

PRACTICAL WIRELESS

FEBRUARY
1972

20p

Quality
HI-FI SYSTEM



ALSO:
CAR REV-COUNTER
TRANSISTORISED 'SCOPE

THE SOUND OF QUALITY



A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE.

REPRESENTING VALUE FAR HIGHER THAN THE PRICES SUGGEST.

SUPER 30 MkIII HI-FI STEREO AMPLIFIER

Only high grade components by leading manufacturers.

COMPLETE KIT OF PARTS Carr. 65p

Or FACTORY BUILT £33-75

with 12 months guarantee

Dep. £5-75 and 9 monthly payments £3-50 (Total £37-25)

Or FACTORY BUILT in Teak finished case as illus. Dep. £6 and 9 monthly payments £3-86

(Total £40-74)

PRINTED CIRCUITRY, TWENTY SILICON TRANSISTORS, FOUR DIODES, FOUR RECTIFIERS.

TECHNICAL DETAILS (Applying to each channel where appropriate)

CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono (5) Mono R (6) SPEAKER DIS. (7) Mains on/off.

OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.

£25



£37-75

- ★ SATIN SILVER METAL FACIA with black lettering. Black edged knobs with bright silver centres.
- ★ PUSH-BUTTON SELECTOR SWITCHING
- ★ NEON INDICATOR
- ★ JACK SOCKET FOR HEADPHONES
- ★ CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC, REGARDLESS OF PRICE.
- ★ WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.

HUM & NOISE - 75dB Min. Vol. - 65dB Full Vol. HARMONIC DISTORTION
 FREQUENCY RESPONSE - 3dB 7Hz to 70KHz 0-1% at 1000 Hz 10 Watts
 TREBLE CONTROL: +16dB to -12dB at 14KHz
 BASS CONTROL: +17dB to -16dB at 40Hz
 CROSS TALK - 58dB
 SENSITIVITIES: Disc Mag. 2-5mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
 REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio, (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

RSC G66 MkII 6+6 Watt HIGH QUALITY STEREO AMPLIFIER



Individual Ganged Controls. Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output

rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12dB. Treble Control ± 13dB. Selector switch for P.U. or Tape/ Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200-250V A.C. mains operation. Attractive Black and Silver finished metal facia plate and matching knobs.

COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT Carr. 40p

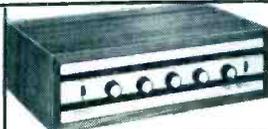
Comprehensive wiring diagrams and instructions

Or FACTORY BUILT IN TEAK VENEERED CABINET

Dep. £3-20 and 9 monthly payments £1-70 (Total £18-50)

£12-50

£15-99



R.S.C. TA12 MKIII 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, 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 20-20,000 c.p.s. - 2dB

★ Harmonic Distortion 0.3% at 1,000 c.p.s. Hum and Noise - 70dB

★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. Carr. 40p.

★ Handsome Brush Facia plate & Knobs. COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. £15-50

Factory built with £19-50 or Dep. £3 & 9 mthly pymts £2-15 (Total £22-85)

12 mths guarantee

Or in Teak veneer housing £23 Dep. £3 & 9 mthly payments £2-55 (Total £25-95)

Send S.A.E. for leaflet

FANE 807 HIGH FIDELITY LOUDSPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω

Please state impedance when ordering



£3-50

HI-FI SPEAKER ENCLOSURES

Modern design. Teak veneer finish. Acoustically lined. All sizes approx. Carr. 30p. per enclosure. JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. SE8 For optimum performance with any 8in. Hi-Fi speaker. Size 22 x 15 x 9in. Ported

SE10 For outstanding results with 10in. Hi-Fi speaker Size 24 x 15 x 10in. P.t'd. £6-74

SE12 For excellent performance with 12in. Hi-Fi speaker and Tweeter. Size 25x16x10 1/2 £7-87



£5-35

£6-47

£7-87

R.S.C. A11 HI-FI 12-14 WATT AMPLIFIER

PUSH-PULL OUTPUT. Two input sockets with sep. vol. controls for mixing S.A.E. for leaflet.



FACTORY BUILT £14-75

or Dep. £3 and 9 monthly payments of £1-60 (Total £17-40)

High sensitivity, 5 valves. Bass and treble controls. Response ± 3dB 30-20,000 c.s. Hum level - 60dB Sensitivity 40 millivolts. For Crystal or Ceramic P.U.s. High Impedance "links". For Musical Instruments etc. Std. AC mains. For 3 & 15 ohm spkrs. Complete kit. Full instructions and point-to-point wiring diagrams. £10-50 Carr. 60p

Twin handled metal cover £1-75

FANE PRESSURE TWEETER

Model 303 Gauss 10,000. Impedance 3 ohms or 8-15 ohms. Excellent value

£2-50

Post Free

SPECIAL HI-FI OFFER

WHARFEDALE UNIT '3' SPEAKER KITS

Normally £12-53 Carr. 25p.

£10-50

★ DEMONSTRATION FACILITIES AT ALL BRANCHES

ALL RSC UNITS MANUFACTURED TO EXACTING SPECIFICATIONS



R.S.C. TA6 6 Watt HI-FI 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 50mV. Output rating I.H.F.M. Fully enclosed enamelled case. 9 1/2 x 2 1/2 x 5 1/2 in. Attractive brushed silver finish facia plate 10 1/2 x 3 1/2 in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. £7-50 Carr. 40p

Or FACTORY BUILT WITH 12 MONTHS' GUARANTEE £9-75

R.S.C. PLINTHS

Superior Solid Natural Wood Construction for Record Playing Units, cut for Garrard 1025, 2025, 3000, AT60, SP25 etc. £3-15 WITH TRANSPARENT PLASTIC COVER £6-30





HIGH-FIDELITY STEREO

PACKAGE OFFERS

Four fully wired units ready to 'plug in'.
 ★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
 ★ GARRARD SP25 MK III Turntable on Plinth with cover
 ★ GOLDRING CS90 Ceramic Pick-up Cartridge with diamond stylus
 ★ PAIR OF STANWAY II Speaker Units
 Special Total Price **£79-80**
 Carr. £1-50

Terms: Deposit £12 and 9 monthly payments £8-55 (Total £88-95).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing
 ★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
 ★ Goldring Magnetic P.U. Cartridge.
 ★ Pair of Stanway II speaker units.
 Special Total Price **£97-75** Carr. £1-50

Terms: Deposit £15 and 9 monthly payments £10-53 (Total £114-55).



ATTRACTIVE TEAK OR AFROMOSIA VENEERED CABINETS AND PLINTHS
 Send S.A.E. for coloured brochure showing other money saving offers.

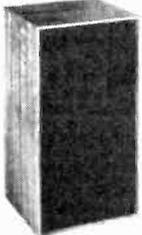
★ TA12 AMPLIFIER 6.5 + 6.5 watt in veneered housing
 ★ GARRARD SP25 MK III Player unit on Plinth
 ★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
 ★ PAIR OF DORCHESTER Loudspeaker Units
 Special Total Price **£58**
 Or Deposit £7-15 and 9 monthly payments £6-35 (Total £64-30). Carr. £1-25
 Trans. Plastic Cover £3-15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. **£51-75**
 Or Deposit £6 and 9 monthly payments £5-70 (Total £57-30)
 Trans. Plastic cover £3-15 extra.

Matching as recommended for optimum performance. Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.

HIGH FIDELITY SPEAKER UNITS

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



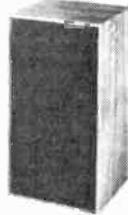
DORCHESTER (Illustrated) Size 16x11x9in. apprx. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13x8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9-45** Carr. 40p.

STANWAY II Size 20x10 1/2 x 9 1/2 in. approx. Rating 10 watts. Inc. 13x8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives **£17-85** smooth realistic sound output. See 'package offers' for above illustration.

'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25x14x10in.
 ★ Response 30-20,000 c.p.s. Impedance 15 ohms
 ★ Performance comparable with units costing considerably 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) 8x5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4-60 and 9 monthly payments £2-47 (Total £26-83).



COMPLETE KIT **£23** Carr. 65p

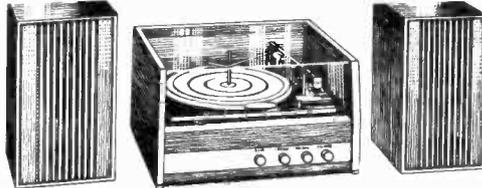
DEMONSTRATIONS AT ALL BRANCHES

AUDIOTRINE A55 HIGH QUALITY STEREO SYSTEM

5 + 5 WATT OUTPUT

Garrard 5200 Changer with low mass pick-up arm and Stereo Cartridge. Controls: TREBLE, BASS, VOLUME, STEREO, BALANCE. Operation on 200-250v. A.C. mains. Output rating I.H.F.M.

Luxurious Teak Veneer Finished Cabinets. Silver finished fascia plate and matching control knobs.



Transparent plastic (tinted) cover included for main unit.
 PAIR OF LOUDSPEAKERS incorporating high flux 8in. 5in. speaker. Size approx. 13 x 7 1/2 x 8 1/2 in.

PRICE COMPLETE ONLY **£42**

Carr. £1-25

Terms: Deposit £5-50 and 9 monthly payments £4-50 (Total £46).

A REALLY SURPRISING STANDARD OF QUALITY IS OBTAINED FROM THIS COMPACT LOW PRICED SYSTEM

RSC TRANSFORMERS, L.F. CHOKES and RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary

Primaries 200-250v, 50c/s. Screened
MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 x 2 1/2 in.
 250v, 60mA, 6.3v. 2a. 99p
 250-0-250v, 60mA, 6.3v. 2a. £1-05
FULLY SHROUDED UPRIGHT MOUNTING
 250-0-250v, 60mA, 6.3v. 2a., 0-5-6.3v. 2a. £1-40
 250-0-250v, 100mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-20
 300-0-300v, 100mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-20
 300-0-300v, 130mA, 6.3v. 4a., c.t., 6.3v. 1a. £2-45
 For Mullard 610 Amplifier. £2-45
 350-0-350v, 100mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-20
 350-0-350v, 150mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-65
 425-0-425v, 200mA, 6.3v. 4a., c.t., 6.3v. 3a. £4-95
 425-0-425v, 200mA, 6.3v. 4a., 6.3v. 3a., 5v. 2a. £5-10
 450-0-450v, 250mA, 6.3v. 4a., c.t., 5v. 3a. £5-50
TOP SHROUDED DROP-THO' TYPE
 250-0-250v, 70mA, 6.3v. 2a., 0-5-6.3v. 2a. £1-35
 250-0-250v, 100mA, 6.3v. 3.5a. £1-55
 250-0-250v, 100mA, 6.3v. 2a., 6.3v. 1a. £1-60
 350-0-350v, 80mA, 6.3v. 2a., 0-5-6.3v. 2a. £1-65
 250-0-250v, 100mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-20
 300-0-300v, 100mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-20
 300-0-300v, 6.3v. 130mA 4a. c.t. 6.3v. 1a. c.t. £2-80
 350-0-350v, 100mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-20
 350-0-350v, 150mA, 6.3v. 4a., 0-5-6.3v. 3a. £2-60

FILAMENT or TRANSISTOR POWER PACK
 Types 6.3v. 1.5a. 48p; 6.3v. 2a. 54p; 6.3v. 3a. 76p;
 6.3v. 6a. £1-30; 12v. 1a. 55p; 12v. 3a. or 24v. 1.5a. £1-35; 0.9-18v. 1 1/2a. £1-10; 0-12-25-42v. 2a. £1-76
CHARGER TRANSFORMERS 0-9-15v. 1 1/2a. 99p;
 2 1/2a. £1-10; 3a. £1-25; 5a. £1-45; 6a. £1-65; 8a. £2-20
AUTO (Step UP/step DOWN) TRANSFORMERS
 0-110/120v. 200-230-250v., 50-80 watts £1-10;
 150 watts, £1-90 250 watts £2-75; 500 watts £5-75.

OUTPUT TRANSFORMERS
 Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p
 Push-Pull 8 watts EL84 to 3 Ω or 15 Ω 83p
 Push-Pull 10 watts 6V6, 6CL6 to 3, 5, 8 or 15 Ω £1-27
 Push-Pull EL84 to 3 or 15 Ω 10-12 watts £1-35
 Push-Pull Ultra Linear for Mullard 610, etc. £2-20
 Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω £1-99
 Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω £3-30

You're never very far from an RSC HI-FI CENTRE

R.S.C. BATTERY/MAINS CONVERSION UNITS



TYPE BMI. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2 in approx. Completely replaces batteries supplying 1.5v. and 90v. to battery radio where A.C. mains 200/250v. 50c/s is available.

Complete kit with diagram. **£3-25** Assembled ready for use **£3-75**

SMOOTHING CHOKES

150mA, 7-10H, 250 Ω 70p;
 100mA, 10H, 200 Ω 80p;
 80mA, 10H, 350 Ω 50p;
 60mA, 10H, 400 Ω 25p.

SELENIUM RECTIFIERS F.W. (Bridged)

All 6/12v. D.C. Output. Max. A.C. Input 18v 1a. 25p, 2a 35p, 3a. 50p, 4a. 65p, 6a. 80p.

RSC BULK BUYING ENSURES YOU GET BETTER VALUE

BRADFORD BLACKPOOL (AGENT) BIRMINGHAM DARLINGTON DERBY EDINBURGH GLASGOW HULL LEICESTER LEEDS LIVERPOOL LONDON MANCHESTER MIDDLESBROUGH NEWCASTLE-ON-TYNE NOTTINGHAM SHEFFIELD

SEE NEXT PAGE FOR TERMS OF BUSINESS, ADDRESSES etc.

THE SOUND

RSC

OF QUALITY

50 WATT SPEAKER



HEADPHONES
MICROPHONE
SEND S.A.E.
FOR LEAFLET



100 WATT AMPLIFIER

HI-FI CENTRES
LTD.

50 WATT SPEAKER



TWIN TURNTABLE
WITH PRE-AMP

**DISCOTHEQUE
EQUIPMENT**

—SAVINGS ON
PACKAGE OFFER

- (1) FAL FG1/2 Console
- (2) 100W Power Amplifier
- (3) Pair High Quality Headphones
- (4) Matching Microphone fitted to Headphones
- (5) Pair 50W Speakers black rexine covered Size approx. 18" x 18" x 8"

TOTAL COST OF ALL
ILLUSTRATED UNITS **£132**

Carr. £2.50
Terms: Deposit £20 and 9 monthly
payments of £14.34 (Total £149.06).

**RSC BASS REGENT
50 WATT AMPLIFIER**



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram., radio, tape. Peak Output rating. Loudspeaker unit optional horizontal or vertical mounting.
★ Two extra heavy duty 12in. 50 watt Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes".
★ Bass and Treble controls.
Send S.A.E. for leaflet.

ONLY £60

Credit Terms Deposit
£16 & 9 mthly pymts Carr.£1.50
of £5.75 (Total £67.75)

SEND S.A.E. FOR LEAFLET

**FAL DISCOTHEQUE CONSOLE
FG1/2**



SEND S.A.E. FOR LEAFLET

Separate Volume Controls plus Treble & Bass Controls
Microphone Socket with associated Switch & Vol. Control
Incorporating twin Garrard SP25 Mk. III turntables and
Golding CS90 Ceramic Cartridges with diamond styli.
Size approx. 36" x 61" x 15".
Black Rexine covered Cabinet with lid. Fitted carrying handle.

TWIN
TURNTABLE
UNIT WITH
MONITORING
FACILITIES

£65 Carr.
£1.25

Terms: Deposit
£11 and 9 monthly
payments of £6.70
(Total £71.80).

DISCO/GROUP EQUIPMENT PACKAGE OFFERS

F.A.L. PACKAGE	PACKAGE PRICE	TERMS
F.A.L. PHASE 50 Mk. II AMPLIFIER PAIR FANE POP 25/2 25W L/SPEAKERS.	£44 carr. £1	Deposit £5.50 and 9 monthly payments of £4.72 (Total £47.98).
F.A.L. PHASE 50 Mk. II AMPLIFIER PAIR FANE POP 50 L/SPEAKERS OR PAIR L12/25 Cabineted Speakers.	£49.50 carr. £1	Deposit £10.50 and 9 monthly payments of £5 (Total £55.50)
F.A.L. PHASE 100 AMPLIFIER PAIR L125 50W L/Speakers in cabinets.	£118 carr. £2.50	Deposit £25 and 9 monthly payments of £11.82. (Total £129.58).
F.A.L. PHASE 100 AMPLIFIER 4 FANE POP 50 LOUDSPEAKERS.	£99 carr. £2	Deposit £15 and 9 monthly payments of £10.52 (Total £109.50).

**30 WATT HI-FI
AMPLIFIER**

FOR GUITAR, VOCAL OR
INSTRUMENTAL GROUP

A 4 input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers.



ONLY £19.95 Carr.
65p

Terms: Deposit £3.70
and 9 monthly payments
of £2.10 (Total
£22.60).



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

Highly sensitive, Push-Pull high output, 11um level, 70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For 11gh Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram., Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes, 200-250 v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £15.75
£1.90 Or factory built with EL34 output valves and 12 months' guarantee for £19.75 Carr. 65p
TERMS: Deposit £4 and 9 monthly payments of £2.10 (Total £22.90). Send S.A.E. for leaflet.

MINIMUM 12 MONTHS GUARANTEE, LABOUR & MATERIALS (Excl. Valves) ON ADVERTISED GOODS

**RE-FUND
OF INTEREST
CHARGES
ON CREDIT SALES
SETTLED IN
3 MONTHS**

**PHASE 50 Mk II
50W AMPLIFIER**

OUTPUT
50 Watts (Music)
40 .. R.M.S.
(Cont.)
100 .. (Peak)

£33.50 Carr.
65p

Terms: Deposit £6 and
9 monthly payments £3.50
(Total £37.50).

SOLID STATE, ALL SILICON TRANSISTORS. ★ Protective circuitry in case of overload or short circuiting of output. ★ Frequency Range 30-20,000 c.p.s. ★ 4 Separately controlled inputs for mixing; plus master volume control. ★ Individual Bass and Treble Controls. ★ Suitable for any loudspeaker combination between 3 & 30 ohms. ★ Cabinet covered in black rexine. Brushed silver finish metal facia, with black lettering. Matching control knobs. For Clubs, Discotheques, Hotels, Restaurants, Schools, Theatres, etc. For Vocal & Instrumental Groups, Gram., Radio or Tape. Send S.A.E. for leaflets.



**PHASE 100
100W AMPLIFIER**

OUTPUT
100 Watts (Music)
70 .. R.M.S.
(Cont.)

I.H.F.M. Output rating
£61.95 Carr.
75p

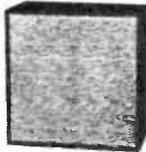
Terms: Deposit £12 and
9 monthly payments £6.25
(Total £68.25).

RSC

GABINET LOUDSPEAKERS

L13 8-10 WATTS

Incorporating high flux 13" x 8" 8-10 watt loudspeaker. Available with 3 or 15 ohm impedance. (State when ordering.) Cabinet finished in Teak or Afrormosia Veneer. **£5-25** (Carr. 37p)



L12/25 25 WATTS

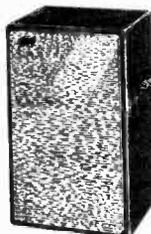
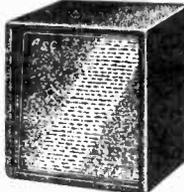
12" 25 watt heavy duty loudspeaker. Impedance 15 ohms. 18" x 18" x 8" approx. Veneered or Rexine/Vynair finish. Suitable small Discotheques, Clubs, Schools etc., etc. (Carr. 45p) **£10-50**

Terms: Deposit £3 and 9 monthly payments £1 (Total £12)

B4/100 100 WATTS

Fitted four extra heavy duty 12" 14,000 Gauss 50 watt speakers for conservative rating of 100 watts. Impedance 15 ohms. Cabinet in 1/2" chipboard with centre reinforcement back to front. Rexine/Vynair covered. Acoustically filled and pressurised. 27" x 27" x 14" approx. Ideal for bass guitar or electronic organ. **£55** Carr. £1-50

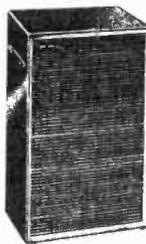
Or Deposit £8 and 9 monthly payments £5-90 (Total £61-10).



L125 50 WATTS

Incorporating two 12" 50 watt 14,000 Gauss extra heavy duty loudspeakers for conservative rating of 50 watts. Impedance 8-15 ohms. Sturdy pressurised cabinet in 1/2" chipboard. Rexine/Vynair Covered 31" x 20" x 16" approx. Suitable Vocal or Instrumental Groups. Bass Guitar or Electronic Organ, etc. For use in Discotheques, Clubs, etc. **£31** (Carr. £1-50)

Or Deposit £4 and 9 monthly payments £3-35 (Total £34-15).



FAL DUO/100

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OB2	.20	6BW7	.54	6BA7GT	.35	12SJ7	.23	50L8GT	.45	E834	.20	EL34	.14	KTW63	.50	PL81A	.44	UCH82	.33	AC113	.25	HCY38	.23	OA202	.10
OZ4	.25	6BZ6	.31	6BA7M	.35	12SH7	.24	83A2	.43	EB31	.10	EL33	1.00	MHLDE	.75	PL82	.30	UCH83	.48	AC127	.17	HCY11	.38	OC23	.38
1A7GT	.35	6CB6A	.28	68C7GT	.33	12BQ7GT		90C1	.59	EB41	.48	EL37	.74	N78	2.05	PL83	.32	UF41	.50	AC128	.20	BF158	.29	OC23	.38
1B9GT	.35	6C4	.28	68C7GT	.33			150B2	.58	EB41	.29	EL41	.53	N308	.95	PL84	.30	UF42	.60	AC154	.25	BF159	.25	OC24	.38
1H5GT	.33	6C9	.73	68H7	.53	13D3	.45	807	.59	EB90	.28	EL42	.53	N339	.44	PL504/500	UF80	.35	AC156	.20	BF163	.20	OC25	.38	
1L4	.13	6CD6G	1.06	68J7	.35	1487	.75	5709	.80	EBF80	.30	EL81	.50	P61	.44	UF85	.34	AC157	.25	BF173	.38	OC26	.38		
1N5GT	.37	6CQ8A	.50	68K7GT	.23	19A45	.24	5763	.50	EBF83	.38	EL83	.38	PABC80	.33	PL505	1.30	UF86	.68	AC165	.25	BF180	.30	OC28	.60
1R5	.28	6C16	.38	68Q7GT	.35	20B6G	.85	AC3/PEN		EBF89	.27	EL84	.22	PC88	.47	PL509	1.80	UF89	.27	AC166	.25	BF181	.40	OC29	.63
184	.22	6CL6	.43	6V6G	.17	19G6	.50			EBL21	.60	EL85		PC89	.53	PL802	.75	UL84	.31	AC176	.55	BF194	.15	OC36	.43
1U4	.29	6CM7	.50	6V6GT	.80	20D4	1.05	AC3/PEN		EC86	.59	EL86	.38	PC95	.53	PM84	.34	UM80	.33	AC177	.28	BFY50	.23	OC42	.63
1U5	.48	6CU5	.30	6X4	.20	20P2	.65	DD	.98	EC88	.59	EL91	.23	PC97	.36	PC90	.32	PX4	1.16	UY1N	.50	ACY17	.25	BFY52	.20
2D21	.35	6CW4	.83	6X5GT	.25	20L1	.98	AC/PEN	.38	EC92	.34	EL95	.32	PC90	.32	PCX25	.88	UY41	.38	ACY18	.20	BFY52	.20	OC45	.11
2GK5	.50	6DE7	.50	7A7	.78	20P1	.50	AC/PEN(7)		EC92	1.50	EL360	.49	PCX84	.29	PY33/2	.60	UY85	.25	ACY19	.18	BY100	.18	OC46	.15
2A4	.25	6DT6A	.50	7B6	.55	20P3	.79		.98	EC93	1.50	EM80	.38	PCX85	.28	UY86	.25	ACY20	.18	BY105	.18	OC70	.15		
3D6	.19	6E2	.35	7B7	.32	20P4	.89	AC/TH1	.50	EC94	.60	EM81	.39	PCX88	.41	PY80	.33	U10	.45	ACY21	.19	BY114	.18	OC71	.11
3Q4	.38	6E6W6	.55	7C6	.80	20P5	1.00	AC/TP	.98	EC98	.18	EM84	.31	PCX89	.45	PY81	.28	U18/20	.75	ACY22	.15	BY126	.15	OC72	.11
3Q5GT	.35	6F1	.59	7H7	.28	25A6G	.29	AL60	.78	EC93	.18	EM84	.31	PCX89	.48	PY82	.24	U18/20	.75	ACY22	.15	BY126	.15	OC72	.11
384	.25	6F6	.63	7H7	.65	25L6G	.20	ATP4	.12	EC93	.22	EM85	1.00	PCF80	.28	PY83	.28	U19	1.73	ACY28	.18	BY127	.18	OC74	.23
3V4	.32	6F6G	.25	7Z4	.50	25Y5	.38	AZ1	.40	EC94	.28	EM87	.35	PCF82	.30	PY88	.32	U22	.39	AD140	.36	BYZ10	.25	OC75	.11
4C8B	.50	6F13	.33	9D7	.78	25Y5G	.43	AZ31	.48	EC95	.24	EY51	.35	PCF84	.40	PY500	.95	U26	.64	AD149	.50	BYZ11	.25	OC76	.15
5C8B	.50	6F14	.42	10C2	.49	25Z4A	.28	AZ41	.53	EC96	.40	EY81	.42	PCF86	.38	PY800	.38	U28	.58	AD161	.45	BYZ12	.25	OC77	.27
5V4G	.34	6F18	.45	10D8T	.50	25Z5	.40	CL33	.90	EC98	.35	EY83	.54	PCF200	.68	PY801	.38	U45	.78	AD162	.45	BYZ13	.25	OC78	.15
5Y3GT	.28	6F23	.68	10F9	.45	25Z6G	.43	CV43	.53	EC9189	.48	EY84	.50	PCF801	.29	PZ30	.48	U47	.64	ADT140	.63	CG12E	.20	OC78D	.15
5Z40	.34	6F24	.68	10F18	.35	30A5	.44	CY1C	.53	EC904	.55	EY87/6	.30	PCF802	.40	QQV03/10	U191	.58	AF102	.90	F8Y11A	.23	OC81	.11	
6/30L2	.55	6P25	.54	10LD11	.53	30C1	.28	CY1C	.28	EC907	1.70	EY88	.40	PCF805	.60	Q95/10	.49	U281	.55	AF106	.50	F8Y41A	.23	OC81D	.11
6A8G	.33	6F28	.60	10P13	.54	30C15	.60	DAP91	.20	ECF80	.27	EY91	.53	PCF806	.57	QV04/7	.68	U281	.40	AF114	.25	GD9	.20	OC82	.11
6A8T	.15	6F32	.15	10P14	1.08	30C17	.77	DAF96	.33	ECF82	.28	EZ40	.40	PCF808	.68	U282	.40	AF115	.15	GET113	.20	OC82D	.11		
6A8S	.25	6G18A	.50	12A6	.63	30C18	.60	DF91	.14	ECF86	.64	EZ41	.42	PCF890	.82	R10	.75	U301	.40	AF117	.19	GET116	.40	OC83	.20
6A8J	.43	6K6	.50	12A6G	.40	30F5	.65	DF96	.34	ECF8042	.10	EZ80	.21	PCL82	.32	R11	.98	U403	.33	AF121	.30	GET118	.20	OC84	.24
6A8K	.25	6G07	.50	12A08	.40	30FL1	.60	DY86	.28	ECH21	.68	EZ81	.22	PCL83	.68	R16	1.75	U404	.38	AF124	.25	GET119	.20	OC123	.23
6A8L	.30	6H6GT	.15	12A26	.48	30FL2	.60	DK40	.55	ECH42	.60	EZ80	.20	PCL84	.34	R17	.88	U801	.98	AF126	.18	GET573	.38	OC139	.23
6A8M	.50	6J5G	.29	12A76	.28	30FL12	.69	DK92	.35	ECH81	.27	PW4/500.75	.39	PCL85/85	.84	R19	.30	U4020	.38	AF139	.65	GET587	.43	OC140	.95
6A8N	.49	6J5GT	.19	12A77	.18	30FL14	.68	DK96	.35	ECH83	.39	PW4/900.75	.40	SP42	.75	VP23	.40	AF178	.68	GET873	.23	OC169	.23		
6A8Q	.22	6J6	.18	12A06	.21	30L1	.28	DL96	.35	ECH84	.34	GZ30	.34	PCL86	.38	SP61	.28	VP41	.38	AF180	.48	GET887	.23	OC172	.35
6A8R	.30	6J7G	.24	12A07	.18	30L15	.58	DM70	.30	ECL80	.30	GZ32	.41	PCL88	.65	TH4B	.50	VP61A	.35	AF186	.55	GET897	.23	OC200	.22
6A8T6	.18	6J7GT	.38	12A06	.28	30L17	.67	DM71	.38	ECL82	.30	GZ33	.70	PD500	1.44	TH233	.98	VU111	.44	AF239	.38	GET898	.23	OC201	.38
6A8U	.20	6J8A	.50	12A07	.29	30P4MR	.95	DY86/7	.24	ECL83	.52	GZ34	.48	PEN4DD		TP2820	.98	VU120	.60	BA102	.45	M1	.15	OC202	.43
6A8V	.28	6K7G	.10	12BA6	.30	30P12	.69	DY802	.35	ECL84	.54	GZ37	.67	UABC80	.30	VU120A	.60	BA115	.14	M3	.15	OC203	.30		
6A8W	.54	6K7GT	.23	12B6G	.30	30P19	.87	E80F	1.20	ECL85	.54	HABC80	.44	UAF42	.49	VU133	.35	BA116	.25	OA5	.28	OC204	.30		
6A8X	.39	6K8G	.16	12B17	.27	30P4	.58	E83F	1.20	ECL86	.40	HD10		PEN36C	.75	UBC41	.45	W107	.54	BA125	.13	OA5	.13	OC205	.43
6B8A	.13	6L1	.98	12E1	.85	30PL1	.59	E88CC	.60	EF22	.63	HL41DD	.98	PEN45	.40	UBC81	.40	W107	.50	BA130	.10	OA10	.43	ORP13	.53
6B8B	.20	6L7GT	.38	12J5GT	.30	30PL13	.75	E92CC	.40	EF40	.49														
6B8C	.50	6L18	.44	12J7GT	.33	30PL14	.65	E180F	.90	EF41	.53														
6B8E	.21	6L19	1.38	12K5	.50	30PL15	.87	E182CC1	.00	EF42	.33														
6B8F	.43	6L20	.48	12K7GT	.34	35A3	.48	E1148	.53	EF54	.98														
6B8G	.39	6N7G	.16	12S4GT	.27	35L6GT	.42	E450	.18	EF72	.75														
6B8Q	.38	6Q7	.43			35W4	.23	E476	.88	EF80	.22														
6B8R	.79	6Q7G	.27	128C7	.35	35Z4T	.24	E48C80	.30	EF83	.48														
6B8S	.63	6R7	.55	128G7	.23	35Z5GT	.30	E4C91	.38	EF85	.28														

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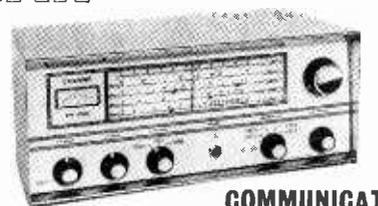
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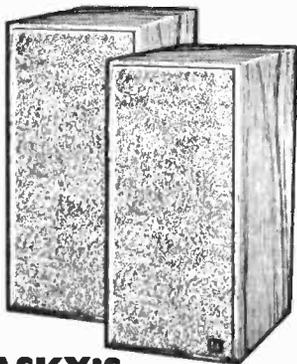
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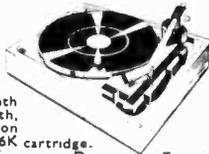
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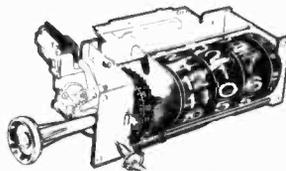
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Models HS-1 and HS-2. Both these sets by TRIO offer really superb stereo reproduction in a lightweight, fully adjustable headset designed for optimum comfort. Listening fatigue is unknown with TRIO headphones. Brief spec. both models: Input imp. 80 nominal (matching 4 to 8Ω); max. input: 0.5W; frequency response 20-19 kHz; output sensitivity at 1mW input; HS-1 118 dB, HS-2 111 dB; weight 0.66lbs. Identical in appearance—both models are finished in ivory with contrasting foam filled ear pads and head band.



LIST PRICE £8.40 LIST PRICE £6.75

HS.1 £5 HS.2 £4 Post 18p



RUSSIAN WORLD BEATER!

JUST ARRIVED! The Fabulous BRAND NEW

WORLD WIDE RECEPTION
THOUSANDS OF TRANSMISSIONS AND STATIONS THE WORLD OVER!

VEF 204
8 WAVEBAND
10 TRANSISTOR PLUS 3 DIODES PORTABLE RADIO

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AND NOW WITH SHIP-TO-SHORE MARINE BAND

BATTERY MODEL £13.97p
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WE COULDN'T EVEN MAKE THEM FOR OUR FANTASTIC PRICE!
*COMPARE ITS PERFORMANCE with £42 RADIOS!

Important! This very latest model incorporates all the latest technological improvements and supersedes all earlier models! Yes DESIGNED FOR WORLD WIDE RECEPTION—it'll probably make your present radio seem like a "crystal set"! It even incorporates a special MARINE WAVEBAND to receive spoken communications from ship-to-shore! We're almost giving them away at only £13.97p—a mere fraction of even today's Russian miracle price! Compare performance with £42 radios! *Refund if not astounded! Purer and sweeter tone than ever! Wider band spread for "pin-point" station selection! The Russians have really surpassed themselves this time proving again their ability in the field of space communications. Yes, 8 separate wavebands, including Standard Long, Medium and Short waves to cover the world, PLUS special "ship-to-shore" MARINE BAND! Thousands of different transmissions and stations at your fingertips 24 hours a day, including ships at sea, etc., and messages from all over world—truly nothing is secret! You must hear it to believe it! Superb, sweet tone—controlled from a whisper to a roar! Push-pull output! Separate ON/OFF volume & Treble/Bass tone controls! Press-button dial illumination! Take it anywhere—runs economically on standard batteries or through battery eliminator from 220/240v. AC mains. Internal ferrite rod plus telescopic aerial. It's also a fabulous CAR RADIO! Black & Chrome case 11ins x 8ins x 3ins. overall approx. Made to give years of perfect service. Complete with WRITTEN GUARANTEE, manual with simple operating instructions & circuit diagram. ONLY £13.97p (with mains/battery eliminator £13.97p extra). POST 50p. Standard batteries 38p extra. Can also be used through extension amplifier, tape recorder or public address system. Send today or call. (SORRY—we cannot change these new radios for any earlier model already purchased!)

fabulous BRAND NEW MODEL **SAVE £13.98 NOW!** FIRST CLASS MAKER'S DE LUXE MODEL

Cassette TAPE RECORDER and PLAYER

WITH REMOTE CONTROL MICROPHONE

RECOMMENDED LIST PRICE £26.97p
OUR PRICE £12.99
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MAKE NO MISTAKE—this is the EXPENSIVE model with "PIANO KEYBOARD" CONTROL PANEL and SPECIAL RECORDING LEVEL! SAVE £13.98! Due to price we cannot mention famous maker's name—but rest assured you're getting one of the BEST! Our latest cassette model—no fiddling with awkward tape and reels, just "slap in" a cassette and off you go! (takes 30-, 60-, and 90-minute standard Philips Cassette tapes obtainable everywhere). Amazing performance ensures perfect tapings and superb reproduction. Remote control microphone. Separate volume control! Rapid rewind! Beautiful tone from a whisper to a roar! Completely self-contained—record anywhere. Separate jacks for remote control microphone, etc. Size 9" x 4 1/2" x 2 1/2" overall approx. Case design can vary slightly. With carry handle. With WRITTEN G'TEE and instructions. Only £12.99, post 30p. ALSO AVAILABLE: SPECIAL BATTERY/MAINS AC/DC MODEL, ready to plug in, £2.50 extra if required. Refund g'tee. BONUS one per customer: Cassette tape, set of Standard batteries and microphone stand all for 51p extra if required. Send quickly or call.

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WITH REMOTE CONTROL MICROPHONE

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FANTASTIC (even by our standards!) Brand new—the latest sensation in the world of sound! First class makers! Not only a fabulous VHF AM/FM Radio AND Cassette Tape Recorder and Player combined, but it also runs off standard batteries or mains (simply plug in the built-in 220/240v. AC line cord) Now you can record and play back anything, anywhere! You can even tape direct from the Radio as you listen! RECOMMENDED RETAIL PRICE GENUINELY £44. YET WE OFFER AT ALMOST HALF PRICE! Just look at these wonderful features:—*Press button Keyboard Control panel! *New 'pop-up' Cassette, ejection system! *"MAGIC EYE" Visual Battery check/recording level indicator! *Separate ON/OFF, and HI-LO volume controls! *Heavy duty built-in speaker! *Earphone (for personal listening or "monitoring") and extension speaker sockets! *Remote control microphone! *Built-in swivel telescopic extension aerial (24 inches approx)! Magnificently made case, size 11ins. x 9ins. x 3ins. overall approx., with carry handle. (DESIGNS VARY SLIGHTLY.) Takes standard 30, 60, 90 or 120 minute Philips Cassette Tapes obtainable everywhere. But wait, the amazing built-in full circuit VHF AM/FM Radio gives you superb clarity of tone and incredible station selection—Unique rotating Station Selector Dial—get all local city & regional stations in every part of the country plus B.B.C. National VHF. Picks up dozens of foreign stations and short mobile transmissions. Fabulous in car! You could pay ££££ more for a Car Radio or Car Cassette Tape Player ALONE! OUR PRICE, ONLY £23.75 CARR. ETC. 35p. Complete with simple instructions, personal listening earphone, remote control microphone with on/off switch and microphone stand, with WRITTEN GUARANTEE. BONUS OFFER—Standard Batteries and Cassette Tape 25p extra. Refund g'tee. it's an offer you cannot afford to miss!

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BRAND NEW MODEL

RUSSIAN WORLD BEATER! WE COULDN'T EVEN MAKE THEM FOR THIS PRICE!

6 WAVEBAND 10 TRANSISTOR PLUS 3 DIODES PORTABLE RADIO

WORLD WIDE RECEPTION THOUSANDS OF TRANSMISSIONS AND STATIONS THE WORLD OVER!

£9.97p BOX POST ETC. 43p

NOT JUST A RADIO—BUT TECHNOLOGICAL MAGIC!

*COMPARE ITS PERFORMANCE with £34 RADIOS!

THE VERY LATEST MODEL, SUPERSEDING ALL PREVIOUS MODELS—FANTASTIC BRAND NEW RUSSIAN "MERIDIAN" 6-WAVEBAND PORTABLE RADIO, DESIGNED FOR WORLD WIDE RECEPTION. Only put into production after incorporation of every conceivable possible up-to-date technological improvement had been carefully considered and thoroughly examined. So advanced it will probably make your present radio seem like a "crystal set"! It's far better than any 6-wave radio even they have produced! Finest value we've ever offered! We're almost giving them away at £9.97—a mere fraction of even today's Russian miracle price! We challenge you to compare the performance and value with that of £34 radios!

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SEND OR CALL A VISIT TO SHOPERTUNITIES COULD SAVE YOU £££!

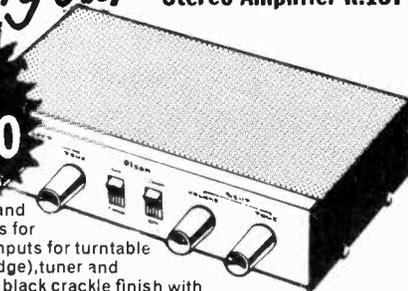
JUST BEGINNING?

Then try our **8-Watt, 10-Transistor Stereo Amplifier R.137**

ROC price
£10.50

Separate tone and volume controls for each channel, inputs for turntable (ceramic cartridge), tuner and tape. Attractive black crackle finish with brushed aluminium front. Frequency response: 70-20,000 Hz \pm 3dB. Output: 4 watts per channel @ 8 ohms. Inputs: Phono 80mV; tuner/aux 80mV.

Normal retail price: £14.70

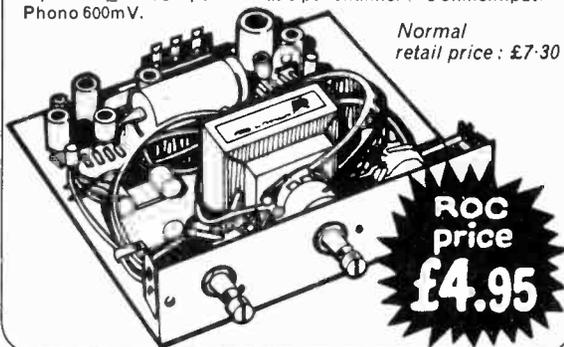


FIRST STEP TO STEREO!

5-Watt Transistor Stereo Amplifier Chassis R.123

Completely self-contained, fully transistorised, mains-powered (240v AC) amplifier, needing only cabinet and knobs. Ideal for adapting mono players to stereo. Frequency response: 40-17,000 Hz \pm 3dB. Output: 2.5 watts per channel @ 8 ohms. Input: Phono 600mV.

Normal retail price: £7.30



ROC price
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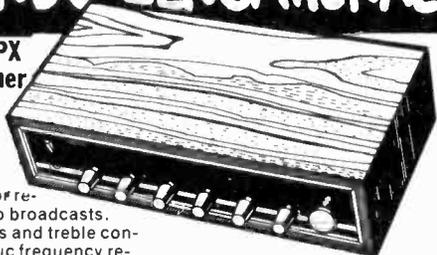
SOUNDS SENSATIONAL

AM/FM/MPX Stereo Tuner Amplifier R.124

A top quality amplifier with facility for receiving stereo broadcasts. Separate bass and treble controls, automatic frequency response, stereo headphone socket, output power: 8 watts. FM frequency range 88-108 MHz; AM frequency range 535-1605 KHz. Inputs for turntable (ceramic cartridge) and tape. Frequency response: 50-10,000 Hz \pm 3dB. Output: 4 watts per channel @ 8 ohms. Inputs: Phono 200mV, tape 100mV. FM: Sensitivity 20 μ V, stereo separation 26dB, image rejection 55dB. AM: Sensitivity 300 μ V.

Normal retail price: £42.00

ROC price: £29.95



SAVE
£14

AM/FM/MPX Stereo Tuner R.132

Matching unit to the R.131 amplifier. Covers full AM and FM bands. Separate signal meter. FM frequency range: 87-108 MHz; AM frequency range 525-1605kHz. AM: Sensitivity 3 μ V, stereo separation 30dB @ 1kHz, image rejection 60dB. AM: Sensitivity 250 μ V.

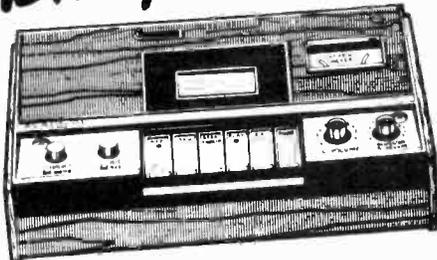
Normal retail price: £50.00

ROC PRICE
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AMAZING OFFER!

Stereo Cassette Tape Unit R.142



Complete stereo record and playback unit with line and microphone inputs. Fitted with tape counter, separate pause control, recording level metres for each channel, pop-up cassette ejection. Supplied complete with two pencil microphones. Wow & flutter better than 0.3%, frequency response 100-10,000 Hz. Tape speed: 1 $\frac{1}{2}$ IPS, 4.75 CMS. Rewind time: Better than 60 sec (C.60 cassette).
Normal retail price: £65.00

ROC price
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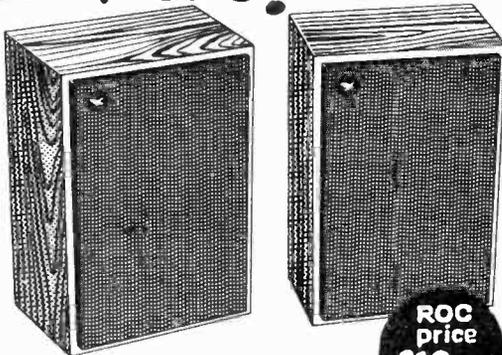


40-WATT TRANSISTOR STEREO AMPLIFIER R.131

Separate bass and treble controls, separate left and right volume controls. Separate loudness control. Switches main and remote speaker outputs. Inputs for turntable (switched for magnetic or ceramic), tuner (see R.132) and tape. Outputs for tape and headphones. Frequency response 20-20,000 Hz \pm 3dB. Output: 20 watts per channel @ 8 ohms. Inputs: Phono magnetic 3.0mV RIAA, crystal 100mV, tape 160mV, tuner 160mV.

Normal retail price: £39.60

2 for the price of one! Matched Stereo Speakers R.446



Heavily lagged teak finish cabinets each with large dual cone base unit and separate tweeter. Power handling: 16 watts peak; frequency range: 40-18,000 Hz; impedance: 8 ohms. Size: 14 x 8 1/2 x 6 1/2.

Normal retail price: £19.60

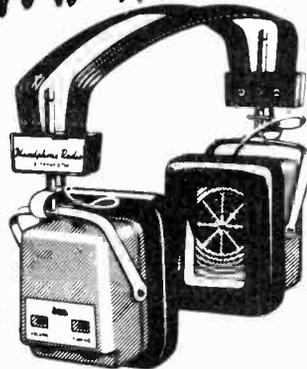
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FANTASTIC BARGAIN



Headphone Radio R.143

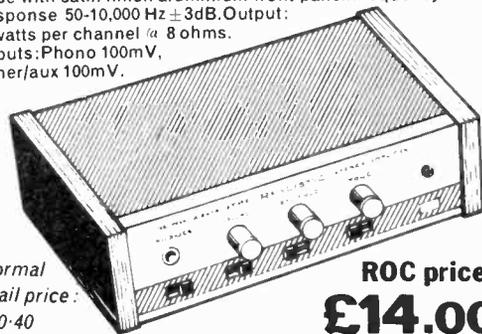
For completely private listening without the distortion of the ordinary earphone adaptor. Battery operated; PP3. Fully transistorised. Frequency range: 535-1600 K Hz, Medium Wave Band. Maximum output: 300mW.

