# PRACTICAL WIRELESS

MAY 1970

3/6

## DECODER for STEREO f.m. transmissions

also:

AERIALS FOR MOBILES

3 BAND RECEIVER

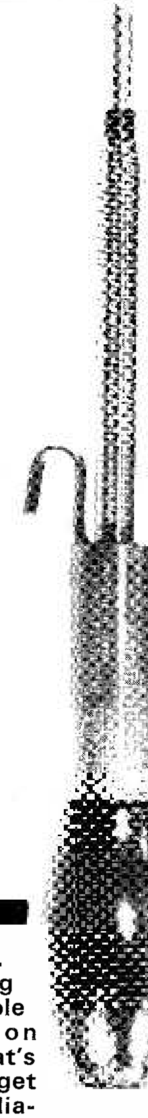
GOING HI-FI

# ADCOLA Soldering Instruments add to your efficiency

## ADCOLA 64

for Factory Bench Line Assembly

A precision instrument—supplied with standard 3/16″ (4.75 mm) diameter, detachable copper chisel-face bit*.
Standard temp. 360°c at 23 watts.
Special temps. from 250°c—410°c.



### *Additional Stock Bits
(illustrated) available

COPPER

B 38 ⅛″ — 3.2 mm CHISEL FACE

B 14 3/32″ — 2.4 mm CHISEL FACE

B 24 3/16″ — 4.75 mm SCREWDRIVER FACE

B 12 3/16″ — 4.75 mm EYELET BIT

B 58 ¼″ — 6.34 mm CHISEL FACE

LONG LIFE

B 42 LL 3/16″ — 4.75 mm CHISEL FACE

B 38 LL ⅛″ — 3.2 mm CHISEL FACE

B 14 LL 3/32″ — 2.4 mm CHISEL FACE

B 44 LL 3/16″ — 4.75 mm SCREWDRIVER FACE

**Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service . . . reliability . . . from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.**

ADCOLA
Regd. Trade Mark.

* *Write for price list and catalogue*

**ADCOLA PRODUCTS LTD.,**
(Dept. M), ADCOLA HOUSE, GAUDEN RD., LONDON, S.W.4.
Telephone: 01-622 0291/3 · Telegrams: Soljoint London Telex ·Telex: Adcola London 21851

# SEMICONDUCTORS

**BRAND NEW AND FULLY GUARANTEED**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1N914 | 1/6 | 2N2906 | 6/- | ACY28 | 4/- | BD121 | 17/6 | MJ481 | 27/6 |
| 1N916 | 1/6 | 2N2906 | 6/6 | AD140 | 8/- | BD123 | 21/6 | MJ490 | 22/6 |
| 1S021 | 4/- | 2N2923 | 3 6 | AD149 | 11/6 | BD124 | 12/- | MJ491 | 29/6 |
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| 2G301 | 4/- | 2N3054 | 12/6 | AF126 | 4/- | BFX12 | 4/6 | NKT262 | 4/- |
| 2G302 | 4/- | 2N3055 | 15/- | AF127 | 3/6 | BFX13 | 4/6 | NKT264 | 4/- |
| 2G303 | 4/- | 2N3702 | 3/6 | AF139 | 7/6 | BFX29 | 12/6 | NKT271 | 4/- |
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| 2N 711 | 6/6 | 2N4288 | 3/6 | BC148 | 3/6 | BSX20 | 3/6 | OA85 | 1/6 |
| 2N1889 | 6/6 | 2N4289 | 3/6 | BC149 | 3/6 | BSX21 | 7/6 | OA90 | 1/6 |
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| 2N2147 | 14/6 | 40361 | 12/6 | BC168C | 3/9 | BSX28 | 6/- | OA200 | 2/- |
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| 2N2193 | 5/6 | 3N140 | 19/6 | BC182L | 4/6 | BSY27 | 4/- | OC28 | 10/6 |
| 2N2193A | 5/6 | 3N141 | 21/6 | BC212L | 5/- | BSY28 | 4/- | OC29 | 15/- |
| 2N2194A | 5/6 | 3N142 | 16/6 | BCY30 | 5/6 | BSY29 | 4/- | OC35 | 6/6 |
| 2N2217 | 5/6 | AAZ13 | 2/- | BCY31 | 5/6 | BSY38 | 4/6 | OC36 | 6/6 |
| 2N2218 | 6/6 | AAZ15 | 2/6 | BCY32 | 7/6 | BSY39 | 4/6 | OC44 | 4/- |
| 2N2219 | 6/6 | AAZ17 | 2/6 | BCY33 | 4/- | BSY40 | 6/6 | OC45 | 2/6 |
| 2N2220 | 5/- | AC107 | 6/- | BCY34 | 4/6 | BSY51 | 8/6 | OC71 | 2/6 |
| 2N2221 | 5/- | AC126 | 4/- | BCY38 | 4/6 | BSY52 | 9/- | OC72 | 2/6 |
| 2N2222 | 6/6 | AC127 | 5/- | BCY39 | 7/6 | BSY53 | 8/6 | OC75 | 4/6 |
| 2N2368 | 5/- | AC128 | 4/- | BCY40 | 6/6 | BSY54 | 10/6 | OC81 | 4/- |
| 2N2369 | 3/- | AC176 | 5/- | BCY42 | 3/- | BSY95A | 2/6 | OC83 | 4/6 |
| 2N2369A | 5/6 | AC187 | 12/- | BCY43 | 3/- | BY100 | 4/6 | OC81D | 4/6 |
| 2N2539 | 4/6 | AC188 | 12/- | BCY54 | 7/6 | BYX10 | 5/6 | OC84 | 5/- |
| 2N2540 | 4/6 | ACY17 | 5/- | BCY70 | 4/6 | BYZ10 | 9/- | OC139 | 6/6 |
| 2N2646 | 11/6 | ACY18 | 5/- | BCY71 | 8/6 | BYZ11 | 7/6 | OC140 | 6/6 |
| 2N2904 | 8/- | ACY19 | 5/- | BCY72 | 4/- | BYZ12 | 6/- | OC200 | 6/6 |
| 2N2904A | 8/- | ACY20 | 5/- | BDY20 | 25/6 | BYZ13 | 5/- | OC201 | 7/6 |
| 2N2905 | 8/- | ACY21 | 5/- | BD116 | 35/- | MJ480 | 20/6 | OC202 | 10/6 |
| 2N2905A | 9/- | ACY22 | 4/- | | | | | | |

## MULLARD INTEGRATED CIRCUITS

| | |
|---|---|
| FCH211 Hextuple DTL Inverter Gate | 28/6 |
| FCH221 Triple 3 Input DTL Line | 28/6 |
| FCJ101 3 Input JK Flip Flop | 35/- |
| TAA241 Operational Amplifier | 47/6 |
| TAA243 Operational Amplifier | 47/6 |
| TAA 263 Linear AF Amplifier | 15/6 |
| TAA 300 Linear A.F. Amp | 47/6 |
| TAA 320 Most LF Preamplifier | 15/6 |
| TAA 350 Wide-band Lim Dif. Amp | 45/- |

Data Sheets 1/-

## SPEAKERS (3 ohm)

10in. x 6in. **37/6**, 9in. x 4in. **23/6**, 8in. x 5in. **19/6**, 7in. x 4in. **15/6**, 5in. x 3in. **12/6**, 3in. **9/6**, 5in. **14/6**, 8in. **27/6**, 12in. **39/6**.

*Post and Packing* 2/9

## THERMISTORS

| | |
|---|---|
| R53 (STC) | 25/6 |
| K151 (1K) | 2/6 |

Various Mullard Thermistors in stock.

SEND 6d. STAMP FOR CATALOGUE
P.P. for Components 1/6 per order.

## THYRISTORS

1 AMP: 50V **5/-**, 100V **5/6**, 200V **7/-**, 400V **9/6**.
3 AMP: 50V **6/-**, 100V **7/6**, 200V **8/-**, 400V **10/6**.
ZENERS. 1½ WATT 2·7–33V **4/6**.
400m/w 3·0–33V **4/-**.

## INTEGRATED CIRCUITS—R.C.A.

CA3005 **30/-**, CA3011 **20/-**, CA3012 **25/-**, CA3013 **30/-**, CA3014 **30/-**, CA3018 **25/-**, CA3019 25/-, CA3020 **27/6**, CA3021 **42/6**, CA3022 **35/-**, CA3023 **32/6**, CA3026 **27/6**, CA3028 A**25/-**, CA3028B **35/-**, CA3035 **35/-**, CA3036 **20/-**, CA300 **84/-**, CA3046 **25/-**, CA3048 **52/6**, CA3051 **25/-**.
FAIRCHILD
L900, 914 **11/-**, L923 14/-, L701C **17/6**, L702C **45/-**, L709C **27/6**
DATA SHEETS FOR RCA DEVICES **2/-** PER TYPE.

## G.E. INTEGRATED CIRCUITS

PA230 **27/6**, PA234 **26/6**, PA237 **45/-**, PA246 **57/6**.
Data Sheet 1/-.

Presets std., horiz. or vert. **1/6**
Potentiometers. Log/Lin **3/3** each

| MFD | V | Price | MFD | V | Price | MFD | V | Price |
|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 1/6 | 25 | 10 | 1/6 | 200 | 6·4 | 1/9 |
| 1 | 40 | 1/9 | 25 | 25 | 1/6 | 200 | 16 | 2/- |
| 2 | 15 | 1/6 | 25 | 50 | 1 6 | 250 | 25 | 2/9 |
| 2 | 350 | 2/- | 32 | 15 | 1 6 | 250 | 50 | 3/9 |
| 2·5 | 16 | 1/9 | 32 | 450 | 5 6 | 320 | 10 | 1/6 |
| 4 | 15 | 1/6 | 40 | 6·4 | 1 6 | 400 | 16 | 2/9 |
| 4 | 40 | 4/9 | 40 | 16 | 1 6 | [illegible] | 6 | 2/6 |
| 4 | 350 | 2/3 | 50 | 12 | 1 6 | [illegible] | 25 | 3/9 |
| 5 | 15 | 1/6 | 50 | 25 | 1 6 | [illegible] | 50 | 4/9 |
| 6·4 | 6·4 | 1/9 | 50 | 50 | 2 - | [illegible] | 16 | 3/6 |
| 8 | 18 | 1/6 | 64 | 25 | 1 6 | [illegible] | 16 | 4/- |
| 8 | 40 | 1/6 | 80 | 6·4 | 1 6 | [illegible] | 25 | 5/- |
| 8 | 450 | 3/- | 80 | 16 | 1 6 | [illegible] | 50 | 7/6 |
| 10 | 15 | 1/6 | 100 | 6·4 | 1 6 | [illegible] | 25 | 8/6 |
| 10 | 25 | 1/6 | 100 | 12 | 1 6 | [illegible] | 50 | 12/6 |
| 12·5 | 25 | 1/9 | 100 | 25 | 2 - | [illegible] | 25 | 9/6 |
| 16 | 18 | 1/6 | 100 | 50 | 2 6 | [illegible] | 25 | 12/6 |
| 25 | 6·4 | 1/6 | 125 | 4 | 1 6 | [illegible] | 50 | 19/6 |

## VERBOARD

| | ·15 Matrix | ·1 Matrix |
|---|---|---|
| 2½in. × 3¾in. | 3 6 | 4 – |
| 2½in. × 5in. | 4 3 | 4 9 |
| 3¾in. × 3¾in. | 4 3 | 4 9 |
| 3¾in. × 5in. | 5 6 | 5 6 |
| 2½in. × 17in. | 12 6 | |
| 3¾in. × 17in. | 16 – | 21 6 |

Cutter 9/-

## RESISTORS

¼ watt 4%. **4d.**
½ and 1 watt 5% **5d.**
1 watt 10%. **6d.**
[illegible] watt 5% **1/6**
[illegible] watt 5% **2/-**
[illegible] watt 5%. **2/6**

# A. MARSHALL & SON

**28 CRICKLEWOOD BROADWAY, LONDON N.W.2**
**01-452 0161 2 3 CALLERS WELCOME**

Post & Packing U.K. only 1/6. Europe 5/-. Commonwealth (Air) 13/-


The Premier Stereo System "ONE" consists of an all transistor stereo amplifier. Garrard 2025 T/C auto manual record player unit fitted stereo mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on off, stereo mono switch. Brushed aluminium front panel. Black metal case with teakwood ends: Size 12 × 5½ × 3½in. high (Amplifier available separately if required £14.19.6. Carr. 7/6.)

## TELETON SAQ203E STEREO AMPLIFIER

A small but powerful amplifier designed for stereo hi-fi reproduction. Incorporates 16 transistors and diodes. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble, Stereo/Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price £28.7.0

OUR PRICE **22 Gns.** P. & P. 10/-

## "NOVA" 505 TRANSISTOR STEREO AMPLIFIER

**A superb stereo amplifier offering every facility for the hi-fi enthusiast. Output 5 watts per channel. Frequency response 40-20,000 Hz ± 3dB. Inputs for radio, P.U. Ceramic, P.U. Magnetic Tape. Separate bass and treble controls, Volume and Balance controls, Mono Stereo Switch. Also features headphone socket and tape output. Teak case with attractive illuminated front panel. Size 14¼ × 9½ × 3½in. A.C. 200/250V.**

**WONDERFUL VALUE AT ONLY** 18 Gns. Carr. 10/-.

## PREMIER STEREO SYSTEM "FOUR"

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

PREMIER PRICE **65 Gns.** Carr. 35/-

## PREMIER STEREO SYSTEM "TWO"

As system 'ONE' above but with Garrard SP25.

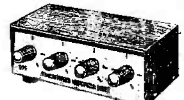
PREMIER PRICE **45 Gns.** Carr. 35/-

## PREMIER STEREO SYSTEM "THREE"

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

PREMIER PRICE **55 Gns.** Carr. 35/-

## VERITAS V-149 MIXER



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

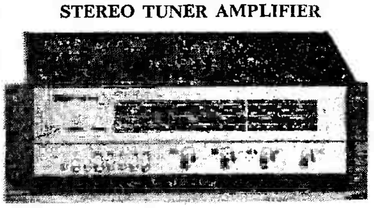
MONO MODEL **59/6** STEREO MODEL **69/6** P. & P. 2/6.

## VERITAS V-313 TAPE HEAD DEFLUXER

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

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

## ALBA UA100D ALL TRANSISTOR STEREO TUNER AMPLIFIER



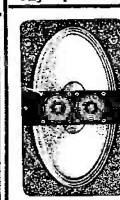
Covers Long, Medium and Short Waves plus VHF/FM with built in stereo decoder and A.F.C. Output 15 watts r.m.s. per channel into 8 ohms (distortion less than 0·3%). Response 20Hz–20kHz. Inputs for Magnetic and ceramic p.u. and Tape. Tape outlet socket. Tuning Volume, Bass, Treble and Balance controls. Push button selector. Black leatherette top, teak ends and brushed aluminium front panel.

PREMIER PRICE **£67.11.6** Carriage 12/6.

## PREMIER STEREO SYSTEM "FIVE"

| | |
|---|---|
| Alba UA100D Tuner/Amplifier | £67.11.6 |
| Garrard Sp25 | £11.19.6 |
| Shure M3D | £6.19.6 |
| Teak base and cover | £5.10.0 |
| Pair of Hi Fi Enclosures fitted E.M.I. Speakers | £26.5.0 |
| Total cost if purchased separately | £118.5.6 |

PREMIER PRICE **£110** Carr. 35/-.



**E.M.I. 13 × 8in HI-FI SPEAKERS**

Fitted two 2½in tweeters and crossover network. Impedance 3 & 15 ohms. Handling capacity 10W. Brand new.

**99/6** P. & P. 7/6

Also available without tweeters.

**49/6** P. & P. 7/6

## TAPE CASSETTES


**C60** (60 min.) **7/6** THREE FOR 21/-

**C90** (90 min.) **12/6** THREE FOR 36/-

**C120** (120 min.) **17/6** THREE FOR 51/-

P. & P. 1/-.

## CASSETTE HEAD CLEANER


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

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

## "VERITONE" RECORDING TAPE


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

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LP3 | 3" | 250' | P.V.C. | 5/6 | LP6 | 5¾" | 1200' | P.V.C. | 12/6 |
| TT3 | 3" | 450' | POLYESTER | 7/6 | DT6 | 5¾" | 1800' | POLYESTER | 22/6 |
| DT3 | 3½" | 600' | POLYESTER | 11/6 | TT6 | 5¾" | 2400' | POLYESTER | 37/6 |
| SP5 | 5" | 600' | P.V.C. | 8/6 | SP7 | 7" | 1200' | P.V.C. | 12/6 |
| LP5 | 5" | 900' | P.V.C. | 10/– | LP7 | 7" | 1800' | P.V.C. | 15/- |
| DT5 | 5" | 1200' | POLYESTER | 15/– | DT7 | 7" | 2400' | POLYESTER | 25/- |
| | | | | | TT7 | 7" | 3600' | POLYESTER | 50/– |

TAPE SPOOLS 3" 1/-, 5", 5¾", 7" 1/9,

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

# PREMIER RADIO

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

OXFORD ST. 23 TOTTENHAM COURT RD. DOMINION

# Laskys

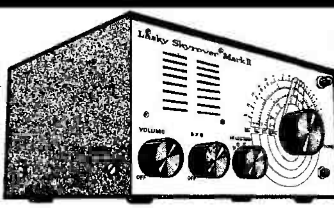
## SCOOP Garrard 3000

**CUSTOM UNIT by Famous British manufacturer**

The unit incorporates the renowned Garrard 300 four speed autochanger with lightweight tubular pick-up arm **FITTED WITH SONOTONE 9TA STEREO CARTRIDGE with diamond stylus.** The beautifully made plinth in finished in richly figured teak veneer with tinted perspex panels in the lid and with attractive charcoal grey "mirror" insert panel on front. All metal trim parts are satin chrome. Black leather grain unc side. The lid allows the player to operate fully automatically when closed and has snap action "stay" when raised. Mains socket and DIN audio output socket are at rear. Overall size 15¾ x 7¾ x 14in.

**LASKY'S SPECIAL PRICE £16.15.0** Post 15/-

## SKYROVER MkII

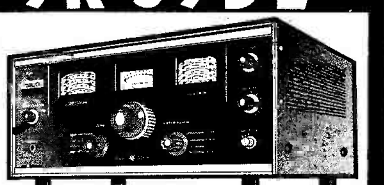



**COMMUNICATION RECEIVER**

A short wave receiver, exclusive to Lasky's, at a real economy price. Four valve line up using one each 6BE6, 6BA6, 6AV6 and 6AR5 valves, gives highly sensitive reception and powerful gain. Switch selected SW frequency range cover: 1·5 to 30MHz in three separate bandspread ranges and full AM medium waveband cover in one range 550-1,600kHz. Reduction drive tuning with hair line cursor. Controls include volume on/off BFO, Band selector. Power on indicator lamp. External antenna connections and mains fuse at rear. Internal speaker plus standard 5mm jack socket for phones on front. For 220/240V a.c. mains operation. Strong metal cabinet finished in grey crackle with anodised silver front panel. Size 9¼ x 5¾ x 5¼in. Complete with mains lead and full instructions. IDEAL BEGINNERS RECEIVER.

**LASKY'S PRICE £13.13.0** Post 5/-

## TRIO 9R-59DE

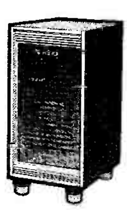


● 8 valve plus 7 diode circuit continuous coverage from 550kHz to 30MHz with Calibrated Bandspread on 10, 15, 20, 40 and 80 metre bands ● Clear SSB reception is achieved through the use of a product detector. ● Finished in light grey with dark grey case. Fully guaranteed, complete with instruction manual and service data.

**SPECIFICATION:** Frequency Ranges: 550-1600kHz; 1.6-4.8MHz; 4.8-14.5MHz; 10.5-30MHz. Bandspread: (Direct Reading on Ham Bands) 3.5MHz 80m; 7MHz 40m; 14MHz 20m; 21MHz 15m; 28MHz 10m. Sensitivity: A, B, C, Bands—Less than 6dB (for 10dB S/N ratio); D Band — 13MHz; Less than 18dB (for 10dB S/N ratio); 28MHz; Less than 10dB (for 10dB S/N ratio). Selectivity: ± 5kHz at —50dB. Audio Output: 1.5w. Power Requirements: AC 115/230V, 50/60Hz. Recommended Speaker Type: 4 or 8 ohm. Built-in Circuits: Bandspread; Automatic Noise Limiter (ANL); Automatic Volume Control (AVC); Headphone Jack. Dimensions: 7in. H 15in. W, 10in. D.

**LASKY'S PRICE £42.0.0** Carriage free

### TRIO SP-5D



Communications speaker unit —matching all the TRIO receivers in both style and size. Contains 5 x 3 in. elliptical 8 ohms speaker specially designed to give extremely crisp reproduction of voice frequencies. Dark grey metal cabinet—size 7 x 3¼ x 5¼ in.

**LASKY'S PRICE 87/6** post 5/-

### TRIO HS-4 HEADPHONES

Rugged construction plus comfort make these a must for the Ham. Dynamic headset. Input impedance 8 ohms, matching 4-16 ohms. Max. power 3w. Frequency range 300-3000Hz.

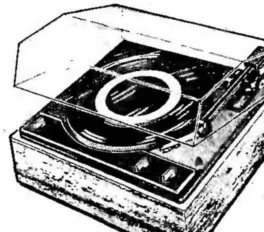
**LASKY'S PRICE £5.19.6** post 3/6

### TTC B-1016

A handy microphone for communications 6ft retractable lead, special hanger bracket built in "talk" switch! imp: 50,000 ohms. Size: 3¼ x 2¼ x 1¼ in.

**67/6** post 3/6

## Garrard



**AUTOCHANGERS**

| | |
|---|---|
| SL 72B | £25 0 0 |
| 2025 TC complete with stereo cart. | £8 17 6 |
| 3000 complete with 9TA HC stereo cart. | £9 19 6 |
| SL 65B | £15 19 6 |
| 1025 complete with stereo cart | £6 19 6 |
| SL 95B | £40 0 0 |
| SL 75B | £32 0 0 |
| **SINGLE PLAYERS** | |
| AP 75 | £18 10 0 |
| AP 75 with AD 76K mag. cart. | £21 10 0 |
| SP 25 Mk II | £11 19 6 |
| SP 25 Mk. II complete AD76K stereo cart | £15 10 0 |
| 401 Transcription unit | £28 0 0 |

**BASES AND COVERS FOR GARRARD UNITS**

Type WB1 and WB5 for models 2025TC, 3000, SL65B, 1025, SP25 Mk. II. Price WB1 £3 16 6. WB5 £5 12 6. Type WB4 for models SL72B, SL75B. SL95B Price £5 12 6, Perspex covers: SPC1 for WB1 £3 14 1. SPC4 for WB4 and WB5 (allows unit to be played with the cover in place—Price £4 8 0.

## PACKAGE DEALS

| | | |
|---|---|---|
| AP 75 complete with AD 76K Stereo magnetic cart., teak plinth and perspex cover (illustrated). | **£30.0.0** | Post 10/- |
| SP 25 Mk II complete with AD 76K magnetic cartridge teak plinth and perspex cover. | **£19.0.0** | Post 7/6 |
| 1025 complete with J2105 stereo crystal cart., teak plinth and perspex cover. | **£11.19.6** | Post 7/6 |

**Post on Garrard units:** 6/- extra—except AP 75, SL 75B, SL 95B and 401 7/6 extra. Post on bases and covers 5/- extra.

## AUDIO DEVELOPMENT AD-76K

Stereo magnetic cartridge with diamond stylus. Frequency response 20-20,000Hz. 5mV output.

LASKY'S PRICE **£4.10.0** Post Free

## THE AMAZING Astrad ORION

**THE WORLD'S SMALLEST 6 TRANSISTOR TWO WAVEBAND RADIO OVER 50,000 SOLD**


Made to the highest space-age standards—this remarkable micro-size set measures only 1$\frac{11}{16}$ x 1$\frac{3}{16}$ x $\frac{7}{16}$in. yet it contains 6 transistors and other components combined in a photo etched circuit, only ¾ x ½ in. tuning capacitor, ferrite rod aerial, battery, wave band selection switch etc. Output to a high impedance crystal earplece, giving ample volume (automatically adjusted) and clear tone. Brief tech. spec.: Waveband coverage—Medium wave 525 to 160kHz. Long wave 150kHz to 480kHz. Sensitivity: 35MV max. Selectivity —10dB (at 30kHz de-tuning). Power source: 1 x 1.4V Mercury battery.

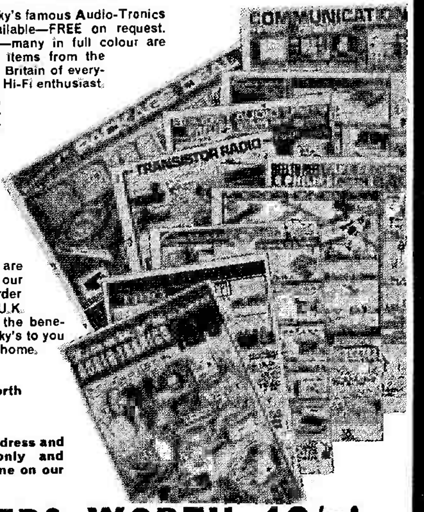
The Orion is supplied fully built and tested complete with battery, left and right fitting earphone supports and attractive black and ivory plastic presentation/carrying case (matching the Orion). Never miss your favourite music, sport, news—the Orion is an ideal gift for all, providing a constant source of enjoyment without disturbing others.

LASKY'S PRICE **ONLY 39/6** Post 2/6 Extra rechargeable battery 3/6

***NOTE: The battery we supply with the Orion is a rechargeable type. Charger units are available enabling you to re-charge the battery from AC Mains 220/240V supply.**

**PRICE 19/6 extra.** Post free with radio-otherwise 2/-

# Audio Tronics 70



The 1970 edition of Lasky's famous Audio-Tronics catalogue is now available—FREE on request. The 28 tabloid pages—many in full colour are packed with 1000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast. Electronics Hobbyist, Servicemen and Communications Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories All the goods shown are available from any of our branches or by Mail Order to any address in the U.K. or Overseas—bringing the benefits of shopping at Lasky's to you in the comfort of your home. **plus Lasky's amazing money saving vouchers worth over £25 0s. 0.**

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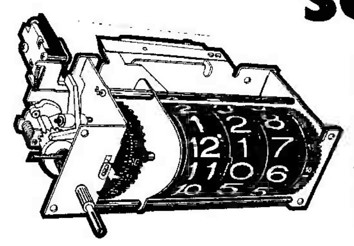
**VOUCHERS WORTH 40/-!**

# JUST ARRIVED
## DIGITAL CLOCK SCOOP!



- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
- MAINS OPERATION
- 12 HOUR ALARM
- AUTO "SLEEP" SWITCH
- HOURS, MINUTES AND SECONDS READ-OFF
- FORWARD AND BACKWARD TIME ADJUSTMENT
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- BUILT IN ALARM BUZZER
- SILENT OPERATION SYNCHRONUS MOTOR

This unique DIGITAL CLOCK is now available **EXCLUSIVELY FROM LASKY'S** in chassis form for you to mount in any housing that you choose.
All settings are achieved by two dual-concentric controls at the front including: ON-OFF-AUTO and AUTO ALARM, "sleep" switch, 10 minute division "click" set alarm (up to 12 hour delay), time adjustment. Ultra simple mechanism and high quality manufacture guarantee reliable operation and long life.
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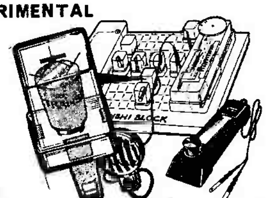
The clock measures 4¾W x 1½H x 3⅜D (overall from front of drum to back of switch). SPEC: 210/240V AC, 50Hz operation; switch rating 250V. 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS FOR THE ELECTRONICS HOBBYSIT.**

*LASKY'S PRICE* **£5.19.6** POST 3/6

*SPECIAL QUOTATIONS FOR QUANTITIES*

# EXCLUSIVE
## DENSHI BOARD KITS

**EDUCATIONAL AND EXPERIMENTAL CIRCUIT SYSTEM**



The **DENSHI BOARD** system enables the young experimenter and electronics hobbyist to produce a wide range of transistor circuits of increasing sophistication—without soldering or the use of any tools at all! Basically the system comprises a slotted circuit board into which plug-in components and bridge pieces are sel to produce up to 30 different circuits. The components are incapsulated in transparent plastic blocks bearing the appropriate circuit symbol and value thus enabling even the complete novice to visually grasp the fundamentals of circuitry after only a few moments study. **Each DENSHI BOARD KIT comes complete with 80-page manual of circuits and data.**
*THESE ARE JUST A FEW OF THE CIRCUITS YOU CAN BUILD IN MINUTES;* VARIOUS RADIO RECEIVERS, AMPLIFIERS, MORSE CODE PRACTICE DEVICE, SIGNAL INJECTOR, SIGNAL TRACER, WIRELESS MICROPHONE, ETC.
**DENSHI BOARD KIT SR-1A** *comprises:* Base board; tuner block; 4 resistors; choke coil transformer; 2SA transistor for RF; 2 diodes; 3 capacitors; battery block; morse key; antenna lead; crystal earphone; various bridge and connecting pieces and manual. **This kit permits the building of 16 basic circuits.**

*LASKY'S PRICE* **87/6** Post 3/6

**MODEL SR-2A** with extra components-builds **30 basic circuits £6.2.6.**

# WIEN FMX-1917 AM/FM STEREO TUNER AMP

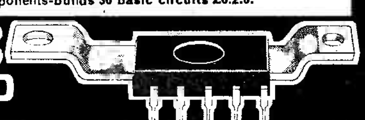
A solid state AM/FM Multiplex tuner Amplifier offering excellent quality and pleasing design at a price you can afford. Brief spec.: 18 transistors, 9 germanium diodes, 1 variable diode and 1 silicon rectifier. Single ended push pull amplifier—output 5W RMS per channel into 8 ohms. Frequency response 30Hz to 12kHz. Frequency range: FM–88 to 108MHz. AM–535 to 1605 kHz. Stereo separation 15dB at 100$\mu$V input. External FM aerial; built-in ferrite rod antenna for AM. Controls: Balance, Mode, Tone, Vol./on-off, tuning. Input for ceramic phono pick-up. Powered by 220/250V a.c. 50/60Hz. Extremely well made oiled walnut cabinet with large clear tuning dial (black/grey/silver trim). Size 14 x 8½ x 5½in.

*LASKY'S PRICE* **£29.0.0** Carriage FREE

**WIEN PACKAGE DEAL**

**WIEN FMX-1917+2 ATOMIX SA-1003** Bookshelf speakers + **GARRARD 1025** auto change with stereo cartridge + **Lasky's Base** and cover for 1025,
**SPECIAL PACKAGE PRICE £51** post 45/-

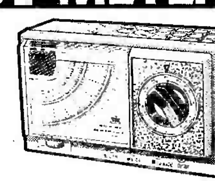
# IC-403 INTEGRATED CIRCUIT



Originally developed for computer and space projects—these tiny modules—size only 25 x 10 x 5 millimetres—represent the most amazing breakthrough in circuit design since the introduction of the transistor. The IC-403 is an integrated power and pre-amplifier requiring only the addition of tone and volume controls, power source and speaker to form a complete audio amplifier of 3W output. **SPECIFICATION** (ratings at 25°C): Output power typically 3W from 250mV input. Frequency response 20Hz to 80KHz + 3dB. Max. operating voltage 21V. Min. operating load 7.5 ohms. Pre-amp, input imp. 2M/Ohms. Pre-amp. D.C. input current 50nA.
THE IC-403 IS AVAILABLE EXCLUSIVELY FROM LASKY'S—COMPLETE WITH INSTRUCTION DATA AND SUGGESTED CIRCUIT APPLICATIONS.

*LASKY'S PRICE* **49/6** Post 1/6 **2 for 95/-** post free

# TTC C-1051 METER



A completely new design 20,000 O.P.V. pocket multimeter with mirror scale and built-in thermal protection. Exceptionally large easy to read meter with D'Arsonval movement. Colour coded scales. Single positive click-in, recessed selection switch for all ranges. Ohms zero adjustment. Range spec. a.c. volts: 0-6-30-300-1,200V at 10K/ohms/V. DC volts: 0-3-15-150-300-1.2KV at 20K/ohms/V. Resistance: 0-60K-6megs. DC current: 0-60$\mu$A—300 mA. Decibels: —20dB to + 17 dB. Extremely high standard of accuracy on all ranges. Uses one 1½V penlight battery. Strong impact resistant plastic cabinet —size only 4¾ x 3¼ x 1¼in. Two colour buff/green finish. Complete with test leads and battery.

*LASKY'S PRICE* **75/-** Post 2/6

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# COMET

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| ARENA HT 21 | £10 10 0 | £9 5 0 |
| ARENA HT 7 | £19 19 0 | £17 0 0 |
| ARENA HT 10 | £22 1 0 | £18 19 6 |
| ARENA HT 20 | £32 11 0 | £26 19 6 |
| ARENA HT 26 | £78 15 0 | £65 19 6 |
| B & W DM3 | £63 0 0 | £53 6 0 |
| B & W P2H | £94 10 0 | £81 5 6 |
| B & W DM1 | £32 0 0 | £25 19 6 |
| CELESTION Ditton 10 | £21 3 2 | £17 5 0 |
| CELESTION Ditton 15 | £29 0 0 | £22 10 0 |
| DULCI AS 3 | £8 8 0 | £6 19 6 |
| GOODMANS Majesta | £57 0 0 | £48 19 6 |
| GOODMANS Maxim | £20 7 9 | £15 19 6 |
| GOODMANS Mezzo II | £30 18 0 | £24 19 6 |
| GOODMANS Magnum-K | £40 2 0 | £31 19 6 |
| GOODMANS Mirimba | £24 0 1 | £19 19 6 |
| GOODMANS Mambo | £22 5 6 | £18 11 9 |
| GOODMANS 3005 (pair) | £25 0 0 | £21 0 0 |
| KEF Celeste | £29 0 0 | £22 10 0 |
| KEF Concord | £43 10 0 | £33 19 6 |
| LEAK Sandwich | £43 10 0 | £34 19 6 |
| LEAK Mini-Sandwich | £29 15 0 | £23 19 6 |
| LOWTHER L.I.P. with PM6 | Special Price | £23 10 0 |
| QUAD Electrostatic | £66 0 0 | £55 19 6 |
| TRUVOX LS200 | £22 7 3 | £15 19 6 |
| WHARFEDALE Speakers | | |
| Airedale | £69 10 0 | £57 14 0 |
| Denton | £18 0 0 | £13 19 6 |
| Super Linton | £21 10 0 | £17 19 6 |
| Melton | £29 10 0 | £23 19 6 |
| Dovedale 3 | £39 10 0 | £29 19 6 |
| Rosedale | £55 0 0 | £43 19 6 |
| WHARFEDALE | | |
| UNIT 3 Speaker Kit | £10 19 6 | £8 19 6 |
| UNIT 4 Speaker Kit | £16 0 0 | £13 10 0 |
| UNIT 5 Speaker Kit | £23 10 0 | £19 19 6 |

Most types o :chassis, speakers, cross over networks, etc., available ex-stock.

### CHASSIS SPEAKERS

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

### STEREO AMPLIFIERS

| | Rec. Retail Price | Comet Price |
|---|---|---|
| ARENA 210 Amplifier | £34 13 0 | £28 0 0 |
| ARMSTRONG 521 | £52 0 0 | £42 19 6 |
| DULCI 207 | £25 0 0 | £17 0 0 |
| DULCI 207M | £30 0 0 | £20 19 0 |
| GOODMANS Maxamp | £54 0 0 | £41 19 6 |
| LEAK Stereo 30 Plus | £53 0 0 | £42 19 6 |
| LEAK Stereo 30 Plus in teak case | £59 10 0 | £47 19 6 |
| LEAK Stereo 70 | £63 0 0 | £49 19 6 |
| LEAK Stereo 70 in teak case | £69 10 0 | £55 19 6 |
| LINEAR LT.66 | £18 18 0 | £14 19 6 |
| PHILIPS RH 591 | £73 0 0 | £56 1 6 |
| PHILIPS RH 590 | £49 0 0 | £37 12 6 |
| PHILIPS RH 580 | £26 0 0 | £19 19 6 |
| QUAD 33 Pre-amplifier | £43 0 0 | £35 19 6 |
| QUAD 303 Main Amplifier | £55 0 0 | £46 19 6 |
| ROGERS Ravensbourne | £59 10 0 | £48 19 6 |
| ROGERS Ravensbourne in teak case | £64 0 0 | £52 13 6 |
| ROGERS Ravensbrook | £44 0 0 | £36 19 6 |
| ROGERS Ravensbrook in teak case | £49 0 0 | £38 19 6 |
| SINCLAIR 2000 | £30 9 0 | £24 19 6 |
| TELETON 203E | £28 7 6 | £21 15 6 |
| TRUVOX TSA.200 | £54 12 0 | £37 19 6 |

### TUNERS

| | Rec. Retail Price | Comet Price |
|---|---|---|
| ARENA F211 with decoder | £39 10 0 | £33 19 6 |
| ARMSTRONG 523 AM/FM | £52 9 0 | £44 19 6 |
| ARMSTRONG 524 FM | £40 4 6 | £34 19 6 |
| ARMSTRONG M8 decoder | £9 10 0 | £7 19 6 |
| DULCI FMT.7 FM | £22 1 0 | £17 19 6 |
| DULCI FMT.7S Stereo | £31 0 0 | £25 5 0 |
| GOODMANS stereomax | £82 10 5 | £71 19 6 |
| LEAK Troughline with MPX | £51 10 6 | £39 19 6 |
| LEAK Stereofetic Chassis | £56 11 0 | £48 19 0 |
| LEAK Stereofetic in teak case | £64 14 4 | £54 19 6 |
| PHILIPS RH 690 | £39 0 0 | £33 2 6 |
| QUAD Stereo FM | £51 0 0 | £41 19 6 |
| ROGERS Ravensbourne Tuner with Decoder | £61 17 9 | £52 12 6 |
| SINCLAIR 2000 | £26 14 6 | £19 4 6 |
| TRUVOX FM 200/IC with decoder | £60 11 10 | £39 19 6 |

### TUNER/AMPLIFIERS

| | Rec. Retail Price | Comet Price |
|---|---|---|
| ARENA 2400 with MPX | £90 6 0 | £69 19 6 |
| ARENA 2600 with MPX | £97 0 0 | £79 0 0 |
| ARENA T1500F with MPX | £72 9 0 | £59 19 6 |
| ARENA T900 with MPX | £303 9 0 | £258 0 0 |
| ARMSTRONG 525 | £87 16 9 | £66 19 6 |
| ARMSTRONG 526 | £98 15 6 | £79 19 6 |
| ARMSTRONG 127 | £43 19 9 | £37 19 6 |
| (Teak Case for 127) | £3 17 0 | £3 10 0 |
| GOODMANS 3000 | £77 14 7 | £66 19 6 |
| PHILIPS RH781 | £74 19 6 | £63 14 6 |
| PHILIPS RH790 | £125 0 0 | £106 4 6 |
| PHILIPS RH 691 | £83 0 0 | £70 10 6 |
| TANDBERG SolvSuper | £75 18 0 | £59 19 6 |
| TELETON F.2000 | £51 0 0 | £37 19 6 |
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### COMPLETE HI-FI SYSTEMS

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|---|---|---|
| TELETON MX.990 | £64 13 2 | £48 19 6 |
| TELETON R.8000 | £60 19 6 | £49 19 6 |
| TELETON CMS 300 | £105 15 0 | £79 19 6 |
| TELETON CMS.400 | £126 0 0 | £89 0 0 |
| GOODMAN 3000 suite | £140 9 0 | £111 0 0 |
| MARCONI UNIT 4 | £77 9 0 | £66 19 6 |
| WYNDSOR System | £59 19 6 | £49 19 6 |
| VIDEORAMA | £42 19 6 | £35 0 0 |

### TURNTABLES

| | Rec. Retail Price | Comet Price |
|---|---|---|
| ARENA SP25 with base, cover and cartridge | £30 19 0 | £24 19 6 |
| GARRARD SP. 25, MK II | £15 11 4 | £11 19 6 |
| GARRARD AP. 75 | £23 16 0 | £17 19 6 |
| GARRARD SL. 55 | £13 17 9 | £11 12 6 |
| GARRARD SL. 65B | £19 6 5 | £14 9 6 |
| GARRARD SL. 75B | £35 12 4 | £28 19 6 |
| GARRARD SL. 95B | £45 9 1 | £37 19 6 |
| GARRARD 401 | £31 14 2 | £26 10 0 |
| GARRARD SL. 72B | £30 2 0 | £24 19 6 |
| GARRARD 3500 with GKS Cartridge | £15 15 0 | £11 19 6 |
| GOLDRING GL 69 | £25 1 6 | £21 5 0 |
| GOLDRING 69P | £33 11 9 | £28 19 6 |
| GOLDRING GL. 75 | £36 8 2 | £27 19 6 |
| GOLDRING 75P | £46 18 8 | £38 0 0 |
| GOODMANS 3025 | £37 14 9 | £32 19 6 |
| GOLDRING COVERS for 69P and 75P | £4 4 3 | £3 8 0 |
| THORENS TD. 125 | £75 17 8 | £59 19 6 |
| THORENS 125 AB | £120 3 11 | £99 19 6 |
| THORENS 150A MK II | £43 12 7 | £32 19 6 |
| THORENS 150AB MK II | £47 8 7 | £40 19 6 |
| THORENS TD. 124/II | £46 15 10 | £39 19 6 |

Bases, plinths and covers stocked.

### PICKUP ARMS

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

### HI-FI STEREO TAPE DECKS AND TAPE RECORDERS

| | Rec. Retail Price | Comet Price |
|---|---|---|
| AKAI 150D | £130 2 4 | £109 0 0 |
| AKAI X-360 | £339 0 0 | £284 0 0 |
| AKAI X-360 D deck | £290 0 0 | £243 0 0 |
| AKAI 1710 | £109 0 0 | £89 19 6 |
| AKAI 1800 | £158 0 0 | £133 0 0 |
| AKAI 1800SD | £199 0 0 | £167 0 0 |
| AKAI 4000 D deck | £87 10 0 | £71 19 0 |
| TRUVOX PD 102 deck | £114 15 3 | £79 0 0 |
| MARCONI 4218 Stereo tape Recorder | £89 11 2 | £69 19 6 |
| MARCONI 4238 4-track tape Recorder | £58 11 0 | £49 19 6 |
| TRUVOX R52 & R54 3-speed 2-track | £77 5 1 | £52 2 0 |

Tandberg also available

### CARTRIDGES

| | Rec. Retail Price | Comet Price |
|---|---|---|
| Goldring 800 Cartridge | £13 0 0 | £10 7 6 |
| Goldring 800H | £10 13 9 | £8 10 6 |
| Goldring 800E | £18 17 1 | £15 0 0 |
| Goldring 800 Super E | £26 0 1 | £20 15 0 |
| Goldring CS90 Stereo Ceramic Cartridge | £5 4 0 | £4 3 0 |
| Goldring CS91/E | £7 16 1 | £6 4 6 |
| Ortofon SL 15E | £29 12 11 | £23 12 11 |
| Ortofon 2X 15K | £7 0 0 | £5 5 4 |
| Shure M3DM | £7 8 3 | £6 8 3 |
| Shure N3D | £5 11 2 | £4 8 8 |
| Shure M31E | £12 19 5 | £10 6 0 |
| Shure N31E | £9 5 3 | £7 8 6 |
| Shure M32E | £12 0 11 | £9 12 0 |
| Shure N32E | £8 6 9 | £6 13 0 |
| Shure M32-3 | £11 2 4 | £8 17 6 |
| Shure N32-3 | £6 9 8 | £5 3 6 |
| Shure M44-5 | £11 2 4 | £8 17 6 |
| Shure N44-5 | £7 8 3 | £6 8 3 |
| Shure M44-7 | £10 3 10 | £8 5 0 |
| Shure N44-7 | £6 9 8 | £5 3 6 |
| Shure M44-C | £10 3 10 | £8 5 0 |
| Shure N44-C | £6 9 8 | £5 3 6 |
| Shure M44E | £14 16 6 | £11 16 6 |
| Shure N44E | £10 3 10 | £8 5 0 |
| Shure M55E | £16 13 6 | £14 13 6 |
| Shure N55E | £11 2 4 | £8 17 6 |
| Shure M75G | £17 12 1 | £14 0 0 |
| Shure N75G | £9 5 3 | £8 17 6 |
| Shure M75-6 | £16 13 6 | £13 6 0 |
| Shure N75-6 | £8 6 9 | £6 13 0 |
| Shure M75EJ | £24 1 9 | £19 4 6 |
| Shure N75EJ | £11 2 4 | £8 17 6 |
| Shure M75E-95G | £27 15 11 | £22 3 6 |
| Shure N75E | £12 19 5 | £10 6 6 |
| Shure V15-11 | £40 15 3 | £32 19 6 |
| Shure VN15E | £16 13 6 | £14 13 6 |
| Shure V15-11-7 | £38 18 3 | £31 0 0 |
| Shure VN7 | £14 16 6 | £11 16 6 |

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Comet guarantee that all prices quoted are genuine. All items offered available at these prices at the time this issue closed for press.
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# Complete stereo system — £29-10

The new Duo general-purpose 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.
Type 1 SPECIFICATION:—
Impedance 3, 8 or 10 ohms (please state requirement) high flux 6″ x 4″ speaker and $2\frac{1}{4}$″ tweeter. Teak finish 12″ x $6\frac{3}{4}$″ x $5\frac{3}{4}$″. **4 guineas** each. 7/6d. p. & p.
Type 2 as type 1. Size $17\frac{1}{2}$″ x $10\frac{3}{4}$″ x $6\frac{3}{4}$″. Incorporating $10\frac{1}{2}$″ x $6\frac{1}{4}$″ speaker and $2\frac{1}{4}$″ high frequency speaker 3 ohms impedance **£6-6-0** plus 15/– p. & p.

