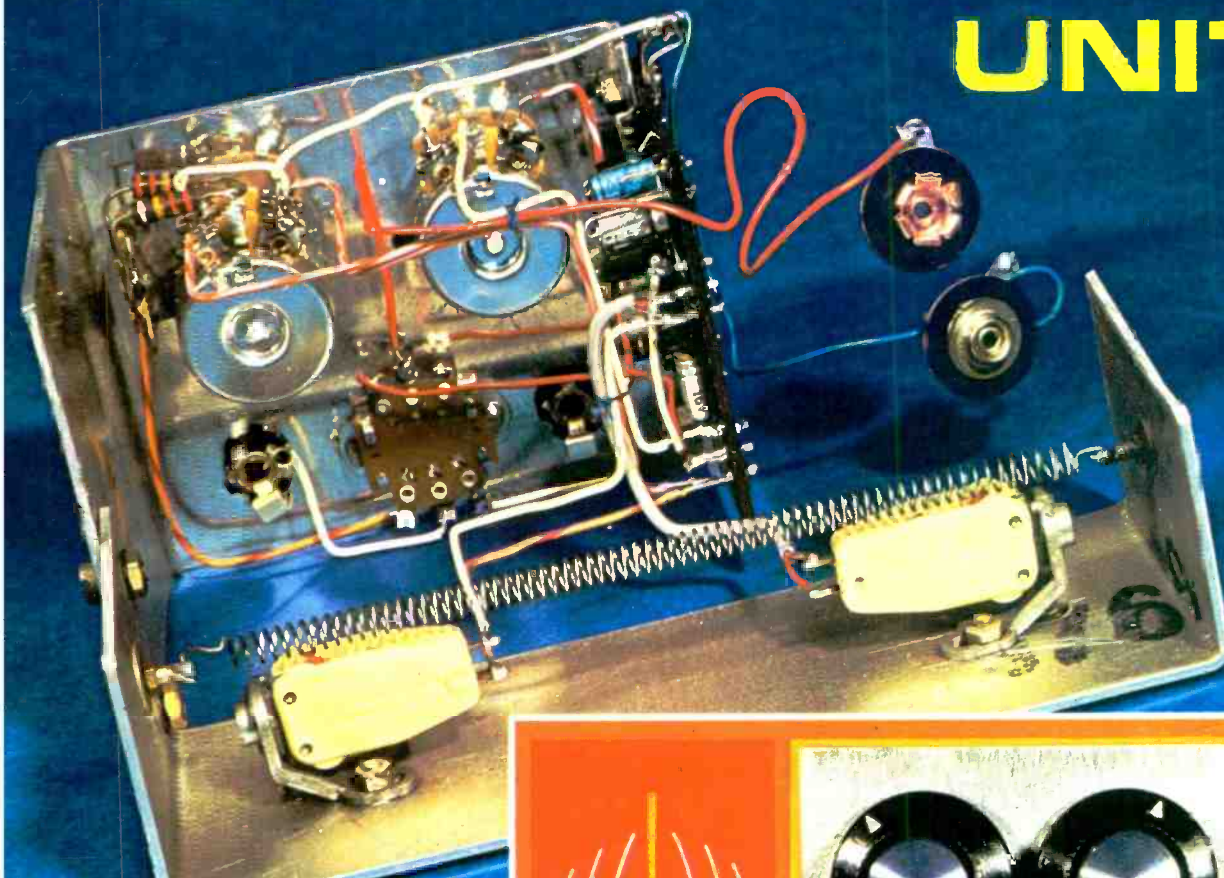
PRACTICAL WIRELESS

JULY 1970

3'6

REVERBERATION UNIT



also:-

LIGHT OPERATED SWITCH

NOVEL SIGNAL INJECTOR

Laskys

SCOOP Garrard 3000

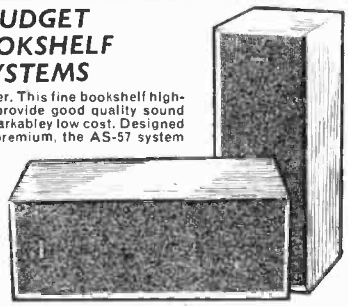
CUSTOM UNIT *BY FAMOUS BRITISH MANUFACTURER*

A deluxe custom styled and built record player unit made by world famous British manufacturer. The unit incorporates the renowned Garrard 3000 four speed autochanger with lightweight tubular pick-up arm **FITTED WITH SONOTONE 9TA STEREO CARTRIDGE with diamond stylus.** The beautifully made plinth is finished in richly figured teak veneer with tinted perspex panels in the lid and with attractive charcoal grey "mirror" insert panel on front. All metal trim parts are satin chrome. Blackleather grain underside. The lid allows the player to operate fully automatically when closed and has snap action "stay" when raised. Mains socket and 5 pin DIN audio output socket are at rear. Overall size 15¾ x 7¾ x 14in.

LASKY'S SPECIAL PRICE £16.15.0 Post 15/-

SONICS AS-57

ELEGANT BUDGET PRICED BOOKSHELF SPEAKER SYSTEMS



The AS-57 is a real space saver. This fine bookshelf high-fidelity speaker system will provide good quality sound anywhere in your home at remarkabley low cost. Designed for use where space is at a premium, the AS-57 system is ideal for the small apartment or isolated area. The special high efficiency 5 x 7in. full range speaker has a frequency range of 70–18,000 Hz with a peak handling capacity of 10 watts. Imp. 8 ohms. Finish: oiled walnut. Size: 5⅞ x 15⅜ x 8¼in.

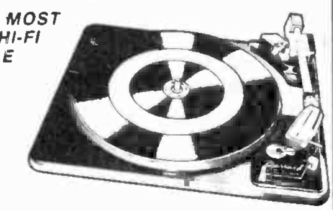
LASKY'S PRICE **£15 per PAIR** Post 10/-

Garrard

SP.25 Mk II

FROM STOCK

THE U.K.'s MOST POPULAR HI-FI TURNTABLE



4-speed single record playing deck features include: heavy precision-built turntable, pick-up arm bias compensation, calibrated stylus-force adjustment, cueing device. After play, the arm automatically rises, returns to rest and switches off motor. Finish: dark green polychromatic and silver.

LASKY'S PRICE **£11.19.6**

SP.25 Mk.11 with A.D.76K Stereo Magnetic Cartridge £15.10.0

OTHER GARRARD UNITS FROM STOCK

AUTOCHANGERS

SL72B	£25 0 0	SL65B	£15 19 6
2025TC with stereo cartridge	£8 17 6	1025 with stereo cartridge	£6 19 6
3000 complete with 9TAHC stereo cartridge	£9 19 6	SL95B	£40 0 0
		SL75B	£32 0 0

SINGLE PLAYERS

AP 75, £18.10.0 AP75 with AD76K mag. cart., £21.10.0. 401 Transcription Unit. £28.0.0

BASES AND COVERS FOR GARRARD UNITS

Type WB1 and WB5 for models 2025TC.3000, SL65B 1025, SP25 Mk II Price WB1 £3.16.6. WB5 £5.12.6. Type WB4 for models SL72B, SL75B, SL95B Price £5.12.6. Perspex covers: SPC1 for WB1, £3.14.1. SPC4 for WB4 and WB5 (allows unit to be played with the cover in place)—price £4.8.0.

PACKAGE DEALS

AP75 complete with AD76K Stereo magnetic cartridge, teak plinth and perspex cover	£30.0.0	Post 10/-
SP25 Mk II complete with AD76K cartridge, teak plinth and perspex cover	£19.0.0	Post 7/6
1025 complete with J2105 stereo ceramic cart., teak plinth and perspex cover	£11.19.6	Post 7/6

Post on Garrard units 6/- extra—except AP75, SL75B, SL95B and 401 7/6 extra. Post on bases and covers 5/- extra.

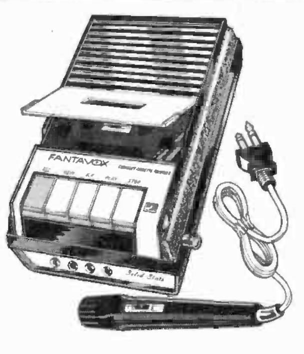
SPECIAL OFFER—BSR-UA-15

4 speed autochangers with modified tubular tone arm. Comp. with stereo cart. £6.19.6. Post 5/-.

FANTAVOX

TPC-2

SOLID STATE COMPACT CASSETTE RECORDER



A Lasky's STAR BARGAIN this beautifully made compact cassette recorder and play back machine offers tremendous performance and value. BRIEF SPEC: 6 transistor and 1 thermister circuit. Constant speed capstan drive system. A.C. bias recording. PM magnet erase. 2½in PM Dynamic speaker. Economical operation on 4 x 1.5V (U-2 type) batteries. SPECIAL FEATURES: Absolutely foolproof operation. Piano key controls. Powerful volume with recessed control. Handsome impact resistant cabinet finished in black with satin aluminium and ivory trim. Size 9½ x 5⅜ x 2⅜. Jack sockets for remote control microphone, earpiece and external 6V battery pack (or A.C. adaptor). COMPLETE WITH Remote control Dynamic microphone, earpiece removable carrying strap, batteries, full instructions and three C-60 cassettes

LASKY'S PRICE **£17.10.0** Post 5/-

Audio Tronics 70

The 1970 edition of Lasky's famous Audio-Tronics catalogue is available FREE on request. The 28 tabloid pages many in full colour are packed with 1000's of items from the largest stocks in Great Britian of everything for the Radio and Hi-Fi enthusiast, Electronics Hobbyist, Servicemen and Communications Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories **plus Lasky's amazing money saving vouchers worth over £25.**

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AT LASKY'S BUDGET PRICES

		5 for	10 for
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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R+TV

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Also at 323 Edgware Road, London, W.2.
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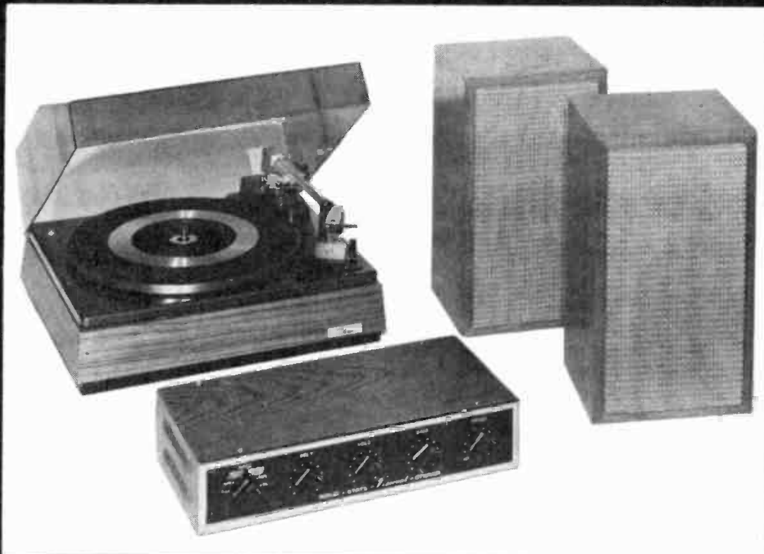
Terms C.W.O. All enquiries S.A.E.

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. 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 6¾in, the Duo type 2 speakers are beautifully finished in teak veneer with matching vynair grills. They incorporate a 10½in x 6¼in 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.

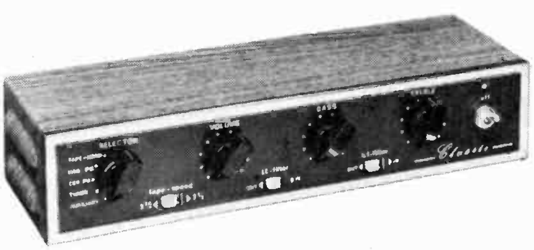
Specification—Output per channel 10 watts r.m.s. Frequency bandwidth 20 Hz to 20 kHz + 1db at 1 watt. Total distortion at 1 kHz at 9 watts 0.5% Input sensitivities CER. P.U. 100mV into 3 meg ohms. Tuner 100mV into 100K ohms. Tape 100mV into 100K ohms. Overload Factor Better than 26db.

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) + 12db at 10 KHz.

Tape recording output sockets on each channel. Size 12½in × 6in × 2¾in. in teak-finished case. BUILT & TESTED.

MkII (MAG P.U.) **£15.15** plus 10/- p. & p.

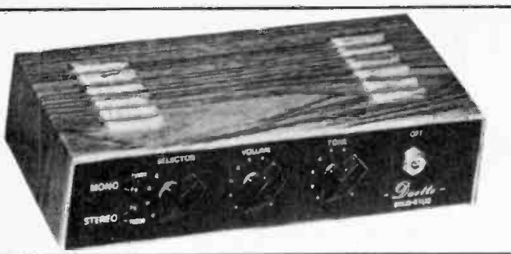
Specification same as Mk I, but with the following inputs. Mag. P.U. CER. P.U. Tuner. Spec. on Mag. P.U. 3mV at 1kHz input impedance 47K. Fully equalised to within ±1db RIAA. Signal to noise ratio—65db (vol. max)



The Classic **£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 3¾i.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 12¼in long, 4½in deep, 2¾in high. Teak finished case.



Duetto Integrated Transistor Stereo Amplifier £9.10 plus 7/6 p. & p.

The Duetto is a good quality 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.

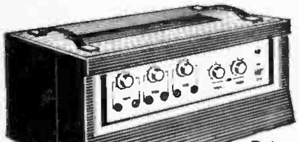
THE DUO SPEAKER SYSTEM

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 5¾in. 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—10½in x 4¾in x 2¾in. 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)

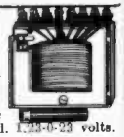
7 transistor fully-tunable M.W.—L.W. superhet portable Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.
MAINS POWER PACK KIT: 9/6 extra.
Price £5.5.0 plus 7/6 P. & P.
Circuit 2/6 FREE WITH PARTS

The DORSET (600mW Output)

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

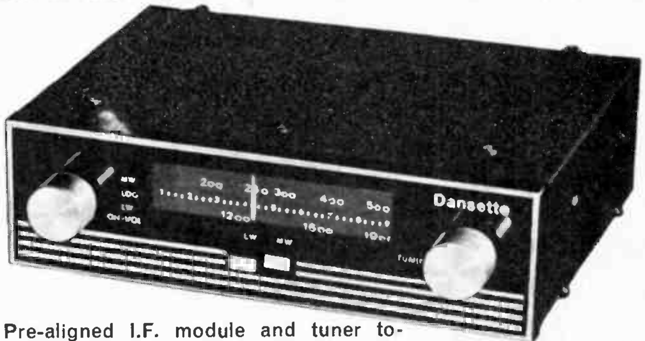
7-transistor fully tunable M.W.—L.W. superhet portable with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in.
MAINS POWER PACK KIT: 9/6 extra

QUALITY MAINS TRANSFORMER



Input 250 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 ensures 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.

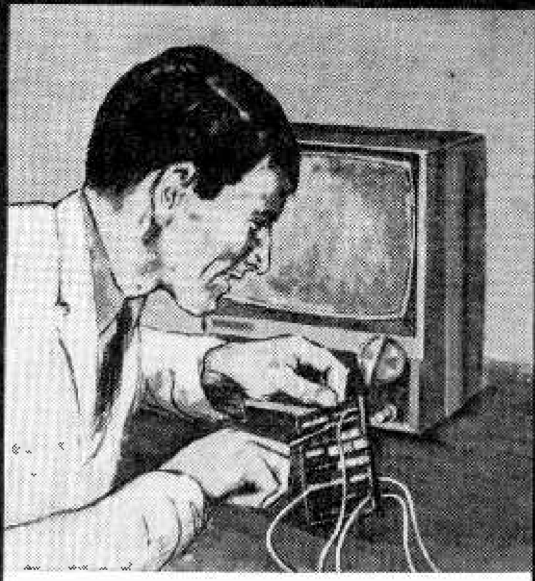
Originally sold complete for £15.4.6.

SET OF PARTS £6.6.0 plus 7/6 P. & P.

Speaker, baffle and fixing kit 25/- extra plus 4/- P. & P.

See top of previous page for address

RADIO & TV COMPONENTS R+TV (ACTON) LIMITED



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Please send, without obligation, details of the Full-time Course in Radio, Television and Electronics.

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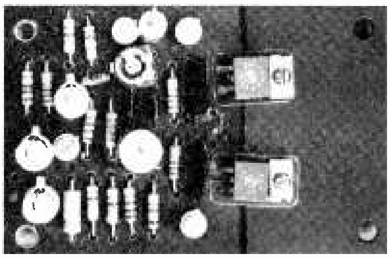
SOUND EQUIPMENT

PRESENT THE LATEST MODULE

THE 6T2 — 20 WATTS (RMS)

AMPLIFIER WITH INTEGRAL PRE-AMP.



This amazing unit measures only 3¾" x 2¼" yet will deliver up to 25 Watts speech and music from a circuit using the latest R.C.A. plastic output transistors

- CONTINUOUS POWER 20 WATTS INTO 4 OHMS, 16 WATTS INTO 8 OHMS
- 10–30,000 Ht @ 10 WATTS ± 1dB
- LESS THAN 0.25% DISTORTION @ 100mW & 15W
- POWER GAIN 80dB INPUT 40mV into 10 Kilohms

ABSOLUTE SATISFACTION GUARANTEED

86/- + 2/6 p. & p. 35VOLT SUPPLY FOR TWO 6T2 MODULES 86/- + 4/6 p. & p.

ALSO !! FIVE ENCAPSULATED CIRCUITS AT LESS THAN £1 EACH !

BRAND NEW FULLY GUARANTEED AND TESTED MODULES

POWER AMPLIFIER MODULE 19/6

Type 3TI

Ideal for intercoms, baby alarms, record-players, etc. 9-12V operation.

500mW maximum output, 200mW for less than 5% distortion. Power gain 50dB. Input 40mV into 400 ohms. 3·15 ohms load. Frequency response 35-45,000Hz ±2dB.

ORGAN MODULE 17/6

Type 3TN

Will make the ideal basis for either monophonic or polyphonic organs. Can be used as a divider, locking in to the correct frequency. Will drive a loudspeaker or can be fed into tone circuits, amplifiers, etc.

Frequency range 30-6000Hz. Power into 80 ohms loudspeaker 100mW, 9V operation.

MULTI-PURPOSE PRE-AMPLIFIER 19/6

Type 3TO

For use with the 3TI, or as an impedance matcher, high gain pre amp, headphone amplifier, etc. It may be used as an oscillator or high fidelity preamplifier using the requisite feedback loops.

Input impedance and gain fully variable up to 500 kilohms and 40dB. Output impedance 300 ohms. Will deliver 30mW into 15 ohms. Frequency response 20-35,000Hz ±2dB. Supply voltage 6-24V. Noise level — 60dB.

DUAL-VOLTAGE PRE-AMPLIFIER 17/6

Type ITO

For increasing the input sensitivity of low gain valve or transistor amplifiers. A high smoothing factor makes operation direct from H.T. lines possible.

Gain 20-26dB. Input impedance 50 kilohms. Frequency response 30-45,000Hz ±2dB. Supply voltages 9-24 and 200-500.

TACHOMETER MODULE 18/9

Type 2TN

For 4 or 6 cylinder, 6 or 12V positive or negative earth vehicles. Will operate 200 microamp to 1mA meters on 12V and 200-500 microamp meters on 6V. Suitable meters from 57/6. This module will provide linear readings up to 10,000 r.p.m. if your car can provide the signal!

Please send S.A.E. with enquiries. We welcome your problems!!

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STEREO AMPLIFIERS

	Rec. Retail Price	Comet Price
ARENA 210 Amplifier	£34 13 0	£28 0 0
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	£53 19 6
LEAK Stereo 70 in teak case	£71 10 0	£57 19 6
LINEAR LT.66	£18 18 0	£15 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
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	£48 19 6
ROGERS Ravensbourne (cased)	£64 0 0	£52 13 6
ROGERS Ravensbrook	£44 0 0	£36 19 6
ROGERS Ravensbrook (cased)	£49 0 0	£38 19 6
SINCLAIR 2000	£30 9 0	£24 19 6
TELETON 203E	£28 7 6	£21 15 6
TRUVOX TSA, 200	£54 12 0	£35 19 6

TUNERS

	Rec. Retail Price	Comet Price
ARENA F211 with decoder	£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 Troughline with MPX	£51 10 6	£39 19 6
LEAK Stereofetic Chassis	£59 18 0	£51 19 6
LEAK Stereofetic in teak case	£67 3 6	£57 10 0
PHILIPS RH 690	£39 0 0	£33 2 6
QUAD Stereo FM	£51 0 0	£39 19 6
ROGERS Ravensbourne Tuner with Decoder	£61 17 9	£52 12 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 with decoder	£60 11 10	£39 19 6

TUNER/AMPLIFIERS

	Rec. Retail Price	Comet Price
ARENA 2400 with MPX	£90 6 0	£71 19 6
ARENA 2600 Stereo AM/FM with MPX	£111 6 0	£94 0 0
ARENA 2700 Stereo with MPX	£105 0 0	£85 0 0
ARENA T1500F with MPX	£72 9 0	£59 19 6
ARENA T9000 with MPX	£303 9 0	£258 0 0
ARMSTRONG 525	£87 16 9	£66 19 6
ARMSTRONG 526	£98 15 6	£79 19 6
ARMSTRONG 127	£43 19 9	£37 19 6
(Teak Case for 127)	£3 17 0	£3 10 0
GOODMANS 3000	£77 14 7	£66 19 6
PHILIPS RH781	£74 19 6	£63 14 6
PHILIPS RH790	£125 0 0	£106 4 6
PHILIPS RH691	£83 0 0	£70 10 6
TANDBERG SolvSuper	£75 18 0	£55 19 6
TELETON F.2000 with MPX	£51 0 0	£37 19 6
TELETON 7ATI with MPX	£133 0 0	£85 0 0
TELETON R4200 with MPX	£51 15 0	£42 19 6
TELETON CR/10T with MPX	£39 0 0	£29 19 6

CARTRIDGES

	Rec. Retail Price	Comet Price
GOLDRING 800 Cartridge	£13 0 0	£10 7 6
GOLDRING 800H	£10 13 9	£8 10 6
GOLDRING 800E	£18 17 1	£15 0 0
GOLDRING 800 Super E	£26 0 1	£20 15 0
GOLDRING CS90 Stereo	£5 4 0	£4 3 0
GOLDRING CS91/E	£7 16 1	£6 4 6
GOLDRING G850	£6 10 0	£5 10 0
PICKERING V15 AC2	£8 8 0	£6 19 6
ORTOFON SL15E / ORTOFON 2X 15K	£29 12 11	£23 12 11
Transformer	£7 0 0	£5 5 4
SHURE M3DM	£7 8 3	£6 8 3
SHURE N3D	£5 11 2	£4 8 8
SHURE M31E	£12 0 11	£9 9 0
SHURE N31E	£9 5 3	£7 8 6
SHURE M32E	£11 2 4	£8 15 0
SHURE N32E	£8 6 9	£6 13 0
SHURE M32-3	£10 3 10	£7 19 6
SHURE N32-3	£6 9 8	£5 3 6
SHURE M44-5	£11 2 4	£8 17 6
SHURE N44-5	£7 8 3	£6 8 3
SHURE M44-7	£10 3 10	£8 5 0
SHURE N44-7	£6 9 8	£5 3 6
SHURE M44-C	£10 3 10	£8 5 0
SHURE N44-C	£6 9 8	£5 3 6
SHURE M44E	£12 0 11	£9 19 6
SHURE N44E	£10 3 10	£8 5 0
SHURE M55E	£12 19 5	£10 19 6
SHURE N55E	£11 2 4	£8 17 6
SHURE M75G	£17 12 1	£14 0 0
SHURE N75G	£9 5 3	£8 17 6
SHURE M75-6	£16 13 6	£13 6 0
SHURE N75-6	£8 6 9	£6 13 0
SHURE M75EJ	£19 9 1	£16 10 0
SHURE N75EJ	£11 2 4	£8 17 6
SHURE M75E-95G	£23 3 3	£17 19 6
SHURE N75E	£12 19 5	£10 6 6
SHURE V15-11	£40 15 3	£32 19 6
SHURE VN15E	£16 13 6	£14 13 6
SHURE V15-11-7	£38 18 3	£31 0 0
SHURE VN7	£14 16 6	£11 16 6
SHURE M75E	£21 6 2	£17 19 6
SHURE M75E/D19	£23 3 3	£18 19 6

TURNTABLES

	Rec. Retail Price	Comet Price
ARENA SP25 with base, cover	£22 1 0	£17 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	£19 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	£28 19 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	£19 19 6	£16 19 6
PHILIPS GA146	£29 19 6	£24 19 6
PHILIPS 217	£32 0 9	£27 4 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	£81 5 6
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
DULCI AS 3	£8 8 0	£6 19 6
GOODMANS Majesta	£57 0 0	£48 19 6
GOODMANS Maxim	£20 7 9	£15 19 6
GOODMANS Mezzo II	£30 18 0	£23 19 6
GOODMANS Magnum-K	£40 2 0	£29 19 6
GOODMANS Marimba	£24 0 1	£19 19 6
GOODMANS Mambo	£22 5 6	£18 11 9
GOODMANS 3005 (pair)	£25 0 0	£21 0 0
KEF Celeste	£29 0 0	£22 10 0
KEF Concord	£43 10 0	£33 19 6
LEAK Sandwich	£45 10 0	£36 19 6
LEAK Mini-Sandwich	£29 15 0	£23 19 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 18 6

	Rec. Retail Price	Comet Price
WHARFEDALE Speakers		
Airedale	£69 10 0	£57 14 0
Denton	£19 0 0	£14 19 6
Super Linton	£22 10 0	£18 19 6
Melton	£29 10 0	£23 19 6
Dovedale 3	£39 10 0	£29 19 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

HI-FI STEREO TAPE DECKS AND TAPE RECORDERS

	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	£89 19 6
AKAI 1800	£158 0 0	£133 0 0
AKAI 1800SD	£199 0 0	£167 0 0
AKAI 4000 D deck	£89 19 1	£71 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 6	£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	£51 19 6
TELETON FXB 570D Stereo	£52 10 0	£43 19 6
TRUVOX PD 102 Stereo Tape Recorder	£114 15 3	£79 0 0

PICKUP ARMS

	Rec. Retail Price	Comet Price
GOLDRING Lenco L75	£12 6 6	£10 10 0
GOLDRING Lenco G65	£7 13 6	£6 4 6
SME 3009 with S2 shell	£31 6 3	£24 19 6
SME 3012 with S2 shell	£33 7 3	£26 19 6

COMET Hi-Fi DISCOUNT WAREHOUSES

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Comprehensive Hi-Fi Catalogue available 5/-

COMPLETE STEREO SYSTEM

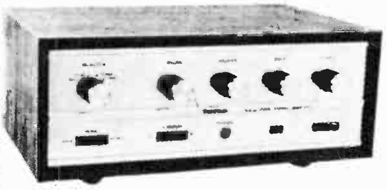
FOR ONLY 39 GNS

CARRIAGE 35/-

PREMIER STEREO SYSTEM "ONE" Consists of an all transistor stereo amplifier. Garrard 2025 T/C auto manual record player unit fitted stereo mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble. Volume, Balance, Selector. Power on off, stereo mono switch. Brushed aluminium front panel Black metal case with teakwood ends: Size 12 × 5¼ × 3¼in. high (Amplifier available separately if required £14.19.6. Carr. 7/6.)

PREMIER STEREO SYSTEM "TWO"
As system 'ONE' above but with Garrard SP25.
PREMIER PRICE 45 Gns. Carr. 35/-

TELETON SAQ203E STEREO AMPLIFIER



A small but powerful amplifier designed for stereo hi-fi reproduction. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble, Stereo/Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price £28.7.0

PREMIER PRICE 22 Gns. P. & P. 10/-

PREMIER STEREO SYSTEM "FOUR"

Teleton SAQ203E Amplifier (as above)	£23.2.0
Garrard SP25	£11.19.6
Shure M3D	£6.19.6
Teak base and cover	£5.10.0
Pair of Hi-Fi Enclosures fitted E.M.I. Speakers	£26.5.0
Total cost if purchased separately	£73.16.0

PREMIER PRICE 65 Gns. Carr. 35/-

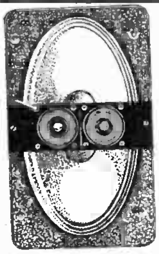
VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 2in. suitable for crystal microphone low impedance microphone, with transformer, radio, tape, etc. Max. input 1·5v. Max. output 2·5v. Gain 6 dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

MONO MODEL 59/6 STEREO MODEL 69/6 P. & P. 2/6.

WIDE RANGE OF HI-FI STEREO EQUIPMENT ON DEMONSTRATION

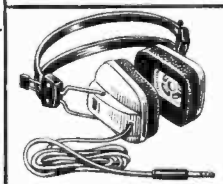
All leading makes available including Rogers, Armstrong, Nikko, Wharfedale, Goodmans, Goldring, Shure, etc. etc.



E.M.I. 13×8ins. HI-FI SPEAKERS

Fitted two 2½in. tweeters and crossover network. Impedance 15 ohms. Handling capacity 10 watts. Brand new.

79/6 P. & P. 7/6



HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2½in speaker units with soft padded car muffs. Adjustable headband. 8 ohms impedance. Complete with 6ft lead and stereo jack plug.

49/6 P. & P. 5/-.

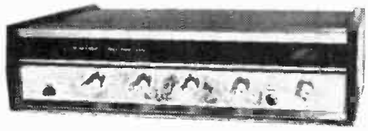
WELLER "E&PERT" SOLDER GUN. Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat. 100/140 watt. 240 volt A.C. 67/6 P. & P. 2/-.

VERITAS V-313 TAPE HEAD DEFLUXER

A must for all tape users! Tape heads become permanently magnetized with constant use: this leads to background noise that prevents perfect recordings. Simply applied to recording head the V313 leaves head free of magnetism. Cleans any tape head in seconds.

34/6 P. & P. 1/6.

"NOVA" 505 STEREO AMPLIFIER



A superb stereo amplifier offering every facility for the hi-fi enthusiast. Output 5 watts per channel. Frequency response 40-20,000 Hz ± 3dB. Inputs for radio, P.U. Ceramic, P.U. Magnetic Tape. Separate bass and treble controls. Volume and Balance controls. Mono Stereo Switch. Also features headphone socket and tape output. Teak case with attractive illuminated front panel. Size 14½ × 9½ × 3¼in. A.C. 200/250V.

PREMIER PRICE 18 Gns. Carr. 10/-

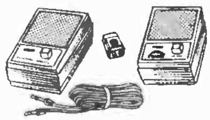
PREMIER STEREO SYSTEM "THREE"

Nova 505 Amplifier (as above)	£18.18.0
Garrard SP25	£11.19.6
Sonotone 9TAHCD	£2.15.0
Teak base and cover	£5.10.0
Pair of Hi-Fi Enclosures fitted E.M.I. Speakers	£26.5.0
Total cost if purchased separately	£65.7.6

PREMIER PRICE 55 Gns. Carr. 35/-

TWO STATION TRANSISTOR INTERCOMS.

Complete with battery and 50ft. connecting wire. Compact size, two way call system. Ideal for home office, factory, etc.



65/- P. & P. 4/-.

TAPE CASSETTES

C60 (60 min.) 7/6 THREE FOR 21/-
C90 (90 min.) 12/6 THREE FOR 36/-
C120 (120 min.) 17/6 THREE FOR 51/-
P. & P. 1/-.

CASSETTE HEAD CLEANER

Removes unwanted deposits from delicate tape heads. Fits all cassette recorders.

11/6 P. & P. 1/-.

All cassettes can be supplied with library cases at 6d extra each

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED. TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped–attractively boxed.

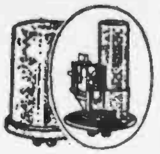
LP3	3"	250'	P.V.C.	5/6
TT3	3"	450'	POLYESTER	7/6
DT3	3¼"	600'	POLYESTER	11/6
SP5	5"	600'	P.V.C.	8/6
LP5	5"	900'	P.V.C.	10/-
DT5	5"	1200'	POLYESTER	15/-
LP6	5¾"	1200'	P.V.C.	12/6
DT6	5¾"	1800'	POLYESTER	22/6
TT6	5¾"	2400'	POLYESTER	37/6
SP7	7"	1200'	P.V.C.	12/6
LP7	7"	1800'	P.V.C.	15/-
DT7	7"	2400'	POLYESTER	25/-
TT7	7"	3600'	POLYESTER	50/-

TAPE SPOOLS 3" 1/-, 5", 5¾", 7" 1/9,
Post and Packing 3" 1/-, 5", 5¾", 1/6, 7" 2/-. (3 reels and over Post Free).