Normal retail price: £9.40

Don't read this!

10-watt Transistor Stereo Amplifier R.136

Ganged volume, balance and tone controls. Inputs for turntable (ceramic cartridge), tuner (see R.134) or tape. Oiled walnut case with satin finish aluminium front panel. Frequency response 50-10,000 Hz \pm 3dB. Output: 5 watts per channel @ 8 ohms. Inputs: Phono 100mV, tuner/aux 100mV.



Normal retail price: £20.40

ROC price: £14.00

The Perfect match!

AM/FM/MPX Stereo Tuner R.134



Matching unit to the R.136 amplifier. Covers AM and FM tuning bands with automatic stereo signal light. FM frequency range: 88-108mHz; AM frequency range: 535-1605kHz. FM: Sensitivity 5uV, stereo separation 25dB @ 1kHz, image rejection 50dB. AM: Sensitivity 250uV.

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Wired with mains cable and 5ft. twin screened stereo cable, 5 pin din plug. 53p extra.

Plinth and Cover for above £4 plus 50p p. & p.

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Teak Cabinet

£12 plus 38p carr. & ins.

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



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Frequency range: 20 to 20,000Hz. **£7** plus 50p p. & p.

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Our price **£3.35** plus 25p. p. & p.

13 1/2" x 8 1/2" elliptical loudspeaker and independent high frequency units with associated crossover network. Frequency range 55 to 13,000Hz. The cone of the bass unit has a surround designed for high travel giving freedom from distortion when operated at low frequencies. EMI 14A/770C **£14.50** plus 50p p. & p. Bass Speaker



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Diamond **£4.00** stylus

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SONOTONE Cartridge ...

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Sensitivity: 9TAHC 55mV/cm/sec rms minimum at 45° at 1,000Hz measured on Decca SXL2057 **£2.50** plus 13p p. & p.

Ronette 105 Stereo cartridge (Sapphire 78 Diamond LP) **£1.25** + 13p. p. & p.

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E.240 20 watt 240 volts soldering iron fitted with 1/4" iron coated bit. Spare bits 3/32", 1/8" and 3/16" available. Can also be supplied for 220 and 110 volts. Price **£1.80**.

ES.240 25 watt 240 volts soldering iron fitted with 1/8" iron coated bit and packed in a transparent display box. Spare bits 3/32", 3/16" and 1/4" available. Can also be supplied for 220 and 110 volts. Price **£1.83**



CN.240/2 Miniature soldering iron 15 watt 240 volts, fitted with nickel plated 3/32" bit and packed in transparent display box. Also available for 220 volts. Price **£1.70**

CN.240 Miniature soldering iron 15 watt 240 volts, fitted with iron coated 3/32" bit. Up to 18 interchangeable spare bits obtainable. This iron can also be supplied for 220, 110, 50 or 24 volts. Price **£1.70**

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your soldering appliance specialists.



CCN.240 New model 15 watt 240 volts miniature soldering iron with ceramic shaft to ensure perfect insulation (4,000 v A.C.). Will solder live transistors in perfect safety; fitted with 3/32" iron coated bit. Spare bits 1/8" 3/16" and 1/4" available. Can also be supplied for 220 volts. Price **£1.80**

CCN.240/7 The same soldering iron fitted with our new 7-star high efficiency bit for very high speed soldering. The triple-coated bits are iron, nickel and chromium plated. Price **£1.95**



SK. 2 SOLDERING KIT

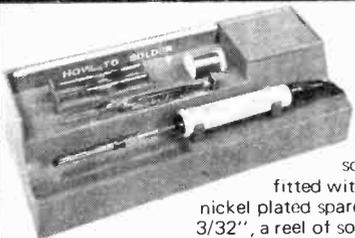
This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

Price **£2.40**.



MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet. Price **£1.95**.

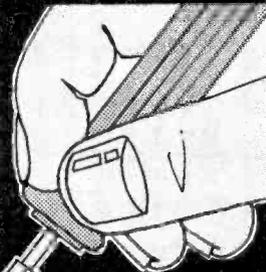


SK.1 SOLDERING KIT

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

Price **£2.75**

sign here to answer all your soldering problems.



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 DC/AC Volts 1-2KV, 600V, 300V, 60V, 12V,
 3V & 0-6V
 DC Current 12A, 300mA, 30mA, 3mA & 60
 micro A
 Switch—Divide by 2 on Volts and Amps. Ranges
 DC 50 & 25K ohms/V 5 & 2.5 Kohms/V
C1085 (Illustrated) £16-25
 Res. Range x1, x10, x1K, x10K
 AC Volts 1-2KV, 600V, 300V, 60V, 12V, 3V
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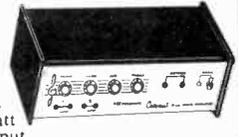
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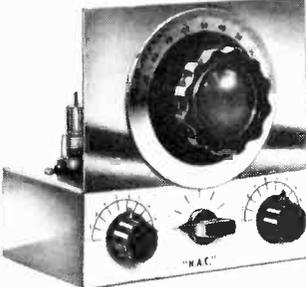
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100-0-100μA \$2.50	300V. D.C. \$2.00	100-0-100μA \$1.75	50V. D.C. ... \$1.50
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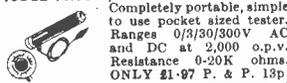
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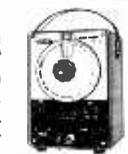


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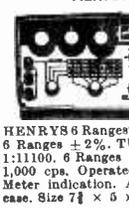


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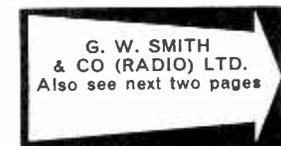
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Transistors	2N3415	2N3416	2N3417	2N3418	2N3419	2N3420	2N3421	2N3422	2N3423	2N3424	2N3425	2N3426	2N3427	2N3428	2N3429	2N3430	2N3431	2N3432	2N3433	2N3434	2N3435	2N3436	2N3437	2N3438	2N3439	2N3440	2N3441	2N3442	2N3443	2N3444	2N3445	2N3446	2N3447	2N3448	2N3449	2N3450	2N3451	2N3452	2N3453	2N3454	2N3455	2N3456	2N3457	2N3458	2N3459	2N3460	2N3461	2N3462	2N3463	2N3464	2N3465	2N3466	2N3467	2N3468	2N3469	2N3470	2N3471	2N3472	2N3473	2N3474	2N3475	2N3476	2N3477	2N3478	2N3479	2N3480	2N3481	2N3482	2N3483	2N3484	2N3485	2N3486	2N3487	2N3488	2N3489	2N3490	2N3491	2N3492	2N3493	2N3494	2N3495	2N3496	2N3497	2N3498	2N3499	2N3500	2N3501	2N3502	2N3503	2N3504	2N3505	2N3506	2N3507	2N3508	2N3509	2N3510	2N3511	2N3512	2N3513	2N3514	2N3515	2N3516	2N3517	2N3518	2N3519	2N3520	2N3521	2N3522	2N3523	2N3524	2N3525	2N3526	2N3527	2N3528	2N3529	2N3530	2N3531	2N3532	2N3533	2N3534	2N3535	2N3536	2N3537	2N3538	2N3539	2N3540	2N3541
2N3415	2N3416	2N3417	2N3418	2N3419	2N3420	2N3421	2N3422	2N3423	2N3424	2N3425	2N3426	2N3427	2N3428	2N3429	2N3430	2N3431	2N3432	2N3433	2N3434	2N3435	2N3436	2N3437	2N3438	2N3439	2N3440	2N3441	2N3442	2N3443	2N3444	2N3445	2N3446	2N3447	2N3448	2N3449	2N3450	2N3451	2N3452	2N3453	2N3454	2N3455	2N3456	2N3457	2N3458	2N3459	2N3460	2N3461	2N3462	2N3463	2N3464	2N3465	2N3466	2N3467	2N3468	2N3469	2N3470	2N3471	2N3472	2N3473	2N3474	2N3475	2N3476	2N3477	2N3478	2N3479	2N3480	2N3481	2N3482	2N3483	2N3484	2N3485	2N3486	2N3487	2N3488	2N3489	2N3490	2N3491	2N3492	2N3493	2N3494	2N3495	2N3496	2N3497	2N3498	2N3499	2N3500	2N3501	2N3502	2N3503	2N3504	2N3505	2N3506	2N3507	2N3508	2N3509	2N3510	2N3511	2N3512	2N3513	2N3514	2N3515	2N3516	2N3517	2N3518	2N3519	2N3520	2N3521	2N3522	2N3523	2N3524	2N3525	2N3526	2N3527	2N3528	2N3529	2N3530	2N3531	2N3532	2N3533	2N3534	2N3535	2N3536	2N3537	2N3538	2N3539	2N3540	2N3541	

Integrated Circuits	FJH101	FJH111	FJH121	FJH131	FJH141	FJH151	FJH161	FJH171	FJH181	FJH191	FJH201	FJH211	FJH221	FJH231	FJH241	FJH251	FJH261	FJH271	FJH281	FJH291	FJH301	FJH311	FJH321	FJH331	FJH341	FJH351	FJH361	FJH371	FJH381	FJH391	FJH401	FJH411	FJH421	FJH431	FJH441	FJH451	FJH461	FJH471	FJH481	FJH491	FJH501	FJH511	FJH521	FJH531	FJH541	FJH551	FJH561	FJH571	FJH581	FJH591	FJH601	FJH611	FJH621	FJH631	FJH641	FJH651	FJH661	FJH671	FJH681	FJH691	FJH701	FJH711	FJH721	FJH731	FJH741	FJH751	FJH761	FJH771	FJH781	FJH791	FJH801	FJH811	FJH821	FJH831	FJH841	FJH851	FJH861	FJH871	FJH881	FJH891	FJH901	FJH911	FJH921	FJH931	FJH941	FJH951	FJH961	FJH971	FJH981	FJH991	FJH1001
FJH101	FJH111	FJH121	FJH131	FJH141	FJH151	FJH161	FJH171	FJH181	FJH191	FJH201	FJH211	FJH221	FJH231	FJH241	FJH251	FJH261	FJH271	FJH281	FJH291	FJH301	FJH311	FJH321	FJH331	FJH341	FJH351	FJH361	FJH371	FJH381	FJH391	FJH401	FJH411	FJH421	FJH431	FJH441	FJH451	FJH461	FJH471	FJH481	FJH491	FJH501	FJH511	FJH521	FJH531	FJH541	FJH551	FJH561	FJH571	FJH581	FJH591	FJH601	FJH611	FJH621	FJH631	FJH641	FJH651	FJH661	FJH671	FJH681	FJH691	FJH701	FJH711	FJH721	FJH731	FJH741	FJH751	FJH761	FJH771	FJH781	FJH791	FJH801	FJH811	FJH821	FJH831	FJH841	FJH851	FJH861	FJH871	FJH881	FJH891	FJH901	FJH911	FJH921	FJH931	FJH941	FJH951	FJH961	FJH971	FJH981	FJH991	FJH1001	

VALVES	6X4	6X5	6X6	6X7	6X8	6X9	6X10	6X11	6X12	6X13	6X14	6X15	6X16	6X17	6X18	6X19	6X20	6X21	6X22	6X23	6X24	6X25	6X26	6X27	6X28	6X29	6X30	6X31	6X32	6X33	6X34	6X35	6X36	6X37	6X38	6X39	6X40	6X41	6X42	6X43	6X44	6X45	6X46	6X47	6X48	6X49	6X50	6X51	6X52	6X53	6X54	6X55	6X56	6X57	6X58	6X59	6X60	6X61	6X62	6X63	6X64	6X65	6X66	6X67	6X68	6X69	6X70	6X71	6X72	6X73	6X74	6X75	6X76	6X77	6X78	6X79	6X80	6X81	6X82	6X83	6X84	6X85	6X86	6X87	6X88	6X89	6X90	6X91	6X92	6X93	6X94	6X95	6X96	6X97	6X98	6X99	6X100
6X4	6X5	6X6	6X7	6X8	6X9	6X10	6X11	6X12	6X13	6X14	6X15	6X16	6X17	6X18	6X19	6X20	6X21	6X22	6X23	6X24	6X25	6X26	6X27	6X28	6X29	6X30	6X31	6X32	6X33	6X34	6X35	6X36	6X37	6X38	6X39	6X40	6X41	6X42	6X43	6X44	6X45	6X46	6X47	6X48	6X49	6X50	6X51	6X52	6X53	6X54	6X55	6X56	6X57	6X58	6X59	6X60	6X61	6X62	6X63	6X64	6X65	6X66	6X67	6X68	6X69	6X70	6X71	6X72	6X73	6X74	6X75	6X76	6X77	6X78	6X79	6X80	6X81	6X82	6X83	6X84	6X85	6X86	6X87	6X88	6X89	6X90	6X91	6X92	6X93	6X94	6X95	6X96	6X97	6X98	6X99	6X100	

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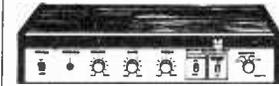
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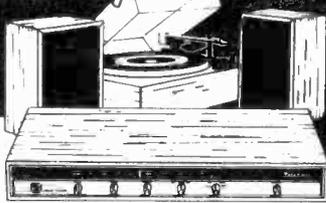
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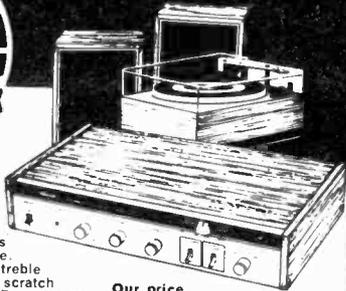
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Ultra 6405	£77.00	£67.25
Ferguson 3450 Stereo	£72.00	£63.50



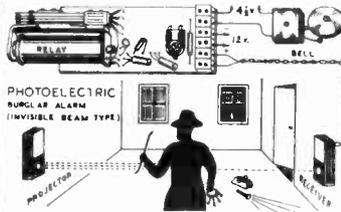
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Versatile Invisible-beam, Relay-less, Steady-light Photo-Switch, Burglar Alarm, Door Opener, Counter, etc., for the Experimenter. CONTENTS: Infra-Red Sensitive Phototransistor, 3 Transistors, Chassis, Plastic Case, Resistors, Screws, etc. Full Size Plans, Instructions, Data Sheet "10 Advanced Photoelectric Designs". Price £1.25. Postage and Pack. 10p (U.K.). Commonwealth 20p; Airmail 50p.

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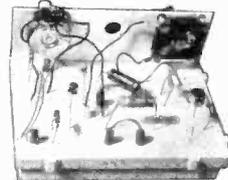
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NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 5" heavy duty Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

Total building cost

£8-50

P. P. & Ins. 30p

(Overseas P. & P. £1)



ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 5" heavy duty Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost **£6-98** P.P. & Ins. 41p. (Overseas P. & P. £1)

ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler

Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, including Micro-Alloy R.F. Transistors. 5" heavy duty speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening. 30p extra.

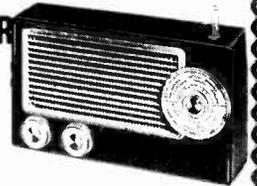
Total building costs **£5-98** P.P. & Ins. 41p. (Overseas P. & P. £1)



ROAMER SIX

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—8 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

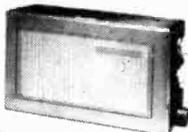
Total building costs **£3-98** P.P. & Ins. 28p. (Overseas P. & P. £1)



POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 6 1/2 x 1 1/2 x 2 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-23** P.P. & Ins. 23p. (Overseas P. & P. 63p)

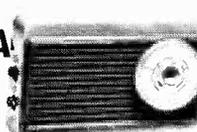


TRANSONA FIVE

NOW WITH 3in SPEAKER

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone 3in. moving coil speaker. Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-50** P.P. & Ins. 22p. (Overseas P. & P. 63p)

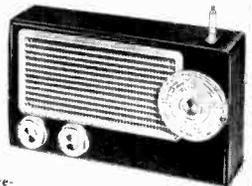


TRANS EIGHT

8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Push pull output. Battery economiser switch for extended battery life. Ampie power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY TO GO DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT.

COMPONENTS INCLUDE:

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POCKET FIVE	<input type="checkbox"/>	EDU-KIT	<input type="checkbox"/>

Parts price list and plans for

Name

Address

PW.38

28watts, r.m.s. 40Hz to 40kHz ±3dB



Viscount III Audio Suite complete **£49**

There are two stereo amplifiers—the R100 for ceramic cartridges, the R101 for magnetic and ceramic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.

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Viscount III R101 amplifier	£22.00+90p p&p
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Garrard SP25 Mk. III with MAG.	
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	p&p

Total £59.00

Available complete for only **£52.00+£3.50 p&p**

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Viscount R101 amplifier	£22.00+90p p&p
2 x Duo Type III speakers	£32.00+£3 p&p
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cartridge, plinth and cover	£23.00+£1.50
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Total £77.00

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Viscount III Amplifier R100	£17.00+90p p&p
2 x Duo Type II speakers, pair	£14.00+£2 p&p
Garrard SP25 Mk. III with CER. diamond	
cartridge, plinth and cover	£21.00+£1.50
	p&p

Total £52.00

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SPEAKERS Duo Type II

Size approx 17" x 10½" x 6½". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet. **£14 pair+£2 p&p.**

Duo Type III Size approx 23½" x 11½" x 9½". Drive unit 13½" x 8½" with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair+£3 p&p.**

SPECIFICATION R101

14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0.1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ± 1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. —58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than -35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13½" x 9" x 3½".

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SOUND 50

50 WATT AMPLIFIER & SPEAKER SYSTEM



The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

Output Power: 45 watts R.M.S. (Sine wave drive). **Frequency response:** -3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB. **Speaker Impedance:** 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10 KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.

To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.

SPEAKERS! Size 20" x 20" x 10" incorporating 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM £50 Plus £6 P. & P.

Sound 50 amp and 2 speakers

or available separately.

Amplifier £28.50 plus £1.50 P. & P.
Speakers £12.50 each plus £2.25 P. & P.

RELIANT mk. IV



Provides a high standard of sound reproduction, with full mixing facilities. It's versatility makes it suitable for: Discotheque, P.A., Home Entertainment Applications, etc.

- ★ Five Electronically Mixed Inputs
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- ★ Mixer employing F.E.T. (Field Effect Transistor)
- ★ Solid State Circuitry ★ Attractive Styling

£9.50 plus P. & P. 60p.

INPUTS:—1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram, Tuner, Monitor, Organ, etc.). All 250mV sensitivity.

CONTROLS:—3 Volume controls. Bass control range: 13db @ 60 Hz. Treble control range ±12db @ 15KHz. Separate ON/OFF Switch. Neon Indicator.

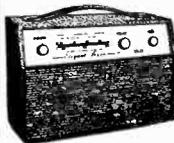
POWER OUTPUT:—12 Watts R.M.S. into 3 to 4 ohms speaker

SIGNAL/NOISE:—Better than -60db on inputs 3, 4 and 5 & -50db on 1 & 2

SUPPLY:—220 - 250 AC Mains. **SIZE:**—12 1/2" x 6" x 3 1/2"

THE ELEGANT SEVEN Mk. III

(350m W Output)



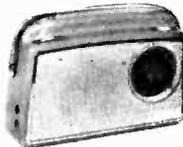
7 transistor fully-tunable M.W.—L.W. superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.

MAINS POWER PACK KIT: 75p extra.

Price **£5.25** plus 50p. P. & P.

Circuit 13p **FREE WITH PARTS.**

THE DORSET (600m W Output)

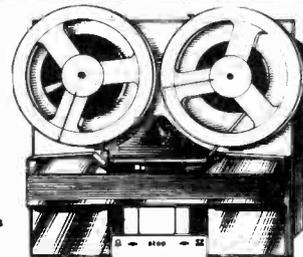


7-transistor fully tunable M.W.—L.W. superhet portable. Set of parts. The latest modulated and pre-alignment techniques make this simple to build. Sizes: 12 x 8 x 3in.

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Circuit 13p **FREE WITH PARTS**

CONTINENTAL 4 TRACK, 3 SPEED TAPE DECK



with high impedance heads

R.C. 74 tape deck. Three speeds—7 1/2, 3 1/2 and 1 1/2 ips.

4-track record/playback head. Plus 4-track erase head. Positive pressure pad system. Takes any tape spool up to and including 7". The R.C. 74 is driven by a powerful 200/250V 50-cycle A.C. motor. A heavy, accurately balanced, flywheel brings wow and flutter levels down to approx. 0.3% total at 3 1/2 and 7 1/2 ips. Fast rewind in both directions.

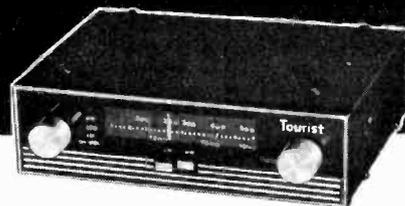
Controls couldn't be simpler! Just five push buttons that interlock to cut out accidental tape damage. Efficient servo-action type braking. Easy drop-in tape loading.

The R.C. 74 comes with an attractive moulded deck cover, which has positions for tone and volume controls. The unit is built into a rigid die-cast frame, and overall size of the whole unit is 12 1/2" x 11 1/2" x 6 inches. Every single deck fully tested before dispatch. Spools not supplied.

Price complete **£15.00.** Plus 75p P. & P.

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MARK 3



ALL TRANSISTOR

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SET OF PARTS

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NEW - TO U.K. MARKET PARTRIDGE EXPORT EQUIPMENT

Size: 6" x 2 1/4" x 4 3/4"
Weight: 2lb



Finish: Gold stove enamel with fascia off-white on maroon.

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7' 6" (2.28m) long. Wt. 1 1/2 lb. The new improved "JOYSTICK" V.F.A.

In matching gold stove enamel, black and red finish.

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The new "JOYSTICK" V.F.A. OUTPERFORMS many beam antennae in practice BECAUSE of its low reflected power factor and absence of harmonics.

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1D5	50	6BR7	90	6K7M	60	7R7	75	20F2	70	50C5	50	DF33	55	ECC82	30	EL95	35	OC3	38	PL802	85	UAF42	55
1H5	50	6BR8	70	6K7G	35	7X4	22-25	20P1	11-10	50D6GT	55	DF91	30	ECC84	30	EM34	21-00	PC86	60	PX4	22-50	UBC41	50
1NSGT	55	6BR8	21-30	6K7GT	35	9BW6	60	20P5	21-20	7L	45	DF92	20	ECC83	40	EM80	45	PC88	80	PY33	85	UBF90	40
1R5	40	6BW6	85	6K8M	60	10C2	85	25A6	35	80	55	DH3-91	20-00	ECH21	63	EM84	35	PC84	40	PY82	35	UCC84	43
1R4	30	6BW7	80	6K8G	40	10F1	75	25L6GT	50	85A2	50	DH77	35	ECH35	21-00	EY51	40	PC89	50	PY88	38	UCC85	40
1R5	30	6C4	33	6K8GT	50	10F3	90	25Y5	65	150B2	80	DK32	45	ECH42	75	EY86	40	PCU89	55	PY500	21-00	UCP80	55
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3A4	40	6C6	25	6L6G	50	10F18	50	25Z8GT	55	801	80	DK92	55	ECH83	45	EZ40	50	PCF82	35	PY801	50	UCB81	40
3Q4	50	6CD4G	21-25	6L18	45	10LD11	85	25Z6	65	807	50	DK96	50	ECL80	45	EZ41	50	PCF84	60	R2	75	UCL82	35
3Q5	50	6CH6	60	6Q7G	40	10P13	60	30C1	35	8131'NA	23-75	DL66	21-25	ECL82	35	EZ80	20	PCF86	60	R19	50	ULC83	60
3B4	35	6C'W4	65	6Q7GT	43	11E3	24-00	30C15	80	886A	75	DL92	35	ECL83	70	EZ81	29	PCF801	50	S130	21-75	UF41	60
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5R4GY	75	6E5	60	68C7M	75	12A77	35	30C14	80	1925	55	DL84	48	ECL800	40	GZ30	40	PCF805	60	SP41	60	UL41	65
5U4G	35	6F1	70	68G7M	40	12A76	35	30F5	65	402'AR	25-50	DL85	50	GZ32	48	PCF86	45	PCF806	70	SP81	75	UL84	40
5V4G	45	6F5G	90	68H7M	40	12A77	30	30FL1	75	5763	70	DL96	45	EF9	75	GZ34	60	PCF808	85	STV280/80	UM80	30	
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5Z4G	40	6F8G	50	68K7GT	40	12B46	40	30FL14	35	7475	50	DY86	33	EF39	50	KT36	21-00	PCL83	65	SU25	21-00	UU7	21-05
6J30L2	80	6F11	40	68L7GT	35	12C86	40	30L15	85	A61	48	DY87	33	EF41	65	KT61	21-25	PCL84	45	SU2150	75	UU8	21-05
6A7	75	6F15	45	68N7GT	35	12C8GT	35	30L17	50	ATP4	45	EY88C	65	EF50	25	KT66	22-05	PCL85	40	T41	21-00	UU9	21-05
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6AM6	35	6F25	21-00	6V5M	30	12K7GT	40	30P19	85	AU2	24-00	EAF42	55	EF86	30	21-13	HN304	21-00	U10	75	UY85	40	
6AM6	35	6F28	65	6V8G	30	12K8GT	50	30PL13	93	AZ1	55	EBC33	50	EF91	33	KTW61	21-00	PEN45	75	U19	23-00	VP4B	21-85
6AQ5	38	6F32	25	6V8GT	40	12Q7GT	40	30PL14	90	AZ31	55	EBC34	55	EF92	35	KTZ41	50	PEN46	40	U35	80	VR105/30	38
6A87G	55	6H6	25	6X4	35	12S4GT	50	38A5	75	CB'L31	21-00	EBC30	30	EF98	75	ML4	88	PL36	55	U26	80	VR160/30	35
6A76	35	6H6	23	6X5G	40	12S17	35	38L6	50	OCH33	75	EBF80	40	EF183	30	ML4	88	PL81	50	U78	35	VU111	75
6A76	35	6H6	23	6X5G	40	12S17	35	38W4	35	CL33	21-30	EBF83	40	EF184	35	ML6	40	PL82	45	U191	75	VU120	21-00
6A76	35	6H6	23	6X5GT	40	12S17	35	35Z3	70	CY30	68	EBF89	30	EL32	50	MP4	50	PL83	45	U261	80	VU508	23-00
6B4G	21-00	6J5G	20	7B6	70	12S7	40	35Z4GT	60	CY31	43	EBL1	21-00	EL33	21-25	MT'14	75	PL84	40	U301	63	W81M	63
6B8G	25	6J5GT	30	7B7	70	12S87	50	35Z5	50	DAC32	50	EBL21	60	EL34	50	MX40	63	PL500	80	U403	60	T63	50

Transistors		2N2218		2N2444		AD149		50 BC169C		15 BFT82		25 NKT223		33 OAZ201		50 OC35		50 OC81D		20 Z8170		10	
1N914	07-2N697	15	2N2646	45	AC126	25	AF127	25	BFY50	25	BFY50	25	BFY50	25	BFY50	25	BFY50	25	BFY50	25	BFY50	25	BFY50
1N118	25 2N706	10	2N2904	20	AC127	25	AF116	25	BFY100	15	MJE2955	10	OA71	10	OAZ224	45	OC58	60	OC170	25	ZTX300	12	
18202	23 2N1132	25	2N2928	10	AC128	20	BC107	10	ZY88	15		11-37	OA81	08	OAZ241	22	OC69	65	OC171	30	ZTX304	25	
2G302	22 2N1305	22	2N3055	75	AC129	20	BC108	10	CRN1-40	47	MJE3055	87	OA85	12	OAZ242	23	OC71	12	OC200	40	ZTX500	16	
2G371	22 2N1347	75	2N3702	10	AD139	60	BC109	10	DDT03	15	NKT212	27	OA91	07	OAZ245	23	OC72	20	OCP71	97	ZTX503	17	
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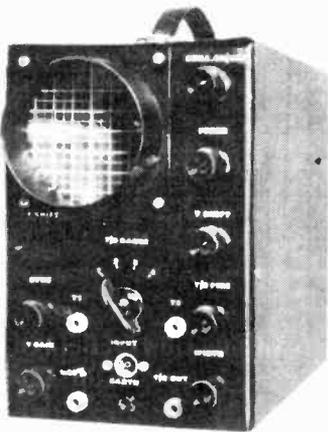
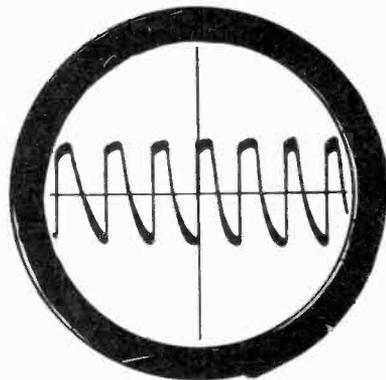
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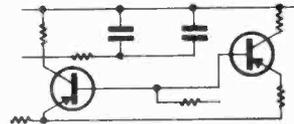
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2N3136 25p	3N140 77p	BC198B 11p	BFX25 1.85	NKT244 17p	T1P30A 60p
2N3391 25p	4022 72p	BC199 12p	BFX29 1.80	NKT245 20p	T1P31A 60p
2N3391A 20p	3N142 55p	BC170 12p	BPY10 11.45	NKT261 20p	T1P32A 75p
2N3391A 30p	3N143 67p	BC171 15p	BPY39 37p	NKT262 30p	TIP33A
2N3392 17p	3N152 87p	BC172 15p	B8X19 17p	NKT264 20p	11.02p
2N3393 15p	R.C.A. 52p	BC176 22p	B8X20 17p	NKT271 30p	TIP34A 22.05
2N3394 15p	40680 55p	BC182 10p	B8X21 37p	NKT272 30p	TIP35A 22.90
2N3402 32p	4022 72p	BC198 10p	NKT273 45p	NKT274 30p	TIP36A 22.90
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SN7405	0.20 18	0.18 18	SN7441A	0.87 0.83	SN7475	0.45 0.44
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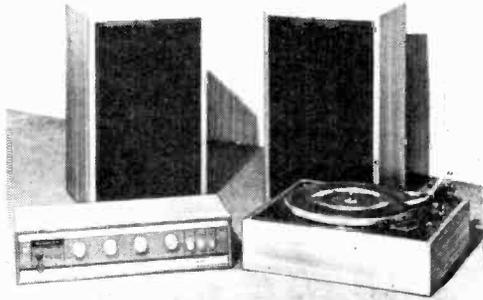
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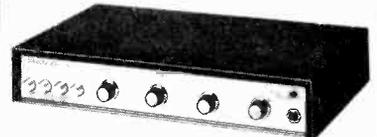
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PRACTICAL WIRELESS

VOL 47 NO 10

Issue 780

FEBRUARY 1972

Preview '72

THIS is the first issue of P.W. to hit the bookstalls, or land on your doormat, in this brand new year of 1972. As you read these lines, the Christmas and New Year festivities will be receding into the past with, we hope, a rosy nostalgic haze. On the other hand, these notes are being written in the rather hectic period just before, as they say, the holiday breaks out. The mood at the moment of writing is perhaps more of looking back over the year that has gone, whereas a more appropriate theme for the moment of reading is 'never mind all that—we are more interested in what is to come.' Therefore, bowing to popular demand, here is a brief preview of some of the items we have in store for the coming year.

Observant readers will note that we have kicked off with a meaty start. The quality hi-fi stereo system, transistor oscilloscope (which was shown at last year's Audio Fair), a car rev-counter, a gate dip oscillator, notes on SSB reception, Take 20, IC of the Month and all the other regulars is a fair mixture. Next month is something of a special issue and will feature a novel cube radio you will all want to build, a car radio signal booster to give that extra something to your mobile radio reception and a special DX Data wall chart which incorporates information not hitherto published in this country.

The line-up of interesting constructional projects jostling for publication include the digital clock which aroused such interest at the Audio Fair, a shortwave receiver covering from 1.7–30MHz, a simple wobblulator for the MW band, a THD distortion meter, a 2-metre FET converter, a transistor tester, a 160m converter, and many more, including some surprise items. Articles on installing car radios, on how to use the oscilloscope (with many waveforms) and thermionic devices in modern electronics will number among the supporting features.

The May issue will include a special extra 8-page supplement and will be of great importance as it will introduce full constructional details of a hi-fi amplifier of radical design, specially developed for P.W. Using ICs, and constructed for low-profile presentation, this new design should cause quite a stir in the world of audio.

These, then, are some of the things we have in store for the coming year and there will, of course, be others introduced into the schedule as convenient. Since we are now unfortunately unable to supply back numbers make sure you get your copy every month by placing a regular order with your newsagent or taking out a subscription. We'd hate you to be disappointed!

W. N. STEVENS—*Editor*

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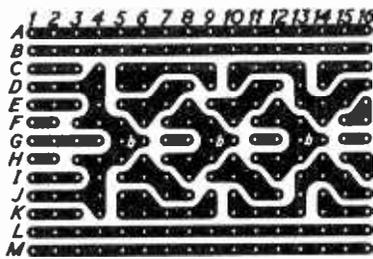
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**MARCH ISSUE WILL BE
PUBLISHED ON FEBRUARY 4th**

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Wiring Board



© Copyright design NIP Electronics 1971 NIPPBOARD 'A'

Nippiboard is a simple to use multi-purpose printed wiring board. It has a specially designed layout that can be used as a basis on which to assemble several kinds of circuit, including amplifiers, oscillators, tone circuits, switching circuits, timers, etc.

The list is formidable, but it can be done on one basic Nippi-

board pattern with up to four or five small transistors. And the amazing thing is that one Nippiboard Type 1a or 1b is little larger than a matchbox.

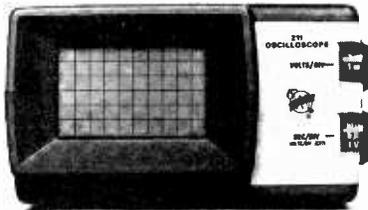
There are two ranges at present available: Range 'A' has an s.r.b.p. base and Range 'B' has a fibreglass base. The s.r.b.p. base is cheaper and easy to work with, but the fibreglass base overcomes some of the problems of "movement" in extreme atmospheric conditions. All Nippiboards are flux varnished to keep the copper clean and make soldering easier.

If larger circuits are multiple circuit systems or building blocks are required, Nippiboard can be obtained in nine different arrangements covering between one and ten basic patterns. Type 1a single basic pattern as shown costs 15p. NIP Electronics, P.O. Box 11, St. Albans, Herts.

Mini Scope

The Tektronix Type 211 is an all solid state miniature oscilloscope with double insulation, and is designed for use in severe environments. Bandwidth is 500kHz. Weighing only 3 pounds and measuring 3 x 5 $\frac{1}{4}$ x 9in., the Type 211 operates from a.c. line or up to 5 hours on internal batteries. Deflection factors are 1mV/div to 50V/div. Sweep rates extend to 1 μ s/div.

In many industrial applications it is frequently necessary to "float" an oscilloscope. The Type 211 may be elevated to 700 Volts above ground when operated from batteries, and to 250 Volts r.m.s. above ground from a.c. Trigger controls are simplified to one rotary control. A bright baseline is provided at all sweep rates, even with no signal in. When a signal is received, the oscilloscope triggers on the signal. Internal and external trigger circuits provide stable displays from about seven hertz to at least 500kHz. Price delivered in the UK is:— Type 211 Oscilloscope £262 including batteries. Duty £29.60. Further information available from: Tektronix U.K. Ltd., P.O. Box 69, Harpenden, Herts.

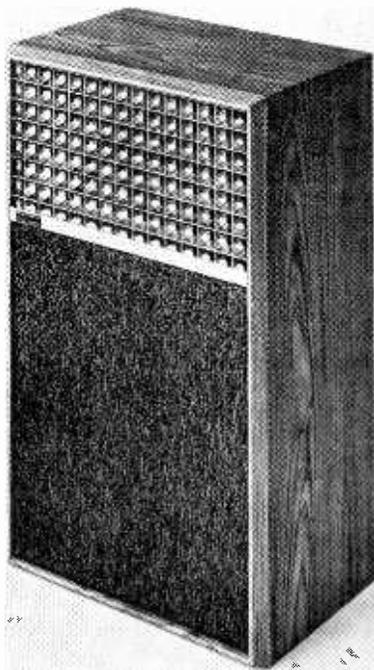


"Verobox"

Vero Electronics announce the introduction of the "E" Series range of cases. The basic shell is identical to the "D" Series but since no front trim is fitted, a slightly larger front panel is required. $\frac{1}{4}$ UNF Front Panel fixing screws are included and the case is finished in R.A.F. blue grey hammertone. Vero Electronics Ltd., Industrial Estate, Chandlers Ford, Hampshire, SO5 3ZR.



Duplex 25



The new Duplex 25 speaker from Metrosound handles a full 25 Watts of power. It has two speaker units—one long throw cone type and the other a radically different electrostatic unit based upon an entirely new patent. The electrostatic unit is mounted behind a lenticular grille. The other is fronted by a specially woven acoustically transparent vinyl cloth. Impedance is 8 ohms. Response 40-18,000Hz. Dimensions: width 16 $\frac{1}{2}$ in., height 27 $\frac{1}{2}$ in., depth 12in.

The smaller version is also available. Called the Duplex 15 it handles 15 Watts and like its big brother it uses both cone and electrostatic units. Impedance 8 ohms. Response of the Duplex 15 is 45-17,000Hz. Dimensions: width 18 $\frac{1}{4}$ in., height 18 $\frac{1}{4}$ in., depth 8 $\frac{1}{2}$ in. For both models the electrostatic unit is energised by a supply voltage of 190-250V, 50-60Hz. Prices: Duplex 15—£32. Duplex 25—£52. Metrosound Audio Products Ltd., Audio Works, Cartersfield Road, Waltham Abbey, Essex.

Moon Laser

A group of scientists of the Moscow Physics Institute and the Crimean Astrophysical Observatory of the U.S.S.R. Academy of Sciences have carried out sessions for laser locating the angular light reflector put on the moon by the *Apollo-15* crew. Clear return signals were recorded.

The angular reflector was placed in the south-east part of the Sea of Rains in the foothills of the lunar apennines, on the dark side of the lunar surface. In order to sight the telescope on it as accurately as possible a small crater was selected on the illuminated part of the moon. Knowing the bearings of this crater and the reflector, one can calculate the angular distance between them. The calculations necessary for sighting the telescope on the light reflector were done at the Academy's Institute of Theoretical Astronomy.

One of the most important tasks of the experiment—the accurate sighting of the laser device on the target—has been solved.

The current experiment is a continuation of the work to investigate the “earth-moon” system by the laser location method. The first Soviet laser locating experiment, for spotting the French reflector mounted on *Lunokhod-1*, was carried out in December 1970 when the measuring accuracy of the distance to the reflectors was of the order of a few metres.

A distinctive feature of the present experiment is that it was possible for the first time to measure the distance to the American angular reflector.

American scientists failed to locate the French reflector mounted on *Lunokhod-1*. This was apparently due to the different methods of calculating the assumed bearings of the reflector.

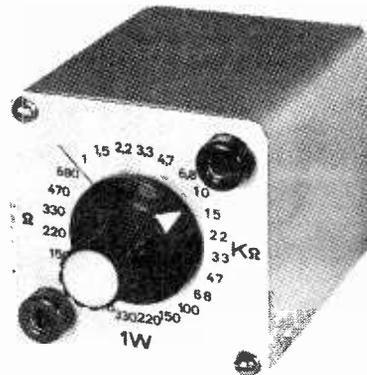
Detailed processing of the results obtained during the location sessions will make it possible to adjust thoroughly many important characteristics of the “earth-moon” system.

Decade Boxes

Two relatively miniature resistance and capacitance decade units are now available from Londex.

Features of Logade units include single-knob operation over the entire range of four decades, and push-fit terminal sockets accepting standard 4mm plugs.

Resistance Decade Type R1 has an overall range of 100 ohm up



to 680kΩ, with a tolerance of ± 2 per cent. Maximum operating voltage is 500V r.m.s., and the rating is 1W continuous.

Capacitance Decade Type C1 has an overall range of 100pF up to 0.68µF, with a tolerance of ± 10 per cent. Maximum voltage ratings are 1,000V d.c. or 400V a.c. Descriptive leaflet (List 253) is available from: *Londex Limited*, 207 Anerley Road, London, SE20 8EW. Telephone: 01-778-3111.

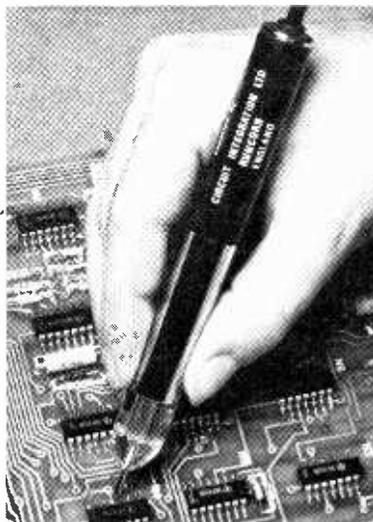
Logic Probes from C.I.

Circuit Integration have announced the introduction of a new product line—a series of Logic Probes.

These pocket-sized probes are designed for the testing of all types of equipment incorporating Integrated Circuits. The units are powered by the equipment under test, and colour-coded readout lights at the probe tip give a clear, accurate indication of “true”, “zero” or “pulse” conditions.

The units can be used with virtually any DTL/TTL IC system, including calculators, business machines, numerical control equipment, computers etc., as an invaluable aid to field service engineers, and as a testing device during laboratory development and manufacture.

There are five models in the series, covering the testing and advanced testing of logic systems



from 4.7V d.c. to 15V d.c. All models incorporate overload protection to protect the circuit under test.

Full details available from:—*Circuit Integration Ltd.*, Davey Rd., Astmoor Industrial Estate, Runcorn, Cheshire. Tel.: Runcorn, 75973/6.

THIS oscilloscope was specifically designed for the first Project Autumn Competition. The most important rule (in the writer's opinion) of that competition was that all components should be readily available; to this the designer has added his own requirement that all circuitry should be completely proved and easily set up using simple test-gear. To the writer there is nothing more frustrating than building up a circuit exactly to the published plans only to find that it does not work because certain component values have been determined empirically and are highly specific to the valves or transistors used in the original equipment. Also, any design that calls for elaborate setting-up or requires specialised test gear for accurate calibration is bound to have an appeal limited to those having either well lined pockets or industrial contacts.

In this design, none of the components is stretched to its limits and this offers the constructor the ability to substitute a wide variety of transistor types for those shown—where transistor selection is somewhat critical this is indicated in the text. If the unit is assembled in the order described then the only test-instrument required is a milliammeter capable of reading currents in the ranges 0-10mA and 0-500mA.

It was thought desirable to make the unit as portable as possible so that it could be used for field work. This, of course, requires that the unit should be capable of working from batteries. A quick calculation revealed that the power consumption



TRANSISTORISED

PART 1

OSCILLOSCOPE

would be such that the use of dry batteries would be out of the question so it was decided that secondary cells would be used as the power source. The obvious choice of supply voltage is 12V as this is readily available from car batteries.

In order to reduce the weight of the unit, no provision for working from the mains has been incorporated, though a 12V power supply can easily be built.

The use of a 12V supply means that the use of valves in the circuit is undesirable from the point of view of efficiency and for this reason it was decided to use transistors throughout. The employment of solid state circuitry enables both weight and power demand to be minimised.

The circuitry and construction of the oscilloscope will be described in sections starting with the power supply. A block diagram showing the relationship of these sections to the finished project is shown in Fig. 1. By tackling each section as it were in reverse, each section can be checked and will be fully functional on completion.

The complete unit is housed in a metal case, the construction of which is shown in Fig. 2. No precise drilling details are given as these will vary according to the components used.

As the layout is completely uncritical the chassis can, in fact, take any conversion form. Indeed there is no need to have a special chassis made as there are many manufacturers of standard ranges of cases and chassis who regularly advertise through the columns of this journal—any of their products will be satisfactory if made from aluminium or other

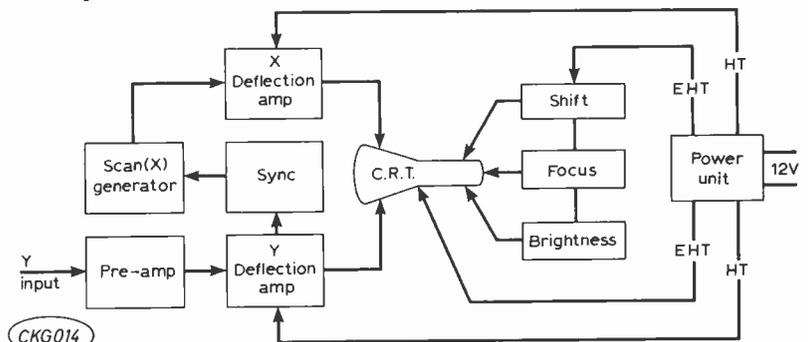


Fig. 1: Block diagram showing the relationship between the various units which will be described separately.

non-magnetic material.

Each component unit will now be described in the suggested building sequence together with the appropriate testing procedures.

POWER SUPPLY UNIT

This was the only part of the whole unit which presented problems from the design point of view. The total h.t. power demand is 3.4 watts and the e.h.t. demand is a little over 1W so that allowing for a conversion efficiency of, say, 60 per cent, the power input to the primary must be in the order of 8W. Using saturated switching circuits it is possible to obtain this sort of power from a single-ended stage but, unfortunately, all the attempts by the writer to attain this theoretical goal ended in failure or disaster!

The next type of circuit to be tried was the push-pull oscillator. Whilst this circuit worked reasonably well, the construction of a suitable transformer appeared to be beyond the scope of this constructor as either one used an inordinate number of turns to get a primary inductance that was satisfactory on the standard range of pot-cores available, or one used a pot-core which is not readily available. After much experimentation the circuit shown in Fig. 3 was developed.

The use of a multivibrator circuit does not seem to offer theoretical advantages over its competitors. Its principle disadvantages being the lower efficiency and the use of more passive components. To the practical constructor, however, it has three major advantages:

- a) it does not stall under heavy load
- b) it is a first-time starter
- c) the construction of the transformer is not critical

Of these (c) is most important in that the transformer windings do not have to be neat, tidy and accurate so long as an adequate turns ratio is maintained. The writer constructed three of these units with differing transistor types and succeeded in getting all three to work first time.

