp	£9.15.0.	20 amp	£37. 0.0.
	PANEL MOUNTING		
1 amp	£5.10.0.	2½ amp	£6.12.6.

B.C. 221 FREQUENCY METERS

latest release
125 KHz—20 MHz
Excellent condition
Fully tested and checked and complete with calibrator charts.
£27.10.0 each. Carr. 10/–

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE



4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit, 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1.5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size 7 × 15 × 10in. With instruction manual and service data. £42, carriage paid. **TRIO COMMUNICATION TYPE HEADPHONES.** Normally £5.19.6. OUR PRICE £3.15.0 if purchased with above reciever.

TRIO JR. 500SE 10-80 Metre Receiver £69.10.0

TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £212. IN STOCK!

RCA COMMUNICATIONS RECEIVERS AR88D

Latest release by ministry BRAND NEW in original cases. 110-250v. A.C. operation. Frequency in 6 Bands. 535 Kc/s—32 Mc/s continuous. Output impedance 2·5-600 ohms. Incorporating crystal filter. noise limiter, variable BFO, variable selectivity, etc. Price £65.0.0. Carr. £2.

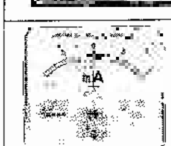
LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

A completely new transistorised receiver covering 152–174 Mc/s. Fully tunable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. £37.10.0. Carr. 10/–.

TELETON CR-10T AM/FM STEREO TUNER AMPLIFIER

A new model from Teleton. 31 solid state devices. 4 + 4 watt output. Inputs for ceramic/crystal cartridge. Frequency range AM 540–1600KHz FM 88–108MHz. Automatic FM Stereo reception. Stereo Indicator. Controls: Tuning, function selector, Tone and R & L volume controls. AFC switch. Stereo headphone socket. Size 13½" × 3½" × 9½" approx. PRICE £34.0.0. Carr. 7/6.

CLEAR PLASTIC PANEL METERS



First grade quality Moving Coil panel meters. Type MR 38P. 1 21/32 in. square fronts.

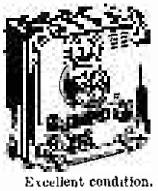
50μA 40/–	.500-0-500μA 27/6	50mA 27/6	150V. D.C...27/6
50-0-50μA 37/6	1mA 27/6	100mA 27/6	300V. D.C...27/6
100μA 37/6	1-0-1mA ...27/6	150mA 27/6	500V. D.C...27/6
100-0100μA 35/–	2mA 27/6	200mA 27/6	750V. D.C...27/6
200μA 35/–	5mA 27/6	300mA 27/6	15V. A.C....27/6
500μA 40/–	10mA 27/6	500mA 27/6	50V. A.C. ..27/6
	750mA 27/6	3V. D.C. ..27/6	150V. A.C...27/6
	1 amp......27/6	10V. D.C. ..27/6	300V. A.C...27/6
	2 amp 27/6	15V. D.C. ..27/6	500V. A.C...27/6
	5 amp 27/6	20V. D.C. ..27/6	S meter 1mA 32/–
	20mA 27/6	100V. D.C. ...27/6	VU meter ..42/–

FULL RANGE OF OTHER SIZES IN STOCK. SEND S.A.E. FOR LEAFLET

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid.
High quality construction. Input 230V. 50–60 cycles.
Output full variable from 0-260 volts. Bulk quantities available.
1 amp.—£5.10.0; 2·5 amp—£6.15.0; 5 amp—£9.15.0;
8 amp.—£14.10.0; 10 amp.—£18.10.0; 12 amp—£21.0.0;
20 amp.—£37.0.0.

CRYSTAL CALIBRATORS NO. 10



Small portable crystal controlled wavemeter. Size 7 × 7½ × 4in. Frequency range 500 Kc/s-10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300V. D.C. 15mA and 12V. D.C. 0.3A. Excellent condition. 89/6. Carr. 7/6.

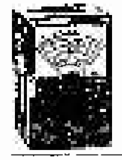
TE-40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100 300V. R.N.S. 4cps.-1·2 Mc/s. Decibels –40 to +50dB Supplied brand new complete with leads and instructions Operation 230V. A.C. £17.10.0 Carr. 5/–.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0–20 Kc/s. on 2 ranges. Output 500 Ω or 5k Ω. Operation 200/250V. A C Supplied in perfect order. £12.10.0 Carr. 10/–.

TE-65 VALVE VOLTMETER

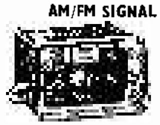


High quality instrument with 28 ranges. D.C.volts 1·5—1,500v. A.C. volts 1·5—1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions. £17.10.0. P. & P. 6/–. Additional probes available: R.F. 42/6. H.V. 50/-

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

D.C. coupled. Band width 1Kc/s. Perfect order. £25. Carr. 30/–.

AM/FM SIGNAL GENERATORS

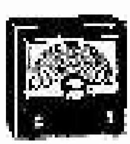


Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1μV-100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. 20/–.

EDDYSTONE VHF RECEIVERS Model 770R. 19–165 Mc/s. Excellent condition. £150.

RUSSIAN C1-16 DOUBLE BEAM OSCILLOSCOPES

5 MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated triggered sweep from 2 sec to 100 milli sec/cm. Supplied complete with all accessories and instructions £87. Carr. paid



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. 5½ × 5½ × 3½in. Complete with instructions and leads. £7.19.6. P. & P. 4/–.

HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES

Features unique mechanical 2 way units and fitted adjustable level controls. 8 ohm impedance. 20–20,000cps. Complete with spring lead & stereo jack plug £7.19.6. P. & P. 2/6.

AUTO TRANSFORMERS

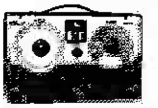
0/115/230V. Step up or step down. Fully shrouded.

150 W.	£2. 2.6.	P. & P. 3/6.
300 W.	£3. 5.0.	P. & P. 4/6.
500 W.	£4.10.0.	P. & P. 6/6.
1,000 W.	£6.10.0.	P. & P. 7/6.
1,500 W.	£7.19.6.	P. & P. 8/6.
7,500 W.	£15.10.0.	P. & P. 20 –.

G. W. SMITH & CO (RADIO) LTD

Also see oppos. page

ARF-100 COMBINED AF-RD SIGNAL GENERATOR



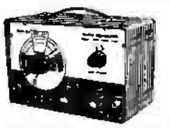
A.F. SINE WAVE 20 – 200,000 c/s. Square wave 20–30,000 c/s. O/P. HIGH IMP. 21V. P/P600 Ω 2.8V. P/P TF 100 Kc/s-300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V. A.C. £32.10.0. Carr. 7/6.

TE-20 RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V a.c. Brand new with instruction. £15.0.0. P. & P. 7/6. S.A.E. for details.

PEAK-SOUND PRODUCTS. Full range of Amplifiers, Kits, Speakers, in stock.

TE22 SINE SQUARE WAVE AUDIO GENERATORS



Sine: 20c/s to 200 kc/s on 4 bands. Square: 20c/s to 30 kc/s. Output impedance 5,000 ohms. 200/250V A.C. Supplied brand new and guaranteed with instruction manual and leads. £18.10.0. Carr. 7/6.

MARCONI TF142E DISTORTION FACTOR METERS. Excellent condition. Fully tested. £20. Carr. 15/-.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 pF-2000 mFd 2 ohms 200 meg-ohms. Also checks impedance, turns ratio, insulation. 200/250V. A.C. Brand New £17.10.0 Carr. 7/6.

TO-2 PORTABLE OSCILLOSCOPE

A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS-1 MHZ. Input imp. 2 meg Ω 25 P.F. Illuminated scale. 2in. tube. 115 × 150 × 230mm. Weight 5lb. 220/240 V a.c. Supplied brand new with handbook. £22.10.0. Carr. 10/-.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons

J1B. AUDIO SIGNAL GENERATOR. 15 c/s to 50 Kc/s. Sine wave. Output 600 ohms or 5 ohms £30.0.0.

VM79. UHF MILLIVOLT METER. 100 Kc/s to 1,000 Mc/s. AC 10mV to 3v. DC. 10 mV to 3v. Current 0.01 uA to 0.3 mA. Resistance 1 ohm to 10 megohm. £125.0.0.

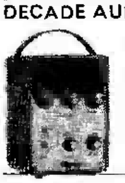
TT15. TRANSISTOR TESTER. Full range of facilities for testing PNP or NPN transistors in or out of circuit. £37.10.0.

Carriage 10/- per item.

HOSIDEN DH04S 2-WAY STEREO HEADSETS

Each headphone contains a 2½in. woofer and a ½in. tweeter. Built in individual level controls. 8 Ω imp. 25-18,000c/s with cable and stereo plug. £5.19.6. P. & P. 2/6.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



New high quality portable instrument. Sine 1 Hz to 100 KHz. Square 20 Hz to 20 KHz. Output max + 10 dB (10 K ohms). Operation 220/240v. A.C. Size 215mm x 150mm x 120mm. Price £27.10.0. Carr. 5/-

GARRARD

FULL CURRENT RANGE OFFERED BRAND NEW AT FANTASTIC SAVINGS

1025 stereo	£7.19.6	SL72B	£25.0.0
40 Mk II stereo	£8.9.0	AP75	£16.19.6
2025T/C stereo	£8.17.6	SL75	£25.19.6
3000 stereo	£9.19.6	SL75B	£28.0.0
SP25 Mk II	£11.9.6	SL95B	£35.0.0
SL55	£11.12.6	A70/11	£11.19.6
SL65B	£14.19.6	401	£25.0.0

Carriage 7/6 extra each item.

TEAK PLINTHS & PERSPEX COVERS

1. For SP25, SL65, SL55, 3000, 2025 T/C 2025, 1000. £4.10.0
2. For AP75, SL75, SL95 £5.19.6.
3. For SP25 etc. to operate with lid in place £5.19.6.

Carriage 7/6 extra each type. Full range of Garrard accessories available.

SPECIAL OFFERS!

Garrard SP25 fitted Goldring G800 cartridge and wooden plinth. Total list price £22.8.6.

OUR PRICE £19.15.0 Carr. 10/-

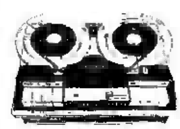
GOLRING GL69 fitted Goldring G800 cartridge complete with de-luxe base and cover.

Total list price £50.16.0.

OUR PRICE £39 Carr. 10/-

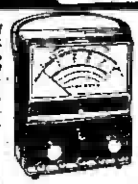
RTC249 4-TRACK TAPE DECK

British Made Speeds 1⅞", 3¾", 7½" P.S. Marriott Heads. 7" reel size. Push Button controls, fully interlocking. Size 13" + 10" + 1¾" above unit plate. 4½" below. Full instructions. £13.19.6 Carr. 7/6



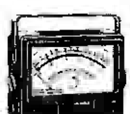
MULTIMETERS for EVERY purpose!

TE-51. NEW 20,000 Ω/VOLT MULTIMETER with overload protection, and mirror scale. 0/6/60/120/1,200v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0.60μA/12/300mA. D.C. 0/60K/6 meg. ohm. 92/6. P. & P. 2/6



TE-900 20,000 Ω/VOLT GIANT MULTIMETER mirror scale and overload protection, 6in. full view meter. 2 colour scale. 0/2.5/10/250/1,000/5,000 v. A.C. 0/25/12.5/10/50/250/1,000/5,000v. D.C. 0/50μA/110/100/500mA/10 amp. D.C. 02K/200K/20 MEG. OHM. £15. P. & P. 5/-.

MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v D.C. 0/6/30/120/300/600v A.C. 0/10μA/6/60/300 mA/12 amp. 0/2K/200K/2M/200M Ω. -20 to + 17dB. £12.10.0. P. & P. 3/6.

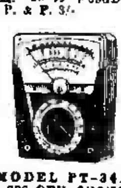


LAFAYETTE 57 Range Super 50k Ω/volt Multimeter D.C. volts 12 mV –1000V. A.C. volts 1.5V –1000V. D.C. current 25μA–10 amp. Ohms 0–10meg Ω dB –20 to +81 dB. Overload protection £12.10.0. Carr. 3/6.

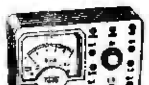
MODEL TE-90 50,000 OPV mirror scale overload protection 0/3/12/60/300/600/1200v. D.C. 0/6/30/120/300/1200v. D.C. .03/6/60/600 mA. D.C. 16K/160K/1.6/16meg Ω. -20 to +63dB. £7.10.0. P. & P. 3/-.

MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/.6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200 V A.C. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. –20 to + 63 db £5.19.6. P. & P. 3/-

MODEL TE-70. 30,000 OPV. 0/3/15/60/300/600/1200v D.C. 0/6/30/120/600/1200v A.C. 0/30μA/3/30/300mA. 0/16K/160K/1.6M/16 Meg. Ω £5.10.0. P. & P. 3/-.



MODEL TE-12 20,000 O.P.V. 0/0.6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF. 0.2mFd. £5.19.6. P. & P. 3/6.



MODEL PT-34. 1,000 OPV. 0/10/50/250/500/1,000v AC and D.C. 0/1/100/500mA D.C. 0/100K Ω. 39/6. P. & P. 1/6.

SAVE UP TO 33⅓% OF HI-FI EQUIPMENT
Send for discount price list

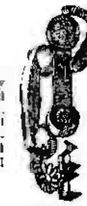
AVO CT471A MULTIMETER

Battery operated, fully transistorised. Sensitivity 100mΩ/v. Measures AC/DC Voltages 12mV to 1,200v. AC/DC Current 12uA to 1.2 Amp. Resistance 12 ohm to 120 mΩ. HF, VHF, UHF Voltage with multiplier 4v to 400v up to 50 Mc/s. 40mV to 4v up to 1,000 Mc/s.

Offered in perfect condition.

£55 each. Carr. 10/-

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM



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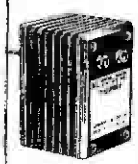

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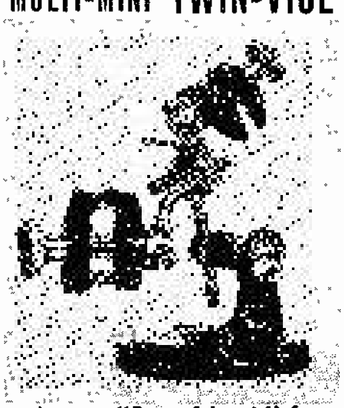

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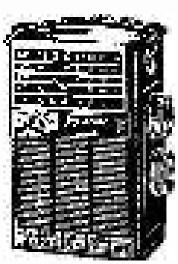

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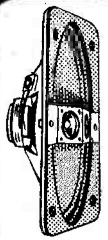

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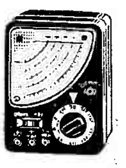
C.1001 MULTI-TESTER



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LIND-AIR PRICE **49 GNS.** Carr. 30

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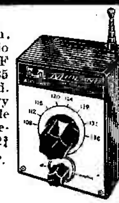
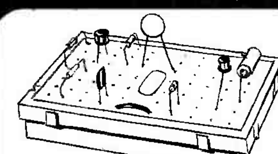


When placed within 1in. of a MW band radio full coverage of VHF Aircraft Band 108-135 Mc/s. can be obtained. All transistor. 9v battery operation. Fully tunable 18½in x 7 section telescopic aerial. Size 4 x 2¾ x 1½in. **79/6** P. & P. 3/6.

62 D. MULTI-TESTER

20,000 p.p.v. DC voltage 5 - 25 - 50 - 250 - 500 - 2. 5 K (20,000 ohms per volt). AC voltage: 10-50-100-500-1000 volts (10,000 ohms per volt). DC Current: 0-50 uA, 0-2.5 mA, 0-250 mA. Resistance; 0-6K, 0-6 Mg (300 ohm and 30K at centre scale). Capacitance: 10f. to .001 mfd. .001 uf to .1 uf. Decibels: —20 to + 22dB. Size 4½ x 3½ x 1in. **71/-** P. & P. 3/6.

S-DEC BREADBOARD



British Made

Solderless breadboard panels, for fast reliable component connections.

Single DeCs. One S-DeC with Control Panel, Jig and Accessories for solderless connections to controls, etc., with booklet "Projects on S-DeC" giving construction details for a variety of circuits. 29/6. P. & P. 2/6.

4-DeC KIT. Four S-DeCs with two Control Panels, Jigs and Accessories and the booklet "Projects on S-DeC" all contained in a strong attractive plastic case. Ideal for the professional user. £5.17.6. P. & P. 3/6.

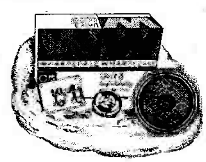
T-DeC KIT £5.17.6. P. & P. 3/6.

LIND-AIR LA.20

A fantastic stereo amplifier made exclusively for Lind-Air and represents considerable advance in solid state stereo amplifiers. Inputs for gram and radio tuner and provision for direct tape recording. Attractive and modern panel with bass, treble balance and volume controls also on/off and stereo/mono switch. Output 5W per channel music power. Frequency response 40-20,000Hz 8-16 ohm speaker matching. Size 16½" × 14" × 4".

LIND-AIR PRICE **£24** P. & P. 10/-.

WHARFEDALE SPEAKER KITS



Complete with all components for building into suitable cabinets.

Unit 3 Kit £11.19.6 each £21 per pair
Unit 4 Kit £16.0.0 each 28gns. per pair
Unit 5 Kit £23.10.0 each 39gns. per pair

P. & P. 10/- each 15/- pair

TELETON SAQ203 TRANSISTOR STEREO AMPLIFIER

Superb quality hi-fi. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble. Attractive oiled walnut cabinet and brushed aluminium front panel. List Price £28.7.0

LIND-AIR PRICE **22 Gns.** P. & P. 10/-.

Garrard HI-FI TURNTABLES

2025 T/C with stereo cartridge ..	£8.19.6
3000 with Sonotone 9TAHCD stereo cartridge......	£10.19.6
SP25 Mk II	£10.19.6
SL65B	£15.19.6
Base and cover for above	£5.19.6
AP75	£18.10.0
SL72B	£24.19.6
SL75B	£28.7.0
SL95B	£39.9.0
401	£28.10.0
Base and cover for above	£8.19.6

P. & P. Decks 12/6. Base & Cover 10/- Deck/Base/Cover 17/6.

SPECIAL OFFERS!

SP25 MkII with base £14.10.0. P.&P. 15/-.

SP25 Mk II with Sonotone 9TAHCD cartridge and base £15.15.0. P. & P. 15/-

Sonotone 9TAHCD cartridge £2.15.0 P. & P. 1/6.

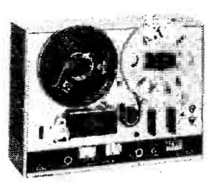
SINCLAIR IC-10 INTEGRATED CIRCUIT

10 watt Amplifier. Size only 1 x 0.4 x 0.2in. A true hi-fi amplifier complete with manual giving details of a wide range of applications and instructions. Guaranteed 5 years.

ONLY **59/6** P. & P. 1/6.

SPECIAL TRANSFORMER FOR OPERATING SINCLAIR IC-10 from A.C. mains 230/250v. Output 13v. at 0.5 amp. **16/6** P. & P. 2/6.

SAVE ON AKAI !



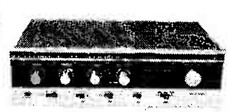
AKAI 4000 Stereo Tape Recorder List Price £124.18.0 (as illus.)

OUR PRICE **99 Gns.** Carr 30/–

AKAI 4000D STEREO TAPE DECK List Price £89.19.1

OUR PRICE **69 Gns.** Carr 30/-

SPECIAL LIND-AIR OFFER!



ROTEL 100 AMP STEREO AMPLIFIER. Fully transistorised with all facilities for the home hi-fi system. List price £45

LIND-AIR PRICE **£37.10.0.** Carr. 10/-

18/19, 25 & 53 TOTTENHAM CT. ROAD, LONDON W.1.
Telephone: 01-580 2255/4532/7679
Open 9-6 pm. Monday to Saturday. Thursday until 7 pm.

All Mail Orders and correspondence to Dept L5/8, Kirkman House, 54a Tottenham Court Road, London, W.1. Tel: 01-580 7041/2.

R.S.C. SENSATIONAL HIGH FIDELITY STEREO 'PACKAGE' OFFERS

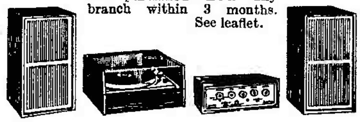
★ Super 30 Amplifier (15+15 watt) in veneered housing
★ Goldring Transcription Turntable on Plinth
★ Shure or Goldring Magnetic Pick-up Cartridge
★ Pair of Stanway II Loudspeaker Units
Special total price. Four fully wired units ready to "plug-in". Carr. 30/-. **86 Gns.**

TA12 Amplifier (6·5+6·5 watt) in veneered housing. Garrard 3000 4 sp. Autochanger unit on plinth. Sonotone 9TA P.U. cartridge. Pair of Dorchester Loudspeaker units. Special Total Price **47½ Gns.** Carr. 25/-.

Or Dep. £9 and 9 monthly payments. £5.4.9 (Total £56.2.9). Transp. plastic cover 3 *gns.* extra.

Matching as recommended for optimum performance. Send for coloured brochure showing other money-saving offers.

Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.



EXTREMELY ATTRACTIVE PLINTHS finished in Teak or Afrormosia veneer. Trans plastic cover.

★ Super 30 amplifier (15+15 watt) in veneered housing
★ Garrard SP25 Mk II Turntable on Plinth
★ Goldring CS90 Ceramic P.U. Cartridge with diamond stylus
★ Pair Stanway II Speaker Units
Four fully wired units ready to "plug-in". Special total price **76 Gns.** Carr. 30/-.

● TA12 Amplifier (6·5+6·5 watt) in veneered housing
● Garrard SP25 Mk II 4 sp. player unit on plinth
● Goldring CS90 Ceramic P.U. Cartridge
● Pair of Dorchester Loudspeaker Units.
Special total price **53gns.** Carr. 25/-.
Or Dep. £10.0.3 and 9 mthly. payments £5.15.5 (Total 59 gns.). Transparent plastic cover 3 gns. extra.
TERMS AVAILABLE ALL PACKAGE OFFERS

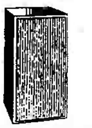
AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. 'L' indicates Roll Rubber cone surround. Impedance 3 or 15 ohms. Please state choice. Exceptional performance at low cost.

HF510L	5"	10W	49/9	HF120	12"	15W	79/9
HF801D	8"	8W	54/3	HF120D	12"	15W	89/9
HF102D	10"	10W	67/11	HF126	12"	15W	£5.5.0
HF100D	10"	15W	£4.19.9	HF126D	12"	15W	£5.15.0
HF105DL	10"	10W	6gns.				

HIGH FIDELITY LOUDSPEAKER UNITS

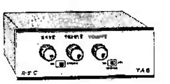
Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled acoustic damping. Ported where appropriate, credit terms available.



DORCHESTER Size 16 x 11 x 9in. appr. Range 45–15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13x8in. Dual Cone spkr. Imp. 3 or 15 ohms. **£8.19.9** Carr. 7/6

STANWAY II Size 20x10¾x9¼in. approx. Rating 10 watts. Inc. Fane 13x8in. speaker with highly flexible cone surround, long throw voice coil and 11,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35–20,000 c.p.s. Imp: 15 ohms. Gives smooth realistic sound output. **16 Gns.**

R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER



200-250v. AC mains operated. Frequency Response 30–20,000 c.p.s. −2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3–15 ohm spkrs. Max. sensitivity 5mV. Output rating I.H.F.M. Fully enclosed enamelled case, 9½x2¾x5½in. Attractive brushed silver finish facia plate 10½ x 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **7 Gns.** Carr. 7/6
OR FACTORY BUILT with 12 months' guarantee. £8.19.9

RECORD PLAYING UNITS

Money saving units. Mounted on Plinth. Supplied with transparent plastic cover. Ready to plug into Amplifier or Tape recorder.

RP2C Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Carr. 9/6 **£24.12.6**

RP5C Garrard 2025 Auto Unit fitted Garrard GCS 23 Stereo Cartridge with diamond tip, Plinth & Cover as RP2C carr. 9/6. **15 Gns.**

Other types available with Magnetic cartridges and with alternative design plinths.

Limited Number of CLEARANCE LINES in leading makes of Hi-Fi equipment at Branches only

R.S.C. PLINTHS

for Record Playing units, cut for Garrard 1025, 2025, 3000, AT60, SP25 etc.

AVAILABLE WITH **3 gns.**
TRANSPARENT PLASTIC COVER **6 gns.**

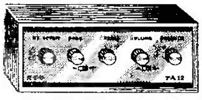
INTEREST CHARGES REFUNDED
On Credit Sales settled in 3 months.

LINEAR L10 HIGH FIDELITY 10W AMPLIFIER **10 Gns.**

with separate Pre-amp Magnetic P.U. matching. To clear

R.S.C. TA12 MKII 6·5 + 6·5 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 6.5 WATTS PER CHANNEL

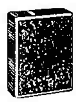


Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3–15 ohms ★ For 200–250v. A.C. mains ★ Frequency Response 30–20,000 c.p.s. −2dB ★ Harmonic Distortion 0.3% at 1000 c.p.s. Hum and Noise −70dB ★ Sensitivites (1) 300mV (2) 50mV (3) 100mV (4) 2mV. Output rating I.H.F.M. ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams & instructions. **13½ Gns.** Car. 7/9.
FACTORY BUILT with 12 mth gntee 17 Gns or Deposit £5.2.6 and 9 mthly pymts 34/- (Total £20.8.6). Or in Teak or Afrormosia veneer housing 20½ Gns.Dep. £5.10.6 and 9 monthly payments £2.1.7 (Total £24.4.9).

AUDIOTRINE HI-FI SPEAKER SYSTEMS

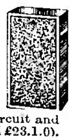
Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5.15.0** Carr. 5/9
OR SENIOR 15 WATT INC. HF126 15,000 line 15ohm Speaker £6.15.0. Carr. 6/6

HI-FI SPEAKER ENCLOSURES



Teak or Afrormosia veneer finish. Modern design. Acoustically lined. All sizes approx. Carr. 5/- per enclosure
JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **£4.14.6**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Ported **£5.15.0**
SE10 For outstanding results with 10in. Hi-Fi 'spkr Size 24x15x10in. P'td. **£5.19.9**
SE12 For exclnt prfmnce with 12in. Hi-Fi speaker and Tweeter. Size 25 x 16 x 10½in. **£6.19.9**

THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM



★ Moderate size, only 25×14×10in. COMPLETE KIT **20 Gns**
★ Response 30-20,000 c.p.s. Impedance 15 ohms
★ Performance comparable with units costing considerably more. Carr. 12/6
Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material (6) Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £5.10.6 and 9 monthly payments 39/- (Total £23.1.0).
DEMONSTRATIONS AT ALL BRANCHES

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

★ High-sensitivity. ★ 200-250v. A.C. Mains operation. ★ Sharp A.M. Rejection× ★ Drift-free reception. ★ Output ample for any amplifier (approx. 500 m.v.). ★ Output for feeding Stereo Multiplexer. ★ Tuner head using silicon Planar Transistors. ★ Designed for standard 80 ohm co-axial input. Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. Printed circuitry. A quality product at considerably less than the cost of comparable units. Factory built 18 *gns.* Or in Teak finished cabinet as illustrated 21 *gns.* Terms: Deposit £6.1.0 and 9 monthly payments. 2*gns.* Total £24.19.0. Stereo version. 23½ *gns.* Carr. 10/6 extra

R.S.C. SUPER 30 MK II HIGH FIDELITY STEREO AMPLIFIER

High Grade Components Specifications comparable with units costing considerably more.

TRANSISTORS 9 high quality types in each channel.
OUTPUT 10 Watts R.M.S. continuous into 15 Ω (per channel). 15 Watts R.M.S. continuous into 3 Ω.
INPUT SENSITIVITIES Mag. P.U. 4 mV. Ceramic P.U. 35 mV. Tape Amp. 400 mV. Aux. 100 mV. Mic. 5 mV. Tape Head 2.5 mV.
FREQUENCY RESPONSE ± 2 dB. 10–20,000 c.p.s.
TREBLE CONTROL +17 dB to −14 dB at 10 Kc/s.
BASS CONTROL +17 dB to −15 dB at 50 c/s.
HUM LEVEL −80 dB.
HARMONIC DISTORTION 0.1% at 10 watts 1,000 c.p.s.

Employing Twin Printed Circuits. 200/250v. A.C. mains operation.
CROSS TALK 52 dB at 1,000 c.p.s.
CONTROLS 5 Position Input Selector. Bass, Treble, Vol., Bal., Stereo/Mono Switch, Tape Monitor Switch, Mains Switch.
INPUT SOCKETS (1) P.U. (2) Tape Amp. (3) Radio, (4) Mic. or Tape Head. (Operation of Input Selector assures appropriate equalisation).
CHASSIS Strong Steel construction. Approx. 12 x 3 x 8in.

FACIA PLATE Attractive design in rigid plastic silver background black lettering. Silver finish matching control knobs as available.
Eminently suitable for use with any make of pick-up or Mic. (Ceramic or Magnetic, Moving Coil, Ribbon or Crystal) currently available. Superb sound output quality can be obtained by use with first rate ancillary equipment.

COMPLETE KIT OF PARTS **22 gns.**
Point to point wiring diagrams and detailed instructions. Carr. 15/-

UNIT FACTORY BUILT **29 gns.**
With 12 months guarantee. or Deposit £7.5.0 and 9 monthly payments 58/9 (Total £33.13.9) or in Teak or Afrormosia veneer housing 32 Gns. Carr. 15/-. Terms: Deposit £7.3.6 and 9 monthly payments of 66/6 (Total £37.2.0). Send S.A.E. for leaflet.

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1
An all-dry battery eliminator. Size 5½ x 4¼ x 2in. approx.
Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 52/6 or ASSEMBLED 3 Gns.

SUPER 15 HIGH FIDELITY SOLID STATE AMPLIFIER

Approx. as Super 30 but single channel. Complete kit with full constructional details and point to point wiring diagrams. **12½ gns.** Carr. 12/6
OR FACTORY BUILT 15½ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9) Available in Teak or Afrormosia veneered housing.19gns.

PARTRIDGE "JOYSTICK" SHORT WAVE AERIALS AND TUNERS AT ALL BRANCHES (S.A.E. for full list)

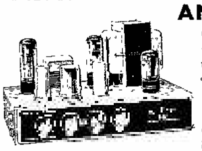
BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
BLACKPOOL (Agent) O. & C. Electronics, 227 Church Street
BIRMINGHAM 30/31 Gt. Western Arcade 021-236-1279 (Half-day Wed.)
DERBY 26 Osmaston Rd., The Spot (Half-day Wed.) Tel. 41361
DARLINGTON 18 Priestgate (Half-day Wed.) Tel. 68043
EDINBURGH 133 Leith St. (Half-day Wed.) Tel. Waverley 5766
GLASGOW 326 Argyle St. (Half-day Tues.) Tel. CITy 4158
HULL 91 Paragon Street (Half-day Thursday) Tel. 20505

R·S·C HI-FI CENTRES LTD.

MAIL ORDERS TO: Audio House, Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries.
Branches open all day Sats.
MAIL ORDERS MUST NOT BE SENT TO SHOPS

32 High Street (Half-day Thurs.) Tel. 56420 **LEICESTER**
5-7 County (Mecca) Arcade, Briggate (Half-day Wed.) Tel. 28252 **LEEDS**
73 Dale St. (Half-day Wed.) Tel. CENtral 3573 **LIVERPOOL**
238 Edgware Road, W2 (Half-day Thurs.) Tel. PAD 1629 **LONDON**
60A Oldham Street (Half-day Wed.) Tel. CENtral 2778 **MANCHESTER**
106 Newport Rd. (Half-day Wed.) Tel. 47096 **MIDDLESBROUGH**
41 Blackett Street (Opp Fenwicks Store) (Half-day Wed.) Tel. 21469 **NEWCASTLE UPON TYNE**
13 Exchange Street (Castle Market Bldgs.) (Half-day Thursday) Tel. 20716 **SHEFFIELD**

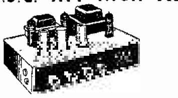
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output, with Pre-amp. Tone Control Stages. Performance figures of factory built units: Hum level—70dB. Frequency response ± 3dB 30-20,000c/s. Sectionally wound output transformer. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36mV. Suitable for high impedance microphones. Crystal or Ceramic P.U's. Designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor** Functions, etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram, Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. **15 Gns.** Carr. 12/6

Twin-handled perforated cover **35/-.** Supplied factory built with EL34 output valves. 12 months' guarantee for **18 gns. TERMS: Deposit £6.3.0** and 9 monthly payments of **34/-** (Total **£21.9.0**). Send S.A.E. for leaflet.

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER

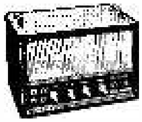


PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with mixing facilities High sensitivity, 5 valves. Independent Bass and treble controls. Frequency response ± 3dB 30-20,000 c/s. Hum level —60dB. Sensitivity 40 millivolts. For Crystal or Ceramic PUs. High Impedance "mikes". For Musical Instruments etc. Std. AC mains. For 3 & 15 ohm spkrs. SAE for leaflet. Complete kit. Full instructions and point-to-point wiring diagrams. Carr. 11/6. Twin handled metal cover **35/-.** Price Factory built **13½** *gns.* or Deposit **99/6** and 9 monthly payments of **26/-** (Total **£16.13.6**). **9½ Gns.**

RSC A11T TRANSISTORISED VERSION of above complete kit **9 Gns.** (Assembled **13 Gns.**)

30 WATT HI-FI AMPLIFIER

FOR GUITAR, VOCAL OR INSTRUMENTAL GROUP



A 4 input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. B.V.A. valves. Peak output rating. Strong **R**exine covered cabinet with handles. Attractive black/gold facia panel. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **19 Gns.** Carr 12/6

Dep. **5 gns.** & 9 monthly payments of **39/8** (Total **22 gns**)

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 years' guarantee. High flux ceramic magnets. Heavy cast chassis. All prices carr. free

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt	15" 60 Watt	12" 50 Watt
14,500 gauss 8/15Ω	14,000 gauss 8/15Ω	14,000 gauss 15Ω
21 GNS.	12 GNS.	10 GNS.

FANE LOUDSPEAKERS

'POP' 30C

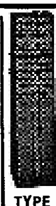
12" 25 Watt Dual cone 15Ω

£5-19-9 Carr. free

F.A.L. P.A. AMPLIFIERS PHASE 50 **29 GNS.** PHASE 100 **59 GNS.**

S.A.E. for leaflets.

R.S.C. COLUMN SPEAKERS



Covered in Rexine and Vynair, ideal for vocalists and Public Address. 15 ohm matching.

R·S·C HI-FI CENTRES LTD.

TYPE C48S 25/30 WATTS. Fitted four 8in. high flux 8 watt speakers. Overall size approx. 48 x 10 x 5in.

16 Gns. Carr. 10/-.

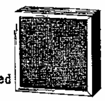
Or deposit **67/-** and 9 monthly payments **34/9** (Total **£18.19.9**).

TYPE C412S 50 WATTS. Fitted four 12in. 11,000 line 15 watt speakers. Overall size 56 x 14 x 9in. approx.

26 Gns. Carr. 15/-

Or Deposit **£5.17.6** and 9 monthly payments of **54/6** (Total **£30.7.0**)

HIGH QUALITY LOUDSPEAKERS



In Teak or Afrormosia veneered Cabinets

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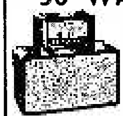

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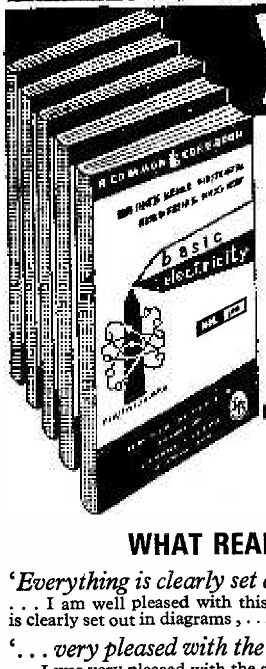

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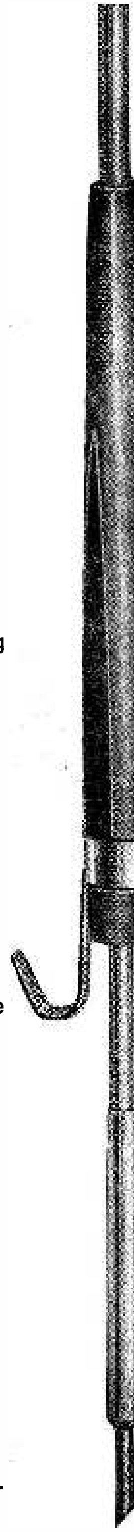

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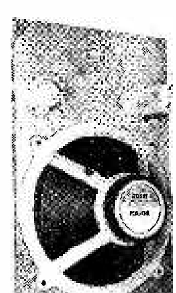

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400	2/6	5/6	7/6	25/–
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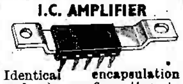

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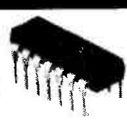

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UIC20 = 5 × 7420N	..10/–	UIC74 = 5 × 7474N	..10/–	UIC94 = 5 × 7494N	..10/–
UIC40 = 5 × 7440N	..10/–	UIC75 = 5 × 7475N	..10/–	UIC95 = 5 × 7495N	..10/–
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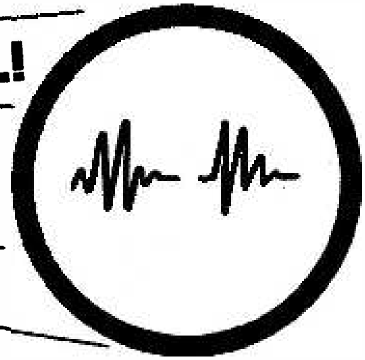

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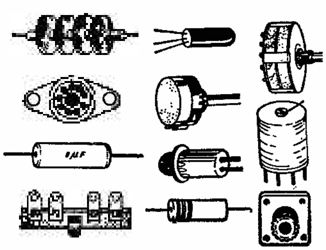

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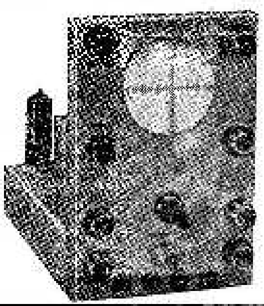

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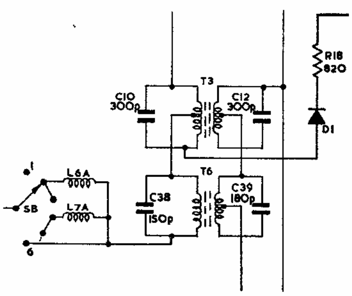

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PRACTICAL WIRELESS

VOL 46 NO 4

Issue 762

AUGUST 1970

TOPIC OF THE MONTH

Learn while you build

EXPERT gardeners are said to have 'green fingers' which implies that they have some magic touch. In the same way, there are service technicians who, seemingly by some sort of telepathy, have an uncanny knack of quickly looking over a faulty piece of equipment, then pointing an accusing finger and saying "C5 has gone down".