PREMIER RADIO

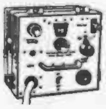
23, TOTTENHAM COURT ROAD, LONDON, W.1 Tel: 01-636 3451

CAR LIGHT FLASHERS



Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset). Housed in strong plastic case. Flashing rate between 60-120 per minute. 12V DC operation. Maximum load 6 amps. Size 2-11/16in. dia. x 4in. Supplied brand new at a fraction of original cost. 6/6 each. P. P. 2/6. (3 for 17/6. P. P. 4/6).

CLASS D WAVEMETERS



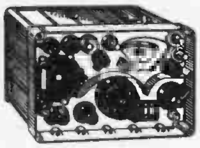
A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.19.6. Carr. 7/6. Or brand new with accessories. £7.19.6. Carr. 7/6.

CLASS D WAVEMETERS No. 2

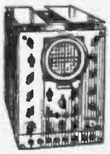
Crystal controlled. 1·2-19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. £12.10.0. Carr. 30/–.

R209 MK II COMMUNICATION RECEIVER

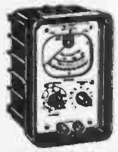
11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, B.F.O., aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked £15.0.0. Carr. 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. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/–.



MARCONI T/44/TF956

AF Absorption Wattmeter

1 µ/watt to 6 watts.

£20. Carr. 10/–.

SOLARTRON CD 711S2

Double Beam Oscilloscopes

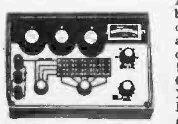
D.C. to 9 Mc/s. Perfect order £65. Carr. 50/–

(Few available less C.R.T.) £25 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



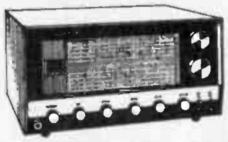
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω–11·1 meg Ω 6 Ranges ±1% L.1 µ H - 111 HENRYS 6 Ranges – 2% C. 10pF – 1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication.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



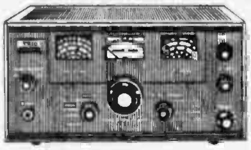
5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s–400 Kc/s and 550 Kc/s–30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8½in. Weight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

UR-1A SOLID STATE COMMUNICATION RECEIVER

4 bands covering 550 Kc/s—30 mc/s continuous. Special features are use of FET transistors. S meter, built in speaker and telescopic aerial, variable BFO for SSB reception, noise limiter, bandspread control, sensitivity control. Output for low impedance headphones. Operation 220/240 volt A.C. or 12 volt D.C. Size 12½in. × 4½in. × 7in. Excellent value. ONLY £24. Carr. 7/6.



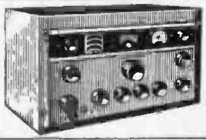
TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

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. £180 IN STOCK!

RCA COMMUNICATIONS RECEIVERS AR88D

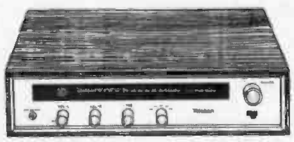


Latest release by ministry BRAND NEW in original cases. 110-250v. A.C. operation. Frequency in 6 Bands. 535 Kc/s—32 Mc/s continuous. Output impedance 2·5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price £65.0.0. Carr. £2.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

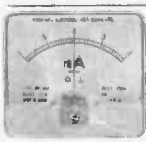
A completely new transistorised receiver covering 152–174 Mc/s. Fully tunable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone 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 outpnt. 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 21/32in. square fronts.

- 50µA 40/–
- 50-0-50µA 37/6
- 100µA 37/6
- 100-0100µA 35/–
- 200µA 35/–
- 500µA 40/–

- .500-0-500µA 27/6
- 1mA 27/6
- 1-0-1mA 27/6
- 2mA 27/6
- 5mA 27/6
- 10mA 27/6
- 750mA 27/6
- 1 amp 27/6
- 2 amp 27/6
- 5 amp 27/6
- 20mA 27/6

- 50mA 27/6
- 100mA 27/6
- 150mA 27/6
- 200mA 27/6
- 300mA 27/6
- 500mA 27/6
- 3V. D.C. 27/6
- 10V. D.C. 27/6
- 20V. D.C. 27/6
- 100V. D.C. 27/6

- 150V. D.C. ... 27/6
- 300V. D.C. ... 27/6
- 500V. D.C. ... 27/6
- 750V. D.C. ... 27/6
- 15V. A.C. ... 27/6
- 50V. A.C. ... 27/6
- 150V. A.C. ... 27/6
- 300V. A.C. ... 27/6
- 500V. A.C. ... 27/6
- S meter 1mA 32/–
- VU meter .. 42/–

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

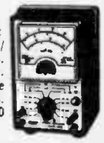
Variable Voltage TRANSFORMERS

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. Outpnt 500 Ω or 5k Ω. Operation 200/250V. A.C. Supplied in perfect order. £12.10.0 Carr. 10/–.

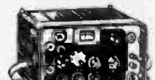
TE-65 VALVE VOLTMETER

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.35/-.H.V.42/6.

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.

PLESSEY SL.403A 3 watt Integrated Amplifier Circuit 49/6. Post 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. 5¼ × 5¼ × 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.

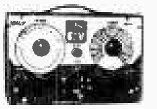
AUTO TRANSFORMERS

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

- 150 W. £2. 2.6. P. & P. 3/6.
- 300 W. £2.19.6. 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/–.

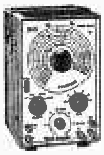
G. W. SMITH & CO (RADIO) LTD.
Also see oppos. page

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 3.8V. 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-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s–500 Mc/s on 6 bands. Directly calibrated Variable R.F attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. **£15.** Carr. 7/6. Size 140 × 215 × 170 mm.

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

TY75 AUDIO SIGNAL GENERATOR

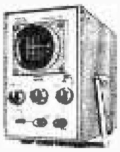
Sine Wave 20c/s to 200 kc/s. Square Wave 20c/s to 30kc/s. High and low impedance output. Output variable up to 6 volts 220/240 volts A.C. Size 210 × 150 × 120 mm. Brand new with instructions. **£16.** Carr. 7/6.

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 megohms. 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 × 180 × 230mm. Weight 8lb. 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.**

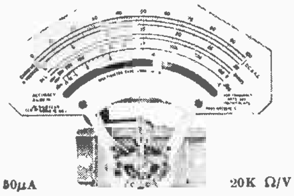
TT1S. TRANSISTOR TESTER. Full range of facilities for testing PNP or NPN transistors in or out of circuit. **£37.10.0.**

Carriage 10/– per item.

HOSIDEN DHO4S 2-WAY STEREO HEADSETS

Each headphone contains a 2½in. woofer and a ⅝in. 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.

AVOMETER MOVEMENTS



50μA 20K Ω/V

Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multimeter. Brand New & Boxed. **69/6.** P. & P. 3/6.

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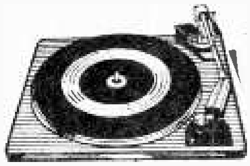
SL65B	£14.19.6	401	£25.0.0



Carriage 7/6 extra each item.

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Garrard SP25 fitted Goldring G800 cartridge and wooden plinth. Total list price £32.8.5.

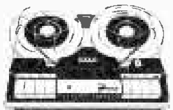
OUR PRICE **£19.15.0** Carr. 10/-

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

Total list price £50.16.0.

OUR PRICE **£39** Carr. 20/-

RTC249 4-TRACK TAPE DECK

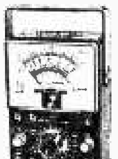


British Made Speeds 1⅞", 3¾", 7½" P.S. Marriott Heads. 7" reel size. Push Button controls, fully interlocking. Size 13" + 10" + 1¼" above unit plate, 4½" below. Full instructions. **£13.19.6** Carr. 7/6

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/-.

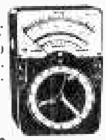


MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v D.C. 0/6/30/120/300/600v A.C. 0/10μA/6/60/300 mA/12 amp. 0/2K/200K/2M/200M Ω. –20 to + 17dB. **£12.10.0.** P. & P. 3/6.

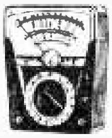
LAFEYETTE 57 Range Super 50k Ω/volt Multimeter' D.C. volts 12 mV – 1000V. A.C. volts 1.5V – 1000V. D.C. current 25μA–10 amp. Ohms 0–10 meg Ω dB – 20 to + 81 dB. Overload protection. **£12.10.0.** Carr. 3/6.

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/-

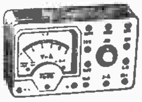
MODEL TE-80. 20,000 O.P.V. 0/10/50/100/500/1,000v A.C. 0/5/25/50/250/500/1,000 v. D.C. 0–50μA, 5/50/500mA. 0/6K/60K/600K/6meg. **£4.17.6.** P. & P. 3/-.



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/160 K/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.

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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

Operative over amazingly long distances. Separate call and press to talk buttons. 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets.

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Z30 Amplifier	89/6
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SPECIAL PACKAGE OFFER !

2 × Z30 Amplifiers. Stereo 60 and PZ5 Power Supply **£19.** Carr. 7/6 or with 2 × Q16 Speakers **£35** Carr. 7/6

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Micromatic Radio Built	59/6
SINCLAIR IC/10 IN STOCK	59/6
2000 Amplifier	£23.10.0 Carr. 7/6
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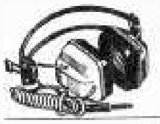
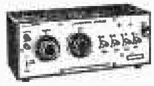
ECHO HS-606 STEREO HEADPHONES



Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25–17,000 cps. 8 ohm imp. **67/6** P. & P. 2/6.

TE111. DECADE RESISTANCE ATTENUATOR



Variable range 0–111dB. Connections. Unbalanced T and Bridge T. Impedance 600 Ω range (0.1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (–3dB). Accuracy: 0.05dB + Indication dB × 0.01. Maximum input less than 4W (50V). Built in 600 Ω load resistance with internal/external switch. Brand new **£27.10.0.** P. & P. 5/–.

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Post extra.

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First grade quality American tapes. Brand new. Discount on quantities.

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5in. 1,200ft. D.P. mylar	15/–
5¾in. 1,200ft. L.P. acetate	12/6
5¾in. 1,200ft. L.P. mylar	16/–
5¾in. 1,800ft. D.P. mylar	22/6
5¾in. 2,400ft. T.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/–
7in. 1,800ft. L.P. mylar	20/–
7in. 2,400ft. D.P. mylar	25/–
7in. 3,600ft. T.P. mylar	45/–

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Top quality in plastic library boxes.
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1H5 7/-	6BW6 14/6	6K8M 11/6	10F1 14/9	25Z4 6/3	801 9/6	DK92 9/-	ECH81 5/9	EZ40 9/-	PCF84 8/-	R19 7/9	UF89 7/6
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3Q4 7/9	6CW4 13/6	6Q7GT 8/6	12AT6 4/9	30F5 17/-	4022AR 67/-	DM70 6/-	EF37A 7/-	HN309 20/-	PCL83 10/3	SU25 19/6	UY21 9/6
3Q5 7/-	6D6 3/9	6SA7M 7/-	12AT7 6/-	30FLI 15/-	5763 12/-	DY86 6/-	EF39 8/-	KT36 18/-	PCL84 8/6	SU2150 12/6	UY41 8/6
3S4 6/3	6E5 7/6	6SC7 7/-	12AU6 5/9	30FL12 19/-	7193 2/-	DY87 6/6	EF41 10/-	KT61 22/6	PCL85 9/3	T41 17/6	UY85 6/6
3V4 6/9	6F1 12/6	6SG7 6/-	12AU7 5/9	30FL14 15/6	7475 14/-	E88CC 12/-	EF50 5/-	KT66 30/-	PCL86 9/3	TDD4 8/6	VMP4G 17/-
5R4GY 10/6	6F5G 8/-	6SH7 3/3	12AX7 6/3	30L15 17/-	A61 9/6	EA50 3/6	EF80 4/6	KT81 35/-	PD500 29/-	U10 7/6	VP4B 25/-
5U4G 5/6	6F6G 5/-	6SJ7 6/-	12BA6 6/-	30L17 17/-	ATP4 2/3	EABC80 6/6	EF85 7/-	KT81 (7C5)	PENA4 20/-	U14 7/6	VR105/30 6/6
5V4G 8/-	6F8G 5/6	6SK7GT 4/9	12BE6 6/3	30P4 22/6	ATP5 12/-	EAF42 10/-	EF86 6/6	22/6	PENB4 20/-	U19 35/-	VR150/30 6/-
5Y3GT 6/-	6F11 6/6	6SL7GT 6/-	12C8GT 5/-	30P12 16/-	ATP7 8/6	EB41 10/-	EF89 5/6	KT88 34/-	PEN45 7/-	U25 15/6	VT25 15/-
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"Welwyn" Resistors Type H12. One value only. 1 kilo-meg ±20%, 5/- each. P. & P. 9d.

Tansitor (U.S.A.) Tantalum, Wet Sintered Anode Polarised Capacitors: 200 UF. 25v. D.C. size: ⅝in. long × ⅜in. dia. UF. 24v. D.C. size: ⅝in. long × ⅜in. dia. 150 UF. 30v. D.C. ⅝in. long × ⅜in. dia. 33UF. .75v. D.C. size: ⅜in. long × 9/32in. dia. One wire each end. All types 5/- each. Also few only Transistor "MICRO-MODULE" capacitors 0.2 Mfd. 15v. wire-ended, size: 3/32in. dia (disc) 5/- each.

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★ 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.

53gns. Special total price Carr. 25/-.

Or Dep. £10.0.3 and 9 mthly. payments £5.15.5 (Total 59 gns.). Transparent plastic cover 3 gns. extra.
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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.

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HF100D	10"	15W	£4.19.9	HF126D	12"	15W	£5.15.0
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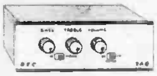
Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled acoustic damping. Ported where appropriate, credit terms available.

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 20x10½x9½in. 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, 9½x2½x5½in. 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
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Money saving units. Mounted on Plinth. Supplied with transparent plastic cover. Ready to plug into Amplifier or Tape recorder.

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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.

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

Available with trans. plastic cover. Carr. free **3 gns.** **6 gns.**

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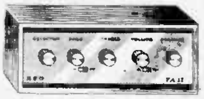
LINEAR L10 HIGH FIDELITY 10W AMPLIFIER

with separate Pre-amp Magnetic P.U. matching. To clear **10 Gns.**

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. 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). **13½ Gns.** Car. 7/9.

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Teak or Afrormosia veneer finish. Modern design. Acoustically lined. All sizes approx. Carr. 5/- per enclosure

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THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ Moderate size, only 25×14×10in. COMPLETE KIT **20 Gns** Carr. 12/6
★ Response 30-20,000 c.p.s. Impedance 15 ohms
★ Performance comparable with units costing considerabley more. 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

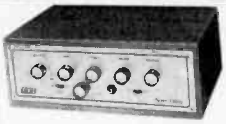
R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

★ 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 Transisters. ★ 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 MkII 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 Point to point wiring diagrams and detailed instructions. **22 gns.** Carr. 15/-

UNIT FACTORY BUILT With 12 months guarantee. **29 gns.** 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.

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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.

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U13	30 PNP-NPN Sil. Transistors OC200 & 28104	10/-
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Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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BP04 = SN7404N	HEX INVERTER	6/6	5/6	4/6
BP10 = SN7410N	Triple 3-Input NAND GATE	6/6	5/6	4/6
BP20 = SN7420N	Dual 4-Input NAND GATE	6/6	5/6	4/6
BP30 = SN7430N	Single 8-Input NAND GATE	6/6	5/6	4/6
BP40 = SN7440N	Dual 4-Input BUFFER GATE	6/6	5/6	4/6
BP41 = SN7441AN	BCD to decimal decoder and NIT Driver	22/6	20/-	17/6
BP42 = SN7442N	BCD to decimal decode (TTL 0/1)	22/6	20/-	17/6
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BP60 = SN7460N	Dual 4-Input—expandable	6/6	5/6	4/6
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UIC30	= 5 × 7430N	10/-	UIC75	= 5 × 7475	10/-
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MDTL dual in-line package.	Price
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FULL DATA SUPPLIED WITH UNITS

BRAND NEW. FULL TO MANUFACTURERS' SPECIFICATION	Price each 1-24	25-99	100 up
BP709 Operational Amplifier, dual-in-line 14 pin package = SN72709 and similar to MIC709 and ZLD709C	10/6	9/-	8/-

This is a high performance operational amplifier with high impedance differential inputs and low impedance output.

FAIRCHILD (U.S.A.) I.C's

RTL Micrologic Circuits	Qty. prices each 1-11	12-24	25-99	100 up
Epoxy case To-5 temp range 15°C to 55°C.				
μL 900 Buffer	9/9	8/-	7/6	6/6
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μL 923 J-K Flip-flop	12/6	11/-	10/6	9/6
Full data and circuits for ICS in Booklet form price 1/6 each.				
μA703E Linear RF-IF AMPLIFIER	11/-	10/-	9/-	8/3
PLASTIC CASE To-5 6 lead up to 100 m/cs.				

Please send all orders direct to our warehouse and despatch department.

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Postage and packing add 1/-. Overseas add extra for Airmail. Minimum order 10/-. Cash with order please.

PRACTICAL WIRELESS

VOL 46 NO 3
Issue 761

JULY 1970

TOPIC OF THE MONTH

PROJECT AUTUMN

IN order to produce a monthly magazine such as Practical Wireless, and to satisfy the requirements of its large readership, it is necessary to maintain a steady flow of material covering all the various facets of the hobby. Bearing in mind the differences in age, experience and preferences of our readers, the permutations involved in selecting a balanced set of contents for one volume of the magazine are rather daunting.

We draw our material from several sources. Some articles are written by members of the staff. Others are supplied by a well-established group of regular contributors, many of such articles being specially commissioned. But Practical Wireless is not a closed shop for prospective technical writers. We receive a constant flow of unsolicited material from almost every type of enthusiast, and quite a few of these ultimately appear in these pages.

One or two of our writers are full time professionals and quite a few more are employed in some technical capacity in the radio or electronics industries, putting in the occasional piece of writing in their spare time to add a little jam to the bread. But a large number of the by-lines which appear in Practical Wireless are of ordinary readers who have built a piece of equipment, or who have something they want to say.

Some of these spare-time writers produce very commendable efforts and our one regret is that many of them are heard from at too infrequent intervals. It has also occurred to us that, hidden among the anonymous ranks of the multitude, there must be quite a few promising potential authors. And it is with the aim of unearthing some of this latent talent that it has been decided to offer a new kind of incentive.

"Project Autumn" is the name of a special competition open to all readers of Practical Wireless. There will be a special trophy for the first prize, the winner being the author whom, in the opinion of a panel of judges, has submitted the best article within the period of the contest. Even losers may be lucky, since the best of the entries will be published at our normal rates. Full details will appear in the next issue. In the meantime, if you have a piece of equipment you think other readers may like to build, or if you want to build something specially for the competition, now is the time to start planning your article.

W. N. STEVENS—*Editor.*

AUGUST ISSUE WILL BE PUBLISHED ON JULY 10

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

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

New from Philips

Philips have introduced two new radios, the RN214 and RN691. The RN214 is a m.w. l.w. manually tuned car radio, costing £17 0s. 0d. Power output is 5 Watts. The radio's modern styling is also safety styling; every forward edge is padded with rubber and the control knobs are designed to snap off at impact—yet are readily replaceable. Philips' research into microminiaturisation has been well used in the production of this receiver, so that there is room for the 5 Watt output transistors to fit inside the radio and not on the rear of the casing where they might have been damaged. The entire radio is screened against interference by a precision-made metal casing that virtually seals off the electronic circuitry. In addition, extra filtering circuits are built into a separate screened compartment.

Philips RN61 was first reviewed in prototype form at the 1969 Motor Show. It is a push-button radio covering long, medium, 50 metre s.w. and v.h.f./f.m. wavebands including all the BBC local stations. The RN691 has approximately 180 microminiaturised components on a printed panel no larger than a woman's hand. Extra circuits have been included to improve performance, such as a tuned r.f. stage and a.t.c. on the f.m. band to hold stations firmly in tune. The five push-buttons can be set to give an instant selection and give a high repeat accuracy; a continuous treble and bass tone control lets you match your car's acoustics; and the facilities are there to connect a car record player, Cassette player or recorder. Recommended retail price is £60.

Audio Transducer

A new device which reproduces music through a variety of ordinary household materials from an apparently invisible source is now available. Called the Sound Scan Capsule, the unit may be concealed in the ceiling, under floorboards, or behind doors, to envelop the whole room in an even volume of music no matter where the listener may be standing or sitting.

This effect is achieved by linking the unit to the output socket of any record player (mono or stereo), tape recorder, or amplifier. The capsule will work on almost any flat surface such as a table, picture or window, and will diffuse sound over large areas—

up to 2,000 square feet in ideal circumstances. It is weather-protected, will play under water and comes with a five-year warranty.

Measuring about 4 inches in diameter and less than 2 inches in depth, the Sound Scan Capsule is technically known as an audio-transducer. It was invented in the U.S.A. where it has been successfully marketed by Photo-Scan International of Los Angeles, manufacturers of electronic systems to combat shoplifting and pilferage.

Costing £10, the Capsule will be available throughout the country from radio and electrical shops.

Further details from: *Mr. Colin Stewart, Sound Scan Ltd., Oakwood House, 63 Pound Lane, Marlow, Bucks. Tel: Marlow 6655.*

U.S. Equipment

Four acoustic suspension loudspeaker systems; an ultra-low-rumble turntable; a 60+60W. amplifier and an f.m. receiver: this is the range of Acoustic Research high fidelity sound equipment now being introduced to the United Kingdom market by Bell & Howell Audio Products Division.

Heading the range of loudspeakers is the well-known AR-3a system. Like all AR speakers, it uses the acoustic suspension principle to achieve very low distortion at low frequencies and, as a result, has a uniform and extended bass response. Each system comprises a 12in. woofer in combination with 1½in. and ¾in. hemispherical domes for mid-range and high-frequency reproduction.

Guaranteed to meet the appropriate specifications for wow, flutter, rumble and speed accuracy laid down by the United States' National Association of Broadcasters, the AR turntable has a miniature synchronous motor.

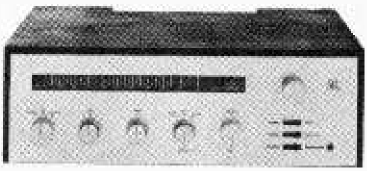
Each AR turntable is ready-mounted on an oiled walnut base and comes complete with arm, plug-in cartridge shell and transparent plastic dust cover.

The AR amplifier uses silicon transistors and has an output of 60+60W. r.m.s. into 4 ohms and 50+50W. into 8 ohms. Frequency response with both channels at full output is 20-20,000Hz. ±1dB and IM distortion is less than 0·25% at any listening level.

The amplifier section of the f.m. receiver has basically the same specification. Receiver sensitivity extends to 2 microvolts and drift is limited to a maximum of 50kHz. Stereo separation exceeds 40dB at 400Hz.

The picture shows the AR amplifier.

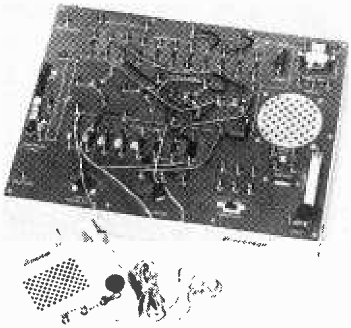
Bell & Howell Ltd., Alperton House, Bridgewater Road, Wembley, Middx., HA0 1EG.



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

Junior Electronic Experiment Kit

A new experimentation course in basic electronics for young people has just been introduced by Heathkit. Designated the Heathkit JK-18, it features 35 exciting experiments using the 'learn-by-doing' technique. The new JK-18 is both fun and educational. All the parts are mounted on a 'breadboard', and then various circuits are constructed according to instructions by connecting them with ordinary wire, as provided in the kit. For speed and easy circuit assembly and disassembly, solderless spring-clip connectors are used throughout the kit. The JK-18 builds any of these 35 different circuits; Code Flasher, Continuity Tester, Battery Tester, Diode Tester, Transistor Tester, Rain Alarm, Timing Relay, Listening Device, Public Address Amplifier, Intercom, Voice Relay, Earphone Code Oscillator, Loudspeaker Code Oscillator, Flasher, Experimental Multivibrator, Electronic Organ, Burglar Alarm, Metronome, Siren, Light Meter, Light Sensing Alarm, Target 'Hit' Alarm, Light Dependent Flasher, Light Dependent Oscillator, Sound Level Meter, three different Solid-State radios, Automatic (Light Dependent) Radio, Field Strength Indicator, Code Transmitter, Voice Transmitter, Capacity Relay,



Wheatstone Bridge and Capacity Bridge. The illustrated manual that comes with the new Heathkit JK-18 includes a fold-out diagram for easy experiment which also describes the operation of the circuit in easy-to-understand language. All parts used in any given experiment are identified by both a pictorial diagram and the standard schematic representation so that the experimenter learns how to read circuit diagrams. The manual also includes a dictionary of common terms and the International Morse Code. Kit JK-18 costs £13 18s. incl. purchase tax; carriage is 5s extra. For further information about the Heathkit JK-18 write: *Daystrom Ltd., Heathkit Division, Gloucester. Tel. 29451.*

Mullard Data Book

Mullard Ltd. announce the publication of the 1970 edition of their Pocket Data Book. It follows the pattern of previous issues and embraces the complete Mullard ranges of valves, TV picture tubes, semiconductors and components for entertainment applications.

For easy reference different coloured paper is used for each of the main product sections. Equivalents and earlier types are listed in the valve section, replacement details are given in the tube section and information on comparables is shown in the semiconductor section.

The book is available through radio and TV dealers and bookshops, and the price is 4s. 0d. a copy.

Swansea Rally

On Sunday, June 21st, at 1 p.m., Swansea University Radio Society will be holding its mobile rally, the venue being the College Campus at Singleton Park (on the A4067 road).

There will be a talk-in on Topband and Two Metres for those unfamiliar with the area.

This will be the type of outing suitable for *all the family* as there are many local amenities. We are situated in spacious parklands *literally* a stone's throw from the beach (Swansea Bay), and we have adequate parking facilities.

Refreshments will, of course, be provided.

Further details may be obtained from *Philip Regan, Union House, University College, Swansea, SA2 8PP.*

Micro 70

An interesting conference sponsored by 'Microelectronics' and 'Electronic Equipment News' was held at the Royal Garden Hotel in London on 28/29th April with the title of "The Interface between the Integrated Circuit Manufacturers and their Customers".

What it turned out to be was a 'down-to-earth', 'face-to-face', very informative session of discussions between those that 'make-em' and those that 'use-em' with a view to better co-operation in the future and in particular to reduce the expenditure in the development field.

Speakers from the leading companies spoke on their own particular problems associated with the production of integrated circuits and delegates were able to quiz the speakers and to put forward their own views.

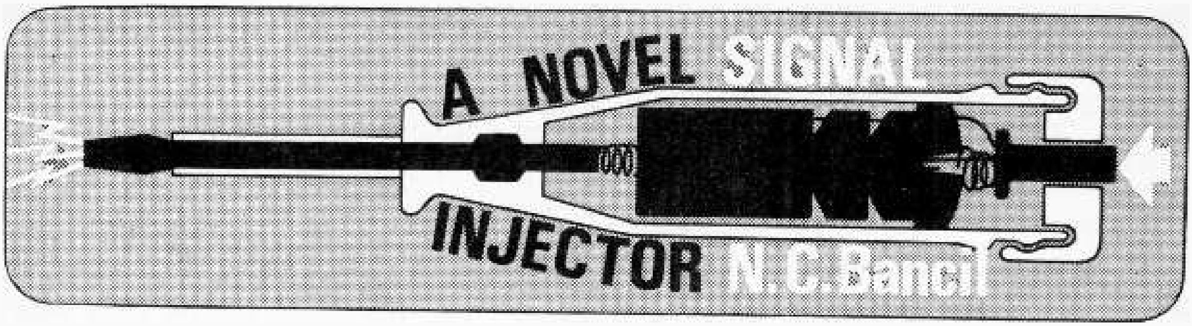
The conference was organised by *Business Conferences and Exhibitions Ltd.*

Mullard Educational Booklet

The most recent addition to the Mullard pamphlets in the series "Educational Projects in Electronics" describes how to build a simple inexpensive, f.e.t. voltmeter. The meter has eight ranges, the smallest being 0 to 250mV and the largest 0 to 500V. Because it has a high input impedance of at least 10MΩ on each range, the instrument is suitable for measuring d.c. levels in transistor and valve circuits.

The meter contains no close-tolerance resistors and the least expensive f.e.t. transistor (type BFW61) has been used. Nevertheless, the Educational prototype has been in constant use since it was built twelve months ago. However, design information is given for those who wish to make a more accurate instrument.

Teachers, lecturers and others professionally concerned with science education can obtain a sample copy of the pamphlet from the *Mullard Educational Service, Mullard Limited, Mullard House, Torrington Place, London W.C.1.*



THE circuit employed is that of a simple multivibrator circuit, Fig. 1. There is no doubt that signal generators of this nature have been made before, but many serving the same function as this are cumbersome to use, and one hesitates to carry the instrument in one's pocket all the time.

The device can be used as a screwdriver, say for opening a receiver, and as a signal injector. The output is 2V peak to peak measured on Servoscope Type D31 and the frequency is 10kHz.

The tester is used mostly without an earth lead, so that even when checking a mains radio, one can, if required, inject a signal into a component carrying h.t. but this is not advisable.

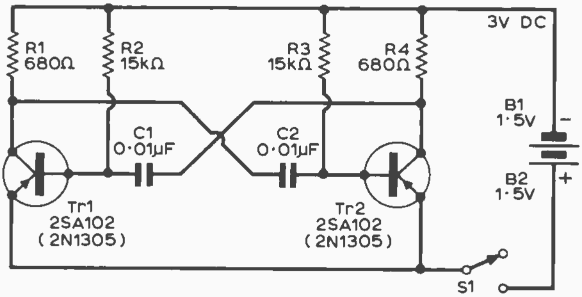


Fig. 1: Circuit diagram of signal injector. All resistors $\frac{1}{8}$W 5%.

However, if the earth lead is required, a piece of wire pushed in the hole at the back of the press-button switch and the other end to earth may do the job. If the injector is used in the above condition, great care must be exercised not to put the injector across h.t. of higher than about 18 volts.

Any transistors of higher cut-off frequency and a reasonable gain may be used, as long as they are not too big. Transistors of case style TO.18 are preferred.

CONSTRUCTION

Step 1. Tin all the leads of the resistors and transistors right to the ends, using a heat sink on transistor leads.

Place resistor R1 nearest to the collector lead of the transistor Tr1. Bend the transistor lead and wrap it around the straight resistor wire. Keep the resistor very close to the transistor, taking great care while bending the transistor leads.

Place resistor R2 next to the base lead and do the same as above. Bend the resistor leads at the other end as shown in Fig. 2.

Step 2. Repeat this procedure with Tr2, R3 and R4 as in step 1. Place back to back, as close as possible, without leaving any space between the transistors, Fig. 3.

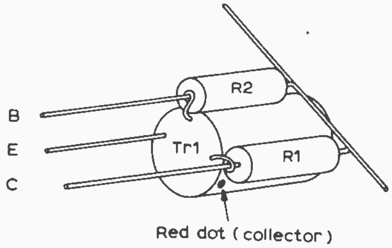


Fig. 2: Initial transistor assembly.

Cut three of the leads to a length so that they do not protrude. Solder all four leads as shown and bend one as close to transistor Tr2 as possible. Put a black sleeve over it, this is going to be the negative terminal. Leave this lead as long as possible.

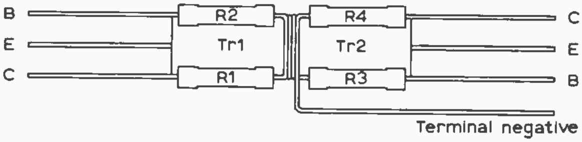


Fig. 3: Two assemblies soldered together.

Step 3. Bend the emitter leads backwards and solder in the middle position together with a 3in. piece of red wire, later to be connected to switch S1, Fig. 4.