The circuit operation is quite straightforward. Tr1 and Tr2 form a simple common emitter multivibrator. The collector load for each transistor is provided by the primary of the transformer T1. The resonant frequency of the circuit is made as high as possible so that the primary inductance can be minimised, for by reducing the primary inductance we lower the number of turns required on the primary of the transformer. This has the effect of reducing the turns-per-volt characteristic of the transformer and eases

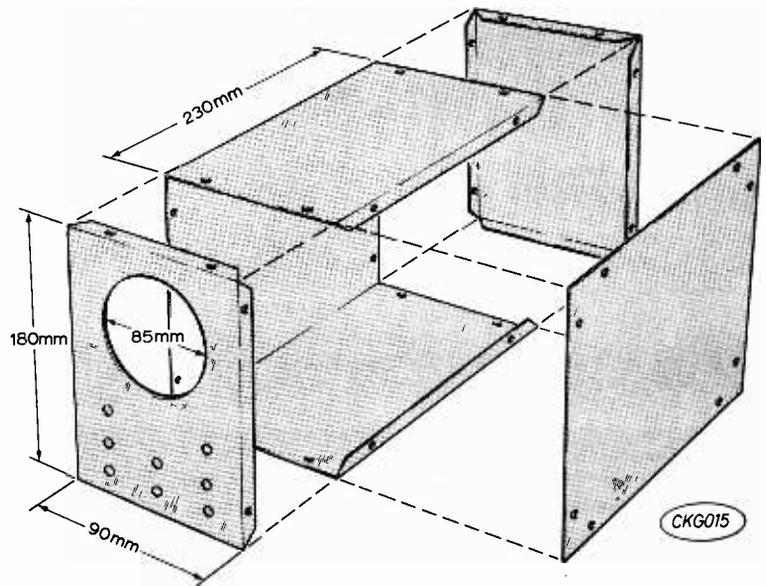


Fig. 2: The basic dimensions of the case used for the prototype and its construction.

construction of the high voltage secondary.

For the circuit shown the total primary inductance is in the order of 1mH and the turns/volt relationship is 1.5 turns-per-volt.

The secondary of the transformer is wound to give an equivalent r.m.s. output voltage in the region of 220V. As the voltage waveform from the transformer is a peaky triangular shape rather than the more conventional sine wave, measurement of the output voltage by means of the normal a.c. voltmeter is misleading and the only valid way of checking the circuit is to measure the d.c. output from the rectifier. Thus we refer to an equivalent r.m.s. output rather than the true peak-to-peak output.

The secondary of the transformer provides power for the h.t. rail via the bridge rectifier D1-D4 and the smoothing and stabilising circuit of C3, R3, ZD1 and C4, and for the e.h.t. line via the voltage doubling circuits of C5, D5 and D6 and the associated smoothing capacitor C19. This circuitry is completely

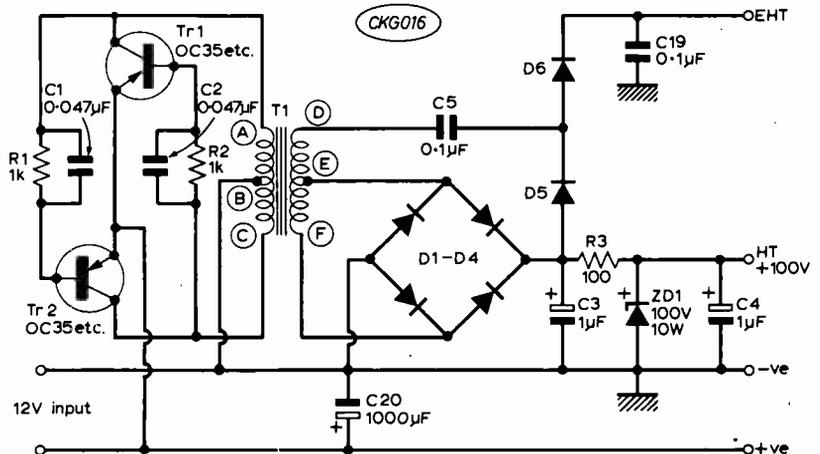


Fig. 3: The power supply circuit which provides the three different voltages necessary.

conventional and does not warrant further discussion here.

The complete power supply is built on to the back of the chassis; the siting of the main components is shown in Fig. 4.

CONSTRUCTION OF T1

T1 is wound on a Mullard LA4 pot-core which is readily available from advertisers in this magazine.

Dismantle the pot core and locate the winding bobbin. This item is fairly fragile and should be handled with care. Wind on to the bobbin 18 turns of 28 s.w.g. double cotton covered enamelled wire. This should occupy one complete layer on the bobbin. Leave several inches of wire at each end of the winding to serve as lead-out wires. Wind on a further 18 turns over the first layer and in the same direction as the previous winding and twist together the end of this winding with the end of the first winding. This is the primary centre tap. Now wrap 1½ turns of p.v.c. self-adhesive tape around the windings. Next wind on 120 turns of 32 s.w.g. enamelled wire (try to be as neat as possible but don't worry about the occasional overlap). Pull off sufficient wire from the coil to form the centre tap and wind on sufficient turns to fill the bobbin (the number of turns will depend on how evenly the previous layers were wound—anything between 100-150 turns will be satisfactory). The lead-out wires forming the start, the tap and the finish of this winding should then be sleeved and the winding taped in place.

The whole unit can now be reassembled by first placing the coil inside the ferrite ring and bringing the lead-out wires through the slots cut in the ring. Now drop this assembly over the core and put on the top-plate. Bolt up the complete assembly tightly.

The transistors Tr1 and Tr2 should next be bolted on to the chassis back-plate which acts as a heat sink and T1 fixed in position together with the battery supply terminals. Note that Tr1 and Tr2 should be insulated from the chassis using mica washers. Once the primary circuit has been built up the unit may be tested. Connect the 12V supply via a milliammeter. The meter should indicate a standing current of 200-300mA. If the current is higher than this, disconnect, and check the wiring particularly on the secondary side.

If all is well connect a 250V neon across the rectifier output (- and +); the neon will light up and the current drawn from the 12V source will increase by about 80mA. If a neon lamp is not available disconnect the milliammeter from the primary circuit and connect in series with a 10kΩ resistor when, if the unit is running correctly, a current of 5-8mA will be indicated. This will rise to 15mA if a 1μF 250V electrolytic capacitor is also connected across the rectifier. The second phase of the power unit construction can now be undertaken. The tag-strips holding the components are anchored at various convenient points as shown in the photograph. The zener diode must be mounted on a heat dissipating plate about 2in. square. This plate should not be anchored to the oscilloscope chassis (unless insulated electrically). Note that some zener diodes of this power rating have their mounting stud at the cathode end of the diode while on others the stud is the anode.

As the e.h.t. voltage is fairly low (about 500V) no special precautions need be taken other than to

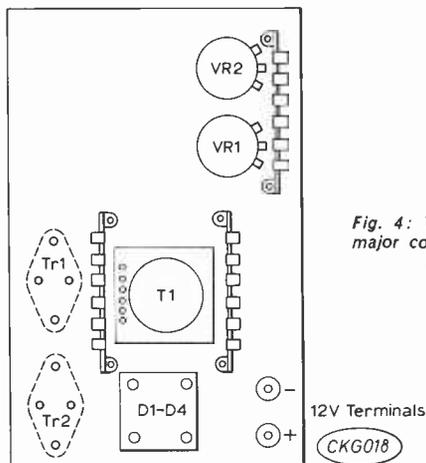
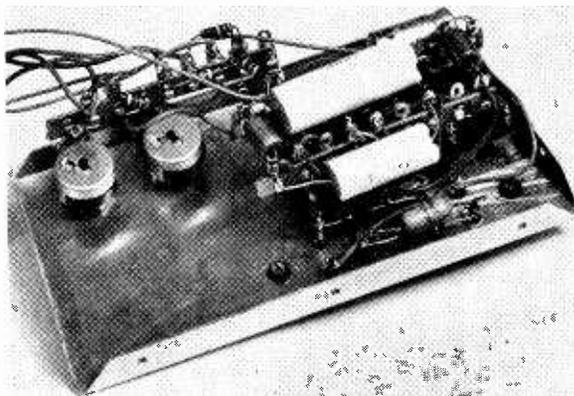


Fig. 4: The siting of the major components on the back panel.



Compare this view of the back panel with Fig. 4.

ensure that there is a reasonable spacing between the components of the e.h.t. circuitry and the other low voltage items.

TESTING

Check all wiring—particularly the e.h.t. side for faults and potential short circuits. As the oscillator is capable of generating sufficient power to burn out the transformer or the transistors under short circuit conditions, this visual check is a wise precaution.

Connect the milliammeter in series with the battery supply lead and switch on. The current consumption should be about 400-500mA. If the current drain is significantly higher than this, switch off immediately and check the wiring. If all is well remove the ammeter from the battery leads and using a 10kΩ resistor in series with one lead, apply this across C4. A current flow of about 10mA is correct. Remove the meter from the circuit and replace the 10kΩ resistor with one of 470kΩ. Apply the meter and series resistance across C19 (remembering that C19 will have across it a voltage of anything up to 600V). Approximately 1mA should be taken by the meter.

The power supply is now complete and ready to connect to the next phase of construction—the Display Unit.

THE DISPLAY UNIT

The theoretical circuit of the Display Unit is shown in Fig. 5. Again the circuitry is absolutely standard and well tried. The potential divider chain of R11, VR4, VR3, R10 and R6 and R7 with VR2 and VR1 in parallel has a total resistance of $1.5M\Omega$ and draws approximately $300\mu A$ from the e.h.t. supply. This gives a control range of 3V to 33V for VR4 and 33V to 185V for VR3. The shift controls have 100V across them and give, therefore, 50V shift either side of the mid-point voltage determined by R6 and R7.

The resistors R4, R5 and R8 and R9 serve to isolate the X and Y plates from "cross-talk" and give a measure of protection to the transistor output stage described later.

CONSTRUCTION

The shift components and X and Y bias and isolating resistors are mounted on the back plate of the chassis next to the power supplies. As the shift controls are only 500V above earth potential they can be mounted directly onto the aluminium plate without further insulation.

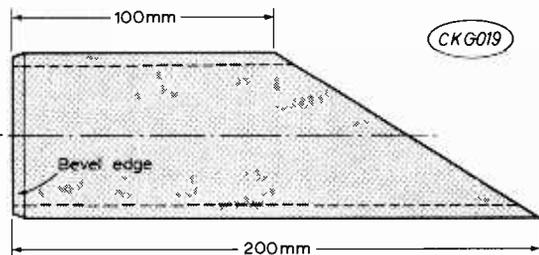
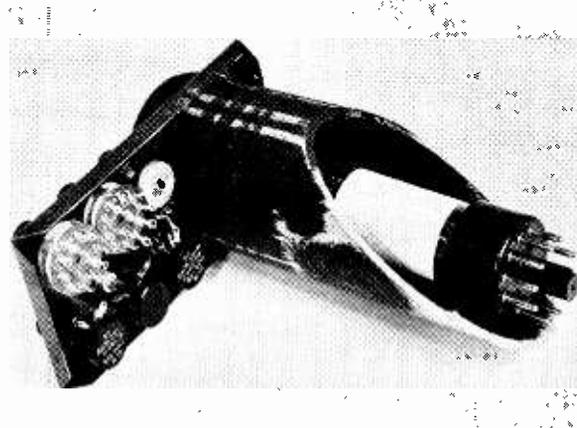


Fig. 6: The dimensions of the CRT cradle.



The front panel, showing the CRT cradle, before wiring.

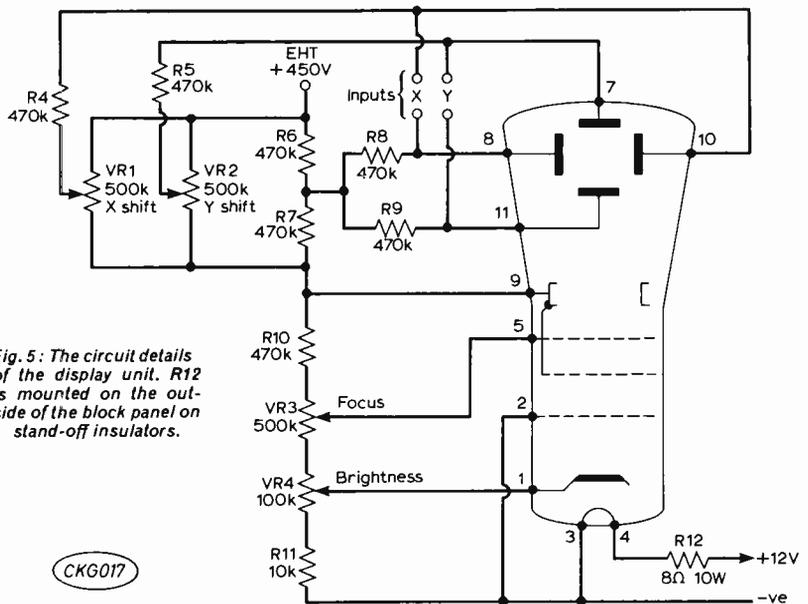


Fig. 5: The circuit details of the display unit. R12 is mounted on the outside of the block panel on stand-off insulators.

The tube itself is mounted inside a cradle which also serves as a light shield. The cradle is made from 75mm dia. ABS or PVC drain-pipe (the actual pipe used by the writer was an Osman soil-pipe). About 200mm is required and this is cut and bevelled as shown in Fig. 6. After cleaning up the cut surfaces the pipe is painted matt black (alternatively use a gloss black pipe which is available from some builders rather than the more usual grey).

The cathode ray tube face rim is next padded to prevent mechanical damage if the unit is dropped. The writer used a self-adhesive foam draught excluder winding two complete turns around the tube rim. The foam should be dyed or painted black.

When the paint is dry the cradle can be pushed through the CRT hole in the front panel (push in from the front) leaving about 10mm of the bevelled edge protruding. The CRT is then pushed into the cradle from the rear and should be a snug fit inside the pipe.

TESTING

Having checked the wiring to the tube base and the e.h.t. connections, set VR4 slider to the R11 end of its travel and set VR3 to its mid-point. Switch on the power unit. Allow a minute for the tube to warm-up and adjust VR1 and VR2 until the spot is at the centre of the screen. Adjust VR4 and VR3 for minimum brightness and spot size.

If no spot can be resolved, insert the meter between R11 and VR4 and check for a current flow of about $300\mu A$. If this current is absent, or very low, follow the e.h.t. down the chain using the meter and the 250kΩ resistor until the break is found. If no break can be discovered, check to see that R11 is taken to the negative line. Inability to centre the spot and/or elliptical movement of the spot is caused by incorrect connections to the X and Y plates.

If all is well, the deflection test unit of Fig. 7 may be built up to test the circuit so far. In building the test unit, make certain that the live leg of the mains is connected to the top of the $1M\Omega$ resistor. For added safety the two neon lamps may be incorporated into the circuit. Only use the test unit when N100 is illuminated.

The high level output from the deflection test unit is first applied to the X input when a straight line about 40mm long will be produced. Turn the tube physically until this line is horizontal. When all is well apply the test unit to the Y input when a vertical line will be produced of roughly equal length

★ components list (complete unit)

Resistors

R1 1kΩ ½W	R19 4.7kΩ ½W	R37 470Ω ½W
R2 1kΩ ½W	R20 4.7kΩ ½W	R38 2.7MΩ ½W 5%
R3 100Ω ½W	R21 10kΩ ½W	R39 1MΩ ½W 5%
R4 470kΩ ½W	R22 10kΩ ½W	R40 470kΩ ½W 5%
R5 470kΩ ½W	R23 1kΩ ½W	R41 33kΩ ½W 5%
R6 470kΩ ½W	R24 1kΩ ½W	R42 27kΩ ½W
R7 470kΩ ½W	R25 10kΩ ½W	R43 47kΩ ½W
R8 470kΩ ½W	R26 47kΩ ½W	R44 1kΩ ½W
R9 470kΩ ½W	R27 1kΩ ½W	R45 18kΩ ½W
R10 470kΩ ½W	R28 47Ω ½W	R46 33kΩ ½W
R11 10kΩ ½W	R29 100Ω ½W	R47 33kΩ ½W
R12 8Ω 10W	R30 47kΩ ½W	R48 18kΩ ½W
R13 33kΩ ½W	R31 47kΩ ½W	R49 1kΩ ½W
R14 10kΩ ½W	R32 1MΩ ½W	R50 220Ω ½W
R15 2.2kΩ ½W	R33 82kΩ ½W	R51 8.2kΩ ½W
R16 2.2kΩ ½W	R34 10kΩ ½W	R52 220kΩ ½W
R17 See text, ½W	R35 470Ω ½W	R53 2.2kΩ ½W
R18 See text, ½W	R36 4.7kΩ ½W	

NOTE: Two off each required R13 to R24 inclusive. All 10% types except where shown.

VR1 500kΩ lin. pot VR4 100kΩ lin. pot VR7 5kΩ
 VR2 500kΩ lin. pot VR5 10kΩ lin. pot log. pot.
 VR3 500kΩ lin. pot VR6 5kΩ preset

Capacitors

C1 0.047μF 150V	C8 0.1μF 1000V	C15 5μF 15V
C2 0.047μF 150V	C9 0.1μF 1000V	C16 1000pF
C3 1μF 250V	C10 5μF 15V	C17 0.1μF 150V
C4 1μF 250V	C11 0.1μF 150V	C18 0.01μF 150V
C5 0.1μF 1000V	C12 6.4μF 25V	C19 0.1μF 1000V
C6 5μF 15V	C13 5μF 15V	C20 1000μF 25V
C7 5μF 15V	C14 64μF 15V	

NOTE: Two off each required C6 to C9 inclusive.

Time base capacitors

CTa 1μF	CTc 0.01μF
CTb 0.1μF	CTd 1,000pF

Semiconductors

Tr1 OC35, 2G222 etc.	Tr7 BSX21	Tr13 2N3906
Tr2 OC35, 2G222 etc.	Tr8 2N3702	Tr14 2N3906
Tr3 2N3906	Tr9 2N2160	Tr15 2N3906
Tr4 2N3906	Tr10 2N3906	Tr16 2N3906
Tr5 BSX21	Tr11 2N3906	Tr17 2N3702
Tr6 2N3906	Tr12 2N3906	

NOTE: Two off each required Tr3 to Tr7 inclusive.

D1-D4 OA202 or combined bridge

D5 1000V 0.6A silicon

D6 1000V 0.6A silicon

D7 OA81.

ZD1 100V, 10W zener

Cathode Ray Tube

ECR30 or VCR139A

Switches

SW1 Timebase 1-pole, 4-way
SW2 Input atten., 1-pole, 3-way
SW3 Sync in/out, on-off toggle.
SW4 Int/Ext Sync, 1-pole, 2-way toggle

Miscellaneous

B12B tube base; 3in diam. pipe for CRT cradle;
 T1, see text, LA4 pot core, 28 s.w.g. D.C.C. enam.
 wire, 32 s.w.g. enam. wire; Tag strips; Veroboard;
 Switches, etc.

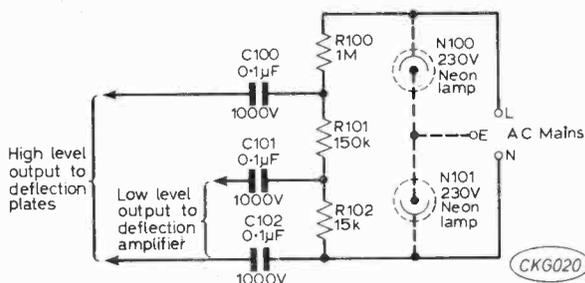


Fig. 7: The deflection test unit.

of that of the horizontal line. Next, connect the X1 and Y1 inputs together and the X2 and Y2 plates together. Apply the test voltage across the combined plates when a circle (or ellipse, depending on the relative deflection sensitivity of the plates) should be produced.

The unit as it now stands can be used as a simple a.m. transmitter modulation monitor.

For this purpose a small demodulation unit will be required—this is shown in Fig. 8. Power from the transmitter is fed directly into the tuned circuit. Modulated r.f. is fed directly to the Y plates of the display unit while the X plates receive the a.f. signal from the demodulation network. The resultant trace is shown in Fig. 9. The area occupied by the

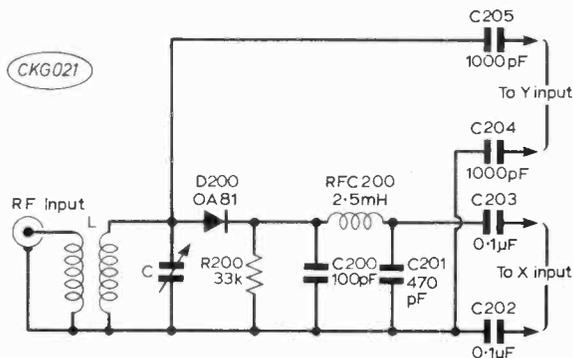


Fig. 8 (above): The circuit of the demodulator unit. L and C are chosen to resonate at the transmitter frequency.

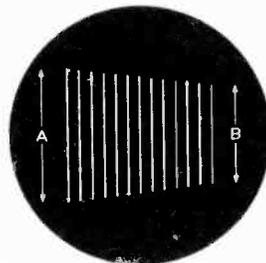


Fig. 9 (left): The display from the demodulator unit. The modulation depth is

$$\frac{A - B}{A + B} \times 100 \text{ per cent.}$$

A and B are measured in any convenient units (mm etc.)

trace is controlled by the power output of the transmitter—by making the r.f. input coil of L loose over the coil former, the coupling and thereby the power input to the demodulator may be varied.

TO BE CONTINUED

GATE DIP OSCILLATOR

B. WOOD

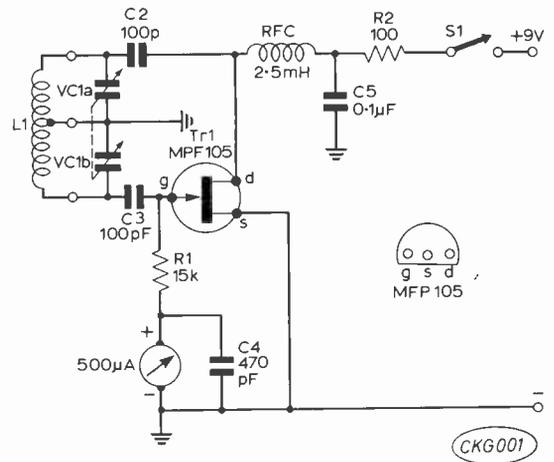


Fig. 1: Circuit of a simple gate dip oscillator.

amended circuit and it will be seen that few extra components are needed. VR1 was included to enable the meter pointer to be adjusted and kept on scale when using different coils.

Fig. 3 shows the addition of a simple modulator. T1 was removed from a small pocket-type transistor set. Modulation was obtainable using several combinations of the windings, but those noted on the circuit diagram proved the best. Failure to oscillate may require the reversal of the leads to either the primary or secondary of the transformer.

The function switch provides the following modes:—

Position 1. Instrument off.

Position 2. S2 closed. Meter amplifier operative. Measurement of the frequency of coil/capacitor combinations in "hot" circuits.

Position 3. S1 and S2 closed. Operates as an unmodulated r.f. oscillator enabling:—

- (a) The adjustment of "cold" coil/capacitor combinations.
- (b) Frequency measurement. Beating the g.d.o. with a station tuned in on the receiver.
- (c) As a beat frequency oscillator. Useful also for resolving s.s.b. signals.

ONE of the most useful and versatile of instruments, usually noticeable by its absence, is the grid or gate dip oscillator. The drawback in the pre-transistor age was that such instruments were valved and hence needed a mains power pack or bulky batteries which restricted operation. To be so restricted when measuring the resonant frequency of a whip aerial, or adjusting the traps on a dipole, is to say the least, inconvenient. The purpose of this article is to show how the author was able to construct a fairly versatile and readily portable g.d.o. almost entirely from bits and pieces found in his junk-box.

DEVELOPMENT

The original circuit is shown in Fig. 1. The f.e.t. costs under 40p, whilst the meter was taken from a No. 19 set. Acceptable results were obtained from this set up, but it was felt that the addition of a diode and an OC71 meter amplifier would increase the usefulness of the instrument. Fig. 2 shows the

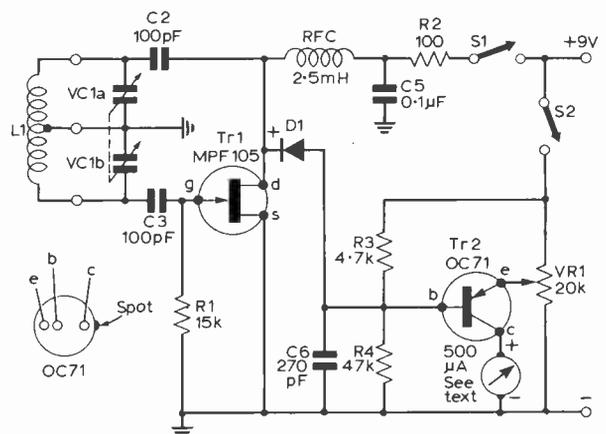


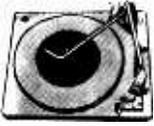
Fig. 2: G.d.o. with d.c. amplifier to permit use of less sensitive meter.

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25/25V 10p	8+16/450V 20p	350+50/325V .. 50p
50/50V .. 10p	16-16/450V 25p	32-32-32/350V 43p
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250-0-250 80 mA. 6.3 v. 4 amp.	£1.40
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350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a. or 5 v. 2 a.	£2.00
300-0-300 v. 120 mA. 6.3 v. 2 a. A.C.T. 8.3 v. 2 a.	£2.50
MINIATURE 200 v. 20 mA. 6.3 v. 1 a. 2 1/2 x 2 1/2 in.	75p
MIDGET 220 v. 45 mA. 6.3 v. 2 a. 2 1/2 x 2 1/2 in.	90p
P.E. AUBORA TRANS. 12 v. 127. 500mA	£1.50
MINI-MAINS 20v. 100mA. 1 1/2 x 1 1/2 x 1 1/2 in.	50p
HEATER TRANS. 6.3v. 3 a.	60p
Diode tapped sec. 1.4 v. 2, 3.4, 5.6, 3 v. 1 1/2 amp.	80p

GENERAL PURPOSE LOW VOLTAGE. Tapped Outputs at 2 amp. 3, 4, 5, 8, 9, 10, 12, 15, 12, 24 and 30 v. £2.00

1 amp. 6, 8, 10, 12, 15, 12, 24, 30, 36, 40, 48, 60. £2.00

2 amp. 8, 8, 10, 12, 18, 20, 24, 30, 36, 40, 48, 60. £3.00

AUTO TRANSFORMERS 115v. to 230v. or 230v. to 115v. Input/Output. 150w. £2.00; 500w. £5; 1000w. £12.

CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v. 1 amp. £1.20; 2 amp. £1.40; 4 amp. £2.00.

FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12 v. outputs, 1 1/2 amp. 40p; 2 amp. 55p; 4 amp. 85p. All transformers Postage 25p extra.

E.M.I. 1 1/2 x 8in. LOUDSPEAKERS

With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4** Post 15p

With flared tweeter cone and ceramic magnet, 10 watts. Bass res. 45-60 cps. Input 10,000 gauss. State 3 or 8 or 15 ohm. **£2.25** Post 15p

Recommended Teak Cabinet Size 16 x 10 x 9in. Post 25p **£5**

10W MINI-MODULE £3.25 LOUDSPEAKER KIT

Post 25p

Triple speaker system combining on ready cut baffle. 1 in. chipboard 15 in. x 8 in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 15 ohm. TEAK VENEERED BOOKSHELF ENCLOSURE. 16 x 10 x 9in. Modern design with **£5** Post 25p fluted wood front. Highly recommended.

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in. MAJOR £9

30-14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. Voice coils 3 or 8 or 15 ohms. Post Free

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11.50**

BAKER "BIG-SOUND" SPEAKERS

'Group 25'	'Group 35'	'Group 50'
12 inch £7	12 inch £9	15 inch £19
25 watt	35 watt	50 watt
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front For 12in. dia. speaker 20 x 13 x 9in. .. £9. Post 25p For 13 x 8in. speaker 16 x 10 x 9in. .. £5. Post 25p For 10 x 6in. speaker 16 x 8 x 6in. .. £4. Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide, 15pft.

GOODMANS HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosures Systems, etc. **£4**



ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3 1/2 x 3 1/2 in. deep. Rating 10 watts. 3 ohm or 15 ohm models. **£1.90** Post 10p



Horn Tweeters 2-16Kcs, 10W 8 ohm or 15 ohm £1.50. De Luxe Horn Tweeters 2-16 Kcs, 15W, 8 ohm 25p. TWO-WAY CROSSOVERS 3 or 8 or 15 ohm 95p. SPECIAL OFFER: 80 ohm, 2 1/2 in. dia.: 35 ohm, 2 1/2 in. dia.: 25 ohm, 2 1/2 in. dia.: 3in. dia.: 8 x 5in.; 8 x 5in. £1 EACH 15 ohm, 3 1/2 in. dia.: 7 x 4in.; 8 x 5in. £1. TYPE 8 ohm, 8 x 4in. 3 ohm, 2 1/2 in. 3in. 5in. 5 x 3in. 7 x 4in. LOUDSPEAKERS P.M. 3 OHMS. 6in. 11.10.8 x 5in. £1.25: 8 x 2 1/2 in. 80p; Sin. £1.75: 10 x 2 1/2 in. 80p. HI-FI WOOFER 8 watt max. 20-10,000 cps. 8 or 15 ohm. £1.80. ELAC 10in. 10W. De Luxe Ceramic, 8 ohm. £4. RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. dia. 4 watt; 10in. dia. 5 watt; 12in. dia. 8 watt 3 or 8 or 15 ohm models £1.85 each. Post 15p. OUTPUT TRANS. EL34 etc. 25p. MIKE TRANS. 50:1 25p. SPEAKER COVERING EL34 etc. 30p. Amplifier, garage S.A.E. GOODMANS OUTPUT TRANSFORMER 5 watt push-pull for valves EL84 etc., 3, 8 and 15 ohms 85p. Post 20p.

BAKER 10W TATT ALL PURPOSE POWER AMPLIFIER

4 inputs speech and music. Mixing facilities. Response 10-30,000 cps. Matches all loudspeakers. 200/250v. Separate Treble and Bass controls. Guaranteed Details S.A.E. **£39** POST FREE



ALL EAGLE PRODUCTS

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

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. STEREO VERSION OF ABOVE £4.25.

BARGAIN FM TUNER 88-108 Mc/s. Six Transistor. 9 volt. Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 x 5 x 4 inch **£10**

BARGAIN FM TUNER as above less cabinet **£7.50**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3.50**

COAXIAL PLUG 6p. PANEL SOCKETS 6p. LINE 18p. OUTLET BOXES, SURFACE OR FLUSH 25p. BALANCED TWIN FEEDERS 5p yd. 80 ohms or 300 ohms. JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS Std. Chrome 15p; 3-5mm Chrome 14p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 15p; 5-pin 25p. DIN PLUGS 3-pin 15p; 5-pin 25p. VALVE HOLDERS. 5p. CERAMIC 5p. CANS 5p.

E.M.I. TAPE MOTORS Post 15p.

120v. or 240v. A.C. 1,200 r.p.m. 4 pole 135mA. Spindle 0.187 x 0.75in. **£1.25** Size 8 1/2 x 2 1/2 in. (Illustrated).

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120v. or 240v. A.C. 1,200 r.p.m. 4 pole 50mA. Spindle 2 x 3/20. Size **85p** 2 1/2 x 2 1/2 in. Post 15p



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Representing really exceptional value

TWO STEREO AMPLIFIERS

IN ELEGANT TEAK FINISH CASES!



LINEAR 606
6+6 WATTS
Recommended Retail Price
£22.50

0-200-230-250v. 50 Hz
A.C. mains operation.
Inputs for magnetic or
Ceramic Pickup, Tape or
Radio Tuner.

TECHNICAL DETAILS

Bass Control ± 12 dB at 40 Hz.
Treble Control ± 12 dB at 14 KHz.
Sensitivities Mag. P.U. 3.5 m.v.
into 47K ohm R.I.A.A. Ceramic
P.U. 35 m.v. into 100K ohm. Tape
Amp. 100 m.v. into 100K. Radio
Tuner 400 m.v. into 400K ohm.
Crosstalk 53 dB.
Hum and Noise -75 dB min.
vol. -85 dB max. vol.
**Total Harmonic
Distortion** 0.1% at 1watt
into 15 ohms.
Output (per channel)
6.5 watts I.H.F.M.

- ★ Individual Bass and Treble Controls.
- ★ Frequency Response $\pm 1\frac{1}{2}$ dB
20 Hz to 65 KHz.
- ★ Outputs for Speaker impedances
between 3 and 15 ohms.
- ★ Stereo/Mono Switch.
- ★ Input Selector Switch.
- ★ Solid State Circuitry.
- ★ Attractive silver finished metal facia
and matching control knobs.

- ★ A modestly priced solid state unit.
- ★ The Silver Facia with black lettering enhanced by
matching control knobs, provides a high standard of
appearance.
- ★ Suitable for crystal or ceramic Gram. Pick-up
cartridges, and Radio input.
- ★ A wide range of tone variation is provided by the
separate Bass and Treble 'lift' and 'cut' controls.
- ★ A selector switch permits instantaneous selection of
Gram. or Radio.
- ★ Speaker impedances between 3 and 15 ohms are
suitable.

TECHNICAL DETAILS

Frequency Range 20 Hz to
20 KHz
Output (per channel) 5 watts
I.H.F.M.
Bass Control ± 12 dB at 60 Hz.
Treble Control ± 14 dB. at
14 KHz.

PRINTED CIRCUIT CONSTRUCTION
EMPLOYING 10 TRANSISTORS



LINEAR 505 5+5 WATTS
Recommended Retail Price
£17.50 0-200-250v. 50 Hz A.C.
mains operation

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TEL. HECKMONDWIKE 4285

Amplifier Unit Type A413. Complete with 524 & 6V6GT valves. 250/230 Volt Transformer. Clean condition untested. £1.25. Carriage 75p.

Air Position Indicator. Contains Gears. Ball Races. Dimmer Unit. Lamps. Four numbered Counters. 24 Volt Motor etc. Great interest to the model makers. Good condition 75p. Carriage 50p.

Ground Position Indicator. Contains 24 Volt Lamp. Prisms Mirror and Gears. Could interest schools and model makers. 75p. Carriage 75p.

Latest Air Ministry Release Radio Receiver. Type R4187. 2.8 to 18 MHz in Three Bands. Complete with 17 miniature valves. 26 Volt Motor. Power supply motor and manually tuned. Very clean, but not tested. £5. Carriage and Insurance 75p.

Control Unit. Type 4190. Complete with three miniature valves. 1 $\frac{1}{2}$ " 500 μ A Meter. Six Relays. Model makers Motor with Gears. 24 Press Buttons. Lots of spares. Clean condition. £1.50. Carriage and Insurance 75p.

Autostabiliser Amplifier Unit. Complete with Carpenter Relay and Base. Many spares. 50p. P/P 33p.

Special Offer. Aircraft Sighting Head. Comprising flexible drive, lens prism unit, Giro. Useful for model constructors, schools, etc. Condition fair. 75p. Carr. 75p.

Reclaimed T.V. Tubes. All with 12 months guarantee.
AW43/88. £2. AW43/80. £1.50. MW43/89 £1. Special offer Brand New Brimar Tubes C17P.M. £1. Many older types in stock. Carriage and insurance on any tube £1-10.

Breaking-up. Ferguson Model 506T. Tested L.O.P.T. £1.45. Post paid. Fireball Tuner Unit with Valves less Knobs. 75p. Post paid. S.A.E. for Price List of other spares for this set and other types.

Valve List Ex Equipment All Valves Tested on a Mullard Valve Tester before despatched. 3 Months Guarantee on all Valves Single Valves P/P 3p. Over three Valves P/P Paid.

ARP12	5p	PCC84	5p	U191	20p
EB91	4p	PCF80	5p	U251	12½p
EF85	12½p	PCL82	12½p	6BW7	10p
EBF80	12½p	PCL83	12½p	6U4	10p
EBF89	12½p	PCF82	12½p	6F23	20p
ECC81	10p	PL36	20p	20P1	20p
ECC82	12½p	PL81	17½p	20P3	10p
ECC83	12½p	PY81	7½p	20D1	10p
ECL80	7½p	PY33	17½p	30P4	20p
EF80	7½p	PY82	7½p	30P12	20p
EF91	4p	PL82	7½p	30FL1	20p
EY86	20p	PL83	7½p	6/30L2	20p
		PCL84	12½p	30F5	10p

loosely coupled to the aerial socket of the station receiver via a short length of wire. With the g.d.o. variable capacitor vanes fully in mesh, a search is made on the receiver for the modulated signal. The search must begin at a frequency much lower than that expected, in order to ensure that one is not working on harmonics of the signal. Throughout calibration, the small variable capacitor should be kept at half mesh.

Having found the lowest frequency to which the

coil will tune, it is only necessary to open up the vanes of the g.d.o. and gradually follow the signal on the receiver up to a higher frequency, in fact to its limit. Should the desired coverage not be obtained on any range it may be necessary to add or take off a few turns of wire.

During calibration use can be made of standard frequency transmissions for checking the receiver as well as the g.d.o. Oscillation on the l.f. ranges could only be obtained if the coils were centre tapped, as indicated.

Should a crystal calibrator be available use can be made of it in the calibration procedure. Loosely couple the calibrator to the station receiver, switch the g.d.o. to c.w. and zero beat the two signals, taking care that the beat is taking place with fundamentals of the g.d.o. In the case of the Class D Wavemeter, it is switched to 1MHz, and coupled to the g.d.o. coil by a 3 turn-coil, when it is possible with the phones connected to the wavemeter, and the g.d.o. switched to c.w., to hear the 1MHz harmonics when tuning the g.d.o. Having marked these in on the dial, it is then possible to fill in the gaps with the 100kHz crystal. It is then only necessary to identify any one of these points by using the g.d.o. in conjunction with the station receiver, to complete the rest of the calibration for that coil. Calibration of the remaining coils was carried out in the same way, working down from the h.f. to the l.f. coils.

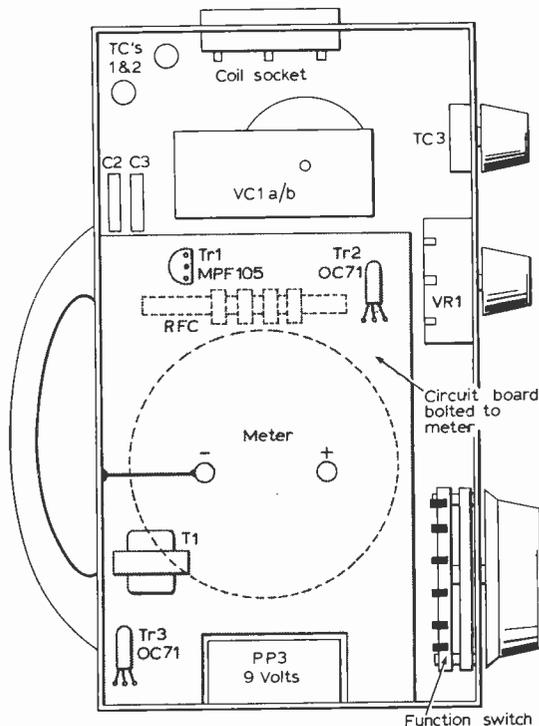


Fig. 4: Layout of main components in the g.d.o. constructed by the author.

★ components list (Fig. 3)

Resistors

R1 15k Ω	R5 1k Ω
R2 100 Ω	R6 1k Ω
R3 4.7k Ω	R7 15k Ω
R4 47k Ω	All $\frac{1}{4}$ W 10%
	VR1 20k Ω linear potentiometer

Capacitors

VC1a-b 250 + 250pF approx. See text	
C2 100pF SM	C6 270pF SM
C3 100pF SM	C7 0.1 μ F
C4 470pF (Fig. 1)	C8 0.33 μ F
C5 0.1 μ F	C9 0.01 μ F
TC1/2 3-30pF trimmer. See text	
TC3 5pF trimmer. See text	

Miscellaneous

Transistor MPF105(1) OC71(2). Miniature audio transformer (T1). RFC 2.5mH.
Meter, see text. Wafer switch 1 pole, 4 way, shorting consecutively.

TELEVISION

FEBRUARY ISSUE

THE DO-BE OSCILLATOR

A timebase oscillator circuit for the constructor—the double-beam oscillator, so called because it employs two valves in a blocking oscillator/discharge valve arrangement. Whilst using a double-triode and transformer the circuit is nevertheless economical in other components and has the advantage of very good locking. Field and line generator circuits are given.

SIMPLE WALL-MOUNTING UHF AERIAL

Another design for the constructor. The main advantage of this dipole-plus-sheet-reflector assembly is that it is very short and can be mounted quite unobtrusively just inside or outside a window. Dimensions are given for group A, B and C/D versions.

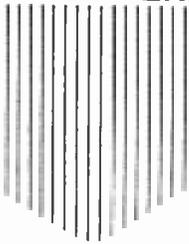
THE SANYO 10-T120U

A further instalment in our series on the interesting circuitry to be found in imported TV receivers. This 10in. mains/battery portable for example features a keyed a.g.c. circuit, noise-cancelled sync separator circuit, emitter-follower line output stage and other arrangements which are illustrated and described.

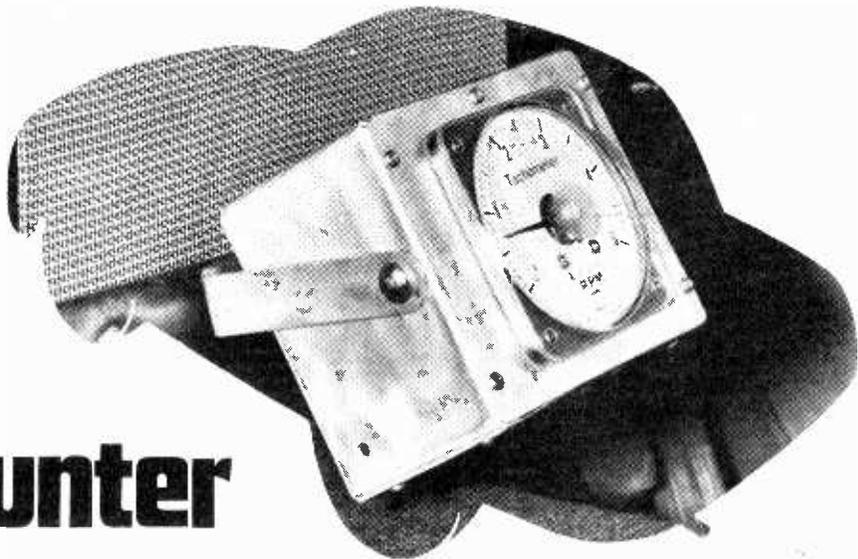
PLUS ALL THE REGULAR FEATURES

ON SALE JANUARY 17

A. LESTER-RANDS'



CAR Rev-Counter



MANY car owners, particularly those who have cars with high revving engines, consider an engine tachometer an essential dashboard instrument and manufacturers of some modern cars now fit a rev counter as a standard. A tachometer gives a direct reading of engine revolutions per minute which can be related to brake horsepower and torque to enable the car owner to get the best performance from the engine with the least wear and tear and at the most economical fuel consumption.

The tachometer described in this article employs a fairly simple circuit which can be adjusted for use with 4, 6 or 8 cylinder engines and calibrated for revolutions per minute of 0-5,000, 0-8,000 or 0-10,000. To give an example of this, the writer's car has a 4 cylinder engine and develops maximum brake horse power at 4,600 r.p.m.; in this case calibration was adjusted for 0-5,000 r.p.m.

The instrument will operate from the car battery regardless of which polarity of the battery is earthed to the car body and no direct electrical connection is necessary to pick up the ignition pulses. The pulse pick-up is capacitive by means of a few turns of insulated wire wrapped around the main ignition lead.

The actual r.p.m. indicator may be any 1mA f.s.d. meter but for a longer calibration scale and a more pleasing appearance, a meter with a 240° scale is worth the extra cost; most of those available have a 3in. diameter scale. The meter can of course be a conventional 90° scale type or an edge scale meter which might lend itself better for dashboard mounting. If there is no room on the dashboard, the complete tachometer could be mounted in a small box of its own and secured where it can be seen at a glance.

THE CIRCUIT

The tachometer circuit is shown in Fig. 1 and is a fairly conventional arrangement using a flip-flop (Tr1 and Tr2) from which to derive a constant amplitude narrow square-wave. The time constant in the flip-flop produces an output pulse of approximately 0.5mS. The supply voltage is held stable by the Zener Diode to 8.2V so that variations in the battery voltage do not effect the readings. The output from Tr3 is, as far as the meter is concerned, a recurrent positive-going pulse of constant amplitude and duration. The meter will read the mean positive voltage developed by the pulses so the slower the pulses the lower will be the meter reading and vice versa. However, the meter reading can be altered by increasing or decreasing the amplitude of the pulse current passing through it by inserting series resistance (PR1 and Rx). This makes it possible to adjust full scale deflection for different maximum readings. Equally the pulse amplitude to the meter can be adjusted relative to the pulse rate so that the meter can be calibrated for 4, 6 or 8 cylinder engines as

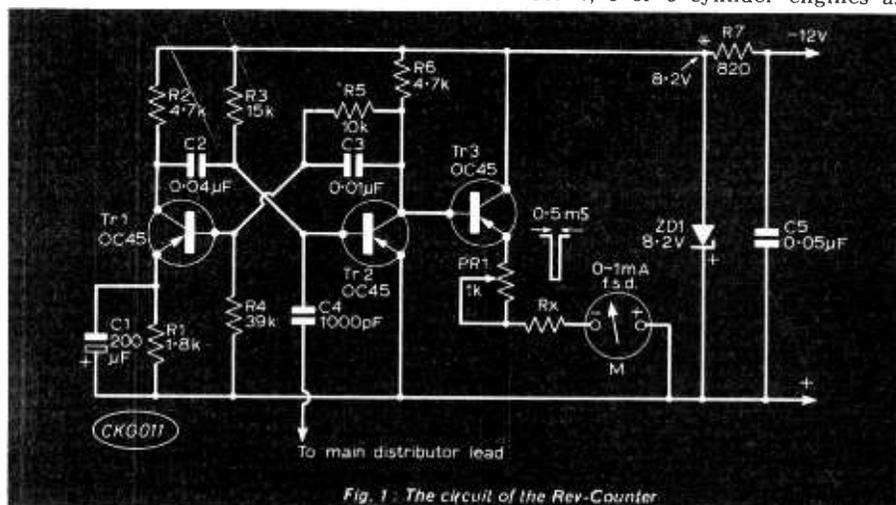


Fig. 1. The circuit of the Rev-Counter

CONTROL DRILL SPEEDS

DRILL CONTROLLER NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. \$1.50 plus 13p. post and insurance. Make up model also available, \$2.25 plus 13p. post & p.

MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 3 circuits each rated at 10amps. Extremely well made by a German Electrical Company. Overall size 2 1/2 x 2 x 2 1/2. \$1 each.



NEED A SPECIAL SWITCH?

Double Leaf Contact. Very slight pressure closes both contacts. 6p each, 80p doz. Plastic pusher suitable for operating. 5p each, 45p doz.



AUTO-ELECTRIC CAR AERIAL

with dashboard control switch fully extendable to 40in or fully retractable. Suitable for 12v positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. \$6 plus 23p post and ins.



TOGGLE SWITCH

3 amp. 250v. with fixing ring 7 1/2 each. 75p doz



MICRO SWITCH

5 amp. changeover contacts. 9p each. \$1 doz. 15 amp. Model 10p each or \$1.05 doz.



MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—4 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 18p each, \$1.80 dozen, your assortment.



WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 50p post free.



BLANKET SWITCH

Double pole with neon led into side so luminous in dark. Ideal for dark room light or for use with waterproof element, new plastic case 30p each. 3 heat model 40p.



CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 38p each or 10 for \$3.42.



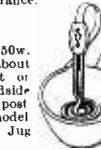
TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. \$2.95 plus 20p post and insurance.



QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use as socket or lamp holder. Have at bedside for tea, baby's food, etc. \$1.25, post and insurance 14p. 12v. car model also available same price. Jug heater \$1.50 plus p. & p. 14p.



SNAP ACTION SLIDE SWITCH

Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuumms, etc. 5p each, 10 for 45p.



NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3. Price \$1.45 each, 10 for \$13.



12 WAY SUB-MINIATURE MULTI-CORE CABLE

7-0076 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 20p per yard.



LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or null light, epoxy resin sealed. Size approx. 1in. dia. by 1/4in. thick. Rated at 500 MW, wire ended. 43p with circuit.

HONEYWELL PROGRAMMER

This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines. Display lighting in meters and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price £5.75 plus 25p post and insurance. Don't miss this terrific bargain.



THE FULL-FI STEREO SIX

The amplifier sensation of the year

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled in simulated teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.M. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and gated volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. UNREPEATABLE PRICE is £9 plus 38p post and insurance

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, £3 plus 25p post and insurance. £2.50 with fitted 13 amp plug; £2.40 with fitted 15 amp plug, plus 23p P. & I.



THIS MONTH'S SNIP

Smiths 24 hour 2 on/2 off Time Switch This is the popular model, as used in the Autosec and Morphy Richards time switches. Only needs a case and an output socket. 250v. 50 cycle. Contacts switch up to 13 amps. Price £2.75p



TANGENTIAL HEATER UNITS

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW. element and 1kW. element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal fire case or cabinet. Only need control switch. £3.50. 2kW. Model as above except 2 kilowatts £2.50. Don't miss this Control Switch 35p P & P. 40p



POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied). 30p or £ for 60p. Post paid



COMPUTER TAPE

2,400ft. of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide £1.00 plus 38p post and insurance, with cassette. 1/2in. wide £1.00 plus 30p post and insurance with cassette. 1/2in. wide 75p plus 26p post and insurance with cassette. Spare spools and tapes 1in. 75p, 1in. 75p each plus 20p post and insurance.

1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4 1/2 x 3 1/2, which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch £1.15.

RADIO STETHOSCOPE

Easiest way to find and—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal capsule. £2—in stethoscope instead of earpiece 75p extra—post and ins. 20p.



SOLDER GUN

A must for every busy man, gives almost instant heat also illuminates job. Dual heat 100/140 watt £3.75 plus post & ins. 40p. 20p. BIG JOB 260 watt model. £4.75 plus post & ins. 40p.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the Wireless World about a year ago. We can supply a kit of parts for an improved and even more efficient version (Practical Wireless June). Price £4.95 plus 30p post. When ordering mention version for positive or negative systems. Also available, ready made ignition systems for 6v. vehicles, £5.25 plus 20p.

ELECTRONIC IGNITION

TYPE 25 RELAYS

These are miniature relays. Size approx. 1 3/16in. high x 3/16in. wide x 1/4in. deep. Change over silver/gold contacts. Contact rating lamp 100V. D.C. Fitted with a plastic cover. Coil operates approx. 260Mv. D.C. Available with the following coils: 280ohms for 4-7.5v. 450hm for 1-2.5v 520hm for 4-9-6v 960hm for 5-5-11.5v 1300hm for 10-15v 5300hm for 17-36v 12500hm for 27-44v 25000hm for 31-65v 58000hm for 27-44v. 75p each, 10 for £6.75. Also one with 16,500hm coil but this has only 2 heavy duty change over gold contacts. Price £1.45.



Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

Veroboard. We are now stocking this in various sizes. Prices as follows:

3 1/2 x 3 1/2	0 1	0 15
2 1/2 x 3 1/2	22p	16p
3 1/2 x 5 1/2	24p	24p
3 1/2 x 6 1/2	24p	24p
3 1/2 x 8 1/2	27p	27p
17 x 2 1/2	75p	57 1/2p
17 x 3 1/2	100p	75p
17 x 6 (plain)		75p
17 x 3 1/2 (plain)		82 1/2p
17 x 2 1/2 (plain)		87 1/2p
2 1/2 x 6 (plain)		17 1/2p
2 1/2 x 3 1/2 (plain)		15p
Pin intersection tool	47 1/2p	47 1/2p
Spot face cutter	37 1/2p	37 1/2p
Pkt. 50 pins	20p	20p

FLUORESCENT CONTROL KITS

Each kit comprises seven items—'choke', 2 tube ends, starter, holder and 2 tub clips, with wiring instructions. Suitable for normal fluorescent tubes or the new 'Grolux' tubes for fish tanks and indoor plants. Choices are super-sized, mostly resin filled. Kit A—15-20 w. £1. Kit B—30-40 w. £1. Kit C—40-60 w. £1.20. Kit E—65 w. £1.20. Kit F for 8ft. 125 w. tube £1.75. Kit MF1 is for 6in., 9 in. and 12in. miniature tubes £1. Kit MF2 for 2 1/2in. 13 w. miniature tube £1. Postage on Kits A and B 23p for one or two kits then 23p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p on first kit then 23p for each kit ordered. Kit MF1 15p on first kit then 15p on each two kits ordered.

0-8 AMMETER

2 in. square full vision for flush mounting. Moving iron instrument. Suitable for charger. Price 43p each 10 for £3.90.



Box Sign for Window Display, at home, office or shop, 2 ft. wide x 14 in. high x 5 in. deep. This is an illuminated box sign made from sheet metal hammer finish enamel with a clear plastic window. You simply have your message printed or written on poster board or thick card. (Or use stick down letters available at most stationers.) You will then have a box sign normally costing anything between £10-£15. Illumination is by a 2 ft. fluorescent tube with control gear enclosed. Message card can be changed quite easily from hinged top back. Price £3 each, plus 65p post, etc.

Motivated Illuminated Box Sign. A previous item but with geared motor moving the message making it change eight times a minute. Very attention arresting. To use this for your own messages you would have to have each sign on card and the one supplied with the box sign. Price £4.50, plus 65p post and service.

Geared Motor with take off socket. The gear train is driven by normal type induction motor and gives a final speed of 8 r.p.m. The motor is mounted behind a chrome plate through which the take off drive protrudes and was originally intended to drive a spit for cooking, is also ideal for driving models or for driving a colour changing disc for the local dance hall, discotheque, etc. Really well made assembly. Price £1.75 plus 26p post etc.

Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil can cannot reach. Home and every-day uses. We have purchased a large quantity of these from the Liquidator and are able to offer them to you at about half of the original list price. 30p per (8 oz.) can or 12 cans for £3 post paid. The lubricant is I.C.I. Bucon L169.

REED SWITCHES

Class enclosed, switches operated by external magnet—gold welded contacts. We can now offer 3 types. Miniature. 1" long x approximately 1/4" diameter. Will make and break up to 1/4 A up to 300V. Price 18p each, £1.20 dozen. Standard. 2" long x 1/4" diameter. This will break currents of up to 1A, voltage up to 250V. Price 10p each, 90p per dozen. Flat. Flat type, 2" long, just over 1/4" thick, flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1A 200V. Price 30p each £3 per dozen. Small ceramic magnets to operate these reed switches 9p each, 90p dozen. Dry Reed Relays. Solenoids on moulded bobbins with magnetic shields—printout circuit or panel mounting.

Ref.	Coil Resistance	Reed Switches	Price
71005	2 K	1 normally open	25p
81916	1 K	1 normally open	25p
		1 normally closed	75p
		1 normally open	25p
05003	4 K	1 normally open	35p
62040	1500 & 500 ohms	1 normally open	25p
Multiple Reed Relay. Ref. 53001. Contains 13 normally open reeds within a solenoid. Operates on 60mW. Coil resistance 9K ohms. Price £1.95 each.			
Multiple Reed Relay. Ref. 081. 2 normally open 1 normally closed coil resistance 30 ohms. Price 75p.			
Thermostat. This is a thermostat with Sensor on the end of a long capillary tube. The temperature range is 50-120° C. approx. The setting is by range is for pointer knob (knob not supplied). The sensor can be immersed in the liquid or can be fixed to the container or as when used on an electric cooker, this can be fitted in the centre of a heating element. Price 65p each. £5.85 for ten. Many other thermostats available please request list.			

J. BULL (ELECTRICAL) LTD.
(Dept. P.W.), 7 Park Street, Croydon CRO 1YD
Callers to: 102/3 Tamworth Road, Croydon.

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B12H	£1.75p	ECH200	82p	OA2	35p
CY31	35p	ECL90	45p	OB2	35p
DAF96	35p	ECL82	32p	PA BCB30	37p
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DL96	41p	ECL86	42p	PC900	47p
DK92	32p	EF36	45p	PCF84	37p
DL94	40p	EF37A	45p	PCF89	45p
DL96	41p	EF39	40p	PCF189	55p
DM70	30p	EF40	50p	PCF800	75p
DY86	45p	EF41	32p	PCF80	30p
DY87	55p	EF80	25p	PCF82	32p
DY802	48p	EF83	55p	PCF84	46p
E88C0/01	£1.80p	EF85	32p	PCF86	57p
E180C	90p	EF86	81p	PCF200	77p
E182C	90p	EF89	21p	PCF201	77p
EF95	37p	EF91	32p	PCF802	48p
EF95	37p	PCF805	72p	PCF805	72p
EA0C80	32p	EF183	32p	PCF806	65p
EA0F42	60p	EF184	35p	PCF808	72p
EB91	15p	EPL200	75p	PCH200	70p
EB93	50p	EPL21	52p	PCL81	47p
EB04	52p	EL41	57p	PCL82	37p
ECC81	30p	EL42	53p	PCL83	65p
EF80	42p	EL84	23p	PCL84	42p
EF83	42p	EL85	40p	PCL85	42p
EF89	30p	EL90	35p	PFL200	57p
ECC82	28p	EL95	35p	PL36	53p
ECC83	30p	EL500	85p	PL81	50p
ECC84	20p	EM31	25p	PL82	40p
ECC85	40p	EM80	40p	PL83	42p
ECC86	50p	EM84	35p	PL84	35p
ECC87	52p	EM87	35p	PL500	75p
RC189	32p	EY51	40p	PL604	75p
ECF80	35p	EY86	35p	PY33	60p
ECF82	35p	EY81	35p	PY80	35p
ECF83	75p	EY88	40p	PY81	27p
ECF801	62p	EZ41	42p	PY82	27p
ECF802	62p	EZ80	25p	PY83	35p
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29/41H. AERIALS each consisting of ten 3ft. jin. dia. tubular screw-in sections. 11ft. (6-section) with aerial with adaptor to fit the jin. rod, insulated base, stay plate and stay assemblies, pegs, reamer, hammer, etc. Absolutely brand new and complete ready to erect. In canvas bag £4. P. & P. 50p.

METERS

Full List of our very large stock of meters on request.

TRANSISTORS, ZENER DIODES etc.

SPECIAL OFFER	OC25	37p	OC200	40p	2N3055	75p	AD149	50p	BYZ13	25p		
OBJ tube	OC26	25p	OC201	60p	2N3730	50p	AD161	37p	BYZ16	85p		
	OC28	62p	OC206	90p	2N3731	£2.75p	AD162	37p	CR81/10	28p		
	OC29	62p	IN21	17p	2N5109	£2.05p	AF118	62p	CR81/20	38p		
	OA5	25p	OC35	50p	IN21B	25p	AF127	17p	CR81/30	40p		
	OA10	25p	OC38	42p	IN215	60p	AF139	30p	CR81/35	48p		
	OA70	10p	OC44	17p	IN43	10p	AF178	45p	CR81/40	45p		
	OA71	10p	OC45	15p	IN70	7p	PRF5	32p	AF186	40p		
	OA73	10p	OC70	12p	IN702-72536P	3N128	87p	AFY19	£1.13p	CR83/20	38p	
	OA74	10p	OC71	15p	IN823A	£1.30	3N139	£1.75p	ABY26	25p	CR83/30	43p
	OA79	10p	OC72	25p	IZM75	35p	3N140	95p	ABY28	25p	CR825/025	
	OA81	10p	OC73	30p	IZM710	35p	3N154	90p	ABY67	48p		
	OA91	7p	OC75	25p	IZT15	67p	3N159	£1.45p	BAW19	25p		
	OA200	7p	OC76	25p	IZT10	68p	6PR5	45p	BC107	12p	CR83/40	50p
	OA202	10p	OC81	25p	24385	51p	12FR60	73p	BC108	12p	GET103	23p
	OA210	25p	OC81D	20p	2G403	15p	10D1	18p	BC113	25p	GET115	45p
	OA211	37p	OC81DM	20p	IN4785	50p	40594	£1.37p	BC118	38p	GET116	50p
	OA221	32p	OC82	25p	2N277	52p	40595	£1.37p	BCY72	15p	GEX66	£1.10p
	OA220	10p	OC83	25p	2N2918	37p	40686	£1.45p	BF115	25p	NKT222	20p
	OA2206	42p	OC83B	15p	2N1304	25p	40689	£1.45p	BFY51	20p	NKT304	50p
	OA2207	47p	OC84	25p	2N1306	25p	40626	23p	BFY52	23p	BD918	28p
	OA2208	16p	OC122	50p	2N1307	25p	AC127	25p	BS03	38p	BD928	31p
	OA2213	32p	OC139	25p	2N2147	74p	AC128	25p	BS	45p	BD938	32p
	OA2223	10p	OC140	37p	2N2904A	32p	AC176	25p	BS2	47p	BD94	21p
	OA2225	50p	OC170	25p	2N2904A	32p	AC176	25p	BS2	47p	BD94	21p
	OC16	50p	OC171	30p	2N3054	55p	ACY17	30p	BSY29	25p	SD988	46p
	OC22	50p	OC172	37p	2N3054	60p	ACY28	17p	BU100	£1.80p	UA05A	40p
	OC29	62p	OC29	62p	IN21	17p	2N5109	£2.05p	AF118	62p	CR81/20	38p
	OC35	50p	OC35	50p	IN21B	25p	40382	60p	AF127	17p	CR81/30	40p
	OC38	42p	OC38	42p	IN215	60p	40383	60p	AF139	30p	CR81/35	48p
	OC44	17p	OC44	17p	IN43	10p	3F100	87p	AF178	45p	CR81/40	45p
	OC45	15p	OC45	15p	IN70	7p	3PR5	32p	AF186	40p	CR83/05	30p
	OC70	12p	OC70	12p	IN702-72536P	3N128	87p	AFY19	£1.13p	CR83/20	38p	
	OC71	15p	OC71	15p	IN823A	£1.30	3N139	£1.75p	ABY26	25p	CR83/30	43p
	OC72	25p	OC72	25p	IZM75	35p	3N140	95p	ABY28	25p	CR825/025	
	OC73	30p	OC73	30p	IZM710	35p	3N154	90p	ABY67	48p		
	OC75	25p	OC75	25p	IZT15	67p	3N159	£1.45p	BAW19	25p		
	OC76	25p	OC76	25p	IZT10	68p	6PR5	45p	BC107	12p	CR83/40	50p
	OC81	25p	OC81	25p	24385	51p	12FR60	73p	BC108	12p	GET103	23p
	OC81D	20p	OC81D	20p	2G403	15p	10D1	18p	BC113	25p	GET115	45p
	OC81DM	20p	OC81DM	20p	IN4785	50p	40594	£1.37p	BC118	38p	GET116	50p
	OC82	25p	OC82	25p	2N277	52p	40595	£1.37p	BCY72	15p	GEX66	£1.10p
	OC83	25p	OC83	25p	2N2918	37p	40686	£1.45p	BF115	25p	NKT222	20p
	OC83B	15p	OC83B	15p	2N1304	25p	40689	£1.45p	BFY51	20p	NKT304	50p
	OC84	25p	OC84	25p	2N1306	25p	40626	23p	BFY52	23p	BD918	28p
	OC122	50p	OC122	50p	2N1307	25p	AC127	25p	BS03	38p	BD928	31p
	OC139	25p	OC139	25p	2N2147	74p	AC128	25p	BS	45p	BD938	32p
	OC140	37p	OC140	37p	2N2904A	32p	AC176	25p	BS2	47p	BD94	21p
	OC170	25p	OC170	25p	2N2904A	32p	AC176	25p	BS2	47p	BD94	21p
	OC171	30p	OC171	30p	2N3054	55p	ACY17	30p	BSY29	25p	SD988	46p
	OC172	37p	OC172	37p	2N3054	60p	ACY28	17p	BU100	£1.80p	UA05A	40p
	OC29	62p	OC29	62p	IN21	17p	2N5109	£2.05p	AF118	62p	CR81/20	38p
	OC35	50p	OC35	50p	IN21B	25p	40382	60p	AF127	17p	CR81/30	40p
	OC38	42p	OC38	42p	IN215	60p	40383	60p	AF139	30p	CR81/35	48p
	OC44	17p	OC44	17p	IN43	10p	3F100	87p	AF178	45p	CR81/40	45p
	OC45	15p	OC45	15p	IN70	7p	3PR5	32p	AF186	40p	CR83/05	30p
	OC70	12p	OC70	12p	IN702-72536P	3N128	87p	AFY19	£1.13p	CR83/20	38p	
	OC71	15p	OC71	15p	IN823A	£1.30	3N139	£1.75p	ABY26	25p	CR83/30	43p
	OC72	25p	OC72	25p	IZM75	35p	3N140	95p	ABY28	25p	CR825/025	
	OC73	30p	OC73	30p	IZM710	35p	3N154	90p	ABY67	48p		
	OC75	25p	OC75	25p	IZT15	67p	3N159	£1.45p	BAW19	25p		
	OC76	25p	OC76	25p	IZT10	68p	6PR5	45p	BC107	12p	CR83/40	50p
	OC81	25p	OC81	25p	24385	51p	12FR60	73p	BC108	12p	GET103	23p
	OC81D	20p	OC81D	20p	2G403	15p	10D1	18p	BC113	25p	GET115	45p
	OC81DM	20p	OC81DM	20p	IN4785	50p	40594	£1.37p	BC118	38p	GET116	50p
	OC82	25p	OC82	25p	2N277	52p	40595	£1.37p	BCY72	15p	GEX66	£1.10p
	OC83	25p	OC83	25p	2N2918	37p	40686	£1.45p	BF115	25p	NKT222	20p
	OC83B	15p	OC83B	15p	2N1304	25p	40689	£1.45p	BFY51	20p	NKT304	50p
	OC84	25p	OC84	25p	2N1306	25p	40626	23p	BFY52	23p	BD918	28p
	OC122	50p	OC122	50p	2N1307	25p	AC127	25p	BS03	38p	BD928	31p
	OC139	25p	OC139	25p	2N2147	74p	AC128	25p	BS	45p	BD938	32p
	OC140	37p	OC140	37p	2N2904A	32p	AC176	25p	BS2	47p	BD94	21p
	OC170	25p	OC170	25p	2N2904A	32p	AC176	25p	BS2	47p	BD94	21p
	OC171	30p	OC171	30p	2N3054	55p	ACY17	30p	BSY29	25p	SD988	46p
	OC172	37p	OC172	37p	2N3054	60p	ACY28	17p	BU100	£1.80p	UA05A	40p
	OC29	62p	OC29	62p	IN21	17p	2N5109	£2.05p	AF118	62p	CR81/20	38p
	OC35	50p	OC35	50p	IN21B	25p	40382	60p	AF127	17p	CR81/30	40p
	OC38	42p	OC38	42p	IN215	60p	40383	60p	AF139	30p	CR81/35	48p
	OC44	17p	OC44	17p	IN43	10p	3F100	87p	AF178	45p	CR81/40	45p
	OC45	15p	OC45	15p	IN70	7p	3PR5	32p	AF186	40p	CR83/05	30p
	OC70	12p	OC70	12p	IN702-72536P	3N128	87p	AFY19	£1.13p	CR83/20	38p	
	OC71	15p	OC71	15p	IN823A	£1.30	3N139	£1.75p	ABY26	25p	CR83/30	43p
	OC72	25p	OC72	25p	IZM75	35p	3N140	95p	ABY28	25p	CR825/025	
	OC73	30p	OC73	30p	IZM710	35p	3N154	90p	ABY67	48p		
	OC75	25p	OC75	25p	IZT15	67p	3N159	£1.45p	BAW19	25p		
	OC76	25p	OC76	25p	IZT10	68p	6PR5	45p	BC107	12p	CR83/40	50p
	OC81	25p	OC81	25p	24385	51p	12FR60	73p	BC108	12p	GET103	23p
	OC81D	20p	OC81D</									

well as for maximum r.p.m. indications mentioned previously for the different number of cylinders.

CONSTRUCTION

The circuit board and component layout is shown in Fig. 2. The board can be quite small and could be either mounted on the back of the meter as shown or installed behind the dashboard by itself but it must be clear of the direct airflow from the car heater

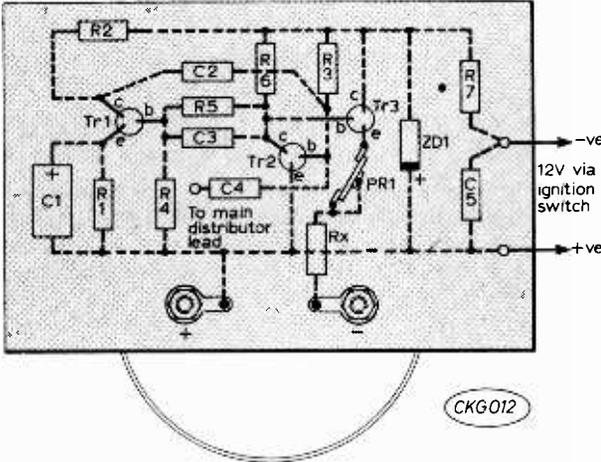
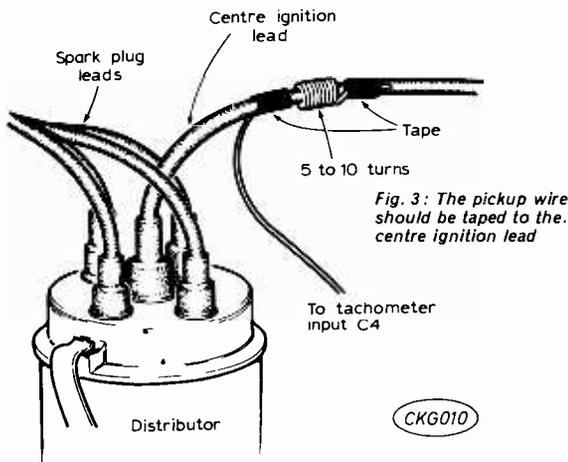


Fig. 2: A suggested component layout. The board is mounted directly on the terminal screws of the meter.

system. In the prototype the board was attached to the back of the meter by the terminal screws. The component layout is not critical and can be altered a little from that shown in Fig. 2. It is most important however, not to connect the common positive supply rail of the circuit directly to either the car body or meter case. The circuit will be effectively 'earthed' via whichever lead, positive or negative, is connected eventually to the car body i.e., via whichever side of the car battery is bonded to the car body. The 12V supply should be taken after the ignition switch.

The only other connection is a length of thin plastic covered wire from the tachometer input C4 which is taken through to the centre ignition lead on the distributor. The end of this wire is wrapped around the centre ignition lead and taped into place as shown in Fig. 3. Between 5 and 10 turns should be sufficient for ignition pulse pick up.



CKG010

CALIBRATION

The ideal method of calibrating the meter is to drive the tachometer from a square-wave audio signal generator. The square-wave should have a peak amplitude of at least 2V and must be differentiated by a simple RC network as in Fig. 4. The output will

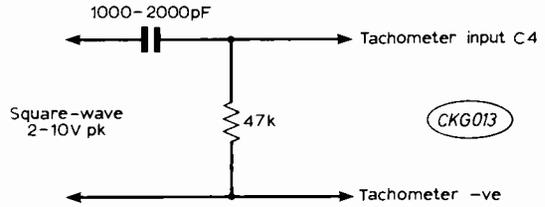


Fig. 4: The differentiating circuit for calibration.

be a series of positive and negative going pulses. The tachometer will respond to the positive going pulses only. It is essential to understand that when the tachometer is driven from a car ignition system (from the centre distributor lead) it will receive either four, six or eight pulses for *each* revolution of the engine, depending on the number of cylinders. The engine r.p.m. will therefore be the number of pulses per minute divided by the number of cylinders. For example, if the pulse frequency per minute is 10,000, the r.p.m. for a 4 cylinder engine would be 2,500. For calibration with a signal generator it is easier to work with pulses per second, so in order to set the tachometer scale for say 2,500 r.p.m. the generator frequency is set to

$$\frac{10,000}{60} = 166.6\text{Hz.}$$

It would be easier of course to set the generator to an even frequency so, for example, 200Hz would be equal to 12,000 pulses per minute (200×60) or $12,000/4$ which equals 3,000 r.p.m. for a 4 cylinder engine.

★ components list

Resistors	
R1 1.8k Ω	R6 4.7k Ω
R2 4.7k Ω	R7 820 Ω
R3 15k Ω	Rx see text
R4 39k Ω	PR1 1k Ω skeleton preset
R5 10k Ω	
All resistors 10%, 1/4W types	
Capacitors	
C1 200 μ F	C4 1000pF
C2 0.04 μ F	C5 0.05 μ F
C3 0.01 μ F	
Semiconductors	
Tr1 OC45	ZD1 NKT/C8V2 or BZY88/C8V2 (Electrovalue)
Tr2 OC45	
Tr3 OC45	
Miscellaneous	
0.1mA f.s.d. meter—see text, prototype type LS65, 240° (Henry's Radio); circuit board; case to suit.	

Most meters, including the 240° type, will have calibration marks of 0 to 10 which is convenient for either 0-5,000 or 0-10,000 r.p.m. The meter scale can of course be taken out and new figures inscribed.

A scale of 0-8,000 would mean providing new calibration marks of 0.8 i.e., the scale must be divided into 8 equal parts. The maximum r.p.m. range must therefore be decided and the meter scale marked accordingly.

Having done this the instrument can be calibrated and to assist in this the following tables relate r.p.m. to frequency and number of cylinders.

Four Cylinder Engines

Engine R.P.M.	Pulses per minute from ignition	Generator Frequency (Hz)
500	2,000	33.3
1,000	4,000	66.6
1,500	6,000	100
2,000	8,000	133.3
2,500	10,000	166.6
3,000	12,000	200
3,500	14,000	233.3
4,000	16,000	266.6
5,000	20,000	333.3
6,000	24,000	400
7,000	28,000	466.6
8,000	32,000	533.3
9,000	36,000	600
10,000	40,000	666.6

The suggested calibration checks for 0-5,000 r.p.m. are as follows:— Set the generator to 200Hz and adjust PR1 to obtain meter reading of 3,000 r.p.m. Set generator at 100Hz and check that meter is reading 1,500 r.p.m. If not, slightly re-adjust PR1 and check again for reading at 3,000 r.p.m. Much the same procedure is adopted for higher maximum r.p.m. readings i.e., for 8,000 r.p.m. full scale use a 400Hz test signal and set PR1 for a reading of 6,000 r.p.m. and check with 200Hz for a reading of 3,000 r.p.m. For a 10,000 r.p.m. maximum set generator to 600Hz and PR1 to obtain meter reading of 9,000 r.p.m. Recheck at 3,000 r.p.m. with 200Hz.

Six Cylinder Engines

Engine R.P.M.	Pulses per minute from ignition	Generator frequency (Hz)
500	3,000	50
1,000	6,000	100
2,000	12,000	200
3,000	18,000	300
4,000	24,000	400
5,000	30,000	500
6,000	36,000	600
7,000	42,000	700
8,000	48,000	800
10,000	60,000	1,000

As the generator test frequencies all come out at even figures the calibration for six cylinder engines for any maximum r.p.m. reading of up to 10,000 is quite easy but a similar procedure i.e., the initial setting of PR1 for a high calibration reading and then check at a lower one, can be adopted.

No table is included for 8 cylinder engines as the 4 cylinder engine table can be used by simply doubling the test frequencies.

CALIBRATION WITHOUT A GENERATOR

With a square-wave generator a calibration accuracy of better than 1 per cent can be obtained, especially if the generator is first checked for

accuracy against the 50Hz mains frequency with an oscilloscope and Lissajou's patterns.

Reasonable accuracy, however, can be obtained by setting the value of PR1 with an ohmmeter. The table shows the values at which PR1 should be set to obtain 0-5,000, or 0-8,000 or 0-10,000 r.p.m. for a 4 or 6 cylinder engine. For 8 cylinder engines the value of PR1 will be double those of the 4 cylinder ones.

Value of PR1 plus Rx for simple calibration

Max. Revs.	Four Cylinders	Six Cylinders
5,000	180Ω	500Ω
8,000	520Ω	1,200Ω
10,000	800Ω	1,500Ω

In operation the meter needle will waver slightly about the engine r.p.m. reading. Violent fluctuation or erratic indication could be due to ignition pulse pick up being too great, in which case reduce the number of turns of the pick up coil. From tick-over the needle should rise quickly as the accelerator is pressed down. **Don't** rev the engine just to see the tachometer read maximum r.p.m., it won't do the engine any good. For test purposes about half the engine maximum r.p.m. will be sufficient to see that the tachometer reading rises accordingly. ■

CO! CO! CO! CO! CO! CO! CO!

INFORMATION WANTED

- ...any information or circuit literature etc. on the Practical Wireless "Strand" amplifier.—G. A. Hocknell, School House, King's School, Canterbury, Kent.
- ...circuit designs for a car anti-theft device of the tuned circuit or capacitance type.—R. E. Hannah, 16 Winton Way, Rainford, Nr. St. Helens, Lancashire.
- ...Heathkit manual for kit EW-1. To be borrowed or bought for £1.—W. Amman, 1 Montague Avenue, London, S.E. 6.
- ...any gen on where I may obtain 5 dust cores for the i.f. transformers for my E.V.R. Radio-Packa Gram.—K. Gibbs, 10 Hayston Ple., North Road West, Plymouth, Devon, PL1 5DU.
- ...information or circuit details and power requirements for the BC-433G and BC-434A radio and direction-finding equipment.—D. Eaton, "Glenfield", Le Foulton, St. Andrew's, Guernsey, C.I.
- ...valve line-up and any relevant data, circuit diagram etc. on the Marconi 219 serial number 942995 receiver which is 20-25 years old. This is needed to help some boys in their school project.—B. C. Matthews (Senior Physics Master) Roan Grammar School for Boys, Maze Hill, Blackheath, London, S.E. 3.
- ...information on converting to stereo the Dansette RG 31 radiogram. It has a stereo-wired autochanger.—R. C. Emery, Kelsall, Saxmundham, Suffolk, IP17 2PA.
- ...instruction book for my Geloaso communications receiver also the address of Geloaso in Italy; the model No. is G207 DR and the serial No. 838 H.—A. G. Tewes, 17 Queens Road, Luton, Chatham, Kent.
- ...circuit diagram and component list for F. J. Camm's Superhet Coronet 4 (a.c.)—G. L. Perkins, "Pensith", High Street, Porlock, Nr. Minehead, Somerset.
- ...information, handbook, etc., of the Kuba German radiogram. Imperial chassis 612.—F. C. Dillien, 20 Hamden Crescent, Fritland Lane, Dagenham, Essex.
- ...any gen at all on the receiver type R3003 Ref. 10db/2.—John Hutcheon, c/o Walter Hannah, High Altercannoch, Barrhill, Giruan, Ayrshire.
- ...service sheet for a Bush TV135R valved version TV.—J. D. Mendham, 12 Henton Road, Edwinstowe, Notts.
- ...any gen on scope tube DG7-5.—C. R. Follenfant, 4 Ash Road, Shirley, Croydon, Surrey.
- ...circuit diagram, alignment information and operating instructions for the Lafayette KT 320 communications receiver.—A. D. Temple, 56 Wood Road, Chorlton, Manchester.
- ...instruction books and spares for the Invicta 500 and 300 a.c.—Ralph Hamilton, Ballyhelmore, Tandragee, NI.
- ...any technical information regarding the photomultiplier tube type 931A.—A. J. Dickinson, 22 Kensington Place, Brighton, Sussex, BN1 4RJ.
- ...any information, diagrams, etc., on Pamphonic type 601F amplifier with 2 x EL34, one U56 and six other valves. Also any of the following issues of P.W.: June 1966, July 1964, June and January 1963, December 1962, September 1962 or earlier.—M. McLean, Stamford Villa, Station Avenue, Haddington, East Lothian.
- ...any details of the power transformer of the Coscor scope model 1039 Mk. 2.—David Snodley, 9 Alexandra Park Avenue, Belfast BT 15ER, N. Ireland.
- ...the book entitled "Oscilloscope Equipment Circuits" by Easterling (Norman Price—out of print). Will buy or borrow.—F. D. Cosgrove, Rowan Chalet, Lower Road, Postcombe, Oxford, OX9 7DU.

ISSUES FOR DISPOSAL

- ...P.W. for May 1969 to December 1970. Offers please to N. J. Moore, 33 Highcliff Drive, Leigh-on-Sea, Essex.

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AC177	0-15	2G303	0-13
AF239	0-37	2N711	0-50
AF186	0-50	2N1302-3	0-20
AF139	0-37	2N1304-5	0-25
BC154	0-25	2N1306-7	0-30
BC107	0-13	2N1308-9	0-35
BC108	0-13	2N3819FET	0-45
BC109	0-14		
BF194	0-15	Power Transistors	
BF274	0-15	OC20	0-50
BFY50	0-20	OC23	0-30
BSY25	0-57	OC25	0-25
BSY26	0-13	OC26	0-25
BSY27	0-13	OC28	0-30
BSY28	0-13	OC35	0-25
BSY29	0-13	OC36	0-37
BSY95A	0-15	AD149	0-30
OC41	0-13	AU110	1-25
OC44	0-13	2S034	0-25
OC45	0-13	2N3055	0-63
OC71	0-13	Diodes	
OC72	0-13	AA42	0-10
OC81	0-13	OA95	0-19
OC81D	0-13	OA79	0-09
OC83	0-20	OA81	0-09
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Adapting for SSB Reception

R. F. GRAHAM

FOR amateur band reception a receiver able to resolve s.s.b. (single sideband) signals is essential. This mode of telephony transmission is used almost exclusively on many amateur frequencies.

Home-constructed or commercial receivers which have no b.f.o. (beat frequency oscillator) cannot be used at all for s.s.b. reception. Other receivers, of communications type but not of recent manufacture, will have a b.f.o., but unsuitable injection, or no product detector and as a result, s.s.b. reception may be poor, unsatisfactory, or tricky.

Fortunately it is easy to overcome these difficulties, by constructing a separate b.f.o. or product detector, and inserting it into the circuit. The older type of communications receiver is then generally able to give excellent s.s.b. reception.

TRANSMISSION MODES

Three main modes of transmission are commonly employed on the short wave bands. A receiver can only produce intelligible signals from those modes for which it is equipped to deal.

AM. Amplitude modulated signals are the usual speech and music obtainable with any domestic receiver. The presence of a carrier allows detection with a diode or other detector.

SSB. With single sideband signals the carrier and one sideband are suppressed, only the other sideband being transmitted. This allows the whole transmitter power to give useful signals, instead of power being wasted on the carrier, as in a.m. To resolve s.s.b. the receiver must provide a carrier which can be

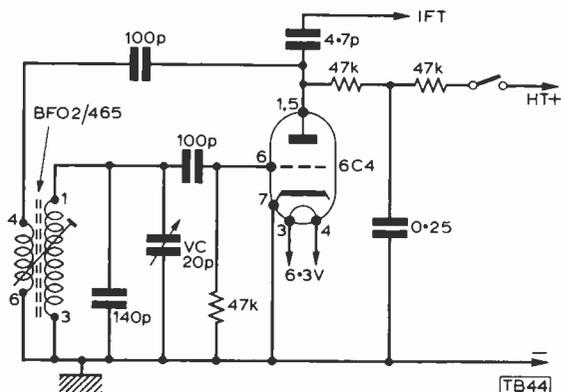


Fig. 1: Simple valve b.f.o. mainly intended to allow reception of c.w. signals.

adjusted in frequency to replace that suppressed before transmission.

CW. CW, or Morse, is a carrier only, interrupted by keying, and the presence of a beat frequency oscillator in the receiver will result in an audio tone. If the receiver has no b.f.o. the same conversion which allows s.s.b. reception will also permit c.w. reception.

BFO

Fig. 1 is a typical b.f.o. circuit for valve receivers, using readily available components. The Denco BFO2/465 b.f.o. coil is suitable for receivers having an intermediate frequency of 455-470kHz. If the circuit is constructed as an addition to a receiver having no b.f.o., the small 6C4 triode is ideal requiring only 0.15A at 6.3V for the heater. When more convenient, one section of a twin triode may be used instead.

The few components are readily assembled on a small chassis or plate. Variable capacitor VC has an extension spindle, or is so placed that it can be controlled by a knob on the receiver panel. The b.f.o.

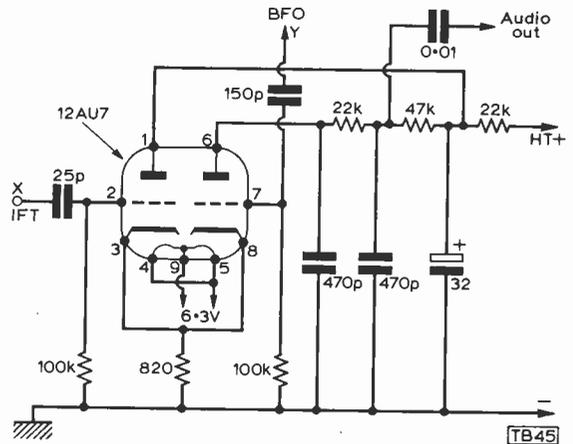


Fig. 2: Twin triode product detector. Used with the b.f.o. it permits satisfactory resolution of s.s.b. signals.

unit is bolted to the main receiver chassis close to the last i.f. transformer.

A 180-250V h.t. supply is suitable. A refinement is to use a stabilised 150V supply, but this is not essential. A switch, anywhere convenient on the panel, interrupts the h.t. supply for a.m. reception.

The circuit is adjusted by placing VC half closed, tuning in a signal, and rotating the b.f.o. coil core until the audible beat falls to zero. Turning VC slightly either way will then cause an audio note which rises in frequency.

For c.w. reception, VC is adjusted to that position which gives best results with the wanted Morse signals.

INJECTION ON SSB

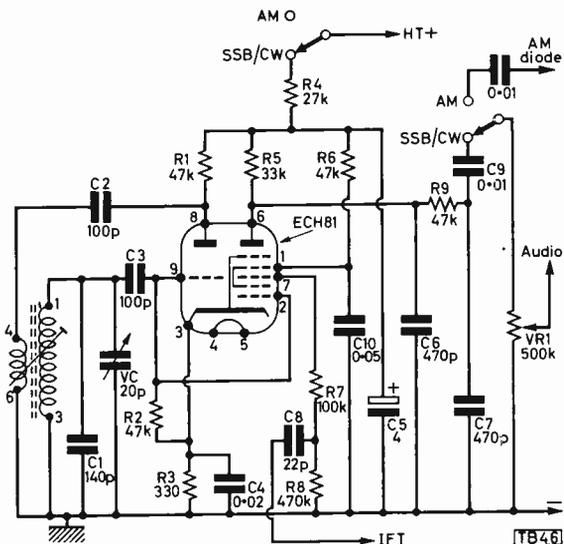
With such a b.f.o., or an older receiver having a similar b.f.o., satisfactory s.s.b. reception is only possible when the s.s.b. signal is weak at the detector. This means that the receiver r.f. gain (and possibly i.f. gain) control must be turned towards minimum

gain, the a.f. gain near maximum. The s.s.b. signal can then be resolved if the b.f.o. frequency is tuned so that it replaces the carrier removed before transmission.

One way to improve matters with the minimum of circuit change is to increase the b.f.o. injection at the final i.f.t. With some receivers, the coupling capacitor (4.7pF in Fig. 1) is of extremely low value, less than 1pF. Changing this to a 3-30pF or similar trimmer will allow increased injection. It is then possible to deal with s.s.b. signals of somewhat greater strength at the detector. The improvement is only relatively slight and insufficient carrier will be available from the b.f.o. to allow the a.m. type detector to deal satisfactorily with strong s.s.b. signals. These, if resolved, will sound like distorted, much over-modulated a.m.

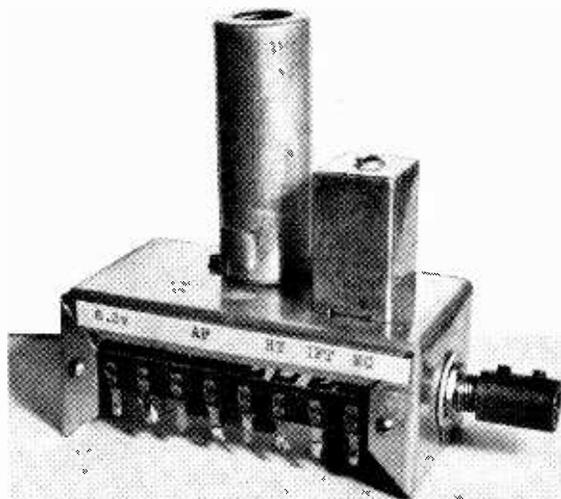
PRODUCT DETECTOR

Fig. 2 is a straightforward standard product detector using a twin triode, cathode coupled, which was found to give very good results with the minimum of difficulty.



Point X is taken directly to the secondary of the last i.f.t. This tag will have previously been wired to the a.m. detector diode. Point Y is connected to the b.f.o. stage anode. (A few commercial circuits use a tap on the b.f.o. coil for the cathode, with the anode grounded for r.f. In this case, take Y to the b.f.o. cathode.)

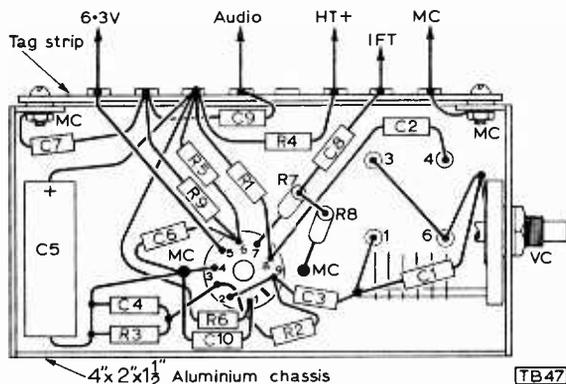
Component values were not found to be particularly critical. The 32μF capacitor is to ensure a decoupled and well smoothed h.t. supply. The audio output runs to the volume control on the first a.f. amplifier. This circuit was found to work very well indeed over a wide range of s.s.b. signal strengths, from extremely weak signals barely audible, to those giving much more loudspeaker volume than could be tolerated without reducing receiver gain.



▲ Completed product detector/b.f.o. unit using the single valve circuit of Fig. 3.

◀ Fig. 3: Circuit using an ECH81 as combined product detector/b.f.o.

▼ Fig. 4: Suggested component layout of circuit shown in Fig. 3.



PRODUCT DETECTOR WITH B.F.O.

The circuit in Fig. 3 has only one valve, an ECH81. B.f.o. injection is to grid 1 of the heptode section, with signals from the final i.f.t. to grid 3. The triode of the ECH81 acts as the b.f.o. oscillator for carrier insertion.

The main advantage of this circuit is that it needs only one valve, and a 2-pole 2-way switch provides for a.m., s.s.b. or c.w. reception. One pole applies h.t. to the ECH81 while the other pole transfers the receiver audio gain control from the usual a.m. detector to the product detector.

All the components may be assembled on a small chassis, Fig. 4 shows suggested construction and wiring. A similar method of building can be adopted with the circuits in Figs. 1 and 2.

The unit is completely wired and tested, then bolted to the receiver chassis, with VC extended

through the panel. The b.f.o. section should be adjusted in the way described for Fig. 1.

TRANSISTOR RECEIVERS

These can be adapted with equal success, and the changes are particularly useful for those receivers which cover several amateur bands.

Fig. 5 is a b.f.o. circuit using a Denco IFT14 coil, for receivers with 465kHz or similar intermediate frequency. A simple method of assembly is to fit the b.f.o. coil, transistor, Z1, resistors and capacitors on a small circuit board, which can be mounted near the 20pF variable capacitor VC, which is attached to the receiver panel. The switch in the negative line cuts the oscillator for a.m. reception and can be located anywhere convenient. The layout should provide a short, direct connection from X to the last i.f. transformer.

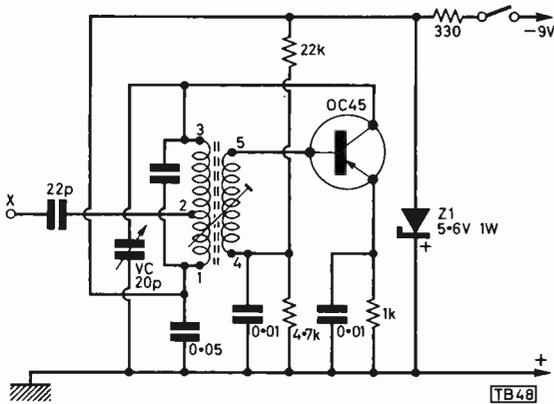


Fig. 5: Circuit of b.f.o. for use with transistorized receiver.

