PRACTICAL WIRELESS

JUNE
1975

30p

digital waveform generator

also

DIRECT CONVERSION RECEIVER

& REPAIRING HI-FI AMPLIFIERS

PRACTICAL WIRELESS

VOL. 51 NO. 2

ISSUE 820

JUNE 1975

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

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Published by IPC Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD. Tel. 01-634 4444

SUBSCRIPTIONS
Publisher's Subscription Rate for one year to the UK is £5·00 and to the rest of the world £5·00 ($13·50 USA/CAN) including postage. Enquiries to Subscription Department, IPC Magazines Ltd., Carlton House, 66 Gt. Queen Street, London, WC2 5DD. Phone 01-242 4477. International Giro facilities Account No. 5122007. Please state reason for payment "message to payee".
Binders (£1·90) and Indexes 30p (inc. VAT) can be supplied by the Binders Dept at the same address.

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NEWS & COMMENT

CONSTRUCTIONAL

OTHER FEATURES

HUGE DISCOUNTS

ON LEADING BRAND HI-FI — **ALL RSC PRICES INCLUDE VAT** — **LOW DEPOSIT CREDIT TERMS**

Full labour and material guarantees for 12 months

	Rec. Price	RSC Price
LINEAR 202 Amplifier	£39·23	£24·95
LINEAR 505 Amp 5 + 5w	£19·75	£16·95
AUDIO FIDELITY Model 60 Amp	£59·95	£45·95
WHARFEDALE LINTON Amp	£68·04	£49·95
LEAK 2100 Amplifier	£119·75	£92·95
LEAK 2002 Cassette	£139·50	£108·95
LEAK 2030 L/Speakers	£94·50 Pr	£69·00
LEAK 2060 L/Speakers	£83·50 Ea	£57·50
LEAK 2000 Tuner/Amp	£193·50	£149·50
ROTEL RX150A Tun/Amp	£84·50	£59·95
ROTEL RX152 Tun/Amp	£94·50	£67·95
ROTEL RX202 Tun/Amp	£107·50	£77·95
ROTEL RX402 Tun/Amp	£145·00	£104·95
ROTEL RT222 Tuner	£59·90	£42·50
ROTEL RT322 Tuner	£84·50	£59·95
WHARFEDALE Denton I L/Spkr	£33·78 Pr	£22·95
WHARFEDALE Denton II L/Spkr	£47·50 Pr	£31·95
WHARFEDALE Linton II L/Spkr	£59·75 Pr	£39·95
FANE Ambassador 35 L/Spkr	£89·00 Pr	£69·50
FANE MARQUESS 30 L/Spkr	£75·00 Pr	£49·95
FANE Model One Spkr Kit	£23·98 Pr	£18·95
WHARFEDALE Linton II Kit	£28·90 Pr	£19·50
WHARFEDALE WHD20 Cassette	£103·68	£76·95

BASF CASSETTES (Carr. Free)

	LH CASSETTES in Snap Pack Rec. Price	RSC Price 1	5	10	SUPER SM CASSETTES in Snap Pack Rec. Price	RSC Price 1	5	10
C60	98p	65p	3·00	4·99	1·08	80p	3·50	6·75
C90	1·36	90p	3·99	6·99	1·40	1·05	4·75	8·95
C120	1·87	1·20	5·50	9·90	1·94	1·46	6·75	12·95

Also Shure Cartridges, Basf Tape, Koss H/Phones, etc.
Prices of above correct at Apl 7 1975

AKAI TAPE UNITS

	Rec. Price	RSC Price		Rec. Price	RSC Price
CS30D	£91·23	£64·95	GXC75D	£209·89	£149·95
CS33D	£111·08	£79·95	GXC510D	£199·39	£135·95
GXC36D	£116·24	£72·50	CR81D	£98·10	£69·95
GXC38D	£144·23	£102·95	GXR82D	£128·77	£92·95
GXC38	£154·53	£109·95	1722L	£146·37	£105·95
GXC40T	£195·35	£139·95	4000DS	£136·59	£97·95
GXC46D	£165·47	£115·95	4000DB	£196·27	£139·95

GOLDRING GL72 T/Table & G800 **£29·95** (Approx. value £46) Carr. 75p
GOLDRING GL75 T/Table & G800 **£34·95** (Approx. value £65) Carr. 85p
PIONEER PL12D T/Table on plinth & cover **£41·75** List £61·90

T/TABLES with MAGNETIC CARTRIDGE/PLINTH & COVER
GARRARD SP25 MK IV with G850 **Special Price £23·95** (Carr. £1)
RANK BD2000 Rec. Price £67·25 RSC Price **£48·95** (Carr. £1)

FANE HIGH FIDELITY SPEAKERS

Limited number at approximately half list prices.

Model		Special Price	Model		Special Price
5″ 501	8 ohms	£5·20	12″ 122/14*	8 & 15Ω	£11·50
8″ 804*	8 ohms	£3·65	12″ 122/14LR	8Ω	£12·95
10″ 1005LR	15Ω	£5·75	12″ 122/17*	8 & 15Ω	£12·95

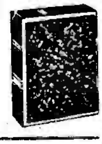
Available by Mail Order carr. free or may be ordered through Branches
*Basic models made to individual specification of equipment manufacturers

HI-FI 7 Watt LOUDSPEAKERS fitted Parasitic Tweeter Imp 8Ω

8″ x 5″ £1·25 ea. 6½″ £1·45 ea. 8″ £1·85 Carr. 20p

HI-FI SPEAKER ENCLOSURES

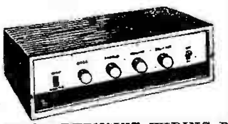
Simulated Teak finish Sizes approx.



ME8 13 × 9½ × 6½in. £3·95 } Both cut for 8in. speaker Carr. 50p. per enc.
JE8 16 × 11 × 9in. £5·95 }
SE10 25 × 16 × 9in. Cut for 10in. and Tweeter £8·95
SE12 25 × 16 × 9in. Cut for 12in. and Tweeter £8.95

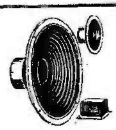
RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. For speaker output impedances of 3 — 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs.



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£12·95** Carr. 40p
Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £16·95 or dep. £2·12 and 8 monthly payments £2·12 (Total £19·08).

AUDIOTRINE HI-FI SPEAKER SYSTEMS

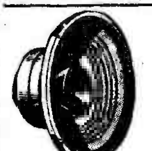


Consisting of matched 12in. 11,000 Gauss 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£6·95** Carr. 45p
OR SENIOR 15 WATT INCLUDING HF123 13,000 GAUSS SPEAKER **£8·95** Carr. 50p

R.S.C. TA6 6 Watt HI-FI AMPLIFIER

200-250v. AC mains operated. Response 30-20,000 c.p.s. −2dB. 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. O/P rating I.H.F.M. Enclosed enamelled case 9½ × 2¾ × 5¼in. Silver finish facia 10¼ × 3¼in. Complete kit, wiring diagrams and instructions. **£7·95** Carr. 40p. FACTORY BUILT **£10·95**

AUDIOTRINE HIGH FIDELITY SPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" or "T" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE.

Exceptional performance at low cost.

HF808T	8″	10W	£2·55	HF120D	12″	15W	£6·50
HF102D	10″	10W	£3·50	HF126	12″	15W	£7·95
HF120	12″	15W	£5·95	HF126D	12″	15W	£8·50

AUDIO FIDELITY MODEL 80 HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 8-15 Ω. £5·40 ea. **£7·98** pr.

MODEL 83 8″ 15w. with parasitic Tweeter. £6·99 ea. **£10·95** pr.
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 8–15Ω.

R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET

Only high grade components by leading manufacturers

* Push Button Selector Switching
* Jack Socket for Headphones
* Neon Indicator
* Satin Silver Finish Metal Fascia
* Solid State Circuitry
* Twenty Silicon Transistors
* Four Diodes, Four Rectifiers

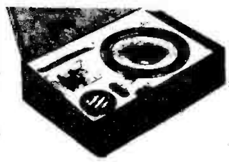
Send S.A.E. for leaflet

For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz

COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £4·90 extra. **£22·95**

AUDIO FIDELITY FRI SPEAKER KIT

Response 30 Hz-15 KHz. Rating 15 watts in sealed cabinet. Imp. 8-15 ohms. 8″ Bass Unit with P.V.C. Cone surround for ultra low resonance. Pressure Tweeter. Printed Circuit. Inductive/Capacitive Cross-over. Damping Material, Screws, Terminal Panels. **£11·78** each. Carr. Free.



SPECIAL OFFER **£15·99** Pair Carr. 50p

R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary. Primaries 200-250v. 50c/s. Screened

MIDGET CLAMPED TYPE 2½ × 2¼ × 2¼in.

250v., 60mA, 6·3v. 2a	£1·50
250-0-250v., 60mA 6·3v 2a	£1·60

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	£2·25
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£3·75
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£3·75
300-0-300v. 130mA, 6·3v. 4a. c.t., 6·3v. 1a. For Mullard 510 Amplifier	£4·50
350-0-350v. 100mA, 6·3v. 4a., 0 5-6·3v. 3a.	£3·75
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£4·50
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	£8·50
425-0-425v. 200mA, 6·3v. 4a., Twice 5v. 3a.	£8·70
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	£9·00

TOP SHROUDED DROP-THRO' TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6 3v. 2a.	£2·25
250-0-250v. 100mA, 6·3v. 3·5a.	£2·50
250-0-250v, 100mA, 6·3v. 2a., 6·3v. 1a.	£2·75
350-0-350v. 80mA. 6·3v. 2a., 0-5-6·3v. 2a.	£2·75
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£3·75
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£3·75
300-0-300v. 130mA, 6·3v. 4a., c.t. 6·3v. 1a. Suitable for Mullard 510 Amplifier	£4·50
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£3·75
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£4·50

FILAMENT or TRANSISTOR POWER PACK Types 6·3v.1·5a.92p; 6·3v. 2a. 95p; 6·3v.3a. £1·45p; 6·3v. 6a. £2 25; 12v. 1a. 95p; 12v. 3a. or 24v. 1·5a £2·25; 0·9-18v 1½a £1·95; 0-12-25-42v 2a£2·75.

CHARGER TRANSFORMERS 0-9-15v. 1½a. £1·75, 2½a. £1·95; 3a.£2·00; 5a.£2·45; 6a.£2·75; 8a.£3·00

AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v. 50-80 watts £2·50, 150 watts, £4·50 250 watts £5·50; 500 watts £8·50

OUTPUT TRANSFORMERS

Std. Pentode 5000-3 Ω or 700-3 Ω	96p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	£1·45
Push-Pull 10 watts 6V6, 3-5-8-15 Ω	£2·25
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	£2·25
Push-Pull Ultra Linear for Mullard 510, etc.	£3·75
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	£3·20
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	£5·50

SELENIUM RECTIFIERS
F. W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 18v.
1a, 38p. 2a, 49p. 3a, 65p. 4a, 81p. 6a, 97p.

L.F. CHOKES
150mA, 7-10H, 250 Ω £1·10; 100mA, 10H, 200 Ω 95p; 60mA, 10H, 400 Ω 35p.

RSC 100watt DISCO SYSTEM

AT FANTASTIC LOW PRICES!

Units listed below
(a) DISCOMASTER TWIN TURNTABLE CONSOLE with integral 100W amplifier
(b) PAIR OF HI-FI HEAD-PHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to h'phone)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18" × 18" × 8"
(a) (b) (c) & (d) Carr. £3·00 **£159·95**

DEP. £19·95 & 18 fortnightly. payments of £9·11 (Total £183·93).

STEREO VERSION

of Above System
Or DEPOSIT £29·95 and 18 fortnightly pymts. £11·11 (Total £229·93) **£199.95** Carr. £3·50

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Acos Cartridges with diamond styli. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or DEP. £9·00 and 18 fortnightly pymts. £4·61 (Total £91·98) **£79·95** Carr. £1·50

TD2S STEREO VERSION OF ABOVE

Terms DEPOSIT £15 and 18 fortnightly payments £6·51 (Total £132·18) **£115·00** Carr. £1·60

DISCOMASTER TWIN TURNTABLE POWER CONSOLE £109·95

Carr. £2·50

Garrard SP25 or McDonald MP60 turntables. Sonotone or Acos cartridges with diamond styli. Facilities as TDI Console but with built-in 100 watt Power Amplifier, complete with lid. Or Deposit £12·95 and 18 fortnightly payments £6·31 (Total £126·53)

STEREO VERSION £145 or DEPOSIT £20 and 18 fortnightly pymts £8·15 (Total £166·70). Carr. £3

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Vynide and Vynair

TYPE C38 40-50 WATTS Incorporating three exceptionally efficient 8" speaker units. Terms: Dep. £2·95 and 8 monthly payments £2·87 (Total £25·91) Carr. 65p. **£21·95**

TYPE C3/70 70 WATTS. Fitted three 12" 25 watt Highly sensitive high flux speakers with high power voice coils. Size approx. 54" × 14" × 11". Dep. £5·11 & 8 mthly pymts. £5·11 (Total £45·99) Carr. 85p **£39·95**

FANE ULTRA HIGH POWER SPEAKERS & KITS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE
High flux ceramic magnets. ALL CARRIAGE FREE.

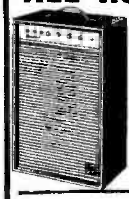
'POP' 100 18" 100 Watt 14,000 gauss 8/15Ω **£31·95** Dep: £5·80 and 8 mthly payments £3·80 (Total £36·20)

'POP' 60 15" 60 Watt 14,000 gauss 8/15Ω **£17·95** Dep. £3·17 and 8 monthly payments. £2·17 (Total £20·53)

'POP' 50 12" 50 Watt 13,000 gauss 15Ω **£13·95** Terms for pairs Dep £5·90 & 8 mthly pymts £3·16 Total £31·18 PAIR SUITABLE ALL PURPOSES

FOR BASS GUITAR, ELECT. ORGAN, ETC.

ALL RSC PRICES INCLUDE VAT



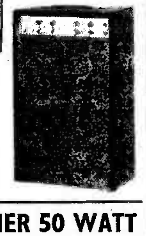
INTEREST on Credit Purchases REFUNDED settled in 3 months

SUPER MINSTREL 10 W GUITAR AMP.

Incorporating Tremolo and 13" × 8" or 10" Speaker. Output 10 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity.
Terms: DEPOSIT £6·73 and 8 monthly payments £3·00 (Total £30·73) Carr. free **£26·73**

FANE CRESCENDO SPEAKERS

FULL RANGE AVAILABLE AT ALL BRANCHES



'POP' 25/T 12" 25W.

Dual cone. 15 ohm Imp. (Not for Bass Guitar use) **£9·95**

PH50 HIGH POWER TWEETER £6·65

with 2 to 4 mfd. Non elect. filter available 55p. Rating 50 Watt Imp 8Ω Response 3KHz 20KHz

D40 FULL RANGE 40 WATT POWER SPEAKER KIT £21·00

Consisting of 12" 40 watt Bass Unit, HPX1 200w Cross-over and PH50 Tweeter. Rating 40w R.M.S. Imp. 8 ohms. Terms: Deposit £5·99 and 8 mthly payments £2·50. (Total £25·99).

FAL MAESTRO

COMBINED 30W AMP. AND 12" SPEAKER **£48·60** Carr. Free

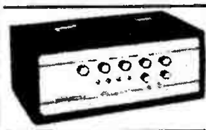
For Lead Guitar, Mic, Gram, Radio, Tape (Not for use with Bass instruments) Inc. 3 inputs and 2 vol controls plus Treble & Bass, TREMOLO with associated controls. Attractively finished in black with silver-finished fascia. Compact size Fitted carrying handle. Deposit £8·60 and 8 mthly payments £5·75 (Total £54·60)

RSC 'PHANTOM 50' Rating 50 watts. 3 inputs, 2 vol. controls. Bass, Treble, Presence **£55·00** Carr. £1·50
Terms: Deposit £8·00 & 8 mthly. pymts. £6·76 (Total £62·08).

TITAN GROUP/DISCO SPEAKERS

as advertised elsewhere in this issue

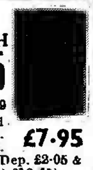
FULL RANGE AT DISCOUNT PRICES



FAL PHASE 50 Mk. III AMPLIFIER 50 WATT

Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective Circuitry against serious output overloading. Output for Speaker/s 8 to 15 ohms. Size 17" × 7" × 7¼". 200–250v. A.C. mains. Output 50 watts music rating. Or deposit £8·60 & 8 monthly payments £5·75. Total £54·60. Carr. Free **£48·60**

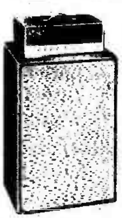
HIGH QUALITY LOUDSPEAKER UNITS



ALL TWO TONE VYNIDE AND VYNAIR FINISH
L12/2 50 WATT Fitted pair of 12" 30 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£39·95**
Or deposit £5·11 and 8 monthly payts. of £5·11. Total £45·99

L12/25G 18" 25 WATT 13,000 lines 15 ohms Terms for Pairs. Dep £3·32 & 8 mthly pymts £3·32 (Total £29·88) **£12·95** Carr. 55p.

L12/10 10–15 Watt Veneered cabinet 12" unit 8-15 ohm. Approx. 14" × 14" × 9". Carr. 65p. Terms for Pairs. Dep. £2·05 & 8 mthly pymts £2·05 (Total £18·45). **£7·95**



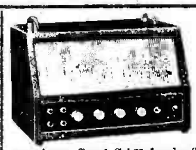
REGENT 50X 50 WATT AMP.

A powerful high quality unit for lead, rhythm guitar, vocalists, gram, radio, tape. 50w Peak O/P rating. Not for Bass Guitar.
★ Two Fane heavy duty high flux 12in. spkrs.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls. Send S.A.E. for leaflet. Credit Terms: Deposit £9·95. & 18 fortnightly payments of £4·15 (Total £84·65). **£74·95** Carr. £2·50

REGENT 50B for Bass Guitar and general purposes. Or Dep. £9·00 & 18 fortnightly payments £4·61. (Total £91·98). Carr. £2·50 **£79·95**

FAL DISCO PRE-AMPLIFIER

T/Table mixing inputs. Headphone Monitoring. Mic. Jack & Tape inputs. Independent Vol. Control. Std. 200-250v A.C. Mains operation **£18·50**



GP30 AMPLIFIER

For Guitar, Vocal or Instr. Group, Gram, Radio or Tape. 4 inputs. 2 Vol. Controls. Current Valves. Peak o/p rating. Strong Vynide covered cabinet with carrying handles. Black/Silver Facia. Neon Indicator. For 200-250v A.C. For 3 or 15 Ω speakers. Send SAE for leaflet. Terms: Dep £5·58 & 8 mthly pymts £3·58 (Total £34·22) Carr. 75p **£29·95**

NOW AVAILABLE I.S.E. CA 127 JINGLE MACHINES £79·95

Terms: DEPOSIT £9 and 18 fortnightly payments £4·61 Total £91·98

LIQUID WHEEL PROJECTORS from £24·75

COMPLETE PULSAR 'SOUND TO LITE' SYSTEM £99·95

AT A WORTHWHILE SAVING ON INDIVIDUAL UNITS purchased separately.
Terms: Deposit £11·48 and 18 fortnightly payments £5·74.
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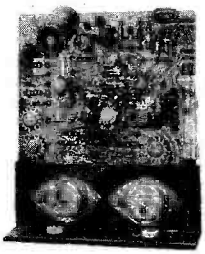

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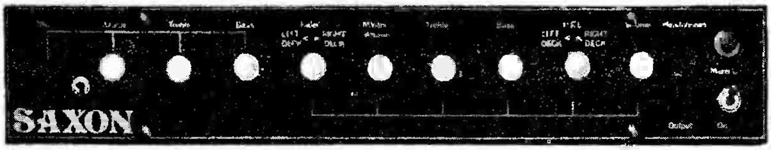

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Thousands sold of this extremely popular mono version. A mic input may be fitted using the VA30 (see below). Low consumption from a 9V battery. Features the same high standards of reproduction as the Stereo version. Controls: H/phone select, vol, Left deck vol, Right deck vol, bass, treble, master vol. Size 12¾in × 3in × 2in deep.

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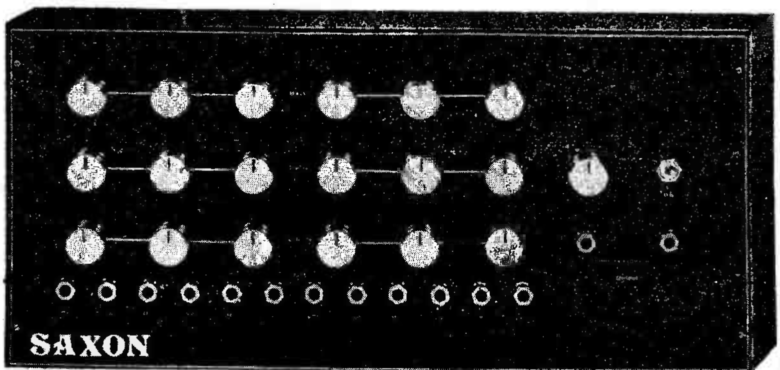

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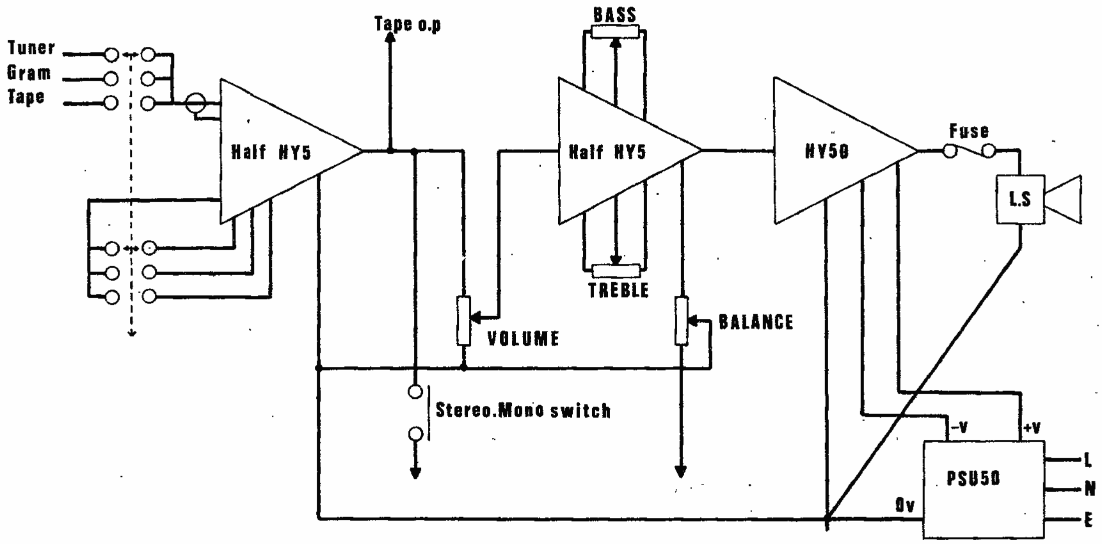
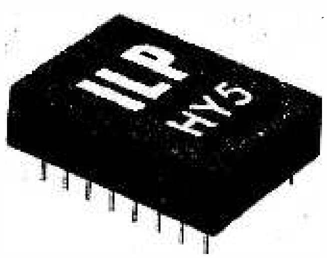
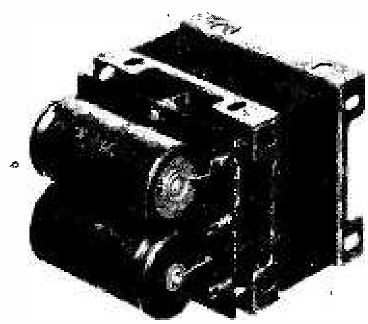


MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN





The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

TECHNICAL SPECIFICATION
Inputs: Magnetic Pick-up 3mV RIAA: Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; Auxiliary 3–100mV; Input/Impedance 47kΩ at 1kHz. **Outputs:** Tape 100mV; Main output 0db (0·775V RMS). **Active Tone Controls:** Treble ± 12db at 10kHz; Bass ± 12db at 100Hz. **Distortion:** 0·5% at 1kHz. **Signal/Noise Ratio:** 68db. **Overload Capability:** 40db on most sensitive input. **Supply Voltage:** ± 16–25V.

PRICE £4·50 + 36p VAT P. & P free

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided, input, output, power lines and earth.

TECHNICAL SPECIFICATION
Output Power: 25W RMS into 8Ω. **Load Impedance:** 4–16Ω. **Input Sensitivity** 0db (0·775V RMS). **Input Impedance:** 47kΩ. **Distortion:** Less than 0·1% at 25W typically 0·05%. **Signal/Noise Ratio:** Better than 75db **Frequency Response:** 10Hz–50kHz ± 3db. **Supply Voltage:** ± 25V. Size: 105 x 50 x 25mm.

PRICE £5·98 + 48p VAT P. & P. free

The PSU50 incorporates a specially designed transformer and can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: 50V (25-0-25V). **Input Voltage:** 210–240V.
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PL84	0·68
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PY82	0·57
PY88	0·56
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U193	0·54
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UBC81	0·71
UBF89	0·58
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ECC82	0·38
ECC83	0·38
ECC84	0·35
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ECC88	0·50
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EF86	0·50
EF89	0·35
EF91	0·40
EF92	0·50
EF95	0·45
EF98	0·80
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EL33	2·50
EL34	0·70
EL36	0·60
EL37	2·50
EL41	0·90
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EL84	0·35
EL95	0·60
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EM81	0·60
EM84	0·40
EM85	1·00
EY51	0·45
EY86	0·45
EZ40	0·60
EZ41	0·75
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PCC88	0·62
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PCF82	0·42
PCF86	0·65
PCF801	0·60
PCF802	0·55
PCF805	0·90
PCF806	0·80
PCF808	1·00
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PCL83	0·70
PCL84	0·50
PCL85	0·60
PCL86	0·50
PCL805/85	0·60
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PL81	0·55
PL82	0·50
PL83	0·50
PL84	0·50
PL500	0·85
PL504	0·85
PL508	0·90
PL509	1·55
PL802	1·00
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PY33	0·63
PY81	0·50
PY82	0·45
PY83	0·50

PY88	0·56
PY500	1·10
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U26	0·85
U191	0·75
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UBC81	0·50
UBF80	0·50
UBF89	0·50
UCC85	0·50
UCH42	0·80
UCH81	0·50
UCL82	0·40
UCL83	0·70
UF41	0·75
UF89	0·50
UL41	0·85
UL84	0·50
UY41	0·55
UY85	0·45
VR105/30	0·40
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1R5	0·50
1S5	0·40
1T4	0·40
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5R4GY	1·00
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6AU6	0·40
6BA6	0·38
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6CW4	1·00
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6J5G	0·45
6J6	0·35
6J7G	0·30
6J7M	0·65
6K6GT	0·80
6K7G	0·35
6K7M	0·45
6K8G	0·45
6K8M	0·70
6K25	1·00
6L6G	0·55
6Q7G	0·40
6Q7M	0·60
6SL7GT	0·55
6SN7GT	0·55
6SQ7GT	0·40
6U5G	1·50
6V6G	0·30
6V6GT	0·60
6X4	0·45
6X5G	0·45
6X5GT	0·55
7B6	0·80
7B7	0·80
7C5	1·30
7C6	1·00
7H7	0·80
7R7	0·80
7S7	2·25
7Y4	0·80
12AT6	0·45
12AT7	0·45
12AU6	0·50
12AU7	0·38
12AX7	0·38
12BA6	0·50
12BE6	0·60
30C1	0·40
30C15	1·00
30C17	1·00
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30L15	0·95
30L17	0·95
30P4MR	1·30
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AD140	0·50
AD149	0·50
AD161	0·39
AD162	0·39
AF115	0·25
AF116	0·25
AF117	0·20
AF186	0·40
AF239	0·44
ASY27	0·30
ASY28	0·25
BA102	0·25
BA115	0·10
BC107	0·12
BC108	0·12
BC109	0·12
BC113	0·16
BC117	0·21
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BC148	0·10
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BF115	0·22
BF167	0·25
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BF195	0·13
BF197	0·15
BF200	0·32
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OC25	0·40
OC28	0·70
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OC44	0·18
OC45	0·18
OC71	0·15
OC72	0·25
OC76	0·30
OC77	0·55
OC81	0·28
OC81D	0·28
OC81Z	0·45
OC83	0·25
OC140	1·00
OC170	0·25
OC171	0·30
OC200	0·55
OC201	1·00
OC202	0·90
OC203	0·55
OCP71	1·00
ORP12	0·55
ORP60	0·45
T1005	0·20
TIC44	0·29
TIC226D	1·50
TIL209	0·25
ZTX107	0·12
ZTX108	0·10
ZTX300	0·14
ZTX301	0·14
ZTX302	0·20
ZTX304	0·24

ZTX500	0·15
ZTX501	0·15
ZTX503	0·16
ZTX531	0·25
ZTX550	0·18
1N914	0·06
IN4001	0·06
IN4002	0·07
IN4003	0·08
IN4004	0·08
IN4005	0·10
IN4006	0·12
IN4007	0·12
1N4009	0·06
1N4148	0·06
1S921	0·07
1S2033	0·20
1S2051A	0·20
1S2100A	0·20
1S3010	0·25
2N696	0·15
2N697	0·15
2N706	0·10
2N706A	0·12
2N1131	0·25
2N1132	0·25
2N1302	0·18
2N1303	0·18
2N1304	0·22
2N1305	0·22
2N1306	0·28
2N1307	0·28
2N1308	0·28
2N1309	0·30
2N1613	0·20
2N1614	0·45
2N2147	0·75
2N2160	1·00
2N2369A	0·16
2N2646	0·50

2N2904	0·20
2N2904A	0·25
2N2905	0·32
2N2905A	0·25
2N2906	0·20
2N2926	0·10
2N3053	0·20
2N3055	0·60
2N3525	0·80
2N3614	0·59
2N3615	0·65
2N3702	0·11
2N3703	0·12
2N3704	0·14
2N3705	0·15
2N3706	0·11
2N3707	0·13
2N3708	0·07
2N3709	0·10
2N3710	0·11
2N3711	0·11
2N3819	0·35
2N3820	0·50
2N3823	0·50
2N3903	0·15
2N3904	0·20
2N3905	0·25
2N3906	0·25
2N4058	0·15
2N4059	0·10
2N4060	0·13
2N4061	0·18
2N4062	0·14
2N4289	0·30
3N125	1·75
3N141	0·81
40360	0·40
40361	0·45
40362	0·40
40430	0·85

SN7400	0·16
SN7401	0·16
SN7402	0·16
SN7403	0·16
SN7404	0·26
SN7405	0·22
SN7406	0·42
SN7407	0·42
SN7408	0·28
SN7409	0·28
SN7410	0·16
SN7411	0·25
SN7412	0·30
SN7413	0·36
SN7416	0·36
SN7417	0·36
SN7420	0·16
SN7422	0·25
SN7423	0·37

SN7428	0·40
SN7430	0·16
SN7433	0·37
SN7437	0·37
SN7438	0·37
SN7440	0·22
SN7441AN	0·92
SN7442	0·79
SN7450	0·16
SN7451	0·16
SN7453	0·16
SN7454	0·16
SN7460	0·16
SN7470	0·36
SN7473	0·41
SN7474	0·42
SN7480	0·60
SN7483	1·10

SN7486	0·47
SN7490	0·55
SN7491AN	1·00
SN7492	0·70
SN7493	0·70
SN7494	0·80
SN7495	0·80
SN7496	0·95
SN7497	3·87
SN74100	1·89
SN74107	0·45
SN74110	0·58
SN74118	0·90
SN74119	1·68
SN74121	0·50
SN74122	0·70
SN74123	1·00
SN74141	0·90

SN74145	1·26
SN74150	1·75
SN74151	1·00
SN74154	2·00
SN74155	1·06
SN74156	1·00
SN74157	0·95
SN74170	2·52
SN74174	1·57
SN74175	1·10
SN74176	1·26
SN74190	2·00
SN74191	2·00

SN74192	2·00
SN74193	2·00
SN74194	1·30
SN74195	1·10
SN74196	1·20
SN74197	1·20
SN74198	2·77
SN74199	2·52

DIL SOCKETS 14 pin **15p** 16 pin **17p**

VAT

8% to be added to all orders including POSTAGE!

THIS MONTH'S

● OSCILLOSCOPE TUBES
Types CV 1526, DG 7-5, VCR 139A
All at **£8·00** each, + p & p 25p.

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TERMS OF BUSINESS: C.W.O. A/c's available to approved companies on application. Telephone and telex orders accepted. Export and trade enquiries welcomed. Lists, etc. on application. Open daily to callers 9 a.m.–5 p.m. Mon.–Sat. Closed Sat. 1–3 p.m. Prices correct when going to press.

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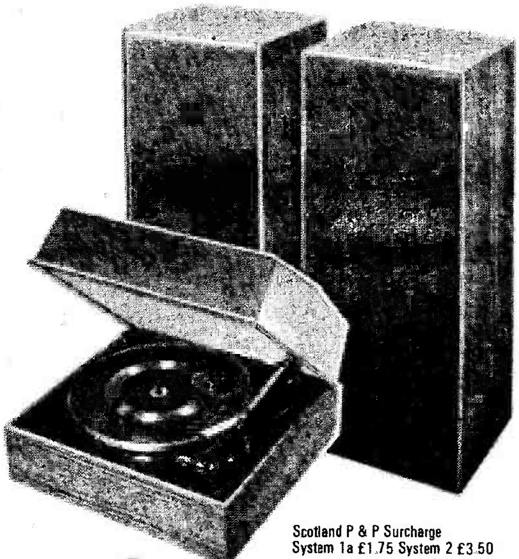
Tel: 01-677 2424 Telex: 946 708.

RTVC

*COMPLETE STEREO SYSTEM



Scotland P & P Surcharge
System 1a £1.75 System 2 £3.50

System 1a. £62.00

40 Watt Amplifier. Viscount III – R102 now 20 watts per channel (40 watts peak).
All systems include:
Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo, on/off function and bass and treble filters. Plus headphone socket.
Specification:
20 watts per channel into 8 ohms 40W peak. Total distortion @10W @1kHz 0.1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV at 1kHz into 47K. equalised within ∓1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to –17dB @60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to –12dB @15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) –58dB. Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾"×9"×3¾".
Garrard SP 25 deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers – Enclosure size approx. 19¼"×9½"×7¾" in simulated teak. Drive unit 13" x 8" with 3" tweeter. 15 watts handling. 30 watts peak.
Complete System with these speakers £62.00 + £5.50 p & p.

System 2. £82.00

Viscount III amplifier (As System 1a)
Garrard SP 25 deck (As System 1a)

Two Duo Type III matched speakers – Enclosure size approx. 27"×13"×11½" Finished in teak simulate. Drive units 13"×8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS, 8 ohms frequency range – 20 Hz to 18,000 Hz.
Complete System with these speakers £82.00 + £6.50 p & p.

PRICES: SYSTEM 1a

Viscount III R102 amplifier	£27.00+£1.60 p & p
2 Duo Type IIa speakers	£26.00+£5.50 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and cover	£21.00+£2.80 p & p
Total if purchased separately: £74.00	

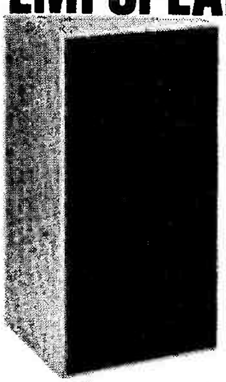
Available complete for only: £62.00 +£5.50 p & p

PRICES: SYSTEM 2

Viscount III R102 amplifier	£27.00+£1.60 p & p
2 Duo Type III speakers	£39.00+£6.40 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and cover	£21.00+£2.80 p & p
Total if purchased separately: £87.00	

Available complete for only: £82.00 +£6.50 p & p

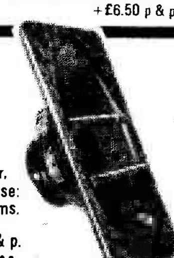
EMI SPEAKERS AT FANTASTIC REDUCTIONS



LE-4 SPEAKERS

Superb performance and beautifully finished in selected teak veneers. A professional standard four-way speaker system giving 25 watts RMS power handling. Bass unit is 14"×9" with 8"×5" unit for mid-range and twin 3" high frequency units to give monitor type quality and performance.
Specification – Size 33"×14"×16" approx. Impedance 8 ohms. Power handling 25W RMS. (Peak 50 watts.) Frequency range 35 Hz–20 KHz.

Our Price £29.00
(normally £56.97) +£5 p & p.



EMI 350 KIT

System consists of a 13"×8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)
Complete with crossover Components and circuit diagram **£5.50** +£1 p & p.

20 WATT SPEAKER SYSTEM *

System consists of a 13"×8" (approx.) eliptical woofer unit with a 8"×5" (approx.) mid-range unit incorporating parasitic tweeter and crossover components and circuit diagram
Technical Specification: Bass Unit: Flux density – 100 K, speech coil – 1½". Cone. Triple laminated paper with P.V.C. surround. Mid-Range Unit: Flux density – 33 K, speech coil – 1" with parasitic tweeter. Power handling: 20 watts RMS, impedance – 8 ohms, frequency response – 20 Hz to 18,000 Hz.

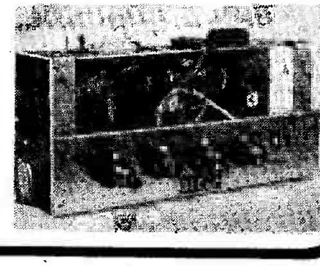
Our Price £7.50
Complete +£1.35 p & p.

EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13"×8" woofer, 3½" tweeter and matching crossover.
Easily put together with just a few basic tools.
Specification (each speaker): Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20–20,000Hz. Size 20"×11"×9½" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.

£18.95 pair complete Complete with crossover Components and circuit diagram
+£4.50 p & p.

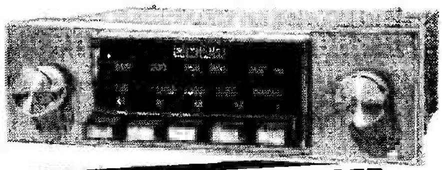
DECCA STEREO AMPLIFIER CHASSIS



Specification: 4+4 watts into 8 ohms. Input Sensitivity 4mV into 47K (for magnetic cartridges). AC Mains only 240V. Controls – volume, bass, treble, on/off, mono/stereo switch. Chassis size 11"×5½"×3¼" approx.

£5.95 +£1 p & p.

PUSH BUTTON CAR RADIO KIT — THE TOURIST TT*



NO SOLDERING REQUIRED

NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board. **TECHNICAL SPECIFICATION:** (1) **Output** 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) **Integrated circuit** output stage, pre-built three stage IF Module.

Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7″ wide 2″ high and 4¾″ deep approx. **£8.00** + 90p. p & p. Speaker including baffle and fixing strip £1.65 + 37p p & p. Car Aerial Recommended — fully retractable £1.37 + 32p p & p.

The Tourist I Kit For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. **Price £7.00** + 90p p & p.

*STEREO 21 QUALITY SOUND FOR LESS THAN £20.00

Stereo 21, easy to assemble audio system kit. No soldering required.
The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth.
Includes — **BSR 3 speed deck**, automatic, manual facilities together with stereo cartridge.
Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
Specifications — For the technically minded:
Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs — radio, tape, etc., and outputs for taping discs.
Overall Dimensions. Speakers approx 15½″ × 8″ × 4″. Complete deck and cover in closed position approx. 15½″ × 12″ × 6″.

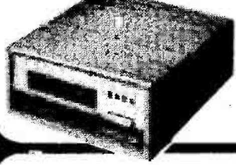
Complete only £19.95 + £2.60 p & p.

Extras if required. Optional Diamond Styli £1.37.
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. £5.00.

*DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).
Inputs *4 electrically mixed inputs. *3 individual mixing controls. *Separate bass and treble controls common to all 4 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State circuitry. *Attractive styling.
INPUT SENSITIVITIES — Input — 1). Crystal mic. guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity.) — Inputs — 2), 3), 4). Medium output equipment — ceramic cartridge, tuner, tape recorder, organs, etc. — all 250mV sensitivity. AC Mains, 240V operation. Size approx: 12½″ × 6″ × 3½″ **£17.00** + £1.15 p & p.