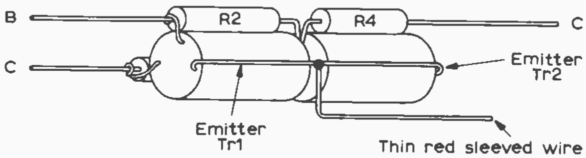


Fig. 4: Emitter connections.

Step 4. By placing capacitor C1 flat on its side, a lead is soldered to the collector. The capacitor must be very carefully placed so that it is roughly diametrically in position to Tr1 and its resistors. If it is out of 'the ring' it may be difficult to insert the whole assembly into the screwdriver, Fig. 5.

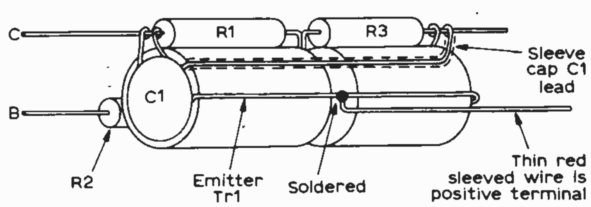


Fig. 5: Note careful placement of disc capacitor C1.

After soldering to the collector wire the rest of the wire of R1 is not cut. Similarly, capacitor C2 is soldered on to Tr2 and R3, R4. The other wire of capacitor C1 is soldered to R3 as shown. It must be sleeved, tightly (keeping the sleeve diameter as small as possible).

Step 6. The black sleeved wire from the four resistors (Step 2) is bent over C2 body and cut to a length slightly greater than the radius of C2 and a thin copper washer is soldered to it. The washer should be one fitting easily inside the screwdriver.

Step 7. The assembly is now slid into the screwdriver body with the spring end first. The batteries are then put in and pressed lightly. If necessary, a packing of thick paper to insulate and prevent damage to the capacitor, should be placed between the transistor and capacitor, also between the capacitor and washer.

A rubber grommet of the same diameter as the hole of the screwdriver is cut in half and placed on the batteries.

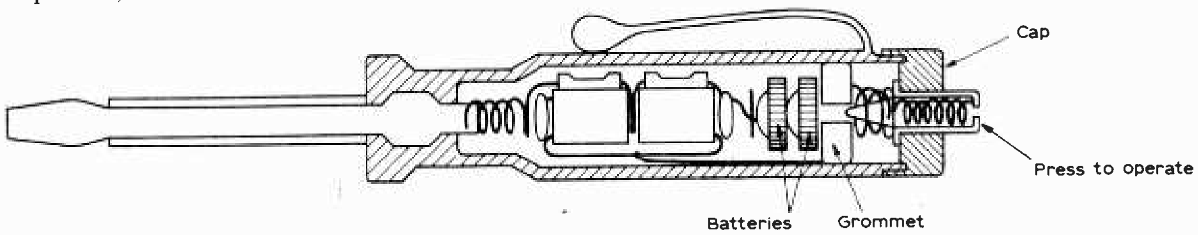


Fig. 9: Completed injector showing mercury cells to supply power.

The other wire of C2 is similarly brought out and wrapped around R2 and soldered. The excess wire of R2 is then cut. When buying the capacitors they must be so chosen that they have no unnecessary projecting material, as shown in Fig. 6. The excess ends of R2, R3 and R4 are now cut.

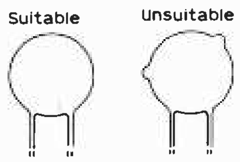


Fig. 6: Selecting suitable capacitor for C1

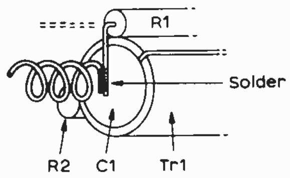


Fig. 7: Attaching spring to assembly.

Step 5. The long wire of R1 is now bent on top of C1 body and cut to a length slightly greater than the radius of C1 body. A piece of spring cut from the main spring found originally in a neon tester, or a ball point pen, is soldered as shown in Fig. 7.

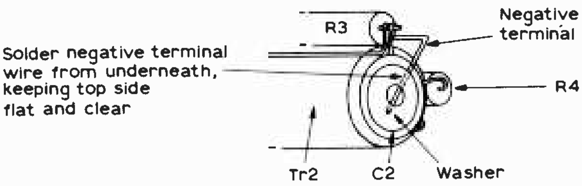


Fig. 8: Washer used as negative contact to battery.

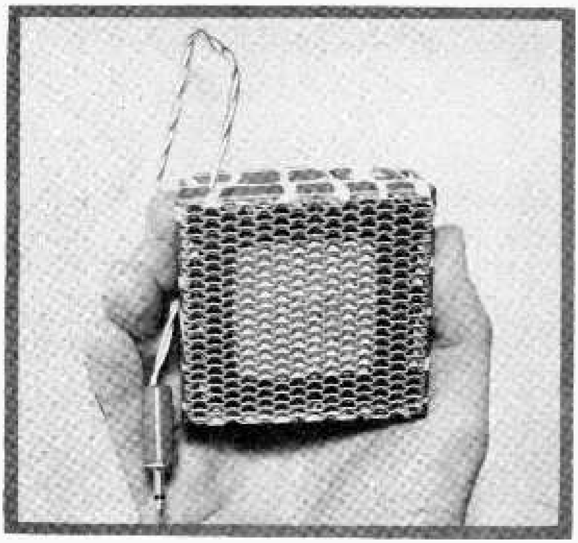
Before soldering the spring, a piece of paper placed between the resistor wire and the capacitor will prevent capacitor wax from melting, and stop damage. The spring is soldered here in order to make firm contact with the metal shaft of the screwdriver.

The battery negative terminal should be placed so as to press against the washer. The red wire which is connected to the emitters is cut approximately by placing the whole assembly into the screwdriver and cutting the wire when just accessible from the top. Fig. 8.

The wire is then soldered to the middle of a spring found originally in a neon tester or ball pen. One end of the spring is crimped, so as to fit into the hole of the plastic plunger.

To the inside of the spring is soldered a piece of stiff wire shaped as a 'V', about ¼in. long.

The spring is put in the screwdriver and rests on the rubber grommet, thus insulating the positive lead, making contact when the plunger is pressed. The cap is then put on the screwdriver, together with the clip. ■



mini AMPLIFIER/SPEAKER

F. G. RAYER

THIS midget amplifier and speaker fit in a case approximately 3in. x 3in. x 1⅜in. deep inside dimensions, this including a PP4 9V battery. Though really intended to allow loudspeaker reception with the *Slimline Superhet* (P.W., June 1969) it can be used with other receivers which normally have only sufficient output for a personal phone or headphones.

Fig. 1 shows the circuit. T1 is the driver transformer, and the primary connections 5 and 6 are to a miniature jack plug which is inserted in the socket of the receiver, normally employed for phone output. The receiver can thus supply signals for the output stage, consisting of Tr1 and Tr2 in a single-ended push-pull circuit, the loudspeaker being coupled through C1.

The miniature amplifier/speaker has its own battery and on-off switch, so no other connections are required to the receiver. Volume is adjusted by the usual receiver audio gain control, so either phones, or the amplifier/speaker, may be plugged at once into the receiver.

The Mini Amplifier/Speaker has been used with other receivers of the type having a small single audio output transistor, and designed to operate headphones or a personal earpiece. In all cases satisfactory reception was possible.

The values used allow for economical running, with adequate volume. A similar type of circuit could be used with other driver transformers, transistors and speaker, but resistor values may then have to be modified to suit.

Circuit Board

The amplifier is constructed on a piece of 1/16in. thick paxolin 2¾in. x 2¾in. (see Fig. 2). A 1⅞in. diameter hole is cut to clear the speaker magnet assembly. When all wiring is finished, the speaker can be attached by bolts with extra nuts, passing through the holes S-S. If preferred, the speaker may be screwed inside the case, and have thin flexible leads to the amplifier.

The holes for resistor and other leads are 1/16in. diameter. One wire of each resistor is bent over, so that these items fit as in Fig. 2.

The driver transformer T1 is held by its lugs, and by soldering wires to the projecting pins. For the transformer listed these come as in Fig. 2.

T1, C1 and the resistors are wired as in Fig. 2, with insulated sleeving where required. Prepare the transistors by placing about ⅜in. of sleeving on each base lead. Pass the wires through the correct holes, solder as in Fig. 2, and snip off excess wire.

The battery positive lead is thin red flex, passed through a hole and fitted with a positive clip. The small slide switch is connected in the negative battery lead. This switch is later fixed to the side of the case with two small bolts, a small slot being cut to take the projection.

Input Connections

These go to 5 and 6 on T1 (Figs. 1 and 2). Thin twin flex was used, and the phase of connection seemed to have no effect on the results with any of the receivers employed. The flex terminates in a miniature jack plug of the same size as used for the receiver phones.

If a screened lead were used, the outer brading should be used as the jack sleeve connection, the inner lead going to the jack plug tip.

Testing

A meter in one battery lead should show about 4mA to 6mA with no signal, rising to 10mA to

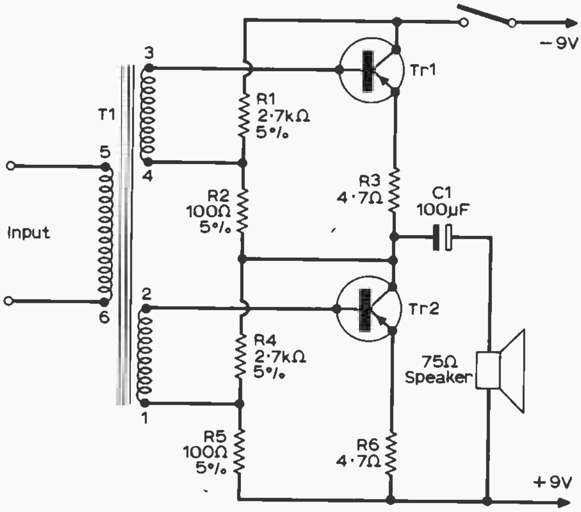


Fig. 1: The circuit of the amplifier

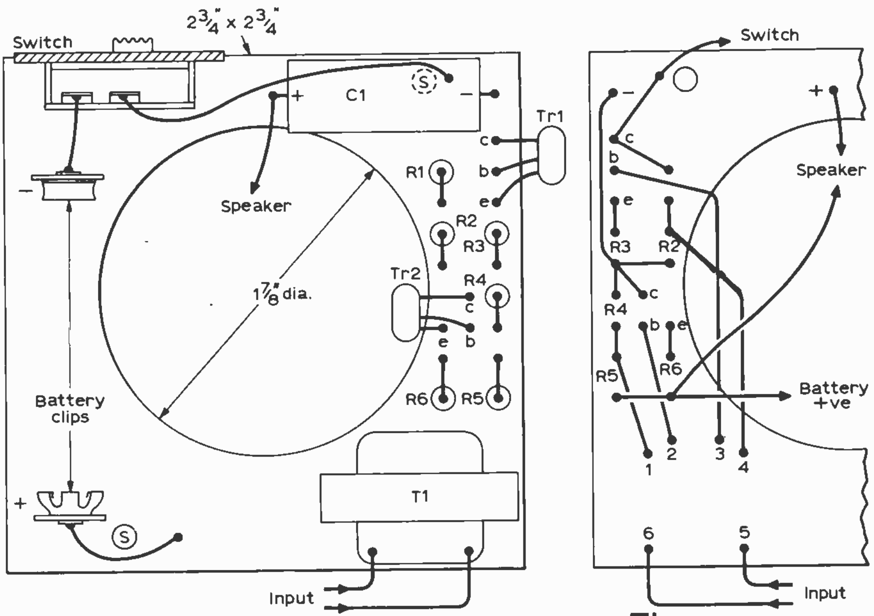
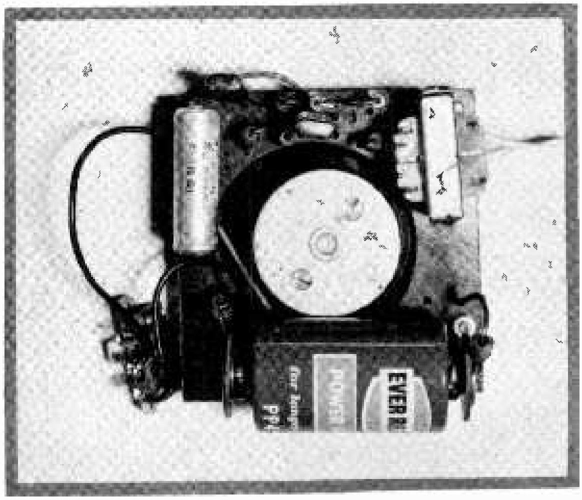


Fig. 2: The components are mounted on a drilled paxolin panel.



The completed unit.

15mA peaks, with normal volume. Should results sound distorted, then R1, R2, R4 and R5 may be incorrect. These resistors should be 5 per-cent tolerance. The 10 per-cent type should only be used if values can be tested with a meter, or if correct operation of Tr1 and Tr2 can be checked.

★ components list

R1 2·7kΩ 5% R4 2·7kΩ 5%
R2 100Ω 5% R5 100Ω 5%
R3 4·7Ω 10% R6 4·7Ω 10%

All resistors ¼watt miniature types

C1 100μF 12V

Tr1/Tr2 Matched pair NKT251/OC72/AC128 etc.

T1 3·6:1+1, Driver transformer, Home Radio Cat. No. TR61

Miniature slide switch.

W.B. 75 ohm 2½in. speaker or similar.

PP4 9V battery, clips, paxolin, etc.

Should current readings be correct, but results sound very distorted and unsatisfactory indeed, this is probably due to one half secondary T1 being in the wrong phase. This should be checked if an alternative transformer is fitted; it is cured by reversing connections to one secondary.

The amplifier/speaker is not intended for use after a receiver already having an output stage able to supply a speaker, but should follow an audio stage using an OC71 or similar transistor, with a collector current of about 1mA.

The case

A ready-made plastic box or similar case would be satisfactory. The one actually used was assembled from 1/16in. thick insulated board, and covered to match the Slimline Superhet. An aperature 1¾in. x 1¾in. was provided in the front. The front surface, from this aperture to within ⅛in. of the edge, all round, was painted black. Thin gold fabric was glued over the aperture inside. Outside, a piece of gold speaker fret metal slightly smaller than the case front was cemented on.

A piece of stout card is cut to fit inside the case and a hole which matches the speaker cone in size and position is cut in this card. When first testing the unit, remember that even this very small case makes an appreciable difference to the results from the loudspeaker. ■

PRACTICAL WIRELESS

QUERY SERVICE

Before using the query service it is important to read the following notes:

The PW Query Service is designed primarily to answer queries on articles published in the magazine and to deal with problems which cannot easily be solved by reference to standard textbooks. In order to prevent unnecessary disappointment, prospective users of the service should note that:

(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.

SUMS plus CIRCUITS equals UNDERSTANDING

PART 4

LESLIE MOORE

LOGARITHMS

As numerous natural phenomena obey logarithmic relationships, electronic circuitry is often given specifications in logarithmic scales. Rather than give a logarithm a complicated definition, a simple example, given in Table 1 should provide a better illustration.

For numbers less than 1, the minus sign for the logarithm is drawn above the first figure in the log, therefore,

-1 becomes $\bar{1}$, called bar 1

-3 becomes $\bar{3}$, called bar 3......... etc.

TABLE 1

Number	Name	Symbol	Number written to the power of 10	Logarithm to the base of 10
1,000,000,000	GIGA	G	10^9	9
1,000,000	MEGA	M	10^6	6
1,000	KILO	k	10^3	3
1	UNITY	—	10^0	0
0·001	MILLI	m	10^{-3}	−3
0·000001	MICRO	μ	10^{-6}	−6
0·000000001	NANO	n	10^{-9}	−9
0·000000000001	PICO	p	10^{-12}	−12

This table illustrates how the values of resistors, capacitors, etc., in everyday use are related to each other, and the meaning of the various prefixes. It is important to note that the symbols have the same meaning regardless of the units to which they refer.

Any number can be given a logarithm, to any base, accepting the fact that the logarithms of infinity and zero are plus infinity and minus infinity respectively. Initially we shall discuss logarithms to the base of 10, often called *common logarithms.*

The uses of logarithms (logs) extend to multiplication and division problems; logs of numbers to be multiplied are added and those of numbers to be divided are subtracted; to demonstrate:

(i) $100 \times 100 = 10{,}000$
or $10^2 \times 10^2 = 10^4$ i.e. add logs

(ii) $1000 \div 100 = 10$
or $10^3 - 10^2 = 10^1$ i.e. subtract logs

Numbers which lie between 1 and 10, 10 and 100 etc. have logarithm values which contain a fraction of a whole number, and although there are methods for determining logarithms by tedious calculations, the logarithms of all numbers between 1 and 10 have been tabulated and are obtainable in book form from any book-shop (log table sets usually also contain the trigonometrical tables).

From log tables, the log of 2 = 0·3010

Should you wish to determine the log of 20, rewrite 20 as 2 × 10, and as shown before, add the logs of 2 and 10 giving,

$$0{\cdot}3010 + 1{\cdot}0 = 1{\cdot}3010.$$

The logarithm of 0·2 is written as

$$\bar{1}+0{\cdot}3010 = \bar{1}{\cdot}3010 \quad \text{............ (a)}$$

and, equally true is also

$$-1+0{\cdot}3010 = \bar{0}{\cdot}6990 \quad \text{.......... (b)}$$

To demonstrate, using result (a).

$$\bar{1}{\cdot}3010 + 1 = 0{\cdot}3010 = \log 2.$$

using result (b)

$$\bar{0}{\cdot}6990 + 1 = 0{\cdot}3010 = \log 2.$$

Logarithms are obtained for the numbers which are to be multiplied or divided, then, when the appropriate additions or subtractions have been made the result must be converted back from the log form to true numerical. Firstly the figures should be broken down into two parts.

e.g. $4{\cdot}3010 = 4 + 0{\cdot}3010$

so that the final answer will appear as

$$10^4 \times 2 = 20{,}000$$

Anti-logarithm tables are used to determine the number relating to the fractional part of the term. Rules for using logarithm tables are usually given with sets of logs.

The Decibel

Electronic and radio engineers use the decibel as a unit for ratios, usually for amplifier gains or network losses. This is used because the human ear sensitivity has a logarithmic relationship with sound intensity.

The decibel, or dB, is defined mathematically as

$$\text{Power gain in dB} = 10 \log_{10} \frac{\text{power out}}{\text{power in}}$$

Suppose the gain is for an amplifier which has equal input and output resistances.

Then at the output:

$$V_{OUT} = I_{OUT} \times R_{OUT}$$

and at the input:

$$V_{IN} = I_{IN} \times R_{IN} = I_{IN} \times R_{OUT}$$

by Ohm's law: Dividing the two equations gives:

$$\frac{V_{OUT}}{V_{IN}} = \frac{I_{OUT}}{I_{IN}} \times \frac{R_{OUT}}{R_{OUT}} = \frac{I_{OUT}}{I_{IN}}$$

Now as Power out $= V_{OUT} \times I_{OUT}$
and Power in $= V_{IN} \times I_{IN}$

Therefore:

Gain in dB=

$$10 \log_{10} \frac{V_{OUT}}{V_{IN}} \times \frac{I_{OUT}}{I_{IN}} = 10 \log_{10} \left(\frac{V_{OUT}}{V_{IN}}\right)^2$$

By the rules of logarithms:

$$\log A^2 = \log (A \times A) = \log A + \log A = 2 \log A$$

Therefore:

$$10 \log_{10} \left(\frac{V_{OUT}}{V_{IN}}\right)^2 = 20 \log_{10} \frac{V_{OUT}}{V_{IN}}$$

$$= 20 \log_{10} (\text{voltage gain})$$

Usually in electronics, however, the assumption that input and output resistances must be the same is neglected, and for general use in electronics amplifier gain is given as above. Should the relationship 20 $\log_{10}$ (voltage gain), ever be a negative value of dB, then the circuit whose gain it represents will attenuate.

Amplifier bandwith is defined as the frequency which exists between the frequencies which causes the power gain to be reduced by a half.

However, in decibels,

$$\text{Power gain} = 10 \log_{10} \frac{P_{OUT}}{P_{IN}}$$

then at the half power points the new gains will be:

$$\text{Power gain} = 10 \log_{10} \tfrac{1}{2} \left(\frac{P_{OUT}}{P_{IN}}\right)$$

$$= 10 \log_{10} \frac{P_{OUT}}{P_{IN}} + 10 \log_{10} \tfrac{1}{2}$$

The term 10 $\log_{10} \frac{1}{2}$ represents $-3{\cdot}010$ decibels. (taken as $-3{\cdot}0$ dB) therefore bandwith can be redefined as the frequency band between the 3dB points of power gain. Fig. 4.1 demonstrates this.

An amplifier frequency response is usually plotted on log-linear graph paper, frequency along the log axis, gain along the linear axis. This means that the frequency range 1-10Hz will be displayed over a smiliar scale length to the 1,000-10,000 Hz range, and prevents information at the lower frequency end from being cramped.

The logarithmic characteristic of the ear has also given rise to the standard practice of using logarithmic potentiometers as radio/amplifier volume controls.

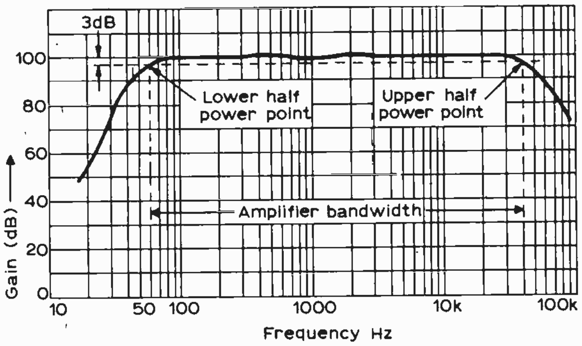


Fig. 4.1 : Amplifier bandwidth as defined by the half-power points.

This practice provides a linear increase in volume with rotation of the volume control whereas a linear potentiometer would provide a logarithmic increase in volume with volume control rotation.

Other Logarithms

Study of the table at the beginning of this article will lead to the conclusion that a logarithmic scale could be written for any base. However, with the exception of one number there are no other logarithmic scales which have much practical use.

The exception is the natural or Naperian logarithm, taken to the base of 'ε' which has an approximate value of 2·71828.

Many physical and electrical systems obey formulae governed by natural logarithms, those with which we are concerned are limited to capacitor charge and discharge, however, the capacitance and inductance of concentric cables, parallel cables and numerous other combinations are dependent on natural log relationship.

The relationship with which we are mostly concerned is in the form:

$$y = A\varepsilon^{-x} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$y = A(1 - \varepsilon^{x}) \quad \ldots\ldots\ldots\ldots (2)$$

where A is constant, x and y are variable, and y is usually a function of time.

When X = O, $\varepsilon^{\circ} = 1$ and for values of increasing X natural logarithm tables will give the necessary values.

Graphs given in Figures 4.2(a) and (b) result from equations. (1) and (2) respectively. The curves produced are "exponential" in shape.

Capacitors in d.c. circuits:

Place a capacitor directly across the terminals of a battery and it will "charge" almost instantaneously. Providing the dielectric is a good insulator then the charge will remain in the capacitor indefinitely. Place a resistor across the capacitor and current will flow in the resistor until the capacitor is discharged. Had the capacitor been connected to the battery, initially, through a resistor, then charging would have taken time.

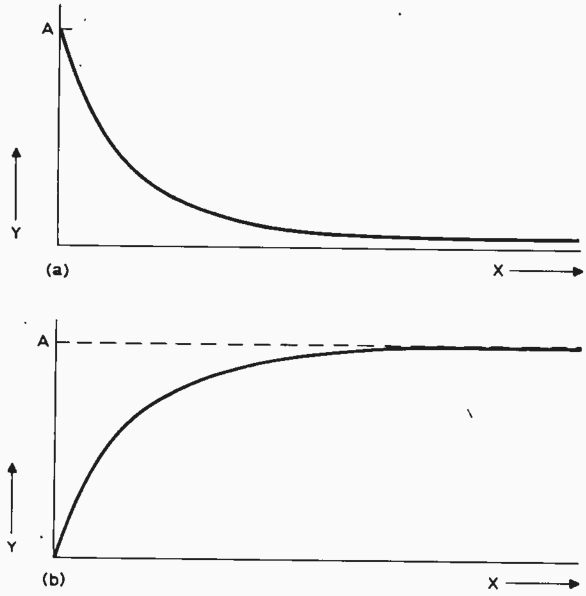


Fig. 4.2: Exponential curves derived from formulae. See text.

The speed at which capacitors charge and discharge in CR circuits depends on values of C and R which constitute the time constant C × R.

For the series circuit shown in Fig 4.3, when the capacitor has no initial charge, the circuit relationships with time are determined by the equations:

$$i = I_{max} \cdot \varepsilon^{-\frac{t}{CR}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where Imax is obtained from Ohm's Law, i.e.

$$I_{max} = \frac{V}{R}$$

C is capacitance value in farads.

e.g. $5\mu F = 5 \times 10^{-6}$ Farads.

R is resistance in ohms.

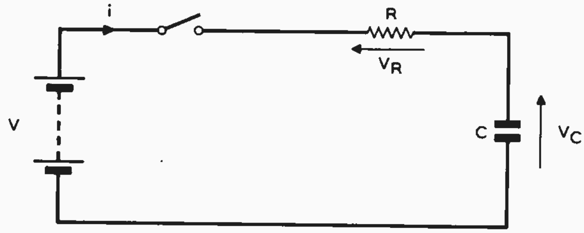


Fig.4.3: Basic circuit for investigating capacitor charging characteristics.

$V_r = V \cdot \varepsilon^{-\frac{t}{CR}}$ which can be obtained from equation (3) by Ohm's law

and $V_c = V(1 - \varepsilon^{-\frac{t}{CR}})$

The product C × R is known as the circuit time constant; t is the time after closing the switch. A characteristic of the C.R. circuit is that when the time after switching, t=CR seconds, equation (3) will become:

$$i = I_{max} \cdot \varepsilon^{1}$$

and from Naperian logarithm tables this becomes.

$$i = I_{max} \times 0{\cdot}3679.$$

Relating this to graph 4.2 (a) this means that in C × R seconds, the circuit time constant, the circuit current has fallen by $(1 - 0{\cdot}3679) \times 100\%$
$= 63{\cdot}21\%$

By further investigation is will be seen that after a second time constant the current again will fall by approximately 63% of the current remaining after the first time constant. This would indicate that current would flow indefinitely. In practice however, it is usually assumed that three time constants are sufficient to charge or discharge a capacitor in a CR circuit.

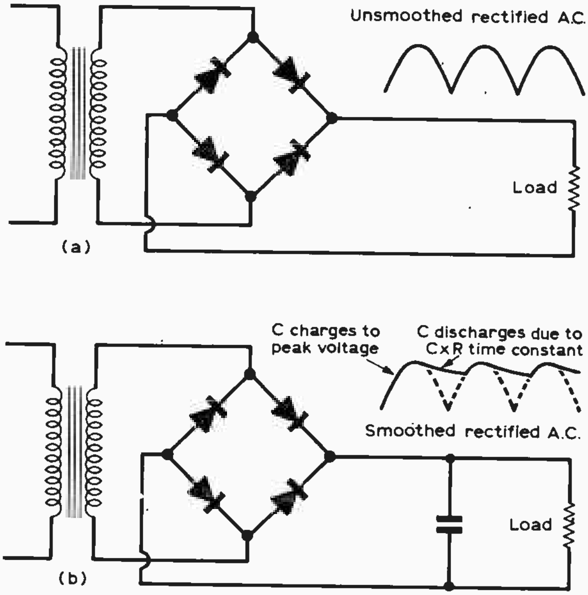


Fig. 4.4: (a) Unsmoothed output of a rectifier. (b) Action of a smoothing capacitor.

After three time constants the current has in fact changed by approx. 95% of its original value, if charging.

It should be noted that the time constant, C × R is made up in value of capacitance in farads and resistance in ohms. For C = 1μF, R = 1MΩ the time constant becomes:

$$1 \times 10^{-6} \times 1 \times 10^{6} = 1 \text{ second.}$$

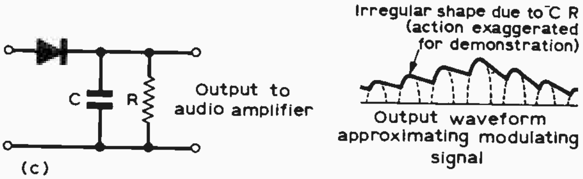


Fig. 4.5: Action of a smoothing capacitor applied to a detector circuit.

Charging and discharging of capacitors has numerous applications in power supplies, a.m. detectors and switching circuits (including multivibrators).

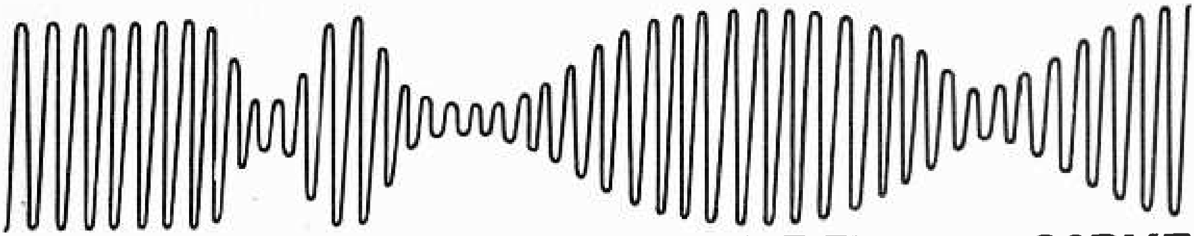
Power supply smoothing circuits are numerous in type. Fig 4.4 indicates capacitor operation and how the charge/discharge helps to smooth the output voltage.

An amplified amplitude modulated signal must be passed through a detector circuit to obtain the audio signal. Figure 4.5 demonstrates how the CR charge/discharge characteristic is utilised in this application.

Note that each of the CR circuits discussed assume that the capacitor charges almost instantaneously.

TO BE CONTINUED

A HYBRID MODULATOR



C.F. Fletcher G3DXZ

TO amplitude modulate an r.f. power amplifier one is faced with two basic choices. Firstly; produce a modulator capable of delivering just over half the power amplifier d.c. input-power and couple it into the final; or secondly, accept the maximum c.w. power available as the peak envelope power, reduce the mean carrier level to one quarter of this power and then modulate by a low power carrier control means.

When building a phone transmitter, high level anode/screen modulation, the first choice, has much to offer in terms of P.A. efficiency and ease of obtaining good results. Low power carrier control systems are generally favoured where space and cost considerations outweigh others or where the amplitude modulator is a second thought. It is not generally easy to obtain results from carrier control systems which are equal to those obtained from high level systems in terms of good quality modulation and ease of adjustment, but such results are possible and indeed easily obtainable with the system to be described.

SYSTEM THEORY

Series modulation is a very old system with very old drawbacks, the biggest one being the provision of a modulator valve capable of carrying the full P.A. current and a power supply capable of providing the modulators anode voltage and also handling the P.A. current. Now really all the modulator has to do is to vary the cathode potential in such a manner that the P.A. cathode current will vary linearly between zero and twice its unmodulated value. To overcome the nonlinearities of the control grid/cathode circuit, it is essential that the cathode current comes from a high source resistance and at the same time withstand the control grid volts necessary for P.A. current cut off.

Both of these functions can be provided by an n.p.n. transistor of the BFY51 variety. This transistor will stand 50V at the collector, more than enough to cut off most P.A. valves in the low and medium power range, whilst its output resistance is very much larger than the input resistance of the P.A. cathode circuit.

MODULATOR CIRCUIT

Figure 1 shows the complete modulator circuit. It consists of a speech amplifier coupled via C3 to a current control section. The speech amplifier is formed by Tr1, Tr2 and Tr3 which make a simple 'ring of three' amplifier. The amplifier was designed for use with a crystal microphone and hence an input resistance of at least 100kΩ was needed. The input transistor Tr1 and its base bias circuit combine to produce an input resistance of about 20kΩ and R1 was introduced in series with the microphone to bring the input resistance up to the required minimum. Tr1 and Tr2 are directly coupled. At first glance this seems an unworkable arrangement as the collector voltage of Tr1 can only be equal to the emmitter-base volts of Tr2. However, with silicon n.p.n. transistors, the switch-on base volts are 0·6V to 0·7V and the bottoming collector voltage is only 0·1V. For a small signal amplifier, 0·7V is adequate as a collector potential and direct coupling also results in economy of components and good frequency response; Tr2 and Tr3 are also coupled in this manner.