The same kind of thing happens in the area of amateur home construction. Some seem to have it, others do not. But although it is obvious that some constructors are neater and cleverer than others, and some people can "de-bug" a project quicker and more effectively than others, it would be wrong to put this down to fate or any other ethereal influence.

Real success in such realms as radio construction is rarely accidental; it is usually achieved only by a combination of common sense and thoughtful application. An enthusiast passes the barrier between the absolute novice and competent constructor when he begins not only to build equipment but starts to puzzle out exactly what each component does and what effect each component has on others. Only by acquiring a solid working knowledge of each individual item will the enthusiast be able to get the optimum performance from his project and to clear up any troubles which may subsequently arise.

One often hears that certain pieces of equipment, such as portable transistor radio receivers, use "standard circuits". This may appear to be superficially true, but in actual practice, variations are legion. These may be minor in character, the basic "blocks" being almost identical, but it is these minor variations which (if fully understood) will give the enquiring hobbyist a much better insight into the whys and wherefores of circuit design.

Basic circuitry can be learnt from text books, but no amount of reading will substitute for practical work; on the other hand practical work will not advance the constructor's knowledge unless he takes the trouble to work out what a circuit is, what it is supposed to do, and how. He should want to know why a certain component is where it is, and why it has a certain value. He should also want to know what might happen should that component become faulty.

W. N. STEVENS—*Editor.*

SEPTEMBER ISSUE WILL BE PUBLISHED ON AUGUST 7

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

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

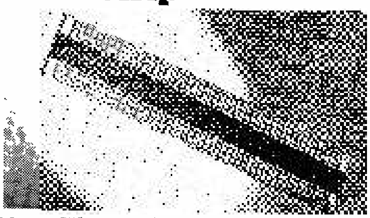
Listeners Club Ceases

Now in its fourth year of service, the Listeners' Club of Radio New York Worldwide has ceased operation.

Irwin Belofsky, the President of the Club, says that they have found it impossible to continue publishing *Radio Worldwide*, their magazine, without a tremendous financial loss. It is a loss incurred through rising costs in postage, print, etc., and these could not be covered through membership dues or advertising.

All Listeners Club members with unexpired subscriptions will, however, receive the balance of their membership in issues of a new publication, *Radio Today*.

Vero Strip



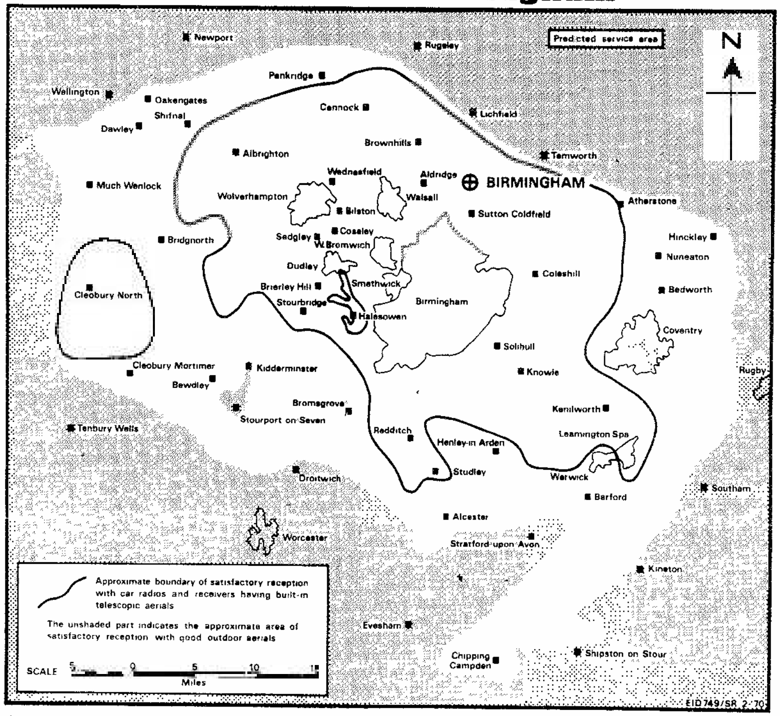
Vero Electronics Ltd., of Chandler's Ford, Hampshire, have recently introduced a new type of terminal board which has been designed as a simple and inexpensive mounting strip for discrete components. These can be mounted across the width of the board or alternatively along its length to effect cross-connection.

The mechanical and electrical specifications of the materials used enable the board to withstand a maximum working voltage of 2kV, whilst still maintaining an insulation resistance of one hundred thousand megohms between adjacent copper pads. These features make the board suitable for all applications where a conventional tag strip or group board might be used.

The dimensions of the strip are such that they can be mounted in standard die-cast boxes.

A number of terminal pins are also available which can be used in conjunction with the Vero strip where such additional facilities are required. *Vero Electronics Limited, Industrial Estate, Chandler's Ford, Hampshire, SO5 3ZR.*

B.B.C. Radio Birmingham



This v.h.f. service transmits on 95·6MHz, horizontal polarisation. Maximum e.r.p. is 5·5kW with a directional aerial.

The transmitter is sited at BBC Sutton Coldfield. Inner and outer service area boundaries correspond to average field-strength contours of 60 and 52dB (relative to 1 microvolt per metre) respectively for a receiving aerial height of 30 feet. The field strength at a particular site may differ by as much as 10dB from that indicated.

Otley Radio Society

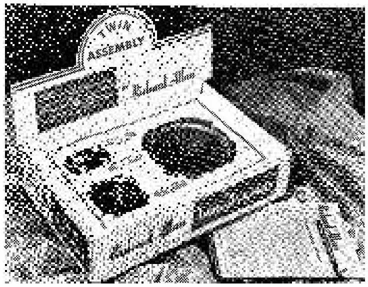
The Chairman of the Otley Radio Society, M. T. George-Powell, G3NNO, informs us that the membership has increased and the Society recently moved to larger premises so that they will be able to hold lectures, slide shows etc. The Society meets every Tuesday evening and on March 19th members visited the Yorkshire TV studios in Leeds. Further details about the meetings may be obtained from: *The Chairman, 82 Forest Avenue, Harrogate, York.*

Loudspeaker Kits

Richard Allan Ltd. announce details of three loudspeaker kits. They have made a special study of the needs of the D.I.Y. individual and believe that they have met all the requirements.

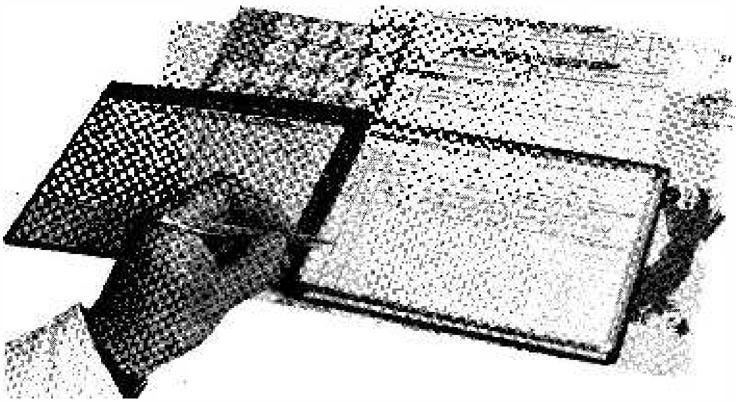
The kits are complete in every sense and contain B.A.F. wadding and foam underlay cut to size and a postcard giving a choice of any three Vynairs. Receipt by Richard Allan of the card giving the user's choice enables them to post him the Vynair by return post. Shown in the photograph is the "Twin Assembly".

For further details contact *Richard Allan Ltd., Bradford Road, Gomersal, Cleckheaton, Yorkshire.*



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

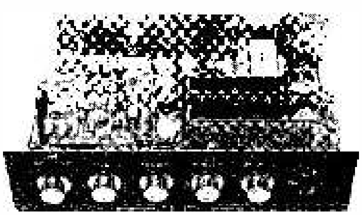
Keeping Track



A new useful accessory for record collectors is a unique system for cataloguing and locating gramophone records easily. The system comprises:- luxury padded simulated pigskin book containing 12 clear P.V.C. slip-in pockets in which are kept specially preprinted index records which can be completed by the user. The index is provided in pad form, each set comprises:- 25 preprinted Index Pages, 3 Records Wanted Pages and 3 Contents Pages; pairs of self-adhesive circular labels numbered 1-100 for attaching to record sleeves; 40 plain self-adhesive labels enabling printed headings of the Index Pages to be covered neatly to provide for hand or typewritten headings. The system can be expanded to 999 records and can also be used for recorded tape.

Made by the *Bib Division, Multicore Works, Hemel Hempstead, Herts.* retail price, including tax, is 34s.

Stereo Amplifier from F.S. Electronics



This amplifier has been designed as an optimum between the simple and sophisticated units presently available, to give performance and looks required by present day living rooms at a moderate cost. This unit is due for export to Czechoslovakia as a solid British product housed in a ¾in. polished cabinet with a choice of woods and front panel colours. Inputs are available for Ceramic/Crystal and Magnetic cartridges, with an Auxiliary input for Radio Tuner or Tape Replay.

Outputs consist of a low impedance Tape Record and Twin speakers.

Specification is as follows:
Ceramic Input: 50mV sensitivity, velocity loaded, R.I.A.A. corrected.
Magnetic Input: 2·5mV sensitivity, velocity loaded, R.I.A.A. corrected.
Auxiliary Input: 100mV into 110K, flat response, ie 20Hz-20kHz ±2dB.
Tape Output: 150mV flat response.
Speaker Output: 6 watts Music Power into 4 ohms per channel.
Tone Controls: Base ±10dB at 20Hz-20kHz. Treble ±15dB at 20kHz.
Signal/Noise: Better than 50dB on all inputs. Aux. input 60dB.
Overall Distortion: 1·5%.

The amplifier retails at £32 10s and the power output modules can be supplied seperately at £3 16s each.

F.S. Electronics Ltd., 93A Balderton Gate, Newark, Notts.

Club Notes

...Meetings of the Chester & District Amateur Radio Society are held at the Y.M.C.A., Chester at 8 p.m. every Tuesday except the first Tuesday of each month which is Nett Night. Recent meetings included lectures on Short Wave Listening and Aerials, visit to BBC, junk sale, and talk entitled On to Square Two by G3ATZ. Further gen from: Alan S. Warne, G8AYW, 113 Queens Road, Vicars Cross, Chester.

...Derby & District Amateur Radio Society are holding their Mobile Rally on Sunday, August 16th. at Rykneld School, Bedford Street, Derby. There will be talk-in stations from 10 a.m. to 3 p.m. G3ERD/A on 160m., G2DJ/A on 4m. and G8DBY/A on 2m. Further gen from: T. Darn, G3FGY, Sandham Lodge, Sandham Lane, Ripley, Derby.

... Stourbridge & District Amateur Radio Society, in collaboration with the Llanfair-Welshpool railway set up a radio station at the Llanfair-Caereinion terminal station on July 4th. They operated between 12 noon and 6 p.m. on 80m. using the call GW601/P. Further gen on the Society from: Sheila Clift, G8BYE, Manorways, 49 Manor Lane, Halesowen, Worcs.

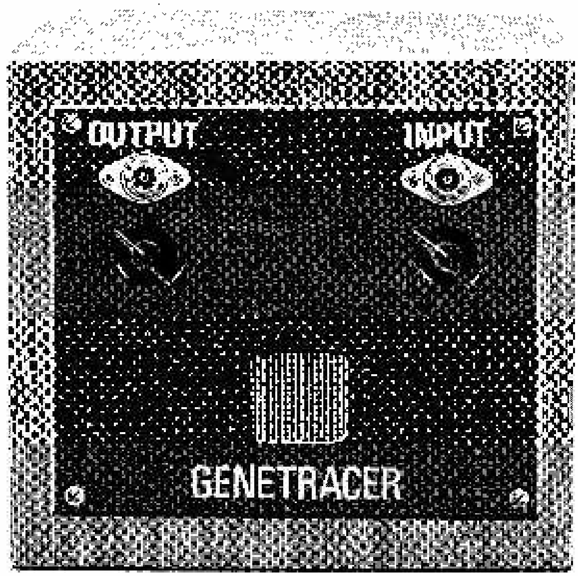
Radio & TV Course

The Stonebridge Evening Institute, Brentfield Road, London, N.W.10. are holding a Radio & TV Course. It will be held on Tuesdays and Thursdays (7p.m.-9p.m.) commencing 22nd and 24th. September 1970. Fees for a course lasting 30 weeks for two evenings per week are £4. Session ends on 28th. May 1971. The course covers theory and some practical work. Enrolment will take place during the week 14th. to 17th. September 1970 or readers may enrol now by writing to: 44 Worcester Crescent, Mill Hill, London, N.W.7. Cheques and P.O.'s should be made payable to "The Brent Borough Treasurer".

genetracer

J. B. WILLMOTT A.I.P.R.E.

A USEFUL AID TO SPEEDY FAULT FINDING



WHAT the serviceman requires is some quick method of "seeing" (or hearing) what is actually happening to the signal passing through any part of equipment under investigation. The sophisticated approach to this requirement is to use an oscilloscope, on the screen of which the actual signal at the test point can be displayed.

But few radio enthusiasts possess such an instrument and the necessary ancillary items such as a wobbulator and calibrated signal generator, which are required to utilise the full potential of an oscilloscope.

A very effective substitute is the use of the procedure known as "signal tracing". Basically, this can be approached in two ways, either an artificial signal can be injected into the equipment under test, at any given point, and the result listened to on the equipment's own speaker, or, alternatively, a sensitive signal tracer can be connected to any suitable point in the equipment being tested, and the signal at that point "picked off" by the tracer, demodulated if necessary (r.f. or i.f. signals), and given sufficient a.f. amplification to produce an audible signal in the speaker built into the tracer itself.

Both systems have their merits and the instrument about to be described combines both functions. If the output socket be connected, preferably by a short length of coaxial cable, to the equipment under test, a wideband signal extending from r.f. to a.f. frequencies can be injected at any desired level by adjustment of the output gain control, and a steady audio note (of about 1 kHz) will be heard from the speaker of the equipment being tested, if all is in order onwards from the point of injection.

Alternatively, if the input socket is connected to the equipment being tested, the tracer will reproduce in its own speaker, a faithful rendering of the signal existing at the test point. It is in fact possible, indeed often useful, to utilise both functions simultaneously.

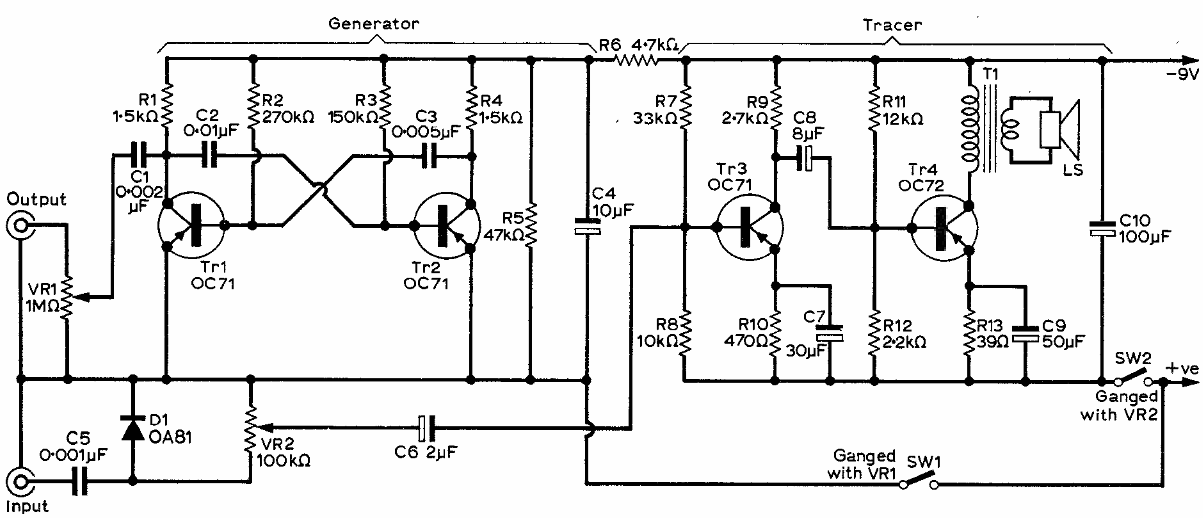


Fig. 1 : Circuit of the Genetracer. The "generator" and the "tracer" are built on separate circuit boards

For example, a signal can be injected at the grid of a valve, and the amplified signal "heard" on the tracer's speaker by connecting the input socket to the anode circuit of the same valve. Thus absence of signal, lack of gain, or distortion arising within the stage under investigation, can be quickly discerned.

Once the faulty stage has been located in this way, voltage and/or resistance checks of all components directly connected thereto will usually show what is amiss.

Circuit

Referring to Fig. 1, it will be seen that the "generator" portion of the instrument comprises the familiar cross-coupled multivibrator circuit, using Tr1 and Tr2. The "tracer" function is carried out by the D1, Tr3 and Tr4 circuitry.

The instrument is in fact constructed as two separate units, on paxolin component boards, powered from a common 9V battery (type PP3 or similar). The full 9V is not necessary for the multivibrator "generator" and so this part of the circuit is fed from a potential divider network (R6 and R5) giving about 6V.

This has all the advantages of printed circuit wiring, yet is much easier for the amateur constructor to reproduce.

For those who have not previously used this material, it comprises a thin strip of pure copper, protected when bought by a plastic backing which when peeled away leaves the adhesive copper strip ready for fixing to any smooth insulating surface. The copper strip is easily cut, bent, or otherwise shaped, to meet circuit needs.

It is already prepared for soldering, and the leads of the various components are bent over and soldered on with a quick application of hot iron and cored solder in the usual way.

Figures 2 and 3 show the component layouts used in the prototype, and it is recommended that these should be adhered to. The drawings are actual size and, for ease of construction, it is suggested that tracings of these be made. A tracing can then be temporarily fixed to the surface of a paxolin panel, and the drilling of all connecting points (shown by a black dot), and component mounting holes made, using the tracing as a template. Holes, ⅜in. diameter, are required for the mounting of the gain controls VR1 and VR2.

All other holes should be small enough to just accommodate the lead out wires from the various

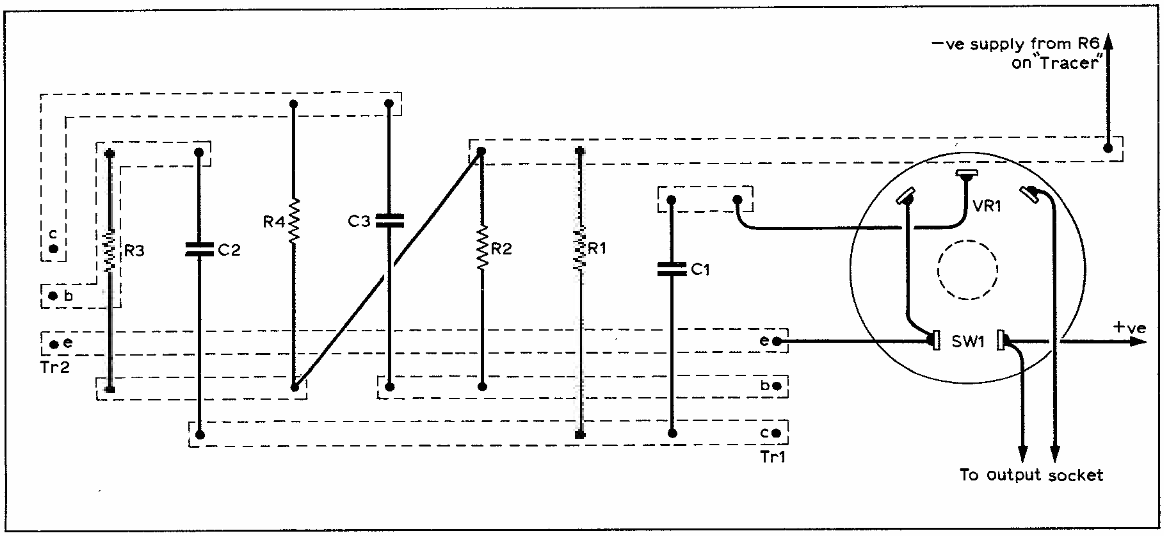


Fig. 2 : Full scale layout of the "generator" circuit board

The circuits of both units are entirely conventional, and standard readily obtainable transistors and components are used throughout. A simple Class A single-ended transistor output stage is used in the "tracer" as a large output is not required.

Construction

For ease of construction and general neatness of the completed units, the popular method of mounting all components on one side of a $\frac{1}{16}$in. thick paxolin panel, with their connecting wires protruding through holes to the other side of the panel, and there connecting them to adhesive "Cir-Kit" copper wiring strips, has been adopted.

resistors, capacitors, etc. Note that the coaxial input and output sockets are mounted on the front control panel (also of paxolin) of the instrument, not on the component panels. Connection to these sockets is thus delayed until the panels have been completed, and fixed to the ¾in. thick wooden spacers glued to the rear surface of the control panel.

The speaker is also mounted on the control panel and, for neatness, is provided with a small square of "fret" fabric.

The Cir-Kit strips are shown in Figs. 2 and 3 as actually lying on top of the component lead out holes, done for the sake of clarity. Actually, the strips should be affixed so that they run just clear of the holes, the component wires then being bent over at right angles (which helps to anchor them in position) and soldered to the appropriate strips.

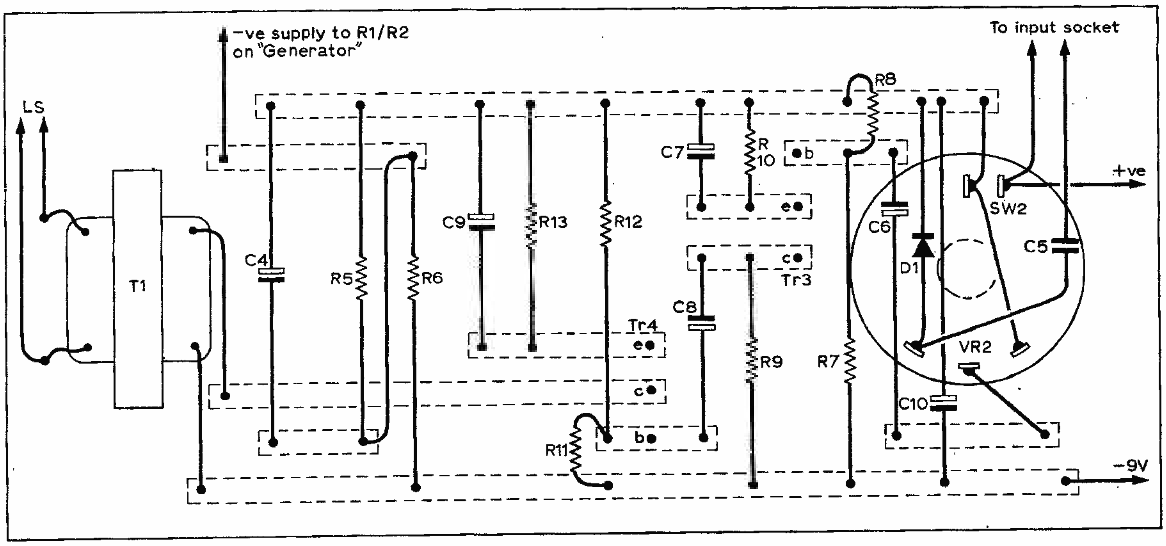


Fig. 3: Layout of the "tracer" circuit board, also full scale

Take care to ensure that the electrolytic capacitors are correctly placed with regard to polarity markings. The transistors should not be soldered into place until all other wiring has been completed on the panels. When soldering the transistor and diode leads take care to use an effective heat sink.

It helps if coloured sleeving is slipped over the transistor leads before connecting them into circuit, a suitable colour code being red for collector, yellow for emitter, and blue for base. Note especially that in the case of Tr3 and Tr4, the relative positions of "b", "c" and "e" are not identical on the component board.

When the two panels have been completed, and checked for correct assembly and wiring, they may be fixed to the spacing strips secured to the control panel by small wood screws. The photograph of the completed assembly shows what is required.

Connect the speaker to the output transformer secondary T1, and connect the input and output sockets to the respective gain controls as shown in Fig. 4.

The battery leads, terminating in a suitable press stud connector to fit the PP3 battery, and composed of red and blue flexible wire, can now be connected. The diagonal interconnection between the tracer and generator panels should also be completed at this stage.

The completed unit is housed in a simple rectangular box of a size to suit the front panel, and about 4in. deep from front to rear. This depth is not required to house the instrument, but rather to provide stability when stood upright on the bench. It is a good plan to fix four small rubber feet at the corners of the base. The actual method of construction and the materials used are left to the discretion of the constructor.

Two lengths of test lead should now be prepared comprising some 12in. to 18in. of TV type coaxial cable, one end of each lead being terminated in a coaxial plug. The other ends should have outer braiding and inner conductor separated for about 6in., and crocodile clips fitted. These form the most convenient means of connecting the instrument leads to the equipment under test.

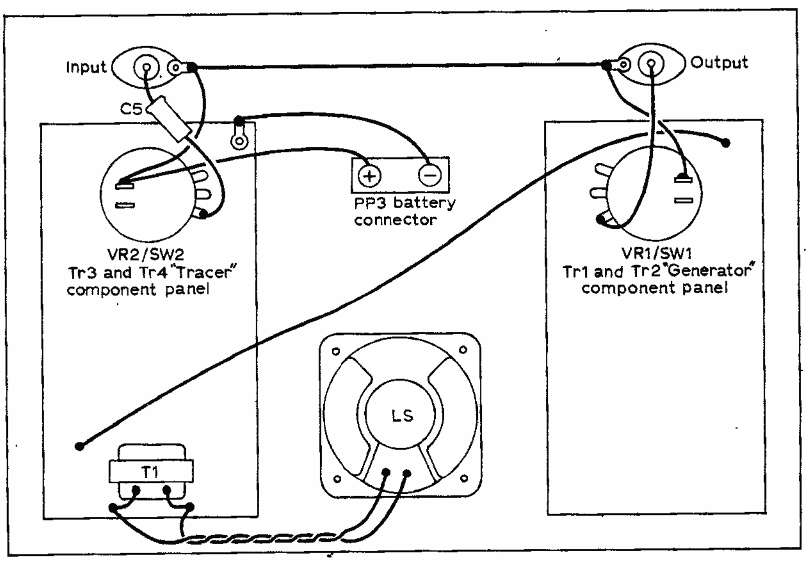


Fig. 4 : Interconnection of the circuit boards after mounting in cabinet.

Testing

To test the completed instrument, plug the test leads into the input and output sockets, and connect the ends of the test leads together, i.e., braiding to braiding and inner to inner. Switch on both the generator and tracer units and, by adjusting the gain controls, the output from the generator can be clearly heard in the tracer's speaker.

—continued on page 305

'PROJECT Autumn'

Readers of
Practical Wireless are
invited to submit articles for
publication and to compete
for the
Practical Wireless
"Designer's Trophy"

RULES.

1. Articles submitted for the competition should conform to the general style of material published in Practical Wireless and must describe the operation and construction of a piece of radio, audio or test equipment that has been designed and built by the author.
2. Articles should, preferably, be typed using double spacing, leaving wide margins, and on one side only of each sheet. Circuit diagrams and any other drawings should be on separate sheets and numbered to agree with the text. Author's roughs must be clear enough to permit re-drawing. Component lists must also be separate and laid out to the standard PW format.
3. Photographs of the equipment are desirable and should be in black and white, sharp and clear. Each photograph should be identified by sticking a piece of paper on the back rather than by writing on the photograph itself.
4. Components used in the design must be readily available from retail sources.
5. An entry form, properly completed, must accompany each article submitted. There is no limit to the number of articles submitted by any one author.
6. Articles must reach the Editor, Practical Wireless, Old Fleetway House, Farringdon Street, London, E.C.4. by the first post on Monday, November 2nd 1970 with the envelope and title sheet clearly marked "Project Autumn". A stamped, self-addressed envelope must accompany each entry.
7. All entries submitted will be considered by a panel of judges and the Editor's decision on all matters arising will be final. The Editor will require authors of winning entries to submit the equipment to him immediately on request for final assessment by the panel.
8. Employees and staff of Practical Wireless are not eligible for entry to this competition.
9. The winner of the competition will receive and retain outright the Practical Wireless "Designer's Trophy 1970". Other prizes will be awarded to the best runners-up. Any article published will be paid for at normal rates.

ENTRY FORM *"Project Autumn"*

Full Name ....

Address ....

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Title of Article ....

....

If my article does not win a prize I should like it:-

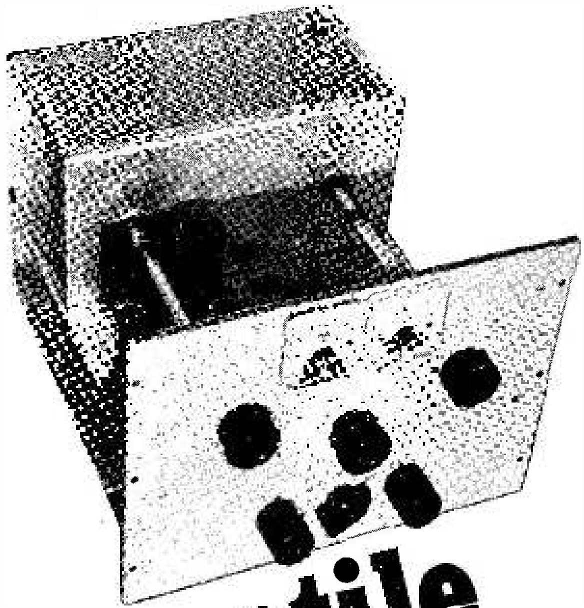
(a) to be considered for publication in the usual way*

(b) to be returned to me.*

Signature ....Date ....

*delete as required

PA-PW-8



BUFFER AMPLIFIER

This is V2, a 5763, and the stage operates as a doubler for 80m, a straight-through amplifier/buffer on 40m, a doubler on 20m, a tripler on 15m, and a doubler for 10m.

In each case S4 selects suitable anode coils, so that the anode circuit can be tuned to the frequency at which transmitter output is to be obtained. This allows the power amplifier V3 to work straight through on all bands.

This arrangement was found to provide better than 3mA grid drive on all bands, and considerably more on the l.f. bands. The combinations of untuned anode circuit in V1, and frequency multiplication, were found to give good stability on all bands.

versatile TRANSMITTER

5/50

F. G. RAYER
G3OGR

THIS transmitter is VFO controlled, and operates on the 80, 40, 20, 15 and 10m amateur bands. A power input of about 40 to 60 watts, according to the h.t. supply, proves very useful, and a single switch selects any band.

Fig. 1 shows the circuit, and the following details should help when checking operation and tuning up.

VARIABLE FREQUENCY OSCILLATOR

V1, a 6CH6, is a Clapp type oscillator, with the voltage stabilised screen grid acting as a virtual anode for the oscillator circuit. L1 tunes 1·75-1·9MHz, and is selected by S1 and S2, output frequency being doubled for the 3·5-3·8MHz band. C1, with TC1 and the core of L1, allow adjustment of band coverage. The anode circuit of V1 is electron coupled, and is untuned on this band, R4 being the anode load.

For the higher frequency bands, S1 and S2 select L2, which has TC2 and C2, VC1 being the main variable tuning capacitor as before. The fundamental range is now approximately 7-7·3MHz, and this with harmonics allows complete coverage of the 7, 14 and 21MHz bands, and coverage from 28-29·2MHz on 10 metres. As all these ranges are direct harmonics, calibration is simplified.

For 7MHz, R4 provides an untuned anode load. L3 is resonant at about 7·1MHz, and is brought in by S3, for the 14 and 21MHz bands. For 28MHz, L4 is in circuit, and is tuned to about 14·5MHz, so that the output from the anode of V1 is doubled in frequency.

POWER AMPLIFIER

This is a v.h.f. type power beam tetrode, a 6146, operated at 100mA anode current. This corresponds to 40 watts input with a 400V supply, 50 watts with 500V, and 60 watts with 600V. It has also been used with 300V (30 watts) with excellent results.

Bias is obtained by grid current through R8. Here, 2mA grid current provides 44V bias and normal operation is with about 2mA to 2·5mA grid current. Since lack of grid current can rapidly damage the 6146 the grid meter is permanently in circuit.

When changing frequency, h.t. is applied to V1 and V2 by closing the "Tune" switch, and VC2 is then adjusted for suitable grid current. When this has been done, the 2-pole transmit/receive switch applies h.t. to all stages.

R.F.C.3 with R10 forms a parasitic suppressor. Anode current is shown by the 150mA meter. The switch S5 and tapped coil L10 allow 5-band coverage. VC3 is for anode tuning, and VC4/5 is the output capacitor of the pi-network, and allows the p.a. to be loaded by a range of impedances.

TC3 with L11 forms a series tuned harmonic trap, which in certain circumstances will be useful when interference is being caused to t.v. reception.

MODES OF OPERATION

The transmitter was built for use with a 30 watt modulator, which permits modulation of V3 anode and screen grid. This is a very trouble-free and satisfactory method, and one which will give excellent results without any special care in adjustment.

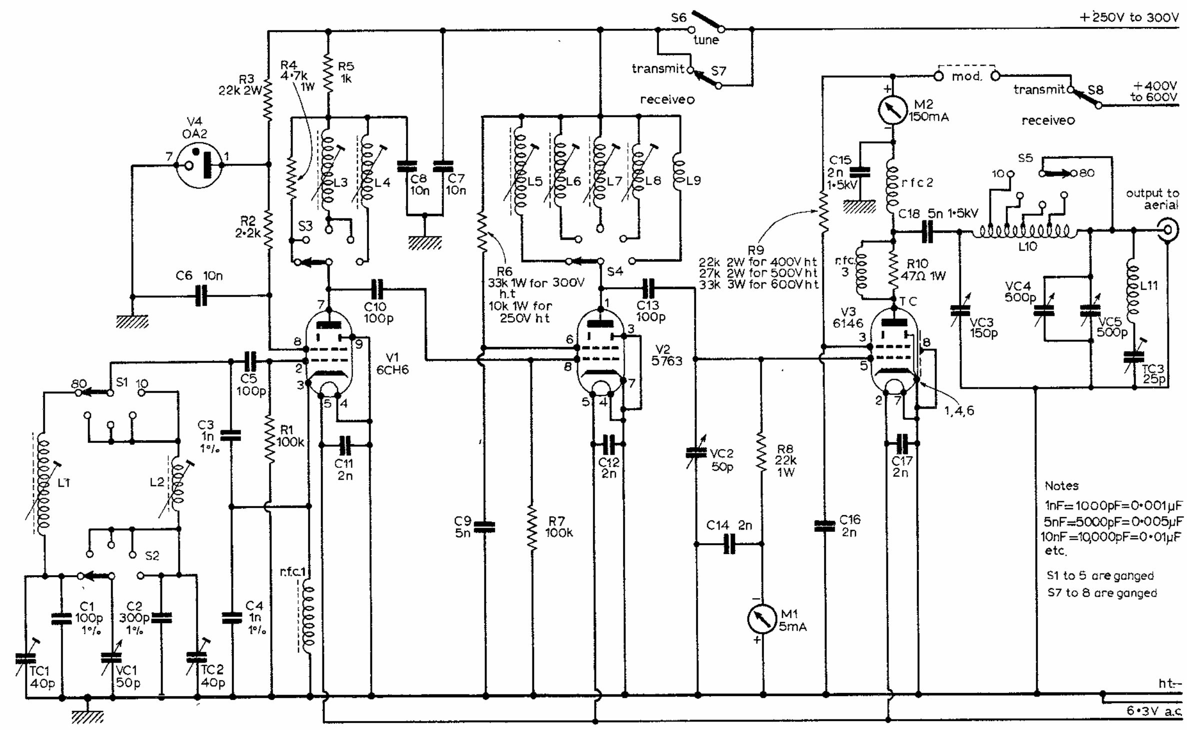


Fig. 1: Complete circuit diagram of the 5-band transmitter.