*8 TRACK HOME CARTRIDGE PLAYER



Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21. Technical specification Mains input, 240V, Output sensitivity 125mV. Comparable unit sold elsewhere at £24.00 approx. Yours for only

£12.95 + £1.45 p & p.

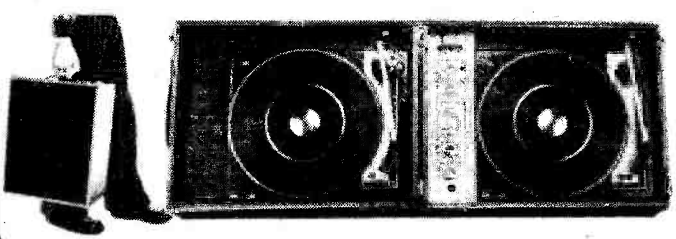
BUILD YOUR OWN STEREO AMPLIFIER*

For the man who wants to design his own stereo — here's your chance to start, with Unisound — pre-amp, power amplifier and control panel. No soldering — just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only.

Also available with 2 speakers (7″ x 4″) £9 + £1.50 p & p. **£7.64** + 90p p & p.

PORTABLE DISCO CONSOLE*

INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.



TECHNICAL SPECIFICATION:
Pre-amp — Output — 200mV. Auxiliary inputs — 200mV and 750mV into 1 meg. Mic input — 6mV into 100K. 240 volt operation. **Turntables capacity** — 7″, 10″ or 12″ records. **Rumble, wow and flutter** Rumble Better than −35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter). **Finish** — Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

Console size —
Unit Closed — 17¼″ × 13¾″ × 8¾″ (app.)
Unit Open — 35¼″ × 13¾″ × 4¾″ (app.)
This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.
The unit is finished in black PVC with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

Yours for only £49.00 + £5.60 p. & p.

BARCLAYCARD — Buy it with Access

DO NOT SEND CARD
Just write your order giving your credit card number

Mail orders to Acton. Terms C.W.O. All enquiries stamped addressed envelope. Goods not despatched outside U.K. Leaflets available for all items listed thus * Send stamped addressed envelope. All items subject to availability. Prices correct at 1st April 1975 and subject to change without notice.
All prices include V.A.T. at 8% rate.

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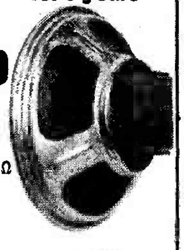
12 inch MODELS

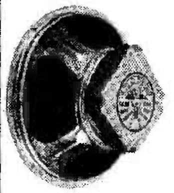
Guaranteed for 5 years

T12/35 Rated Power 35 WATTS

Centre Pole Diam. 1½" Imp. 8–15Ω
Twin Cone. Range: 50–17000Hz
Ceramic Magnet
Weight: 600 Gms

Rec. Price **£10·50**

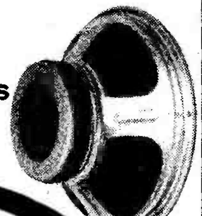




T12/60 Rated Power 60 WATTS

Centre Pole Diam. 2" Imp. 8–15Ω
Range: 60–9000Hz
Ceramic Magnet
Weight 1150 Gms.

Rec. Price **£17·50**



T12/100 Rated Power 100 WATTS

Centre Pole Diam. 3" Imp 8–15Ω
Range: 40–5000Hz
Ceramic Magnet
Weight: 1250 Gms

Rec. Price
£29·00

Power Ratings R.M.S. Continuous

All Rec. Prices inc. VAT

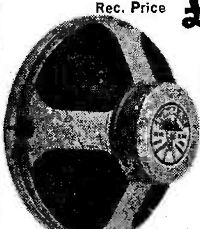
15 inch MODELS

Guaranteed for 5 years

T15/70 Rated Power 70 WATTS

Centre Pole Diam. 2" Imp 8–15Ω
Ceramic Magnet
Weight: 1150 Gms
Range: 50–4000Hz

Rec. Price **£19·00**

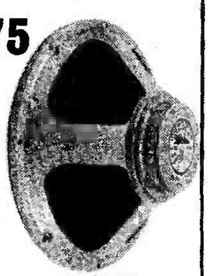


T15/100
Rated Power 100 WATTS

Centre Pole Diam. 3" Imp. 8–15Ω
Ceramic Magnet
Weight: 1250 Gms.
Range: 50–4000Hz

Rec. Price **£32·75**

18 inch MODEL



T18/100 Rated Power 100 WATTS

Centre Pole Diam. 3" Imp. 8–15Ω
Ceramic Magnet
Weight: 1250 Gms.
Range: 35–4000Hz

Rec. Price **£37·50**

Wholesale, Retail and Export enquiries to Sole Distributors:-

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GUEST ELECTRONIC DISTRIBUTION LIMITED

Guest, normally supplying electronic components to industry, are making available packs of specially selected components for the home constructor. These components are of professional quality at hard to beat prices.

PACK 1—CAPACITOR PACK

30 Miniature vertical mounting electrolytic capacitors 50V working.

5 x 0·47μF	5 x 10μF	**£2·00** (one pack)
5 x 1·0μF	3 x 22μF	**£3·50** (two packs)
5 x 2·2μF	2 x 33μF	
5 x 3·3μF		

PACK 2—RESISTOR PACK

Pack of 200 medium power (0·75 & 1W) resistors. Assorted values throughout E24 range 5%.
£2·00 (one pack)

PACK 3—POTENTIOMETER PACK

Pack of skeleton potentiometers linear ¼W.

4 x 250Ω	4 x 10KΩ	**£2·50** (one pack)
4 x 500Ω	4 x 50KΩ	
4 x 1KΩ	4 x 100KΩ	
4 x 2·5KΩ	4 x 2·5MΩ	

PACK 4

A special pack designed for the constructor who is "stocking up" generally and seeks excellent value.

Comprising:
- Selection of electrolytic capacitors (30+)
- Comprehensive selection of medium power resistor (5%) E24 series (100+)
- Selection of skeleton potentiometers (32+)
- Selection of lampholders (5+) with bulbs
- Miniature 250V 2A toggle switches, 3 or 4 poles (2+)

£5·50 (one pack)

All prices include VAT and Post and Packing.

Please send cheque/P.O./Cash, clearly stating pack required and address to:

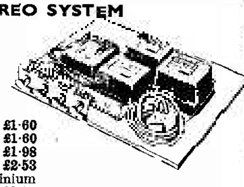
BRIAN WOODS
(REF: B.D.) Marketing Services, Guest Distribution, Redlands, Coulsdon, Surrey CR3 2HT

NEW ITEMS THIS MONTH

The bargains in this column are just some of the items which appeared in the April supplement to our catalogue. You can receive this catalogue and the next 12 supplements by sending £1.

Miniature microswitch with roller, Cherry ref. no. E62, size approx. ⅝" long × ⅜" high × ¼" thick with steel roller on ⅞" long actuating lever. **35p** each.
Triac, ex unused computer American "GE" ref. no. SC 40D, this is a 600v 12 amp triac. A snip at **£1·40.**
Rectifier, American "GE", 100v 10 amp. **65p** each.
Computer condensers, American made Sangamo, their type DCM: 21,500 mfd, 35v DC working with mounting clip and terminal sockets. Price **£1** each + 25p post.
Reel to reel tapes, pre-recorded with classic and light music, new in perspex type storage box, 10 different titles (our assortment). **£5** the lot, which makes them worth buying even if you do not like the music recorded on them. Please add 30p post. **50 all different £25.**
Multi-voltage transformer 13 watts, an extremely versatile transformer and it is quite surprising the number of different voltages which may be obtained by using its two windings or parts of these windings in assisting or opposing modes. In addition to these, such voltages as 20-0-20 or 25-0-25 or 130-0-130 may be obtained. The two secondary windings are (1) 50v tapped at 30v and (2) 260v tapped at 240, 220, 200 and 130. Special snip price, only **£1** + 30p post.
Ring main cable. Springtime is the time for alterations at home and if you are contemplating any lighting or heating alterations, then note we have good quality ring main cable 13 amp twin and earth, price **15p** per metre, cut to your length, or **£11·75** per 100 metres + £1 post.
Ditto for lighting, 12p per metre, cut to your length, or **£7·75** per 100 metres. Also for ring mains etc. we have **junction boxes** at **14p** each, **13 amp ring main sockets,** flush mounting, white, at **40p** each, brown at **25p** each or brown switched at **30p** each. **13 amp 2 gang sockets,** brown, unswitched, at **60p** each. **5 amp 3 pin sockets,** white at **25p** each, switched **30p.** White **spur boxes 20p** each—white **spur with 13 amp socket 50p. 3KW tangential heaters.** We have had a further small delivery of these and can once again supply. Price, a little up unfortunately, now **£4·80** + 60p post. Control switch **55p.** Knob for same **25p.**
Break-down unit, contains a whole range of most useful parts some of which are as follows—66 silicon diodes equivalent OA91. 68 resistors, mostly ¼ watt 5% covering a wide range of values. 4 × ·1 mfd 400v condensers. 15 × ·01 mfd 100v condensers. 2 RF chokes. 8 × B9 valve holders. 1 × 4H choke. 1 × 115v transformer. 1 boxed unit containing 4 delay lines. Tag panels, trimmer condensers, suppressors, all mounted up on a useful chassis sized approx. 9" × 5" × 7". Offered at only **75p**—the 66 diodes would cost at least 10 times this amount, so this is obviously a snip not to be missed. Post and packing 60p.
Waterproof 3 core leads for lawn mowers etc., new colour code, 5A rating, this is a perfectly standard pvc circular flex which will cost you **15p** per metre in your local shop. Offered at the special price of **£1·85** per 25 metre length + 30p post. Fix a 13 amp socket to a cable drum, wind this lead round it and terminate with a 3 amp rubber covered plug (available, price **40p**) and you have a very useful extension lead.
Acquarium thermostat, in a sealed glass tube, but adjustable over the tropical fish range. Price **£1** each.
Computer boards with ICs. We guarantee each board have at least 15 ICs, the boards are in tip top condition, as far as we know they were never put into service. Price **75p** each.
Computer cooling fans, the famous Plannair, these are a six bladed 4½" fan rotating at approx. 3000 revs per minute, in a die cast case sized approx. 5" square with 4 fixing holes and cable entry box. Now new, but any not in perfect working order would be replaced. Price **£3** each + 30p post.
Double-ended mains motors, special snip this month! It has a normal induction motor, not high powered but quite suitable for operating a fan in a heater or cooker hood or similar. This has the advantage that having a spindle from each end thus any fan blade should be right. Another feature is that this has 4 mounting feet. Special price, only **55p** each.
Slot meter. Another special bargain this month because of its high and useful breakdown value is the slot meter. (a) It is in a useful box with lock, size approx. 8" × 3" × 4" (b) it has a Sangamo motor of 1 rev per hour which the makers price is in excess of £3 (c) it has 3 digit counter and (d) it has a coin switch mechanism. Undoubtedly an unrepeatable bargain at **£2** + 30p post.
High power battery motor, 12v operated, strong enough to power a motor mower, go-cart or similar. Speed easily variable. These motors can also be used as a brake for any rotating machine, simply by coupling the spindle to the machine and short-circuiting the windings by a variable resistance, price **£2·50.**
Transistor type 2N3055, thoroughly checked, for high gain, suitable for fluorescent lighting in verters etc. **45p** each.
Relay "elasta" Swiss made with watchmaker's precision, 1600 ohm coil operates heavy duty gold or silver contacts, one set changeover and two other sets open or relay closing. A really high-class relay, supplied in a transparent plastic box which can be used as a dust cover. Do not miss this bargain at **55p.**
2 circuit toggle switch normal panel mounting through ⅜" hole, one circuit changeover, the other circuit simply on-off. **20p** each.

MULLARD UNILEX STEREO SYSTEM



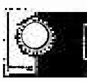
There is no doubt that it is a good system, we believe that for the money it is without comparison. We demonstrate gladly at our Tamworth Road depot. Prices of the individual items for this:

1 Unilex Amplifier	Ref. EP.9000	£1·60
1 Unilex Amplifier	Ref. EP.9000	£1·60
1 Unilex Pre-Amp	Ref. EP.9001	£1·98
1 Unilex Power Unit	Ref. EP.9002	£2·53
1 Control panel kit with spun aluminium faced knobs		£3·80

Pair of 15 ohm speakers made by Goodmans are also available if required, price **£3·30** the pair. No extra postage if ordered with the above, otherwise add 25p.

SPECIAL PRICES TO COLLEGES AND INSTITUTIONS WISHING TO INCLUDE THIS KIT IN THEIR CURRICULUM.

SMITHS CENTRAL HEATING CONTROLLER



Push button gives 10 variations as follows:—(1) continuous hot water and continuous central heating (2) continuous hot water but central heating off at night (3) continuous hot water but central heating on only for 2 periods during the day (4) hot water and central heating both on but day time only (5) hot water all day but central heating only for 2 periods during the day (6) hot water and central heating on for 2 periods during the day time only—then for summer time use with central heating off (7) hot water continuous (8) hot water day time only (9) hot water twice daily (10) everything off. A handsome looking unit with 24 hour movement and the switches and other parts necessary to select the desired programme of heating. Supplied complete with wiring diagram. Originally sold, we believe, at over **£15**—we offer these, while stocks last, at **£5·95** each, post 30p.

WALL THERMOSTATS

Wall mounting and in a handsome plastic case. (Cream and beige). Adjustable by slider (lockable) and may be set to control temperatures from around freezing through to 50°C. The slide panel is engraved and indicates (frost), (warm), (very warm), etc. The thermostat will control heaters, etc., up to 15 amp at normal mains voltage and is ideal for living room, bedroom and greenhouse, etc. Price **£1·65.** Don't miss this.

THIS MONTH'S SNIP

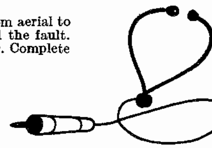
Latest BSR Record Changer with ceramic Stereo Cartridge **£6·95** and if purchased at the same time teak veneered wooden plinth and Perspex cover for only **£4·00** instead of **£4·95** P.&P. £1 on one or both items.

TRANSISTOR ASSISTED CAR IGNITION

This system which has proved to be efficient and reliable, was described in the April *Wireless World.* We can supply kit of parts. Price **£5·55** plus 30p post. When ordering please state whether for positive or negative systems.

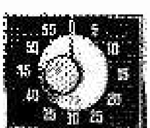
RADIO STETHOSCOPE

Easiest way to fault find, traces-signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube and crystal earpiece, **£2·20** twin stetho-set instead of earpiece **88p** extra post and ins. 20p.



DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. **£2·75** plus 40p P. & P.

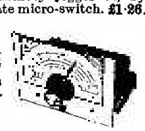


1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4⅝in. × 3¼in., which can be set in 1 minutes up to 1 hour. After preset period the bell rings. Ideal for processing a memory jogger or, by adding simple lever, would operate micro-switch. **£1·26.**

SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 39 metre bands-Kit contains chassis front panel and all the parts, **£1·25**—crystal earphone **50p.**



INSTANT START FLUORESCENT LIGHTING BARGAINS

Starterless control gear, complete with tube ends and tube clips for window lighting, signs, fascias, etc. 4 ft. 40 w. **£1·50**; 5 ft. 65w. **£1·60**; 5 ft. 80w. **£1·75**; 6 ft. 80w. **£1·95**; and for pairs as follows:— twin 2 ft. 20w. **£2·55**; twin 3 ft. 30w. **£2·75**; twin 4 ft. 40w. **£2·95**; twin 5 ft. 65w. **£3·25**; twin 5 ft. 80w. **£3·95**; twin 8 ft. 125w. **£4·50.** These are about one half of maker's current prices and can't be repeated once stocks are cleared. Please add 30p per piece to cover postage or carriage.

MAINS TRANSFORMERS

All standard 230-250 volt primaries.

		£ p
1v	1 amp (special)	1·75
2·4v	5 amp ..	·85
6·3v	2 amp ..	1·00
6·3v	3 amp ..	1·50
9v	1 amp ..	·95
9v	3·5 amp ..	1·95
12v	1½ amp ..	1·50
12v	1 amp ..	1·00
6·5v-0·6 5v	1 amp ..	1·35
18v	1 amp ..	1·25
20v	½ amp	1·00
24v	1 amp ..	1·50
24v	3 amp ..	3·50
12·0-12v	50mA ..	1·20
6·0-6v	50mA ..	1·20
8·0-8v	½ amp ..	1·25
18·0-18v	2 amps ..	3·50
25v	1½ amp ..	1·95
50v 2 amp & 6·3v ..	1 amp ..	4·50
60v 5 amp & 5v ..	1 amp ..	7·50
27v	8 amp ..	4·50
30v	37 amp ..	22·00
80v tapped 75v & 70v	4 amp ..	5·50
230v-60mA & 6·3v ..	1·5 amps	1·75
275-0·275v at 90mA & 6·4v	3 amps ..	2·25
EHT Transformer 5000v 23mA	(intermittent)	5·50
Charger Transformers		
6v and 12v	2 amps ..	1·25
6v and 12v	3 amps ..	2·25
6v and 12v	5 amps ..	3·50

DEDUCT 10% IF YOU ORDER 10 OR MORE OF ONE TYPE, ADD 35p PER TRANSFORMER IF NOT COLLECTING.

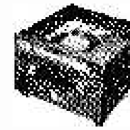
RELAY BARGAIN

Type 600 relay, 2 changeover one open and one closed contact. Twin 500 ohm coils make this suitable or closing off DC 6v, DC 12v, DC 24v or AC mains using resistor and rectifier. **33p** each. Resistor and rectifier **20p** extra.

BLACK LIGHT

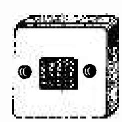
As used in discotheques and for stage effects, etc. Virtually no white light appears until the rays impinge on luminous paint or white shirts, etc. We offer 12" 8w tubes complete with starter, choke, lamp-holders and starter-holder. Price **£2·75** + 30p post. Tubes only **£2** + 30p post.

TAPE DECK



In metal case with carrying handle, heavy fly wheel and capstan drive. Tape speed 3¾. Mains operated on metal platform with tape head and guide. Not new but guaranteed good working order. Price **£1·95** plus £1 post and insurance.

LIGHT SWITCH



Automatically switches on lights at dusk and off at dawn. Can also be used where light and dark is a convenient way to stop and start an operation. Requires only a pair of wires to the normal switch. In bakelite box, normal switch-plate size. 1 amp model **£2·95.**

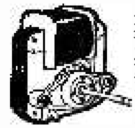
MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **£1·20.**

SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450w). Unit in Box all ready to work. **£7·95** plus 95p VAT and postage.

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. Snip at **75p** Postage 20p for first one the 10p for each one ordered.
1" stackmotor **£1·04.**
1½" stackmotor **£1·20.**

AUTO—ELECTRICAL CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£6·95** plus 25p post and insurance.

TERMS:—
ADD V.A.T.
Send postage where quoted—other items, post free if order for these items is £6·00, otherwise add 30p.

J. BULL (ELECTRICAL) LTD.
(Dept. P.W.), 103 TAMWORTH ROAD, CROYDON CRO 1XX

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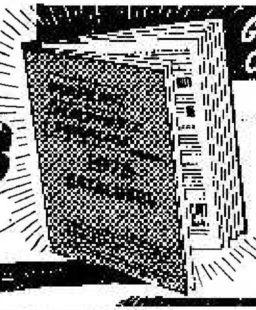

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132 Big Pages

Includes dozens of useful & interesting circuits you can build; data; hundreds of pictures, transistor equivalents list and hundreds of new lines. Packed with information. Only 40p.

NEW SHOP NOW OPEN, details below

SUPERSONIC SAME-DAY-SERVICE — MEANS QUALITY COMPONENTS — FAST!

● RESISTORS

CARBON FILM
¼W 1 Ω to 1M: 5%, 1M2 to 10M: 10% E12
½W 1 Ω to 10 Ω: 5%, 1M2 to 10M: 10%
E12 11 Ω to 910k: 5% E12 & E24 **1p** each
METAL OXIDE
½W 10 Ω to 1M: 2% E12 & E24 **4p** each
WIREWOUND
3W 0·22 Ω, 0·27 Ω, 0·33 Ω, 0·47 Ω: 10%, 1 Ω 5% **18p** each
1·2 Ω to 270 Ω: 5% E12 **14p** each
Other ranges stocked. See our catalogue for details.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades.
E24: 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades.

● POTENTIOMETERS

Rotary miniature carbon track ¼" spindle.
Values available: 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M.
Log. Single-gang **17p**
Lin, Single-gang (+ 1K) **17p**
Log. or Lin. Single-gang with switch **36p**
Log. or Lin. Dual-gang without switch **54p**
Slider 60mm track. Metal-cased: overall length 86·15mm (knob extra **7p**)
Values available: 1k; 5k; 10k; 25k; 50k; 100k; 250k; 500k;
Lin. Single Gang **38p**
Log Single Gang **42p**
Lin or Log Dual Gang **49p**
Presets: 0·1W Vertical or Horizontal.
100 Ω, 220 Ω, 470 Ω, 1K, 2k2, 4k7 10k, 22k, 47k, 100k, 220k, 470k, 1M **7p** each

● CAPACITORS

Sub-miniature
Axial lead electrolytic

Mfd	V	Price	Mfd	V	Price	Mfd	V	Price
1	63	6p	68	6·3	6p			
1·5	63	6p	68	16	6p			
2·2	63	6p	68	63	14p			
3·3	63	6p	100	4	6p			
4·7	63	6p	100	10	6p	470	6·3	6p
6·8	40	6p	100	25	6p	470	10	14p
6·8	63	6p	100	40	6p	470	25	16p
10	25	6p	100	63	16p	470	40	25p
10	63	6p	150	6·3	6p	680	6·3	14p
15	16	6p	150	16	6p	680	16	16p
15	40	6p	150	25	6p	680	25	25p
15	63	6p	150	40	14p	680	40	28p
22	10	6p	150	63	16p	1000	4	14p
22	25	6p	220	4	6p	1000	10	16p
22	63	6p	220	10	6p	1000	16	25p
33	6·3	6p	220	16	6p	1000	25	28p
33	16	6p	220	25	14p	1500	6·3	16p
33	40	6p	33	40	6p	1500	10	25p
47	4	6p	220	63	25p	1500	16	28p
47	10	6p	330	4	6p	2200	6·3	25p
47	25	6p	330	10	6p	2200	10	25p
47	0	6p	330	16	14p	3300	6·3	28p
47	63	6p	330	63	28p	4700	4	28p

● MAINS CONNECTORS

P360 3-pin 1·5A Chassis Plug with Line Socket **40p**
SA2190 3-pin 5A Chassis Plug **28p**
SA1862 Line Socket for SA2190 **32p**
P437 3-pin 5A Chassis Socket with Line Plug **77p**

● TRANSISTORS & DIODES

AC127	18p	BY126	13p
AC128	18p	BY127	13p
AC176	17p	BY164	49p
AD161/162 MP	93p	BZY88 series	13p
BA100	9p	MPF102	36p
BA145	22p	OA91	6p
BC107	10p	OA200	7p
BA108	10p	OC71	20p
BC109	13p	SC146D	88p
BC109C	15p	T1843	28p
BC142	23p	WOO5	30p
BC143	26p	WO4	33p
BC147	10p	1N914	4p
BC148	10p	1N4001	6p
BC149	12p	1N4002	6½p
BC168C	12p	1N4003	7p
BC169C	12p	1N4004	7½p
BC178	17p	1N4005	8p
BC182L	10p	1N4006	8½p
BC183L	12p	1N4007	9p
BC184L	12p	1N4148	4p
BC212L	14p	2N1302	20p
BC213L	15p	2N1303	20p
BC214L	18p	2N1304	30p
BCY71	22p	2N1711	24p
BD131	45p	2N2219	25p
BD132	54p	2N2646	45p
BD131/BD132		2N2905	33p
MP	£1·20	2N29260r	12p
BD135	36p	Ye	12p
BD139	49p	Gn	13p
BD140	69p	2N3053	18p
BF258	35p	2N3055	49p
BF259	25p	2N3819	22p
BFX29	30p	2N5459	51p
BFX30	33p	7400	16p
BFX84	30p	7413	39p
BFX85	36p	7447	£1·10
BFX87	30p	7473	54p
BFX88	25p	7474	45p
BFY50	20p	7490	93p
BFY51	22p	7493	93p
BFY52	20p	74121	39p

L.E.D. RED
2mcd ⅕" only **15p**
Panel mtg. clip **5p**
(Other colours and 7-seg. displays in our catalogue)

● INTEGRATED CIRCUITS

CA3046 (14-pin DIL) **69p**
LH0042CH (TO99) **£4·25**
MC1310P (14-pin DIL) **£2·50**
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MFC6040 **83p**
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TBA810S **£1·00**
μA741C (8-pin DIL) **36p**
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VOLTAGE REGULATORS
μA7805 5V 1·5A (TO3) **£1·75**
μA7815 15V 1·5A (TO3) **£1·75**
MVR 5V, 12V, 15V, 500mA (TO3) **£1·60**
μA78M05 5V 500mA (Plastic power) **£1·05**
μA78M15 15V 500mA (Plastic power) **£1·05**
μA78L05 5V 100mA (TO92) **60p**
μA78L15 15V 100mA (TO92) **60p**
μA723C Variable 2 to 37V (TO99 or 14-pin DIL) **75p**
Our catalogue contains application circuits and data for all the above I.C.'s and many more

● DISCOUNTS

Details in our catalogue. Start collecting MES Discount Vouchers NOW!

● SWITCHES

Rotary adjustable stop. 1 pole, 2 to 12 way; 2 pole, 2 to 6 way; 3 pole, 2 to 4 way; 4 pole, 2 or 3 way **46p** each
Slide Sub-min DPDT **10½p**
Slide Min. DPDT **14p**
Push to make Non-locking SPST **14p**
Push-on, Push-off Locking DPST 250V 4A **36p**
Rocker White DPST 250V 10A **42p**
Rotary Mains DPST 250V 2A **26p**
Toggle with ON/OFF plate DPDT 250V 1·5A **26p**

BCD OUTPUT SLIDE SWITCH
Marks the end of the old-fashioned thumb-wheel switch With 7-segment type read-out. Full details in our catalogue. **£1·38**

● PLUGS & SOCKETS

DIN	PLUG	CHASSIS SOCKET
2-pin	8p	7p
3-pin	9p	8p
4-pin	10p	8p
5-pin A (180°)	12p	8p
5-pin B (240°)	12p	8p
6-pin	12p	9p

JACK PLUGS
¼in. Std. Mono Plastic Barrel **13p**
¼in. Std. Mono Metal Barrel **24p**
¼in. Std. Stereo Plastic Barrel **18p**
¼in. Std. Stereo Metal Barrel **33p**
2·5mm Plastic Barrel **10p**
2·5mm Metal Barrel **15p**
3·5mm Plastic Barrel **10p**
3·5mm Metal Barrel **15p**

JACK CHASSIS SOCKETS
2·5mm Open-type metal **9p**
3·5mm Open-type metal **9p**
¼" Std. Mono Open-type metal **14p**
¼" Std. Mono Moulded with 2 break contacts **16p**
¼" Std. Stereo Open-type metal **18p**
¼" Std. Stereo Moulded with 3 break contacts **21p**

PHONO
Plastic-topped Plug **7p**
Screened Plug **12p**
Chassis Socket Single **5p**
Chassis Socket Twin **8p**

● TRANSFORMERS

LT700 min. output. Pri. 1k2; Sec. 5 Ω 200mW **55p**
Sub-min mains 6-0-6V 100mA **£1·03**; 12-0-12V 50mA **£1·03**
(Size both approx. 30 × 27 × 25mm)
Min. mains
0-6V 500mA, 0-6V 500mA **£1·88**
0-12V 250mA, 0-12V 250mA **£1·88**
0-20V 150mA, 0-20V 150mA **£1·88**
0-24V 125mA, 0-24V 125mA **£1·88**
Mains MT3AT: Sec: 12-15-20-24-30V 2A **£4·23**
Mains MT206AT: Sec: 0-15-20V 1A, 0-15-20V 1A **£3·98**

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A Full Scale Electronic Organ that you can Build to Your Own Specification.

FULL CONSTRUCTIONAL DETAILS IN OUR LEAFLETS

Leaflet MES 51: Price **15p**, describes a fully polyphonic basic organ which can later be used as the basis of a large sophisticated instrument. Leaflet MES 52: Price **15p** continues the description of the MES 50 series organs and shows you how to add a second keyboard with lots more stops.

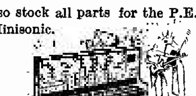
● THE AMAZING DMO2

A ready-built, tested and guaranteed digital master oscillator. Accurately generates the top 13 notes for your organ system and reduces the complete tuning of your organ to ONE SIMPLE adjustment. New design gives selectable C to C output ranges of (approx.) 4k to 8k (highest) or 2k to 4k or 1k to 2k, etc. right down to 16Hz to 32Hz! And this new compatible design is even smaller:—only 3·5in × 3·7in including gold-plated edge connexion.
DMO2T includes built in variable depth and rate frequency shift tremulant.
DMO2 **£12·25** DMO2T **£14·25**
SAJ 110: 7-stage frequency divider in 14-pin DIL package. Sine or square wave input. Square wave output may be converted to saw-tooth. **£1·30** each or 6 for **£9·94** or 12 for **£18·16**.
Keyboards high quality, fully sprung.
Flat-front 48-note F to E **£15·95**
Sloping-front 49-note C to C **£15·95**
Sloping-front 61-note C to C **£20·44**
Swell pedal with 10k log. pot **£6·33**
*Spring Line Unit (Short) **£3·05**
*Spring Line Unit (Long) **£8·29**
*Reverberation Driver Module **£5·34**
* S.A.E. please for full details: leaflet MES 24.
Gold-clad phosphor-bronze wire **30p** per yd.
Palladium earth bar **15p** per octave length.
Contact Blocks 2-make (GB2) **22p**
Stop Tabs rocker type not engraved (white, red, grey or black) with DPDT switch **59p**

SPECIAL OFFER
15 BC108C £1.00
All brand new marked I.T.T. Guaranteed full spec. highest gain group.

"ELECTRONICS TODAY INTERNATIONAL" 4600 SYNTHESISER

We stock all parts for this brilliantly designed synthesiser. This includes all the P.C.B.s, metal-work and drilled and printed front panel giving a truly professional finish. Authoritative opinions agree the E.T.I. International Synthesiser is technically superior to most of today's models. Complete constructional details in our booklet, available shortly. S.A.E. please for price list and specification.
We also stock all parts for the P.E. Synthesiser and Minisonic.



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VAT Please add 8% to the final total. Post and packing included in U.K.
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First-class post pre-paid envelope supplied free with every order.

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price
AC107	0·22
AC113	0·20
AC115	0·22
AC117K	0·32
AC122	0·13
AC125	0·19
AC126	0·19
AC127	0·20
AC128	0·20
AC132	0·16
AC134	0·16
AC137	0·16
AC141	0·20
AC141K	0·32
AC142	0·20
AC142K	0·28
AC151	0·17
AC154	0·22
AC155	0·22
AC156	0·22
AC157	0·27
AC165	0·22
AC166	0·22
AC167	0·22
AC168	0·27
AC169	0·16
AC176	0·22
AC177	0·27
AC178	0·31
AC179	0·31
AC180	0·22
AC180K	0·32
AC181	0·22
AC181K	0·32
AC187	0·24
AC187K	0·25
AC188	0·24
AC188K	0·25
ACY17	0·28
ACY18	0·22
ACY19	0·22
ACY20	0·22
ACY21	0·22
ACY22	0·18
ACY27	0·20
ACY28	0·21
ACY29	0·39
ACY30	0·31
ACY31	0·31
ACY34	0·23
ACY35	0·23
ACY36	0·31
ACY40	0·19
ACY41	0·20
ACY44	0·39
AD130	0·42
AD140	0·53
AD142	0·53
AD143	0·42
AD149	0·55
AD161	0·39
AD162	0·39

Type	Price
AD161 & AD162(MP)	75
ADT140	0·55
AF114	0·27
AF115	0·27
AF116	0·27
AF117	0·27
AF118	0·39
AF124	0·33
AF125	0·33
AF126	0·31
AF127	0·31
AF139	0·33
AF178	0·55
AF179	0·55
AF180	0·55
AF181	0·55
AF186	0·55
AF239	0·41
AL102	0·72
AL103	0·72
ASY26	0·28
ASY27	0·33
ASY28	0·28
ASY29	0·28
ASY50	0·28
ASY51	0·28
ASY52	0·28
ASY54	0·28
ASY55	0·28
ASY56	0·28
ASY57	0·28
ASY58	0·28
ASY73	0·28
ASZ21	0·44
BC107	0·9
BC108	0·9
BC109	0·9
BC113	0·11
BC114	0·17
BC115	0·17
BC116	0·17
BC117	0·20
BC118	0·11
BC119	0·33
BC120	0·88
BC125	0·13
BC126	0·20
BC132	0·13
BC134	0·20
BC135	0·13
BC136	0·17
BC137	0·17
BC139	0·44
BC140	0·33
BC141	0·33
BC142	0·33
BC143	0·33
BC145	0·50
BC147	0·11
BC148	0·11
BC149	0·13
BC150	0·20

Type	Price
BC151	0·22
BC152	0·19
BC153	0·31
BC154	0·33
BC157	0·20
BC158	0·13
BC159	0·13
BC160	0·50
BC161	0·55
BC167	0·13
BC168	0·13
BC168	0·13
BC170	0·13
BC171	0·16
BC172	0·16
BC173	0·16
BC174	0·16
BC175	0·24
BC177	0·21
BC178	0·21
BC179	0·21
BC180	0·27
BC181	0·27
BC182	0·16
BC182L	0·16
BC183	0·16
BC183L	0·16
BC184	0·22
BC184L	0·22
BC186	0·31
BC187	0·31
BC207	0·12
BC208	0·12
BC209	0·13
BC212L	0·14
BC213L	0·14
BC214L	0·18
BC225	0·28
BC226	0·29
BC301	0·30
BC302	0·27
BC303	0·35
BC304	0·40
BC440	0·34
BC460	0·40
BCY30	0·27
BCY31	0·29
BCY32	0·33
BCY33	0·24
BCY34	0·28
BCY70	0·16
BCY71	0·22
BCY72	0·16
BCZ10	0·22
BCZ11	0·28
BCZ12	0·28
BD115	0·68
BD116	0·88
BD121	0·66
BD123	0·72
BD124	0·76
BD131	0·55
BD132	0·66

Type	Price
BD133	0·72
BD135	0·44
BD136	0·44
BD137	0·50
BD138	0·55
BD139	0·61
BD140	0·66
BD155	0·88
BD175	0·66
BD176	0·66
BD177	0·72
BD178	0·72
BD179	0·77
BD180	0·77
BD185	0·72
BD186	0·72
BD187	0·77
BD188	0·77
BD189	0·83
BD190	0·83
BD195	0·94
BD196	0·94
BD197	0·99
BD198	0·99
BD199	£1·05
BD200	£1·05
BD205	0·88
BD206	0·88
BD207	£1·05
BD208	£1·05
BDY20	£1·10
BF115	0·27
BF117	0·50
BF118	0·77
BF119	0·77
BF121	0·50
BF123	0·55
BF125	0·50
BF127	0·55
BF152	0·61
BF153	0·50
BF154	0·50
BF155	0·77
BF156	0·58
BF157	0·61
BF158	0·61
BF159	0·66
BF160	0·44
BF162	0·44
BF163	0·44
BF164	0·44
BF165	0·44
BF167	0·24
BF173	0·24
BF176	0·39
BF177	0·39
BF178	0·33
BF179	0·33
BF180	0·33
BF181	0·33
BF182	0·44
BF183	0·44

Type	Price
BF184	0·28
BF185	0·33
BF187	0·30
BF188	0·44
BF194	0·13
BF195	0·13
BF196	0·16
BF197	0·16
BF200	0·50
BF222	£1·05
BF257	0·50
BF258	0·66
BF259	0·94
BF262	0·61
BF263	0·61
BF270	0·39
BF271	0·33
BF272	0·88
BF273	0·39
BF274	0·39
BFW10	0·66
BFX29	0·30
BFX84	0·24
BFX85	0·33
BFX86	0·24
BFX87	0·27
BFX88	0·24
BFY50	0·22
BFY51	0·22
BFY52	0·22
BFY53	0·19
BSX19	0·17
BSX20	0·17
BSY25	0·17
BSY26	0·17
BSY27	0·17
BSY28	0·17
BSY29	0·17
BSY38	0·20
BSY39	0·20
BSY40	0·31
BSY41	0·31
BSY95	0·14
BSY95A	0·14
Bu105	£2·20
C111E	0·55
C400	0·33
C407	0·28
C424	0·28
C425	0·55
C426	0·39
C428	0·22
C441	0·33
C442	0·33
C444	0·39
C450	0·24
MAT100	0·21
MAT101	0·22
MAT120	0·21
MAT121	0·22
MJE2955	0·95
MJE3055	0·62

Type	Price
MJE3440	0·55
MPF102	0·46
MPF104	0·41
MPF105	0·41
OC19	0·39
OC20	0·70
OC22	0·52
OC23	0·54
OC24	0·62
OC25	0·42
OC26	0·32
OC28	0·55
OC29	0·55
OC35	0·46
OC36	0·55
OC41	0·22
OC42	0·27
OC44	0·17
OC45	0·14
OC70	0·11
OC71	0·11
OC72	0·16
OC74	0·16
OC75	0·17
OC76	0·17
OC77	0·28
OC81	0·17
OC81D	0·17
OC82	0·17
OC82D	0·17
OC83	0·22
OC139	0·22
OC140	0·22
OC169	0·28
OC170	0·28
OC171	0·28
OC200	0·28
OC201	0·31
OC202	0·31
OC203	0·28
OC204	0·28
OC205	0·33
OC309	0·44
OCP71	0·48
ORP12	0·48
ORP60	0·44
ORP61	0·44
P20	0·55
P346A	0·22
P397	0·46
ST140	0·14
ST141	0·19
TIP29	0·48
TIP30	0·56
TIP31A	0·60
TIP32A	0·73
TIP41A	0·78
TIP42A	0·88
TIS43	0·34
UT46	0·30
ZN414	£1·20
2G301	0·21

Type	Price
2G302	0·21
2G303	0·21
2G304	0·27
2G306	0·44
2G308	0·39
2G309	0·39
2G339	0·22
2G339A	0·18
2G344	0·20
2G345	0·18
2G371	0·18
2G371B	0·18
2G373	0·19
2G374	0·19
2G377	0·33
2G378	0·18
2G381	0·18
2G382	0·18
2G401	0·33
2G414	0·33
2G417	0·28
2N388	0·39
2N388A	0·61
2N404	0·22
2N404A	0·31
2N524	0·46
2N527	0·54
2N598	0·46
2N599	0·50
2N696	0·14
2N697	0·15
2N698	0·27
2N699	0·39
2N706	0·09
2N706A	0·10
2N708	0·13
2N711	0·33
2N717	0·39
2N718	0·27
2N718A	0·55
2N726	0·31
2N727	0·31
2N743	0·22
2N744	0·22
2N914	0·16
2M918	0·33
2N929	0·23
2N930	0·23
2N1131	0·22
2N1132	0·24
2N1302	0·16
2N1303	0·16
2N1304	0·19
2N1305	0·19
2N1306	0·23
2N1307	0·23
2N1308	0·26
2N1309	0·26
2N1613	0·22
2N1711	0·22
2N1889	0·35
2N1890	0·50

Type	Price
2N1893	0·41
2N2147	0·79
2N2148	0·63
2N2160	0·66
2N2192	0·39
2N2193	0·39
2N2194	0·39
2N2217	0·24
2N2218	0·22
2N2219	0·22
2N2220	0·24
2N2221	0·22
2N2222	0·22
2N2368	0·19
2N2369	0·16
2N2369A	0·16
2N2411	0·27
2N2412	0·27
2N2646	0·52
2N2711	0·23
2N2712	0·23
2N2714	0·23
2N2904	0·19
2N2904A	0·23
2N2905	0·23
2N2905A	0·23
2N2906	0·17
2N2906A	0·20
2N2907	0·22
2N2907A	0·24
2N2923	0·16
2N2924	0·16
2N2925	0·16
2N2926(G)	14
2N2926(Y)	12
2N2926(O)	11
2N2926(R)	11
2N2926(B)	11
2N3010	0·77
2N3011	0·16

Type	Price
2N3053	0·19
2N3054	0·51
2N3055	0·45
2N3391	0·16
2N3391A	0·18
2N3392	0·16
2N3393	0·16
2N3394	0·16
2N3395	0·19
2N3402	0·23
2N3403	0·23
2N3404	0·31
2N3405	0·46
2N3414	0·17
2N3415	0·17
2N3416	0·31
2N3417	0·31
2N3525	0·83
2N3614	0·74
2N3615	0·82
2N3616	0·82
2N3646	0·10
2N3702	0·13
2N3703	0·13
2N3704	0·14
2N3705	0·13
2N3706	0·13
2N3707	0·14
2N3708	0·09
2N3709	0·10
2N3710	0·10
2N3711	0·10
2N3819	0·31
2N3820	0·55
2N3821	0·39
2N3823	0·31
2N3903	0·31
2N3904	0·33
2N3905	0·31
2N3906	0·30

Type	Price
2N4058	0·13
2N4059	0·11
2N1060	0·13
2N4061	0·13
2N4062	0·13
2N4284	0·19
2N4285	0·19
2N4286	0·19
2N4287	0·19
2N4288	0·19
2N4289	0·19
2N4290	0·19
2N4291	0·19
2N4292	0·19
2N4293	0·19
2N5172	0·13
2N5294	0·60
2N5457	0·35
2N5458	0·35
2N5459	0·44
2N6221	0·75
2S301	0·55
2S302A	0·46
2S302	0·46
2S303	0·61
2S304	0·77
2S305	0·86
2S306	0·86
2S307	0·86
2S321	0·62
2S322	0·46
2S322A	0·46
2S323	0·62
2S324	0·77
2S325	0·77
2S326	0·77
2S327	0·77
2S701	0·46
40361	0·44
40362	0·50

DIODES AND RECTIFIERS

Type	Price	Type	Price	Type	Price
AA119	0·09	BY128	0·17	OA10	0·15
AA120	0·09	BY130	0·18	OA47	0·08
AA129	0·09	BY133	0·23	OA70	0·08
AAY30	0·10	BY164	0·55	OA79	0·08
AAZ13	0·11	BYX38/300	0·46	OA81	0·08
BA100	0·11	BYZ10	0·39	OA85	0·10
BA116	0·23	BYZ11	0·33	OA90	0·07
BA126	0·24	BYZ12	0·33	OA91	0·07
BA148	0·16	BYZ13	0·28	OA95	0·08
BA154	0·13	BYZ16	0·44	OA200	0·07
BA155	0·16	BYZ17	0·39	OA202	0·08
BA156	0·15	BZY18	0·39	SD10	0·06
BA173	0·16	BYZ19	0·31	SD19	0·06
BY100	0·17	CG62		1N34	0·08
BY101	0·13	(OA91 Eq)	0·06	1N34A	0·08
BY105	0·19	CG651—		1N914	0·06
BY114	0·13	(OA70-79)	0·07	1N916	0·06
BY124	0·13	OA5	0·39	1N4148	0·06
BY126	0·16	OA5 short		IS021	0·11
BY127	0·17	leads	0·23	IS951	0·07

BB104 VARICAP BACK TO BACK 0·16

LINEAR I.C's—FULL SPEC.