To obtain the maximum output voltage swing from Tr3, half the supply voltage needs to be dropped across R6 giving Tr3 a standing collector voltage of about 2·5V. The d.c. operating conditions of the 'ring of three' amplifier are stabilised by d.c.

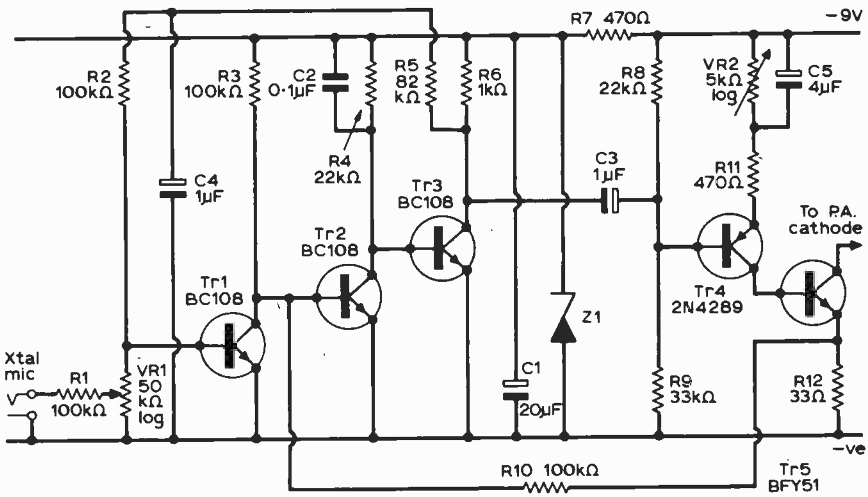


Fig. 1: The circuit of the modulator.

negative feedback via R2, R5 and VR1, giving good temperature stability. Capacitor C4 decouples the feedback loop at audio frequencies and allows a high audio gain to be achieved. Zener diode Z1, decouples the supply rail in conjunction with R7 and provides a stable d.c. voltage for the amplifier.

The P.A. current control system is formed by Tr4 and Tr5. Tr4 is a p.n.p. type whereas Tr5 is n.p.n. This choice of transistors again allows direct connection, collector to base, and no coupling components are required. Tr4 is a current source, the magnitude of the current being set by VR2. This current passes directly into the base of Tr5 which amplifies it and thus provides the P.A. cathode current.

The standing current produced by Tr4 is modulated by introducing the audio signal at its base, via C3. The maximum possible peak audio voltage is just less than half Tr3 supply volts, assuming best possible d.c. conditions, and this must be enough to swing Tr4 emmitter current between zero and twice its standing value. To achieve this VR2 must be decoupled and R11 selected to provide the required current swing. The quoted value of 470Ω is sufficient to modulate a P.A. current of 50mA. If a greater standing PA current is to be controlled, R11 should be reduced until adequate control is achieved.

To linearise the audio amplifier and modulator, negative feedback is taken from the emmitter of Tr5 via R10 and introduced at an early stage in the speech amplifier. As the emmitter current of Tr5 is the cathode current of the P.A. stage, this feedback loop reduces distortion in the modulator by using the P.A. cathode current to produce the feedback voltage. This feature contributes directly to the good linearity of the modulator.

The power supply for the whole modulator is obtained from a 6·3V heater line, provided one side of the heater winding is earthed, using a silicon diode in a half-wave circuit. A positive supply of 7·5V to 8·0V is obtainable by this method, adequate smoothing being provided by C6.

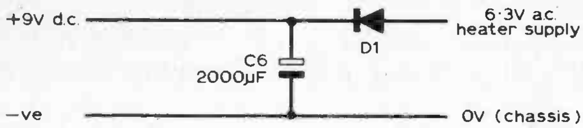


Fig. 2: The power supply circuit.

OPERATION AND ADJUSTMENT

The mechanism of setting up a carrier control modulator of this type is simplicity itself but the implications of such adjustments are not always so readily appreciated. So to begin with, the setting up procedure is as follows:

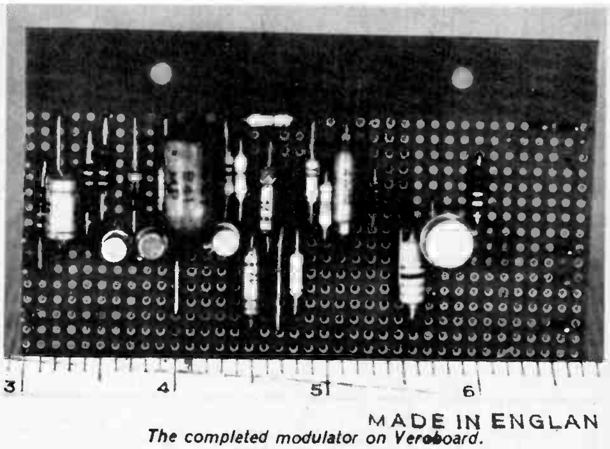
1. Set the P.A. current control (VR2) for maximum current. This will result in Tr5 bottoming and having no effect upon the P.A. current.

2. Tune up the P.A. to the maximum it will take. This statement assumes a medium-sized rig, 20 to 60 watt variety, and not on Top Band!

3. Note the maximum "loaded" P.A. current and reduce it using VR2 to half maximum.

4. Adjust the modulator gain, VR1, to produce a fully modulated carrier preferably using an oscilloscope.

The transmitter will now produce a fully modulated carrier with a mean carrier power one quarter



The completed modulator on Veroboard.

of the maximum reached in stage 2 of the setting up. Note carefully, that the P.A. loading should not be adjusted after the P.A. current has been reduced by VR2 to less than the maximum value. This is a temptation which must be resisted, for if tried, one will find that the output can be increased —in fact doubled! However, after such an adjustment, only downward modulation is possible and all that will be achieved is a poorly modulated carrier.

The reason for this apparent shortcoming becomes clear if the mechanism of the modulation system

★ components list

Resistors :

R1	100kΩ	R7	470Ω
R2	100kΩ	R8	22kΩ
R3	100kΩ	R9	33kΩ
R4	22kΩ	R10	100kΩ
R5	82kΩ	R11	470Ω
R6	1kΩ	R12	33Ω

All 5% tolerance, ¼ watt except R12, ½ watt

VR1 50kΩ log. pot.

VR2 5kΩ log. pot.

Capacitors :

C1	20μF 16V	C4	1μF 16V
C2	0·1μF 150V	C5	4μF 16V
C3	1μF 16V	C6	2,000μF 16V

Semiconductors

Tr1	BC108 or BC168	Tr5	BFY51
Tr2	BC108 or BC168	D1	Rectifier silicon diode, 100V p.i.v., 250mA
Tr3	BC108 or BC168	Z1	4·7V zener diode, 400mW, 20%
Tr4	2N4289 or 2N3702		

Miscellaneous :

Crystal microphone, input jack, Veroboard

is considered. Such consideration also highlights the necessity for the unusually high initial setting up powers.

An amplitude modulated carrier varies in amplitude, at 100% modulation, between zero and twice mean carrier. Now if the mean carrier is represented by a voltage E, then it will rise to 2E on peaks. The voltage E delivers a mean carrier power P into some load resistance R, hence $P_{mean} = \frac{E^2}{R}$. Now when on peaks E becomes 2E, then $P_{max} = \frac{(2E^2)}{R} = 4\ P_{mean}$.

—continued on page 230

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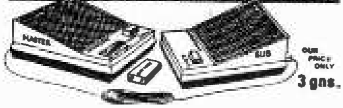

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TRANSMITTER / RECEIVER

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F.G.RAYER G3OGR

Continued from last month

RF Power Amplifier. Connect a 15 watt household lamp to a co-axial plug and insert in the aerial socket, or clip the lamp across VC3/4. To load the p.a. turn VC3/4 to maximum capacity, switch to transmit, and tune VC2 until the meter shows a dip in anode current. Input will be low and is raised by decreasing VC3/4, meanwhile readjusting VC2 for minimum current. At 9-15W input (30-50mA) the lamp should be quite bright.

Microphone Amplifier. The external lead must be screened in the usual way, and the connection from microphone socket to pin 7 of V4A runs against the chassis. Other leads should be clear of the heater connection X. Screened lead is used for connections to S5. Audio from the receiver was not taken to V4B because the extra stage of amplification was found unnecessary. The audio amplifier can be tested by temporarily shorting S5 and S7, the microphone and loadspeaker being well separated to avoid feedback.

Load up the transmitter into the lamp as described and tune in the signal with an independent receiver (r.f. gain of the latter should be at minimum, and the aerial removed). Speech into the microphone should sound clean and clear in the receiver speaker.

V5 operates at about maximum ratings on transmit, but screen grid and anode voltages fall to about 220V on receive, bias across R15 then dropping to about 10V.

Receiver RF Stage. It is only necessary to adjust the core of L4 so that VC5 is about half closed when resonant at 1·9MHz. VR1 is the r.f. gain control which is useful with very strong signals, and some kinds of noise.

Mixer and Oscillator. L4, L5 and L6 have small trimmers incorporated during manufacture. VC6/VC7 can have a maximum capacitance of about 20pF each section. The core and trimmer of L6 are adjusted to give coverage of about 1·8 2·0MHz, with a little to spare at the ends. The core of L5 is then adjusted near 1·8MHz, and the trimmer near 2·0MHz, for best reception.

With a given value for VC6/VC7, frequency coverage falls as L5/L6 trimmers are adjusted to higher capacitance, the cores being unscrewed to restore band coverage. On the other hand, frequency coverage increases as inductance is increased by adjusting the cores, and the trimmers are re-set to a lower capacitance. In this way the receiver tuning can be closely matched to the v.f.o. tuning. It is also possible to use a 25pF+25pF or similar gang, with extra 30pF trimmers for both sections, L5 and L6 cores being unscrewed to compensate.

IF Circuits. A connection should pass across the holder for V8, as in Fig. 3, earthing the central spigot, or instability is likely. The four i.f.t. cores should be adjusted with a proper tool, either with a signal generator set to about 465kHz and fed to the input of V7 or with a stable signal. To avoid using shunts for a more sensitive meter the 50mA panel instrument reads the whole receiver current. This is about 30-35mA with no signal, falling to 25mA or so with average signals, or 15mA or so with the v.f.o. on and tuned to the receiver frequency. The procedure is thus to tune for minimum meter current and to peak VC5, cores and trimmers for lowest minimum.

It would be feasible to use a 1mA meter, with a shunt giving 0-50mA on transmit, and any standard S-meter circuit on receive but the metering as shown was found satisfactory.

Connections to VR2 were screened as shown in Fig. 3.

Power Circuit. With the transformer, rectifiers and choke listed, 300V was available at 100mA for transmission. With other transformers or chokes, it might be necessary to change R17 and R18. These may be increased if more than 300V is found at the anode of V3 or V5.

General Points

Tag strips help to secure various items, as shown in Fig. 3. Well insulated leads should be used where high voltages are present except for r.f. wiring. In many places 0·02μF 500 V disc ceramics, and 1800pF 1kV ceramics, are used as the cost of these is only a few pence but in most circuit positions other reasonable values can be fitted.

In case of any difficulty the equipment can be tested in sections—the receiver, alone and with V5, then V4A/B, and each stage of the transmitter r.f. circuit, and power pack.

Switching

Details of this have been mentioned and connections should be checked against Fig. 1. The switch must be a "break before make" type. A 3-way "make before break" switch can be used the central way being ignored. This was actually done the click mechanism modified accordingly.

As those switch tags which lie near the chassis cannot be reached very easily it is wise to solder on coloured leads beforehand, the colours used being marked on the circuit.

The section nearest to the co-axial lead and VC3/4

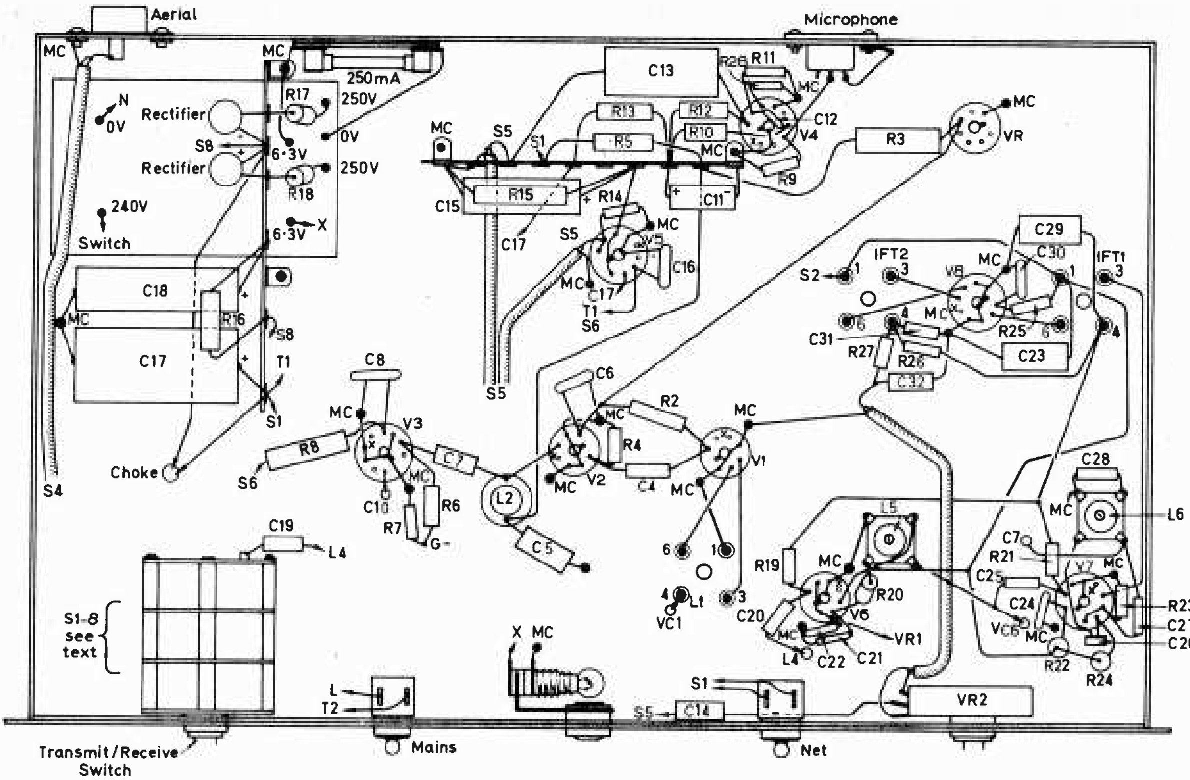


Fig. 3: Underneath of chassis with practical wiring details

is used for C4. S2, S3 and S6 can be adjacent on one wafer. S5 is on a separate wafer. If necessary, check with a meter after wiring, with the switch alternately in transmit and receive positions.

Notes on use

The v.f.o. is best calibrated with the aid of a 100kHz crystal marker, by tuning in the harmonics on 1·8, 1·9 and 2·0MHz, on a separate calibrated receiver and setting the v.f.o. to zero beat, and marking the frequency on the scale. Intermediate markings can be estimated, or found by using a receiver on the 3·6-4·0MHz range. The 2nd harmonic of 1·85MHz will be heard on 3·7MHz, and so on.

VC1 is a double-bearing metal frame type, with fixed plates well screened. A box 2 x 2¼ x 4in. encloses VC1 and L1. This item is readily made from a "universal chassis" (Home Radio) 9 x 2in. flanged runner, cut to bend 2¼in. from each end. The flanges can then be bolted to chassis and panel, and the top closed with a 4 x 2¼in. plate fixed with self-tapping screws.

Input should not be over 10W on Top Band, and loading is carried out in a similar manner to that described using a lamp. The aerial can be a random length of wire, or a planned 160m system. Some aerial lengths fall outside the matching capability of the pi tank circuit. The simplest method of correcting this is to place a loading coil between the aerial socket and aerial, if a tuner is not available. The coil can be similar to that wound for L3, and should have eight or ten tappings. The number of turns in circuit can then be adjusted until normal tuning is possible. Such a method allows full power input with very short aerials, but a longer aerial will naturally give greater signal strength.

80m Working

An end-fed wire on 160m can also be used on 80m. At times this band is more active than 160m and is also capable of longer distance contacts.

The circuit in Fig. 1 has been found to give very good results on 80m, so it is quite in order to use it for this band, or for both 160m and 80m. For single band working on 80m a VFO4 unit is fitted instead of the VFO2, and calibrated for 3·5-3·8MHz. L2 is broadly resonant at about 3·65MHz. L3 is either an 80m tank circuit or one half the 160m tank circuit described. For VC2, about 500pF may be retained, but 250pF is adequate.

In the receiver section, L4, L5 and L6 are replaced by 3·5MHz type bandspread aerial, mixer and oscillator coils. C28 is 2000pF.

For switched 2-band working, which has also proved successful, the VFO2 unit can be adjusted to cover about 1·75-2·0MHz. The 1·8-2·0MHz sector is used for 160m, and the 1·75-1·9MHz section for 80m. For 80m, one-half of L3 is shorted by an on-off switch near L3, and connected from VC3/4 to a centre-tap on L3. V2 anode circuit is switched from L2 to an 80m coil, to double the v.f.o. frequencies.

In the receiver, a 2-way 6-pole switch is required, to transfer from 160m to 80m coils. An extra pole on this switch can change over the coils for V2. ■

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. 15
SHORT WAVE RECEIVER

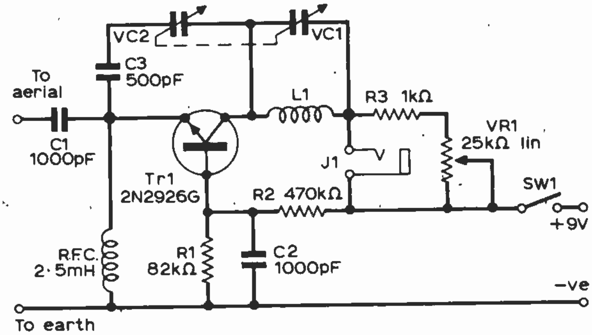


Fig. 1: The circuit of the one transistor short wave radio.

I CLEARLY remember the first project I ever tackled—a one valve short wave receiver; it took hours to build, especially the coil winding, but the final results were worth it. With the introduction of transistors things have become very much easier and the short wave receiver described here is the transistor equivalent of the frequently published "one-valve receiver" of a few years ago. The performance, though not comparable to a superhet, is quite good enough for the beginner and it will sort out the closely packed signals in the short wave bands with a 10ft. aerial. On the prototype 10 countries were logged in an hour and of course there were dozens of other signals that could have been identified with a little more patience.

In the published form the receiver should provide hours of fun but it is primarily designed as a starting point for experiments and at the end of the article I will give some clues on where to start.

THE CIRCUIT

The circuit may at first seem rather bewildering to the less experienced constructor. The transistor Tr1 is connected in the common base mode, an arrangement not often used outside v.h.f. tuners. The characteristics of this type of arrangement are low impedance input (about 50Ω), high output impedance (about 1MΩ), *no* current gain but high voltage gain. Additionally, the input and output are in the same phase and we make use of this in applying the regeneration.

The antenna is connected to the emitter via C1. The radio frequency choke (r.f.c.) connects the emitter to earth potential without losing any of the r.f. signal which cannot pass through it. The base of Tr1 is supplied with its bias by the potential divider R1 and R2, C2 smoothes the voltage. The tuned circuit comprises L1 and VC1. R3 and VR1 act as the audio load and the output is taken from across this to a crystal earpiece.

The unusual feature of this design is the method of feedback. Since the amount of feedback should be the same irrespective of frequency it must be arranged that the value of the capacitor gets less with the increase in frequency. This is usually done by using a separate variable capacitor but here we are using a double-ganged capacitor and we obtain the correct value of feedback level by padding it with 500pF. This will mean that the level of regeneration will be roughly correct whatever the frequency. However, since the level of feedback has to be *exactly* correct for maximum performance in this type of receiver, a fine adjustment is obtained by varying the collector load resistor, VR1 achieves this.

★ components list

R1	82kΩ 10%, ¼ watt	VC1, VC2	250pF + 250pF ganged
R2	470kΩ ,,	RFC	2.5mH choke, miniature
R3	1kΩ ,,	Tr1	2N2926G
VR1	25kΩ lin. pot with switch	L1	See text
C1	1000pF	J1	Earpiece output jack
C2	1000pF		
C3	500pF		

CONSTRUCTION

We are limiting ourselves to 20s. in this series and VC1 and VC2 will take a handsome section of this, so if we don't want to go over the limit we shall have to wind our own coil. This is a very simple business and all we need is the plastic housing from an old "Bic" ball-point and a couple of feet of wire. Two holes should be drilled through opposite faces of the hexagonal (six-sided) body and thirty turns of wire wound around it using the holes as terminal anchoring points. The type and gauge of wire matters very little, anything between 20 and 36 s.w.g. will do—even plastic covered hook-up wire will do for those without a supply of enamelled copper wire. Figure 2 shows the construction of this. Coverage with this coil will be from 5 to 15MHz but this will depend on the actual capacitor chosen.

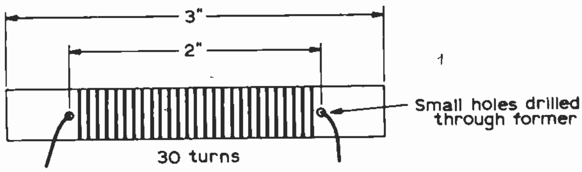


Fig. 2: The construction of L1.

Note that the common connection of VC1/VC2 is not at earth potential, it is connected to the collector and therefore it will have to be isolated if a metal chassis is used.

Layout should not be too critical but do not try crowding the components—construction on tag-strips would probably be the easiest.

continued on page 222

VOLTAGE STABILISATION

I. R. SINCLAIR

THERE is hardly any piece of electronic circuitry which does not employ some form of voltage stabilisation, meaning that the voltage at some point is held steady despite variation in supply voltage or in current drain. The voltage from a power pack can vary in both ways; when the mains voltage varies, then the output voltage varies in the same ratio, and when the current supplied by the power pack increases the output voltage falls because of the drop across the internal impedance of the power pack.

The simplest and least effective form of voltage stabiliser is the decoupling capacitor (Fig. 1). When the supply voltage changes, the voltage across the capacitor changes much more slowly, so that the voltage is stable for a short time. In this way *rapid* changes of the input voltage (occurring in a time shorter than the time constant of the decoupling circuit) are stabilised.

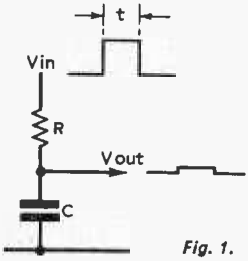


Fig. 1.

In addition, any extra demand for current by the device connected to the capacitor can be supplied from the capacitor (which stores an electric charge) for a short time so that the voltage is also stabilised against rapid changes of current.

These effects are illustrated by the use of decoupling circuits to prevent feedback of audio output to earlier stages of an amplifier as in Fig. 2(a) and by the use of a decoupling capacitor on the screen connection of a valve (to prevent negative feedback due to voltage variations as the current varies) as in Fig. 2(b).

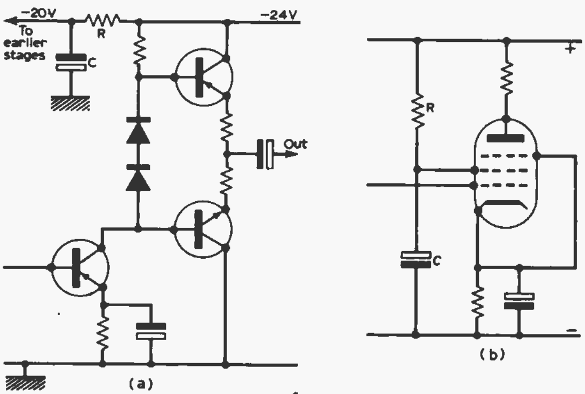


Fig. 2: Typical decoupling circuits utilising a capacitor C

The use of a decoupling capacitor, however, is not very effective when very low frequencies are concerned (hence the problem of stability in high-gain amplifiers having good low frequency response) and is quite ineffective when the steady voltage must be controlled, as for example, in an oscillator circuit where the frequency of the output is affected by the supply voltage.

In pulse circuitry also, voltage stabilisation is almost essential to avoid large pulses at one part of the circuit affecting stages which are easily triggered. Finally, when a power supply is used to test "breadboards", it is much more satisfactory to stabilise the power supply than to have to build in decoupling at every stage of the circuit under test.

Apart from the feature of stabilisation, many stabilised supplies can be varied in voltage, and this feature may in itself be extremely useful. A variable voltage can, of course, be obtained from a normal power supply if the mains feed is through a variable transformer or if a potentiometer is used to tap down the output.

The first method costs more than stabilisation, however, and the second considerably raises the impedance of the power supply, so causing large voltage variation when the current drain changes.

Stabilising Elements

All voltage stabilising circuits require some source of *reference voltage* to which the output voltage can be compared or from which the output can be taken. The three reference sources most often used are gas reference valves, zener diodes, and batteries.

Gas stabilising valves (Fig. 3) are diodes containing one or more of the rare gases found in very small quantities in the air (neon, argon, krypton) at a low pressure. At a low voltage between anode and cathode, no current flows, but at a certain voltage, the *striking* voltage, the gas is ionised and current passes, causing the gas to glow.

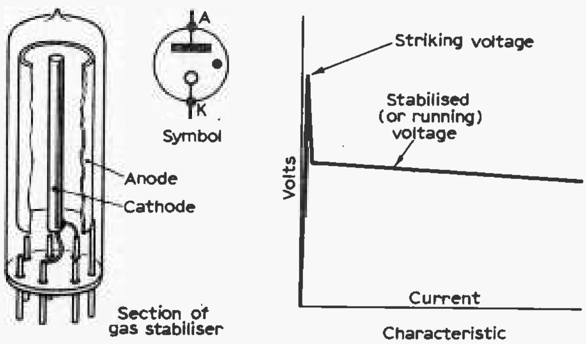


Fig. 3: Cut-away view of gas stabiliser and its characteristics (right)

At the same time the voltage between anode and cathode *falls* to a value called the *stabilised* voltage, and remains at this voltage almost unchanged for a wide range of currents. Gas stabilising valves, like any other gas-filled valve, must be fed from a resistance which can limit the current passing to a safe value, because the voltage across the valve *falls* as the current increases; compare this to a resistor, where the voltage across the resistor rises as current increases.

For this reason, gas stabilisers are said to have "*negative resistance*". The purity of the gas and the material used to form the cathode (usually a rod of molybdenum) and the anode (a cylinder of molybdenum or nickel) greatly affect the usefulness obtained with stable voltages of 45V, 75V, 80V, 90V, 105V, 150V and 180V (due to changes in the gas and other materials used), and the striking voltages which may be up to 50% greater.

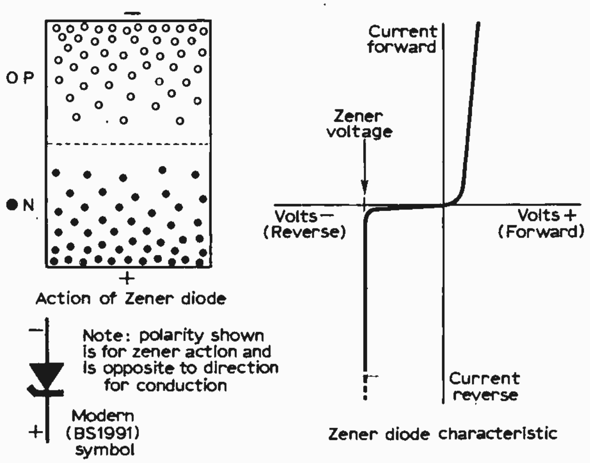


Fig. 4: The zener diode—semi-conductor equivalent of the gas stabiliser.

The zener diode (which should properly be called the avalanche diode) is the semiconductor equivalent of the gas stabiliser tube in its effects. When any junction diode has a reverse bias applied, a very small current flows due to the main current carrying charges in the semiconductor being attracted away from the junction (Fig. 4) leaving only the charges which are present in smaller amounts. As the reverse bias voltage is increased, however, the charges which are carrying the small current make more violent collisions with the atoms of the semiconductor, releasing more charges capable of carrying current. These in turn are accelerated and generate other charges by collision so that the current increases very greatly for only a small change in voltage. This process of creating new charges by collision is very similar to the process called avalanche multiplication which takes place in gas stabilisers, and has the same effect, that the voltage is almost steady for a very wide range of current when this effect is taking place.

Zener diodes can be made for a wide range of voltages from 1·5V to 180V and an equally wide range of dissipation from ⅛W to 50W or more, but the higher voltage and higher wattage versions are very expensive.

It is worth noting that a zener diode acts as a diode when biased forward and stabilises when biased back so that zener stabilisers appear to be connected the wrong way round at first glance. By comparison, gas stabilisers act only as stabilisers and have no diode action where biased oppositely.

Batteries can also be used as sources of fairly stable voltages. Though dry cells have a high internal impedance making them unsuitable for maintaining a stable voltage when the current drawn varies, they can be used as a reference supply whose voltage is fixed providing that practically no current is drawn. Examples of circuits in which batteries can be used will be given later.

The simplest stabilising circuit consists of a resistor and a stabiliser gas valve or zener diode, as shown in Fig. 5. The resistor is chosen so that the current flowing through it is rather more than the maximum demand, and the voltage across it is the minimum power supply voltage less the stabilised voltage. When no current is being drawn from the stage, all the design current will flow through the stabiliser; when current is drawn, it is taken at the expense of the stabiliser.

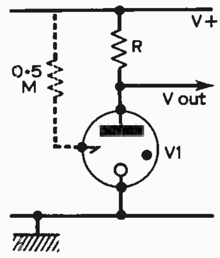


Fig. 5.

If more than the designed current is drawn, the stabilisation will fail, and the voltage will drop sharply. As an example, consider the problem of supplying 10mA to an oscillator circuit at 9V, given a "12V" supply which actually delivers about 12·5V at zero current drain and 12V when 10mA are drawn, Fig. 6(a). A 9V zener will be used as the stabiliser, and the difference between stabilised voltage and supply voltage (12—9=3V) must appear across the resistor when 10mA are being drawn.

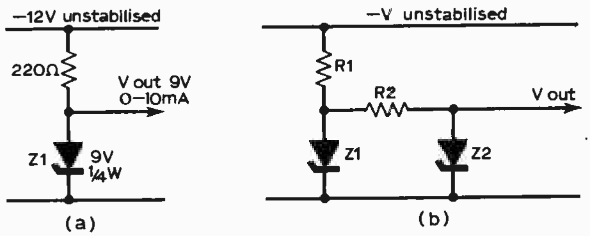


Fig. 6: (a) Simple zener diode circuit
(b) A second zener diode for additional stabilisation

Since most zener diodes require at least 1mA current through them to maintain the stable voltage, we shall design for a current of 12mA through the stabiliser, so requiring the voltage drop across the resistor to be about 3V at 12mA. Using Ohm's Law, V=R×I, this gives a value for the resistor of 3/12Ω=250Ω.

The nearest available values are 270Ω and 220Ω and to allow for a possible drop in the supply at 12mA, it is better to use the lower value, provided there is no likelihood of causing over-dissipation in the zener. When the load is not drawing current, the zener diode will be passing about 12mA; when the load is drawing 10mA the zener will be passing 2mA. The maximum dissipation in the zener diode will be when maximum current is passing at the stable voltage, i.e. 12mA at 9V=108mW and the maximum dissipation in the resistor is 12mA at 3V=36mW.

A $\frac{1}{4}$W zener and a $\frac{1}{8}$W resistor would therefore give adequate safety margins in this design unless the load shorted, when the whole 12V would appear across the resistor, causing a dissipation

$$\left(I^2R \text{ or } \frac{V^2}{R}\right) \text{ of } \frac{12\times12}{250} \text{ watts} \quad \text{or about } \tfrac{1}{2}\text{W.}$$

For the design to be "fireproof" therefore, the resistor should be rated at $\frac{1}{2}$ or $\frac{3}{4}$W. This calculation has been done in detail because many users of zener diodes are rather hazy about the dissipation calculation.

The design of a gas-valve stabiliser of this type follows exactly similar lines, but there is one important difference. The gas stabiliser will not pass current until the voltage across it has reached the striking voltage, so that the voltage input must always be higher than the striking voltage. If excessive current is drawn, the valve will cease to conduct, and cannot conduct again until the striking voltage is reached.