Garrard Changers from £7.19.6d. p. & p. 7/6d.
Cover and Teak finish Plinth £4.15.0d. 7/6d p. & p.

*The items illustrated can be purchased together for £29-10.*

The Duetto is a good quality amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.
SPECIFICATION:—
R.M.S. power output: 3 watts per channel into 10 ohms speakers.
INPUT SENSITIVITY. Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.
TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.

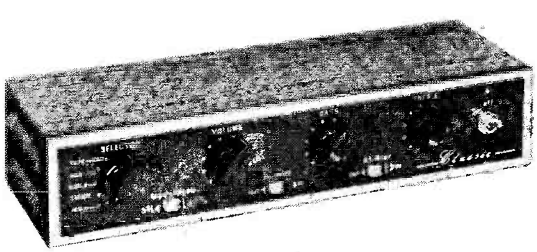
**£9-10**
Integrated Transistor Stereo Amplifier plus 7/6d. p. & p.

***The above 5 items can be purchased together for £29.10 + £1.10.0 p. & p.***

## *The Classic* — **£9** plus 7/6 p. & p.

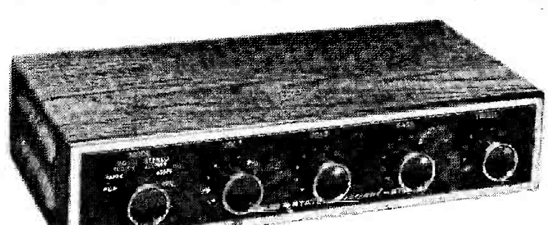
**Controls:** Selector switch Tape speed equalisation switch ($3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s.). Volume. Treble. Bass. 2 position scratch filter and 2 position rumble filter.

**Specification:** Sensitivities for 10 watt output at 1KHz into 3 ohms. *Tape head:* 3mV (at $3\frac{3}{4}$ i.p.s.). *Mag.P.U.:* 2mV. *Cer.P.U.:* 80 mV. *Tuner:* 100mV. *Aux.:* 100mV. *Tape/Rec. output:* Equalisation for each input is correct to within $\pm$2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone control range:* Bass $\pm$13dB at 60Hz. Treble $\pm$14dB at 15KHz. *Total distortion:* (for 10 watt output) $<$1·5%. *Signal noise:* $<$—60dB. A.C. mains 200–250v. Built and tested. Size $12\frac{1}{2}$in. long, $4\frac{1}{4}$in. deep, $2\frac{3}{4}$in. high. Teak finished case.



## *The Viscount* — **£14.5** plus 7/6 p. & p.

**Integrated High Fidelity Transistor Stereo Amplifier.** Specification—Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts monaural). Input: 6 position rotary selector switch (3 pos. mono and 3 pos. stereo), P.U., Tuner, Tape and Tape Rec. out. Sensitivities: All inputs 100mV into 1·8M ohm. Frequency Response: 40Hz–20KHz $\pm$2dB. Tone Controls: Separate bass and treble controls; treble, 13dB lift and cut (at 15KHz); Bass, 15dB lift and 25dB cut (at 60Hz). Volume Controls: Separate for each channel. A.C. Mains Input: 200–240V. 50–60Hz. Size $12\frac{1}{4}$″ x 6″ x $2\frac{3}{4}$″ in teak finished case. Built and tested.
**VISCOUNT MARK II** for use with magnetic pick-ups specification as above. Fully equalised for magnetic pick-ups. Suitable for cartridges with minimum output of 4mV/cm/sec. at 1kc. Input impedance 47k. **£15.15** plus 7/6 p. & p.



*also see opposite page*

RADIO & TV COMPONENTS
**R+TV**
(ACTON) LIMITED

## SPECIAL OFFER!

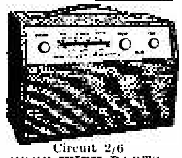
Complete stereo system comprising BALFOUR 4-speed autoplayer with stereo head, 2 Duo speaker systems, size 12in. x $6\frac{3}{4}$in. x $5\frac{3}{4}$in. Plinth (less cover) and the DUETTO stereo amplifier. All above items

**£25** plus £2 p. & p.

## *NEW* COMPLETE HI-FI STEREO SYSTEM - £41

comprising SP 25 Garrard Mk II with diamond cartridge, or 2025 TC, Viscount Mk I amplifier, two type 2 speakers, plinth and cover

**£41** plus £2-10-0 p. & p.



Circuit 2/6
FREE WITH PARTS.

## The ELEGANT SEVEN
### Mk. III (350mW Output)

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

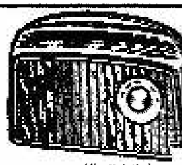
**Price £5.5.0 plus 7/6 P. & P.**

## The DORSET
### (600mW Output)

**7-transistor fully tunable M.W.-L.E. superhet portable**—with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 × 8 × 3in.

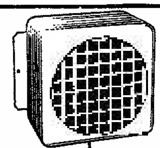
**Price £5.5.0 plus 7/6 P. & P.**

MAINS POWER PACK KIT: **9/6** extra



Circuit 2/6
FREE WITH PARTS

## EXTRACTOR FAN

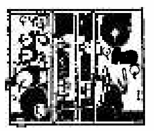


A.C. mains 230/250v. complete with pull switch. Size: 6 × 6 × 4in.

**Price 27/6 plus 7/6 P. & P.**

## X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP

**Specifications:** *Power Output* (into 3 ohms speaker) 10 watts. *Sensitivity* (for rated output): 1mV into 3K ohms (0.33 microamp). *Total Distortion at* 1KHz at 5 watts, 0.35%, at rated output 1.5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *Speaker:* 3-4 ohms (3-15 ohms may be used). *Supply voltage:* 24V. DC. at 800mA (6-24V. may be used).



**Price 69/6 plus 2/6 P. & P.**

**Control assembly:** including resistors and capacitors. 1. Volume: PRICE **5/-**, 2. Treble: PRICE **5/-**. 3. Comprehensive bass and treble: PRICE **10/-**. The above 3 items can be purchased for use with the X101

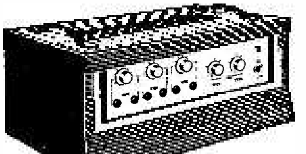
**Power Supplies for the X101:**
P101 M (for mono) **35/-** plus 4/6 p. & p.
P101 S (for stereo) **42/6** plus 4/6 p. & p.

## CAR TRANSISTOR IGNITION SYSTEM
### by famous manufacturer

For 6 volt or 12 volt positive earth systems, Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardwear (screws, washers, etc.).

**Price £4.19.6 plus 5/- P. & P.**

## 50 WATT AMPLIFIER — A.C. Mains 200-250V



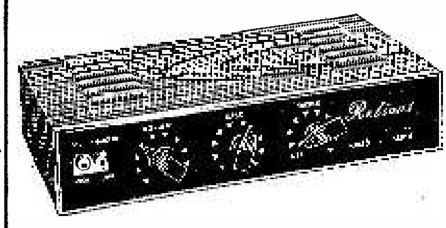
**Price £28.10** plus 20/-p. & p.

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

## B.S.R. TD-2 TAPE DECK

Takes 5$\frac{3}{4}$in. spools, fitted with B.S.R. $\frac{1}{4}$ Track Heads. Size 13$\frac{1}{4}$in. long by 8$\frac{3}{4}$in. wide.
**Price £8.19.6 plus 7/6 P. & P.**

## The RELIANT — SOLID-STATE GENERAL PURPOSE AMPLIFIER



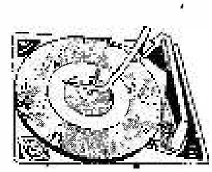
**SPECIFICATIONS**
Output—10 watts. Output Impedance—3 to 4 ohms
Inputs—1. -xtal mic 10mV Tone Controls—Treble control range ± 12dB at 10KHz.
2. -gram/radio 250mV Bass control range ± 13dB at 100Hz
Frequency Response—(with tone controls central) Minus 3dB points at 20Hz and 40KHz. Signal to Noise Ratio—better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

**RELIANT Mk. I**
As above less teak case
**£5.15** plus 7/6 P. & P.

**RELIANT Mk. II**
In teak finished case.
**£6.16** plus 7/6 P. & P.

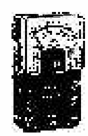
## RECORD PLAYER SNIP — A.C. Mains 240V

The "Princess", 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7" to 10" or 12". Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess. a most useful feature with portable equipment-other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and ins. 7/6 extra.



**ONLY £5.19.6 plus 7/6 P. & P.**

## POCKET MULTI-METER



Size 3$\frac{3}{4}$ × 2$\frac{1}{4}$ × 1$\frac{1}{8}$in. Meter size 2$\frac{1}{4}$ × 1$\frac{3}{8}$in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. volts 0-15, 0-150, 0-1,000 D.C. current 0-150mA Resistance 0-100k Ω Complete with test prods, battery and full instructions.

**42/6 plus 3/6 P. & P.**

**FREE GIFT** for limited period only, 30 watt Electric Soldering Iron value **15/-** to every purchaser of the Pocket Multi-Meter

## 40W FLUORESCENT LIGHT KIT

Incorporating **GEC** Choke size 8$\frac{1}{4}$ × 1$\frac{1}{2}$ × 1$\frac{1}{4}$in, 2 bi-pin holders. starter and starter-holder. P. & P. 5/6. **11/6**

Similar to above: 80W. Fluorescent Light Kit incorporating **GEC** choke size 11$\frac{1}{2}$ × 1$\frac{1}{2}$ × 1$\frac{3}{4}$in. 2 bi-pin holders, start and starter holder. P. & P. 6/6 **17/6**

## THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss crossover network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40-60 c/s. Frequency range 50c/s to 20Kc/s. Size 13$\frac{1}{4}$ × 8$\frac{1}{16}$ × 4$\frac{1}{2}$in. By famous manufacturer.

**List price £7    OUR PRICE 74/6 plus 5/- P. & P.**

Similar speaker to the above without tweeters in 3 and 15 ohms **44/6** plus 5/- p. & p.

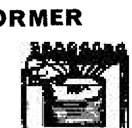
## PYE CAR RADIO
### Push Button Tuning Heart

This PRESTOLOCK 5 station Push-Button Tuner Heart with Manual Over-ride is an ideal basis for a quality AM car radio. Size 6$\frac{1}{2}$" × 4" × 2".
As illustrated but without knobs.

**25/- plus 3/- P. & P.**

## QUALITY MAINS TRANSFORMER

Input 250 volts. OUTPUT (All RMS values) 4 windings of 11.5 volts connected in series total 46 volts at 4.5 amps (conservatively rated). The following combinations may be used. 1.23-0-23 volts. 2.46 volts.
Both of these above voltages are commonly used in medium to high powered transistor amplifiers, power supplies, etc.



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

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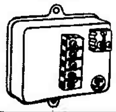
### ★ EXPERIMENTERS MODULE

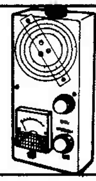


Brand new STC time delay electronic units. Relay output. Adjustable 3–15 secs. 9–12V operated. Supplied complete with uses and circuits **STC Module Price 35/-, or 3 for 90/-**

### ★ MULTIMETER

Return of a popular model. 2,000 ohms/V 0/10/50/500/1,000V a.c./d.c. 0/50μA. 0/10/250mA d.c. 0/10/100k Ω/1M Ω resistance. dB and capacitance scales. Size 5in. × 3½in. × 1½in. Robust and easy to use. Complete with leads, batteries and instructions. **THL33a. Price 82/6,** p.p. 2/6. Leather case. **Price 22/6**

### GRID DIP METER

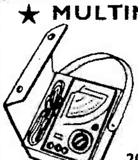


All transistor grid dip meter, absorption and osc. detector. Frequency range 440 kc/s to 280Mc/s in 6 coils. Uses 3 transistors plus diode with 500μA meter. Internal battery.
**TE15 Price £11.10.0.** p.p. 3/6.

### ★ RF SIGNAL GENERATOR

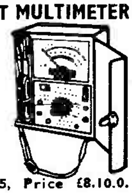
Accurate wide range signal generator covering 120 Kc/s–500Mc/s on 6 bands. Directly calibrated. Variable RF attenuator, audio output. Xtal socket for calibration. 220/240V. a.c. Brand new with instructions. Size 140 × 215 × 170mm.
**TE20D Price £15** p.p. 7/6

### ★ MULTIMETER 20Ω/V



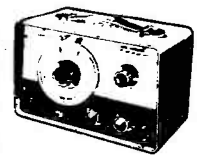
Popular model but with extra scale range 20,000 ohms per volt. 0/5/25/50/250/500/2,500V d.c. 0/10/50/100/500/1,000V a.c. 0/50μA, 0/2½/250mA. Resistance 0–6K Ω and 6M Ω. Also dB scales and capacitance.
**200H, Price 77/6** p.p. 2/–. Leather case, **Price 15/-**

### ★ 50,000 OHMS PER VOLT MULTIMETER



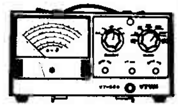
Recommended quality instrument with mirror scale and overload protection. 0/0·3/3/12/60/120/300/600/1,200V d.c. 50k Ω/V; 0/6/30/120/300/600/1,200V a.c. 10k Ω/V; 0/30μA/6/60/300mA, 0/12A; resistance 0/10k Ω/10/1.00M Ω. Meter movement 20μA. Polarity reversing switch. Complete with batteries, leads and instructions. **AF105, Price £8.10.0.** p.p. 2/6. Leather case **28/6**

### ★ SINE/SQUARE WAVE AUDIO GENERATOR



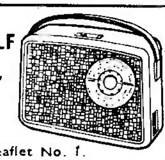
Provides audio output on 4 bands. Sine wave 20c/s to 200kc/s, output up to 7V. square wave 60c/s to 30kc/s, 7V p–p Distortion under 2%. Output impedance 1k Ω. Variable output amplitude control Supplied with leads and instructions. A.C. mains operated.
**TE22, Price £16.10.0.** Carriage, etc., Also **TE22D (matching TE20D) Price £17.** p.p. 10/–.

### ★ LOW COST VACUUM TUBE VALVE VOLTMETER



New model Multi-Range and easy to use. d.c. and a.c. Volts 0/1½/5/15/50/150/500/1,500, a.c. p–p 0/4·2/14/42/140/420/1,400/4,200. Resistance 0·2 ohm to 1,000 Megohm—7 ranges. dBm scales —20 to +25dBm. Input impedance: d.c. 11 Meg, a.c. ±5 Meg. Response: ±1dB 20c/s to 5Mc/s. Complete with probe and handbook. (Size 10½in. × 5⅞in. × 4$\frac{1}{16}$in.
**VT650 Price £16.10.0.** p.p. 7/6

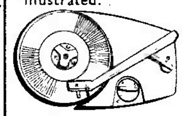
### BUILD YOURSELF A QUALITY RADIO



New printed circuit design with full power output. Fully tuneable on both MW/LW bands. 7 Mullard transistors. Fitted 5in. speaker. Room filling power. Easy to build with terrific results. Two colour leathercloth cabinet with silvered front. All local and continental stations. Complete detailed instructions.
**Total cost £6.19.6.** p.p. 4/6. Ask for Leaflet No. 1.

### SCOOP! STAAR RECORD PLAYER

Deck plays 33, 45, 78, r.p.m. records, 9V operated, with mono cartridge. BRAND NEW . . . as illustrated.

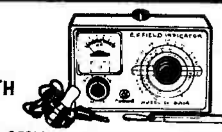


**Price 59/6** p.p. 3/6. Send for leaflet No. 2.

### MULLARD 1 WATT AMPLIFIER

Portable Transistor Unit—Ideal for Intercoms, Baby Alarms, Telephone, Record Players or Guitar Practice. 9V 5 transistors with volume control, output 3 ohms. Ideal for use with Staar Record Deck. **Price 45/–,** p.p. 2/6

### ★ FIELD STRENGTH METERS



5-ranges 1–250Mc/s. Fitted 200A meter. Earphone output. Calibrated tuning scales.
**FL30HA** **Price 72/6** p.p. 2/–
Also non calibrated type peaking F/S Meter. **FSI Price 45/–** p.p. 2/6

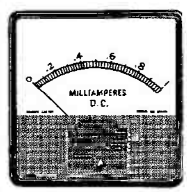
### ★ TRANSISTOR CHECKER

Complete capacity for checking all transistors npn and pnp for alpha, beta and Leakage. Also diodes complete with leads and instructions.
**ZQM-2 Price £5.19.6.** p.p. 3/6

### ★ SIGNAL INJECTOR AND TRACER

Pocket, speed model for checking all audio and RF up to VHF. Simple to use. Battery operated. Output approx. 1kc/s, 1.4V Harmonics up to VHF.
**SE250B Price 35/-** p.p. 1/6
*Matching Signal tracer
**SE500 Price 27/6** p.p. 1/–

● All parts in stock to build the integrated circuit and other designs appearing in Practical Wireless and Electronics. Ask for quotations—see latest catalogue editions.




### ★ QUALITY PANEL METERS (D.C. RANGES)

**38 Series.** Face size 42mm × 42mm (1⅝in. × 1⅝in.). 50μA, **37/6;** 100μA, **35/–;** 200μA, **32/6;** 500μA, **27/6;** 1mA, 5mA, 10mA, 50mA, 100mA, 500mA, **25/–** each; 10V, 20V, 50V, 100V, 300V, and 500V, **25/–** each; 1A and 5A, **25/–** each "S" meter, 1mA, **29/6** VUmeter, **37/6. 65 Series.** Face size 86mm × 78mm (3⅜in. × 3⅛in.). 50μA, **62/6;** 100μA **52/6;** 200μA, **47/6;** 500μA, **45/–;** 1mA 5mA, 10mA, 500mA, **37/6** each. "S" meter, 1mA, **42/6.** Other ranges and sizes in stock. Ask for list.

### ★ 10 in 1 TEST UNIT

**A new design tests most circuits. Model SE400 Price £9.10.0.**

*A.c./d.c. Volts (4K/Volt) 0/15/50/150/500.
*Resistance 0/10K/100k/1 Meg.
*Five values resistance and capacitance substitution.
*RF F/S Meter 1 to 140Mc/s.
*455/700kc/s RF Generator Size 7½in. × 3⅛in. × 1$\frac{7}{16}$in.
*D.c. Ammeter 0/500mA.
*400c/s Audio Generator.

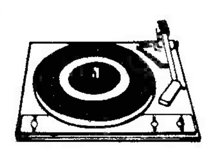
## COMPONENTS

UK's LARGEST STOCKISTS
ASK FOR QUOTES—SEE LATEST CATALOGUE

## HENRY'S FAMOUS CATALOGUES – SEE BACK COVER FOR DETAILS

## GARRARD TURNTABLES

### GOLDRING - BSR - GARRARD



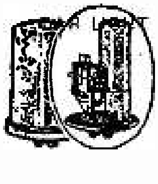
| | | |
|---|---|---|
| BSR UA25 mono | | £5 19 6 |
| 2025 GKS25 stereo | | £7 19 6 |
| 2025 TC | 9TAHC | £8 19 6 |
| 3000 LM | DIAM | £9 15 0 |
| | Ceramic | |
| 3500 | Stereo | £12 19 6 |
| Deccadec Deram | | £18 10 0 |

### ★ NOTE THESE SPECIAL PRICES WITH DIAMOND STYLUS CARTRIDGES ★

| Cartridge Model | Less Cartridge | 9TAHC Diam. | AT21 or M3DM | AT66 AT21X* | AT33 Deram* | G800 | J2203 800SE* | CS91E Ceramic |
|---|---|---|---|---|---|---|---|---|
| | £ s d | £ s d | £ s d | £ s d | £ s d | £ s d | £ s d | £ s d |
| SP25 Mk II | 11 9 6 | 13 12 6 | 19 0 0 | 10 15 0 | 16 10 0* | 21 0 0 | 15 10 0 | 19 0 0 |
| AP75 | 17 15 0 | 19 15 0 | 25 10 0 | 23 0 0 | 27 0 0 | 27 0 0 | 21 17 6 | 25 10 0 |
| GL75P | 46 0 0 | — | 53 10 0 | 60 0 0* | 55 10 0 | 53 0 0 | 70 0 0* | 53 10 0 |
| GL69P | 35 0 0 | 37 0 0 | 42 10 0 | 40 0 0 | 44 10 0 | 42 0 0 | 59 0 0* | 42 10 0 |
| MA70 | 12 10 0 | 14 10 0 | 20 0 0 | 17 12 6 | — | — | 16 10 0 | 20 0 0 |
| AT60 Mk II | 13 10 0 | 15 15 0 | 21 7 6 | 19 0 0 | 18 0 0* | — | 17 12 6 | 21 10 0 |
| GL75 | 33 0 0 | 35 0 0 | 40 10 0 | 47 0 0* | 42 10 0 | 40 0 0 | 57 0 0* | 40 10 0 |
| SL72B | 25 0 0 | 27 0 0 | 32 10 0 | 30 10 0 | 34 10 0 | 34 0 0 | 29 0 0 | 32 10 0 |
| SL75B | 31 0 0 | 33 0 0 | 33 10 0 | 36 10 0 | 40 10 0 | 40 0 0 | 35 0 0 | 38 10 0 |
| SL95B | 39 0 0 | 41 0 0 | 46 10 0 | 53 10 0* | 48 10 0 | 48 0 0 | 43 0 0 | 46 10 0 |
| SL65B | 15 19 6 | 18 0 0 | 23 10 0 | 21 10 0 | 20 10 0* | 25 0 0 | 19 15 0 | 23 10 0 |
| GL69 | 23 0 0 | 25 0 0 | 30 10 0 | 28 0 0 | 32 10 0* | 30 0 0 | 47 0 0* | 30 10 0 |

Plinth/covers 2025, 3000, 3500, SP25 95/–, p.p. 6/–. (Note GL69P and GL75P complete with plinth/cover). 2025, 3000, 3500, SP25, SL65B, SL72B, SL75B, SL95B Deluxe type—plays with top on (state model) £8.10.0. p.p. 7/6.

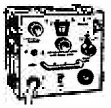
● **SPECIAL** Sinclair Stereo 60 Preamp. Two Z30 AD PZ5 Power Pack (usually £23.18.0) **£19**



## FLASHERS

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

## CLASS D WAVEMETERS



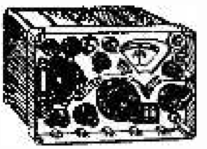
A crystal controlled heterodyne frequency meter covering 1·7-8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. **£5.19.6.** Carr. 7/6. Or brand new with accessories. **£7.19.6.** Carr. 7/6.

## CLASS D WAVEMETERS No. 2

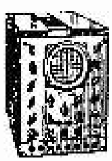
Crystal controlled. 1·2-19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. **£12.10.0.** Carr. 30/-.

## R209 MK II COMMUNICATION RECEIVER

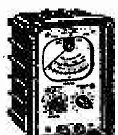
11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, B F.O., aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked **£15.0.0.** Carr.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



## TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope. T.B. 2 cps-750 Kc/s. Bandwidth 5.5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. **£22.10.0.** Or complete with all accessories, probe, leads, lid, etc. **£25.** Carriage 30/-.



## MARCONI T/44/TF956

**AF Absorption Wattmeter**

1 μ/watt to 6 watts.

**£20.** Carr. 10/-.

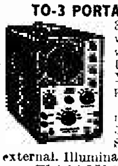
## SOLARTRON CD 711S2

### Double Beam Oscilloscopes

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

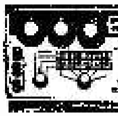
(Few available less C.R.T.) £25 Carr. 50/-

## TO-3 PORTABLE OSCILLOSCOPE



3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps-1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps 800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. **£37.10.0.** Carr 10/-.

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



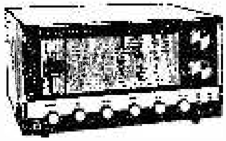
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω-11·1 meg Ω 6 Ranges ± 1% L.1 μ H - 111 HENRYS 6 Ranges -2% C. 10pF - 1110mFd. 6 Ranges ± 2%. TURNS RATIO 1:1/1000-1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. **£20.** P. & P. 5/-.

## UNR-30 4-BAND COMMUNICATION RECEIVER

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

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

## LAFAYETTE SOLID STATE HA600 RECEIVER

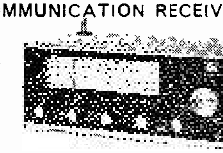


5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s-400 Kc/s and 550 Kc/s-30 Mc/s FET front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9¾in. × 8¼in. Weight 18 lbs. EXCEPTIONAL VALUE. **£45.** Carr. 10/- S.A.E. for full details.

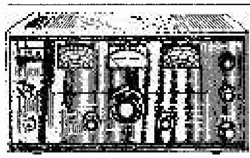
**LAFAYETTE HA-800 SOLID STATE AMATEUR COMMUNICATION RECEIVER**

Six bands 3·5-4, 7-7·3, 14-14·35, 21-21·45, 28-29·7, 50-54Mc/s. Dual conversion on all bands. 2 × 455 Kc/s mechanical filters. FET front end, product detector, variable BFO, 100Kc/s crystal calibrator. 'S' Meter. Huge slide rule dial. Operation 230V AC or 12V DC. Size 15 × 9¾ × 8¼in. Complete with instruction manual. **£57.10.0** Carr. Paid. 100Kc/s crystal 39/6 extra.

## UR-1A SOLID STATE COMMUNICATION RECEIVER



4 bands covering 550 Kc/s—30 mc/s continuous. Special features are use of FET transistors. S meter, built in speaker and telescopic aerial, variable BFO for SSB reception, noise limiter, bandspread control, sensitivity control. Output for low impedance headphones. Operation 220/240 volt A.C. or 12 volt D.C. Size 12¾in. × 4¾in. × 7in. Excellent value ONLY **£24.** Carr. 7/6.

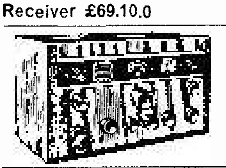


## TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

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

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

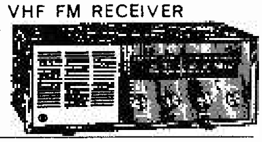
**TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £180 IN STOCK!**



## RCA COMMUNICATIONS RECEIVERS AR88D

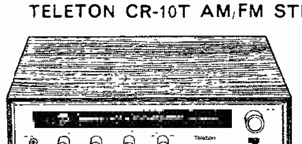
Latest release by ministry BRAND NEW in original cases. 110-250v. A.C. operation. Frequency in 6 Bands. 535 Kc/s—32 Mc/s continuous. Output impedance 2·5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price **£87.10.0.** Carr. £2.

## LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

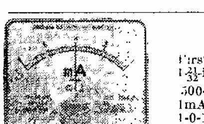


A completely new transistorised receiver covering 152-174 Mc/s. Fully tunable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone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

## TELETON CR-10T AM/FM STEREO TUNER AMPLIFIER




A new model from Teleton. 31 solid state devices. 4 + 4 watt output. Inputs for ceramic/crystal cartridge. Frequency range AM 540-1600KHz FM 88-108MHz. Automatic FM Stereo reception. Stereo Indicator. Controls: Tuning, function selector, Tone and R & L volume controls. AFC switch. Stereo headphone socket. Size 13⅞" × 3½" × 9½" approx. PRICE **£34.0.0.** Carr. 7/6.



## CLEAR PLASTIC PANEL METERS

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

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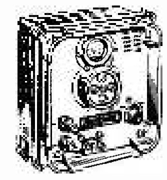
|---|---|---|---|
| | 500-0-500μA 27/6 | 50mA ..... 27/6 | 150V. D.C. .. 27 6 |
| | 1mA ...... 27/6 | 100mA ..... 27/6 | 300V. D.C. .. 27 6 |
| | 1-0-1mA ... 27/6 | 150mA ..... 27/6 | 500V. D.C. .. 27/6 |
| | 2mA ....... 27/6 | 200mA ..... 27/6 | 750V. D.C. .. 27/6 |
| | 5mA ....... 27/6 | 300mA .....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

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

## Variable Voltage TRANSFORMERS

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

## CRYSTAL CALIBRATORS NO. 10



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

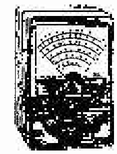
## TE-40 HIGH SENSITIVITY A.C. VOLTMETER

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

## LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

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

## TE-65 VALVE VOLTMETER

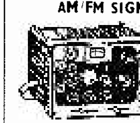


High quality instrument with 28 ranges. D.C.volts 1·5—1,500v. A.C. volts 1·5—1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions. **£17.10.0.** P. & P. 6/-. Additional probes available: R.F.**35/-**.H.V.**42/6.**

## COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

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

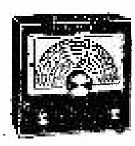
## AM/FM SIGNAL GENERATORS



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

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

**PLESSEY SL.403A** 3 watt Integrated Amplifier Circuit **49/6.** Post paid.



**TE-16A Transistorised Signal Generator.** 5 ranges 400kHz—30mHz. An inexpensive instrument for the handyman Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¾ × 3⅝in. Complete with instructions and leads. **£7.19.6.** P. & P. 4/-.

## HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES

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

## AUTO TRANSFORMERS

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

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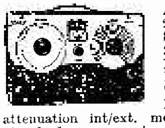
|---|---|---|
| 150 W. | **£2. 2.6.** | P. & P. 3/6. |
| 300 W. | **£2.19.6.** | P. & P. 4/6. |
| 500 W. | **£4.10.0.** | P. & P. 6/6. |
| 1,000 W. | **£6.10.0.** | P. & P. 7/6. |
| 1,500 W. | **£7.19.6.** | P. & P. 8/6. |
| 7,500 W. | **£15.10.0.** | P. & P. 20/-. |

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

## ARF-100 COMBINED AF-RD SIGNAL GENERATOR



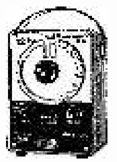
A.F. SINE WAVE 20 – 200,000 c/s. Square wave 20–30,000 c/s. O/P. HIGH IMP. 21V. P/P600 Ω 3.8V. P/P TF 100 Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V. A.C. **£32.10.0.** Carr. 7/6.

## TE-20D RF SIGNAL GENERATOR

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

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

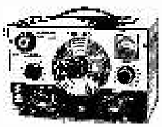
## TY75 AUDIO SIGNAL GENERATOR



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

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

## LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER



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

**MODEL ZQM TRANSISTOR CHECKER**

It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0.7–0.9967. B: 5–200. Ico: 0–50 microamps 0–5mA. Resistance for diode 200 Ω – 1M Ω. Supplied complete with instructions, battery and lead. **£5.19.6.** P. & P. 2/6

## ADVANCE TEST EQUIPMENT

**Brand new and boxed in original sealed cartons**

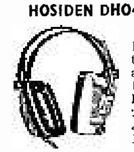
**J1B. AUDIO SIGNAL GENERATOR.** 15 c/s to 50 Kc/s. Sine wave. Output 600 ohms or 5 ohms **£30.0.0.**

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

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

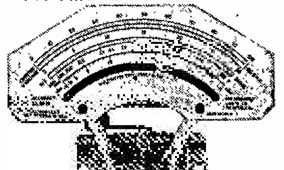
Carriage 10/- per item.

## HOSIDEN DH04S 2-WAY STEREO HEADSETS



Each headphone contains a 2½in. woofer and a ⅝in. tweeter. Built in individual level controls. 8 Ω imp. 25–18,000c/s with cable and stereo plug. **£5.19.6.** P. & P. 2/6.

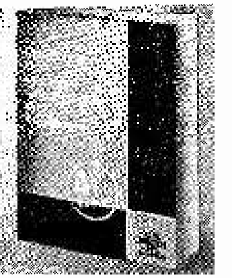
## AVOMETER MOVEMENTS



50µA 20K Ω/V

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

# Latest Catalogue



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| 2025T/C stereo | £9.17.6 | SL75 | £25.19.6 | | |
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| SL55 | £11.12.6 | A70/11 | £11.19.6 | | |
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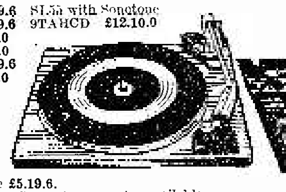
| SL72B | £25.0.0 | | | | |



Carriage 7/6 extra each item.

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3. For SP25 etc. to operate with lid in place **£5.19.6.**

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

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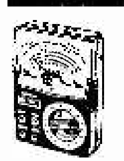
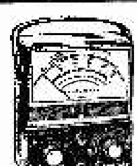
19 transistors, 8 diodes, 1HF music power, 30W at 8 Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16 Ω. Separate L and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10¼ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. **£24.** Carriage 7/6.

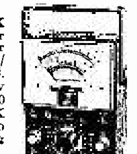
# MULTIMETERS *for EVERY purpose!*



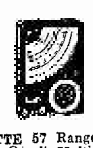
**TE-51. NEW 20,000 Ω/VOLT MULTIMETER** with overload protection and mirror scale. 0/6/60/120/1,200v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0.60µA/12/300mA. D.C 0/60K/6 meg. ohm. **92/6.** P. & P. 2/6.



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

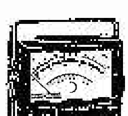


**MODEL AS-100D. 100K Ω/VOLT.** 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v D.C. 0/6/30/120/300/600v A.C. 0/10µA/6/60/300 mA/12 amp. 0/2K/200K/2M/200M Ω. −20 to +17dB. **£12.10.0.** P. & P. 3/6.

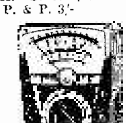


**MODEL TE-10A.** 20k Ω/Volt 5/25/50/250/500/2,500v. D.C. 10/50/100/500/1,000 v. A.C. 0/50µA/2.5mA/250mA D.C. 0/6K/6 meg. ohm. −20 to +22dB. 10.0, 100mFd. 0.100-0.1mFd. **69/6.** P. & P. 2/6.

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

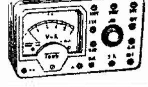


**LAFEYETTE 57 Range Super 50k Ω/volt Multimeter'** D.C. volts 12 mV —1000V. A.C. volts 1.5V —1000V. D.C. current 25µA–10 amp. Ohms 0–10meg Ω dB −20 to +81 dB. Overload protection. **£12.10.0.** Carr. 3/6.



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

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



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

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

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6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108Mc/s Ready built ready for use. Fantastic value for money. **£6.7.6.** P. & P. 2/6. Stereo multiplex adaptors **99/6.**

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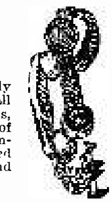
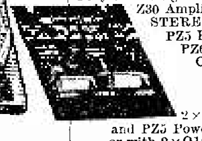


Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. **£6.19.6.** P. & P. 3/6.

## SINCLAIR EQUIPMENT



Project 60 range of new models now in stock

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

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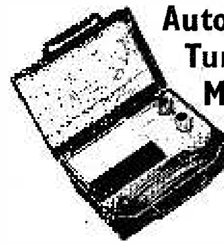

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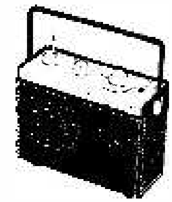

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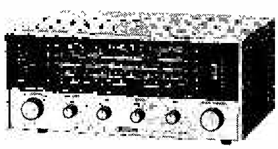

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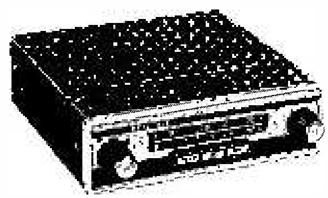

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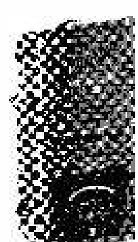

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# R.S.C. SENSATIONAL HIGH FIDELITY STEREO 'PACKAGE' OFFERS

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

TA12 Amplifier (13 watt) in veneered housing Garrard 3000 4 sp. Autochanger unit on plinth Sonotone 9TA P.U. cartridge. Pair of Dorchester Loudspeaker units
Special Total Price Carr. 25/-. **47½ Gns.**
Or Dep. £9 and 9 monthly payments. £5.4.9 (Total £56.2.9).
Transp. plastic cover 3 *gns.* extra inc. carr.

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

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

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

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

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● Garrard SP25 Mk II 4 sp. player unit on plinth
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● Pair of Dorchester Loudspeaker Units. **53gns.**
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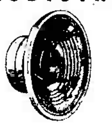
## AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS



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

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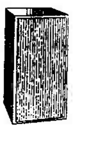
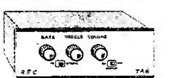
**Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled acoustic damping. Ported where appropriate, credit terms available.**



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

**STANWAY II** Size 20x10¼x9¾in. approx. Rating 10 watts. Inc. Fane 13x8in. speaker with highly flexible cone surround, long throw voice coil and 11,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 15 ohms. Gives smooth realistic sound output. **16 Gns.**

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



200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV. Output rating I.H.F.M. Fully enclosed enamelled case, 9¼x2¾x5¼in. Attractive brushed silver finish facia plate 10½ x 3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **7 Gns.** Carr. 7/6
Or factory built with 12 months' guarantee. £8.19.9

## RECORD PLAYING UNITS

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

**RP2C** Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Carr. 9/6 **23 Gns.**

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

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

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

## R.S.C. PLINTHS

for Record Playing units, cut for Garrard 1025, 2025, 3000, AT60, SP25 etc.
Available **3 gns.**
with trans. plastic cover. **6 gns.**

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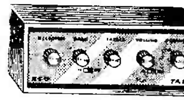
## LINEAR L10 HIGH FIDELITY 10W AMPLIFIER

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

## R.S.C. TA12 MKII 13 WATT STEREO AMPLIFIER

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



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

## AUDIOTRINE HI-FI SPEAKER SYSTEMS

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

## HI-FI SPEAKER ENCLOSURE

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

**JE8** Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **£4.15.0**

**SE8** For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Ported **£5.15.0**

**SE10** For ontstanding results with 10in. Hi-Fi 'spkr Size 24x15x10in. P'td. **£5.19.6**

**SE12** For exclnt prfmnce with 12in Hi-Fi speaker and Tweeter. Size 25 x 16 x 10½in. **£6.19.9**

## THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

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

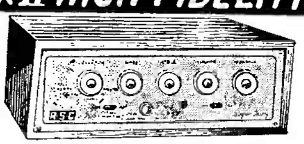
## R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

★ High-sensitivity. ★ 200-250v. A.C. Mains operation. ★ Sharp A.M. Rejection× ★ Drift-free reception. ★ Output ample for any amplifier approx. 500 m.v.J. ★ Output for feeding Stereo Multiplexer. ★ Tuner head using silicon Planar Transistorx. ★ Designed for standard 80 ohm co-axial input. Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. Printed circuitry. A quality product at considerably less than the cost of comparable units. Factory built 18 *gns*. Or in Teak finished cabinet as illustrated 21 *gns*. Terms: Deposit £6.1.0 and 9 monthly payments. 2*gns*. Total £24.19.0. Stereo version, 28½ *gns*. Carr. 10/6

## R.S.C. SUPER 30 MkII HIGH FIDELITY STEREO AMPLIFIER

**High Grade Components Specifications comparable with units costing considerably more.**

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



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

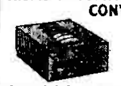
**FACIA PLATE** Attractive design in rigid Perspex. Silver finish matching control knobs as available.

**Eminently suitable for use with any make of pick-up or Mic. (Ceramic or Magnetic, Moving Coil, Ribbon or Crystal) currently available. Superb sound output quality can be obtained by use with first rate ancillary equipment.**

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

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

## R.S.C. BATTERY/MAINS CONVERSION UNITS



Type BM1
An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 52/6 or assembled 3 Gns.

## SUPER 15 HIGH FIDELITY SOLID STATE AMPLIFIER

Approx. as Super 30 but single channel. Complete kit with full constructional details and point to point wiring diagrams. **12½ gns.** Carr. 12/6
OR FACTORY BUILT 15¼ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9) or in Teak or Afrormosia veneered housing. 19 gns.

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

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

**R·S·C**
HI-FI CENTRES LTD.

**MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds 13.** No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries.
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**MAIL ORDERS MUST NOT BE SENT TO SHOPS**

32 High Street (Half-day Thurs.) Tel. 56420 **LEICESTER**
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73 Dale St. (Half-day Wed.) Tel. CENtral 3573 **LIVERPOOL**
238 Edgware Road, W2 (Half-day Thurs.) Tel. PAD 1629 **LONDON**
60A Oldham Street (Half-day Wed.) Tel. CENtral 2778 **MANCHESTER**
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41 Blackett Street (Opp Fenwicks Store) (Half-day Wed.) Tel. 21469 **NEWCASTLE UPON TYNE**
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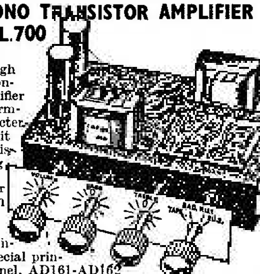
## MONO TRANSISTOR AMPLIFIER HSL.700



A really high fidelity monaural amplifier with performance characteristics to suit the most discriminating listener. 6 transistor circuit with integrated pre-amplifier assembled on special printed sub panel. AD161-AD162 operating in symmetrical complementary pair. Output transformer coupled to 3 ohm and 15 ohm speaker sockets. Standard phono input sockets. Full wave bridge rectifier power supply for AC mains 200-240v. Controls: Bass, Treble, Volume/on/off. Function selector for PU1, PU2, Tape, Radio. The HSL.700 is strongly constructed on rigid steel chassis bronze hammer enamel finish, size 9½ × 5 × 4¼in. high.

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

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

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

**LOUDSPEAKER BARGAINS**

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

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

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

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

**35 OHM SPEAKERS**

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

**80 OHM MOVING COIL SPEAKERS**

High Flux Magnet. 2¾in. dia. **12/-** each. P. & P. 1/6.

**BALANCED ARMATURE EARPHONE**

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

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

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

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

**HONEYWELL MICROSWITCHES. S/P. C/O.** Push button action. Rating 250v. AC at 15 amps. Size approx. 1⅞ × ⅞ × ⅝in. **5/-** each. P. & P. 1/- (6 or more post free).

**TELESCOPIC AERIALS WITH SWIVEL JOINT.** Can be angled and rotated in any direction. 12 section Heavy Chrome. Extends from 7in. to approx. 56in. Maximum diameter ½in. **10/-** each. P. & P. 1/6. 6 section Lacquered Brass. Extends from 6in. to 22½in. approx. Maximum diameter ¼in. **5/-** each. P. & P. 1/-.

### TRANSFORMER BARGAINS!

**BRAND NEW MULTI-RATIO MAINS TRANSFORMERS.** Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price **32/6**, P. & P. 6/-.

**MAINS TRANSFORMER.** For transistor power supplies. Pri. 200/240v. Sec. 9–0–9 at 500mA. **11/-**. P. & P. 2/6. Pri. 200/240v. Sec. 12–0–12 at 1 amp. **14/6**. P. & P. 2/6. Pri. 200/240v. Sec. 10–0–10 at 2 amp. **27/6**. P. & P. 3/6. Tapped Primary 200–220–240v. Sec. 21.5v. at 500mA. **12/6**. P. & P. 2/6.

**BATTERY CHARGER TRANSFORMERS.** 200/240v. input. Nominal output for 6 or 12v. batteries 4 amps. Size approx. 3" x 2½" x 2½". Brand New. Price **22/6**. P. & P. 7/-.

**HIGH GRADE COPPER LAMINATE BOARDS.** 8 × 6 × $\frac{1}{16}$in. FIVE for **10/-**. P. & P. 2/-.

## SPECIAL OFFER ! !

**Your opportunity to acquire a first class HI-FI LOUDSPEAKER SYSTEM at an extremely moderate price! Beautifully made teak finish enclosure with most attractive Tygan front. Size 16½" high × 10½" wide × 6" deep. Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 15 ohm impedance.**

**OUR PRICE WHILE LIMITED STOCKS LAST 8 Gns.** Carriage 10/-

## TRANSISTOR STEREO 8 + 8 MK II

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

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

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

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

**GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER**

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. Can be operated from 9-18v. battery supply or direct from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" x 1½" x ⅞". Brand new complete with instructions. Price **17/6**. P. & P. 2/6.

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

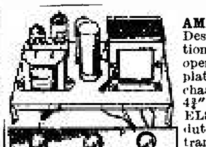
Heavy 8½in. metal turntable. Low flutter performance 200/250v. shaded motor (90v. tap). Complete with latest type lightweight pick-up arm and mono cartridge with t/o stylii for LP/78. ONLY **63/-**. P. & P. 6/6.

**QUALITY RECORD PLAYER AMPLIFIER MK II**

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

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

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



**3-VALVE AUDIO AMPLIFIER HA34 MK II.**

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

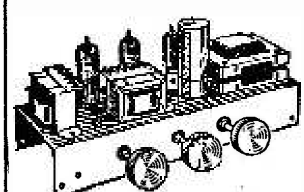
**HSL "FOUR" AMPLIFIER KIT.** Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **79/6.** P. & P. 6/-.

**HARVERSON'S SUPER MONO AMPLIFIER**

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

OUR ROCK BOTTOM BARGAIN PRICE **55/-** P. & P. 6/-

## DE LUXE STEREO AMPLIFIER



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

**4-SPEED RECORD PLAYER BARGAINS**
**Mains models. All brand new in maker's packing.**

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

**LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000. AT60 etc. Send S.A.E. for latest Prices!**

**PLINTH UNITS** cut out for Garrard Models, 1025, 2025, 2000, 3000, AT60, SP25. With transparent plastic cover. OUR PRICE **5 gns.** complete. P. & P. 8/6.

**LATEST ACOS GP91/1SC** mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **30/-**. P. & P. 1/6.

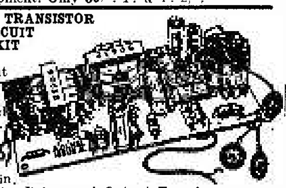
**SONOTONE 2539** High output Stereo Cartridge. T/O stylus for Stereo/LP/78. Complete with universal mounting bracket. List Price **48/7.** OUR PRICE **25/-**. P. & P. 1/6.