Type No.	Price 1	25	100+
72702	50p	48p	45p
72709	25p	23p	20p
72709P	20p	19p	18p
72710	35p	33p	30p
72741	30p	29p	28p
72741C	28p	27p	26p
72741P	30p	29p	28p
72747	85p	80p	75p
72748P	38p	36p	34p
SL201C	59p	45p	40p
SL701C	50p	45p	40p
SL702C	50p	45p	40p
TAA263	80p	70p	60p
TAA293	£1·00	95p	90p
TAA350A	£1·85	£1·80	£1·70
μA703C	28p	26p	24p
μA709C	20p	19p	18p
μA711	35p	33p	30p
μA712	35p	33p	30p
TBA800	95p	93p	90p
76003	£1·50	£1·45	£1·40
760023	£1·50	£1·45	£1·40
76660	95p	93p	90p

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3015F Minitron .. .. £1·50
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Comprises three 66-bit 2 0 dynamic shift registers with independent inputs and outputs. TTL compatibility and buffered clock lines to reduce the capacitive load presented at the clock pins. A boot-strapped buffer ensures a full logic swing at the output.
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Type	Price 1	25	100+
BP930	15p	14p	13p
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BP933	16p	15p	14p
BP935	16p	15p	14p
BP936	16p	15p	14p
BP944	16p	15p	14p
BP945	30p	28p	25p
BP946	15p	14p	13p
BP948	30p	28p	25p
BP951	70p	65p	60p
BP962	15p	14p	13p
BP9093	45p	43p	40p
BP9094	45p	43p	40p
BP9097	45p	43p	40p
BP9099	45p	43p	40p

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μR7818 £1·35

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

PROF. TYPE No.	1-24	25-99	100up.
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TSO 16 pin type	38p	35p	32p
LOW COST No.			
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BPS 16	17p	15p	13p
BPS 8 pin type	15p	13p	11p

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7401	0·15	0·14	0·13
7402	0·15	0·14	0·13
7403	0·15	0·14	0·13
7404	0·15	0·14	0·13
7405	0·15	0·14	0·13
7406	0·39	0·34	0·31
7407	0·39	0·34	0·31
7408	0·25	0·24	0·23
7409	0·25	0·24	0·23
7410	0·15	0·14	0·13
7411	0·25	0·24	0·23
7412	0·28	0·27	0·26
7413	0·32	0·31	0·30
7416	0·30	0·29	0·28
7417	0·30	0·29	0·28
7420	0·15	0·14	0·13
7422	0·30	0·29	0·28
7423	0·40	0·39	0·38
7425	0·40	0·39	0·38
7426	0·40	0·38	0·36
7427	0·40	0·38	0·36
7428	0·45	0·42	0·40
7430	0·15	0·14	0·13
7432	0·40	0·38	0·36
7433	0·42	0·40	0·38
7437	0·35	0·32	0·30
7438	0·35	0·32	0·30
7440	0·15	0·14	0·13
7441	0·74	0·71	0·64
7442	0·74	0·71	0·64
7443	1·20	1·15	1·10
7444	1·20	1·15	1·10
7445	1·60	1·55	1·50
7446	1·20	1·15	1·10
7447	1·10	1·07	1·05

Type	Quantities 1 £ p	25 £ 0	100+ £ p
7448	1·10	1·07	1·05
7450	0·15	0·14	0·13
7451	0·15	0·14	0·13
7453	0·15	0·14	0·13
7454	0·15	0·14	0·13
7460	0·15	0·14	0·13
7470	0·32	0·29	0·27
7472	0·32	0·29	0·27
7473	0·41	0·39	0·35
7474	0·41	0·39	0·35
7475	0·60	0·58	0·56
7476	0·44	0·43	0·42
7480	0·60	0·58	0·85
7481	1·10	1·05	1·00
7482	0·90	0·85	0·80
7483	1·20	1·15	1·05
7484	1·00	0·97	0·95
7485	1·60	1·55	1·50
7486	0·35	0·34	0·33
7489	4·00	3·75	3·50
7490	0·65	0·63	0·60
7491	1·10	1·05	1·00
7492	0·74	0·71	0·64
7493	0·74	0·71	0·64
7494	0·85	0·82	0·75
7495	0·85	0·82	0·75
7496	0·96	0·93	0·86
74100	1·50	1·45	1·40
74104	0·60	0·58	0·55
74105	0·60	0·58	0·55
74107	0·44	0·42	0·40
74110	0·60	0·55	0·50
74111	0·90	0·88	0·85
74118	1·00	0·95	0·90
74119	1·50	1·40	1·30
74121	0·50	0·48	0·45

Type	Quantities 1 £ p	5 £2p	100+ £ p
74122	0·70	0·68	0·65
74123	0·75	0·73	0·70
74141	0·85	0·82	0·79
74145	1·30	1·25	1·20
74150	1·50	1·40	1·30
74151	1·10	1·05	1·00
74153	1·20	1·10	1·00
74154	1·70	1·65	1·60
74155	1·20	1·15	1·10
74156	1·20	1·15	1·10
74157	1·00	0·95	0·90
74160	1·40	1·35	1·30
74161	1·40	1·35	1·30
74162	1·40	1·35	1·30
74163	1·40	1·35	1·30
74164	1·80	1·75	1·70
74165	1·80	1·75	1·70
74166	1·60	1·53	1·50
74174	1·60	1·53	1·50
74175	1·10	1·05	1·00
74176	1·25	1·20	1·15
74177	1·25	1·20	1·15
74180	1·25	1·20	1·15
74181	3·95	3·85	3·75
74182	1·25	1·20	1·15
74184	1·80	1·75	1·70
74190	1·95	1·90	1·85
74191	1·95	1·90	1·85
74192	1·95	1·90	1·85
74193	1·95	1·90	1·85
74194	1·30	1·25	1·20
74195	1·10	1·05	1·00
74196	1·20	1·15	1·10
74197	1·20	1·15	1·10
74198	2·75	2·70	2·65
74199	2·50	2·40	2·30

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T3	8	D1216	OC81D
T4	8	2G381T	OC81
T5	8	2G382T	OC82
T6	8	2G344B	OC44
T7	8	2G345B	OC45
T8	8	2G378	OC78
T9	8	2G399A	2N1302
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Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 6p each. Any Qty.

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Q10	7 LC 71 type transistors	0·54
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Q18	4 MADT'S 2×MAT 100 & 2×MAT 120	0·54
Q19	3 MADT's 2×MAT 101 & 1×MAT 121	0·54
Q20	4 OC 44 Germanium transistors A.F.	0·54
Q21	4 AC 127 NPN Germanium transistors	0·54
Q22	20 NKT transistors A.F. R.F. coded	0·54
Q23	10 OA 202 Silicon diodes sub-min	0·54
Q24	8 OA 81 diodes	0·54
Q25	15 IN914 Silicon diodes 75 PIV 75mA	0·54
Q26	8 OA95 Germanium diodes sub-min IN 69	0·54
Q27	2 10A PIV Silicon rectifiers IS425R	0·54
Q28	2 Silicon power rectifiers BYZ 13	0·54
Q29	4 Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·54
Q30	7 Silicon switch transistors 2N706 NPN	0·54
Q31	6 Silicon switch transistors 2N708 NPN	0·54
Q32	3 PNP Silicon transistors 2×2N1131, 1×2N1132	0·54
Q33	3 Silicon NPN transistors 2N1711	0·54
Q34	7 Silicon NPN transistors 2N2369, 500MHz (code P397)	0·54
Q35	3 Silicon PNP TO-5. 2 × 2N2904 & 1×2N2905	0·54
Q36	7 2N3646 TO-18 plastic 300 MHz NPN	0·54
Q37	3 2N3053 NPN Silicon transistors	0·54
Q38	7 NPN transistors 3×2N3703, 2×2N3702	0·54

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U 5	60 200mA Sub-Min. Silicon Diodes	0·54
U 6	30 Sil. Planar Trans. NPN like BSY95A. 2N706	0·54
U 7	16 Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·54
U 8	50 Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·54
U 9	20 Mixed Voltages, 1 Watt Zener Diodes	0·54
U10	20 BAY50 charge storage Diodes DO-7 Glass	0·54
U11	25 PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·54
U13	30 PNP-NPN Sil. Transistors OC200 & 2S 104	0·54
U14	150 Mixed Silicon and Germanium Diodes	0·54
U15	25 NPN Sil. Planar Trans. TO-5 like BFY51. 2N697	0·54
U16	10 3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·54
U17	30 Germanium PNP AF Transistors TO-5 like ACY 17-22	0·54
U18	8 6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·54
U19	25 Silicon NPN Transistors like BC108	0·54
U20	12 1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·54
U21	30 AF Germanium Alloy Transistors 2G300 Series & OC71	0·54
U23	30 MADT's like MHz Series PNP Transistors	0·54
U24	20 Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·54
U25	25 300 MHz NPN Silicon Transistors 2N708, BSY27	0·54
U26	30 Fast Switching Silicon Diodes like IN914 Micro-Min.	0·54
U29	10 1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·08
U32	25 Zener Diodes 400mW DO-7 case 3-18 volts mixed	0·54
U33	15 Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·54
U34	30 Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	0·54
U35	25 Silicon Planar Transistors PNP TO-18 2N2906	0·54
U36	25 Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·54
U37	30 Silicon Alloy Transistors SO-2 PNP OC200, 2S322	0·54
U38	20 Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·54
U39	30 R.F. Germ. PNP Transistors 2N1303/5 TO-5	0·54
U40	10 Dual Transistors 6 lead TO-5 2N2060	0·54
U43	25 Sil. Trans. Plastic TO-18 A.F. BC113/114	0·54
U44	20 Sil. Trans. Plastic TO-5 BC115/116	0·54
U45	7 3A SCR. TO66 up to 600PIV	1·08
U46	20 Unijunction transistors similar to TI848	0·54
U47	10 TO220AB plastic triacs 50V 6A	£1·08
U48	9 NPN Sil. power transistors like 2N3055	£1·08
U49	12 NPN Sil. plastic power trans. 60W like 2N5294/5296	£1·08

Code No's mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

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100	0·05	0·07	1N4002	0·06	0·10	0·17	0·23	0·75
200	0·06	0·10	1N4003	0·07	0·12	0·22	0·25	1·00
400	0·08	0·15	1N4004	0·08	0·15	0·30	0·38	1·35
600	0·09	0·17	1N4005	0·10	0·18	0·36	0·45	1·95
800	0·12	0·19	1N4006	0·11	0·20	0·38	0·55	2·10
1000	0·14	0·30	1N4007	0·12	0·25	0·48	0·65	2·50
1200	—	10·35			0·30	0·58	0·75	3·00

INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00	=12×7400	0·54	UIC46	=5×7446	0·54	UIC90	=5×7490	0·54
UIC01	=12×7401	0·54	UIC48	=5×7448	0·54	UIC91	=5×7491	0·54
UIC02	=12×7402	0·54	UIC50	=12×7450	0·54	UIC92	=5×7492	0·54
UIC03	=12×7403	0·54	UIC51	=12×7451	0·54	UIC93	=5×7493	0·54
UIC04	=12×7404	0·54	UIC53	=12×7453	0·54	UIC94	=5×7494	0·54
UIC05	=12×7405	0·54	UIC54	=12×7454	0·54	UIC95	=5×7495	0·54
UIC06	=8×7406	0·54	UIC60	=12×7460	0·54	UIC96	=5×7496	0·54
UIC07	=8×7407	0·54	UIC70	=8×7470	0·54	UIC100	=5×74100	0·54
UIC10	=12×7410	0·54	UIC72	=8×7472	0·54	UIC121	=5×74121	0·54
UIC20	=12×7420	0·54	UIC73	=8×7473	0·54	UIC141	=5×74141	0·54
UIC30	=12×7430	0·54	UIC74	=8×7474	0·54	UIC151	=5×74151	0·54
UIC40	=12×7440	0·54	UIC76	=8×7476	0·54	UIC154	=5×74154	0·54
UIC41	=5×7441	0·54	UIC80	=5×7480	0·54	UIC193	=5×74193	0·54
UIC42	=5×7442	0·54	UIC81	=5×7481	0·54	UIC199	=5×74199	0·54
UIC43	=5×7443	0·54	UIC82	=5×7482	0·54			
UIC44	=5×7444	0·54	UIC83	=5×7483	0·54	UICXI	=25 Assorted 74's	£1·65
UIC45	=5×7445	0·54	UIC86	=5×7486	0·54			

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PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0·63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
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LEGISLATION

FOLLOWING our recent comments on the reception of privileged transmissions and the illegal use and sale of walkie-talkie type radios, we have, as a result, acquired quite a postbag from many of our readers. We apologise for the fact that we may have been unable to answer all your individual comments, but we are publishing a small selection of them in our Letters pages.

Comments have been wide and varied and much controversey has been aroused. Readers may judge for themselves whether or not our comments were justified. One particular point has arisen over the sale of "non UK licensable walkie-talkies" and this also applies to the sale of equipment that is licensable. This is the ease by which transmitting/receiving equipment, portable or otherwise, may be quite openly acquired. Anyone may purchase a transmitter/receiver without any formality whatsoever, simply by passing the cash over the counter, or ordering by post from a multitude of sources.

A considerable amount of radio interference, much of which is deliberate, is being caused to licensed users by other "sources". There is no evidence, so far, to support some views that deliberate interference is being caused by licensed stations.

It is the unlicensed operator and the indiscriminate sales of transmitters/receivers to these persons that must be checked. It is essential that a measure of control be introduced to stop sales to non licence holders.

One suggestion that certainly meets with our approval, is that it should be a legal requirement that intending purchasers should produce the necessary licence before equipment of this nature is sold, and that the sale be recorded and registered. Of course, this will raise the battle-cry, "shades of 1984" but what is the alternative? After all, purchasers of TV receivers, firearms etc have their purchases recorded and the details are passed to the appropriate government licensing dept. It is quite clear that appropriate legislation is long overdue.

LIONEL E. HOWES—Editor

THE NEW *TELEVISION*
Next month we have a surprise for you! A new, bigger and better *Television* magazine, starting with the July issue. The page size will be larger, and there will also be more pages. We have been experiencing increasing difficulty in getting all we want into each month's issue of the magazine in its present form. Colour servicing, for example, calls for the inclusion of more and more complicated circuitry. This has been tending to squeeze out some of the other features we feel should be included. But with larger and more pages we consider we will be able to provide the service we aim to give.

NEWS...

18th Longleat Mobile Rally

THIS annual event, organised by the City of Bristol Group of the R.S.G.B., will take place at Longleat House, Longleat Park, near Warminster, Wiltshire, on Sunday, June 29th, 1975.

As in previous years the trade stands will be housed in spacious marquees. The rally starts at 10 a.m. and talk-in stations will be operational. 160 metres (G6YB/P) 1920kHz. 80 metres (G3JMY/P) 3755kHz. 2 metres (G3TAD/P) 145·00, 145·50MHz plus VFO.

There will be a walking DF hunt starting at 3 p.m. on 160 metres. Bring your DF equipment or your transistor radio converted to top band and join in the fun. All members of the family can take part in this.

As well as the trade stands there will be the grand raffle, RSGB book stand, bring and buy stand (no rubbish please), all goods to be marked with the price and name and call sign of the person selling the article. Refreshments will be available on site.

There is something for everyone in the grounds. The wild life park, the stately house, the gardens, children's zoo and pet corner with plenty of space to picnic, park the car or just "rag-chew."

Overnight camping as from 6 p.m., Saturday, June 28th, 1975.

Details from **Brian Croker** G3ULJ, 36 Portland Street, Staple Hill, Bristol, BS16 4PT.

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

Plessey distributor

PLESSEY Semiconductors have recently appointed Semiconductor Specialists as distributors for the Plessey range of IC's in the UK and North America.

Semiconductor Specialists are situated at *Premier House, Fairfield Road, Yiewsley, West Drayton, Middx.*, and state that they will hold stocks in the UK., so that buyers can obtain their supplies of both Plessey and U.S. components from a single source.

Although large stocks of UK franchised products are held at the West Drayton depot, the firm further states that U.S. franchised products in stock at the company's Chicago warehouse are shipped to the UK every weekend and can be delivered in four working days.

New book

THE new book is written by Robert Brown and Mark Olsen entitled 'Experimenting with Electronic Music'. It's contents cover exactly what the title suggests and includes details on the construction of tone generators, a small electronic organ and a series of electronic modifiers such as tremolo, reverberation, and a chime device. Price is £1·50.

Other useful publications to help the novice understand the various aspects of electronics, comprise: 'Basic Maths Course' by Henry Jacobwitz, 'The oscilloscope' by George Zwick, and '199 TV Tough Dog Problems Solved' by Art Margolis. Price for these books is £1·40, £1·75 and £1·75 respectively and are all available from the publishers Foulsham-Tab Ltd., Yeovil Road, Slough, SL1 4JH.

Pyser look-out for antiques

PYSER LIMITED, sole UK distributors of Marantz high fidelity equipment, are in the market for "antiques". The company wishes to purchase certain "classic" high fidelity units in first-class condition, and at present the list (with prices offered) is: Marantz 7C, £100; McIntosh MC-275, £100; McIntosh C-22, £90; JBL SA660, £90; JBL SA600, £50.

In addition, Pysers would like to hear from audiophiles who would like to sell other "classic" Marantz units in good condition. contact *Malcolm Blockley, Electronics Division, Pyser Limited, Fircroft Way, Edenbridge, Kent.*

BREMA news

NEWS now from BREMA (British Radio Equipment Manufacturers Association) which must surely emphasise the economic climate that envelopes us all. They state that deliveries of colour TV's, whether UK-made or imported, dropped in Dec. '74 by 23% over the same period in '73. This brought the total for the year to 2·2 million, a fall of 20% compared with 1973. This may all sound pretty bad, but for the monochrome TV its even worse! A total fall of 42% for the year's deliveries, resulting in a mere 810,000 sets being delivered.

This dramatic fall, however, is not limited to TV's; audio systems fell by 17% and radio receivers by 28%. It must be seen that if this trend continues, many people in the TV/radio industries will be redundant. This not only hits these people hard but, indirectly, thousands of others.

The MC 14435

THE MC 14435 $3\frac{1}{2}$ digit DVM i.c. is the latest addition to the rapidly growing Semicomps Ltd. McMOS family and contains the logic for use in a dual slope integration A/D converter system. The device consists of $3\frac{1}{2}$ digits of BCD counters, 13 memory latches and multiplexed BCD outputs. An internal clock oscillator is provided which needs only a single external capacitor.

In order to complete the system use is made of the MC 1505L dual-ramp generator and comparator. Only one external capacitor and two calibration potentiometers are required. Further gen from *Semicomps Ltd., Northfield Industrial Estate, Beresford Avenue, Wembley, Middx. HA0 1SD.*

Books received

Use of Microphones
By Alec Nisbett
Shows one how to choose microphones to suit various jobs, how to position them, move them, balance and control them etc.
Price: £1·75
Focal Press Limited, 31 Fitzroy Square, London W1P 6BH

Dictionary of Data Processing
By Jeff Maynard
A dictionary for those wishing to keep abreast of current data processing terminology. More than 4,000 terms are defined.
Price: £3·90
Newnes Butterworths Limited, 88 Kingsway, London WC2B 6AB

Television
By Heinz Kurth
The author takes the whole concept of television to pieces and shows how a TV camera takes pictures, how the image is broadcast, how the receiver works, how colour TV works, what goes on in the studio etc.
Price: 95p
World's Work Limited, The Press, Kingswood, Tadworth, Surrey

Colour Television Servicing (2nd edition)
By Gordon J. King
Deals with the servicing of PAL receivers in a down-to-earth manner and with a minimum of mathematics. It is divided into three sections the first looking at colour TV systems as a whole, the second studies the elements involved such as picture tubes, conversion systems, chroma channels etc. The third section is devoted exclusively to matters of servicing.
Newnes Butterworths Limited, Borough Green, Sevenoaks, Kent TN15 8PH

Principles and Calculations for Radio Mechanics (Part 2)
By R. A. Bravery & A. P. Gilbert
The second of two volumes designed to meet the needs of students studying principles and calculations as part of the City & Guilds Radio Mechanics' Course 222.
Price: £1·90
Newnes Butterworths, 88 Kingsway, London, WC2B 6AB

DIRECT CONVERSION RECEIVER

R.H. LONGDEN

MOST licensed amateurs began their specialised amateur activities by listening to some of the amateur bands. These bands are frequencies in the short wave range used by amateurs licensed to operate transmitting equipment. Once it was easy for anyone to listen to amateur transmissions, because general purpose all-wave and short wave receivers cover some of the amateur bands.

Due to the very greatly increased use of single sideband (SSB) transmission by amateurs, this is no longer so, since the carrier has been removed and as a result, their transmissions cannot be resolved by general purpose all-wave or short wave receivers. In addition, such receivers cannot be used for CW (Morse). This is a severe limitation to the interested listener who may wish to take advantage of the RSGB Slow Morse transmissions which are available in some areas, or who wish to gain speed in Morse reception.

Such limitations do not apply to a communications type receiver as this will be equipped to deal with AM, SSB and CW signals. On the other hand, such receivers require quite complicated circuits. An answer to the problem of receiving amateur SSB and

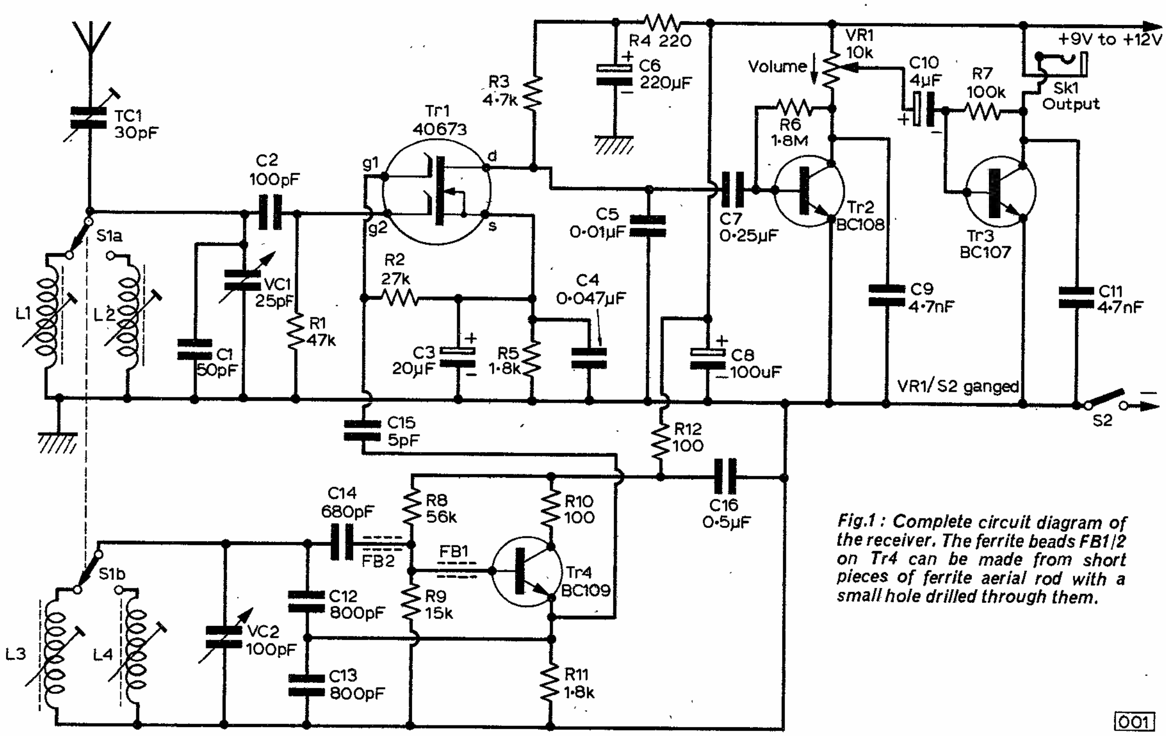
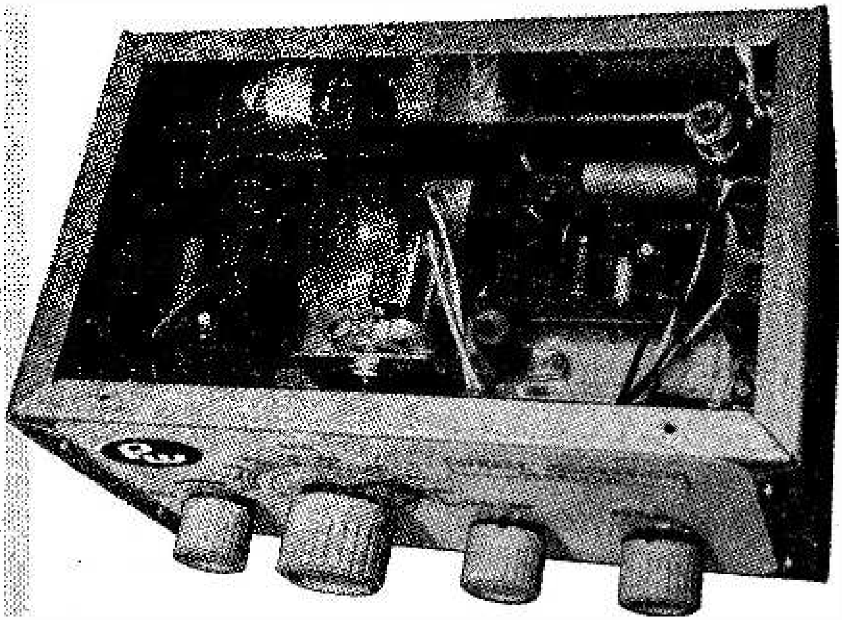


Fig.1: Complete circuit diagram of the receiver. The ferrite beads FB1/2 on Tr4 can be made from short pieces of ferrite aerial rod with a small hole drilled through them.



Inside the receiver with the oscillator/mixer board to the right with input coils at extreme right. Oscillator coils L3/4 are positioned near the main tuning capacitor. The audio amplifier board is on the left.

CW signals can be found in the direct conversion receiver. This omits the frequency changer, intermediate frequency amplifier, product detector and carrier or heterodyne oscillator of the communications superhet. Instead, conversion of the incoming signal to an audio signal takes place directly.

★ components list

Resistors

R1	47kΩ	R5	1·8kΩ	R9	15kΩ
R2	27kΩ	R6	1·8MΩ	R10	100Ω
R3	4·7kΩ	R7	100kΩ	R11	1·8kΩ
R4	220Ω	R8	56kΩ	R12	100Ω

All 5% ½ or ¼W
VR1 10kΩ log-pot with switch S2

Capacitors

C1	50pF SM	C9	4·7nF
C2	100pF SM	C10	4μF 6V
C3	20μF 6V	C11	4·7nF
C4	0·047μF	C12	800pF SM 5%
C5	0·01μF	C13	800 pF SM 5%
C6	220 μF 12V	C14	680pF SM
C7	0·25μF	C15	5pF SM
C8	100μF 12V	C16	0·5μF
TC1	30pF pre-set	VC1	25pF variable (Jackson C804)

VC2 100pF variable (Jackson C804)

Semiconductors

Tr1	40673	Tr3	BC107
Tr2	BC108	Tr4	BC109

Miscellaneous

Coilformers 10mm ($\frac{7}{16}$in.) diameter, with cores (4). Ferrite beads FX115 (2). Ball slow motion drive (Jackson 4511/DRF). Knobs (4). S1 2-pole 2-way wafer switch. Jack socket, insulated. Case, flanged members 203 x 101mm (8 x 4in.) (2), 127 x 101mm (5 x 4in.) (2), 203 x 76 (8 x 3in.) (1), flat plates 203 x 127 (8 x 5in.) (2) (Home Radio). Aerial and earth sockets. Rubber feet

BANDS USED

Of the amateur bands available, the 80 metre band (3·5 to 3·8MHz), will probably be of most interest for general reception of amateur signals, likely to be available at any time, while at weekends and evenings there is usually a great deal of activity. So the receiver is primarily intended for this band. However, Top Band, 160m (1·8 to 2MHz) coverage is also included, as this band carries Slow Morse, local and other transmissions.

Both these bands are influenced by seasonal, daily and other propagation changes, but it is unusual for 80m, in particular, to lack all amateur signals as this band is much used for regular Nets and other contacts.

RECEIVER CIRCUITS

In the circuit in Fig. 1. L1 tunes 160m and L2 tunes 80m, VC1 with C1 in parallel providing suitable coverage. VC1 is panel operated and is peaked for best reception. Aerial coupling is via TC1, which can be set to suit long or short aerials. Pole S1a of the switch selects either L1 or L2 as required. Tr1 is the converter stage signal passing to gate 1 of the 40673 which is internally diode protected, and thus much less liable to damage than an unprotected insulated gate transistor. For the reception of CW, Tr4 acts as a heterodyne oscillator, with injection to gate 2 of Tr1 via C15. When receiving CW, the pitch of the audio tone depends on the difference in frequency between the received signal and osillator Tr4.

During SSB reception, Tr4 performs as the conversion oscillator, resulting in an audio signal appearing at the drain of Tr1. This audio is resolved into intelligible speech when Tr4 is so tuned that it is able to replace the carrier suppressed during transmission. If Tr4 is tuned to the wrong side of the SSB signal, the speech is inverted and unintelligible.

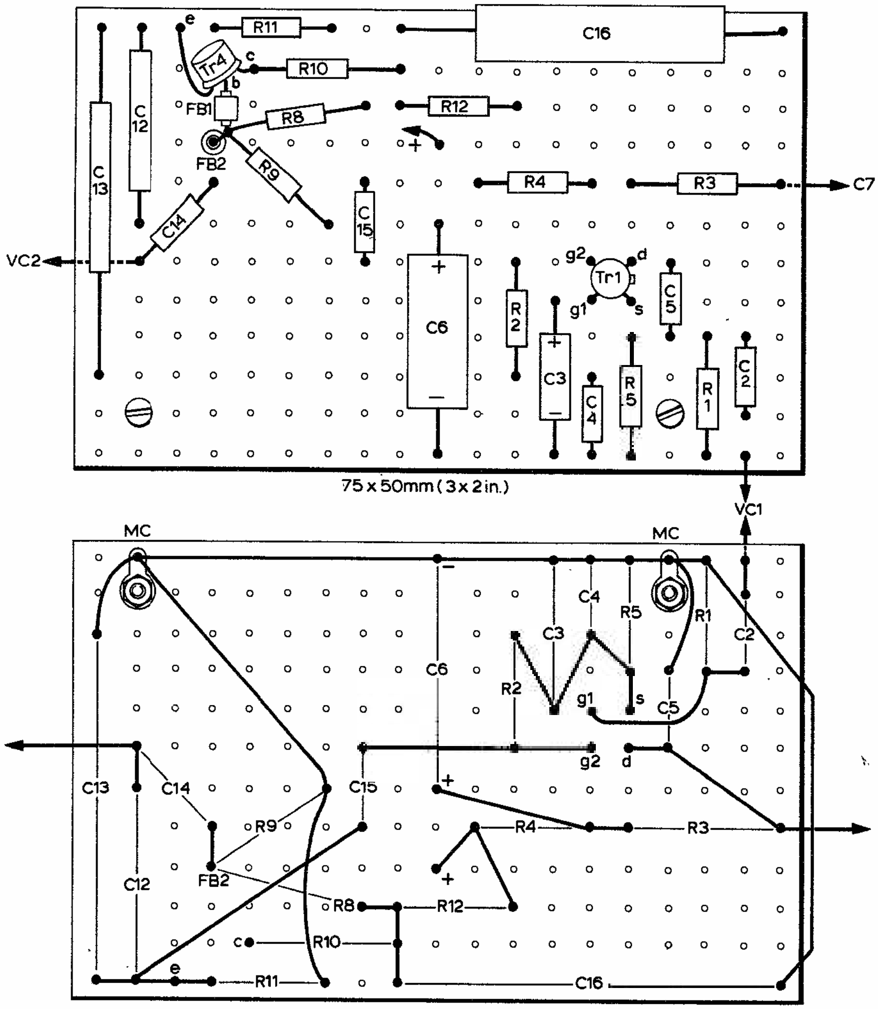


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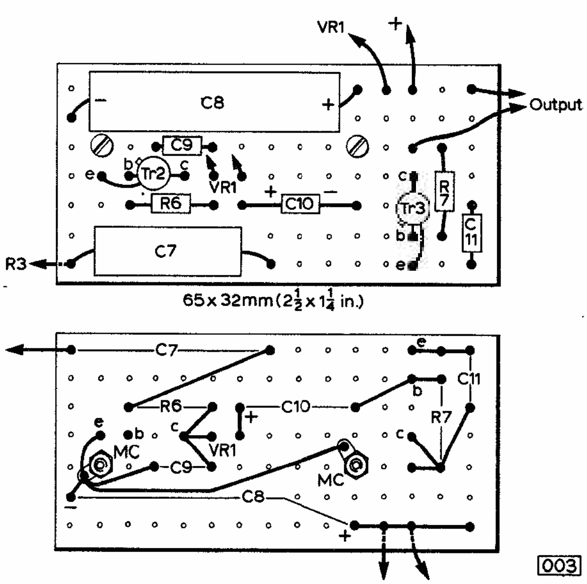
Fig.2: above, gives details of the construction of the oscillator/mixer board. Fig.3, below, shows the audio amplifier board. Both boards are 0·15in. matrix.



The second section of the switch, S1b, selects L3 for 160m, and L4 for 80m with VC2 giving approximately correct coverage. C12 and C13 are 1% or 2% silver mica capacitors and no adjustment is required, except to the coil cores, to bring the oscillator into the band.

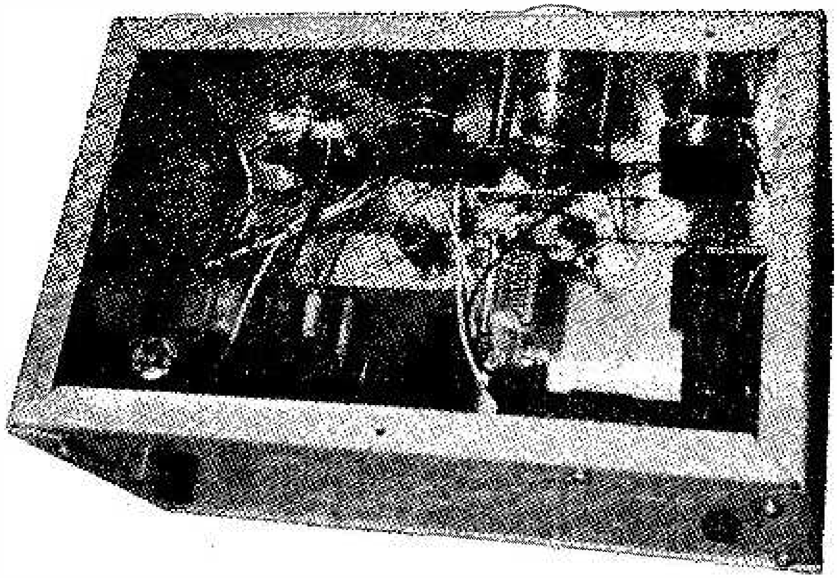
Ferrite beads FB1 and FB2 are to avoid VHF parasitics, although this oscillator circuit was found to be very stable and reliable.

Audio signals from Tr1 are taken to a simple two-stage audio amplifier Tr2/3. Capacitors C3 and C4 by-pass the source of Tr1 at audio frequencies. VR1 is the audio volume control the output from the final audio amplifier Tr3 going to a jack socket.

INDUCTORS

The coils are all wound on 10mm ($\frac{7}{16}$in.) diameter formers with adjustable cores. L1, L2 and L3 are wound with 32SWG enamelled wire, L4 is wound with 24SWG enamelled wire.

L1 has 70 turns, wound in a compact pile. L2 has 40 turns, L3 has 32 turns and L4 has 20 turns, all close wound.



View from the rear of the completed receiver. If the potentiometer VR1 has a metal spindle it is important to check that it is isolated from the track, see Fig.1. If not, insulating panel bushes must be used. Leads between the coils and their respective tuning capacitors should be rigid and as short as possible.

Each winding is begun as near to the top of the coil former as possible. The wire can be secured with a little quick-setting adhesive, or with a turn or two of cotton or thread to which a little adhesive has been applied. After winding, the end of the coil is secured in the same way. A few touches of an adhesive, such as Bostick 1, can be applied to keep turns in place, but the whole windings should not be painted, varnished or waxed.

The bottom end of each winding is soldered to a tag. This will be held by one of the fixing bolts in contact with the metal chassis. The top end of each winding is cut to a suitable length to reach S1.

The cores of L3 and L4, in particular, should be fixed against further movement after adjusting them, by wax or thin elastic placed between core and former.

OSCILLATOR MIXER BOARD

The board is approximately 75 x 50mm (3 x 2in) and components are positioned as in Fig. 2. Begin by drilling holes for two 6BA bolts, which secure the tags MC. Later, additional nuts on these bolts will allow the board to be secured to the metal chassis, with a little clearance for underside wiring.

In most places the wire ends of components will be long enough to reach the various connecting points. Elsewhere, 22SWG tinned copper or other connecting wire can be used, with insulated sleeving where necessary.