The connection to R9 can be broken, and screen grid modulation used. This has the advantage that an ordinary audio amplifier, giving about 2-4 watts output, will readily modulate the transmitter but r.f. output is reduced, so correct and full aerial loading is essential, to avoid distortion.

Though the transmitter was intended for telephony working on all bands, cathode and other forms of keying have been found satisfactory for c.w. It is also possible to substitute an inexpensive 807 for the 6146.

CONSTRUCTION

VC1, C1, C2, TC1 and TC2, with L1 and L2, occupy an enclosed box on top of the chassis, Fig. 2. To simplify metal work, the front and both sides of this box are formed from an 8×2in. universal chassis runner. Segments are cut from each flange 2½in. from the end.

The runner is then bent at right angles at these points, to form a member 3×2½in. L1 and L2 are mounted, and also the ball-drive for VC1. VC1 is fitted to a bracket bolted to the runner.

This assembly is then bolted to the chassis in the position shown in Fig. 2, and is completely wired. Leads pass down through the chassis from L1 and L2, to S1 and S2. VC1 is also wired to S2.

TC1 and TC2 are ceramic trimmers, on brackets bolted to the chassis. A piece of aluminium 4¾×3in. is bent to form the coil box top and back, ¼in. forming a flange to bolt to the chassis. This part is attached to the box flanges by self-tapping screws. Holes allow TC1 and TC2 to be reached.

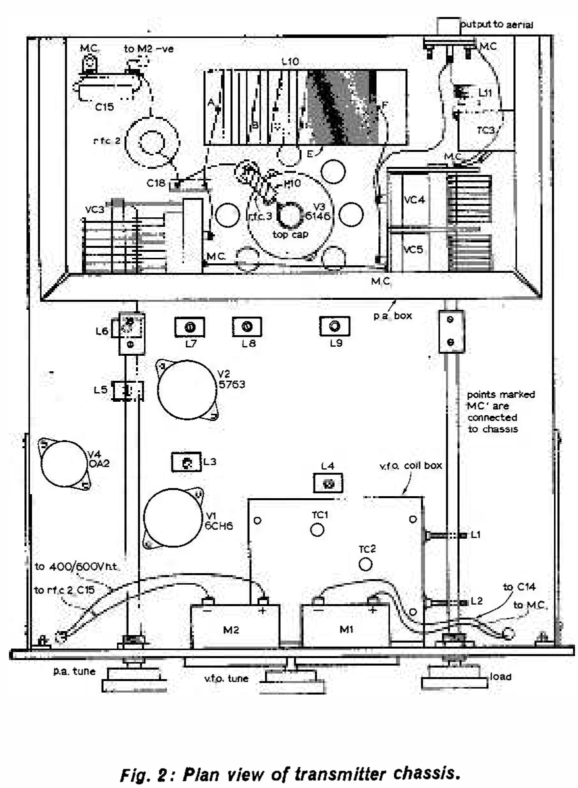


Fig. 2: Plan view of transmitter chassis.

VFO ANODE CIRCUIT

A universal chassis runner 11×2in. has its flanges cut $3\frac{3}{4}$in. from the ends, so that it can be bent into a box $3\frac{3}{4}\times3\frac{1}{2}$in. This is bolted to the chassis and chassis front in the position in Fig. 3, and contains V1 holder, L3, L4, etc.

R.F.C.1 is supported on a tag strip. All wiring associated with S1/S2, C3, C4, C5 and V1 should be stout and rigid. A tag strip also anchors R2 and R5. S3 is wired to select R4, L3 or L4.

C10 is inside this box, and a lead passes through the box to tag 8 of V2. This and R7 are positioned as in Fig. 3. The box is closed by cutting a plate $3\frac{1}{2}\times3\frac{3}{4}$in. and fixing it to the flanges with self-tapping screws.

BA ANODE CIRCUIT

Coils L5/L6/L7/L8 and L9 are selected by the wafer S4, and are tuned by VC2. C7 should be on short leads from VC2 to L9, while C13 is directly connected from S4 to V3, with a short wire to VC2. A coupler and long shaft operate VC2.

S4 is arranged so that very short leads are possible to the h.f. range coils, especially L8 and L9. All other wiring needs to be reasonably short and direct.

POWER AMPLIFIER STAGE

Cathode and r.f. circuits in this stage should be wired with 16 s.w.g. or stouter conductors. Tags 1, 4, 6, 7 and 8 are well earthed, see Fig. 3. A tag strip supports R8 and C14, a lead passing from here to the grid current meter. A tag strip near the rear of the chassis is used for h.t. and other connections, and allows easy disconnection of R9 for screen grid modulation.

The p.a. and anode circuit components occupy a box $8\frac{1}{2}\times4\frac{1}{2}\times4$in. high, Fig. 2. This was purchased ready made (see component list). A number of holes are punched in the chassis around the holder for the 6146. The box is finally closed with perforated metal or similar material, holes being punched in this for TC3 and the co-axial output socket.

VC3 and VC4/5 are joined by a stout lead, and earthed to the chassis. R.F.C.3 is 5 turns of 18 s.w.g. wire, wound to $\frac{3}{8}$in. diameter, and stretched to occupy about $\frac{5}{8}$in. R10 is in the centre of R.F.C.3, and both are soldered directly to the anode cap clip of the 6146. All leads to VC3, C18 and L10 should be very stout and short.

A tag strip holds R.F.C.3. The output socket is bolted to a bracket in contact with the chassis, and is wired to VC4/5. TC3 is held with a small bracket and L11 is fitted directly between TC3 and the output socket, as shown.

INDUCTORS

L1 is a medium wave type dipped coil with unwanted windings and some turns removed until 1·75MHz is reached with VC1 closed. L2 is 11 turns of 24 s.w.g. enamelled wire close-wound on a $\frac{1}{2}$in. diameter former. L3 is 50 turns of 32 s.w.g. enamelled wire, and L4 is 17 turns, both on $\frac{1}{2}$in. diameter formers.

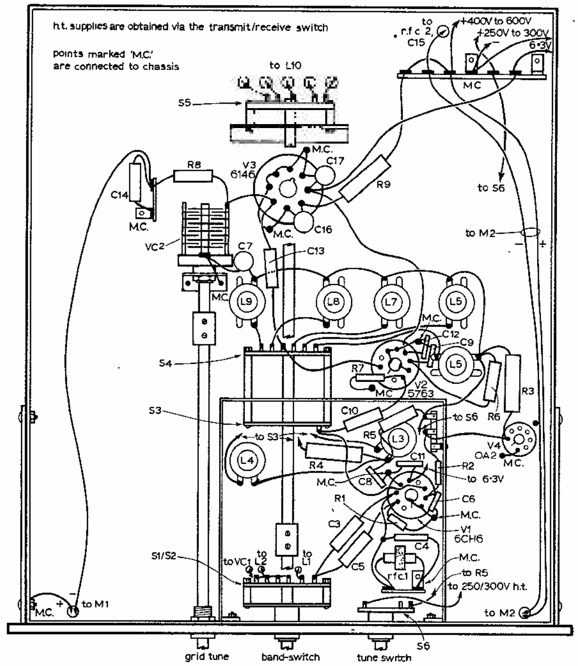


Fig. 3: Underneath the chassis showing main wiring.

L5 has 65 turns of 34 s.w.g. enamelled wire, and L7 has 14 turns of 32 s.w.g. all close-wound on $\frac{1}{2}$in. diameter cored formers. L8 has nine turns of 26 s.w.g., spaced by the wire diameter, and L9 has eight turns of 26 s.w.g., also spaced by the wire diameter. Both formers are $\frac{1}{2}$in. diameter, and L8 has a core, but not L9. If necessary, the inductance of L9 can be reduced by spreading the turns.

L1 should tune from 1·75-1·9MHz, with a trifle to spare, and L2 from about 7-7·3MHz. This can be checked by applying h.t. to V1 only, with R4 in circuit, and listening for the v.f.o. signal with a receiver. Final calibration is by adjusting the cores of L1 and L2, in conjunction with trimmers TC1 and TC2. The v.f.o. should be adjusted in conjunction with the 100kHz harmonics from a crystal marker when all construction is finished.

L3, with stray circuit capacitances, should be tunable to 7MHz. This can be shown by grid current through R7 or R8, or by using a wavemeter. L4 is similarly tunable to 14MHz. When the transmitter is tested, the cores of L3 and L4 can be rotated slightly for maximum p.a. grid current around the middle of the respective bands.

L5 should tune to about 3·6MHz with VC2 about half closed. L6 is resonant at about 7MHz with VC2 about one-third closed.

The cores of both L7 and L8 are adjusted so that 14MHz and 21MHz can be tuned with VC2 only slightly closed. No core was used with L9, and the winding is adjusted so that VC2 is almost at minimum capacitance at 29MHz.

If L8 and L9 have insufficient inductance, and resonance on 21 and 28MHz bands is only obtained with VC2 near maximum, grid current will be reduced. If the coils are adjusted as explained, it will not be possible to tune to wrong harmonics with VC2.

A grid-dip meter should be used to check that each anode coil L5 to L9 operates on the correct harmonic, when first aligning the buffer-amplifier, with h.t. off. Since V1 provides 7MHz output for 14MHz and 21MHz, and 14MHz output for 28MHz, wrong tuning of the anode circuit of V2 is unlikely.

Final adjustments to the cores of these coils must be made by observing grid current on the grid current meter, V3 being in position, but anode and screen grid voltages being removed from this stage.

TANK COIL

This is wound on a paxolin tube $3\frac{1}{2}$in. long and $1\frac{1}{2}$in. in diameter subsequently mounted on 6BA bolts with extra nuts, to be $\frac{1}{4}$in. clear of the chassis. The ends A and F, and tappings B, C, D, and E, Fig. 2, are on the underside of the coil, so that leads to wafer S5, Fig. 3, are short.

Some 16 s.w.g. wire is anchored at A, and four turns are wound with a pitch of 8 turns-per-inch. The wire is taken along to allow a $\frac{1}{4}$in. space, and two more turns are wound. After another $\frac{1}{4}$in. space, three turns are wound, and the wire is anchored at D. Stout leads are securely soldered at B and C. The coil is finished by winding 22 turns of 20 s.w.g. wire from D to F, these turns occupying $1\frac{1}{4}$in. Tapping E is a short loop seven turns from D.

F is connected directly to S5 rotor tag. B, C, D and E are connected so that turns in circuit are as follows: 10 metres, 4; 15m, 6; 20m, 9; 40m, 16; 80m, whole coil.

POWER SUPPLIES

V1 and V2 draw current from a separate h.t. supply of around 250/300V. A 230V supply was found to give a minimum grid current of 3mA on all bands, with R6 reduced to 10kΩ. The supply should be able to provide 60mA, so a receiver-type power pack is thus generally suitable.

The h.t. for V3 can depend somewhat on the modulator power or available supplies. For high-level modulation, an audio output of about one-half the p.a. input is required. Modulator circuits actually used had 2×6V6 for 15W of audio, 2×6L6 for 20W, and 2×807 for 30W.

For screen grid modulation, R9 is disconnected from the positive line, and receives modulated h.f. from a small amplifier. A single 6BW6 or similar output stage is quite adequate. The p.a. anode is then supplied from a higher voltage source—preferably 500/600V.

BANDSWITCH

S1/S2 is a 2-pole 5-way wafer and S3, S4 and S5 are each single-pole 5-way wafers. S3 and S4 are mounted on the box, Fig. 3, with long bolts and spacers. S5 is fixed to a bracket near V3 and immediately under L10.

The shaft is a long insulated $\frac{1}{4}$in. diameter rod (see component list) with flats filed to engage with the holes in the rotating part of the wafers. A hole in the rear of the chassis allows this rod to be pushed in from the back, and through each wafer. A coupler connects it with the metal shaft of S1/S2.

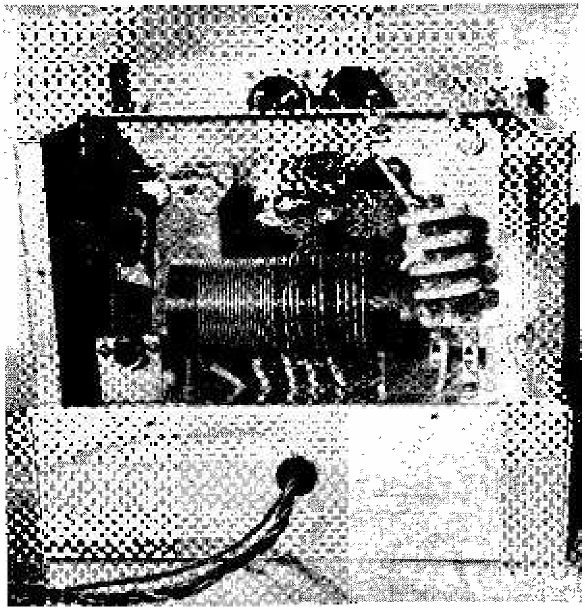


Fig. 4: View of p.a. compartment at rear of chassis.

A switch in which tags are progressively shorted all round is often used for a pi-tank of the type shown in Fig. 1. R.F. output was measured on all bands with such a wafer, and again with an ordinary single-pole 5-way wafer, and no measurable difference could be observed. In view of this, the ordinary 5-way wafer seems suitable.

FUNCTION SWITCHING

The "Tune" switch applies h.t. to V1/V2 only, to allow adjusting transmitter frequency, and tuning for grid current. The 2-way T/R switch applies h.t. to both V1/V2 and to V3. This was arranged by having the T/R switch on the power-pack/modulator.

Should the high voltage supply be from a separate h.t. transformer, h.t. may be taken off the p.a. and modulator valves by placing an h.t. on/off toggle switch in the mains supply to this transformer. (The transformer must then be for h.t. supply only, and not include rectifier, heater or other supplies.)

The actual method of h.t. switching is not important, provided h.t. can be applied to V1 and V2 separately, with V3 off. It should not be possible to apply h.t. to V3, with V1 and V2 inoperative.

If the T/R switch has extra poles, these may be used to operate an aerial change-over relay, or to switch the aerial directly from receiver to transmitter. With the latter method, switch wiring should be done with co-axial cable, and the receiver aerial input should be earthed on transmit, to reduce stray r.f. at the receiver.

OPERATION

V3 anode circuit must always be tuned to resonance, by VC3, as shown by a dip in anode current. A check is most readily made on 80m, with an artificial load such as a 60 watt domestic lamp plugged into the output socket or connected across VC4/5.

With h.t. on V1/V2 only, VC2 is rotated for about 2·5mA grid current. VC4/5 is at maximum capacity. H.T. is applied to V3, and VC3 at once adjusted for minimum anode current. This minimum is raised by reducing VC4/5, simultaneously re-adjusting VC3 for minimum current. When this minimum has reached 100mA the lamp should light brightly.

Working on the other bands is similar, except that tuning becomes more critical. For the h.f. bands, VC3 should be at almost minimum capacity.

R.F. output for screen grid modulation will be much less than with high level modulation, and the p.a. must be loaded in the manner described until the anode current dip found with VC3 is very flat.

★ components list

Resistors:

R1	100kΩ ½W	R7	100kΩ ½W
R2	2·2kΩ ½W	R8	22kΩ 1W
R3	22kΩ 2W	R9	22kΩ 2W*
R4	4·7kΩ 1W		27kΩ 2W*
R5	1kΩ ¼W		33kΩ 3 E*
R6	33kΩ 1W	R10	47Ω 1W
(10kΩ for 250V)			* see text

Capacitors:

C1	100pF 1% S.M.	C10	100pF mica
C2	300pF 1% S.M.	C11	0·002μF 500V disc
C3	1000pF 1% S.M.	C12	0·002μF 500V disc
C4	1000pF 1% S.M.	C13	100pF mica
C5	100pF 1% S.M.	C14	0·002μF 500V disc
C6	0·01μF 500V disc	C15	0·002μF 1·5 kV
C7	0·01μF 500V disc	C16	0·002μF 500V disc
C8	0·01μF 500V disc	C17	0·002μF 500V disc
C9	0·005μF 500V disc	C18	0·005μF 1·5kV
TC1	40pF ceramic trimmer		
TC2	40pF ceramic trimmer		
TC3	25pF double spaced variable		
VC1	50pF air spaced variable		
VC2	50pF air spaced variable		
VC3	150pF double spaced variable		
VC4/5	2 x 500pF ganged variable		

Switches:

S1/2 2 pole 5 way wafer } 'Bandswitch'
S3/4/5 1 pole 5 way wafer }
S6 Single pole single throw rotary. 'Tune'
S7/8 2 pole 2 way "T/R Switch"

Valves:

V1 6CH6 with B9A holder and screen.
V2 5763 with B9A holder and screen.
V3 6146 with octal holder, low-loss or ceramic.
V4 OA2 with B7G holder.

Metalwork:

Chassis 10½ x 9 x 2½in. Type K (H. L. Smith & Co.)
Chassis 8½ x 4½ x 4in. Type P (H. L. Smith & Co.)
2 Panel brackets 4 x 4in. Type C (H. L. Smith & Co.)
Panel, 10 x 7in. (H. L. Smith & Co.)
Universal chassis runner 8 x 2in. (Home Radio)
Universal chassis runner 11 x 2in. (Home Radio)
Perforated metal 9 x 8½in.
Sheet metal for covers, etc.

Miscellaneous:

R.F.C.1. 2·5 mH midget cored choke.
R.F.C.2. 2·6mH choke, (Denco RFC9).
R.F.C.3. and L1-11 see text.
Panel meters, O-5mA and 0-150mA.
Slow motion drive, knobs, 3 panel bushes, 3 shaft couplers, ¼in. insulated rod.
Tag strips, co-axial socket.

Switching should be so arranged that screen voltage cannot be applied to the 6146 unless anode voltage is also present.

It is essential that the power amplifier is not left operating off-tune, or with insufficient grid current, as this will rapidly damage the valve.

The transmitter is best operated into a low impedance load, such as a multiband dipole with 75 ohm feeder, or a tuner feeding an all-band aerial.

HARMONIC TRAP

This is a series-tuned acceptor, using L11 and TC3. A very closely spaced midget capacitor is not suitable except when working into low impedances.

L11 is best adjusted with a grid-drip meter, so that TC3 gives resonance on the particular channel required. L11 will usually be from about 5 turns ⅜in. in diameter and ½in. or so long, up to 14 turns close-wound ½in. in diameter. It can be 16 s.w.g. wire, self-supporting.

The best method of adjustment is to operate the transmitter into a dipole or 75 ohm non-reactive load, adjusting VC4/5 for the correct p.a. input. With power off and TC3 about half closed, check the resonant frequency with the grid dip meter, and adjust L11 as required. Then with power on, rotate TC3 while observing any interference to t.v. reception. Actual trouble in this direction depends on the siting and type of aerials, efficiency of earthing, strength of the t.v. signal, and other factors.

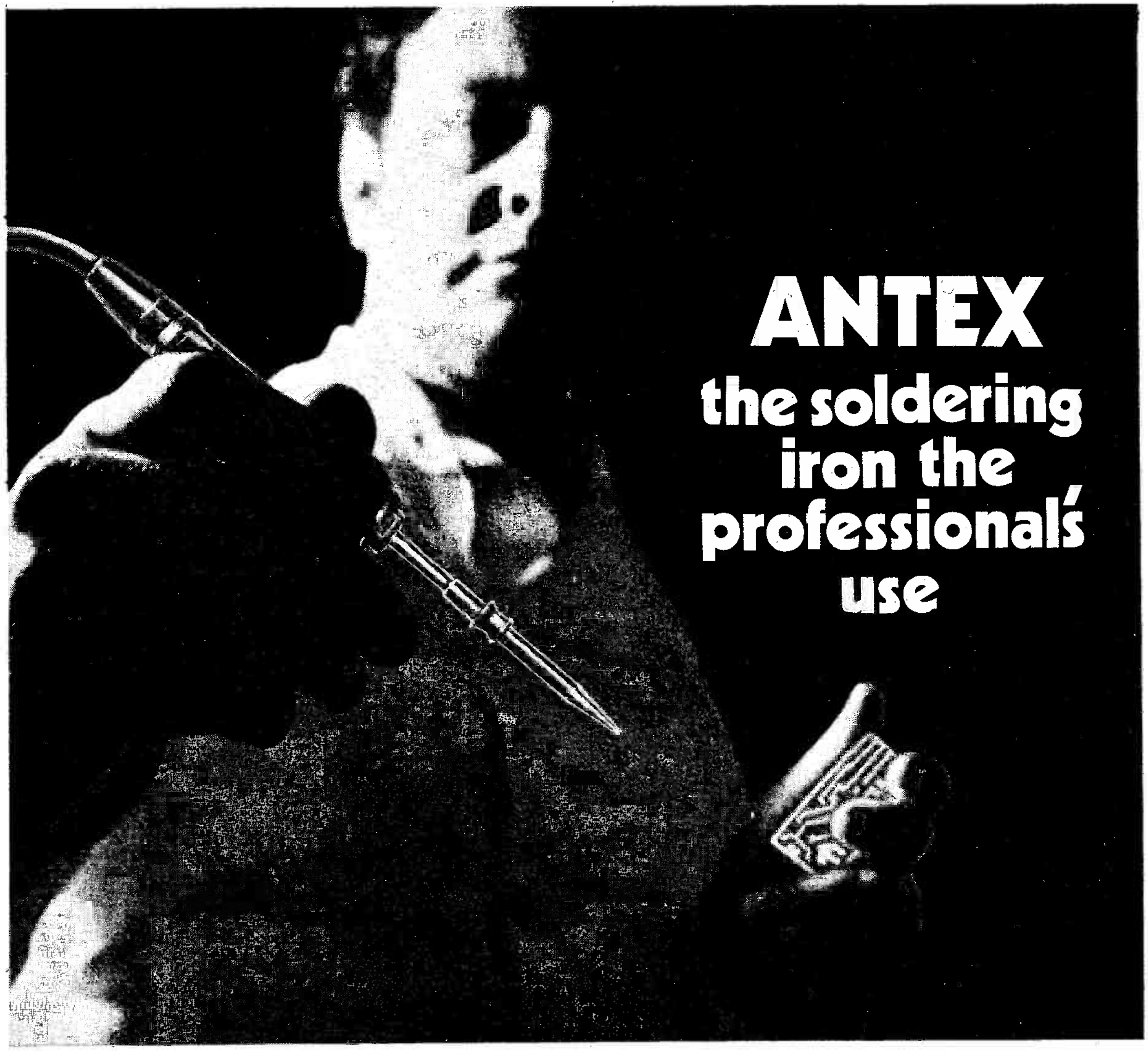
CALIBRATION

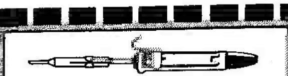
The ball drive is fitted with a transparent cursor and hair-line. Calibration on 3·5-3·8MHz is for the 80m band only. The 5·5, 6·5 and 7·5MHz points can be found by listening to the second harmonic of the v.f.o. on the receiver, beating with 100kHz harmonics from a 100kHz crystal.

Calibration on the 20, 15 and 10m bands is obtained by direct multiplication from 40m, so these four bands are marked simultaneously. L2 core and TC2 are adjusted for suitable coverage, with 7MHz obtained when VC1 is almost fully closed. This is also 14, 21 and 28MHz. In the same way, 7·1MHz corresponds to 14·2HMz, 21·3MHz, and 28·4MHz. ■

LATE PUBLICATION OF PRACTICAL TELEVISION

We apologise to readers of our sister magazine Practical Television for the late appearance of the June and July issues, due to a dispute at the printers. We are doing our best to publish the August issue on time but this may also be a little late.





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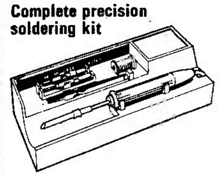

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1A5	5/-	6BQ5	4/9	6R7	11/-	12BE6	5/9	30PL1	13/9	AC/TH1	10/-	DW4/500	8/6
1A7GT	7/3	6BQ7A	7/-	6R7G	7/-	12BH7	6/-	30PL13	15/6	AC/TP	19/6	DY86	5/9
1C5	4/9	6BR7	15/9	6SA7GT	7/-	12E1	17/-	30PL14	15/-	AC/VP2	10/6	DY87	5/9
1D5	7/6	6BR8	12/6	6SA7M	7/-	12J7GT	6/6	30PL15	15/-	AL60	15/6	E80F	24/-
1D6	9/6	6BS7	25/-	6SC7GT	6/6	12K5	10/-	35A3	10/-	ARP3	7/-	E83F	24/-
1FD1	6/6	6BW6	14/3	6SG7GT	6/-	12K7GT	6/9	35A5	15/-	ATP4	2/3	E88CC	12/-
1FD9	4/3	6BW7	13/-	6SH7	3/-	12Q7GT	5/-	35D5	12/6	AZ1	8/-	E180F	19/-
1G6	6/-	6BZ6	6/-	6SJ7	6/6	12SA7GT	8/-	35L6GT	8/6	AZ31	9/6	E182CC	22/6
1H5GT	7/-	6C6	3/9	6SK7GT	4/6	12SC7	5/-	35W4	4/6	AZ41	10/6	E1148	10/6
1L4	2/6	6C9	14/6	6SN7GT	4/6	12SG7	4/6	35Z3	10/-	B36	6/6	EA50	1/6
1LD5	6/-	6CD6G	23/-	6SQ7GT	7/6	12SH7	3/-	35Z4GT	4/9	CL33	18/6	EA76	13/-
1LN5	8/-	6CH6	7/-	6U4GT	12/-	12SJ7	4/6	35Z5GT	6/-	CV6	10/6	EABC80	6/6
1N5GT	7/9	6CL6	8/6	6U7G	10/6	12SK7	4/9	50B5	7/-	CY1C	10/6	EAC91	3/-
1R5	5/6	6CW4	12/-	6V6G	3/6	12SQ7GT	8/-	50C5	6/3	CY31	7/6	EAF42	10/-
1S4	4/9	6D3	7/6	6V6GT	6/6	14H7	9/6	50CD6G	43/3	D63	5/-	EB34	3/-
1S5	4/3	6D6	3/-	6X4	4/3	14S7	15/-	50L6GT	9/-	D77	2/3	EB41	4/6
1U4	5/9	6F1	12/6	6X5GT	5/-	19AQ5	4/9	72	6/6	DAC32	7/-	EB91	2/3
2D21	6/6	6F6	12/6	6Y7G	12/6	19H1	40/-	85A2	8/6	DAF91	4/3	EBC41	9/6
3A5	10/-	6F6G	5/-	7B6	10/9	20D1	13/-	85A3	8/-	DAF96	6/6	EBC81	6/6
3B7	5/-	6F12	3/3	7B7	7/-	20D4	20/5	90AG	67/6	DCC90	10/-	EBC90	4/-
3D6	3/9	6F13	3/6	7C6	6/-	20F2	14/-	90AV	67/6	DD4	10/6	EBC91	5/6
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ELECTRONIC metronome

M. WALLIS

THE project described here has a number of uses. First, it will operate as a conventional metronome, that is it can be used to provide the time for playing musical instruments. It may also be used as a short-duration timer or in a situation when using a clock is impractical such as in a dark-room. A similar circuit has been used by the author as a bird scarer; after two years of being without a single ripe cherry from a tree in the garden, a more powerful version was waterproofed and placed at the foot of the tree. A healthy click every few seconds succeeded in keeping the crop intact.

It is possible to build a cheaper metronome than the one described here using one PNP and one NPN transistor (such a circuit was described in Take 20 No. 3, Practical Wireless, July 1969) but this type, although it has several uses, suffers from inaccuracy due to the beat being dependent on the supply voltage and to a lesser extent on the ambient temperature. The circuit used here is very stable and overcomes these inaccuracies by using a unijunction transistor.

The metronome may be calibrated very accurately and once this is done the settings can be relied upon. When the battery voltage falls the output level drops but the beat timing is unaffected.

THE CIRCUIT

The circuit for the metronome is shown in Fig. 1 and consists of a 2N2646 unijunction transistor operating as a relaxation oscillator. The second transistor, a BC108 in the prototype, simply boosts the output though it is being operated more as a switch rather than as an amplifier.

The operation of the unijunction has been described in past issues of the magazine and for those interested in its operation these should be consulted.

When no voltage is applied to the circuit the emitter junction of the u.j.t. will be at earth potential as the capacitor has no charge on it, but as the unit is switched on C1 charges up through VR1 and R1 so that voltage at the emitter of Tr1 rises.

When this junction reaches a certain level Tr1 starts to conduct and C1 is discharged through R3. At the same time current flows between b_1 and b_2

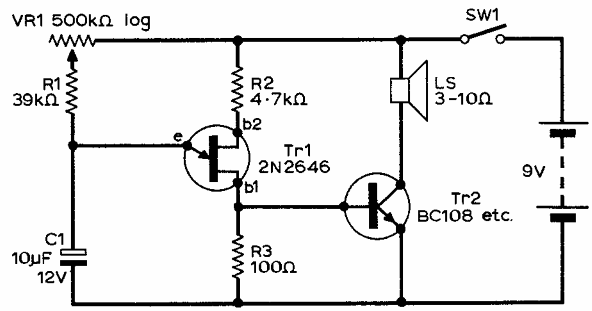


Fig. 1: The circuit of the metronome

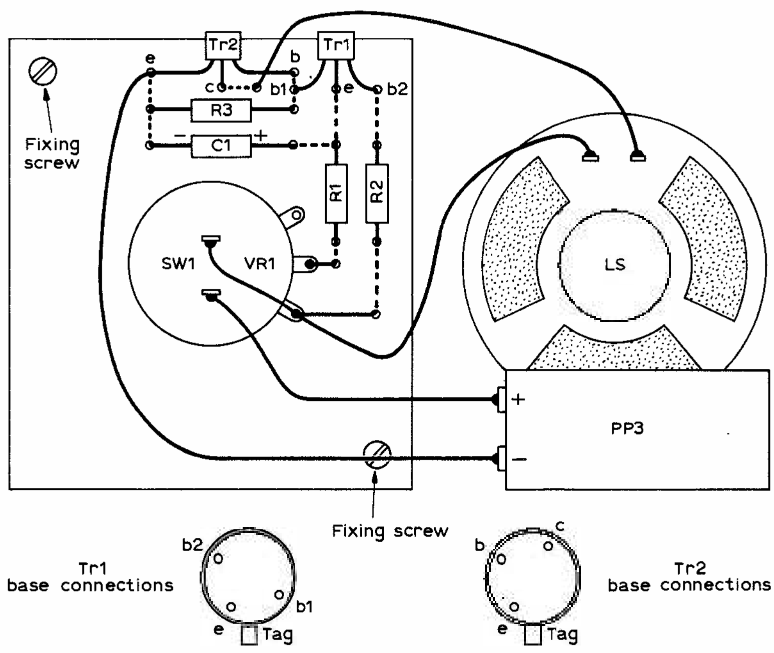
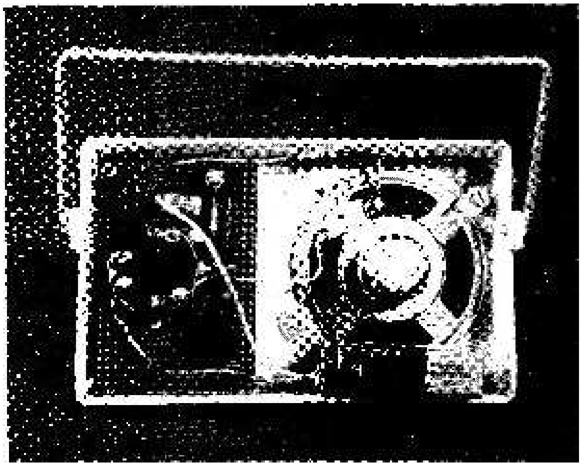


Fig. 2: The component layout and transistor base connections


Internal view of the completed metronome

and the voltage at b_1 rises.

However, as C1 has discharged the unijunction is switched off and the voltage rapidly falls. All this takes place very quickly and all you actually get is a series of pulses across R3.

Tr2 is connected with its emitter grounded, its base directly connected to Tr1 b_1 and the loudspeaker acting as the collector load. When Tr1 is not conducting the base of Tr2 is negative so no current flows but when Tr1 is producing the pulses Tr2 is switched on and the pulse is transferred to the loudspeaker, giving a healthy click.

The timing of the beats depends on the time constant of VR1 plus R1 and C1 and a wide range of frequencies are possible by altering VR1. The values in the circuit cover beats from 4 per second to one every 4 seconds and this should cover most music and timing requirements. For other ranges C1 can be changed—for faster beats reduce C1, for longer ones increase the value.

It is an easy matter to set the control accurately and this has been done on the prototype at the one second setting, this being very useful for timing applications.

VR1 can be either a linear or logarithmic type, but to give more control over the faster beats a log. type was chosen.

Almost any silicon NPN transistor can be used for Tr2, including the cheap surplus types.

The output volume is almost entirely dependent upon battery voltage, but a PP3 delivering 9V gives a pretty healthy click.

CONSTRUCTION

The prototype was built in a transistor radio case and many readers will recognise it. Several kits were based on this case and they are still advertised separately from time to time. If this type is not available local component suppliers often have surplus transistor radio cases and most of these should be suitable. The advantage of using such a case is that it will have a speaker grill and mounting facilities for the circuit board.