**SONOTONE 9TAHC** compatible Stereo Cartridge with diamond stylus **50/-**. P. & P. 2/-.

**LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE** for EP/LP/Stereo/78. **32/6**. P. & P. 2/-.

**LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE** for playing EP/LP/78 mono or stereo records on mono equipment. Only **30/-**. P. & P. 2/-.

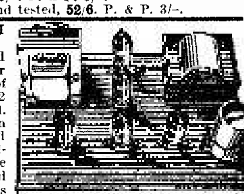
**HGIH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT**
**Type TA1**



- Peak output in excess of 1½ watts.
- All standard British components
- Built on printed circuit panel size 6 × 3in.
- Generous size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors (GET114 or 81 Mullard AC128D and matched pair of AC128 o/p).
- 9 volt operation.
- Everything supplied, wire, battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram **2/6** (Free with Kit). All parts sold separately.

**SPECIAL PRICE 45/-**. P. & P. 3/-.
Also ready built and tested, **52/6**. P. & P. 3/-.

**10/14 WATT HI-FI AMPLIFIER KIT**



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **2/6** (Free with parts). **All parts sold separately.** ONLY **£7.9.6.** P. & P. 8/6. Also available ready built and tested complete with std. input sockets, **£9.5.0.** P. & P. 8/6.

**BRAND NEW TRANSISTOR BARGAINS.** GET 15 (Matched pair) **15/-**; V15/10p **10/-**; OC71 **5/-**; OC76 **6/-**; AF117 **3/6**; 2G339 (NPN) **3/-**.
Set of Mullard 6 transistors OC44, 2—OC45, AC128D matched pair AC128 **25/-**; ORP12 Cadmium Sulphide Cells **10/6**. All post free.

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

*Open all day Saturday*
*Early closing Wed. 1 p.m.*

*A few minutes from South Wimbledon Tube Station.*

# HARVERSON SURPLUS CO. LTD.

**170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985**

*SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES*

*(Please write clearly)*

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# PRACTICAL WIRELESS

VOL 46 NO 1
*Issue 759*

MAY 1970


## TOPIC OF THE MONTH

### The Vintage Years

SOMETIMES in this column, certain elements are berated for not being as up-to-date as we think they should be. This month, with that special perversity of editors, the clock is going to be turned backwards—not, exactly, to the dawn of time but to those days when radio was a crude, exciting newcomer.

It has become clear from correspondence that there is a growing interest in those early days. So many readers have written to us on the subject that it has not been possible to answer everyone individually. These interesting letters have been greatly appreciated and, for those who have not had an acknowledgement, a grateful thank-you. Those who have asked for a feature on the history of radio will be pleased to know that something *will* be done about this as soon as possible. In the meantime, historically-minded readers might care to ponder on a couple of points.

Quite a few enthusiasts have added a useful sideline to their hobby by collecting pieces of vintage radio equipment, either components or complete models. In this way, some useful little private collections have been formed, quite apart from specimens in museums or owned by radio companies. These pieces of equipment are quickly passing from the phase of being 'junk' to becoming respectable 'antiques'. We think it important that readers keep a weather eye open for anything in this line which might otherwise end up in the dustbin—a good home can always be found for such items.

The second point is that, although there are vintage car organisations, vintage record societies, vintage gramophone clubs and vintage-practically-everything-else-clubs, there is to our knowledge no vintage radio equipment organisation. The need obviously exists and such an organisation could do much to collate information and put fellow enthusiasts in touch with each other. We would be pleased to give space to any readers wishing to start such an enterprise.

W. N. STEVENS—*Editor.*

**JUNE ISSUE WILL BE PUBLISHED ON MAY 5**

## NEWS AND COMMENT



## CONSTRUCTIONAL



## OTHER FEATURES

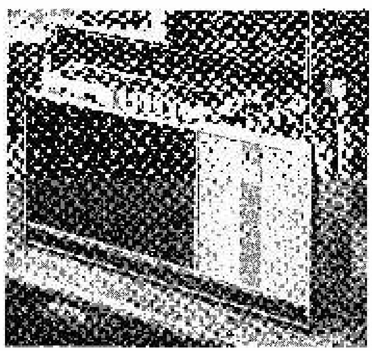
# NEWS... NEWS... NEWS...

## Marconiphone 1970

First new models for 1970 announced by British Radio Corporation are three Marconiphone sets, a portable radio and two tape recorders.

The Marconiphone model 4170 is a a.m./f.m. transistor radio with a recommended retail price of £32 10s.

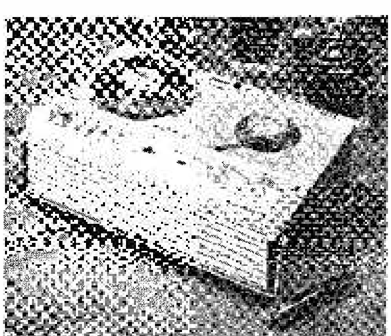
Waveband coverage includes long, medium, short and v.h.f., with built-in a.m. and f.m. aerials. There is a permeability-tuned aerial circuit for matching a car aerial on long and medium wavebands. The receiver has automatic frequency control on v.h.f. with push button on/off switch.



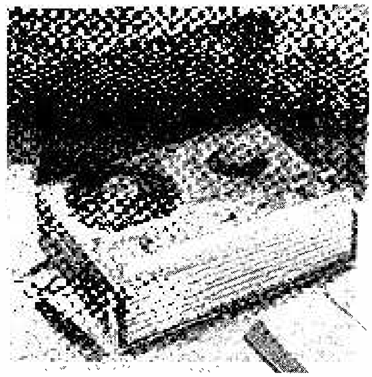
*Model 4170 receiver.*

Output is approximately 1W, at less than 5% harmonic distortion through a 6 x 4in. loudspeaker. Sockets are included for a car aerial, tape recorder, earphone and an external power unit; when this latter socket is used the internal battery is switched out.

The Marconiphone tape recorder model 4245 is a twin-track single-speed machine with $5\frac{3}{4}$in.



*Model 4245 tape recorder.*



*Model 4246 tape recorder.*

spools. With lid removed it will accommodate spools up to 7in. diameter. Tape speed is $3\frac{3}{4}$i.p.s.

Incorporating an entirely new BRC tape deck, model 4245 has automatic recording level control, switched for either speech or music. Other facilities include a combined input and output socket for recording and playback, automatic end stop, pause control and 4-digit tape position indicator with reset button.

Solid state, model 4245 has an amplifier output of 3W, speech and music rating at 5% distortion; speaker size is $5\frac{1}{2}$ x $2\frac{3}{4}$in. elliptical.

Supplied with a moving coil microphone, 900 feet of LP tape on a $5\frac{3}{4}$in. spool, a DIN 2-pin speaker plug and connecting lead in a plastic wallet, model 4245 has a recommended retail price of £35 19s.

Marconiphone model 4246 is a 4-track single speed tape recorder running at $3\frac{3}{4}$i.p.s. Of very similar specification to the 4245, the model 4246 has a switched automatic recording level control for the more advanced recording enthusiast to go on to manual when required. Recommended retail price of Marconiphone model 4246 is £41 14s.

## Rastra Catalogue

Rastra Electronics Ltd. announce the issue of a new 17-page loose-leaf catalogue of i.c.'s, transistors, triacs, thyristors, rectifiers, computer diodes, breadboards, sockets etc. *Rastra Electronics Ltd., 275 King Street, Hammersmith, London, W.6.*

## Local Radio on MW

The BBC local radio stations, soon numbering 20, can use the Medium Wave in the future. The Minister of Posts and Telecommunications (GPO) John Stonehouse recently released the necessary frequencies and freed the BBC from its restrictive v.h.f. allocation.

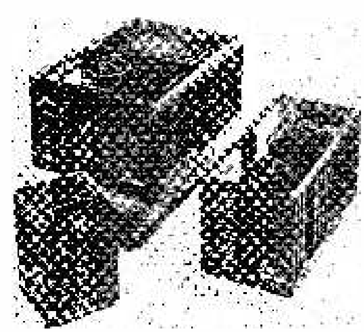
The reason for this move is that while v.h.f. gives superior reception only a limited number of listeners have or can afford suitable receivers. Local stations will in future use the "opt-out" channels used for local radio.

These stations will, of course, be best received during the daytime as at night the Continentals come up and make local reception on m.w. virtually useless. V.H.F. will still however be used.

## ITT Power Supply

ITT Components Group Europe now offer a new MP range of stabilised power supplies.

The MP range is available in output d.c. current ratings of 0·5, 1, 2, 3, 5 and 10A. Each current rating may be specified in stabilised output voltage ranges of 0-16, 0-30 and 0-50V.



A key feature of the MP range is that two versions of each unit are offered. The "industrial" version meets the majority of normal industrial requirements.

Stability ratio of the industrial version is 1000 : 1 above 6V output and 250 : 1 below, compared with 10000:1 for the professional version at all voltages. *ITT Components Group, Europe, Standard Telephones and Cables Limited, Edinburgh Way, Harlow, Essex.*

# NEWS... NEWS... NEWS...

## IC FM tuner kit

We have been informed by General Avionic Associates Ltd. that they have changed their address to: 2 Cheam Court, Station Way, Cheam, Sutton, Surrey. They apologise for any inconvenience caused to readers and ask that if they sent cheques and postal orders to the old address (9 Wimpole Street, London, W.1) would they be kind enough to cancel them and re-order from the Sutton address.

## Amateur radio network links 'shut-in' operators

In an age when satellites make communications swifter and more extensive than ever before, it can be surprising to discover that some people are still cut off from their fellow men by physical handicaps. For the deaf and the blind there are hearing aids, Braille printing and similar devices to help overcome disabilities. Yet other ailments can shut in the victim from the world—unless he is determined not to be left out, and some physically sound friends respond to that determination.

That is what happened in San Ysidro, a city in California close to the Mexican border, where two young men, victims of a crippling disease, have become amateur radio operators, able to communicate with the world. The identical twin brothers, Henry and Jack Johnson, are only able to talk, move their eyeballs and control a capillary nerve in one arm. But now, thanks to the efforts of a group of dedicated amateur radio "hams," they are able to talk to the four corners of the earth.

As a result, there is now a radio network linking handicapped operators around the world. The organisation, called International Handicappers' Net (IHN), grew out of a conversation with the disabled twins and a Lieutenant Commander Ray E. Meyers, a retired Navy communications officer. Soon other amateurs joined the group and an exotic control system was developed for operating the radio equipment within the limited abilities of Henry and Jack.

It was the Johnson brothers who suggested starting a radio network of handicapped amateurs along with the possibility of listing the members so that others might immediately recognise fellow members. The result would be "on the air" contact, discussion, or relaying of messages.

Members are classified as operators or honorary—the honorary members are unhandicapped persons who help the handicapped to learn to operate their sets and solve problems of managing transmission and reception. Membership is also graded according to the operator's skills, as novice, technician, general and extra. The net has more than 3,000 members in all the states and in almost all countries. Many operators were "hams" before they became handicapped; the others learned their skills after illness made them shut-ins.

Because the physical handicaps include a wide range of crippling conditions, the honorary members have resorted to a variety of systems of instruction in addition to creating ingenious devices to meet individual difficulties in handling transmission and reception of messages.

Some helpful amateurs developed voice-controlled relays permitting an armless or paralyzed operator to send intelligible code. Others have perfected radio controls which can be turned on and off by the flick of an eyelid. Another device enables a bed-ridden operator to manage his controls by air pressure blown through a flexible hose.

## Practical Wireless and Practical Television Filmshow—1970

The meeting was opened by the Chairman, W. N. Stevens, Editor of *P.W.* and *P.TV.* He paid tribute to Mr. A. T. Collins, the recently retired Managing Editor of the Practical Group magazines who had been with the firm 40 years, and who had worked with F. J. Camm in the early days of *P.W.* When Mr. Camm died, Mr. Collins took over as Managing Editor. Referring to the subject of the evening, the Chairman said that the integrated circuit was not the end of the Home Constructor by any means and that it should stimulate ideas and open up new fields. He said that *Practical Wireless* tried to keep up to date as far as it possibly could and that it was one of the first magazines to publish regular articles on integrated circuit projects in each issue.

Two films were shown, the first entitled "Mullard-ability" and was described as a profile of Mullard Ltd, the largest manufacturer of electronic components in the U.K. The second film, entitled "Something Big in Microcircuits" was set against a background of a ¼-million square feet of production space, years of scientific work in research labs and millions of pounds of invested capital.

The film showed how hundreds of components are created on a tiny chip of silicon less than three square millimetres in area and described why modern technological progress has made this process necessary. Also shown, were some of the ways in which microcircuits are already being used and outlined the future of these devices in the 1970s.

After the films, there was the usual break for refreshments and when the audience had returned, Philip Hunt deputising for Ian Nicholson gave a talk entitled "The Integrated Circuit". He said that integrated circuits had necessitated an entirely new approach to the whole subject of circuitry and circuit design. He discussed the reasons for and the results of this and told of their development and manufacture by Mullard Ltd.

After the talk, the meeting was opened to questions and some interesting points of view were brought forward.

# F.M. STEREO DECODER

W. CAMERON

SINCE publication of the Author's "Transistor FM Tuner" (P.W. Feb.-Mar. 1969) there has been a considerable call from constructors for a stereo decoder unit suitable for use with this tuner. The tuner unit itself was designed for use with a decoder, so it requires no modification. The decoder may be used with other tuners which have an output which by-passes, or otherwise renders inoperative, the de-emphasis network.

This or any other decoder will not work satisfactorily from a tuner which has inadequate i.f. bandwidth, poor a.f. response, or is verging on instability, which may cause lack of bandwidth or a poor frequency/phase relationship. It is also very desirable, if not essential, that the tuner have a.f.c. or be crystal controlled, as channel separation depends largely on the signal being always correctly tuned.

A signal which is of just sufficient strength to provide acceptable mono reception is likely to be inadequate for stereo. Similarly, at some sites or beyond the service area of the v.h.f. station concerned, the change from mono to stereo reception may introduce additional background noise. This is an unavoidable consequence of the decoding process which can only be overcome by improving the signal into the tuner by means of a better aerial system.

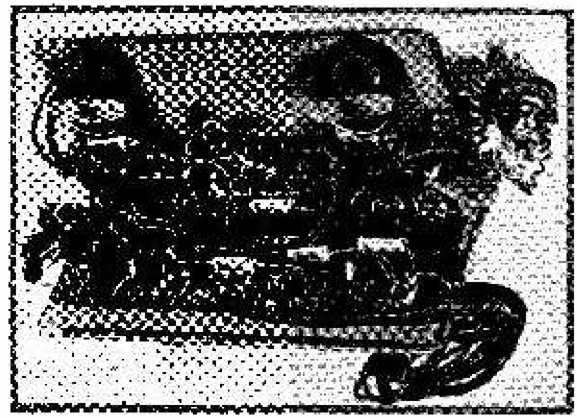
In any case the aerial should be in a fixed position and not just a flying lead hanging from the receiver's aerial socket.

With these points already in mind, it is as well to have some idea of how stereo broadcasting works.

The system the BBC is using is the pilot tone (Zenith G-E) system, which is a method of transmitting both left (A) and right (B) channels on a single wavelength, coded at the transmitter by a multiplexing process.

At the receiver, the decoder converts the multiplexed signal back into the A and B signals for the two channels. The system is compatible, so that on a mono only receiver the stereo signal is reproduced only as mono, being the sum of the A and B signals.

For stereo reception however, additional information is necessary to enable the decoder to seperate the A and B signals. This extra information consists of a "difference" signal (A−B) which is transmitted



as the upper and lower sidebands of a 38kHz suppressed sub-carrier.

A simple way to envisage this operation, and which would give the same result, is as a process of alternately switching the signal to left and right hand channels at a rate of 38,000 times per second.

The same sort of switching process in the decoder extracts the A and B channels for feeding to the respective left and right amplifiers and loudspeakers.

This rate of switching is syncronised between the transmitter and receiver by means of a 19kHz pilot-tone, which is doubled to 38kHz for the switching operation. The two frequencies are phase coherent.

The block diagram (Fig.1) should explain the operation of the decoder.

## CIRCUIT DESCRIPTION

The first stage, Tr1, has unity gain and serves only to provide an inverted audio signal from the collector with respect to the emitter. The 19kHz pilot tone is taken off by the tuned circuit L1-C5 via R5 and C3, and amplified by Tr2. Tr3 is directly coupled to the collector of Tr2 and its base bias is set (by adjustment of VR1) to or beyond cut-off to ensure efficient frequency doubling in the 38kHz tuned circuit L2-C8. The silicon diode D1, holding the emitter at 0·6V, ensures that the transistor will turn on only when the pilot tone reaches a sufficient amplitude to operate the transistor switches Tr4 and Tr5. The diode therefore also ensures that Tr3 remains cut off when no pilot tone is received (mono) so that the switches will not be spuriously operated by high level audio signals, which may otherwise shock L1 and hence T1 into excitation.

The transistors Tr4 and Tr5 are shunt gates, driven by the anti-phase voltages appearing at each end of the centre-tapped L3.

Outputs A and B will be left and right channels

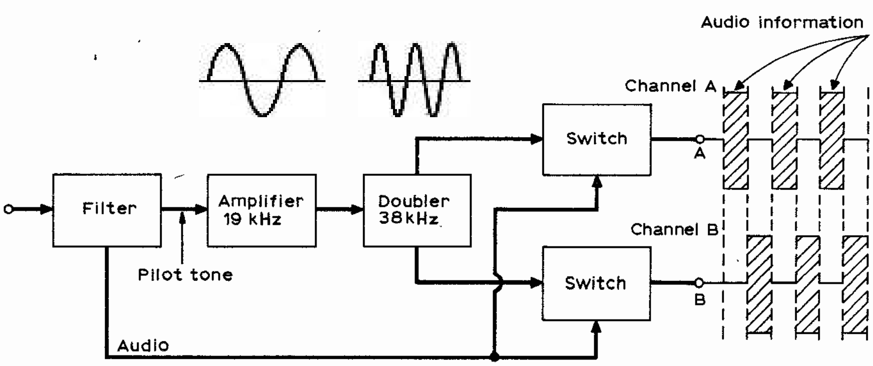



*Fig. 1: Block diagram showing operation of decoder*

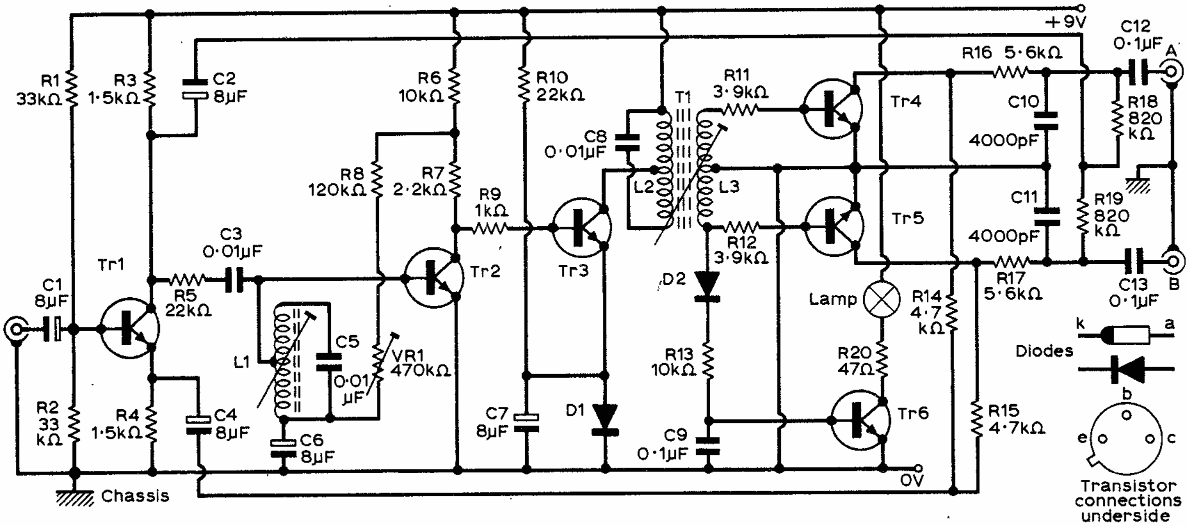



*Fig. 2: Circuit shown is for −ve earth. For +ve earth, chassis connection is made to + rail and C1 reversed in polarity.*

respectively when the phasing of T1 is as shown in the circuit diagram (Fig.2). Reversing the connections of L3 will invert the channels.

Series gate systems were tried, but were found to have the disadvantage that a large switching rate signal was present in the output, sufficient to overload the following amplifier if its response extended to over 38kHz, unless rather elaborate filtering was used.

Although a transistor switch can never be like a perfect switch, the shunt gate system is very efficient. Crosstalk (measured at 1kHz) due to inefficiency is −26dB, which is improved to better than 40dB by applying an out of phase signal via

## ★ components list

**Resistors:**

| | | | |
|---|---|---|---|
| R1 | 33kΩ | R12 | 3·9kΩ |
| R2 | 33kΩ | R13 | 10kΩ |
| R3 | 1·5kΩ | R14 | 4·7kΩ |
| R4 | 1·5kΩ | R15 | 4·7kΩ |
| R5 | 22kΩ | R16 | 5·6kΩ |
| R6 | 10kΩ | R17 | 5·6kΩ |
| R7 | 2·2kΩ | R18 | 820kΩ |
| R8 | 120kΩ | R19 | 820kΩ |
| R9 | 1kΩ | R20 | 47Ω for 60mA bulb<br>68Ω for 40mA bulb |
| R10 | 22kΩ | | |
| R11 | 3·9kΩ | | |

All resistors ¼ watt, 10% miniature types

VR1 470kΩ 1in. miniature preset

**Capacitors:**

| | | | |
|---|---|---|---|
| C1 | 8μF 12V | C8 | 0·01μF 2% polyester |
| C2 | 8μF 12V | C9 | 0·1μF ceramic |
| C3 | 0·01μF ceramic | C10 | 4,000pF ceramic |
| C4 | 8μF 12V | C11 | 4,000pF ceramic |
| C5 | 0·01μF 2% p'ster | C12 | 0·1μF ceramic |
| C6 | 8μF 12 V | C13 | 0·1μF ceramic |
| C7 | 8μF 12V | | |

**Semiconductors:**

Tr1—Tr6 BC108 or BC109

D1 Silicon diode BA100, OA202, etc.

D2 Germanium diode AA119, OA91, etc.

**Miscellaneous:**

Pot Core assemblies, STC 10D/WR Type A1; Miniature 18-way group board; 13-way tag strip; Aluminium panel 5in x 5in; Bulb 6V 60mA (or 40mA); Bulb holder; 40 s.w.g enamelled wire for coils.

R18 and R19 to each channel. These resistors may be adjusted to improve overall seperation as mentioned later. The potential of the switching signal in the output is very small and is almost completely removed by the de-emphasis capacitors C10 and C11.

The germanium diode D2 and transistor Tr6 and associated components are optional, and are to provide an indication by means of a light when a stereo programme is being transmitted. The power supply for the decoder will dictate whether or not it can be used.

Without the pilot light circuit, the decoder requires a supply of 9V at only 11mA, but with the light and Tr6 etc., requires a supply of 9V at 70mA.

In the Author's case, both tuner and decoder are powered from the amplifier supply, (Low Cost Hi-Fi, P.W. Jan.-Feb. 1968) the tuner from the negative supply line and the decoder from the positive line, the chassis or earths all being common. Figure 3 shows the additional components required when the decoder is powered from a 12V source. The decoupling capacitor should be 1000μF if audio is present on the 12V line.

The input impedance to the decoder is 10kΩ and is suitable for direct connection to a transistor tuner with an output of 600mV to 1V peak to peak

## TRANSISTOR VOLTAGE READINGS

| | MONO | | | STEREO | | |
|---|---|---|---|---|---|---|
| | E | B | C | E | B | C |
| Tr 1 | 3.8 | 4.2 | 5.0 | 3.8 | 4.2 | 5.0 |
| Tr 2* | 0 | 0.4 | 0.3 | 0 | 0.15 | 0.2 |
| Tr 3* | 0.6 | 0.3 | 9.0 | 0.6 | 0.2 | 9.0 |
| Tr 4 | 0 | 0 | 0 | 0 | 1.5 | 0 |
| Tr 5 | 0 | 0 | 0 | 0 | 1.5 | 0 |
| Tr 6 | 0 | 0 | 9.0 | 0 | 0.7 | 0.9 |

* Depends upon setting of VR1.

Readings may vary slightly. Measured using a 20kΩ/V meter; 9V battery supply.

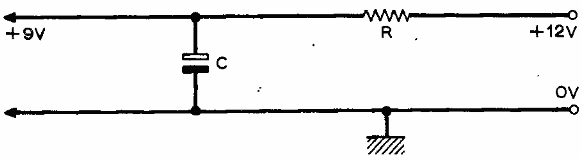



*Fig. 3: Additional components required when using a 12V supply.*

(approx. 200 to 300mV r.m.s.).

With a valve tuner, it may be necessary to fit a resistor in series with the input (typically 10kΩ to 47kΩ) to provide the correct input level to the decoder and also to reduce the tuner discriminator loading to an acceptable value. It may be necessary to shunt the resistor with a capacitor of 300-1000pF to maintain the h.f. response.

The amplifier input impedance should be not less than 50kΩ for the de-emphasis to be effective, and so that the decoder shall not give an insertion loss.

Allowance must be made for the fact that on stereo, as the audio modulation is shared at the transmitter between the A and B channels, the output per channel will be approximately halved compared to mono.

## CONSTRUCTION

Layout is not critical provided the coils L1 and T1 are not too close to each other. They should be about 3in. apart to avoid mutual coupling.

The layout shown (Fig.4) is preferred as it results in a rigid as well as a compact unit, while the aluminium chassis gives a useful degree of screening and provides a good earth connection for the ferrite pot cores.

Coil winding details are given in Fig.5. The capacitors C5 and C8 may be either polystyrene or silver mica types with a tolerance of 2 per cent or better.

To allow for winding and capacitor tolerances, it is wise to wind the tuned windings L1 and L2 with a few extra turns, which can be removed later if necessary depending on how the coils tune. (It is not important that the centre tap be exact except for L3).

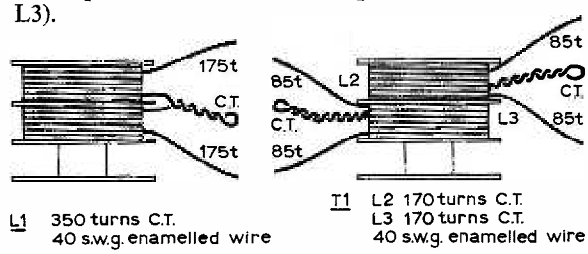



*Fig. 5: Coil winding details.*

The coils and the length of tag strip with its associated components are mounted first. Only the end lugs on the strip are used for mounting, the remainder being cut off. The completed group board is then put into position, taking care that the transistor cases (which are internally connected to the collector) do not come into contact with any metal part. The board is secured to the chassis with a couple of 6BA screws; nuts between the board and chassis serve as spacers to hold the board clear of the chassis.

A solder tag on each screw provides the screen connection for the input and output screened leads. A single lead from the chassis to the negative line

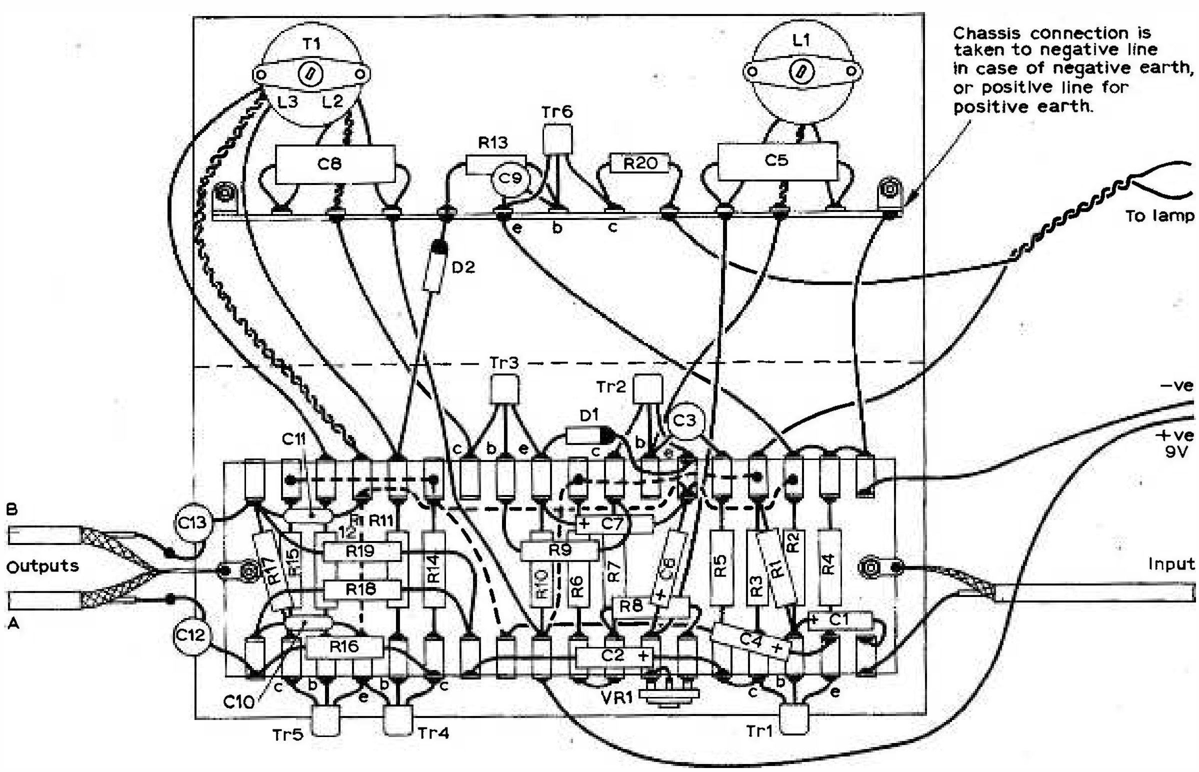



*Fig. 4: Component layout and wiring details.*

## TEST TONE TRANSMISSIONS, BBC RADIO 3 WEDNESDAYS AND SATURDAYS

| TIME | LEFT CHANNEL(A) | RIGHT CHANNEL(B) |
|---|---|---|
| 2330 | 250Hz at zero level | 440Hz at zero level |
| 2332 | 440Hz at zero level | 440Hz at zero level, antiphase to left channel |
| 2335 | 440Hz at +8dB | 440Hz at +8dB, antiphase to left channel |
| 2337 | 440Hz at +8dB | 440Hz at +8dB, in phase with left channel |
| 2339 | 250Hz at +8dB | 440Hz at +8dB |
| 2340 | 250Hz at zero level | Nothing |
| 2344 | Nothing | 440Hz at zero level |
| 2347.20 approx. | Tone sequence at −4dB: 60Hz, 900Hz, 5kHz, 10kHz. This sequence is repeated. | Nothing |
| 2348.20 approx. | Nothing | Tone sequences as for left channel at 2347.20 |
| 2351 approx. | 250Hz at zero level | Nothing |
| 2352 | Nothing | Nothing |
| 2353 | Reversion to monophonic transmission | |

NOTES

1 This schedule is subject to variation to accord with programme requirements and essential transmission tests.

2 The zero level reference corresponds to 40 per cent of the maximum level of modulation applied to either stereophonic channel before pre-emphasis. All tests are transmitted with pre-emphasis.

3 Periods of tone lasting several minutes are interrupted momentarily at one-minute intervals.

*Every day except Wednesday and Saturday*

To facilitate channel identification and adjustment of channel cross-talk, 250Hz tone is transmitted in the left channel only from about four minutes after the end of the Third Programme until 2355. This test may be interrupted from time to time.

completes the earth line when the unit is to be powered from a negative earth supply. This lead will be taken to the positive line in the case of a positive earth supply, and C1 reversed in polarity.

When operating from a 12V supply the dropping/decoupling resistor will be in the positive line in the case of negative earth, or in the negative line for positive earth. (Fig.3).

### SETTING UP

The unit can be set up on any BBC stereo transmission, and checked finally with the BBC test transmissions, details of which are given in this article.

It is first necessary to set VR1 to its approximate operating position. This is done by adjusting VR1 until the voltage at the collector of Tr2 is 1V.

Temporarily connect a potentiometer (any value between 50kΩ and 250kΩ will do) across the tuner output, with the slider connected to the decoder input. Turn the control to maximum and tune the receiver to a stereo broadcast. Connect a meter (2·5V scale) between the negative line and the base of Tr4 (or Tr5), negative probe to base, and adjust the cores of L1 and T1 for maximum, when the reading will be about 1·5V. Limiting occurs at this point and it will not be possible to tune the coils accurately, so the input signal must be reduced to below the point of limiting by means of the potentiometer so that the reading at Tr4 base is 1V or less and the coils adjusted again for maximum. Repeat as necessary always keeping the input low enough below the point of limiting to obtain a definite peak.

The stereo indicator lamp itself can serve as an indication of correct tuning if desired, with only slightly less accuracy than a meter, by reducing the input as above so that the lamp glows at half brilliance and adjusting the cores for maximum brightness.

It is desirable that when correctly tuned, the screw cores of L1 and T1 should be neither right out of nor right into the coils. If right out, turns should be removed as necessary. If right in, it is rather difficult to add more turns, but it is permissable to shunt the 0·01$\mu$F capacitor with a small capacitor of 100-200pF. Now remove the potentiometer and connect the decoder direct.

The pre-set VR1 must now be set correctly. Turn the pre-set to minimum so that only R8 is in circuit. At this point there will be no voltage at the bases of Tr4 and Tr5 and the indicator lamp will be out. Gradually increase the value of VR1 when the voltage on the bases will rise and the lamp will light. The correct point of adjustment of VR1 is where the voltage at the base of Tr4 just reaches maximum (maximum brilliance). Further adjustment will cause the voltage (and bulb brightness) to fall again as Tr3 is driven beyond limiting and produces a distorted waveform.

When the decoder is set up as described, it should require little or no further adjustment, as in this unit when L1 and T1 are correctly peaked, maximum output coincides with correct phase.

The unit can now be checked with the BBC test transmission, but if it has been carefully set up on a normal stereo broadcast, it is likely that only marginal improvement can be made for channel separation, by slight adjustment of T1 and VR1.

As resistors R18 and R19 are fixed and are about optimum for cancelling crosstalk due to switch inefficiency, it is possible to improve overall separation by making these resistors variable.

The procedure would be to identify the left channel while a tone is being transmitted, and then disconnect this channel from the amplifier. The resistor in the right hand channel should then be adjusted for minimum crosstalk. The procedure is repeated in the other channel.

Messrs. C. and D. Electronics, who advertise elsewhere in this issue have agreed to wind the coil bobbins at a nominal fee for those constructors who may hesitate to wind their own. ■


# A Direct Reading FREQUENCY METER

T. J. MELVILLE

A RELIABLE direct-reading frequency meter has various uses in the home workshop. It can, for example, check the frequency of oscilloscope timebases, bias oscillators in tape recorders, and, of course, the output from signal generators. To be of any value, such an instrument should be capable of giving accurate readings regardless of the waveform and amplitude of the signal presented to it, and the meter to be described is, in fact, capable of a high level of accuracy from 10Hz to 200kHz, providing the input signal is above a certain minimum level, typically 50mV r.m.s. (for sine waves) at the extreme frequencies. and somewhat less for those in between.

Readers with little or no other test gear should have few difficulties in building or using this meter, since setting-up requires the adjustment of only one pre-set potentiometer, and the microammeter retains its linear 0-200 calibration.

The design incorporates a device known as a "diode-transistor pump", which was originally developed a few years ago to operate as an f.m. discriminator, frequency divider or, as used in this meter, a linear frequency to voltage converter. The basic design and theoretical operation of the system have been described by D. E. O'N. Waddington (*Wireless World*, July 1966); so the author claims no particular credit for the present design.

## Operation

Figure 1 illustrates schematically the various stages of the circuit, and Fig. 2 shows the circuit in component form. The pre-amplifier is a straightforward single transistor stage (Tr1 of Fig. 2), using a silicon npn transistor in the common emitter mode, and enabling the instrument to test low-level signals. The *mark/space ratio standardiser* is D1 of Fig. 2. This diode comprises the base-emitter junction of an npn transistor connected in reverse across the base-emitter junction of Tr2. The negative-going portion of the waveform reaching D1 will therefore be earthed, leaving only the positive going pulses to be amplified by TR2. In practice D1 will maintain the mark/space ratio of the waveform at a constant 1:1.

Since a square wave is needed to drive the diode-transistor pump part of the circuit, the next stage required is the *waveform standardiser*, or square-wave converter, which is, in effect, an overdriven amplifier stage consisting of Tr2. Assuming for the moment that sinusoidal pulses are being fed into Tr2's base, the collector current available for the transistor in its given circuit reaches the maximum well before the input pulses reach their peak. Hence the corresponding pulses appearing at the collector of Tr2 will have their tops clipped, and if the input pulses are of sufficient amplitude, a square-wave output will be obtained. Clearly, sawtooth waveforms will be modified in the same way as sine waves, and square waves, not requiring modification, will come out as they went in. It also follows that once full limiting of Tr2 has been reached, any

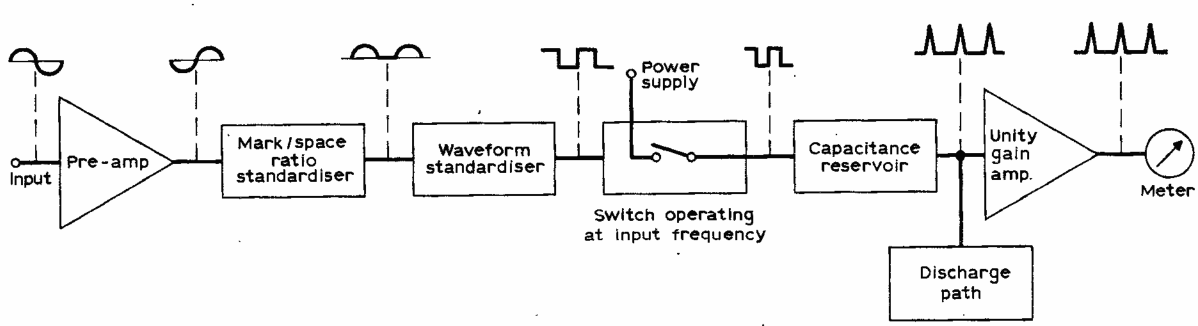



*Fig. 1 : Block diagram showing stages of the Frequency Meter*

increase in signal input amplitude cannot affect the pulses appearing at the collector.

Although Tr2 has been described as an overdriven amplifier, it could just as well be thought of as an electronic switch, especially as the box labelled *switch operating at input frequency* in Fig. 1 is operated by this transistor. Tr2's bias resistor, R4, provides only a small amount of base current, and the transistor is, in practice, switched on and off by the pulses reaching it from the previous stage. When the transistor is "off", very little current passes through R5, enabling whichever of the capacitors C3-6 that is in circuit to charge up to almost the full supply voltage. However, with Tr2 in the "on" state, current in R5 increases, and a larger voltage is dropped across it. Hence, the voltage charge available for C3-6 varies square-wave fashion, and is directly related to the square wave of the original signal that reaches Tr2's collector.

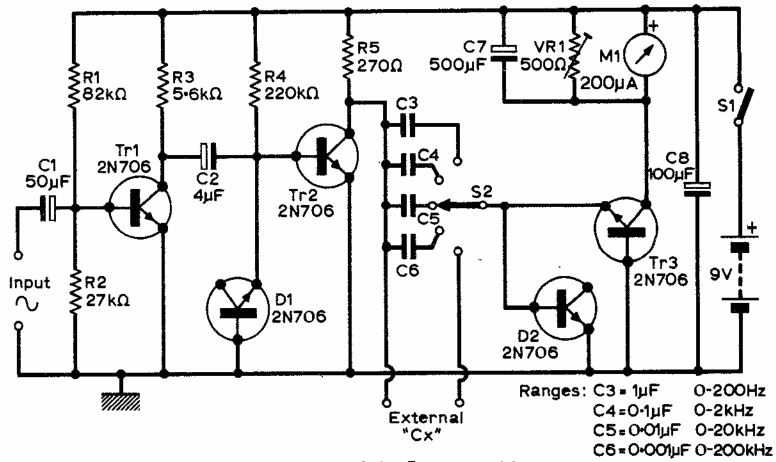



*Fig. 2 : Circuit of the Frequency Meter*

As the supply voltage is the nominal reference level for the charge stored in C3-6, the resistor R5 must have a low value. Ideally, there should be no resistance at all in between the power supply and the capacitor to be charged, but obviously the circuit could not function if this were the case. If the author had the inclination (or more likely the wit!) to produce pages of theoretical calculations on the effect of different time constants for the combinations R5/C3-6, it could no doubt be shown mathematically that R5 must be well under 500Ω for measurements at different frequencies to be reasonably accurate. Experimentally, it was found that 470Ω was the maximum permissible value of R5 before non-linearity of readings on the meter became apparent. To put it simply, since capacitors C3-6 draw current initially on charging up (Tr2 off), a large blocking resistor would prevent them from attaining their full charge before Tr2 switched on again. To allow for "experimental error", the value chosen for R5 is 270Ω, as indicated in Fig. 2. This value allows for more than an adequate output to drive the pump, which comprises the reservoir capacitors, D2 and Tr3. These two semiconductors also constitute the discharge path for the reservoir, and D1 the resistive emitter load for Tr3.

The charging and discharging of a capacitor is momentary of course; so although the switching voltage available for charging C3-6 would look like a square wave on a graph, the actual current flow in and out of these reservoirs would graphically look like a row of spikes. The spikes or pulses reaching D2 and Tr3 switch from a positive potential to zero and back again. When positive, D2 conducts and prevents current flowing in Tr3; when zero, Tr3 conducts, and a proportion of the average collector current is registered on the scale of the meter M1.

As indicated in the block diagram, Tr3 operates as a common-base amplifier with a current gain of almost unity. In fact, the gain is slightly under that, as the collector current includes base as well as emitter current. The power gain of the final stage is however much greater than unity, enabling a pulsed d.c. voltage to appear across the transistor's collector load. The meter M1 can thus be considered to be either a voltmeter measuring the voltage drop across VR1, or as a current meter sharing the collector load with the pre-set potentiometer. In either case, the current flow and output voltage of Tr3 are linearly related to the number and size of the pulses at its emitter.

Increasing the frequency of the input signal obviously increases the number of pulses reaching Tr3, and if only one reservoir capacitor, say 1µF, were used, the meter's pointer would reach full scale at 200Hz, and the instrument would be unable to check higher frequencies. Fortunately, the substitution of different value capacitors for the reservoir is quite straightforward, since the *average* current flow in Tr3's collector remains unchanged when the pulse count at the emitter is increased, provided that the amplitude of the pulse is reduced by the same amount. So, if our 1µF reservoir is reduced by a factor of ten to 0·1µF, pulse size will be similarly reduced, and f.s.d. will be achieved with an input signal of 2kHz.

## Practical Considerations

The accuracy of readings obtainable on the meter over the four ranges depends on the absolute values of the reservoir capacitors C3-6. These should have a tolerance of ±1%, or better. Polyester or silver mica types are preferable, though old-fashioned, large paper types with a high voltage rating may be suitable if they can be tested for low leakage. But on this score, most modern minature paper capacitors have to be ruled out, and minature disc ceramics are equally suspect. 1% 1µF polyester types are usually unobtainable, and if they were they would be inordinately expensive. The usual solution to this problem is to select a capacitor with a nominal tolerance of 10% or 20%, which turns out to be slightly under 1µF, and then wire an extra small capacitor in parallel, using a capacitance bridge as a check. Alternatively, the frequency meter can be used to test its own 1µF capacitor, preferably with a suitable signal generator, and this process will be described below.

The accuracy of the meter also depends on the semiconductors used. Transistors with a high cut-off frequency are essential (the $F_T$ of the types specified is 200MHz), but their current gain is relatively unimportant, and so almost any silicon planar epitaxial transistors would do. A high-gain type for Tr1 will improve sensitivity somewhat, but little advantage is to be gained by using high-gain transistors for Tr2 and Tr3. The reverse-connected diode pairs (D1/Tr2 base-emitter and D2/Tr3 base-emitter) must be fairly accurately matched, not only for different Vf's at different currents, but also for frequency-dependent characteristics; the easiest way to achieve this is to use the base-emitter junctions of transistors of the same type as Tr2 and Tr3. In any case, general purpose diodes, such as the germanium OA81 and silicon OA200 have been found to be unsuitable. The 2N706's used in the final version of the prototype were "untested" types obtained from advertisers in this journal at very low prices. Providing some preliminary testing (for short and open circuits) is undertaken, these types appear to be eminently suitable for this design.

The capacitor connected across the meter M1 needs to be large, certainly at least 100μF. The waveform at Tr3's collector is pulsed d.c., and so the varying inductive reactance of the meter winding will produce inaccurate readings if this current is not smoothed. Further, at very low frequencies, the vibration of the meter's pointer would make readings impossible without a large amount of smoothing.

## ★ components list

**Resistors:**
R1 82kΩ
R2 27kΩ — All ½ watt 10%
R3 5·6kΩ
R4 220kΩ
R5 270Ω

**Capacitors:**
C1 50μF 6V electrolytic
C2 4μF 6V electrolytic
C3 1μF 1%
C4 0·1μF 1%
C5 0·01μF 1%
C6 0·001μF 1%
C7 500μF 4V electrolytic
C8 100μF 12V electrolytic

**Semiconductors:**
Tr1, Tr2, Tr3, D1 and D2
all Type 2N706

**Miscellaneous:**
VR1 500Ω pre-set, panel mounting
S1 s.p.s.t. toggle switch
S2 1-pole 5 way rotary switch
M1 200μA moving coil meter
Battery, Veroboard, terminals, metal case.