No special care is necessary when fitting Tr1, except to avoid lengthy heating of the leads, as with any transistor. Other dual-gate FET's may be used in this circuit, but if they are not gate-protected it is

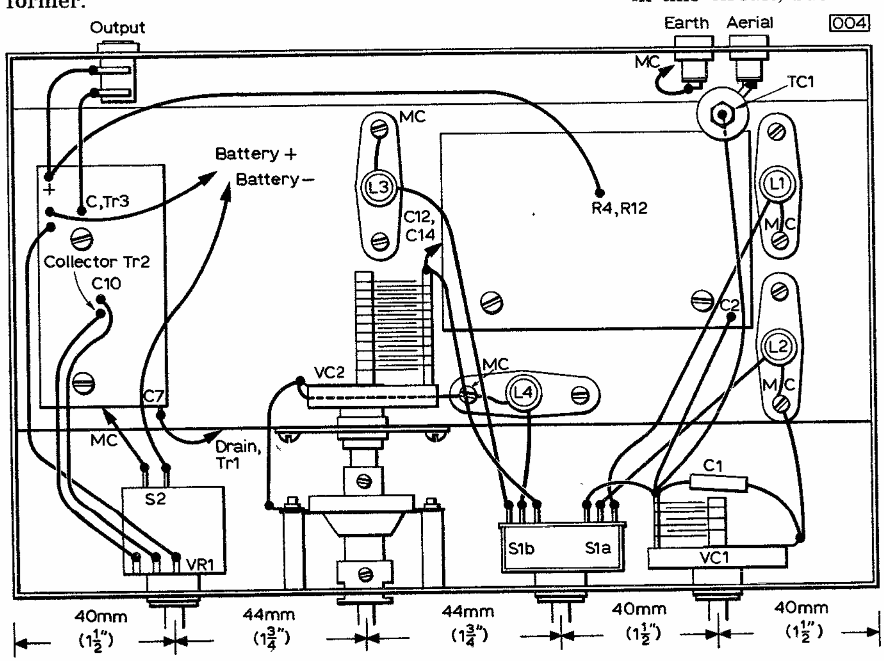


Fig.4: Layout of components on sub-chassis and panel. The aerial and earth sockets are shown displaced for clarity but their actual positions are not important. Both circuit boards are raised off the sub-chassis to avoid short-circuits.

absolutely essential that the shorting wire supplied round the leads is **not removed** until R1, R2 and R5 are connected, at least.

When fitting Tr4, take the collector lead to R10 and the emitter lead to R11, as in Fig. 2. A piece of insulated sleeving slightly longer than the ferrite bead is put on the base lead, and bead FB1 is added. R8 and R9 are then soldered in place, with very short leads at the base. Bead FB2 is then fitted in the same way, and the base lead is taken through the board to C14.

Some flying leads are provided, for connecting later. One runs from C2, to C1, VC1 and S1a. A short projecting wire passes from the junction of C12 and C14, for VC2 and S1b. A connection is also provided from the drain of Tr1, R3 and C5, to go through the chassis to the audio amplifier. A red lead from R4 and R12 is the positive connection. The negative circuit is completed by the bolts MC.

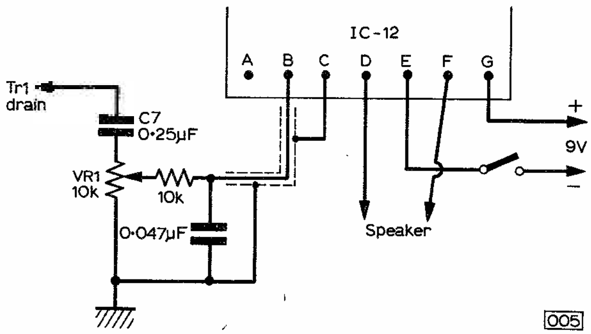


Fig.5: If a separate audio module is available stages Tr2 and Tr3 can be omitted. Connections for the Sinclair IC2 are shown here.

AUDIO AMPLIFIER

The board 65 x 32mm ($2\frac{1}{2}$ x $1\frac{1}{4}$in.) is assembled in a similar way, as in Fig. 3, with bolts MC again providing a connection to the metal chassis. The wire end of C7 can be taken through the board, then bent up to provide a connecting point for the lead from Tr1 drain circuit. A pin is inserted for the positive connecting point. Leads from here run to R4/R12, output jack and battery positive, the latter going through a hole in the board, with a clip soldered to the end of the flex.

Three leads run to VR1. That from C10 positive goes to the centre tag of VR1, while the outer tags go to Tr2 collector and positive line. Switch S2 is connected to the chassis and to a flexible lead with a negative battery connector.

Leads from Tr3 collector and positive run to the output jack. This must be an insulated type, giving complete isolation from the metal.

CONSTRUCTION

The flanged members form a rigid assembly and make a good case for the receiver when top and bottom are closed with flat plates. The general layout of items will be seen from Fig. 4.

The internal 205 x 75mm (8 x 3in.) member is raised about 32mm ($1\frac{1}{4}$in.), and is set back about 40mm ($1\frac{1}{2}$in.) to clear the drive, VR1 and other panel controls. It is necessary to place the member forming the panel **inside** the flanges of the sides.

Front, back and sides are secured together with the 4BA bolts provided, using the holes already punched for this purpose. Holes are drilled to take bolts to secure the internal member.

Fit VC1, S1 and VC1 about 40mm ($1\frac{1}{2}$in.) from the bottom of the panel. The drive for VC2 is 50mm (2in.) from the bottom edge, so that VC2 clears the chassis. A clearance hole is punched for the drive, which is fixed with spacing sleeves and long bolts. VC2 is attached to a bracket, or to a piece of scrap metal which is bolted to the front flange of the chassis. The drive and VC2 should be lined up correctly, so that tuning is smooth and easy. If needed, large or elongated holes can be provided on the bracket, to allow a little adjustment for this purpose.

If a different drive is employed, it should have a fairly high ratio, or tuning will be rather critical. The cursor is attached by two small screws.

Fix the two circuit boards in the way described, taking care that no short circuits can arise to the metal. Leads can then be taken to the two sections of the bandswitch, etc., as shown in Fig. 4. C1 is soldered directly across VC1. Insulated sockets provide for aerial and earth connections, the earth socket being connected to the metal.

ALIGNMENT

The cores can be provisionally located with each about 4 or 5 turns down from the top of the former, but this will have to be adjusted to secure band coverage.

If no other means of adjustment is available, each band can probably be located fairly readily at a time when there is plenty of amateur activity, such as on a Sunday morning. With the receiver switched to 80m, set the core of L4 so that amateur signals are heard throughout almost the whole swing of VC2. Tuning from the maximum capacitance position for VC2, CW signals should be heard for about the first one-third of rotation, and SSB signals for about the other two-thirds.

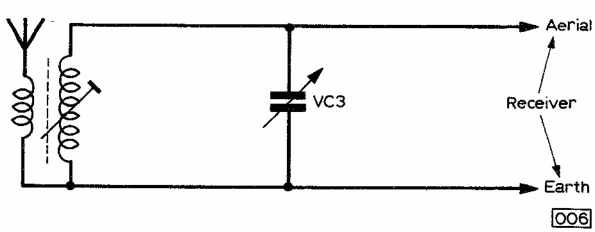


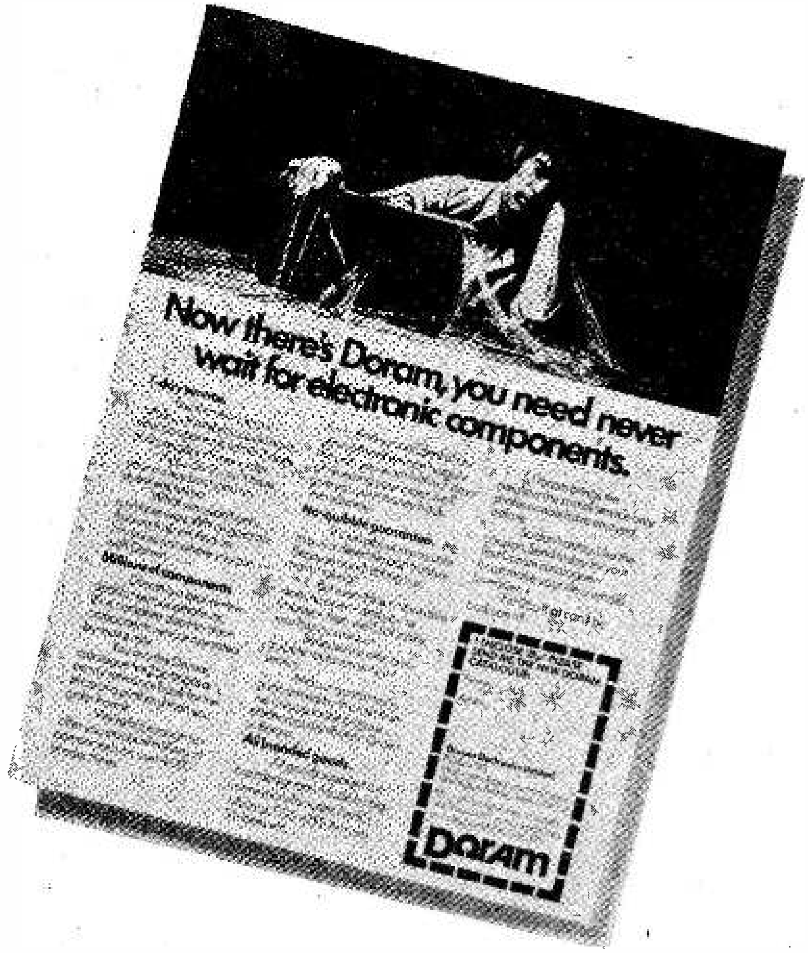
Fig.6: A bandpass input can be formed by adding the above circuit but TC1 must be reduced in value, see text.

Should it be possible to borrow a communications-type receiver, place a temporary wire from its aerial socket to near VC2 and adjust L4 so that the carrier picked up by the receiver can be tuned from about 3·5 to 3·8MHz. In the same way, adjust L3 for about 1·8-2·0MHz. Otherwise adjust L3 to bring amateur activity within the range tuned by VC2.

Subsequently, it is only necessary to adjust L1 on the 160m band, and L2 on the 80m band, so that VC1 can be peaked for best volume, throughout both bands. Here, TC1 will have some influence on tuning. With other than short aerials, TC1 should be unscrewed to quite a low value.

Should a signal generator be available, it can of course provide a means of adjusting the circuits for correct coverage.

continued on page **158**



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I.C. OF THE MONTH

Number 51 SN76023N AUDIO POWER AMPLIFIER

THE Texas Instruments SN76013N and SN76023N IC audio amplifiers can provide a continuous output power of typically 5W RMS into an 8Ω loudspeaker when it is driven from a 24V power supply. The minimum output power before clipping obtainable from any device of either type is 4W into an 8Ω load or 3W into a 16Ω load using a 24V supply.

The absolute maximum permissible power supply voltage is 28V, but it is wise to regard the upper limit as about 24V so as to allow a suitable margin of safety.

The minimum recommended load impedance is 8Ω.

Both ICs incorporate a finned heat sink made of extruded aluminium providing a total effective area of about 75 square centimetres in a small space. Its efficiency can be appreciated by the fact that the absolute maximum continuous output power rating into an 8Ω load is 8W RMS at 25°C, or 6W at 70°C.

The quiescent power supply current at zero signal is about 10mA at a power supply voltage of 24V.

AVAILABLE TYPES

The only difference between the SN76013N and the SN76023N is in the feedback circuit. No internal feedback components are included in the SN76023 device and suitable external components must therefore be employed. This increases the versatility of the device, since tone controls can be used as part of the feedback circuit.

The SN76013 contains two internal feedback resistors which minimise the number of external components required. The gain of this device can be reduced of necessary.

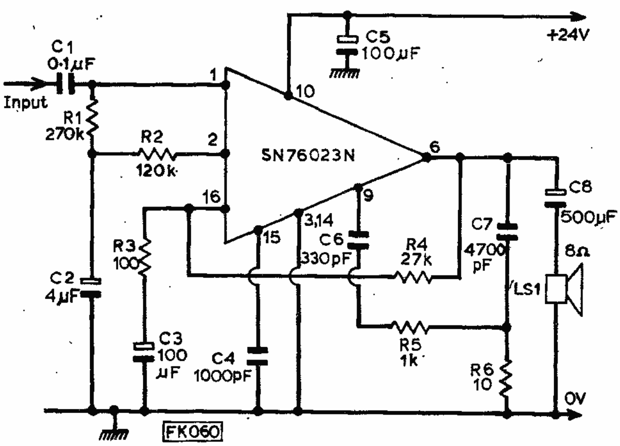
The SN76013 and SN76023 are each available in either a dual-in-line package which has a gap in the centre of each line of pins or a quad-in-line encapsulation in which alternate pins on each side are bent so that one can see four lines of pins when the device is viewed from one end. The same gap is present at the centre of each line of pins.

The SN76013ND is electrically identical to the SN76013N but has no metal fins, possessing instead a metal tab at the centre of each of the two lines of pins. It provides a minimum output power of 3W into a 15Ω load, but the use of a load of smaller impedance may result in the device overheating owing to the absence of cooling fins. It can be used in the same circuits as the SN76013N, but will not be discussed further here.

SN76023N AMPLIFIER CIRCUIT

A typical circuit for the use of the SN76023N as a power amplifier is shown in Fig. 1.

The bias voltage at pin 2 is smoothed by R2 and C2 to remove mains hum or any other signals on the power supply line which reach pin 2. The bias is then applied via R1 to the input pin 1. The value of this bias voltage determines the mean output potential at pin 6.



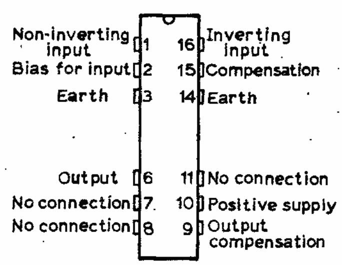


Fig. 1: Typical circuit using the SN76023N integrated circuit as an audio amplifier. The pin functions are shown to the right (viewed from above).

If a well-smoothed power supply is employed, C2 may be reduced to 0·1μF. There is no point in increasing its value above about 10μF, especially as the use of a large value will result in a short time delay at switch-on whilst this capacitor charges.

The input impedance of the circuit is approximately equal to R1, since the input impedance of the integrated circuit itself is well over one megohm.

The optimum value of C5 depends on the type of power supply employed. If a well-regulated mains power pack is used, C5 may be as low as 0·1μF, but for the other types of supply it should have a value of at least 100μF—preferably considerably more when batteries are used. C5 should be soldered as close to the integrated circuit as possible. Alternatively a 0·1μF capacitor may be soldered directly between pin 10 and ground and a larger electrolytic capacitor in parallel with it at a more convenient point.

Frequency compensation is provided by C4. The value shown will provide low distortion at frequencies approaching 100kHz. Instability may occur if the value of this component is made too small in an attempt to raise the upper frequency limit for non-audio applications.

The value of C6 is not at all critical; this component maintains high frequency stability on negative going half cycles by compensating for the difference between two internal complementary transistors.

The low frequency response is mainly determined by the value of C8. This component prevents the loudspeaker from taking a steady current from the output of the amplifier. The filter C7-R6 compensates for the inductance of the speaker.

VOLTAGE GAIN

The voltage gain of the circuit is equal to (R4+R3)/R3. If the values shown are used, the gain is about 270 or about 48dB. If R3 is increased to 470Ω, the voltage gain falls to about 57 or about 35dB. R3 should not be increased above about 1kΩ (at which value the gain is 28 or about 29dB) unless an additional capacitor is connected between pins 1 and 16 to reduce the gain at very high frequencies and thereby maintain stability.

The value of the feedback resistor R4 can be increased to give a very high gain, but this will result in increased distortion and the circuit will be more prone to instability. In addition, there will be a delay at switch-on as C3 charges through R4.

THE SN76013N CIRCUIT

The SN76013N may be used in the same type of circuit, but the following modifications must be made to the circuit of Fig. 1.

(a) The feedback resistor R4 is omitted, since an internal 25kΩ resistor is connected between pins 6 and 16 of the SN76013N device.

(b) The SN76013N contains an internal 100Ω resistor which functions as R3 of Fig. 1. The inverting input is not connected directly to pin 16, but via the 100Ω resistor.

If a voltage gain of 250 (about 48dB) is required, C3 is connected directly between pin 16 and ground. If a lower gain is required, an additional resistor is connected between pin 16 and the upper end of C3. This additional resistor will be in series with the internal 100Ω resistor.

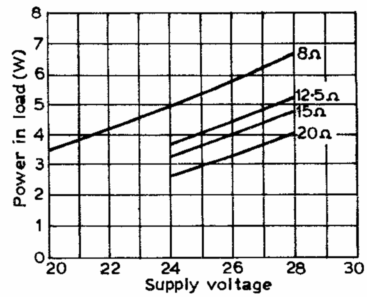


Fig. 2: Output power plotted against supply voltage for a distortion of one per cent.

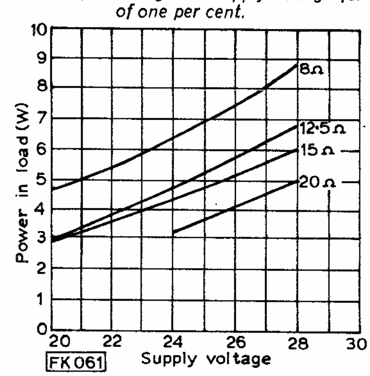


Fig. 3: Output power plotted against supply voltage for a distortion of ten per cent.

PERFORMANCE

The output power from these devices is plotted against the power supply voltage for distortion levels of one and ten per cent in Figs. 2 and 3 respectively.

The minimum supply voltage at which the devices will function satisfactorily at low power is about 8V.

Although a speaker of impedance greater than 8Ω may be used, the power delivered to the speaker at any given value of the supply voltage will be reduced as shown in the graphs.

The power dissipated in these devices can reach about 3·8W with a 24V supply or 5·4W with a 28V supply when an 8Ω loudspeaker is used. The corresponding figures for a 15Ω speaker are about 2·1W and 2·6W.

RADIO RECEIVERS

The writer has used the SN76023N in the circuit of Fig. 1 with an input from a t.r.f. radio receiver using the ZN414 device. The supply voltage was 9 to 12V.

It was found that the gain was rather too high and therefore the value of R3 of Fig. 1 was increased to 330Ω. This comment will probably apply to the use of the Fig. 1 circuit with most radio tuners. It would have been necessary to increase the power supply voltage if the output of 5W had been required.

These audio amplifiers can also be used with superheterodyne IC radio receivers such as the TBA 651, LM1820, μA720, etc.

USE IN RECORD PLAYERS

The circuit of Fig. 4 shows how the SN76023N can be used with a record player employing a ceramic cartridge. This relatively simple circuit includes separate bass and treble controls and a volume control.

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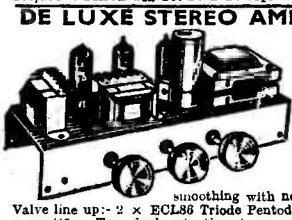

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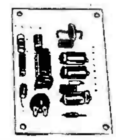

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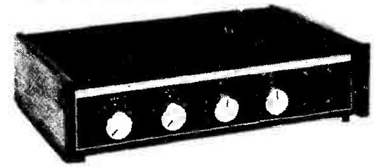

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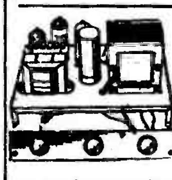

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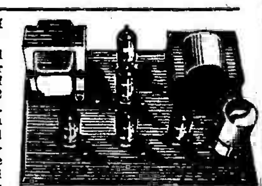

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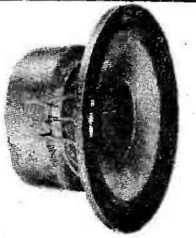

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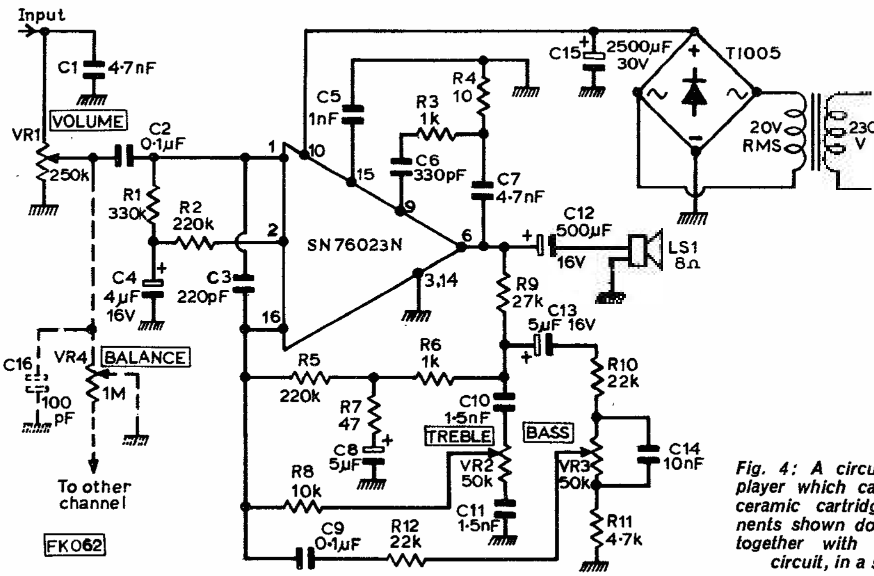


Fig. 4: A circuit for a record player which can be fed from a ceramic cartridge. The components shown dotted are required, together with another identical circuit, in a stereo system.

If a stereo system is required, the additional components shown dotted may be employed to provide a channel balancing control. The lower end of VR4 would be connected to the slider of the volume control in the other identical channel.

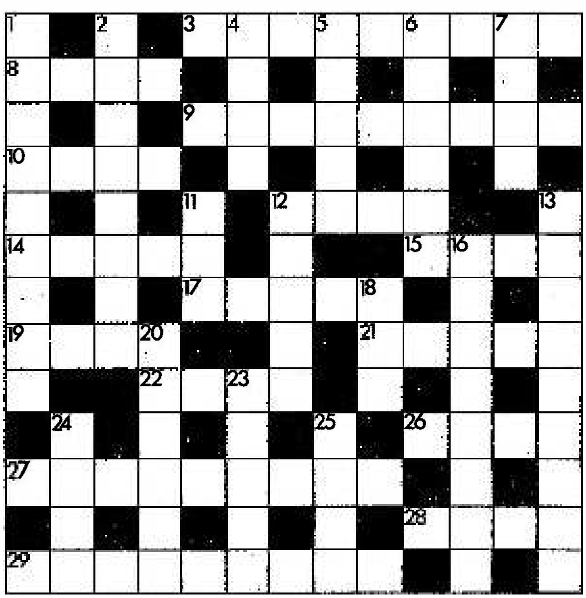
The 27kΩ resistor R9 is the main feedback resistor which passes the feedback current to the tone control network.

A power supply unit is shown in Fig. 4 which is also suitable for use with the circuit of Fig. 1. If the lead to pin 10 is not short, an additional 0·1µF capacitor should be soldered close to the integrated circuit between pin 10 and ground. It will provide a low impedance at high frequencies and will thus preserve stability.

AVAILABILITY

The SN76013N and the SN76023N are available from S.D.S. Components Ltd., Hilsea Industrial Estate, Portsmouth, PO3 5JW at £1·57 each plus V.A.T. plus 20p packing and postage.

PW TECHNICROSS PUZZLE No.9



ACROSS

3 The airman's voice in stereo? (5, 4)
8 A tester set this short one . . . (4)
9 . . . and essences to test this mike distortion! (9)
10 Cable erosion joins don't look straight (4)
12 Put unclean material on the air? (4)
14 Echo irking the group inside (5)
15 Box handled only with gloves on? (4)
17 Stationary selector? (5)
19 The law for resistance units? (4)
21 Non-transmitters (5)
22 Six to one it's such a triode! (4)
26 Head of a solid state for oiling? (4)
27 Solar orbit makes speakers hum? (5, 4)
28 Shorten aerial for a bit of opera? (4)
29 Annoyed about such a network? (9)

DOWN

1 Quite a dish with open-air Mike! (9)
2 A graphic account of a signal success (8)
4 One girl got me to switch up, boss . . . (4)
5 . . . and another's ring is radioactive! (5)
6 Rough ways to make L.P.'s? (6)
7 Component between arm and head (4)
11 Painting transistors back and front only! (3)
12 It's groovy before you hear a sound! (3,2)
13 Tape device to rub out the chief! (5,4)
16 Modulators containing liquid? (8)
18 Short value with ship-to-shore link? (3)
20 America is solid with them (6)
23 Reception's not so hot in this house? (5)
24 Den a beginner on this broadcasting? (4)
25 The magnetism of that Rod! (4)

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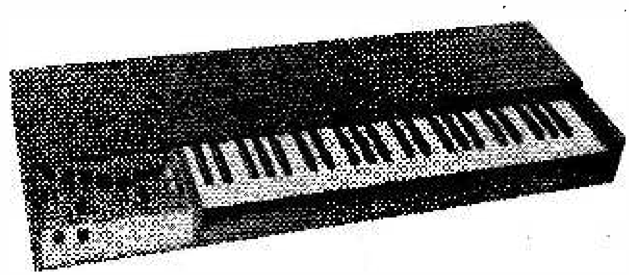
PW 'Easybuild' ELECTRONIC ORGAN

PART 4

M. J. HUGHES M.A., C.Eng. MIERE

This, the fourth and final part of the PW Easybuild Organ, covers in detail the construction of the cabinet, the dimensions required to cut out the aluminium cover plate, and the final wiring of the keyboard and pitch switches.



AS with the rest of this project, follow the details of the cabinet very carefully to prevent any problems which might arise with parts not fitting exactly. The cabinet design has been kept as simple as possible avoiding any fancy carpentry. Most of the structure is held together with butt joints, pins and resin glue. Chipboard, plywood and softwood battens are the basic materials required but the final attractive appearance is obtained with iron-on wood veneer which also covers the less attractive details of the assembly!

CABINET CONSTRUCTION

Stage one is to make the basic structure which is, in effect, a shallow tray comprising a base made from 6mm ($\frac{1}{4}$in) plywood with 12·5mm ($\frac{1}{2}$in) chipboard ends and back, Fig. 14. An elliptical aperture for the speaker is cut at one end of the back, using a coping saw, while a recess can be cut in the outer surface if one wishes to use an inlaid loudspeaker grill which will give the back surface of the finished organ a nice flush appearance. No details of this grill are shown because it is felt that readers can use their own initiative here. The prototype used a commercial grill made from thin strips of wood glued to hessian.

The two sides and back are glued and pinned into position and a strip of softwood is similarly fixed along the front edge, giving extra strength to the edge and finishing off the gap which would otherwise be under the keys. A notch has to be cut in one end of this batten for the aluminium cover which is fitted later.

A long batten is fixed towards the rear of the tray to which the keyboard hinge is screwed, likewise two short blocks are required at either end of the keyboard so that it can be firmly screwed down into place. Make sure that these pieces are accurately located otherwise the keyboard will not fit properly.

Stage two is to make and fit the supporting battens for the two printed circuit boards. These are glued and pinned into position as shown in Fig. 14. The main printed board should fit snugly into the back left hand corner of the cabinet and be supported on all edges. The power supply need only be supported along its two longer edges. Make sure that the battens are not too high otherwise the top of the transformer might protrude.

FITTING INTERNAL COMPONENTS

The third stage is to fit the internal component parts into place. Start with the keyboard. The hinge should be opened up horizontally, and when resting on the long batten, the two side support blocks should just fit under the end flanges of the keyboard sub frame. Ensure that the busbars are short enough at the ends not to foul on these blocks! The front edge of the keys should be just about flush with the front edge of the cabinet, they should be inset rather than proud. Screw the hinge firmly to the long batten but do not, at this stage, screw the end flanges down to the support blocks.

Place the main PCB in position and when satisfied that it is seated correctly, screw it down on all four sides. Hinge the keyboard up and carefully lay the bunch of wires, that will form the loom, under the keyboard and then shut the keyboard down on them for the time being. There should be sufficient clearance for the wires to run between the hinge batten and the left-hand end support block.

Next screw the power supply PCB and loudspeaker into position. Cut to shape, but do not fix, the two keyboard cheeks. These are made from softwood and veneered to match the cabinet Fig. 15. Note that the left-hand cheek has a recess along two edges to match the recess in the end of the front strip, for locating and fixing the aluminium cover plate. The cheeks will ultimately be fixed into position from the underside of the cabinet with long thin screws. They take very little strain and really only serve to finish off the appearance.

At this stage, cut, bend and grain (with wire wool) the aluminium cover plate, shown in Fig. 16. Fix the three switches and two jack sockets into position and make any adjustments so that it will fit over the slider controls of the main PCB, without fouling. This can now be put to one side because the connections to it will be made later. Finally assemble the lid which is designed to fit on to the top of the cabinet and be fixed with three screws, one in each end and one in the centre of the back. To finish the cabinet, veneer all visible exterior surfaces, not forgetting the inside surfaces of the two ends.

LOOM CONNECTIONS

First connect the three leads from the power supply board to the three corresponding terminals on the main PCB. Run leads from the 0V and LS1 pins of the main board to the loudspeaker and mains leads to S1 and the power supply board. Now complete the loom wiring by hingeing up the keyboard.

Take a piece of twine about 1·85m (6ft) long and gently bundle the 60 wires together about 50mm (2in) away from the main PCB. Do not put too much strain on them and make sure there are no kinks. They should give the appearance of long hair converging to the top end of a plait. Instead of plaiting the wires they should be kept as straight and as parallel as possible once they have been formed into the bunch. Use the twine to tie the bunch securely and then tie a tight loop of twine round the wires approximately every 25mm down their length while forming the loom round and under the keyboard.

When the corner has been negotiated and the loom is close to the tags for bottom "C", locate the wire which carries the flag number 31 and cut it to length so that it can be neatly soldered to the tag which carries RK2. After soldering into position tie another loop around the loom and then cut and solder wire

CABINET DIMENSIONS

accurate dimensions in metric, imperial to nearest ⅛in

A (2 off)	355 x 84 x 10mm	(14 x 3¼ x ⅜in.)
B	925 x 84 x 10mm	(36⅜ x 3¼ x ⅜in.)
C	945 x 355 x 6mm	(37¼ x 14 x ¼in.)
D (2 off)	103 x 31 x 25mm	(4 x 1¼ x 1in.)
E	720 x 45 x 25mm	(28⅜ x 1¾ x 1in.)
F	657 x 32 x 17mm	(25¾ x 1¼ x ⅝in.)
G (2 off)	322 x 35 x 10mm	(12⅝ x 1⅜ x ⅜in.)
H (2 off)	205 x 35 x 10mm	(8 x 1⅜ x ⅜in.)
I (2 off)	80 x 12·5 x 10mm	(3⅛ x ½ x ⅜in.)
J	190 x 12·5 x 10mm	(7½ x ½ x ⅜in.)
K	945 x 250 x 10mm	(37¼ x 9⅞ x ⅜in.)
L (2 off)	152 x 12·5 x 10mm	(6 x ½ x ⅜in.)
M	665 x 12·5 x 10mm	(26⅛ x ½ x ⅜in.)
N	50 x 12·5 x 10mm	(2 x ½ x ⅜in.)
P	925 x 44 x 22 mm	(36⅜ x 1¾ x ⅞in.)
Q	205 x 7 x 7mm	(8 x 5/16 x 5/16in.)
R	} see Fig. 15	
S		

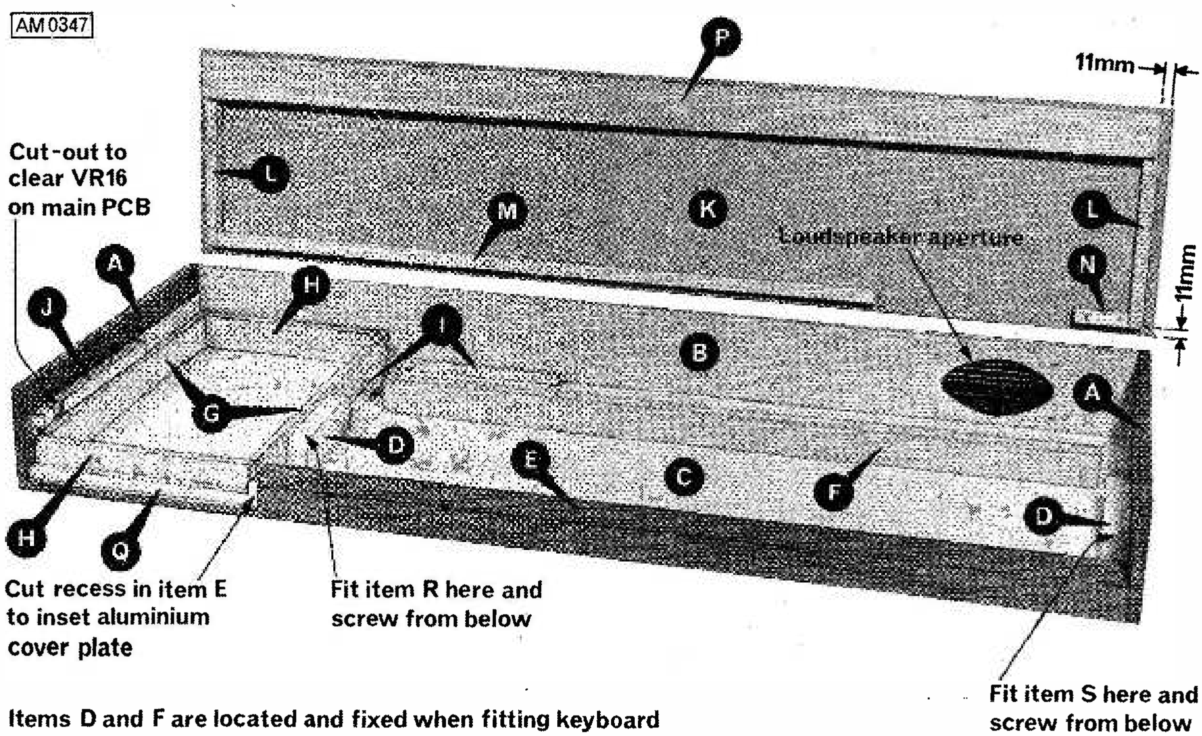


Fig. 14: The complete cabinet, showing internal construction and the veneer on exposed surfaces. Sizes for the individual sections are obtained by noting the relevant letter on the section and referring to the table immediately above this figure.

56 to the next tag; tie another loop and then work steadily down the keyboard referring all the time to the wiring schedule, connecting one wire at a time and carefully and neatly tying the loom tightly after each soldering operation.

After the first two or three connections it will be found to be quite a simple operation and it has the distinct advantage that it gets easier as the loom gets thinner. If this step is done neatly, a great deal of satisfaction will be gained from the end result. It will look neat and professional, but more importantly, will give a strong, reliable job.

BUSBAR CONNECTIONS

The next stage in the construction is to connect the busbars via the switches to the main PCB, Fig. 17. Use screened pick-up lead for this and make sure the screen is earthed exactly as shown. Two of the connections go straight to the board while two go via S2 and S3. A little loose cable can be left under the aluminium cover plate so that it can be readily lifted out of position without the leads restraining its movement (do not forget the solder tag under one of the switch fixing screws). The screened leads should roughly follow the same routing as the loom and, if wished, could be anchored to the loom with twine to stop them flopping about under the keyboard.

TESTING

The organ can now be tried out properly and final tests and adjustments carried out as follows:—

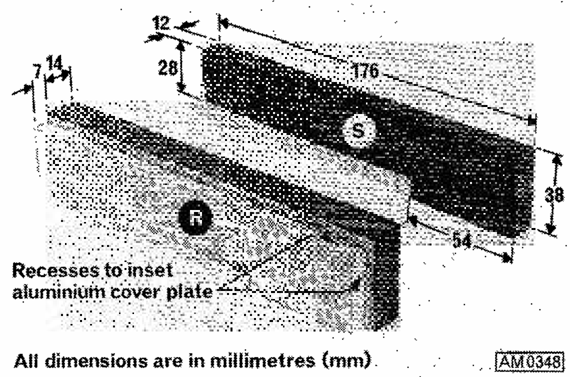


Fig. 15: Annotated photograph of the cheeks, which are placed at either end of the keyboard when cabinet construction is completed.

Assuming that the main PCB is exactly as it was left after the initial tests it should be possible to apply power, and with the vibrato at minimum and volume at maximum, be able to advance each "voice" for each of the two pitches in turn and get a sound from the loudspeaker for **every** note on the keyboard as the keys are depressed. There will be much less volume than previously because the keyboard series resistors have been introduced which reduce the output level to about 1/50 of the original. It is possible to compensate for this by increasing the gain of the busbar pre-amplifiers and, if that is not enough, by means of VR15.

Check that every note sounds correct at each pitch. If not, check for bad connections in the line for that note. Try playing several notes at the same time and then a tune. It may be that you will hear a

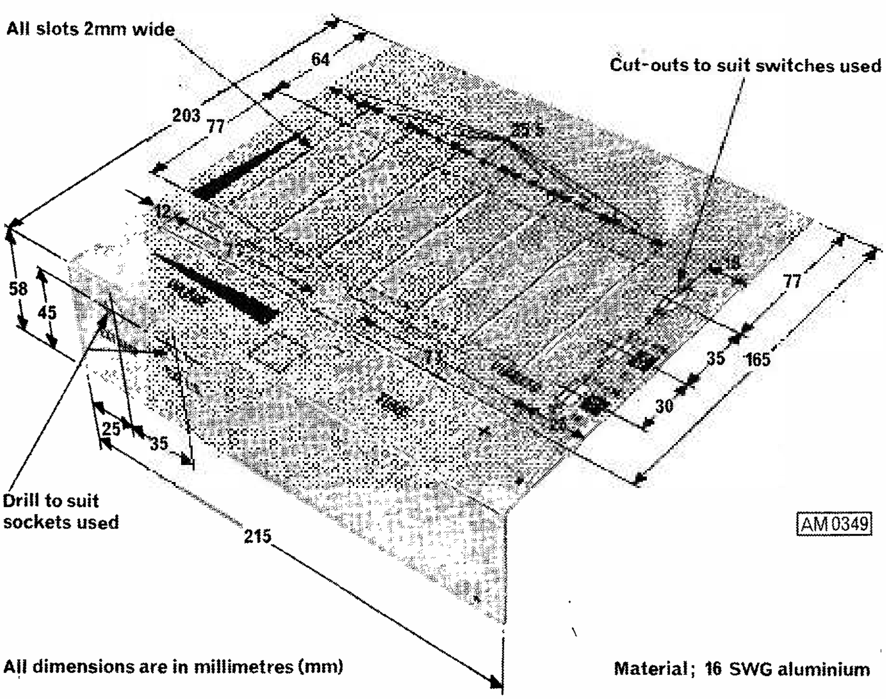


Fig. 16: Aluminium cover plate, giving drilling and cutting dimensions of the slots and holes required for the organ controls.

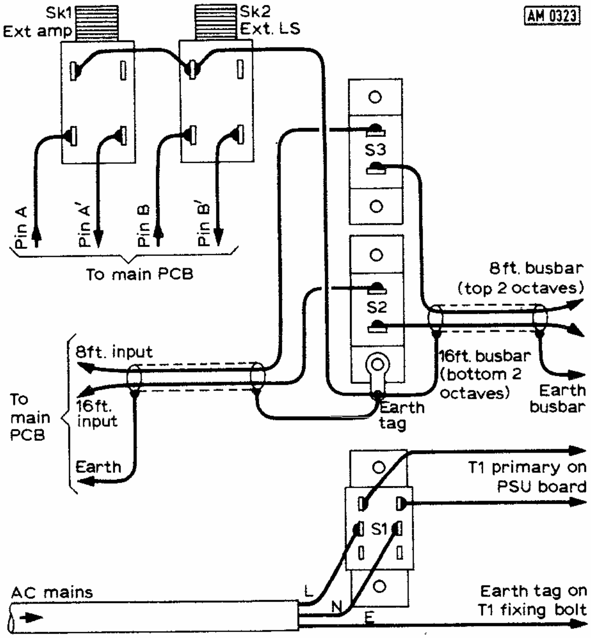


Fig. 17: Pitch controls and jack socket wiring for the underside of the cover plate.

sort of click as you play some notes. This is to be expected and is most likely caused by the key contacts making before they break from the earth busbar. For a fraction of a second the whole busbar will be shorted to earth as the offending keys are pressed.