A zener stabilised supply is essential for the oscillator. Most receivers have an audio output stage in which the current drawn fluctuates with the audio signal level and this may cause troublesome frequency modulation effects in the oscillator. The circuit draws about 10mA.

Fig. 5 alone is satisfactory for c.w. reception. It will also provide reception of s.s.b. when the strength of the s.s.b. signal is limited in the way described for Fig. 1. An a.m. signal should first be tuned in and VC set half closed. The coil core is then adjusted as for

Fig. 1 Varying VC then allows best reception of c.w. or s.s.b. signals.

Fig. 6 is a product detector which can be used in conjunction with Fig. 5. It has the advantage of providing a.m. detection when the b.f.o. is switched off, so that no switching of audio circuits is required.

Carrier injection is at Y, from point X in Fig. 5. Signals reach the second transistor via the 100pF isolating capacitor. This connection may be to the primary or secondary of the last i.f.t. in the receiver, according to which gives the better results.

Audio output is taken to the usual audio gain control. Other transistors of similar type may be used, and the supply to this part of the circuit need not be stabilised. With transistor receivers, a diode generally provides a.g.c. and a.m. detection, and this diode can be retained for a.g.c. purposes. In many circuits a 5kΩ potentiometer serving as a.f. gain control is also the diode load resistor. As this is now not available for this purpose, a 5.6kΩ resistor should be substituted.

Most transistor receivers have no manual gain control for the i.f. stages (or r.f. stage, if present) and since such a control is useful for s.s.b., it can be inserted by disconnecting the i.f. stage emitter resistors and adding a 2kΩ potentiometer between this point and the positive line.

NOTES

Some receivers have a 1.6MHz i.f. in which case the appropriate b.f.o. coil must be used (Denco BFO2/1.6).

When adjusting the variable capacitor VC, the b.f.o. must be put on the correct side of the s.s.b. transmission. Speech can then be resolved and VC carefully adjusted for the best results. If VC is altered to put the b.f.o. on the wrong side of the s.s.b. signal no possible adjustment will resolve the signals. The manner of adjusting VC, for upper or lower sideband signals as the case may be, will soon become clear in use. The standard practice is upper sideband (USB) above 10MHz and lower sideband (LSB) below 10MHz.

When making or altering connections to the last i.f.t., alignment may be slightly upset. So a final check should be made of this, and the i.f.t. cores re-adjusted for best results.

In some circuits, the same diode is employed to obtain a.g.c. voltage and a.m. detection. Then when a b.f.o. is added as in Fig. 1, its carrier will produce an a.g.c. voltage, reducing sensitivity. This still arises when a.g.c. is derived from a separate diode, usually with a small capacitor to the last i.f. anode. With a circuit like Fig. 2, the a.g.c. can be left in use. Otherwise a switch may be added, to short the a.g.c. line to earth for s.s.b. or c.w. reception. Communications type receivers generally have a manual control for r.f. gain, i.f. gain, or both. If this is not present in a receiver, it should be fitted. A cathode bias potentiometer is generally employed.

Bandspread tuning, or an excellent slow motion drive, will be found helpful for s.s.b. reception.

Normal circuit precautions should be taken when wiring. The i.f. leads should be short, and clear of earlier i.f. circuits. H.T. and heater leads can run against the chassis. Where a.f. circuits are extended, as for Fig. 3, the leads should be screened, or carefully placed to avoid picking up hum from heater circuits.

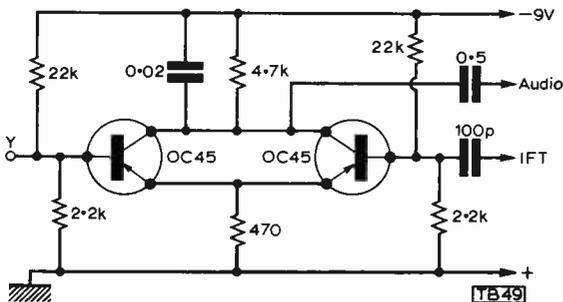
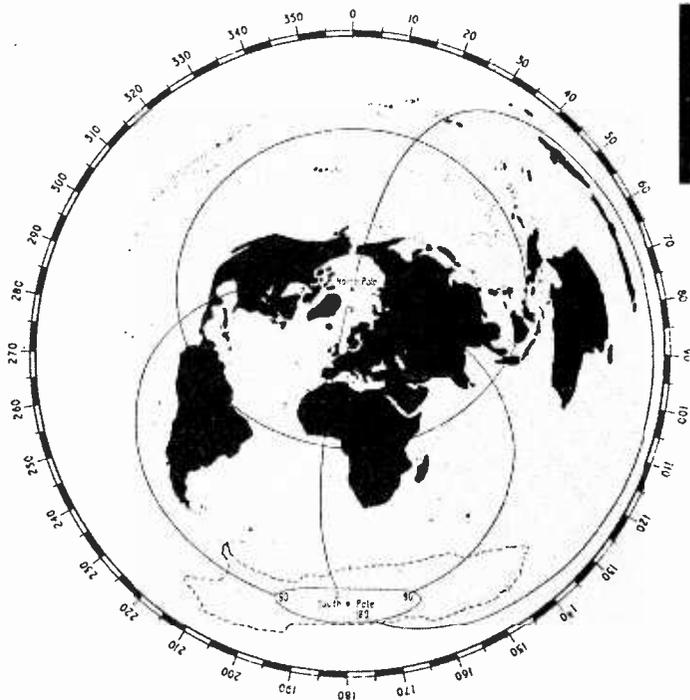


Fig. 6: Two transistor product detector used in conjunction with the b.f.o. of Fig. 5.

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PRACTICAL WIRELESS

DX DATA WALL CHART

Next month your QSL cards will have a companion—our **DX DATA WALL CHART**—and it's one that you'll keep for years. Features include a P.W. Exclusive: a specially designed frequency allocation chart giving all broadcasting and amateur bands, shipping and aeronautical frequencies and a lot, lot more—much of this information has never before been published in this country. **PLUS** a large great circle map based on London to give true distances and bearings together with a World Time table and International Call Sign allocations.

ARTICLES INCLUDE:

the P.W. **CUBE RADIO** 7 Transistor Superhet

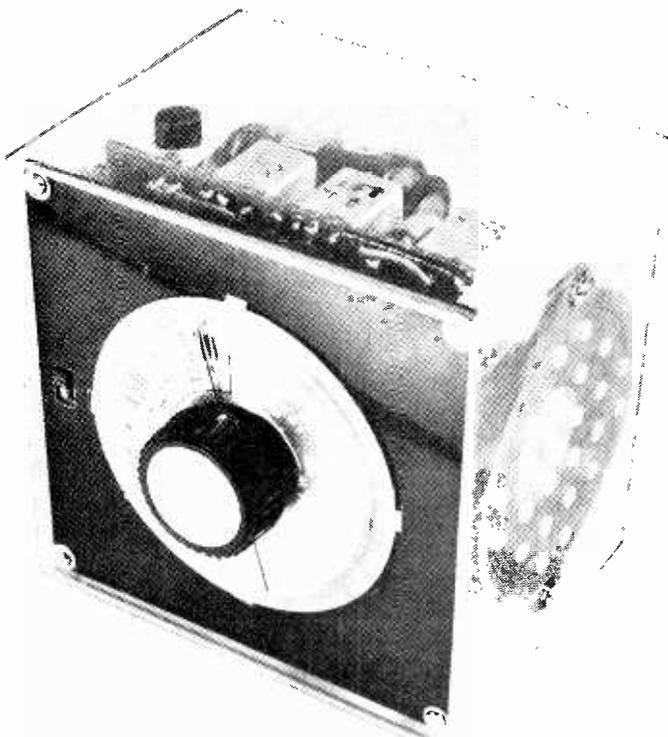
With "Novelty Radios" the emphasis is more often on the 'novelty' rather than the 'radio'; the electronics is sacrificed to the appearance. But not in ours. Built into a perspex cabinet, the **P.W. CUBE RADIO** is a full seven transistor superhet receiver giving exceptional performance for its size. Be sure not to miss this one; full details are given to build this ingenious project.

DARKROOM THERMOMETER

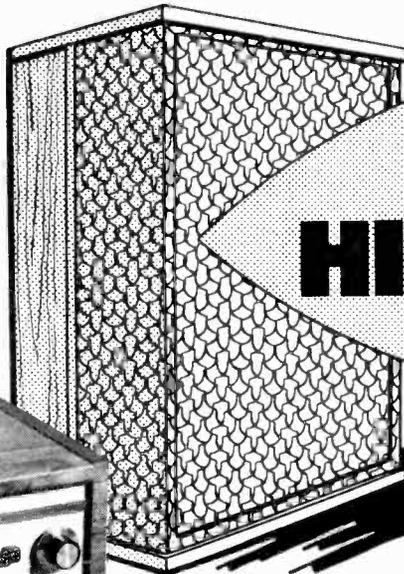
We don't want to deride conventional thermometers but from the photographers point of view they leave a lot to be desired in the darkroom. This circuit uses a thermistor and has rapid response, is very easy to read in the worst light and is accurate to within 0.25°C—and all this with a mere handful of components.

CAR RADIO SIGNAL BOOSTER

This simple amplifier gives a useful improvement in MW and LW reception on any car radio. It has the feature that it is designed for mounting at the base of the aerial to overcome interference pickup. The total cost for this project is something under 50p!



**ALL IN THE MARCH
ISSUE ON SALE FEB. 4th.**



Qua
HI-FI S



PART 1



SELECTING the units of a hi-fi system these days is mainly an exercise in economics. The more expensive equipment from any of the many reputable makers will invariably give a good performance as the specification is the prime selling feature in this market. There is a danger not so much of getting poor value for money in the separate units (of the chain turntable-cartridge-amplifiers-loudspeakers) but of budgeting unevenly so that the performance of some links in the chain exceeds that of others. When this happens, the system's performance is somewhat *below* that of its worst component and the unexploited potential of the better units can be regarded as so much wasted money.

There are three basic units in the design to be described. They are:

The plinth which contains the turntable, amplifiers and controls, and *two* identical floor-standing *loudspeaker enclosures*.

Either design may be of interest for use with other equipment, but together they form a well matched system in which no performance is wasted. The three units are finished with teak veneer to match in appearance.

The Plinth

The plinth carries the turntable and separate pickup arm. These are covered by a hinged transparent tinted lid. This props in an open position for changing records and can be closed while playing. Inside the plinth is the power supply for the system, the preamplifiers which are in the form of two plug-in boards, and the power amplifiers. These are a

fairly new type of hybrid Class AB module with a rating of no less than 25 watts r.m.s. each into the correct loudspeaker loads. On the front of the plinth are all the controls for the system, with space provided for future expansion. This might be the addition of an in-built f.m. multiplex tuner, or audio filters.

The Loudspeaker Enclosures

The loudspeaker enclosures are intentionally massive. The author regards their internal volumes of 8 cubic feet as essential to reproducing the full bass content of modern records. A separate woofer and tweeter, fed separately by a crossover network and brilliance control, are used in each enclosure. The enclosures are the infinite baffle type, i.e. are completely sealed. This type is only effective if it is completely airtight, and there is no flexing of the enclosure walls under low frequency sound pressure. To achieve the densest possible structure, the vertical walls are a sandwich of two sheets of hardboard with a $\frac{1}{2}$ in. gap between, packed with fine sand. The top, bottom and speaker mounting boards are solid $\frac{1}{2}$ in. thick chipboard. To minimise internal reflections the interior is heavily damped with carpet felt. The felt is not attached directly to the inner surfaces, but is spaced about $1\frac{1}{2}$ inches away from them by a layer of fibre egg-crate material for better reduction of standing waves. The internal height, width and depth are in the ratios 3:2, again to reduce standing waves. The front and the forward parts of the sides are covered with Tygan fret, other visible parts are veneered in teak.

When the walls are filled with sand, each speaker can hardly be lifted by four men! But the payoff is

lity SYSTEM



C.R. BRADLEY

The system to be described in this series embodies the author's ideas on the best way to spend about £130 on stereo record playing equipment. A fair amount of carpentry is required but no special skill. Constructors may well introduce modifications to the design but if the system is built as described, one will obtain a very high standard of reproduction at a cost so far below that of equivalent commercial equipment (there is nothing sufficiently similar for a direct comparison anyway) that the saving is hard to calculate. The best assessment the author can offer of the pleasure the system provides is that he has not yet heard any commercial equipment for which he would care to swap his system.

that with a good stereo record, the complete orchestral volume can be reproduced with a bass realism that is truly free of resonance, boxy-ness or boomy-ness. Midrange and treble performances are also very satisfactory, with no harshness. The speakers have a crisp presence which can be modified by a 6-position Brilliance control for best stereo directionality in a particular room.

Construction of the Loudspeaker Enclosures

Each identical enclosure is based on a skeleton frame made up from nominally 1in. square pine, which when bought usually turns out to be nearer $\frac{7}{8}$ in. square—see Fig. 2. Saw the lengths listed as accurately as possible with the ends square. No difficult joints are required, the pieces being simply butted together and fixed with countersunk $1\frac{1}{2}$ in. woodscrews at the ends.

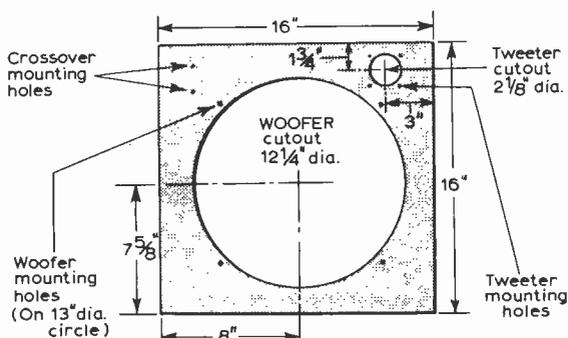


Fig. 1: Speaker mounting board, rear view.

The speaker mounting board is cut from 1in. chipboard to suit the units specified—see Fig. 1. The large cutout for the woofer is easiest made with a jigsaw, or more laboriously by drilling holes around the circumference and knocking out the middle. Use wood that is perfectly flat or the woofer chassis may be irreparably distorted when it is screwed down. The board should fit snugly in the centre of its aperture in the frame. The join at the top must be airtight, which is ensured by gluing a strip of wood ('S' in Fig. 1) along the outside of the join; this piece also keeps the top edge of the fret straight.

The inner hardboard sheets can now be fitted. These must be cut accurately or there will be problems of inward sand leakage. They are screwed from the inside to the frame by screws every 6 inches approx. Their vertical edges simply butt together and these joints must be made sand-tight by a wide strip of adhesive tape (e.g. 2in. Tuftape) stuck along the *outside* i.e. just behind the four corner verticals. Drill the small hole for the speaker leads at the centre of the inner rear sheet.

Cut out the outer hardboard sheets, again accurately. Make an appropriate cutout in the rear sheet at bottom centre for a small aluminium panel to carry the terminals and the brilliance control; this is made up along the lines indicated in Fig. 3. Mount the panels in place, without sand, and fix with countersunk screws every 6 inches approx. Paint the entire front of the enclosure and the forward 10in. of the sides matt black so the speaker cutouts will not be visible after the fret is fitted.

Next cut out and fit the top and bottom pieces (both 1in. chipboard). Screw down firmly and check that the fit is reasonably airtight, planing the surfaces if necessary.

Sand Panels

The sand filling can now begin. The sand used is fine beach sand, usually available from seed merchants. The author used 'real' beach sand but this had first to be dried thoroughly (in the kitchen oven!) and sifted free of pebbles. The filling must be done as follows to minimise the strain on the enclosure structure.

QUALITY HI-FI SYSTEM—SPECIFICATION

PLINTH SPECIFICATION

PREAMPLIFIERS (two)

General: Each preamplifier consists of a circuit using four silicon planar transistors and is wired on a piece of Veroboard which plugs into a 24-way edge connector.

Frequency response: 10Hz to 30kHz (—3dB points)

Disc equalisation: RIAA microgroove standard

Signal-to-noise ratio: Better than 80dB

Input impedances and sensitivities: (for 400mV output)

TUNER: 150mV into 500k Ω

DISC: 4mV into 47k Ω

AUXILIARY: 300mV into 500k Ω (Alternative sensitivities possible e.g. to suit crystal or ceramic devices)

Tape output: 3.5mV into 10k Ω , 350mV into 2M Ω

Distortion: Below 0.15% (on 400mV output); at least 20dB overload possible (i.e.: 4V output) without serious distortion.

Tone controls: Baxandall type giving approx. 20dB max. boost and cut at 20Hz and 20kHz

AMPLIFIERS (two)

General: Each amplifier is a Sanken SI-1020A hybrid module containing a complete single-ended push-pull Class AB amplifier on an isolated heat sink. (6 transistors).

Frequency response: 20Hz to 100kHz

Output power into 8 ohm load: 25 watts r.m.s. continuous, approx. 40 watts peak.

Distortion: Below 0.1% at usual listening levels (see graph)

Short circuit protection: Can be adequately protected by a 1 amp power fuse.

FRONT PANEL LAYOUT

RADIO - DISC - AUXILIARY, VOLUME, TREBLE, BASS, BALANCE, Stereo headphone outlet, Pilot lamp, OFF - HEADPHONE - SPEAKERS.

REAR PANEL

Stereo radio, auxiliary and spare inputs, and stereo tape recorder output (all phono sockets).

Left, right and common loudspeaker connections (screw terminals)

POWER SUPPLY

General: Unstabilised, silicon bridge rectifier.

Outputs: Separately fused 45V, 1A supplies to amplifiers; 30V (low ripple) to preamplifiers.

ENCLOSURE SPECIFICATION

TYPE: Two-way floor-standing infinite baffle, sand loaded walls.

SIZE: 38in. high x 27 $\frac{3}{4}$ in. wide x 18 $\frac{3}{4}$ in. deep overall approx.

WOOFER:

Type: Baker Major 12in.

Quoted response: 30Hz to 14.5kHz

Flux density: 14,000 gauss

Voice coil: 1 $\frac{1}{2}$ in. diameter, 8 ohm impedance

Main cone: paper with roll surround, fitted with concentric parasitic cone for higher frequencies

Mounting requirements: 11in. diameter aperture, four fixing holes on 13in. diameter circle.

TWEETER:

Type: Eagle MHT10, metal diaphragm with exponential horn type

Quoted response: 2kHz to 18kHz

Flux density: 13,000 gauss

Impedance: 8 ohm

CROSSOVER:

Eagle type CN28, 8 ohm series LC type

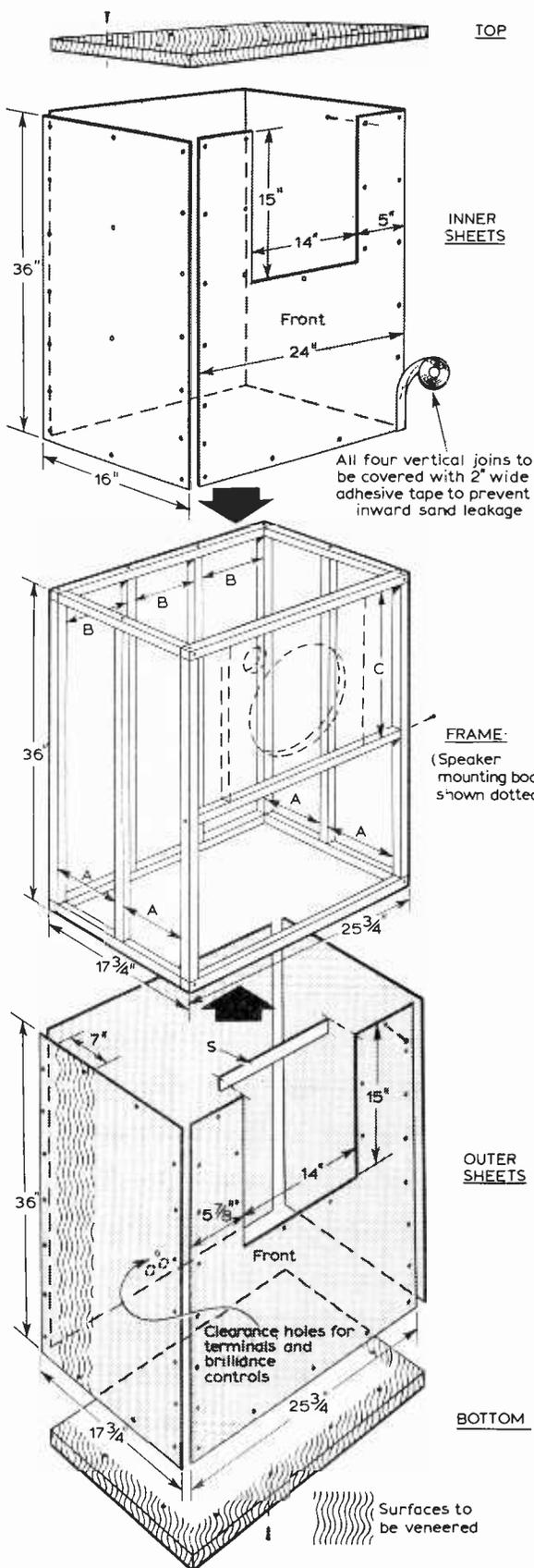
Crossover frequency: 3kHz

BRILLIANCE CONTROL:

Six-position resistive attenuator, unmatched.

Lay the enclosure on one side. Remove the uppermost panel and use rubber solution or putty to seal any possible leakage points in the two sand compartments revealed. Ensure that all the other panels are screwed on firmly to give strength to the structure. Fill the compartments with fine sand and level off. Replace and screw down the outer panel checking that no sand is trapped between it and the frame to spoil the seal. Also be sure no sand enters the screw holes or the screws may break; steel screws are preferable to brass for this reason. Tip the enclosure on

its back, supporting it as necessary to avoid crushing the rear terminals and brilliance control. Remove the outer front panel and fill the compartments with sand as before. Next fill the remaining side, and lastly the back. At this stage the connecting wires can be laid through the sand from the aluminium panel to the hole in the inner rear panel, which must be sealed with rubber solution to prevent inward sand leakage. Before fitting the back, be sure that the brilliance control switch is well sealed against sand ingress by means of a polythene bag or something similar.



Material:
 27 $\frac{1}{4}$ in. \times 18 $\frac{1}{4}$ in. \times 1in. chipboard
 Fix to frame with 1 $\frac{1}{2}$ in. countersunk woodscrews.
 Front and side edges protrude 1in. approx. Fit must be airtight (see text).

Material:
 2 off 36in. \times 24in. \times $\frac{1}{4}$ in. hardboard
 2 off 36in. \times 16in. \times $\frac{1}{4}$ in. hardboard
 Fix sheets to frame with 1in. countersunk woodscrews, screwed from inside. Drill small hole at centre of rear sheet for speaker wires.

Material:
 8 off 34 $\frac{1}{2}$ in. \times $\frac{7}{8}$ in. \times $\frac{7}{8}$ in. pine (verticals)
 4 off 25 $\frac{3}{4}$ in. \times $\frac{7}{8}$ in. \times $\frac{7}{8}$ in. pine
 1 off 24in. \times $\frac{7}{8}$ in. \times $\frac{7}{8}$ in. pine
 ($\frac{7}{8}$ in. \times $\frac{7}{8}$ in. bought as nominal 1in. \times 1in. pine)
 A = 7 $\frac{9}{16}$ in., B = 7 $\frac{1}{2}$ in., C = 16in.
 Fix joints with 1 $\frac{1}{2}$ in. countersunk woodscrews.

Material:
 2 off 36in. \times 25 $\frac{3}{4}$ in. \times $\frac{1}{4}$ in. hardboard
 2 off 36in. \times 17 $\frac{3}{4}$ in. \times $\frac{1}{4}$ in. hardboard
 1 off 14in. \times 1 $\frac{1}{2}$ in. \times $\frac{1}{4}$ in. wood or hardboard (S)
 Fix sheets to frame with 1in. countersunk woodscrews (steel preferred—see text), screwed from outside. Glue strip S over joint at top of speaker mounting board to make airtight.

Material: as Top section

Fig. 2: Construction details of loudspeaker enclosures.

Mount the woofer, tweeter and crossover, and connect them as shown in Fig. 4. This is a convenient stage at which to start running the speaker since the sound vibration will help shake down the sand. For the woofer the manufacturer recommends a 'running in' period at less than full power. The sound quality will not be good until the damping material is fitted as follows.

Obtain some large corrugated fibre (not plastic) egg-crates such as most grocers throw away. Glue these over the whole inside area of the enclosure including the top and bottom pieces, but not the speaker mounting board. Allow plenty of ventilation as the glue vapour might possibly be harmful to the woofer. The egg-crate alone provides some acoustic damping but it serves mainly to space the carpet felt away from the inner walls. This felt should be the

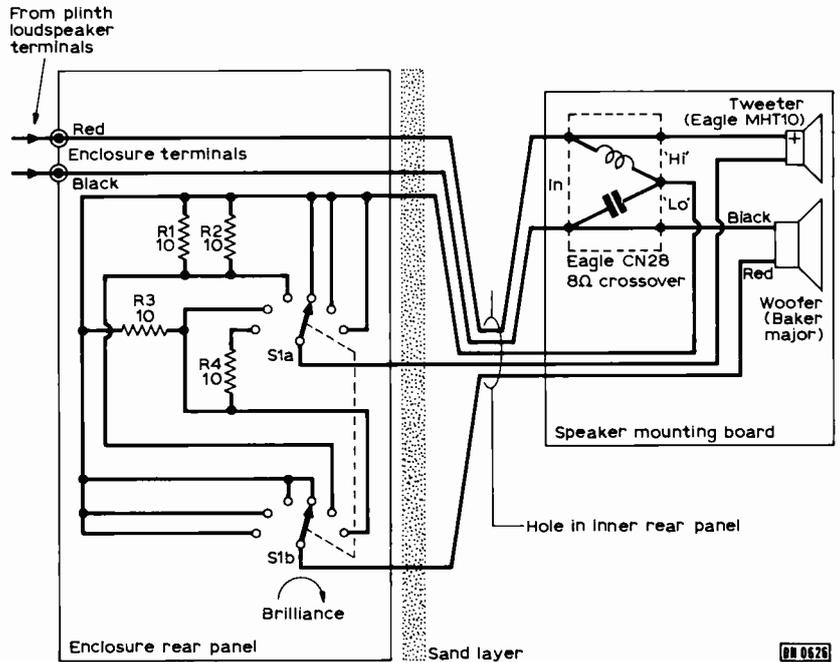
heaviest grade obtainable and most carpet dealers will have suitable offcuts. A single piece can be used for the whole enclosure apart from the top piece. Fix the felt in place by tacking down the edges all round so the egg-crate volume is sealed off.

Again check the fit of the top and bottom pieces for airtightness. The danger here is that the weight of the sand may have warped the frame. If necessary a thin strip of expanded polystyrene or draught excluder can be used to pack any gaps. Once airtightness is ensured the enclosure is functionally complete.

The author decided to cover as much as possible of the enclosure with Tygan loudspeaker fret (maroon/gold pattern). A 36in×54in. piece of this is enough to cover the whole of the front and part of the sides. This is cut into three pieces and glued to the panels

continued on p 911

Fig. 3: Theoretical diagram showing loudspeaker enclosure circuitry.



DN 0626

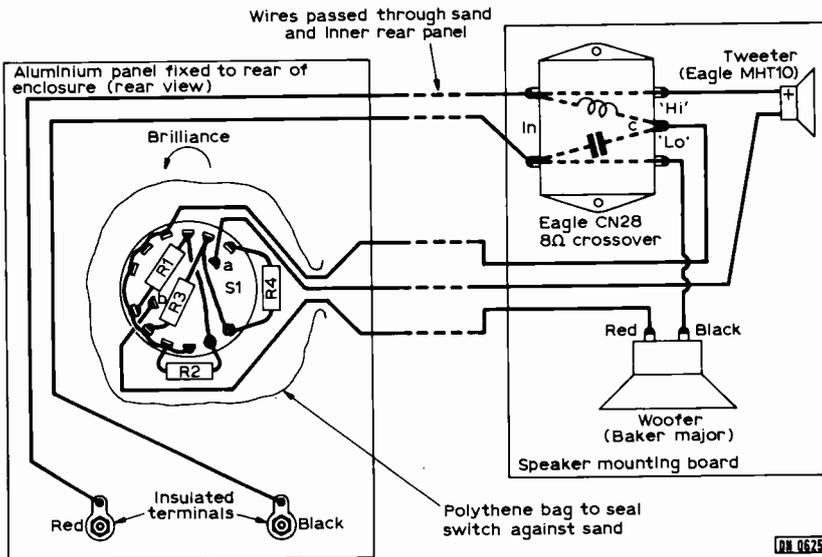


Fig. 4: Wiring details of each loudspeaker enclosure. Observe polarity of woofer and tweeter connections for correct phasing.

DN 0625

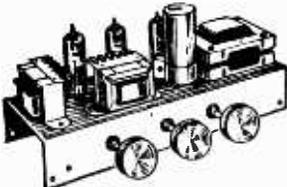
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts into 8 ohm. Frequency response 12Hz-30KHz \pm 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, ecutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7 1/2" deep. AC 200/250V. PRICE \pounds 10-50. P. & P. 25p.

r.m.s. into 8 ohm. Frequency response 12Hz-30KHz \pm 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, ecutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7 1/2" deep. AC 200/250V. PRICE \pounds 10-50. P. & P. 25p.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 V. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 x ECL86 Triode Pentodes, 1 x E280 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 8 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" x 4". Overall height including valves 5". Ready built & tested to a high standard. PRICE \pounds 28-92 P. & P. 45p.

Valve line up:—2 x ECL86 Triode Pentodes, 1 x E280 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 8 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" x 4". Overall height including valves 5". Ready built & tested to a high standard. PRICE \pounds 28-92 P. & P. 45p.

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SOMOTONE 9TACH COMPATIBLE STEREO CARTRIDGE
T/O stylus Diamond Stereo LP and Sapphire 78. ONLY \pounds 2-50 P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. \pounds 3. P. & P. 10p.

LATEST BOWETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. \pounds 1-68 P. & P. 10p.
LATEST BOWETTE T/O MONO COMPATIBLE CARTRIDGE for mono EP/LP/78 mono or stereo records on mono equipment. Only \pounds 1-50 P. & P. 10p.

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Circuit motor board size 14 1/2 x 12in. clearance 2in. below, 5 1/2 in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 x 15 x 8in. PRICE \pounds 4-75. P. & P. 60p.

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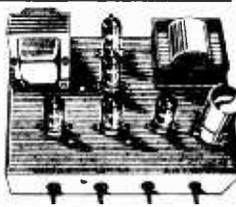
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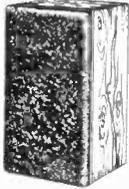
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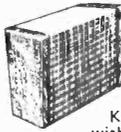
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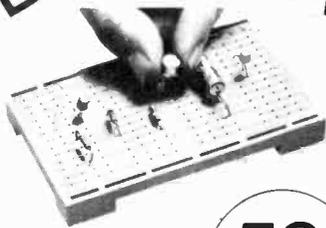
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separately in such a way that the screws are just accessible, so that the panels can be removed occasionally to top up the sand. All other visible parts of the enclosure are covered with teak veneer. Fig. 5 shows how teak strips and standard corner moulding (itself covered with matching fret) are used to hide the screws at the sides and the join between front and sides respectively. These additions are held lightly in place by dabs of glue so they can be removed easily when required.

During the first month or so of use the sand will shake down and require topping up. This can be done without removing any vertical panels if $\frac{1}{4}$ in. diameter holes are drilled through the frame at the top of each sand compartment.

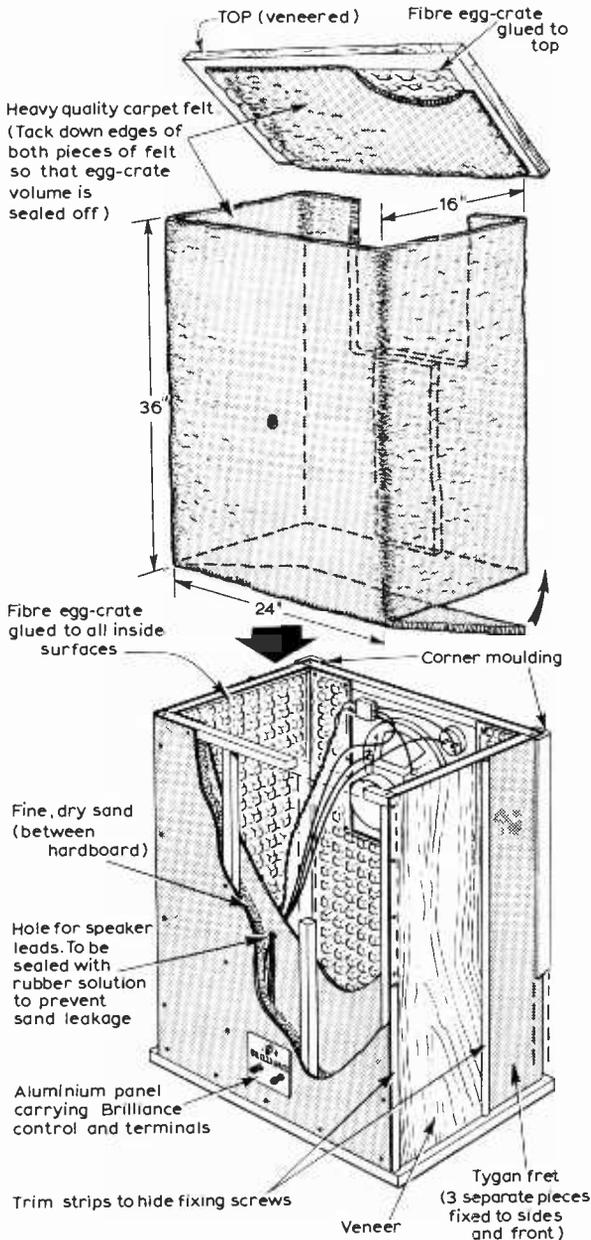
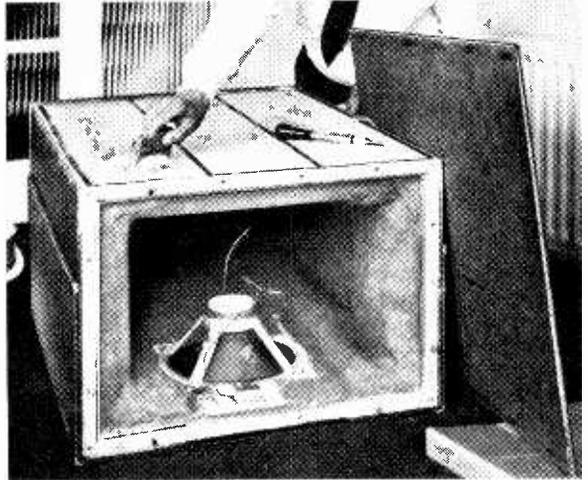


Fig. 5: Cutaway rear view of loudspeaker enclosure showing damping and external finish arrangements.

Crossover

The enclosure circuit is shown in Fig. 3. With the brilliance switch S1 in the position drawn the coil and capacitor in the ready-made crossover unit divide the incoming signal so that high frequencies pass to the tweeter and low frequencies to the woofer. The separation is not abrupt but occurs progressively above and below about 3kHz. The two frequency ranges combine again in the listener's ear so that nothing unusual should be heard. The advantage of a two-way speaker system such as this is that there is less of the intermodulation distortion which arises when a single speaker is asked to reproduce high and low frequencies simultaneously.



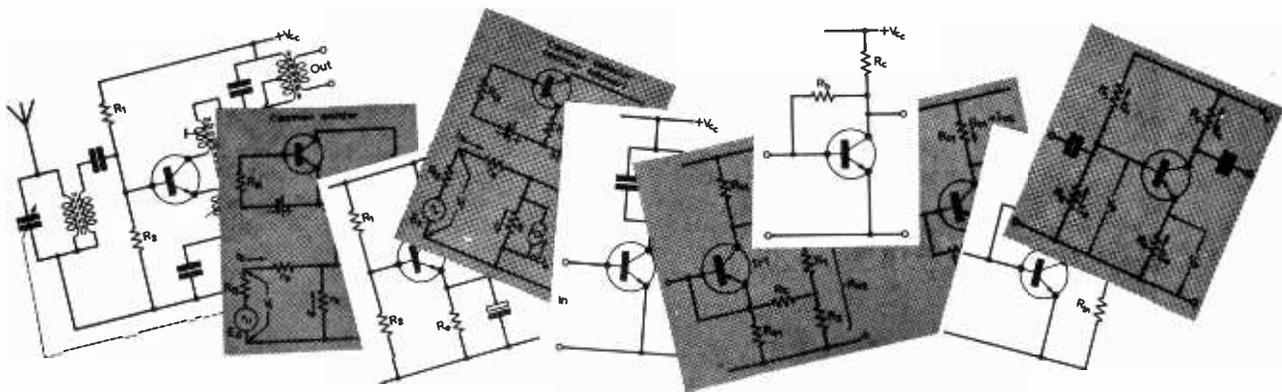
Photograph shows sand filling of a loudspeaker enclosure in progress.

Brilliance Control

The sound heard by the listener will only be satisfactory if the sound levels from the woofer and tweeter are correctly related. Several things can upset this, such as the two units having different efficiencies, the fact that the tweeter is more directional than the woofer so that the listener's position is important, and the acoustics of the room. The enclosures are therefore fitted with brilliance controls which vary the relative sound volumes from the woofer and tweeter. The subjective effect of these controls and their optimum setting for a particular room is usually quickly found. If retarded too much the sound is mellow and poorly located, if advanced too far the sound has excessive 'presence' and may seem harsh. Independent adjustment of these controls may improve the stereo 'spread' obtainable with speaker positioning which is not ideally symmetrical but dictated by the shape of the room.

It may be argued that the brilliance control must upset the action of the crossover whose component values are calculated for 8 ohm speaker loads, since it works by inserting resistance in series with the speakers. However listening tests indicated there was nothing to be gained by using a more theoretically correct version which would maintain correct matching but need many more components.

Constructional details follow for the plinth next month.



TRANSISTOR CIRCUITRY for beginners

PART 5

H.W. HELLYER & MICHAEL HOLLIER

Circuit Building

Meet Mike. This month, a practical exercise in circuit building, from scratch. My friend and colleague, M. E. Hollier, is an ardent home constructor, and a gifted designer—the sort of chap who pursues a problem to the roots, even to the extent of making his own printed circuits by the photo-resist method. He has compromised to some extent this month, for our benefit, by designing and building the buffer to be described on easily obtainable Veroboard. The device is a high-to-low impedance converter. It can be used to overcome many of those difficult matching problems.

Our brief was to make transistor circuitry clear for the beginner and to be helpful to the more advanced reader. You may be surprised: I have among my correspondents an aircraft fitter who has built an electronic organ in his front room, currently valued at over seven hundred pounds, and a Ph.D. who cannot usefully wield a soldering iron. We must, as our Editor commented in his personal piece a couple of months ago, cast our nets as widely as possible.

To comply with this brief, Mike has torn a few basic circuits to bits, showing what makes them tick. This means that we shall, to some extent, be repeating some of the data I have already expounded: but repetition of salient points helps to fix them in the mind, so I'll make no excuses for that.

After digging a little into the theory, we shall construct the practical circuit, and make this the basis for future designs. The article concludes with some measurements of the constructed device, as much to illustrate the sort of deviations from pure theory that the constructor must learn to expect as to prove that the darn thing really works!

Silicon Planar Epitaxial Transistors

The most modern development in audio bipolar transistors is the silicon planar epitaxial device. We

touched briefly on these in Part 2, underlined their use in Part 3, and now come to the practical problem of using them.

Some possible troubles have been anticipated by the makers. Silicon planar epitaxial transistors such as the BC108 and BC109 that we shall be using this month, have their surfaces protected by a layer of silicon oxide which prevents contamination—which would alter the characteristics.

From the design viewpoint, working with such transistors is made easier because their collector leakage current is almost negligible. Moreover, they are easily obtainable—everybody seems to make a BC109! More about minor differences later.

Parameters

In previous articles, and in the wallchart, a choice of several parameters was given. No, let's be precise—a choice between ways of expressing transistor parameters. Our choice is determined by convenience as much as by an academic ache for accuracy. So we use, this month, the 'h' or hybrid parameter.

Hybrid, in this context, means that the symbols

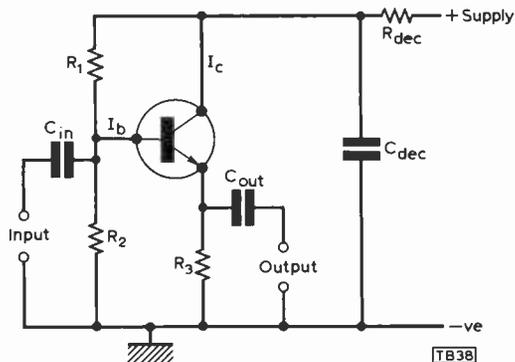


Fig. 20 : Basic single stage circuit. Emitter-follower configuration.

represent a mixture of ratios, impedances and admittance values. (Admittance is impedance upside-down; its reciprocal.)

We use the lower case 'h' as our parameter indicator, and the two subscripts after it indicate either d.c. or large-signal measurements. For example: h_{FE} , or, small-signal, h_{fe} . These will be explained as we need to use them.

In Fig. 20, we see an emitter follower circuit that we have met before. The emitter follower is so called because the input to the stage that comes after it FOLLOWS the emitter of the stage. Alternatively, we could call this a common collector circuit; the collector is common to both input and output signals.

The output signal is taken from C_{out} , the live side with reference to the signal. The input is between the C_{in} live side and the collector. Hence, common collector. But while the earthy side of the input terminals is quite obviously connected to the negative line, we have to remember that the decoupling capacitor, C_{dec} , presents almost a short-circuit to the frequencies we are working with. The collector line is therefore virtually connected to the earth line so far as alternating currents are concerned. Our signal is a.c.: ergo, the collector is common.

Input Impedance

One of the constant bothers is the calculation of input impedance. It seems at first alarming, even when, as in Fig. 20, we know the component values. So we begin, as in Fig. 21, by breaking it down to fundamentals, taking the transistor with its internal resistances, r_b and r_e .

The input resistance of the transistor, looking into the base, in this grounded emitter configuration, is h_{ie} . H parameters again, but h_{ie} simply means input resistance, common emitter mode. Sometimes, we can get this easily from maker's data and there may be a graph so that h_{ie} can be plotted against collector current, I_c . Then the input resistance of the transistor can quickly be found.

If this graphical information is not immediately available, we must have recourse to a bit of simple arithmetic. The internal resistance, r_e , and h_{fe} , the small signal current gain, are what we need at first.

Whereas h_{fe} will almost invariably be specified, r_e and r_b may not. We can take r_e as around 25 ohms in a planar transistor where the collector current is about 1mA. From the known facts we obtain the formula,

$$h_{ie} = \frac{25 \text{ ohms}}{I_c \text{ (mA)}} \times h_{fe}$$

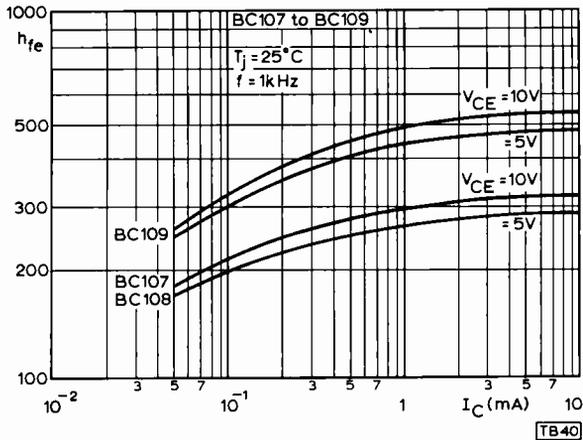
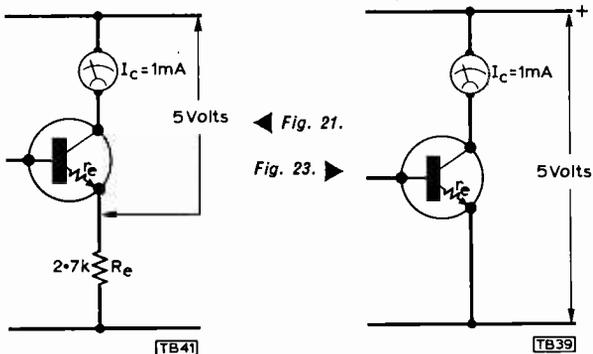


Fig. 22: Typical variation of input impedance and small signal forward current transfer ratio with collector current.

r_b is so small in relation to the result of this formula that it can be ignored for all practical purposes.

If we take a practical example (see Fig. 21), for a BC109 operating at a collector current of 1mA, the voltage between collector and emitter (V_{CE}) being 5 volts. From the data sheet (see Fig. 22) we find that the h_{fe} is 440. Putting this into the above formula, we now have:

$$\begin{aligned} h_{ie} &= \frac{25}{1} \times 440 \\ &= 11,000 \text{ (11k } \Omega \text{ input resistance).} \end{aligned}$$

External R_e

The presence of an emitter resistor in the circuit of Fig. 21 alters the calculations. If we now look at Fig. 23 we see that the voltage reading is still across collector/emitter, but as R_e is not bypassed, the input impedance will increase by an amount equal to the resistive value of R_e , multiplied by h_{fe} . From this, we can construct a formula for input impedance, R_{in} . Since we now have a component external to the transistor, h_{ie} can no longer be applied to this value of input impedance.

Let us take R_e to be 2.7kΩ. Now we get:—

$$\begin{aligned} R_{in} &= (R_e \times h_{fe}) + h_{ie} \\ &= (2,700 \times 440) + 11,000 \\ &= 1188k\Omega + 11k\Omega \\ &= 1.2M\Omega \end{aligned}$$

The input impedance can be increased by the addition of an unbypassed emitter resistor.

Base Bias

Now we develop the circuit by adding base bias resistors R_1 and R_2 in Fig. 24, and a few more voltages have to be considered. Take a collector current of 1mA. Since the base current is very small, we can say the emitter current—for practical purposes—is the same.

So 1mA through the emitter resistor, R_e , which is 2.7kΩ, gives us a volts drop of 2.7V. This is the emitter voltage. To work out the required supply voltage, we take the voltage across the transistor.

V_{CE} and add to it the 2.7 volts across R_E . Answer: 7.7V.

There is an irreducible voltage between base and emitter of a transistor and in the case of silicon transistors, this is generally 0.6V. Simple addition gives us a base voltage of $0.6 + 2.7 = 3.3$ volts. The base to collector voltage must therefore be $7.7 - 3.3 = 4.4$ volts.