## Construction

Most of the components in the prototype are accommodated on a small piece of 0·15in. matrix Veroboard (normally advertised as 2·5×1in.), and the layout is shown in Figs. 3 and 4. Note the breaks in the copper strip at holes D9, D15 and E4. Layout is not particularly critical, and the author more or less followed the "layout" of the circuit diagram.

Two holes are provided in the module for fixing purposes. C3-6 are connected directly to the tags on S2 and to a thick copper busbar (eg. 16s.w.g. wire) secured to one of the *Cx* terminals. C7 is wired directly across M1, and C8 in the prototype is a largish type requiring a separate securing clip.

The power supply is a small battery mounted inside the metal case housing the instrument. The minimum supply voltage has been found to be 4V and the maximum 9V. It should be noted that higher voltages increase the collector current of Tr3 to the point where linearity is not maintained. A battery of 6 to 9V (PP3, PP4 types, etc.) is quite suitable, and should have a long life, since the quiescent current drain is only 1·5mA. This, however, will increase to up to 20mA when a hefty input signal is applied. Incidentally, the maximum input signal should be limited to about 4V r.m.s. or 6V peak. The maximum can be roughly determined from the maximum reverse voltage that can be applied to Tr1's base-emitter junction; in the case of the 2N706, this is 3V. With the prototype, signals of up to 10V r.m.s. have been applied without any ill effects, apart from Tr1 getting rather warm, but such experimenting is inadvisable.

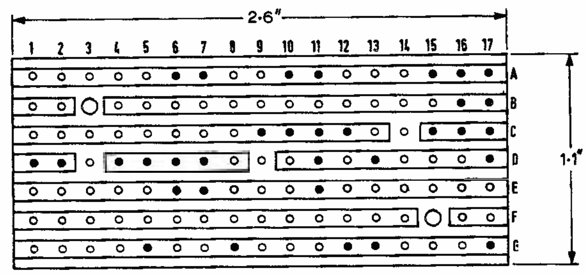


*Fig. 3 : Basic circuit board*

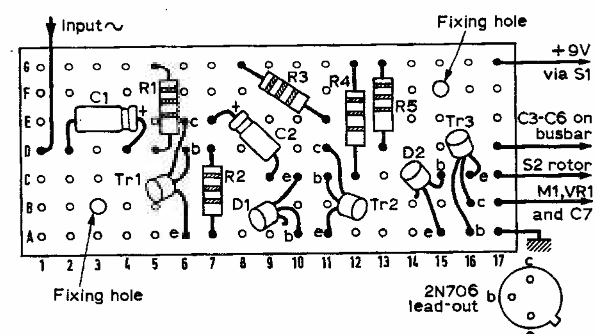


*Fig. 4 : Top of circuit board*

It is strongly recommended that the whole instrument is housed in a metal box, since powerful magnetic fields from domestic mains wiring will otherwise affect the instrument's performance. Far less than the nominal limiting voltage is needed at the input terminals for "things to happen", and if a length of unshielded wire is connected up and allowed to float around near a mains cable or an unscreened oscillator, the behaviour of the meter's pointer can only be described as berserk. This will in fact tell the user without access to a millivoltmeter when full limiting has occurred. In the latter condition, the needle will stay motionless at some point on the scale; just below limiting, a higher reading will be indicated, but the pointer tends to waver about, and at lower input levels still, the meter movement becomes more erratic until it finally settles at zero when the input is removed.

Providing suitable components have been used, the pre-set pot VR1 need only be adjusted on one range. An accurate signal generator can of course be used to check all four ranges, but with the prototype it is sufficient to set VR1 for a reading of 50Hz on the lowest range with a mains-derived input; the author then gets an accurate reading of 200kHz on the top range on connecting the instrument up to a signal generator tuned to Radio 2.

Since a 1 pole 12-way switch will normally have to be purchased for S2, the constructor can add extra ranges if desired; eg. a 0·2μF capacitor will give a f.s.d. of 1kHz. A 20Hz range could theoretically be provided if a close tolerance 10μF capacitor could be acquired. But electrolytic capacitors are quite unsuitable as a rule, since they have a poor leakage factor, a typical +100-20% tolerance, and frequently do not assume their maximum capacitance until an unpredictable fraction of the stated working voltage is applied to them. Unfortunately, a 2MHz range seems to be an equally unlikely possibility from extensive experiments carried out by the author. The a.c. gain of most "r.f." and "fast-switching" transistors ($F_T$ 100-300MHz) falls quite rapidly above 100kHz, so that the input signal level required for limiting of Tr2 increases to several volts even at 1MHz.

The main reason, in fact, why a 200μA meter was chosen for M1 instead of a more standard 100μA type, was because the useful response of the instrument with a 50mV or so input almost abruptly stopped at about 300kHz. A claimed response of up to 200kHz might therefore seem rather presumptuous. Certainly no "guarantee' is offered, but various types of high $F_T$ silicon transistors have been tried, and the equipment demolished and rebuilt several times without affecting the response at this frequency. An additional reason for making 200kHz the top frequency was that even with an uncalibrated home-made signal generator, an accurate check can be made using a radio tuned to Radio 2 to check the signal generator.

## Capacitance Meter

This is merely a logical refinement to the basic frequency meter design. If a wide-range low-frequency signal generator is available, the "standard" capacitors incorporated in the frequency meter may as well be put to good use. The only extra cost incurred is that of buying four instead of two connecting terminals. The extra two are marked *Cx* in Fig. 2. The unknown capacitor is simply connected across them, and the range selector S2 switched to the appropriate position. The signal generator is connected to the input terminals of the meter, and the test frequency increased from the lowest available up to 200Hz, 2kHz, 20kHz or 200kHz, the frequency selected being the one at which a reading somewhere between 20 and 200 is obtained on the meter. One of the capacitors C3-6 is then switched into circuit as appropriate, and the signal generator adjusted, if necessary, to obtain an exact reading of 200. The reading given by "Cx" is then rechecked. If, for example, "Cx" gives a reading of 100 on the 20kHz range, the value of the capacitor can be readily calculated as $\frac{100}{2}$ % of 0·01μF or 0·005μF. Suspect capacitors can be checked against any other close-tolerance types in a similar fashion of course, not only against the four in the meter.

As mentioned earlier, it is possible to use a nondescript capacitor fished out of the junk box for the 1μF standard in the meter, using the 0·1μF ±1% already acquired as a reference, and using furthermore only a 50Hz input, if no signal generator is available. If a mains-derived input is to be used, a higher resistance pot should be temporarily substituted for VR1 (1-5kΩ should do). With a 9V supply, adjust this so that the meter reads 20 (instead of 5) on the 2kHz range, and then "pad up" a capacitor slightly under 1μF connected to the *Cx* terminals so that a reading of 200 is obtained with S2 in the *Cx* position.

The reliability of this procedure depends on the meter's being accurately calibrated and having a hairline pointer (and the constructor having good eyesight!). A somewhat more dependable but more laborious or expensive method would be to use ten close-tolerance 0·1μF capacitors—each one could be an ordinary type checked against C4, if necessary. The tolerance of this cumulative capacitor would still be ±1%, if C4 was of that rating. A less bulky 1μF could then be assembled and checked against this. ■

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## CORRIGENDA

*Noise limiter*—December 1969. In Fig. 2; the component layout, R2 should be shown connected between 9-k and 7-k and not between 9-k and 8-k as shown.

*A Stereo Decoder*—December 1969. In the circuit diagram Fig. 1: the base of Tr1 should go direct to the bottom end of R3. C3 should be between R1 and the junction of R3/Tr1 base.

*The Chelmer Six*—February 1970. In the Component List the three i.f.t.'s should be types P51/1, P51/2 and P50/3v respectively. The output transformer T2 used in the prototype was a Weyrad OPT1.

*Vox Control Unit*—March 1970. In the circuit diagram the value of the potentiometer should be shown as 470kΩ and marked VR1. The capacitor CX should be shown as C1.

*A Versatile Power Supply Stabiliser*—March 1970. If the stabilised output current is to be of the order of several amperes the Zener diode Z2 must be capable of handling this current and not of a low power rating as indicated in the text. Stabilised currents up to the limit set by Tr3 may however be taken from point Vx and earth.

# practically wireless commentary by HENRY

No. 68

## Four-Eared Monsters

AUDIO again—and what better subject, with Sonex 70 soon to be ringing in our ears? Will the arguments ever cease? What is better, the intimacy of the hotel room or the garish fair of an open exhibition? About the same number that thought last year's jamboree at Olympia an audio success have decried it in the trade and specialist magazines as an expensive waste. Very soon we shall know their opinion of the Skyways venture.

That is the trouble with audio; its progress has been strewn with the besoms of criticism rather than the psalms of praise. Gimmickry! cries a weary public at the news of each fresh development. Now it is Quadrasonics that stands on trial.

Four-channel stereo is not all that new, despite the hysterical ranting of some advertisements. We had multi-channel stereo in 1933, and when Bell Telephones settled for 3-channel systems it was to fill the 'hole in the middle' of a two-channel frontal stage, and the Philadelphia and Washington DC experiments at that time included four, five and more channels. It was only on grounds of economy that a two-channel system was used when stereo tape was launched. Twenty years ago, believe it or not.

Six-channel stereo systems were used for Cinerama and only Mickey Mouse knows how many channels Disney's 'Fantasia' was planned for. But these were aural gimmicks, unashamedly. Serious multi-channel work included a 12-channel system by one of tape recording's pioneers, Martin Camras, an eight-channel recording of the Boston Symphony Orchestra by Prof. Bose and those complicated hundred speaker systems with circuits like a telephone exchange that EMI and Philips used for their 'ambiphonic' experiments.

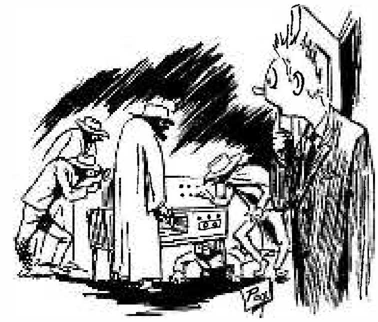
*Will the arguments never cease?*

Four-channel stereo is supposed to fill the room, not just the hole in the middle. One of the complaints of the audiophile has been the added reverberation of his listening room (not solved by using phones, merely altered) and the unfaithful rendering of the reverberation of concert hall or studio where the recording originated. Quadraphonics puts this lost ambience back by using the rear two speakers of a four-speaker system for the reverberation, and delayed direct sound, as it would be in the concert hall—or, mark the term, for 'special purposes'.

O.K. so you would like to hear the Berlioz *Requiem* played properly, with a brass band in each corner of the lounge. Me, I prefer to keep the peace with my neighbours.

Edward Tatnall Canby—who is Associate Editor of the American magazine '*Audio*'—started the controversial ball rolling over here with a report in the December 1969 *Hi-Fi News*, 'Four-channel Stereo'. He reported on the venture by Vanguard Recording Society in New York, who were bringing out four-channel recordings on $\frac{1}{4}$-inch tape, and then on an experimental series of stereo broadcasts from Boston which had commenced on September 27th, 1969.

*PW* readers will be interested in knowing that while so many of us are fretting busily over the continued inability of the BBC to comply with their charter and give us even two-channel stereo, the Acoustical Research Company was able to sponsor two simultaneous broadcasts from Boston stations of Boston Symphony Orchestra concerts. The programmes are picked up on two f.m. multiplex receivers. The series of demonstrations should have finished in April, and to judge by the reports of my transatlantic spies, initial reception will have been maintained and the four-channel stereo boom is decidedly on.



*My transatlantic spies.*

The other experiments, with Vanguard tape and the 'surround stereo' system, were less encouraging. Henry was tickled by Ed Canby's comment that 'the lady who sang out in front of us seemed about forty foot tall'.

A four-channel multiplex broadcasting licence is being petitioned for, and the FCC are reported to be wilting. The sponsors want to use the 'Halstead System'. That is normal stereo for the two front channels and two additional f.m. modulated subcarriers in a left-right configuration at 72kHz and 92kHz for the rear two channels. Len Feldman (who already has the hardware on the shelf at $89.95) claims that 'using Panoramic Spectrum Analyser' no problem of sideband spillage is encountered.

You know, that comforts Henry, with his single channel, unmultiplexed, wavering f.m. noisebox. The only thing multi about his reception are the paths along which the mono signal bounces.

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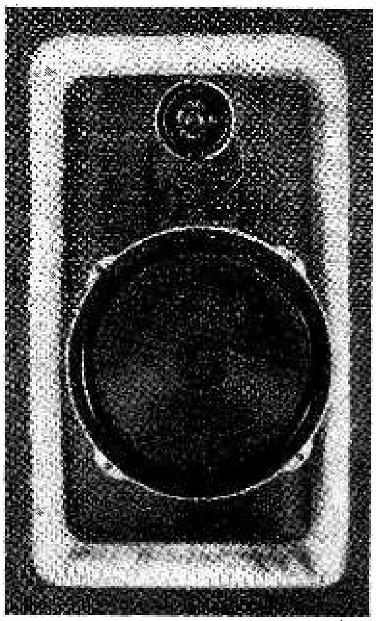

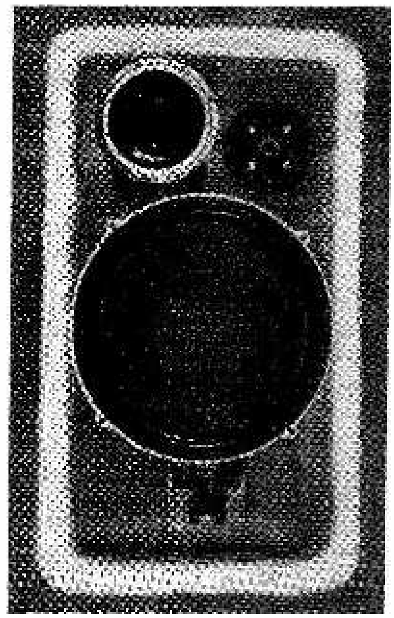

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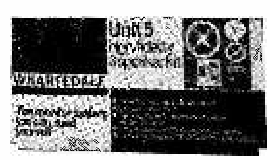


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**PART 2**

**LESLIE MOORE**

## GRAPHS

OF all mathematical techniques available to circuit designers, graphs often prove to be the most useful; they conveniently display much information which would otherwise be contained in complicated formulae or be widely dispersed in leaflets giving technical data; they provide a practical approach to circuit design and eliminate many possible sources of error. It is often thought that graphs provide approximate solutions only, and that results obtained from them will most likely be in error. This leads to an important point which should be understood from the outset.

If the component tolerances with which one is working are large, then of course results will be approximate. Allowances should be made for spreads in component characteristics, for instance; although modern production techniques have improved the possibility of being able to interchange field-effect transistors, without altering other circuit parameters to compensate for characteristics spreads, field-effect transistors of the same type number can still vary by as much as $\pm$ 30% in drain current for the same value of gate current.

Conversely, many high precision voltmeters etc are provided with calibration graphs allowing voltage measurements to within a $\pm$ 0.05% accuracy. Graphs will give the result to a problem as accurate as associated factors (tolerances, graph scale etc) will allow.

The most basic graphs show a mathematical relationship between one variable and another. The simplest of these are:—

$y = a$ $\qquad y = cx$
$y = x$ $\qquad y = dx^2$
$y = x + b$

(where $x^2$ is x multiplied by x).

The graphs these equations described are shown in Fig. 2.1.

In the equations the letters a, b, c & d, represent constant values whereas the letters x and y represent variables. The graphs show how y will vary as x varies for the different equations.

$y = a$ means that for all values of x, y will have the value a. When $y = x$, y will have the value of x at all times. Obvious perhaps, but the simplest of facts can prove awkward in much more complicated equations.

The equation $y = cx$ has a direct application to our work as it is in a similar form to that derived from Ohm's law: $V = RI$.

Assuming that the resistance R is held constant, then the relationship between voltage V and current I, is the resistance.

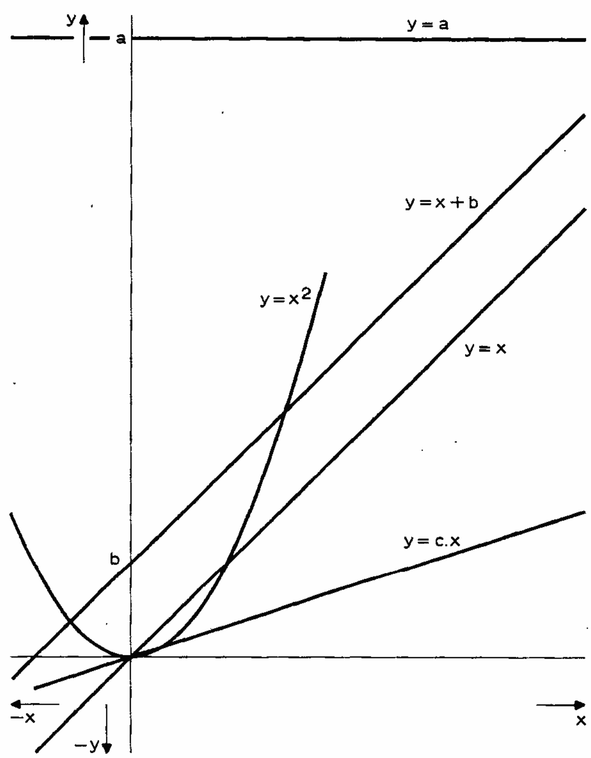


*Fig. 2.1 : Basic graphs*

Simple relationships can be useful in graphical analysis in determining the operation or limits of operation of a component or circuit.

The load line drawn on a set of transistor characteristics to determine operation limits etc is a straight line determined by $V = RI$.

A further example is the maximum power limit of a transistor or similar device.

Suppose a transistor is rated at 25 mW (or 0·025 Watts). Power is related to voltage and current in the manner:

$$\text{power} = VI$$

Due to transistor operation it is convenient to use units of volts and milliamperes (mA), and we can write that

$$1\text{mW} = 1\text{ Volt} \times 1\text{mA}$$

To draw a graph of the maximum power we must treat the maximum power limit as a constant and therefore:

$$VI = 25 \text{ therefore } I = \frac{25}{V}$$

From this simple equation we can form a table of different values of current flow obtained by varying the voltage value.

e.g. when V = 1 volt, I = 25 mA.

| | | | | | | |
|---|---|---|---|---|---|---|
| V volts .. | 1 | 2 | 5 | 10 | 12.5 | 25 |
| I mA .. | 25 | 12·5 | 5 | 2·5 | 2 | 1 |

This may be plotted as shown in Fig. 2.2. Such curves are usually given, or must be plotted, where a maximum power limit is an important consideration as for all semi-conductor components.

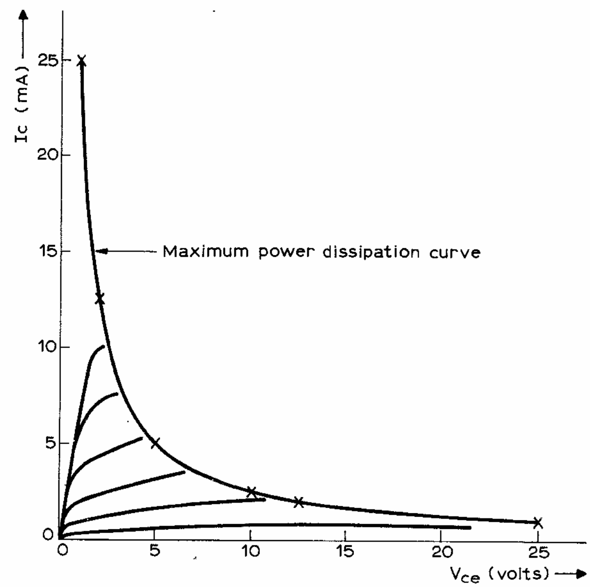


*Fig. 2.2: Plot of maximum power dissipation*

## Graphs and Amplifiers

Graphs have particular use in electronic and radio circuitry for describing the characteristics of a circuit. For an amplifier several relationships are important:

(I) Between output and input: showing the limits which must be placed on the input signal to prevent saturation of the output, and it indicates the amplifier's linearity.

(II) Between gain and frequency: showing the useful range of frequencies for which the amplifier can be operated.

(III) Distortion level and frequency: this plot can indicate an amplifier's usefulness for specific applications.

(IV) Output voltage and supply voltage for constant levels of input signal: This will indicate the variation of power supply voltage allowable for good performance.

Examples of these graphs are given in Fig. 2.3.

Waveforms are a form of graph often taken for granted. These show how a voltage or current magnitude varies with time. A few common waveforms are shown in Fig. 2.4.

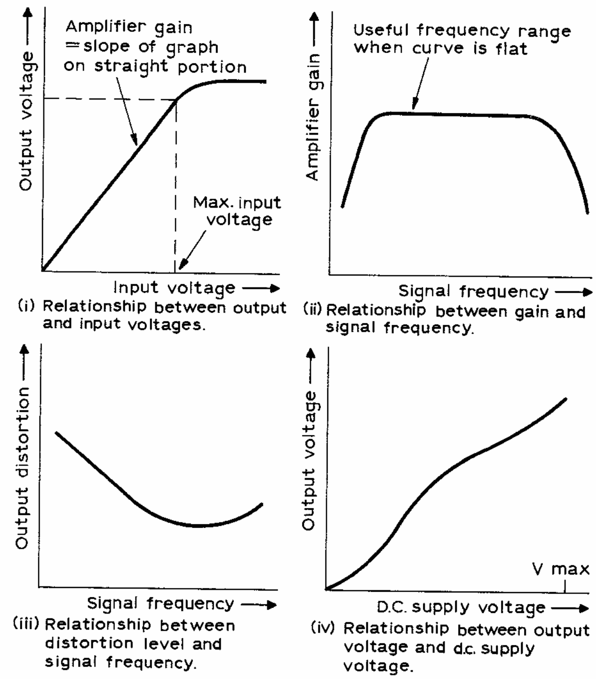


*Fig. 2.3: Examples of graphs showing amplifier characteristics*

## Waveforms

An ability to understand the formation of these waveforms and how and where they are used in electronic circuitry is essential in practice, especially when oscilloscopes are used.

The waveforms with which we are concerned are periodic functions of time, that is, they produce a pattern which repeats at regular intervals. The time taken for the waveform to completely pass through one cycle of operation is known as "periodic time". The number of repeats in one second is called the waveform "frequency" whose units are Hertz (Hz), although called "cycles per second" until recently.

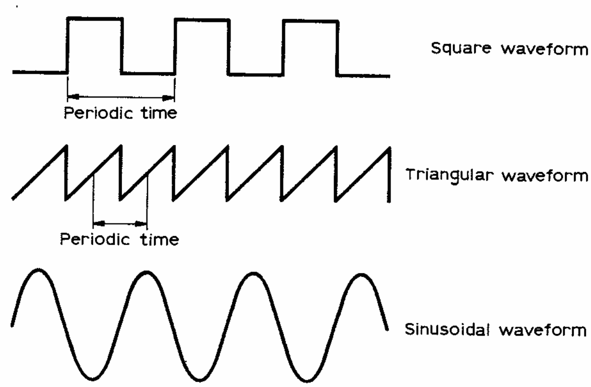


*Fig. 2.4: Examples of waveforms*

It can be shown mathematically that all waveforms which are not sinusoidal are, in fact, composed of a number of sinusoidal waveforms having different frequencies. A square waveform is made up of a fundamental frequency and all its odd harmonics.

—continued on page 37


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PW5

—continued from page 34

A square wave of 1 Volt peak to peak amplitude and 1 Hz frequency will have the following sinusoidal components.

| | peak-peak Amplitude | Frequency |
|---|---|---|
| Fundamental .. .. | 1 Volt | 1 Hz |
| 3rd harmonic .. .. | $^1/_3$ Volt | 3 Hz |
| 5th harmonic .. .. | $^1/_5$ Volt | 5 Hz |
| 7th harmonic etc. .. | $^1/_7$ Volt | 7 Hz |

so that the very high harmonic frequencies have little effect on the waveform amplitude.

This fact is used in a technique called "pulse testing" which, simply, is the application of a square waveform to the input of an amplifier and comparing it against the output waveform. In doing this, the amplifier is subjected to a complete range of frequencies so the output waveform can yield much valuable information. Fig. 2·5 gives examples of waveforms obtained from pulse testing.

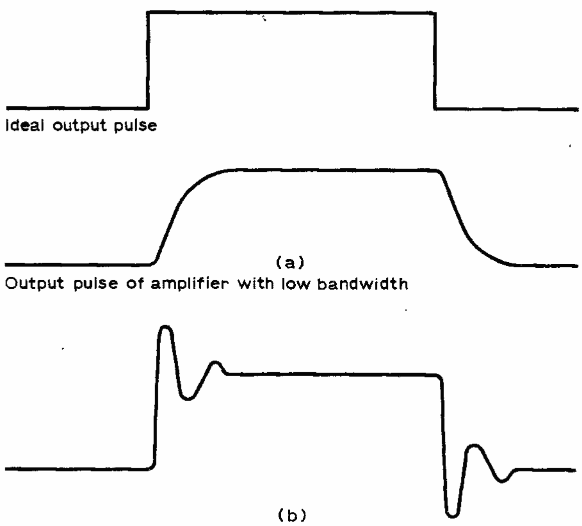



*Fig. 2.5: Pulse testing*

## Graphs and Bandwidth

Due to reactive components inherently contained in semi-conductor devices, thermionic devices and other necessary circuit components, amplifiers do not reproduce input signals as might be expected. Those illustrated indicate (a) an amplifier with low bandwidth i.e. only suitable for fairly low frequency work and, (b) an unstable amplifier due to some sort of feedback within the amplifier circuit.

Amplifiers which amplify one frequency only are called tuned amplifiers. It would be desirable, if in practice, we could amplify only one frequency. We are, however, able to reach a good approximation to a perfect tuned amplifier. The reasons for capacitance and inductance in an amplifier circuit affecting gain at different frequencies will become more apparent later in the series, here we shall discuss the use of graphs in tuned amplifier design.

The factors which govern the design of a tuned amplifier are, required amplifier bandwidth, power output, signal frequency and gain at that signal frequency. A typical tuned amplifier stage is shown in Fig. 2.6.

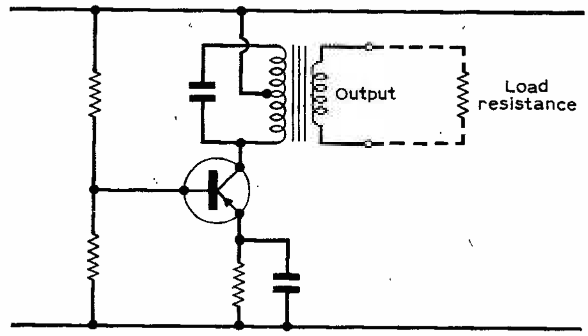



*Fig. 2.6: Typical tuned amplifier stage*

Bandwidth is dependent on transistor characteristics, Q factor of the tuned circuit (or its "goodness"), transformer turns ratio and the amplifier load resistance. Often a compromise must be made between one or other of these factors as the amplifier's tuned frequency also depends on tuned circuit characteristics and loading.

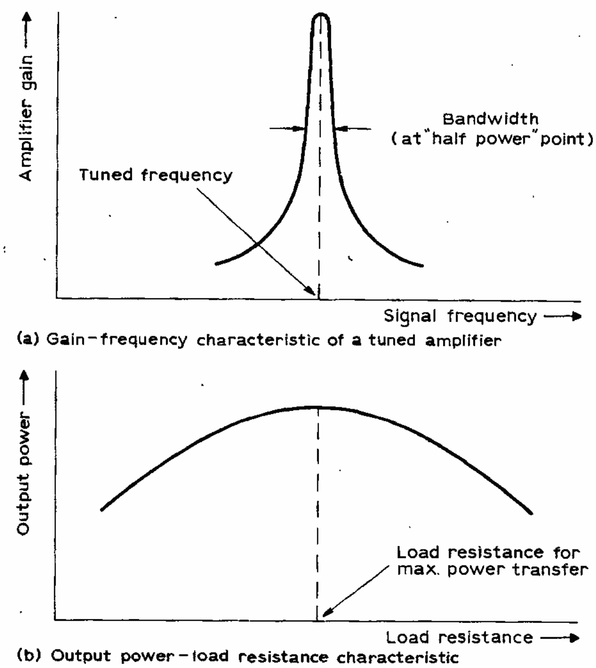



*Fig. 2.7: Useful graphs for a tuned amplifier*

Often maximum power output is required. This means that the transistor output resistance must be equal to the load multiplied by the transformer turns ratio. The frequency response of the amplifier and the output power/load curve are shown in Fig. 2·7.

Graphs can be shown to give far more assistance to the electronics engineer or enthusiast. However, to understand them and their uses further basic mathematical concepts must be understood. We shall begin to cover some of these in the next article.

**TO BE CONTINUED**

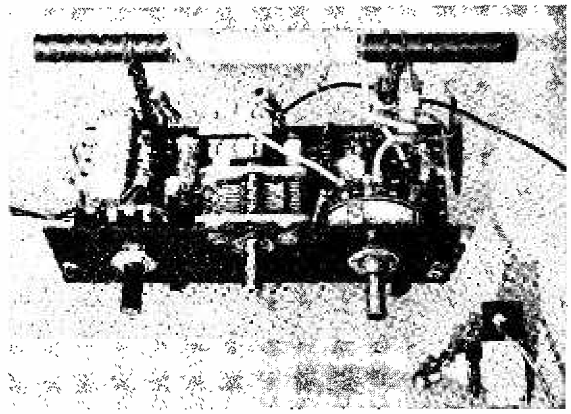
# 3 BAND TRF 4 RECEIVER

F.G.RAYER

FOUR transistors in a reflex type t.r.f. circuit will give good loudspeaker volume from quite a large selection of stations, and a receiver of this kind is easy to assemble and wire. The receiver shown here has a main tuning range of about 2,000-480kHz, or 150-620 metres. Tuning at the h.f. end of the medium wave band is usually rather critical so the band selection switch brings into use a "bandspread" type of circuit, similar to that in some superhets, covering approximately 2·2-1·7MHz, or 140-185 metres, with the full rotation of the tuning capacitor. To avoid switching inductors, the third switch position loads the ferrite aerial so that a band of about 190-210kHz is obtained, for reception of the 200kHz or 1500 metre BBC transmission.

These ranges, and particularly that in the bandspread position, can be easily changed. The 2·2-1·7MHz range was used because it was found that quite a number of interesting amateur and other signals could be received.

The actual receiver is 5×2½×2½in., the ferrite rod increasing the width to 6in. To this must be added space for the battery and loudspeaker. Headphones may be plugged in when wanted.



## CIRCUIT

This is shown in Fig. 1 and the ferrite aerial L1 is tuned by VC1 with the switch in the "M" (Medium Wave) position. Moving the switch to "BS" (Bandspread) brings the small capacitor TC1 in series with VC1, so that only a narrow band near the h.f. end of the range is tuned. The highest frequency reached is slightly increased because the minimum capacity is lower. When the switch is at "L" (Long Wave) VC1, C1 and TC2 are in parallel across the tuned portion of L1, and TC2 is adjusted so that 200kHz will be reached with VC1 about half closed. This arrangement does not give full long wave frequency coverage, but allows a narrow band around 1500m or 200kHz to be tuned.

Feedback from Tr1 collector is through TC3, and regeneration is controlled by VR1. R.F. is blocked

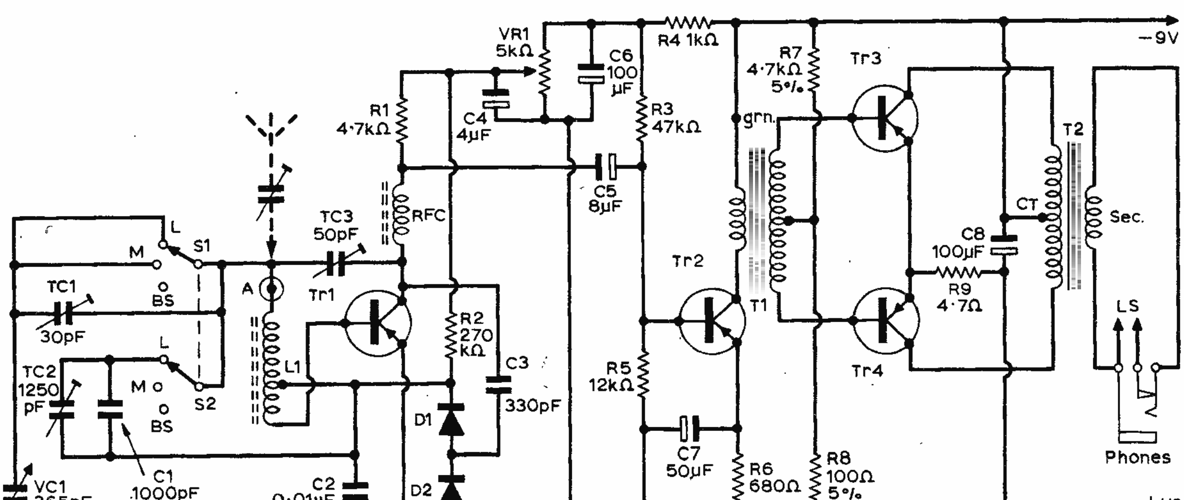



*Fig. 1 : Circuit of complete receiver*

by the r.f. choke, but reaches diodes D1 and D2 through C3. The audio obtained by detection passes through L1 to Tr1 base, and after amplification signals reach Tr2 from C5, R1 being Tr1 collector audio frequency load.

Tr2 is an audio amplifier, driving the push-pull transistors Tr3 and Tr4 through the driver transformer T1 and T2 is the output transformer.

## CIRCUIT BOARD

Construction is on a ready-perforated board 2¼ × 5in. and having holes at 0·2in. intervals but plain 1/16in. thick paxolin can be drilled to suit.

The receiver panel is 5 × 1½in. and 1/16in. thick, and is fixed with two brackets, Fig. 2. A lead is soldered to the frame tag of VC1 and passed down through the board. VC1 is mounted with very short 4BA bolts. When the completed receiver is put in a cabinet it is held by the fixing nuts of VR1 and the band switch so bolt heads on the panel should be countersunk.

Two pieces of paxolin 2 × ½in. are shaped at the top to fit the ferrite rod, and are drilled for elastic and mounting brackets, so that they can be fitted as in Figs. 2 and 4.

## CONSTRUCTION

The resistors and other items can now be inserted in the positions shown in Fig. 2. Place diodes D1 and D2, and the electrolytic capacitors with the positive ends as indicated. The wire ends are spread slightly, to prevent the components falling out.

The board can then be turned over, and wired as in Fig. 3. A wire between the two tags forms the positive line. Bend and shape the leads, solder them, and cut off excess. Sleeving should be put on wires which cross other leads.

## ★ components list

**Resistors:**

| | | | |
|---|---|---|---|
| R1 | 4·7kΩ | R6 | 680Ω |
| R2 | 270kΩ | R7 | 4·7kΩ 5% ½ watt |
| R3 | 47kΩ | R8 | 100Ω 5% ½ watt |
| R4 | 1kΩ | R9 | 4·7Ω |
| R5 | 12kΩ | | |

10% ½ watt unless otherwise stated.

**Capacitors:**

| | | | |
|---|---|---|---|
| C1 | 1000pF 1% s.m. | C5 | 8μF 6V |
| C2 | 0·01μF 150V | C6 | 100μF 12V |
| C3 | 330pF mica | C7 | 50μF 6V |
| C4 | 4μF 12V | C8 | 100μF 12V |

VC1 365pF Jackson Type 01
TC1 3-30pF Type VC29C (Home Radio)
TC2 40-1250pF Type VC29SA (Home Radio)
TC3 4-50pF pre-set

**Semiconductors:**

D1 OA81
D1 OA81
Tr1 OC44
Tr2 OC81D
Tr3/4 OC81's (matched pair)

**Miscellaneous:**

T1 Weyrad LFDT4
T2 Weyrad OPT1
Paxolin panels 1/16in: 2 off 2 x ½in. 1 off 5 x 1½in.
Paxolin or eyelet board BTS33 (Home Radio)
Opening circuit miniature jack plug and socket
On/off toggle switch
2 pole 3-way rotary switch
3Ω speaker
Ferrite rod 6in x 3/8in
26 s.w.g. DCC wire

The receiver is intended to use the internal ferrite aerial but a short external aerial (rod or wire) can be connected to A on L1, Fig. 1, a very small capacitor (such as 30pF pre-set) being put in series with the lead.

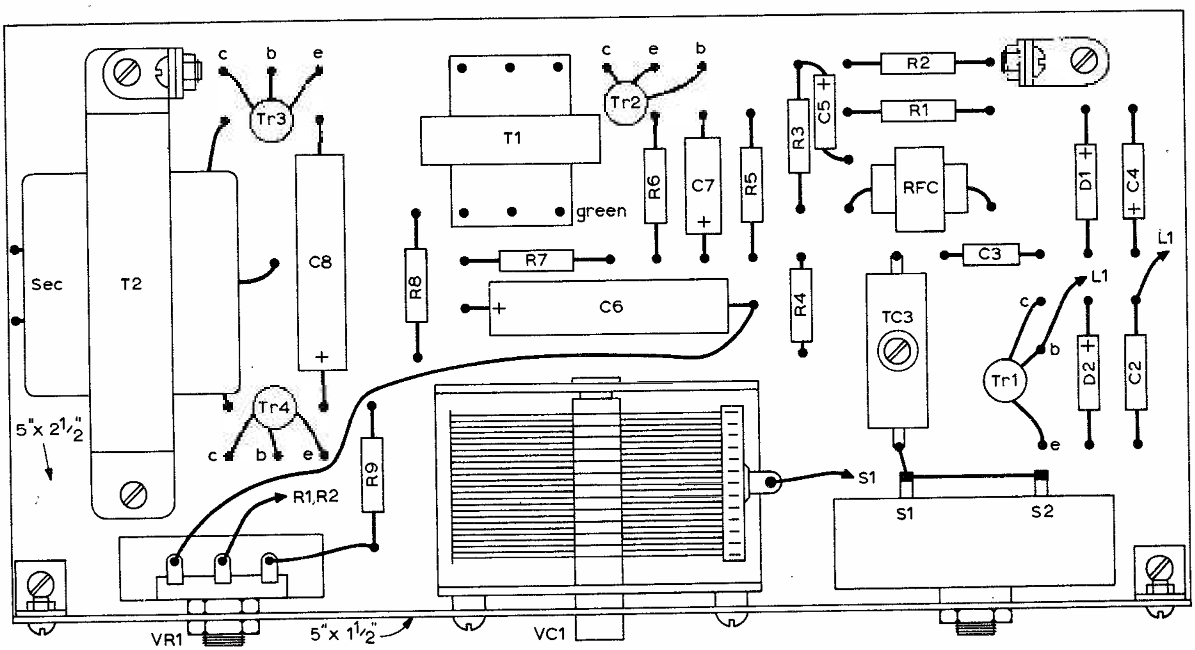



*Fig. 2: Top of circuit board with panel attached*

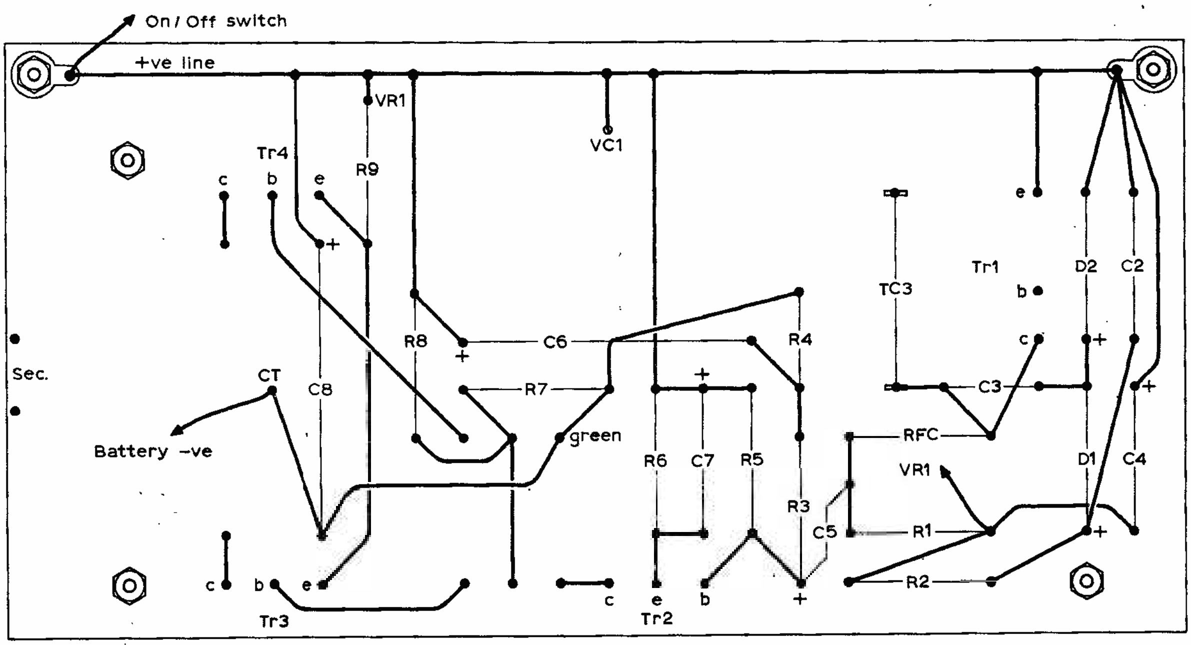



*Fig. 3: Reverse side of circuit board*

## TRANSISTORS AND DIODES

The wire ends of these can be at least ½in. to ¾in. long. It should only be necessary to keep the iron in contact with the joint to be made for a second or two, and this will normally cause no damage but a heat shunt can be used. Place sleeving on the transistor wires, or shape them so that they cannot touch each other. The transistor type given for Tr1 is recommended. If any alternatives are tried, it may be necessary to change R1 and R2.

If diodes D1 and D2 are not as given in the component list, R2 may have to be changed, for best results and will generally lie between about 100k$\Omega$ and 470k$\Omega$. If totally different types are used for Tr2, and Tr3/4, the values of R3, R5 and R6 may need changing, or R7 and R8. If other transistors are to hand resistors R3 to R9 should be of the values recommended for the actual transistors fitted. T1 and T2 may also have to be changed.

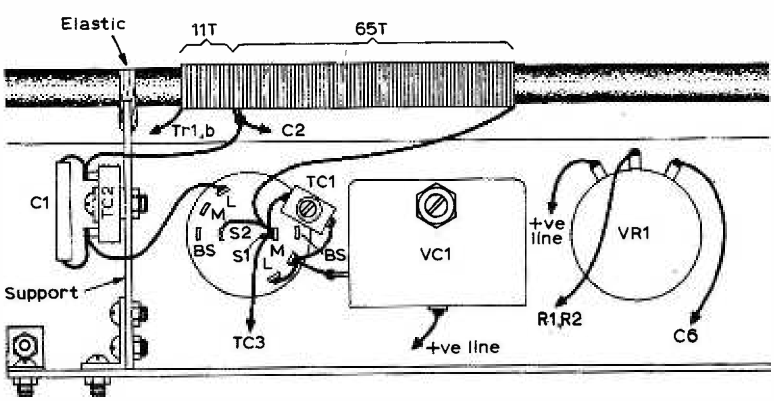



*Fig. 4: Details of ferrite aerial and associated wiring*

## AERIAL

The ferrite rod is 6×⅜in. and the winding is 26 s.w.g. double cotton-covered wire, 76 turns wound side by side, with a tapping at 11 turns, Fig. 4, which also shows the switch wiring.

In both long and medium wave positions S1 shorts out trimmer TC1 but this is in series with VC1 for bandspread. S2 connects C1 and TC2 across the 65 turn position of the rod, for 1500m reception. TC2 is mounted in a hole in the paxolin support but TC1 is soldered directly to the switch tags.

## TESTING

A meter may be placed in one battery lead, and should indicate about 10-12mA with no signal or moderate volume. A much lower current, with distortion, may indicate that R7 and R8 are of unsuitable values for Tr3 and Tr4. With good volume, current peaks will be about 25-40mA.

Unscrew TC3, switch to medium waves, and rotate VR1 clockwise for about two-thirds of its travel. Tune in a signal with VC1, screwing TC3 down until oscillation just commences. Switch to long waves, set VC1 half closed, and adjust TC2 until the 200kHz BBC transmission is tuned in. With the switch at bandspread, coverage is adjusted with TC1, which is slightly unscrewed. Screwing down TC1 increases coverage at the l.f. end of this band.

For all but strong signals, VR1 must be advanced just enough to bring the receiver near oscillation giving best sensitivity. Turning

VR1 too far will worsen reception. If necessary, adjust TC3 slightly, so that smooth regeneration is possible on all three bands, controlled by VR1. With a t.r.f. receiver results depend very much indeed on the correct control of regeneration, and this circuit can give a smooth build up of volume on all bands.

If bandspreading is to cover the bottom of the medium wave band, a 50pF trimmer can be connected across the tuned portion of L1, or the number of turns on the ferrite rod can be increased. In each case, frequencies which occupied only a few degrees rotation of VC1, at the high frequency end of the band, are opened out to occupy the full 180 degrees. Reception on these frequencies will normally be greatly improved as darkness falls, though 160m amateurs are often active during daylight hours, especially at weekends.

## CABINET

A suitable size, inside dimensions, is 6½in. wide, 6in. high, and 3in. deep. Work is greatly simplified by using ready-planed wood 3×¼in. Top and bottom are then 7×3in., and the sides are 6×3in. and the front can be ⅛in. hardboard, 7×6½in. Put adhesive on all meeting surfaces and fix them together with a few small panel pins. When the adhesive is dry, smooth joints and edges with a glasspaper block. The case shown was covered with self-adhesive material but the wood must be smooth and free of dust beforehand. Place the cabinet front down upon a piece about 9×8½in., smooth out wrinkles, and cut each corner, so that about 1in. folds over on to top, sides and bottom. A strip about 4in. wide is then cut, long enough to go round and overlap. This is put on, tightly stretched, and the corners cut so that excess can be folded over inside.