To correct this, methodically go through every 'b' wire of the contact while listening to sounds at 8ft pitch only. Press bottom "C" and keep it pressed; very slowly depress C♯ next to it, and if the sound of bottom 'C' disappears at a certain depression of C♯ then it means that the 'b' wire of the C♯ contact block furthest away from the 'a' wire must be moved. A pair of forceps helps make this a very simple operation.

Having cured C♯, move on to 'D' while listening to C♯, and adjust the 'b' wire for note 'D'. Carry on like this for every note on the keyboard and then start again by adjusting the 'c' wire while listening to notes at 16ft pitch. It sounds a formidable job but in actual fact is very quick and quite interesting and curiously relaxing!

OUTPUT MATCHING

The keyboard can now be screwed down via its end flanges and the end cheeks fixed into position which hide the flanges from view. It is now necessary to break the shorting links at A/A¹ and B/B¹ on the main circuit board and connect the output jack sockets as shown in Fig. 17. Before fixing the cover plate into position permanently, test the phono output by feeding from the correct jack socket to a radio tuner or ceramic cartridge input of a hi-fi system. Set the volume control of the main amplifier to the level normally used and try playing a tune. The output may be lower or higher than expected, in which case use VR15 in the organ to set the output to match the levels normally associated with the volume setting of the hi-fi system. This action however, may cause the loudspeaker inside the organ to be either overloaded or too weak. In order to overcome this problem leave all the preset controls as they are and change the value of R29.

This can be done by reducing its value (to prevent the loudspeaker overloading when the volume control is set to maximum) by shunting it with another similar value resistor and keep reducing the value of this shunt resistor until a satisfactory state of affairs is reached. If however the output from the internal loudspeaker is too weak after all the adjustments to match the hi-fi system have been made, the value for R29 should be increased. This is achieved by carefully cutting one of R29's leads on the top side of the board and inserting another similar value resistor in series with it.

COMPLETION

The organ is now complete and the aluminium cover plate can be screwed into position; fix the top and give the veneer a polish with good quality wax. Finally check that everything is working satisfactorily, the fine tuning, the vibrato, the keyboard splitting switches and then, if you are anything like the author, get some lessons on how to play it! Or start on another one for your neighbour! PW

Notes

It has been brought to our attention that the connections of certain manufacturers' 747 IC's (IC14 & IC15) do not conform to those used by the author. We therefore advise all constructors to check the positive supply to pins 9 and 13. The IC's used by the author, and the subsequent circuit board published, assumed that all 747's had pins 9 and 13 internally shorted. This is not always the case. Link pins if necessary.

H. L. Smith, 287 Edgware Road, London, W2 have agreed to supply the cover plate. Material used will be 16SWG aluminium and it will be bent and cut to size with the control slots machined out. Price is 75p or £1·06 by post. Both prices are inclusive of VAT.

Studio Electronics, PO Box 18, Harlow, Essex. Tel: 0279 416771 have informed us that they will be able to supply ready-built cabinets and all components including the keyboard, IC's and pcb's. Prices on request.

Integrated circuits, transistors and diodes are also available from Marshalls, 42 Cricklewood Broadway, London, NW2. Tel: 01-452 0161.

Another manufacturer who is willing to supply both main and power supply printed circuit boards for the Easybuild Organ is WKF Electronics, Welbeck Street, Whitwell, Worksop, Notts. Price for both boards, which are constructed from fibre glass and roller tinned is £5·50 plus 20p p & p.

For the more adventurous constructor, PW is offering a full-size paper drawing of the main PCB, showing track layout. For those who require one of these, please write, marking envelope **'Easybuild Organ'** *to* **Practical Wireless, Fleetway House, Farringdon Street, London EC4A 4AD** *enclosing a PO or cheque for 25p and a 10 × 8in S.A.E.*

HOTLINES ON RECENT DEVELOPMENTS

TAKE NOTE

It's getting harder and harder these days to make a dishonest living. Take forgery of banknotes as an example. In this field, electronics is making it really difficult. Onto the US scene has just come a midget bank note forgery detector—and it's hand held, too.

Far from being a leg pull, the device is quite ingenious and has certain patented ideas within it. Basically, all US notes are printed in an ink which contains certain ferrous oxides. What the detector does is to magnetize these inks as its read/write head (rather like a tape recorder's) is passed over the note. On stroking the detector back across the note again, it will immediately flash a light if the note is genuine. On its return path, the read/write head is detecting the residual magnetic field on the finely engraved lines of the money. If the light fails to flash, it's a forged note. The unit itself is less than half the size of a one dollar note, requires only a single activating button to be depressed to operate it, and it runs from a 9V battery.

ORGANITIS

Exponents and enthusiasts of the electronic organ will delight in hearing about a new IC from SGS Ates, the Italian semi-conductor manufacturer. The new chip, called an arpeggio/chord generator makes even the beginner sound like an accomplished organ player. For while he plays a simple one note melody on the top keyboard, the new IC will produce the correct chord for accompaniment and the bass notes also. So with a single note playing, you get the correct chord accompaniment and bass—all from a single chip.

Also from SGS Ates come two new rhythm generator chips. Eight instruments and twelve rhythms are offered but two of these rhythms can be used at the same time thus offering a wide variety—again from a single chip. I suppose the ultimate will be when some semiconductor manufacturer brings out a complete electronic organ on a chip; all you'll have to connect will be a keyboard and a set of tabs/switches to select voices and rhythms.

"KEEPING CHEQUE"

Talking about money (Ginsberg's favourite topic) I note with interest the launch of a "computer check book". It's not available in the UK yet but it seems a very good idea. The entire unit is about the size of a cheque book case and it quite simply keeps the balance of your bank account continually in its mind—figuratively speaking. It'll do this for about a year. The device utilises a shift register type of memory and requires very little current indeed. What a wonderful idea—just have a super overdraft and let a shift register worry about it! (Dare I suggest that this might register a shift in responsibility?).

LASER LINK

I see that yet another application has arrived for the laser. This time it's Xerox who is using in its latest facsimilie (fax) machine. This is a unit which can be connected to the telephone, and documents, letters or photographs etc. can be transmitted to one of the terminal stations at the other end of the telephone link. What is remarkable is that the new copier takes only 120 seconds of line time to transmit the document. Besides employing a helium-neon laser and being very fast it has another interesting "plus". Most copiers need special paper, but this telecopier uses plain, unsensitised paper.

At the 120 second speed, resolution is around 6,200 picture elements to the square inch, but if you run at 180 seconds this can be improved on. Don't bank on having one as a toy—the price stands at around the equivalent of £3,400 although leasing one works out at £78/month plus extra charges per document sent over a certain number.

VIDEO DISC

A German manufacturer has launched a TV video disc system, which is compatible with US, French and Japanese standards. The system is currently offered for sale in West German radio and TV stores for around the £250 mark. At present, there are around 50 different records to choose from but this should increase to about 300 plus by the end of this year. Titles include, children's programmes, education and entertainment. The records last for about 10 minutes (in colour) and cost something like £1·60p each. Perhaps, in the near future, you'll be able to see as well as hear a performance when you buy a record?

BUG FINDER

Are there bugs in your house? Not the hairy, creepy kind, the electronic sort? If there is a bug about, the new development from Britain's EMI will sniff it out. Designated Bloodhound, the device is a wideband receiver. Most of the listening bugs around consist of an f.m. solid state transmitter with a range of a few hundred yards at best. The microphones in these devices can normally detect conversation at anything up to about 30ft.

Unfortunately for this type of bug Bloodhound's sensitive little earholes can listen over a very wide band—300MHz and it can soon ferret out listening devices, even those attached to telephones or mains wiring. So if something's bugging you, this could be the answer.

FOURIER CHIPS

The quest to pack more and more on a single IC chip continues. The latest to catch my eye has been one which carries out things called Fourier transformations. This is a method of analysing a signal into its many component parts and is very useful in military/security applications where one can identify a wanted signal from a masking signal etc. The new chip will perform fast Fourier transforms in a few milliseconds—something that normally takes a digital computer. Perhaps the most impressive thing is the density of packing on the device. The chip size is only a meagre 270 thou. by 350 thou. and the manufacturers have managed to pack what amounts to a 13,000 transistor capability in this tiny area. Makes that tiny transistor portable of yours that you thought was small look a bit silly doesn't it?

Ginsberg

UPDATE your PW TEXAN stereo amplifier...

IN NEXT MONTH'S PRACTICAL WIRELESS

...with the TEXAN II

Improve the performance with a few simple modifications. New toroidal-wound mains transformer gives higher power output per channel. Reduced susceptability to mains-borne interference. Plus-optional tape monitoring facility.

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All electric tuner using varicaps . . . double linear phase filter IF strip . . . stereo decoder with low-pass filter and stereo beacon. Modular construction allows choice of FM or AM facilities, or both.

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Five cheap ICs and a handful of components are all that you need to make this unit. Tones indicate the success, or otherwise, of your shots! A highly desirable addition to our popular game.

DON'T MISS THIS EXCITING ISSUE!

ON SALE IN JUNE

DIGITAL WAVEFORM

TO anyone possessing an oscilloscope, a waveform or function generator is a very useful but expensive, item of test gear. There are a number of excellent commercial instruments available, the least expensive of these being in the Heathkit range of generators. The instrument described in this article is cheaper than any of the commercially available units and gives a very useful performance. Some sacrifices have of course been necessary, but in general these do not detract from the instruments' usefulness for the majority of applications.

PERFORMANCE

The generator provides selected sine, sawtooth or square waveforms having a maximum peak amplitude of 10 volts. The calibrated frequency range is 0·1Hz to 100kHz with an additional "high" range giving useful signals up to 1MHz. An unusual feature of the instrument is the decade switching giving "period" or time, instead of frequency. If for example, the decade switches were set to a "period" of 10μSec, this represents the time interval between the signal peaks. Frequency is given by the reciprocal of this period i.e. $1/10.10^{-6}=1/10^{-5}=100$kHz. A period-to-frequency conversion chart will be given later. This form of presentation together with a "decimal point" using light emitting diodes (LED) makes the instrument particularly useful when employed with a modern oscilloscope. A DC shift control is also provided, capable of shifting the signal ± 5 volts. By this means the signal may be either positive going 10 volts, negative going 10 volts or symmetrical about earth ± 5 volts. An attenuator is also provided so that the signal and DC shift may be used at low levels.

Unloaded, the attenuator gives the following approximate peak voltages 10V, 2V, 1V, 200mV, 100mV, 20mV, 2mV and 1mV. Loads as low as 600 ohms can be driven with reasonable accuracy on the 1 to 20mV ranges. On the higher ranges loads must be greater than 100kΩ in order to maintain attenuator accuracy. If accuracy is unimportant the instrument will drive 2kΩ on the higher ranges and even smaller loads, less than 600 ohms, on the low ranges.

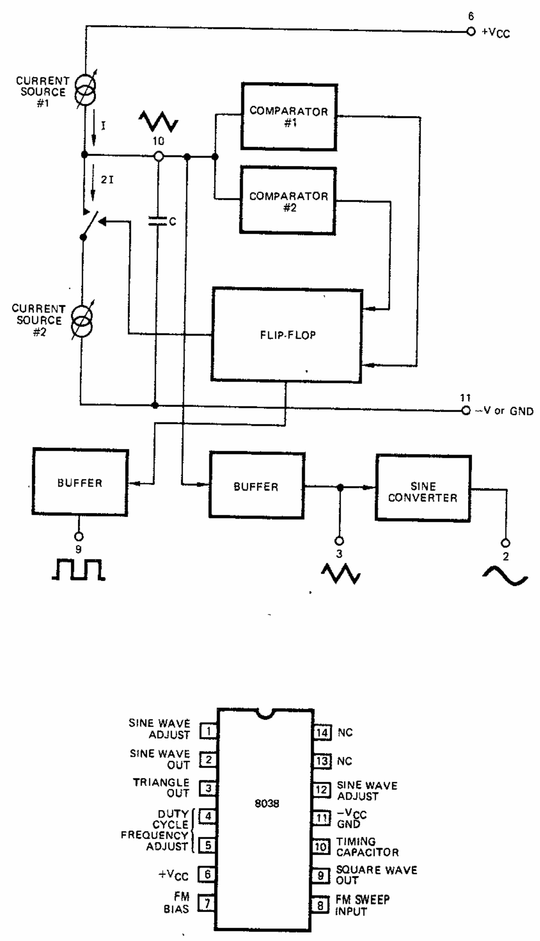
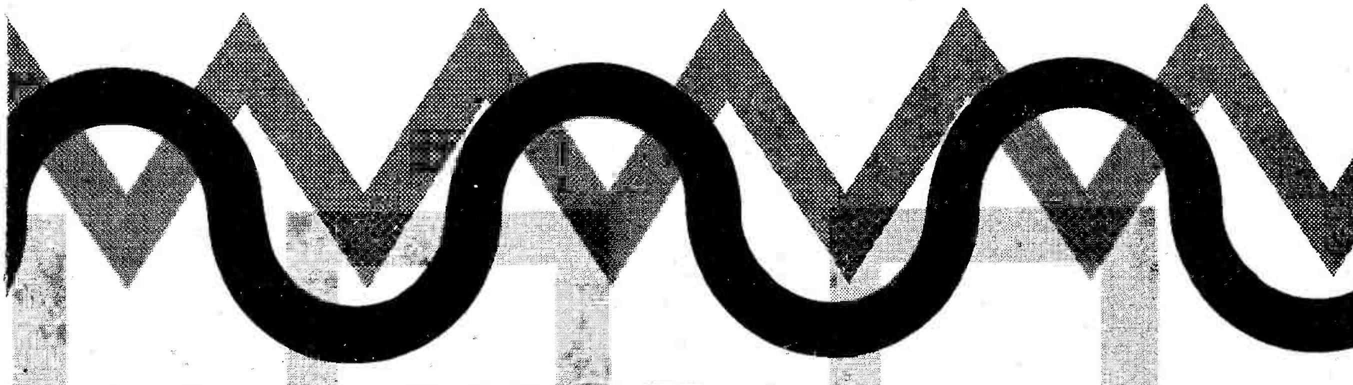


Fig. 1 : Block diagram of the Intersil 8038 waveform generator IC. The lower diagram shows the pin designations.



GENERATOR

John Smith C.Eng PART ONE

SPECIFICATION

Frequency Range:—	0·1Hz to 100kHz 100kHz to 1MHz (uncalibrated)
Waveforms:—	Sine, Triangle and Square
Output:—	10V peak (attenuated to 1mV)
DC Shift:—	± 5V

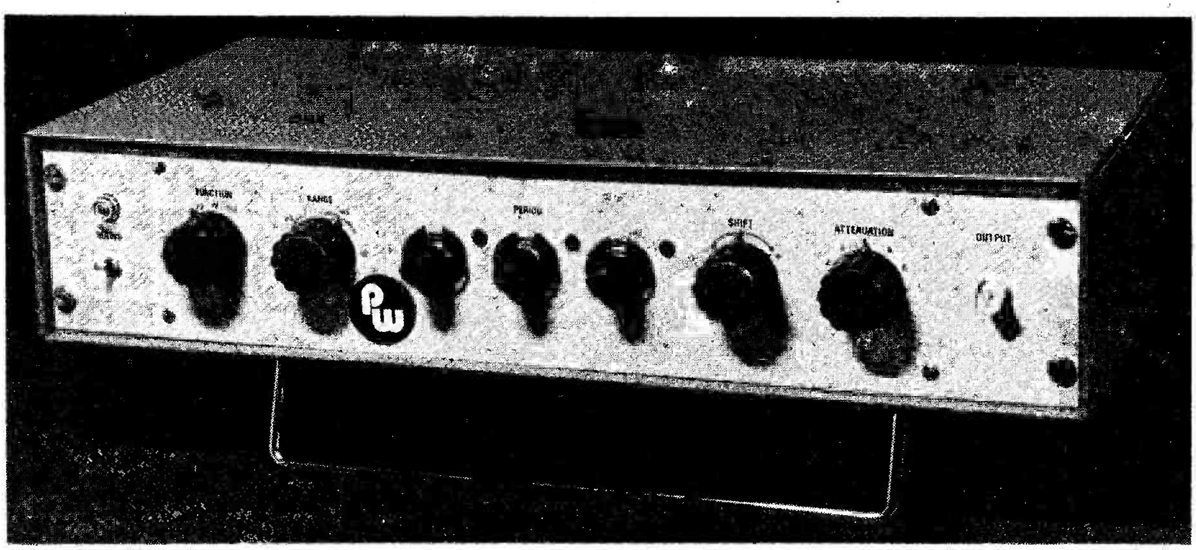
CIRCUIT DESIGN

The generator design is based on the Intersil 8038 IC waveform generator (see Fig. 1) capable of producing sine, square or triangular waveforms. Two types are available, the 8038CC, which is the cheaper version, and the 8038BC, which has a superior preformance; another model the 8038AC has a military specification, but is rather expensive for use in this application. The 8038BC has been selected for this instrument. However, some users may be able to make do with the cheaper unit. A certain amount of component selection is necessary to achieve the best from the circuits.

The constructor has a number of options open to him with regard to performance and simplicity thus:—

1. 8038 BC with component selection (gives maximum performance)
2. 8038 BC with components as designed (gives a reduced performance)
3. 8038 CC with component selection
4. 8038 CC without component selection
5. 8038 BC with a simplified circuit
6. 8038 CC with a simplified circuit.

The performance gets worse as one approaches option Number 6, but for those people who want waveforms, but are not particularly concerned about accuracy, then option 6 is the cheapest. Options 5 and 6 use a simplified circuit which will be dealt with in a later article.



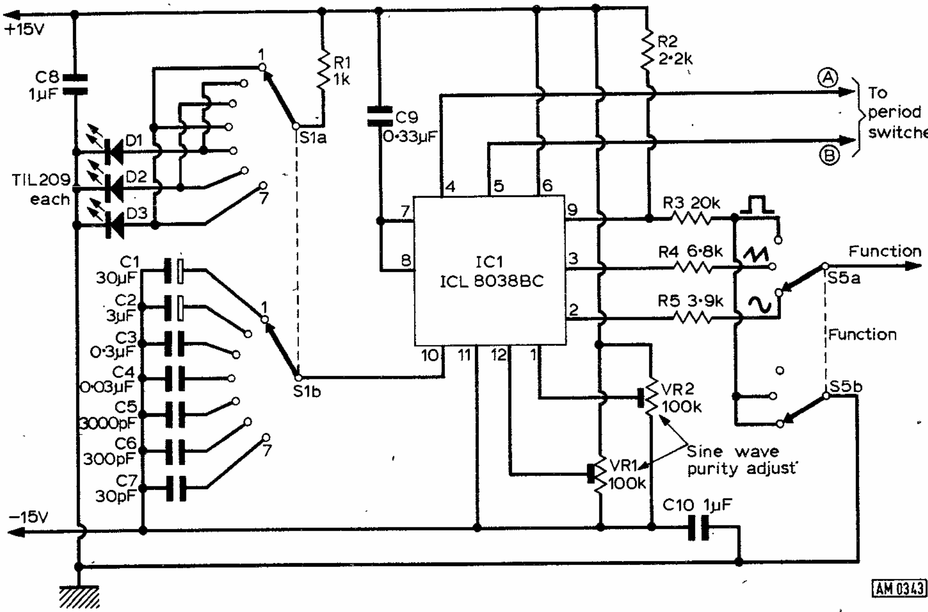


Fig. 2: Circuit diagram of the main generator section of the waveform generator. The light emitting diodes D1-D3 are the decimal point indicators on the front panel. The capacitors C1-C7 are nominal values and must be adjusted for required accuracy.

The circuit diagram is given in Figs. 2 to 5. Frequency or period range is controlled by capacitors C1 to C7 selected by switch S1a. Switch S1b operates the LED decimal point indicator. Position 1 is the seconds range where the first LED (D3) is lit. The maximum period which may be set on this range is 9·99 seconds (0·1Hz). Position 2 is calibrated in milliseconds and the last LED (D1) is lit. This means that the switches can be set to 999 milliseconds, i.e. 1Hz approximately but 1Hz can be obtained precisely on range 1 by setting the switches to 1·00 seconds. However, in practice this fine distinction is outside the capability of the instrument. The period adjustment is carried out on switches S2 to S4 connected to pins 4 and 5 of the 8038 (Fig. 3).

Capacitors C8 and C9 are decoupling components which must be mounted close to the IC for optimum performance. R1 is a current limit resistor for the light emitting diodes and may be reduced in value to give more current in the diodes if necessary. R2 is a load for the 8038 whilst R3 to R5 set the voltage levels for each of the output waveforms. VR1 and VR2 are used to adjust the purity of the sine wave output. C10 is a decoupling capacitor

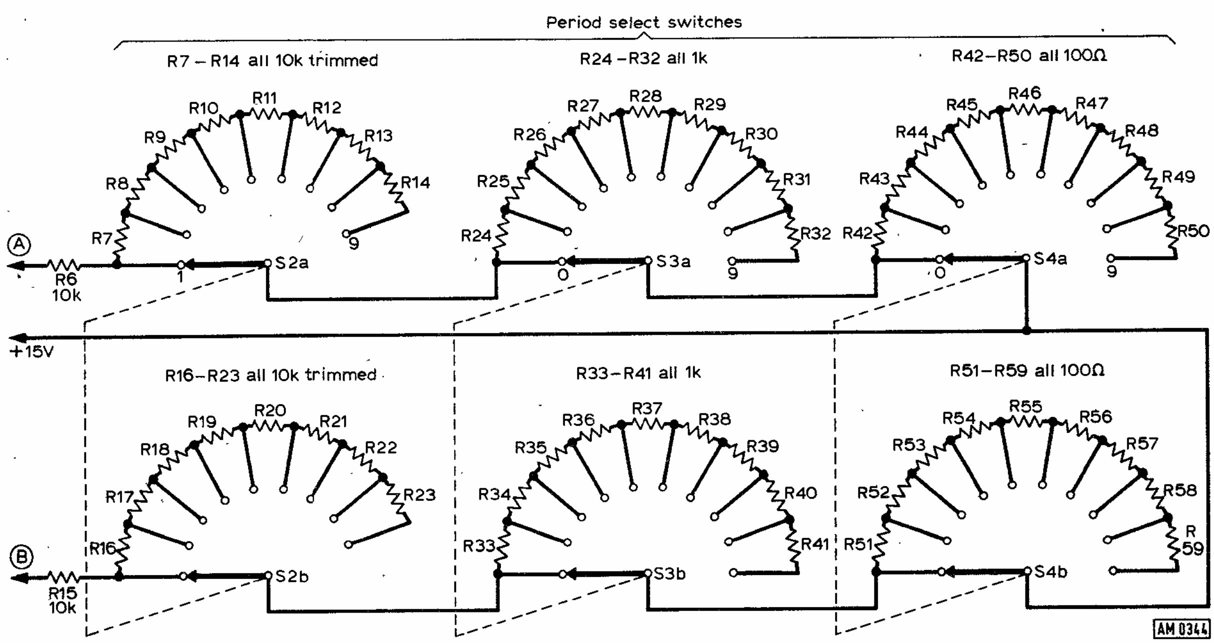


Fig. 3: Wiring of the three period select switches. These allow period to be varied over a range of 1000 to 1.

★ components list

Resistors

R1 1 kΩ
R2 2·2kΩ
R3 20kΩ
R4 6·8kΩ
R5 3·9kΩ
R6 10kΩ
R7–R14 10kΩ
R15 10kΩ
R16–R23 10kΩ
(R3 to R16–R23: trim)
R24–R32 1kΩ
R33–R41 1kΩ
R42–R50 100Ω
R51–R59 100Ω
R60 6·8kΩ
R61 10kΩ
R62 4·7kΩ
R63 560Ω
R64 110Ω
R65 1kΩ
R66 6·8kΩ
R67 2·4kΩ
R68 2·4kΩ trim
R69 2kΩ
R70 200Ω
R71 8kΩ (4·7k + 3·3k)
R72 1kΩ
R73 800Ω (470 + 330)
R74 100Ω
R75 80Ω (47 + 33)
R76 10Ω
R77 8Ω (4·7 + 3·3)
R78 1Ω
R79 1Ω
R80 1·2Ω
R81 1·2Ω
(R80, R81: 2·5W wire-wound)

All ± 2% ½W unless otherwise stated
VR1, VR2 100kΩ preset (2 off)
VR3 100Ω preset
VR4 1kΩ carbon

Capacitors

C1 30μF 25V
C2 3μF
C3 0·3μF
C4 0·03μF
C5 3000pF
C6 300pF
C7 30pF
(C1 to C7: trim)
C8 1μF
C9 0·33μF
C10 1μF
C11 10pF
C12 1000pF
C13 1000μF 50V elect.
C14 0·22μF 50V
C15 100μF 25V elect.
C16 1000μF 50V elect.
C17 0·22μF 50V
C18 100μF 25V elect.

Capacitors and resistors marked "trim" are nominal values and should be trimmed to working values using the method to be described in the text.

Semiconductors

IC1 8038BC (see text)
IC2, IC3 MVR15V (RS)
D1–D3 TIL209 light emitting diode (3 off)
D4, D5 REC76 (RS) or similar 200V, 2A bridge rectifier (2 off)
Tr1–Tr3 BC184 (3 off)
Tr4 BC214

Switches

S1 2 pole 7 way
S2 2 pole 9 way
S3 2 pole 10 way
S4 2 pole 10 way
S5 2 pole 3 way
S6 1 pole 9 way
S7 Double pole mains switch

Miscellaneous

T1 Mains primary, 0–20V 0–20V 30mA secondary (RS)
LP1 Mains neon indicator
Sk1 BNC socket
Instrument case 432 x 200 x 88mm (RS type 4) with tilt bail (RS type D), knobs 28mm (4 off), Knobs 14·5 mm (3 off), Veroboard 0·1in matrix 330 x 70mm (13 x 2¾in), 80mm 4BA studding (4 off), 25mm stand-off (4 off), finned heatsink 50 x 50 mm (2 x 2in) (2 off), capacitor clips, 14 pins DIL socket.

Note

Please note that RS Components will not supply direct to the public, but components can be ordered from them through a retailer. The MVR15V, case, REC76 and transformer are available from Doram, PO Box TR8, Wellington Road Industrial Estate Wellington Bridge, Leeds LS12 2UF.
Order numbers are 305-399, 509-620, 261-592, 196-319 respectively (see catalogue).
Switches S1 to S6 can be made from RS Makaswitch components.
The 8038 is available from Ambit, Technomatic or Trampus.

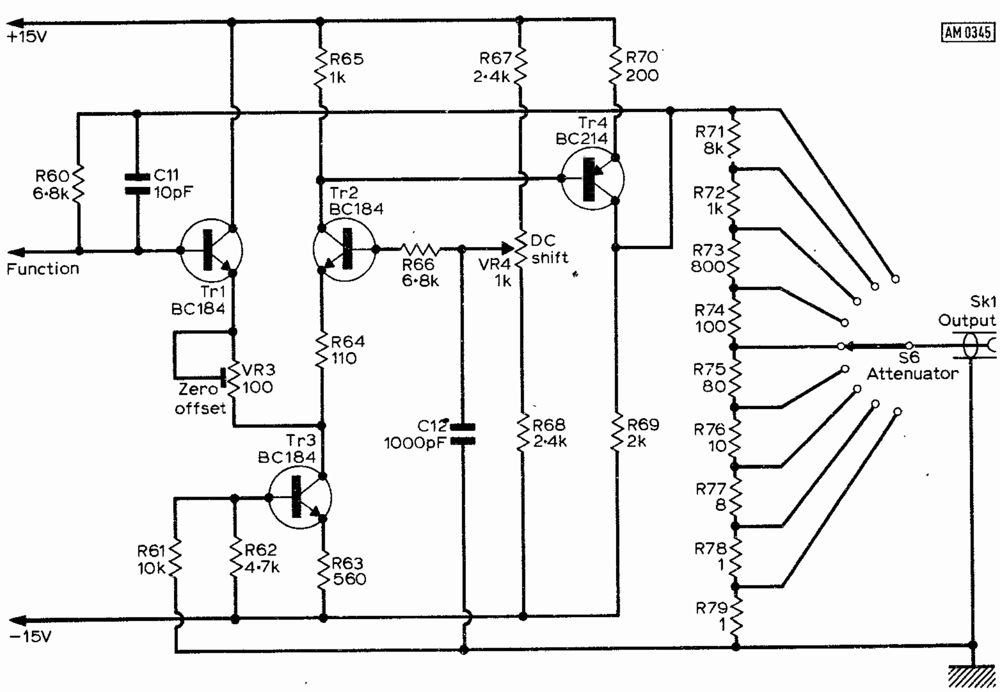


Fig. 4: Circuit diagram of the differential amplifier used in the waveform generator to give up to 10V peak output.

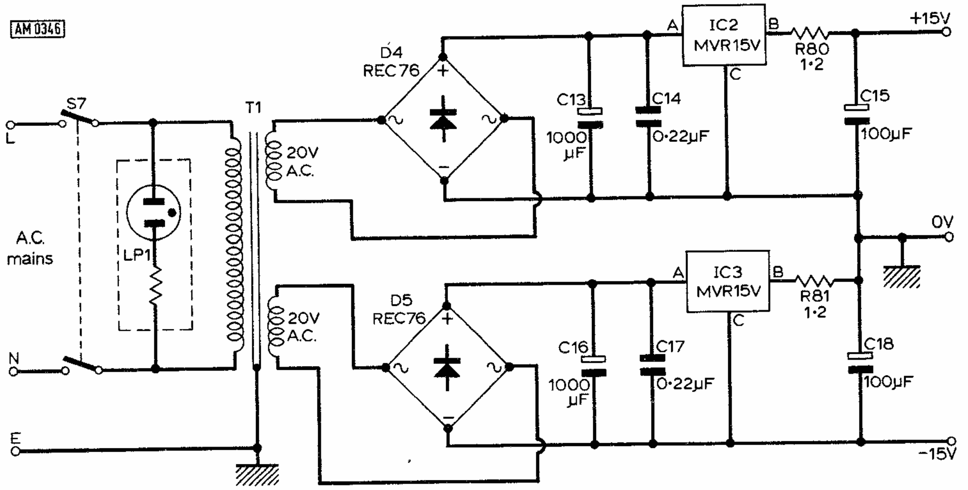


Fig. 5: Circuit diagram of the power supply which gives the required +15 and −15V supply rails.

which must also be mounted close to the 8038. C1 to C7, R3 to R5, R6 to R23 are marked for selection. These are the components which must be adjusted to obtain the highest accuracy of options 1 and 3.

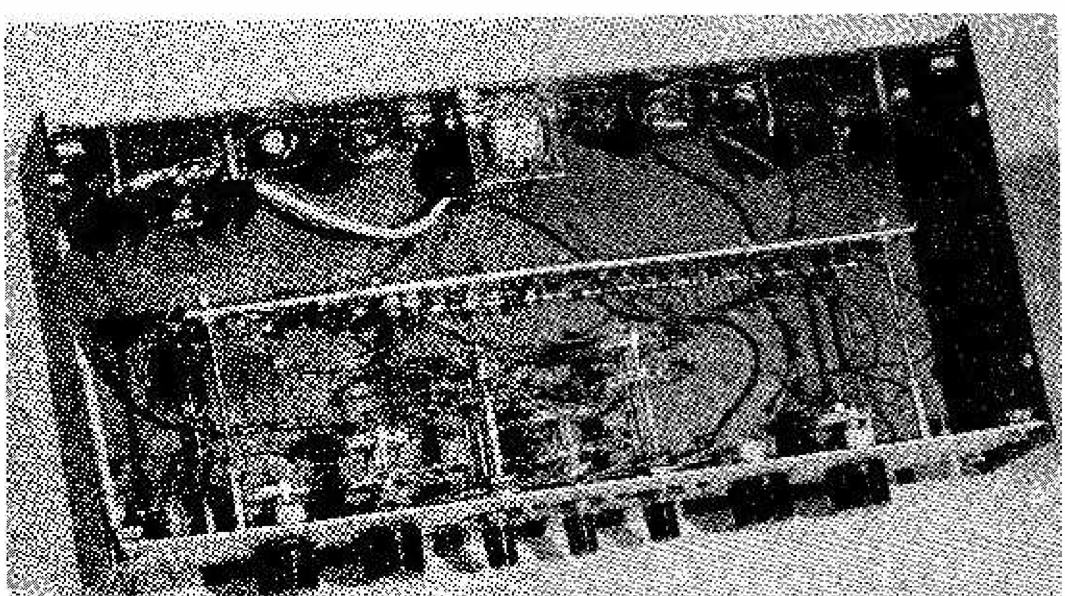
The three output waveforms from the 8038 function generator are fed via S5 to a differential amplifier (Fig. 4). S5b is necessary to short the pulse waveform to earth when the sine or triangular waveform is selected. This prevents the pulse interfering with these two functions through the switch stray capacitance. If possible, a large, low capacity switch should be employed in this position together with another pole to short the triangle waveform to earth when the generator is switched to sine operation.

The differential amplifier Tr1, Tr2, Tr3 couples the selected waveform to Tr4, an emitter follower output stage. Tr1 and Tr2 form the differential amplifier proper with feedback in the emitter and a constant current "tail" formed by Tr3. VR3 is used to adjust the calibration of the DC shift potentiometer VR4 at zero. A small portion of the output signal is fed back to the input of Tr1 via R60. C11 is a stabilising capacitor. Emitter follower Tr4 is coupled to a simple output attenuator which is capable of driving the loads already specified.

POWER SUPPLY

The power supply (Fig. 5) uses a transformer having two 20 volt windings. DC is obtained from bridge rectifiers D4 and D5 smoothed by 1000μF capacitors C13 and C16. The DC voltage from the two capacitors is applied to voltage regulators contained in a TO5 package IC2 and IC3. C14, C15, C17, C18, R80 and R81 are stabilising components which prevent the regulators from oscillating.

To be continued



The completed waveform generator with the top cover plate removed to show the disposition of the components within the case. The power supply is built on the back panel and the rest of the generator on the long panel in the centre of the case.

PW APOLLO series Part 2

TRIPLE VARICAP BIASING METHODS : SWEEP OSCILLATOR TECHNIQUES

W. POEL*

HAVING introduced the two new Motorola diodes for AM tuning in Part 1, this month's feature examines and explores the possibilities and potential that this breakthrough in price represents for the art of radio and electronics in general.

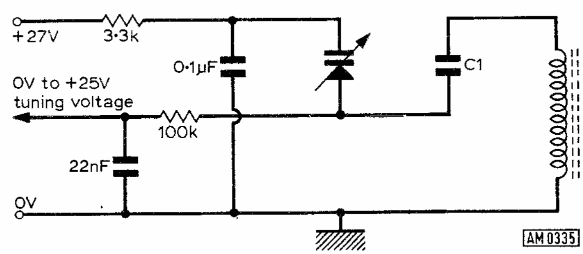


Fig. 2.1: By using a separate 27V bias voltage the common cathode varicap diode can be tuned using a variable voltage from 0 to 25V.

BIASING TECHNIQUES

Both the new diodes, the MVAM1 and MVAM2, employ a negative voltage to perform the tuning function, so with the almost universal adoption of negative earth circuitry techniques, this presents a few problems.

A solution is proposed in Fig. 2·1 which shows how a 27V bias can be used to keep the varicap reverse biased as the tuning voltage is varied from 0V to 25V. Until such time as the manufacture of a diode for direct negative earth applications is completed, this method is the best compromise.

The +27 volts still have to be found from somewhere in the circuit. In mains equipment, this will be another tapping on the transformer—or possibly a simpler arrangement via a voltage doubler from the main winding. In battery portable equipment, the only solution is a separate battery supply, or a DC to DC converter.

* Ambit International

DC TO DC CONVERTER

In the application of tuning a varactor, there is little actual current required, apart from that required to operate the voltage stabilisation circuitry. The principle is simple. An AC voltage is derived from an oscillator, and this can then be transformed up to the required level, and rectified with the earth in any sense that may be required.

The preferred means of deriving the AC in this type of application is with a sinewave oscillator. Square wave circuits will inevitably radiate many harmonics that will probably interfere with the AM radio, and nonetheless, the sinewave oscillator should be carefully screened to prevent unwanted radiation occurring.

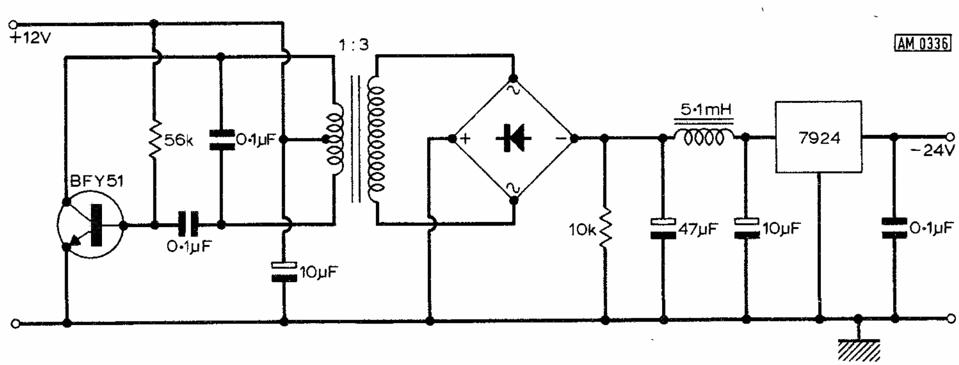


Fig. 2.2: A generalised circuit diagram for an inverter to give −24V from a +12V source. The 12V is fed to a one transistor oscillator, the resultant A.C. is then rectified and regulated.

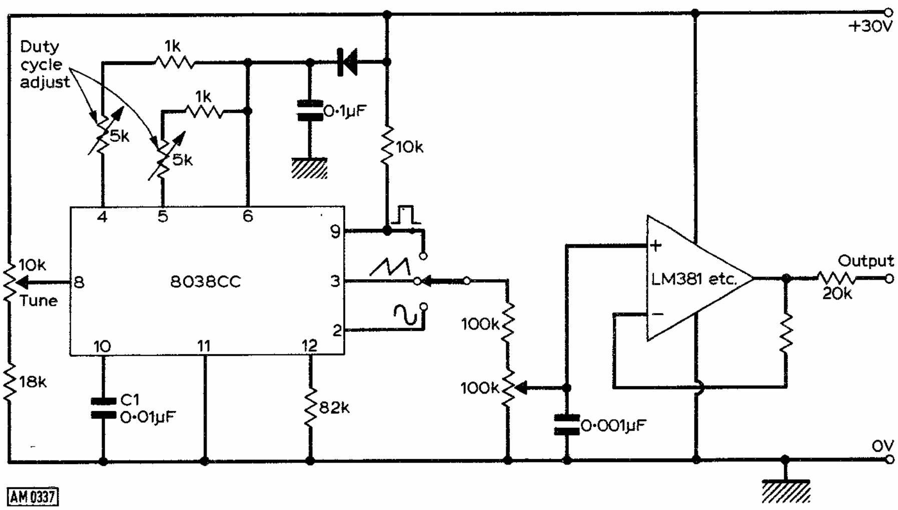


Fig. 2.3: The 8038CC can be used as a simple sweep voltage generator. The output can be amplified by an I.C. amplifier such as the LM381 to give a sweep of the required amplitude.

A general circuit is shown in Fig. 2·2, employing just a single transistor and inverter inductor. The turns ratio of the primary to secondary will determine the voltage step up—so from 12V to 36V, 1 to 3 is necessary.

The output from this inverter is carefully decoupled and filtered to prevent any residual remains of the AC signal being present by the time the voltage gets to the tuning diodes.

The inductor used can be of the bobbin, pot core or iron cored variety, but should be suitable for operation at the selected frequency of the inverter. Iron cored inductors may not be suited to frequencies above 20kHz.

The current that can be taken from the circuit will depend on the rating of the inductor—the overall efficiency for such a configuration is in the region of 40 to 50 per cent, given the correct components.

For simplicity, the method of voltage stabilisation is the three terminal 7924 (24V fixed negative regulator). A cheaper alternative can no doubt be devised using a Zener diode and a resistor, but the 7924 maintains better stability and has a far greater degree of supply rejection.