In this form of potential divider biasing, to maintain stabilisation of the circuit, it is normal to have five times as much current flowing through the biasing resistors as the base current of the transistor.

The base current, I_B , is found from the formula

$$I_B = \frac{I_C}{H_{FE}}$$

where H_{FE} is the d.c. current gain of the transistor.

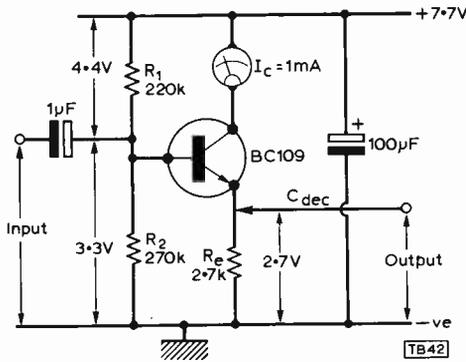


Fig. 24 : The final circuit. Component values are worked out and explained in the text.

For the BC109, with an I_C of 1mA, this is typically 380.

$$\text{So } I_B = \frac{1\text{mA}}{380} = 2.6 \text{ microamps.}$$

Taking a value of five times this we get 13 microamps. So the voltage drop across R_2 is 3.3V, the current 13 microamps and the ohmic value of R_2 must be:—

$$\frac{3.3}{0.000013} \text{ or } \frac{3.3 \times 10^6}{13} = 254\text{k}\Omega.$$

The nearest preferred value resistor would be 270k Ω . A 5% component will do.

A different condition obtains with R_1 , which has the base current of the transistor flowing through it as well as the $5 \times I_B$ which flows through R_2 . So we have a total current of six times I_B . The formula for R_1 is:—

$$R_1 = \frac{4.4}{0.0000156} = \frac{44 \times 10^6}{156} = 211\text{k}\Omega$$

The nearest preferred value is 220k Ω , at 5%.

Stage Resistance

Now that we have the component values, we can calculate stage resistance. Input resistance is what we are interested in here. Remember that as far as

alternating currents are concerned, the top end of R_1 is joined to the lower end of R_2 by the very low impedance of C_{dec} . So the input resistance is effectively R_1 , R_2 and R_{in} , all in parallel. Again applying Ohm's Law:—

$$\begin{aligned} \frac{1}{R_{IN}} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_{in}} \\ &= \frac{1}{220\text{k}\Omega} + \frac{1}{270\text{k}\Omega} + \frac{1}{1.2\text{M}\Omega} \\ &= 110\text{k}\Omega \end{aligned}$$

Output resistance is calculated from a combination of R_E , the total input resistance of the transistor and r_e .

Total input resistance presented to the base of the transistor is the parallel combination of R_1 , R_2 and the output impedance of the device which is feeding the input of our considered circuit. The effect of this lumped resistance (R_s) on the emitter circuit is reduced by the h_{fe} of the transistor, i.e. the lumped resistance is divided by h_{fe} .

If the source resistance is one-fifth of R_{IN} , say 20k Ω , then R_s is R_1 , R_2 and the external source resistance, all in parallel, or

$$\begin{aligned} \frac{1}{R_s} &= \frac{1}{220\text{k}\Omega} + \frac{1}{270\text{k}\Omega} + \frac{1}{20\text{k}\Omega} \\ &= 17.2\text{k}\Omega. \end{aligned}$$

This resistance when looked at by the emitter seems smaller, due to h_{fe} :—

$$\frac{R_s}{h_{fe}} = \frac{17.2\text{k}}{440} = 39 \text{ ohms.}$$

This is in parallel with R_E and any external load. If we consider an external load of a minimum value of 20k Ω (and these 'taken' values, throughout, are not just dreamed up; they are 'from life'), then the minimum output resistance would be:—

$$\begin{aligned} \frac{1}{R_{out}(\text{min})} &= \frac{1}{39} + \frac{1}{2.7\text{k}\Omega} + \frac{1}{20\text{k}\Omega} \\ &= 38.2 \text{ ohms.} \end{aligned}$$

In other words, for an input of 100k Ω , our stage has given us an impedance reduction of around 2,500:1.

Coupling Capacitors

A stumbling block to many would-be circuit designers. . . . the value of the capacitor which joins two stages is very important and must be calculated in the following way for optimum performance.

This input capacitor, C_{in} , must have a reactance that is small in relation to the input resistance of the stage, at the lowest frequency we want the stage to handle.

Taking a practical example, if C_{in} was made 0.02 μf , its reactance at little under a 100Hz would be 100k Ω . Since this is the same as the input resistance of the stage, which we have already worked out, a 2:1 attenuator would be formed at the critical frequency, actually 90Hz. In fact, the voltage drop would be 6dB, around half this would fall with decreasing frequency at the rate of 6dB per octave.

If we made C_{out} as low as 0.02 μf and then fed our



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emitter follower into a 100kΩ input, we would have a 12dB drop at the critical frequency with a falling off equal to 12dB per octave.

Normally, with a circuit of this type, acting simply as a buffer, the low-frequency roll-off will have been determined by associated circuitry.

A value of $C_{in}=1\mu\text{f}$ and $C_{out} 10\mu\text{f}$ are adequate down to a few hertz, even if the load into which the circuit is feeding is as low as 20kΩ.

The load on the circuit should be at least 5 times greater than the output impedance: preferably, ten times.

Decoupling Components

We must consider the practical matter of the available supply voltage and what we have calculated as being desirable. For convenience, a 9-volt battery will do. This could be a PP6, for the current being drawn by this device does not demand a battery of large capacity.

Our circuit calls for a supply voltage of 7.7 volts, so the difference will have to be dropped by a resistor, R_{dec} . The current flowing through this resistor will be the collector current, I_c , which is 1mA, plus the $6 \times I_B$ current in the base bias network. This gives us a total current of 1.0156mA, not significantly far from 1mA to matter.

So, again having recourse to Ohm's Law, we say that:—

$$R_{dec} = \frac{1.3}{1 \times 10^{-3}} = 1,300 \text{ or } 1.3\text{k}\Omega.$$

For our purpose, 1.2kΩ at 5% is enough, but it so happens that 1.3kΩ is a standard value in the E24 resistor series, so if you have one of these available, so much the better.

The decoupling capacitor has to have a low reactance for us to maintain good low frequency response. Another function C_{dec} performs is to bypass any signal currents which may have crept into the supply line from other sections of circuitry. A value ten times greater than C_{out} is desirable.

From this, without further calculation, we make $C_{dec} 100\mu\text{f}$. This gives us a reactance at 20Hz of around 80ohms, which will be quite small in comparison with the minimum a.c. load on the circuit of 20kΩ.

Construction

Fig. 25 should be self-explanatory. Mike chose Veroboard, cutting a portion of a group board to make a 13-way section. This type of board has three copper strips at each outer line, leaving the centre clear. Holes can be cleared with a No. 33 drill (6BA clearance), and relating to the grid of our Fig. 25 holes are first drilled at 2F and 12F for mounting. Next stage is to fit the links, 3B to 4B and 4B to 6B, going around 5B. Link 7B to 8B, and 7B to 6I, using sleeved wire, and the same for 5B to 10B. Link 4I to 5I and 5I to 8I and 9I.

Battery connections are red, positive, to 7J and black, negative, to 5J. Input lead, 'live', 3J with the earthy braid to 4J; output live to 10J, earthy braid to 9J. Finally the BC109 transistor, which should be fitted as shown, to 5A (emitter), 6A (base), and 7A (collector). Components are mounted as shown.

Results

Measurements on the prototype built from this circuit gave an output of 1.85 volts r.m.s. at the onset of clipping. This is equivalent to 2.6 volts peak, the measured emitter voltage on the prototype. A glance at the circuit shows that the emitter voltage, when driven by a sine wave, can swing down to the negative line. This represents a peak negative swing of 2.7 volts.

The positive swing, however, can push the emitter voltage up near collector voltage of 7.7 volts, a peak swing of 5 volts. Since this circuit would only be called upon to handle a few hundred millivolts, this unbalance is only academic—but the point is worth making.

Input impedance measured 105kΩ, output impedance 78.5 ohms with 20kΩ source. Deviations from the calculated value can easily occur due to the spreads in h_{fe} . For example: the h_{fe} spread for a BC109 operating at a collector current of 1mA is from 240 to 960, a ratio of very nearly four to one. Frequency response was within 0.1dB of reference (1kHz) from 10Hz to 100kHz.

The upper limit frequency will be determined by the source resistance of the device being fed into our circuit, and the capacity of the interconnecting cables.

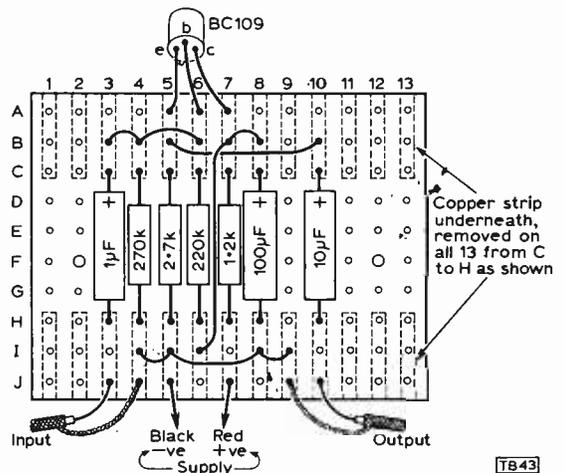


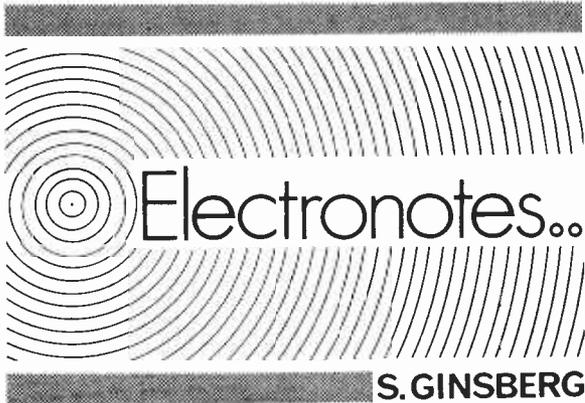
Fig. 25 : Practical layout using 0.15in. matrix Veroboard. Approximately to scale.

Gain, between input and output, is less than unity, a measured 0.98. The object of the exercise is not to get gain but to convert impedances—very often, when doing this, one is also concerned to attenuate, but this is done externally.

Total harmonic distortion is almost too low for measurement with normal workshop instruments. In fact, the figures were as follows:—

Output level	20Hz	1kHz	20kHz
300mV	0.008 %	0.007 %	0.005 %
500mV		0.01 %	
750mV		0.06 %	
1V		0.08 %	

TO BE CONTINUED



Electronotes..

S. GINSBERG

It seems that there are very few areas where electronics has not penetrated in one way or another. The automobile industry is a natural market for electronics but it seems to be slow in getting off the ground. The home constructor and "amateur" has not been slow to appreciate the benefits, however, and items like windscreen wiper speed controls have appeared in the popular construction journals. For the do-it-yourself man there is a good opportunity to get electronics into his car and to increase the comfort and efficiency. Transistorised ignition is one example and one company, Transmetrix (Research & Development) Ltd., have just launched a tiny transistorised ignition unit which sells for just over £10. It was tested, along with those from other manufacturers, by a leading motor magazine and came out number one. At this sort of price, one wonders how long it will be before the motor car manufacturer fits transistorised ignition as a standard or at least an available option on all models.

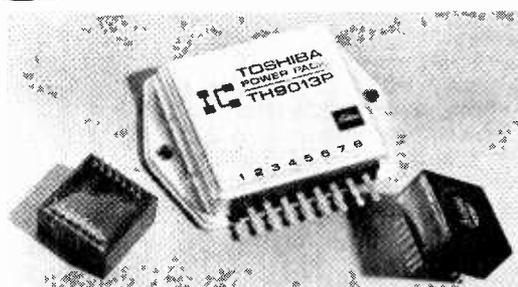
Another thing which has a great deal to offer is thick film technology but again it is a thing which has been slow to catch on. Thick film circuitry is achieved by taking an insulating substrate and printing the wiring pattern on it with a special conducting ink using silk screen printing techniques. The circuit is then put on a belt which passes through a special oven which fuses the ink and bakes it.

The inks are composed mainly of glass together with a conductive element. By reducing the amount of conductive material in the ink, the pattern will have a greater and greater resistance dependent upon the amount of conductive material remaining. Thus resistors can be "printed" down in the same way as the wiring. Usually, these resistors have a tolerance of around 15%—good enough for some circuits.

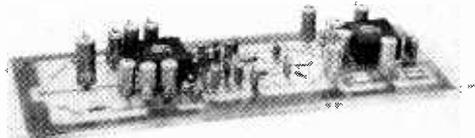
For closer tolerance, down below 1 per cent for example, the circuit is put in a jig and probes measure the actual value of resistance. This is fed to a circuit which compares this actual resistance against the value required. A jet of air plus an abrasive is then fired at the resistor through a tiny nozzle. This erodes away tiny parts of the resistor pattern, gradually reducing the resistance value. When the actual value reaches the required value set up on the resistance bridge, the air/abrasive is automatically switched off.

Capacitors, transistors and integrated circuits may be bonded onto the thick film substrate once the initial pattern has been laid down. By laying down an insulating layer, another pattern may be printed over the top of the first and thus a multilayer circuit can be built up.

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

Buy British

I recently asked at a local radio shop for an OC44 transistor and was offered one marked "Mullard, Foreign Made" and when I asked the price I was told it would be 70p. When I protested at the price I was informed that others I said I could obtain cheaper could only be "seconds".

I tried another radio shop a few miles away and obtained an OC44 marked "Mullard, British Made" for 41p, which the dealer assured me was the correct price according to his list.

Since then, I have had occasion to purchase a volume control, tone control/switch for a well-known continental radio and the price in this case was £1.90 plus 10p purchase tax. A comparable British-made component would certainly not have been more than 50p and apart from this, the printed circuit was in my opinion inferior in workmanship to many Hong Kong made sets costing a fraction of the price this one did.

—R. J. Hall (Penzance, Cornwall).

purpose and I do know they were tried on me with this intention.

Whether they worked or not is obscured by other issues—but none of the people using them had any radio knowledge at all and I am wondering how many of their claims belong to the realm of legends.

I am aware that some years ago, there were reports of odd individuals who claimed that they could receive BBC transmissions without receiving apparatus, but whether such claims have been substantiated, I do not know.

If however, telemetering is a reality, would anyone be kind enough to give me in brief, the principles on which it is accomplished?

I am highly suspicious about claims that I have heard made: particularly since the accepted sense of the word "telemetering" is in connection with recording instruments being read at a distance.—V. D. Butler (Kirkstall Hill, Leeds).

has been unmarked or otherwise of surplus origin, and in several cases your name has been mentioned as the supplier. In addition the diagram I saw shows D5 connected in reverse.

It is imperative that any modification to a car ignition system be as reliable as possible since sudden failure could, in certain circumstances, cause an accident situation. For this reason I must condemn the use of unmarked or otherwise low grade components.

Unfortunately many constructors have become disillusioned with the results and have laid the blame at my door saying that it is a design fault. This has caused me a lot of unnecessary work and expense in replying to this type of complaint, and has delayed the writing of a follow up article since I feel I must in future recommend specific types and sources of all components.

Yours faithfully,
S. Soar."

Ignition!

This is a copy of a letter sent to one of our advertisers by Mr. S. Soar, author of the Electronic Ignition article published in P.W. June 1971. We do not feel that any further comment by us is needed.—Editor.

"Dear Sirs,

With reference to the electronic ignition article, I have one or two comments which I would like to raise.

As the author of the original article I have received several hundreds of letters from constructors, in the main these have been very encouraging and I estimate that the unit has now covered an aggregate distance in excess of one million miles.

However, several constructors writing to me have been disappointed with the results, and in general they fall into two categories, circuit construction faults and component failure, the latter accounting for something like 90 per cent of all problems encountered. In almost every case of component failure or malfunction the component in question

WHO MAKES WHAT?

In the October 1971 issue, the Editor expressed his concern at the winding up of the Merchandise Marks Act as from November 30th last, after which it was no longer obligatory for imported goods to bear a "country of origin" mark. One aspect of concern was the fact that some goods bearing well-established UK trade names are, in fact, made in low-cost labour countries and that after the ending of the Act there would be no way of telling where, the goods were actually manufactured.

While it appears that there is little hope of reversing the decision to end the Act, one ray of hope is that the Government is likely to support a Private Member's Bill which will provide that if a UK company's name or trade mark or any UK place name appears on imported goods it will have to be accompanied by a statement of where the goods were actually made.

All in the mind

I would be grateful if anyone could assist me in a little private research. What I need is an authoritative assertion or denial as to whether it is possible by the use of radio equipment to transmit any messages that can be received by people without any receiving equipment at all. In other words, can messages be transmitted directly to a person's mind?

I have heard this claimed on several occasions—the first time being from a Gendarmee Commissionier in France in 1946 and although he was a learned man, he was not familiar with radio technology. From that time, I had heard nothing more about it until three years ago.

In a district I left two years ago, a great deal of talk centred around this subject under the name of "telemetering" and I do know that a number of people had radio transmitters which they claimed they were using for this

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AC188	25p			OC43	50p	2N2218	20p
ACY17	30p	BF115	25p	OC44	15p	2N2218A	
ACY18	25p	BF154	20p	OC45	12p	2N2219	20p
ACY19	25p	BF158	15p	OC70	12p	2N2221	20p
ACY20	20p	BF159	35p	OC71	15p	2N2221A	
ACY21	20p	BF180	35p	OC72	25p	2N2222	20p
ACY22	10p	BF194	15p	OC75	25p	2N2222	25p
ACY39	55p	BF195	15p	OC76	25p	2N2221	20p
ACY40	20p	BF196	15p	OC77	40p	2N2221A	
ACY41	15p	BF197	15p	OC81	20p	2N2222	20p
ACY44	25p	BFX13	25p	OC81D	20p	2N2222	20p
AD140	50p	BFX12	25p	OC82	20p	2N2222	20p
AD145	50p	BFX30	25p	OC83	25p	2N2222	20p
AD161	35p	BFX84	25p	OC84	25p	2N2369	15p
AD162	35p	BFX85	30p	OC139	25p	2N2369A	
AF114	25p	BFX86	25p	OC140	40p	2N2646	40p
AF115	25p	BFX87	25p	OC170	25p	2N2904	20p
AF116	25p	BFX88	20p	OC171	30p	2N2904	20p
AF117	20p	BFY18	25p	OC172	40p	2N2905	25p
AF118	60p	BFY51	20p	OC201	70p	2N2905A	
AF124	25p	BFY52	20p	OC202	80p	2N2906	20p
AF125	20p	BFY53	15p	OC206	95p	2N2906A	
AF126	20p	BFY90	65p	OC207	97p	2N2906A	
AF127	30p	BFY90	65p	OC207	97p	2N2906A	
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AF185	50p	BST95A	15p	ST11	15p	2N2907A	
AF186	40p	BST95A	15p	ST11	15p	2N2907A	
AF239	40p	BU105	22.25p	TIP30A	60p	2N2925	15p
AS726	25p	BY100	15p	TIP31A	60p	2N2926	15p
AS727	30p	BY126	12p	TIP32A	70p	2N3011	20p
AS728	25p	BY124	15p	TIP33A	20p	2N3053	50p
AS729	20p	BY125	15p	TIP33A	20p	2N3053	50p
AS721	55p	BY210	85p	TIP34	£1.00	2N3055	70p
BA100	15p	BY211	30p	TIP34	£1.00	2N3525	
BA102	30p	BY212	30p	TI843	40p	£1.00	
BA110	25p	BY213	25p	TI850	12p	2N3614	55p
BA115	7p	BZV78L1	0p	TI851	10p	2N3702	10p
BA131	5p	GET102	35p	TI852	10p	2N3703	10p
BA136	7p	GET103	25p	TI860	18p	2N3704	12p
BA137	7p	GET111	45p	TI861	20p	2N3705	10p
BA138	15p	GET113	25p	TI862	25p	2N3707	12p
BC107	10p	GET114	20p	V405A	25p	2N3708	10p
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BC149	12p	MJE371	80p	IN916	10p	2N3903	20p
BC153	20p	MJE520	75p	IN4148	7p	2N3906	25p
BC154	20p	MJE521	70p	IN844	7p	2N4058	12p
BC167	15p	MJE2855		IR821	7p	2N4061	12p
BC169	12p		£1.10	IR822	8p	2N4062	12p
BC169C	12p	MJE3051		2G301	25p	2N4289	15p
BC177	20p		75p	2G302	30p	2N4290	12p
BC178	20p	MPC806	25p	2G303	35p	2N4871	35p
BC179	20p	MPC806	25p	2N404	20p	2N5457	30p
BC182L	10p	MPC870	15p	2N696	15p	2N5458	30p
BC183L	10p	MPC806	25p	2N697	15p	2N5459	40p
BC184L	12p	MPC806	25p	2N698	30p	40250	50p
BC212L	12p	NKT214	20p	2N706	10p	40380	40p
BC213L	12p	NKT216	35p	2N706A	12p	40381	40p
BC214L	15p	NKT403	75p	2N708	15p	40382	50p
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7440	Dual 4-input NAND buffer gates	20p	18p	16p	14p	12p
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7442	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7443	Excess 3-Decimal decoder TTL outputs	£1.00	95p	90p	80p	70p
7447	BCD-Decimal 7 seg. decoder/indicator driver	£1.75	£1.60	£1.45	£1.30	£1.15
7448	BCD-Decimal 7 seg. decoder/indicator TTL O/P	£1.75	£1.60	£1.45	£1.30	£1.15
7450	Expand dual 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
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7460	Dual 4-input expanders	20p	18p	16p	14p	12p
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7492	Divide twelve counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	75p	70p	65p	60p	55p
7494	Dual entry 4-bit shift register	80p	75p	70p	65p	60p
7498	5-bit parallel/serial in/out shift register	£1.00	95p	90p	80p	70p
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74118	Hexuple Set-Reset latches	£1.00	95p	90p	80p	70p
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74141	BCD-Decimal decoder/Nixie driver	£1.00	95p	90p	80p	70p
74145	BCD-Decimal decoder (1-4 line) TTL O/P	£1.50	£1.40	£1.30	£1.10	£1.00
74151	16-bit data selector/multiplexer	£2.00	£1.75	£1.55	£1.30	£1.05
74153	Dual 4-line to 1-line data selector/multiplexer	£1.35	£1.27	£1.20	£1.15	£1.10
74154	16-bit decoder/demultiplexer	£2.00	£1.75	£1.55	£1.30	£1.05
74155	Dual 2-line to 4-line decoder/demultiplexer	£1.55	£1.47	£1.35	£1.10	£1.05
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74180	Sync decade up-down counter, 1-line mode	£1.95	£1.85	£1.75	£1.60	£1.50
74181	Sync 4-bit up-down counter, 1-line mode	£1.95	£1.85	£1.75	£1.60	£1.50
74182	Sync decade up-down counter, 2-line mode	£2.00	£1.90	£1.80	£1.65	£1.55
74183	Sync 4-bit up-down counter, 2-line mode	£2.00	£1.90	£1.80	£1.60	£1.40
74196	Asynchronous presettable decade counter	£1.50	£1.40	£1.30	£1.10	£1.00
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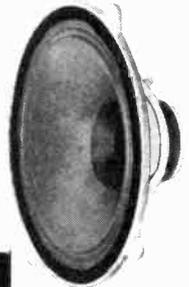
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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

NEW ZEALAND is one of the countries that can only be heard for a few months in each year.

The transmitter power is only 7.5kW and the aerials are beamed to Australia and the Pacific Islands. Propagation conditions only allow reception in this country in the last few months of the year and possibly in January as well.

Our first reporter this month is **David Watters** of Edinburgh. The equipment consists of an old Philips domestic superhet and a six foot whip antenna fixed on the roof. David's reports of Radio New Zealand should prove useful to all those trying to catch this rare country.

- 6010 *R.T. Belge*, Belgium in Dutch at 1430.
- 7105 *CBC, Canada* in Russian at 0330.
- 9520 *New Zealand* in English at 0900.
- 9525 *RSA, South Africa* in English at 0500.
- 9540 *New Zealand* in English at 0600.
- 9550 *Finland* in English at 1800.
- 9560 *ABC, Australia* in English at 0645.
- 9625 *CBC, Canada* in English at 0715.
- 9755 *New Zealand* in English at 1700.

Jean A. Meghriche of Elstree has again concentrated on the 60 metre band and produced the following results:—

- 4920 *R. Caracas, Venezuela* at 0620.
- 4945 *R. Colosal, Colombia* at 0610.
- 4955 *R. Nacional, Colombia, s/off* at 0505.
- 4965 *R. Santa Fe, Colombia* at 0605.
- 4970 *R. Rumbos, Venezuela* at 0450.
- 4980 *Radio Accra, Ghana* at 1815.
- 4980 *Ecos del Torbes, Venezuela* at 2320.
- 4990 *R. Barquisimeto, Venezuela* at 0305.
- 5010 *R. Cristal, Dominican Republic* at 0525.
- 5025 *R. Clube de Huila, Angola* at 2010.
- 5035 *R. Bangui, Cent. African Rep.* at 2000.
- 5047 *R. Lome, Togo* at 0630.
- 9535 *ETLF, Ethiopia* at 1830.
- 11920 *R. Abidjan, Ivory Coast* at 1750.
- 11925 *R. Bandeirantes, Brazil* at 2050.
- 11865 *R. Clube de Pernambuco, Brazil* at 2015.

Alexander Morton of Framlington, Suffolk has a VEF-204 receiver and a 20 foot long-wire in the loft. This combination produced a very long log of which the following is an extract:—

- 5875 *HCJB, Quito, Ecuador* in English at 0810.
- 6025 *Radio Sweden* in English at 1600.
- 9770 *R. Sofia, Bulgaria* in English at 1930.
- 11860 *R. Portugal* in English at 1900.
- 15225 *RSA, South Africa, news* at 1600.
- 15380 *CBC, Canada* at 1120.
- 17787 *WINB, Red Lion, U.S.A.* at 1820.
- 17840 *HCJB, Quito Ecuador* at 2030.
- 17885 *R. Lebanon* in English at 1840.
- 17970 *R. Pakistan, news* in English at 1350.

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

- 21560 *RSA, South Africa* at 1400.
- 21582 *Radio Accra, Ghana* at 1445.
- 21800 *Radio Norway, in English* at 1800.

Steve Mathews of Hull has used his Trio 9R-59DS and 90 foot long-wire to hear the following:—

- 3265 *R. Clube Mozambique* in English at 2100.
- 4833 *Bamako, Mali* in French at 2130.
- 5010 *R. Cristal, Dominican Republic* at 0245.
- 6040 *Voice of the Coast, Dubai* at 0410.
- 6055 *ABC, Australia (Darwin relay)* at 1715.
- 6120 *R. El Mundo, Argentina* at 0200.
- 15430 *KBS, Korea* in Spanish at 0205.
- 15440 *FEBC, Philippines* at 1545.
- 21500 *R. Brazzaville, Congo, French* at 0845.

D. A. Hairon of St. Clement, Jersey is now using a Codar CR70A, a PR30 preselector, a 19 metre band dipole and a 100 foot long-wire. His log for this month included:—

- 9560 *RSA, South Africa* in English at 0230.
- 9710 *HCJB, Quito, Ecuador* in English at 0245.
- 11710 *AIR, Delhi* in English at 2330.
- 11765 *R. Dif. Sao Paulo, football* at 0100.
- 11775 *VOA, Philippines, s/off* at 1700.
- 11785 *TWR, Bonaire* in English at 0115.
- 11885 *R. Maua, Brazil* in Portuguese at 0000.
- 11925 *R. Bandeirantes, Brazil* at 2030.
- 15185 *R. Havana, Cuba* in English at 2010.
- 21570 *NHK, Japan* in English at 0800.

Craig Tyson of Wembley, Western Australia has concentrated on 19 metres and his log includes:—

- 15105 *R.T. Belge, Belgium* at 1600.
- 15120 *Radio Ceylon* in English at 0320.
- 15155 *RSA, South Africa* in English at 1810.
- 15165 *R. Damascus, Syria* in French at 1950.
- 15175 *R. Norway* in English at 0800.
- 15190 *R. Brazzaville, Congo, French* at 1810.
- 15235 *NHK, Japan* in English at 0930.
- 15285 *R. Accra, Ghana* in English at 1820.
- 15345 *VOA, Philippines* in English at 1100.
- 15355 *R. Lebanon* at 2300.

Stephen Hillman of Warley has a Teleton 136F4 receiver connected to a 50 foot long-wire enabling him to hear:—

- 4970 *R. Rumbos* in Spanish at 0200.
- 5960 *HCJB, Quito, Ecuador* in English at 0800.
- 11795 *WINB, Red Lion, USA* in English at 2000.
- 11805 *R. Globo, Brazil* in Portuguese at 2030.

Reports should arrive by the 15th of the month and be addressed to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz ● Times in GMT

HANDS up all those who got a new receiver from Santa. Just think of all those exotic callsigns you'll be hearing—or perhaps you've heard them already in which case how about sending in a log?

What antennas are you going to try this year? Now is the time to start planning and doing all the paperwork. If '3JDG's experience is anything to go by then this definitely is the time. After you've changed your mind half a dozen times and bought lengths of wire you find you don't need after all it works out a bit expensive in both time and money. Much better to work out everything while you're sitting by the fire in the cold months. You'd be surprised how much time you can save by planning well in advance. How about an all-band automatically-switched vertical for the loft?

"The most exciting band for me this month was two metres," says **Stefan Kaye** (Witney). Gear is a 4-over-4 in the loft, Space Mark converter and an AR88D tuning 12-14MHz. Ears are the Kaye, MK1 types and were stimulated to the tunes of the following on 144MHz; DC2JN, DC6EQ, DJ4AX, DJ4EU/P, DK4TP, DL0ER, DL0WU, DL1XG, F1KCG, G8ABP, G8EJH, ON5NY, PA0QX, PA0WCH.

Some people have written in asking how a receiver tunes in 144MHz signals since the frequency given for the receiver tuning is never anywhere near 144MHz. Idea is that you use a converter between the main station receiver and the aerial. The converter "converts" (surprise, surprise) the 144MHz incoming signals and lowers the frequency down to a range which can be covered by the main receiver. Popular converter output frequencies are 12-14MHz and 28-30MHz. The converter doesn't need tuning, you just plug the antenna in one end and the receiver into the other.

But I digress! **R. Gillon** uses a Wein Flight 4 on 144MHz. Signals received from: DM0ER, DL0PT, EI2BY, F6AP, GW8ASA, GM3NYY/P, OL60L, ON5NY, PA0LM. QTH is Richmond.

Brian Lucas (Gillingham) has an RBX-2 Halli-crafter and describes the antenna as "chopped down v.h.f. dipole loitering on the end of a 3ft beam under the eaves." (Bet he only listens in the evenings! Squeaks of r.f. on 144MHz from: DL0ER, F0YT/M, F1PD, F1AXI, F1BMF, F1BCD, F5ID, F6HWH plus 12 G3s, a G4 and 18 Gs.

A 46 (forty-six) element Multibeam, converter and 9R59DE tuning 28-30MHz is **N. Richardson's** visiting card on 70cm. Goodies arriving at Aylesbury at this rarified frequency include: DC8AMA, DC8UA, PA0DGH, PA0JNH, PA0EZ, PA0QX.

Down on 144MHz, **Nicholas** and 8-element yagi, converter plus 9R59DE, did a bit of eavesdropping on: DC0QA, DJ8SW, DJ8VRA, DJ9UXA, DK2T/P, DK4TP, DL0ER, DL1XG, F1AEX, F2XO, F5DA, F6BBA, F6BOM, F9QW, GC8AWE, GC8BMO, ON4OR, ON5QW, ON5VU, PA0APE, PA0HWB, PA0CML, PA0ELL, PA0HAG.

All this v.h.f. is a bit too rich for the old '3JDG blood, let's flick the bandswitch to 28MHz and see who heard what. Ten metre addict **M. Shields** (Abergavenny), JR500-SE, 70ft long wire end fed running NS, sends in a mouth-watering log of callsigns. Pages from an immaculate log read: CE3EZ, CE7TJ, CR4BS, CR6IK, CR6TP, CR7LE, CR7IA, CP6FG, CT3AS, CX7BF, CX8BE, CN8HD, DJ4OI, EL8I, FY7AD, F9XF, G3MUL/CE3, HK4AFT, HR1JA, KV4FD, KP4CQB, K4AVD, LU6ECE, PY3BNJ, RA3AFL, VP8MM, VP9DC, W6JIF/4, W3FXG, XX6FL, YN2OM, ZP5AQ, ZC4AVU, ZE1BP, ZE1GDS, ZS2AG, ZS4UCC, ZS5KS, ZS6ATA, 4Z4HF, 5N5ABG, 8R1G, 9G1DY, 9H1AQ, 9J2DT, 9Q5ELA.

Letter from **Karl Muller** (Swaziland) informs that ZD5 stations are now all 3D6A stations. Karl says that forty metres has been disappointing in the evenings mainly because of QRM from BC stations. How about all transmitting amateurs having a 1972 40-metre activity year, I'm sure we could make some of these pests QSY out of our band? It would make forty a greater attraction for the s.w.l. and would dissuade greedy eyes from pilfering our last (in the UK) 100kHz. How about it, r.f. makers?

Robert Ferguson (near Birmingham), has an HRO plus a "... one element rotatable beam." (Good gracious, Holmes!). Ten metres yielded: CX8BE, CR6TP, CX8BE, LU5DTA, VK9XK, ZS1JA, 7Q7BC, 9G1DY, 9J2DT, 9Y4VU plus hoards of JAs.

Best from **Martin Evans** (Colwyn Bay) on 3.5MHz using a three-transistor t.r.f. with 150ft end fed plus a.t.u. were: CT1BH/P, OX3RA, OY400, TF5TP, TI2GI, VE1AM/VP9, VP7NH, ZS6DW, 4U1ITU, 4X4YM, 4Z4HF.

Keith Monham (Feltham) bagged these on phone on 160 metres; DJ4SS, DK2JX DL0WU, EI9ONE, GM3NVU, GM3YCB, GM4NR/P, GW3AAC, GW4AJ/A, OH1VR, OH5GM, OH5SM, PA0PN. Cor, think what was about on c.w. Gear is a 60ft. end fed with a.t.u. plus a B40 receiver which draws sparks between earth wire and chassis. (Shocking state of affairs!).

Nicholas Minns (Letchworth), CR300, 110ft. end fed, sends in this list of topband hearings; DK0WA, DK2WA, HB9CM, OH1VR, OH5SM, PA0PN, EI9ONE.

On 3.5MHz, the same set up raised: FM7WN, HR1WSG, OY2X, PJ2CW, PZ1CU, TI2CAP, WA6EGL/P/TF, VP2VAG, ZB2AV. While the dreaded forty metres surrendered signals from: CN8CS, EP2BQ, FL7ZX, JA6BSM, 4X4LNI, 6W8DY.

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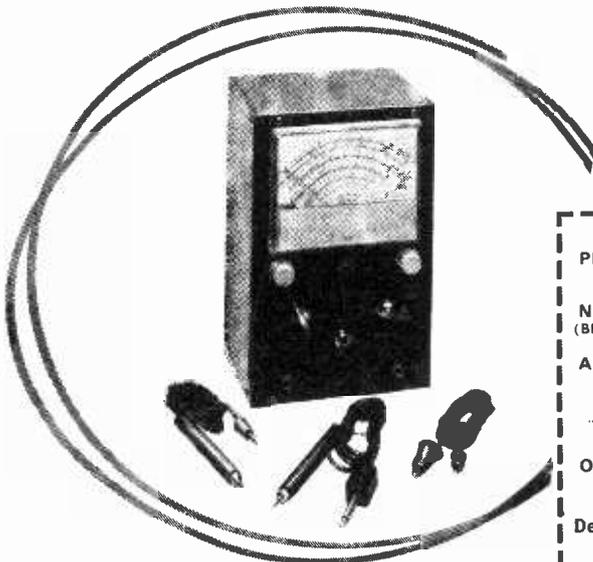
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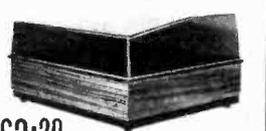
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FELSTEAD ELECTRONICS (PW 53)

LONGLEY LANE, GATLEY, CHEADLE, CHES. SK8 4EE

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RECORDING TAPE: Finest quality/value British Mylar available. STANDARD 5" 600ft 38p; 6" 900ft. 50p; 7" 1200ft. 56p; LONG PLAY 5" 900ft. 50p; 5 1/2" 1200ft. 56p; 7" 1800ft. 90p. (7p on 5" and 5 1/2", 9p on 7"). Other sizes, Cassettes and accessories in List.

CARTRIDGES. All with standard fittings and styli. Mono GP87 85p; Stereo-compatible Mono GP91/8C £1.10; STEREO GP93 £1.40; Stereo Ceramic GP94 £1.85. (6p) Comparatives shown in List, with more types incl. Sonotone 9TAHC, Goldring etc. at below prices.

DIAMOND STYLUS: Single tip types: Acos GP7, GP8, GP9, GP17, BSR TCR/EPST, COLLEO O. P. etc. DC284; GARRARD GC2, GC8, GC12, GC810; RONETTE BF40. O. P. and T: PHILIPS 3301 (3080, 3066, 3302, 3304), 3010 (12, 13, 16); SONOTONE 19T/20T ALL AT 40p each (6p). Double-tip turn-over types (78 sap. on other side). For ACOS GP73, GP91 (for cartridges GP93, GP94 etc). GP918C (for stereo-compat. types) GP104, BSR ST4 (ST3, ST5), ST9 (ST8), ST12/14/15, SONOTONE 8TA, 9TA, 9TAHC, PHILIPS 3308 (3310, 3224, 3228/32, GP280), GARRARD GC21, 22, GC83, GC85, 28 and 28, CM917 and 22T, GK24T, GC8231, GK823T & 26T GC831, GC836, GC835, GC838, K840A, K841B ETC. ALL AT 75p (6p). **DOUBLE DIAMOND STYLUS:** (Same dia. tip each side: no 78) All types £1.50 (6p). **PICK-UP WIRE:** Super thin twin flex screened, sheathed, 6p per yard (Up to 6 yds. 6p over charges paid). All sapphires in list.

MICROPHONES: CRYSTAL: LAPTEL 1 1/2", clip/hand, lead 3.5mm jack plug 32p (6p). CM20 Cream Plastic hand 58p; CM21 Grey Plastic Hand/Desk 62p; both have 3.5mm jack plug and lead (8p either). "BTOK" 6p £1.02; CM70 "PLANET" Metal, tapered, with neck cord, adaptor for stand £1.474; "MIC 91" hand/clip 81p; "MIC 45" Curved metal hand/grip £1.00. ALL with leads (all 8p). **MICROPHONE INSERTS:** Dia. 1.75" or 0.9" either size 27p (Up to 6 for 8p). DYNAMIC: 209 Car-Hold Ball, 50K/800 Ω built-in volume control, on/off switch, special 20ft. lead, the best value anywhere at £8.30; U0130, uni-dir. mesh ball 50K/800 Ω jack plug, cable, adaptor, £4.80; D3150, omni-dir. Ball mesh, 50K, jack plug and lead (8p either). "BTOK" 6p £1.02; CM70 "PLANET" Metal, tapered, fitted tweeter, 3 or 15 ohms (state which) £1.871 (27p) — or pair for stereo £4.25, charge-paid. **HEAD 2 1/2"** 3 Ω or 8 Ω, (state which) 87p (6p). More speakers in List. **HEADPHONES:** High resistance 2000 Ω adjustable: 82p (7p). **EARPIECES:** With lead and min. 2.5mm or 3.5mm (state which) jack plug, MAGNETIC 8p. CRYSTAL (3.5mm plug only) 24p (Up to 3 for 6p any type). **SOLDERING IRON:** 81mm, modern, British high speed, 91", all parts replaceable, highest quality fully guaranteed £1.71 (10p). **TRANSFORMERS:** Sub-min 11 x 11 x 12mm. OUTPUT 1 (3 Ω for OC72, etc.) 14p or DRIVER 15p (Up to 12 for 6p). **CONNECTING WIRE.** Packs of 5 coils, each coil 5 yds. asstd. coils. **SOLID CORE:** 14p. FLEXIBLE or SUPER THIN for transistor wiring, etc. either 18p (Any pack 6p). **RETRACTABLE FLEXIBLE LEADS.** (CURLIES): With phono plug, each end, 6ft 83p, 12ft 30p. With phono plug/phone socket other end 6ft, 25p, 12ft, 42p (6p lead any type). **WIRE TORS:** 12 1/4 pin non-crimp, highest quality £1.71 (10p). **TRANSFORMERS:** USA, 20p, 12v/7 pin, synch. (12BR7) 2 1/2" ex. plug 82p (6p any type). **TRANSISTORS,** etc. AC/128 12p, AF115 20p, AF116 15p, AF117 20p, OA5 10p, OA10 10p, OA81 10p, OC44 14p, OC45, OC71, OC72, OC75, OC81D, OC82D, all at 12p each. OC81 15p, OC170 20p, OC171 12p, BY100/800 p/v 14p. Many more incl. power tubes, thyristors, etc. in List.

MAINS NEONS, 6v leads 10p. **NEON SCREWDRIVER** (pocket tester) 17p (6p either). **BATTERY ELIMINATOR:** Input 240v-AC. Output 3, 6, 7.1 and 9v-DC by switch selector. On/off switch, pilot lamp, leads, plug, adaptor to suit most transistor sets and cassette recorders. Suitable for model use: £3.15 (24p).

OUR CURRENT LIST (see heading) includes more details of all above plus cartridge replacement table, many unrepeatable Special Offers, and cable, cord, clips, Volume control-Din plugs, G-Ax, standard, miniature, phono plugs, sockets and adaptors, Tape Recorder and Record Player assemblies, panel and test meters and equipment, Multimeters, multi-motors, test probes, cabinets, rotary, toggle, slide, cam, etc. electrolytics, terminals, Veroboard, valve holders, extending aerials for cars and portable sets, incl. lamps and bulbs, diodes, mikes, telephone amplifiers and pick-ups, drive cord, Inter-com, sub (testing) boxes, Stereo Headphones etc. etc.

practically wireless

commentary by **HENRY**

No. 87

Milk
Teeth

IT IS ALL TOO EASY to blame lack of foresight on teething troubles. That, after all, is what happens when car doors fall off, when vacuum cleaners shed belts, when 'fridges go up in smoke—or when radio gear develops a case of the twitches only weeks after delivery.

"Teething troubles," if I may quote John Pudney, "is an indulgent phrase which has become a blanket term for incompetence."

Ralph Nader may have a lot to say about the automobile industry and its tendency to blanket its failings with next year's model draped with nudes, or not. Henry cannot cap his quotes, perhaps because he has had to manage with a succession of second-hand cars—and you know what the public thinks of *their* advertisements. . . . But on the subject of newly-sold radios and associated gear, your correspondent speaks with some authority.

And bitterness! I often wish some fully-equipped Nader would rise and berate the manufacturers of our domestic electronic equipment. And not only our homegrown makers, for at least we must give them a Beta-minus for trying, but also the importers.

However elegant the drawn circuit, reality will always have rough edges. Any constructor will verify that. Even with the

mollycoddling given to us by such redoubtables as Heathkit, it is possible to make mistakes. Human error enters into Fate's formula and *reductio ad absurdum* is the result.

Absurd as the contretemps Henry observed when working as a "tester" in a radio factory—instructions were given to those doing routine alignment: "twiddle until the needle on the meter reaches maximum, then seal the screw." Nobody considered that there were two alternative peaks when the mixer circuit was tuned in—so, of a batch of well over a thousand sets, boxed and despatched, a goodly proportion were completely misaligned—and nobody noticed till the complaints came rolling in!

Teething troubles were blamed for many of the television set assinities that kept field engineers buzzing about like bluebottles when ITV first opened, when dual-standard receivers became the vogue, and harass them now, when colour is the order of the day.

Teething troubles are given as the reason why quite famous hi-fi makers foist amplifiers on the public with an inherent rumble and noisome hiss and then announce a Mark II model with alternative front-end transistors.

There will always be teething troubles while makers, greedy for profit without the responsibility that once pervaded our industry, market gear that is not in any way backed with a spares service or even the vital information the retailer's engineer will need.

Ask half the agents that are pushing their newest models, and you'll get the answer: "Our service manual's being prepared." And by that time, the poor old dealer has had to rip half a dozen of the units to bits to find why sundry minor ailments were apparently missed on final test.

A reviewer, not a hundred miles from where I sit, refuses pointblank to accept equipment



My largest pair of pliers.

for appraisal unless it is accompanied by the service information that was available to the factory engineers. He has bitter memories of putting a mediocre system through its paces, according to British Standards, only to be hauled over the coals because he had not tested it the way originally laid down. The fact that *their* way was a palpable con trick (resetting tone controls to fiddle a flat response curve) made but little difference—he should have waited for the gen. So now he does, and the panting manufacturer can whistle for his review.

But I don't know whether that is preferable to those who launch a new radio in a blaze of publicity, then proceed to Mark II, III and IV during a twelvemonth without a word to anyone. Which becomes embarrassing, when a customer toddles into one's shop with a request for a "volume control for the Superstar, please." How does one explain that there have been a veritable constellation of models bearing that name, and the clue is in the suffix to the number on the back?

I'd like to solve some of those makers' teething troubles with my largest pair of pliers.



Buzzing around like bluebottles.



New Books

Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in **heavy type** should be quoted.

FOUNDATIONS OF WIRELESS AND ELECTRONICS

By M. G. Scroggie

Published by Iliffe Books,

521 pages, 9 × 6in. £3.00 (hard cover)

HOW do you start to review a book that will without doubt become a classic? Do you try to pick holes in it to fill out the copy? That would be unfair and very difficult so all there is left to do is to praise it as strongly as you can and thoroughly recommend it to all and sundry.

I don't know how old Mr. Scroggie is; we are told on the flyleaf that he graduated in 1922 and has been writing ever since. Here he has produced a book that radiates freshness and originality and is far more up-to-date than any book I have seen for several years.

The author appears to recognise that the semiconductor is here to stay and now forms the basis of electronics and he has started from scratch with this new edition to take this into account—what a contrast to authors half his age who still regard semiconductors as upstarts!

In future, whenever I am asked to recommend a book for beginners, I shall quote this one; it doesn't give circuits or constructional details of course—it isn't that sort of book—but the explanations are clear, complete and logical.

Congratulations Mr. Scroggie and Iliffe—a fine book!—*H.W.M.*

SIMPLE SHORT WAVE RECEIVERS

By F. A. Baldwin

Published by Data Publications.