Excessive current drawn from a gas stabiliser therefore means that the voltage will drop sharply (due to the excessive current) and will be unstabilised until the current has dropped sufficiently to allow the voltage across the stabiliser to reach the striking voltage—this may mean a long period of unstabilised operation with large changes in voltage. A zener diode, on the other hand, has no striking voltage. The current increases smoothly as voltage increases, so that stabilisation starts again whenever the stabilised voltage is reached.

Simple stabilised supplies of this kind are quite effective where low currents are drawn, as for example, in the stabilisation of one stage of a circuit (perhaps an oscillator) or when a transistor radio is run from a car battery or a mains power pack. When greater currents are needed, the dissipation in the stabiliser becomes excessive.

When greater stability is required from a simple stabiliser, two stabilisers can be used in tandem as shown in Fig. 6(b).

Indirect Stabilisers

Circuits in which the stabiliser (gas or zener) no longer supply the current taken by the load are indirect stabilisers; almost without exception they use the principle of the cathode or emitter follower.

In the circuit of Fig. 7(a), the gas stabiliser controls the voltage of the grid of triode V1, which is connected with the unstabilised voltage to its anode and the load to its cathode. If the load current varies, the valve acts to try to maintain a fixed voltage at the cathode.

For example: if the valve used has a Gm of 5mA/V and is passing 30mA at the bias setting used, then an increase of 5mA in load current requires an increase in bias of 1V which means that the cathode voltage will drop by 1V. This could be otherwise put by saying that the output impedance is 200Ω (1V/5mA=0·2K=200Ω).

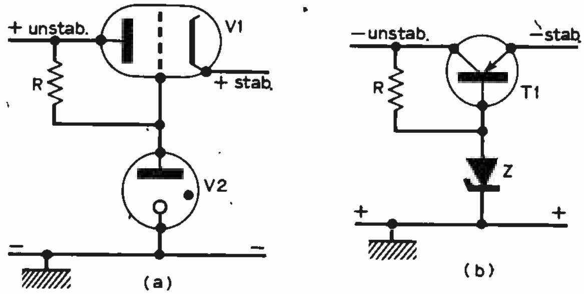


Fig. 7: (a) Gas stabiliser to control series valve stabiliser
(b) Semi-conductor version of (a)

Obviously, for stabilising in this way, the higher the Gm used the better is the stabilisation, and transistors with their high Gm figures (about 40mA/V for each 1mA collector current) make excellent stabilising stages at the voltages at which they can be used.

More Complex Stabilisers

The simple stabiliser is useful for many circuits where the degree of stabilisation does not have to be very great. The voltage can even be altered by taking the grid supply from a potentiometer fed from the gas stabiliser (Fig. 8), though this does not work very well with transistor circuits due to the base current drawn from the potentiometer.

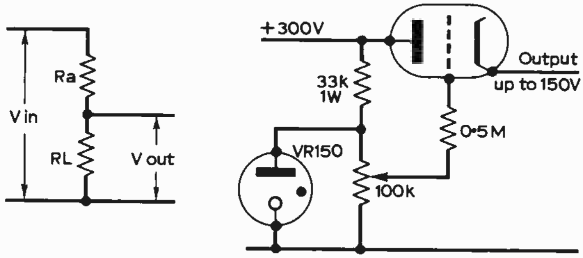


Fig. 8: Modification to permit variable stabilised output voltage

Fig. 9 shows a circuit which has been widely used. V1 is a pentode to which is applied both the gas valve voltage and a portion of the output voltage. The gas valve is used in the cathode of the pentode, and a bleed resistor ensures that some current flows through the gas valve even when the pentode cuts off.

The output voltage is divided by the resistor potentiometer chain and is applied to the grid, so that any change in output voltage is divided by the potentiometer ratio. This has the undesirable effect of reducing the stabilisation, and a capacitor is usually connected between the grid and the output line so that full stabilisation can be obtained against rapid voltage changes.

The bias on V1 is now the difference in voltage between the gas valves and the voltage at the potentiometer and this controls the current through the valve. Any change in this bias changes the current in the valve V1 which alters the voltage at the anode which in turn changes the bias on the series valve V2.

Note that the anode load of V1 is split between

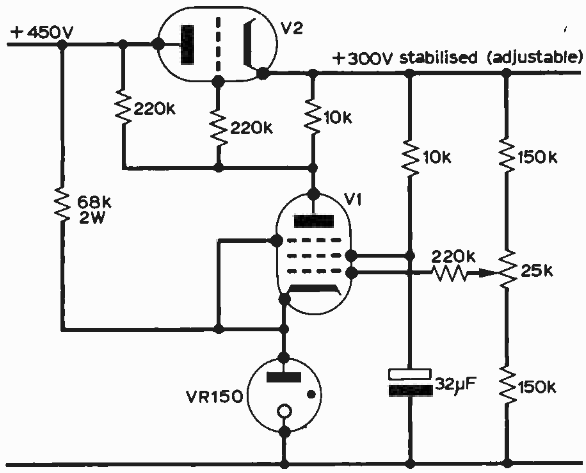


Fig. 9: Typical valve stabilising circuit with component values

output voltage and unstabilised voltage (to keep a voltage at the anode in the event of failure of the other resistor) and that a grid stopper is used between the anode of V1 and the grid of V2 to avoid excessive grid current if the load should be shorted out.

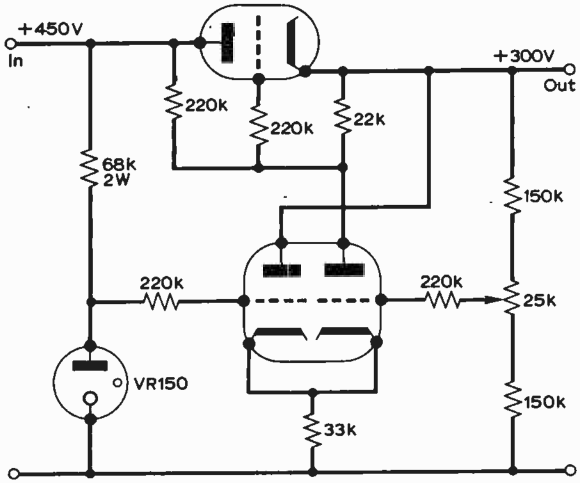


Fig. 10: Practical circuit using a double-triode instead of a pentode

A more elaborate stabiliser circuit is shown in Fig. 10. The stable voltage obtained from gas valve or zener diode is used to bias one half of a long-tailed pair, and the voltage obtained from a potential divider across the output is applied to the other half.

Notes On Design

Though the design and construction of a stabilised power supply is not particularly difficult, there is a sequence of steps which should be adhered to if trouble is to be avoided.

The choice of a series stabiliser is the first step. For low voltages, a power transistor will be the automatic choice, but for higher voltages both triode and tetrode (or pentode) valves are available. Generally, for the simple circuits where a gas valve controls the series valve directly, a pentode gives better regulation, but requires a separate supply for the screen. This separate supply may have to be obtained from a separate rectifier.

For the more elaborate circuits, a triode with high Gm and very low Ra is better. A valve such as the type 6080 can handle very high currents and has a large anode dissipation, but tetrodes and pentodes can give good results when connected as triodes.

The type of valve or transistor chosen depends very much on the rating of the power supply—the maximum current to be drawn must be less than the current rating of the series valve or transistor, and the power dissipated in the series controller must be within the rated value.

The dissipation in the series controller is the maximum current (Imax) multiplied by the voltage across the stage (Vv), and this voltage is equal to the unstabilised voltage (at maximum current) minus the stabilised voltage.

The rectifier stage must be able to supply sufficient voltage at maximum current to maintain a voltage across the series controller sufficient to pass maximum current through it. For this reason, transistors and triodes are preferred for elaborate series stabilisers, since they can pass large currents at low voltage differences. In general, for a 300V supply, a 350-0-350V mains transformer is the absolute minimum which can be used and many commercial designs use a 400-0-400V or 450-0-450V transformer.

Having selected the series controller, the maximum output voltage swing required from the amplifier stage is now known; it is equal to the grid base of the series controller. If, of course, a simple circuit is being used, design stops at the choice of the series controller!

The anode load for the amplifier valve is now chosen. It should be the resistor which will give an anode voltage equal to stabilised voltage minus half the grid base at a steady bias current of about 1mA; this is about the maximum load and minimum bias generally practicable, and some long-tailed pair valves may need more bias.

Remember, especially in the case of the circuit of Fig. 9, that the cathode of the amplifier valve will not be at earth potential, but somewhere around the voltage of the gas stabiliser. Having fixed the load and current for the amplifier, the cathode circuit can be designed, either a stabiliser valve for the Fig. 9 circuit or a resistor for the Fig. 10 circuit.

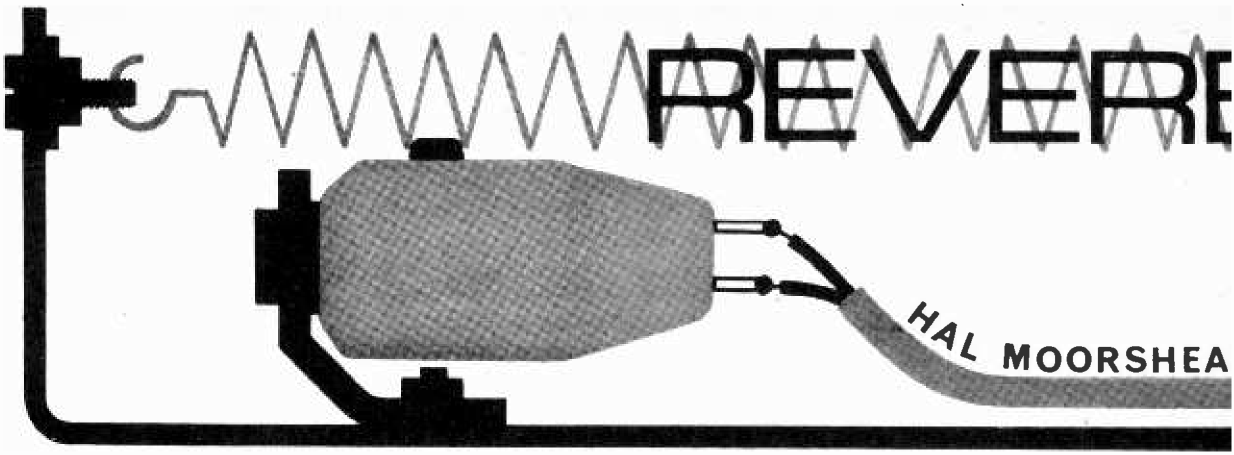
Since the current and voltage are fixed for one half of the long-tailed pair, the value of the resistor depends on the current used in the other half. If this is now chosen as 1mA also the value of the resistor is approximately:— Voltage of gas valve/2 in kilohms.

The rest of the circuit almost designs itself. The potentiometer chain across the output must deliver voltage, at maximum setting, equal to the voltage of the gas valve, and the minimum voltage is less than this by the grid base of the amplifier, so that the amplifier can be almost cut off. The output voltage can then be controlled smoothly from minimum to maximum.

Design refinements can then be added, resistors to ensure that the gas stabiliser stays running under all conditions, capacitors to ensure sudden voltage changes cause a quick response, etc.

When transistor stabilisers are being designed,

—continued on page 226



REVERBERATION is an effect which can greatly improve certain types of audio signal yet one which is underestimated and not greatly used outside professional recording studios. All of us have heard artificial reverberation frequently, even though we are rarely aware of it, because when used properly, it serves to make a sound *more* natural and not make it appear artificial.

A sound picked up on a microphone outside sounds very different to one inside because a tiny part of the signal picked up by a microphone will not be direct and will arrive after being reflected from walls etc. These reflected sound waves are almost impossible to identify by listening but although the percentage of these reflected signals is minute compared to the direct signal, their absence is very noticeable. In fact, to simulate 'out-of-doors' conditions in a studio involves special techniques and special rooms are used with high complicated sound absorbing walls.

Sounds with no vibration appear dead and the opposite applies—a sound containing reverberation takes on life.

The author has a fair interest in old gramophone records and has tried to improve the sound of these in several ways. It is a relatively simple matter to correct the frequency response of these and then to chop the bass rumble and the top scratch but anyone who has tried this knows that something is still lacking—in fact, reverberation is the missing link.

Although originally designed for use with old records, the unit can of course add "life" to any sound. Modern discs are normally superbly recorded and such a unit will add nothing, but recordings made at home can easily be improved.

Pop groups frequently make use of reverberation to increase the liveliness of their music but commercially available units are not inexpensive and usually need to be connected to additional amplifiers and mixer units.

The reverberation unit described here simply requires connection into the chain. It must be added that the unit has *not* been tested in surroundings of extreme high sound levels such as those produced by pop groups and use in this way could cause acoustic troubles since the spring used in the unit may be almost impossible to isolate from excessive sound. But for normal use—even with 12 watts operated in an average sized room—it has proved entirely satisfactory.

The 'delay' time in the prototype is extremely short but is more than enough to add life to a sound. However, the principle holds good and it should be a simple matter to adapt the unit to give longer delays.

DESIGN CONSIDERATIONS

The reverberation unit makes use of a delay spring —this is the principle adopted in most types—and it is necessary to drive this spring at one end with an audio signal and to pick it up at the other. The spring keeps the sound going for a few fractions of a second after it has been triggered.

Originally the unit was designed using telephone pick-up coils to drive the spring and to pick it up at the other end but experiments were relatively unsuccessful due to the high power needed to drive the spring.

The unit described here uses normal crystal pick-ups—the type nearly always fitted to cheap record players. These are very sensitive and in practice proved ideal. These are widely available on the surplus market costing upwards of 7s. 6d.

High quality is not really necessary on the pick-up side because it comprises only a tiny fraction of the output but despite this, care was taken in the design of the amplifiers and other sections to keep the quality as high as possible throughout, bearing in mind that even minute distortion will add to the whole chain if introduced in the reverberation unit.

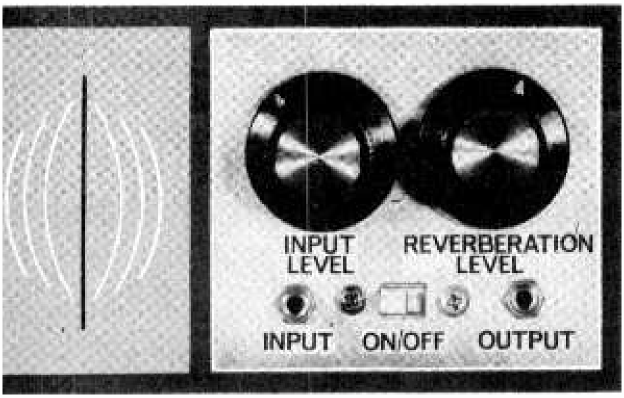
For versatility an early prototype incorporated a method of altering the spring tension, thus providing a method of easily adjusting the delay time. There were considerable problems in this, though later in the article an alternative method is shown by adjusting the length of delay path. For normal use however, the unit as it stands should prove perfectly adequate.

THE CIRCUIT

The block diagram in Fig. 1 should indicate the general operation of the unit, this is included since the circuit—shown fully in Fig. 2—appears bewildering at first sight.

The input is connected directly to VR1. It is assumed that most readers are using transistorised equipment and this unit presents an impedance of 10kΩ which should suit most equipment. There is gain in the unit and for use with high impedance equipment it is perfectly satisfactory to include a 330kΩ resistor at the input and increase the value of VR1 to 250kΩ as in Fig. 3a. This attenuates the signal but since low noise transistors are used no

ERATION UNIT



unacceptable factors are introduced when it is further amplified.

C1 couples the output of VR1 to the base of Tr1, a BC169C—a high gain, low noise transistor. With R1 acting as its collector load this first stage is directly coupled to Tr2, also a BC169C, which further amplifies the signal. R4 acts as the collector load and the output is taken via C3 to the drive crystal, X1. The emitter of Tr2 is raised to the necessary operating voltage by R3 decoupled by C2. R2 connects from here to provide the base bias for Tr1. This mode of connecting the bias ensures d.c. stabilisation.

If it is found that VR1 is nearly always at a near minimum setting (indicating high input levels) C2 can be left out or removed later. This will lower the amplification of the amplifier by introducing negative feed back thus also improving the quality.

If C3 were only to drive the crystal its value need not exceed 0.1μF since it is feeding a high impedance but in fact the output of this amplifier is also taken to the final mixer unit. It is necessary to amplify the original signal because of the losses introduced at the mixer.

The pickup crystal, X2, has, like the drive crystal a high impedance and it is important this is connected to a high input impedance, in this case Tr3 arranged as an emitter follower stage (or common collector as it is also known).

The input impedance, being high, necessitates a capacitor of only 0.1μF (C5). The input impedance of this stage is approximately the emitter resistor times the gain of the transistor, in this case about 800, giving a figure of about 800kΩ which provides a fairly decent match for the pickup.

The output from this matching stage is connected via C6 to Tr4, a 2N2926G, and this amplifies the signal which is finally coupled to VR2 via C7. The excellent properties of the BC169C are not really required for Tr4 but if desired one could be used here without any modifications to the circuit.

The output of the first amplifier, as we have already seen, couples to the drive crystal. It is also taken to the top of VR3 in the mixer.

VR2 and VR3 consists of a 25kΩ + 25kΩ ganged linear potentiometer and they are wired in

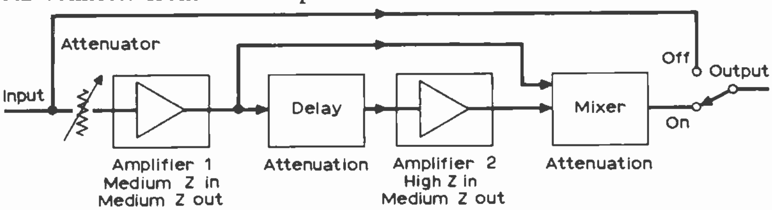


Fig. 1: Block diagram showing the basic operation.

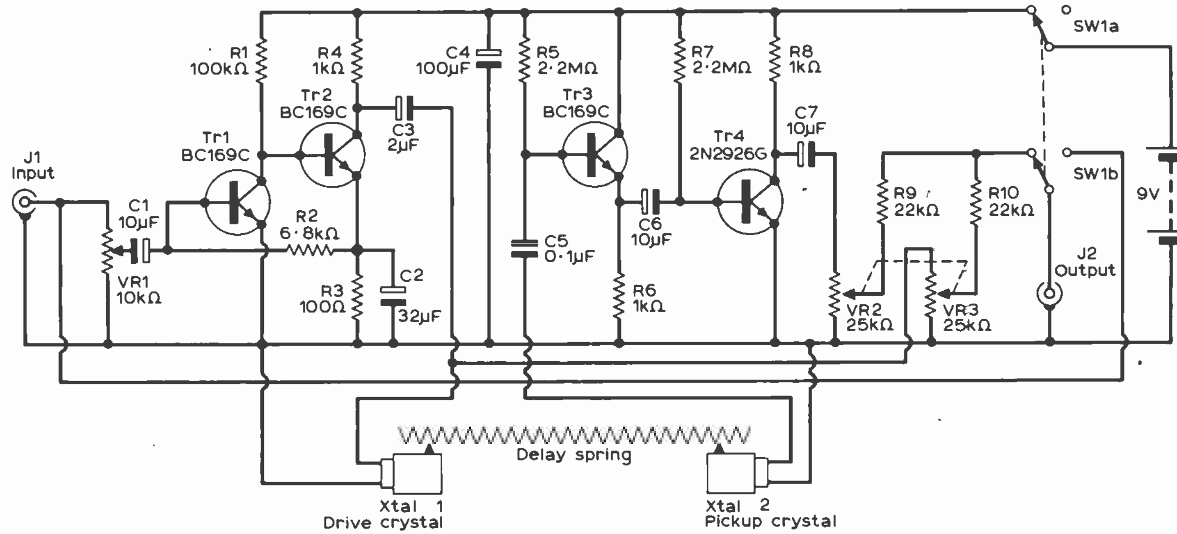


Fig. 2: The complete circuit of the reverberation unit.

such a way that when VR2 is at maximum, VR3 is at minimum and vice versa.

In this way one control provides a smooth transition from maximum reverberation to nil reverberation while always maintaining the same level.

To prevent interaction between the two sections of the control, R9 and R10 are connected to the sliders. The combination of these resistors and VR2 and VR3 give an output impedance of approximately 15kΩ which will be a close match to most transistor equipment.

If unity gain is required from the reverberation unit the output arrangement in Fig. 3b should be substituted.

To enable the unit to be connected at all times, SW1, a two-pole two-way slide switch, is connected in such a way that when the unit is off the input and output are connected directly together. C4, a 100μF capacitor, serves to decouple the two stages.

THE DELAY UNIT CONSTRUCTION

Although the delay unit comprises a simple aluminium chassis to which the pickups are fitted and to which the spring is attached, care is needed in the construction. Figure 4 shows the metalwork details which should be prepared first. If when constructing the unit it is intended to build a longer delay unit it is recommended that initially the unit is built on a chassis with a 6in. bed as shown. This will greatly simplify testing and later it will only be necessary to cut the chassis in half and add a few more holes around the existing components.

The springs used can cause quite a tension between the two upright sections of chassis 1 and 16 s.w.g. aluminium is needed to avoid distortion of the vertical members.

Slight modification is necessary to the pickup cartridges. First, both needles must be removed. It will be seen on inspection that a small spring device provides the locking in either the L.P. or 78 position. This must be removed and be replaced by a screw, usually 6BA. This will firmly lock the crystal relative to the mounting. The turnover knob can be removed and the spindle cut off if required, though this only improves neatness.

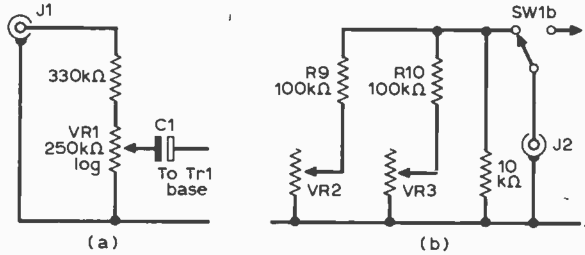


Fig. 3: (a) Modified input for use with high impedance source; (b) Modified output with attenuation.

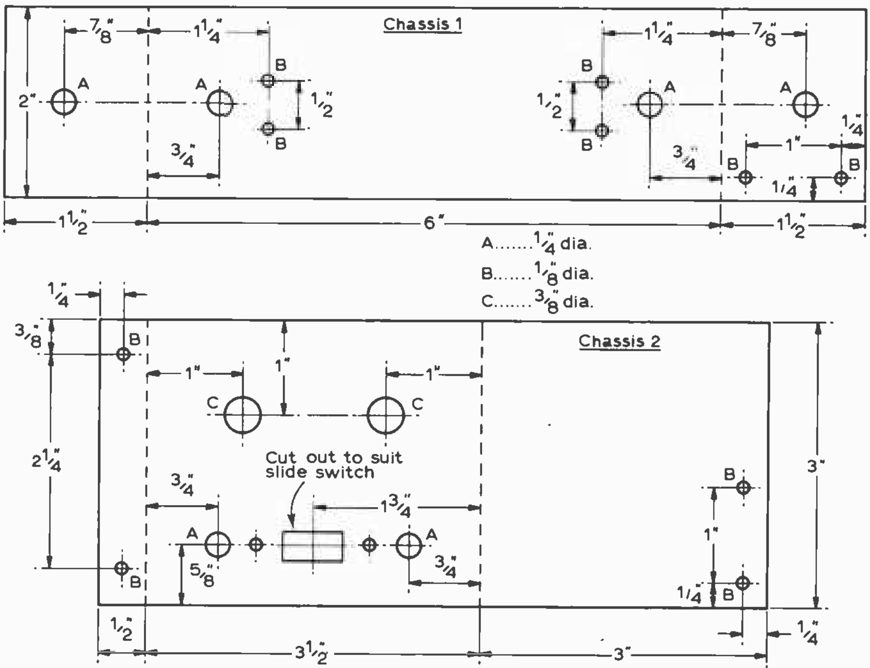
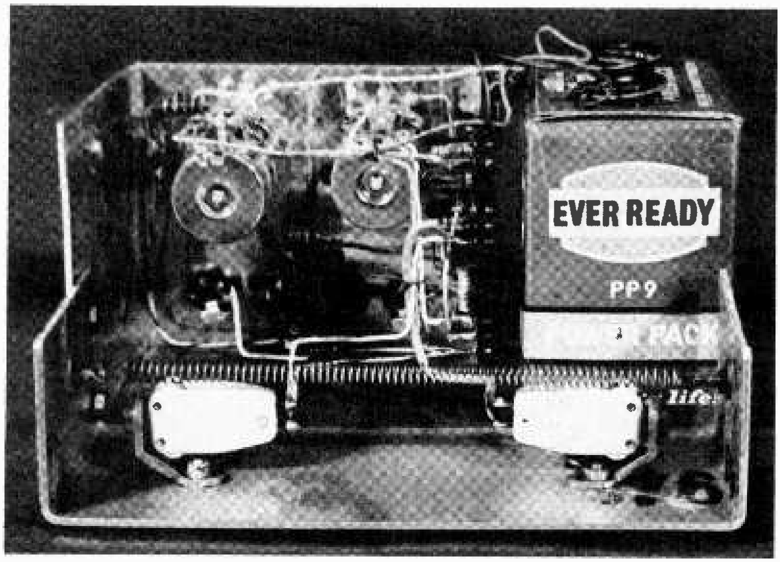


Fig. 4: The metalwork details for the two chassis.



Rear view of the completed unit.

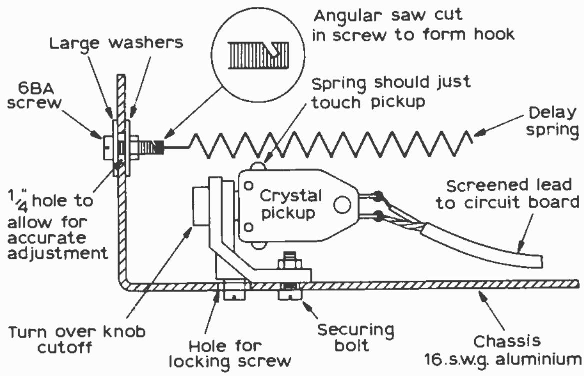


Fig. 5: The construction around the drive and pickup crystals.

The cartridges are mounted by means of 6BA screws passing through the base of the chassis and the oblong holes which are standard. These oblong holes make it possible to accurately align the cartridges if the holes are out.

A further hole has to be drilled in the chassis to take the head of the locking screw, its size is only important in that it should leave plenty of space for the head.

The spring itself is held by means of a 6BA screw with an angular sawcut as shown in Fig. 5. Before cutting, screw on a nut behind the area that will take the cut since when this nut is later unscrewed it will clear the odd burrs created by the cutting. Fit the head of the screw firmly in the vice and use a hacksaw at an angle for the actual cutting.

Two large washers should be fitted as shown as the screw passes through a ¼in. hole.

It is very important that adequate adjustment is allowed for with the spring hooks as the spring itself must be carefully positioned so that one coil *just* touches on to the plastic needle holder which transfers the movement to the crystal itself.

The spring itself should have it's final turn bent at right angles and shaped to lock onto the hook.

The choice of spring is not too important; it needs of course to be an expansion type of approximately ¼in. diameter. The length should be between two-thirds and a quarter of the length of the bed. Obviously the spring should not be expanded beyond its return position.

On the prototype the spring used was about 2in. long unstretched and was from an old BSR TD2 deck. The springs may well be available as spares but as previously mentioned its actual origin is not too important.

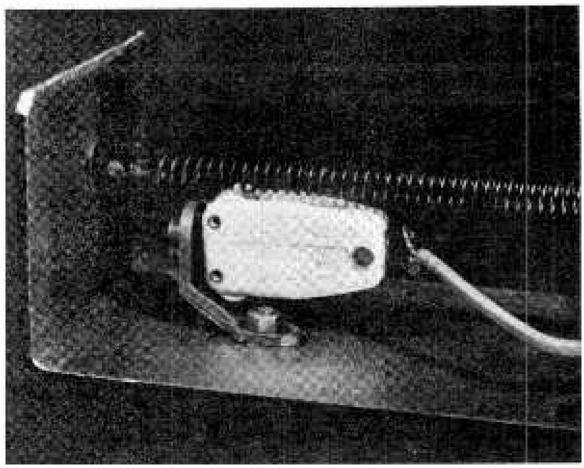
Figure 5 shows in detail the construction around one end only but in fact both ends of the delay unit are identical.

The front panel should also be prepared at the same time as the other chassis; the size and drilling details are shown in Fig. 4.

The two ⅛in. holes on the right should line up with those on chassis 1 to enable the two to be bolted together.

VR1 and the ganged potentiometer VR2/VR3 fit through the two ⅜in. holes and the input jacks fit into the ¼in. holes. SW1 is a two-pole two-way slide switch and as these vary in dimensions the cut-out and screw positions will have to be worked out by the constructor.

The narrow flap on the left hand side of this



Close-up view of the pickup crystal.

chassis is designed to hold the circuit board and two holes 2¼in. apart will line up with the holes made in this. The arrangement of the circuit board and control panel at right angles leads to a neat layout and one that can be worked on readily.

Once the control panel chassis has been prepared J1, J2, VR1, VR2/VR3 and SW1 should be mounted. A simple tag with one earth connection and one insulated connection should be mounted near VR2/VR3 to provide an anchoring point for R9 and R10.

Figure 7 details the wiring. Note that C4 is connected to the earthed tag mentioned above and to the slide switch as there is not sufficient room for it on the circuit board.

The input and output jacks are the 3·5mm type and it should only be necessary to connect one wire to these as the screw section is normally connected to the earthing tag.

Screened wires in this section are not really necessary since the impedances and the signal levels are fairly low.

THE CIRCUIT BOARD

The majority of the components are mounted on a piece of Veroboard, 0·15in. matrix, 2½ × 2in. (16 × 12 holes) with the strips running across the shorter side. 2½in. is a standard width in Veroboard and the 12 hole length can be cut from a longer length.

It is necessary to drill out two corner holes as shown with an ⅛in. drill for the mounting screws and to break the strips around this to stop the bolts shorting them out.

The copper strips are broken at J2 and G6 and jumper wires are connected from K1 to K7 and from L5 to L13.

The arrangement shown in Fig. 6 brings all the connections to row L and pins are soldered to holes L2, L5, L6, L7, L12 and L14 for connections to be made later.

As Fig. 6 shows, some of the components are mounted vertically while others remain horizontal. All transistors are mounted in their 'natural' positions, that is none of their leads are crossed. All of the transistors have one flat edge and if Fig. 6 is followed there will be no possibility of wrong connection. Make sure that all electrolytic capacitors are mounted the correct way round, polarities are shown in Fig. 6.

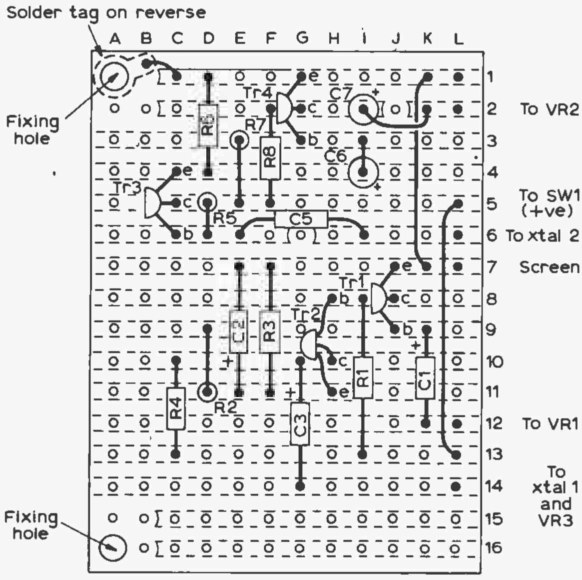


Fig. 6: The component layout on Veroboard.

When securing the circuit board to chassis 2 fit a solder tag under the top screw and run a wire to hole C1, this provides the negative connection; the battery negative lead also goes to this point.

Once the circuit board is fitted, the wires from the control panel can be connected to the pins as shown.

Wires must be run from L7 and L1 to X1, the drive crystal. These wires need not be screened as one side is at fairly low impedance. However the connection from X2, the pickup crystal runs from a high impedance to the high impedance presented by Tr3 and a screened lead must be used here. The inner should go to L6, the screen to L7.