Apart from the loudspeaker and the battery, all components are mounted on a drilled paxolin board. Figure 2 shows the component layout and this should be fairly easy to follow. ■

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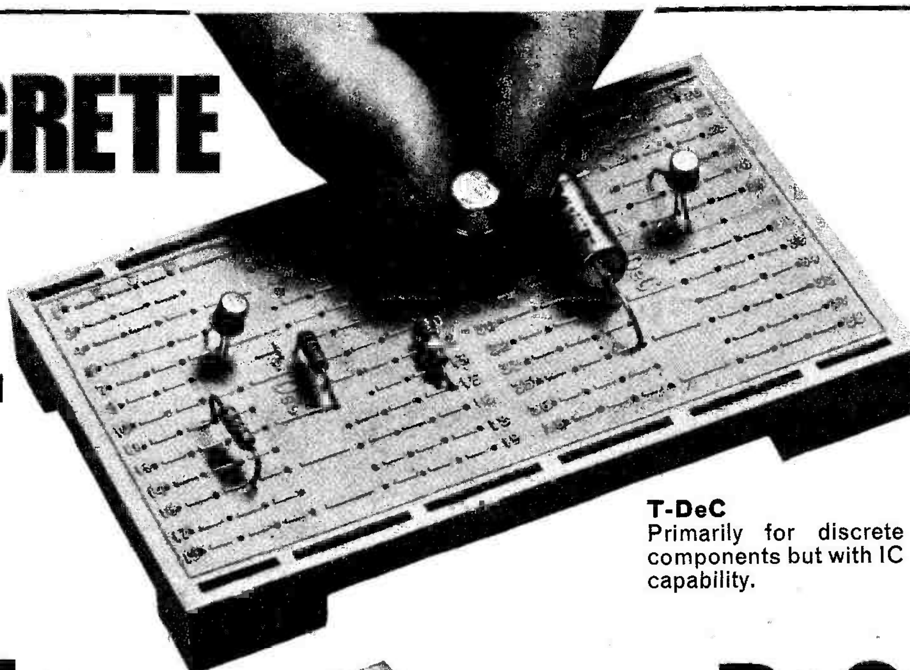

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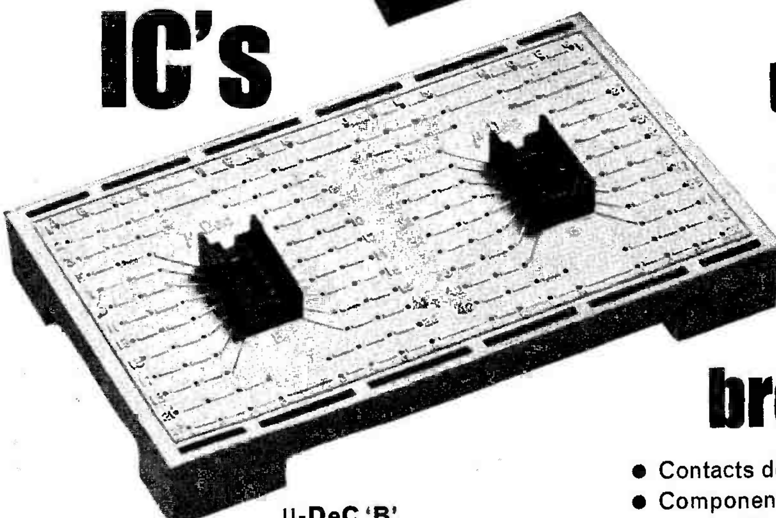

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2N1304	5/-	AF181	8/6	OA85	2/6
2N1305	5/-	AF186	9/-	OA86	4/-
2N1306	5/-	AF239	8/-	OA90	2/-
2N1307	5/-	AFY19	22/6	OA91	1/6
2N1308	6/-	AFZ11	8/-	OA95	1/6
2N1309	5/-	AFZ12	10/-	OA200	1/9
2N1613	5/-	ASY26	6/6	OA202	2/-
2N2147	17/6	ASY27	7/6	OA210	6/-
2N2160	15/-	ASY28	6/6	OA211	9/6
2N2287	25/-	ASY29	6/-	OAZ225	7/6
2N2646	10/6	ASY67	9/6	OAZ228	7/6
2N2904	8/6	ASZ21	8/6	OAZ229	9/6
2N2905	10/-	AUY10	19/6	OAZ231	9/6
2N2925	4/-	B3M	19/6	OAZ234	7/6
2N2926	2/6	BA110	5/-	OAZ238	9/6
2N3011	7/6	BAY31	2/-	OC16	10/-
2N3053	5/-	BC107	3/-	OC19	7/6
2N3054	12/6	BC108	2/9	OC20	19/6
2N3055	15/-	BC109	3/-	OC22	9/6
2N3702	3/6	BC113	6/-	OC23	12/6
2N3703	3/6	BC116	8/-	OC24	12/6
2N3704	4/-	BC118	7/6	OC25	7/6
2N3705	3/6	BC134	7/6	OC26	5/-
2N3707	4/-	BC135	6/-	OC28	12/6
2N3709	3/6	BC136	7/-	OC29	12/6
2N3710	3/-	BC137	8/-	OC35	10/-
2N3711	3/6	BC138	8/-	OC36	12/6
2N3730	10/-	BCY30	5/6	OC41	5/-
2N3731	12/6	BCY31	8/6	OC42	6/-
2N3794	2/6	BCY32	10/-	OC43	8/-
2N3819	8/-	BCY33	5/-	OC44	4/-
2N3820	19/6	BCY34	6/-	OC45	3/6
2N3823	17/6	BCY38	7/-	OC46	5/6
2N4058	5/6	BCY39	8/6	OC70	3/-
2N4061	4/-	BCY40	10/-	OC71	3/-
2N4286	3/-	BCY42	5/-	OC72	5/-
2N4288	3/-	BCY43	5/-	OC73	6/-
2N4289	3/6	BCY70	4/-	OC74	6/-
2N4290	3/-	BCZ11	7/6	OC75	5/-
2N4291	3/-	BC147	3/9	OC76	5/-
2N4292	3/-	BC148	2/9	OC77	8/-
40361	12/-	BC149	4/-	OC78	5/-
40362	13/6	BF152	6/-	OC81	5/-
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2S002	10/6	BF195	3/-	OC82	5/-
2S003	9/6	BD124	12/6	OC83	5/-
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2S005	14/-	BF115	5/-	OC122	10/-
2S012	25/-	BF154	8/-	OC123	10/-
2S013	20/-	BF158	6/-	OC139	5/-
2S017	15/-	BF159	12/-	OC140	7/6
2S034	12/6	BF163	8/-	OC141	15/-
2S036	25/-	BF167	5/-	OC169	5/-
2S320	9/-	BF173	6/-	OC170	5/-
2S321	6/-	BF180	7/6	OC171	6/-
2S322	7/6	BF181	7/6	OC200	5/-
2S323	10/-	BFX30	6/-	OC201	9/6
2S324	12/6	BFX88	5/-	OC202	12/6
2S512	9/6	BFY20	12/6	OC203	7/6
2S701	8/6	BFY50	5/-	OC204	8/-
2S702	11/-	BFY51	4/6	OC205	12/6
2S731	8/6	BFY52	5/-	OC206	15/-
2S732	8/6	BFY53	4/-	OC207	15/-
2S733	9/6	BFY64	8/6	OCP71	19/6
AA178	8/6	BLY10	20/-	ORP12	12/6
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I.C. OF THE MONTH

L.A.J. IRELAND

Number 10 MC1303 Stereo Preamplifier/MC1304 Decoder

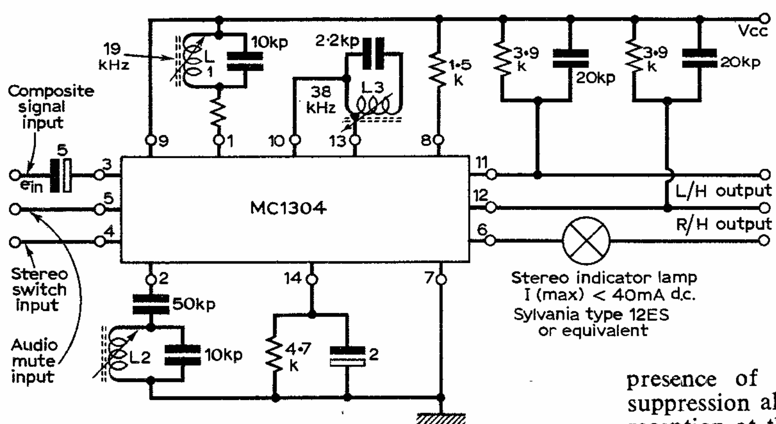
As long ago as December 1967 "P.W." carried a report, with full assembly details, on an f.m. tuner incorporating a special-purpose linear integrated circuit, the R.C.A. type CA3014, as the i.f. amplifier stage. Since then other manufacturers have introduced competing f.m. i.f. amplifier i.c.s, and now there are also available units to perform the other functions required in a hi-fi audio system. This month two of them are considered, a stereo decoder and the audio preamplifier to follow it.

MC1304 Stereo Decoder

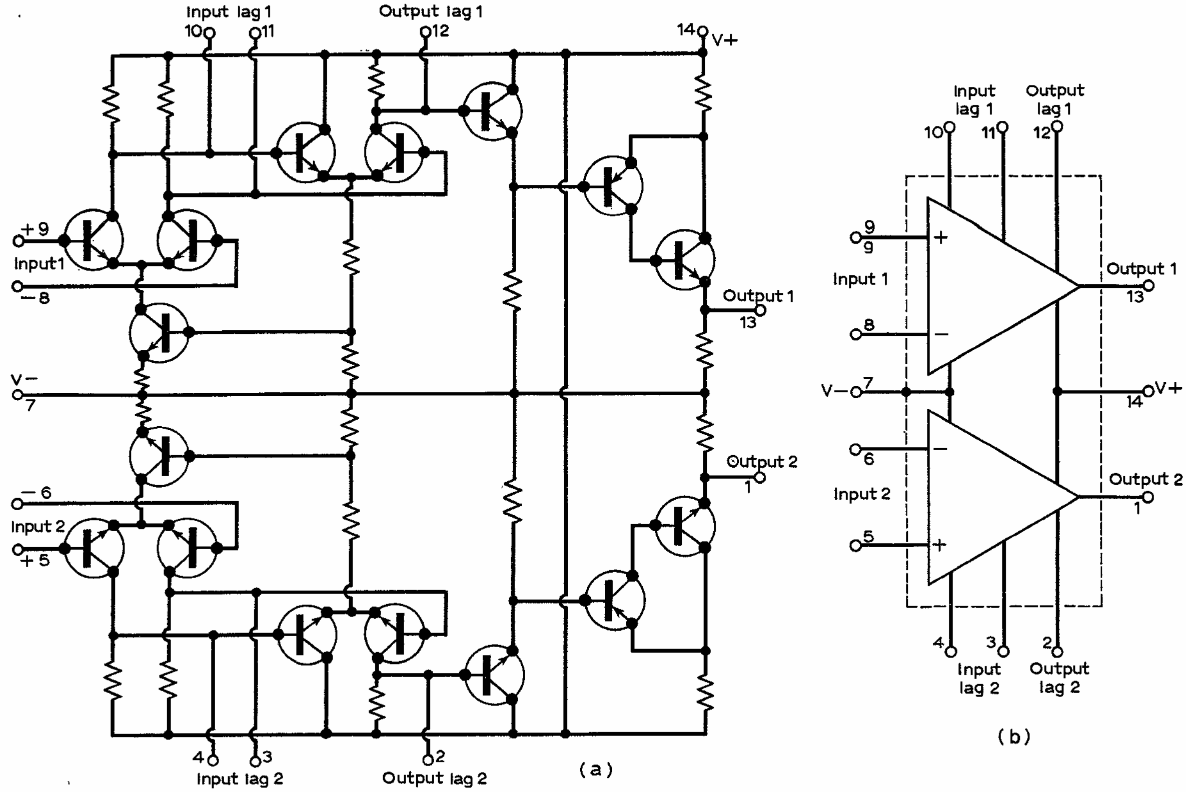
First, the stereo decoder, a Motorola unit type MC1304. With a handful of resistors, capacitors and coils this unit takes a "pilot tone" type multiplex stereo signal from the discriminator stage of an f.m. tuner and sorts out the separate right and left channels to feed the audio stages of the receiver system. As many readers will know, the pilot tone system of stereo f.m. transmission was chosen by the broadcasting networks since it is "compatible," i.e. can be received as a mono signal on a standard f.m. receiver. This is because the primary signal is the average of the two stereo channels. However, the demodulated stereo signal also contains components at a frequency beyond the limits of aural sensitivity which carry the difference information, determining the extent to which right and left channels differ at any given moment.

The difference is actually transmitted in the form of an amplitude modulation of a subcarrier at 38kHz, and therefore a decoder is analogous to a t.r.f. receiver tuned to this frequency, followed by a matrix which produces the separate channels from the now known sum and difference signals. There is one final complicating factor; to conserve bandwidth the sidebands only of the 38kHz a.m. subcarrier are allowed to contribute to the frequency modulation. The "suppressed carrier" must be provided if a conventional a.m. detector is to function, and this is in fact produced in the decoder with the assistance of a 19kHz "pilot tone" accompanying the sum signal.

To these essential functions the MC1304 adds a few "optional extras" in the form of a lamp driver output activated by the pilot tone to indicate the presence of a stereo signal, together with stereo suppression allowing comparison of stereo and mono reception at the touch of a switch. A similar system allows complete audio muting, switching the receiver into a stand-by mode. Like the stereo preamp type MC1303, described below, the MC1304 is supplied in a standard 14 lead dual in-line epoxy package, and the circuit and application diagrams should enable the experienced constructor to achieve success with this unit. Layout of the decoder system is not critical, as the highest frequency occurring is the upper sideband of the 38kHz suppressed carrier a.m. signal. In regard to matching this unit to the circuitry of the f.m. tuner, the input impedance is typically 12kΩ,



Left: The external circuitry required for full stereo decoder facilities using the MC1304. The righthand side of the indicator lamp goes to the 12V supply. Lefthand channel output is between pin 11 and earth and righthand channel output between pin 12 and earth. With a supply voltage of 12V the resistor at pin 8 should be changed to 2·7kΩ.



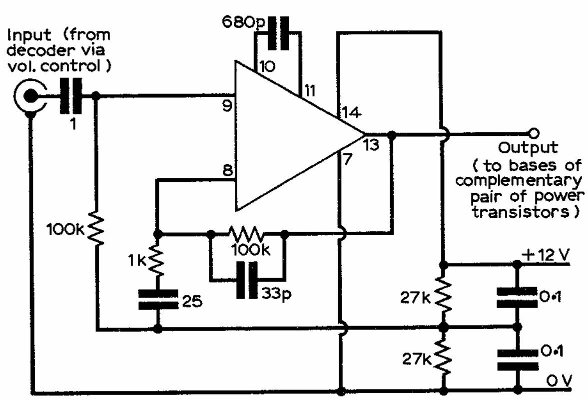
Left: Circuit of MC1303, stereo preamplifier unit. Right: Simplified diagram of the preamplifier.

and with this light loading of the discriminator stage of the tuner, no difficulty should be experienced. (One point, however, the satisfactory operation of a stereo decoder presupposes that the tuner had the specified bandwidth for f.m. reception, which must allow for a 75kHz frequency deviation. This is assured in conventional circuits with 10·7MHz i.f. and discriminator circuits, but may not be available in pulse-counting type tuners, with their very low i.f. frequencies, even though a particular specimen appears fully satisfactory in its mono performance.)

The output for each channel of the decoder is taken from the collector of a common emitter transistor stage, so that the only constraint on the audio amplifier following it is that its input impedance should not be too low. However, any standard stereo preamp will have an input impedance of 50kΩ or greater, so again no difficulty in matching should be experienced. For standard applications elegant and effective output stages to follow the decoder, with power levels in the range of 0·5 to 2 watts per channel, can be provided with i.c.s already mentioned in the pages of this magazine, such as the R.C.A. CA3020 or the General Electric (USA) PA237.

MC1303 Stereo Preamplifier

Motorola intend their MC1303 preamp to drive an output stage using discrete power transistors to a level of ten watts per channel or greater. The circuit is a development of an industrial dual operational amplifier, the MC1535, and as such provision is made for operation from a dual power supply, which gives both positive and negative inputs to the unit as well as an earth reference. For single source operation, as would be provided in the amateur circuit and for compatibility with the decoder, the base bias to the input transistors is drawn from a potential divider. The output level will then also be approximately one-half of the supply voltage, and correct for direct coupling to the bases of a complementary output transistor pair of the appropriate power rating.



Typical circuit of one channel of a stereo preamplifier built around the MC1303.

The power supply unit will be a standard system chosen with regard to the requirements of the output stage, with suitable decoupling for the preamp and decoder. Neither this nor the tone control circuits, also conventional, should provide any difficulty for the competent constructor. ■

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

Very interesting

Your correspondent J. B. Jobe (Feb. 1970) describes a phenomenom which I remember witnessing a couple of years ago when servicing a receiver.

I cannot remember the make of the set, though I know it was of foreign manufacture. Its owner had complained of no response from the volume control, although the sound was of reasonable quality and at a reasonable level.

Upon dismantling the set, I immediately noticed that one of the loudspeaker leads had come adrift, though at the time I thought this had occurred during dismantling.

However, after having duly fitted a new potentiometer, I switched the set on before I had connected the speaker and music miraculously emanated from . . . somewhere!

Unfortunately pressure of work precluded me from pursuing the matter at the time, so I wired up the L.S. and forget about it until I read Mr. Jobe's letter.

In retrospect, I know that the sound could not have come from the speaker transformer and I seem to remember suspecting the transistors at the time, though I do not remember whether they were "canned" or not.

As for explaining the phenomenom, I'm afraid I cannot! I am in the process of experimenting with various makes and types of transistors in an effort to reproduce the effect but so far without success. Dare we hope for speaker-less radios in the future?—**David A. Evered,** *(Roath Park, Cardiff).*

Some views

I write first to say how much I agree with your Editorial comment in the April 1970 issue of P.W.

The recent decisions by the broadcasting authorities have all been negative to a high degree, and it has always been my opinion that they seem intent on filling up m.w. channels, especially since the outrageous affair of the "pirates" being kicked off the air (although I am by no means a whole-hearted supporter of piracy!).

It seems that an important part of our cultural and entertainment facilities are being used as a political and financial pawn in the hands of the authorities.

My second point is entirely removed from the first and concerns the availability of components and the shops that supply them.

I recently decided to build the "Injectrace" in the Dec. 1969 issue and as I was anxious to get optimum performance from it, I decided to buy new components throughout instead of consulting my "odd-box". Having made a special journey to London to obtain the components for this, you can imagine my dismay and outrage when half the bits were as obtainable as Moondust! In one shop I was informed with great authority that the capacitors (Mylar) were no longer available as the firm called Mylar had "gone bust" six months ago. In another shop I was asked what circuit the capacitors were for and when I showed them the circuit in P.W. I was treated to a long tirade of abuse directed at P.W. and its staff who "didn't ought to specify fings cos the manufacturer sent em a free sample or two", (or words to that effect). In a very well-known shop I stood for 7½ minutes awaiting service whilst the assistants discussed in great detail the latest pop music.

The assistants in one well-known shop have the annoying habit of putting all one's purchases in a paper bag and not showing to one *before* doing so. This resulted in my coming away one or two items short. One could of course check them at the counter but this would be after paying as they are so quick to take the money.

Several other minor things happened all adding up to a very frustrating day, after which I resolved firmly to shop from the excellent small men who advertise in P.W., by post.—**Paul Newman** *(Aylesbury, Buckinghamshire).*

Oldest in the world?

South Africa may claim to have the oldest ham net in the world in the Early Morning Gang (sic), which is international in character and has been in existence since 1935. It is also one of the most informal, and although I as an associate and short wave listener have known it for 12 years, I have not sounded the depths of its traditions, customs and "deep mysteries".

From the chairman, affable O. M. Ted (ZS6 William Ida), Johannesburg, I learn that the only founder member is O. M. Bill (Horizontal Willie) who resides symbolically enough in Vereeniging, Transvaal, where the Treaty of Vereeniging was signed in 1902 restoring full peace to South Africa and establishing the Union.

Bill Yapp sets the pace for the amusing mimicry of the EMG (which must *never* be called a group) by claiming to reside in "the depths of the River Vaal" from which he emerges with a gurgling of water (recorded on a tape recorder) to give his matinal greeting.

The Early Morning Gang is only heard in the mornings between 0400 GMT and 0600 on the 40-metre band (7056·3 kHz), on a.m., and migrates to 3600 kHz during the South African winter. It is a very far flung gang and has members in Cape Town (1,000 miles from Johannesburg) Bulawayo, Rhodesia, East London, C. Province, Lesotho, Botswana and Swaziland. Among its members are farmers, a retired hotel keeper, a pharmaceutical expert, a retired mining official, and one nursing sister, who is the only YL. Most of the members put out a pretty good signal, and the gang has been heard in many parts of Africa, and sometimes in Australia and South America. On Christmas mornings as many as 42 hams in Southern Africa have exchanged greetings within the EMG, and passing of the "over" has been expertly handled by the chairman assisted by veterans with more than 20 years membership.

It has dozens of faithful listeners each morning and has officially awarded Five Star Listener status to two for their services in sending in reports.

I'm one, so that's why I've written this.—**Hector Watt** *(Johannesburg).*

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT • Frequencies in kHz

THE BROADCAST BANDS

Malcolm Connah

THE arrival of spring always seems to drag DXers out of their shacks and put them to work in the garden or around the house. One DXer who remained in his shack was **J. G. Sowerby** of Stranraer and he was suitably rewarded when he heard Radio New Zealand. His equipment is a Lafayette HA600 with either a Joystick or an external long-wire.

This is a case of the early bird catching the worm as reception occurred at 0500 GMT with news followed by music and talks until close-down at 0545. The broadcast is beamed to the Pacific Islands on several frequencies but only 15280 is audible in this country.

Geoffrey Gilham of London S.E.12 has, once again, used his Eddystone EC10 and Trio 9R59D to good effect and sent in the following log:

4935 *Radio Poti*, Brazil with light music at 0220
4835 *Radio Mali* with news in French at 2015
4870 *Dahomey* with radio play at 1939
4890 *Radio Baré*, Brazil at 2315
15125 *BED60*, Taiwan in English at 1802
15440 *DZF8*, FEBC in English at 1530

A new reporter this month is **Mervyn Winters** of County Antrim whose equipment consists of an AR88D and a 12 foot whip aerial. His list of two dozen stations has been severely pruned by your scribe but among the better catches were:

6095 *Radio Baghdad*, Iraq in English at 2000
9545 *Accra*, Ghana in English at 2045
11730 *R. Nederland*, Bonair in English at 0625
11915 *HCJB*, Ecuador in English at 0900
15020 *Radio Hanoi*, Vietnam in English at 2000
15160 *Radio Ankara*, Turkey in English at 2200
15165 *Radio Damascus*, Syria in English at 1930
15345 *Radio Kuwait* in English at 1830
21480 *RSA*, South Africa in English at 1750
21485 *Radio Australia* in English at 2310

Another regular reporter is **T. R. Gibbs** of Swindon. His report this month contained the following loggings:

3322 *Radio New Guinea* at 1200
7135 *Radio Peking* in German from 2000 to 2030
9715 *Cyprus B.C.* from 1900 to 2000
11855 *RTA*, Algeria at 1600
15270 *Radio Sudan* (// with 11835) from 1715 to 1800

Philip Batt of Littleborough, Lancashire is another new reporter, his equipment is a PCR3 receiver and a 92 foot long-wire at 15 feet elevation. His log included:

7105 *Radio Tirana*, Albania at 0015
7110 *All India Radio* at 2115
11995 *Teheran*, Iran at 2010
15335 *Deutsche Welle*, Kigali relay at 0659
15365 *R.N. Espana*, Canary Is. in Spanish at 1910
15400 *Radio Kiev at* 1935
15405 *Voice of Nigeria* at 1815
17750 *Radio Pakistan* in English at 0900
17825 *NHK, Tokio*, Japan in English at 0900
21600 *Radio Australia* at 0620

Raymond Peart of Worcestershire used his Spidola transistor receiver and 100 foot long-wire to send in his first report to the column:

6135 *Radio Warsaw*, Poland at 1830-1900
7210 *Radio Norway*, English news, 1200-1230
7219 *Radio Nederland*, Happy Station at 0930
9605 *Radio Prague* in English at 1730-1830
9665 *Radio Switzerland* Calling at 1830
9770 *Austrian Radio* with news in English, 1300-1400
17705 *Radio Havana*, Cuba in English at 2010-2138

Roy Patrick of Derby has sent in some very interesting items of news including:

Radio Pyongyang has been heard by Roy at 1900 in a frequency of 6540 with programmes in English.

Radio Mexico is now using two frequencies, according to Roy these are 9745 and 15135kHz.

Malcolm Robinson of Liverpool sent me the schedule of *Radio RSA*, South Africa which reads as follows:

English: Daily Transmission to:—

U.K. and Ireland from 1756 to 1850 still using the 21480 and 15250 outlets.

Africa General from 1056. Heard at good strength on 25790 and 21535 also with unheard outlet of 15220; and from 1450 to 1550 heard on 21535 and unheard on 15220. An additional outlet on Saturdays and Sundays on 11900 is in use from 1056 to 1450.

Monday-Saturday Transmissions to:—

North-West Africa from 0645 to 0658 heard on 21535 and 17805 and unheard on 15220 and 11900.

Afrikaans: Monday-Saturday Transmissions to:—

Rhodesia, Malawi and Zambia from 0600 to 0613 heard on 17805 and 15220, also broadcasting on 11900 and 9525.

Sundays to:—

East and Central Africa from 0656 to 0950. Heard on 25790 also broadcasting on 15220.

French: Monday-Saturday to:—

Central and North Africa from 0630 to 0643 heard on 21535 and 17805 also outlets on 15220 and 11900.

Potuguese: Monday-Saturday to:—

Angola from 0615 to 0628 heard on 17805 also with outlets on 15220, 11900 and 9525.

We have been asked to point out that in the report on page 57 in the May 1970 issue, the reference to the Codar CR70A was not intended to be detrimental. It was not intended as a report on the receiver and reception was of course governed by conditions.

THE AMATEUR BANDS

David Gibson, G3JDG

READ all about it. Who is GB3WRA? Why are strange callsigns coming from PY land? Who has a 21-mile antenna buried in ice?

Listen out on all bands 160-10 metres on Saturday, September 5, for GB3WRA. This will be a special station located at High Wycombe, Bucks, for the annual Wycombe show. Visiting amateurs and s.w.ls welcome.

Brazilian stations apparently used the prefixes ZV, ZW, ZX, ZY and ZZ for the CQ WW contest because the contest was for prefixes. You begin to wonder if a countries list or a callbook is really of much use these days.

John Moore (Leicester), relates the strange saga of KC4AAD who is located near the U.S. base "Byrd" some 650 miles from the South Pole at 120°30′W, 79°54′S. Are you sitting comfortably? Then I'll begin. This station has a 21-mile dipole which is resonant at just under 1kHz and is used on 3kHz for experimental purposes. Quick, get the hi-fi out, you might log him. Apparently some five years ago the antenna, all 21 lovely, dangly miles of it, was lying on the ice. Now, it is four feet below the surface. Anyone at the North Pole is advised to be on the lookout for a long piece of wire which should be through in about another seven million years' time.

J. Leaver (Lancs), home brew s/het, 100ft wire wound round the loft, a.t.u., has sent in a fantastic topband log which is 99·893% c.w. Among the stations heard, which includes 30 OK and 13 OL stations are: DL9KRA, EI9BG, GI3JEX, GI6TK (s.s.b.), GM3BGW, GM3LQI/P, GM3SVK, GW3TUG, GW3ZEY, OK1ABK, OK2BMR, OK3TCA, OK5TOL, OL1AUL, OL2ANK, OL4AMF, OL5AMA, OL6AKP, OL8ANL, PAØPN, 5B4NZ, 9H1BL. Would-be c.w. sleuths are advised to QRX 1·85MHz down to band-edge.

Steve Ireland (Kent), PW Clubman, 19-set variometer, 67ft end fed, says best time to listen for DX on 80 is 2130, especially the net on 3·795MHz. Steve's best on the band are: CN8HD, CT2AK, CR6IV, EP2DX, HBØLL, OY2X, OD5BA, PY1HA, PY7BFN, PZ1AH, SM6CNS/MM, TA2E, W4RDD/P/VP9, W2NIN, K3JH, XE7KS, YVØAI, ZC4CB, ZM2BCG, 4X4KT, 4X4YM.

I've heard of "A little bird" whispering in someone's ear, but when it comes to 14MHz, the PCR3 belonging to **P. Batt** (Lancs), takes a lot of beating. The 22ft 45° "vertical" is connected via a 70ft single wire feeder and an a.t.u. Proof of this r.f. pudding is: AX2AYE, AX3AD, AX3LAF, AX4SD, CE3OE, EP4OE, HP1MD, K4ZL, KP4CM, KV4AB, LU5B, PY1BSC, PY7ARM, VK5RFJ, VK7WH, VP2DOE, VP2VO, VR1IC, VE3CU, VE4SK, YV3US.

Messrs **Anderson, Roberts** and **Apperley** have confessed! Their chemistry master is none other than G3XMM. Heard on 21MHz on the guv's HRO and 80ft end fed: AX3DCR, DU1CH, EL2AI, EP2KB, G3PAC/W9, HR2HHP, HV1CN, JA6MDD, JA8DGR, KR6HR, LU5XE, MP4MBB, MP4TDR, PY2EIR, SV1CZ, VE3EQA, VP7CG, VP9GE, VU2DK, YV1SA, ZM1AIX, ZS6AL, ZX1MB, ZX2DVH, 9Y4MM all on s.s.b.

A. Crooks (Leicester), RA1 plus PR30, 45ft end fed also reports a series of interesting squeaks on 21MHz s.s.b. Andy's log reads: CR4BC, CR6GA, CR7IZ, EA8GZ, EL2BZ, EP2DX, HS3ACP, JA1SQI, JA1YGM, JA4AOF/MM (near the Phillipines), JA5ARU, JA6MS, JA9IL, JH1BLX, JW7UH, KP4ES, OA4LM, OI3NY PY4BLH, TG9RR, TJ1AR, UA0SU, VO1FX, VU2KV, VU2OLK, ZS2PX, 4X4BR, 6W8BD, 9H1CB.

Gear—CR100/2, 60ft end fed. Listener—**J. Moore** (Leicester). Log: AX3VK, CR6GA, CR6MH, CR7BB, CX7BF, DU1FH, FG7XL, FL8MB, HK3VA, HS5ABD, HT1HSM, JA1HTM, JA2EQ, JA4FRB, KV4AD, KZ5JW, LU2DEK, LU5DDM, LU9NA, OA4LM, OD5BZ, PJ9JR, PY2HT, PY8II, UH8BX, UL7GAW, VE3MR/4X4, ZE1AA, ZE3JO, ZS6AL, ZV2CK, ZY2RZ, ZZ1CAD, 4S7PB, 4Z4HF, 5J3WO, 5Z4LS, 7Q7LZ, 9H1BA, 9J2PV all on ten metres s.s.b.

It's all happening on two metres. **N. Richardson** sends in an impressive log which included F1BCI/P located some 10km south of Calais. Nicholas is in Bucks, and uses an 8-element Yagi, Garex converter, PR30 and CR7OA tuning 28-30MHz.

"Keep up the good work in printing 2 metre logs in PW," says **S. Carter** (Staffs), while **Glyn Richards** (Isle of Wight), admits to riding his trusty 4-over-4 slot fed on the 144MHz trail. The JXK converter and GC-1U got these a.m. stations which are between 120 and 180 miles away: G3GZJ (c.w.), G3PWJ, G8CSU/P, GW3CBY, GW3ITZ/P, GW3OXD/P, GW3NWR, GW3VKL/P.

From France, Glyn logged: F1AAD/A, F1TE/P (both in Cherbourg), F1BCI/P (Calais), F3LP (Le Havre), and from further afield—HB9AEN/P.

Mobile rallies in July include: July 5th, Cornish ARC rally at St. Ives; 5th, ARMS rally at RAF/USAF air base, Alconbury (highly recommended); 12th, Upton Mobile Rally, Upton-upon-Severn, Worcs; 19th, Mobile Rally at Scarborough; 26th, White Rose rally at Leeds; 26th, Saltash rally; August 2nd, Mobile picnic at Bristol; August 9th, Woburn Abbey mobile rally; August 9, Mobile picnic at Stratford-upon-Avon.

Deadline for logs for The Amateur Bands this month is the 15th.

RSGB EXHIBITION 1970

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WHERE?
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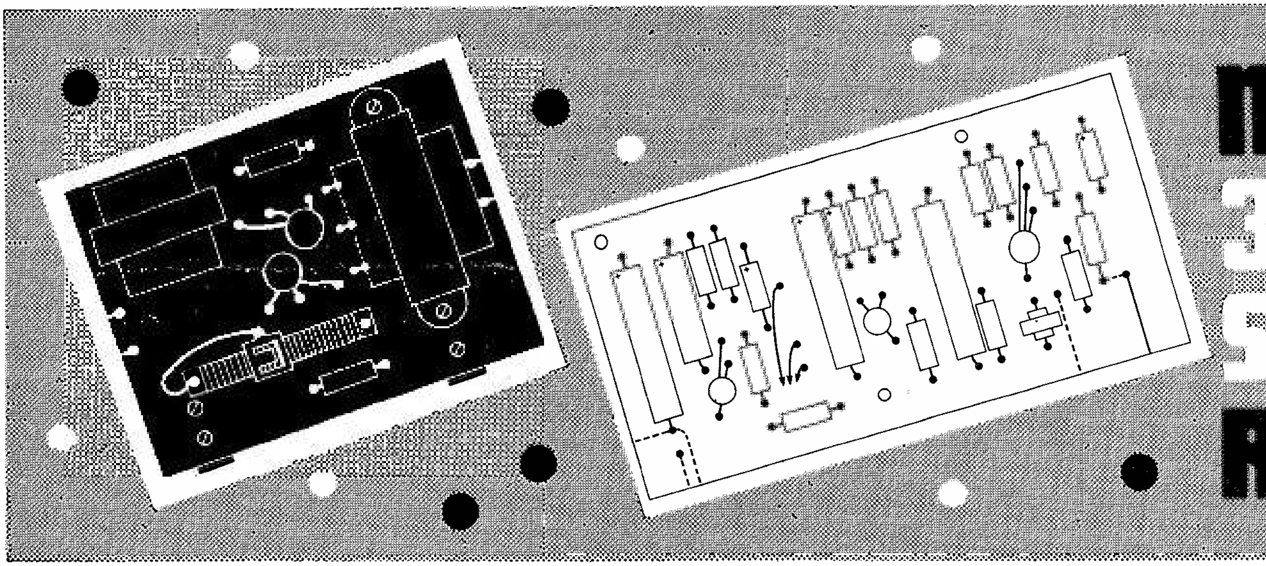
BE CAREFUL . . . ! ! ! NOTE THE DATE
THE SHOW'S EARLY THIS YEAR!



AS is well known, a t.r.f. type receiver is capable of surprisingly good results, when correctly operated and circuit design is very much simpler than with a superhet.

The receiver described here covers approximately 1·3MHz to 20MHz or 230 to 15 metres, in three switch selected wavebands. The OC81D output stage gives very good headphone volume, from a large number of transmissions. Coverage includes the 160m and 80m amateur bands, ship and other frequencies, as well as the more usual short wave bands.

A push-pull output stage can be added to boost volume for loudspeaker reception. This stage is in the form of an optional module which can be plugged into the receiver output socket.

Circuit

This is shown in Fig. 1, with the coil for one band only. The remaining two coils are wired in the same way as that shown.

VC1 is the main tuning or band-setting capacitor and the small capacitor VC2 is for bandspreading.

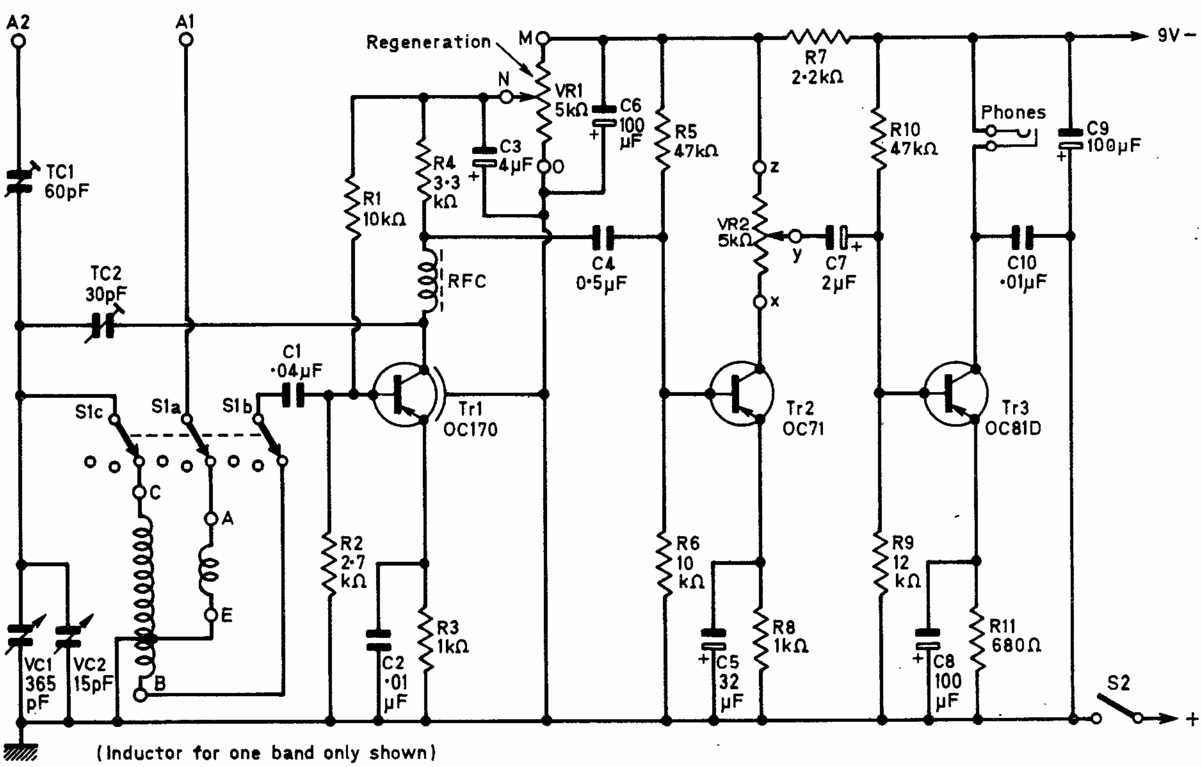


Fig. 1: Circuit of receiver. The circuit of the additional audio module is shown in Fig. 7.

ODULAR -Band hort Wave ECEIVER

R.F. GRAHAM

Its full rotation covers only a narrow band of frequencies. In use, VC1 is set for a band required, such as the 25m or 31m band, and this is tuned with VC2. The tuning "rate" with VC2 is about the same as that which would be obtained with a 20 : 1 reduction drive on VC1, and this method is inexpensive, convenient, and easy from the building point of view. These capacitors need not have the exact values shown.

Each inductor has a tuned section C to E, base coupling E to B, and aerial coupling A to E and 3-pole 3-way switch brings in the coil required. Alternative aerial sockets are fitted, A1 is better with a reasonably long aerial and when an earth is available. A2 is used in other circumstances, and has a small series capacitor TC1.