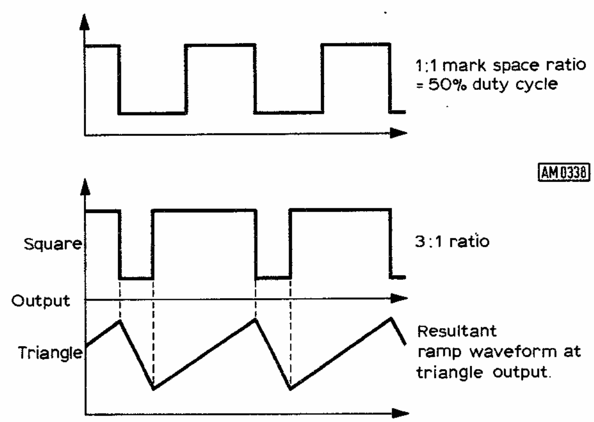


Fig. 2.3b: Waveforms associated with the circuit of Fig. 2.3. The upper waveform is that appearing at pin 9 when the duty cycle is adjusted to 50%. With a 3:1 mark space ratio (75% duty cycle) the waveforms at pins 9 and 3 appear as shown.

SQUARE LAW

When biasing any single varicap in the radio frequency circuit, remember that the law of the tuned circuit scale will be the "square law", so to obtain a scale of uniform linearity, the potentiometer should have an inverse square law.

Such a potentiometer is not presently widely available, but it is anticipated that a special long slider will be available with this feature designed specifically for radio tuning applications.

The two trimmers at the extremities of the main tuning pot are an important feature when aligning the scale. Although the various tuning diodes in the same package are matched to one another to a close degree of tolerance, this is not necessarily so between different samples.

It is also wise to remember that the lowest value of the tuning voltage should not be permitted to fall below two or three volts. This is because there is a chance that the oscillator circuit in the receiver will have an RF voltage that could exceed the total reverse bias on the diode tuning it. The result is that the oscillator RF gets rectified, and ceases to function at low frequencies with various audible manifestations of the instability. This can also be the case with an RF stage that is handling a very high level signal—this may become rectified, and will then modulate the supply to the other diodes on the same tuning bias supply.

OTHER APPLICATIONS AND FACILITIES

Anywhere that one uses a conventional variable capacitor of the mechanical variety, the varicap can be used for greater layout flexibility.

There are a couple of qualifications, based on the effect of strong signals becoming rectified by the diodes; so the devices would not, for instance, be suited to transmitter power circuitry; but in test gear, they certainly have many applications.

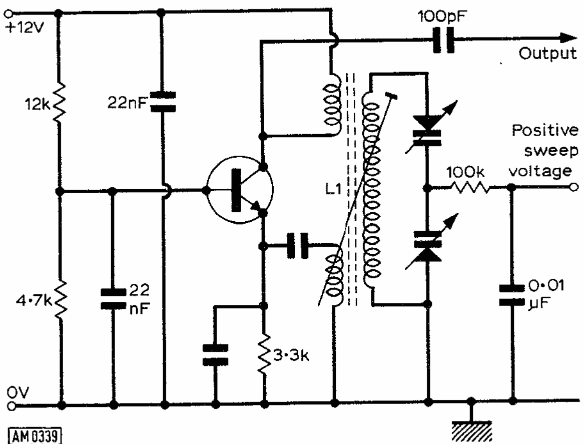


Fig. 2.4: The circuit diagram for a basic wobbulator or voltage controlled oscillator. The sweep voltage is used to vary the capacitance of the varicaps and hence the tuned frequency of the one transistor oscillator.

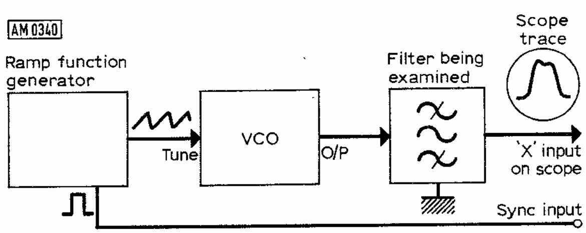


Fig. 2.5: The ramp generator of Fig. 2.3 and the VCO of Fig. 2.4 can be combined as shown in order to display the response characteristics of a tuned circuit.

SWEEP OSCILLATORS

Sweep oscillators are used extensively for radio tuned circuit alignment, and are known under various guises as panoramic adapters, wobbulators, spectrum analysers, etc. They all employ the same basic principle, namely that an RF oscillator is varied in frequency in synchronism with an oscilloscope trace.

The circuit under test is fed with the output of the oscillator and the performance of the tuned circuit is then assessed by the visible display of the amplitude response. Fig. 2·3 details a simple form of sweep voltage generator, and in conjunction with the oscillator of Fig. 2·4 a basic wobbulator is formed. Fig. 2·5 shows how this combination is used in conjunction with an oscilloscope for displaying the response characteristics of a tuned circuit.

SWEEP GENERATOR

The 8038 function generator IC is used to provide the basic waveform generation. It is a fascinating device in its own right, in that the single chip provides triangle, square and sine wave outputs simultaneously with a fixed phase relationship.

The duty cycle (Fig. 2·3b) can be simply adjusted with the potentiometers on pins four and five, and the actual frequency of the sweep is again set by a potentiometer.

As an audio oscillator, the 8038 can be swept by up to 1000:1 by the application of a suitable sweep voltage at pin 8. However, the sweep voltage is basically a low duty cycle triangle wave—or ramp voltage and the amplitude of this, direct from the chip is approximately one third of the supply voltage.

With a 30V supply, this gives 10 volts, so to increase this, an operational amplifier is employed to amplify to around 28V peak to peak.

The values shown on the circuit allow the frequency of sweep to be varied from 20Hz to 20kHz. By switching additional capacitance across the timing capacitor at pin 10 the frequency can be lowered, though to fully appreciate the capability of the 8038, reference should be made to the very comprehensive manufacturer's data sheet.

The square wave output from the 8038 can then be employed as the trigger for the oscilloscope timebase, to ensure that the sweep voltage and the trace start simultaneously.

SCAN WIDTH SELECTION

Applying the whole voltage to the varicap diodes will result in a very large sweep being achieved—but this is not the only factor, since it is desirable to be able to select a specific area of the spectrum for examination. Fig. 2·6 shows how this is accomplished by simply adding the sweep voltage into the main tuning voltage. This technique is often employed in VHF varicap tuners, where it is desirable to be able to control all the tuned circuits at once, rather than just the local oscillator.

Adjusting the amplitude of the sweep voltage will vary the width of the scan. Remember that the sense (polarity) of the tuning voltage for the single ended MVAM diodes should be considered when testing equipment, as separate power supplies may need to be employed.

EXISTING RECEIVERS

It is a relatively simple matter to append the spectrum analyser feature to an existing receiver design by simply adding the MVAM diodes across the various sections of the tuning capacitor. The scale linearity of the main receiver will suffer—but if used in conjunction with a signal generator to provide marker reference points, the result will be fascinating at least, and probably very useful as well.

By monitoring the diode voltage at the detector, one will obtain a frequency/amplitude plot on the oscilloscope trace—giving a visible display of signals present within the swept part of the band, as shown in Fig. 2·7.

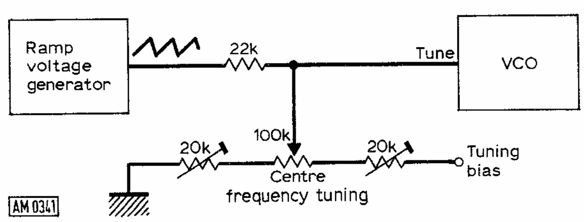


Fig. 2.6: To investigate a specific area of the spectrum the sweep voltage is added to the main tuning voltage. Adjusting the amplitude of the sweep voltage will vary the width of the scan.

continued on page **158**

PRODUCTION LINES

colin riches

RADIO CONTROL COMPONENTS

Home Radio inform us that they can supply the following components for the Radio Control Monitor: VC1 (Cat. No. VC26D); TC1 (Cat. No. VC62); PHF3 coil (Cat. No. CO84C); OA90 (Cat. No. OA90); C1 - 0·047μF (Cat. No. 2CN155); 3·5mm jack socket (Cat. No. JH18) and 100 Microamp meter (Cat. No. TG76). Total price including post, packing and VAT is £5·88 — *Home Radio (Components) Ltd., 234-240 London Road, Mitcham, Surrey.*

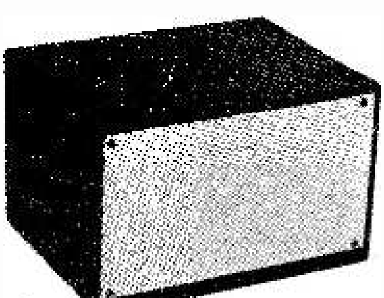
INSTRUMENT CASES

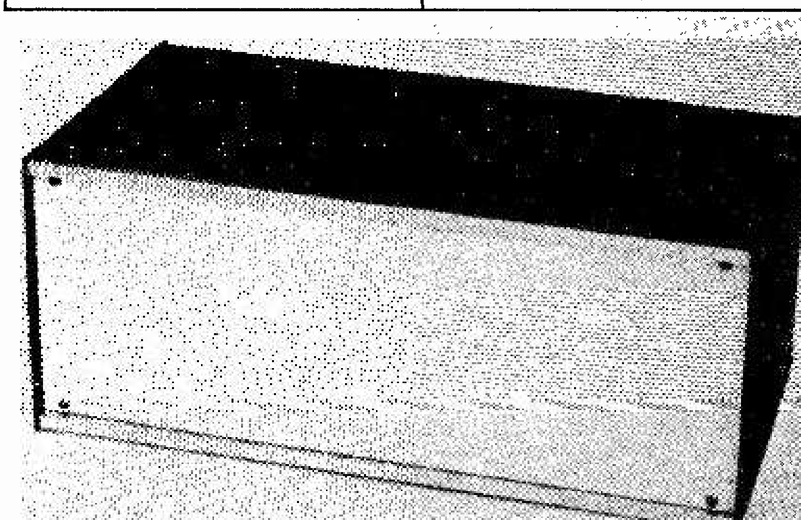
Arbour Electronics Limited have sent us details of their 'Centurion' instrument cases. The two shown in our picture are the 222F and 321F.

Model 222F (left) comes packed flat. The front and rear panels are of aluminium and the case of mild steel. The front panel is finished in white gloss and the other sections in blue hammer stove enamel. Price of the 222F (197 x 254 x 159mm) is £3·40 plus VAT (postage paid).

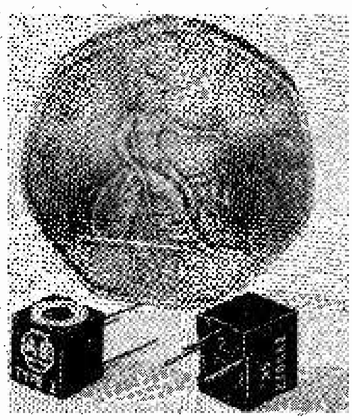
Model 321F (203 x 406 x 165mm) has an aluminium front panel. The case and rear panel are of mild steel. The front panel is finished in white gloss and the other sections are a black 'crackle' finish. This cabinet is finished with top and bottom aluminium trim. Price of the 321F is £5·80 plus VAT post paid.

Further information on these instrument cases or the sheet metal work service run by Arbour, contact them at *Unit 13, East Hanningfield Industrial Estate, Nr. Chelmsford, Essex. Tel. Chelmsford (0245) 400700.*





TRIMMER POTS



The Allen Bradley single trim type Z trimmer potentiometer is ideal for use in miniature equipment for it only measures a 6·35mm cube.

Power rating is 0·5W at 70°C and terminations are by pins with the option of vertical or horizontal mounting. High power rating is achieved by cermet technology in the 50Ω to 1MΩ range.

Both vertical and horizontal types are available in 10% tolerance (price 95p each for 25 off) ex-stock from *Jermyn Industries, 74 Vestry Estate, Sevenoaks, Kent.*

TELE-TENNIS REPRINTS

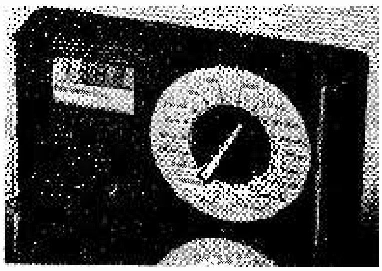
These are still available from:

Chief Cashier (P.W. Tele-Tennis) IPC Magazines, Tower House, Southampton St., WC2E 9QX. Price is 75p + 7p postage.

THE DANAMETER

Dana Electronics have developed a "personal" volt-ohmmeter which features a $3\frac{1}{2}$-digit liquid crystal display. A single 9V transistor radio battery will last a year with normal use.

Sixteen ranges are available on the switch: four each of d.c. volts, a.c. volts, d.c. current and ohms. Both a.c. and d.c. volts scales are 2, 20, 200 and 1kV; d.c. current is measured from 20μA through 2mA, 200mA to 2A, and ohms from 200 through 20kΩ, 2MΩ to 200MΩ. Reading accuracies vary from ±(0·5% of reading + 0·05% of range) (2V d.c. range) to ± (8% of reading + 0·05% of range) (200MΩ range). When 'd.c. volts' is selected the input resistance is 10MΩ, and the impedance for a.c. volts is 2MΩ. Switch



position 17 is for internal battery checks, and position 18 is 'Off'.

The Danameter costs £99·50. Further information may be obtained from *Dana Electronics Ltd., Collingdon Street, Luton, Beds.*

LARSHOLT VHF TUNERSET

The constructor who feels that making a VHF receiver is a bit too complicated a venture will welcome the Larsholt "Tunerset" made by Larsen and Hoedholt in Denmark. It will also appeal to the experienced constructor who may not have too much spare time on his hands.

This elegent and well-constructed unit is only 168 x 65 x 25mm ($6\frac{5}{8}$ x $2\frac{1}{2}$ x 1in.) with clearly numbered pins for connecting to the external circuitry. The input accommodates 75 or 300Ω feeders and provides around 330mV of audio at medium impedance at the output with signals greater than 2μV. Gate-protected 40822 and 40823 MOSFET'S are used in the RF and mixer stages and a BF224 in the local oscillator. All three stages are varicap tuned by an external stabilised voltage which can be fed into the unit by the conventional push-button panel. A voltage from 2·3 to 12 volts will provide a frequency range from 87·5 to 104·5 MHz. The recommended stabilised main supply is 20 volts, taking 65mA.

The signal at the usual IF of 10·7MHz passes through a double ceramic filter to a CA3089E limiting stage and an LM3900 IC. Quadrature detection, muting and AFC facilities are provided. Two sections of the LM3900 are unused and their input and output connections brought out to pins so that they can be used as additional audio amplifiers. With stereo, the audio output signal can be routed via an external decoder IC, such as the CA3090AQ or MC1310 or KB4400, the two channels then being fed back to the two spare sections of the LM3900 for further amplification.

Simple external circuits connected to the appropriate pins will provide a signal strength meter, centre-zero tuning meter as well as muting aud AFC switching. A frequency scaled meter can be linked to the varicap tuning voltage if desired.

The technical specification adequately meets today's requirements and a first-class receiver can be quickly built around the Tunerset. The accompanying technical literature is clear and provides all the necessary information to accomplish this. Indeed, the frills can be left to later and the tuner made to work initially with just the 20V power supply and a couple of PP3 batteries across a potentiometer for the tuning voltage, the output being fed into some audio amplifier such as a Hi-fi set-up. All necessary tuning and alignment points are clearly marked but it is suggested that these be left alone until the final alignment when the finished receiver is working properly.

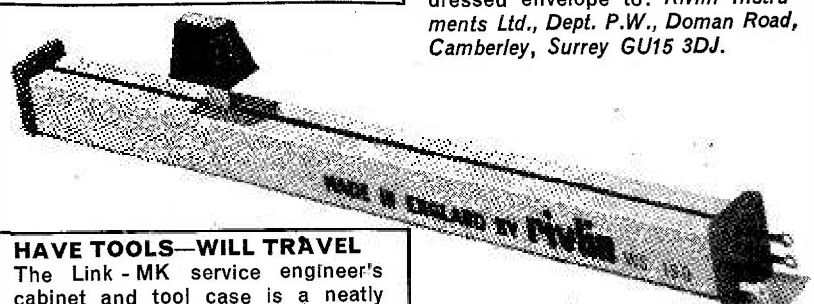
Full information on the Tunerset can be had from *Ambit International, 37a High Street, Brentwood, Essex.*

RIVLIN POT.

Rivlin for many years have been known for their quality precision wirewound resistors and resistive standards.

The new Rivlin Type WS150 potentiometer is developed from experience gained during the last 2 years of producing a 60mm Carbon Slide Potentiometer, which has been much praised for its price and technical merit.

This latest pot is the first of their WS range and features a wirewound 50kΩ, 150mm track, of near professional standards. It is being used in our P.W. "Apollo" m.w. tuner/receiver featured in P.W. This component is intended to satisfy a need in the Audio and lighting industry where a linearity of 0·1% and resolution of 0·03% are required. Further developments in the range will incorporate varying track lengths as market dictates. For further information, please send a stamped addressed envelope to: *Rivlin Instruments Ltd., Dept. P.W., Doman Road, Camberley, Surrey GU15 3DJ.*



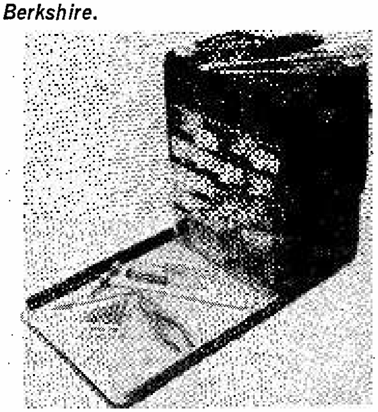
HAVE TOOLS—WILL TRAVEL

The Link-MK service engineer's cabinet and tool case is a neatly adapted standard small-parts cabinet. It comprises a Link-MK cabinet containing four sizes of transparent drawer in various combinations, together with a wooden tray for larger tools, all housed in a lockable simulated leather carrying case.

When open, the rigid front of the case folds down to make a convenient platform for tools. All the drawers can be subdivided to hold large or small items (an assortment of dividers is supplied) and each drawer has a label slot.

The cabinet, measuring 15in x $12\frac{1}{2}$in x 8in, is intended to meet the needs of both professional service engineers and hobbyists of all sorts, from DIY enthusiasts to modellers and photographers.

It is obtainable from storage specialists at a recommended price of £14·80 plus VAT. Names of local stockists will be provided by the manufacturers on request. *Link-Hampson Ltd., Bone Lane, Newbury, Berkshire.*



ELECTRONI-KITS

Electroni-kit, the UK distributor for Denshi Block Mfg. Co. Ltd., tell us that they can supply the SR Series of educational electronics kits.

The one shown in our photograph is the SR-3A de-luxe kit from which one can build 105 projects including things like a solar-battery-operated transistor radio, three-transistor intercom, amplifiers, electronic sirens metronomes, organs, etc., etc.

These kits are very good for youngsters to learn the basic elements of radio and electronics for all components plug into a circuit board. No soldering is needed. For further information and prices write to *Electroni-kit, 408 St. John's Street, London EC1B 1LJ.*

Repairing HI-FI AMPLIFIERS

H. LEEMING G3LLL

IN the "good old days" of valve equipment it was quite surprising what one could get away with, and many engineers who really hadn't much idea what was going on, managed to execute quite successful repairs by trial and error. As we shall see, this kind of approach with directly-coupled transistorised equipment can do far more harm than good, and it is hoped that this article will, at the very least, indicate to readers how not to repair equipment! Let us imagine that an amplifier has blown its fuse and has come in for service. How does Fred, the bodger, tackle the job?

First, Fred replaces the fuse which immediately blows again, to give himself a chance to find the fault he fits a larger fuse! Noting that this also blows he decides to check the output transistors on a tester and sure enough, one of them seems faulty. Fred swops the transistor, switches on, and blows another fuse! Fred next decides to isolate the two channels, and so disconnects the supply voltage from the left hand one, and sure enough the right hand channel functions satisfactorily without the destruction of any more fuses. Fred is now convinced that one of the output transistors is still faulty, but just to prove the point he decides to swop over the power amplifier boards which, fortunately, plug in. Soon the amplifier works on neither channel, blows mains as well as low voltage fuses, and so, in desperation, Fred sends the amplifier back to the manufacturers.

When the bill arrives, Fred's customer finds that he has to pay for eight transistors, four rectifier diodes, a mains transformer and several sundry parts which, together with Fred's time, and carriage amounts to over £30. Fred assures the customer that it wasn't his fault as the amplifier had so many faulty components that he just hadn't a chance! What went wrong?

WRONG APPROACH

In the first place Fred made a totally wrong approach to the job. Transistorised amplifiers, unlike their valve counterparts, are invariably directly-coupled devices, and this really does throw a spanner in the "lucky dip" type of approach to servicing, as faults in one stage can often damage components, as well as affecting voltages, in other stages. In the case in question, the only original fault could well have been incorrect quiescent current brought about by the setting of VR1 in Fig. 1 or that one of the transistors was faulty. The fuse had blown to protect the equipment, and the real trouble did not start until a larger fuse was fitted. With Tr8 and Tr9 incorrectly biased the supply current surged up blowing all the output and driver transistors.

As the circuit boards do not include the output transistors, swopping the boards around connected a good board to a faulty pair of output transistors and a faulty board to a good pair of output transitors. This resulted in another collection of blown components. In the end, so much current was drawn that the rectifier went short-circuit taking the mains transformer with it. We might well laugh at Fred's approach, but how does one go about tracing faults in transistorised equipment?

REGAINING SUPPLY VOLTAGE

With a transistorised amplifier that blows fuses, one has a real problem, as, without power, not many meaningful tests can be made. Simple faults, such as the mains rectifier or smoothing capacitor being short circuited will blow the mains fuse and can be found by ohmeter tests. But faults causing excessive current to be drawn in the amplifier section do not usually respond to such a simple approach. The first problems when dealing with a case of a blown LT fuse, is to get the amplifier into some kind of working order without destroying more components in the process. There are two possible answers here.

1. Restrict the voltage applied to the equipment.
2. Restrict the maximum LT current possible.

In the first approach the amplifier is connected to a supply derived from a variable voltage transformer or Variac with a milliameter connected in place of the LT fuse. The amplifier is switched on with the applied volts at zero, this is then gradually increased until the meter measures, say, 100mA. This method works quite well, but does not protect the amplifier or the test meter against any sudden avalanche of current, should the amplifier suddenly break down at some particular applied voltage. This method also ties up a valuable meter and necessitates the use of a variable AC supply which might not always be available.

The second approach, shown in Fig. 1 is the best one. Here a resistor RX is used to replace the LT fuse, its value being calculated so that under short-circuit conditions the possible current is limited to a safe value. The value of the resistor is not particularly critical and if a resistor of around 250Ω is fitted this will ensure that under conditions of even a dead short, the current will not exceed a few hundred milliamps. Note that under short-circuit conditions the resistor could get hot so it should be rated at 10 or 20W depending upon the supply voltage. Having connected the resistor, the amplifier can be switched on safely and under fault conditions, only a small voltage will appear at point Y (if the amplifier was not faulty the voltage at point Y, with the amplifier drawing only its standing current, would only be a few volts below normal). Having got a small voltage at point Y it is now possible to do a little fault tracing, and to find out just where the excessive current is going.

The first point to ascertain is which channel is the faulty one, and under low voltage conditions this might not be at all obvious, as sometimes the channel which appears to have the queerest voltages turns out to be the good one! The certain way to tell where the current is going, is to disconnect the LT supply separately from each channel; but sometimes a quick dodge is to feel the temperature of the transistors, as the warmest ones will usually be those which are passing most current.

FAULT TRACING

Having got the amplifier into some sort of operating condition and established which channel is faulty we are ready to apply some logical fault tracing techniques—or are we? Practice shows that the slowest way to trace faults in a transistorised directly-coupled power amplifier is to try and trace them logically! A few shots in the dark are very well worthwhile.

The first items to test are the output transistors and, if in doubt, checks on these made by an ohmeter or a simple transistor tester should be compared against tests made on known good samples. Silicon output transistors should show no noticeable leakage, but often good germanium transistors will register quite high leakage. With amplifiers where it is possible to swop over the circuit boards, it is very simple to tell whether the fault is in the board or the output transistors by swopping them over, but in this case ensure that RX is fitted and not a fuse. One point to note here is that confusion can be caused if, as quite frequently happens, in addition to there being a faulty output transistor there is also a fault on the driver board.

Presuming that the output transistors are found to be in good condition, or are made so, but that the amplifier still tries to draw excessive current, the next components in order of their likelihood of being faulty are; Tr8, Tr9, Tr6, Tr7 and C34. This order seems to apply to all of the many transistorised amplifiers which use circuit arrangements similar to that shown in Fig. 1 and in 95% of cases the fault will lie in one of these components. If the fault does not appear to be due to a transistor or an output capacitor, a considerable amount of time may have to be spent tracking it down, remembering all the time to try and separate cause from effect. In the case of amplifiers where the driver boards containing all the power amplifier components, with the exception of the output transistors, are removable, it might be advisable to swop the whole board. If it is necessary

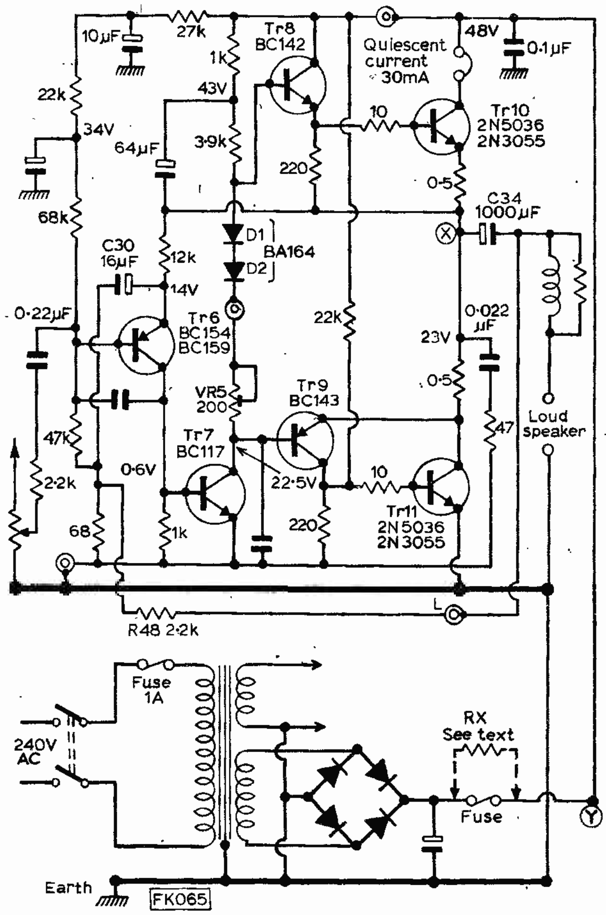


Fig. 1: Output stage of a typical hi-fi amplifier, showing component values and theoretical voltages.

to trace the trouble without outside help, here are a few tips which may be of use:—

1. When things are working correctly, the output stage current is determined by the difference between the base voltages of Tr8 and Tr9. This, in turn, is controlled by the voltage drop across D1, D2 and VR5. D1/D2 stabilize the voltage, whilst VR5 adjusts it to the correct value depending upon the current through Tr7. If any fault occurs which tends to increase the voltage between the bases of Tr8, Tr9, such as an open-circuit diode or potentiometer, this will result in excessive current.
2. In a correctly functioning stage using NPN silicon transistors, the base will always be about 0·6V more positive than the emitter (using PNP transistors the voltage will be about the same but negative, whilst germanium transistors will be found to have about 0·1V between base and emitter). More voltage than this indicates that the transistors base/emitter junction is open circuit, whilst less voltage indicates that there is insufficient bias.
3. The amplifier's DC stabilization will be completely upset by the low supply voltage which is applied under test conditions. In these circumstances it is no use at all trying to scale down voltage readings from those given in the service manual, and any voltage checks in a stereo amplifier should be made by comparison with the known good channel.

LOW OUTPUT AND DISTORTION

Having discussed the faults which can cause excessive current to flow let us now have a look at other troubles which can occur. In a normally operating amplifier point X should be at about half the LT supply voltage, and any departure by more than, say, 10% from this indicates trouble. Such a departure from the correct voltage would usually result in low output or audible distortion, and when trying to track down such troubles, checking the centre voltage between the output transitors is one of the first tests that should be made. In many amplifiers this voltage is adjusted by a pre-set potentiometer in the base circuit of Tr6, while others use self-stabilising circuits. In either case, the trouble can be caused by almost any component and checking through from the output transistors backwards, as previously suggested, is as good an approach as any.

If low output or excessive distortion in the power amplifier section occurs without any apparent centre voltage deviation, it is quite possible that there is a lack of quiescent current and this should be checked and re-set if necessary by adjusting VR5, or its equivalent, according to the makers' instructions. When checking quiescent current it is wise to solder a resistor of about ten times the milliameter's internal resistance across the measurement point; otherwise, should the test leads drop off, or the meter cut-out blow, Tr8 will be destroyed as it will try to take over the work of the output transistor.

If, upon checking, the standing current is found to be too low or non-existent but is not adjustable, the fault will possibly lie in either D1 or D2 being short-circuit, as, whilst there are exceptions, a faulty transistor will usually upset the centre voltage reading.

OTHER FAULTS

Up to now we have confined ourselves to looking at DC faults in the directly-coupled power amplifier section, as this type of trouble is exclusive to transistorised equipment. More normal "valve type" faults occur however, and there is no reason why some unwanted effect should not turn out to be an open-circuit capacitor or a resistor "gone high". To be fair, such faults are rare and 95% of troubles in the power amplifier section are of such a nature that they affect the DC operating conditions.

"What is the trouble with my amplifier?" asked our customers. "Oh, it will be either the output transistors, the input transistor, or somewhere in between," replied our service engineer, and believe it or not, he was right! This may sound a little facetious, but just as the output transistors are the most failure-prone devices in the power amplifier section, so the input transistors are the most troublesome component in the pre-amplifier section. Lack of gain, or distortion, in the input stage can usually be traced by simple voltage checks, once again noting the magic figure of 0·6V which should appear between base and emitter on any amplifier using modern silicon devices. Whilst measuring this voltage do not forget to allow for the loading effect of the test meter, as the base voltage of an input transistor, which should be 4V for instance, would be wildly out if an attempt was made to measure it using the 5V range of a 1000Ω/V test meter.

Hissing or spluttering is invariably caused by noisy transistors and the offender can often be found by the application of a little heat or cold, and a marked change in the level of the noise will normally result if the offending transistor is approached with the tip of a soldering iron or is squirted with aerosol freezing fluid. In any case, if in doubt about the goodness of a transistor, substitution is the final test.

REPLACEMENT TRANSISTORS

Many transistors are basically very similar, different types being picked out by a selection process during production. The BC109 for instance, is guaranteed to have high gain and low noise, but the makers do not guarantee a very high voltage rating. The BC107 however has a guaranteed higher voltage rating but does not claim as good a noise or gain performance. These characteristics are guaranteed for the sake of users who want a transistor which they know will work without the need for further tests.

In workshop practice for instance, by carrying only the BC109 in stock, it is quite possible to select individual transistors that will replace the BC107, the BC108 or the BC109, or for that matter nearly any other NPN small signal transistor. The gain of transistors can be checked to sufficient accuracy with quite cheap transistor checkers. As well as voltage and gain ratings the power rating of transistors also has to be taken into account, but to some extent this can be judged from physical size. In a service department almost all faulty small-signal silicon audio transistors end up being replaced by a BC109!!

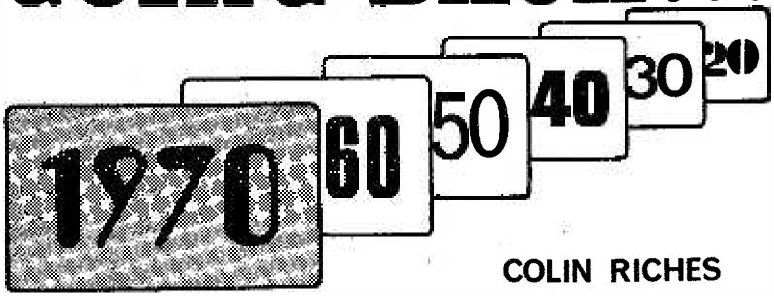
Output and driver transistors come in a multitude of shapes, and sizes but many are interchangeable. If an NPN silicon output transistor is required for an amplifier which is rated at 30W and which has a 60V supply rail, it is almost certain that another NPN output transistor which is the same physical size, and which is used in another makers' 45W amplifier with a 70V rail, will be a more than adequate replacement. Likewise the driver transistors of the larger amplifier can more than likely be used quite successfully with the smaller amplifier.

This approach of using transistors which exceed the specification of the original items fitted might seem extravagant, as it entails fitting a more expensive replacement. It does, however, much reduce delay and the number of parts carried in stock, and in the end it makes sound economics, even where it is felt desirable to replace both output or driver transistors to ensure a matched pair, instead of waiting weeks or months whilst a reluctant maker deems to deliver replacements.

FINAL TESTS

As a final check, all amplifiers should preferably be checked to their original specification for power output and distortion and should also be checked with an oscilloscope for performance on square waves. If, due to lack of the requisite test equipment, this is not possible, a fairly reliable comparison test can be made using a mono signal. This is fed into both channels of the amplifier and set to balance each other out by carefully adjusting the balance and tone controls. Any distortion existing in one channel alone will not balance out, and, if excessive, will indicate that further attention is required. PW

GOING BACK...



COLIN RICHES

The Fultograph

ANGUS Kennedy, who is aged 12½ and lives in Ludlow, Shropshire, recently sent me a cutting from a 1928 newspaper and asks if anyone can advise on a machine called the "Fultograph".

If any other readers can help us out on this one—information, a picture of a built unit or anything, we shall be pleased to mention it in "Going Back".

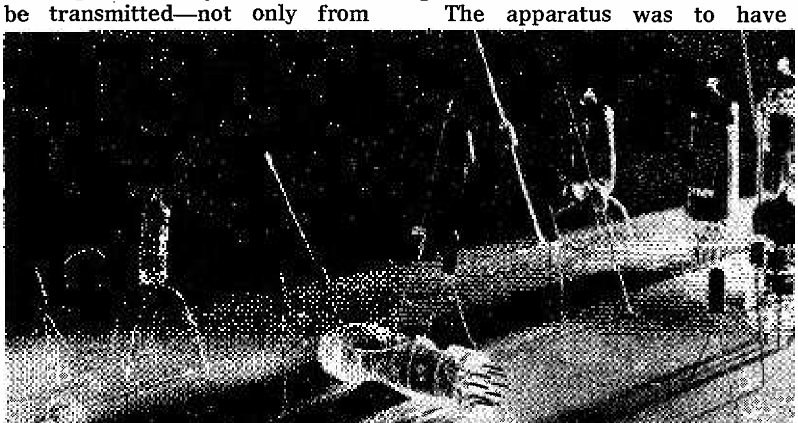
The newspaper item is entitled "Forecasting the Fultograph—Pictures to be broadcast" and is described as the "wonderful new feature of the BBC transmissions".

Readers were told that extraordinary interest was attached to the then recent announcement by the British Broadcasting Corporation of their plans for the prospective broadcasting of pictures. A new and more entertaining type of programme was to be expected and wireless would be afforded a fresh and entirely new dimension. News pictures of events within a few hours of their happening, illustrations of childrens' stories, latest Paris fashions, winning race horses, football favourites, weather charts, portraits of missing people—these were but a few of the possible subjects that could be transmitted—not only from English stations but some of the more powerful continental stations.

The Fultograph was described as being "not only for the wealthy few". By the cheapness of the apparatus, pictures by wireless would be at the disposal of a vast majority of wireless owners in England to whom its utter simplicity would appeal. It only had to be connected to any ordinary wireless set capable of working a loudspeaker and it operated automatically, requiring no tuning, no additional batteries and no more current than for one ordinary valve. In roughly three minutes the complete picture would be reproduced on specially-prepared paper and just to watch it evolve would be not the least fascinating feature of the device. On the paper's removal from the instrument no fixing or developing by photographic means would be required.

The Fultograph system was described as being used by the British Broadcasting Corporation and was an invention perfected only after years of research and experiment. Long before 1928 a less-effective instrument could have been put on the market but it was decided to wait until the device described had been fully perfected.

The apparatus was to have been marketed by Wireless Pictures (1928) Limited. It was obviously some form of facsimile machine which would have been available to everyone and was, basically an exceedingly good idea. It was probably dropped because of the developmenut of the television receiver but—does anyone know the inside story on the "Fultograph"? We would be very pleased to hear from you if you do.



Wireless Museum

THE Vintage Wireless Museum of the Wireless Preservation Society has been transferred from South Lincolnshire to the Isle of Wight, and is to be established in Arreton Manor, which is open to visitors throughout the year. It is the Home of Count and Countess Slade de Pomeroy, and already houses a folk museum and exhibition of domestic and agricultural bygones, many of which were collected on the Island. There is also a superb collection of dolls, dolls' houses and toys of past ages.

The Wireless Preservation Society was established some three years ago, and is exclusively devoted to the collection, preservation and restoration of wireless, electronic and sound reproducing equipment, including television receivers, for purely cultural, educational and historical purposes. It is an entirely non-profit-making organisation, and all its officers are honorary.

The Hon/secretary and curator, Mr. Douglas Byrne, G3KPO, is now living at No. 32 Luccombe Road, Shanklin, IOW (Tel. 098-386 2586), from whom further information can be obtained.

Revolution?

GOING back through my photographic files the other week I came across this Mullard photograph, released back in the '60's. Its caption reads: "The Trons are forced to retreat as they are overwhelmed by armies of Semicons". It is very interesting to see how their photographer envisaged the transistor "revolution". I am sure however, that amongst our Going Back readers there are many thousands that feel the valve will live for ever!

Dear Sir, letters

The Law is an Ass!

The law which states that the public must not listen to certain wavelengths or use the dial pointer over certain parts of the radio scale is as ludicrous as it is archaic; and is typical the backward thinking of British politicians as was the law requiring a man carrying a red flag to walk in front of every motor car. Further to your Editorials in the March and April issues, I feel it is not the public nor the small print that needs to be looked at, but the Law; this unrealistic aspect of it should be rescinded, and the sooner the better!

I draw the distinction, however, between the use of the air and the use of on-the-spot "bugging" devices for the surreptitious eavesdroppings of private conversations. This is quite a different matter and should be prohibited out of common respect and decency, backed (so far as necessary) by law.

But the air should be free whether we breathe it or listen to it (at any frequency).

Those who are brave enough to preach democracy should be brave enough to practise it.—**Peter W. Feesey** (London)

Naughty!!

I would be grateful if you could let me know if it is possible to convert a pocket transistor radio to receive Public Service Transmissions.

I would be quite content if the conversion meant that I would receive PST only.—**J. Bonnar** (Scotland)

Sorry this is just not on. You have not been reading my recent editorials!—Ed.

Designers—take note

As a reader of PW for the past 25 years, I would like to say how excellent your magazine is, and to further state how pleased I am that you have kept to the sensible "zig-zag" sign for resistors instead of the "oblong box" symbol of foreign origins. In particular I'm grateful for new equipment designs using IC's and varicap tuning.

May I however, make a plea, and beg for an article which deals with a varicap-tuned, digital frequency readout communication receiver, covering frequencies from 10kHz to 30MHz. Also a digital readout frequency meter, covering the range 10kHz to 30MHz and 30MHz to 100MHz.

Preferably the RF, Osc., and IF stages of the 10kHz to 30MHz communications receiver should have FET's of MOS FET's, and should be able to receive NBFM, SSB and CW. Sensitivity should be at least 1μV for 50mW output on all ranges. Power should be derived from a 12V source to enable the set to be completely portable.

The equipment that I have just described costs "a bomb" if bought commercially, so surely PW could publish a design that would enable the home constructor to build one, at a fraction of the cost of the ready-made article.—**G. B. Corry** (West London)

PW in Parliament?

In a recent letter to my MP (Neil Macfarlane—Sutton and Cheam) regarding the continual erosion of individual liberty, I cited the Home Office's deplorable behaviour in sending letters to editors as reported in your March editorial. My MP, in reply, said he had not seen a copy of the letters sent, and asked for a sight of one if I wished him to take the matter up with the Home Secretary.