With the cabinet shown, the front was cut to clear all the control knobs, and a panel was glued behind this opening for the receiver. Silk was placed over the speaker aperture in the cabinet front before covering the case, and a hole cut in the covering material.

The headphone outlet and switch are fixed directly to the cabinet. If headphones are not required, connect the speaker directly to the secondary of T2. When the headphone plug is inserted, this opens contacts which silence the speaker. ■

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# THE MW COLUMN

THERE are a few countries that do not broadcast on the short waves, consequently the DXer who would like to add them to his list of countries heard and verified, will have to turn to the medium waves. The listener in the UK is fortunate that a number of these 'medium wave only' countries can be logged without too much difficulty.

The nearest and easiest is Andorra which currently is broadcasting on two frequencies only, both on the medium waves. *Radio Andorra* 701kHz has programmes in Spanish while *Radio Sud* 818 is in French: both verify. Further south and more difficult is Gibraltar on 1484kHz which is an international common frequency also used by Radio 4. Try in summer before the BBC signs-on. The BBC relay in Malta is now on 1546kHz and is audible as a background to Radio 3 during the evening. It has been heard clear of interference at 0430hrs GMT. Spanish Sahara has two medium wave transmitters, *Radio Sahara* EAJ103 654kHz in El Aaiun is usually logged in the late evening with programmes in Spanish and EAJ203 *Radio Villa Cisneros* on 998kHz is sometimes audible about 2100hrs GMT broadcasting in Hausa and Spanish. The Portuguese island of Madeira has CSB91 on 1529kHz which can be recognised by it's fluttery signal during the hour before closedown at midnight GMT.

The Faroe Islands have a single 5kW transmitter at Torshaven on 584kHz. This is a difficult station but it was logged several times last winter shortly after sunrise. A loop aerial is essential to combat interference on this channel. Nearby Iceland is much easier: Hofn 665kHz is usually strong after midnight. *Radio St. Pierre* 1375kHz on the French islands of St. Pierre and Miquelon near Newfoundland is fairly easy but be careful not to confuse it with Lille on 1376kHz which closes down at 2300hrs GMT. There are three MW stations in Bermuda the easiest being ZBM1 on 1235kHz which is usually heard when the path to North America is open. The other two, ZFB1 960 and ZBM2 1340 are more difficult but can sometimes be heard amid North American QRM. There are a number of 'MW countries' in the Caribbean. Listen after midnight for Point Galina 750kHz in Jamaica; WIVI 970 and WBNB 1000 in the U.S. Virgin Islands; WKVM 810, WBMJ 1190 and WMDD 1480 in Puerto Rico; Trinidad on 730 ZNS 1540 in Nassau, Bahamas. ZNS is usually logged at sunrise during the summer when European QRM is light.

Mediumwave DXers now have their own radio programme from *Radio Nederland*. Included in 'DX Juke Box' on the 5th Thursday of the month, the next is on April 30th, is a feature on mediumwave DXing run by the National Radio Club of America. It is broadcast on two frequencies in the 49m band at 2000hrs GMT and at other times from the relay in Bonaire. Full information is available from Radio Nederland, Postbox 222, Hilversum, Holland.

**CHARLES MOLLOY**

# MINIATURISATION

R.A.YATES

## MAKING PRINTED CIRCUIT BOARDS

THE "art" of miniaturisation is within the reach of everyone and made possible by the use of printed circuits and suitable for small current circuits such as radio tuners, pre-amps, multivibrators and electronic switches.

The process of miniaturisation is relatively simple but it can become tedious if one is not experienced in printed circuit techniques.

### CHOICE OF COMPONENTS

The choice of components is very critical and will dictate the final size of the device. Sub-miniature components are available but they tend to be too expensive for the ordinary constructor.

Resistors are no worry at all as there are relatively cheap types on the market which are small enough for our needs. The normal Radiospares 1/4W resistor measures 0·12in diameter and 0·25in. long. The $\frac{1}{4}$W carbon film resistor measures 0·12in in diameter and 0·32in long. Both types are excellent, the difference being that the latter is more stable and reliable but is slightly more expensive.

Capacitors are available small enough for miniature circuits but they are expensive, compared to resistors. Electrolytic capacitors are quite reasonable, especially the Mullard C426 range, which are available up to 400$\mu$F in the 4V working range. Other suitable types of capacitor are ceramic, polystyrene, polyester and silver mica. Polystyrene capacitors are quite suitable as they are tubular but at least one centimetre of the leads must be left. Ceramic capacitors can be obtained in either disc or tubular form and they are both suitable for printed circuits. For the person who puts size above cost there are extremely small capacitors available. These "tantalum bead" capacitors are expensive, costing about 4s each.

Transistors can be quite large when compared with the rest of the miniature components. Transistors like OC71's tend to stand well above the rest of the circuit, their leads having to be left quite long so that a heat sink can be used between the encapsulation and the soldered ends.

The coils in a circuit are usually a problem. I.F. coils (Japanese) can be obtained quite small—measuring only 0·4×0·4×0·5in. Aerial coils can be made quite small by using a suitable former and radio frequency chokes can be obtained in miniature form. These are quite expensive but can be made by using a resistor as a former.

### PRELIMINARY DESIGN

By means of a scaled-up drawing the components are positioned so that the device is made as small as possible. The positioning of the components can be done in either of two ways; first, so that the final device is relatively thick (all the components standing up—Fig. 1) and a small area of copper laminate board used; secondly, so that the device is relatively thin (all the components lying flat—Fig. 2), and a large area of copper laminate board used. The former of these two ways is usually the more compact as some components when laid flat take up too much space.

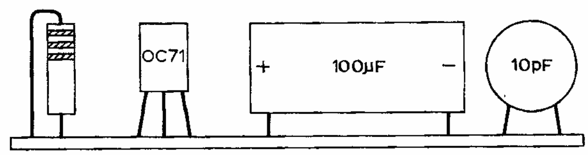


*Fig. 1: 'Vertical' mounting of components*

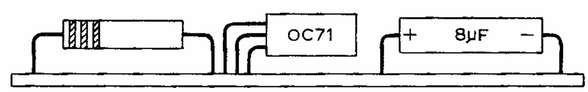


*Fig. 2: 'Horizontal' mounting of components*

### FINAL DESIGN

Once the position of the components has been decided the job of interconnecting the components can begin. The components are drawn in plain view about four times actual size. This is best done in rough as more than one sketch will have to be made. The distances between the components should be exaggerated as this will make the interconnections clearer. These are seen better if they are represented by a thick line made with a soft pencil.

The components should be rearranged slightly until none of the interconnections cross. If this is impossible to do without waste of space an external connection should be made by means of an insulated jumper lead.

### MAKING THE PRINTED CIRCUIT

Once the design has been finalised a life size drawing is made (graph paper is a boon at this stage). The outline of the components should be drawn in lightly and the holes for their leads and the interconnections shown clearly. The copper laminate board is now cut to size with the copper side facing upwards so that the copper foil (which is only about 0·002in. thick) is not forced off the laminate board.

The "patina" on the surface of the copper is now removed by means of a damp cloth and a domestic cleansing powder which acts as an abrasive and therefore a good electrical contact is ensured.

A tracing of the holes for the leads is now taken from the life size drawing and this is reversed (the original drawing was done as if one was looking down on the component side of the printed circuit board and the holes are to be transferred on to the copper side of the printed circuit board) and accurately located on the copper side of the printed circuit board.

With a pointed bradawl the positions of the holes are transferred to the copper foil. The holes can now be drilled with a $^{1}/_{32}$in. drill. As the drill bit is very fine a special brace, for use with small bits, should be used. If one of these special braces is not obtainable an electric drill can be used, but very carefully as these bits are very easily broken.

The masking of the copper laminate board can now be done. The design is painted on to the copper, using a suitable medium such as nail varnish, but gloss, cellulose, or enamel paint can be used with equally good results.

The masking of the copper laminate board can be done by either of two ways depending on the size of the copper laminate board.

By the first method the interconnections are painted directly on to the copper using a fine brush. This method is suitable for large printed circuits where there is enough room to use a brush.

By the second method the copper is painted with the medium and then the paint around the interconnections scraped away using a pin or a fine pointed bradawl. This method is suitable for small printed circuit boards where a brush is too large to use.

Both these methods have the same effect but the latter is more suitable for miniaturisation as it is possible to put the interconnections closer together than if they were directly painted on.

Now that the "resist" has been applied the excess copper can be etched away. There are several solutions that can be used but one of the quickest acting solutions is 50% concentrated nitric acid and 50% water. A good solution for those afraid of handling concentrated acids is ferric chloride ($FeCl_3$). It is much slower acting than nitric acid but just as effective. A suitable solution of ferric chloride is 920 grams of ferric chloride in one litre of water.

NOTE!—apart from the fact that nitric acid is extremely corrosive it is also dangerous giving off poisonous brown fumes when reacting with copper.

The solution is poured into a suitable glass or plastic vessel and the copper laminate board immersed copper side up, and left for a while. If nitric acid is used the etching process will be finished when no more brown fumes are given off. If ferric chloride solution is used the way to find out whether or not the etching process has been completed is to look at the copper itself. When the etching process has been completed any remaining unwanted pieces of copper can be removed with a knife. The "resist" can now be removed with a cloth and a suitable solvent.

## FINAL ASSEMBLY

The components are now prepared for soldering to the copper laminate board by bending the leads into the correct shape (Fig.3), and then tinning the ends, care being taken not to enlarge the ends of the leads too much, by tinning, because the enlarged leads might not fit into the holes previously drilled.

The transistors are soldered in place after as many as possible of the other components have been fitted. The leads are pushed through the appropriate holes with about $^{1}/_{16}$in. protruding out of the copper foil. These leads are now bent over (Fig. 4) and carefully soldered to the copper. It is advisable, when soldering a printed circuit board, to use a miniature soldering iron of not more than fifteen watts rating with a one millimetre bit, so that the joints can be made closer together.

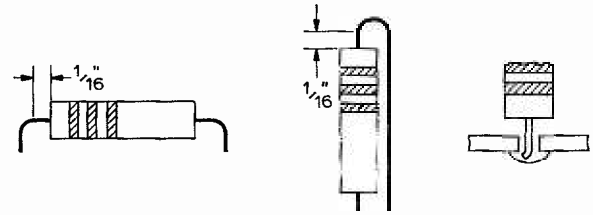


*Fig. 3: Left and centre: preparation of component leads*
*Fig. 3: Right: Position of leads in circuit board*

When soldering transistors special care has to be taken so as not to permanently damage them a heat-sink being used between the encapsulation and the joint. A pair of long nosed pliers is suitable but surgical forceps are better as they grip the lead leaving both hands free. 22 s.w.g., 60/40 (60% tin and 40% lead) solder should be used with a quick, firm application of the soldering iron directly on the tinned lead, making sure that none of the solder flows on to an adjacent joint and therefore producing a short-circuit. If a short-circuit is produced in this manner it can be rectified by either scraping away the offending solder with a pointed bradawl or by quick and careful use of the soldering iron.

When all the components are soldered in place the printed circuits should be checked against the circuit diagram, and that there are no short circuits, and that all the joints are good. This may be done by moving the components slightly and if any joint is worked lose it will not be electrically sound.

These printed circuit techniques described may not be the same as those that other printed circuit makers use but they are tried and tested and work well and give good results. ■

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

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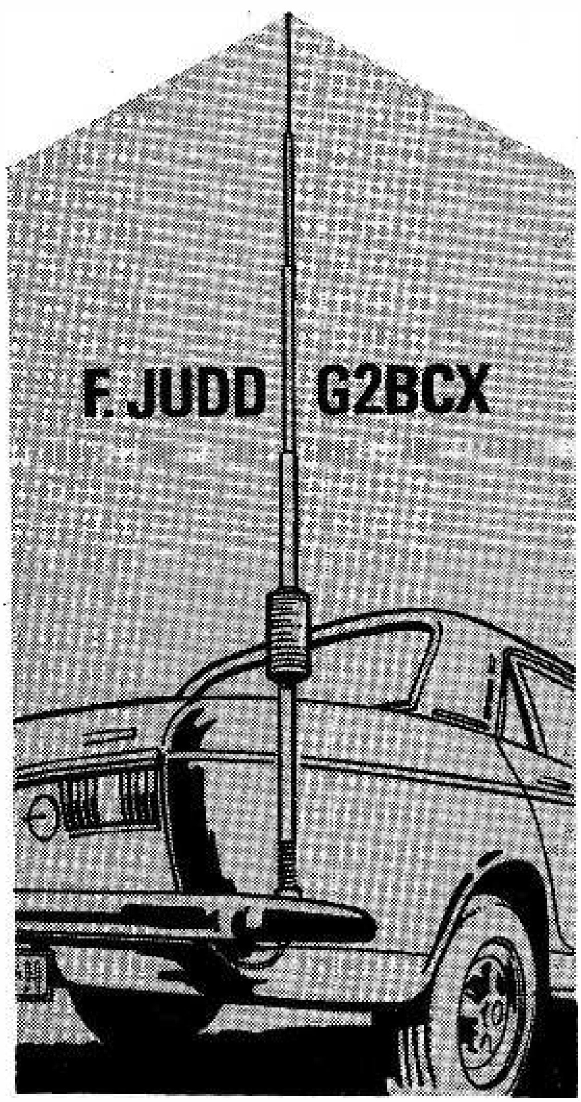
PRACTICAL WIRELESS, MAY 1970

# AERIALS FOR MOBILES



F. JUDD G2BCX

AERIALS for mobile operation in the h.f. amateur bands between 1·8 and 28 MHz are normally short vertical types with inductive loading, especially those operating at the lower frequencies. Short vertical aerials produce a vertically polarised wave which is radiated in the horizontal plane equally well in all directions, i.e., the aerial is omni-directional. Assuming the ground to be flat and perfectly conducting and that the current distribution in the aerial is sinusoidal, the radiated power in the vertical plane of an aerial less than $\frac{1}{8}$th of a wavelength is approximately as shown in Fig. 1.

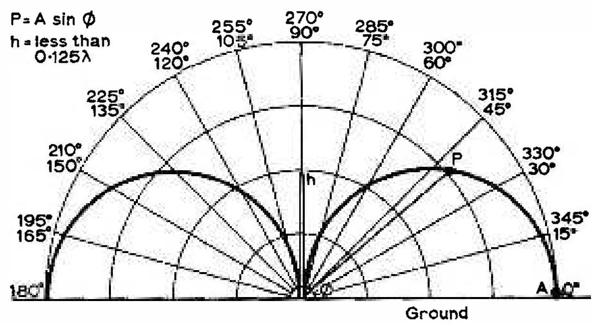
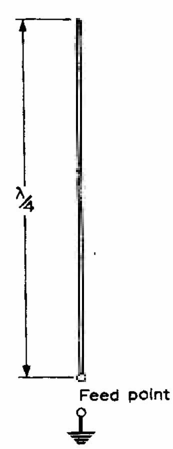



*Fig. 1 : Radiation pattern of a short vertical aerial.*

As the aerial length is increased, the pattern of the vertical radiation (as in Fig. 1) tends to flatten with a resultant increase in energy along the ground and a reduction of energy skywards. Mobile aerials for the lower frequency bands (1·8, 3·5 and 7MHz etc) must, for obvious reasons, be much smaller physically than even $\frac{1}{8}$th of a wavelength and although they may be tuned to resonance they can not radiate with the same efficiency as a resonant aerial a $\frac{1}{4}$ wavelength long.

The main reason for the high efficiency of a $\frac{1}{4}$ wavelength aerial is that an aerial of this length being resonant behaves as an almost pure resistance. This resistance is known as the *radiation resistance* and is equivalent to the impedance at the feed point of the aerial as in Fig. 2. Almost all the power fed into the aerial will be radiated. As the aerial length is reduced to fractions of a wavelength less than a quarter the aerial will show an increasing capacitive reactance and a decreasing radiation resistance. For an



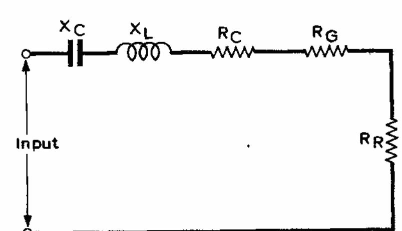




*Fig. 2 : (Left) Feedpoint of short vertical aerial*

*Fig. 3 : (Above) Equivalent circuit of loaded vertical aerial*

average 6 to 8ft. long mobile whip aerial the capacitive reactance may range from about 150Ω at 21MHz to as high as 8,000Ω at 1·8MHz resulting in a radiation resistance of about 15Ω at 21MHz to as low as 0·1Ω at 1·8MHz.

If the radiation resistance is low a large current must flow in the circuit if any power is to be radiated at all. By cancelling out the capacitive reactance with an equivalent inductive reactance the aerial can be made resonant resulting in a higher and much more useful radiation resistance. This does not, however, produce an aerial of high efficiency, i.e., one equal to a truly self resonant aerial of a quarter-wavelength or more in physical length.

Radiation resistance is also reduced as the effective height of the aerial is reduced and physically small mobile aerials particularly those for 1·8, 3·5, 7 and 14MHz have a very small effective height. Inductively loaded aerials of small dimensions are, therefore, something of a compromise and the only way of preserving efficiency is to keep all other possible losses to a minimum, for example, in mobile operation there are losses due to ground resistance which at the lower frequencies may be quite high. Coils used for loading also introduce resistance loss and although the coil may radiate some energy, thus adding to the all important radiation resistance, this will usually be small compared to the coil resistance loss.

The equivalent circuit of a loaded whip is shown in Fig. 3. The reactance due to the self capacity of the aerial $X_c$ is of course cancelled by the inductive reactance of the loading coil $X_l$. This still leaves the coil resistance $R_c$ and the ground loss resistance $R_g$ in series with the radiation resistance $R_r$. Only the power flowing in $R_r$ is radiated. That in $R_c$ and $R_g$ is dissipated in heat! A resonant mobile aerial for 1·8MHz and about 8ft overall is by comparison with its full quarter-wave counterpart (132ft) only approximately 4% as efficient.

## Mobile Aerials for the HF Bands

Any amateur radio mobile rally will reveal a wide assortment of loaded aerials, some unusual, some dangerous, some efficient and some not so efficient. They range from base loaded types to helical coil arrangements with or without 'capacity' hats but which will all add up to the same thing—a resonant aerial, i.e., one tuned by inductive loading to simulate ¼ wavelength resonance.

The 28 to 29·7MHz band is the only one for which inductive loading will not be required providing the physical length of the aerial is a quarter-wavelength. If the aerial is to be of fixed length, i.e.,, non telescopic, this should be 8ft. 3in. which allows for series tuning to resonance over the whole of the band by means of a 500F variable capacitor in series with the co-axial feed cable as shown in Fig. 4. With this system a co-axial cable of 70-80Ω can be used to couple the aerial to the transmitter even though the feed point impedance is only about 40Ω. The capacitor should be adjusted for maximum current into the aerial at point X.

If a telescopic aerial is used the overall length should be that required for the lowest frequency (28MHz). This is 8ft. 5in. and the aerial can be adjusted to resonance by sliding in the top section of the whip. In this case the co-axial feeder should be 50Ω but it may be worthwhile using an impedance

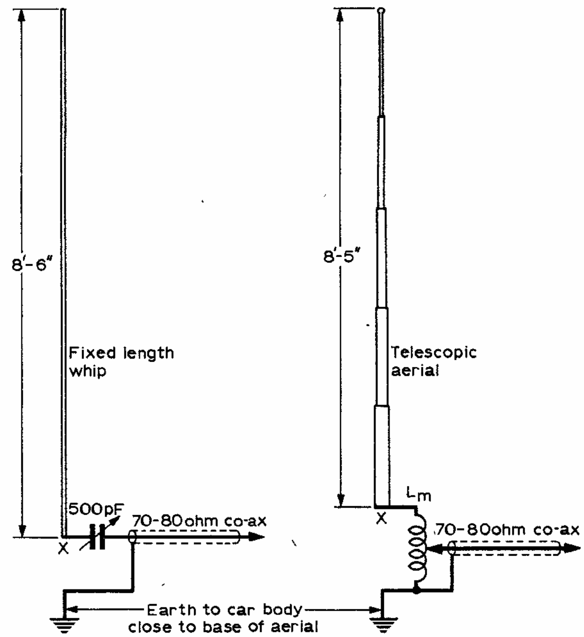



*Fig. 4 : (Left) Capacity tuned aerial for the 10 metre band.*
*Fig. 5 : (Right) Alternative version with inductance loading.*

matching arrangement similar to that shown in Fig. 5. The amount of inductance required for $L_m$ will be very small and is best determined experimentally. Five or six turns of 16 or 14 s.w.g. wire on a 2in. diameter former with ½in. spacing between turns should be ample. The aerial should first be adjusted to resonance at a midband frequency with a grid dip oscillator but with the co-axial feed line disconnected. The line is then connected to a point along the coil which produces maximum current into the aerial at point X.

It is worthwhile keeping in mind that the top of an aerial 8ft. or so in length may well be 11 or 12ft. above the ground if it is mounted on the rear of a car body. This should be regarded as a reasonably safe height limit even for a whip of fairly rigid but otherwise lightweight material. At 21MHz a quarter-wavelength is a little over 11ft. and just a bit too long for safety. Reduction of the overall aerial length to 8ft. or so means using inductive loading for 21MHz and of course for the 14, 7, 3·5 and 1·8MHz bands, in fact aerials for all these bands should be restricted to an overall length not exceeding 8ft. It may be necessary to make the aerial even shorter depending on the size of the car and the point where the aerial can be safely mounted.

The proximity of the loading coil and the whip section to the car body must also be given consideration. It is not possible therefore to give precise dimensions and constructional details for any given types of aerial. The inductance of the loading coil for instance will vary with the length of aerial above it and to some extent its own proximity to the car body. For this reason final adjustment of coils and aerial lengths for resonance should be carried out with the aerial mounted on the car.

The two most efficient forms of loaded mobile aerials are the base loaded and centre loaded types. The base loaded aerial has the advantage of greater physical stability and the fact that the coil resistance loss is lower because a smaller value of inductance is required. The centre loaded aerial, having a smaller whip section above it, requires a larger inductance which may result in a higher coil resistance loss. The use of a capacity hat above the coil does help to reduce the inductance required and therefore the coil resistance losses but it is generally believed that because the largest proportion of current will be flowing in the section of aerial beneath the loading coil the radiation resistance of the aerial will be greater. Measurements have shown a gain of 3dB or so over a base loaded aerial of the same physical length and height. There is little that can be done about ground loss resistance except good earth contact between the transmitter and the car body. The screening braid of the co-axial feed line to the aerial should be earthed at the transmitter and to the car body at a point as close to the feed point of the aerial as possible.

## Loading Coils

The inductance of the loading coil depends very largely on the capacity of the aerial section above it which, for an aerial approximately 8ft long and averagely a ¼in. diameter, will be about 25pF. This means a fairly large inductance for a 1·8MHz base loading coil and if the Q is to be kept high and the coil resistance losses low, the coil itself will be quite big. As the length of the aerial section above the coil becomes smaller the coil inductance must be increased. This applies also to centre loaded aerials where the inductance may be as much as twice that required for base loading.

Tables 1 and 2 give approximate inductance values and winding details for base loaded and centre loaded aerials of about 8ft. total length including the coil. It must be noted that the coil winding will have to be adjusted to bring the whole aerial to resonance when it is mounted on the car.

In order to keep the Q of the coil as high as possible it is recommended that low loss formers are used but these must, however, be strong enough to support the aerial section above. Paxolin tube with a ⅛th to ¼in. wall thickness is ideal. Plastic drain pipe with a wall thickness of $\frac{3}{16}$ths to a ¼in. is also suitable. Solid wood formers should be avoided, for despite coats of varnish, water can seep in and will not only lower the coil Q but also detune it. Plugs at each end of the former for attaching a supporting stub and/or the whip section can be of hard wood or metal but if metal is used the ends of the coil windings should finish at least 1in. from the plugs because the plugs can behave as short circuited turns and lower the Q of the coil.

When the loading coil has been finally adjusted it may be given two or three coats of good quality varnish which will not effect the Q. Plastic containers also make good rain covers but never use a metal cover.

## Mounting the Aerial on the Car

The exact place on the car at which the aerial is to be mounted may have some bearing on the construction of the aerial as a whole. Some mobile operators favour the offside of the rear bumper

**TABLE 1**

**BASE LOADING COILS for 8ft aerials**

| Band MHz | Inductance μH | Turns | Wire Size s.w.g. | Coil Dia (inch) | Approx winding length (inch) |
|---|---|---|---|---|---|
| 1·8 | 345 | 135 | 18 | 3 | 10 |
| 3·5 | 77 | 75 | 14 | 2½ | 10 |
| 3·5 | 77 | 29 | 12 | 5 | 4½ |
| 7 | 20 | 17 | 16 | 2½ | 1¼ |
| 7 | 20 | 22 | 12 | 2½ | 2¾ |
| 14 | 4·5 | 10 | 14 | 2 | 1¼ |
| 14 | 4·5 | 12 | 12 | 2½ | 4 |
| 21 | 1·25 | 6 | 12 | 1¾ | 2 |

**TABLE 2**

**CENTRE LOADING COILS for 8ft aerials**

| Band MHz | Inductance μH | Turns | Wire Size s.w.g. | Coil Dia (inch) | aprox. winding length (inch) |
|---|---|---|---|---|---|
| 1·8 | 700 | 190 | 22 | 3 | 10 |
| 3·5 | 150 | 100 | 16 | 2½ | 10 |
| 7 | 40 | 28 | 16 | 2½ | 2 |
| 7 | 40 | 34 | 12 | 2½ | 4¼ |
| 14 | 8·6 | 16 | 14 | 2 | 2 |
| 14 | 8·6 | 15 | 12 | 2½ | 3 |
| 21 | 2·5 | 8 | 12 | 2 | 2 |

bracket provided this projects far enough from the rear of the car body. On most small modern cars the bumpers seem to have become part of the body and offer no safe area for supporting a long aerial. If a bumper or bumper bracket is used be sure that the aerial remains fairly rigid when the car is in

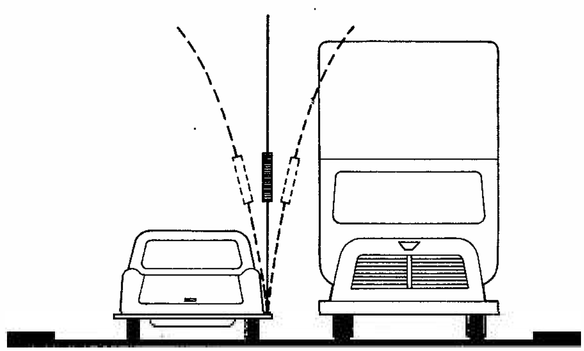


*Fig. 6 : Importance of adequate rigidity in aerial mountings.*

motion. Long, thin and very flexible aerials with heavy centre loading coils can be dangerous as illustrated in Fig. 6. An alternative to bumper bracket mounting is a flat bracket extending from beneath the chasis as in Fig. 7. This form of mounting is suitable for cars where the rear comes down directly from the roof. A centre loaded aerial would be advantageous here to keep the loading coil away

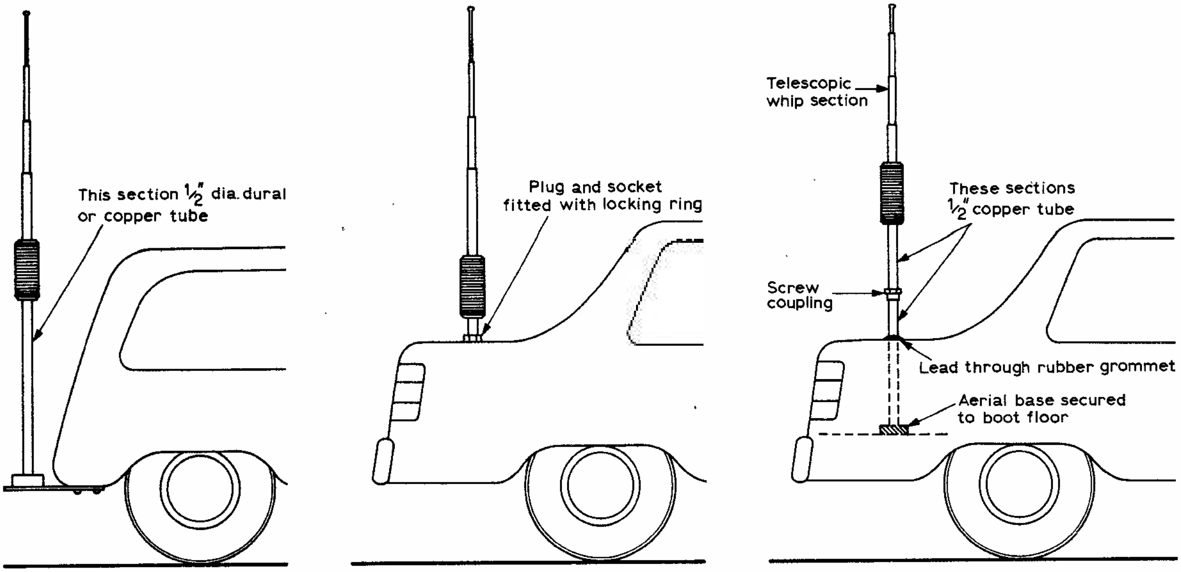



*Fig. 7 : 8 : 9 : Three possible methods of mounting whip aerials*

from the vertical part of the car body. For cars where the boot extends back from the rear window the offside bodywork might be found suitable for direct mounting of base loaded aerials as in Fig. 8. The method suggested is suitable for a centre loaded aerial and is used by the writer on a Triumph Herald Fig. 9. Note that the drawing is not to scale

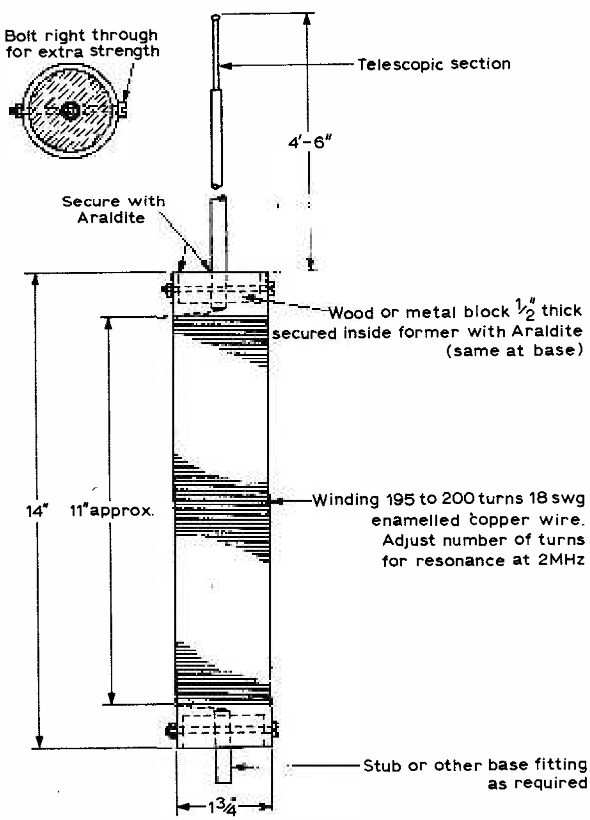



*Fig. 10 : Base loaded aerial for Top Band.*

and the section of aerial rod inside the boot is only a few inches long. This has no effect on the efficiency of the aerial. Aerials should always be mounted on the offside of the car so as to remain clear of overhanging trees and hedges on country roads. Also remember that the aerial must either be demountable or can be telescoped to get the car into a garage. A demountable type is best and for this purpose ½in. diameter copper water pipe is useful for making mounting stubs as these can be fitted with screwed couplers. Large co-axial type sockets can also be used for demountable base loaded aerials the plug being fitted to the bottom of the loading coil.

## Aerial Construction

For centre loaded aerials the coil should not be too large in diameter or the former made of too heavy material. Plastic piping 2 to 3in. in diameter is very suitable and plastic rolling pins have been used with success. The lower section of a centre loaded aerial should be either copper, brass or dural of at least ½in. diameter. Lengths, up to about 4ft. will support a loading coil and top whip section without swaying. The whip section above the coil may be a telescopic receiving aerial but use a heavy duty type that will not telescope of its own accord. Base loaded aerials require a long whip section and most of the receiving type telescopic aerials are too short. A section of copper or dural tube plus a telescopic section will make up height and copper-plated steel whips can be used successfully as they have nothing to support but their own weight.

Methods of joining whip sections to coil formers must be left to the reader but such joins must be secure and able to withstand vibration. As long as the aerial is fairly rigid it will not be affected very much when the car is in motion. A typical method of assembly is shown in Fig. 10.

**TO BE CONTINUED**

# TAKE 20

JULIAN ANDERSON

# No. 13 TWO TRANSISTOR RADIO

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

FROM the letters we receive it would seem that there are thousands of readers continually constructing simple radios using one, two or three transistors. I can well understand these people since I belong in their ranks and must have built over fifty of these in various sizes and to different designs in the last few years.

I make no apology for describing yet another radio; if you follow this series you will remember that a one transistor and a three transistor design have already been described. The circuit described here is particularly suitable for miniaturisation and although no direct constructional details are given, several comments are made later regarding component choice etc.

The problem with most published designs is that to achieve the high gains necessary for such sets very accurate biasing etc. is required, and since transistors have appreciable spreads in their characteristics the published circuits will only work well with ones used in the prototype. The circuit shown here has been thoroughly tested and over thirty transistors were tried. All worked well and only one resistance has to be chosen with care for the complete circuit to be sensitive and stable.

The supply voltage can vary between 3V and 15V with no circuit modifications though performance is, of course, better using the higher supply voltages. The circuit has very high gain and so the ferrite rod aerial—which is a problem when miniaturisation is the aim—can be very small. The prototype uses a 1½in. x ⅜in. size cut from a longer length.

## The Circuit

VC1, L1 and C1 comprise the tuned circuit and the overwind on L1 auto-transforms the r.f. picked up and feeds this to the base of Tr1. The collector of Tr1 is connected directly to the base of Tr2 whose emitter voltage is raised to the necessary level by R3 smoothed by C2. Detection takes place in in Tr2 and the rectified r.f. is smoothed by C3 connected between the negative and the collector of Tr2. R2 acts as the collector load of Tr1 and provides the bias for Tr2.

The base bias for Tr1 is provided by R1 which is connected through the aerial coil. This gives a measure of regeneration to the first stage and has the advantage over capacitively coupled feedback in that it is not frequency selective and gives smooth regeneration over the complete m.w. band. It is this resistor that has to be chosen with care. Stray capacitance will contribute to the regenerative process and so the value will depend not only on the actual transistor used but on the physical layout. The values in the prototypes varied between 56kΩ and 1MΩ.

The earpiece used should be a high impedance

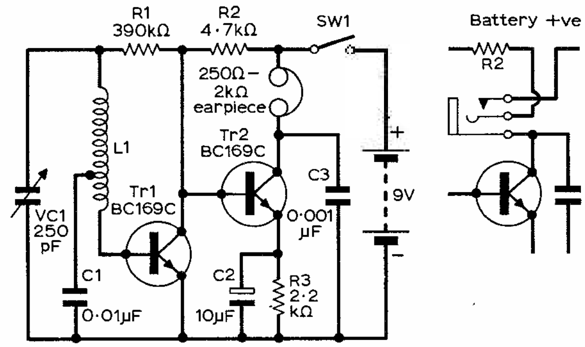



*Fig. 1: The circuit of the two transistor radio. If the jack socket is connected as shown a switch is unnecessary.*

magnetic type between 250Ω and 2000Ω. These earpieces seem to be fairly widely available (they're all made in Japan of course) but if these are difficult to obtain in your area a crystal earpiece connected across a 3·3kΩ resistor will work just as well.

## ★ components list

**Resistors:**
R1 390kΩ—see text R3 2·2kΩ
R2 4·7kΩ
All ⅛th watt

**Capacitors:**
C1 0·01µF C3 0·001µF
C2 10µF 10V VC1 250pF trimmer

**Transistors:**
Tr1 BC169C Tr2 BC169C
Available from Electrovalue Ltd of Egham.

**Miscellaneous:**
L1—see text; 250Ω or 2000Ω magnetic earpiece—see text; miniature jack socket; 4·5V–15V battery—see text.

## Construction

The aerial rod is easily made and about 80 turns on a ⅜in. ferrite rod tapped at 8 turns will do. Enamelled copper wire of almost any guage will suffice.

The cheapest and smallest tuning capacitors are the Radiospares 250pF or 500pF trimmers and these are ideal for miniature radios. The 250pF is quite adequate for this set and using the aerial coil described above will give a coverage from about 600kHz to 1·5MHz.

The components can be mounted on Veroboard or on paxolin sheet. The battery switch can easily be incorporated in the earphone socket by bending the contacts so that the jack socket makes rather than breaks the switch contacts.

The finished set draws only about 1·5mA and so all resistors can be ⅛th watt types and the battery will last a long while. ■

# WHAT DO YOU KNOW ABOUT METER SHUNTS?

H. A. COLE, C.ENG., M.I.E.R.E.

## PART 2

THE principle of the **universal shunt method** for multi-range current measurement is illustrated in Fig. 5. A single shunt ($R_{st}$) consisting of a number of series-connected resistors ($R_s1 - R_s5$), is permanently connected in parallel with the meter. The interconnections between the constituent resistors which make up the total shunt ($R_{st}$) are taken to a number of input sockets or to a single pair of sockets by way of a range selection switch.

The main advantage of the universal shunt is that contact resistance of the switch, if used, has a negligible effect on the measurement accuracy. This is because the shunts are always positively connected across the meter whereas in the separate shunt method they are connected through the contact resistance of the switch. The contact resistance is still present, of course, but it is now in series with the resistance of the external circuit which is producing the current where its comparatively low value will have little effect.

The first thing which has to be considered when designing a multi-range universal shunt, is the choice of an overall resistance ($R_{st}$) for the shunt. The major factor influencing this decision is the maximum effective resistance which can be accepted for the testmeter. The larger this resistance, the greater will its effect be on the total resistance of the external circuit supplying the current to be measured; and hence the greater will be its influence on the measurement accuracy. For good accuracy it is necessary to keep the effective resistance of the testmeter as low as possible. One can now develop a design procedure for the same current ranges previously catered for in the separate shunt method. The same type of meter will be used, 50$\mu$A f.s.d. ($I_m$) and 1,000$\Omega$ internal resistance ($R_m$).

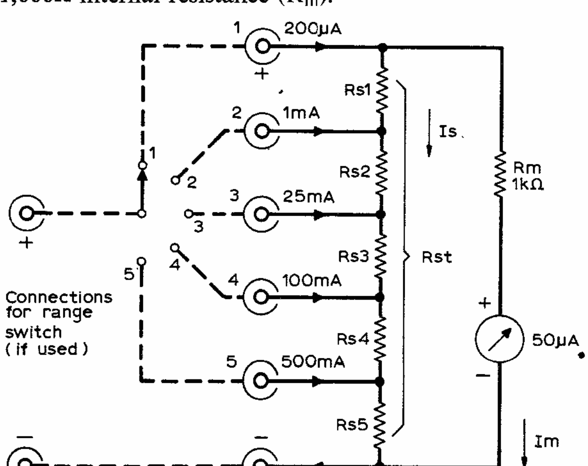



*Fig. 5 Universal shunt method.*

Firstly, to derive a simple formula which will then be used to determine the individual sections of the universal shunt, consider the meter circuit for the lowest current range (range 1). This range uses the total value of the shunt ($R_{st}$), and the simplified circuit looks like that shown in Fig. 6. '$I_t$' is the total current flowing in the testmeter; $I_s$ is the current in the shunt, and $I_m$ is the current in the meter. Determine the value of $R_{st}$ by

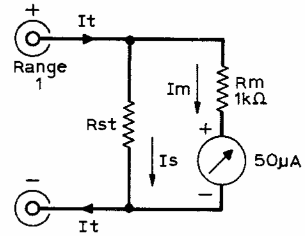



*Fig. 6 Single range shunt.*

using equation (iii) i.e., $R_{st} = \frac{R_m}{N-1}$ (where N is the f.s.d. magnification factor). The next step is to draw the circuit showing the next higher current range i.e., range 2. This has been done in Fig. 7 where the same circuit has been drawn in two different ways in order to make the explanation clearer. The total shunt resistance ($R_{st}$) is the same value as shown in Fig. 6 but it is now split into the two sections formed by $R_s1$ and $R_s2$ (Fig. 7a).

When the input current ($I_t$) is applied to the range 2 socket, some flows into the shunt section $R_s2$, and the remainder ($I_m$) flows into the shunt section $R_s1$, now in series with the meter resistance ($R_m$). The value of $R_{st}$ has been calculated using equation (iii). The problem is to determine the value of $R_s2$. It is known that $R_s1 + R_s2 = R_{st}$, and also that $I_s + I_m = I_t$. From these two facts is derived the equation needed.

The voltage developed across $R_s2$, due to the current $I_s$, equals that developed across $R_s1 + R_m$, due to $I_m$. From Ohm's law:

$$I_sR_s2 = I_m(R_s1 + R_m).$$

But $R_s1 = R_{st} - R_s2$, therefore substituting for $R_s1$ in the above equation:

$$I_s \cdot R_s2 = I_m(R_{st} - R_s2 + R_m).$$

multiplying the terms within the brackets by $I_m$,

$$I_sR_s2 = I_m \cdot R_{st} - I_mR_s2 + I_mR_m.$$

Collecting the terms containing $R_s2$:

$$I_sR_s2 + I_mR_s2 = I_mR_{st} + I_mR_m$$

Factorising both sides:

$$R_s2(I_s + I_m) = I_m(R_{st} + R_m)$$

But $I_s + I_m = I_t$, therefore:

$$R_s2I_t = I_m(R_{st} + R_m)$$

$$\text{or, } R_s2 = I_m(R_{st} + R_m)$$

Now, the f.s.d. current range factor

$$\text{'N'} = \frac{I_t}{I_m}, \text{ therefore } \frac{I_t}{I_m} = \frac{1}{N}$$

Substituting $\frac{1}{N}$ for $\frac{I_m}{I_t}$ in the above equation:

$$R_s2 = \frac{R_{st} + R_m}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

(this is the same value of N as used in equation (iii), and it means exactly the same).

This equation can be used to determine any sectional value of $R_{st}$, having first selected the value of $R_{st}$ using equation (iii).

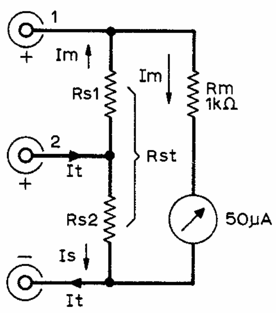



*Fig. 7(a) Two range shunt.*

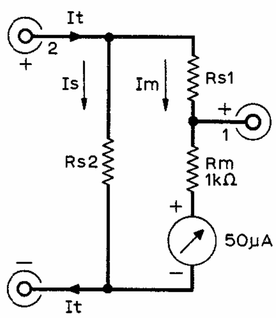



*Fig. 7(b) Equivalent circuit.*

Now use these two equations to derive the values of the shunt sections shown in Fig. 5. First determine $R_{st}$ for range 1 (200$\mu$A), using equation (iii).

$$R_{st} = \frac{1{,}000}{\left(\frac{200}{50} - 1\right)} = \frac{1{,}000}{3}$$

Therefore $R_{st} = 333\Omega$

Now derive the shunt section required for range 2 (1mA), using equation (iv); (note that this section of $R_{st}$ is composed of $R_s2 + R_s3 + R_s4 + R_s5$, which we will label $R_s2\text{-}5$).

$$R_s2\text{-}5 = \frac{333 + 1{,}000}{\left(\frac{1{,}000}{50}\right)} = \frac{1{,}333}{20} = 66{\cdot}66$$

$$R_s2\text{-}5 = 66{\cdot}66\Omega$$

Similarly, for range 3 (25mA),

$$R_s3\text{-}5 = \frac{333 + 1{,}000}{\left(\frac{25{,}000}{50}\right)} = \frac{1{,}333}{500} = 2{\cdot}666$$

$$R_s3\text{-}5 = 2{\cdot}666\Omega$$

For range 4 (100mA),

$$R_s4\text{-}5 = \frac{333 + 1{,}000}{\left(\frac{100{,}000}{50}\right)} = \frac{1{,}333}{2{,}000} = 0{\cdot}666$$

$$R_s4\text{-}5 = 0{\cdot}666\Omega$$

Lastly, for range 5 (500mA),

$$R_s5 = \frac{333 + 1{,}000}{\left(\frac{500{,}000}{50}\right)} = \frac{1{,}333}{10{,}000} = 0{\cdot}1333$$

$$R_s5 = 0{\cdot}1333\Omega$$

With this data now work out the individual values for $R_s1$, $R_s2$ .... $R_s5$, as follows:

$R_{st} = 333\Omega.$

$\therefore R_s1 = R_{st} - R_s2\text{-}5 = 333 - 66{\cdot}66 = 266{\cdot}4\Omega$

$R_s2 = R_s2\text{-}5 - R_s3\text{-}5 = 66{\cdot}66 - 2{\cdot}66 = 64\Omega$

$R_s3 = R_s3\text{-}5 - R_s4\text{-}5 = 2{\cdot}666 - 0{\cdot}666 = 2\Omega$

$R_s4 = R_s4\text{-}5 - R_s5 = 0{\cdot}666 - 0{\cdot}133 = 0{\cdot}533\Omega$

$R_s5 = 0{\cdot}133\Omega.$

Check for $R_s1 + R_s2 + R_s3 + R_s4 + R_s5 = R_{st} = 333\Omega.$

$266{\cdot}4 + 64 + 2 + 0{\cdot}533 + 0{\cdot}133 = 333{\cdot}06$ (satisfactory).