An OC170, Tr1, is used as a regenerative detector, with feedback through TC2 and regeneration control

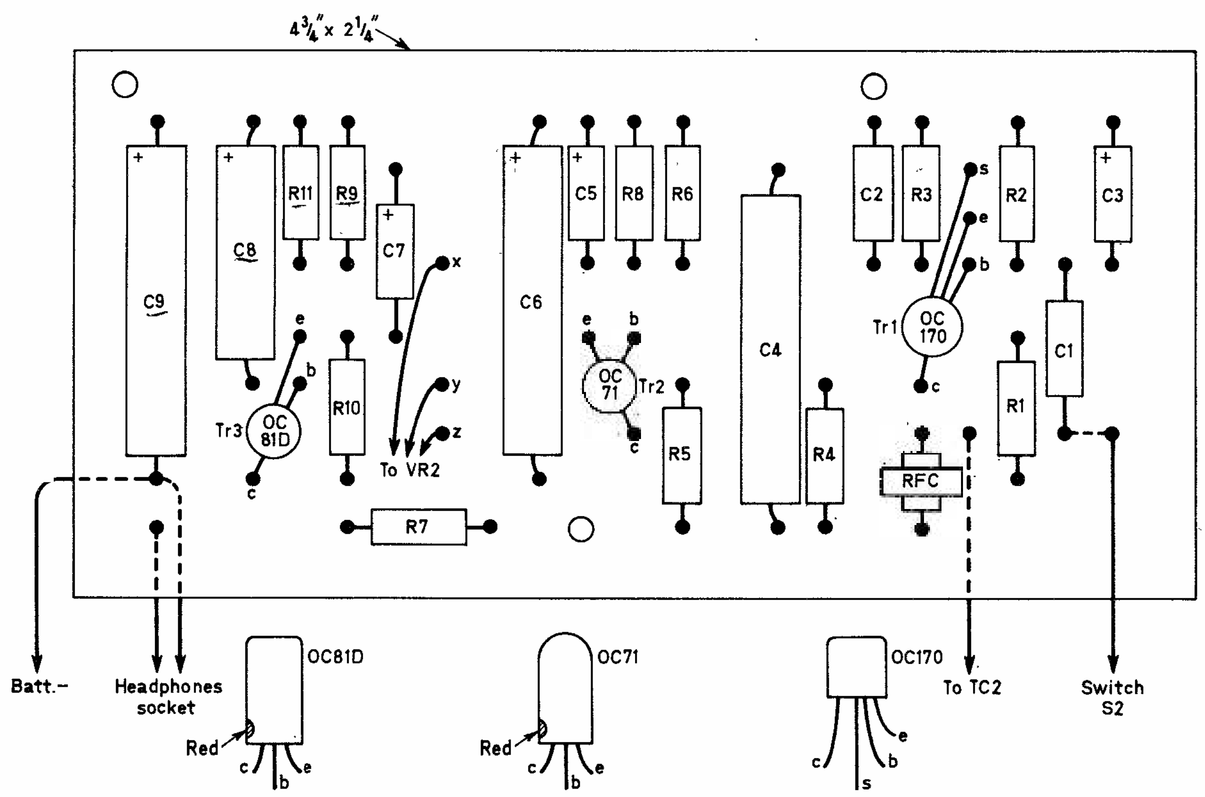


Fig. 2: Top view of circuit board and identification of transistor connections.

VR1. For proper results with a t.r.f. receiver, proper regeneration on all frequencies is absolutely essential, and this circuit was found to perform well.

The output of the detector is coupled to an OC71, Tr2, first audio amplifier, and VR2 is the audio gain control. Tr3, an OC81D, is intended for use with medium impedance (500Ω) headphones. A single earpiece or miniature personal earphone not being very suitable for regular s.w. listening.

Circuit Board Module

Most of the components are assembled upon a ready perforated insulated board about $4\frac{3}{4} \times 2\frac{1}{4}$in. which is later fixed to the chassis by three bolts, two of which provide earth returns.

Fig. 2 is the top of the board. The easiest method is probably to insert the resistors and capacitors a few at a time, spreading the wire ends so that they do not fall out. The board is then turned over, and the leads are cut to suitable length, and soldered. Check all component values as they are fitted, and note that the larger capacitors have their polarity indicated, as shown.

Fig. 3 is the underside of the board. Where wire connections are necessary, some 22 s.w.g. tinned copper or similar wire is used. Insulated sleeving is put on all leads which may touch other bare wires or joints. Two tags are placed as in Fig. 3, and are common to the positive or earth circuit and chassis. These tags are tightly held by nuts or $\frac{1}{2}$in. long bolts.

When the circuit board is fixed to the chassis, put an extra nut on each bolt, so that the board is about $\frac{1}{4}$in. clear of the chassis. The bolts then pass through holes in the chassis, and further nuts are put on and locked tight. Bare joints and wires should be clear of the metal chassis, but a piece of card can be put under the circuit board, to avoid any possible short circuit.

Transistor connections are shown in Fig. 2, and it may be found helpful to put thin coloured sleeving on the wires to help identify them. Red may be used for the collector, black for the base, and some other colour for emitter leads. The wires are left at such a length that the transistors are about $\frac{1}{2}$in. clear of the circuit board.

A number of flexible leads run from the circuit board, for connections to the volume control and elsewhere. It is helpful to identify these wires by using coloured sleeving, or by employing thin coloured flex.

A lead from C1 passes directly down through the chassis to the bandswitch, Fig. 4. Leads from VR1 go down through a common hole, as do leads from VR2. Take a flexible lead from C9, for battery negative, and solder on a negative battery fastener. Run leads from C9 and OC81D collector which go to the headphones socket.

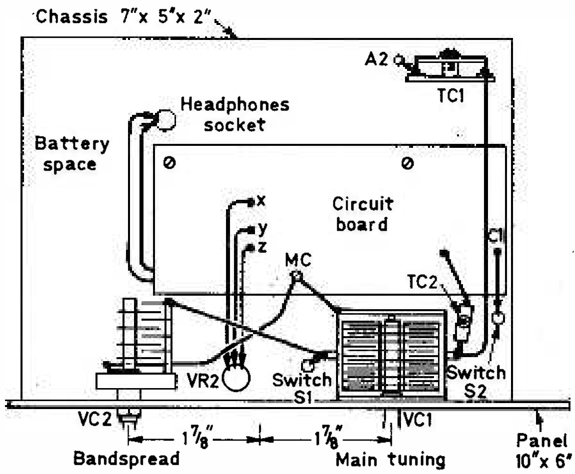


Fig. 4 : Top view of chassis and circuit board.

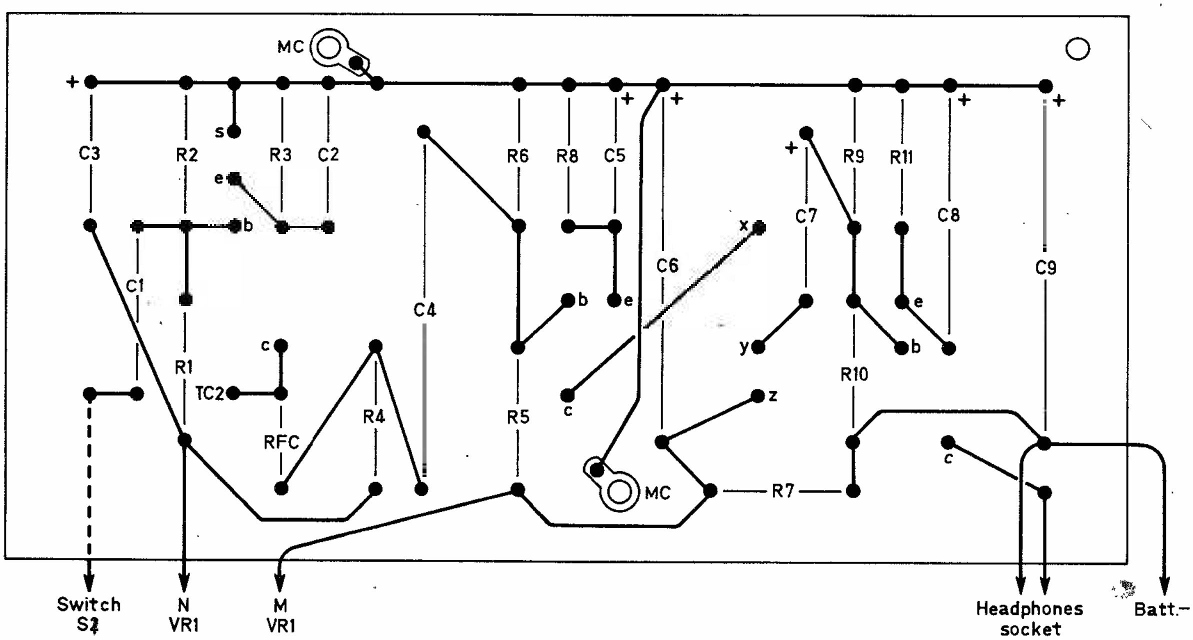


Fig. 3 : Bottom view of circuit board showing interconnection of components.

Chassis

The chassis has flanges to which the panel is bolted as in Fig. 5, and Fig. 4 shows how the circuit board is fitted. The rotor connections for both VC1 and VC2 run to a tag MC, in Fig. 4. A further tag, under the chassis on this bolt, is the earth return point for the coils, Fig. 5.

TC1 is soldered to the insulated tags of a tag-strip, Fig. 4, and TC2 is soldered directly to one of the stator tags of VC1. A lead from the other stator tag passes directly down through the chassis to the band-switch.

The tags of VR1 and VR2 are lettered, and must, of course, be correctly connected to the circuit board. The metal chassis is the common positive or earth return. A lead with a positive battery fastener is soldered to the switch incorporated in VR2, as in Fig. 5.

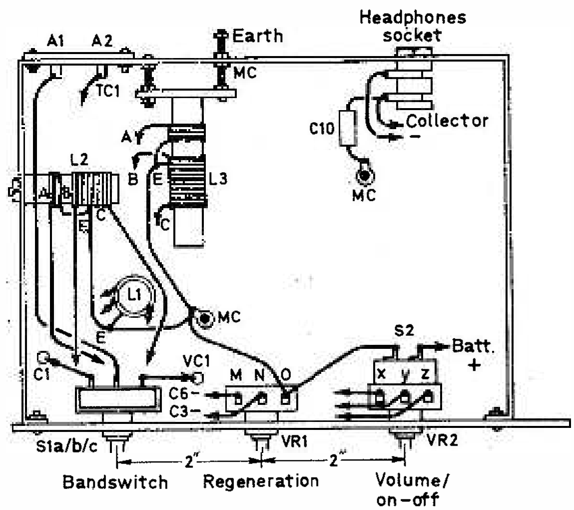


Fig. 5: Bottom view of chassis and wiring of coils and controls.

The cabinet listed has an inner flange, so the chassis has to be mounted a little high, as in Fig. 6, to clear this. With a receiver of this kind, a metal case is helpful in avoiding hand-capacity effects.

Coils and Calibration

The three coils are wound in the same way, except for the numbers of turns. L1 and L2 are on $\frac{1}{2}$in. diameter insulated formers, $1\frac{1}{2}$in. long, and L3 is wound on a ferrite rod 2in. long and $\frac{3}{8}$in. in diameter. Paxolin tubes can be mounted by cutting discs of insulating material, and cementing these in one end. A small bolt will then fix the coil to the chassis.

All windings for L2 are of 32 s.w.g. enamelled wire, turns wound side by side. Fix the wire at C, Fig. 5, near one end of the tube, by passing it through small holes, or cementing it. Wind on 34 turns. Bare the wire and form a loop E, continue for a further 4 turns in the same direction, and finish at B. Leave the wire ends long enough to reach the switch. Solder the wire on at E, leave about $\frac{1}{8}$in. space, and wind 7 turns, finishing at A.

With all coils C goes to VC1 (via switch), E to chassis and earth line, B to transistor base (via switch and C1), and A to aerial, again via the switch.

The highest frequency coil L1 has 15 turns from C to E, and 3 turns from E to B, of 22 s.w.g. enamelled wire. E to A is 4 turns.

The lower frequency coil L3 is wound on a ferrite rod to reduce the number of turns required. C to E is 27 turns, and E to B is $1\frac{1}{2}$ turns, of 24 s.w.g. double

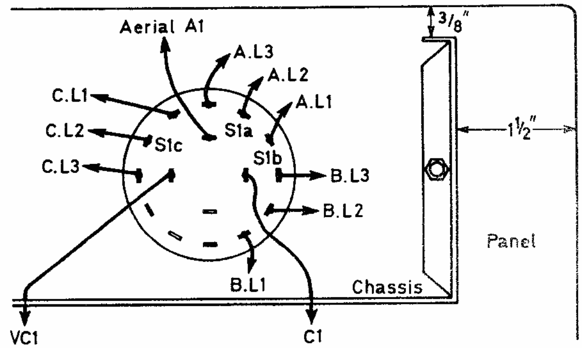


Fig. 6: Position of chassis relative to panel and bandswitch connections

cotton-covered wire. E to A is 7 turns of 32 s.w.g. enamelled wire. The end of the ferrite rod is a tight push fit in a hole in a strip of paxolin, and is cemented here. It is then mounted with two bolts, as in Fig. 5.

Fig. 6 shows the rotary switch connections, as seen from behind. (This is actually a 4-pole switch, with one pole unused. To avoid any chance of a mistake here, L2 only can be wired in, and the receiver tested with the switch in its central position. If the wrong tags are used for any coil or connection, the receiver cannot function.

VC1 and VC2 are fitted with large knobs and dials calibrated 0-100. VC1 is secured with three bolts, which must be very short to avoid fouling the plates. A small bolt was fitted above each dial, with its slot vertical and filled with paint, so that the dial numbers can be logged. Dial readings of VC1 for the various bands are given below. These are only a guide, because the home-wound coils and other factors will influence coverage.

	Freq.	*Dial*
Band 1.	20MHz	10
	15	20
	10	38
	8	55
	6	90
Band 2.	8MHz	12
	6	20
	4	40
	3	70
Band 3.	4MHz	15
	3	25
	2	50
	1·6	68
	1·3	95

Operation

With a t.r.f. receiver, adjustment of the regeneration is of the greatest importance. If there is little or no regeneration, almost no signals will be heard, and tuning will be very flat, but as regeneration is increased, a point is reached where sensitivity and selectivity improve enormously. This shows that the detector is approaching the point where it will begin to oscillate. Optimum results are with regeneration so adjusted that the receiver is *just* failing to oscillate. Advancing regeneration further will cause whistles when tuning through signals, and an almost complete loss of signals.

Initially, TC2 is almost wholly unscrewed. When VR1 is rotated slowly in a clockwise direction, background noise should begin to increase, and signals heard. If oscillation occurs when tuning through a signal back off VR1 very slightly. If regeneration up to the oscillating point cannot be obtained on some frequencies, screw down TC2 a little.

TC1 should normally be fairly well open, except for a very short aerial. If TC1 is screwed down, and a long aerial attached, the damping introduced may prevent regeneration, and may cause flat tuning.

Current drain is about 6-8mA or so, and any 9V battery is satisfactory.

Push-pull Amplifier Module

This amplifier, Fig. 7, can be plugged into the t.r.f. short wave receiver, to obtain speaker reception. No changes are needed to the receiver. The jack plug is put in the receiver headphones socket, audio signals being taken to the primary of the driver transformer T1. The plug also provides the supply voltage for the output stage.

★ components list

Resistors

R1	10kΩ	R8	1kΩ
R2	2·7kΩ	R9	12kΩ
R3	1kΩ	R10	47kΩ
R4	3·3kΩ	R11	680Ω
R5	47kΩ	R12	1·5kΩ
R6	10kΩ	R13	50Ω WW (Home Radio VR 101)
R7	2·2kΩ	R14	4·7Ω

All ¼W 10% except R13

VR1 5kΩ linear pot. VR2 5kΩ linear pot with switch.

Capacitors

C1	0·04μF 150V	C6	100μF 12V
C2	0·01μF 150V	C7	2μF 6V
C3	4μF 12V	C8	100μF 6V
C4	0·5μF 150V	C9	100μF 12V
C5	32μF 6V	C10	0·01μF 150V

VC1 365pF (Home Radio No. VC1A)
VC2 15pF (Home Radio No. VC26D)
TC1 60pF pre-set (Home Radio)
TC2 30pF pre-set (Home Radio)

Semi-Conductors

Tr1	OC170	Tr3	OC81D
Tr2	OC71	Tr4/5	OC81 matched pair

Miscellaneous

S1a-b-c, 3P3W rotary switch (Home Radio WS17). Transformer T1 (Weyrad LFDT4). Transformer T2 (Weyrad OPT1). 2 Dials, 2¾in dia. (Home Radio KN2). Chasis components, aluminium plate 7 x 5in (Home Radio CU168), 2 sides 5 x 2in (Home Radio CU134), 1 side 7 x 2in (Home Radio CU136). Miniature R.F. choke 2·5 mH. Case 10 x 6 x 6in (Electroniques 'Dinkicase'). Headphones jack and plugs. Paxolin panel 3 x 2¼in. Eyelet board.

R12 and R13 set the base operating conditions for the pair of output transistors, and R13 is a miniature pre-set resistor. This allows easy adjustment for best results with any pair of output transistors of the type shown, or similar type.

The amplifier module is mounted on two small brackets which form the positive or chassis return. This connection is essential. If the amplifier is not fixed to the chassis in this way, a lead must be provided here to complete the circuit. In this case, the amplifier could be in the speaker cabinet.

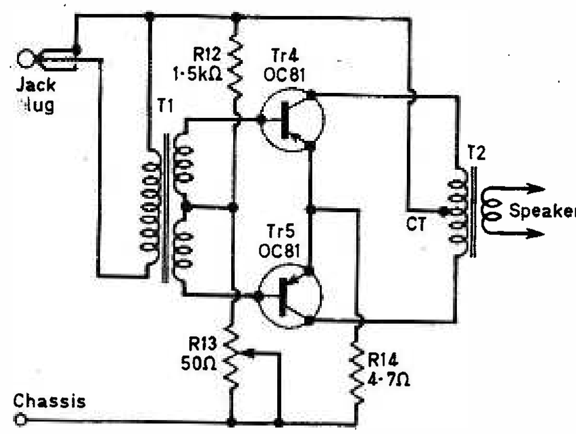


Fig. 7 : Circuit of amplifier module.

The components are mounted on an insulated board about 3×2¼in., Fig. 8. Provide a short flexible lead from the slider of R13, to one end, as shown. One tag of the driver transformer T1 is identified by a green dot, and this should be placed as in Fig. 8. Flexible leads run from the primary to the jack plug. Connect the plug is such a way that the negative circuit is correctly made when it is inserted.

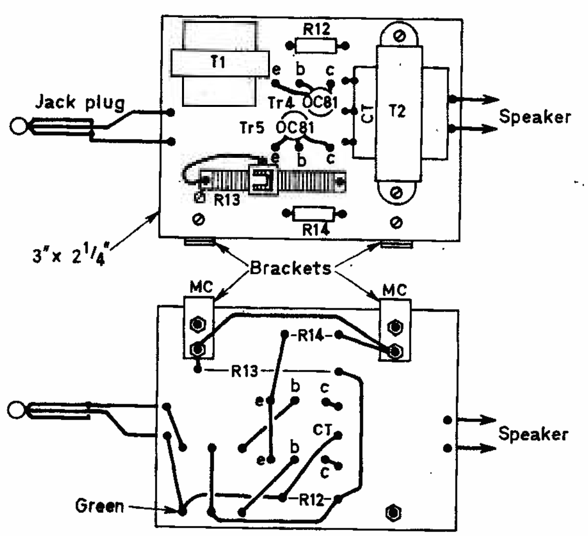


Fig. 8: Views of amplifier circuit board. Care must be taken to ensure correct wiring of jackplug.

Flexible leads from T2 run to the speaker, which should be a reasonably large 2Ω or 3Ω model, fitted in a cabinet, or attached to a baffle board. The amplifier is attached to the receiver by the two brackets, and stands vertically behind the receiver circuit board.

When the amplifier is in use, a PP9 or similar large 9V battery is more suitable. Temporarily, place a 100mA or similar meter in series with one battery lead. Set R13 to minimum resistance and plug the amplifier plug into the receiver headphones socket. When the receiver is switched on, the meter should show about 8-10mA. Move the slider of R13 to increase its resistance until the current rises about 2mA to 4mA above the original figure.

Subsequently R13 may be re-adjusted, if necessary, for best results with a signal tuned in. Current should not be over 15mA or so with no signal, rising to 30-40mA with good volume. The best setting for R13 depends somewhat on the individual transistors.

Headphones can be used as before, when wanted, by withdrawing the amplifier plug, and inserting the headphone plug. This puts the push-pull amplifier completely out of use. ■

CQ!CQ!CQ!CQ!

...buy or borrow manual of Stern-Clyne Veritone STP-1 stereo Tape Preamp.—S. Stubbs, 48 Neil Lane, Manchester, M21 25H.

...mods and official handbook for the No. 19 set Mk. 3.—F. G. Shepherd, 16 Frances Road, Purbrook, Portsmouth, Hants.

...details of the WS 19 and ancilliaries (operating procedure etc).—A. Howard, 2 Castle Close, Raffley Estate, Kings Lynn, Norfolk.

...any information at all on the T15D23 full-wave rectifier.—R. Collins, 39 Cadogan Gardens, South Woodford, London, E.18.

...any information regarding the c.r.t. indicator unit type 26.—R. A. Carter, 2 Wolsingham Drive, Acklam, Middlesborough, Teeside.

...information and details on converting Ferguson 12in. TV into an oscilloscope.—I. Dyche, 49 Marlowe Drive, Whitecross, Herts.

...circuit and constructional details of an a.t.u. which covers Top Band and Eighty. Also buy or borrow December 1961 issue of P.W.—Martin Swift, 341 Walsall Road, Stone Cross, West Bromwich, Staffs.

...information on the indicator unit c.r.t. type 26 ref. 10Q/16058. Information particularly required is on plug connections, power requirements, circuit diagram etc.—L. K. Ferguson, 49 Bulloll Road, Kempston, Leeds.

...circuit and any other information on Indicator Unit c.r.t. type 26 A.M. reference 10Q/16058. I am also in need of a power supply for the unit which requires 80V at 400-2240/cs and would be glad to hear from anyone who has any ideas on this.—M. K. Dakin, 145 The Broadway, Norton, Stourbridge, Worcs.

...circuit diagram of the P. W. Monophonic Electronic Organ's Professional Amplifier.—C. W. G. McGiffie, 10 Bryn-Awel, Bryntirion Hill, Bridgend, Glamorgan, South Wales.

...information on the Elliott Multiversal Testing Set, No. D474763 (this may be serial number). It is a Wheatstone bridge, Insulation tester and fault localisation unit.—L. O. Tully, 120 Victoria Street, Fairfield 4103, Brisbane, Australia.

...manual or circuit diagram of the ex-Govt. signal generator CT53. I understand that these were manufactured by different contractors but the maker of my one is H. C Atkins of S.W.6.—The Occupier, 145 Brighton Road, South Croydon, Surrey.

...any information at all on surplus R103 Mk. 2 receiver.—J. M. Gunter, 65 Hamilton Road, Taunton, Somerset.

...v.h.f. receiver type R1392D. I would like to purchase the i.f. transformer on the right of the chassis looking from the front.—L. K. Ferguson, 49 Balloil Road, Kempston Beds.

...name of supplier of resistance line cord 3-way, 0.3 amp to reduce 240V a.c. to 112V a.c. I also have many copies of P.W. for disposal.—R. G. Clark, 101 Warnham Court Road, Carshalton, Surrey.

...any gen at all on the echo sounder type 621 made by Rikoh.—John Bartlett, 35 Brambleton Avenue, Farnham, Surrey.

...diagrams and service sheet for Korting Mk. 112 tape recorder.—R. Stansfield, 23 Well Walk, Hampstead, London, N.W.3.

...details on how to convert a TV set into an oscilloscope.—R. Johnson, 44 Queenborough Road, Halfway, Sheppey, Kent.

...any gen on an old radio receiver—the Osram Four New Music Magnet.—P. Shea, 17 Cranmore Park, Belfast, 9.

...handbook of the Trio 9R-59 receiver.—G. L. Hill, BRS31721, 51 Hallfields Lane, Gunthorpe Estate, Peterborough.

...details on improving the s.s.b. on an AR88.—G. McKindry, 29 Whitehurst, Bearsden, Glasgow, Scotland.

...information, circuit or handbook and any useful mods for the R.3673.—A. Howard, 2 Castle Close, Reffley Estate, King's Lynn, Norfolk.

...loan or purchase hanbook for BC454 Command receiver.—A. Rawlings, 37 Kingswood Avenue, London, N.W.6.

...information on use or purchase of manual on Simon SP5 tape recorder.—P. C. Hill, 42 Church Road, Bishopsworth, Bristol, BS13 8JW.

...gen on using VCR139A or CV1588 c.r.t. for an oscilloscope. Also the socket for the CV1588.—A. Kitchen, Rosery, Star, Shipham, Somerset.

THE MW COLUMN

MEDIUM-WAVE stations in Europe operate on channels spaced 9kHz apart as laid down in the Copenhagen Plan. There are a number of African and Asiatic stations in the gaps between these channels and these can be heard during the evening before the majority of Europeans close down. A selective receiver of communications standard is an advantage for this type of DX while a loop aerial is helpful in cutting down splash from adjacent channels. *Baghdad* Iraq 760kHz can be located between West Germany on 755 and Sottons 764. The programming is in Arabic though it sometimes broadcasts western music before closedown at 22.30 GMT. Occasionally there is a 1kHz heterodyne on this station caused by *CQA* 759kHz in the Portuguese island of Sao Tome West Africa. Sandwiched between USSR on 890 and Milan on 899 is EFJ57 *Radio Juventud de Canarias* Tenerife on 895kHz. This station relays news from *Radio Nacional Espana* and specialises in serious music until sign-off at midnight. Deir el Zor 959kHz Syria has Arabic programmes until 2230hrs and can be found just below Paris 962kHz. Other stations to look for on these 'split' frequencies include *Riyadh Saudi Arabia* on 588; *Jerusalem* 677; *Kermanshah Iran* 985; *Kuwait* 1345; BBC Eastern Relay in the Persian Gulf on 1410. *Urumchi* in western China is a regular on 1525 with Russian propaganda and jamming. Two long wave Asiatics logged recently are *Tselinograd* in Kazakstan behind Warsaw 227kHz and *Ashkhabad* 375kHz, both at 2200hrs.

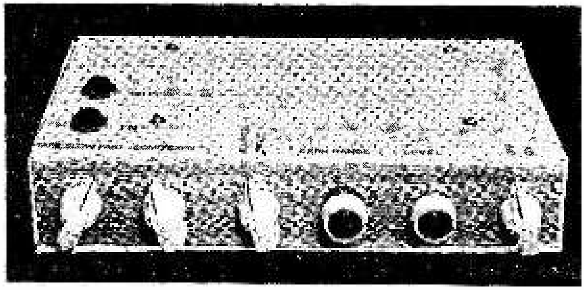
A mystery Greek-speaking station has been heard just out-of-band on 1610kHz. It was first reported to Sweden Calling DXers by a listener in Austria and further information has just come to hand in a letter from Angelo Coppola of Naples who has logged it several times after sunset. The programmes are mainly Greek folk music and the identification sounds like *Radiophonikos Stathmos Chidas*. Has anyone heard this station? There is nothing listed on 1610, the highest MW channel being 1603.

Stations along the east coast of North America can be logged for about one hour before sunrise during July. European interference is light at this time owing to the aproaching daylight from the east while QRM from inland North America is absent, enabling stations that would be classed as 'difficult' in winter, to be heard. Look for *WHAM* Rochester NY on 1180; *WLIB* New York City 1190; *CKCW* Moncton N.B. 1220; *WSYB* Rutland Vermont 1380; *WNJR*, the all-negro station in Newark N.J. 1430; *CBG* Gander Newfoundland 1450; *WHEC* Rochester NY 1460; *WPTR* Albany NY 1540 mixed with *ZNS1* Nassau Bahamas. Those right on the top of the band are usually prominent, such as *WSFR* Ft. Lauderdale Florida 1580; *WSMN* Nashua N.H. and *WAKR* Akron Ohio, both on 1590 and *CJRN* Niagara Falls Ontario 1600. Nearer home on the periphery of Europe are three A.F.R.T.S. stations not normally heard except at sunrise in summer. These are *Kenitra* Morocco 1484; *Lajes Terceira* Azores 1500 and *Tripoli* 1594.

CHARLES MOLLOY

AUDIO EXPANDER COMPRESSOR

C.R.Bradley



ALMOST every audio source can benefit from a degree of compression or expansion of the volume range. The unit described here provides a variable amount of compression or expansion with low distortion and can be added to almost any sound system. It can be an additional 'luxury' control (like the tone controls) in a hi-fi system, or it can have more important uses in tape recording, pop music and radio communication as will be described. It can also be used to sustain notes played on an electric guitar, or give a tape recorder automatic level control.

PRINCIPLE

The level of an audio signal may be controlled by passing it through a stage with variable gain. A simple example is the volume control in a radio receiver, if we can regard it as a stage on its own—see Fig. 1a. When the slider is at the bottom end of the track, the gain of the stage is zero and the output signal is zero. When the slider is at the top end of the track, the gain is unity (disregarding loading effects) and the output signal is maximum. The range of gain is 0 to 1 and it is controlled by mechanical action on the control spindle. Note that if the slider is left in a certain position, say half way along the track (gain$=\frac{1}{2}$), the *dynamic range* (volume range) of the signal is not affected. Thus if the input level doubles the output level doubles also, regardless of the control setting (except at zero of course).

Now suppose the volume control in Fig. 1a could be turned up when the input level is low and turned down when the level is high, all this to be done automatically without noticeable delay. The output level could then be held constant in spite of wide variations in the input level. This would be *volume compression* or reduction of the dynamic range. Conversely, if the volume control could be turned down when the input level is low and turned up when the level is high we would get *volume expansion* or exaggeration of the dynamic range.

Either of these processes can properly be called a.v.c. (automatic volume control). The circuit in a radio receiver which maintains a constant r.f. input to the detector is sometimes misnamed the a.v.c. circuit; it is more correctly a.g.c. (automatic gain control) applied to an r.f. stage, whereas a.v.c. is a.g.c. applied to an a.f. stage.

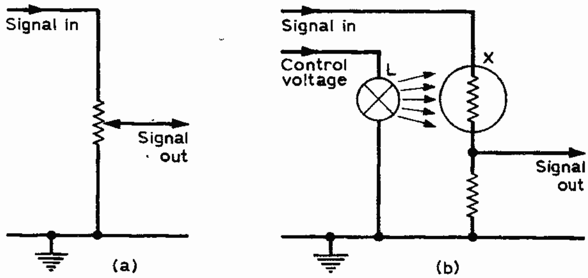


Fig. 1: A standard volume control and a simple method of audio expansion or compression using an L.D.R.

It might be thought possible to obtain volume compression or expansion by driving the volume control in Fig. 1a with a servo motor. Unfortunately, any practical mechanical linkages would have significant inertia and friction and the system would be too slow to keep up with fast volume changes. Therefore it is necessary to design a stage whose gain can be controlled electrically. But before considering all-electric stages, the circuit in Fig. 1b provides an interesting use of light for a.v.c. X is a cadmium sulphide photocell and L is a lamp mounted close to it. The lamp brilliance depends on the control voltage. When the control voltage is high the lamp shines brightly and the resistance of

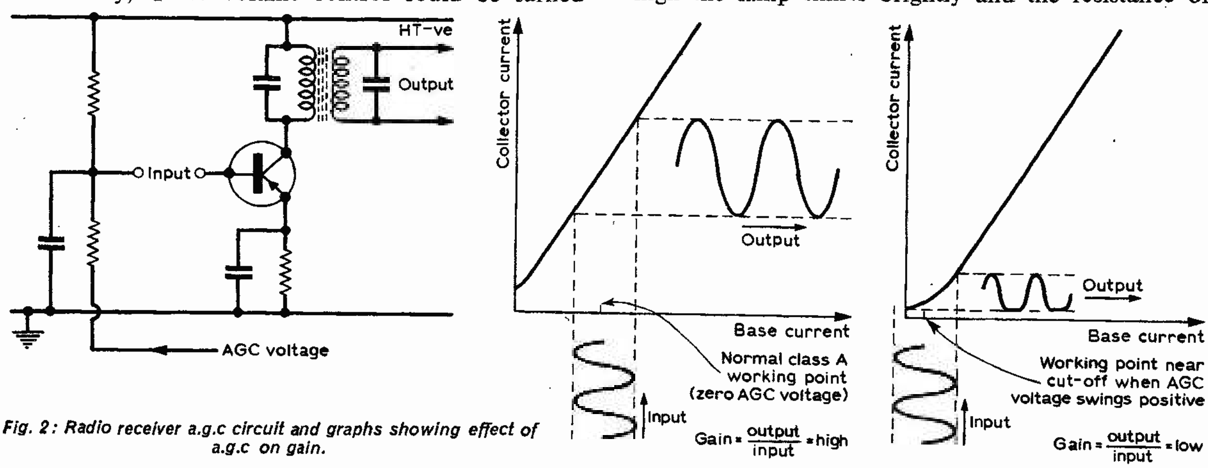


Fig. 2: Radio receiver a.g.c circuit and graphs showing effect of a.g.c on gain.

X is low, resulting in a high output level. When the control voltage is low the lamp shines dimly and the resistance of X is high, resulting in a low output level. This arrangement is often used in remote volume control applications and in some audio compressor and expander circuits. The lamp and photocell can be bought as a single sealed unit for this use. After experiment, this circuit was discarded in favour of the circuit to be described because the power consumption of the lamp is high and the relation between the control voltage and the output level is very non-linear. Also the heat mass of the lamp filament and the photocell characteristics introduce a delay in response.

VARIABLE GAIN STAGES

The gain of a class A amplifier stage can be varied by moving the bias toward cut-off. This is a type of gain control used in radio a.g.c. circuits—see Fig. 2. This circuit has the disadvantage of severe distortion of the output waveform when the stage is near cut-off. In a tuned r.f. stage this distortion is tolerable as the next tuned circuit will eliminate harmonics and restore the sine waveform. But the distortion is excessive for a full range a.f. stage, particularly in an audio compressor where the stage would be biased near cut-off when the input signal was at maximum.

Another circuit which was investigated is shown in Fig. 3. This is a long tailed pair where the audio signal is passed through one of the transistors (Tr2). When the control voltage swings negative, Tr1 turns

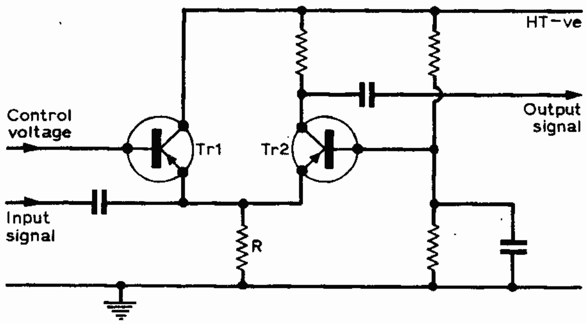


Fig. 3: Two transistors connected as a long tailed pair can control dynamic range but only at low input levels.

on. As Tr2 base is held at constant potential, the increased voltage drop across R biases Tr2 toward cut-off and the audio signal is attenuated. This circuit gives a good performance but the input signal must be small to avoid distortion.

The final choice of circuit is shown in Fig. 4. It

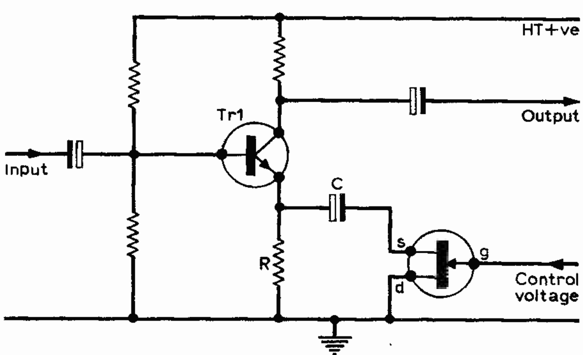


Fig. 4: The basic control circuit used in the final circuit.

is a conventional common emitter amplifier with a field effect transistor placed in series with the emitter bypass capacitor. The f.e.t. is used as a variable resistor controlled by the gate voltage. When the gate voltage is zero, the source-to-drain resistance is low and Tr1 emitter is fully decoupled by C. When the gate voltage swings negative, the resistance rises so that the decoupling action of C on Tr1 emitter is reduced. The gain of the stage is now reduced by negative feedback from the unbypassed emitter resistor R.

It will be noticed that the f.e.t. is being used to control alternating current. The circuit was first tried with an additional resistor from h.t. positive to the f.e.t. source to give a steady d.c. bias. This was discarded when it was found that as the f.e.t. is basically a symmetrical device, it can be used on a.c. In this circuit the source and drain leads can be swapped with no great effect on performance, althought one arrangement is slightly better with the low cost f.e.t. specified—which is not specified as a symmetrical type in any case.

The main advantage of this circuit is the low distortion over a wide range of signal level. The transistor is always biased in class A where distortion is minimum. Unlike any of the previous circuits, the distortion *reduces* as the gain is reduced; this is due to the increased negative feedback from R. This makes it particularly suitable for an audio compressor. The transistor and the f.e.t. also provide useful amplification of the audio signal and the control voltage respectively.

COMPRESSOR CIRCUIT

The arrangement for audio compression is shown in Fig. 5. The output signal is sampled by a single stage amplifier A. This provides a signal across R1 which is rectified by D to give a negative-going voltage across the diode load R2. Audio frequency components are smoothed by C1 to produce the steady control voltage which is fed to the f.e.t. gate. Since the gate impedance of the f.e.t. is very high, the attack/decay time of the compressor is determined by the values of R3 and C2. The graph in Fig. 6 illustrates the action of compression. When the input signal is low, the f.e.t. gate voltage V_g is between 0V and −2V and the transistor gives a high gain.

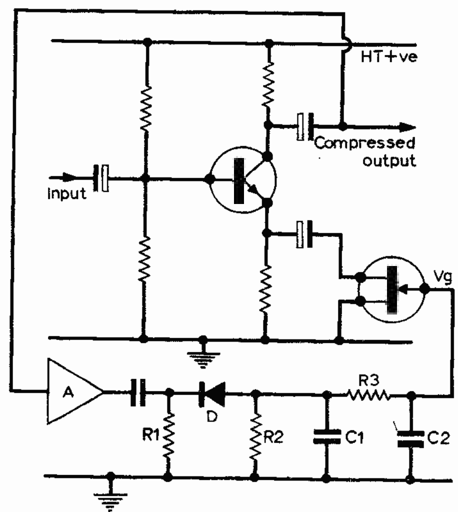


Fig. 5: The compressor circuit principle.