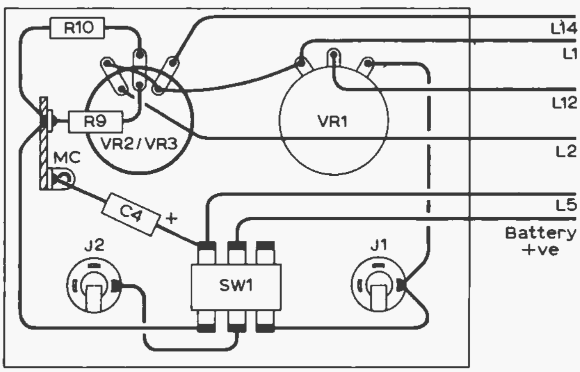


Fig. 7: Rear view wiring of the control panel.

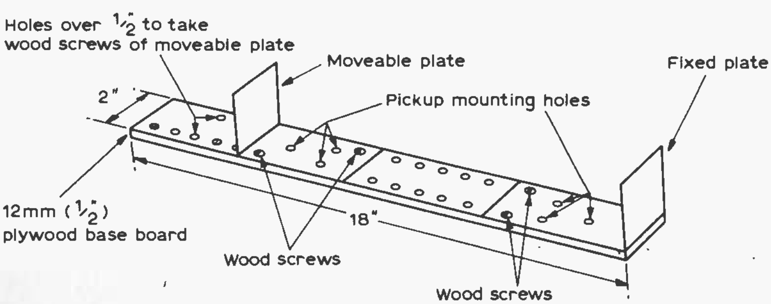
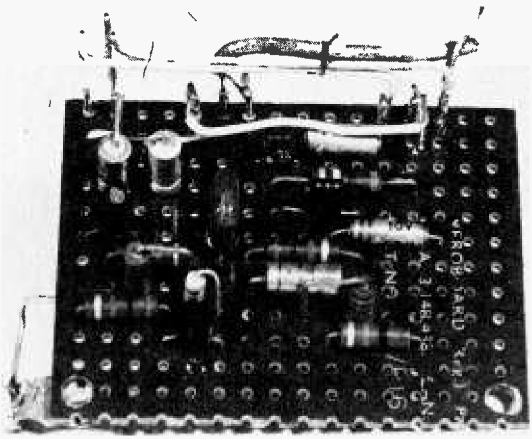


Fig. 8: Method of increasing delay period.



The Veroboard layout; compare this with Fig. 6.

OPERATIONAL NOTES

Once the connections have been made the unit is ready for testing. This is best done by connecting the input to the volume control on a transistor radio to J1 and using a crystal earphone with a 3·5mm plug in J2. The radio should provide a choice of different types of music and speech for testing. The reason for the crystal earphone is that it will not load the output and if there are any faults it is easy to connect a crocodile clip to the earth of the earphone and trace the signal through to establish the position of the fault.

When all is well, turning VR2/VR3 should now give a smooth transition between no reverberation and all reverberation. If a radio is used it will be noticed that the difference on music will be small but considerable on speech.

One problem that was envisaged by the author but which did not materialise was phasing. It could be that the outputs of amplifier 1 and amplifier 2 are out of phase and this will lead to no signal output—or a weird one—at the centre setting of VR2/VR3. Although not experienced by the author this may occur and the connections to one of the crystals might have to be reversed. If this does not cure it a different spring almost certainly will.

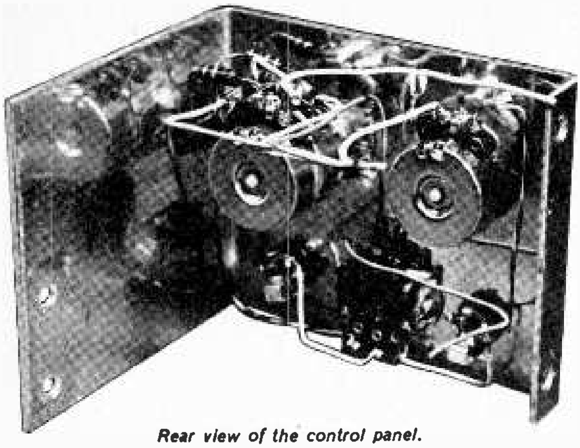
LONGER DELAY

Once the reverberation unit has been built and tested it is a simple matter to remove the delay spring and cut chassis 1 in half.

The right hand section (viewed from the front) should be screwed to a piece of 12mm (½in.) plywood 18in. × 2in. The other pickup section can then be sited at an experimental length of say 12in. from this and a longer spring fitted. A series of positions can well be drilled in the new plywood bed.

It is well worthwhile experimenting with various lengths and tensions of spring, bearing in mind the previously mentioned matter of phase relationship which may cause trouble.

Details of a cabinet are not given but this can be made easily from hardboard or plywood.



Rear view of the control panel.

★ components list

Resistors

R1	100kΩ	R6	1kΩ
R2	6·8kΩ	R7	2·2MΩ
R3	100Ω	R8	1kΩ
R4	1kΩ	R9	22kΩ
R5	2·2MΩ	R10	22kΩ

All resistors ¼ watt 10% types
VR1 10kΩ log.
VR2 + VR3 25kΩ + 25kΩ ganged lin.

Capacitors

C1	10μF 16V	C5	0·1μF polyester
C2	32μF 16V	C6	10μF 16V
C3	2μF 16V	C7	10μF 16V
C4	100μF 16V		

Transistors

Tr1	BC169C	Tr3	BC169C
Tr2	BC169C	Tr4	2N2926G or BC169C

Miscellaneous
Two crystal pickups; two 3·5mm jack sockets; slide switch, two pole two way; Veroboard 2¼in. × 2in. (16 × 12 holes) 0·15 in. matrix; PP9 9V battery; Insulated stand-off tag; metalwork and spring—see text.

However, make certain that the combined chassis are not fixed directly to the base but are mechanically insulated from it, using foam rubber, since the loudspeakers, which will presumably be operated in the same room, will otherwise cause acoustic troubles.

In operation the reverberation unit has proved entirely satisfactory, giving results better than hoped for, even using the extremely short delay of the 6in. bed. ■

THE MW COLUMN

SOME of the more exotic DX on the medium waves is heard in mid-summer between the hours of 0200 and 0400 GMT. Last year Kitwe, Zambia 1070kHz was logged on July 1st at 0255hrs by Harold Emblem of Warrington, Lancashire, and Johannesburg 1286kHz by Glyn Morgan, Tredegar, South Wales on June 22nd at 0230hrs. Others heard in this country are Dar-es-Salaam, Tanzania 629; Bloemfontein 782; Lourenço Marques, Mozambique 917; Pretoria 1268. New stations that could be logged at this time are Abu Dhabi, Qatar in the Persian Gulf, on 809; *Radio Yaounde*, Cameroon on 998 with 10kW; *Radio Angola*, Portuguese West Africa, also on 998; *The Voice of the Coast*, Trucial Oman 737.

During the evenings in summer, stations from the Near East are often logged. From 2100hrs onwards look for Riyadh, Saudi Arabia on 588kHz approx. (it wanders); Jerusalem 677; Aleppo, Syria 746; Beirut, Lebanon 836; Omdurman, Sudan 960; Diyabakir, Turkey 1061; Haifa, Israel 1097; Kuwait 1345; Shkodra, Albania 1394; BBC Relay Masirah Island 1410. The Greek Armed Forces operate a number of MW stations, two of which have been logged recently—Thessaloniki 1178 and an out-of-band and unlisted station on 1610kHz. Try the long waves for a change and some interesting DX in the late evening. The part of the LW band between 280 and 433kHz is clear of locals and contains a number of Asiatics plus a few distant Europeans. The regulars are Minsk, USSR on 281; Orenburg, USSR 300; Ashkhabad, Turkmenia 375; Kharkov, USSR 385; Minsk, 400; Oulu, Finland 433. A good outdoor aerial is an advantage on this band and a screened lead between the aerial and receiver should eliminate TV buzz.

It is now mid-winter in the Southern Hemisphere and we are at the height of the season for Latin American DX. Stations from the south of the continent appear at about 0130hrs GMT and gradually increase in strength until sunrise. Brazilian stations are usually very strong; look for PRA3, 860kHz, *Radio Mundial* in Rio de Janeiro; PRF4, 940, also in Rio; PRF8, 980, *Radio Nacional*, Rio; PRB9, 1000, *Radio Record*, Sao Paulo; PRG9, 1100, *Radio Nacional*, Sao Paulo; PRE3, 1180, *Radio Globo*, Rio; PRH6 1340 *Radio Guarani*, Belo Horizonte. The language used in Brazil is Portuguese. Spanish speaking Latin Americans include HJDK, 750kHz, *La Voz de Antiquoia*, Medellin, Colombia; CX16, 850, *Radio Carve*, Montevideo in Uruguay; LR3, 950, *Radio Belgrano*, Buenos Aires; OAX4U, 1010, *Radio America*, Lima, Peru; YVRS, 1020, *R. Margarita*, Venezuela; CB106, 1060, *R. Mineria*, Saniago de Chile; LR1, 1070, *R. El Mundo*, Buenos Aires; CB118, 1180, *Radio Portales*, Santiago; CX140, 1400, Tacuarembo, Uruguay. The *Voice of America* operates a station on Marathon Key in Florida on 1180kHz which broadcasts in Spanish and could easily be mistaken for a Latin American. This frequency is shared with WHAM Rochester N.Y. and *Radio Globo* in Rio, any of which may be heard.

CHARLES MOLLOY

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT • Frequencies in kHz

THE BROADCAST BANDS

Malcolm Connah

YET another month has gone by and still the number of reports to this page is on the increase; the first one this time comes from **C. R. S. Stacey** of Tunbridge Wells who has a Lafayette HA-700 and an indoor Joystick:—

4825 *Radio Ashkabad*, Home Sce. 1905-1945
4870 *Radio Ceylon*, Comm. Sce. 1707-1745
4965 *Zambia* in English at 1853-1928
4975 *Radio Dushanbe* at 1611-1637
21455 *VOA*, Tangier in English at 1435-1626
21480 *RSA*, S. Africa in English at 1800-1845
21485 *R. Australia* (Darwin) at 1417-1430

A new reporter this month is **V. P. Smith** of Banbury who does not say what equipment he uses but he managed to hear the following:—

9560 *R. Amman*, Jordon in English at 1706
9590 *R. Vilnius*, U.S.S.R. in English at 2230
11672 *R. Pakistan* in English at 1945-2030
11710 *RAE*, Argentina in English at 2300
11855 *Jeddah*, Saudi Arabia in French 2025
15160 *R. Ankara*, Turkey in English 2200-2230
15165 *R. Damascus*, Syria in English at 2030
15405 *R. Kuwait*, English news at 0800

Another new reporter is **R. Blakey** of Newcastle upon Tyne who used an R107 and a 50ft long-wire to hear some very interesting stations including:—

4810 *R. Popular*, Venezuela in Spanish at 0150
4980 *Ecos del Torbes*, Venezuela in Sp. at 0600
4990 *Barquisimento*, Venezuela in Spanish, 0600
5026 *Uganda* with news in English at 1800
9530 *R. Afghanistan* in English at 1800-1830
9545 *R. Ghana* in English at 2045-2215
15105 *R. Japan* in English at 2100-2130
15165 *VOA*, Philippines in English at 2200
15350 *R. Lebanon* in English at 1830
17895 *Free China* in English at 1800-1900

Roy Patrick of Derby sent in another interesting report. He starts by saying that he has logged *Radio Australia* on a new frequency of 21485 with sign-off at 1330, he believes that this is the Darwin relay station and he is correct in this assumption.

The full schedule from *Radio Iran* is as follows: Foreign Service on 17735 and 15135 with English at 2000, Roy has also heard these broadcasts on 7064. The Home Service operates on 11730, 7064 and 3998, and a number of regional stations operate as follows: *Radio Tabriz*, 6155, 7·5kW, 0220-2030; *Radio Rezaieh*, 6940, 500W; *Radio Sakandaj*, 6818, 400W; *Radio Gorgan*, 6520, 400W.

Roy has also received a press cutting from New Zealand which gives the news that the off-shore station *Radio Hauraki* has been granted a licence to operate a private commercial station in the Auckland area. *Radio International* which leases time from NZBC will also have a licence to operate a private commercial station in the same area. This is a reintroduction of private commercial radio in New Zealand.

S. J. Plant of Cwmbran, Monmouthshire, describes his equipment as "a domestic superhet complete with images, and the antenna used varies from a 30ft vertical (courtesy of T.V. rental company) to an 80ft long-wire end-fed." Some of the stations he heard were: *BBC*, Atlantic relay, Ascension Island on 15235 at 0730; *Radio Beirut*, Lebanon in English on 11785 at 0130 and on 11790 at 0230; *Radio Pakistan* in English on 11672 at 1950: and *Trans-World Radio, Bonaire*, Netherlands Antilles on 11820 at 0054.

Alan Crookes of Sheffield has a Unica UNR-30 receiver with a 120ft long aerial at 15ft and some of the stations he has heard are: *HCJB*, Ecuador in the 13 metre band; *Radio Sweden* in the 19 metre band; *The Voice of Vietnam* in the 19 metre band and the Windward Islands Broadcasting Service in the 13 metre band.

John Adams also of Sheffield has a Veritone CR-150 with a Joystick antenna and a Joymatch antenna and he received:—

15165 *R. Damascus*, Syria at 2050
15345 *Radio Kuwait* at 1655
17760 *Radio New York Worldwide* at 2100
21480 *RSA*, S. Africa at 1823
21595 *CBC*, Canada at 1638

T. R. Gibbs of Swindon sent in the following list of stations that he has heard recently: *Radio Damascus* on 15165 from 2145-2215; *Radio Ankara* on 15160 at 2300-2330 and *Radio Ghana* on 9525 at 1445-1630.

Radio North Sea International

At the request of several people who have written to me I will include some details about this station. At the time of writing the short wave transmitter is still off the air. On the 10th of April the station re-opened on the new frequency of 1578kHz and they were very apologetic about the interference that they had caused to essential communications services. On the afternoon of the 15th April, however, a jamming signal was broadcast by the Ministry of Posts and Telecommunications and the station went off the air. I understand that they intend to start broadcasting again as soon as they have had a chance to change their frequency again.

Anyone who is interested in these broadcasts may be interested in joining the Free Radio Association whose address is 239 Eastwood Road, Rayleigh, Essex. *R.N.I.* announced that reception reports should be sent to this address.

All reports, preferably in frequency order, should arrive at 58 Kensington Gardens, Ilford, Essex by the 17th of each month.

THE AMATEUR BANDS

David Gibson, G3JDG

A SUGGESTION for something a bit different comes in this month from Alan Gordon, G3XOI. He suggests that hidden stations in D/F hunts may well appreciate a signal report. Alan is often a hidden signal generator himself, running 700mW to 1W, and says he will QSL 100 per cent for SWL cards giving useful information on his sigs from ten miles or more. He is in the Chelmsford area and lists the following D/F hunts for topband enthusiasts to listen out for: June 14 and 21; July 19 and 26; August 23 and September 13.

The bands have been kind to the patient this last month. **John Young** (Oxted) logged half Europe on his Pye domestic receiver on 7 and 21MHz. **J. Hind** (Manchester) reckons that 2400 until the cock crows is the time to QRX on 7MHz if you want to bag the goodies. Fill in the time until midnight by digging a hole in the back garden. It'll be handy for a good earth and give the neighbours something to talk about, too.

David Robson (Co. Durham) admits that he is weakening and listening on the amateur bands when the BC bands are slack. (From killiwatts to milliwatts?) He says that the RA prefix is worn by v.h.f. types, but in the U.S.S.R. 28MHz is included.

High Logs

I have just joined the R.S.G.B. says **J. Martin** (Edinburgh). The receiver is a DFG 24/2 which duly reported signals on 14MHz from: AX3IAC, AX3MO, AX4ABJ, AX5MF, JA1JAN, JA1WOX, JA6PVR, PY1CAD, PY2BFO, PY7AOJ, PYØAWD, TF2WKP, TF5TP, W5IU, W6IZ, W7RS, ZM1BHO, ZM3DIJ, 4X4RW, 4X4WP, 4Z4BJH.

David Henbry (Rye), KW77, 7ft. vertical at 30ft. reports on some very nice 14MHz DX sigs from: AC3PT, AP5HQ, FB8WW, FK8BH, FO8AB, FR7ZG, KC6BY, KS6DH, KX6VF, TJ8AT, UA9VH/JT1, VKØHM, VQ9CD, VS5PH, YBØAAE, YBØAB, YK1AA, ZD5X, 9V1PM.

D. Brown (Kent), QP166, CR100/2, 45ft. end fed bagged these on twenty s.s.b. between 0600 and 0800: AX3AF, AX2PJ, AX2UDK, VE3AJK, VE2DDO, VK3LN, VK3OB, ZL3GE, ZL3UY.

M. Bayes (Surrey), 9R59DE, 100ft. long wire had a snuffle round 21MHz. Aromas *à la* r.f. from: CE3RR, CE6CA, CN8HL, CR6GA, CT2AT, EA6DJ, EA8AB, EL2BZ, EP2FB, ET3RU, HC1JC, HS5BD, JA1LCG, JA2LZN, JA3PDV, JA5FZR, JA6HSC, JA7GSN, JA8AHH, JAØCUV/P1, JH1FGS, JH1GNE, JR1VUH, JW7UH, K5QHS, KG6BZ, KP4OC, KR6HR, LU5DL, LX2LQ, MP4MBB, PJ9JR, PZ2AH, SU1CB, VE1ASJ, VE2AQS, VE3GCO, VE5NW, VE7ABB, VK5BB, VK5PB, VP9GE, VU2DK, W6OJO, W7IJX, WA5PDF/P/HC1, YA9VH, YV1SA, ZD9BM, ZE1GB, ZE2KL, ZM1AMK, ZM2MQ, ZM2NY, ZM3QM, ZS1AK, ZS2PD, ZS3TV, ZS6IW, ZX2DVH, 3Z8AJK, 3Z8JAC, 4U3OV, 4Z4HF, 5Z4LR, 7Q7BC, 9G1GD, 9H1BA, 9Q5FM, 9Y4MM. All these on s.s.b. with lowest report of 5 and 5.

A. Usher (Cheshire), B40, 80ft. long wire, determination, logged: AP5HQ, CR6GA, DU1FH, IRØCM, JA1WTI, JA6MBL, K6BW, K6ND, KR6UYC, TF2WKF, VU2OLK, VE5UI, VP7CG, VK2AN, W5BG, W6DQE, YD1CD, 9K2AV/A, on 21MHz s.s.b.

T. Maxwell (Lanarkshire) tells of hoards of a.m. Russian stations heard on 28MHz. Other stations heard on the CR7OA and 18ft. end fed include: EP2DX, SVØWK, UH8BX, UT5OF, ZS6BDD, 3V8AL and 9J2EJ, all on s.s.b.

D. Clark (Bucks) has just completed a homebrew receiver using a GC166 front end, single conversion with a 1·6MHz i.f. Topband, yielded a signal from 9H1BL at 469; while at the other end, on ten metres, Desmond raised: CR6GA, CT3AW, CX2CN, FL8MB, FR7ZW, HK3VA, HR2HHP, HS1ABC, KG6AAY, KR6HS, KV4AD, PY2DVH, PZ1CU, RAØABV, TG1AU, VQ8CW, VU2KV, YA1EXZ, YS2CEN, ZE6JN, 5H3LV, 5N2ABG, 5Z4MD, 8P6BQ, 9J2EJ, 9K2BG, 9X5AA.

Low Logs

I. Simpson (Newcastle upon Tyne), Marconi Guardian receiver, 120ft. end fed had a session on 3·5MHz from 2105-0230. Results of the vigil include squeaks from: CR4BC, CT1MC, EA8HA, GC3UML, HM5KD, KZ5AE, OD5DA, PJØHTR, TW3AX, VO1NP, VS6DO, ZX2DO, 5Z4KW, 9H1DA, ZS8AJK.

P. Johnson (Durham), RX6O, PR3O, a.t.u. and "various aerials" reports weak r.f. on 3·5MHz from: CT1MC, CT2AK, K1OVO, K2RSR/VP9, PY7BFN, TF3BV, TF5TP, VE1AIH, VO1FG, VP2VI, YV5BTS, 6W8DY, 9H1BA.

S. Ireland (Kent), PW Clubman Mk. II, 19 set variometer, 67ft. end fed has been burning the candle at three ends. Surveillance times were 2230-2400 and 0430-0630. Resultant vibration to the eardrums from: CO2FA, CT1BH, CT2AT, CR4BC, EA8HA, HC4BS, HK3WD, HK3ACN, HKØBKW, HP1JC, HR2PEV, JW7UH, JX8IL, KG4AS, KZ5DA, OA8V, PJ7CC, PZ1AH, TF5TP, TG9CD, PY7AF, VEØMS, VP2EX, VP2SY, XE1J, XE1KS, YV5BTS, ZL2BDK, ZL2AJQ, ZL2BCG, LZ4NH, ZM3GQ, ZM3AAY, 4X4UF, 6W8DY, all 3·5MHz. Steve queries the callsign OI3QA.

J. Cross (Dorset), AR88D, 60ft. end fed braved 7MHz and surfaced with: AX3AOW, AX3HW, AX3ND, AX7KJ, CN8MN, OA4AB, PY2EWL, PY4AP, VK2AVA, XE2IH, YV1AGT, YV2OV, YV4TI, ZS6BDO, ZL2PG, all on s.s.b.

D. Quint reports a heavy concentration of G stations on 7MHz, which is often a good starting place to begin listening to the DX.

Happenings

Very busy month is June especially for rally enthusiasts. Contests include: June 6-7th, N.F.D.; 14th, microwave contest (above 1,296MHz); 14th, DF event at Salisbury; 21st, 4 metre portable; 28th, DF event at High Wycombe; July 4-5th, 1·8MHz contest; July 4-5th, 2 metre contest. Mobile rallies: June 14th, Anniversary rally at HMS Mercury, Portsmouth; 20-21st, Anglian rally at Ipswich; 21st, rally at Singleton Park, Swansea; 28th, Longleat rally.

practically wireless commentary by HENRY

No. 70

Mods to Follow

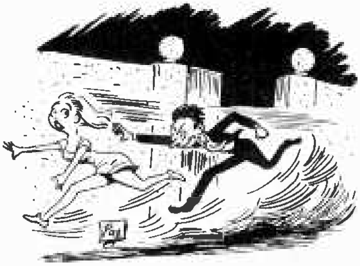
ONE knack I did learn at Oxford, said Alan Brien, was always to wait for the second edition of any work of scholarship. Only after all the author's friends and colleagues had courteously put the boot in could you be reasonably confident that major errors, ommissions and misprints were corrected.

I must confess that I feel the same way about radio and audio equipment. My son, who is one of these mad rallyists, assures me that the same 'second-thought syndrome' is evident in the world of the automobile. He, and I, would not dream of purchasing a prototype, even if we could afford anything better than a 'one-owner, low mileage' second-hand model.

I can only hope that these remarks do not make too many readers glance nervously over their shoulders at that gleaming 'new' radio which has just been added to their insurable assets.

Those of us who are on the mailing lists of equipment makers are accustomed to receiving regularly the details of modifications to current equipment. The process begins even before we have unpacked the first of the new models—as if some Johnny in a white coat stood at the factory gates shouting: 'Bring that back, I haven't finished making it yet!'

Sometimes it seems pointless; half a sheet of foolscap wasted on the instruction, '. . . for watts read Watts' or a note that where a green wire is fitted the non-existant black will no longer be used for an earth return. But at other times one studies the list of necessary alterations, mentally tots up the cost of the time needed to make them, deducts it from the profit on the sale and offers up curses.



One knack I did learn at Oxford . . .

Buttin: why can they not perfect the equipment before it is allowed to leave the factory?

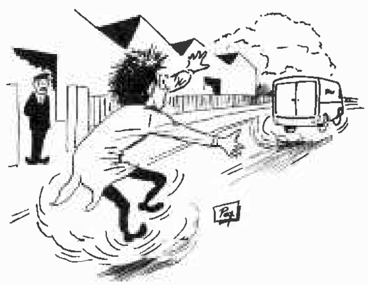
Henry: well, I don't rightly know. Let's ask that Production Manager who just by chance happens to be passing through the office.

He, poor chap, has to waffle grandly about 'a continuing policy of improvement' to hide the fact that he blames it all on those lazy blighters in Design. They, with some justification, pass the ball back into production's court, and have a sideswipe at Inspection on the way.

'We are given a basic specification,' says an earnest-looking graduate. 'And we mock-up a working model. From there, someone else takes over and costs it—'

'—and what comes out is nothing like the ruddy original," muttered his breadboard man. Fairly new to the game, he still resents his work being eschewed in the name of the great god Economy.

After that, the production line starts swinging along and several hundred sets have been made, tested and packed before somebody realises that changing the rectifier from ABC rating to XYZ means that the electrolytic capacitors are going to last about as long as it takes the first dealer to demonstrate the junk. Immediately the modification sheets are drawn up . . . 'we leave no stone unturned . . .' and better capacitors are forwarded to distributors. Then it strikes some boffin that the resultant surge is going to strain the emitter load of the output pair . . . 'in our quest for perfection . . .' and another emendation is made.



"Bring that back, I haven't finished"

But what about us? You and me, Joe. We may have bought a Superset Special, pristine fresh in its polystyrene packing. Shall we feel confident that we have got the ultimate in Superset design, or will there always remain that niggling doubt that there have been modifications that we shall never know about?

I think of all those owners of Mark I Buzz-Box amplifiers who have been uneasily accepting a hum level like the noise that the BBC are currently perpetrating on the West of England Home VHF (now that they have eradicated the whistle). Mark II models have the loudspeaker return lines earthed to a different point on the chassis than the outer end of a bus-bar where the input sockets are fixed.

Buttin: now you are inventing . . .

Henry: don't kid yourself. Some of these half-baked essays in construction that reach the showrooms would shame PW readers with any pride in their workmanship. And most of the time the inadequacy is due to sheer greed and shortsightedness—a rush to get the thing onto the market before it has been thoroughly developed. Every new set ought to be given a six-month trial run in a houseful of growing kids. And just now again someone in authority might care to listen to the criticisms that feed back from the dealer and his service staff.

EXPERIMENTERS CORNER

A NOVEL AERIAL FOR VHF

ARTHUR DOW

THE idea for this particular aerial came one day when the author found himself gazing absent-mindedly at one of those charming Chinese wall pictures that are to be seen occasionally in this country. These pictures are made of a frame of iron wire on which are mounted pieces of thin metal cut out to depict typical Chinese scenes such as pagodas, birds and farm animals, not forgetting the farmer.

However, the author, with his one-track mind, saw the wire frame as the basis of a u.h.f. slot aerial! Further thoughts developed along these lines and it became a ground plane and this led on to thinking about the DDRR aerial that to date seems to remain mainly a theoretical concept with little published information on successful practical applications, especially by amateurs.

The DDRR aerial, or to give it its rather clumsy full name of the Directional Discontinuity Ring Radiator, is vertically polarised normally and was first described by J. M. Boyer in 1963. Great things were expected of the design, which is basically a single loop aerial working against another loop on the ground or a ground plane which must be somewhat larger in area than the loop. (Fig. 1.)

The aerial is tuned to resonance by the variable capacitor and the feeder matched to the aerial by adjustment of the position of the feed point X. The various dimensions can be worked out for any particular frequency from the following formulæ:

$$\text{Height of loop H} = \frac{8{\cdot}5}{\text{F(MHz)}}\ \text{ft}$$

$$\text{Circumference of loop C} = \frac{252}{\text{F(MHz)}}\text{ft.}$$

$$\text{Feeder tap X} = \frac{28}{\text{F(MHz)}}\text{ft.}$$

The formula for the feed point assumes the use of coaxial cable of about 52Ω impedance.

In starting to work out a practical design one is immediately struck by the compactness of the aerial, especially in view of the claims made for its performance. Typically, on the 20m amateur band the height would be only 6in. and the diameter of the loop 54in.!

However, the author's immediate problem was poor reception of the BBC v.h.f. programmes. The commercial receiver in use has a built-in aerial consisting of a loaded dipole which gives fair results when correctly aligned with respect to the local station. Unfortunately, the receiver is also a piece of furniture and its unalterable position in the drawing room puts the dipole end-on to the station!

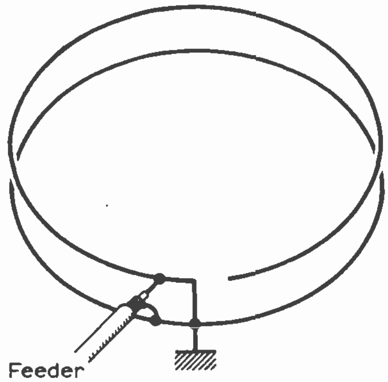


Fig. 1: Layout of the basic DDRR aerial.

It would, of course, be simplicity itself to put up an outside aerial but that project is a long way down the list of "things to be done". This is where the Chinese wall picture and the DDRR aerial came together and a design worked out for such an aerial which could be hung on a picture rail in the correct position for best reception, be near to the receiver and yet still be decorative.

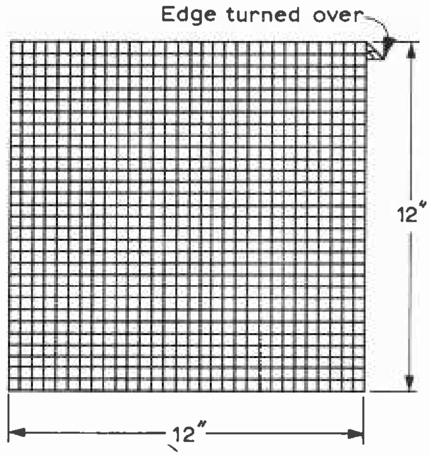


Fig. 2: Ground plane formed from wire netting.

Construction

The ground plane in this case is made from wire netting of about ½in. mesh with the top edge turned over to allow it to be hung on the picture rail. (Fig. 2.) The loop is formed from copper wire of 16 s.w.g.

bent to the shape shown, before fitting it to the ground plane. (Fig. 3.)

In the search for suitable stand-off insulators, some were found with soldering tags at each end and which were just the right height for the job. Three were used but more can be fitted for additional rigidity of the loop if thought necessary.

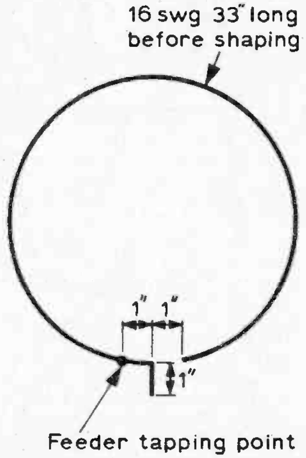


Fig. 3: Formation of aerial loop.

The loop is centralised on the ground plane and the end of the vertical portion of the loop soldered to the nearest convenient wire of the ground plane. The three insulators were then positioned and likewise soldered to the ground plane.

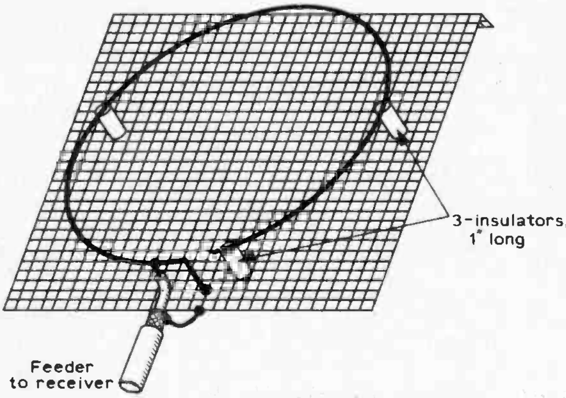


Fig. 4: Completed DDRR aerial for VHF.

A suitable length of 72Ω coaxial cable about $\frac{3}{16}$in. diameter was attached by soldering the outer braid to the ground plane and the inner conductor to the tapping point on the loop. A co-axial connector was fitted to the other end of the cable and plugged into the receiver after disconnecting the internal dipole.

The completed aerial (Fig. 4) was then sprayed with paint from an Aerosol can, the colour being chosen to match the decor of the room. Before painting, the insulators were temporarily covered with Sellotape to protect them.

When the aerial is hung up the ground plane is vertical and the polarisation horizontal as required for the v.h.f. transmissions. The aerial should be moved around until best reception is obtained. ■

CQ! CQ! CQ! CQ!