As this is a clear case of a Govt. Dept. misusing an Act of Parliament and trying to limit individual rights I would ask if you are prepared to supply a copy of the letter in question for me to pass on to my MP.

I have already put it to him that the Home Office is a totally unsuitable Dept. to overlook communications and that in any event the Act in question should be repealed or amended as it attempts to deny an undeniable human right to receive magnetic waves—radio frequencies being no different from light and heat from the sun.

It is up to those who desire secrecy to apply that little extra to obtain it by coding or scrambling.—**SM Sugden** (Surrey)

Whose kidding who!

We at the Gullibalivsky Institute of Leggapullov are dismayed at the pirating of our research work, as described in your April issue. The device was invented by us and we called it a "Bogatron". It was not envisaged by us to be used at radio-frequency, (which is testimony to its versatility), but at extremely low frequencies, barely above D.C.

At these frequencies of about 5 cycles per day, it was enormously successful in flushing out phonies. (Would you like to buy a couple?).—**George W. Spray** (Isle of Wight)

From the many enquiries on the Unitron article (April issue), it would appear that many readers enjoyed the joke—Ed.

Problem solved!

I was interested to read in the March 1975 issue of your magazine an article on building a Sinclair Scientific Calculator. In the last paragraph the author says "On the other hand the most annoying omission is a "clear last entry" key. Having to repeat a lengthy calculation because you push a wrong button can be very frustrating." Well, fret no more! I bought one of these calculators, ready-built I am ashamed to say, and have also found the lack of this particular key annoying. So I worked out this key sequence to effect the same operation.

Example Say we wish to multiply 1·2345 by 6·7890 and we accidentally key in 6·7990 then we can clear this number by keying E, −, 9, 9, + this has the effect of adding $6{\cdot}7990 \times 10^{-99}$ to 1·2345 which gives 1·2345, then key in the correct value and continue the calculation.

I hope you, and all other Sinclair Scientific users will find this useful.—**W. S. Mcbriar** (Cambridge)

Illegal sales

Having read your magazine for many years, I can't recall anyone writing to you regarding "public enemy No 1"—the imported walkie-talkie. I'm sure every reader knows that these sets are illegal, yet a walk up the Edgware Road will show a selection of these sets on display to the general public. Granted most have written in the sales literature, in small print, "not licensable in the UK", but I was horrified when I visited a well known shop and overheard the sales chat of one of the salesmen.

He was telling a potential customer of a walkie-talkie set, costing in excess of £50, that it would be virtually impossible to trace the signal due to the high density of the buildings in London.

This of course it utter rubbish, as with todays sophsticated tracing equipment, it wouldn't pose much of a problem for the GPO. The salesman further went on to explain, that in the event of a "10,000 to one" chance of being traced he would probably be ticked-off or suffer a maximum £5 fine. Unfortunately the salesman neglected to say that his £50 worth of equipment would also be confiscated.

In my opinion the law should be changed, so that it would be illegal to sell any transmitting device, without first obtaining proof that the buyer has a licence to use the set in question, and that the set conforms with the regulations.—**D. Lane** (London)

Think negatively

Having constructed the PW electronic ignition circuit, published June 1971, and successfully used it on two Ford Escort cars in the last $2\frac{1}{2}$ years, I've found one fault in the system—and this is due to the car manufacturers! What happens if a positively earthed vehicle is changed for a negatively earthed one? Is the ignition circuit obsolete?

In my particular case, the vehicle earthing did change, as above, which necessitated only four alterations to the circuitry. These were to remove the supply from the transformer centre tap, and transfer it to the link connecting the collectors of Tr1 & 2 to R2/R3. An earth was then placed on the transformer centre tap; D5 was removed altogether, and D4 reversed, so that its anode was connected to R7/R6. Finally, Tr1 and Tr2 were insulated from the chassis.—**C. A. Emms** (Suffolk).

Attention Hoarders!

We are trying to assemble a small collection of old electrical equipment, mainly radios, record players, etc. As we rely on donations, we have so far been limited to equipment no more than 40 years old. If anyone in the Belfast area has any old, unused, or damaged equipment (the condition is immaterial) we would be very glad to hear from him.

There are two particular items for which we are looking: an old valve portable radio (with DF91 and similar valves), and an old "Cat's Whisker" crystal set.—**C. J. Steenson** (Annedale Grammer School, Belfast).

Wake-up, Home Office

Having been a reader of *P.W.* for over 20 years I have gained a lot of knowledge and enjoyment from it. But the time has come when I can no longer restrain myself from writing to your columns for the very first time.

Your editorial article in the March '75 issue really makes one wonder. When will the powers that be, i.e., the Home Office, wake up from their 1900 era of thinking and acting? Where, might I ask them, can the public obtain a copy of the Terms, Provisions and Limitations, that we must abide by since a licence to use a radio receiver for the reception of Wireless Telegraphy is no longer required?

No doubt the Home Office would point out, if a situation arose that required taking a person to court for breach of Section 5 of the "Wireless Telegraphy Act, 1949", that ignorance of the law does not exempt a person from being prosecuted under it! Even if, and it is a big **IF**, the public had access to the aforesaid mentioned Act, etc., how many would actually read it, and further, how many would really digest it or understand it?

Like most small print in any document it is written in a pedantic style of wording, appropriate to the year 1900. Again, I wonder how many people have read Clause 4 of the Television Broadcast Receiving Licence, and of those who have read it, how many have understood it? Especially as it refers to "messages" unintentionally received. What about "visual images?"

With reference to no licence being required for a radio receiver, again I think the powers that be are doing the BBC a grave injustice in taking money away from them; they say that more money is lost collecting a licence fee than is gained. What a ridiculous statement, have they not got any brains, or are they just too lazy to use them?—**H. H. Berry** (Cheshire).

Unavailable licence?

Your editorials on walkie-talkies etc were long overdue. For years this equipment has been sold without restraint, aided and abetted more recently by the Home Office who seem to have insisted that advertisers add a note that such equipment needs a licence for use in the UK or, even more ludicrous, that a licence is required but is not generally available to the public!

The advertisers must be laughing their heads off! Tell everyone that it will be illegal to listen to such-and-such transmissions on their XYY Superset and they'll rush round in their hundreds to buy one! Surely the answer is simple, no licence, no sale!—**A. Smith** (Romford, Essex).

Modified or not?

I am writing in response to your editorial in the March edition—regarding the Home Office claim that it is illegal to listen to private communication channels under Section 5 of the Wireless Telegraphy Act.

I am quite sure that this Act was modified at the time FM broadcasting by the BBC was introduced on VHF; purely because breakthrough was inevitable and it was not possible **not** to hear Public Service Transmissions.

I think Barlow on TV was correct in his statement that it was not illegal to listen to Public Service Broadcasts because I am sure the modified section of the Wireless Telegraphy Act made it, not illegal to listen, but illegal to **act on, or pass on** any information received in this way.

Unfortunately, I cannot put a date on this modification but I am sure it happened and I would welcome any comment from legal advisers.—**D. H. Myers G8AYG** (Cheshire).

ON THE AIR

by Eric Dowdeswell G4AR

LET'S give a big cheer this month to regular correspondent **Tim Charles** (Colchester) who has heard New Zealand on Top Band! That's just about the ultimate in DX'ing, combining maximum distance with the lowest of our HF band allocations. Tim was aroused by the activity of many G stations around the DX 'window' of 1825 to 1835kHz at 0647 on 9 March last. He tuned up to 1872, the usual frequency for ZL's, and heard ZL3RB calling CQ DX although he was only RST 349 and disappeared in a couple of minutes. It is not known if any positive QSO's resulted but now is the time to try, as we approach the bottom of the sunspot cycle.

Tim suggests, and I think correctly, that G2PU worked a ZL about 12 years ago when we were around the bottom of the last cycle. With the improvements in technique which have been made by Top Band enthusiasts over the last few seasons I should not be surprised to hear of several QSO's being made with ZL in the near future. Let's hope that Tim can now get a QSL from ZL3RB. That would be something really worth having on the wall of the shack!

While in the southern hemisphere I should mention an interesting letter received from **David Down** in Christies Beach, South Australia. An ex-Royal Australian Navy operator David sticks to CW. He has taken his examination for a licence so he ought to be on the air very soon now. His list of stations heard on 7, 14 and 21MHz does not contain any G's, unfortunately, seemingly due to the unfavourable times that he has been listening, as far as G operation is concerned. I have asked him to keep a lookout for Europeans on 160m!

John Porter (Baslow Derbys) and family got a bit fed up with tripping over radio equipment scattered around the house so he moved it into an outside shack where I am sure he will be very happy! He was able to get his 10, 15 and 20m dipoles connected to his FR50B without any difficulties. He was pleased to copy KC4USG/MM2 on 14MHz SSB. This is the US icebreaker Glacier which itself was trapped in thick ice in the Antarctic, after damaging a propellor. On 10 March the Daily Express reported that the scientists and crew aboard the Glacier had been flown out. **Andrew Swiffin** (Cheadle) was kind enough to send me details of his crystal-controlled converter mentioned last month. It first appeared in QST and uses a 6AK5 RF stage with another 6AK5 as mixer. A 6J6 double triode uses a single crystal on 6·2 or 8·3MHz, or thereabouts, harmonics being selected according to the band required. It is very versatile when used in front of a general coverage receiver.

A brief letter from **Tom Proctor,** aged 16, who lives in Bristol and uses a No. 19 set on which he copies SSB signals. No mean achievement with that equipment! **Michael Connolly** (Yeovil) joins the column for the first time, using a CR70A and PR40 and a dipole on 80m. He can also copy on 2m with a Sentinel converter fed from a halo aerial in the loft. **Gary Edge** (Culcheth, Warrington) stuck to 80m SSB like so many others, using his 9R59DS and 150ft wire plus a whip aerial. A PS says 'have sold my 9R5 and bought an HA500'. We all hope you will both be very happy!

Paul Barker (Sunderland) comes up with yet another VE oddity! CY6GQ special event station in Calgary, work ten CY6's for an award. Well, don't just sit there, go and get those CY6's! **Ian Moore** aged 14 has got a head start on most of you. His Dad is G3JQJ ex-DL2WM and he allows Ian to use the receiver part of his treasured FT200 provided Ian learns the Morse Code. What a clever Dad! But watch out Dad 'cos once Ian has his ticket you won't be able to get near your FT200!

Old friend **David Saul** A8723 hopes to leave us by the end of the year! He takes his RAE in May and looks forward to a nice new G4+3 callsign. We hate to lose you OM but sincerely hope you make it. **David Coupe** (Nr Middlesborough) joins us and says his main interest is 2m using a Microwave Modules converter into an Eddystone 888A at 28-30MHz. Input comes from a six element Yagi at about 22ft. A good clear path to the north has enabled him to hear many GM's on SSB with the odd ON and PA0 to the south. He has also logged many stations through Oscar 7.

Malcolm Sole (Lancaster) reports a quiet month but still managed good catches like ST2AY and KG4FO Guantanamo Bay on 80m SSB. **Ron Newall** (Richmond Sy) joins the column with a first log of stuff heard on 160 and 80m, presumably SSB. There can't be that number of stations still using double sideband and carrier! I deliberately omitted to say 'AM' because the statement would have been incorrect! It is quite surprising how many amateurs, and others, who talk and write about SSB and AM as if they were two completely different methods of modulation. They are both amplitude modulation or AM! It's just that SSB is the result of conventional 'AM' losing one sideband and its carrier. The methods of generation are quite different of course but that is another matter. I am surprised that those who still use the old style of AM do not incorporate all the refinements which have developed around SSB such as VOX, restricted audio bandwidth etc. There is no reason why they should be thought of as being peculiar to SSB.

Stephen Terry BRS35669 (Banbury) kept his log to the real goodies and a nice lot they are too, from 15 to 80m using his FR50B and a dipole fed 'off-centre'. Watch your matching OM, the impedance rises rapidly away from the centre and if you are using low impedance cable you could be losing some of the signal voltage developed on the aerial. Stephen doesn't say which band the dipole is cut for so it is probably rather ineffective on the other bands anyway. **Alan Doherty** (Portrush Co. Antrim) just beat the deadline with a log that concentrates on his favourite band, 20m, again with an FR50B fed from a 132ft aerial. One early morning stint was rewarded with KC6PS, quite a rare prefix.

Log extracts

J. Porter:— **80m** **HP4HCU** TG8AU **20m** **CE8AA** KC4USG/MM2 (see text) **KV4AA** **ZD8TM** **ZS2PR** (Marion Is) **15m** 5L2JJR (Liberia)

A. Swiffin:— **80m** FG7AO PZ1AP UI8MV VP2DM **20m** KL7IEU TA2SC VS5LH ZS3TP **15m** CE6EZ OA4O VP2A (Antigua) VP2EEE (Anguilla)

T. Charles:— **160m** **VE1BCZ** **ZL3RB** (see text) **80m** **HP1CWP** VP2DAJ YB2AU ZL1AHI ZL3FZ ZL4FB **40m** **CO2SM** **VK7CH** **ZL1BN** **ZL2AGY** **20m** CR4BS TR8VE **VP2LAW** ZS3DO **2m** via Oscar 7 from 70cm DJ2IF **DJ2RE** DL1JV **ON4DY**

M. Bennett:— **20m** CP1OY CR3AH P29MI **15m** JY9CR VS9MB ZS4MZ

M. Connolly:— **80m** CT2AE PI1VKL **20m** CR4BS TU2FG ZD7SD 8P6BU

G. Edge:— **80m** EP2VJ M1I TZ1AC YB0ABV ZS5LB 7X5AH

S. Budd:— **20m** C5AU (Gambia) TA1BW VQ9MC **15m** VQ9HCS (Astove Is)

P. Barker:— **40m** VU2AIK **20m** FL8DN PJ2RC P29FV VP2VBG 5T5GS

I. Moore:— **20m** HR1KS VQ9DC **40m** VP2A

D. Saul:— **80m** EA8CR VP2AC VP2DM VP2KX VP2MDB (VP Club Net) **20m** ET3USE FL0JN FP8DH TR8BJ

D. Coupe:— **20m** HH2FW VQ9NB **2m** via Oscar 7 DJ9DL F9FJ LA1FH OE2CAL PA0GCA plus W2 W6 W8 and W0.

M. Sole:— **80m** A9XH (Bahrein) KG4FO ST2AY UA9VH/JT1 (Ulan Bator) ZL2BT 8Q6AB (Maldive Is) **40m** HI8XKP VK7DJ

S. Terry:— **80m** VQ9M ZL3PX 8Q6AB 9M2DQ **20m** C5AR VP8NP ZD7SD 5T5CJ **15m** EA9AQ ZP5WM 7P8AT

A. Doherty:— **80m** HS5ABD VU2GDG **20m** C5AR FY0BHI HR3JJR KC6PS P29CW VP5GT VQ9HCS VQ9MC YS1JWD 5L2FW

All stations are SSB except those in bold which are CW.

SHORT WAVE BROADCASTS

by Derek Bell

SEVERAL letters recently reproved me for referring to a megahertz when I should have said kilohertz. This was in the item on using 300,000 to find wavelength or frequency. The answer I offer is that MHz has long been preferred to describe frequencies, so that instead of saying "five thousand kilohertz" we say "five megahertz" while for values under one megahertz the frequency is referred to in kilohertz.

Recently I asked for info on DX shows, in order to compile a list for you. I am glad to say that shoals of letters arrived giving not only days and times but four or five frequencies for each station. This is because of the practice of many stations of putting out signals on several frequencies at the same time. This posed an insoluble problem, namely which frequency would be audible here on any given day? Last year was, it is agreed, one of the worst years in memory for the short wave DXer, due to solar storms. So which frequency do I select when there is every chance that it may be blotted out by noise or that it may not be carrying DX at all?

In order to get round this I selected one frequency and one alternate and the list is as follows:—

Mondays	Japan	1640	11815	5990
	Norway	0810	11850	15175
Tuesdays	Finland	1800	9550	11755
	Hungary	1615	21505	17890
Wednesdays	Prague	1900	7245	7345
	S. Africa	2226	11970	7270
Thursdays	Holland	1842	6085	6020
	Bonaire	0045	11815	—
Fridays	Bulgaria	1930	6070	9700
	Rumania	1930	6150	7225
Saturdays	Israel	2030	9395	9495
	Monaco	0920	7230	9640
Sundays	Lisbon	0935	9670	—
	Austria	0915	9770	—

The first set of figures, that is the time, is the advertised start of transmission and you will realise that the DX shows are slotted into the session for a particular target area and that this session may be of an hour or so duration. The second set, the frequencies, are those in English, since some stations repeat the show in more than one language. My thanks go to among others, **Messrs Mead, Chowanietz, James** and **Forkin** for taking the trouble to help me compile the list. There are of course other stations that do DX shows, for instance BBCs World Service, that are crowded out through space problems, but your World Radio and TV Handbook will give more information on these.

John Godwin of Rugeley sends some detailed information for the new European service of Radio Sri Lanka. This starts every evening at 1900 on 15120 and 11800 and comprises talks, requests and news and John says that for a QSL the DXer should write to:—

English Services
Sri Lanka Broadcasting Corp.
PO Box 1510
Colombo, Sri Lanka

We have at last lured into the column one of the licensed amateur operators. Part of the condition of the amateur ticket is the right to listen to time-signal stations and **G. F. Painter G3CFO** sends a comprehensive list of unusual stations that he has heard. One in particular, LOL Buenos Aires, "popped up", as Mr. Painter puts it, on 5MHz while he was doing something irrelevant to the rig, at his house in Chipping Norton.

John Haines has his rig in the living room with his aerial made of five feet of cable suspended from the curtain rail. This and the Heathkit SW717G he runs brought in Radio Nacional de Brazil on 11780 at 2135, **John Higginbotham** of Holyhead, however, goes in for a fifty foot long wire in the loft and has an ITT Euromarine dangling on the end of it. John has been fortunate enough to pull in

Voice of Nigeria on 7275 at 1530
Radio Norway on 9590 at 1300
RSA on 11900 at 2100

John hopes to take possession shortly of an ex-RAF 1132A. This is a fine example of the full coverage ex-service set that can be bought very reasonably, if you are lucky. The trouble is that there are so very few

ON THE AIR

of them ever come on the market! From the charming town of High Wycombe **Terry Gilbert** sends a logging of a very rarely reported station, Radio Afghanistan on 15195 at 1130. This goodie was pulled in via a Codar CR70A and Joystick, coupled to a Hamgear preselector ATU. Terry very kindly says that this column gets read first in PW and wonders if anyone can fill him in on the Heathkit GR78, as he is looking for a set to take on holiday (*We shall be reviewing this kit in the July PW-Ed*).

The other month I featured a set bought in a jumble sale, but this month one that was actually given away because it apparently did not work! This happy event happened to **J. Sharmen** of London who was given a Pye five band set by his grandmother. He does not tell us the aerial type but he has managed to log:

Radio Peace and Progress	on 9800 at 1415
Vatican Radio	on 9645 at 1500
Radio Cairo	on 9455 at 2315

We will all, I am sure, want to wish **Alan Crookes** of Deepcar, Sheffield a "get well soon". He had an accident at work which will, as he says, put him "out of circulation" for a spell. Nothing daunted he turned to his Murphy B40 and hooked this on to the PW aerial tuner unit which sucks the signals from a redundant TV aerial. This set up brought in, among others, Radio Australia on 11840 at the unusual time of 1710 along with another rarity the Gospel station ETLF Ethiopia on 11830 at 2215.

To wind up this month's items a quick look around the stations. WDXC report that Adventist World Radio plan to broadcast from the Deutche Welle Malta relay by the summer, while FEBA plan to put into action a 100kW transmitter which they test on 15325 from 1230 to 1500.

MEDIUM WAVE DX

by CHARLES MOLLOY

F. F. **WILDMAN** (Bournemouth) has been trying the medium waves with his Codar CR70 and 75ft outdoor aerial. He reports excellent reception of WINS New York City on 1010kHz at 2345 on the 4th March, both Hilversum on 1007kHz and Mainz/Wolfheim on 1016kHz having signed-off at 2300 to leave a clear space for the North American. Another outlet in NYC—WNEW on 1130 kHz—was logged on the 7th March at 0620. Reception was very good with occasional interference from Brussels on 1124kHz, and lasted until 0650 which was well past daybreak.

Fred Dinning pulled-in a good bag of Canadians at his QTH at Dunlop in Scotland using a Hammerlund SP600 and medium wave loop. DX logged includes VOCM St John's Newfoundland on 590kHz; CKCM Grand Falls, Nfld 620kHz; CFCY Charlottetown, Prince Edward Island 630kHz; CBN St John's 640kHz; CJCN Grand Falls 680kHz; CBNM Marystown, Nfld 740kHz; CBH Halifax, Nova Scotia 860kHz; CJCH Halifax 920kHz; CJON St John's 930kHz; CHER Sydney, N.S. 950kHz; CHNS Halifax 960kHz; CKBW Bridgewater, N.S. 1000kHz; CBA Monoton, New Brunswick 1070kHz; CBD Saint John N.B. 1110kHz; CKEC New Glasgow, N.S. 1320kHz. Newfoundland, which is located approx. 2,200 miles west of the U.K. and $3\frac{1}{2}$ hours behind GMT in time is the first part of North America to fade-in (some 4 to 5 hours after sunset in the U.K.), followed shortly afterwards by the eastern seaboard states of Canada (GMT−4) and the United States (GMT−5). Even in midsummer the outlets logged by Fred can be heard in the U.K. for an hour before sunrise. Reception is often very good as dawn approaches—a reward for the keen DXer who tunes round the band at this hour.

Harlod Emblem reports again from Mirfield in Yorkshire. Using an Eddystone 730 and medium wave loop he logged Kabul, Afghanistan on 1280kHz with sign-on at 0200; CKVO the new outlet at Clarenville, Newfoundland on 710kHz and Radio Caribbean on 840kHz. (Radio Caribbean transmits with a power of 10kW from Castries on the island of St. Lucia). Listen for medium wave broadcasts from the Caribbean between 0100 and sunrise during the summer. Stations to search for that are logged regularly in the U.K. are Radio Surinam, Paramaribo on 725kHz; Point Galina, Jamaica 750kHz; Radio Demerara, Guyana 760kHz; Trans World Radio, Bonaire 800kHz; Radio Antilles, Montserrat 930kHz; Radio Victoria, Aruba now on 960kHz; Radio Paradise, St. Kitts 1265kHz; Radio Bahamas in Nassau on 1540kHz.

A. J. Fenton (Warley) has heard a Russian station on 254kHz after the close down of Lahti, Finland at 2130. Yerevan, Armenia is on this frequency until 2200 while Dushanbe, Tadzhikistan signs-on at 2300. Either of these is capable of being logged in the U.K. **David Blair** (Airdrie, Scotland) asks if an Aerial Tuning Unit would improve reception on the medium waves. An ATU is inserted between the aerial and receiver and is adjusted to give a good match between the two. In many cases this will bring a considerable increase in signal strength. Partridge Electronics, who advertise in Practical Wireless, can supply a Joymatch ATU suitable for use on the medium waves.

BROADCAST BANDS

Short Wave Reports by the 15th of the month to Derek Bell, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS

Logs covering any amateur band/s in band/alphabetical order by the middle of the month to **Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.**

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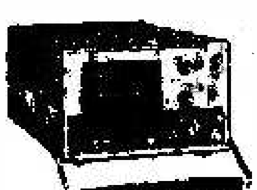

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PART 15—RF OSCILLATORS

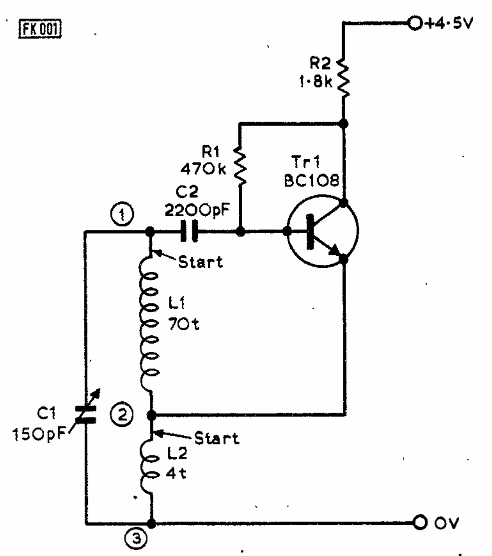
SO far in this series we have concerned ourselves only with oscillators that use resistors and capacitors to introduce frequency selective feedback. Oscillators using RC frequency determining components are usually restricted to the lower frequencies, up to a few hundred kilohertz. Above these frequencies we enter into the area of **Radio Frequencies** and it is usual to find the frequency selective networks using capacitors and inductors instead of resistors. The reasons are various, e.g. resistors are usually rather temperature sensitive and consequently the time constants of the circuits could change from time to time; the quality factor or "Q" of RC circuits is not usually as high as for LC circuits at the higher frequencies and often we require inductive coupling to help with feedback control.

One of the most common LC oscillators is the Hartley oscillator which we shall be describing and using this month. The basic circuit is shown in Fig. 108a. To prevent experimental problems we shall be making this circuit oscillate with frequencies in the range of 500kHz to about 1MHz, i.e. over the medium wave band. This allows us to use any conventional transistor radio, having a medium wave tuning range, to detect oscillation and, at the same time, the frequencies are not so high to give us problems with parasitic capacitance and layout.

Tr1 is operated in a very similar mode to the simple feedback biassed audio amplifier stages described previously, but note that its emitter is not returned direct to the earth rail. Imagine that L1 and C1 had been left out of the circuit as we have drawn it; L2 would act as an emitter load to the transistor. Any signal that we applied through C2 to the base of the transistor would cause collector current to vary through R2 and L2. This gives rise to voltage variations at the collector of the transistor. There will be pretty insignificant voltage variations at its emitter but there will be reasonable levels of current flowing through the windings of L2. These currents cause varying magnetic fields within the windings and these magnetic variations are used to generate our feedback to make the circuit provide self-sustained oscillation.

New let's see what happens when we introduce L1 to the circuit. This winding is coupled electrically to the top end of L2 and is wound on the same magnetic axis. We shall be using a ferrite rod on

FK001



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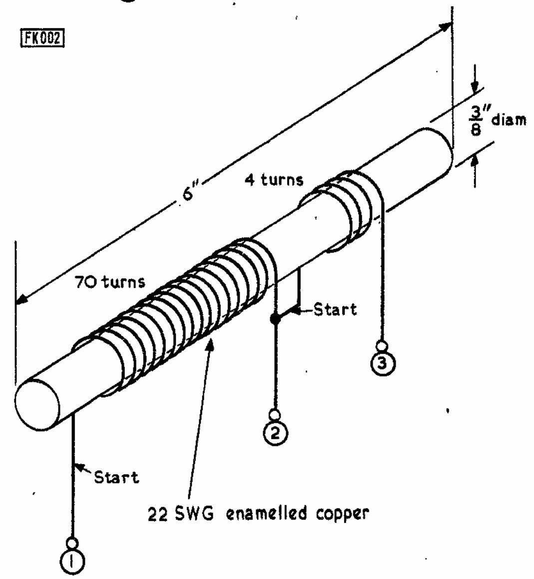


Fig. 108a, top: Shows the basic Hartley oscillator circuit. Fig. 108b, bottom, gives the details of the coils L1 and L2, wound on a ferrite rod.

which to wind the coils as this helps increase the magnetic coupling between the two coils. By adding the extra turns for L1 on the same core that we are using for L2 gives us the equivalent of an **Autotransformer.** If an AC signal was applied between the top end of L2 and earth it would induce a signal across the top of L1 and earth having a higher voltage. The voltage increase would be proportional to the ratio of turns.

$$V_{out} = V_{in} \times \frac{\text{Turns on L1} + \text{Turns on L2}}{\text{Turns on L2}}$$

This simple turns ratio expression does not make allowances for losses but is sufficiently accurate to give an indication of what is happening. In our case we get voltages at the top end of L1 that are approximately 20 times greater than are applied across L2. We must, however, remember that something has to go to allow this voltage magnification and, of course the current is reduced by a factor of 20. In other words we can say that the impedance across L1 and L2 in series is higher than that across L2 on its own.

capacitor exactly equals the reactance of the inductor. For given values of inductance and capacitance the frequency at which this state of affairs occurs is given by:—

Capacitive reactance = Inductive reactance

$$\text{or } \frac{1}{2\pi \times f \times C} = 2\pi \times f \times L$$

$$\text{or } f = \frac{1}{2\pi \sqrt{LC}}$$

where f is in hertz, L in henrys and C in farads.

Remember, in our circuit, the value for inductance is obtained from the **total** inductance of L1 and L2 together!

It is a feature of a parallel tuned circuit that when the two reactances are equal the impedance of the parallel circuit becomes extremely high, the limiting value of this impedance being set by the Q factor of the coil. This means, in real terms, that at resonance we shall see the highest values of AC voltage appearing across the tuned circuit. At all other frequencies, whether higher or lower, the voltage across C1 will be less. It should, therefore, be quite obvious that we shall get higher values of feedback voltage at the resonant frequency than at any other and the circuit will prefer to oscillate at the resonant frequency.

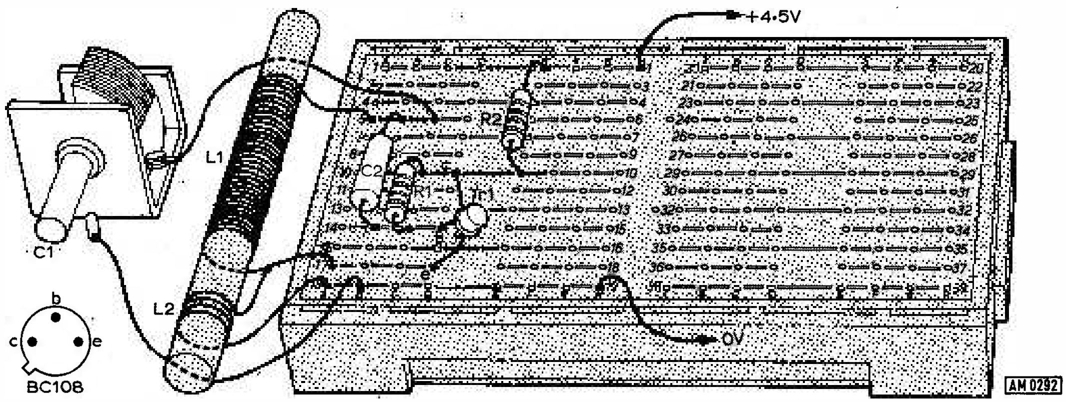


Fig. 109: Shows the practical layout of Fig. 108a assembled on S-dec.

If we now connect the top end of L1 to C2 we shall be feeding back a higher voltage to the base that was generated at the emitter. Provided the transistor has a high enough current gain (greater than the current loss factor caused by the transformer action) the feedback voltage will produce a voltage change back at the emitter at least as great as the original signal that set the ball in motion. Provided we get our phasing right we can provide positive feedback with the necessary amplification to produce self-sustained oscillation but don't worry about its frequency at present. Provided that both the windings of L1 and L2 are wound on the same core with the same sense, i.e. in the same direction, and the starts of each winding are as shown in Fig. 108a, any voltage applied across L2 will be presented across L1 and earth in the **same phase** and, of course, at a higher level. We already know, from emitter follower action, that voltages at the base of a transistor appear at its emitter with no phase shift so consequently we shall get positive feedback in our circuit if we obey the foregoing points.

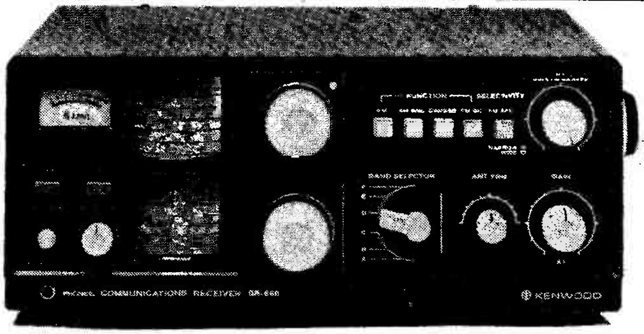
We now have to consider how to get oscillation at a predetermined frequency and this is where C1 comes into play. C1 with L1 and L2 form what is called a **parallel tuned circuit.** For a given frequency we can select values for C1 and the total inductance of L1 and L2 together so that the reactance of the

By making C1 a variable component we can alter the frequency of oscillation to suit ourselves. The inductor we shall use is identical to the ferrite aerial coil one would use for a simple transistor radio set. After all, the input stages of a medium wave radio have to tune to the same frequencies we are hoping to generate so it should seem only right that the inductance and capacitance values should be the same. Wind L1 and L2 with 22SWG enamelled copper wire on about a 6in length of $\frac{3}{8}$in diameter ferrite aerial rod. They should be close wound and there should not be more than about $\frac{1}{8}$in gap between L1 and L2, Fig. 108b. Make sure that you start each winding at the right place and keep the same winding sense.

Now wire up the circuit of Fig. 108a according to the given layout, Fig. 109, and apply power from a $4\frac{1}{2}$V battery. Lay (do not connect) a piece of insulated wire close to Tr1 and connect the other end of the wire to the aerial input socket of a medium wave radio. If there is no aerial socket the chances are that there is a ferrite rod inside the radio; if so it should be sufficient, for our experiment, to

continued on page 157

LOWE ELECTRONICS



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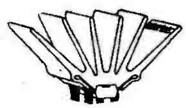

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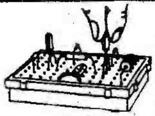

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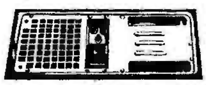

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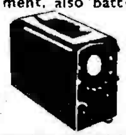

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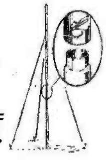

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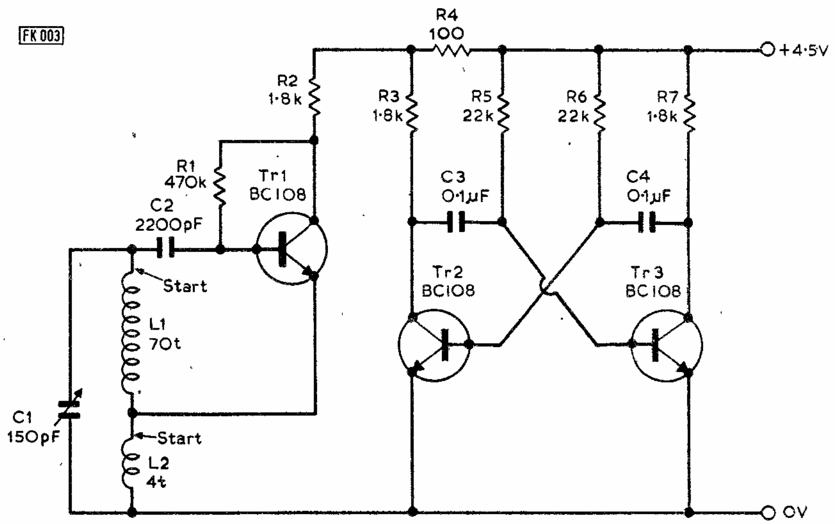


Fig. 110: An audio tone is generated by multivibrator Tr2/3, modulating the carrier produced by oscillator Tr1.

place the radio close to the ferrite rod of our oscillator. Tune in a broadcast station on the radio and then adjust C1 of our oscillator. At one setting you should hear a very loud whistle changing in pitch as you adjust C1. This is **heterodyning** or beating of the signal we are generating and the signal coming in from the distant station.

Try different positions on the tuning scale of the radio and you should be able to check the range of frequencies our oscillator generates. It is easiest to beat this signal against incoming signals otherwise you will hear no noise from the loudspeaker when in tune, apart, perhaps, from a slight reduction in background hiss as the AGC circuits of the radio come into operation.

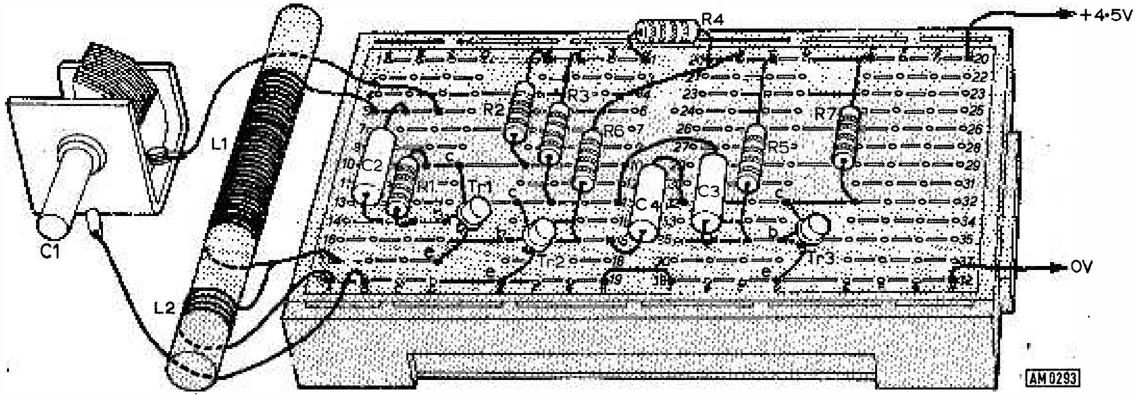
If the level of positive feedback is too great Tr1 might be driven into saturation and instead of getting a pure sinewave signal we will get a clipped signal. This clipping introduces high order harmonics and you might find in the case of excessive feedback, spurious signals occurring all over the tuning range of the radio. You can increase the level of feedback by increasing the value of C2 and vice versa. With too little feedback the circuit will, of course, not oscillate. Ideally the value for C2 should be selected to enable the circuit to **just** oscillate. Try altering the number of turns for L1. Reducing the turns makes the circuit operate at higher frequencies, shorter wavelengths, because we are reducing its inductance, and vice versa.

The circuit we have just made produces what is called an RF carrier signal. It is a pure, constant amplitude sinewave and, as such, carries no intelligible information. However, in the case of broadcasting we need just such a signal but need to impress audio information upon it so that we can get an intelligible signal from the loudspeaker of our radio. The simplest way of doing this is by a process known as amplitude modulation, AM. This entails altering the level of signal our oscillator produces in proportion to the amplitude of audio signal we wish to transmit.

Fig. 110 shows a simple modification that allows us to modulate our carrier signal with a square wave produced by the multivibrator, Tr2 and Tr3. Resistors R3 and R4 form the collector load for Tr2 and we use the junction of these two components to provide the power rail voltage to our RF oscillator. As the waveform at the collector of Tr2 rises and falls so does the voltage driving the oscillator and the amplitude of the resulting carrier will be amplitude modulated at the frequency of the multivibrator. A clear tone should be detectable over the medium wave range of the radio as C1 is adjusted. Such a circuit can form the basis of a test signal generator. The layout is shown in Fig. 111.

Next month: Simple radio receiver circuits.

Fig. 111: Layout of components used in Fig. 110.



DIRECT CONVERSION RECEIVER—*contd from page 118*

IN USE

When receiving SSB signals, accurate tuning is absolutely necessary, since small errors will influence the quality of the signal. No resolution of speech is possible if the oscillator is on the wrong side of the signal. This will soon become apparent in use.

For CW reception, the oscillator may be either side the signal, as is found to give best reception. Tuning slightly either way will change the pitch or audio tone.

The receiver is not intended for conventional AM reception as AM signals produce a continuous heterodyne except when tuning of the oscillator agrees exactly with the carrier frequency.

The output stage is suitable for headphones of medium or high impedance type with a resistance of about 100Ω to 1·5kΩ. Battery current is about 7mA with 1·5kΩ phones and 20mA with 100Ω phones, the latter providing greater volume.

MODIFICATIONS

Other audio amplifiers could be used, omitting Tr2 and Tr3. An example is the Sinclair IC-2, which can be connected as in Fig. 5.

C7 and VR1 are already present. The additional resistor and capacitor are a high frequency filter, to help produce a frequency response more suitable for the purpose. The amplifier is operated from its own 9V battery and a 3 to 15Ω speaker can be used.

When using this or other Class B amplifiers it is essential to prevent frequency modulation of Tr4 at syllabic rate from a common battery supply. The simplest method is to use separate batteries, as mentioned. The alternative is a decoupled and regulated supply for Tr1 and Tr4. The amplifier in Fig. 1 gives excellent headphone volume with many signals, but it is not really intended for a loudspeaker.