When the input signal level rises so that the gate voltage passes from −2V to −3V the gain is progressively reduced. Higher signal levels cannot be further compressed as the f.e.t. has already blocked all the emitter decoupling. However, distortion due to clipping only sets in with very high signal levels.

The flattish portion of the solid curve in Fig. 6

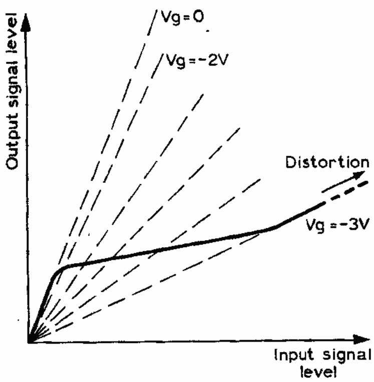


Fig. 6: The dashed lines on the graph show the audio stage gains at different f.e.t gate voltages for the circuit in Fig. 5.

shows the range of compression. The higher the gain of amplifier A the flatter it will be and the greater will be the degree of compression. As A samples the compressed output and not the input signal, the circuit cannot 'over compress' strong signals no matter how high the gain of A, i.e. it is impossible for the curve to slope downwards from left to right.

It must be understood that the non-linearity of the curve in Fig. 6 does not cause harmonic distortion in the output signal as it represents a non-linear *volume* response, not instantaneous response. The time constant R3/C2 is chosen so that the gate voltage does not change appreciably during even the longest (bass) audio cycles. The instantaneous response curve at any time is one of the dashed lines in Fig. 6, and these are linear.

EXPANDER CIRCUIT

Although audio expansion has simply the reverse effect of audio compression, the circuit design is not as simple as this might suggest. We might try to use the circuit in Fig. 5 but with a negative bias on the f.e.t. gate and the diode D reversed. The transistor would then give a low gain on weak signals and a high gain on strong signals, as desired. Unfortunately a positive feedback loop exists. A strong signal causes the gate voltage to swing towards zero which increases the gain; this increases the signal sampled by A which drive the gate voltage further towards zero and so on. The arrangement gives a squelch action illustrated in Fig. 7a i.e.: signals below a threshold level are amplified with low gain and signals above the threshold level are amplified with high gain. Although squelch has its own uses it is not the kind of volume expansion required.

The same arrangement is more workable if the signal sampled by A is the unexpanded input signal; this removes the positive feedback loop. However, a very high gain is requred in A and the expansion proves to be very non-linear (Fig. 7b).

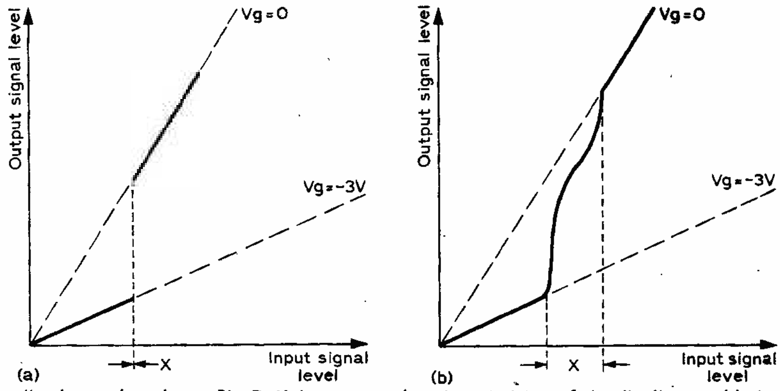
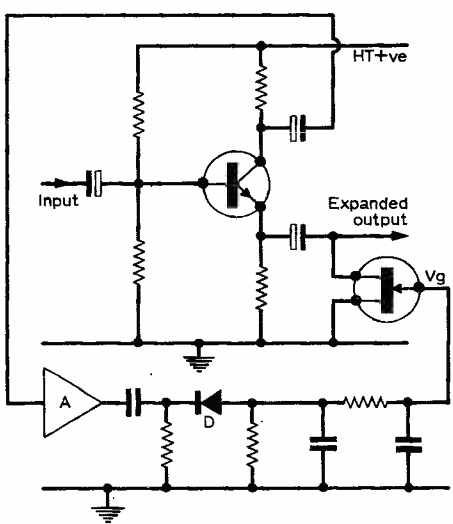


Fig. 7: Volume expansion characteristics of circuits discussed in text. In (a) expansion operates over an infinitely small range; in (b) the range is real but expansion is non-linear.

The solution to the requirement for linear volume expansion over a wide range is shown in Fig. 8. This is in fact the volume compression circuit with the output taken from a different point. When the input signal level is low, the f.e.t. gate voltage is near zero and therefore the source to drain impedance is low compared to the output impedance of Tr1 acting as an emitter follower. Hence the output level is low. When the input signal level is high, the f.e.t. gate is driven negative and the source to drain impedance is high; hence the gain of the circuit increases to unity. Amplifier A is part of a negative feedback loop as it samples the *compressed* signal at Tr1 collector; this feedback ensures linear expansion of the signal.

FINAL CIRCUIT

The final compressor/expander circuit is shown in Fig. 10. The variable gain stage is formed by Tr1 and Tr2 (f.e.t.) with S1 selecting compression or expansion. The compressed signal at Tr1 collector



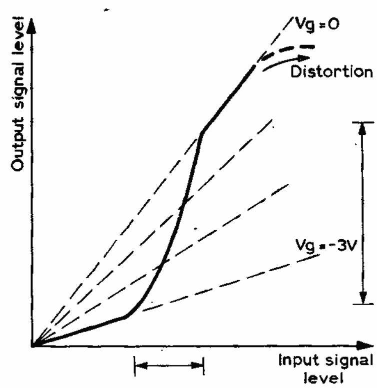


Fig. 8: (left) Expansion circuit principle.
Fig. 9: (above) The arrows on the graph show how a small range of volume in the input is expanded to a wider range.

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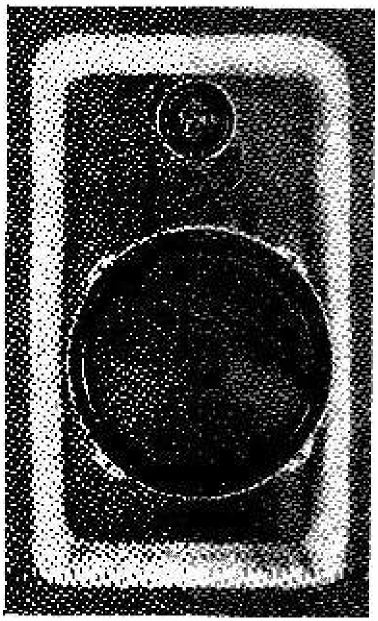

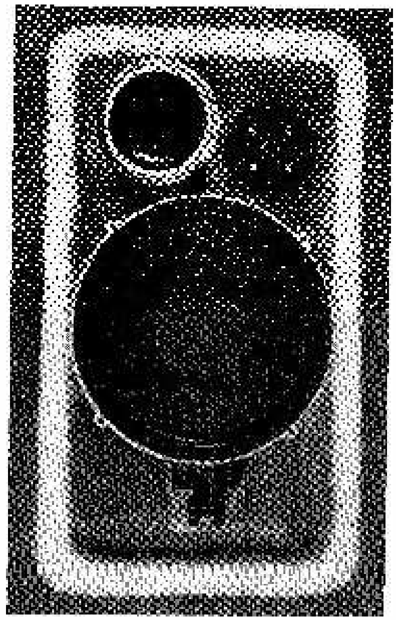

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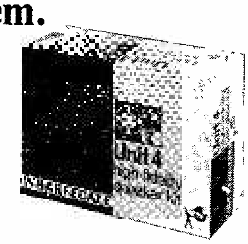

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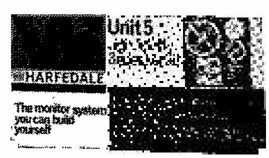

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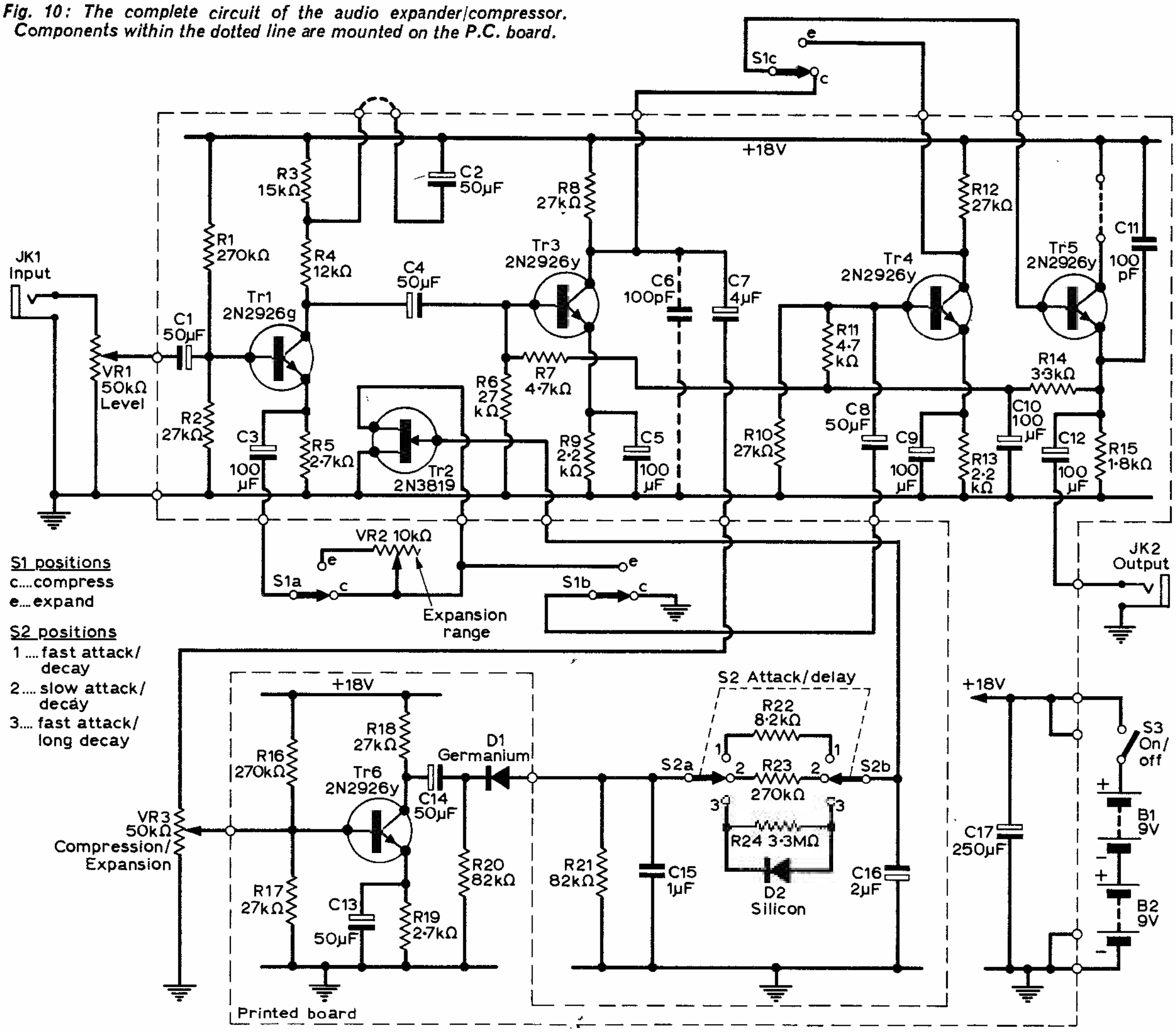
Fig. 10: The complete circuit of the audio expander/compressor. Components within the dotted line are mounted on the P.C. board.



is amplified by Tr3 and fed via C7 and VR3 to Tr6 which is the amplifier A in Fig. 4. The degree of compression (or expansion) is controlled by VR3. The signal at Tr6 collector is rectified by D1, smoothed by C15 and fed to the f.e.t. gate via one of the sets of time constant components selected by S2.

For compression, the signal at Tr3 collector is also taken directly to the base of emitter follower Tr5 which provides a low impedance output on JK2; in this mode Tr4 has no function.

For expansion, the signal at Tr1 emitter is used as described in Fig. 8. This signal is taken through VR2 and C8 to Tr4 base. The signal at Tr4 collector is taken directly to the base of output stage Tr5. The potentiometer VR2 works only on expansion; its resistance forms a potential divider with the varying source-to-drain resistance of the f.e.t. and it is used to set the range of expansion. All the transistors are working as Tr3 is still delivering a compressed signal to Tr6.

Base bias for both Tr3 and Tr4 is provided via R14 from Tr5 emitter; Tr5 forms a d.c. feedback pair with either Tr3 or Tr4 on compression or expansion respectively.

It is possible to experiment with the time constant components selected by S2 to obtain any desired attack/decay characteristic; some quite complex networks might be used here to obtain a particular result. The values of R22 to R24 shown in Fig. 10 have been chosen to give the following choice of characteristics in conjunction with C16. In position 1 of S2, C16 can rapidly charge and discharge through R22. The compressor/expander therefore has as fast a response to volume changes as is possible without feedback arising from audio frequencies reaching Tr2 gate. In position 2 of S2, R22 is replaced by a higher value R23 resulting in a slower response. Position 3 of S2 gives a special attack/decay characteristic intended for automatic level control use with a tape recorder (S1 switched to compression).

The compressor responds very quickly to an *increase* in signal volume when forward current flows in D2 to charge C16 negatively, but C16 can only discharge very slowly through R24 as the leakage current of the f.e.t. gate is negligible. Hence the f.e.t. gate voltage depends on the *peak* volume level. This characteristic is ideal for the purpose since volume peaks are quickly brought down to a constant level to avoid over-modulating the tape, but the gain does not increase much during lower level sound passages. Thus the dynamic range of the material recorded is not greatly affected.

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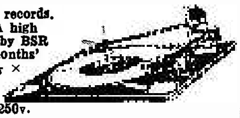

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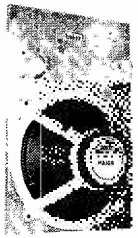

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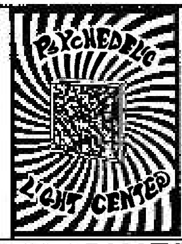

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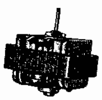

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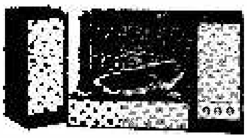

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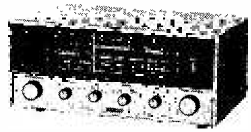

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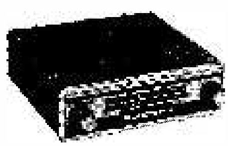

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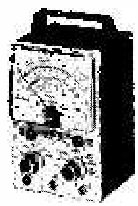

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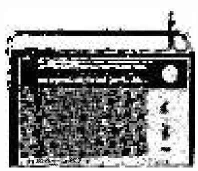

Severn AM/FM Radio
Kit K/Severn £18.18.0
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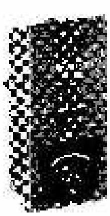

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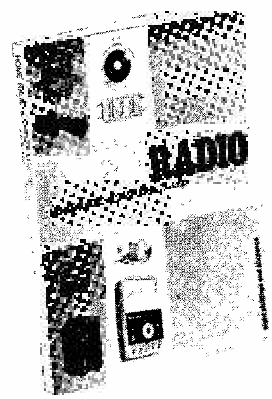

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The value of R24 can be increased to give an even longer discharge time for C16. The combination of R24 and silicon diode D2 (low leakage) can be replaced by a germanium diode (higher leakage) but this prevents any experimentation with R24.

CONSTRUCTION

Most of the components are carried on a printed circuit board shown in Fig. 11. The board and the controls are mounted in a two piece aluminium box (see Fig. 12) for effective screening. The author used a separate component for the ON/OFF switch S3; this results in a rather large number of knobs on the front of the unit and it might be preferable to have a third 'OFF' position on S1. In this case S1 would need to be a 4-pole 3-way type.

Arrangements have been made for readers to obtain the printed board ready made and drilled from the suppliers listed in the parts list. If making the board oneself, the pattern of conductors shown in Fig. 11 should be traced and the resist painted on the copper in a mirror image of the pattern.

The transistor types used, viz: 2N2926 (popular plastic silicon planar) and 2N3819 (general purpose f.e.t.) are available cheaply from advertisers in the magazine. Ensure that the electrolytic capacitors and the semiconductors are wired with correct polarity as indicated in Fig. 11. All components should be soldered quickly and with short leads. The germanium diode D1 is the only component where particular care should be taken to avoid heat damage. The wiring between the board and the controls should be short and the indicated leads screened as shown. All earth connections are made to a common point, the body of VR1.

The inclusion of C11 should be sufficient to ensure stability if the layout is followed. If instability arises due to poor layout or the use of higher gain transistors, a 100pF capacitor C6 can be added between earth and Tr5 base (connect at S1) or in the position shown on the printed circuit (normally unoccupied). The compressor / expander should remain stable even with an overload input.

Two links are shown on the printed circuit. When the link between C2 negative and R3/R4 is made, the gain of the unit is reduced slightly but the range of compression or expansion is increased. The link between Tr5 collector and the positive line may be opened to measure Tr5 collector current. This should be around 3·5 mA in both compress and expand positions of S1.

Under some conditions, it may be possible to drive the circuit into low frequency oscillation when VR3 is fully on (clockwise). Some improvement in this, and in the circuit's recovery time from an extreme overload, can be found by wiring a low-wattage 2·7V zener diode across C16 (positive to positive).

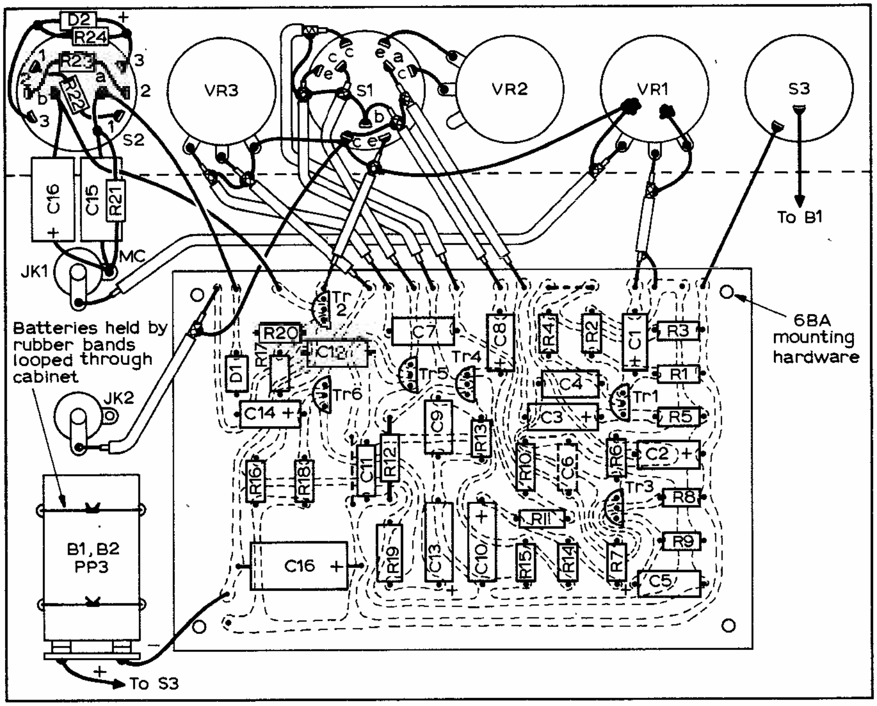
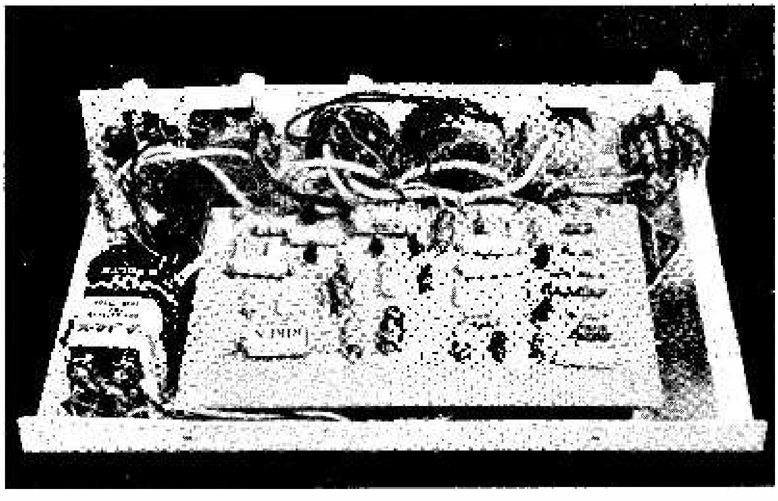


Fig. 11: The component layout. Using the recommended P.C. board makes for easy construction and a neat final layout.



USE

For compression, the unit is set up as follows. Start with S1 at COMPRESS, VR1 (LEVEL) anticlockwise and VR3 anticlockwise. Feed the

◀ *Interior view of the completed project. Compare this with Fig. 11.*

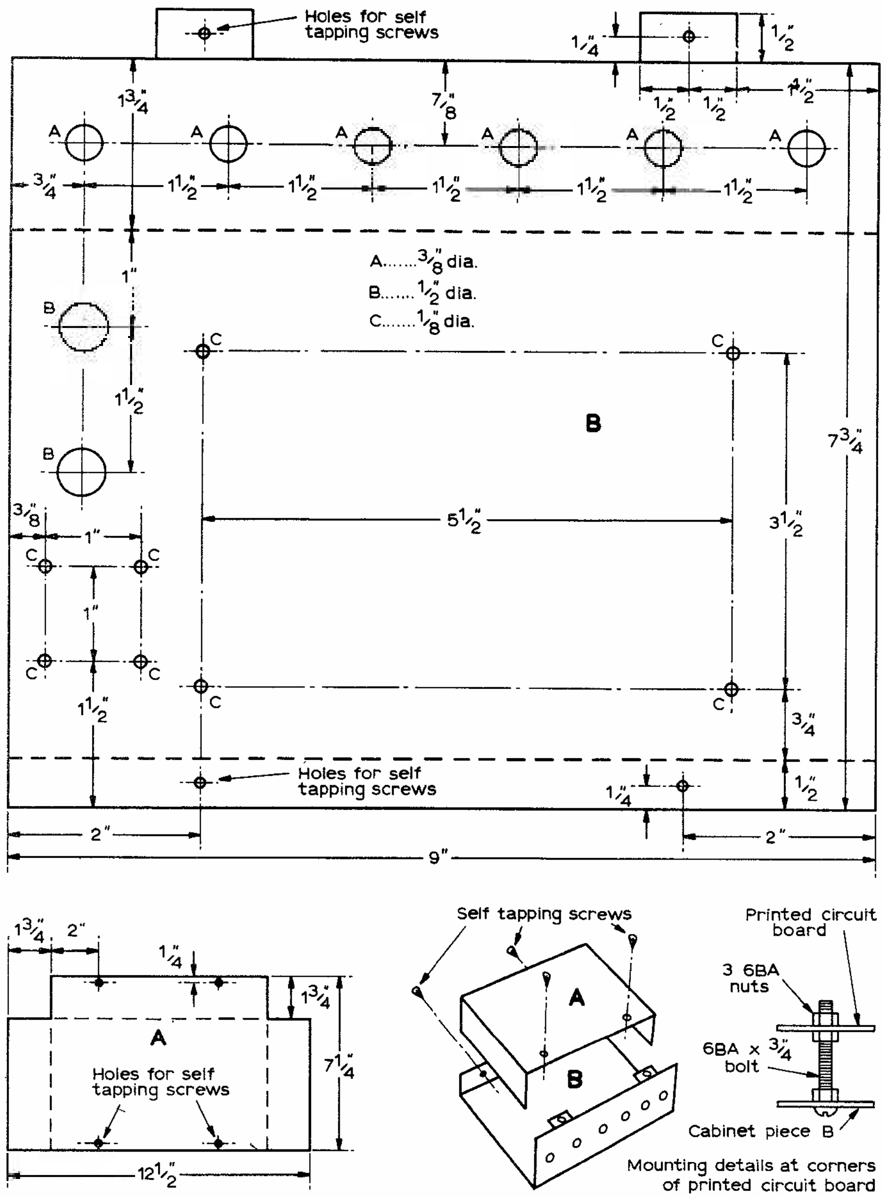


Fig. 12: The cutting and drilling details of the two piece aluminium cabinet.

signal input to JK1. The unit can be driven by a dynamic microphone, electric guitar, magnetic pick-up, tuner, etc. A crystal microphone or pickup can also be used but a resistor of 47kΩ to 220kΩ should be put in series with JK1 to reduce distortion. The output at JK2 may be fed to any valve or transistor amplifier. Advance VR1 (LEVEL) until the lowest level sound passages are reproduced at the desired volume. Then advance VR3 until the louder passages are sufficiently compressed.

Expansion is a little harder to set up as VR1, VR2 and VR3 have interdependent effects. With S1 at EXPAND and VR3 anticlockwise, set VR2 for the desired range of expansion, from slight (anticlockwise) to extreme or 'squelch-like' (clockwise). Advance VR1 until the lowest level sound passages are just audible. Then advance VR3 until the louder passages are sufficiently expanded.

If a voltmeter is available, the voltage across C16 can be monitored. Note that the internal resistance of a moving coil voltmeter will affect the attack/decay times. A change in signal level is expanded or compressed when it causes a voltage change in the range 1·8V to 2·5V d.c.

APPLICATIONS

Volume compression can be applied usefully to almost any audio signal where full reproduction of the dynamic range is not essential. Compression reduces the demands made on audio equipment and on the listener. In the extremes, 'loud' sounds are prevented from causing overload distortion while 'quiet' sounds are not lost. The use of compression for tape recorders has already been mentioned and is a great help when recording 'wild' sounds out of doors. Some further applications are described below.

Compression is useful in a public address system as it compensates for poor microphone technique. Intelligibility is improved and this may enable the amplifier to be used at lower gain with consequently less risk of feedback howls.

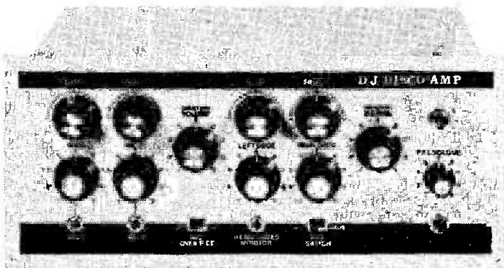
Compression can be used in radio communication to increase 'talk power' (intelligibility) over a noisy channel. It is preferable to speech clipping as it does not introduce harmonic distortion. A combination of compression and clipping would give excellent intelligibility over a poor quality speech link.

Compression can be useful to the hard of hearing who may need to listen to radio or television at an uncomfortably high volume (to others) in order to hear everything. If the dynamic range of the material is compressed, the annoyance caused to others by peak sound levels is reduced.

Compression is used in commercial record making where the dynamic range of the material to be recorded exceeds the range that can be cut on the record. Pop music often employs a high degree of compression; in this way the 'backing' sound can be recorded at full level without drowning out the singer. Even the most idolised groups usually provide live performances which seem 'weak' compared with their recorded offerings; compression can provide

DISCOSOUND

DJ DISCO-AMP



The DJ Disco-amp has been designed specifically for use with discotheques and has many exclusive features not normally found on P.A. amplifiers. The unit will be of use to the professional D.J. as well as in clubs and mobile discotheques.

The pre-amp section features independent inputs and volume controls for two mics with separate bass, treble and master volume, plus two independent inputs and volume controls for turntables, again with separate bass, treble and master volume controls.

A complete Pre-fade listen (P.F.L.) cueing monitor section is also featured with separate input for headphones (either stereo or mono) with an independent volume control for headphone monitoring, and a P.F.L. switch, so that either turntable can be monitored for accurate cueing up of records. A mic over-ride switch is also added which cuts the music volume by half so that mic announcements may be made over the music without altering the volume controls.

The power amplifier section has an output of 70 watts R.M.S. into 8 ohms and has elaborate protection against thermal, short or open circuit. The unit is designed for panel mounting.

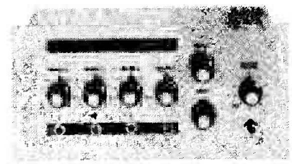
SPECIFICATION

Output power	70 watts R.M.S. ± 1db at 8 ohms.
Frequency response	30-20,000 Hz ± 3 db.
Harmonic distortion	Less than 1% at full output.
Signal/noise ratio	Better than − 65db.
Speaker impedance	8-16 ohms.
Headphone impedance	8-16 ohms.
Bass control	Variable 20 db at 100 Hz.
Treble control	Variable 20db at 10 kHz.
Inputs:	Mic 1 & 2 5 mV at 50 K ohms.
turntable	1 & 2 100mV at 1 meg ohm.

50 ohm or 600 ohm mic inputs may be ordered at extra cost.
Size: Front Panel 16½" x 7". Cut out 15½" x 6". Fuses: A.C. 1.5 amp (B.S.) mounted on back panel.

PRICE £85.0.0 inc. P & P.

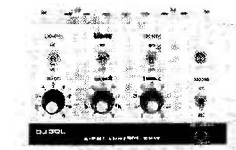
DISCOSOUND PRE-4



This is a four channel fully mixable pre-amp, with separate treble, bass and master volume controls, and is completely self powered. All four inputs are by standard jack socket on the front panel with the addition of inputs 3 and 4 being duplicated on the back panel, with two paralleled outputs also featured for versatility in use. Frequency response: 30-20,000 HZ ± 3db. Signal/Noise Ratio: −65db. Size: front panel 12½ × 5½ cut out required 11½ × 4½. Completely built and tested.

PRICE £18.0.0 inc. P & P.

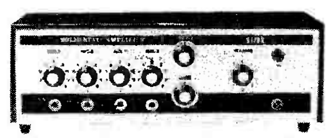
DJ 30L PSYCHEDELIC LIGHT CONTROL UNIT



3 channel light control unit that handles up to 1,000 watts per channel. Separate bass, middle and treble controls for full frequency separation.
Completely built and tested

PRICE £37.10.0 inc. P & P.

DJ 70S INTEGRATED MIXER-AMPLIFIER



One of the finest units available on the market today, regardless of price. The front end of the unit consists of a four channel mixer with separate inputs and volume controls, plus a separate bass, treble and master volume control. One of the main features of this remarkable amplifier is its elaborate protection against short and open circuit and we can guarantee that it is virtually indestructable. Allied to this is its very high power output (70 watts R.M.S.) a frequency response (30-20,000 Hz ± 3db) that is superb, and distortion that is well below 1% even at full output. The unit is suitable for use with discotheques, groups, P.A., clubs etc., or anywhere that high quality high output is required. Size: 15½in × 5in × 6in.

PRICE £55.0.0 inc. P & P.

Also available DJ105S 30 watt P.A. Amplifier. Similar specification to above.

PRICE £35.0.0 inc. P & P.

DISCOSOUND 70 MAIN AMPLIFIER

A 70 watts RMS (8 Ohms) High Fidelity power Amplifier which utilises all silicon transistors of modular construction and features full automatic overload protection against short or open circuits. Frequency response: 20-20,000 Hz ± 2db. The High output is ideally suited for discotheques, groups, clubs, etc., or anywhere where reliability and quality are required. This unit is the companion model for use with our control pre-amp Discosound PRE-4, or can be used with any other high quality pre-amp control unit. Size: 7" × 9" × 6".
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1N5054	4/–	2N3709	3/–	AC126	6/6	BC153	10/–	BY238	3/6
1S940	1/–	2N3710	3/6	AC127	6/–	BC154	11/–	C106B1	14/6
2N696	o/6	2N3711	3/11	AC128	6/–	BC157	3/9	MC140	5/–
2N697	5/6	2N3731	24/–	AC176	11/–	BC158	3/6	MJ480	21/–
2N706	2/9	2N3794	3/3	ACY22	3/9	BC159	3/9	MJ481	27/–
2N1302	4/–	2N3819	8/6	ACY40	4/–	BC167	2/6	MJ491	30/–
2N1303	4/–	2N3820	25/6	ACY41	5/–	BC168	2/3	MPF102	7/6
2N1304	4/6	2N3904	7/6	AD142	14/3	BC169	2/6	NKT403	15/6
2N1305	4/6	2N3906	7/6	AD149	17/6	BC177	6/3	NKT405	15/–
2N1306	6/9	2N4058	5/3	AD161/AD162		BC178	5/8	OA47	1/9
2N1307	6/9	2N4059	4/–	(matched)	16/– pr	BC179	6/–	OA90	1/3
2N1308	8/9	2N4060	4/3	AF114	7/–	BC182L	4/3	OA91	1/3
2N1309	8/9	2N4061	4/3	AF115	7/–	BC183L	2/3	OA95	1/3
2N1613	6/–	2N4062	4/3	AF116	6/6	BC184L	2/6	OA99	3/–
2N1711	7/–	2N4284	3/3	AF117	6/6	BC186	8/6	OA200	1/11
2N2147	18/9	2N4286	3/3	AF124	7/6	BC212L	5/–	OA202	2/–
2N2218	9/3	2N4289	3/3	AF127	7/–	BC213L	5/–	OC71	5/6
2N2270	12/9	2N4291	3/3	AF139	9/6	BC214L	5/3	TIP31A	17/6
2N2484	13/6	2N4292	3/3	AF180	18/6	BCY70	5/6	TIP32A	23/9
2N2646	10/9	2N4410	4/9	AF239	9/9	BD121	18/–	TI843	10/6
2N2904	11/–	2N5062	12/3	ASY26	6/6	BD123	24/3	ZTX300	3/6
2N2924	4/–	2N5163	5/–	ASY27	8/3	BD124	16/–	ZTX301	3/6
2N2925	4/6	2N5192	25/–	ASY28	6/6	BF167	8/6	ZTX302	4/6
2N2926	2/3	2N5195	28/3	B5041	15/–	BF178	10/6	ZTX303	4/6
2N3053	5/6	2N5457	9/9	BA102	9/–	BF180	12/–	ZTX304	6/9
2N3054	14/3	2N5458	9/9	BA156	4/–	BF194	7/–	ZTX500	5/–
2N3055	16/–	2N5459	9/9	BA130	4/6	BF195	7/6	ZTX501	5/–
2N3325	10/9	40250	14/3	BA145	5/6	BFX29	10/9	ZTX502	6/–
2N3663	11/6	40361	12/6	BC107	2/9	BFX84	7/5	ZTX503	5/–
2N3702	3/6	40362	16/–	BC108	2/6	BFX85	8/3	ZTX504	12/–
2N3703	3/3	40406	16/3	BC109	2/9	BFX87	8/6		
2N3704	3/9	40408	14/6	BC125	12/–	BFX88	6/9	ZTX530	5/5
2N3705	3/5	40430	37/–	BC126	12/–	BFY50	4/6	ZTX531	6/9

RESISTORS

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	18	16	15
C	1/8W	5%	4·7 Ω–330K Ω	E24	2·5	2	1·75
C	1/4W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·75
C	1/2W	5%	4·7 Ω–10M Ω	E24	3	2·5	2·25
C	1W	10%	4·7 Ω–10M Ω	E12	6	5	4·5
MO	1/2W	2%	10 Ω–1M Ω	E24	9	8	7
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12		15d all quantities	
WW	3W	5%	12 Ω–10K Ω	E12		15d all quantities	
WW	7W	5%	12 Ω–10K Ω	E12		18d all quantities	

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 same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1d. on total 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.

INTEGRATED CIRCUIT AMPLIFIERS

SINCLAIR IC10 complete with instruction book giving amplifier circuit details and range of applications. **59/6** nett.

PLESSEY SL403A only **48/6** each. 3W into 7·5Ω for 18V supply. Application data sent with two more.

WAVECHANGE SWITCHES LONG SPINDLES

1P 12W; 2P 6W; 3P 4W; 4P 3W — **4/9** each

SLIDER SWITCHES D.P.D.T. — **3/–** each

NEON INDICATOR LAMPS

all 200/250V. Square bezel, red only — **3/9**
Round chrome bezel red, amber, clear — **4/9** each

Toggle switches, 250V a.c. 1.5A.
chrome dolly and chrome milled nut S.P.S.T. **3/9**; S.P.D.T. **4/6**; D.P.D.T. **5/9**; S.P.D.T. centre off **5/–**.

S-DeC's put an end to "birdsnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC only **30/–**. Compact T-DeC, increased capacity, may be temperature-cycled. T-DeC only **50/–** post free. Full range stocked.

MULLARD polyester C280 series

250V 20%: 0·01; 0·022; 0·033, 0·047 **8d** ea. 0·068; 0·1 **9d** ea., 0·15 **11d.**, 0·22 **1/–**, 10%: 0·33 **1/5**, 0·47 **1/8**, 0·68 **2/3**, 1μF **2/9**. 1·5μF **4/2**, 2·2μF **4/9**.

MULLARD SUB-MIN ELECTROLYTIC

C426 range axial lead — **1/3** each

Values (μF/V): 0·64/64; 1/40; 1·6/25; 2·5/16; 2·5/64; 4/10; 4/40; 5/64; 6·4/6·4; 6·4/25; 8/4; 8/40; 10/2·5; 10/16; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/4; 32/10; 32/40; 32/64; 40/16; 40/2·5; 50/6·4; 50/25; 50/40; 64/4; 64/10; 80/2·5; 80/16; 80/25; 100/6·4; 125/4; 125/10; 125/16; 160/2·5; 200/6·4; 200/10; 250/4; 320/2·5; 320/6·4; 400/4; 500/2·5.