ISSUES FOR DISPOSAL

...all 1968 issues of P.W.—G. Taylor, 57 Woodlawn Road, Fulham, London, S.W.6.

...P.W. from June 1965 to September 1967 except for September 1965 and May 1967. S.A.E. for details.—D. Pearey, Hiatt Baker Hall, Parry's Lane, Bristol, BS9 1AD.

...copies of P.W. and W.W. from 1931 to 1939. The P.W.'s are 1946–47 and odd issues up to 1968.—L. Keyte, 31 Greenfields, Redditch, Worcs.

... a number of P.W.'s from 1955 to 1966. S.A.E. for details.—L. V. Thomas, 69 Haverstock Court, St. Paul's Cray, Kent.

...over 40 copies of P.W. (1967 complete) (1968 January to July) with blueprints. Sell or swap for stamp collection.—Cyril Timmins, 16 High Street North, West Mersea, Colchester, Essex.

...May 1965–April 1966, May 1966–August 1967, January 1968–March 1968.—S L.. Stanbridge, 45 Roman Road, Worting, Basingstoke, Hants.

...P.W. from December 1963 to February 1966. Will sell or exchange for translator components.—A. Beveridge, The Schoolhouse, Tibbemore, Perth.

...issues of P.W. from 1951 to 1966.—L. Levell, Popes Hill, Newnham, Glos.

...57 issues of P.W. from 1961–66 in excellent condition. 47 copies before 1961 in reasonable condition. S.A.E. please.—M. Pardoe, 3 Dunwell Avenue, Newby, Scarborough, Yorks.

...many issues of P.W. and P.TV.—J. Foy, 101 Sandringham Road, Birmingham 22B.

...P.W. from January 1956–April 1968 inclusive. Will sell or swap for anything interesting electronic or otherwise.—I. R. W. Bram, 38 Muirfield, Perth, Scotland.

...1968 issues January–November. Also Radio and Television Servicing 1966–67 models.—A. S. Holmwood, 8 Dock Street, Pembroke Dock, Pembs.

...copies of P.W. from 1959 to 1967 (42 copies).—E. D. May, 104 Northumberland Avenue, Hornchurch, Essex.

...P.W. July 1964 to April 1966, May 1966 to February 1969 and P.E. October 1965 to February 1969. S.A.E. for details.—I. P. Brockley, "Torbeth", New Road, Bignall End, Stoke-on-Trent, Staffs.

...30 copies (1950–1953) of P.W., 60 copies (1963–1968) of P.W. and 48 copies (1948–1952) R.S.G.B. Bulletin.—W. H. Booker, 45 Annesley Road, Greenhill, Sheffield, 8.

...most copies of P.W. from 1961. S.A.E. please.—P. Barrow-Maudsley, 1a Well Street, Buckingham.

...large numbers of P.W.'s and a full set of P.E. from start to May 1969. Offers.—S. Heap, 29 Broadway, Helmshore, Rossendale, Lancs.

...all 1964, 1965 and 1966 issues. All 1967 except July and the full set of 1968. Can only dispose of in years.—J. Currie, 156 Hillhead Road, Kirkintilloch, Dunbartonshire, Scotland.

...copies of P.W., P.TV and P.E. and 400 service sheets. Large S.A.E.'s please.—D. W. Robson, 125 Atkinson Road, Newcastle-on-Tyne, NE4 8XX.

...numbers of P.W. in very good condition.—A. S. Davy, 123 Chapel Road, Brightlingsea, Essex.

...many issues of radio magazines going back to 1946.—A. G. W. Thompson, Thursley Cottage, Church Road, East Molesey, Surrey.

...May 1963, September and November 1964, November and December 1965 and January and February 1966.—D. P. Matthews, 18 Queen Anne's Gardens, Bush Hill Park, Enfield, Middx.

...P.W. issues January to December 1968, January to October 1969 and Radio & TV Servicing 1966 '67. S.A.E.—A. S. Holmwood, 8 Dock Street, Pembroke Dock, Pembs.

...many issues of P.W., P.TV., W.W., P.E. and R.C. Will dispose of in years (12 issues).—E. T. Bradford, 160 West Drayton Road, Colham Green, Uxbridge, Middx.

...most issues of P.W. from 1943 to 1967. Sell or exchange WHY.—W. J. Anderson 18 Stuart Road, Welwyn, Herts.

...an almost mint copy of No. 1, Volume 1 P.W. Offers?—T. E. Phelps, 143 Barn Mead, Harlow, Essex.

BOOKS WANTED

...radio and Television Servicing volumes 61–62, 62–63 and 64–65. Details to P. Hoyle, 95A Pimlico Road, London S.W.1.

CORRESPONDENTS WANTED

...someone of my own age (13) who is studying for the RAE.—Kenneth May, 71 West Street, Erith, Kent.

...any reader who has modified and HRO. Also any reader who would be willing to sell me coil packs for this set and anyone who can give me information on the QP166.—Ian Burr, The Hollands, Lower Icknield Way, Chinnor, Oxon.

...a shortwave listener who is also interested in radio and electricity in England.—G. Eveleigh, 28 Reigate Avenue, Sutton, Surrey.

...anyone of my own age (18) who is interested in amateur radio in general.—W. J. Cowell, 35 Bare Avenue, Bare, Morecambe, Lancashire.

...anyone of my own age (11) who is interested in semiconductors.—Paul Mallon, 522 Tay Street, Invercargill, New Zealand.

...anyone who knows how to wire up a crossover network in an audio system. The unit I am particularly interested in is a Harrow 3-way crossover network, model HN-3.—T. M. Blea, 'Tilings', Fair Mile, Henley-on-Thames, Oxon.

...anyone of my own age (18) who is interested in short wave listening.—I. Simpson, 2 Taylor Cottages, Derryhale, Portadown, Co. Armagh, N. Ireland.

...someone who speaks English, is about 17 years old and who likes anything connected with electronics.—B. Cameron, 84 Pownall Street, Masterton, New Zealand.

TAPESPONDENTS WANTED

...boy or girl of my own age (17). I have Philips cassette recorder and a Grundig $\frac{1}{2}$-track machine with speeds of $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s.—Louis Smit, 42 Langton Road, Montclair, Durban, South Africa.

...girl with interest in Amateur radio or electronics. About 16 years old.—R. Collins, 17 Heathfield, Chippenham, Wilts.

...near my own age (17) from the Hong Kong, Kowloon area who are living in this country. I already have a pen friend in Causway Bay, Hong Kong and know a little about the area. My tape speeds are: $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s. and my hobbies are short wave listening, tape recording and photography and electronics.—A. M. N. Hoare, 4 Fairfield Drive, Whitburn, Sunderland, Co. Durham.

...someone of my own age (16) who is interested in electronics and radio. I have a Ferguson 2-track machine with speeds of $1\frac{7}{8}$ and $3\frac{3}{4}$ i.p.s.—R. Richards, 33 Rogers Road, Canning Town, London, E.16.

INFORMATION WANTED

...service sheet for an Ultra T491 radio.—D. Gregory, 53 Wellinger Way, Leicester, LE3 1RG.

...the addresses of the agents for Japanese transistor receivers and in particular "Challenge" agent. Also details of connections to amplifier and switching connections of the Minister Transistor Royal 410 tape recorder.—G. Kingston, Kruse Cottage, Trevidland, Liskeard, Cornwall.

...loan of theoretical circuit of Sound Sales amplifier type A-Z serial A.50/75 and tone unit C51/2.—R. V. Flexman, Horseshoe Cottage, The Haven, Billingshurst, Sussex.

A LIGHT Operated SWITCH

R. COLLINS

THIS unit will switch itself on automatically when light is dim and switch itself off again when light level increases. It is controlled by the varying amount of light falling upon an ORP12 light dependent resistor, (L.D.R.).

The ORP12 is a cadmium sulphide photoconductive cell and its resistance in bright light is between 75 and 300Ω and in complete darkness is greater than 10MΩ.

Care should be taken that the leads are not bent too close to the seal and heat conducted to the seal should be kept to the absolute minimum. The unit to be discussed contains a light-sensing element and an electronic switch using a "Schmitt Trigger" circuit.

THE SCHMITT TRIGGER

An example of the circuitry involved is shown in Fig. 1. Two transistors are employed with a common emitter load—resistor R4. Transistor Tr1 uses base bias network R1 and R3 which have their values selected to ensure that Tr1 is normally biased off. R5 and R6 comprise the base bias network for Tr2.

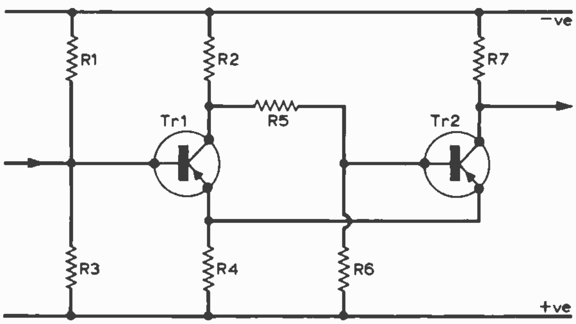


Fig. 1: Circuitry of a Schmitt Trigger.

Since Tr1 is normally off, its collector is near the full potential of the negative rail and Tr2 is biased on by a suitable choice of base bias resistor network.

Should a negative-going input signal be fed to the base of Tr1 and this signal be of sufficient magnitude to cause the transistor to begin to conduct, its collector will then become less negative, reducing the bias of Tr2 and so reducing its emitter current. This then results in positive feedback via the common emitter resistor R4 which increases the emitter current of Tr1 even further.

Cumulative action then takes places, switching Tr1 and Tr2 off. Should the input signal be removed, the circuit returns to its original state.

PRACTICAL APPLICATION

The circuit shown in Fig. 2 has an extra transistor added—Tr3—which carries the current to control the bulb used in the prototype. The voltage at the collector of Tr2 rises and this in turn raises the voltage on the base of Tr3 thus switching it on and causing current to flow through LP1.

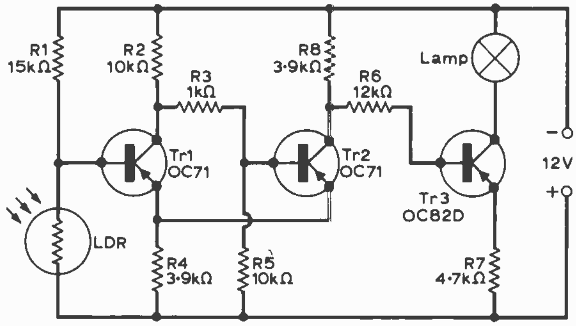


Fig. 2: The light-operated switch

Transistor Tr3 must be mounted on a heatsink so that it does not overheat and thus maintains its thermal stability. As it should not be made to pass a high current continuously thermal runaway is unlikely to occur.

ASSEMBLING THE UNIT

The circuit is assembled on a piece of Veroboard measuring $1\frac{3}{8} \times 1\frac{11}{16}$in. The layout and wiring of the components being shown in Fig. 3. The ORP12 cell is mounted so that it protrudes over an edge of the Veroboard and when the unit is mounted in a small

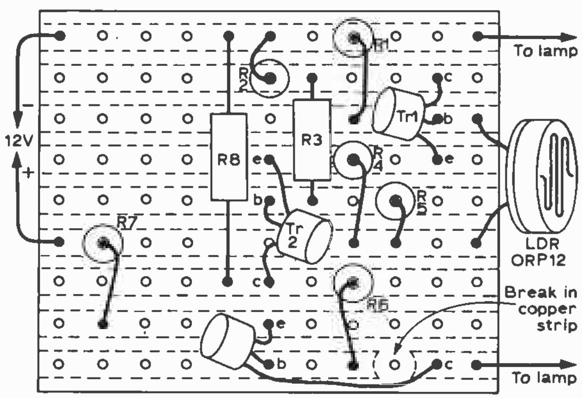


Fig. 3: Veroboard wiring and component layout.

plastic case, the cell can be mounted close to the plastic so that it can pick up the light easily (see photograph).

If it is decided to build the unit in a clear plastic case such as that illustrated, the case may be sealed with glue and so eliminate all possibility of dust and damp getting at the "works."

The mounting bolt for the Veroboard also acts as part of the heatsink for transistor Tr3 and is passed through the Veroboard and locked with a nut. A space of about ¼in. is left, then another nut is fitted. The heatsink is then slipped over the shaft of the bolt and secured with another nut. A washer is then used, the bolt passed through the plastic case and finally secured with another washer and nut. If too much of the bolt is left protruding, it may be cut off.

★ components list

Resistors:

LDR	ORP12	
R1	15kΩ	
R2	10kΩ	
R3	1kΩ	
R4	3·9kΩ	All 20% ¼W
R5	10kΩ	
R6	12kΩ	
R7	4·7kΩ	
R8	3·9kΩ	

Transistors:

Tr1	OC71
Tr2	OC71
Tr3	OC82D

Miscellaneous:
LP1, (6V 0·06A), heat sink for Tr3, 12V supply.

The reason the author did not insert this bolt from the outside of the case was that care must be taken to see that no nuts or washers short out the Veroboard strips and as a small-headed bolt was being use, it was thought advisable to mount it in the manner described.

The same care that one would exercise when soldering transistors (use of heat shunt, etc.) should be shown when soldering the ORP12 into the circuit.

USES

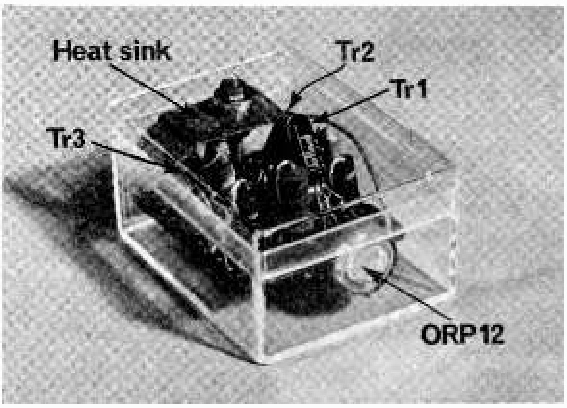
This versatile circuit may be employed in a number of applications. It may be used as an automobile parking light which will switch itself on automatically at dusk and switch itself off in the morning. As mentioned above, it should not pass a high current during the day time so that thermal runaway is unlikely to occur.

It is however very important that the completed unit when used in a vehicle should not be mounted near the engine which when warm may possibly affect the efficient working of the transistors.

Should the unit be built in a plastic box as described, a rubber sucker pad should be fixed so that the device may be mounted on either the inside of the windscreen of the car or on a flat metal surface inside. Some constructors may wish to glue a small bar magnet to the case in order that the unit may be attached to a metal part of the car.

The ORP12 should, when the unit is mounted in the vehicle, be placed in a shielded position, facing downwards and to the inside of the car. If this is not done, street lighting or the headlamps of other vehicles may make the device switch off the parking light!

It may be necessary to carry out a few experiments to find the best place to locate the automatic parking light to make sure that the light operates at the desired level of illumination.



Constructors should purchase one of the non-automatic parking lights that are available from garages and chain stores and which are designed to be clipped on to the side window of the car and which will, when illuminated, show a white light to the front and a red light to the rear.

It is possible that constructors building this unit may not be mobile and in this case other applications can be found. It may be used with a relay in the place of the bulb and used with a porch-light so that when it gets dark the unit will trigger the relay and switch on the light. ■

Take 20—*continued from page 203*

EXPERIMENTATION

The value of C3 should be chosen so that the tracking of VC2 gives the best possible results over the band. It will also be found to vary with aerial length and if an earth is used. VC2 and C3 can be replaced by a separate control and various types can be tried; where this is done R3 should be made 2·2kΩ and VR3 omitted.

Since the coil should cost virtually nothing to wind there is plenty of room for experiment in this direction.

Also try varying R2 by replacing it with a 500kΩ pot. with 47kΩ in series.

The value of C1 also bears experimenting with and the optimum value may well be less than 20pF depending on aerial characteristics. Other transistors can also be tried but some will be found to be unsatisfactory in that it will be hard to control the regeneration—this was found especially with the BC109. The f_t of the transistor should be at least 50MHz for satisfactory operation.

It is not an easy matter to add an amplifier to this set—though of course it can be done, since the amplifier could affect the operation of this very simple circuit. In the near future I will deal with this by describing a suitable amplifier in this series. ■

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POWER OUTPUT 70 watts RMS ±1 db at 8 OHMS.
FREQUENCY RESPONSE 20–20,000 HZ ±1 db.
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INPUTS VOL. 1 8 mV at 50K OHMS (mic).
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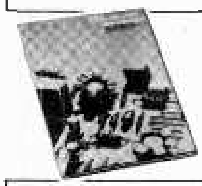
VOL. 4 50 mV at 500K OHMS (aux).
50 OHM and 600 OHM Mic inputs may be ordered at £2.0.0. extra per Input.
1 or 2 meg OHM aux inputs may be ordered at no extra cost.
FREQUENCY RESPONSE 30–20,000 HZ ±3 db.
SIGNAL/NOISE RATIO Better than – 65 db.
HARMONIC DISTORTION Less than 5% at 1 volt.
BASS Contiauously variable 20 db at 100 HZ.
TREBLE Continuously variable 30 db at 10 KHZ.
SIZE 12½" × 6" × 4½".
CUT OUT REQUIRED 11½" × 5".
FUSE 60 ma internally mounted.

Recommended Retail Price £24.0.0.



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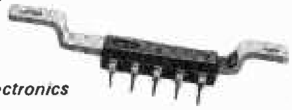

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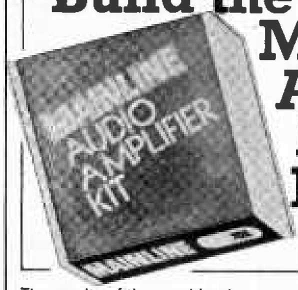

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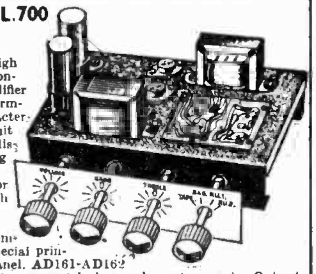

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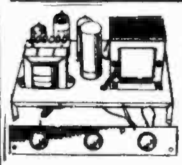

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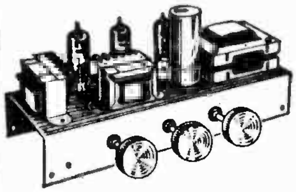

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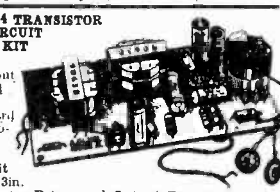

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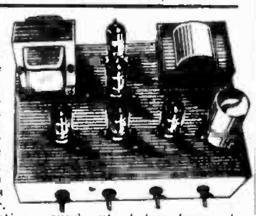

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

Mains Colours

Mr. Baigent of High Wycombe is one of many people who condemn the new mains-lead colours, merely because they are used to the old colour code.

I welcome the new colours as I can now wire up apparatus without any danger of wrong connections. This has proved difficult in the past since I cannot distinguish red from green and some rubber insulation left both these colours looking very black.

Any change that eliminates the need to reorganise colour is, in my opinion, a change for the better.—**J. Gallacher** *(Motherwell).*

Discarded material boxes!

As a YL radio amateur, since 1936, may I point out that I have had radio junk boxes since 1924, and, although obviously no longer a *young* lady, still have several. Also I have the usual "clobber" that women acquire through the years—cotton reels—(some empty —they make good door stops) cotton reels with varying amounts of cotton, and sylko etc., pieces of material, wool (well I may want to repair that old pullover one day) needles, pins, scissors, tape measure and so on.

The only real difference is that women do not call it junk! My dictionary says that "junk" is "discarded material". It does not say that it is unusable—there is untold treasure in them there boxes, so please all of you, respect each others; I know which I prefer! Oh, by the way XYLs (wives), never attempt to dust "radio junk", it might shock you!—**Constance Hall, G8LY** *(Lee on the Solent, Hants).*

A reader comments

I was particularly interested in Mr. Jobe's comments on sound from transistors (Letters, Feb. 1970). I also have come across this effect.

I constructed a phase shift oscillator using computer transistors and I found that when the oscillator was set to around 6kHz, one of the transistors merrily squeaked at 6kHz. I believe this may be due to the Peizo Electric effect.—**P. Everett** *(Hull).*

A cheaper way

I would like to comment on H. C. Bennet-Clark's article on the repair of loudspeaker cones. For loudspeakers with minor cuts and holes etc. it is rather expensive to pay between 12s. 7d. and 14s. 9d. for such a small job, so I bought myself a packet of tissue handkerchiefs and a tube of thin glue.

The method I employed was: apply a thin coat of glue to the speaker cone and to the tissue. Place the tissue on the cone and apply a little pressure. Leave this to dry then if required, add another layer of tissue and glue.—**Jim Mahoney,** *(South Ockendon, Essex).*

The printed circuit

I feel I must point out that in my humble opinion, the term "printed circuit" is in many cases misused. A printed circuit board is one that has components actually etched out on its surface during manufacture, whereas a printed wiring board has components mounted on to a sheet and connected by copper strips.—**M. L. Clayton,** *(R.A.F. Gutersloh, B.F.P.O. 47).*

XYL's unite

I cannot agree with F. G. Sadler, G3UZ, in his article "Home and Dry", February issue of Practical Wireless. Not every XYL conforms to the nagging, dense, insensitive creature he portrays.

The radio shack in our house is in a recess in the kitchen. It measures 6ft.×4ft.×12ft. high, and is filled from top to bottom. From where I am sitting, I can see my husband bent over his workbench (an old dining-table). On his left is a 7ft. high shelving-unit crammed with various wireless sets in various stages of construction, or destruction, boxes of transistors, diodes, condensors, valves, etc., etc., etc. A small panel of sockets faces him, ready to connect any of the umpteen cables that festoon the shack. On his right are some small shelves holding tools and meters—at least that is what they are supposed to hold. At the moment, I can see a speaker, screwdrivers of various sizes and a tangled mass of spare cable. Above all this is a loft, used for storing larger spares, such as whole wireless sets and cases which might come in useful for that thingummy he intends building when he can afford it.

If a howl of anguish or a heart-felt cuss-word issues from the shack, I know that my husband has reached for the soldering-bolt, while keeping his attention on a very delicate joint, and has found it sooner than he expected. But I don't let it worry me. If the bit breaks when he drops it, I'll allow him to buy another.

At the front of the shack, edging out into the kitchen, sits a hulking great B40 receiver. I was with my husband when he bought it, and have even learned what all the knobs, switches and dials are for. What's more, I enjoy it!

I must be one of the very few XYLs who are allowed to enter the Holy of Holies without protest. When I clean the bench I follow a very simple rule: Lift the article, dust under it, then replace it exactly as it was before. After all, there just might be an important reason for an expensive meter to be sitting right on the point of balance at the edge of the bench. When it comes to cleaning the floor I have another rule: Sweep round the larger objects, gather up the smaller ones which obviously have been dropped, then brush up everything else. Carefully sort through the dust, pieces of wire and cigarette ends, picking out the minute components, crocodile clips, screws, etc. Place all salvaged parts on a saucer and leave on a clear space (she must be joking) on the bench.

I do not, as Henry's wife seems to do, file magazines according to the colour of the cover. I bung them all in one ruddy great pile, sorted neither by name nor by date, and let him hunt happily, secure in the knowledge that it must be there, whatever it is.

As I write this, my spouse is almost strangling himself in a cable which loops from back to front of the shack, with a graceful but dangerous curl in the middle.

Perhaps I had better rescue him. Or would that be construed as interference?—**Morag Greer** *(Glasgow, W.4).*

NEXT MONTH IN

PRACTICAL WIRELESS

MODULAR 3 BAND S.W. RECEIVER

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A handful of components, quickly assembled, build up into this highly accurate Electronic Metronome. Giving sharp beats at a rate varying from 0·25 to 4 second intervals, this project has a wide variety of uses in hobbies ranging from music to photography.

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This transmitter will operate at 50 watts input on the five major amateur bands, from 10 to 80 metres. The main feature is instant bandswitching with a minimum of retuning between bands. A good solid design ensures success by any constructor.

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Don't miss your copy of the August issue of Practical Wireless —on sale 10th July—price 3s. 6d.

Voltage Stabilisation—*continued from page 207*

several points of difference emerge. First, the series transistor is easily damaged if the output is shorted, and commercial stabilisers use elaborate protection circuits. Secondly, all the amplifying transistors require a current drive to the base, and the zener diode and voltage divider circuits must be able to supply this current.

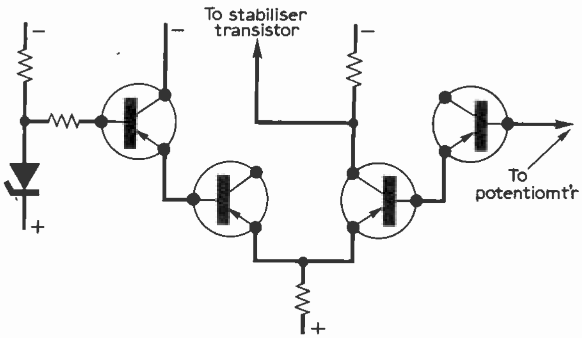

Fig. 11: Compounded circuit using semi-conductors

Thirdly, long-tailed pair circuits are usually compounded (Fig. 11) so that the final circuit can supply sufficient current drive to the power transistor used as the series stage.

More Advanced Methods

Many modern stabilised power supplies use a "prestabiliser" stage. This stage consists of a band of thyristors in place of the rectifiers of the conventional power pack and controlled from a source of stable voltage (gas or zener), so that the voltage output of the rectifiers is already stabilised against load variation and this can be done better when the conflicting requirements of main stabilisation are not required (as we have seen, good load current stability requires a low impedance output, good mains voltage stability requires a high impedance series valve).

The circuit of Fig. 10 is also found greatly elaborated with a valve or transistor used in place of the cathode resistor of the long-tailed pair, compounded long-tailed pairs, multiple series controllers, additional stages of amplification, etc. ■

BLUEPRINT SERVICE

We would like to draw readers' attention to the fact that the BLUEPRINT SERVICE has been discontinued and therefore no further BLUEPRINTS are available.

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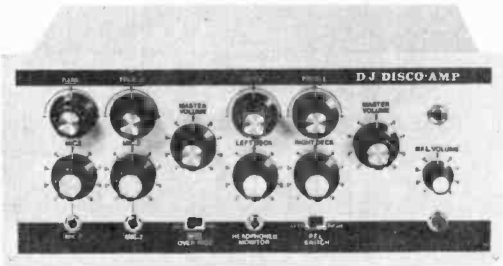
PRACTICAL WIRELESS, JULY 1970

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.

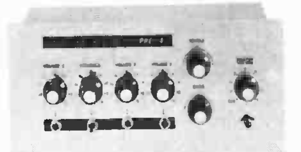
SPECIFICATION

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.

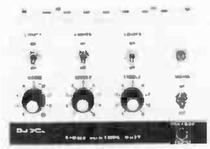
DISCOSOUND PRE-4



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.

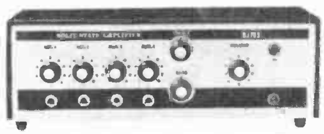
DJ 30L PSYCHEDELIC LIGHT CONTROL UNIT



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.

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GOING BACK... 1970 60 50 40 30 20

COLIN RICHES
ARTHUR DOW

FOLLOWING his editorial, "The Vintage Years" in in P.W. for May, another avalanche of letters descended on the Editor strengthening his conviction, if strengthening was needed, that P.W. should run a regular feature dealing with the early days of radio communication, or should we say "wireless"!

This is the first of that series and it is hoped that it will be possible to fill a much wanted need. We shall be including reviews of some of the equipment and of the experiments that were carried out in those early pioneering days. We shall not be forgetting contemporary stories and anecdotes some of which were incredibly prophetic!

How better to start this series than with a photograph of the 'father' of communication by wireless? But was Marconi really the first?

Marconi *1874-1937*

Let's hear some comments on this point, circa 1923 . . . "Lord Riddell attributes it to Clerk-Maxwell but Marconi himself holds that James Bowman Lindsay, who sent a message across the river Tay without wires about 1840, was the inventor" ! !

However, Clerk Maxwell's work was purely theoretical but it did point towards the possibility of communication by means of electromagnetic waves, his theory being published in 1864. It was Heinrich Hertz, in 1888, who proved the theory to be correct with his experiments with spark coils and resonators.

While early experimenters were able to detect radiation at short distances from spark discharges it is not so easy to decide who was responsible for putting the effect to good use as a means of communication.

It was Marconi, who, in 1901, demonstrated that electromagnetic waves could be detected well beyond the short visual ranges that had been obtained up to that time.

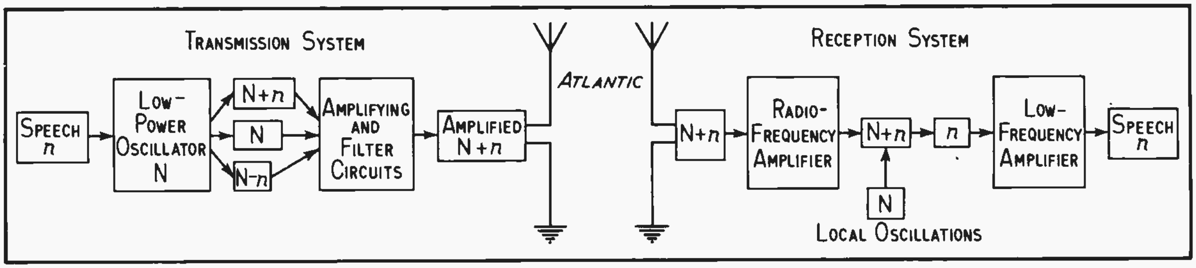
Utilising several tuned circuits in the transmitter at Poldhu, Cornwall, and in the receiver in Newfoundland, as outlined in the famous patent No. 7777 dated 1900, he was able to span the Atlantic by wireless for the first time.

Radiograms

"Will the aluminium chassis eventually entirely supersede the wooden baseboard which has held the field for so many years?? The ali chassis undoubtably makes a neater and more workmanlike job but for sheer simplicity and quickness of assembly the baseboard scores every time" (October 1932) *. . . looking at the modern version of the base board we seem to have got back to the point from whence we started!*

"The word selected by the *Daily News* as the prizewinner of their competition to suggest an alternative word to 'listener-in' was 'broadcatcher'. Other words suggested were radiolist, auditor, harker and Noah, the last being because they 'Ark!!! . . . *no comment!* (Febraury 1923).

"An improved amplifier is claimed to have been invented which will amplify the tone of the wireless voice, but not its imperfections" (March 1923) . . . *we're still waiting!!*



. . . SO WHAT'S NEW?

"The daily Press has recently reported on the successful transmission of speech from America to the British Isles. The achievement is the more remarkable in view of the fact that the transmission originated in a New York office which was connected to the wireless transmitting apparatus by an ordinary telephone line. At the time of writing no technical details have been published other than the fact that the transmission was accomplished on one 'side band', no carrier being used" (March 1923). *An excellent description of the system was given (see block diagram) . . . sooooh!! SSB is not so new-fangled after all!*

READERS COMMENT

. . . I still enjoy the "magic" of listening on a crystal set (*C. R. Gunn, Liverpool*).

. . . My first licence was obtained in 1921 (*Alfred Reeve, G & WN, Southampton*).

. . . It is almost fifty years since I acquired my first wireless magazine (*James Foye, Cornwall*).

. . . There is no doubt that the Twenties period was the heyday of radio experimentation (*E. J. Walker, Kent*).

. . . My—to me—priceless leftovers of that era are two books published in 1928 (*G. Valentin, Dundee*).

. . . The first radio broadcast I heard was in 1922 when I was allowed into a London pub for a few moments to listen to 2LO broadcasting from Savoy Hill (*P. W. Ellis, Hull*).

. . . In 1923 I acquired a double-barrelled crystal detector. The theory was that a crystal grabbed half a wave so that two crystals would get the lot with twice the volume (*R. A. Ball, Scotland*).

. . . One of my own favourite recollections is of a design published in the '30s of a 2-valve battery short-wave set (*J. W. Davidson, Co. Durham*).

. . . In the 1920-1930s radio was thrilling, exciting and wonderful (*C. Butler, Co. Durham*).

. . . I have a book of 1930 vintage. It is full of outdated methods and ideas but it is very interesting to be able to learn how radio was tackled in those days (*N. Taylor Suffolk*).