140 pages, 8½ × 5½in. Price 80p.

FRANK Baldwin is an author who certainly knows what he's talking about when it comes to short-wave listening and it is a name that crops up frequently as the author of articles in *Radio Constructor* and amongst the short wave listening fraternity. This book is a collection of simple short wave circuits—four in all—and they are all good stuff and I have no doubts that they all work—and work well. Drawings, circuits and descriptions are all very clear and well presented and these in themselves should give the reader a certain amount of confidence.

Having said that, some less kind comments must follow. All circuits use valves—and some are very old types indeed. The date is 1971—transistors rule the day, yet there is not one mention of them in the whole book. A title such as "Simple Short-Wave Receivers" must surely be aimed at beginners and wouldn't circuits using semiconductors have been far, far better? Still this is a criticism that can be levelled at nearly all books of this type and it is a reflection on *all* authors and publishers rather than on this book.

For what the book sets out to do, it is excellent. Without actually building the circuits it is difficult to judge the performance but they are all well tried and tested circuits and are described in great detail. It is tempting to find fault with the length—it is very long for only four circuits—but that would be unfair for the price is very reasonable at 80p and for that you do not feel cheated and the extra space has at least been used to detail the construction thoroughly.

J.A.

ABC'S OF THERMISTORS

By Rufus P. Turner

Published by Foulsham-Sams

96 pages, 8½ × 5½in. Price £1.10.

ONE'S first reaction to this book is to wonder how nearly one hundred pages can have been written on such a simple device as the thermistor. Knowing that "thermistor" derives from "thermally sensitive resistor" and that its temperature coefficient can be positive but is usually negative, what else is there to say?

After the "specially written chapter for the guidance of the English reader" the rest of the book, printed in the United States, does give an adequate description of the characteristics of the thermistor and its many applications, in a non-mathematical way.

It was pleasant to see a reference to the fact that our own Michael Faraday observed the negative temperature coefficient of silver sulphide as long ago as 1833.

Circuits show the thermistor in its basic role as a temperature measuring device as well as its derived use as an anemometer, flowmeter, vacuum gauge etc. and as an altimeter. This last application is based on the fact that the boiling point of a liquid decreases with altitude but it is hoped that expeditions to the Himalayas have something more sophisticated to determine their altitude than a thermistor in a pot of boiling liquid as shown in this book!

A most useful application of the thermistor in the electronics field is the measurement of r.f. power levels well into the microwave region by means of a small bead type thermistor mounted within a waveguide; others include audio compressors/expanders, c.r.t. deflection circuitry, a.g.c. systems and oscillators where the thermistor is used to control negative feedback.

Unfortunately all the circuits shown are purely theoretical, no thermistor type numbers are indicated or values given for other components. The introductory chapter "for the English reader" does admit that the circuits are basic and not for the d.i.y. types and that values of small components etc. are not stated. In fact no values are given anywhere in the book for any component, large or small.

A pity, because the book *could* have been so good.—*AED.*

ELECTRONIC VALVES

1A2	0-25	51L7GT	0-25	DY87	0-50	PC888	0-50
OA3	0-45	68N7GT	0-35	DY802	0-50	PC089	0-50
OB2	0-35	68Q7	0-40	E88CC	0-50	PC189	0-50
OB3	0-60	68R7	0-40	E180F	0-50	PC285	0-50
OC3	0-38	67R	0-35	E810F	2-90	PC806	0-85
OD3	0-35	6U4GT	0-60	EABC80	0-35	PCF80	0-30
1B3GT	0-88	6U8A	0-40	EAF42	0-55	PCF82	0-35
1CP31	6-00	6V6GT	0-38	EBC33	0-50	PCF84	0-50
1L4	2-00	6X4	0-30	EBC41	0-55	PCF85	0-50
1B4	0-35	6X6GT	0-35	EBC57	0-30	PCF87	0-50
1R5	0-35	6X8	0-55	EBF80	0-40	PCF801	0-50
184	0-27	6Y6G	0-65	EBF83	0-40	PCF802	0-50
185	0-25	7Y4	0-60	EBF89	0-30	PCF805	0-75
1T4	0-25	9BW6	0-50	EC53	0-50	PCF806	0-70
1U4	0-27	10C2	0-50	EC86	0-60	PCF809	0-75
1U5	0-60	10D1	0-50	EC88	0-60	PCL200	0-70
1V2	0-45	10D2	0-40	EC96	0-33	PCL81	0-50
1X2B	0-40	10F1	0-90	EC91	0-50	PCL82	0-35
2D21	0-35	10F9	0-50	EC92	0-35	PCL83	0-65
3A4	0-35	10F18	0-45	EC93	0-50	PCL84	0-45
3B28	2-15	10L1	0-45	EC8010	2-25	PCL85	0-40
3BF1	2-75	10LD11	0-60	ECU40	0-60	PCL86	0-45
3Q4	0-40	10P13	0-55	EC881	0-33	PCL88	0-50
5V3	0-45	10P14	1-10	EC882	0-30	PCL800	0-83
3V4	0-45	12A5	0-90	EC883	0-30	PCL801	0-70
5Y4GY	0-60	12AC6	0-40	EC884	0-30	PD600	1-50
5Y4G	0-38	12A15	0-45	EC885	0-40	PF86	0-60
5U4GB	0-42	12A25	0-43	EC888	0-40	PF818	0-85
5V3	0-42	12A7E	0-30	EC889	0-50	PLF200	0-70
5Y3GT	0-32	12B7	0-30	EC890	0-30	PL82	0-35
5Z4	0-40	13U16	0-30	EC8189	0-60	PL36	0-85
5Z4G	0-40	12AU7	0-30	ECF80	0-35	PL81	0-50
6J90L2	0-75	12AV6	0-33	ECF82	0-35	PL82	0-45
6A8A	0-35	12AV7	0-50	ECF86	0-65	PL83	0-45
6AF4A	0-50	12AX7	0-30	ECF804	1-50	PL84	0-40
6AG7	0-40	12AX7	0-70	EG142	0-30	PL89	0-30
6AH6	0-30	12BA6	0-35	EG44A	0-30	PL504	0-80
6AJ8	0-30	12BA6	0-85	EC1H83	0-40	PL508	0-90
6AK5	0-30	12BA7	0-35	EC1H84	0-45	PL509	1-30
6AK6	0-57	12BE6	0-35	ECL80	0-40	PL801	0-80
6AL3	0-43	12BH7	0-40	ECL81	0-45	PM84	0-50
6AL5	0-20	12BY7	0-55	ECL82	0-35	PY31	0-80
6AM5	0-32	12C43	0-35	ECL83	0-45	PY33	0-85
6AM6	0-33	12K7GT	0-85	ECL84	0-55	PY80	0-35
6AQ5	0-35	12Q7G	0-30	ECL85	0-55	PY81	0-30
6AQ6	0-55	12R7	0-35	ECL86	0-40	PY82	0-30
6AR5	0-35	14S7	0-80	ECLL800		PY83	0-38
6AR6	0-40	20D1	0-45		1-50	PY88	0-40
6AR11	1-25	20F1	1-10	EF37A	0-40	PY900	0-50
6AS7	0-35	20P1	0-50	EF39	0-40	PY900	0-50
6AS7G	0-80	20P4	1-10	EF40	0-50	PY901	0-50
6AT6	0-30	20P5	1-20	EF41	0-65	PZ30	0-35
6AU6	0-25	25C5	0-50	EF42	0-70	QQV2-6	2-15
6AV6	0-30	25L6GT	0-45	EF80	0-25	QQV3-10	
6AW8A	0-55	25Z4C	0-30	EF83	0-35	QQV3-20A	
6BA6	0-25	25Z6GT	0-65	EF85	0-35	QQV6-4A	5-25
6BE6	0-30	30A5	0-45	EF86	0-30		
6BF5	0-60	30AE3	0-40	EF89	0-28		
6BF6	0-50	30C1	0-30	EF91	0-33		
6BH5	0-45	30C15	0-50	EF92	0-40	TT21	2-85
6BJ8	0-45	30C17	0-35	EF93	0-45	TT22	2-80
6BZ7A	0-55	30F18	0-75	EF97	0-65	18H/20	0-75
6BN6	0-43	30F5	0-85	EP98	0-65	U25	0-75
6BN6G	0-40	30FL1	0-70	EP183	0-30	U26	0-75
6BQ6	0-25	30FL12	0-93	EP184	0-35	U31	0-45
6BR8	0-65	30FL14	0-78	EP800	1-00	U37	1-60
6BR7	1-30	30L1	0-40	EP804	0-35	U38	0-40
6BW8	0-35	30L15	0-85	EK90	0-30	U78	0-80
6BW7	0-70	30L17	0-80	EL33	1-25	U78	0-80
6BX6	0-25	30P12	0-80	EL34	0-50	U191	0-75
6BZ6	0-35	30P19	0-80	EL36	0-50	U201	0-35
6C4	0-33	30P11	0-70	EL37	1-25	U281	0-40
6C6GT	0-40	30PL13	0-68	EL38	0-75	U282	0-40
6CB8	0-30	30PL14	0-60	EL42	0-85	U301	0-40
6CD6GA	1-15	35A3	0-55	EL81	0-55	U403	0-50
6CG7	0-50	35A5	0-75	EL83	0-42	U404	0-50
6CH6	0-55	35B5	0-65	EL84	0-25	U801	1-00
6CL6	0-50	35C5	0-40	EL85	0-45	UABC80	0-35
6CW4	0-63	35D5	0-70	EL86	0-50	UAF41	0-50
6CY5	0-43	35F6GT	0-80	EL90	0-35	UAF42	0-55
6C7	0-45	35W4	0-30	EL95	0-35	UBC41	0-50
6D3	0-45	35Z3	0-60	EL803	1-00	UBC81	0-40
6DC6	0-75	35Z4G	0-30	EL821	0-55	UBF80	0-40
6DK6	0-48	35Z5GT	0-40	EL822	0-80	UBF89	0-35
6DQ6B	0-62	50A5	0-70	ELL50	0-78	UBL1	0-50
6D84	0-75	50B5	0-45	EM34	0-90	UBL21	0-60
6EA8	0-58	50C5	0-40	EM71	0-75	UC92	0-35
6EH7	0-30	50CD6G	1-65	EM80	0-40	UCC85	0-40
6EJ7	0-35	50L6GT	0-50	EM81	0-60	UCF80	0-55
6EW6	0-65	85A2	0-40	EM84	0-35	UCH21	0-80
6F1	0-70	90AG	2-40	EM85	1-00	UCH42	0-70
6F3	0-50	90AV	2-50	EM87	0-55	UCH43	0-75
6F6G	0-30	90C1	0-60	EN91	0-35	UCHR1	0-35
6F11	0-38	90CV	1-25	EY51	0-40	UCL81	0-80
6F13	0-33	807	0-50	EY80	0-45	UCL82	0-35
6F14	0-65	813	3-75	EY81	0-40	UCL83	0-80
6F15	0-65	806A	0-75	EY83	0-38	UF41	0-60
6F18	0-45	EY82	0-60	EY86	0-90	UF42	0-60
6F23	0-80	6080	1-50	EY87	0-43	UF43	0-80
6F24	0-75	6146	1-60	EY88	0-43	UF80	0-35
6F25	0-75	6360	1-25	EZ40	0-45	UF85	0-40
6F26	0-35	6670	2-50	EZ41	0-45	UF89	0-35
6F28	0-80	6939	2-15	EZ80	0-35	UL41	0-65
6F4	0-50	7197	0-75	EZ81	0-28	UM84	0-30
6J5GT	0-30	7360	1-80	GY601	0-80	UM84	0-30
6J7	0-45	7586	1-25	GZ30	0-40	UY1N	0-50
6K6GT	0-55	7895	1-25	GZ31	0-33	UY11	0-60
6K7	0-35	9002	0-35	GZ32	0-48	UY41	0-45
6K8G	0-35	9003	0-50	GZ33	0-30	UY92	0-50
6K35	0-60	AZ1	0-45	EZ34	0-48	UY85	0-80
6LAGT	0-45	AZ31	0-55	HABC80	0-40	WZ29	0-60
6L7	0-40	CBL1	0-80	HK90	0-35	Z789	1-85
6L18	0-45	CBL31	0-90	KT66	0-20	Z803U	0-90
6LD20	0-40	CY31	0-35	KT88	2-05		
6N7GT	0-40	DAF96	0-42	N78	1-45		
6P1	0-60	DF96	0-45	PAABC80	0-40		
6P25	1-25	DK40	0-55	PC86	0-60		
6P28	0-65	DK92	0-50	PC88	0-60		
6Q7	0-40	DK96	0-42	PC97	0-50		
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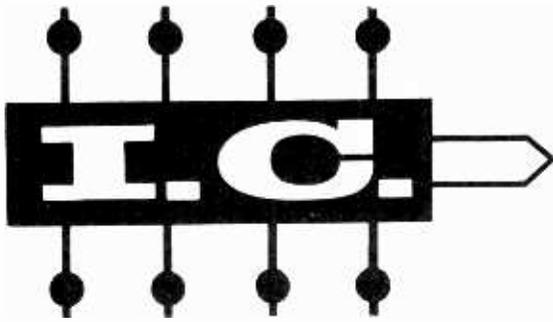
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OF THE MONTH

L.A.J. IRELAND

Number 26

S.G.S. TBA631 TV Audio Detector/Amplifier

IN modern times, after-sales service in the electronics industry is proving to be far too costly so any advance which limits this service to simply plugging in replacement units will be enthusiastically welcomed by both manufacturer and consumer alike. Lately the way has been paved for the introduction of a complete modular TV consisting of plug-in type i.c. sub-systems thereby providing enormous savings in production costs and after-sales service.

In addition to the obvious advantages of lower cost and greater reliability, inexperienced or semi-skilled technicians can perform repairs on a trial and error basis by simply plugging in replacement i.c.'s until the set functions.

Over the past few years great strides have been made particularly in the TV industry in this regard and today practically every i.c. manufacturer has on offer an integrated form of the i.f. sound amplifier and detector. In fact some firms included an audio preamp on the same chip as the i.f. strip and so it was only a logical step from here that eventually the complete audio power amplifier and i.f. sound section should appear in integrated form.

S.G.S. have recently released a new i.c. device capable of performing just these functions (TBA631), with the very attractive feature of having a price tag less than £3 and an audio power output in excess of 2.5 watts.

As far back as Dec. 1967 PW published a design for an i.c. f.m. tuner using an RCA type CA3014. Other manufacturers quickly followed with remarkably similar versions of this i.c. and in fact the wide band limiting section of the TBA631 is almost identical with it. However, the similarity ends there as a coincidence type detector, low frequency separator and low frequency preamp follows before the recovered audio signal enters the more or less separate power amplifier, on the silicon chip.

Specification

The electrical specifications of the TBA631 are quite good. It gives an almost flat frequency response from 50Hz to 10MHz with an input threshold limiting voltage of 100 microvolts at 5MHz rising to 230 microvolts at 10MHz. Total harmonic distortion at an output power of 2 watts is less than 1% and this provides adequate volume for most domestic purposes.

A separate power supply is used for the r.f. and demodulation part of the circuit and this is designed

to operate at any voltage between 4.5 and 15V. Up to 24 volts can be applied to the power amplifier and with a quiescent current of a mere 18mA with a 12 volt supply, the i.c. should prove particularly useful for inclusion in portable tv systems.

The i.c. consists of an i.f. limiting amplifier section following the well established differential amplifier patterns. A phase shift network applied between pins 10 and 11 allows for the demodulation of the inter-carrier signal and, electrically isolated from the i.f. stages, follows a typical i.c. power output stage.

Applications

Fig. 1 shows a practical application of the TBA631 in the sound section of a TV receiver. Overall savings in components and simplification of alignment is fairly obvious and of course a similar circuit with a rearrangement of coil values can be made to function admirably as the i.f. and output stages of an f.m. tuner. The drop in gain of 4dB in the i.f. stage as compared to its operation at 5.5MHz will hardly be noticed.

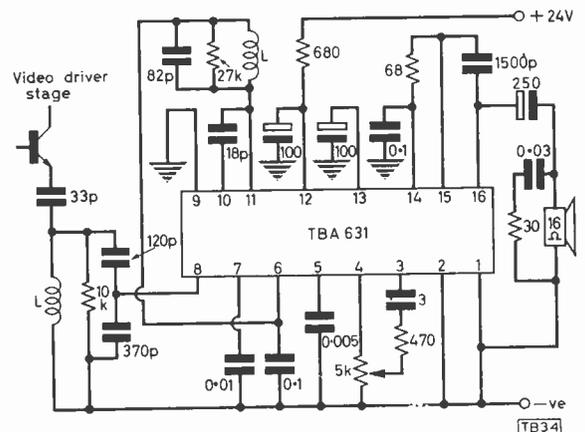


Fig. 1: In this practical application, inductors L may consist of 55 turn of 36g. enamel wire on a $\frac{1}{4}$ in former, for 5.5MHz.

At its price and specification the TBA631 is a good buy and no doubt its appearance will shortly be felt in the consumer TV market. It is available from any S.G.S. distributor or from Neltronics, 14 Wellington Park, Belfast, BT9 6DJ.

TAKE 20

JULIAN ANDERSON

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

I CONFESS that I don't know very much about Mr. Darlington but his name has been given to a transistor circuit configuration which has many uses in many fields of electronics. Some months ago we featured an ultra simple audio amplifier using two transistors, a resistor, a loudspeaker, a capacitor and a volume control and from the reaction of readers, it was a highly popular little circuit.

This month we are using basically the same circuit configuration but this time it is for a simple medium wave radio. It is the aim of this column to get the best possible use out of the minimum number of components and this circuit certainly achieves that. No external aerial or earth are required and reception may be expected of all local and some more powerful distant stations. The circuit operates from a PP3 battery and the small size of this and the other components means that the circuit lends itself to miniaturisation.

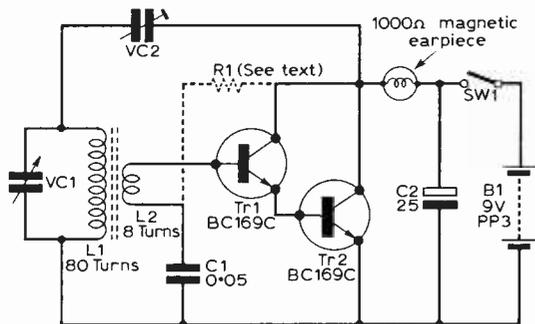


Fig. 1: The Circuit.

TB18

The magic of the Darlington Pair lies in the massive amplification available; the gain of the combined pair is equal to the product of the individual transistor gains. So, taking the best case, where both transistors have a gain of 900 (the maximum quoted for a BC169C), the circuit gain will be a massive 810,000. We are unlikely, however, to have two such high gain transistors but even with the minimum gain versions we shall have plenty of amplification in what is effectively a single stage.

The r.f. signals are induced into the tuned circuit comprising VC1 and L1 and are transformed by L2 and fed to the base of Tr1. This feeds directly to Tr2 where the signal is further amplified and applied to the magnetic earpiece. Astute readers will note that there is no obvious way in which the r.f. signals are detected and smoothed. Detection takes place in two ways: a circuit of this simplicity is hardly likely to amplify completely linearly and this means that there is a degree of detection. Alternatively there is a small degree of regeneration applied to the tuned circuit via VC2 and this aids detection. The self-capacity of the earpiece has been found sufficient to smooth the r.f. to allow it to be heard.

No. 33

TWO TRANSISTOR RADIO

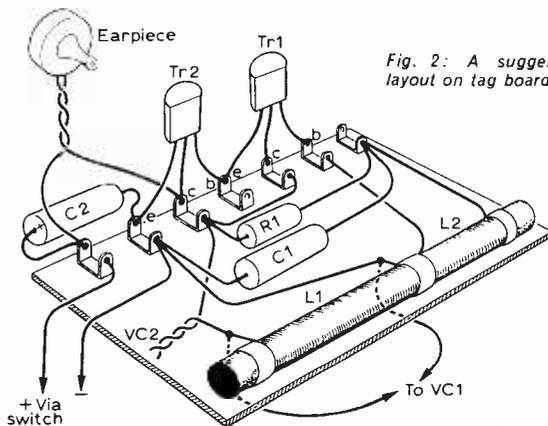


Fig. 2: A suggested layout on tag board.

TB19

★ components list

R1	See text	1p
C1	0.05µF	4p
C2	25µF 25V	6p
Tr1	BC169C	11p
Tr2	BC169C	11p
VC1	500pF	30p
VC2	See text	
L1, L2	See text	10p
Magnetic earpiece	See text	25p
		98p

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

R1 is shown dotted in the circuit. The value of this resistor will depend entirely on the individual transistors used and it is not possible to give an absolute value for all types—indeed with several combinations of transistors used in the prototype it was not even found necessary; the gain is so high that the tiny leakage currents were sufficient to apply the bias. However a resistor will normally be required and the value may lie anywhere between 470kΩ and 10MΩ.

The aerial comprises 80 turns of enamelled copper wire (about 30 s.w.g. but this is not critical) wound on a 3in. length of 3/8in. diameter ferrite rod. L2 comprises a further 8 turns. VC2, as shown is made up from two short lengths of insulated wire, twisted together for optimum performance over the complete band.

The magnetic earpiece is shown in the circuit as 1000Ω impedance; this is the ideal but any type between 250Ω and 2,000Ω will suffice. Low impedance types (usually 8Ω) and crystal types will not work in this circuit.

A suggested layout is shown in Fig. 2 on a short piece of tagboard with the tags along one side removed. If, by twisting VC2 together, there is no improvement or tendency to oscillation, then the connections to L2 should be reversed.

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1N5407	28p	AC187K	17p	BF15	23p
1844	9p	ACY11	31p	BF167	18p
18940	5p	ACY18	19p	BF173	25p
2N696	17p	ACY19	23p	BF177	19p
2N697	18p	ACY20	20p	BF194	14p
2N706	12p	ACY21	21p	BF195	15p
2N930	29p	ACY22	21p	BF254	14p
2N1132	26p	ACT39	63p	BF255	15p
2N1302	21p	ACY40	17p	BFX29	31p
2N1303	19p	ACY41	18p	BFX84	25p
2N1304	26p	ACY44	31p	BFX85	32p
2N1305	26p	AD142	50p	BFX87	29p
2N1306	33p	AD149	58p	BFX88	26p
2N1307	33p	AD150	50p	BFY50	23p
2N1309	36p	AD161	33p	BFY51	20p
2N1613	23p	AD162	36p	BFY52	23p
2N1711	26p	AF114	24p	BFX20	16p
2N1893	54p	AF115	24p	BY164	45p
2N2147	95p	AF116	22p	RY238	18p
2N2218	34p	AF117	23p	RYX38-300	82p
2N2218A	26p	AF118	23p	RYX38-300R	38p
2N2219	38p	AF124	24p	C407	17p
2N2270	62p	AF125	24p	C762	19p
2N2369A	19p	AF126	22p	EA403	10p
2N2483	35p	AF127	22p	EB383	10p
2N2484	42p	AF139	33p	EC401	18p
2N2646	47p	AF239	36p	EC402	17p
2N2904	38p	ASY26	27p	NKT211	25p
2N2905	44p	ASY27	36p	NKT212	25p
2N2905A	47p	ASY28	27p	NKT213	25p
2N2924	20p	ASY29	36p	NKT214	23p
2N2925	22p	AU111	97p	NKT217	50p
2N2926	11p	B30C250	24p	NKT261	21p
2N3053	27p	B1912	66p	NKT271	18p
2N3054	60p	B5041	72p	NKT274	18p
2N3702	13p	BA102	22p	NKT403	65p
2N3703	13p	BA130	22p	NKT405	79p
2N3704	13p	BA145	27p	NKT613F	34p
2N3705	13p	BA156	13p	NKT674F	20p
2N3706	13p	BI103B	16p	OA47	8p
2N3708	10p	BI103G	16p	OA90	5p
2N3709	11p	BC108	11p	OA91	5p
2N3710	13p	BC109	12p	OA95	6p
2N3711	13p	BC122	21p	OA200	9p
2N3794	15p	BC125	15p	OA202	10p
2N3819	23p	BC126	22p	OC19	50p
2N3820	53p	BC140	30p	OC25	42p
2N3904	35p	BC147	10p	OC29	76p
2N3906	35p	BC148	9p	OC35	60p
2N4036	55p	BC149	10p	OC36	65p
2N4058	13p	BC153	19p	OC41	42p
2N4059	10p	BC159	11p	OC44	42p
2N4060	11p	BC177	14p	OC70	21p
2N4061	11p	BC178	13p	OC71	38p
2N4124	18p	BC179	14p	OC75	40p
2N4126	27p	BC182L	11p	OC81	25p
2N4284	15p	BC183L	10p	OC81D	25p
2N4286	15p	BC184L	11p	OC83	25p
2N4289	15p	BC186	42p	OC84	25p
2N4291	15p	BC212L	16p	P346A	26p
2N4410	24p	BC213L	16p	S2CN1	10p
2N4991	62p	BC214L	16p	SD1	10p
2N5062	61p	BC257	9p	8D4	12p
2N5457	49p	BC259	9p	V763	25p
2N5459	49p	BC267	17p	W106B1	45p
40250	71p	BC268	15p	W02	40p
40251	89p	BC269	17p	WP02	95p
40381	55p	BC300	49p	ZTX300	14p
40382	68p	BC301	37p	ZTX301	16p
40602	52p	BC303	60p	ZTX302	22p
AC107	48p	BCY30	60p	ZTX303	22p
AC126	20p	BCY31	75p	ZTX304	27p
AC127	20p	BCY70	18p	ZTX300	23p
AC128	20p	BCY71	33p	ZTX331	27p
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C	1/8W	5%	4.7-470K	E24	1	0.8	0.7
C	1/4W	10%	4.7-10M	E12	1	0.6	0.7
C	1/2W	5%	4.7-10M	E24	1.2	1	0.9
C	1W	5%	4.7-10M	E12	2.5	2	1.9
MO	1/2W	2%	10-1M	E24	4	3.5	3
WW	1W	10% ± 1/20Ω	0.22-3.9	E12	7	7	6
WW	3W	5%	12-10K	E12	7	7	6
WW	7W	5%	12-10K	E12	9	9	8

Codes: C—carbon film high stability low noise
MO—metal oxide Electrofil TR5 ultra low noise
WW—wire wound Plesey

Values: E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. E24 as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 72, 91 and their decades. Prices are in pence each for same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1p on total value of resistor order.)

VEROBOARD. All popular sizes: INDICATOR LIGHTS; DIN CONNECTORS, etc.

MULLARD polyester C280 series

0.1W 20%, 0.01; 0.022; 0.033, 0.047 3p ea. 0.068; 0.1, 0.15 4p, 0.22 5p, 10%; 0.33 7p, 0.47 8p, 0.68 11p, 1µF 14p, 1.5µF 21p, 2.2µF 24p.

MULLARD SUB-MIN ELECTROLYTIC

C420 range axial lead 6p each
Value (µF/V): 0.64/64; 1/40; 1.6/25; 2.5/16; 2.5/64; 4/10; 4/40; 5.6/4; 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; 100/2.5; 200/6.4; 200/10; 250/4; 320/2.5; 320/6.4; 400/4; 500/2.5.

LARGE CAPACITORS

High ripple current types: 1000/25 28p; 1000/50 41p; 1000/100 82p; 2000/25 37p; 2000/50 57p; 2000/100 £1.43; 2500/64 77p; 2500/70 95p; 5000/25 62p; 5000/50 £1.10; 5000/100 £2.91; 10000/50 £2.40.

SIEMENS' 5% TOLERANCE POLYCARBONATE CAPACITORS

250V up to 0.1mF, 100V 0.1mF and above.
0.01, 0.12, 0.015, 0.018, 0.022, 0.027 5p
0.033, 0.047, 0.056, 0.068, 0.081, 0.01, 0.1 to 0.22 6p.
0.33, 0.39, 9p, 0.47, 10p, 0.56, 13p, 0.68, 15p.

S-DeCS

Manufacturer's prices increase roughly by 20% on these on pages 51, 52 and 53 since printing our catalogue. S-DeC £1.44, Four pack £5.10, DeCSTOR pack £2.88, T-Dec, may be temperature-cycled (208 points), £2.88, µDecA, £3.18, µDecB, £5.94. Also I.C. carriers.

AMPLIFIERS

30 WATT BAILEY PARTS

Transistors and PCB for one channel £6.46

Capacitors, resistors (metal Oxide), and transistors, one channel. £8.41
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Suitable heatsink 10DN400C. 55p

MAINLINE

70W. main amplifier module £12.60 nett.

Power supply kit £6.00 nett
Suitable pre-amp kit £6.25 nett (less chassis & panel)

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STEREO PACK OF UNITS for building into your own cabinet—2 power amps, pre-amp control unit, power supply unit and matched controls, nett £38.40.

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5% full range E24 values: 400mW: 2.7V to 30V 15p each
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Clip to increase 1.5W rating to 3 watts (type 266F) 4p.

CARBON TRACK POTENTIOMETERS, long spindles

Double wiper ensures minimum noise level.
Single gang linear 100 Ω to 2.2M Ω 12p
Single gang log 4.7K Ω to 2.2M Ω 12p
Dual gang linear 4.7K Ω to 2.2M Ω 42p
Dual gang log 4.7K Ω to 2.2M Ω 42p
Log/antilog 10K, 47K, 1M Ω only 42p
Any type with ½ A D.P. mains switch, extra 12p

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, 2K, 4K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 5M, 10M Ω vertical or horizontal mounting 5p each.

Handbook of transistor equivalent and substitutes, 40p. (Postage 3p if ordered alone.)

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Free on orders over £2. Please add 10p if orders under £2. Overseas orders welcome: carriage and insurance charged at cost.

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PEAK SOUND ENGLEFIELD 840A AMPLIFIER
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Hours: 9—5.30: Sat. 1 p.m. Tel.: Egham 5533 & 4757 (STD 0784-3) Telex 264475

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This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** Extremely sensitive. **NO SIGNIFICANT PRESENCE OF CERTAIN OBJECTS BURIED SEVERAL FEET BELOW GROUND** No knowledge of radio or electronics required. Can be built with ease in one short evening by anybody from nine years of age upwards with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2-37 + 27p p. & p.** (Sectional handle as illustrated 75p extra). Parts available separately. Made up looks worth £15!

Eavesdrop on the exciting world of Aircraft Communications

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Listen in to AIRLINES, PRIVATE PLANES, JETPLANES. Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower. Hear for yourself the disciplined voices hiding tenseness on talk downs. Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including HEATHROW, GATWICK, LUTON, KINGWAY, PRESTWICK, ETC. ETC. CLEAR AS A BELL. This fantastic fully transistorised instrument can be built by anyone over nine in under two hours. No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). **NO CONNECTIONS WHAT-EVER NEEDED!** ONLY £2-37 + 23p p. & p. for kit including case, nuts, screws, wire, etc. etc. (parts available separately).

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Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 75 stations logged on rod aerial in 80 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4 1/2" x 1 1/2" Only £2-25 + 17p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).

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ONLY £2-75

CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. It even stops by itself so you don't have to worry about it being on all night! The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, the effect it has on people is amazingly very similar to hypnosis. A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. **No soldering necessary.** Works off standard batteries, extremely economical. Size only 3" x 4 1/2" x 1 1/2"—take it anywhere. Kit includes case, nuts, wire, screws, etc. **SEND £2-75 + 25p p. & p.** (parts available separately).

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Don't confuse with ordinary electronic organs that simply blow air over mouth organ type reeds etc. Fully transistorised. **SELF TUNING LOUDSPEAKER.** Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc. You have the thrill and excitement of building it together with the pleasure of playing a real live portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, Simple as ABC to make. **Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.** ONLY £2-75 + 23p p. & p. for kit including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

Find buried treasure with this READY BUILT & TESTED TREASURE LOCATOR MODULE

ONLY £4-95

FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. Ready built and tested—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20! Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. **penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects buried SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN! £4-95 + 30p carr. etc. (High quality Danish Stethoscope headphones £2-75 extra if required). **EXCHANGE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.**

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CUTS OUT NOISE POLLUTION—SOOTHE YOUR NERVES! Don't underestimate the use of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rather mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING surroundings, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones, components, nuts, screws, wire, etc. no soldering. **£2-25 + 25p p. & p.** Parts available separately

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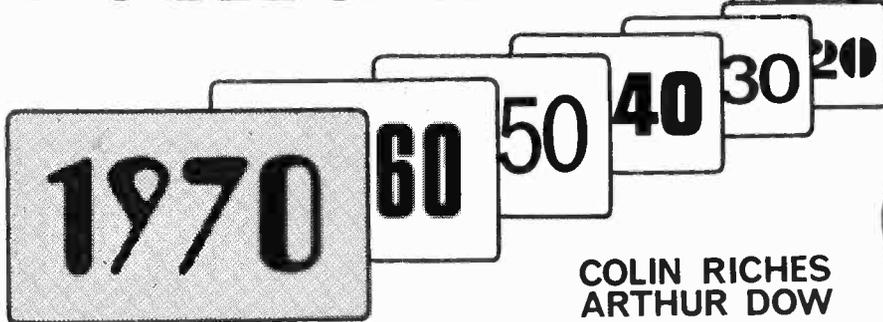
1R5	-28	30C17	-76	EABC80	-32	EM81	-41	PCL84	-34	UBC41	-52
1R4	-22	30C18	-81	EP42	-50	EM84	-32	PCL85	-38	UBF80	-34
1T4	-18	30F5	-64	EB41	-40	EM87	-34	PCL86	-38	UBF89	-32
354	-21	30FL1	-61	EB71	-41	EF81	-33	PCL88	-65	UCB84	-32
3V4	-37	30FL12	-69	EB33	-40	EF82	-29	PCL89	-32	UCB85	-36
5U4G	-31	30FL14	-68	EB41	-54	EZ40	-43	PEN44	-77	UCF80	-32
5V4G	-36	30L1	-29	EB90	-22	EZ41	-43	PEN36C	-70	UCH42	-58
5Y3GT	-26	30L15	-57	EBF80	-32	EZ80	-22	PFL200	-52	UCH81	-32
6Z4G	-35	30L17	-67	EBF89	-29	EZ81	-22	PL36	-49	UCB82	-32
930L2	-54	30PL1	-57	EC81	-27	GZ30	-34	PL81	-44	UCF83	-55
6AL5	-21	30P12	-72	EC82	-22	GZ32	-40	PL84	-47	UF41	-56
6AM6	-18	30P19	-57	EC83	-25	GZ34	-48	PL89	-31	UF89	-30
6AQ5	-22	30PL1	-60	EC85	-34	KT41	-77	PL83	-33	UL41	-57
6AT6	-20	30PL13	-75	EC90A	-54	KT61	-55	PL84	-30	UL44	£1-00
6AU6	-20	30PL14	-65	ECF80	-27	KT66	-78	PL800	-63	UL84	-30
6BA6	-20	30PL15	-90	ECF82	-28	LN319	-63	PL504	-63	UM84	-22
6BE6	-21	35L6GT	-45	ECB35	-30	LN329	-72	PM84	-33	UY41	-42
6BJ6	-41	35W4	-25	ECB42	-61	LN339	-63	PT25	-95	UY85	-25
6BW7	-52	35Z4GT	-25	ECH81	-29	N78	-87	PT32	-55	VF4B	-77
6F14	-40	807	-45	ECH83	-40	P61	-40	PY33	-55	X78	£2-75
6F23	-68	6063	-62	ECH84	-36	PABC90	-34	PY81	-25	X79	£2-75
6F22	-53	AC/VF2	-77	ECL80	-30	PC86	-47	PY82	-25	Z77	-22
6F71	-19	B45	-61	ECL82	-31	PC88	-47	PY83	-23	Transistors	-19
6K8G	-17	B29	-62	ECL86	-37	PC96	-43	PY89	-32	AC10	-17
6Q7G	-35	CC35	-67	EP39	-38	PC97	-39	PY800	-24	AC127	-18
68N70T	-30	CY31	-30	EP41	-60	PC900	-31	PY801	-34	AD140	-37
6V6G	-23	DAF91	-22	EP80	-23	PC884	-20	R19	-30	AF115	-20
6V6GT	-23	DAF96	-38	EP85	-28	PC86	-26	R20	-58	AF116	-20
8T4	-23	DF92	-38	EP86	-30	PC88	-40	U25	-64	AF117	-20
6X6GT	-28	DF91	-18	EP89	-26	PC89	-45	U36	-56	AF118	-45
10P13	-58	DF96	-36	EP91	-13	PC189	-48	U47	-64	AF123	-17
12AT7	-17	DH77	-20	EP98	-66	PC805	-58	U49	-56	AF127	-17
12AU6	-20	DK32	-33	EP183	-28	PCF80	-28	U30	-26	OC26	-25
12AU7	-20	DK91	-28	EP184	-31	PCF82	-31	U52	-31	OC44	-12
12AX7	-22	DK92	-38	EP190	-35	PCF86	-46	U78	-59	OC45	-12
198BG4	-87	DK96	-38	EL33	-62	PCF90	-58	U161	-59	OC71	-12
20F2	-67	DL36	-40	EL34	-45	PCF801	-28	U193	-42	OC72	-12
20P3	-77	DL92	-26	EL41	-54	PCF802	-40	L251	-64	OC75	-12
20P4	-98	DL94	-37	EL42	-23	PCF805	-61	U301	-38	OC81	-12
26L6GT	-20	DL96	-38	EL90	-28	PCF806	-56	U329	-68	OC81D	-12
28U4GT	-57	DY86	-24	EL95	-33	PCF808	-88	U801	-80	OC82	-12
30C1	-62	DY87	-24	EL90	-62	PL42	-32	TA BC90	-32	OC82D	-12
30C15	-58	DY802	-33	EM80	-41	PCL83	-57	UAF42	-51	OC170	-33

READERS RADIO

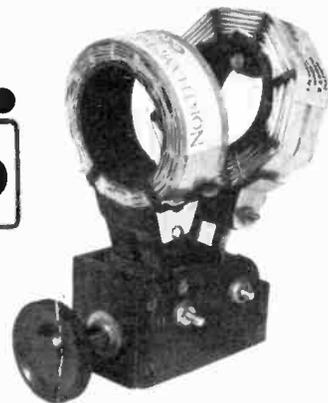
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GOING BACK...



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ARTHUR DOW

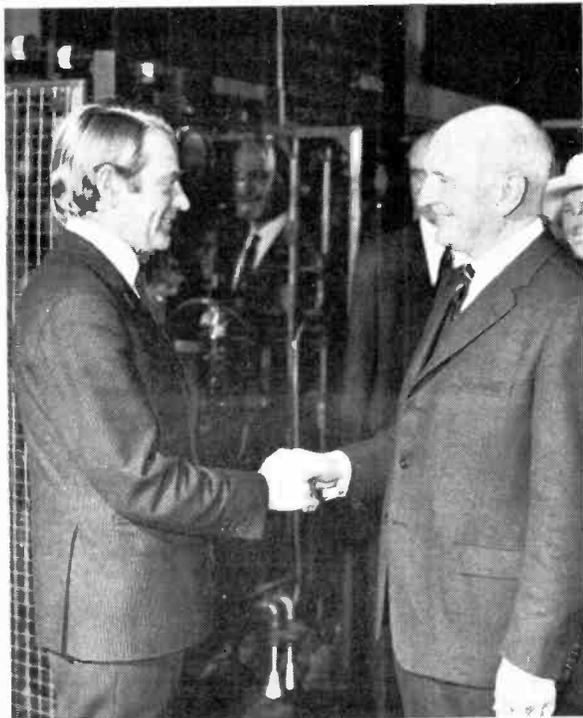


QUITE a few of our readers, interested in the history of wireless, will have paid a visit to the Science Museum in South Kensington, London, and seen the collection of the old and not so old equipment on view there. The old gallery has now been moved to the third floor and on October 26th last a new and resplendent Telecommunications Gallery was formally declared open by the Minister for Posts and Telecommunications, the Rt. Hon. Christopher Chataway, M.P. Later the Minister, accompanied by Sir Harold Bishop, Chairman of the Museum's Advisory Council, toured the gallery with other distinguished visitors.

The North side of the gallery is devoted to the development of telegraph and telephone systems and many pieces of equipment from the early 1800's are displayed. The South side of the gallery is perhaps of more interest to our readers since it covers



The spacious nature of the new gallery is illustrated in this view of part of the collection of Army equipment.



The Minister for Posts and Telecommunications (left) is greeted by Sir David Follett, Director of the Science Museum.

radar and radio communications as well as broadcasting. Many examples of equipment, both civil and military, are exhibited in well-lit spacious showcases with detailed descriptive explanations.

Many were the oo's and ah's among us older visitors as we spied transmitters and receivers from the early days of the last war! Memories were stirred as thoughts went back to the problems of getting that last watt from a transmitter in a bouncing aircraft or bumping tank!

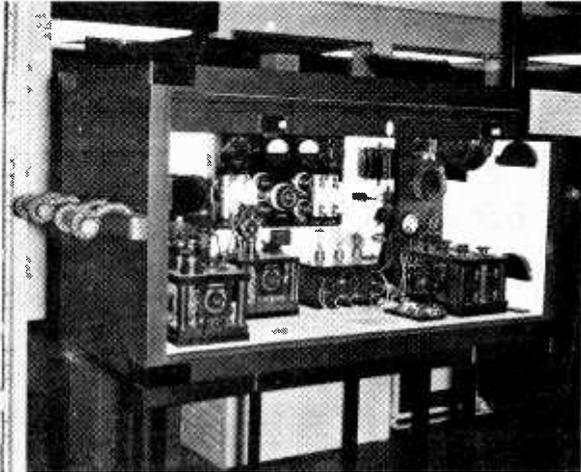
The equipment on view traces the history of wireless from the late 1800's and the discovery of the existence of electromagnetic waves by Hertz, who, although proving that the waves could pass through solid objects, took the matter no further. This aspect was left to Marconi who developed a practical wireless telegraphy system despite the very crude equipment of the time and the scorn of the "line-of-sight only" scientists of the day.

Great progress was made when shipping companies accepted the idea of ship-borne wireless realising its value from the commercial point of view and its potential as a means of getting assistance for their ships when they ran into trouble.

The next great push forward came with the 1914-18 war when rapid developments provided radio telegraphy and telephony facilities for the forces on land, sea and in the air. The crude spark and arc

days were over and valves came into their own. Following the early experimental work of the radio amateurs long distance commercial circuits were established on short waves.

Subsequent discoveries are hardly "vintage" having taken place in the lifetime of many of us but even so the early radar equipment and certainly the Army's communication gear of that time looks crude beyond belief.



A complete 120watt field wireless station of 1918.

Broadcasting and TV have not been forgotten in the new gallery which, inevitably, includes Baird's 30-line television receiver. A visit to the exhibition is a must and after spending a while in the gallery one can return to the present day by visiting the amateur radio station GB2SM now re-sited adjacent to the new gallery.

MAXWELL

by G8DSH



"You're biased!"

CHARLES MOLLOY

THE Medium Wave Column

"IMPOSSIBLE," I thought, writes **Ian Rennison** of Horsham, Sussex, when he read reports in *Practical Wireless* of American and Canadian stations being heard in UK on the medium waves. Ian now has a Trio 9R59D and he sends an impressive list of stations heard using a medium wave loop antenna in his bedroom.

CBNA 600kHz St. Anthony Nfld; CKCM 620 Grand Falls Nfld; CBN 640 St. John's Nfld; WNBC 660 New York; WOR 710 New York; CJOX 710 Grand Bank Nfld; WSB 750 Atlanta Georgia; WJR 760 Detroit Michigan (The Great Voice of the Great Lakes); WABC 770 New York; WCBS 880 New York; CJON 930 St. John's; CBM 940 Montreal; CHER 950 Sydney N.S.; CHNS 960 Halifax N.S.; WINS 1010 New York (All-news all the time); CFRB 1010 Toronto; WHN 1050 New York; CBA 1070 Moncton N.B.; WBAL 1090 Baltimore; WNEW 1130 New York; WHAM 1180 Rochester N.Y.; WOWO 1190 Ft. Wayne, Indiana; WCAU 1210 Philadelphia; WLOB 1310 Portland, Maine (5kW); WKLX 1350 Portsmouth, Virginia (5kW); WMYR 1410 Fort Myers, Florida (1kW at night); WTOP 1500 Washington D.C.; WMBX 1510 Boston; CJRS 1510 Sherbrook, Quebec; WKBW 1520 Buffalo, N.Y.; WCKY 1530 Cincinnati, Ohio.

Hugh Martin (G3XCD) of Wallasey, Cheshire, abandoned the Amateur Bands temporarily and connected his 20m dipole with 30ft downlead, to a BC946 medium wave 'Command' receiver. The time was 2340 hrs and he heard WINS 1010kHz New York and CBA 1070kHz Moncton N.B. This one-band receiver covers 520kHz to 1530kHz and only requires to be modified to convert from 28V to mains working. The MW Command receiver is not often available from commercial sources these days, but one can often be obtained, suitably modified, from private hands, for quite a modest sum.

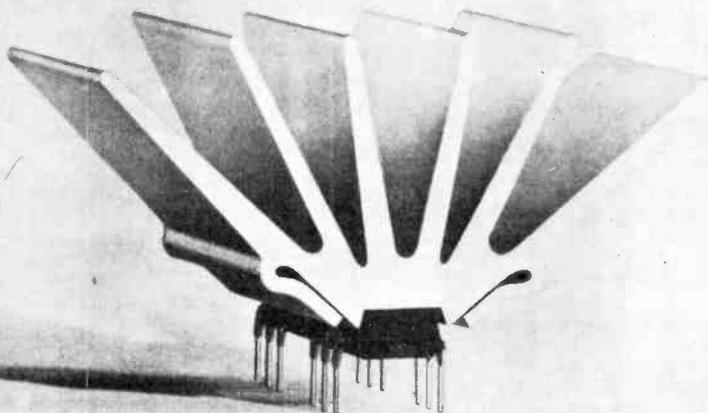
George Harpur of Brentwood, Essex, logged 4 North American medium wave stations between 2300hrs and 2330hrs, the first time he tried out his new Eddystone 680X. George raises some interesting questions on operating techniques. Always turn OFF the a.v.c. when DXing on the medium waves. Set the l.f. (audio) gain control to a comfortable level and control the incoming signal with the r.f. gain. If the a.v.c. is left ON and an attempt is made to listen to a weak station only a kHz or two from a strong one, then the strong signal will operate the a.v.c., reduce the receiver gain and the weak station will be missed.