LARGE CAPACITORS

High ripple current types: 1000/25 **5/6**; 1000/50 **8/2**; 1000/100 **16/3**; 2000/25 **7/4**; 2000/50 **11/4**: 2000/50 **11/4**; 2000/100 **28/9**; 2500/64 **15/5**; 2500/70 **19/6**; 5000/25 **12/6**; 5000/50 **21/11**; 5000/100 **58/3**; 10000/15 **17/–**; 10000/25 **24/6**; 10000/50 **44/–**; 10000/70 **61/–**.

MEDIUM RANGE ELECTROLYTICS

Axial leads: 50/50 **2/–**; 100/25 **2/–**; 100/50 **2/6**; 250/25 **2/6**; 330/25 **2/6**; 250/50 **3/9**; 500/25 **3/9**; 500/50 **4/6**; 1000/25 **4/–**; 1000/50 **6/–**; 2000/25 **6/–**.

SMALL ELECTROLYTICS

Axial leads: 4·7/10; 4·7/25; 5/50 **1/–** ea. 10/10; 10/25; 10/50, 33/10; 50/10 **1/–** ea. 25/25; 25/50; 47/25; 100/10; 220/10 **1/3** ea.

PEAK SOUND PRODUCTS

ENGLEFIELD CABINET KITS

Build it 12 + 12 or 25 + 25

Stereo amplifier in modular kit form 12 watts per channel **£38/9/–**; 25 watts **£58/15/–** Cabinet kit only **£6**. These prices nett.
As recently reviewed in Hi Fi Sound.

BAXANDALL SPEAKER SYSTEM

Designed by Peter Paxandall. Superb reproduction for its size. Handles 10 watts with ease. Uses ELAC 15 Ω 59RM109 speaker Unit. Kit **£13/12/–** nett: built **£19/8/6** nett.

STEREO AMPLIFIER S.A. 10-10.

Developed from the very successful SA.8–8 amplifier giving first class stereo amplification featuring separate volume controls for each channel, bass and treble controls. 10 watts per channel into 5 to 8 Ω. Kit **£19/7/6** nett; built **£24/16/8** nett. Suitable 8 Ω wide range speakers available **£13/15/–** each nett.

MAINLINE AMPLIFIER KITS

RCA/SGS designed main amplifier kits.
Input sensitivity 500–700mV for full output into 8 Ω.

Power	Kit price including components	Suitable unreg. power supply kit
12W	140/– nett	92/–
25W	165/– nett	N/A
40W	195/- nett	115/1
70W	210/– nett	131/–

30 WATT BAILEY AMPLIFIER KIT

Special summer reduction (to Sept. 30th 1970 only)
Sensitivity 1·2V for full output into 8 Ω
Transistors for one channel **£7/5/6** list, **£6** only nett.
Transistors for two channels **£14/11/–** list **£11** only nett.
Capacitors and resistors (metal oxide) **30/–** per channel nett.
Complete unregulated power supply kit **87/6** nett

ZENER DIODES

5% full range E24 values: 400mW: 2·7V to 30V **4/6** each
1W: 6·8V to 82V **9/–** each 1·5W: 4·7V to 75V **12/–** each
Clip to increase 1·5W rating to 3 watts (type 266F) **9d.**

CARBON TRACK POTENTIOMETERS, long spindles

Double wiper ensures minimum noise level.

Single gang linear	220 Ω, to 2·2M Ω	2/6
Single gang log	4·7K Ω to 2·2M Ω	2/6
Dual gang linear	4·7K Ω to 2·2M Ω	8/6
Dual gang log	4·7K Ω to 2·2M Ω	8/6
Log/antilog	10K, 47K, 1M Ω only	8/6
Any type with ½A D.P. mains switch, extra		2/6

Please note: only decades of 10, 22 and 47 are available within ranges quoted.

CARBON SKELETON PRE-SETS

Small high quality, type PR, linear only 100 Ω, 220 Ω 470 Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10M Ω Vertical or horizontal mounting **1/–** each.

COMPONENT DISCOUNTS

10% on orders for components for £5 or more. 15% on orders for components for £15 or more (No discount on nett items).

POSTAGE AND PACKING

Free on orders over **£2**. Please add **1/6** if under. Overseas orders welcome: carriage charged at cost.

ELECTROVALUE (Dept. PW.8) 28 ST. JUDES ROAD. ENGLEFIELD GREEN, EGHAM, SURREY.
Hours: 9—5.30: Sat. 1 p.m. Tel.: Egham 5533 (STD 0784-3) Telex 264475

some improvement here. The usual technique seems to be to overload amplifiers and speakers to a ludicrous extent, presumably to achieve volume compression by extreme clipping! A local pop group has been experimenting with a prototype of the compressor/expander and are enthusiastic about it. The effect of extreme compression on the sound of an electric guitar is to sustain the notes played; the result is more like an organ than a guitar. Compression also removes the need to change the amplifier gain between playing accompaniment and single note solos.

Compression has a side effect of worsening the apparent signal to noise ratio of an audio system. This happens because hum and noise are amplified at high gain during silent passages when they are most noticeable.

Volume expansion is not quite as useful as compression as most audio material already has a wide dynamic range. It can be used to counteract previous volume compression when replaying records or tapes. Expansion has a remarkable side effect of improving the apparent signal to noise ratio of an audio system. This is because the gain is only high when the signal level is high, and hum and noise are not very noticeable at this time. This effect reduces the fatigue of listening to short wave signals against a noisy background, although any fading will be exaggerated.

If VR2 is set for the maximum degree of expansion, the circuit behaves similarly to a squelch. The usefulness of squelch in muting radio receiver noise when no signal is present has already been described in Practical Wireless October 1969. ■

★ components list

Resistors:

R1	270kΩ	R13	2·2kΩ
R2	27kΩ	R14	3·3kΩ
R3	15kΩ	R15	1·8kΩ
R4	12kΩ	R16	270kΩ
R5	2·7kΩ	R17	27kΩ
R6	27kΩ	R18	27kΩ
R7	4·7kΩ	R19	2·7kΩ
R8	27kΩ	R20	82kΩ
R9	2·2kΩ	R21	82kΩ
R10	27kΩ	R22	8·2kΩ
R11	4·7kΩ	R23	270kΩ
R12	27kΩ	R24	3·3MΩ

All resistors ¼ watt, 10% tolerance.

VR1 50kΩ log.
VR2 10kΩ log.
VR3 50kΩ log.

Capacitors:

C1	50μF 6V	C9	100μF 6V
C2	50μF 10V	C10	100μF 6V
C3	100μF 6V	C11	100μF ceramic
C4	50μF 10V	C12	100μF 10V
C5	100μF 6V	C13	50μF 6V
C6	100pF ceramic —see text	C14	50μF 10V
		C15	1μF paper
C7	4μF 15V	C16	2μF 6V
C8	50μF 10V	C17	250μF 20V

Switches:

S1 3-pole 2-way rotary
S2 2-pole 3-way rotary
S3 Single pole on/off (or see text)

Semiconductors:

Tr1 2N2926G (green)
Tr2 Texas 2N3819 (f.e.t.)
Tr3 2N2926Y (yellow)
Tr4 2N2926Y (yellow)
Tr5 2N2926Y (yellow)
Tr6 2N2926Y (yellow)
D1 OA70, OA91 or any germanium diode.
D2 1N914 or any silicon diode.

Miscellaneous

JK1, JK2, jack sockets; B1, B2, PP3 9V batteries; printed circuit board*; knobs; battery clips etc.

*** The printed wiring board is available from: Walsall Timing Developments Ltd., Hall Lane, Walsall Wood, Staffs for 10s. post paid. Delivery 7-10 days.**

GENETRACER—*continued from page 270*

It is recommended that the instrument be tested on a radio receiver in known working order, first injecting a signal from the "generator" at the control grid (valve receivers) or base (transistor receivers) at each stage in turn, listening to the resultant response in the receiver's speaker.

★ components list

Resistors:

R1	1·5kΩ	R7	33kΩ
R2	270kΩ	R8	10kΩ
R3	150kΩ	R9	2·7kΩ
R4	1·5kΩ	R10	470Ω
R5	47kΩ	R11	12kΩ
R6	4·7kΩ	R12	2·2kΩ
		R13	39Ω

All ¼W 10%

VR1/SW1 1MΩ pot. with switch
VR2/SW2 100kΩ pot. with switch

Capacitors:

C1 0·002μF 500VW mica
C2 0·01μF 150VW ceramic
C3 0·005μF 150VW ceramic
C4 10μF 15VW electrolytic
C5 0·001μF 500VW mica
C6 2μF 15VW electrolytic
C7 30μF 15VW electrolytic
C8 8μF 15VW electrolytic
C9 50μF 15VW electrolytic
C10 100μF 25VW electrolytic

Semi-conductors:

Tr1, 2, 3 OC71
Tr4 OC72
D1 OA81

Miscellaneous:

Paxolin panels: 1 off 10 x 8in x $\frac{1}{16}$in. 2 off 6 x 2¾in. x $\frac{1}{16}$in. Reel of "Cir-Kit" adhesive connector strip. T1—Transistor output transformer OC72 to 3Ω speaker. Speaker, 3Ω impedance. PP3 battery and connector. 2 control knobs. 2 Coaxial sockets, chassis mounting. 2 Coaxial plugs. 2 lengths TV coaxial cable about 12 to 18in long. 4 crocodile clips.

Now switch off the "generator", switch on the "tracer", and listen to the signal at the input and output of each stage in the receiver, on the tracer's own speaker. Finally, try the effect of injecting a signal from the "generator" at the input side of a receiver stage, simultaneously listening to the output in the "tracer's" speaker. ■

SUMS plus CIRCUITS equals UNDERSTANDING

PART 5 (FINAL)

LESLIE MOORE

FEEDBACK

THE operation of amplifying circuits with feedback can be analysed quite simply using a few basic principles. Figure 5.1 shows an amplifier of gain 'A' with a feedback network which has a gain, or attentuation, of 'B'.

Because most amplifiers have negative feedback we will assume that the voltage fed back will be subtracted from the input voltage, and by algebraic manipulation we arrive at the formula.

$$V = V_{IN} - B \times V_O \quad \ldots\ldots\ldots\ldots (1)$$

This means that the voltage actually fed into the amplifier is less than the voltage supplied.

We can say that because the amplifier has a gain of A,

$$V_O = A \times V \quad \ldots\ldots\ldots\ldots (2)$$

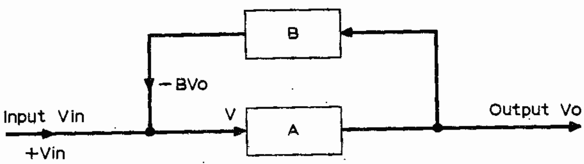


Fig. 5.1. Basic circuit of a feedback network

As we require a relationship between the output, V_O, and input, V_{IN}, we must manipulate the terms in equations (1) and (2) to contain only constants and variables V_{IN} and V_O.

From equation (2). $V = \dfrac{V_O}{A} \quad \ldots\ldots\ldots\ldots (3)$

and substituting equation (3) into equation (1) gives:

$$\frac{V_O}{A} = V_{IN} - B \times V_O$$

rewriting

$$V_O\left(\frac{1}{A} + B\right) = V_{IN} \therefore V_O\left(\frac{1+AB}{A}\right) = V_{IN}$$

$$\therefore \frac{V_O}{V_{IN}} = \frac{A}{1+AB} = \text{gain with negative feedback}$$

From this formula it would appear that the application of negative feedback would reduce gain.

e.g. if $A = 100$, $B = \dfrac{1}{100}$

$$\frac{V_O}{V_{IN}} = \frac{100}{1+1} = 50$$

This is a disadvantage. However, a very important advantage of applying negative feedback can be demonstrated quite easily.

Bandwidth was defined as the frequency range between the half power points. Suppose at the 3dB point of an amplifier the power gain was 50

$$\text{or} = 10 \log_{10} 100 - 10 \log_{10} 2$$
$$= 20 - 3\text{dB}$$

Now at the same frequency with negative feedback applied, the amplifier gain would be

$$\text{Gain} = 10 \log_{10} \frac{A/2}{1 + A/2\,B}$$

If $B = \dfrac{1}{100}$ then gain with feedback becomes:-

$$10 \log_{10} 50 - 10 \log_{10} (1 + \tfrac{1}{2})$$
$$= 16{\cdot}99 - 1{\cdot}76\text{dB}$$

It can be seen by comparing the amplifier gains at the same frequency, the reduction of gain with feedback applied is only 1·76dB, indicating that the −3dB point occurs at a higher frequency at the upper half power point and a lower frequency at the lower half power point. Therefore, although the mid-band gain has been reduced, bandwidth has been increased.

It would seem logical that by applying positive feedback gain would increase and bandwidth reduce. This is so, in fact if sufficient positive feedback is applied to an amplifier, gain would be so far increased and bandwidth reduced that the amplifier would become unstable and produce oscillations. This is not a particularly good way of producing oscillations of predetermined signals—there are numerous other more reliable methods.

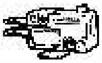
Oscillators

Oscillators which produce sinusoidal waveforms, can, in general, be simplified to an amplifier and feedback network as shown in Fig 5.2.

Usually the amplifier will produce an output voltage 180° out of phase with an input voltage. For oscillations to be self sustaining the feedback network should produce the amplifier's input voltage from its output voltage, therefore the feedback network should also produce a 180° phase shift to compensate for amplifier phase shift. Another governing factor is that any losses which are present in the feedback network must be compensated for by the amplifier gain.

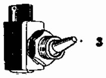
—continued on page 309

MICRO SWITCH



5 amp. changover contacts, 1/9 each, 18/- doz. 15 amp Model 2/- each or 21/- doz.

TOGGLE SWITCH



3 amp 250v. with fixing ring. 1/6 each, 15/- doz.

CONSTRUCTORS PARCEL

1. Plessey miniature 2 gang tuning condenser with built in trimmers and wave gang switch. 2. Ferrite slab aerial with coils to suit the above tuning condenser. 3. Circuit diagram giving all component values for 6 transistor circuit covering full medium wave and the long wave band around Radio 2. The three items for only 7/6d which is half of the price of the tuning condenser alone.

10 AMP 24V BATTERY CHARGER

Ideal unit for garage, boat station etc. £22.10.0d. each plus carriage and cost.

BEHIND THE EAR DEAF-AID

Made by a very famous maker. Thoroughly overhauled, cleaned and re-conditioned. Guaranteed 6 months. Regular price around £50. Our price £10.

ISOLATION TRANSFORMERS 200-250 Mains

A must if you work on mains equipment. Prevents accidents and shocks even in damp conditions. Input and output separately screened by connection block. 100 watt £3.10.0. 250 watt £5.

SLOW MOTION DRIVES

For coupling to tuning condensers etc. One end ¼in. shaft, the other end fits to a ¼in. shaft with grub screws. Price 4/6 each 48/- dozen.

LARGE PANEL MOUNTING MOVING COIL METERS

Size 5in. x 4in. Centre zero 200-0-200 micro amp made by Sangamo Weston. Regular price probably £8. Our price 59/6. ditto but 100-0-100 79/6.

A.C. Ammeter 0-5 amps. flush mounting—moving iron. Ex equipment but guaranteed perfect 29/6.

CIRCUIT BOARDS

Heavy copper on 3/32 paxolin sheet ideal for making power packs etc. as sheet is very strong and thick enough to allow copper to be cut away with hacksaw blade. 5in. x 5in. 1/6 each. 15in. x 5in. 4/6d. each.

6KVA Auto-transformer in ventilated sheet steel case—tapped 110v-140v-170v-200v-230v. Ex equipment but guaranteed perfect £19.10.0. carriage at cost.

PP3 BATTERY ELIMINATOR

Run your small transistor radio from the mains—full wave circuit—made up ready to wire into your set and adjustable high or low current. 8/6 each.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:

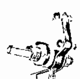
Miniature. 1in. long × approximately ⅛in. diameter. Will make and break up to ½A up to 300 volts. Price 2/6 each. 24/- dozen.

Standard. 2in long × 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price 2/- each. 18/- per dozen.

Flat. Flat type, 2in. long, just over 1/16in. thick, approximately ⅛in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price 6/- each. £3 per dozen.

Small ceramic magnets to operate these reed switches 1/9 each. 18/- dozen.

0.005mFd TUNING CONDENSER



Proved design, ideal for straight or reflex circuits 2/6 each, 24/- doz.

SUB-MINIATURE MOVING COIL MICROPHONE

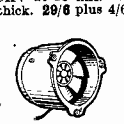
as used in behind the ear deaf aids

Acts also as earphone size only ⅜in. × ⅜in. × ⅛in. Regular price probably £3 or more. Our price 19/6. Note these are ex-equipment but if not in perfect working order they will be exchanged.

Chart Recorder Motor. Small 2″ diameter (approx) instrument motor with fixing flange and spindle (¼″ long, ⅛″ diameter) intregal gear box gives 1 rev per 24 hours. 19/6.

Ignition (E.H.T.) Transformer made by Parmeko Ltd., Primary 240V 50 cps. Secondary 5KV at 23 mA. Size approx. 4½″ + 3½″ + 2½″ thick. 29/6 plus 4/6 p. & p.

12V EXTRACTOR FAN BY DELCO



Ideal for ventilation in Caravan, Car or Boat. 6 Bladed 5″ diameter fan inside heavy duty cylinder with 3 point fixing flange. 5½″ diameter fixing hole. Length approx. 8½″. Exceptional bargain 27/6 plus 5/6 post and insurance.

4 Push Switch. Ideal to control fan Heater, etc. 3 on switches and 1 off. Contacts rated at 15 amp on all switches. 4/6 each, 48/- doz.

INTEGRATED CIRCUIT BARGAIN

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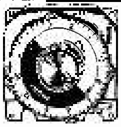

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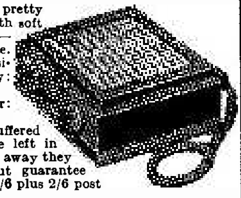

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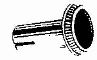

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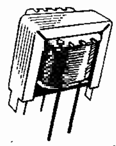

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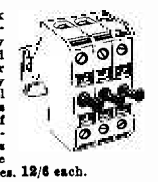

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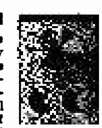

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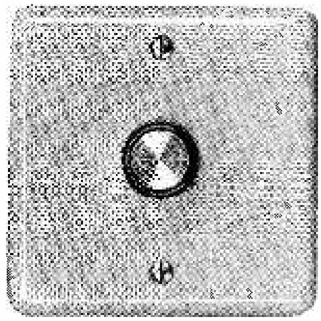

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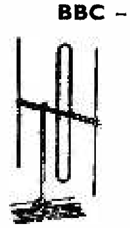

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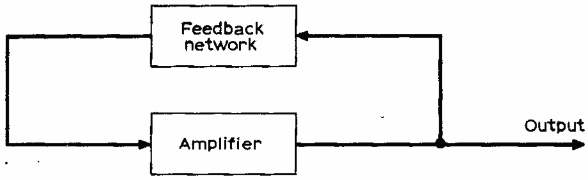

Fig. 5.2. Feedback network employed to produce an oscillator

Figure 5.3 shows the circuit diagram of a CR feedback network oscillator which can be analysed as follows.

R at the input of the amplifier should include the transistor input resistor and the biasing resistors in parallel. This circuit consists of a single stage amplifier providing a 180° phase shift and a 3-stage CR feedback network.

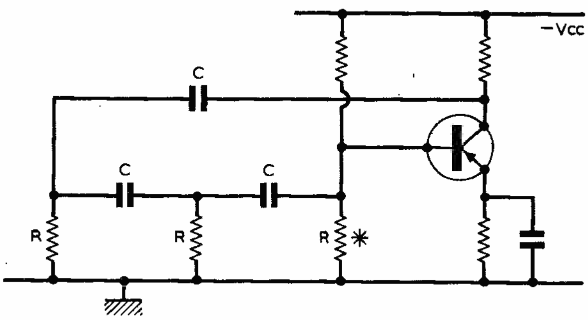

Fig. 5.3. Typical oscillator circuit utilising a CR feedback network

Neglecting the effects of the individual CR networks loading each other, each CR network will produce a 60° phase change as indicated by the vector diagram in Fig 5.4.

$$\text{Tangent } 60^\circ = \frac{\sqrt{3}}{1} = \frac{V_C}{V_R} = \frac{X_C}{R}$$

$$\text{but } X_C = \frac{1}{2\pi f C}$$

$$\therefore \sqrt{3} = \frac{1}{2\pi f CR}$$

therefore the frequency of oscillation,

$$f = \frac{1}{2\sqrt{3}\,\pi CR}$$

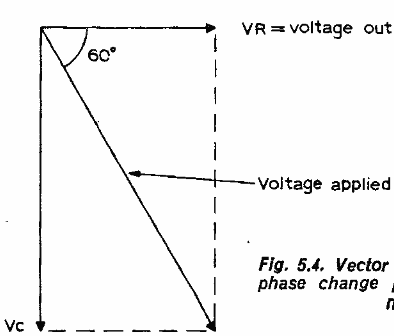

Fig. 5.4. Vector diagram showing 60° phase change produced by the CR network

For this circuit it can be shown that the amplifier must have a gain of slightly more than 29 to compensate for losses in the network.

The Wien bridge oscillator shown in Fig 5.5 is perhaps the most widely used for frequency generator circuits in test equipment as a wide range of frequencies can be generated by varying C and R values.

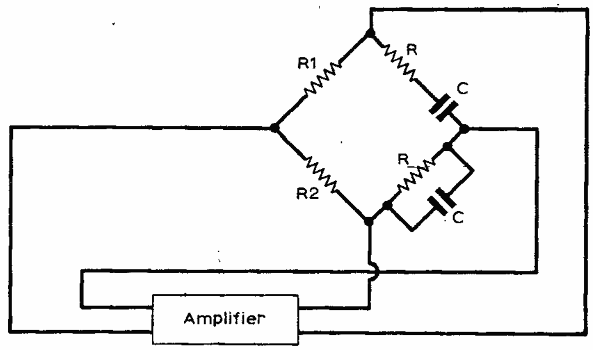

Fig. 5.5. Basic circuit of the Wien bridge oscillator

It can be shown by making the appropriate circuit assumptions that frequency of oscillation is given by:

$$f = \frac{1}{2\pi CR}$$

Relaxation Oscillators

These are circuits which again involve feedback in amplifiers, but here switching of current flow is obtained by CR network feedback rather than by producing sinusoidal oscillations. Fig 5.6 shows the basic circuit.

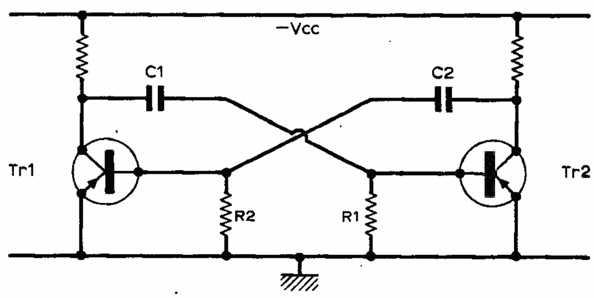

Fig. 5.6. Relaxation oscillator using two feedback networks C1R1 and C2R2

The time taken for switching is half the periodic time of the waveform. This time can be obtained from the equations discussed in the last article.

$$\text{Periodic time} = 2 \times 0{\cdot}693 \times CR = 1{\cdot}386CR$$
$$\text{or approximately } 1{\cdot}4CR$$

$$\therefore \text{ frequency} = \frac{1}{1{\cdot}4CR}$$

This type of circuit, although used in logic circuits in the main, is often used in electronic organs, the keyboard used to switch different values of C_1 and R_1 into the circuit thus providing the different notes. Filter circuits are sometimes used to filter out some of the higher harmonics to give a purer sound.

So far these articles have shown that mathematics applied to electronics can remove all the guesswork normally encountered in circuit designing and building. It is now up to the reader to put these principles into practice not only in the workshop but in understanding radio and electronics a little more clearly. ■

TAKE 20

JULIAN ANDERSON

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

No. 16
SIGNAL INJECTOR

ONCE a piece of equipment has been built, it is often necessary to provide some form of signal input with which to test it. I am sure many of you use the trick of tapping the audio from either the loudspeaker or the volume control of a transistor radio. This is fine where an audio signal is required but will not help where r.f. is needed. For this type of equipment radio broadcasts can often be used but if this does not work you will not know if something is wrong or if the equipment is just not sensitive enough.

It is however very easy to build a signal injector which produces a basic audio signal which is so distorted that the harmonics reach way up into the r.f. spectrum.

Various types of oscillator will do this but the one described here will achieve all the others do and the cost will be under 10s.

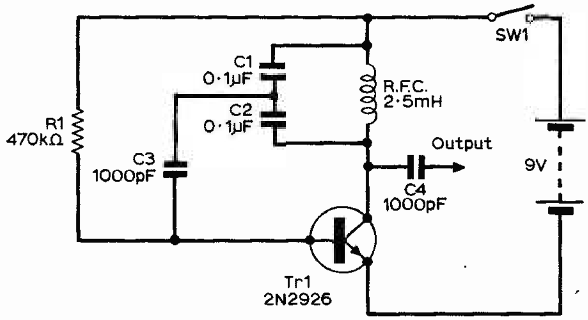

Fig. 1: The circuit diagram of the signal injector.

★ components list

R1	470k Ω ¼watt 10%
C1	0·1µF
C2	0·1µF
C3	1000pF
C4	1000pF
R.F.C.	2·5mH radio frequency choke
Tr1	2N2926

THE CIRCUIT

The transistor is connected in the common emitter mode with base bias being provided by R1. The collector load comprises a radio frequency choke which has two capacitors, themselves in series, connected across it. C1 and C2 are 0·1µF each so that the effective capacitance across the choke will be 0·05µF. The junction of these capacitors is connected to the base via a 1,000pF capacitor which starts and maintains the oscillation.

By coupling far too much positive feedback to the input, a grossly distorted waveform is achieved, this being necessary to produce the harmonics.

In operation for radio frequency usage, the choke itself will radiate the harmonics to be picked up on any tuned circuit and it is only necessary to place the injector near the equipment. For audio purposes C4 taps off the output and this can be coupled to the equipment under test via some form of probe.

A huge variety of transistors can be used for Tr1, we are using a 2N2926 here only for economy; the frequency response should be over 10MHz otherwise the higher harmonics will not be produced. PNP transistors, if used, of course require that the battery polarities be reversed.

Component layout should prove to be easy, a small piece of Veroboard will take all the components and make the finished article neat.

Just a few lines on test equipment. Many beginners seem to ignore this feeling that, since it is rarely used, it is a waste of time and money. I am sure that many constructors who are frustrated by early failures drop the hobby for this reason. If they had paid proper attention to it and realised that test equipment will often sort out troubles in seconds that would otherwise take hours they would still be with us. Good test equipment enables one to churn out projects quickly and of a high standard but even the simplest types, such as that described here, is very useful. ■

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(a) We cannot undertake to design equipment or to supply wiring diagrams or circuits, to individual requirements.

(b) We cannot undertake to supply detailed information for converting war surplus equipment, or to supply circuitry.

(c) It is usually impossible to supply information on imported domestic equipment owing to the lack of details available.

(d) We regret we are unable to answer technical queries over the telephone.

(e) It helps us if queries are clear and concise.

(f) **We cannot guarantee to answer any query not accompanied by the current query coupon and a stamped addressed envelope.**

QUERY COUPON

This coupon is available until 7th August 1970 and must accompany all queries in accordance with the rules of our Query Service.

PRACTICAL WIRELESS, AUGUST 1970

TRANSISTOR RADIOS TO BUILD YOURSELF

Backed by after sales service

NEW! roamer eight mkI

WITH VARIABLE TONE CONTROL

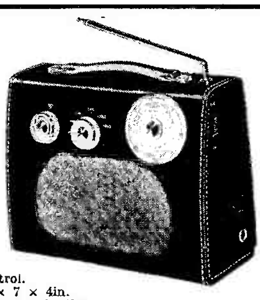
7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for Medium and Long Waves. Five section 22in. chrome plated Telescopic aerial for Short Waves can be angled and rotated for maximum performance. Push pull output using 600 mW transistors. Socket for car aerial. Tape record socket. Selectivity switch. Switched earpiece socket complete with earpiece for private listening. Eight transistors plus 3 diodes. Famous make 7in. x 4in. Speaker. Air spaced ganged tuning condenser. On/Off switch volume control. Wave change switch and tuning control. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams make the Roamer Eight a pleasure to build.

Total Building Costs **£6.19.6**

P & P 7/6.

Parts Price List and Easy Build Plans 5/- (FREE with parts).

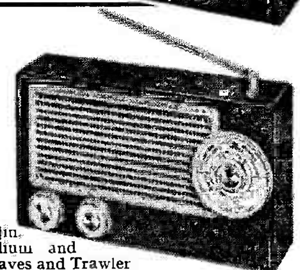
roamer seven mkIV



SEVEN FULLY 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 Medium and Long Waves. Five Section 22in. chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push-pull output. Seven transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in. P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build. Parts price list and easy build plans 3/- (FREE with parts). Personal Earpiece with switched socket for private listening, 5/- extra.

Total building costs **£5.19.6** P.& P. 7/6

NEW! trans eight

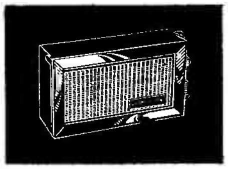


SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 x 5¼ x 2⅝in. approx. Tunable on Medium and Long Waves, three Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. Eight improved type transistors plus 3 diodes. Push pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/– (FREE with parts). Earpiece with switched socket for private listening 5/– extra.

Total building costs **89/6** P & P 5/6

pocket five

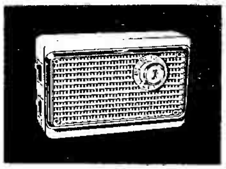


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive black and gold case. Size 5½ x 1½ x 3½in. Tunable over both Medium and Long Waves 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. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs **44/6** P. & P. 3/6

transona five

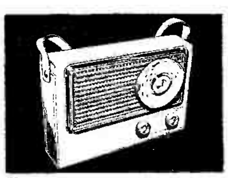


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive case with red speaker grille. Size 6½ x 4½ x 1¼in. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs **47/6** P. & P. 3/9

roamer six



SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings. Size 7½ x 5½ x 1½in. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/-. (FREE with parts).

Total building costs **79/6** P. & P. 4/6

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I enclose £.................... please send items marked

ROAMER EIGHT ☐ ROAMER SEVEN ☐
TRANSONA FIVE ☐ TRANS EIGHT ☐
POCKET FIVE ☐ ROAMER SIX ☐

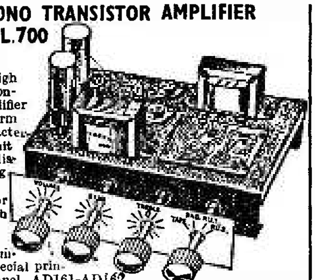
Parts price list and plans for ....

Name ....

Address ....

.... PW.20

MONO TRANSISTOR AMPLIFIER HSL.700



A really high fidelity monaural amplifier with performance characteristics to suit the most discriminating listener. 6 transistor circuit with integrated pre-amplifier assembled on special printed sub panel. AD161-AD162 operating in symmetrical complementary pair. Output transformer coupled to 3 ohm and 15 ohm speaker sockets. Standard phono input sockets. Full wave bridge rectifier power supply for AC mains 200-240v. Controls: Bass, Treble, Volume/on/off. Function selector for PU1, PU2, Tape, Radio. The HSL.700 is strongly constructed on rigid steel chassis bronze hammer enamel finish, size 9¼ × 5 × 4½in. high.

Sensitivity: PU1-50m/v. 56K input impedance.
PU2-110m/v. 1 meg input impedance.
Tape—110m/v. 1 meg input impedance.
Radio—110m/v. 1 meg input impedance.

Output power measured at 1Kc—6.2 watts RMS into 3 ohms. 5.8 watts RMS into 15 ohm. Overall frequency response 30 c/s-18 Kc/s: Continuously variable tone controls: Bass, +8db to—12db at 100c/s. Treble, +10db to—10db at 10Kc/s. The HSL.700 has been designed for true high fidelity reproduction from Radio Tuner, Gramophone deck and Tape Recorder preamp. Supplied ready built and tested, complete with knobs, attractive anodised aluminium front escutcheon panel, long spindles (can be cut to suit your housing requirements) full circuit diagram and operating instructions.

Our Special Price **£7.19.6** P. & P. 7/6

LOUDSPEAKER BARGAINS

2½" 4 ohm 10/- P. & P. 1/6 5in. 3 ohm 16/-. P. & P. 3/-. 7 × 4in. 3 ohm 21/-, P. & P. 4/-, 10 × 6in. 3 ohm 27/6, P. & P. 6/-, E.M.I. 8 × 5in. 3 ohm with high flux magnet 26/-. P. &. P. 4/- E.M.I. 13½ × 8in. 3 ohm with high flux ceramic magnet 42/- (15 ohm 45/-), P. & P. 6/-. E.M.I. 13 × 8in. 3 or 15 ohm with two inbuilt tweeters and crossover network 4 gns.P. & P. 6/-.

BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly £5.10.0. P. & P. 7/6 Guitar models: 25w. £6.0.0, 35w. £8.0.0.

E.M.I. 3½in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 ohms 15/- each; 15 ohms 18/6 each. P. & P. 2/6.

12in. "RA" TWIN CONE LOUDSPEAKER. 10 watts peak handling, 3 or 15 ohm 37/6, P. & P. 6/-.

35 OHM SPEAKERS

3½in. 14/-, P. & P. 2/6; 7 × 4in. 21/-, P. & P. 4/-.

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS. Approx. 54in. wide. Usually 35/- yard. OUR PRICE 15/- per yard length. P. & P. 2/6 (min. one yd.). S.A.E. for samples.

MAGNAVOX DESK TYPE MOVING COIL MICROPHONE. Medium impedance. Brand New. Special Price 42/- p. & p. 2/-.

BALANCED ARMATURE EARPHONE Approx 70 ohm impedance. Can be used as ultra sensitive mike or speaker. ONLY 3/6. P. & P. 1/6.

CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity, 18/6, P. & P. 1/6.

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE 21/-, P. & P. 1/6.

HIGH IMPEDANCE DYNAMIC STICK MIKES. High sensitivity, 39/6, P. & P. 2/6.

HONEYWELL MICROSWITCHES. S/P. C/O. Push button action. Rating 250v. AC at 15 amps. Size approx. 1¼ × ¾ × ⅝in. 5/- each. P. & P. 1/- (6 or more post free).

SPECIAL OFFER! PLESSEY TYPE 29 TWIN TUNING GANG. 400pF + 146pF. Fitted with trimmers and 5:1 integral slow motion. Suitable for nominal 470 k/sc I.F. Size appox. 2×1×1½. Only 8/6. P. & P. 2/6.

TELESCOPIC AERIALS WITH SWIVEL JOINT. Can be angled and rotated in any direction. 12 section Heavy Chrome. Extends from 7in. to approx. 56in. Maximum diameter ½in. 10/- each. P. & P. 1/6. 6 section Lacquered Brass. Extends from 6in. to 22½in. approx. Maximum diameter ⅜in. 5/- each. P. & P. 1/-.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price 35/-, P. & P. 6/-.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9-0-9 at 500mA. 14/-. P. & P. 2/6. Pri. 200/240v. Sec. 12-0-12 at 1 amp. 17/6. P. & P. 2/6. Pri. 200/240v. Sec. 10-0-10 at 2 amp. 27/6. P. & P. 3/6. Tapped Primary 200-220-240v. Sec. 21.5v. at 500mA. 12/6. P. & P. 2/6.

BATTERY CHARGER TRANSFORMERS. 200/240v. input. Nominal output for 6 or 12v. batteries 3 amps. Size approx. 3" x 2½" x 2½". Brand New. Price 21/-. P. & P. 5/-.

HIGH GRADE COPPER LAMINATE BOARDS. 8 × 6 × ¹⁄₁₆in. FIVE for 10/-. P. & P. 2/-.

STOCKISTS OF SINCLAIR EQUIPMENT

Z.30 Amplifier 89/6 p. & p. 2/6.
Stereo 60 Pre. Amplifier £9 19 6 p. & p. 5/-
PZ5 Power Supply £4 19 6 p. & p. 3/6.
PZ6 Power Supply £7 19 6 p. & p. 3/6.
IC.10 Integrated Circuit 59/6 p. & p. 2/-.

SPECIAL OFFER ! !

HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Uynair front. Size 16½" high × 10¼ wide × 6" deep. Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 15 ohm impedance.

8 Gns. Carriage 10/-

TRANSISTOR STEREO 8 + 8 MK II

Now using Silicon Transistors in first five stages on each channel resulting in even lower noise level with improved sensitivity. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W. mono). Integrated pre-amp with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work. Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Freq. response ±3dB. 20–20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to —16bB. Negative feedback 18dB over main amp. Power requirements 25V at .6 amp.

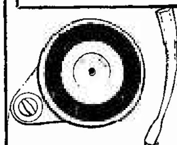
PRICES: AMPLIFIER KIT £10.10.0; POWER PACK KIT £3.0.0; CABINET £3.0.0. All Post Free.