Substituting these values in Fig. 5, the testmeter circuit will now look like that shown in Fig. 8; the range selection switch could be replaced by individual sockets, as shown in Fig. 5.

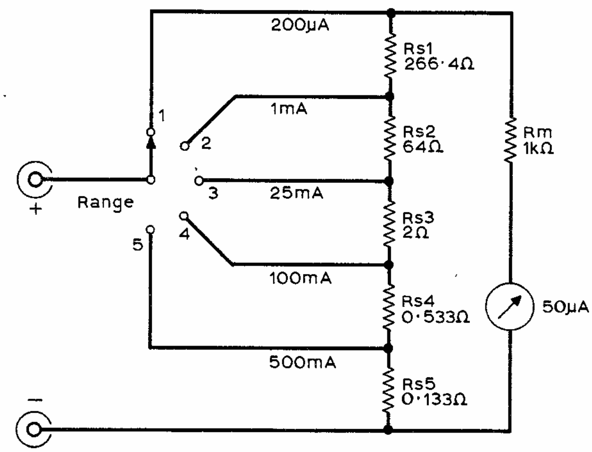



*Fig. 8 Final circuit using Universal shunt.*

By deliberately working out each shunt section familiarity with the working of equation (iv) is obtained. It is, after all, nice to know what one is doing, and why one is doing it. As many will have noticed from the results, however, a much simpler procedure is possible, once having determined $R_{st}$ using equation (iii). For example, requiring a shunt section of 66·66Ω for 1mA, will require a shunt section equal to one hundredth of this value (0·666Ω) for a range 100 times as great i.e., 100mA. Similarly, if 2·666Ω is required for 25mA, then $\frac{25}{500} = \frac{1}{20}$th of 2·666Ω i.e., 0·133Ω, is required for 500mA.

This is a very simple procedure but its simplicity is not readily appreciated without having first understood the derivation of equation (iv). The bit that puzzles most people when using the simple approach is "what happens to the unwanted sections of $R_{st}$ i.e., those sections which end up in series with $R_m$!

To end this discussion, one very important point should be noted about the universal shunt method of measuring current, and that is the fact that the minimum current range can never be made equal to the f.s.d. of the meter, as it could in the separate shunt method. This is because the presence of $R_{st}$ being permanently connected in parallel with the meter, will always bypass some of the current applied to the meter, even though this can be made very small by using a large value of $R_{st}$. It can now be seen why 100$\mu$A and not 50$\mu$A was selected for the minimum current range of our hypothetical testmeter. ■

# Beginners A.F. AMPLIFIER

A.S.ELLIS

The low cost and simplicity of this little amplifier make it eminently suitable as a beginner's project. Despite this simplicity, however, the unit is capable of a fairly high standard of reproduction, albeit at very modest output levels, and is ideal for boosting the output from a phones-only transistor radio to loudspeaker strength.

In the prototype, the frequency response is exceptionally good, (−2dB at 15Hz and 40kHz).

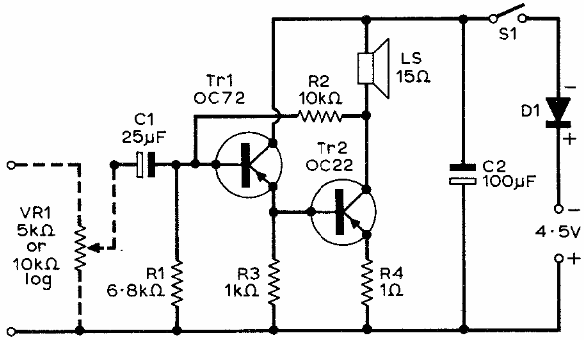



*Fig. 1: Circuit of amplifier*

## CIRCUIT

The circuit diagram is shown in Fig. 1. It will be noted that direct coupling has been used between the two stages: this makes for simplicity and minimises the number of circuit components. Tr1 operates in common collector mode, feeding the common emitter amplifier Tr2. The 10kΩ resistor R2 is part of the base-bias network for Tr1, and incidentally also introduces negative feedback, so contributing to the stability of the configuration. The base bias current for Tr2 is derived from the standing emitter current of Tr1. The emitter resistor R4 introduces a small amount of negative feedback, in addition to that already provided by R2. The overall effect of the total feedback shows up in the extremely good frequency response of the unit. (See Fig. 2).

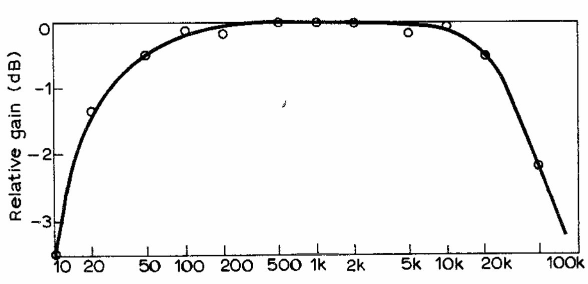
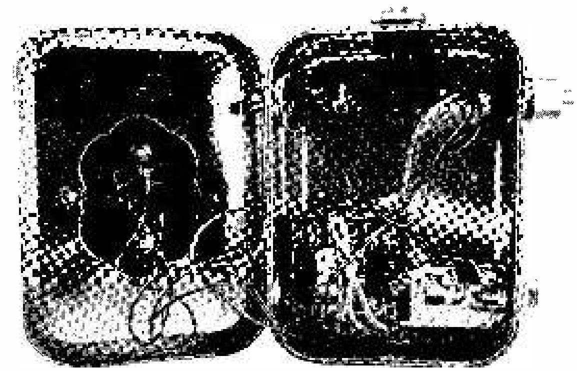



*Fig. 2: Response curve of amplifier*



## CONSTRUCTION

All small components, including Tr1, are mounted on a miniature 6-way groupboard as in Fig. 3. The power transistor, however, is mounted on a suitable flat surface (ideally paxolin) and is connected to the groupboard by flying leads. Fig. 4 gives drilling details for the paxolin mount. The unit is small

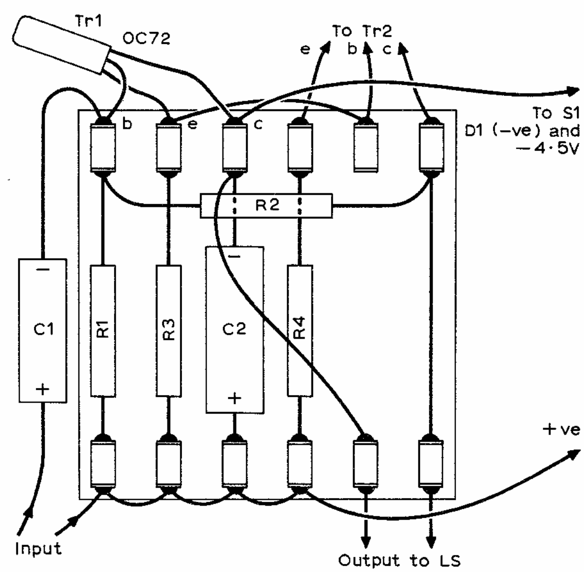



*Fig. 3: Component board*

enough to be constructed inside a 2 oz. tobacco tin, complete with input and output jacks. But note that if general practice were followed, using the tin as earth (+VE supply) the output jack would need to be of the insulated variety. Neither would it be permissible to mount Tr2 directly on the tin, since the transistor collector is directly connected to its casing. In this event, a suitably large hole would need to be cut in (say) the lid of the tin, and the paxolin sheet carrying Tr2 bolted over it. In circumstances where such a transistor was running at full power, it would need to be bolted to a metal plate heatsink. In the circuit here however, the device operates well within its power rating, and remains cold at all times: a heatsink is therefore unnecessary.

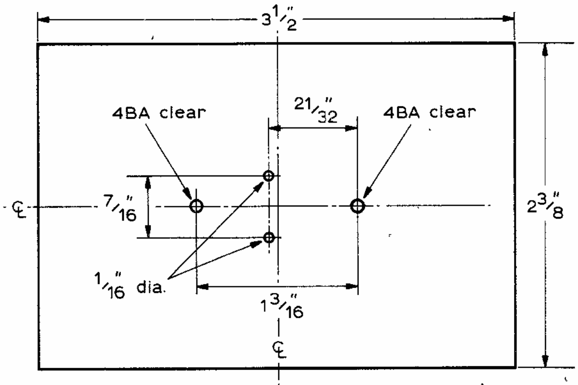



*Fig. 4: Mounting board for power transistor*

Although an OC72 has been specified for Tr1, an OC81 will do just as well, and the author has even used some of the more robust specimens of a batch of unmarked, untested transistors, all with equal success. Alternative transistors have not been tried in place of Tr2, although it is probable that ither types could be used, provided that one is prepared to juggle a little with component values.

## ★ components list

**Resistors:**
R1 6·8k Ω
R2 10k Ω
R3 1k Ω
R4 1 Ω
All resistors $\frac{1}{2}$ watt 20%
VR1 5k Ω or 10k Ω Log.

**Capacitors:**
C1 25$\mu$F 12V wkg.
C2 100$\mu$F 12V wkg.

**Semiconductors:**
Tr1 OC72 (see text)
Tr2 OC22
D1 10 p.i.v. 250mA

**Miscellaneous:**
Groupboard (6 way); Input and output sockets; Piece of paxolin $2\frac{3}{8}$"x$3\frac{1}{2}$"; 4BA nuts & bolts; Switch, single pole on/off; Battery, 4.5V.

Finally, a word about power supplies: unlike the more commonly encountered class B transistor amplifiers, this unit draws a steady high current all the time it is switched on (class A), regardless of whether or not a signal is applied. The prototype has an appetite which requires about 110mA at 4.5V to satisfy it. Correspondingly, the battery needs to be as large as convenience allows. The prototype draws its nourishment from a 4.5V Bell-battery Type 126. A couple of these in parallel or a PP11 might be a better idea.

Damage resulting from incorrect connection of the power supply is prevented by the inclusion of diode D, in the negative supply line. ■

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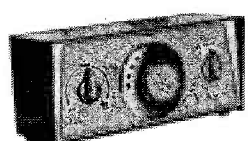

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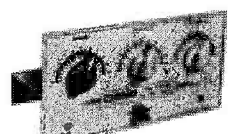

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# ELECTRONIC RECEIVER SWITCH FOR TRANSMIT ↔ RECEIVE

## F.G.RAYER G30GR

IT is usual to employ the same aerial for transmission and reception, and to have an aerial change-over switch, change-over relay, or switching in the transmitter to transfer the aerial from the transmitter output socket to the receiver aerial input socket. As the receiver speaker generally needs to be muted while transmitting, this makes necessary some inter-connection of units, which may be found a nuisance when using two or more transmitters.

The circuit in Fig. 1 avoids the need for such switching, and is permanently connected to the aerial, which will also be used for transmission. During reception, V1 acts as a cathode follower, with bias and output developed across R4. C3 couples signals to the receiver.

V2 is the first audio amplifier of the receiver, in this case with contact potential bias from R5 and R2. C4 is coupled to the volume control, and C6 provides signals for the output stage and speaker.

When the transmitter is on, a high r.f. voltage appears at V1 control grid, and rectification develops bias across R1 and R2, thus virtually cutting off V1 so that the signal is not applied to the receiver aerial circuit. The bias voltage developed across R2 is beyond the cut-off value for V2, thus muting the audio section and speaker.

Stray coupling through V1 and elsewhere allows the receiver a.g.c. circuit to cut down the sensitivity of i.f. and other controlled stages while transmitting. When the r.f. signal from the transmitter is removed, the receiver returns almost instantly to its usual condition.

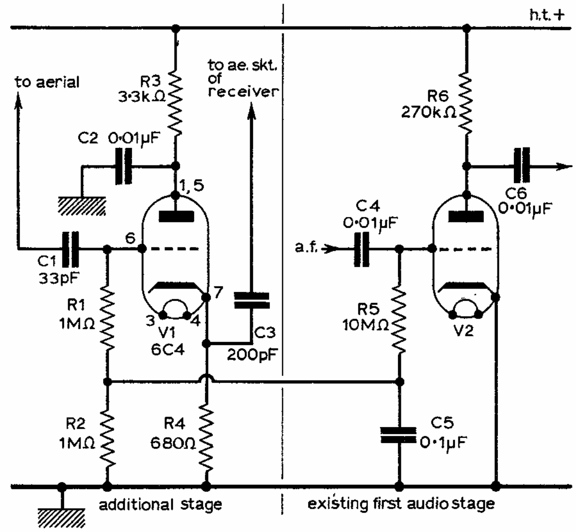


*Fig. 1: Circuit of switch.*

## CONSTRUCTIONAL POINTS

As the circuit was fitted in a home-built receiver, V1 was mounted on the chassis between aerial socket and aerial coils. This stage should be assembled on a small sub-chassis, and fully screened as far as possible. The voltage across C1 depends on the type of aerial and transmitter power, so a 1kV mica component was fitted. For Top band, moderate power, or feeding from a 75Ω or similar line, 500V would suffice. The r.f. voltage across C1 is greatest with end-fed half-wave systems where the receiver is operated from the aerial without a tuner but this is not recommended.

R4 suits the general medium impedance receiver aerial input circuit. For a receiver with 300Ω or 75Ω input, signal strength would be improved by reducing R4 and increasing C3. The h.t. voltage is not very important, and can be about 150 250V, taken from the receiver supply.

The speed of recovery of the whole circuit depends largely on the receiver a.g.c. component values. Recovery of the cathode follower and audio stage is practically instantaneous. If the receiver has a very sluggish a.g.c. circuit, the effects of this can be reduced by decreasing the capacitor and resistor values in the a.g.c. circuit.

With the circuit in use, omit all inter-connection of receiver and transmitter, and any aerial change-over relay or similar device. The aerial is permanently connected to the receiver by a single lead, or preferably by co-axial cable, to suit the type of aerial feed. The transmitter is connected to the aerial directly, or through a tuner, as usual. If desired the tuner may be in circuit for reception.

The transmitter is normally switched on by closing a switch in the main h.t. circuits, where low voltages are involved, or a switch or relay in the supply to a transformer which provides h.t. current in other cases.

The circuit was intended for use in conjunction with a.m. transmitters. Where high power is used, the voltage rating of C1 should at least be equal to that of the p.a. anode circuit coupling capacitor.

The circuit was found to be satisfactory with an s.s.b. transmitter, for automatic receiver muting, but not suitable for c.w., due to the long time constant of the receiver a.g.c. circuits.

It is not recommended that this switch be used with receivers having transistorised r.f. stages as the transistors could be damaged by the high r.f. voltages that exist around V1 in the transit mode. ■

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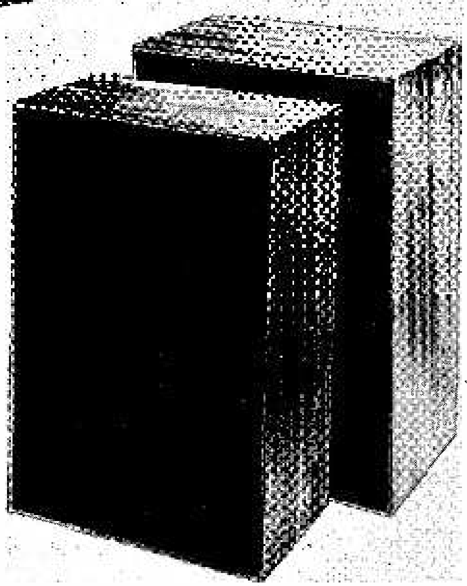

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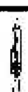

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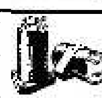

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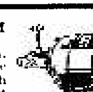

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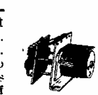

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# THE BROADCAST BANDS

Malcolm Connah

FOR the second month in a row I have received enough information to fill several pages. I would like to thank all those who have reported to this column and to apologise for the fact that I have had to severely edit their reports in order to include the maximum amount of information.

### Reader's logs and news

**Alexander Lex-Arnold** of Hemel Hempstead uses a Heathkit Mohican Mk. II and a 16 foot indoor wire which enabled him to hear:

11795 WINB, Red Lion, Pa., 2115-2200 SINPO, 52533. 11855 Saudi Arabia 1935-2000 in English, 53444. 15110 WIBS, Grenada, 2005-2045 in English, 55434. 21480 RSA, S. Africa, 1800-1850 in English, 43433.

**Geoffrey Gilham of London SE12** heard my plea for l.f. logs and used his Eddystone EC10 and Trio 9R59D to send in some of the best DX this month:

4680 *R. Nacional Espizo,* Ecuador 0437, 44333. 4690 *R. Reloj,* Costa Rica at 0535, 44444. 4720 *R. Clube Mindelo,* Cape Verde at 2200, 33333. 4850 *R. Mauritania* at 2030, 43443. 4865 *Ponta Delgada,* Azores at 2035, 43443. 4965 *R. Sante Fe,* Colombia at 0737, 43443. 15110 XERR, Mexico at 2339, 54444.

**Mr. N. Colton** of Ventnor, I.o.W. reports hearing *Radio RSA,* S. Africa on 21480 as above but also on 15250 at the same time. He has also heard *Radio Kiev* in English to West Europe at 1930-2000 on 7120 and 5920; *Radio Ghana* in English at 1445-1530 on 13930, 16790, 17870 and 21505; WNYW, *Radio New York World Wide* at 2200 on 15440. His equipment consists of a 4 valve domestic superhet and a longwire antenna.

**Maurice Williams** of Sleaford, Lincs. is yet another reader who has a Trio 9R59DE this time with a 20 foot base loaded vertical or a 70 foot long wire:

4967 KBS, Kuwait at 2100, 34233. 11765 HCJB, Ecuador at 2210-2300 in English, 32332. 11855 Saudi Arabia at 1830-2000, 44444. 15115 WIBS, Grenada at 2110, 45444.

**Chris Stacey** of Tunbridge Wells has a Lafayette HA700 and a Joystick antenna yielding:

3295 *R. Zambia* at 2009, unreadable. 4040 *R. Yerevan,* Armenia, Domestic Service at 1644. 4500 Urumchi, China with poor reception at 1552. 4775 Afghanistan in Pustu/Dari at 1611, poor. 4880 *R.TV Congolaise* at 1810, poor. 7255 VOA, Okinawa in Chinese at 1628, poor.

**Richard Ellis** of Stroud has a 1944 vintage Hammarlund receiver and a 49 metre 'V' dipole and heard:

11710 *R. Nacional,* Argentina at 2300-2352, 55445. 15125 ELWA, Liberia in Arabic with Eng. ID. every 15 minutes from 2130 to 2200, 54555. 17705 *Radio Havana,* Cuba at 2010-2030, 54344. 17825 NHK, Japan at 0800-0830, 33233.

**Nigel Pope** of Chesterfield does not seem to have much luck with his Codar CR70A and Joystick, the only station he reported was:

17705 *Radio Havana,* Cuba at 2047, 44444.

The station asked for reports and suggestions to be sent to P.O.Box 7026, Havana, Cuba.

**C. Williams** of London SW18 had more luck with his Codar CR45 and 40 foot end-fed antenna and heard:

11710 *Radio Australia* at 0645-0745, poor. 15185 *Radio Finland* in English at 1800-1830, strong. 21690 *UN Radio* with news in English at 1800 & 1825.

**Roy Patrick** of Derby reports that *HCJB, Ecuador* has placed a new 100kW transmitter into service on s.w. They plan to introduce two further 100kW transmitters in the future.

*Radio Brazzaville,* Congo has been heard on a new frequency of 4800, at 1915 they relay Paris with an English programme, reception is good apart from the c.w. QRM.

**John Adams** of Sheffield does not let us know what equipment he has but he managed to hear:

9600 approx. *R. Vilnius,* Lithuania at 2240, 55545. 17720 WINB, Red Lion, P.a., at 1800.

**John W. Smith** of Anstruther, Fife used his Eddystone 840C and Joystick to send in a very interesting log of Brazilian stations:

9610 *R. Tamois* at 2035-2100. 11875 *R. Soc. de Bahia,* Brazil. 15125 *R. Dif. de Soc. de Bahia,* Brazil. 15145 *R. Journal do Comercio* at 2035-2100. 15155 *R. Dif de Sao Paulo* at 2035-2100. 15370 *R. Tamois & Tupi* at 2035-2100.

### News from the Clubs

The Pathfinder Radio Group (PRG) is now a special section of Euradio and has an observer on the European DX Council. Euradio accounts are via the PRG and all communications should be sent to them at 13 Little Road, Hemel Hempstead, Herts.

The International Shortwave League (ISWL), 60 White Street, Derby, DE3 1HA, now offers a reduced subscription rate of 25s. to members under the age of 18 years. It is hoped that this move will encourage young people to take an interest in the hobby at a time when they may be unable to afford the full subscription.

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

# THE AMATEUR BANDS

## David Gibson, G3JDG

THERE have been so many logs this month that it seems a good idea to get in as many as possible and let readers draw their own conclusions about the amateur bands. One or two letters have pointed out that two metres is far from dead and that the souls of long lost carriers do roam about in the 144MHz region. A few more point out that the Codar CR70A is a superhet and not a t.r.f.

**D. Robbins** (Warks.), draws attention to the prefix game and confesses confusion. He says that YU is now YT, UA and RA are the same, I1 is IØ to commemorate the founding of Rome, VK is AX and HT1HSM lives in Nicaragua but so does YN1HSM. Heard during the A.R.R.L. contest, 9E3USA who became ET3USA the following day.

**J. Leaver** (Lancs.), has a BC348L, a 100ft. long wire round the attic and the mains earth. Goodies bagged on topband c.w. include—DL9KRA, GD3SVK, GI3JEX, GI3RNY, GM3TMK, HB9ANW, HB9NL, K1PBW, K2GNC, OE3AX, OI3NQ, seventeen OL stations, nine OK stations, PAØNF, PAØPN, VO1FB, VO1HN, W1BB, W8ANO, WB2OZW, YU3TMX, ZB2BO, 5Z4LE/HZ. James notes hearing VO1HN coming through at 2200 calling CQ and ZB2BO at 2355 also calling CQ but getting no replies.

**W. Waldron** (Mon.), 840C, a.t.u. fed by a three-wire folded dipole, claims this bunch for 80 metres—CO2DR, CO2FA, CR4BC, HS5ABD, HV3SJ, K3UZE, KV4FZ, KZ5AG, MP4BFO, OA8V, OY5NS, PJ7JC, PZ1DF, TA3MQ, VO1FB, VP5TH, WB2LWH/P/VP9, W5KUC, W8KYD, 4S7PB, 4X4UF, 6Y5EM, 9H1CB, TG9EP.

**D. Henbry** (Sussex), KW77, 7ft. vertical at 30ft., (that could be dangerous to a low-flying gull), skewered these on 80 s.s.b.—CP1GN, CT2AC, CT2AK, EA8HA, FP8AP, HK3WO, HV3SJ, KG4AS, KP4CL, MP4BFO, OD5FA, TG9EP, VP2SY, VP2VI, VS6DO, W5GC, WB2LWH/VP9, XE1KS, XW8BP, YV5BPG, ZB2BX, 4X4UF, 5Z4KL. On 40, David hooked—CT2AC, HC2HM, HK6BRK, YV1PW, YV4YC, XE1RRK.

**G. Jones** (Ayrshire), GR64, 88ft. end-fed, went s.s.b-ing on 80. Rewards include—CT1BH, CT2AK, GB2DX (?), PZ1DF, TA3MQ, VE1IE, VO1BD, VO1DE, VP1AAW, VP2VI, VP5TH, W1FRR, W5AEQ, XW8BP, 4S7PB, 4X4UH, 5Z4KL, 9H1BI, 3Z5BT.

**S. Ireland** (Kent), PW Clubman Mk II, 19-set variometer, 67ft. end-fed is also an l.f. enthusiast. Eighty produced — CT1VY, CO2FA, CR4BC, EA6BC, HC1RF, HK3BQM, HK3WO, HL1HN, HL1LLA, IS1DF, KG4AS, KP4CL, KZ5AE, LX1BW, OX5BJ, OA3KD, OA4ABK, TI9CE, TF5TP, scores of VE/VO/W including VE2BUP/P/VE1 on Prince Edward Is., VP2VI, VP2SY (St. Vincent), XE1KS, XE2IH, ZL4NH, ZM3LE, 9Y4MM.

No doubts about the l.f. end and v.h.f. sleuths are enthusiastic about the coming summer days, so it could be a bumper DX year.

**S. Cole** (Mon.), tells that ON4UN has worked over 200 countries since January 1969. Stephen claims 111 countries which include 9M, ZF, PY, 3V8 and VP9.

**A. Mercer** (Lancs.), no mention of a receiver or aerial so he must have mighty sensitive headphones. Twenty metres yielded—AC3DK, CN8MC, CR8AF, CRØRL, EP7BST, FG7US, KC4AA, LX1CV, MP4DDI, OA7AC, OX2EY/MM, PJ1HT, PY1AY, PZ1BC, SV1DK, TN2TJ, VK2XQ, VK7AV, VK7PN, VKØAN (Heard Is.), VP9VV, YA8RMO, YA5ZAR, YV5VX, ZS6SR, 4X4PZ, 6W8DY.

**A. Crooks** (Leics.), RA1 plus PR30, 45ft. end-fed, invaded twenty to discover—AC3PT (Sikkim), AX7DK, ET3USA, FP8CS (Miquelon Is.), HI8LA, JX3MN, OA4LM, OX3BE, OY3B, PY7AEW, SU1MA, TA2SC, VO1CU, W7EQB, YV5CRZ, ZB2BV, ZL3BQ.

On fifteen, Andy bagged—AX1JL, AX2AU, AX3ADO, AX4FD, AX6NM, C31AP (Andorra ?), EA8DZ, EP2JP, FG7TD, HT1HSM, IRØIJ, JW7UH, JX3MN, MP4TDA, SV1BX, TF2WKI, UAOBP, VE5TM, VP2MA, VP5GM (South Caicos Is.), VP7CG, VU2DK, W6LZV, YA1GNT, ZM3NS, 9N1RA.

**M. Bayes** (Surrey), 9R59DE, TV aerial (Cor, Peyton Place and ZLs), reports signals on fifteen from—AX2ADJ, AX2BAS, AX4UL, CE3FA, CT1UV, EA6BK, EA8HB, EA9EA, EL9BVZ, ET3RU, HC2GG/1, HR1WSG, IRØWRP, IT1SPI, JA1ISG, JA2GAR, JA3MNR, JA6DGN, JA7ECH, JA8ADJ, K2MKD/MM, KP4BCM, KZ5IT, LU3JS, LX1BW, OY1WP, SVØWII, TI2MGM, VE2DFY, VE3GEC, VE5TM, VE8EQI, VK2ASS, VK2FU, WA5ZUB, WB6IYK, 9G1GD, 9H1BH.

**P. Starling** (Essex), had a quick look around ten metres. His best include — K6UDR, OD5BZ, SVØWII, VE1ATJ, VE1QJ, VP2VI, YL9APB, 3V8AL, 9J2RQ.

**D. Robbins** (Warks.), CR70A superhet. plus 60ft. end-fed listened to s.s.b. from—HC2KF, HR2WTA, KZ5EK, LU2AHI, LU6DRB, SV1AB, VP9BK, W5NMF, W5RER, W6DLN, YV3AQ, ZC4JW, 6W8DY, 9H1BP.

**G. Richards** pens some strong words disagreeing with my comments about two metres. His best on this band to date are PAØCML and PAØWTE at distances of 300 and 410 miles respectively. Glyn uses a GC-1U, a JXK converter with an i.f. tuning 28-30MHz, and the aerial is a 120ft. long wire. He now has a four-over-four slot-fed yagi so things should improve. A listen on ten produced—K7TEG, VP7CG, WA6BVY/P/W6, WA6DLI, WA6GRQ, WA6UAG, WAØTOF, 9J2DT all s.s.b. On a.m.—UA9KMK, VE5VV, W7RSP, YV3MC.

"What about some six metre logs?" queries **F. Smales** (Yorks). This band is used by American amateurs and ranges from 50-54MHz. Using a National NC155 with a four-element broad-band beam, the following were logged on six metres—WA1BSR, W2ERV, W3FAU, W3FET, W4OGX, W4OSJ, W9EKP, W9BGX.

Still a large proportion of mail received asks about the various prefixes and where can a list be found. So, for all those who are thinking about asking the question, here's the answer. Send 1s 4d to the Radio Society of Great Britain, 35 Doughty Street, London, W.C.1., and ask for a "Countries List". Incidentally, it pays to get a new one each year, just to try to keep track of all the changes.

Goings on in April include: April 5th., 80 metre low power contest; 11-12th., 4 metre open contest; 19th., North Midlands Mobile Rally; 26th., DF qualifying event (good fun these if you like streaking about the countryside with a small d.f. portable).

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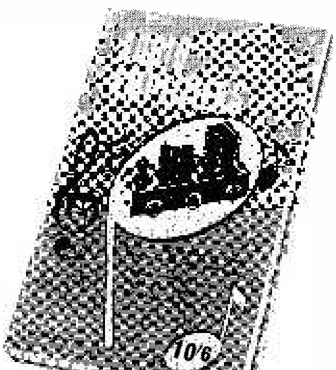


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## Number 7 — The R.C.A. CA3052 with 4 Amplifiers

THERE are many quality high power audio amplifiers on the market nowadays such as the Sanken SI-1020A model with a power output of 25 watts which may be purchased at a fairly reasonable price but they nearly all require an external preamplifier stage before they can be driven to their full output power. Very few microphones or pick-ups are capable of producing an output signal in the region of 300mV which is the usual level required for such amplifiers and so the constructor is faced with the problem of building a suitable preamplifier. Another consideration is the necessity for having more than one input facility and this together with the associated volume and tone controls very often make the preamplifier and mixer unit more expensive than the main amplifier.

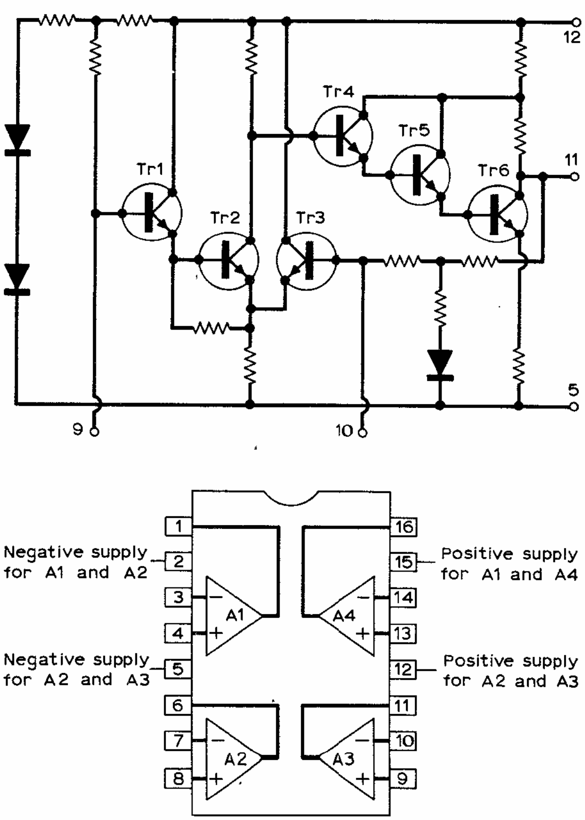



*Fig. 1 : top : Schematic diagram of a single amplifier.*
*bottom : Pin connections for the four amplifiers.*

One of the newer types of IC's recently released by RCA, CA3052, provides in a 16 lead dual-in-line package four independent A.C. amplifiers. A schematic diagram showing one of the amplifiers is given in Fig. 1 together with a block diagram indicating the pin configuration of the various amplifiers. It can be seen by referring to Fig. 1 that a choice of input impedances is provided. By feeding the input signal to the Darlington pair Tr1, Tr2 via pin 9, a medium input impedance of about 90kΩ is obtained while alternately pin 10 offers an input impedance in the region of 50Ω. The amplified signal appearing at the collector of Tr2 is further amplified by Tr4, Tr5 and Tr6 with the output taken from pin 11, the collector of Tr6, via an external capacitor. A degree of negative feedback is applied to the base of Tr3 by the resistor chain from pin 11.

### Tone Control Unit

Ideally tone control circuits should be placed, electronically speaking, as close to the loudspeaker as possible but in actual practice this is impossible as the main amplifier would need to handle all input signals without overloading. Most quality amplifiers compromise and place volume and tone control circuits after the preamplifier stage. The CA3052 provides this facility for the constructor who wishes to make a high quality stereo preamplifier with a signal to noise ratio greater than 70dB. Fig. 2 gives the theoretical diagram and component values for one channel. Two amplifiers are used in each channel since the equalisation and tone control circuits reduce the overall gain of the first stage by about 30dB.

### Mixer Unit

The average constructor, however, is not concerned with looking for such high quality reproduction and would consider the use of the two preamplifiers as rather wasteful. To locate the volume and tone controls at the input to the amplifier will be quite adequate and a signal to noise ratio of about 50dB obtainable by this mode of operation is acceptable. Consequently, each amplifier can then be utilised separately to provide a four-channel mixer. Used in this way only a handful of passive components

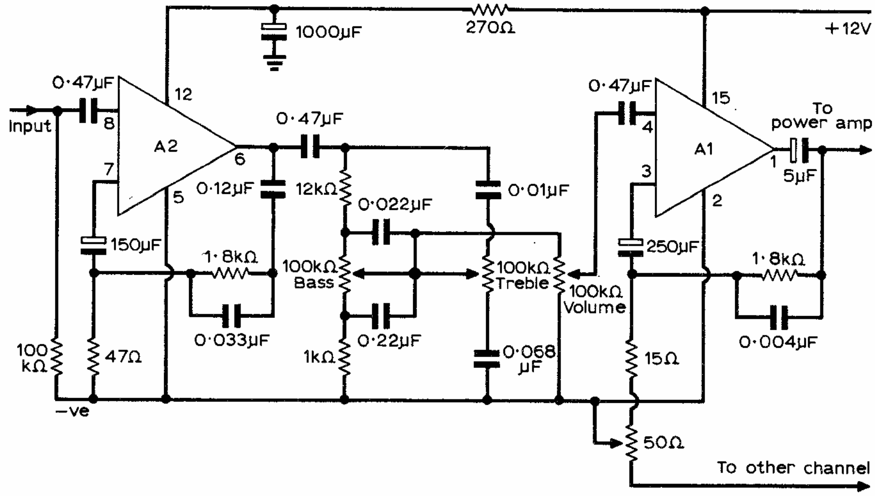



*Fig. 2: Circuit for a tone control unit utilising two of the amplifiers for one channel of a stereo preamplifier.*

is required for each amplifier and a reasonable quality four-channel mixer can be built for under £4. Fig. 3.

Another interesting feature of the CA3052 is its use as a tremolo unit as shown in Fig.4. The tremolo effect is obtained by amplitude modulating

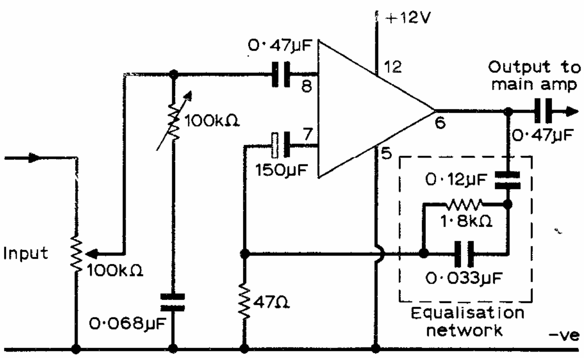



*Fig. 3 : One channel of a four channel mixer.*

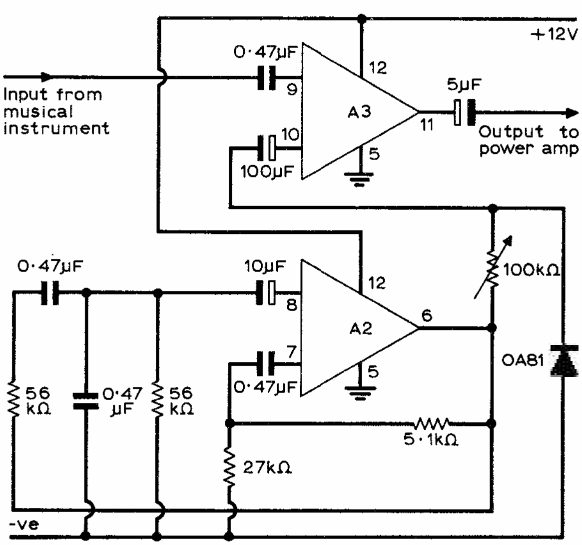



*Fig. 4 : Circuit for a tremolo unit.*

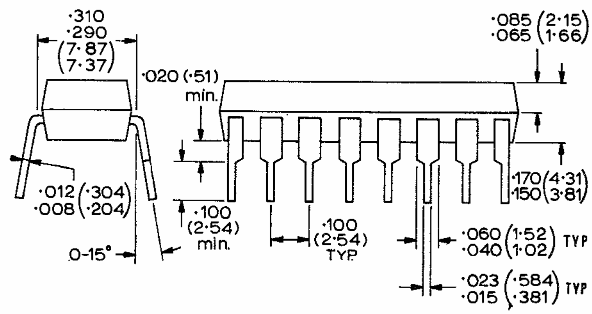



*Fig. 5 : Outline dimensions of the i.c.*

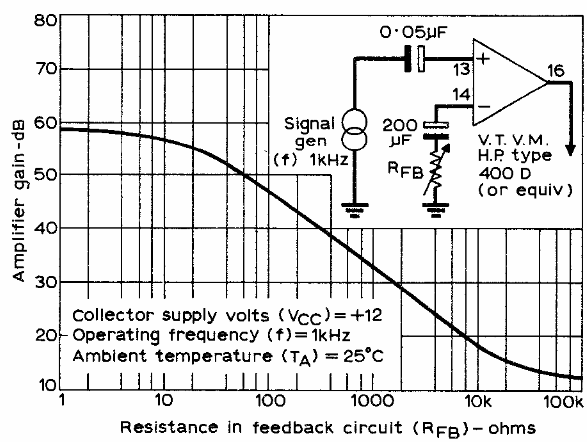



*Fig. 6 : Graph showing variation of gain with change in feedback resistance.*

the signal from a musical instrument at a very low frequency, typically under 10Hz. In the diagram amplifier No. 2 is used as a Wien bridge oscillator running at a frequency of 5Hz. Its output is fed through a 100kΩ variable resistor acting as a modulation depth control, to the preamplifier stage No. 3. The output is taken to the power amplifier through the 5µF capacitor. This arrangement can, of course, be duplicated with the other two amplifiers in the IC or they can be used as two independent amplifiers. ■

*If you have difficulty in obtaining*

**PRACTICAL WIRELESS**

*Please place a regular order with your newsagent or send 1 year's subscription (£2-5-0) to Subscription Department, Practical Wireless, Tower House, Southampton St., London, W.C.2.*

# P.W. GUIDE TO COMPONENTS

PART 17

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

## INTEGRATED CIRCUITS

*(continued)*

### Design Limitations

MOST active devices can be produced in integrated circuit form and indeed many integrated circuit f.e.t. and m.o.s.t. devices are on the market. All the specialist devices discussed in parts 5, 6, 11, 12, 13 and 14 of this series can be fabricated and many are.

Monolithic circuits have resulted in new design techniques due in part to the method of isolating components which automatically incorporate parasitic resistors and capacitors. Also the limitations in component values—particularly inductors—considerably reduce design flexibility. Initially design is carried out from basic, known circuits with parasitic elements included. Very often this design is analysed by computers and studied at a breadboard stage. In order to give cost effectiveness a minimum die size must result in order to give maximum yield per wafer.

Now die size depends largely on component values since a high value capacitor requires a large surface area, as does a high value resistor. In fact the area required for one transistor is roughly equivalent to that required for a resistor of 500Ω to 1.5kΩ or a capacitor of 3 to 6pF. A typical discrete circuit may require, say, 27Ω for base bias and 100 pF for feedback etc. In terms of die size required these components would accupy the area equivalent to 25-30 and 20 transistors respectively. In consequence design is regulated by a primary requirement to use active components as much as possible. A circuit containing two low value resistors and 20 transistors is therefore considerably smaller than one containing one high value resistor and one or two transistors. It is for this reason that seemingly complicated multi-transistor circuits—such as the JK flip flop discussed later—are produced.

Two further basic design rules are followed: resistor ratios are used in preference to single resistors in order to reduce tolerances from ±10% to ±3% as discussed earlier; also matched pairs of transistors are used since true matching can be achieved and hence temperature and other effects can be minimised. These design principles are illustrated in the circuit for an operational amplifier discussed later.

### Parasitic Components

Parasitic components are also fundamental in design consideration. As illustrated in Fig. 8 isolation is achieved by reverse biased diodes which have associated capacitance and leakage resistance paths. In this case each capacitance is directly across the output and can considerably reduce the overall frequency response. In addition feedback and modulation effects can occur through the capacitance varying with changing bias levels.

Figure 11 illustrates the parasitic elements associated with the diffused resistor structure shown in Fig. 9. Again capacitance will reduce frequency response and must be carefully taken into account in the basic design. Other design limitations include crosstalk from interconnecting leads and p-n-p-n (Thyristor) switching action. However, good design and layout can usually reduce all these effects at least to the levels associated with discrete component circuits.

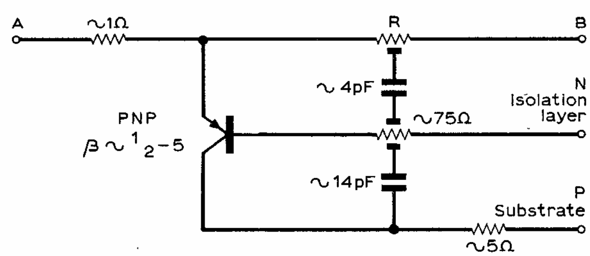



*Fig. 11: Parasitic elements of diffused resistor structure.*

### Using Monolithic IC's

The previous discussion has shown how monolithic integrated circuits are fabricated and some of the reasons for the seemingly peculiar circuits which result. In the light of this knowledge let us examine the rules associated with the use of such components.

Initially it will be appreciated that they are essentially low power, low dissipation assemblies. At no stage should the loads to such circuits be exceeded since localised overheating could result. Generally the supply voltages are limited to around 6V and the reason for this relatively low voltage is generally the breakdown characteristics of the isolation diodes

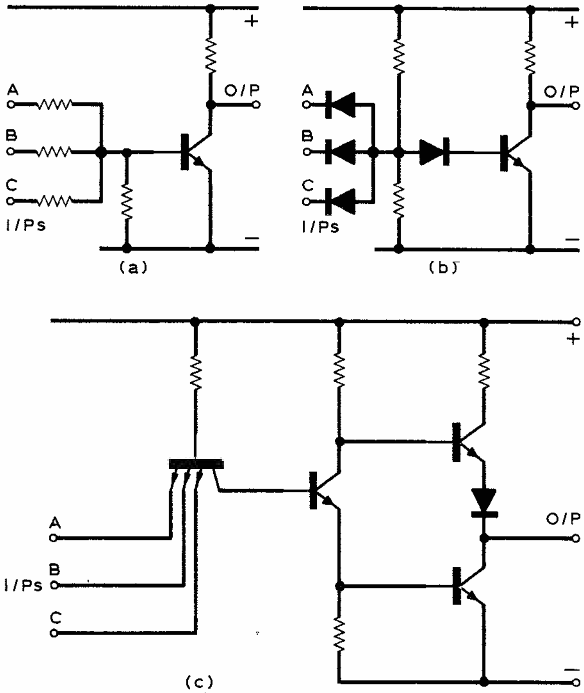


*Fig. 12: Three typical logic systems.*

—coupled with maximum power dissipation in resistive elements. Commonly the supply voltage is directly connected to the substrate but, if not, care should be taken to ensure that it is connected to the highest supply potential in order to eliminate loss of isolation or p-n-p-n switching action taking place. Interfaces between integrated circuits and other mechanisms or circuits should always be within the voltage and current ratings of the device.

Having emphasised the limitations let us consider the advantages of using integrated circuits. They are small—but this is not an advantage to everyone. They are extremely reliable, and this is a very considerable advantage in many fields. They are complete, in that they can perform the entire specification of some requirements. They are cheap—this at first seems rather hasty but relative to the cost of design and development or even the construction of equivalent circuits they are very often cheaper substitutes.

## Digital Devices

Digital devices are designed to operate in switching logic circuits. Generally they are derived from transistors operating in two stable states, "off" and "on" (fully saturated). They are many ways of applying potentials to a transistor in order to change its state from fully on to off and as a result there are many forms of logic available. The three most common logic systems are illustrated in Fig. 12 and each of these circuits represents what is known as a three input gate.

Figure 12(a) shows the schematic of a resistor transistor logic (RTL) gate and the circuit is often referred to as a NOR (NOT OR) gate. The NOR terminology is derived from its operation—since if input A *or* B *or* C is connected to the positive rail then the transistor conducts and produces a negative (i.e. NOT positive) potential at the output. Fig. 12(b) illustrates a different bias system known as diode transistor logic (DTL) and this circuit is commonly referred to as a NAND gate. Again the terminology is derived from its operation since if inputs A *and* B *and* C are connected to the positive rail the output is negative (NOT +). Fig. 12(c) shows a transistor transistor logic (TTL or T²L) circuit which is also a NAND gate. It follows therefore that only DTL and TTL circuits are interchangeable.

Many other logic forms are available but these three are by far the most common. RTL was the first system and is generally a direct replacement of discrete component modules used in computers. DTL was produced at roughly the same time but TTL is relatively new and is superior in speed of operation over DTL. At present it would seem that TTL is the form most likely to be used in the future.