Conditions on the medium waves are better now than for several years and will continue to improve as we approach the minimum of the current sunspot cycle. Many North Americans can be heard before midnight, WINS 1010 New York being particularly prominent.

Send logs and information about the Medium Waves to:
132 SEGERS LANE, SOUTHPORT
PR8 3JG

new

Super IC-12



High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor, the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

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.

Output power 6 watts RMS continuous (12 watts peak).

Frequency Response 5 Hz to 100KHz \pm 1 dB.

Total Harmonic Distortion Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.

Load Impedance 3 to 15 ohms.

Power Gain 90dB (1,000,000,000 times) after feedback.

Supply Voltage 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

Size 22 x 45 x 28 mm including pins and heat sink.

Input Impedance 250 Kohms nominal.

Quiescent current 8mA at 28 volts.

With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project-60 range such as the Stereo 60 and A.F.U. may be added. The comprehensive manual supplied with each unit gives full circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include car radios, oscillators etc. The very low quiescent consumption makes the Super IC.12 ideal for battery operation.



Price, inc. FREE printed circuit board for mounting.

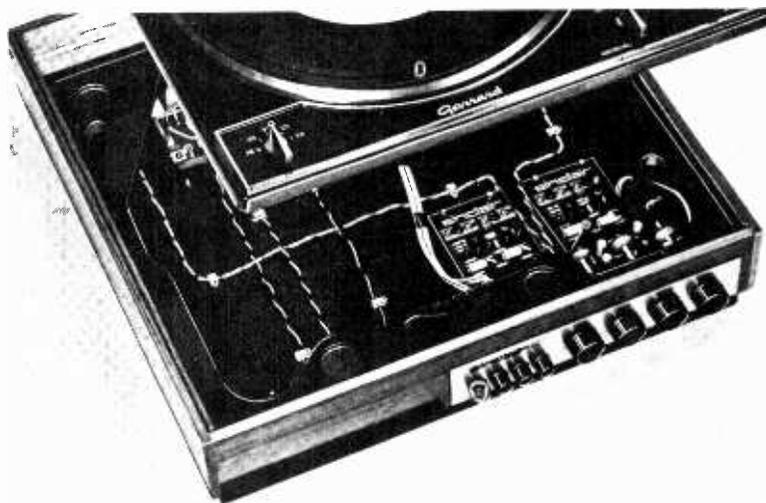
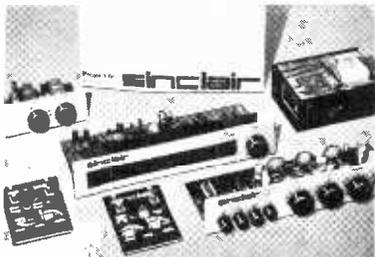
£2.98 Post free

Sinclair Radionics Ltd, London Rd. St. Ives Huntingdonshire PE17 4HJ
Telephone St Ives (048 06) 4311

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Sinclair Project 60

The World's leading range of high fidelity modules



New!

Project 605

The easy way to buy and build Project 60



Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

All you need for a superb 30 watt high fidelity stereo amplifier.

Sinclair Radionics Limited, London Road,
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Tel: St. Ives (048 06) 4311

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Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.

Performance characteristics are so good they hold their own with any other available system irrespective of price or size.

Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

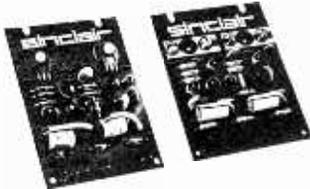
Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control	£4.48
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control etc.	£9.45
20 + 20 W. stereo amplifier for most needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	£23.90
20 + 20 W. stereo amplifier with high performance spkrs.	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc	£26.90
40 + 40 W. R.M.S. de-luxe stereo amplifier	2 x Z.50s, Stereo 60, PZ.8, mains trsfmr	As above	£34.88
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£19.43

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

from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules

Z.30 & Z.50 power amplifiers



The Z.30 and Z.50 are 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 Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications).

Power Outputs

Z.30 15 watts R.M.S. into 8 ohms using 35 volts; 20 watts R.M.S. into 3 ohms using 30 volts.

Z.50 40 watts R.M.S. into 3 ohms using 40 volts; 30 watts R.M.S. into 8 ohms using 50 volts.

Frequency response: 30 to 300,000Hz \pm 1dB.

Distortion: 0.02% into 8 ohms.

Signal to noise ratio: better than 70dB unweighted.

Input sensitivity: 250mV into 100 Kohms.

For speakers from 3 to 15 ohms impedance

Size: 14 x 80 x 57 mm.

Z.30

Built, tested and guaranteed with circuits and instructions manual. **£4.48**

Z.50

Built, tested and guaranteed with circuits and instructions manual. **£5.48**

Project 60 Stereo F.M. Tuner



First in the world to use the phase lock loop principle

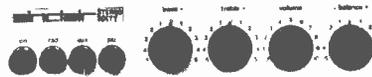
The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an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

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB **Sensitivity:** 2 μ V for 30dB quieting; 7 μ V for lock-in over full deviation. **Squelch level:** 20 μ V. **A.F.C. range:** \pm 200 KHz. **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10 Hz - 15 KHz (\pm 1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2 μ V. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC. **Indicators:** Power on/tuning/stereo. **Size:** 93 x 40 x 207 mm.

£25

Built and tested. Post free.

Stereo 60 Pre-amp/control unit



Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS—Input sensitivities: Radio - up to 3mV. Mag. p.u. 3mV. correct to R.I.A.A curve \pm 1dB; 20 to 25,000 Hz. Ceramic p.u. - up to 3mV; A.L.X. - up to 3mV. **Output:** 250mV.

Signal to noise ratio: better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE \pm 15 to \pm 15dB at 10 KHz; BASS \pm 15 to \pm 15dB at 100Hz.

Front panel: brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

£9.98

Built, tested and guaranteed.

Power Supply Units

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ.5 30 volts un stabilised **£4.98**

PZ.6 35 volts stabilised **£7.98**

PZ.8 45 volts stabilised (less mains transformer) **£7.98**

PZ.8 mains transformer **£5.98**



A.F.U. High & Low Pass Filter Unit



For use between Stereo 60 unit and two Z.30s or Z.50s, and is 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. The A.F.U. is suitable for use with any other amplifier system. Two filter stages - rumble (high pass) and scratch (low pass). 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. Distortion at 1KHz (35V supply) (0.02% at rated output. **Size:** 66 x 40 x 90 mm.

Built tested and guaranteed. **£5.98**

The Sinclair Guarantee

If within 3 months of purchasing Project 60 modules directly 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 service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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Address _____

I enclose cash/cheque/money order.

PW272

Sinclair Q16/Micromatic

Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.

Loading: up to 14 watts RMS.

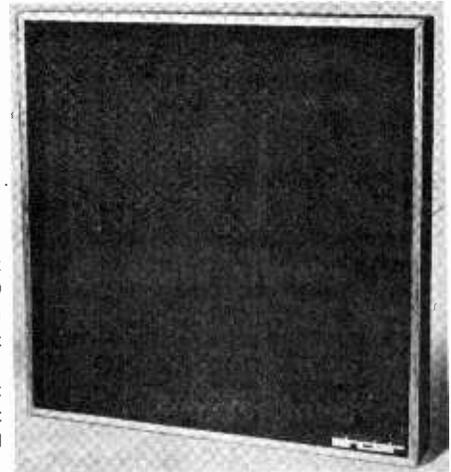
Input Impedance: 8 ohms.

Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.

Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.

Size and styling: 9½ in. square on face x 4½ in. deep with neat pedestal base. Black all over cellular foam front with natural solid teak surround.

Price £8.98.



Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. Powerful AGC counteracts fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided, matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver 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.

Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)

Weight: including batteries, 28.4 gm (1 oz.)

Case: Black plastic with anodised aluminium front panel and spun aluminium dial.

Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).

Earpiece: Magnetic type.

On/off switching: By inserting and withdrawing earpiece plug.

Kit in pack with earpiece, case, instructions and solder **£2.48.**

Ready built, tested and guaranteed, with earpiece **£2.98.**

Two Mallory Mercury batteries type RM675 required from radio shops, chemists, etc.



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Please send _____

Name _____

Address _____

for which I enclose cash/cheque/money order

PW272

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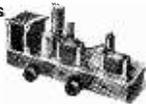
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Complete set of parts for this MW/LW Transistor Radio. Originally sold by world-famous company as a set for more than £17. Coverage 192-550m+1070. 1870m. 9 volt 6 transistor superhet using 3 AF117 in RF and IF stages powered by a two stage AF amplifier using 3 x AC128. Output approx. 500MW. Also works off car-aerial. Full instruction book 121p free with parts. Reel only, ply case, resin covered. Requires PP7 battery, price 221p extra. 3 1/2 in high-quality speaker. Price £6 plus 40p P. & P. Size 8 1/2" x 6" x 3".

STEREO AMPLIFIER Type SHV—2 x 3 watts

Fully built. Separate vol., base and treble controls each channel; 12 x 4 1/2 x 6 in high. EZ80, ECC83. 2 x ECL86 valves. O.P. trans. for 3-ohm speakers. Double wound mains trans. Suitable for crystal, magn. cartridge, tuner, etc. Fitted mono-stereo switch. 200-250V a.c. mains. £7 25, 30p P. & P.



MONO GRAM CHASSIS 3 WATT

3 Wave band long-med-short. Gram., 200-250V A.C. Ferrite aerial. Chassis 13 x 7 x 1 1/2 in. Dial 13 x 4 in. Double wound mains transformer 5 valves ECH81, EF99, EIM81, EL84, EZ80. Price £10 821. (371p p. & p.) Output trans. for 3-ohm speaker



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Postage in bracket
6.3V at 21A, 40p (15p)
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90V at 20mA and 1.4V at 250mA, 50p (15p).
Deduct 10 per cent from total bill for more than one transformer.

Miniature A.M. transistor tuning gang, 250 + 250pf ± 2 x ohm. fixings, size 1 1/2 x 1 1/2 x 1 in; gearing 3:1 to 3/4 in dia. moulded bush. Plastic dust cover; Plessey. 25p post. pd., less 10% for 6.



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66 ELMS ROAD, ALDERSHOT. Hants

(2 mins. from Station and Buses). FULL GUARANTEE. Aldershot 22240
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6 Watt QUALITY STEREO

At a competitive price you can afford

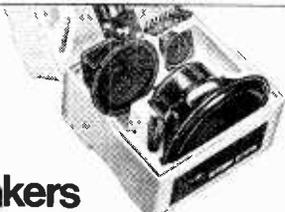


This is a genuine high quality low distortion (0.2%) stereo amplifier incorporating two of the latest Plessey integrated circuit amplifiers each with its own separate 3 transistor pre-amp plus 11 transistor main-amp and built in thyristor protector circuit in case of wiring accidents. With a total maximum power of up to 6 watts r.m.s. (8Ω load 3w/channel), this amplifier has more than enough power to rock the average living room. The circuit features Volume, Balance and tone controls, has a separate on/off switch, and requires only a source of 14v a.c. to be fully operational. Input is designed to suit most crystal pick-ups and frequency response is 50-15KHz. Price £6-25

Also Dual Tone Control Model Price £7-48
Mains transformer for either of the above amplifiers 99p.
and Mini Discotheque three colour lamp driver attachment, has three bright 6w lamps, fun for any party! at £8-20

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200	0.35	0.37	0.57	0.61	0.75	1.60
400	0.43	0.47	0.67	0.75	0.93	1.75
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50	0.40	0.05	0.05	0.07	0.14	0.21	0.47
100	0.04	0.08	0.05	0.13	0.16	0.23	0.75
200	0.05	0.09	0.06	0.14	0.20	0.24	1.00
400	0.06	0.13	0.07	0.20	0.27	0.37	1.25
600	0.07	0.18	0.10	0.23	0.34	0.46	1.35
800	0.10	0.17	0.13	0.25	0.37	0.55	2.00
1000	0.11	0.25	0.15	0.30	0.46	0.63	2.50
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AFV39 PNP GERM. SIEMENS VHF TRANSISTORS. RF MIXER & OSC. UP TO 900 MHz. USE AS REPLACEMENT FOR AF139-AF198 & 100% OF OTHER USES IN VHF. OUR SPECIAL LOW PRICE:—1-24 87p each, 25-99 34p each, 100+ 30p each.

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20,000 TO CLEAR

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ORP12 43p
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300mV 30. .050
40P(V)(Min.) 100. .150
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Full Tested 1,000. .900
Ideal for Organ Builders.

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A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

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2-55V. 400mW TO-7 Case) 13p ea. 14W (Top Hat) 18p ea. 10W (SQ-10 Stud) 25p ea. All fully tested 8% tol. and marked. State voltage required.

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T1 8 2G3713 OC71
T2 8 D1374 OC75
T3 8 D1316 OC81D
T4 8 2G381T OC81
T5 8 2G382T OC82
T6 8 2G344B OC44
T7 8 2G345B OC45
T8 8 2G378 OC78
T9 8 2G399A 2N1302
T10 8 2G417 AF117
All 50p each pak

2N2060 NPN SIL. DUAL TRANS. CODE D1699

TEXAS. Our price 25p each

120 VCB MIXIE DRIVER TRANSISTOR 8m.

BSX21 & C407, 2N1893 FULLY TESTED AND CODED ND 120. 1-24 17p each. TO-5 N.P.N. 25 up 15p each.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqv. ZTX300 5p each. Any Qty.

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AF117 transistors. Large can 4 leads type. Leads cut short but still usable, real value at 15 for 50p.

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SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.	Description	5p
U1	120 Glass sub-min. general purpose germanium diodes	0.50
U2	60 Mixed germanium transistors AF/RF	0.50
U3	75 Germanium gold bonded diodes sim. OA5, OA47	0.50
U4	40 Germanium transistors like OC81, AC128	0.50
U5	60 200mA sub-min. Sil. diodes	0.50
U6	30 Silicon planar transistors NPN sim. BSY95A, 2N708	0.50
U7	16 Silicon rectifiers Top-Hat 750mA up to 1,000V	0.50
U8	50 Sil. planar diodes 250mA, OA/200/202	0.50
U9	20 Mixed volta 1 watt Zener diodes.	0.50
U11	30 PNP silicon planar transistors TO-5 sim. 2N1132	0.50
U13	30 PNP-NPN all. transistors OC290 & 28104	0.50
U14	150 Mixed silicon and germanium diodes	0.50
U15	25 NPN Silicon planar transistors TO-5 sim. 2N697	0.50
U16	10 3-Amp silicon rectifiers stud type up to 1000 PIV	0.50
U17	30 Germanium PNP AF transistors TO-5 like ACY 17-22	0.50
U18	8 6-Amp silicon rectifiers BYZ13 type up to 600 PIV	0.50
U19	25 Silicon NPN transistors like BC108	0.50
U20	12 1.5 Amp silicon rectifiers Top-Hat up to 1,000 PIV	0.50
U21	39 A.F. germanium alloy transistors 2G300 series & OC71	0.50
U23	30 Mull's like MAT series PNP transistors	0.50
U24	20 Germanium 1-Amp rectifiers GJM up to 300 PIV	0.50
U25	25 300 Mc/s NPN silicon transistors 2N708, BBY27	0.50
U26	30 Fast switching silicon diodes like IN914 micro-fin	0.50
U29	10 1-Amp SCR's TO-5 can up to 600 PIV CR81/25-600	1.00
U31	20 Sil. Planar NPN trans. low noise amp 8N3707	0.50
U32	25 Zener diodes 400mW D07 case mixed volta, 3-18.	0.50
U33	51 Plastic case 1 amp silicon rectifiers IN4000 series	0.50
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 28302/4	0.50
U35	25 Sil. planar trans. PNP TO-18 2N2906	0.50
U36	25 Sil. planar PNP trans. TO-5 BFY50/51/52	0.50
U37	30 Sil. alloy trans. SO-2 PNP. OC200 28322	0.50
U38	20 Fast switching sil. trans. NPN, 400Mc/s 2N3011	0.50
U39	30 RF gerin. PNP trans. 2N1303 5 TO-5	0.50
U40	10 Dual trans. 6 lead TO-5 2N2060.	0.50
U41	25 RF germ. trans. TO-1 OC45 NKT72	0.50
U42	10 VHF germ. PNP trans. TO-1 NKT987, AF117	0.50
U43	25 Sil. trans. plastic TO-18 A.F. BC131/114	0.50
U44	20 Sil. trans. plastic TO-5 BC115/116	0.50
U45	7 3A SCR's TO-66 up to 600 Piv.	1.00

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

NEW QUALITY TESTED PAKS

Pak Description	Price 5p
Q1 20 Red spot trans. PNP AF	0.50
Q2 16 White spot R.F. trans. PNP	0.50
Q3 4 OC77 type trans.	0.50
Q4 6 Matched trans. OC44/45/81/81D	0.50
Q5 4 OC75 transistors	0.50
Q6 4 OC72 transistors	0.50
Q7 4 AC128 trans. PNP high gain	0.50
Q8 4 AC126 trans. PNP	0.50
Q9 7 OC81 type trans.	0.50
Q10 7 OC71 type trans.	0.50
Q11 2 AC127/128 comp. pairs PNP/NPN	0.50
Q12 3 AF114 type trans.	0.50
Q13 3 AF117 type trans.	0.50
Q14 3 OC171 H.F. type trans.	0.50
Q15 5 2N2926 all. epoxy trans.	0.50
Q16 2 (ET880 low noise germ. trans.	0.50
Q17 3 NPN 1 8T141 & 2 8T140	0.50
Q18 4 Madic's 2 MAT 100 & 2 MAT 190	0.50
Q19 3 Madic's 2 MAT 101 & 1 MAT 121	0.50
Q20 4 OC45 trans. A.F.	0.50
Q21 3 AC127 NPN germ. trans.	0.50
Q22 20 NKT trans. A.F. R.F. code	0.50
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Q24 8 OA81 diodes.	0.50
Q25 6 IN914 sil. diodes 75PIV 75mA	0.50
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Q28 2 8il. power rect. BYZ13	0.50
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Q30 7 8il. switch trans. 2N706 PNP	0.50
Q31 6 8il. switch trans. 2N708 NPN	0.50
Q32 3 PNP all. trans. 2 x 2N1131, 1 x 2N1132	0.50
Q33 3 8il. NPN trans. 2N1711	0.50
Q34 7 8il. NPN trans. 2N2369, 500MHZ	0.50
Q35 3 Sil. PNP TO-5 2 x 2N2904 & 1 x 2905	0.50
Q36 7 2N3548 TO-18 plastic 300MHZ	0.50
Q37 5 2N3055 NPN sil. trans.	0.50
Q38 7 PNP trans. 4 x 2N3703, 3 x 2N3702	0.50
Q39 7 NPN trans. 4 x 2N3704, 3 x 2N3705	0.50
Q40 7 NPN trans. 4 x 2N3707, 3 x 2N3708	0.50
Q41 3 Planar NPN TO-18 2N3904	0.50
Q42 6 NPN trans. 2N5172	0.50
Q43 7 BC107 NPN trans.	0.50
Q44 7 NPN trans. 4 x BC108, 3 x BC109	0.50
Q45 3 BC113 NPN TO-18 trans.	0.50
Q46 3 BC115 NPN TO-5 trans.	0.50
Q47 6 NPN high gain 3 x BC167, 3 x BC168	0.50
Q48 4 BCV70 NPN trans. TO-18	0.50
Q49 4 NPN trans. 2 x BFY51, 2 x BFY52	0.50
Q50 7 BSY28 NPN switch TO-18	0.50
Q51 7 BSY95A NPN trans. 300MHZ	0.50
Q52 8 BY100 type sil. rect.	1.00
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OC22 30p OC29 40p AL102 85p BD132 80p BD140 85p
OC23 83p OC35 33p AL103 85p BD133 70p BD155 75p
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BP01 = 7401	Quad 2-input pos. NAND gate (with open collector output)	0.15	0.14	0.12
BP02 = 7402	Quad 2-input pos. NOR gates	0.15	0.14	0.12
BP03 = 7403	Quad 2-input pos. NAND gates (with open collector output)	0.15	0.14	0.12
BP04 = 7404	Hex Inverters	0.15	0.14	0.12
BP05 = 7405	Hex Inverter (with open-collector output)	0.15	0.14	0.12
BP10 = 7410	Triple 3-input pos. NAND gates	0.15	0.14	0.12
BP13 = 7413	Dual 4-input Schmitt trigger	0.29	0.26	0.24
BP20 = 7420	Dual 4-input pos. NAND gates	0.15	0.14	0.12
BP30 = 7430	8-input pos. NAND gates	0.15	0.14	0.12
BP40 = 7440	Dual 4-input pos. NAND buffers	0.15	0.14	0.12
BP41 = 7441	BCD to decimal trix driver	0.67	0.64	0.58
BP42 = 7442	BCD to decimal decoder (4-10 lines, BCD to 10)	0.67	0.64	0.58
BP46 = 7446	BCD-to-seven-segment decoder/driver (15V outputs)	2.00	1.75	1.50
BP47 = 7447	BCD-to-seven-segment decoder/drivers (15V outputs)	0.97	0.94	0.88
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BP50 = 7450	Expandable dual 2-input and-or-invert	0.15	0.14	0.12
BP51 = 7451	Dual 2-wide 2-input and-or-invert gates	0.15	0.14	0.12
BP63 = 7453	Quad 2-input expandable and-or-invert	0.15	0.14	0.12
BP64 = 7454	4-wide 2-input and-or-invert gates	0.15	0.14	0.12
BP60 = 7460	Dual 4-input expander	0.15	0.14	0.12
BP79 = 7479	Single-base J-K flip-flop	0.29	0.26	0.24
BP72 = 7472	Master slave J-K flip-flop	0.29	0.26	0.24
BP73 = 7473	Dual Master slave J-K flip-flop	0.37	0.35	0.32
BP74 = 7474	Dual D type flip-flop	0.37	0.35	0.32
BP75 = 7475	Quad latch	0.47	0.45	0.42
BP76 = 7476	Dual J-K with pre-set and clear	0.43	0.40	0.38
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BP81 = 7481	16-bit read/write memory	0.97	0.94	0.88
BP82 = 7482	2-bit binary full adders	0.97	0.94	0.88
BP83 = 7483	Quad full adder	1.10	1.05	0.95
BP86 = 7486	Quad 2-input exclusive NOR gates	0.32	0.30	0.28
BP90 = 7490	BCD decade counter	0.87	0.84	0.78
BP91 = 7491	8-bit shift registers	0.87	0.84	0.78
BP92 = 7492	Divide-by-two counters	0.67	0.64	0.58
BP93 = 7493	4-bit binary counters	0.67	0.64	0.58
BP94 = 7494	Dual entry 4-bit shift register	0.77	0.74	0.68
BP95 = 7495	4-bit up-down shift register	0.77	0.74	0.68
BP96 = 9496	5-bit parallel in parallel out shift-register	0.77	0.77	0.68
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BP104 = 74104	Single J-K flip-flop equivalent 9000 series	0.97	0.94	0.88
BP105 = 74105	Single J-K flip flop equivalent 9001 series	0.97	0.94	0.88
BP107 = 74107	Dual Master slave flip-flops	0.40	0.38	0.36
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BP111 = 74111	Dual data lock-out flip-flop	1.25	1.15	1.00
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BP141 = 74141	BCD-to-decimal decoder/driver	0.87	0.84	0.88
BP145 = 74145	BCD-to-decimal decoder/driver O/C	1.50	1.40	1.30
BP150 = 74150	16-bit data selector	1.80	1.70	1.60
BP151 = 74151	8-bit data selectors (with strobe)	1.00	0.95	0.90
BP152 = 74152	Dual 4-line-to-1-line data	1.20	1.10	0.95
BP154 = 74154	4- to 16-line decoder	1.80	1.70	1.60
BP155 = 74155	Dual 2- to 4 line decoder	1.40	1.30	1.20
BP156 = 74156	Dual 2- to 4-line decoder O/C	1.40	1.30	1.20
BP180 = 74180	Sync. decade counter	1.80	1.70	1.60
BP161 = 74161	Sync. 4-bit binary counter	1.80	1.70	1.60
BP190 = 74190	Sync. up-down BCD counter	3.50	3.25	3.00
BP191 = 74191	Sync. binary up-down counter (single clock line)	3.50	3.25	3.00
BP192 = 74192	Sync. up-down decade counter	2.10	1.95	1.75
BP193 = 74193	Sync. binary up-down counter (two clock lines)	2.10	1.95	1.55
BP196 = 74196	Pre-settable 80MHz decade counter	1.80	1.70	1.60
BP197 = 74197	Pre-settable 80MHz binary counter	1.80	1.70	1.60
BP198 = 74198	8-bit parallel L-R shift register	5.50	5.00	4.00
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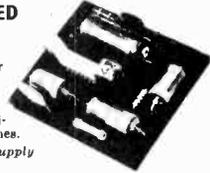
Devices may be mixed to qualify for quantity price. Larger quantities—prices on application (TTL 74 Series only).
Data is available for the above series of I.C.'s in booklet form. Price 18p.
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BP 701C—8L701C	TO-5	8	OP Amp	88p	50p	45p
BP 702C—8L702C	TO-5	8	OP Amp Direct OP	83p	50p	45p
BP 702—72702	D.I.L.	14	G.P. OP Amp Wide Band	53p	45p	40p
BP 709—72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P— μ A709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP 710—72710	D.I.L.	14	Differential comparator	53p	45p	40p
BP 711— μ A711	TO-5	10	Dual comparator	53p	50p	45p
BP 741—72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
μ A 703C— μ A703C	TO-5	6	R.F.—I.F. Amp	47p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	55p
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TAA 350	TO5	8	Wide band limiting amplifier	170p	158p	150p

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Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

NOTE THESE PRICES!

Type No.	Function	Price		
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BP930	Expandable dual 4-input NAND	23p	20p	15p
BP932	Expandable dual 4-input NAND buffer	25p	23p	20p
BP933	Dual 4-input expander	25p	23p	20p
BP935	Expandable Hex inverter	25p	23p	20p
BP936	Hex Inverter	25p	23p	20p
BP944	Dual 4-input NAND expandable buffer without pull-up	25p	23p	20p
BP945	Master-slave JK or RS	35p	32p	29p
BP946	Quad, 2 input NAND	23p	20p	15p
BP948	Master-slave JK or RS	35p	32p	29p
BP951	Monostable	90p	85p	80p
BP962	Triple 3 input NAND	23p	20p	15p
BP9098	Dual Master-slave JK with separate clock	80p	75p	70p
BP9094	Dual Master-slave JK with separate clock	80p	75p	70p
BP9097	Dual Master-slave JK with Common Clock	80p	75p	70p
BP9099	Dual Master-slave JK Common Clock	80p	75p	70p

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

DTL & TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C.'s and experimental work.

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UIC930 = 12 x μ A 930	50p	UIC946 = 8 x μ A 946	50p
UIC932 = 12 x μ A 932	50p	UIC961 = 8 x μ A 961	50p
UIC933 = 12 x μ A 933	50p	UIC961 = 8 x μ A 961	50p
UIC935 = 12 x μ A 935	50p	UIC9093 = 5 x μ A 9093	50p
UIC936 = 12 x μ A 936	50p	UIC9094 = 5 x μ A 9094	50p
UIC944 = 12 x μ A 944	50p	UIC9097 = 5 x μ A 9097	50p
UIC945 = 8 x μ A 945	50p	UIC9099 = 5 x μ A 9099	50p
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UIC02 = 12 x 7402N	50p	UIC48 = 5 x 7448N	50p	UIC83 = 5 x 7483N	50p
UIC03 = 12 x 7303N	50p	UIC50 = 12 x 7450N	50p	UIC84 = 5 x 7484N	50p
UIC04 = 12 x 7404N	50p	UIC51 = 12 x 7451N	50p	UIC85 = 5 x 7485N	50p
UIC05 = 12 x 7405N	50p	UIC53 = 12 x 7453N	50p	UIC86 = 5 x 7486N	50p
UIC10 = 12 x 7410N	50p	UIC54 = 12 x 7454N	50p	UIC87 = 5 x 7487N	50p
UIC13 = 8 x 7413N	50p	UIC70 = 12 x 7460N	50p	UIC89 = 5 x 7489N	50p
UIC20 = 12 x 7420N	50p	UIC72 = 8 x 7472N	50p	UIC94 = 5 x 7494N	50p
UIC40 = 12 x 7440N	50p	UIC73 = 8 x 7473N	50p	UIC95 = 5 x 7495N	50p
UIC41 = 5 x 7441N	50p	UIC74 = 8 x 7474N	50p	UIC96 = 5 x 7496N	50p
UIC42 = 5 x 7442N	50p	UIC75 = 8 x 7475N	50p	UIC121 = 5 x 74121N	50p
UIC43 = 5 x 7443N	50p	UIC76 = 8 x 7476N	50p	UICX1 = 26 x Ass'd	74's \$1.50
UIC44 = 6 x 7444N	50p	UIC77 = 8 x 7477N	50p		
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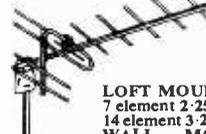
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 40-41 MONARCH PARADE, LONDON ROAD, MITCHAM, SURREY
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BARGAIN PARCELS 14lb at £1-45 plus 32p p.p.: 28lb at £2-75 plus 52p p.p.: 56lb at £4-50 plus £1-25 p.p. Contain pots, Res, Valves, Diodes, Tagboards, Chassis, Valveholders, etc. Good value save £££. Lucky Dip Service.

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**Alba UA700	£34.50	£24.00
**Metrosound ST20E	£39.50	£27.50
**Rotel 310	£45.00	£32.00
*Rogers Ravensbrook 2	£52.50	£40.00
**Armstrong 521	£56.00	£45.00
*Leak 30+	£62.50	£44.00
*Rogers Ravensbourne	£64.00	£49.00
*Leak 70	£75.00	£54.00
CARRIAGE £1.00		

	Rec. Retail	Our Price
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*R. Allen Flamenco/pr.	£59.26	£46.00
*New Leak 250/pr.	£65.00	£48.00
*R. Allen Pavane/pr.	£70.50	£49.00
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*Wharfedale Dovedale 3/pr.	£90.00	£65.00
CARRIAGE £1.00		

	Rec. Retail	Our Price
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*Goldring G850 Dia.	£6.27	£4.00
*Goldring G800 Dia.	£12.55	£6.50
*Shure M44.7 Dia.	£9.84	£7.50
*Goldring G800E Dia.	£18.16	£11.00
*Shure M55E Dia.	£12.52	£9.50
*Shure M75E/2 Dia.	£20.57	£14.00
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	Rec. Retail	Our Price
TURNABLES		
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**McDonald MP60	£15.20	£10.50
*Goldring GL69/2	£27.60	£19.50
**Goldring GL69/2/P	£36.21	£26.00

	Rec. Retail	Our Price
*Connoisseur BD2/SAU2	£31.00	£25.00
*Connoisseur BD2/SAU2/P/C	£38.00	£33.00
*Goldring GL75	£40.15	£30.00
**Goldring GL75P	£48.76	£36.00
*Garrard 401/3009/2 arm	£71.26	£53.00
PI Spacer and Mtg. Board	£6.00	£4.00
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with G850 Cartridge ... **£17.00**
with G800 Cartridge ... **£19.50**
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	Rec. Price	Retail Price	Comet Price
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ALBA UA 700	34.50	24.95	
ALPHA 212 By Highgate	36.75	26.95	
AMSTRAD Stereo 8000 Mk 2	27.95	17.95	
AMSTRAD J.C. 2000	42.95	27.95	
ARMSTRONG 521	59.00	44.95	
DULCI 207	26.00	16.95	
DULCI 207M	32.00	19.95	
FERROGRAPH F307 Mk. II (cased)	64.00	46.95	
FERROGRAPH F307 MII (Metalcase)	60.00	43.95	
GOODMANS Maxamp	54.00	37.95	
LEAK Delta 30 (cased)	85.00	51.95	
LEAK Delta 70 (cased)	79.50	63.95	
METRO SOUND ST20E	39.50	27.95	
METRO SOUND ST60	70.00	49.95	
PHILIPS RH 591	79.00	54.95	
PHILIPS RH 590	52.00	36.95	
PHILIPS RH 580	29.00	19.95	
PIONEER SA500	53.62	38.95	
PIONEER SA600	83.75	59.95	
PIONEER SA700	97.97	66.95	
PIONEER SA800	109.21	75.95	
PIONEER SA900	133.83	93.95	
PIONEER SA1000	137.56	95.95	
PIONEER Reverberation 202	46.35	33.95	
RANK Rotel 310	47.50	35.95	
RANK Rotel 610	74.50	53.95	
RANK ROTEL 210	34.90	24.95	
ROGERS Ravensbourne	59.50	42.95	
ROGERS Ravensbourne (cased)	64.00	47.95	
ROGERS Ravensbrook Mk. II	47.50	36.95	
ROGERS Ravensbrook (cased) Mk. II	52.50	39.95	
SINCLAIR 2000	35.00	23.75	
SINCLAIR Project 60/2 x Z30/PZ5	23.90	15.95	
SINCLAIR PROJECT 60/2 x Z50/			
PZ8/trans	34.86	23.25	
SINCLAIR PROJECT 605	29.95	21.95	
SINCLAIR AFU	5.95	4.45	
SINCLAIR Neoteric	61.95	43.95	
SINCLAIR 3000	45.00	31.50	
TELETON SAQ 206	32.50	18.25	
VOLTEX 100w. Stereo Discotheque,	185.00	139.00	
8 electronically mixed inputs			
WHARFEDALE Linton Amplifier	60.00	47.95	
All take both ceramic and magnetic cartridges.			
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*ARMSTRONG 524 FM	42.17	33.95	
ARMSTRONG M8 Decoder	9.50	7.70	
*DULCI FMT. 7 FM	25.10	17.95	
DULCI FMT. 7S Stereo	33.79	27.25	
GOODMANS Stereomax	80.07	47.95	
LEAK Delta FM	75.00	58.95	
LEAK Delta AM/FM	89.50	69.50	
PHILIPS RH 690	45.30	36.50	
PHILIPS RH 691	85.80	69.95	
PIONEER TX500 AM/FM	66.09	57.95	
PIONEER TX900 AM/FM	147.15	118.00	
RANK ROTEL 320	54.94	43.95	
ROGERS Ravensbourne chassis	59.63	46.95	
ROGERS Ravensbourne in teak case	64.45	48.95	
ROGERS Ravensbrook chassis	43.37	34.95	
ROGERS Ravensbrook (cased)	49.39	38.95	
SINCLAIR 2000	45.90	33.95	
SINCLAIR Project 60 Tuner (stereo)	25.00	19.95	
TELETON GT 101	43.93	30.95	
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TUNER/AMPLIFIERS			
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AKAI 6600	137.34	108.00	
AKAI 6300	128.85	99.95	
AKAI 6200	91.56	79.95	
ARENA 2600	111.30	69.95	
ARENA 2700	88.63	73.95	
ARENA T9000	303.45	285.00	
ARMSTRONG M8 Decoder	9.50	7.70	
ARMSTRONG 525	92.77	71.95	
ARMSTRONG 526	105.75	84.95	
GOODMANS Module 80, 35w. RMS	91.59	71.95	
GOODMANS Module 80 Compact	165.00	129.00	
GOODMANS Model 110 FM/MV/LW/SW 100W RMS	135.00	108.00	
LEAK Delta 75	165.00	139.95	
MIDLAND 18/542	49.43	37.50	
PHILIPS 882 with stereo cas./rec.	95.50	76.95	
PHILIPS RH 790	134.00	79.95	
PIONEER SX770 AM/FM	139.23	109.95	
PIONEER SX990 AM/FM	167.83	129.95	
PIONEER 440	104.18	82.95	
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TANDBERG 1171	110.00	91.95	
TANDBERG TR200	99.00	82.95	
TELETON F2000	51.50	28.95	
TELETON T7A T20	119.75	69.95	
TELETON 10/T1 150w. RMS	160.00	94.00	
TELETON TFS50	79.65	52.95	
TELETON TFS50 LA MW/LW/FM	86.64	60.95	
TELETON CR55	125.26	67.95	
WHARFEDALE 100-1	139.00	89.95	
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F2000 which takes ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

	Rec. Price	Retail Price	Comet Price
CARTRIDGES			
AUDIO TECHNICA AT66	6.47	4.50	
GOLDRING 800	12.35	8.75	
GOLDRING 800E	18.16	10.50	
GOLDRING 800 Super E	25.10	15.95	
*GOLDRING CS90 Stereo	5.02	4.10	
*GOLDRING CS91E	7.53	6.00	
GOLDRING G850	6.27	3.95	
EMPIRE 1000ZE/X	60.34	51.25	
EMPIRE 999E/X	43.00	34.95	
EMPIRE 999TE/X	28.69	21.00	
EMPIRE 999SE/X	20.31	16.95	
EMPIRE 999E/X	15.89	12.50	
EMPIRE 999I/X	12.55	10.25	
EMPIRE 909E/X	12.37	9.95	
EMPIRE 909I/X	9.26	7.75	
EMPIRE 909E/X	9.56	7.95	
ORBIT Magnetic NM 22	Special Price	2.95	
ORTOFON SL15E	28.62	22.95	
ORTOFON 2 x 15K Transformer	7.00	4.95	
ORTOFON M15E	29.08	23.50	
SHURE M3DM	7.16	4.75	
SHURE M31E	11.63	8.70	
SHURE M32E	10.73	8.05	
SHURE M32-3	9.84	7.80	
SHURE M44-5	10.73	7.19	
SHURE M44-7	9.84	7.15	
SHURE M44E	9.84	7.15	
SHURE M55E	12.52	8.95	
SHURE M75G	16.99	13.75	
SHURE M75-6	16.10	12.45	
SHURE M75EJ	18.78	14.95	
SHURE M75E	20.57	13.50	
SHURE V15-11	39.35	27.95	
Starred cartridges above are ceramic. All others are magnetic.			
PICKUP ARMS			
GOLDRING Lenco 75	13.98	9.50	
GOLDRING Lenco L69	10.04	6.50	
SME 3009 with S2 Shell	33.26	24.95	
SME 3012 with S2 Shell	35.42	26.45	
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The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.			
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GARRARD SP25 Mk III with Shure M.44.7	Special Price	£22.95	
GARRARD SP25 Mk III with Shure M.55E	Special Price	£23.95	
GARRARD AP76 with Goldring G800	Special Price	£32.95	
GARRARD AP76 with Shure M55E	Special Price	£35.95	
GARRARD AP76 with Shure M75EJ	Special Price	£39.95	
GARRARD 2025 with Sonotone 9T4HC	Special Price	£14.50	
GOLDRING 705/P with G850 26-00	£16.95		
GOLDRING GL75 with G800	Special Price	£39.95	
GARRARD SP25 Mk III	15.85	9.95	
GARRARD SL65 B	20.48	13.45	
GARRARD SL95 B	49.23	32.95	
GARRARD 401	39.26	27.45	
GARRARD SL72 B	31.83	23.95	
GARRARD Zero 100A	56.25	42.95	
GARRARD Zero 100S	51.75	41.95	
Base and Cover to fit GARRARD SP25, SL55, SL65B	Special Price	3.95	
GARRARD 40B	13.34	10.49	
GARRARD AP76	27.85	18.90	
GOLDRING GL69 Mk. II	27.60	19.50	
GOLDRING GL69P Mk. II	36.21	28.95	
GOLDRING GL75	40.15	28.95	

	Rec. Price	Retail Price	Comet Price
GOLDRING GL75P	48.76	35.95	
GOLDRING Covers for 69P and 75P	4.48	3.75	
GOLDRING C99—plinth and cover for G99	11.05	9.75	
GOLDRING G99	26.89	19.95	
GOLDRING G101P	28.68	22.95	
GOLDRING GL72 Chassis	28.68	22.95	
GOLDRING GL72P	37.29	29.95	
GOLDRING GL85	62.74	47.95	
GOLDRING GL85P	72.78	55.95	
GOODMANS 3025	37.74	21.95	
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DECCA Sound 613	70.14	57.95	57.95
DECCA Sound 614	66.55	54.95	54.95
DECCA Sound 1204	89.44	72.95	72.95
DECCA Compact 3	119.56	103.95	103.95
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FIDELITY UA1 Music Master with radio	103.29	79.97	79.97
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HMV 2450 with stereo radio	134.20	109.00	109.00
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PHILIPS GF 831	67.10	52.95	52.95
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GOODMANS Trebax 100	8.60	5.50	5.50
GOODMANS Axent 100	6.90	4.95	4.95
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WHARFEDALE 8in. Bronze RS/DD	4.82	3.50	3.50
WHARFEDALE Super 8/RS/DD	8.19	6.75	6.75
WHARFEDALE Super 10/RS/DD	11.20	9.50	9.50
WHARFEDALE WMT1 Matching Transformer	0.84	0.70	0.70
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AMSTRAD Stereo 1000	48.00	36.95	36.95
DECCA Sound 613	70.14	57.95	57.95
DECCA Sound 614	66.55	54.95	54.95
DECCA Sound 1204	89.44	72.95	72.95
DECCA Compact 3	119.56	103.95	103.95
FERGUSON 3423	114.15	89.95	89.95
FERGUSON 3425 with radio	140.10	109.00	109.00
FERGUSON 3450 with radio	72.40	61.95	61.95
FERGUSON 3451	99.50	79.95	79.95
FIDELITY UA2 Music Master	44.41	34.95	34.95
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GOODMANS Module 80 Compact System FM/35W. R.M.S. (less L/S)	165.00	129.00	129.00
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H.M.V. 2404/5/6 with radio	198.00	153.00	153.00
HMV 2452	65.65	54.95	54.95
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MARCONI 4450 with radio	72.40	56.95	56.95
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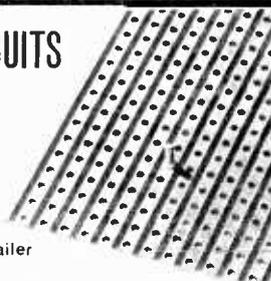
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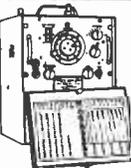
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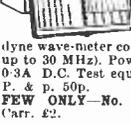
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EM81	0.50	PCF801	0.50	QQV03-15	1.25	UF9	0.60
EM84	0.35	PCF802	0.50	QQV03-20A	1.25	UF11	0.60
EM85	1.00	PCF805	0.70	QQV06-40A	5.25	UF41	0.60
EM87	0.70	PCF806	0.75	UF42	0.60	UF43	0.60
EN91	0.38	PCF808	0.85	UF43	0.60	UF80	0.40
EY51	0.40	PCL2000.70		TT21	2.50	UF82	0.40
EY80	0.55	PCL81	0.50	TT22	3.60	UF85	0.40
EY81	0.40	PCL82	0.85	TT2-125		UF89	0.40
EY83	0.55	PCL83	0.65	UL41	0.65		
EY86	0.40	PCL84	0.45	U18-20	7.75	UL84	0.40
EY87	0.43	PCL85	0.40	U25	0.80	UM84	0.25
EY88	0.43	PCL86	0.45	U26	0.80	UY18	0.50
EY89	0.55	EZ40	0.60	PCL801	0.93	UY11	1.00
EZ41	0.50	PCL801	0.75	U37	2.10	UY41	0.48
EZ80	0.27	PD500	1.30	U52	0.35	UY82	0.50
EZ81	0.29	PF86	0.65	U76	0.35	UY85	0.40
GY501	0.80	PF86	0.65	U78	0.35	W729	0.75
GZ30	0.40	PF818	0.55	U79	0.35	Z739	0.00
GZ31	0.35	PF200	0.65	U91	0.75	Z803U	1.20
GZ32	0.48	PL33	0.35	U201	0.35		

TRANSISTORS

2N696	0.17	AC127	0.20	BD123	0.80
2N697	0.17	AC128	0.15	BD131	0.85
2N698	0.30	AC132	0.35	BD132	0.85
2N705	0.70	AC130	0.20	BF116	0.20
2N706	0.15	AC154	0.15	BF119	0.18
2N708	0.15	AC157	0.20	BF173	0.20
2N753	0.25	AC169	0.10	BF179	0.30
2N929	0.22	AC176	0.25	BF180	0.35
2N930	0.25	AC187	0.30	BF181	0.25
2N947	0.30	AC188	0.30	BF184	0.25
2N1131	0.25	ACV17	0.275	BF185	0.25
2N1132	0.25	ACV18	0.20	BF184	0.15
2N1184	1.25	ACV19	0.25	BF195	0.15
2N1301	0.40	ACV20	0.20	BF196	0.20
2N1802	0.75	ACV21	0.20	BF197	0.20
2N1804	0.25	ACV22	0.15	BF200	0.35
2N1905	0.25	AD140	0.20	BFW87	0.20
2N1906	0.25	AD149	0.50	BFW88	0.25
2N1907	0.30	AD161	0.35	BFW89	0.20
2N1908	0.25	AD162	0.35	BFW91	0.20
2N1909	0.30	ADZ11	1.25	BFX88	0.25
2N1913	0.22	ADZ12	1.25	BFY17	0.40
2N1911	0.25	BF119	0.20	BFY19	0.50
2N1916	0.75	BF115	0.20	BFY50	0.25
2N2147	0.75	BF116	0.20	BFY51	0.20
2N2160	0.65	AF117	0.20	BFY52	0.25
2N2217	0.30	AF118	0.45	BSY26	0.20
2N2218	0.30	AF119	0.25	BSY27	0.20
2N2219	0.35	AF120	0.20	BSY28	0.20
2N2369A	0.20	AF180	0.35	BSY65	0.20
2N2477	0.65	AF181	0.35	BSY95A	0.15
2N2646	0.65	AF186	0.40	OC16	0.50
2N2905	0.35	AF239	0.40	OC22	0.50
2N2923	0.15	AFZ11	0.45	OC23	0.60
2N2924	0.15	AFZ26	0.25	OC24	0.60
2N2926	0.125	ASY27	0.30	OC25	0.35
2N3053	0.25	ASY28	0.25	OC26	0.25
2N3054	0.60	ASY29	0.30	OC28	0.80
2N3055	0.75	ASY84	0.25	OC29	0.60
2N3133	0.30	ASZ15	0.70	OC30	0.75
2N3134	0.30	ASZ16	0.65	OC35	0.60
2N3391	0.20	ASZ17	0.75	OC36	0.60
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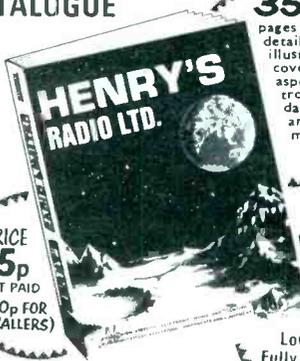
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