Also available STEREO 10 + 10. As above but 10 watts per channel. **PRICES:** AMPLIFIER KIT £12; POWER PACK KIT £3.10.0

Circuit diagram, construction details and parts list (free with kit) 1/6 (S.A.E.).

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" x 1½" x ⅜". Brand new complete with instructions. Price 17/6 P. & P. 2/6.



SPECIAL PURCHASE! E.M.I. 4-SPEED PLAYER

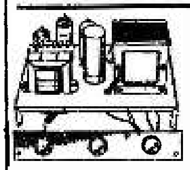
Heavy 8½in. metal turntable. Low flutter performance 200/250v. shaded motor (90v. tap). Complete with latest type lightweight pick-up arm and mono cartridge with t/o stylii for LP/78. ONLY 63/-. P. & P. 6/6.

QUALITY RECORD PLAYER AMPLIFIER MK II

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE 75/-. P. & P. 6/-.

ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE 97/6, P. & P. 7/6.

DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE 79/6, P. & P. 9/6.



3-VALVE AUDIO AMPLIFIER HA34 MK II.

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4.15.0. P. & P. 6/-.

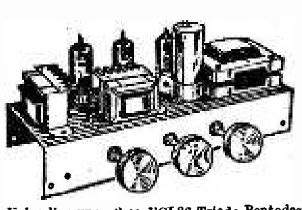
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. 79/6. P. & P. 6/-.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound mains transformer, EZ80 rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with valves and good quality output transformer.

FEW ONLY. BARGAIN PRICE **55/-** P. & P. 6/-

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as full wave rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built and tested to a high standard. PRICE 8 gns. P. & P. 8/-.

4-SPEED RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.

SPECIAL OFFER! Famous GARRARD 3500 fitted Sonotone 9TAHCD Diamond Stereo Cartridge. List price over £16. Limited Number at £10. Carr. 8/6.

LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER. With latest mono compatible cartridge £6.19.6. Carr. 6/6. With stereo cartridge £7.19.6. Carr. 6/6.

LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000. AT60 etc. Send S.A.E. for latest Prices!

PLINTH UNITS cut out for Garrard Models, 1025, 2025, 2000, 3000, AT60, SP25. With rigid transparent plastic cover. Special design enables unit to be used with cover in position. OUR PRICE £5.15.0 complete. P. & P. 8/6.

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. 30/-. P. & P. 1/6.

SONOTONE 2539 High output Stereo Cartridge. T/O stylus for Stereo/LP/78. Complete with universal mounting bracket. List Price 48/7. OUR PRICE 25/-. P. & P. 1/6.

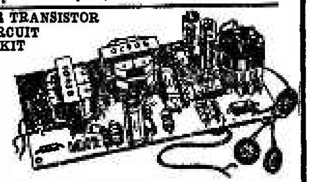
SONOTONE 9TAHC compatible Stereo Cartridge with diamond stylus 50/-. P. & P. 2/-.

LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. 32/6. P. & P. 2/-.

LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only 30/-. P. & P. 2/-.

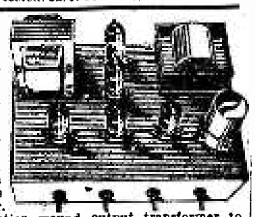
HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT

Type TA1



Peak output in excess of 1½ watts. All standard British components. Built on printed circuit panel size 6 × 3in. Generous size Driver and Output Transformers. Output transformer tapped for 3 ohm and 15 ohm speakers. Transistors (GET114 or 81 Mullard AC128D and matched pair of AC128 o/p). 9 volt operation. Everything supplied, wire, battery clips, solder, etc. Comprehensive easy to follow instructions and circuit diagram 2/6 (Free with Kit). All parts sold separately. **SPECIAL PRICE 45/-.** P. & P. 3/-. Also ready built and tested, 52/6. P. & P. 3/-.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 2/6 (Free with parts). All parts sold separately. ONLY £7.9.6. P. & P. 8/6. Also available ready built and tested complete with std. input sockets, £9.5.0. P. & P. 8/6.

BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched pair) 15/-; V15/10p 10/-; OC71 5/-; OC76 6/-; AF117 3/6; 2G339 (NPN) 3/-.

Set of Mullard 6 transistors OC44, 2—OC45, AC128D matched pair AC128 25/-; ORP12 Cadmium Sulphide Cells 10/6. All post free.

Open 9-5.30 Monday to Saturday

Early closing Wed. 1 p.m.

A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, LONDON, S.W.19 **Tel.: 01-540 3985**

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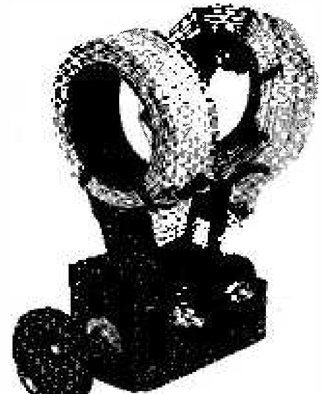


COLIN RICHES
ARTHUR DOW

Vintage Radio Society

In connection with our previous notes on the possible formation of a VRS we have had an offer from a reader to compile a list of those people who have a genuine interest in the collection and preservation of "vintage" radio equipment. All communications direct to: Mr. K. Lancaster, 40 Great Gardens Road, Hornchurch, Essex.

It is of interest at this point to raise the question as to just what constitutes "vinage" radio equipment. In our view the term should apply to equipment produced prior to 1930 by which time broadcasting had become firmly established in this country and the basic design of radio receivers more or less stabilised.

However, would readers care to express their own views on this matter?

Radiograms

"According to the latest reports Captain Amundsen, at present *en route* to survey the Arctic region, will broadcast Eskimo music to the world.". . . 1922 . . . *possibly more pleasing to the ear than some of today's pop!!*

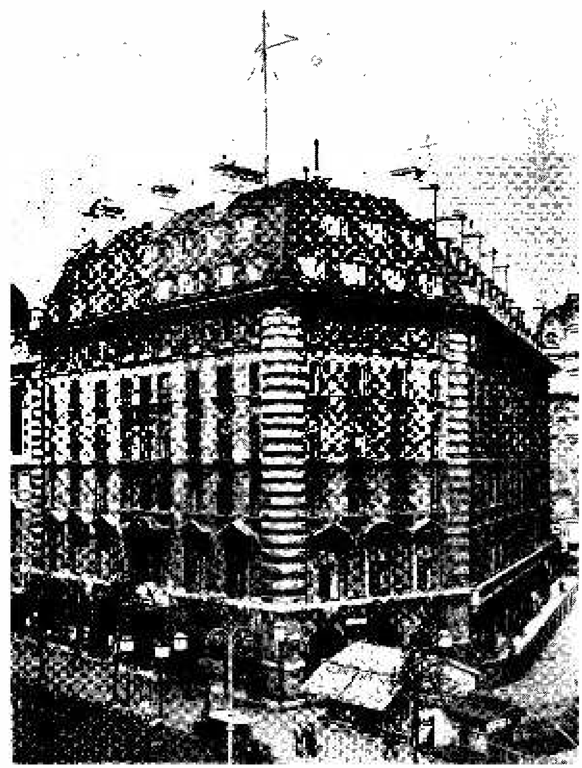
"One of the simplest ways of cutting down atmospherics is to lower the aerial.". . . 1932.

"Increasing the height of the aerial is often as effective as adding another valve.". . . 1932. . . . *your move!* . . .

"America promises us a new method of waging war in her promised production of a giant airship capable of carrying large numbers of pilotless gliders laden with bombs. These gliders would be guided to the spot at which it was desired to drop bombs by means of a wireless ray." . . . 1922 . . . *but what about anti-missile missiles??*

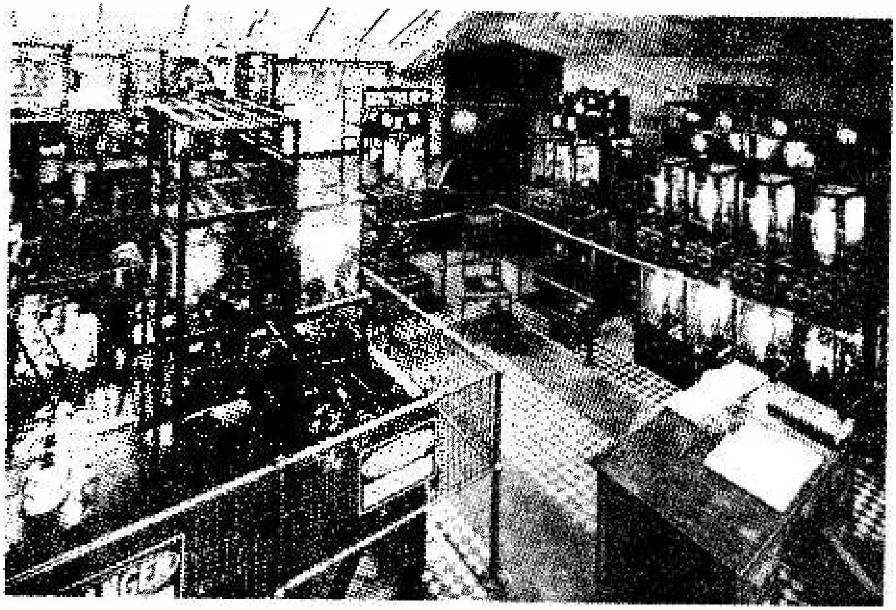
"How Germany does it . . . in Germany the listening tax is paid monthly and its collection from set-owners is made by the postman on his rounds. The annual cost is approximately 30s. Radio pirates are discovered by the municipal chimney-sweeps who in the course of their daily duties visit all houses, flats and apartments. It is their duty to notify all wireless receivers to the local authorities." . . . ! ! . . . . 1932. . . . *M of P & T to note . . . using postmen that is. not chimney sweeps!*

. . . in addition to the Post Office Licence it is also necessary to have a licence from Marconi's Wireless Telegraphy Co., for the use of their patents. The home constructor is not immune from this levy . . . if you construct a receiver for your own use and make use of any of the above company's patents you should write to them for a licence plate which will be supplied on payment of the royalty. If in doubt send them a wiring diagram of the receiver. The Post Office Licence is 10s. per annum, the Home Constructors Marconi Licence is 12s. 6d. and Manufacturers Licence is 5s. per valve! ! . . . 1932 . . . *we should be grateful that this at least has been dropped! !*



In 1922 the first broadcasts, as we know them today, took place from Marconi House in the Strand in London. Initially the power used was only 100 watts but this was soon increased to 1·5kW. The British Broadcasting Company came into being in December the same year and in a matter of months a network of eight 1·5kW stations, similar to 2LO, were operational around the country.

diodes and very low level of distortion.



A first glance at the transmitter hall of 2LO gives the impression of many mighty kilowatts but in fact it was only 1·5kW. On the right are the early audio stages and modulator with the master oscillator in the centre background. The power supply with its transformers and valve rectifiers is on the left.

Readers' Comment

...Recently I sorted out one of the old 2V triodes and made a single valve reaction set. The coil was home-wound on a former made from a toilet roll. The results were fantastic. *(J. Taylor, Lancashire.)*

...I got the wireless "bug" in 1920 when I was given some odd pieces of World War 1 surplus equipment. *(F. H. Osborn, G2CVO, London, E.4.)*

...I constructed a John Scott Taggart design delivering 12W of audio and had the police hammering on the door at 2 a.m. (*B. Richardson, Nottingham.)*

...I clearly remember several of your crystal receiver designs. (*Raymond A. Hounslow, Carlton, Bedford.)*

...I collect old wireless components and still have the Vol. 1, No. 1 issue of Practical Wireless. *(Alan Barnes, Yorkshire.)*

...The years which P.W. has survived are clear proof of quality. I have many fond memories of its earlier days. *(Maurice Dean, Sheffield.)*

...Wireless has been the No. 1 all-devouring interest for me since I was 11 in 1932. I collect books, magazines and components from the much earlier days of wireless. (*Basil D. Van Der Syde, M.S.E.R.T., Dorset.)*

...I still have many magazines dating back to the early days and would not part with them for all the world. *(B. Richardson, Nottingham.)*

...I built my first wireless receiver at the end of the First World War. (*Norman Gilbertson, Southampton.)*

...My first receiving licence was a Constructor's Licence issued in 1924. *(E. C. Parker, Middlesex.)*

...I have taken P.W. since the first issue and would like to see some early designs of transmitters. *(John R. Davidson, G3FG, Surrey.)*

These are but just extracts from some of the many letters we have received on the subject of the early days of radio.

Testing 'Phones

Back in 1922, this was an inexpensive way to test your earphones: "The two leads from the earphones are connected to the two terminals of an ordinary electric bell. No battery whatever is put in the circuit. The clapper is pressed forward to the bell and then quickly released. It will vibrate several times before coming to rest. A similar vibration will take place and will be plainly heard in the phones. The explanation of the action is that there is a small amount of magnetism in the magnet of the bell when it is not connected to the battery which usually works it. When you cause the armature of the bell to vibrate the magnetism is disturbed and sets up currents in the coils of the magnet core. These currents work the diaphragms of your phones, and you hear a sound agreeing with the vibration of the armature of the bell."

...So What's New?

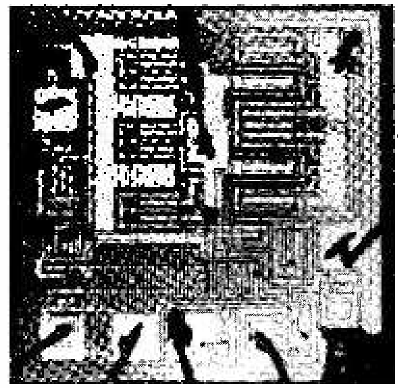
"Various means have been designed for the purpose of operating the 'change-over' switch automatically. de Forest used an electromagnet which was energised by a delicate contact inserted in the microphone mouthpiece.

"This contact was closed by the actual air pulses from the mouth and the electromagnet thereupon moved a pivoted switch so as to break the receiving circuit and couple the transmitter to the aerial." . . . *VOX 1923!*

"In response to a query from a reader concerning the operation of station 5HY the owner of the station, Mr. Baynham Honri, writes to say that his station is licensed for 10 watts but that he actually uses from 4 to 6 watts only on 440 and 200 metres."

. . . January 1923. . . . *Readers may be interested to know that Mr. Honri is still very much alive and is the author of the monthly feature "Underneath the Dipole" in our "sister" magazine Practical Television.*

MONOLITHIC INTEGRATED CIRCUIT HIGH FIDELITY AMPLIFIER AND PRE-AMP



the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output of 5 watts R.M.S. (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 Zener diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of such components as tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs, servo amplifiers (it is d.c. coupled throughout) etc. The photographic masks required as part of the process of producing monolithic I.Cs are expensive but once made, the circuits can be produced with complete uniformity and at very low cost. This enables us to cover every IC-10 with the Sinclair guarantee of reliability.

■ SPECIFICATIONS

Output	10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response	5 Hz to 100 KHz$\pm$1dB.
Total harmonic distortion	Less than 1% at full output.
Load impedance	3 to 15 ohms.
Power gain	110dB (100,000,000,000 times) total.
Supply voltage	8 to 18 volts.
Size	$1 \times 0.4 \times 0.2$ inches.
Sensitivity	5mV.
Input impedance	Adjustable externally up to 2.5 M ohms.

■ CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback is used round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

■ APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

SINCLAIR

IC.10 *with IC.10 manual* **59/6**

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SINCLAIR RADIONICS LIMITED
22 NEWMARKET ROAD · CAMBRIDGE
Telephone 0223 52731

Project 60

laboratory-standard high fidelity modules

Sinclair Project 60 comprises a range of modules which connect together simply to form a complete stereo amplifier with really excellent performance. So good, in fact, that only 2 or 3 amplifiers in the world can compare in overall performance. Now with the addition of three new modules to the range, the constructor has choice of assemblies with either 20 or 40 watts output per channel, with or without filter facilities.

The modules are: **1.** The Z-30 and Z-50 high gain power amplifiers, each of which is an immensely flexible unit in its own right. **2.** The Stereo 60 pre-amplifier and control unit. **3.** The Active Filter unit with both high and low audio frequency cut-offs. **4.** The PZ-5 and PZ-6 power supplies. A complete system could comprise, for example, two Z-30's, one Stereo-60, and a PZ-5. The PZ-6 is stabilised and should be used where the highest possible continuous sine wave rating is required. An A.F.U. may be added as required. In a normal domestic application, there will be no significant difference between using a PZ-5 or PZ-6 unless loudspeakers of very low efficiency are being used, in which case the PZ-6 will be required. For assemblies using two Z-50's there is the new PZ-8 stabilised supply unit to ensure maximum performance from these more powerful amplifiers.
All you need to assemble your Project 60 system is a screwdriver and soldering iron. No technical skill or knowledge whatsoever is required and, in the unlikely event of you hitting a problem, our customer service and advice department will put the matter right promptly and willingly. Project 60 modules have been carefully designed to fit into virtually all modern plinth or cabinets and only holes need be drilled into the wood of the plinth to mount the control unit and the A.F.U. Any slight slip here will be covered by the aluminium front panels of these two units.
The Project 60 manual gives all the building and operating instructions you can possibly want, clearly and concisely. Perhaps the greatest beauty of the system is that it is not only flexible now but will remain so in the future as the latest additions to the range show. A stereo F.M. tuner is next to come. These and all other modules we introduce will be compatible with those already available and may be added to your system at any time. And because Sinclair are the largest producers of constructor modules in Europe, Project 60 prices are remarkably low.

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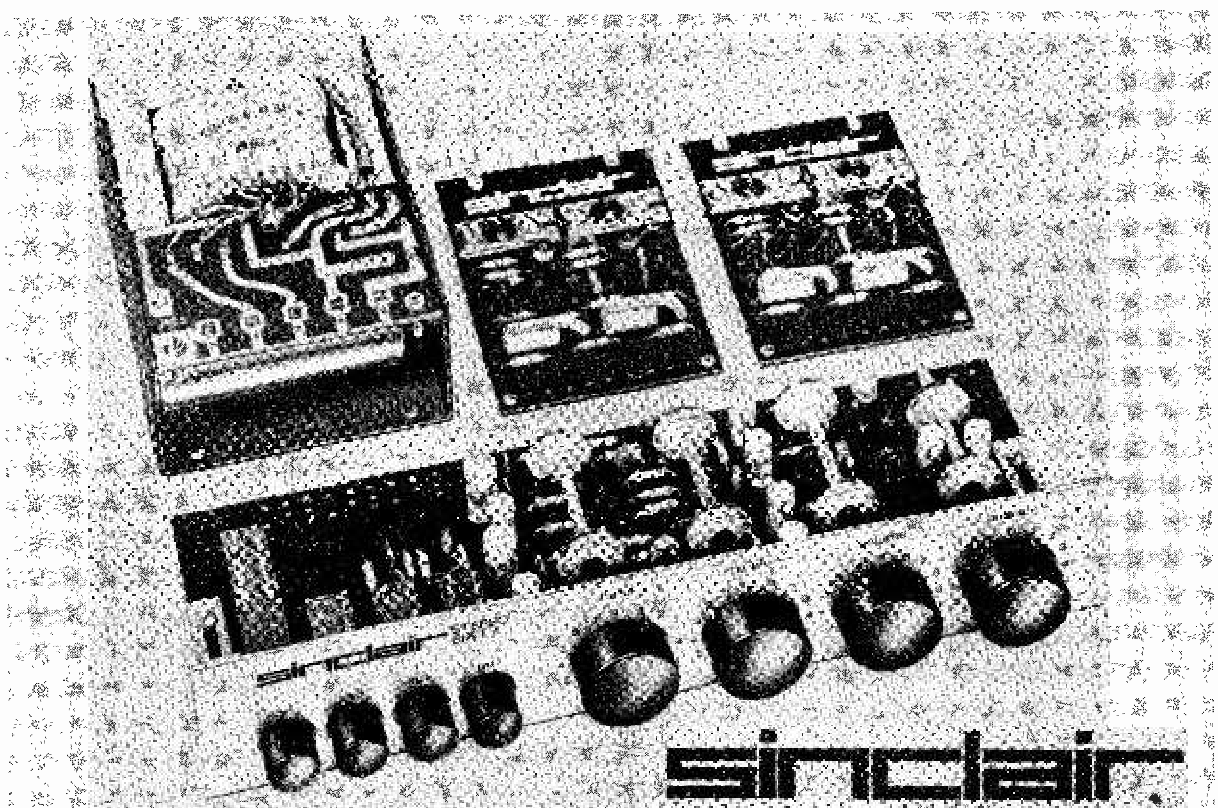


Z.30 20 WATT R.M.S. POWER AMPLIFIER (40 WATTS PEAK) Z.50 40 WATT R.M.S. POWER AMPLIFIER (80 WATT PEAK)

The Z.30 together with the higher powered Z.50 are both of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use the Z.30 or Z.50 power amplifiers in your Project 60 system will depend on personal preference, but they are both the same physical size and may be used with other units in the Project 60 range equally well. The Z.30 is unique in that it may be used with any power source between 8 and 35 volts without need for adjustment and may thus be driven from a car battery for example. For operating from mains, for the Z.30 use PZ.5 power supply unit for most domestic requirements, or PZ.6 if you have very low efficiency loudspeakers. For Z.50, use the PZ.5, PZ.6 or the PZ.8 described below.

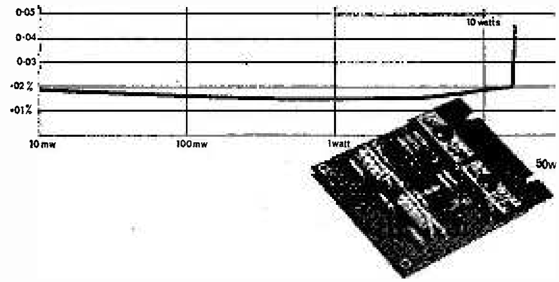
SPECIFICATIONS

The Z.50 is completely interchangeable with the Z.30 and can be used in all Z.30 applications

Power Outputs

Z.30 15 watts R.M.S. into 8 ohms, using 35V: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms: 30 watts R.M.S. into 8 ohms, both continuous, using 50V.
Frequency response 30 to 300,000 Hz ± 1 dB
Distortion 0.02% into 8 ohms
Signal to noise ratio better than 70 dB unweighted
Input sensitivity 250mV into 100 Kohms
For speakers from 3 to 15 ohms impedance
Size 3½" x 2¼" x ½"

APPLICATIONS
Hi-fi amplifier; car radio amplifier; record player amplifier fed directly from pick-up; intercom; electronic music and instruments; P.A.; laboratory work etc. Full details for these and many other applications are given in the manual supplied with the Z.30.



Power versus distortion curve of Sinclair Z.30 and Z.50

Z.30 *Built tested and guaranteed with circuits and instructions Manual* **89/6**

Z.50 *Built, tested and guaranteed with circuits and instructions manual* **109/6**

STEREO 60 Pre-amplifier and tone control unit

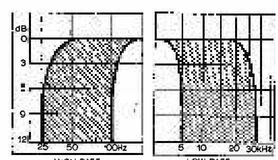
The Stereo 60 is a stereo preamplifier and control unit designed for the Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout and great attention has been paid to achieving a really high signal-to-noise ratio and excellent tracking between the two channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

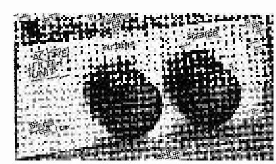
- Input sensitivities—Radio—up to 3mV Mag. p.u.—3mV: correct to R.I.A.A. curve ±1dB: 20 to 25,000Hz. Ceramic p.u.—up to 3mV: Aux.—up to 3mV.
- Output—250mV
- Signal-to-noise ratio—better than 70 dB.
- Channel matching—within 1dB.
- Tone controls—TREBLE +15 to −15dB. at 10 kHz: BASS +15 to −15dB at 100Hz.
- Power consumption 5mA.
- Front panel—brushed aluminium with black knobs and controls.
- Size 8¼ x 1½ x 4 ins.

Built, tested and guaranteed **£9.19.6**

ACTIVE FILTER UNIT High Pass and Low Pass

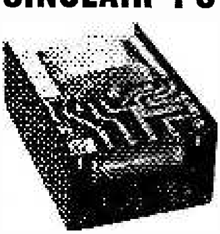
For use between Stereo 60 unit and to Z.30s or Z.50s, the Active Filter Unit matches the Stereo 60 in styling and is as easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible by reason of the careful design and generous negative feed back employed.
Supply voltage—15 to 35V. Current—3mA
H.F cut-off (−3dB) variable from 28kHz to 5kHz.
L.F cut-off (−3dB) variable from 25Hz to 100Hz.
Filter slope, both sections 12dB per octave
Distortion at 1kHz (35V supply) 0.02% at rated output





Built, tested and guaranteed **£5.19.6**

SINCLAIR POWER SUPPLY UNITS



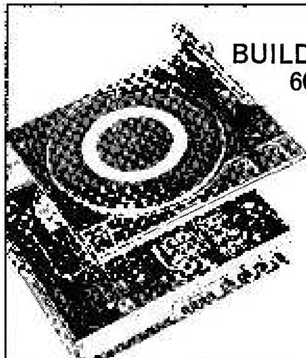
PZ-5 *30 volts unstabilised* **£4.19.6**

PZ-6 *35 volts stabilised* **£7.19.6**

PZ-8 *45 volts stabilised (less mains transformer)* **£5.19.6**

PZ-8 *Mains transformer* **£5.19.6**

BUILDING A PROJECT 60 ASSEMBLY



The illustration here shows quite clearly how easily Project 60 can be contained in one of today's slim, modern plinths. Very little space is required to house these Sinclair units, and within the space of the motor plinth, you can install a stereo amplifier of the very highest quality. If, for example you have already put together an assembly as illustrated here, adding the Active Filter Unit would be very easy.

GUARANTEE

If at any time within 3 months of purchasing Project 60 modules from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for services thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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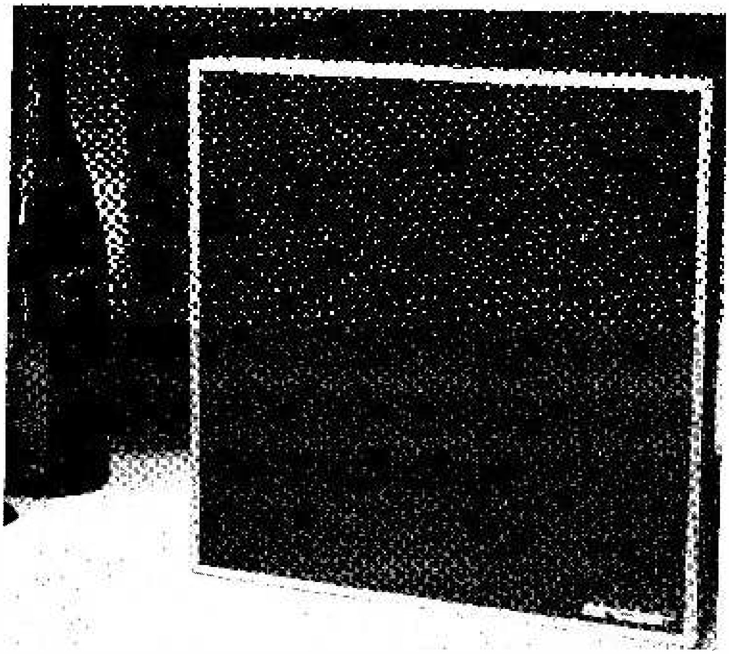
Q.16

new elegance in an outstanding loudspeaker



All the superb features which went to make the Sinclair Q.14 have been incoporated in the new Q.16 which gives an exciting new opportunity for you to match your Sinclair equipment with modern decor. Employing the same well proven acoustic system in which materials, processing and styling are used in such a radical and successful departure from conventional design. This speaker presents an entirely new appearance with its attractive teak surround and all-over special cellular foam front chosen as much for its appearance as for its ability to pass all audio frequencies without loss. The Q.16 is compact and slim. Its new styling makes it eminently suitable for shelf mounting, but it is no less versatile than its famous predecessor. Listen to a pair of Q.16s in stereo and marvel at the standards of quality and clarity they give. At the price this Sinclair speaker represents outstanding value as you will discover the moment you see and hear it.

The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000Hz with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good transient response at all frequencies. Size: $9\frac{3}{4}''$ square × $4\frac{3}{4}''$ deep from front to back.

£8.19.6

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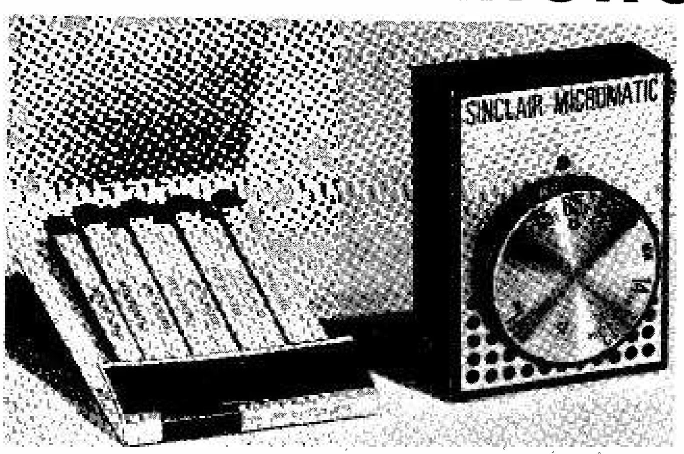
SINCLAIR MICROMATIC

The world's most successful miniature radio



SPECIFICATIONS—Size: $1\frac{13}{16}'' \times 1\frac{7}{16}'' \times \frac{1}{2}''$ (46×33×13mm). **Weight incl. batteries:** 1 oz. (28·35gm) approx. **Tuning:** Medium wave band with bandspread at higher frequency end. **Earpiece:** Magnetic type. **Case:** Black plastic with anodized aluminium front panel, spun aluminium dial.

Complete kit incl. earpiece, case, solder and instructions in fitted pack. **49/6**

Ready built, tested and guaranteed, with earpiece. **59/6**

Mallory Mercury Cell RM675 (2 req.) 2/9 each

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.... PW 870

Considerably smaller than an ordinary box of matches, this is a multi-stage A.M. receiver meticulously designed to provide remarkable standards of selectivity, power and quality. Powerful A.G.C. is incorporated to counteract fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy at all times. Vernier type tuning plus the directional properties of the self-contained special ferrite rod aerial makes station separation much easier than with many larger sets. The plug-in magnetic earpiece which matches exactly with the output provides wonderful standards of reproduction.

Everything including the batteries is contained within the attractively designed case. Whether you build your Micromatic or buy it ready built and tested, you will find it as easy to take with you as your wristwatch, and dependable under the severest listening conditions.

SINCLAIR GENERAL GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

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1T4	2/9	30C17	16/-	DY87	5/9	EM81	8/6	PCL800	15/6	UCH81	6/6
3S4	5/9	30C18	13/6	EABC80	6/6	EM84	6/9	PENA4	8/6	UCL82	7/-
3V4	6/3	30F5	16/-	EAF42	10/-	EM87	7/6	PFL200	11/9	UCL83	11/9
5Y3GT	5/9	30FL1	12/9	EB91	2/3	EY51	7/3	PL36	9/9	UF41	10/6
5Z4G	7/6	30FL12	14/6	EBC33	8/-	EY86	6/6	PL81	9/3	UF85	6/9
6/30L2	12/-	30FL14	14/6	EBC41	8/6	EZ40	8/-	PL82	6/6	UF89	6/9
6AL5	2/3	30L1	6/6	EBF80	6/9	EZ41	8/-	PL83	6/6	UL41	12/-
6AM6	2/9	30L15	13/-	EBF89	6/3	EZ80	4/6	PL84	6/6	UL44	20/-
6AQ5	4/6	30L17	15/6	ECC81	3/9	EZ81	4/9	PL500	13/-	UL84	7/-
6AT6	4/-	30P4	12/-	ECC82	4/9	GZ32	8/9	PL504	13/6	UM80	5/-
6AU6	4/6	30P12	13/9	ECC83	7/-	KT41	15/6	PL508	28/6	UM84	4/6
6BA6	4/6	30P19	12/-	ECC85	5/-	KT61	9/9	PM84	7/6	UY41	7/6
6BE6	4/9	30PL1	13/9	ECC804	12/-	KT66	16/9	PX25	23/6	UY85	5/9
6BJ6	8/6	30PL13	15/6	ECF80	6/6	LN329	14/6	PY32	10/-	VP4B	15/6
6C5G	4/9	30PL14	14/6	ECF82	6/6	N78	17/6	PY33	10/-	W77	3/6
6F13	3/6	35L6GT	8/9	ECH35	8/-	P61	10/-	PY81	5/3	W119	7/-
6F14	9/-	35W4	4/6	ECH42	13/6	PABC80	7/-	PY82	5/3	Z77	2/9
6F23	14/3	35Z4GT	5/-	ECH81	5/9	PC86	10/3	PY83	5/9	Transistors	
6F25	13/-	6063	12/6	ECH83	8/3	PC88	10/3	PY88	6/9	AC107	3/6
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6X4	4/3	CL33	18/6	EF41	11/9	PCC89	10/9	U47	13/6	AF127	3/6
6X5GT	5/9	CY31	6/6	EF80	4/6	PCC189	10/6	U49	13/6	OC26	5/-
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12AT7	3/9	DF33	7/9	EF91	2/9	PCF86	10/-	U251	14/6	OC72	2/6
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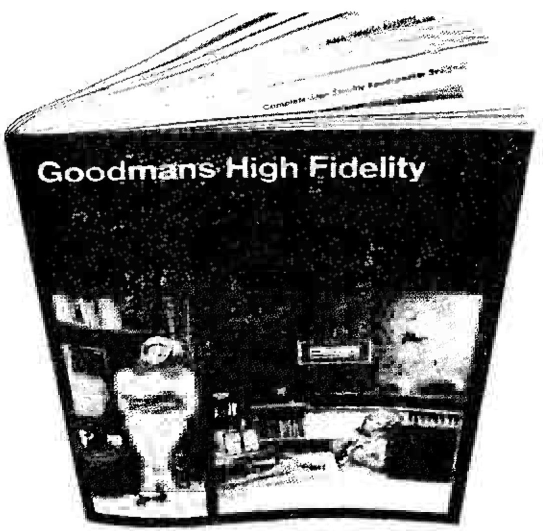

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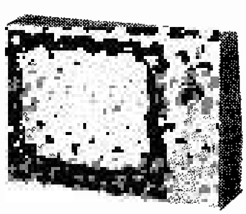

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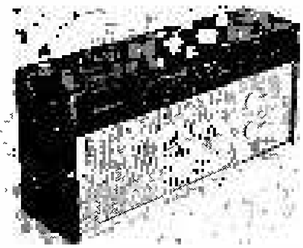

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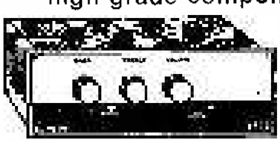

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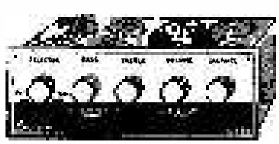

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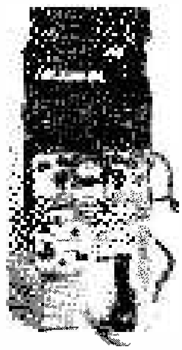

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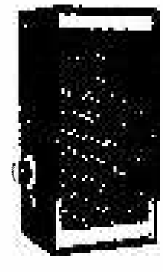

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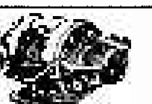

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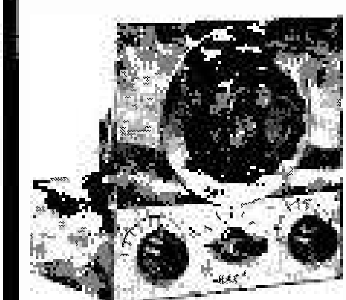

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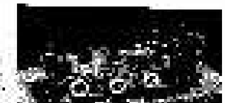

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EL360	23/-	PCC806	17/-	PY33	12/6	UCH21	11/-
EL803	17/-	PCE800	15/-	PY80	6/6	UCH42	13/-
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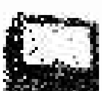

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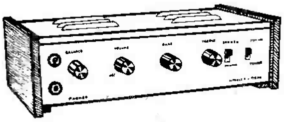

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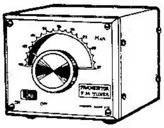

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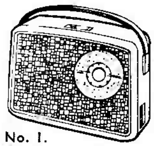

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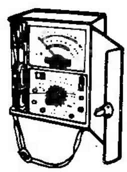

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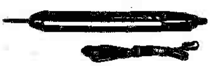

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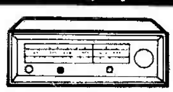

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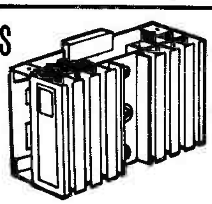

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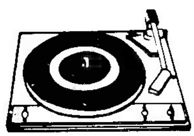

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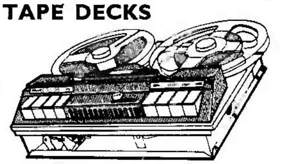

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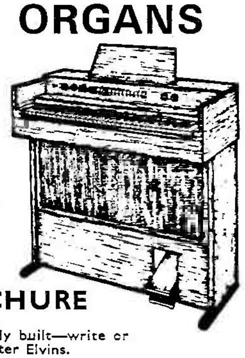

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