A typical family of gates is shown in Table 1 together with costs for the three logic systems. Most of us will continue to think of these gates in terms of the basic circuit but for complex circuits logic symbols are used and these are illustrated in the table. Many other digital circuits are available such as monostables, normal or Set Reset (RS) bistables, expanding circuits, driver units, etc. Most can how-

| Function | Symbol | Costs | | |
|---|---|---|---|---|
| | | RTL | DTL | TTL |
| Single 8 input gate | & NAND 1 off | 20/- to 35/- | 15/- to 30/- | 20/- to 40/- |
| Dual 4 input gate | & NAND 2 off | " | " | " |
| Triple 3 input gate | NOR 3 off | " | " | " |
| Quad 2 input gate | NOR 4 off | " | " | " |
| JK Flip flop | R J T K S Input; Q $\bar{Q}$ Output | 40/- to 60/- | 25/- to 50/- | 15/- to 40/- |

Note All RTL gates are NOR symbol and all DTL or TTL gates are NAND

*Table 1: Typical gates and their average costs.*

*—continued on page 69*

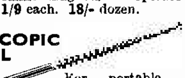
## FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. **19/6.** Kit B—30-40 w. **19/6.** Kit C—80 w. **23/6.** Kit E—65 w. **19/6.** Kit MF1 is for 6in., 9 in. and 12in. miniature tubes, **19/6.** Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

## REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:
**Miniature.** 1in. long × approximately ⅛in. diameter. Will make and break up to ½A up to 300 volts. Price **2/6** each. **24/-** dozen.
**Standard.** 2in long × 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price **2/-** each. **18/-** per dozen.
**Flat.** Flat type, 2in. long, just over 1/16in. thick, approximately ¼in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price **6/-** each. **£3** per dozen.
Small ceramic magnets to operate these reed switches **1/9** each. **18/-** dozen.

## TELESCOPIC AERIAL



For portable, car radio or transmitter. Chrome plated—six sections, extends from 7¼ to 47in. Hole in bottom for 6BA screw. **7/6**

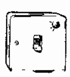
## TOGGLE SWITCH

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

## MINIATURE EAR PIECE

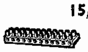
As used with imported pocket radios 1/6 each **15/-** doz.

## ISOLATION SWITCH



20 Amp D.P. 250 volts. Ideal to control Water Heater or any other appliance. Neon indicator shows when current is on, **4/6.** **48/-** per dozen.

## 15/20 AMP CONNECTORS



Polythene insulated 12-way strip. **2/6** each, **24/-** doz.

## 13 AMP FUSED SWITCH

Made by G.E.C. For connecting water heater etc., into 13 amp ring main. Flush type **3/6** each, **30/-** doz. Metal boxes for surface mounting **1/6** each, **15/-** doz.

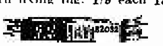
## MICRO SWITCH

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

## SUPPRESSOR CONDENSER TCC

1 mfd. 250v. A.C. working, metal cased with fixing lug. 1/9 each 18/ doz.

## REED RELAY



Glass encapsulated reed switch in 24-volt solenoid, neatly enclosed in neat metal case, size 2¼in. × ⅝in. × ½in. **3/6** each. Operates from 24 volts D.C. or from A.C. mains using rectifier, resistor and condenser (**3/6** extra).

## SHEET PAXOLIN

Ideal for transistor projects, panels 12in. × 6in.. **1/9** each, **15/-** per dozen.

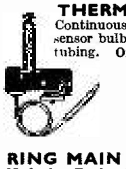
## G.E.C. MULTIPLE SWITCHES

Metal boxes (with cable knockouts) sprayed silver with cover and switch mounting grid. For 12 switches **6/-**, 6 switches **5/-**, 4 switches **4/-**, 2 switches **3/6.**

## G.E.C. Clipper Switches

For the above boxes, 5 amp A.C. rating, one-way **1/6**, 2-way **2/-**, Bell push **2/-**, intermediate **2/6**, secret **2/6**, 15 amp one-way **2/6.**

## THERMOSTAT



Continuously variable 30°-90°C. Has sensor bulb connected by 33in. of flexible tubing. On operation 15 amp 250 volt switch is opened and in addition a plunger moves through approx. ⅛in. This could be used to open valve on ventilator etc. **29/6** plus 4/6 p. & ins.

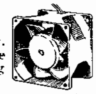
## RING MAIN JUNCTION BOXES

Made by Rock. This won Designs Award for making quick and neat junctions in 9.029 twin and earthed cable as used for ring main circuits. Our price **1/6** each, **15/-** per dozen.

## 15, 30 & 100 WATT HI-FI SPEAKERS

**FULL FI 12 INCH LOUDSPEAKER.** This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—Specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5⅜in. A £6 speaker offered for only **£3.19.6** plus 7/6 p. & p. Don't miss this offer. 15in. 25 watt **£7.19.6** 18in. 100 watt **£19.10.0.**

## MINIATURE EXTRACTOR FAN



Beautifully made by famous German Company. PAPST System, 230/240 A.C. Mains operated, size 3½in. × 3½in. × 2in. Made for instrument cooling but ideal to incorporate in a cooker hood, etc. **65/-** P. & p. 2/9.

## DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplier complete with 7 feet of heavy cable wired up, ready to work **39/6** less plug, **45/-** with fitted 13 amp plug. **47/6** with fitted 15 amp plug. plus 4/6 post & insurance.

## STANDARD WAFER SWITCHES

Standard Size 1½ wafer—silver plated 5 amp contact standard ¼" spindle 2". long—with locking washer and nut.

| No of Poles | 2 way | 3 way | 4 way | 5 way | 6 way | 8 way | 10 way | 12 way |
|---|---|---|---|---|---|---|---|---|
| 1 pole | 6/6 | 6/6 | 6/6 | 6/6 | 6/6 | 6/6 | 6/6 | 6/6 |
| 2 poles | 6/6 | 6/6 | 6/6 | 6/6 | 6/6 | 6/6 | 10/6 | 10/6 |
| 3 poles | 6/6 | 6/6 | 6/6 | 6/6 | 10/6 | 10/6 | 14/6 | 14/6 |
| 4 poles | 6/6 | 6/6 | 6/6 | 10/6 | 10/6 | 10/6 | 18/6 | 18/6 |
| 5 poles | 6/6 | 6/6 | 10/6 | 10/6 | 14/6 | 14/6 | 22/6 | 22/6 |
| 6 poles | 6/6 | 10/6 | 10/6 | 10/6 | 14/6 | 14/6 | 26/6 | 26/6 |
| 7 poles | 6/6 | 10/6 | 10/6 | 14/6 | 18/6 | 18/6 | 30/6 | 30/6 |
| 8 poles | 10/6 | 10/6 | 10/6 | 14/6 | 18/6 | 18/6 | 34/6 | 34/6 |
| 9 poles | 10/6 | 10/6 | 14/6 | 14/6 | 22/6 | 22/6 | 38/6 | 38/6 |
| 10 poles | 10/6 | 10/6 | 14/6 | 18/6 | 22/6 | 22/6 | 42/6 | 42/6 |
| 11 poles | 10/6 | 14/6 | 14/6 | 18/6 | 26/6 | 26/6 | 46/6 | 46/6 |
| 12 poles | 10/6 | 14/6 | 14/6 | 18/6 | 26/6 | 26/6 | 50/6 | 50/6 |

## THIS MONTHS SNIP

A parcel of integrated circuits made by the famous Plessey Company. A once in a lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first grade device definitely not sub-standard or seconds. The ICs are all single silicon chip General Purpose Amplifiers. Regular price of which is well over £1 each. Full circuit details of the ICs are included and in addition you will receive a list of 50 different ICs available at bargain prices **5s.** upwards with circuits and technical data of each. Complete parcel only **£1** post paid or List and all technical data.

## 1 WATT AMPLIFIER & PRE-AMP

5 transistors—highly efficient, made for use with tapehead G4 but equally suitable for microphone or pick up—limited quantity **29/6** Full circuit diag. also shows tape controls 5/-

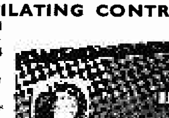
## VARIAC CONTROLLERS

With these you can vary the voltage applied to your circuit from zero to full mains without generating undue heat. One obvious application therefore is to dim lighting. We offer a range of these, ex-equipment but little used and in every way as good as new. Any not so, will be exchanged or cash refunded.
2 amp **£4.19.6.** 5 amp **£7.19.6.** 8 amp **£12.19.6.** 10 a,mp **£15.19.6.**

## HOUR COUNTERS

If you wish to know how long your equipment has been switched on then this is what you need. Counts running time up to 999 hours. Resettable 3in. dial. 50 c/s mains operation. **49/6** plus **3/6** post and insurance. Resettable type **69/6** plus **3/6** p. & i.

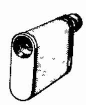
## THE PECTRON HEATING/VENTILATING CONTROL



This neat unit contains all the controls needed for a gas-fired central heating system as follows:—
(*a*) A clock switch giving 2 on/off periods per 24 hours.
(*b*) A thermal delay switch to prevent cold air being blown while fire warms up.
(*c*) Auto transformer to vary voltage and thus control fan speed.
(*d*) A 24-volt transformer to provide the low voltage necessary to operate solenoid of gas valve.
(*e*) A changeover switch to bypass the clock.
(*f*) Changeover switch to cut off heat so allowing cold air to be blown for Summer ventilation.
(*g*) Neon indicator and fuses.
The unit has a circuit diagram and five leads labelled "Mains," "Fan," "Thermostat 1," "Thermostat 2," "Gas valve," **£5.19.6** plus 4/6 postage and insurance.

See in the dark

## INFRA RED MONOSCOPE



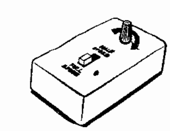
This equipment is complete and portable. Basically it consists of an infra red image converter tube with optical lenses for focusing the image and a Zambini pile to provide the necessary E.H.T. The monoscope is housed in a hide case size 9 × 6 × 4in. approx. Made originally for the army for night observations, sniping etc.. this equipment has many scientific and practical applications; a limited quantity only is available in original sealed carton. Price **£9.19.6**
NOTE. Although unused in fact still in original sealed cartons. The equipment is approx. 25 years old and consequently the Zambini pile may not be operating. Drying out might help but a better idea might be to replace it with a battery operated power unit; there is plenty of room

## MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **3/6** each. **36/-** dozen, your assortment.

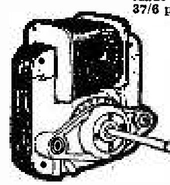
**WATERPROOF HEATING ELEMENT**
26 yards length 70W. Self-regulating temperature control. **10/-** post free.

## DRILL CONTROLLER



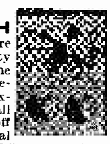
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions **19/6**, plus 2/6 post and insurance. Made up model also available **37/6** plus 2/6 p. & p.

## MAINS MOTOR



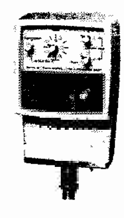
Precision made — as used in record decks and tape recorders — ideal also for extractor fans, blower, heater, etc. New and perfect. Snip at **9/6.** Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

## ELECTRIC CLOCK WITH 25 AMP SWITCH



Made by Smith's, these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **39/6**, less than the value of the clock alone—post and insurance 2/9.

## COOKER CLOCK with Temperature Control



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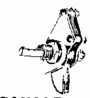

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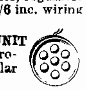

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| 600 | 3/3 | 6/9 | 9/- | 37/- |
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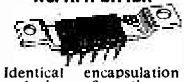
Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

## I.C. AMPLIFIER



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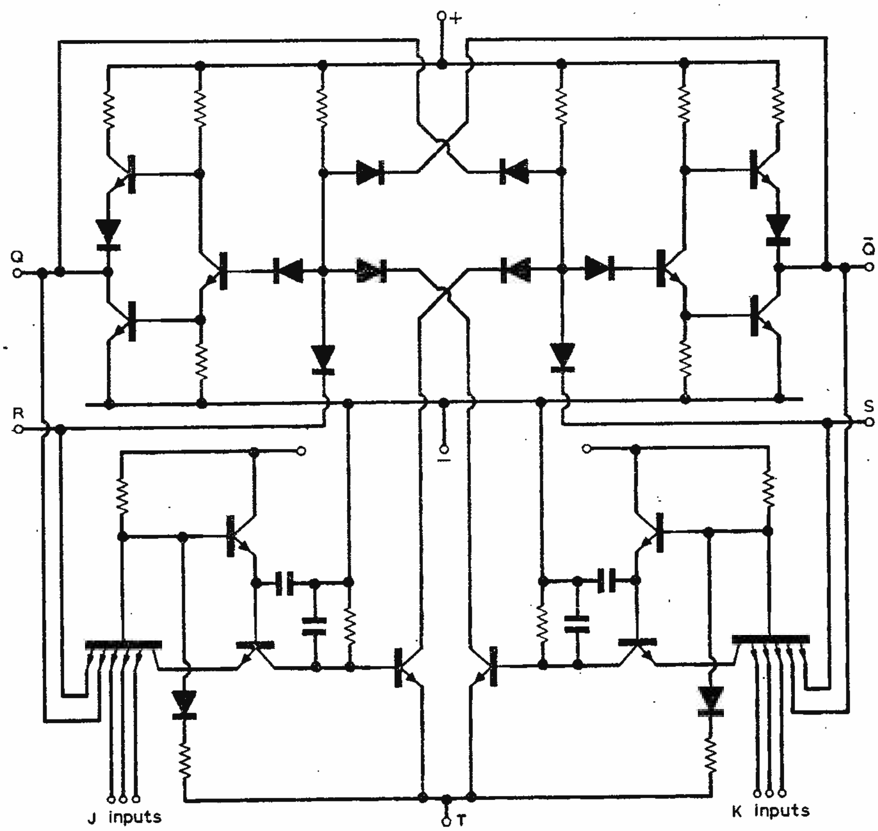



*Fig. 13: Left: Circuit of a JK flip-flop. Note the number of components contained in this relatively inexpensive device.*

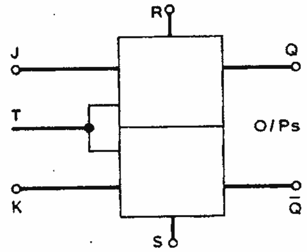



*Fig. 14: Block diagram of Fig. 13: to facilitate understanding the operation of the flip-flop circuit.*

*—continued from page 66*

ever be built up from the basic gate units and additional discrete components.

Currently, very much more sophisticated binary circuits have appeared such as complete decade counters, code changing circuits, shift registers and half adders. Although at present they are expensive the space saving and reliability very often outweigh this consideration. In addition f.e.t. and m.o.s.t. binary elements are now available and although expensive they have advantages in terms of noise immunity; power requirements, speed of operation and feedback.

In order to illustrate the circuit complexity which can be achieved in a relatively inexpensive device the circuit of a JK flip flop is shown in Fig. 13. This device illustrates the advantages derived from using many active elements in preference to passive components. It is also a device which is often misunderstood because of the terminology (JK) used to describe it. Because of the circuit complexity—which contains two cross connected bistables—it is preferable to refer to the block diagram shown in Fig. 14. The circuit has five inputs T, J, K, R and S as well as the two outputs Q and Q.

T is the trigger or clock pulse input whilst the other inputs inhibit or direct the bistable. If the R or S inputs are activated then the bistable is held in a fixed state until the input is released. If the J or K inputs are operated then the bistable will change when the clock pulse occurs. Hence a delayed pulse on the J or K inputs can be retimed at the bistable output by the system timing sequence at T. The JK flip flop can therefore be used as a divide by two binary or a retiming circuit.

## Encapsulations

Unlike a great many other semiconductor devices the encapsulations used for integrated circuits have been standardised. The three main encapsulations are: the 10- or 12-terminal TO-5 casing shown in Fig. 15; the flat pack illustrated in Fig. 16; and the dual in-line package shown in Fig. 17. Fig. 15 also shows a typical chip with interconnections. In all cases the numbering is standard and in a very large number of cases the terminals used for supply

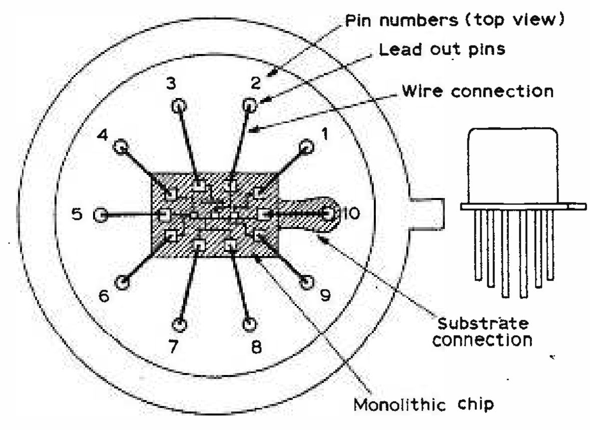



*Fig. 15: TO-5 encapsulation and typical chip interconnections.*

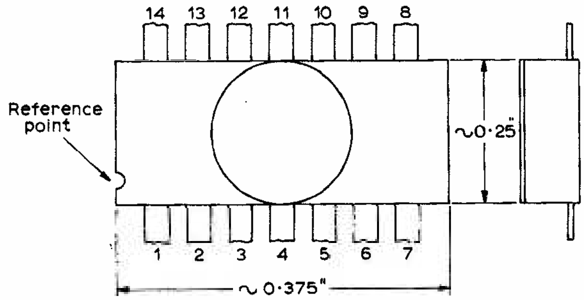



*Fig. 16: Flat pack outline.*

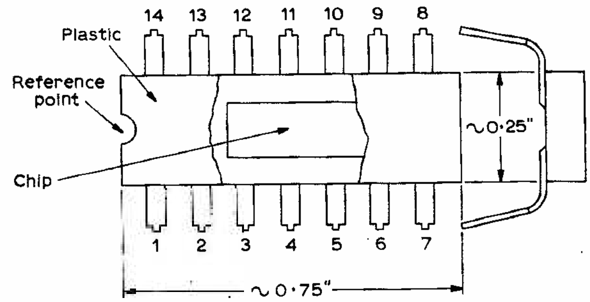



*Fig. 17: Dual in-line package outline.*

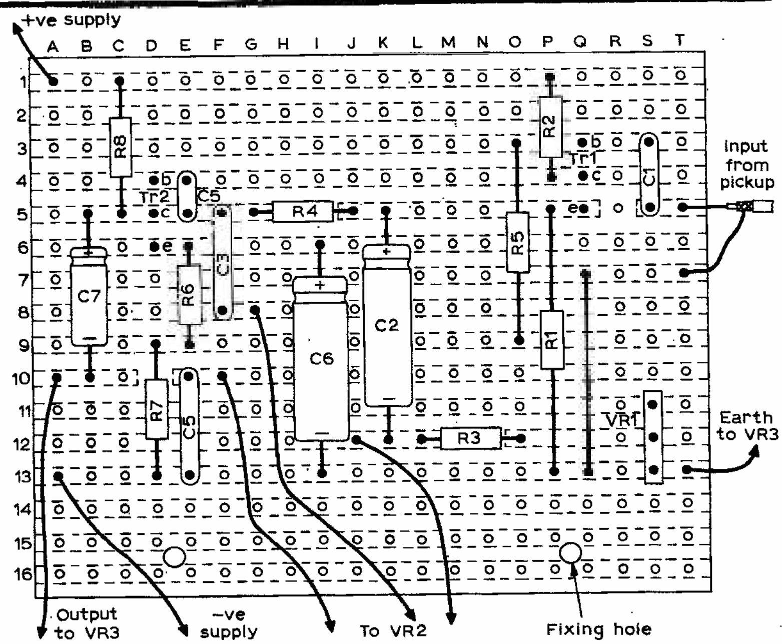
voltages and polarities are common.

Both the flat pack and dual in-line packages are available with ceramic mouldings when used for high frequency circuits, but in general epoxy resin is used. Although the TO-5 can is still the most widely used encapsulation it is rapidly being superseded by the plastic dual in-line package. The plastic package has resulted in a cheaper encapsulation and the dual in-line structure has the added advantage that it can be plugged directly into a socket. As a word of warning however it must be emphasised that dual in-line sockets are expensive (about 30/-) and are in consequence often dearer than the integrated circuit.

**TO BE CONTINUED**

# PW STEEL GUITAR

## Alternative Construction for Preamplifier




READERS building the *Practical Wireless* Pedal Steel Guitar described in the November, December (1969) and January (1970) issues may prefer to assemble the preamplifier on Veroboard rather than plain pin-board, which makes for a tidier layout and some simplification of construction. A prototype Veroboard preamplifier has been built and the layout is given in the accompanying diagram.

A sheet of 0·15in. matrix Veroboard with copper strips, 20 holes long by 16 holes wide (2½in.) is required, and any larger size can easily be cut to size with sidecutters. To ensure that everything will fit into the space shown it is suggested that constructors endeavour to obtain the following components, which are described a little more fully than in the Components and Materials table (Part 2), and in most cases differ.

All resistors are ⅛th watt hi-stabs, which are quite freely available from the larger suppliers. C1 is a 0·05μF Mylar (Japanese, green), while C3 and C4 are 0·01μF and 0·022μF Mullard polyester ("candy-stripe"). The electrolytics are Mullard (blue): C2, 100μF 4V; C6, 80μF 16V; C7, 10μF 16V; C5 is an ultra-miniature ceramic with side leads. VR2 and VR3 are not critical, but VR1 is a miniature 5kΩ skeleton preset with 0·15in. lead spacings. Tr1 and Tr2 are BC169s, which is the cheaper plastic encapsulated version of the BC109. They are not, however, physically interchangeable, because the lead order is different.

Construction is very easy, only four strips needing to be broken. One bridging wire is needed from Q7 to Q13, so that the braid from the pickup coax can be anchored close to the input point. The board will mount straight onto the original board fixing holes if the drilling positions on the layout drawing are followed. ■

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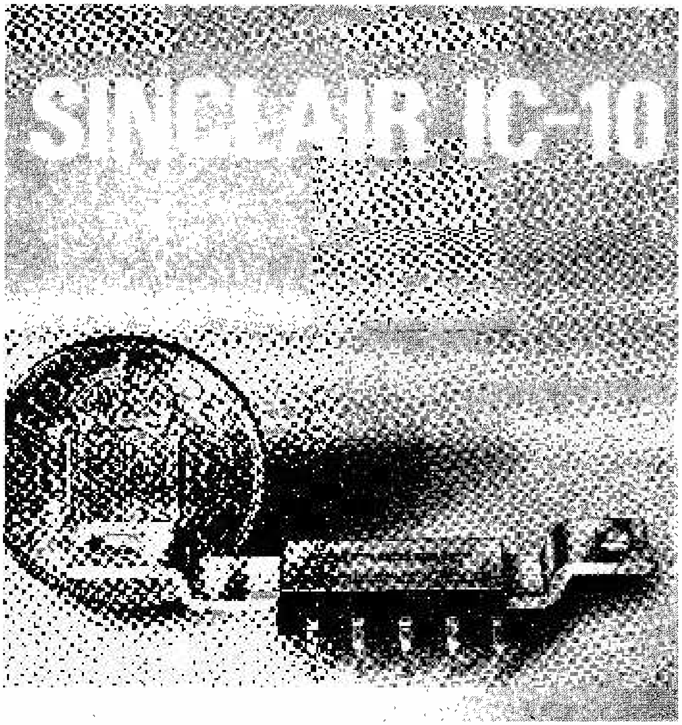
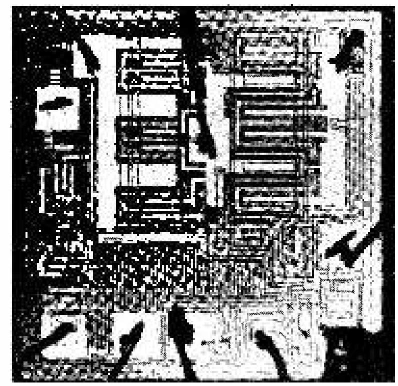



# MONOLITHIC INTEGRATED CIRCUIT HIGH FIDELITY AMPLIFIER AND PRE-AMP



## the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output of 5 watts R.M.S. (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 Zener diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of such components as tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs, servo amplifiers (it is d.c. coupled throughout) etc. The photographic masks required as part of the process of producing monolithic I.Cs are expensive but once made, the circuits can be produced with complete uniformity and at very low cost. This enables us to cover every IC-10 with the Sinclair guarantee of reliability.

### ■ SPECIFICATIONS

| | |
|---|---|
| Output | 10 Watts peak, 5 Watts R.M.S. continuous. |
| Frequency response | 5 Hz to 100 KHz$\pm$1dB. |
| Total harmonic distortion | Less than 1% at full output. |
| Load impedance | 3 to 15 ohms. |
| Power gain | 110dB (100,000,000,000 times) total. |
| Supply voltage | 8 to 18 volts. |
| Size | 1 $\times$ 0.4 $\times$ 0.2 inches. |
| Sensitivity | 5mV. |
| Input impedance | Adjustable externally up to 2.5 M ohms. |

### ■ CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback is used round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

### ■ APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

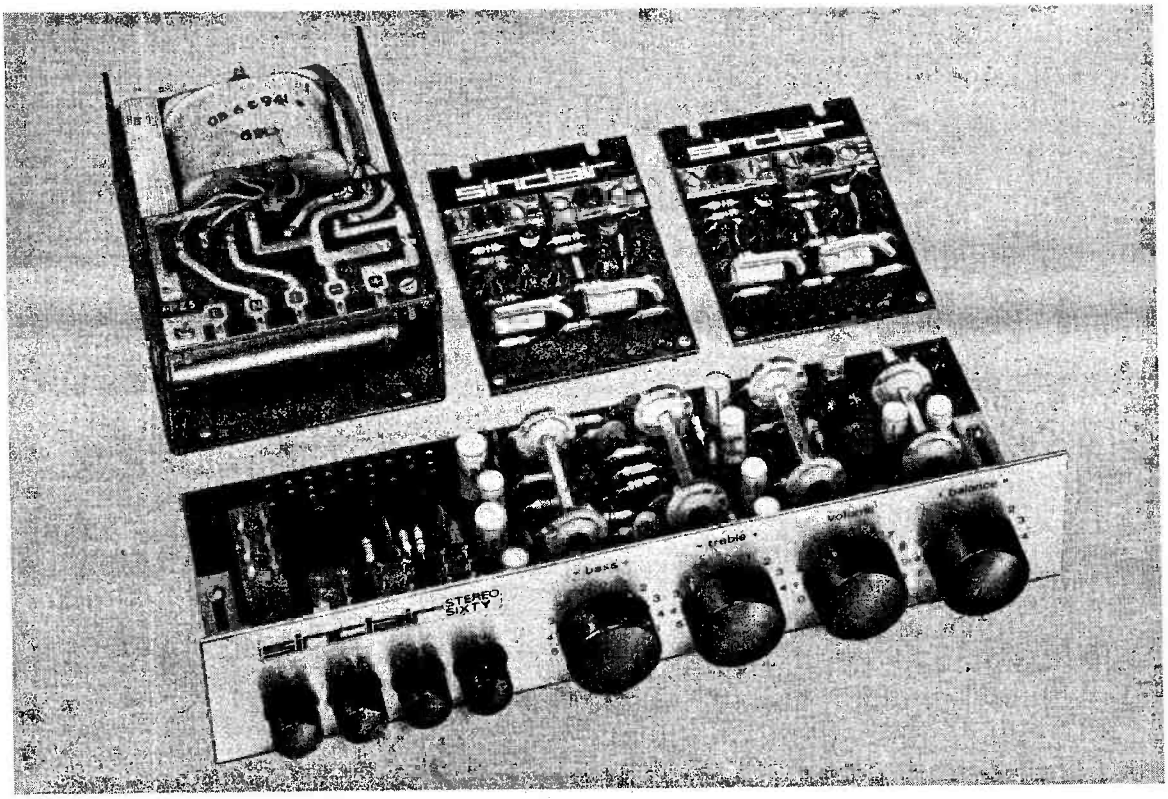
**SINCLAIR**

**IC.10** *with IC.10 manual* **59/6**

**POST FREE**

sinclair

**SINCLAIR RADIONICS LIMITED**
**22 NEWMARKET ROAD · CAMBRIDGE**




# Project 60 an exciting alternative

The buyer of an amplifier today has a remarkably wide variety to choose from. It is unlikely that a purchaser would have real difficulty in finding a unit that met all his requirements, although the price might not be as low as could be wished. The only snags are that one's needs can change and that the technically correct amplifier may be physically inconvenient. If you are confident that there is an amplifier available, of the right size and price, which will meet all your needs for the forseeable future, then that is your best buy. If not, however, we can offer you another possibility which we believe to be an exciting alternative approach. That alternative is **Project 60.**

Project 60 is a range of modules which connect together simply to form a complete stereo amplifier with really excellent performance. So good, in fact, that only 2 or 3 amplifiers in the world can compare with it in overall performance.

The modules are: **1.** The Z-30 high gain power amplifier, which is an immensely flexible unit in its own right. **2.** The Stereo 60 preamplifier and control unit. **3.** The PZ.5 and PZ.6 power supplies. A complete system comprises two Z-30's, one Stereo-60 and a PZ-5 or PZ-6. The power supplies differ in that the PZ-6 is stabilised whilst the PZ-5 is not. This means that the former should be used where the highest possible continuous sine wave rating is required. In a normal domestic application there will not be a significant difference between using either power unit unless loudspeakers of very low efficiency are being used.

In view of the very high performance of an amplifier system built with Project 60 modules, the cost may seem surprisingly low. There are two reasons for this: Firstly, we are the largest producers of this type of module in Europe and we are able therefore to use highly efficient production methods. Secondly, you are not paying for a cabinet which you may not require anyway.

All you need to assemble your system is a screwdriver and a soldering iron. No technical skill or knowledge whatsoever is required and, in the unlikely event of you hitting a problem, our customer service and advice department will put the matter right promptly and willingly.

Project 60 modules have been carefully designed to fit easily into virtually every type of plinth or cabinet to provide a complete unit of great compactness. Only holes have to be drilled into the wood of the plinth and any slight slips here will be covered completely by the aluminium front panel of the Stereo 60. The Project 60 manual gives all the instructions you can possibly want clearly and concisely.

Perhaps the greatest beauty of the system is that it is not only flexible now but will remain so in the future. We shall shortly be introducing additional modules which will include a comprehensive filter unit, a stereo F.M. tuner and an even more powerful amplifier for very large systems. These and all other modules we introduce will be compatible with those shown here and may be added to your system at any time.

sinclair

**SINCLAIR RADIONICS LIMITED**
**22 NEWMARKET ROAD, CAMBRIDGE** **Tel: 0223 52731**

# Z.30 TWENTY WATT R.M.S. (40 WATT PEAK) HIGH FIDELITY POWER AMPLIFIER

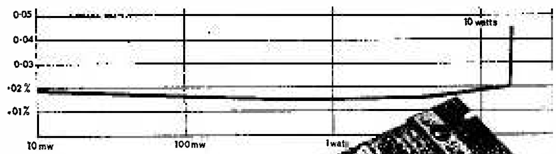
The Z.30 is a complete power amplifier of very advanced design employing 9 silicon epitaxial planar transistors. Total harmonic distortion is incredibly low being only 0.02% at full output and all lower outputs. As far as we know, no other high fidelity amplifier made can match this specification, no matter what the price. Thus you can be utterly certain that your Project 60 system will do full justice to your other equipment however good it may be. The Z.30 is unique in that it will operate perfectly, without adjustment, from any power supply from 8 to 35 volts. It also has sufficient gain to operate directly from a crystal pickup. So in addition to its use in a high fidelity system you can use a Z.30 to advantage in your car or a battery operated gramophone for your children, for example. These, and many other applications of the Z.30 are covered in the manual of circuits and instructions supplied with every Z.30 high fidelity power amplifier.

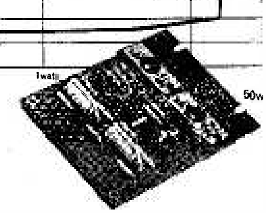
## SPECIFICATIONS

**Power output**—15 watts R.M.S. into 8 ohms using a 35 volt supply: 20 watts R.M.S. into 3 ohms using a 30 volt supply.
**Output**—Class AB.

| | |
|---|---|
| **Frequency response:** | 30 to 300,000 Hz ± 1dB. |
| **Distortion:** | 0.02% total harmonic distortion at full output into 8 ohms and at all lower output levels. |
| **Signal-to-noise ratio:** | better than 70dB unweighted. |
| **Input sensitivity:** | 250mV into 100Kohms. |
| **Damping factor:** | > 500. |
| **Loudspeaker Impedances:** | 3 to 15 ohms. |
| **Power requirements:** | From 8 to 35 V.d.c.(The Z.30 will operate ideally from batteries if required.) |
| **Size:** | 3½ × 2¼ × ½ inches. |

**APPLICATIONS**
Hi-fi amplifier; car radio amplifier; record player amplifier fed directly from pick-up; intercom; electronic music and instuments; P.A.; laboratory work etc. Full details for these and many other applications are given in the manual supplied with the Z.30.



*Power versus distortion curve of Sinclair Z.30 amplifier*

**Z.30**
*Built, tested and guaranteed, with circuits and instructions manual*

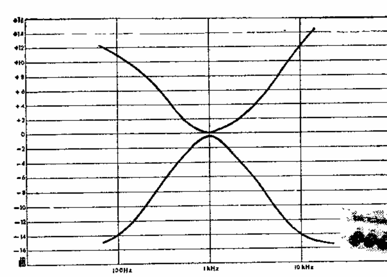
**89/6**

# STEREO SIXTY PREAMPLIFIER AND CONTROL UNIT

The Stereo 60 is a stereo preamplifier and control unit designed for the Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout and great attention has been paid to achieving a really high signal-to-noise ratio and excellent tracking between the two channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

## SPECIFICATIONS

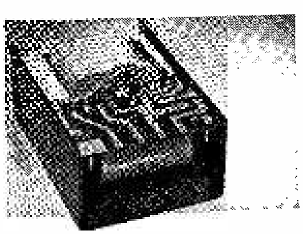
- Input sensitivities—Radio—up to 3mV Magnetic Pickup—3mV: correct to R.I.A.A. curve ± 1dB; 20 to 25,000 Hz. Ceramic Pickup—up to 3mV: Auxiliary—up to 3mV.
- Output—250mV
- Signal-to-noise ratio—better than U0dB.
- Channel matching—within 1dB.
- Tone controls—TREBLE + 15 to −15dB. at 10KHz: BASS +15 to −15dB at 100Hz.
- Power consumption 5mA.
- Front panel—brushed aluminium with black knobs and controls.
- Size 8¼ × 4 ins.



*Treble and bass cut and boost curves of Sinclair Stereo Sixty*

*Ready for immediate installation* **£9. 19s. 6d.**

# SINCLAIR POWER SUPPLIES



**PZ-5**
*30 volts unstabilised—sufficient to drive two Z.30's and a Stereo 60 for the majority of domestic applications.*
*Price:* **£4. 19s. 6d.**

**PZ-6**
*35 volts stabilised—ideal for driving two Z.30's and a Stereo 60 when very low efficiency speakers are employed.*
*Price:* **£7. 19s. 6d.**

## GUARANTEE

If at any time within 3 months of purchasing Project 60 modules from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for services thereafter. No charge for postage by surface mail. Air-mail charged at cost.

**SINCLAIR RADIONICS LIMITED**
**22 NEWMARKET ROAD, CAMBRIDGE**
**Telephone 0223 5273:**

sinclair

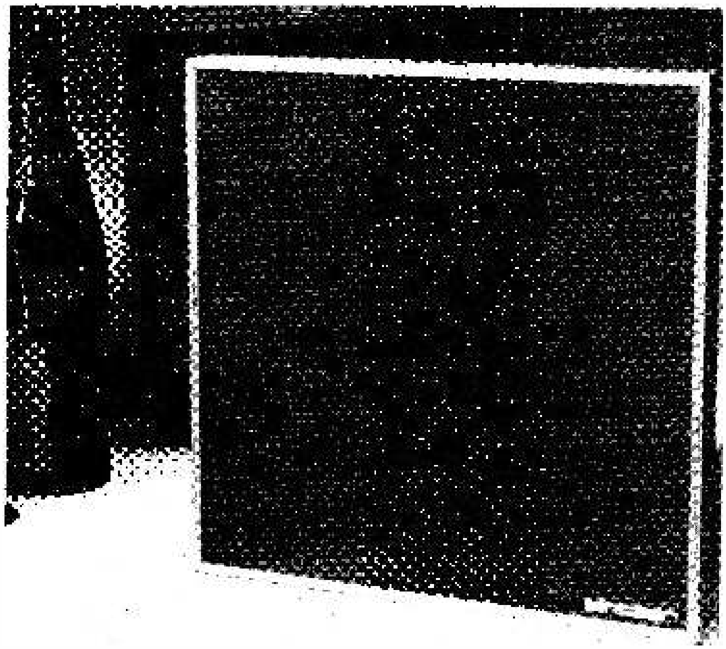
**To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE**
*Please send* ........................................
*NAME* ........................................
*ADDRESS* ........................................
*For which I enclose cash/cheque/money order*
PW 570

# SINCLAIR

# Q.16

## new elegance in an outstanding loudspeaker

All the superb features which went to make the Sinclair Q.14 have been incorporated in the new Q.16 which gives an exciting new opportunity for you to match your Sinclair equipment with modern decor. Employing the same well proven acoustic system in which materials, processing and styling are used in such a radical and successful departure from conventional design, the new Q.16 presents an entirely new appearance with its attractive teak surround and all-over special cellular foam front chosen as much for its appearance as for its ability to pass all audio frequencies without loss. The Q.16 is compact and slim. Its new styling makes it eminently suitable for shelf mounting, but it is no less versatile than its famous predecessor. Listen to a pair of Q.16s in stereo and marvel at the standards of quality and clarity they give.



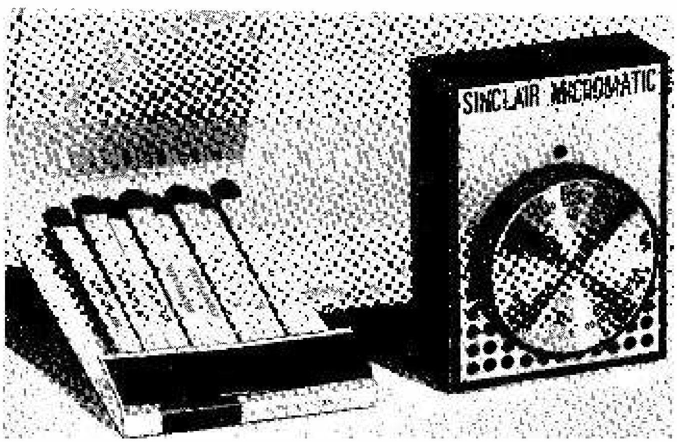
The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000Hz with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good transient response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

**£8.19.6**

**POST FREE**

# SINCLAIR MICROMATIC

**The world's most successful miniature radio**




**SPECIFICATIONS—Size:** $1\frac{13}{16}$" × $1\frac{7}{16}$" × $\frac{1}{2}$" (46×33×13mm). **Weight incl. batteries:** 1 oz. (28·35gm) approx. **Tuning:** Medium wave band with bandspread at higher frequency end. **Earpiece:** Magnetic type. **Case:** Black plastic with anodized aluminium front panel, spun aluminium dial.

| | |
|---|---|
| *Complete kit incl. earpiece, case, solder and instructions in fitted pack.* | **49/6** |
| *Ready built, tested and guaranteed, with earpiece.* | **59/6** |

*Mallory Mercury Cell RM675 (2 req.) 2/9 each*

Considerably smaller than an ordinary box of matches, this is a multi-stage A.M. receiver meticulously designed to provide remarkable standards of selectivity, power and quality. Powerful A.G.C. is incorporated to counteract fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy at all times. Vernier type tuning plus the directional properties of the self-contained special ferrite rod aerial makes station separation much easier than with many larger sets. The plug-in magnetic earpiece which matches exactly with the output provides wonderful standards of reproduction.

Everything including the batteries is contained within the attractively designed case. Whether you build your Micromatic or buy it ready built and tested, you will find it as easy to take with you as your wristwatch, and dependable under the severest listening conditions.

**To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE**

*Please send*

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*For which I enclose cash/cheque/money order*

*NAME* ...........................

*ADDRESS* ...........................

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...........................

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PW 570

### 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.

sinclair

**SINCLAIR RADIONICS LIMITED**

22 NEWMARKET ROAD, CAMBRIDGE

Tel: 0223 52731

# TRANSISTORS etc.

| | | | |
|---|---|---|---|
| AC107 | 3/- | OC35 | 9/- |
| AC126 | 2/- | OC44 | 2/- |
| AF115 | 3/- | OC45 | 2/- |
| AF116 | 3/- | OC70 | 2/3 |
| *AF117 | 4/- | OC71 | 2/- |
| BFY18 | 4/6 | OC72 | 2/2 |
| BFY51 | 4/- | OC73 | 2/9 |
| GET113 | 2/6 | OC75 | 2/2 |
| OA5 | 1/6 | OC81 | 2/- |
| OA9 | 1/8 | OC81D | 2/- |
| OA47 | 1/9 | OC82D | 2/3 |
| OA81 | 1/6 | OC140 | 5/- |
| OA85 | 1/6 | OC169 | 3/6 |
| OC23 | 6/6 | OC170 | 2/6 |
| OC25 | 6/- | *OC170 | 4/- |
| OC26 | 7/6 | OC171 | 2/2 |
| OC28 | 8/6 | OC202 | 4/6 |
| | | TK22C | 1/6 |

* With 4 leads

Crystal Diodes—6 for **2/6** (7d.)

**SILICON DIODE RECTIFIERS**

| | |
|---|---|
| BY 100 800 piv | **2/10** |
| 500mA 250 piv | **1/9** |
| Avalanche 1¼A 1200 piv | **4/-** |
| **Six Amp Series** | |
| BYZ13 300 piv | **3/6** |
| BYZ12 600 piv | **4/6** |
| BYZ11 900 piv | **5/-** |
| BYZ10 1200 piv | **5/6** |
| **Mullard Stack FW Bridge** | |
| 12A 100 piv | **39/6** (3/-) |

**THYRISTORS**

| | |
|---|---|
| **5 amp series** | |
| 100 piv | **7/6** |
| 200 piv | **9/-** |
| 300 piv | **10/6** |
| 400 piv | **12/-** |
| 800 piv | **25/-** |
| **10 amp series** | |
| 50 piv | **10/-** |
| 100 piv | **12/-** |

100 amp series prices available on request.

**Midget Electrolytic Conds. Wire Ends**

| | |
|---|---|
| 4μF | 150 volt |
| **At 9d. each** | |
| 0.8μF | 25 volt |
| 2μF | 350 volt |
| 4μF | 12 volt |
| 8μF | 12 volt |
| 16μF | 16 volt |
| 30μF | 10 volt |
| 100μF | 6 volt |
| 125μF | 4 volt |
| 640μF | 2.5 volt |
| **At 1/- each** | |
| 50μF | 10 volt |
| 100μF | 12 volt |
| 200μF | 10 volt |
| 320μF | 10 volt |

If extact voltage shown is not available, nearest is sent.

| | |
|---|---|
| 2000 MFD. 30V | **5/6** |
| 1500 MFD. 30V | **4/6** |

Also 8μF 350V **1/2**, 25μF 25V **1/3** and 50μF 50V **1/9**. Other electrolytics in current list. Postage, Packing and Insurance all above 1/- up to 11, 12 and over charges paid.
**2 GANG VAR. CONDENSER:** Mod., air-spaced, .0005 ea. sec. **5/-** (1/-), **3 GANG, 7/6** (1/6).
**SUB-MIN. TRANSFORMER:** Output (3 Ω for OC72 etc) **2/9** (Up to six 1/-).
**MULTIMETER:** 20,000 Ω/V D.C., 10,000 Ω/V A.C. 0–5/25/50/500/1K volts D.C. ●–10/50/100/500/1K *volts A.C.* ●0–50μA 2.5mA/250mA D.C. ●0–6K Ω/6 meg Ω. ●10μF–.001mfd/1mfd. ●–20 to ×22dB. ●Complete with test leads and instructions–●Over-load protected 1970 model with every refinement. **£4.10.0** (2/6). **JUNIOR MODEL** at **47/6** (2/6). 1000 Ω/V described in free list. Spec. subject to slight variation.
**SOLDERING IRON.** Slim Mod. British High speed, 8¼in., all parts replaceable, fully guaranteed for professional, radio and general D.I.Y. use, 19/6 (1/6).

**DIAMOND STYLI** Replacements for BSR TC8LP, TC8/S and TC8LP/STEREO: COLLARO "O"; RONETTE BF40LP; GARRARD GC2LP and GC8LP; ACOS GP65/67; all at **7/6** each (1/-). ACOS GP73 and GP91; BSR ST4 and ST9; SONOTONE 8TA, 9TA and 9TAHC; PHILIPS AG3306, 3060, (3063, 3066, 3301, 3302, 3304), all at **13/6** (1/-). Double diamond types omitting 78 r.p.m., out shortly at lowest prices.
**SAPPHIRE** all the above 7/6 types only, also ACOS GP37 at **3/3** each (1/-). ACOS GP91 at **7/6** (1/-). No other types at present, and no 78 rpm available in any type.

**PICK-UP CARTRIDGES** All fitted Styli and Standard fittings, Mono GP67/2, 15/-. ●Stereo compatible—Mono which also plays Stereo records monaurally with min. wear, **GP91/SC, 21/-**. ●latest Stereo **GP93, 24/6.** ●Ceramic Stereo, top quality for expensive outfits, **GP94, 38/6** (all 1/-).
**PP3 ELIMINATOR** (A.C.) **17/6** (1/6). **TWO STATION TRANS. INTER-COM.** Excellent baby alarm. Instant, easy fitting with leads, plugs and battery. All you require **52/6** (3/-).
**TRANSISTORISED AMPLIFIERS,** 3 watt, 9V operation, **45/6** (1/6); 7½ watt, 6 trans. 24V operation **67/6** (2/6).
Extra High Torque **MINI-MOTOR,** 4½ to 12V, 1½ × ⅞in. **5/-** (1/-). 9,000 r.p.m.
**SUBSTITUTION BOXES.** Capacitance **25/6** (1/6). Resistance **32/6** (1/6). Both full range and complete. Full details in list.
**TEST PRODS:** Flexible, unbreakable 24in. Red and Black leads, thin 4¼in. prods, 1¾in. plugs **4/9** (1/-). **CROC. CLIPS:** Plated with screw, or with red/black hn dles, **6d.** each, 5/- doz. (1/-).