. . . I have been a reader for 40 years and have many fond memories of the early days (*J. W. Geoghegan, Wigan*).

. . . I am interested in the days when amateurs had to construct even the most basic of components (*P. J. Wardle, A6953, Co. Durham*).

. . . I would greatly appreciate reprints of early articles. They would bring back memories of the exciting past when radio was just really "growing up" (*G. J. Turnbull, C. Eng., M.I.E.E. Edinburgh*).

Vintage Radio Society

A final note . . . don't forget the Editor's offer to provide publicity for any efforts to form a Vintage Radio Society.

HYBRID MODULATOR

—continued from page 196

Now in carrier control systems, the peak carrier voltage is fixed by the h.t. supply and is approximately equal to it. So when the P.A. is loaded up, we in fact adjust the load resistance R such that the maximum P.A. anode current drops the whole of the h.t. across the tank circuit. When we subsequently reduce the P.A. anode current by half, then the voltage across the tank circuit will fall to half h.t. and the power produced to quarter peak power.

From the previous paragraph, two conclusions can be drawn. Firstly, as half P.A. current drops half h.t. across the tank circuit when correctly adjusted, it is obviously possible to re-adjust the effective load resistance to drop the whole h.t. and increase the output power as before mentioned. Secondly, the rating of the modulated carrier is only one-quarter of the maximum the P.A. can produce. For example, on top band, to produce a 10 watt modulated carrier, the P.A. must be capable of producing 40 watts of carrier on initial setting up! Anyone familiar with s.s.b. and linear amplifiers will realise that the same power considerations pertain. Just one final point about power output. Knowing the P.A. h.t. volts, one is used to looking at the P.A. anode current and quoting the mean P.A. power as the product. In this case, once carrier control is in operation the mean power is half the product of the h.t. and the anode current.

CONSTRUCTION

Since little power is dissipated in Tr5, the whole modulator can be built on Veroboard. If the P.A. valve employed has a low mutual conductance or runs with a mean current above 50mA when adjusted for modulation, the BFY51 will need to be replaced by a transistor capable of greater collector dissipation. A BD123 type should cope with almost any conceivable P.A. stage if mounted on a suitable heat sink.

One worthwhile check on the speech amplifier after construction is Tr3 d.c. collector voltage, which should be between 2V and 3V positive with respect to the common rail.

As crystal microphones vary greatly in their output, should the amplifier be found to be short of gain, R11 may be reduced until adequate gain is available. ■

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P & P 7/6.

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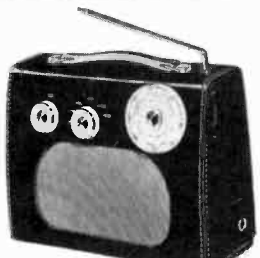


SEVEN FULLY TUNABLE WAVEBANDS—MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. Five Section 22in. chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak 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

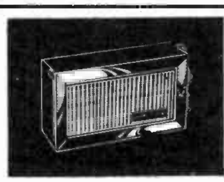
NEW! trans eight

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 5½ x 2⅞in. 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 1¼ 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

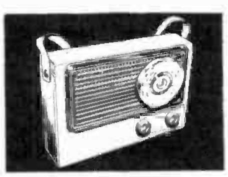
transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6¼ x 4¼ x 1½in. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. 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 5¼ 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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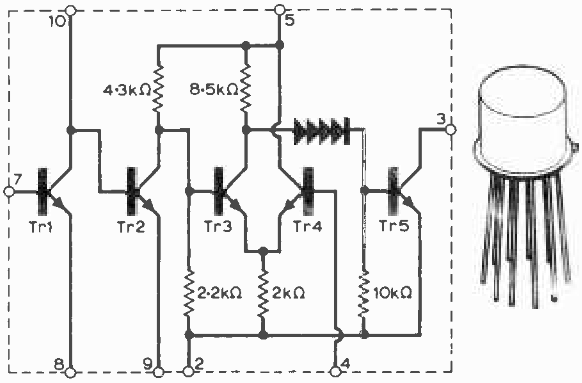
I.C. OF THE MONTH

L.A.J. IRELAND

Number 9 — Mullard TAA310 Audio Preamplifier

IT is a prominent feature of the semiconductor scene at the present time that as areas of high demand are identified, integrated circuits specially designed to fill the need are quickly introduced. It is not that general purpose units will cease to find a market, as the discrete transistor is still commonly used, but as manufacturers build up experience, and i.c.s become accepted, response to demand becomes more rapid, and a smaller production run becomes economically feasible.

One such device to be described this month is the Mullard type TAA310, a monolithic low noise audio preamplifier with specialised features for tape record-playback applications.

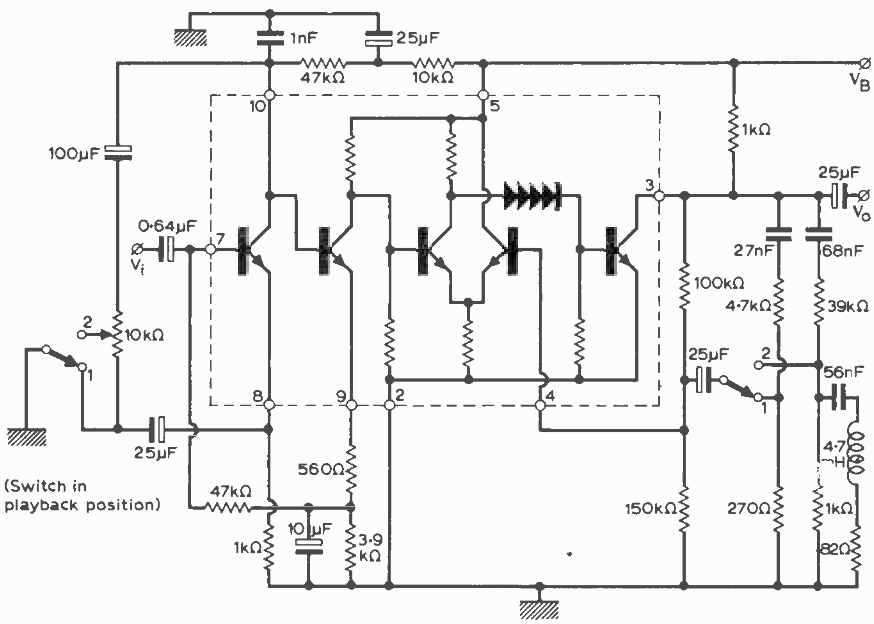


Circuit of TAA310 and package style.

Circuit

First, a brief look at the specification of the unit. In a TO-74 style ten pin package there is a five transistor, four stage, direct coupled amplifier, rated for the temperature range −20 to +75°C., with a typical gain (open loop, i.e. without negative feedback) of 100 dB, and a noise figure of 4 dB on a 7 volt supply.

In a practical circuit, the full open loop gain is not used; rather, use is made of the differential stage, comprising transistors Tr3 and Tr4, the third stage of the amplifier, to apply negative feedback. In a tape amplifier, the feedback loop is designed to have a frequency characteristic such that the ampli-



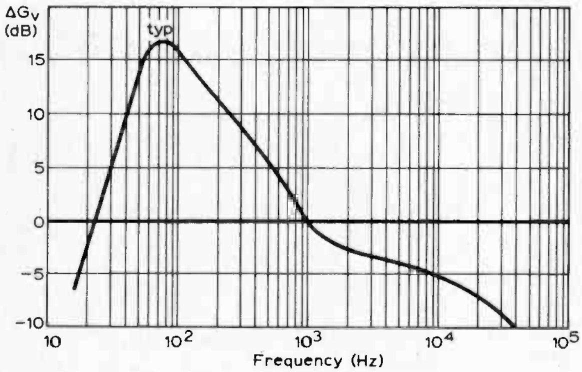
A practical circuit utilising the TAA310 integrated circuit package in a record/playback configuration. A simple switch is all that is required to change the amplifier frequency response from that required for record to that for playback as shown on the separate graphs.

fier as a whole will have a performance in accordance with international tape standards without any additional tone or frequency selective networks.

As is evident from the diagram, only two poles of a two way switch are required to transfer from the characteristics for recording to those recommended for playback. (The switching between microphone or other signal source, and playback head, and between record head and power amplifier, are not included in the diagram as these are not strictly related to the application of the TAA310. They must, however, be remembered when designing the record/playback system as a whole).

A Practical Design

Now for a few points related to the operation of the unit. The input impedance of the circuit is typically 20 kΩ which should provide a satisfactory match for medium impedance microphones such as are commonly used for recording or p.a. work, and a signal level of 20mV is characteristic. It must be remembered that the circuit must also be a satisfactory match to the playback head of the tape deck with which it is used; there is a preset potentiometer (10 kΩ) in the input circuit in the record position only to compensate for any difference in the signal conditions.

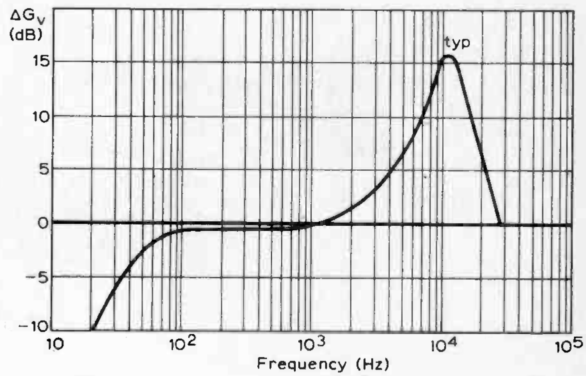


Frequency response curve of amplifier during playback.

The first two stages are conventional common emitter configurations, but note should be made of the method of biasing Tr1 from the emitter circuit of Tr2. Next is the differential stage, as already mentioned, with both a.c. and d.c. feedback from the output stage. Only the a.c. feedback requires special mention; it can be seen that the frequency response will be completely different depending on the setting of the record/playback switch.

In the record mode, high frequencies are emphasised, with low frequencies preferentially amplified in the playback configuration. The effective high-frequency cutoff of the tape preamp is 15 kHz. In the record mode the output from Tr5 is coupled through a capacitor to the recording head; it may be noted that often the same head serves as record and playback head, with the erase function performed by a separate head or by a permanent magnet. (Somewhat different characteristics are required, e.g. a different "gap" in an erase head compared with those used for an audio signal).

It is also common practice to apply a small h.f. bias to the record head when transcribing material on to a tape. This is obtained from the erase oscillator, and of course will be inaudible during playback since it is at a frequency beyond those to which the ear responds, but it does result in a lower noise level on the tape by minimising permanent magnetisation of the poles.



Frequency response curve of amplifier during recording.

It can be applied through a small capacitor, say, 1000pF, from the erase oscillator coil. Should it be decided in the interests of simplicity to use permanent magnet erase, a d.c. bias in the recording head may be experimented with. Many small imported tape recorders use a bias current of 0.1 mA to achieve results only a little inferior to those from an h.f. system, and even without bias satisfactory reproduction may be expected.

The TAA310 should be available from any Mullard semiconductors supplier, or by post from Kinver Electronics Ltd., who advertise in this magazine.

One last item of news: Radiospares, who supply a wide range of electronic items to the retail market, are now distributing integrated circuits, notably an audio power amplifier with specifications identical to the SL402 described in these pages some time ago, and also a hybrid d.c. regulator operational up to 30 volts output. ■

NOTE TO RADIO CLUB SECRETARIES
If you would like to see your Club featured in PRACTICAL WIRELESS, drop a line to Colin R. Riches, IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4.

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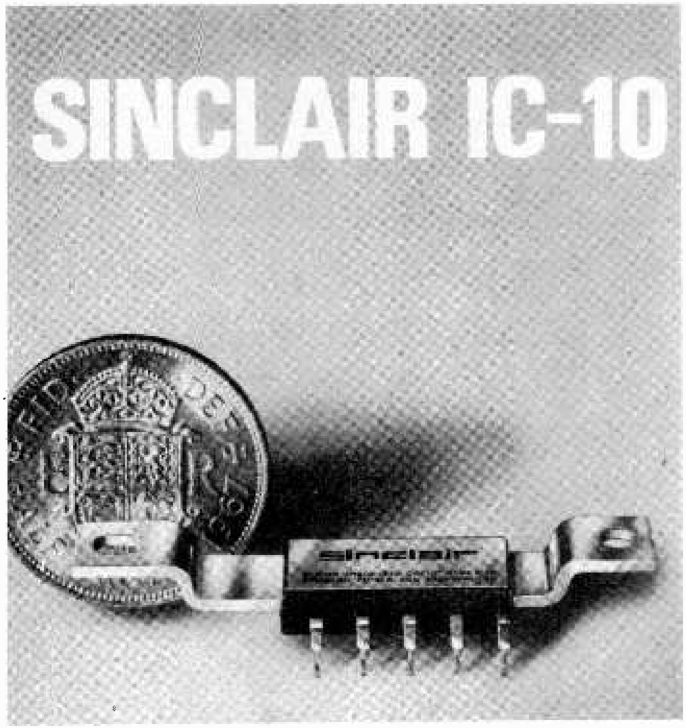
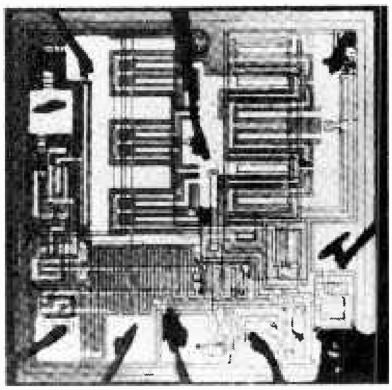


MONOLITHIC INTEGRATED CIRCUIT HIGH FIDELITY AMPLIFIER AND PRE-AMP



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±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 × 0.4 × 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**

POST FREE

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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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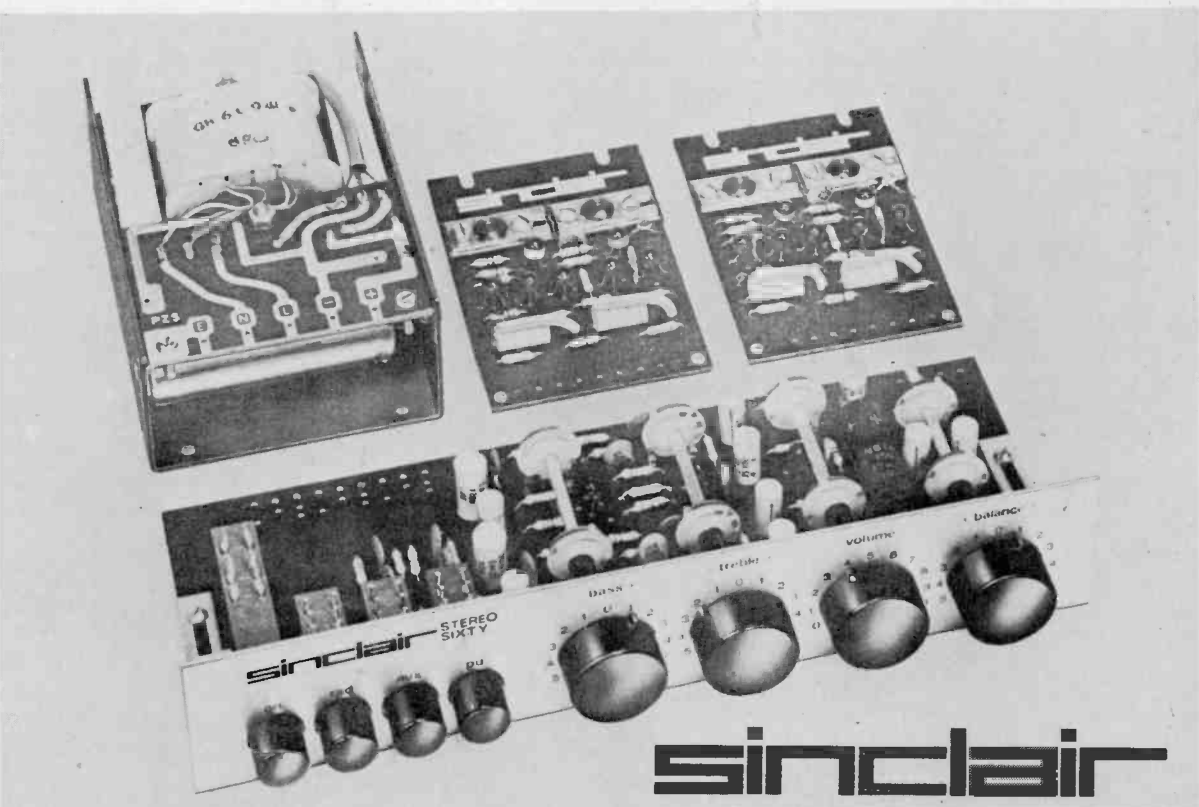


Z.30 20 WATT R.M.S. POWER AMPLIFIER (40 WATTS PEAK) Z.50 40 WATT R.M.S. POWER AMPLIFIER (80 WATT PEAK)

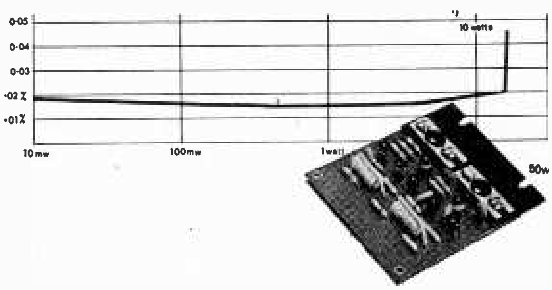
The Z.30 together with the higher powered Z.50 are both of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use the Z.30 or Z.50 power amplifiers 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

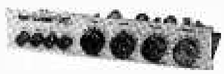
Z.30 *Built tested and guaranteed with circuits and instructions Manual* **89/6**

Z.50 *Built, tested and guaranteed with circuits and instructions manual* **109/6**

STEREO 60 Pre-amp 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.

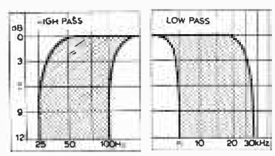
- Input sensitivities—Radio—up to 3mV Mag. p.u.—3mV: correct to R.I.A.A. curve ± 1dB: 20 to 25,000Hz. Ceramic p.u.—up to 3mV: Aux.—up to 3mV.
- Output—250mV
- Signal-to-noise ratio—better than 70 dB.
- Channel matching—within 1dB.
- Tone controls—TREBLE +15 to −15dB. at 10 kHz: BASS +15 to −15dB at 100Hz.
- 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



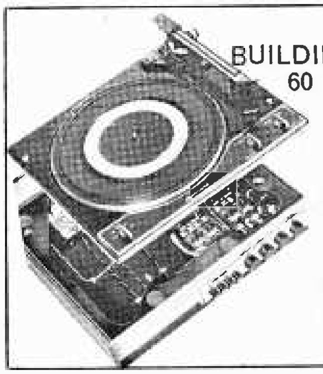
SINCLAIR POWER SUPPLY UNITS

PZ-5 *30 volts unstabilised* **£4.19.6**

PZ-6 *35 volts stabilised* **£7.19.6**

PZ-8 *45 volts stabilised* **£5.19.6**
(less mains transformers)

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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NAME ....
ADDRESS ....
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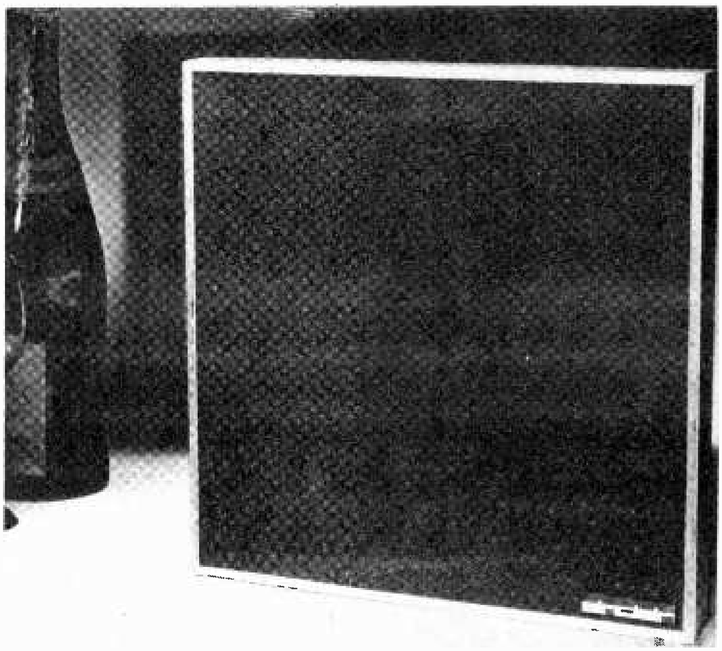
.... PW 670

SINCLAIR

Q.16

new elegance in an outstanding loudspeaker

All the superb features which went to make the Sinclair Q.14 have been incorporated 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, the new Q.16 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.



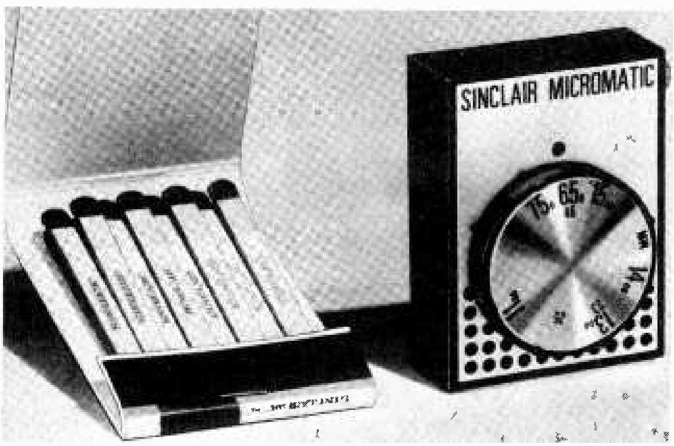
The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000Hz with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good transient response at all frequencies. Size: $9\frac{3}{4}$" square × $4\frac{3}{4}$" deep from front to back.

£8.19.6

POST FREE

SINCLAIR MICROMATIC

The world's most successful miniature radio



SPECIFICATIONS—Size: $1\frac{13}{16}$" × $1\frac{7}{16}$" × $\frac{1}{2}$" (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

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 wrist-watch, and dependable under the severest listening conditions.

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE
Please send

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For which I enclose cash/cheque/money order

NAME ....

ADDRESS ....

PW 770

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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ELECTROVALUE

EVERYTHING BRAND NEW & TO SPECIFICATION • LARGE STOCKS

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1N914	1/3	2N3706	3/3	40512	45/6	BC147	3/6	BFY51	4/3
1N3754	4/-	2N3707	4/-	40602	9/6	BC148	3/3	BSX20	3/9
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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	AD140	19/-	BC168	2/3	MPF102	7/6
2N1304	4/6	2N3904	7/6	AD142	14/3	BC169	2/6	NKT403	15/6
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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	3/6	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
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2N3054	14/3	2N5458	9/9	BA115	4/-	BF194	7/-	ZTX500	5/-
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2N3702	3/6	40362	16/-	BC108	2/6	BFX85	8/3	ZTX504	12/-
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2N3705	3/5	40430	37/-	BC126	12/-	BFY50	4/6		

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–3·92 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.

Component pack for IC10 stereo amplifier, complete, inc. knobs, switch, neon ind. plugs, sockets, etc. £4 15 0 nett

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.

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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 1/9; 100/25 1/9; 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/-.

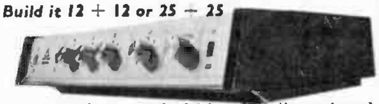
SMALL ELECTROLYTICS

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 Baxandall. Superb reproduction for its size. Handles 10 watts with ease. Uses ELAC 15 Ω 59RM109 speaker Unit Kit £13/12/- nett; built £18/8/6 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	86/-
25W	165/- nett	N/A
40W	198/- nett	101/6
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.

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SERVICE MANUALS for Pre 1958 H.M.V. and E.M.I. MODELS. Radio and Record Player Manuals 5/- each. Television Manuals 7/6 each. Send C.W.O. stating model required. Also limited range of components and spares. Send details of your requirements. R.D.I. Ltd., Chilton Works, Garden Road, Richmond, Surrey.

BUILD IT in a DEWBOX quality cabinet. 2in.x 2½in. x any length. D.E.W. Ltd., Ringwood Road, FERNDOWN, Dorset. S.A.E. for leaflet. Write now—Right now.

PARAPHYSICAL LABORATORY, Downton, Wilts. Telekinesis. Magazines. Send S.A.E. for list. Samples 20s.

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EZ80	5/6	PCL800	18/-	U18/20	13/6	UY11	11/-
EZ81	5/6	PCL801	15/6	U20	13/6	UY21	11/-
EZ90	5/-	PD500	30/-	U25	15/-	UY41	8/-
GS10C	100/-	PEN4DD	8/-	U26	15/-	UY82	10/-
GY501	16/-	PEN45	7/-	U31	9/-	UY85	6/6
GZ30	7/6	PEN45DD	15/-	U37	30/-	VR75/30	9/-
GZ31	6/-			U50	6/-	VR105/30	7/-
GZ32	9/6	PEN46	7/6	U52	6/-	VR150/30	6/6
GZ33	16/-	PEN383	10/-	U76	5/-	VU39A	10/-
GZ34	11/-	PEN384	10/-	U78	5/-	VU111	10/-
HABC80	8/6	PEN453DD	11/-	U191	15/-	VU120	15/-
HBC90	5/-			U201	7/-	VU133	10/-
HBC91	6/-	PENA4	8/6	U281	8/-	W729	12/-
HF93	6/6	PF86	11/-	U282	8/-	Z309	10/-
HF94	5/6	PF818	17/-	U301	11/6	Z329	17/-

TRANSISTORS

Quantity prices quoted on request

2N404	3/6	2N3707	4/-	BCY34	5/-
2N410	3/6	2N3709	3/5	BCY39	5/-
2N412	3/6	2N3710	3/-	BCY72	3/10
2N444A	5/-	2N3819	12/-	BCZ11	7/6
2N696	4/6	2N3906	6/-	BD121	18/-
2N697	4/6	AC113	3/-	BC123	25/-
2N698	8/6	AC125	6/6	BF167	5/-
2N705	15/-	AC126	5/-	BC173	6/-
2N706	3/-	AC127	5/6	BF181	6/-
2N708	3/6	AC128	4/6	BF184	7/6
2N753	4/9	AC153	5/-	BF194	3/6
2N929	6/-	AC154	3/-	BF195	3/-
2N930	6/8	AC157	4/-	BF196	4/6
2N987	6/6	AC169	2/-	BF197	4/6
2N1131	8/6	AC176	6/9	BFX88	5/4
2N1132	9/6	ACY17	6/-	BFY17	8/6
2N1184	19/7	ACY18	4/-	BFY18	5/-
2N1301	7/-	ACY19	4/9	BFY19	5/-
2N1302	7/-	ACY20	4/-	BFY50	5/-
2N1304	4/6	ACY21	3/11	BFY51	4/6
2N1305	4/6	ACY22	2/8	BFY52	4/10
2N1306	5/-	AD140	16/-	BSY26	5/-
2N1307	6/-	AD149	12/6	BSY27	5/6
2N1308	7/6	AD161	9/-	BSY28	5/-
2N1309	9/6	AD162	9/-	BSY65	4/6
2N1711	6/-	AD102	15/6	BSY95A	3/9
2N1756	15/-	AF114	6/-	OC16	15/-
2N2147	14/9	AF115	6/-	OC22	13/-
2N2160	23/-	AF116	5/6	OC23	12/6
2N2217	6/6	AF117	4/6	OC24	15/-
2N2218	7/9	AF118	10/-	OC25	7/6
2N2219	8/6	AF125	6/-	OC26	6/-
2N2369A	4/6	AF126	5/3	OC28	14/6
2N2477	12/6	AF127	5/3	OC29	14/9
2N2646	12/6	AF178	12/6	OC30	15/-
2N2905	10/-	AF186	11/-	OC35	11/3
2N2923	3/-	AF239	10/-	OC36	12/6
2N2924	3/-	AFY19	22/6	OC42	6/6
2N2926'b'	3/-	AFZ11	9/-	OC44	4/-
2N2926'r'	3/-	ASY26	6/-	OC45	3/6
2N2926'o'	3/-	ASY27	6/6	OC71	3/6
2N2926'y'	3/-	ASY28	6/6	OC72	5/-
2N2926'g'	5/6	ASY29	6/-	OC73	7/6
2N3053	6/3	ASY54	6/-	OC75	5/-
2N3055	15/-	ASY73	10/-	OC76	5/-
2N3133	7/-	ASY74	16/-	OC78	5/-
2N3134	8/6	ASY77	7/-	OC78D	3/3
2N3391	4/-	ASY82	4/-	OC81	4/6
2N3392	3/2	ASY86	4/6	OC81D	3/-
2N3393	2/6	BC107	3/-	OC83	4/6
2N3394	2/6	BC108	3/-	OC84	5/-
2N3395	3/6	BC109	4/-	OC139	7/6
2N3402	5/-	BC113	8/6	OC140	9/6
2N3403	5/-	BC118	8/6	OC170	5/-
2N3404	6/6	BC147	4/6	OC171	5/6
2N3414	4/-	BC148	3/3	OC200	4/4
2N3415	4/3	BC149	3/6	OC201	10/-
2N3416	4/6	BC152	3/2	OC202	13/-
2N3417	5/2	BC175	5/6	OC203	6/3
2N3702	4/6	BCY30	7/-	OC204	6/-
2N3703	3/10	BCY31	5/-	OC205	23/-
2N3704	5/6	BCY33	5/-	OC206	14/-

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IN5408	1000p.i.v.	3A	6/3
IS113	400p.i.v.	400mA	4/6
IS115	600p.i.v.	400mA	7/6
BY127	600p.i.v.	1A	3/6
BY130equivalent(Y1928)	450p.i.v.	800mA	1/6
D226B	400p.i.v.	300mA	2/9
D226V	300p.i.v.	300mA	2/6

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D242	100p.i.v.	10A	6/-
KD202A	50p.i.v.	3A	5/-
KD202B	50p.i.v.	1A	3/-
KD202D	200p.i.v.	3A	6/-
KD202E	200p.i.v.	1A	3/6
KD202G	100p.i.v.	1A	3/3
KD2021	300p.i.v.	1A	3/8
KD202V	100p.i.v.	3A	5/-

MULTIMETERS

TYPE MF16

D.C. voltage range:
0-0.5-10-50-250-500V.
A.C. voltage range:
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D.C. current range:
500μ-10-100mA.
Resistance ranges: 100MΩ-1MΩ. The meter is also calibrated for capacity and output level measurements. Sensitivity 2000Ω/V. Accuracy ± 2.5% for D.C. and ± 4% for A.C. measurements.
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120DA	250 microamps	65/-
120DA	10 amps with internal shunt 3" × 2¼" face	60/-
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70DA	600 microamps	49/-
70DA	250 mA	46/-
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PA234 Audio Amplifier providing a max. output of 1 watt 27/6

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TAA263 3-stage direct coupled amplifier for use from DC to 600kc/s; 70mW dissipation. Output 10mW into 150 Ω load 15/-

TAA293 3-stage amplifier with connection brought out to the individual leads. Bandwidth 600kc/s. 160mW dissipation. Output 10mW into 150 Ω load 20/-

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TAD100 Integrated AM receiver circuit containing *all* active components, except output stage, required to build a complete receiver 45/-

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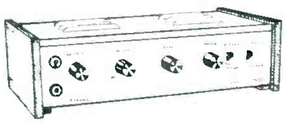

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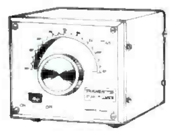

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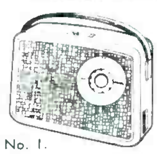

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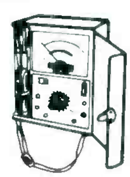

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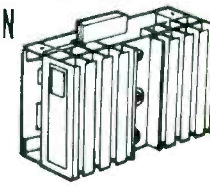

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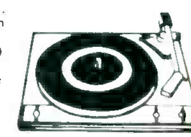

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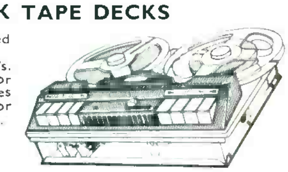

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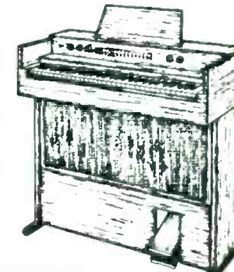

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