**RECORDING TAPE** Finest quality British Mylar. **STANDARD:** 5in. 600ft. **7/3.** 5¾in. 850ft **8/9**, 7in 1200ft. **11/3**, **LONG PLAY** 5in. 900ft. **10/-**, 5¾in. 1200ft. **11/3**, 7in. 1800ft.**18/-** (1/3 reel). Still the finest quality and value obtainable.
**MICROPHONES—CRYSTAL.** MIC91, Desk, **16/3**; MIC45, curved hand grip **17/6**; Stick "60" **20/3**; Stick "39" **26/6** (1/6 each type). Cream plastic hand type **7/6**, or with "strut" stand, switch and 2 leads with 2.5 and 3.5 plugs **12/6** (1/3). Lapel (or hand) with clip **6/6** (1/-). Machined metal tapered stick type with neck cord and adaptor to fit standard floor stands, **25/-** (1/6). **DYNAMIC:** Cream hand/table **15/6** (1/6). **MS10** 50K Ω, 3½ × ⅞in. with Base. Adaptor **37/6** (2/6). **MS11**, similar but fixed on flexible Swan neck to switch-fitted base **42/6** (2/6).
**CARDIOID DYNAMIC OMNI-DIRECTIONAL:** Two highly successful makes "SQUARE" 208, **£5.10.0.** "BALL" type, 209, with 50K/600 ohms imp., **£5.17.6 (either type 5/-).**
**MICROPHONE INSERTS:** Diameter 1.75in. or 0.9in., either size **5/6** (1/-).
**SPEAKERS:** 12in. round, fitted Tweeter, 6W, 3 or 15 Ω (state which), **37/6** (5/6); or for stereo, **80/-** per pair (charges paid), 2½in. 3 Ω **(6)6** (1/-); 6 × 4 heavy duty 3 Ω **14/6** (3/6) or for Stereo **34/6** pair (charges paid). Limited quantity powerful 2½in. PM transistor replacement speaker, high ohms, excellent **5/9** (1/-). **HEADPHONES:** High Res. 2000 Ω ea. earpiece **18/6** (1/6); Stereo Dyn 8–16 Ω **63/-** (3/-). **EARPIECES** with lead and min. jack plug, magnetic **1/9.** Crystal **4/9** (up to 3 for 1/- on either). State if 2.5 mm. or 3.5mm. plug required. (Crystal 3.5mm. only).
**AERIALS, Car Types:** Telescopic, vandal proof, locks retracted, 2 keys and all fittings, **22/6** (2/6). Motor driven, 12V, 5 section, complete **£7.10.0** (5/-).
**FOR ALL PORTABLES and F.M. SETS.** 7-Section 5½–32in., no swivel, screw hole in base, **6/6.** 10-section 6⅛–47½in., no swivel, screw hole in base, **12/6.**
**DISAPPEARING** 8 section, swivel fixing assembly, 6½–33in. **10/-**. New 6 section 5¼–25¼in., screw hole in base, no swivel **4/-** (1/- all sizes).
**SWITCHES:** Standard toggle, metal, 250V 2A. One hole fixing: SPST **2/3**, SPDT **2/9**, DPST 3/- DPDT **3/3.** Slide type, Sub-min. DPDT **1/6** each. Small DPDT 3 way, centre "off" **1/9,** Reed magnetic on/off **1/9** (up to three, 1/-; 1d each all additional). Rotary Switches etc. in list.
**VIBRATORS:** Famous makes only, 12 volt 4 pin non-synch, **4/6.** 12 volt 7 pin synch. **12/6** (1/- each either type). No other types available.
**MAINS NEON TESTER:** Fly leads **2/-**. Pocket screwdriver type **3/6. PLUGS:** Std. Jack, plastic body **2/3.** Screened **3/-**. **VALVE HOLDERS:** B7G or B9A, Moulded **6d.** (all above 1/- up to three).
**CONNECTING WIRE:** 5 coils asstd. coils. each 5 yds. Solid Core **2/6.** Flexible **3/-**. Super thin for transistor wiring etc. **3/-** (/1- all types per 5 coils). **PICK-UP WIRE:** Twin Super thin Flex, Screened, Sheathed, **1/3** yd. (6d. up to 6 yds., over 6 yds. post free). **TWIN MIKE CABLE: 1/3** yd. **SINGLE MIKE CABLE: 8d.** yd. Both flexible, screened and sheathed. (Up to 3 yds. 8d., each additional yard 1d. extra.)
**R.F. FIELD INDICATOR,** 5-band with antenna, monitoring crystal earpiece, visible indicator etc. **48/6** (1/6). Details in list.
**RETRACTABLE FLEXIBLE LEADS.** Space saving "Curly", many uses in car and home: with phono plug each end, 6ft., **4/6**; 12ft., **7/9**; With phono plug one end, phono socket at other, 6ft., **5/-**, 12ft., **8/6** (1/- each all types).
**CAR RADIO:** Splendid new All-British dash-mounting radio using Mullard transistors and circuit. M. and L. wave. Separate speaker and baffle. Absolutely complete for + or – chassis, **£11.11.0** (6/6). A huge success since introduction.
**CURRENT LIST:** With many more items sent with all orders or Free. For S.A.E. This advertisement cancels all previous ones and lists supplied prior to March 31st 1970.
**ANNUAL HOLIDAYS**
No orders or correspondence received after May 23rd will be dealt with until June 8th.

# FELSTEAD ELECTRONICS

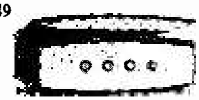
**(PW30) LONGLEY LANE, GATLEY, CHEADLE, CHESHIRE, SK8 4EE**

TERMS: Cash with order only. No C.O.D. or caller service. Post, packing and insurance charges are shown in brackets after all items. Regret orders under 5/- plus carriage cannot be accepted, and a minimum charge of 1/- is now made. Charges apply to G.B. and Eire only. Overseas orders welcomed. Air or surface mail at cost. Sent at buyer's risk, unregistered and uninsured unless specified and min. insurance/reg. fee of **3/2** sent.
*S.A.E. please for all enquiries, otherwise regret cannot be replied to.*

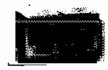
# M. & B. RADIO

**38 BRIDGE END, LEEDS 1**

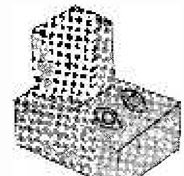
**Telephone: 0532-35649**



**STEREO CABINETS.** A beautifully finished polished wood cabinet supplied in original carton. Size approx. 22 × 16 × 8in. New 47/6 plus 6/6 carriage.



**TELEMETERS.** A well finished cabinet containing lots of useful items for the constructor. Endless tape unit and tape head, 2 motors, auto and mains transformers, miniature valve I.F. strip etc. Ideal for modifying or stripping. 77/6 plus 7/6 carr.
**STETHOSCOPE HEADSETS.** Brand New. Ideal for stereo or mono. Low impedance. 27/6 plus 3/6 pp.
**MICROPHONES.** Radiotelephone type, used. 5/- plus 2/- pp.
**TRANSISTORISED 2 METER CONVERTERS.** Please state preference of I.F. frequency when ordering. £7.15.0 plus 5/- pp. 4 metre models available at the same price. VHF Marine band model £8.5.0 plus 5/- pp.
**12V TRANSISTOR INVERTERS.** 12vdc input. 275vdc at 150mA output. Size of aluminium case 1⅜" x 2⅞" x 4" approx. Size of transformer approx. 1⅜" x 2" x 2". £3.5.0 plus 5/- pp.



**2 to 3 WATTS INTEGRATED CIRCUITS.** Tested c/w circuit. £1 plus 1/- pp.
60 UNTESTED TRANSISTORS 5/- plus 1/- pp.
60 UNTESTED DIODES 2/6 plus 1/- pp.
BYX25 800R Silicon diodes 800 piv 16amps on heat sink 5/- plus 1/- pp. 455Kc/s FM Transistorised I.F. strips. Faulty usually low in gain but new. 6 transistors. 12/6 plus 1/- pp.
**USED TESTED VALVES.** QQVO3/10 6/-, 6AQ5/EL90 3/-, 6BJ6 1/6, 6BH6 1/6. 12AX7/ECC83 2/6, 5U4 6/-, ECF80 2/-. All plus 1/6 pp.
**AERIAL CHANGE OVER RELAYS** 6v, 12v or 50v 4/- plus 1/6 pp.
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**TRANSISTORISED STEREO HI-FI RECORD PLAYER**

Build your own Hi-Fi Record Player with the Serenade fully transistorised amplifier which comes complete with 2-10" x 6" speakers and the latest BSR 4 Speed Stereo/Mono Record Changer.
Advanced solid state amplifier only 4½" deep. 14 transistors plus 4 diodes, separate Bass and Treble – 10 watts total power. Frequency response 50-15,000 c/s.
EASY TO INSTALL
NO TECHNICAL KNOWLEDGE REQUIRED
Only **28** Gns. +P&P 17/6
Credit terms available, first monthly payment £3.6.2 followed by 9 monthly payments of £3.6.2. (Total "Credit Sale" Price £33.1.8). Send £4.3.8 today.

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**"TRANSCONTINENTAL"**

**FULLY TRANSISTORISED STEREOPHONIC RADIOGRAM CHASSIS**

Complete with 2-10" x 6" speakers and the latest BSR Mono/Stereo Record Changer – a complete radiogram at half normal price ONLY
10 Watts Total output
17 Transistors & 10 diodes **£36.10.0** P&P 17/6
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**Credit Terms available. First monthly payment £4.2.2 followed by 9 monthly payments of £4.2.2. (Total "Credit Sale" Price £41.1.8.) Send £4.19.8 today.**

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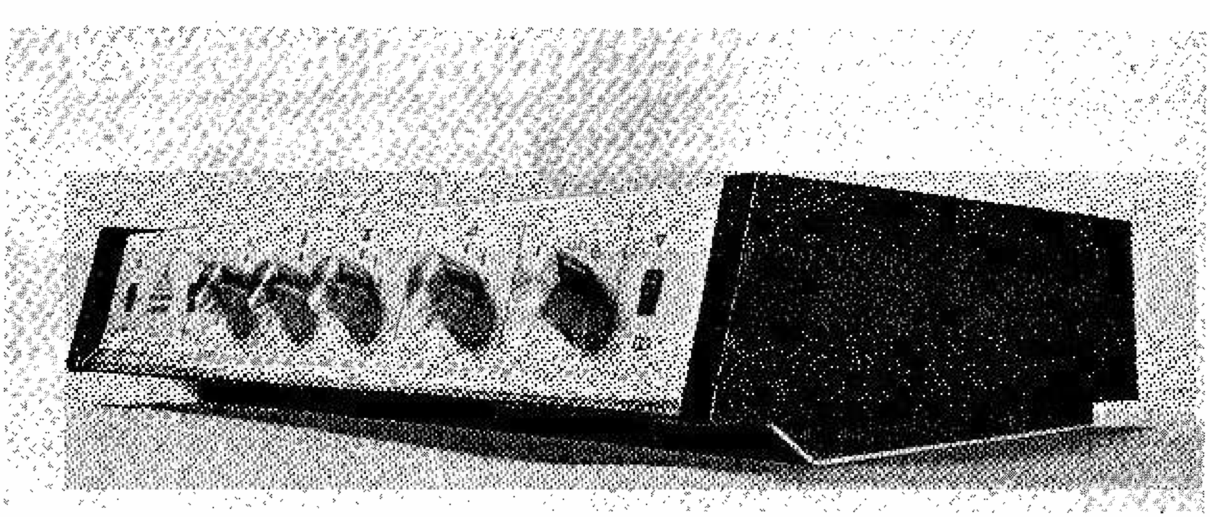
# peak sound englefield



## developed out of the highly successful PW. 12+12 and now in complete kit form to save you still more

**The Peak Sound Englefield** is a system offering great flexibility whilst providing cost-performance ratios which have never been bettered in high fidelity. Here top-flight circuitry is housed in a cabinet of elegantly original styling which is both beautiful and completely practical front and back. Now we carry design standards further by offering a 12+12 watt version completely in kit form. The resultant specification surpasses that even of the original PW.12+12 which again was based on Peak Sound design. In this Englefield kit, printed circuit boards are supplied for you to mount the components on. Standards of input sensitivity and overload factor on all channels as well as filter performance are all improved. By giving you the satisfaction of building the Englefield this way, you save considerably and finish with a completely professionally styled instrument. Go to your dealer and start building now, or send direct for delivery by return in case of difficulty.

***and this is the Peak Sound Specification Guarantee***

*Peak Sound guarantee that their equipment meets all specifications as published by them and that these are written in the same terms as used in equipment reviews appearing in this and other leading British hi-fi journals. Audio output powers are quoted at continuous sine wave power in terms of Root Mean Square values (R.M.S.) into stated loads at stated frequencies.*

### The specification that tells you everything *(See guarantee)*

*Using two Peak Sound PA. 12-15's*, driven simultaneously at 1 KHz from 240 V. mains supply.
Output per channel: 11 watts into 15Ω: 14 watts into 8Ω.
Frequency bandwidth: 10Hz to 45 KHz for 1dB at 1 watt.
Total Harmonic Distortion at 1 KHz at 10 watt into 15Ω—0.1%.
Input sensitivities: Mag. PU.3.5 mV. R.I.A.A. equalized into 68KΩ: Tape, 100mV linear into 100KΩ: Radio, 100mV linear into 100KΩ.
Overload factor: 29dB on all input channels.
Signal/noise ratio: —65dB on all inputs. Vol. control at max.
Controls: Volume, Treble, Bass, Low-pass Filter. Mono/Stereo: On/off; Balance.

Complete kit of parts including cabinet assembly, knobs, transistors, well-prepared instructions and wire to length, colour coded and stripped at ends as well as built-in mains power supply. *(Post free in U.K.)* **£33.2.0**

Englefield assembly as above, but in easy-to-put-together modules. *(Post free in U.K.)* **£38.9.0**

Peak Sound ES.10-15 BAXANDALL LOUDSPEAKER. Fantastic performance and value. Ideal with your Englefield. Cabinet 18"x12"x10" natural teak finish. Ready built—18½ gns. Parts available separately for building yourself with appreciable saving. Leaflet on request.

# peak sound

PEAK SOUND (HARROW) LTD., SAINT JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY. *Egham 5316*

**To Peak Sound, Saint Judes Road, Englefield Green, Egham, Surrey**
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## COILS & TRANSFORMERS FOR CONSTRUCTORS

Special versions of our P50 Series are now available for AF117 or OC45 Transistors. They can be used in the standard superhet circuit with slight changes in component values.

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Components for several receivers are available, including the following for the "Clubman".

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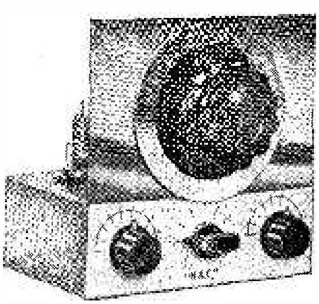
**WEYRAD (ELECTRONICS) LIMITED**
**SCHOOL STREET, WEYMOUTH, DORSET**

## H.A.C. SHORT-WAVE KITS

### WORLD-WIDE RECEPTION



Famous for over 35 years for Short-Wave Equipment of quality, "H.A.C." were the Original suppliers of Short-Wave Receiver Kits for the amateur constructor. Over 10,000 satisfied customers—including Technical Colleges, Hospitals, Public Schools, R.A.F., Army, Hams, etc.

**IMPROVED 1970 RANGE**

One-valve model "DX", complete kit—price **56/6** (Postage and packing 3/6).

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**£7/15/0**

Solve your communication problems with this **4-Station Transistor Intercom** system (1 master and 3 Subs), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master**. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 7/6.

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No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control. Price £11.19.6. P. & P. 8/6 extra.

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OUR PRICE ONLY **3 gns.**

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 4/6.

**Transistor TELEPHONE AMPLIFIER**

**59/6**

Why not boost business efficiency with this incredible De-luxe **Telephone Amplifier**. Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume Control. Battery 2/6 extra. P. & P. 3/6. Full price refunded if not satisfied in 7 days.

**WEST LONDON DIRECT SUPPLIES (P/W4)**
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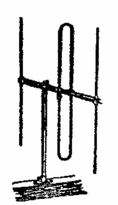
## NEW RANGE U.H.F. TV AERIALS

All U.H.F. aerials new fitted with tilting bracket and 4 element grid reflectors.
**Loft Mounting Arrays**, 7 element, **40/-**. 11 element, **47/6**. 14 element, **55/-**. 18 element, **62/6**. **Wall Mounting with Cranked Arm**, 7 element, **60/-**. 11 element, **67/-**. 14 element, **75/-**. 18 element, **82/6**. **Mast Mounting** with 2in. clamp. 7 element, **42/6**. 11 element, **55/-**. 14 element, **62/-**. 18 element, **70/-**. **Chimney Mounting Arrays, Complete.** 7 element, **72/6**. 11 element, **80/-**. 14 element, **87/6**. 18 element, **95/-**. Complete assembly instructions with every unit. **Low Loss Cable, 1/6 yd. U.H.F. Preamps from 75/-.** State clearly channel number required on all orders.

### BBC – ITV AERIALS



**BBC (Band 1).** Loft, **25/-**. External S/D, **30/-**. "H" **£2.15.0. ITV (Band 3).** 3 element loft array, 30/-. 5 element, 40/-. 7 element, 50/-. Wall mounting, 3 element, 50/-. 5 element, 55/-. **Combined BBC/ITV.** Loft 1 + 3, 40/-; 1 + 5, 50/-; 1 + 7, 60/-; Wall mounting 1 + 3, 60/-; 1 + 5, 70/-; Chimney 1 + 3, 70/-; 1 + 5, 80/-.
VHF transistor pre-amps, 75/-.

COMBINED BBC1 — ITV — BBC2 AERIALS 1 + 3 + 9, 70/-. 1 + 5 + 9, 80/-. 1 + 5 + 14, 90/-. 1 + 7 + 14, 100/-. Loft mounting only.
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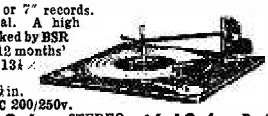
**40-41 MONARCH PARADE**
**LONDON ROAD, MITCHAM,**
**SURREY 01-648 4884**

## BSR 4-SPEED SUPERSLIM MODEL UA25 RECORD CHANGER



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. Size 13¼ × 11¼in. Above motor board 3⅛in. below 2¼in. AC 200/250v.

MONO PRICE **£5.19.6** STEREO PRICE **£6.19.6** Post 5/6

BSR UA70 Stereo/Mono Transcription Auto Changer. Calibrated Stylus Pressure. **£12.19.6**

BSR Minichanger UA50 Stereo/Mono. Size 12 × 8¾in. AC 200/250v. Post 5/6. **£7.19.6**

GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond/Mono Sapphire. SP25 Mk II £14.19.6. AT60 Mk II £14.19.6. Model 3000 £12.19.6. Post 5/6.

RECORD PLAYER PORTABLE CABINET Space for amplifier and autochanger. Post 5/-. **75/-**

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made and tested. A 2-stage unit using triode pentode valve, giving 3 watts output. Tone and volume controls. Isolated mains transformer. With knobs, loudspeaker and valves ECL82, EZ80. Frequency response 50-12,000 cps. Sensitivity 200mV. Post 5/6. **89/6**

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GARRARD PLASTIC COVER SPC.1 for WB.1 BASE. Durable tinted attractive appearance. **77/6**

EMI PICK-UP ARM. Complete with mono cartridge 29/6.

EMI JUNIOR 4 SPEED RECORD PLAYER

Mains operated motor, turntable and pick up complete. Post 5/6. **59/6**

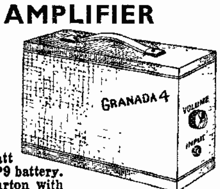
HI-FI PICK UP CARTRIDGES

GP94 55/-; GP93 45/-; GP91 30/-; GP67 19/6, ACOS L.P. only 10/6. All standard fixing complete with stylus.

### CRYSTAL MIKE INSERTS

1½" dia. 6/6. ACOS 1¾" dia. 12/6. BM3, 1" dia. 9/6

## PORTABLE AMPLIFIER




Portable mini p.a. system. Many uses — ideal for Parties, or as a Baby Alarm, Intercom, Telephone or Record Player Amplifier, etc. Attractive rexine covered cabinet, size 12 × 9 × 4in., with powerful 7 × 4in. speaker and four transistor one watt power amplifier. Uses PP9 battery. Brand new in Makers' carton with full makers' guarantee. World famous make.

Only **75/-** Post 5/-

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| RA2W Ferrite Aerial ..12/6 | Spare Cores .......... 6d. |
| Osc. P50/1AC ..........5/4 | Driver Trans. LFDT4 .. 9/6 |
| I.F. P50/2CC 470 kc/s .. 5/7 | Printed Circuit, PCA1 .. 9/6 |
| 3rd I.F. P50/3CC ........6/- | J.B. Tuning Gang .... 10/6 |
| P51/1, P51/2 ..........5/7 | Weyrad Booklet ...... 2/- |

P51/3, 6/-; Telescopic Aerials 6in. to 23in. 5/-. Ferrite Rod 8 × ⅜in. 4/-. 6 × ¼in. 5/-.

### VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/- STEREO L/S 10/6, D.P. 14/6 Edge 5K. S.P. Transistor, 5/-.

### 80ohm Coax 8d. yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. 20/-; 60 yd. 30/-. FRINGE LOW LOSS Ideal 625 lines **1/6**yd.

WIRE-WOUND 3-WATT POTS. Small type with small knob. Values 10 Ω to 30 K., Carbon 30 K to 2 meg. **4/6**

WIRE-WOUND 3-WATT STANDARD SIZE POTS. LONG SPINDLE 10 OHMS to 100 K. **7/6**

VEROBOARD 0·15 MATRIX

2½ × 5in. 3/8. 2½ × 3¾in. 3/2. 3¾ × 3¾in. 3/8. 3¾ × 5in. 5/2.

EDGE CONNECTORS 16 way 5/-; 24 way 7/6.

PINS 36 per packet 3/4. FACE CUTTERS 7/6.

S.R.B.P. Board 0·15 MATRIX 2½in. wide 6d. per 1in., 3¾in. wide 9d. per 1in.; 5in. wide 1/- per 1in. (up to 17in.). S.R.B.P. undrilled $\frac{1}{16}$in. Board 10 × 8in. 3/-.

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1¼inch DIAMETER WAVE-CHANGE SWITCHES. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 4/6 each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way 4/6 each. 1 inch DIAMETER Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. 1 wafer 12/-, 2 wafer 18/-. 3 wafer 24/-, 4 wafer 30/-, 5 wafer 36/-.

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| H.R. HEADPHONES 2000 ohms Super Sensitive.. | 35/- |
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"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 v. A.C. Leaflet S.A.E. Post 2/6 **42/6**

★ ALL PURPOSE TRANSISTOR PRE AMPLIFIER BRITISH MADE ★

9-12v. and 200-300v. D.C. operation. Size 1¼" × 1¼" × ¾". Response 15 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions. Brand new. Guaranteed. **17/6 each**

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SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250mF 15V 2/-; 500, 1000mF 12V 3/6; 2000mF 25V 7/-.

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SILVER MICA. Close tolerance 1%. 5-500pF 1/-; 560-2,200pF 2/-; 2,700-5,600pF 3/6; 6,800pF-0·01, mfd 6/-; each.

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SHORT WAVE. Single 10pF, 25pF, 50pF, 75pF, 100pF, 160pF, 200pF, 10/6 each.

TUNING. Solid dielectric. 100pF, 300pF, 500pF, 7/- each.

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RESISTORS. Preferred values, 10 ohms to 10 meg. ¼ w., ½ w., 1 w., 20% 3d.; 1½ w. 8d.; 2 w. 1/-; ½ w. 10% 6d.

HIGH STABILITY. ½ w. 1% 10 ohms to 10 meg., 2/-. Ditto 5%. Preferred values 10 ohms to 22 meg., 9d.

WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K. 2/- each; 2½ watt. 1 ohm to 8·2 ohms. 2/-.

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TT45. Push Pull Drive, 9:1 CT, 6/-. TT46 Output, CT8:1, 6/-. TT49. Interstage, 4·5:1, 6/-; TT52 Output 3 ohms, 20:1, 6/-. TT23/4 PAIR 10 watt Amp. Transformers and circuit 35/-.

TRANSISTOR MAINS POWER PACKS. FULL WAVE 9 volt 500mA. Size 4½ × 2½ × 2in. Metal case. Crackle finish. Output terminals. On/off switch. **49/6**

Half Wave 9 volt 50mA. Size 2½ × 1¼in. Snap terminals 32/6

9 volt 500mA. TRANSFORMER ONLY. 2¼ × 1¾ × 1¾in. 10/6

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COAXIAL PLUG 1/3, PANEL SOCKETS 1/3, LINE 3/6. OUTLET BOXES. SURFACE OR FLUSH 4/6. BALANCED TWIN FEEDERS 1/- yd. 80 ohms or 300 ohms. JACK SOCKET Std. open-circuit 2/6, closed circuit 4/6; Chrome Lead Socket 7/6. Phono Plugs 1/-. Phono Socket 1/-. JACK PLUGS Std. Chrome 3/-; 3·5mm Chrome 2/6. DIN SOCKETS Chassis 3-pin 1/6; 5-pin 2/-. DIN SOCKETS Lead 3-pin 3/6; 5-pin 5/-. DIN PLUGS 3-pin 3/6; 5-pin 5/-. VALVE HOLDERS, 9d.; CERAMIC 1/-; CANS 1/-.

## E.M.I. 13½ × 8in. LOUDSPEAKERS

With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45-60 cps. Flux 10,000 gauss. Speech coil, 3 or 15 ohm. **45/-**

Recommended Teak Cabinet Size 16 × 10 × 9in. **94/6**

Also with twin tweeters 3 or 8 or 15 ohms. 10 watt. **79/6**

## MINI-MODULE LOUDSPEAKER KIT

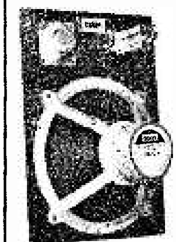
10 WATT **65/-** CARRIAGE 5/-

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8¾ 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 8 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9 in. Modern Scandinavian fluted front design for Mini-Module. **94/6** Post 5/-

ALL MODELS "BAKER SPEAKERS" IN STOCK

## BAKER 12in MAJOR £8



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 45 c.p.s. Rated 20 watts. Voice coils 3 or 8 or 15 ohms.

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£10.19.6**

BAKER "GROUP SOUND" SPEAKERS – POST FREE

| 'Group 25' | 'Group 35' | 'Group 50' |
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| 12in 25 watt **6gns.** | 12in 35 watt **8½gns.** | 15in 50 watt **18gns.** |

TEAK HI-FI SPEAKER CABINETS. Fluted wood front.

| | |
|---|---|
| For 10 or 12in round Loudspeaker ............ | £8.10.0. |
| For 13 × 8in or 8in round Loudspeaker ........ | £4.14.6. |
| For 10 × 6in or 6½in round Loudspeaker ........ | £3.16.6. |

LOUDSPEAKER CABINET WADDING 18in wide, 2/6ft

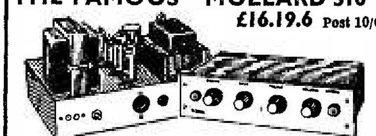
Goodmans Tweeter 3½in 3 ohm 35/-, EMI 2½in 8 ohm 17/6. Horn Tweeters 2-18kc/s, 10W 15 ohm 29/6. Crossover 16/6. LOUDSPEAKERS P.M. 3 OHMS. 2¾in, 3in, 4in, 5in, 5 × 3in, 7 × 4in. 17/6 each; 6½in 22/6; 8 × 5in, 21/-; 8 × 2½in 21/-; 10 × 6in. 30/-; 10in. or 12in. Double cone 3 or 15 ohm 39/6.

SPECIAL OFFER! 80 ohm. 2¼in, 2¾in. 35 ohm, 3 in. 25 ohm, 6 × 4in; 8 × 5in. 15 ohm. 7 × 4in.; 8 × 5in. **15/6** EACH TYPE

8in LOUDSPEAKER UNITS 3 ohm 27/6; 15 ohm 30/-. ELAC 8 in. De Luxe Ceramic 3 ohm 45/-; 15 ohm 50/-. 8in LOUDSPEAKER. TWIN CONE 3 ohm 35/-. 5 in. WOOFER. 8 watts max. 20-10,000 cps. 8 or 15 ohm. 39/6. OUTPUT TRANS. EL84 etc. 4/6; MIKE TRANS. 50:1 3/9. SPEAKER COVERING MATERIALS. Samples Large S.A.E.

## THE FAMOUS "MULLARD 510"

**£16.19.6** Post 10/6



Main power, amplifier and 2 valve pre-amplifier. Silver grey facia panel. Volume, treble, bass controls. Function switch: Radio, Tape 1, Tape 2, Mic, Gram LP, Gram 78. Tape output socket. Valves: 2 × EL84, 3 × EF86. 1 × ECC83, 1 × EZ81. Ultra linear Parmeko output transformer. 20 db negative feedback. 10 watts rms. mono. 3 and 15 ohm output. Brand new. Guaranteed.

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SUPPLIED AT LOWEST PRICES. ILLUSTRATED EAGLE CATALOGUE 5/-. Post free.

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **79/6**

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| Practical Radio Inside Out ................................ | 4/6 |
| Supersensitive Transistor Pocket Radio .................. | 3/6 |
| Radio Valve Guide, Books 1, 2, 3, or 4 ea. 5/- No. 5 ea. | 6/- |
| T.V. Fault Finding 405/625 lines ........................... | 8/6 |
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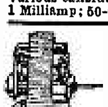
Various calibrations/movements. 500 Microamp; 1 Milliamp; 50-0-50 Microamp. etc. S.A.E. for list. **37/6**



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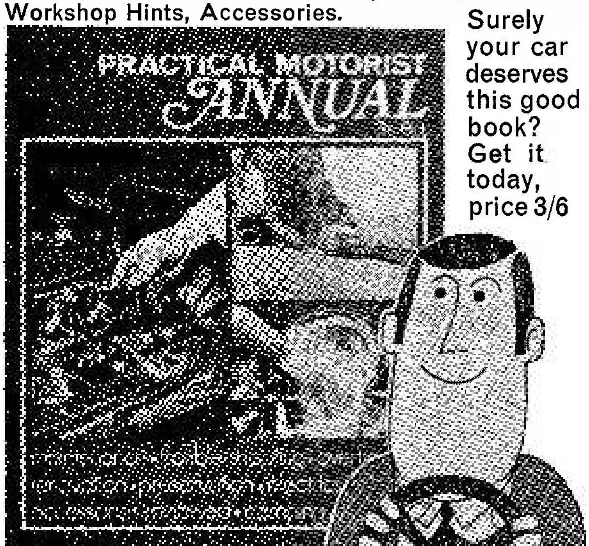


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## PADGETTS RADIO STORE

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**Telephone: Heckmondwike 4285**

**AW48-80 TV Tubes** good picture—no guarantee **£1** plus 12/- carriage.

**Aircraft Sighting Head** with Gyro Unit. Condition Fair **18/6**, carriage B.R.S. 12/-.

**Small 12-way Plug and Socket, 1/6** each p. & p. 1/-, **15/-** per doz. p. & p. 3/6. Ex unit.

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**Panels of Resistors and Condensers 8/-** per doz., post paid. Ex unit.

**Bombsight-Computors** containing a large selection of gears. A delight for The Model Maker. **55/-** carriage paid.

**Complete untested 17 inch TV Sets** 12 channel **50/-**, 15/- carriage.

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**Speakers removed from T.V. Sets.** All PM and 3 ohm. 6in. round **3/-**, p. & p. 3/-; 6 for **24/-**, post paid 6 x 4in. **3/-**, p. & p. 3/-; 6 for **24/-**, post paid. 5in. round **3/-**; p. & p. 3/-; 6 for **24/-** post paid. 7 x 4in. **5/-**, p. & p. 3/-; 6 for **34/-** post paid. Slot Speakers 8 x 2½in. **5/-**, p. & p. 3/-; 6 for **30/-** post paid.

**Reclaimed T.V. Tubes,** with 6 months' guarantee 17in. Type AW43/80. AW43/88 **40/-**. MW43/69 **30/-**. 14in. Type **17/-**. All Tubes 12/- carriage.

**Silicon Rectifier** 500mA 800 PIV. **2/6**, post paid. **24/-** per dozen, post paid.

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**Top Grade Mylar Tapes,** 7in. Standard **11/6**. 7in. Long Play **14/-**. 5in. Standard **7/9**. 5in. Long Play **10/-**, plus post on any tape 1/9.

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| ARP12 | 1/6 | PCL82 | 4/- | 6B8 | 1/8 |
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| EF85 | 3/- | PL36 | 5/- | 6K7 | 1/9 |
| EBF80 | 3/- | PL38 | 6/- | 6U4 | 5/- |
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| PCC84 | 2/- | U329 | 5/- | 30FL1 | 5/- |
| PCF80 | 2/- | U251 | 5/- | 6/30L2 | 5/- |

## BAKER 12in. MAJOR £8

The remarkable quality and performance of the "**Major**" makes possible truly brilliant and rich sound from a single loudspeaker. It recreates the entire musical spectrum from 30 to 14,500 c.p.s. The unit consists of the latest double cone, woofer and tweeter cone together with a special **Baker** magnet assembly **Alcomax II** having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 45 c.p.s. For Hi-Fi or P.A. Rated 20 watts. Voice coils available 3 or 8 or 15 ohms.

**Major Module** 30-17,000 cps with tweeter, crossover, baffle 19 x 12½in. and instructions. **£10.19.6**

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# TRANSISTOR RADIOS TO BUILD YOURSELF

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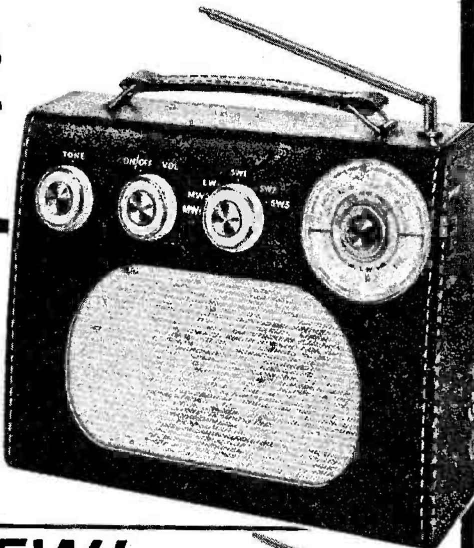


## *NEW!* roamer eight mkI
### WITH VARIABLE TONE CONTROL

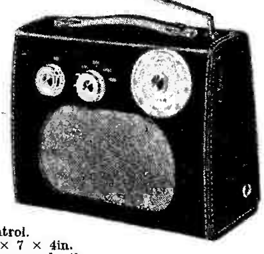
7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for Medium and Long Waves. Five section 22in. chrome plated Telescopic aerial for Short Waves can be angled and rotated for maximum performance. Push pull output using 600 mW transistors.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

Total Building Costs **£6.19.6**

P & P 7/6.

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

## roamer seven mkIV



SEVEN FULLY TUNABLE WAVEBANDS—MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. Five Section 22in. chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push-pull output. Seven transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in. P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build. Parts price list and easy build plans 3/- (FREE with parts). Personal Earpiece with switched socket for private listening, 5/– extra.

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

## *NEW!* trans eight

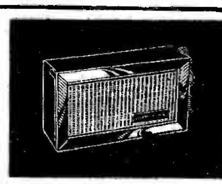
**SIX WAVEBAND PORTABLE WITH 3in. SPEAKER**

Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 x 5½ x 2¾in. approx. Tunable on Medium and Long Waves, three Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. Eight improved type transistors plus 3 diodes. Push pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/– (FREE with parts). Earpiece with switched socket for private listening 5/– extra.

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

## pocket five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

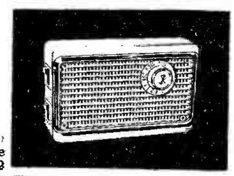


Attractive black and gold case. Size 5¼ x 1½ x 3¼in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Easy build plans and parts price list 1/6 (FREE with parts).

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

## transona five

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

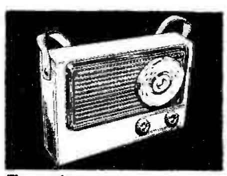


Attractive case with red speaker grille. Size 6¼ x 4½ x 1½in. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

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

## roamer six

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER



Attractive case with gilt fittings. Size 7½ x 5¼ x 1¾in. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/-. (FREE with parts).

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

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Parts price list and plans for ..............................

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Address ..............................

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## Everything brand new and to specification • Large stocks • Good service

**RESISTORS :**

| Code | Power | Tolerance | Range | Values available | 1 to 9 | 10 to 99 | 100 up |
|---|---|---|---|---|---|---|---|
| | | | | | SEE NOTE BELOW | | |
| C | 1/20W | 5% | 82 Ω–220K Ω | E12 | 18 | 16 | 15 |
| C | 1/8W | 5% | 4.7 Ω–830K Ω | E24 | 2.5 | 2 | 1.75 |
| C | 1/4W | 10% | 4.7 Ω–10M Ω | E12 | 2.5 | 2 | 1.75 |
| C | 1/2W | 5% | 4.7 Ω–10M Ω | E24 | 3 | 2.5 | 2.25 |
| MO | 1/2W | 2% | 10 Ω–1M Ω | E24 | 9 | 8 | 7 |
| C | 1W | 10% | 4.2 Ω–10M Ω | E12 | 6 | 5 | 4.5 |
| WW | 1W | 10%+1/20 Ω | 0.22 Ω–3.3 Ω | E12 | 15d all quantities | | |
| WW | 3W | 5% | 12 Ω–10K Ω | E12 | 15d all quantities | | |
| WW | 7W | 5% | 12 Ω–10K Ω | E12 | 18d all quantities | | |

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

**Values :** E12 denotes series: 1, 1.2, 1.5, 1.8, 2.2. 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2 and their decades.
E24 denotes series: as E12 plus 1.1, 1.3, 1.6, 2, 2.4, 3, 3.6, 4.3, 5.1, 6.2, 7.5, 9.1 and their decades.

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

**COLVERN 3 WATT WIRE-WOUND POTENTIOMETERS :**
10 Ω, 15 Ω, 25 Ω, 50 Ω, 100 Ω, 150 Ω, 250 Ω, 500 Ω, 1K Ω, 1.5K Ω, 2.5K Ω, 5K Ω, 10K Ω, 15K Ω, 25K Ω, 50K Ω. Price only **5/6** each.

**CARBON TRACK POTENTIOMETERS :** Double wiper ensures minimum noise level.

| Long plastic spindles | each | | each |
|---|---|---|---|
| Single gang linear: 220 Ω, 470 Ω, 1K etc. to 2.2M Ω | 2/6 | Log/Anti-log: 10K, 47K, 1M Ω only | 8/6 |
| Single gang log: 4K7, 10K, 22K, etc. to 2.2M Ω | 2/6 | Dual anti-log: 10K only | 8/6 |
| Dual gang linear: 4K7, 10K, 22K etc. to 1M Ω | 8/6 | Any type with ½ amp. double pole mains switch | extra 2/3 |
| Dual gang log: 4K7, 10K, 22K etc. to 2M2 Ω | 8/6 | | |

**FETS** n-channel low cost general purpose 2N5163, 25 volt, only 5/- each. Audio/r.f. Texas 2N3819 8/6, Motorola 2N5459 (MPF105) 9/9 each. Motorola 2N5457 (MPF103) 9/9 each.

**NEW PLESSEY INTEGRATED CIRCRIT POWER AMPLIFIER TYPE SL403A.** Only **48/6** nett. Operates with **18V** power supply. Sensitivity 20mV inoy 20M Ω, 3 watts into 7.5 Ω. Applications data with two or more. PE Nov. 69 Stereo Amplifier kit less metal work **£11/18/-** NET complete.

**30 WATT BAILEY AMPLIFIER COMPONENTS:**
Transistors for one channel **£7/5/6** list, with 10% discount only **£6/11/0.**
Transistors for two channels **£14/11/0** list, with 15% discount only **£12/7/5.**
Capacitors and resistors for one channel list **£2.**
Printed circuit board free with each transistor set.
Complete unregulated power supply kit **£4/17/6** mono or stereo, subject to discount.
Complete regulated power supply kit **£9/5/-** subject to discount. Further details on application.

**SINCLAIR IC.10** Integrated Circuit Amplifier and Pre-amplifier. This remarkable monolithic integrated circuit amplifier and pre-amp now available from stock. The equivalent of 13 transistor/18 resistor circuit plus 3 diodes and the first of its kind ever. It is d.c. coupled and applicable to an unusually wide range of uses as detailed in the manual provided with it. As advertised, post free **59/6** NET.

**CARBON SKELETON PRE-SETS.** Small high quality, type PR: Linear only, 100 Ω, 220 Ω, 470 Ω, 1K Ω, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M Ω, 2M2, 5M, 10M Ω vertical or horizontal mounting, 1/- each.

**S-DeCs** put an end to "birdsnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC only **30/6** post free. Compact T-DeC, increased capacity, may be temperature-cycled T-DeC only **51/-** post free. Full range available.

**CAPACITORS: All new stock**
High ripple current types:
2000μF 25V **7/4**; 2000μF 50V **11/4**; 5000μF 25V **12/6**; 5000μF 50V **21/11**; 1000μF 100V **16/3**; 2000μF 100V **28/9**; 5000μF 70V **36/-**; 5000μF 100V **58/3**; 1000μF 50V **8/2**; 2500μF 64V **15/5**; 2500μF 70V **19/6.**

**Medium electrolytics**
Axial leads: Values (μF/V): 50/50 **2/-**; 100/25 **2/-**; 100/50 **2/6**; 250/25 **2/6**; 250/50 **3/9**; 500/25 **3/9**; 1000/10 **3/3**; 500/50 **4/6**; 1000/25 **4/-**; 1000/50 **6/-**; 2000/25 **6/-**; 3030/25 **2/6.**

**Small electrolytics**
Axial leads: 5/10, 10/10, 25/10, 50/10 **1/-** each, 25/25, 47/25, 100/10, 220/10 **1/3** each.

**PEAK SOUND ENGLEFIELD KITS**
Brilliant new styling and available in two forms:

**Stereo 15 watts per channel**
In kit form with complete amplifier and pre-amplifier modules and power supply. **Build it 12 + 12 or 25 + 25**
Output per channel into 15 Ω 12 watts R.M.S. Price **£38/9/- net**

**25 WATTS PER CHANNEL.** As above but Output per channel into 15 Ω 25 watts R.M.S. Price **£58/15/- Net**
Brief specification: Total harmonic distortion 0.1%.
Inputs: Magnetic, Ceramic, Tape, Radio, Signal to noise ratios: Better than 60dB all inputs. O/load factor 28dB all channels.

**ENGLEFIELD CABINET** to house either above assemblies (as illustrated) **£6 Net.** OTHER PEAK SOUND PRODUCTS AS ADVERTISED.

**MULLARD Sub-min electrolytic C426 range:** Price **1/3** each. Axial leads, Values (μF/V): 0.64/64; 1/40; 1.6/25, 2.5/16; 2.5/64; 4/10; 4/40; 5/64; 6.4/6.4, 6.4/25; 8/4; 8/40; 10/2.5; 10/16; 10/64; 12.5/25; 16/40; 20/16; 20/64; 25/6.4; 25/25; 32/4; 32/10, 32/40, 32/64; 40/16; 40/2.5; 50/6.4; 50/25; 50/40; 64/4; 64/10; 80/2.5; 80/16; 80/25; 100/6.4; 125/4; 125/10; 125/16; 160/2.5; 200/64.; 200/10; 250/4; 320/2.5; 320/6.4; 400/4; 500/2.5μF/V.

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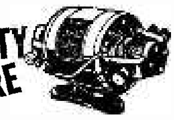

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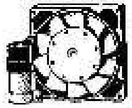

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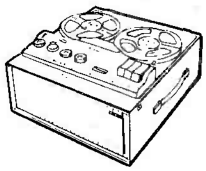

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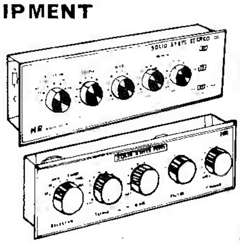

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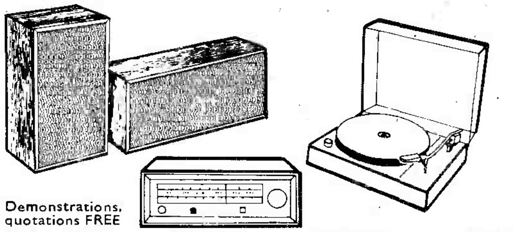

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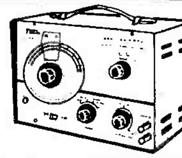

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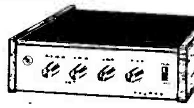

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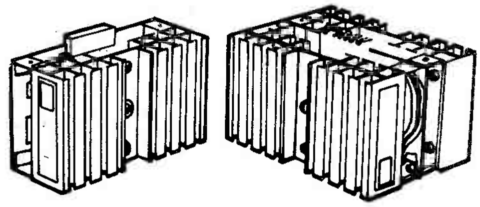

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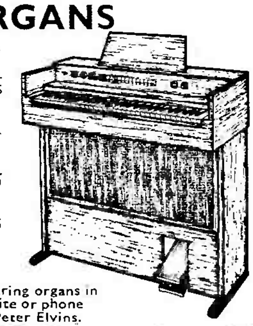

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