BANDPASS INPUT

If a resonant aerial or tuning unit is not available, the coil and capacitor in Fig. 6 may be added near the receiver aerial socket.

VC3 can be 100pF or larger, if one coil is to cover both bands. The tuned winding resembling L1 or L2 in the receiver. For the aerial coupling winding, use about one-third as many turns as the tuned winding. TC1 is almost fully opened providing top-capacitance coupling between the tuned circuits. PW

APOLLO—*continued from page 139*

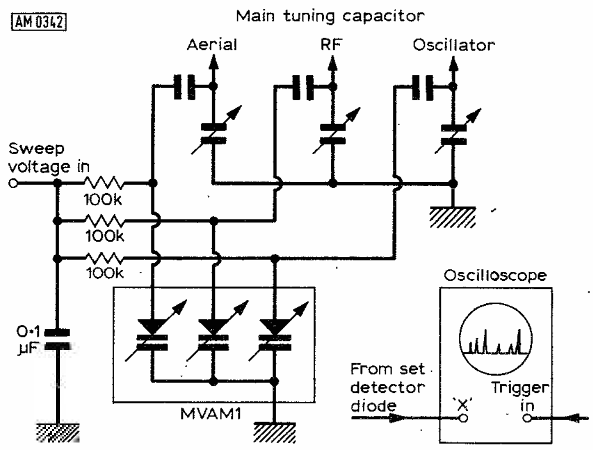


Fig. 2.7: Using this set-up one may obtain a visible display o signals present within the swept part of the band.

If in any doubt about one's proficiency to undertake such a modification to an existing set, take great care to become accustomed to using the varicaps, and the techniques necessary to avoid damaging them through over-voltage when coupling to an existing circuit.

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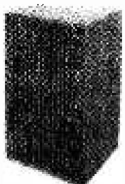

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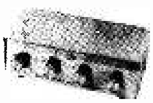

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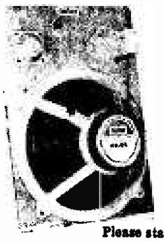

30-14,500 c/s. 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

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Teak veneered ½in thick wood cabinet. Size 18½in × 13½in × 8½in. Weight 23lbs. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½inch Woofer. £7·50 Carr. 85p. Rosewood Version £8·50 Carr. 85p. Baffle could be cut to take larger speaker.

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Bass Resonance 45cps
Flux Density 12,000gauss
Useful response 45-13,000cps
3 or 8 or 15 ohm models.

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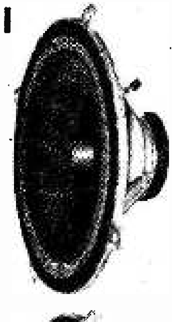
DE-LUXE Mk II
12in 15 watts



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

Bass Resonance 30cps
Flux Density 14,000gauss
Useful response 25-16,000cps
8 or 15 ohms models.

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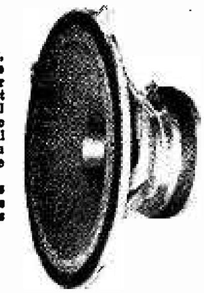
SUPERB
12in. 20 watts



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

Bass Resonance 25cps
Flux Density 16,500gauss
Useful response 20-17,000cps
8 or 15 ohms models.

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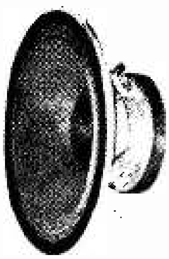
AUDITORIUM
12in. 25 watts



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Bass Resonance 35cps
Flux Density 15,000gauss
Useful response 25-16,000cps
8 or 15 ohms models.

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15in. 35 watts

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

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Flux Density 15,000gauss
Useful response 20-14,000cps
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Recommended retail price £11·99 including V.A.T.

SPECIFICATION OF UNITS	Model 805	Model 303/8
Overall Diameter	8"	3"
Natural resonance	30Hz	—
Main resonance	*35Hz	1200Hz
Magnet Pole Diameter	1"	¾"
Magnet Flux Density	11,000 gauss	8,000 gauss
Frequency response	30Hz-8kHz	2kHz-17kHz
Impedance	8-15 ohms	8-15 ohms
Power Handling	*15 watts	*15 watts

**When used in sealed cabinet*

Very easy to assemble, this boxed kit comes with acoustic foam damping material, panels, screws, wire, wiring diagrams and instructions to provide a remarkable loudspeaker assembly—a pair is ideal for stereo.

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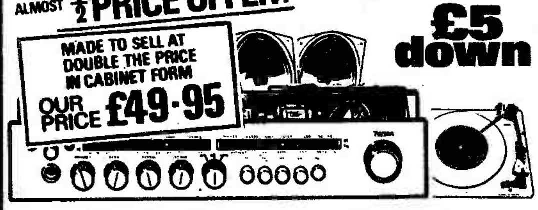

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40P1	PNP	15	15	20p
40P2	PNP	40	40	30p

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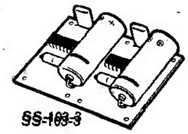

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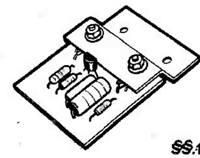

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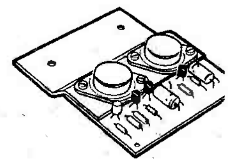

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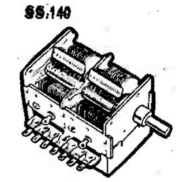

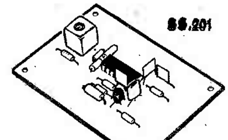

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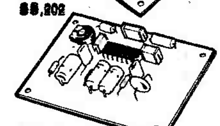

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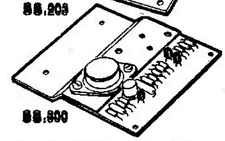

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Prr. 120/240 V Sec. 120/240 V Centre Tapped and Screened

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	P & P £	p
07	20	1	8	7·0 x 6·0 x 6·0	2·80	38
149	60	3	12	9·9 x 7·7 x 8·6	4·37	45
150	100	5	8	9·9 x 8·9 x 8·6	4·89	45
151	200	8	0	12·1 x 9·3 x 10·2	8·13	53
152	250	13	12	12·1 x 11·8 x 10·2	9·83	73
153	350	15	0	14·0 x 10·8 x 11·8	11·88	73
154	500	19	8	14·0 x 13·4 x 11·8	13·65	91
155	750	29	0	17·2 x 14·0 x 14·0	20·51	*
156	1000	38	0	17·2 x 16·6 x 14·0	29·15	*
157	1500	46	0	21·6 x 13·4 x 18·1	33·23	*
158	2000	60	0	21·6 x 15·3 x 18·1	37·07	*

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	P & P £	p
113	20	1	0	5·8 x 5·1 x 4·5	0-115-210-240	1·67	30
64	75	2	4	7·4 x 6·7 x 6·1	0-115-210-240	2·90	38
4	150	3	4	8·9 x 7·7 x 7·7	0-115-200-220-240	4·12	45
66	300	6	4	9·9 x 9·6 x 8·6	,,	5·82	53
67	500	12	8	12·1 x 11·2 x 10·2	,, ,,	8·82	67
84	1000	19	8	14·0 x 13·4 x 14·3	,, ,,	13·68	91
93	1500	30	4	14·0 x 15·9 x 14·3	,, ,,	18·31	*
95	2000	32	0	17·2 x 16·6 x 14·0	,, ,,	24·20	*
73	3000	40	0	21·6 x 13·4 x 18·1	,, ,,	35·09	*

CASED AUTO TRANSFORMERS

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TRANSFORMERS

PRIMARY 240·250 VOLTS 12 AND OR 24 VOLT RANGE

Ref. No.	Amps. 12V	24V	Weight lb	oz	Size cm.	Secondary Windings	P & P £	p
111	0·5	0·25		8	4·8 x 2·9 x 3·5	0·12V at 0·25A x 2	1·47	23
213	1·0	0·5	1	4	6·1 x 5·8 x 4·8	0·12V at 0·5A x 2	1·74	30
71	2	1	1	12	7·0 x 6·4 x 6·1	0·12V at 1A x 2	2·29	38
18	4	2	2	12	8·3 x 7·7 x 7·0	0·12V at 2A x 2	2·86	38
70	6	3	3	8	8·9 x 8·0 x 7·7	0·12V at 3A x 2	4·12	45
108	8	4	5	8	9·9 x 8·9 x 8·6	0·12V at 4A x 2	4·56	45
72	10	5	6	4	9·9 x 9·6 x 8·6	0·12V at 5A x 2	5·14	53
116	12	6	6	12	9·9 x 10·2 x 8·6	0·12V at 5A x 2	5·52	53
17	16	8	8	12	12·1 x 9·9 x 10·2	0·12V at 8A x 2	7·28	60
115	20	10	11	8	14·0 x 9·6 x 11·8	0·12V at 10A x 2	10·39	73
187	30	15	15	8	14·0 x 12·1 x 11·8	0·12V at 15A x 2	13·59	85
226	60	30	32	0	17·2 x 15·3 x 14·0	0·12V at 30A x 2	16·83	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
112	0·5	1	4	6·1 x 5·8 x 4·8	0-12-15-20-24-30V	1·81	30
79	1·0	2	4	7·0 x 6·7 x 6·1	,, ,,	2·40	38
3	2·0	3	4	8·9 x 7·7 x 7·7	,, ,,	3·49	38
20	3·0	4	8	9·9 x 8·3 x 8·6	,, ,,	4·53	45
21	4·0	6	4	9·9 x 9·6 x 8·6	,, ,,	5·13	53
51	5·0	6	12	12·1 x 8·6 x 10·2	,, ,,	6·41	53
117	6·0	8	0	12·1 x 9·3 x 10·2	,, ,,	7·16	60
88	8·0	12	0	12·1 x 11·8 x 10·2	,, ,,	9·90	67
89	10·0	13	12	14·0 x 10·2 x 11·8	,, ,,	9·87	73

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
102	0·5	1	12	7·0 x 6·4 x 6·1	0-19-25-33-40-50V	2·58	30
103	1·0	2	12	8·3 x 7·4 x 7·0	,, ,,	3·38	38
104	2·0	5	8	9·9 x 8·9 x 8·6	,, ,,	4·68	45
105	3·0	6	12	9·9 x 10·2 x 8·6	,, ,,	5·81	53
106	4·0	10	0	12·1 x 10·5 x 10·2	,, ,,	7·60	67
107	6·0	12	0	14·0 x 10·2 x 11·8	,, ,,	12·10	67
118	8·0	18	0	14·0 x 12·7 x 11·8	,, ,,	12·98	85
119	10·0	25	0	17·2 x 12·7 x 14·0	,, ,,	16·99	*

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
124	0·5	2	4	7·0 x 6·7 x 6·1	0-24-30-40-48-60	2·33	38
126	1·0	3	4	8·9 x 7·7 x 7·7	,, ,,	3·41	38
127	2·0	6	4	9·9 x 9·6 x 8·6	,, ,,	5·08	45
125	3·0	8	12	12·1 x 9·9 x 10·2	,, ,,	7·52	60
123	4·0	13	12	12·1 x 11·8 x 10·2	,, ,,	8·75	67
40	5·0	12	00	14·0 x 10·2 x 11·8	,, ,,	9·75	73
120	6·0	15	8	14·0 x 12·1 x 11·8	,, ,,	11·30	85
121	8·0	25	00	14·0 x 14·7 x 11·8	,, ,,	15·00	*
122	10·0	25	00	17·2 x 12·7 x 14·0	,, ,,	17·52	*
189	12·0	29	00	17·2 x 14·0 x 14·0	,, ,,	19·98	*

MINIATURE TRANSFORMERS WITH SCREENS

Ref.	MA.	Weight		Size cm	VOLTS	P & P £	p
238	200		2	2·8x2·6x2·0	3-0-3	1·54	10
212	1A 1A	1	4	6·1x5·8x4·8	0-6 0-6	1·84	30
13	100		4	3·9x2·6x2·9	9-0-9	1·41	13
235	330,330		4	4·8x2·9x3·5	0-9, 0-9	1·56	19
207	500, 500	1	00	6·1x5·4x4·8	0-8-9, 0-8-9	1·92	30
208	1A, 1A	1	12	7·0x6·4x6·1	0-8-9,0-8-9	3·30	38
236	200, 200		4	4·8x2·9x3·5	0-15, 0-15	1·43	19
214	300, 300	1	4	6·1x5·8x4·8	0-20, 0-20	1·93	30
221	700 (D.C.)	1	8	7·0x6·1x6·1	20-12-0-12-20	2·17	38
206	1A, 1A	2	12	8·3x7·7x7·0	0-15-20, 0-15-20	3·46	38
203	500, 500	2	4	8·3x7·0x7·0	0-15-27, 0-15-27	3·00	38
204	1A, 1A	3	4	8·9x7·7x7·7	0-15-27, 0-15-27	3·85	38

* *Carriage via BRS*

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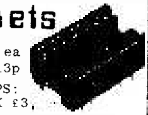

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3.5mm*	20p	12p
standard *	25p	15p
stereo *	27p	21p
side entry standard	48p	

* screened

I.C. SOCKETS

T05 Style
8 pin 31p
10 " 35p

Dual-in Line	
8 pin	13p
14 pin	15p
16 pin	15p
24 pin	26p
28 pin	30p
36 pin	37p
40 pin	44p

I.C. PIN SOCKETS

I.C. pins in strips of 100.
Just snip off what you need.
65p per strip

P.C. CONNECTORS

0-1" pin centres 24 way + key supplied with ends 64p

Etch resist from a pen. Draw your own printed circuit, then etch it. 86p

SWITCHES

High Quality 250v 1A
S.P.S.T 25p
D.P.D.T. 45p

Rotary 2A Mains Switches 35p

Bulgin
push-to-make 25p

Rendar
Subminiature Toggle
S.P.D.T. 48p

Slide
D.P.D.T. 12p

Erg Dil Switches
1 pole 8 way 99p
2 pole 4 way 85p
4 pole 2 way £1.24

Lorlin Water Switches 27p
1 pole 12 way; 4 pole 2 way
3 pole 4 way; 4 pole 3 way

POWER OUTPUT WATTS	Supply Volts	Load Ohms	Style	Power I.C. Amplifiers	Price	Pre- Amplifiers	Supply Volts	Style		
0.25	9	16	C	MFC4000B	78p	Dual Low Noise	±24	A	LM381	£2.16
0.5	9	8	E	MC1306P	68p	Dual Low Noise	±14	A	LM382	£2.19
1	9	8	F	TAA300	£1.76	Dual Pre-Amp	±13	A	MC1303L	£1.59
2	12	8	G	TBA820	74p	Dual Low Noise	±12	A	MC1339P	£1.31
2	18	8	A	LM380	£1.08	Dual Low Noise	±15	A	TBA231	88p
2½ + 2½	18	8	A	LM377	£2.91	General				
3	18	8	J	SL414	£1.72	D.C. Controlled attenuator			MFC6040	83p
5	24	16	J	SL415	£2.24	3 stage G.P. amp.		B	TAA263	80p
5	24	8	H	TBA800	96p	Tape Pre-Amp		F	TAA310	£1.34
7	16	4	H	TBA810S	£1.07	Bi-Fet		B	TAA320	97p
7	16	4	K	TBA810AS	£1.07	Hear/Aid Amp 1.3v		I	TAA370	£5.05
10	20	4	M	TCA940	£1.94	PPL stereo decoder(i)		A	MC1310	£2.14
15	30	3	O	BHA0002	£2.60	4 channel SQ " (ii)		A	MC1312	£2.42
35 driver	25	8	F	NE540L	£1.08	4 " pre-amp (ii)		16	MC1314	£4.05
20	±15	4	N	TDA2020	TBA	CBS SQ Logic (ii)		16	MC1315	£5.37

(i) & (ii) Separate leaflets available free only with purchases over £1

MAINS TRANSFORMERS

secondaries

6-0-6v, 100mA 97p ; 20-0-20v 1A £4.55
9-0-9v, 100mA 97p ; 24-0-24v ½A £2.48
12-0-12v, 100mA 97p ; 28-0-28 1A £6.18
18-0-18v, 200mA plus 0-24v 40mA 97p

	1A	2A	4A
0-9-17v	£1.95	£2.27	£2.64
0-12-15-20-24-30v	£2.48	£4.15	-
0-24-30-40-48-60v	£5.18	£7.02	-
	½A	1A	2A
0-19-25-33-40-50	£2.70	£3.40	£4.53

RENDAR INSTA~POWER

safe; inexpensive; quick, A.C. mains connector. A 13 amp plug top containing snap connectors
£1.75

VAT INCLUSIVE PRICES AT 8%

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VAT INVOICES ON REQUEST
P&P On U K Orders 15p Overseas Orders at Cost

2/27

CHROMASONIC electronics

Dept. 1
56, Fortis Green Road, London, N10 3HN.
telephone: 01-883 3705

RESISTORS

The standard ranges of Resistors stocked are either E12 or E24 and the values are all in multiples of ten times the decade shown below. The E12 items are only those in bold type. The E24 items are both those in bold and light type.

10	**18**	**33**	**56**
11	20	36	62
12	**22**	**39**	**68**
13	24	43	75
15	**27**	**47**	**82**
16	30	51	91

CARBON FILM /⅓ watt ± 5% tol. 2p ea.
E12 Series 10Ω to 330KΩ

CARBON FILM ½ watt ± 5% tol. 1½p ea.
E24 Series 10Ω to 10MΩ

'CERMET' THICK FILM ½ watt ± 2% tol. 8p ea.
E12 series 56Ω to 150KΩ

METAL OXIDE FILM ½ watt ± 2% tol. 4½p ea.
E12 series 10Ω to 1MΩ

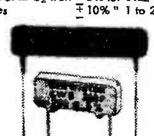
CARBON COMPOSITION ½ watt 4½p ea.
2.2 ; 2.7 ; 3.3 ; 3.9 ; 4.7 ; ±0.5 tol.
5.6 ; 6.8 ; 8.2 ±10% tol.

CARBON COMPOSITION 1 watt 5½p ea.
2.2 ; 2.7 ; 3.3 ; 3.9 ; 4.7 ; ±0.5 tol.
5.6 ; 6.8 ; 8.2 ±10% tol.

CARBON FILM 1 watt ± 5% tol. 3½p ea.
E12 series 10Ω to 10MΩ

CARBON FILM 2 watt ± 5% tol. 6½p ea.
E12 series 10Ω to 10MΩ

WIREWOUND 2½ watt ± 5% tol 0.22 to 0.47Ω 15½p
E12 series ± 10% " 1 to 270Ω 13p



WIRE WOUND 5 WATT 13p ea.

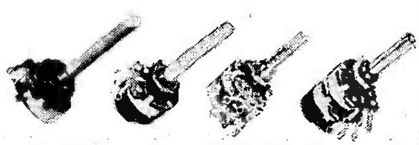
½	**25**	**250**	**1.5K**
1	30	270	1.8K
1.8	39	**300**	2K
2.2	**50**	330	2.2K
2.7	60	350	**2.5K**
3.3	**68**	400	2.7K
3.9	75	470	3K
4.7	82	**500**	3.3K
5	**100**	560	**3.5K**
5.6	125	600	3.9K
6.8	133	**680**	4.7K
8.2	**150**	**750**	**5K**
10	180	820	5.6K
15	**200**	1K	**6.8K**
21	220	1.2K	8.2K

WIRE WOUND 10 watt 14p ea.
All the values shown in bold in the 5 watt range

WIRE WOUND 10 watt ± 5% tol. 20p ea.
10K ; 15K ; 20K ; 25K

WIRE WOUND 15 watt 13½p ea.
All the values from 10Ω upward shown in bold in the 5 watt range.

POTENTIOMETERS



5K	250K	Log or Lin Less Switch (and 1K Lin)	14p
10K	500K	Log or Lin with Switch	26p
25K	1 Meg	Dual Less Switch	46p
50K	2 Meg	1 Meg Log only	57p
100K		10K Log + 10K Antilog Less Switch	

Sliders

10K
25K
50K
100K

Single 33p
DUAL 55p

Presets

Vertical or Horizontal
.1 Watt 5½p .25 Watt 7p

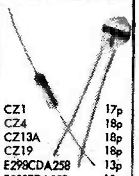
100	1K	10K	100K	1Meg
250	2.5	25K	250K	2.5 Meg
500	5K	50K	500K	5Meg

Cermets

100	2.5K	25K	250K
500	5K	50K	500K
1K	10K	100K	1Meg

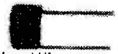
40p

VDR's & Thermistors



CZ1	17p
CZ4	18p
CZ13A	18p
CZ19	18p
E298CDA258	13p
E298EDA258	13p
E298EDA260	13p
E298EDA262	13p
E298EDA265	13p
E298EDP268	13p
E298ZZ05	13p
E298ZZ06	13p
E299DDP336	14p
E299DDP338	14p
E299DDP342	14p
E299DDP348	14p
GL16	£1.21
GL23	£1.21
R53	£1.49
R54	£1.61
VA1005	16p
VA1026	16p
VA1033	16p
VA1034	16p
VA1039	16p
VA1040	16p
VA1053	16p
VA1055S	16p
VA1056S	16p
VA1066S	17p
VA1067S	19p
VA1067S	19p
VA1077	19p
VA1098	21p
VA1104	31p
VA1107	29p

CAPACITORS



Silvered Mica 350V.

Tol.± 0.5pf 11p each

2.2 pf	18pf	30pf
3.3 pf	20pf	33pf
5 pf	22pf	39pf
10 pf	25pf	47pf

Tol.± 1% 11p each

50pf		150pf
56pf	82pf	180pf
68pf	100pf	200pf
75pf	120pf	220pf

12p each

250pf	330pf	560pf
270pf	390pf	680pf
300pf	470pf	820pf
	500pf	

17p each

1000 pf	1500pf	220pf
	1800pf	

26p each

2700pf	3600pf	5000pf
	4700pf	

33p each

6800pf	8200pf	10000pf

Mixed Dielectric 600 Volts Wkg.

0.01 uF	8p ;	0.1 uF	9 p
0.022 uF	8p ;	0.22 uF	17½p
0.033 uF	8p ;	0.47 uF	26½p
0.047 uF	8p ;	1 uF	36½p
0.068 uF	9p ;		

Mixed Dielectric 1000 Volts Wkg.

1000 pf	6½p;	0.022uF	11p
2200 pf	5½p;	0.047uF	13p
3300 pf	7p ;	0.1 uF	13p
4700 pf	7p ;	0.22 uF	24½p
0.01 uF	10p ;	0.47	33p

Solid Tantalum Beads
all at 16½p

0.1 uF	35v ;	10 uF	6.3v
0.22 uF	35v ;	10 uF	16v
0.47 uF	35v ;	10 uF	25v
1.0 uF	35v ;	22 uF	16v
2.2 uF	35v ;	47 uF	6.3v
4.7 uF	35v ;	100 uF	3v

Feed-through Ceramics
1000 pf 350v 6p

Disc Ceramics 750 Volt Wkg.
all at 5½p each

470 pf; 1000 pf; 5000 pf; 0.01 uF

Tubular H1-K Ceramics 750 Volts Wkg.

1000 pf	5½p	3000 pf	5½p
1500 pf	5½p	5000 pf	5½p
2000 pf	5½p	0.01 uF	5½p

Pulse Ceramics all at 10p each

12 kv.D.C. Wkg		8kv D.C.
10pf	120pf	200pf
22pf	140pf	220pf
68pf	150pf	250pf
82pf	180pf	270pf
100pf	200pf	300pf

CAPACITORS

Ceramic Plate

Mullard C333 Series 63 Volts Wkg.

all at 5½p each

±0.25pf	1.8 pf	±2%	12 pf	±2%	68 pf
	2.2 pf		15 pf		82 pf
	3.3 pf		18 pf		100 pf
	3.9 pf		22 pf		120 pf
	4.7 pf		27 pf		150 pf
	5.6 pf		33 pf		180 pf
	6.8 pf		39 pf		220 pf
	8.2 pf		47 pf		270 pf
	10 pf		56 pf		330 pf

Mullard 630 series 40 volts ± 10% tol.
629 series 100 volts
all at 5½p each

390 pf	1000 pf	3300 pf
470 pf	1200 pf	3900 pf
560 pf	1500 pf	4700 pf
680 pf	1800 pf	* 10 nf
820 pf	2200 pf	* 22 nf
	2700 pf	

Erie Monolithic Ceramic 30 Volts Wkg.

27 nf 11p; 47 nf 13p; 100 nf 17p

Low Voltage Disc Ceramics
all at 5½p each

0.01 uF	18v ;	0.1 uF	30v
0.022 uF	18v ;	0.22 uF	6v
0.047 uF	18v ;	0.47 uF	3v

Mylar Film 100 Volts Wkg.

1000 pf	2½p ;	0.05 uF	3½p
2000 pf	2½p ;	0.068uF	5p
5000 pf	2½p ;	0.1 uF	5p
0.01 uF	3½p ;	0.2 uF	6½p
0.02 uF	3½p ;	0.47 uF	7p
0.04 uF	3½p ;		

MULLARD C295 Series 63 volts

Tolerance ± 1%		Polystyrene	
6,800pf	(6.8nF)	C295 AH/D6K8	11p
8,200pf	(8.2nF)	C295 AH/D8K2	11p
13,000pf	(13nF)	C295 AH/D13K	15p
18,000pf	(18nF)	C295 AH/D18K	15p
20nF	(.02uF)	C295 AH/D20K	15p
30nF	(.03uF)	C295 AH/D30K	18p
39nF	(.039uF)	C295 AH/D39K	18p
51nF	(.051uF)	C295 AH/D51K	25p

Polystyrene 160 volts Wkg.
Tolerance ±½pf up to 33pf; ± 5% 47pf up.

10 pf to 10,000 pf (0.01 uF) in multiples of:
10 ; 15 ; 22 ; 33 ; 47 ; 68.

Wima MKS 0.22uF ± 5% 100v 11p

Mullard C280 Series. 250 Volts Wkg.
Metallised Polyester Film

0.01 uF	3½p ;	0.22 uF	5½p
0.015 uF	3½p ;	0.33 uF	7p
0.022 uF	3½p ;	0.47 uF	9p
0.033 uF	3½p ;	0.68 uF	12p
0.047 uF	3½p ;	1.0 uF	14½p
0.068 uF	4 p ;	1.5 uF	22p
0.1 uF	4½p ;	2.2 uF	26½p
0.15 uF	4½p ;		

Mullard C281 series 400 Volts Wkg.
Metallised Polycarbonate Film ±10%

0.01 uF	5p ;	0.1 uF	8p
0.015 uF	5p ;	0.15 uF	9p
0.022 uF	5p ;	0.22 uF	11p
0.033 uF	6p ;	0.33 uF	15½p
0.047 uF	6½p ;	0.47 uF	16½p
0.068 uF	6½p ;		

VAT INCLUSIVE PRICES AT 8%

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BRAND NEW COMPONENTS by return. Electrolytics, 15V, 25V, 50V 0·47, 1, 2·2, 4·7, 10 Mfds.—4p. 22, 47—4½p (50V—5p). 100—5½p (50V—7p). 220—6p (50V—9p). Subminiature bead-type tantalums 0·1/35V, 0·22/35V, 0·47/35V, 1/35V, 2·2/35V, 4·7/35V, 10/16V, 22/16V, 47/6V, 100/3V—9p. Mylar Film 100V 0·001, 0·002, 0·005, 0·01, 0·02—2½p. 0·04, 0·05—3p. Mullard Tubular Polyester 400V E6 series, 0·001-0·022—3p. 0·033-0·1—4p. Mullard miniature C333 ceramics E.12 series 2% 1·8pf.-47pf.—2½p. 56pf.-330pf.—3p. Polystyrene 63V. E12 series 10pf.-1,000pf.—2½p. 1,200pf.-10,000pf.—3½p. Miniature Highstab Carbon Film Resistors ⅓W E12 series 5% 1Ω-10MΩ (10% over 1 Megohm)—1p. Postage 10p. Prices VAT inclusive. The C.R. Supply Co., 127 Chesterfield Road, Sheffield S8.

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FOR BETTER PRICES

TRANSISTORS		DIODES & RECT		BRIDGE RECT.	
AC187/8 PR	0·40	IN914	0·04	1A 100v	0·20
BC107/8/9	0·09	IN4148	0·04	1A 200v	0·22
BC109C	0·11	BY127	0·14	1A 600v	0·30
BC147/8	0·10	IN4001/2	0·05	25A 200v	£2·00
BCY70/71/72	0·18	IN4003/4/5	0·06	**ZENERS**	
BFX88	0·20	IN4006/7	0·08	BZY88c 3·3-33v 5%	0·09
BFY50	0·18	IN5401	0·11	1 watt 6 8-200v 5%	0·15
BFY51/52	0·12	**7 SEG DISPLAYS**		**L.E.D.**	
OC25	0·45	3015F	£1·00	209-RED	0·17
OC36	0·35	DL707-LED	£1·70	LED CLIP	0·02
2N2646	0·30	DL747-LED	£2·45	**OP. AMP. IC's**	
2N2905A	0·21	**D.I.L. SOCKETS**		709C TO99	0·30
2N3053	0·14	8 Pin	0·12	709C D.I.L.	0·30
2N3055	0·38	14 Pin	0·12	741C TO99	0·36
TIP29A	0·49	16 Pin	0·14	741C D.I.L.	0·36
TIP30A	0·57	V.A.T. INC.		723C D.I.L.	0·80
TIP31A	0·61			747C D.I.L.	0·85
TIP32A	0·74			748C D.I.L.	0·36
TIP41A	0·74				
TIP42A	0·90				
7400N	0·16	**74 SERIES T.T.L.**		7474N	0·37
7401N	0·18	7420N	0·18	7490N	0·63
7402N	0·18	7427N	0·28	7492N	0·63
7404N	0·19	7430N	0·18	7493N	0·82
7408N	0·23	7440N	0·18	74121N	0·50
7410N	0·18	7447N	£1·00	74122N	0·70
7413N	0·39	7472N	0·32	74123N	£1·26
				74141N	£1·13

C.W.O. PLUS P.P. 15p TO BETA DEVICES,
Abbey Chambers, 4, Highbridge Street. Waltham Abbey, Essex.

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250mA. **Cartridge Fuses** 1¼" **90p** per 100.
Unused Carbon Resistors. 100 different **50p.**
Unused W/W Resistors. 100 assorted **£1·10.**
100 Capacitor Mixture, 85p.
½lb. 8 to 2BA. Nut & Bolt mixture **28p.** Brass **38p.**
18 Assorted Potentiometers Unused £1·15
Ex Government Standard Jack Plugs 4 for **50p**
6 volt 36 or 18 watt Bulbs. SBC. 70p per doz.
Earphones Ex Govt. 85p per pair.
New Meter or Cassette Cases, stiff imitation leather 6¼" x 3½" x 4". **Only 55p.**
Ex T.V. Speakers. Perfect. 3Ω eliptical **55p.**
300mA **Meters New. £1·75p.**
7" **Tape Spools 16p** each.
All postage in U.K. included in price
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676 Foxhall Rd., Ipswich, Suffolk IP3 8NQ

MULLARD 10W RMS AMPLIFIER MODULES. Absolutely complete. £2·65 inclusive. LTE, 46 Minehead Road, South Harrow, Middx.

ELECTROLYTICS 6½p
DESPATCH BY RETURN.
2.2uF, 4.7uF-63v. 10 uF, 22uF, 47uF, 100uF - 25v.
ALL 6.5P (inc. Vat) +10P p&p
Discount: 10% on totals over £3, 15% over £6. C.W.O.
BUG SOUND ELECTRONICS, THE SHOP BLACKMORE END, BRAINTREE, ESSEX

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Precision Polycarbonate Capacitors

All High Stability—Extremely Low Leakage

440V AC (±10%)			63V Range	±1%	±2%	±5%
0·1μF	(1⅜"×⅜")	50p				
0·22μF	(1⅜"×½")	59p	0·47μF	56p	46p	36p
0·25μF	(1⅜"×½")	62p	1·0μF	66p	56p	46p
0·47μF	(1⅜"×½")	71p	2·2μF	80p	65p	55p
0·5μF	(1⅜ ×½")	75p	4·7μF	£1·30	£1·05	85p
0·68μF	(2"×½")	80p	6·8μF	£1·64	£1·29	£1·09
1·0μF	(2"×⅝")	91p	10·0μF	£2·00	£1·60	£1·40
2·0μF	(2"×1")	£1·22	15·0μF	£2·75	£2·15	£1·90

TANTALUM BEAD CAPACITORS—Values available: 0·1, 0·22. 0·47. 1·0, 2·2, 4·7, 6·8μF at 15V/25V or 35V; 10·0μF at 16V/20V or 25V; 22·0μF at 6V/10V or 16V; 33·0μF at 6V or 10V; 47·0μF at 3V or 6V; 100·0μF at 3V. ALL at 10p each, 10 for 95p, 50 for £4.

TRANSISTORS:					
BC107/8/9	9p	BC183/183L	11p	BFY50	20p
BC114	12p	BC184/184L	12p	BFY51	20p
BC147/8/9	10p	BC212/212L	14p	BFY52	20p
BC153/7/8	12p	BC547/558A	12p	AF178	30p
BC182/182L	11p	BF194	12p	OC71	12p
		BF197	13p	2N3055	50p

POPULAR DIODES—1N914 6p, 8 for 45p. 18 for 90p; 1N916 8p, 6 for 45p, 14 for 90p; 1S44 5p, 11 for 50p, 24 for £1·00. 1N4148 5p, 6 for 27p, 12 for 48p; 1N4001 5½p; 002 6p; 003 6½p; 004 7p; 005 7½p; 006 8p; 007 8½p.
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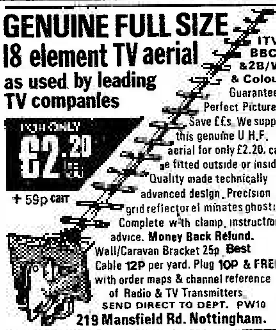

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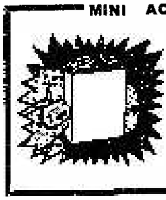

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BC108	10p	BD145	55p	OC41	15p	ZTX501	13p	2N2904	20p	2N5458	30p
BC108B	12p	BDY60	75p	OC42	15p	ZTX502	18p	2N2906	15p	2N5459	30p
BC109	10p	BDY61	65p	OC44	12p	ZTX504	42p	2N2907	18p	3N140	85p
BC109C	12p	BF115	22p	OC45	12p	ZTX531	23p	2N2926G	10p	3N141	85p
BC147	8p	BF177	26p	OC70	12p	ZTX550	18p	2N2926O	9p	40361	45p
BC148	8p	BF178	28p	OC71	12p	1S44	5p	2N2926R	9p	40362	40p

TTL 74 DIGITAL ICs
Less 5% for 15+ mixed
Less 10% for 25+ mixed
Less 15% for 50+ mixed

7400	14p	7428	38p	7473	33p
7401	14p	7430	15p	7474	32p
7402	15p	7432	25p	7475	47p
7403	15p	7433	36p	7476	32p
7404	18p	7437	27p	7480	44p
7405	18p	7438	27p	7481	99p
7406	38p	7440	15p	7482	75p
7407	38p	7441	75p	7483	83p
7408	15p	7442	65p	7484	90p
7409	15p	7443	120p	7485	125p
7410	15p	7444	105p	7489	334p
7411	20p	7445	86p	7490	47p
7412	20p	7446	105p	7491	80p
7413	35p	7447	100p	7492	48p
7414	60p	7448	86p	7493	47p
7416	35p	7450	15p	7495	63p
7417	35p	7451	15p	7496	72p
7420	15p	7453	15p	74121	32p
7422	24p	7454	15p	74122	45p
7423	27p	7460	15p	74141	75p
7425	27p	7470	30p	74190	160p
7426	27p	4772	26p	74191	160p

DIODES

AA120	10p
BY100	18p
BY127	11p
BY164	35p
BYZ11	25p
OA5	38p
OA9	9p
OA79	10p
OA81	8p
OA85	13p
OA90	6p
OA91	6p
OA200	6p
OA202	6p
PL4001	6p
PL4004	6p
PL4006	6p
1N914	5p
1N4001/2	5p
1N4003	6p
1N4004/5	6p
1N4006/7	7p
1N4148	5p

APOLLO—MW TUNER/RECEIVER
(all parts available)

5–25 pF Miniature DAU Trimmers	20p
LM 1820N	£1·40
MVAM1	£2·70
6-Way Tuner Unit IMI 9932	£3·40
Slider 5KΩ Lin	35p
Slider 50KΩ Lin 150mm Rivlin WS 150	£3·00

INDUCTORS

TOKO 6A6408	30p
TOKO Y18576AQ	30p
TOKO YHCS11100AC2	30p
TOKO CFUO50D	55p
P.C. Board	75p

(5% discount for complete Kit)

LINEAR IC'S

709C 14 pin	30p	LM300H	170p	NE562	310p
723C	60p	LM301	42p	SL403D	150p
741C	26p	LM304H	170p	SL414A	150p
747C	80p	LM305	170p	SN76033	250p
748C	28p	LM309K	185p	SN76115	200p
7805 (T03)	160p	LM380	100p	TAD100	130p
7815	210p	LM381	185p	TBA800	110p
AY-1-0212	5·50p	LH3900	75p	TBA810	150p
AY-1-5051	1·15p	MC724P	60p	ZN414	110p
CA3018	72p	MC1303L	130p		
CA3020	145p	MC1304P	360p		
CA3036	90p	MC1310P	240p		
CA3046	55p	MC1710CG	55p		
CA3048	220p	MSC6040	90p		
CA3075	150p	MFC4000B	54p		
CA3081	150p	MLM309K	158p		
CA3089E	210p	MVR12	170p		
CA3090Q	310p	NE555	55p		
		NE565	285p		

TRIACS

3A200V	90p
3A400V	99p
6A400V	120p
6A500V	147p
10A400V	150p
10A500V	164p
15A400V	178p
15A500V	198p

ZENER DIODES
Range 2·7V–33V 400mW 9p
3·3V–33V 1·3W 17p

BRIDGE RECTIFIERS
(plastic case)

1A200V	24p
1A600V	25p
2A50V	30p
2A100V	35p
2A200V	40p
2A400V	45p
2A600V	45p
4A100V	48p
4A400V	60p
4A800V	90p
BY122	54p
BY164	37p

SCR (Thyristors)

1A 50V	38p
1A 100V	42p
1A 200V	47p
1A 400V	52p
1A 600V	70p
3A 50V	38p
3A 100V	43p
3A 200V	55p
3A 400V	74p
5A 400V	90p
7A 400V	95p
7A 600V	108p
C106B	37p
C106D	47p
TIC44	29p
2N3525	90p
2N4444	191p
40430	85p

DIAC
ST2 20p

FUSES AND HOLDERS

20mm 150mA–5A	3p
1" 2A–13A mains	4p
1¼" 500mA–15A	13p
Panel Holder Single	6p
Chassis Holder 20mm	16p
Chassis Holder 1¼"	22p

ENAMEL COPPER WIRE (2oz reel)

16, 18, 20, 22 SWG	32p	P & P
24, 26, 28, 30 SWG	39p	5p per
32, 34, 36, 40 SWG	48p	reel

FERRITE RODS: ⅜" diam.
2" – 8p; 5¼" – 15p; 6¾" – 18p

ALUM. BOXES with lid

2¼x5¼x1½"	48p
4x4x1½"	48p
4x2¼x1½"	48p
4x5¼x1½"	53p
4x2¼x2"	50p
3x2x1"	38p
7x5x2½"	78p
8x6x3"	99p
10x7x3"	118p
10x4½x3"	99p
12x5x3"	120p
12x8x3"	150p

OPTO ELECTRONICS

LED TIL 209 (red) with socket.	16p
MINITRON 3015F 7 seg display	110p
OCP 70	40p
OCP 71	85p
ORP 12	58p
ORP 61	46p
2N 5777	45p

EARPHONES
With Cord and Jack Plug

Magnetic 2·5 mm plug	15p
3·5 mm plug	15p
Crystal 3·5 mm plug	28p

SPEAKERS
8Ω 3" 0·5W 68p

THERMISTORS 15p each
VA 1034; VA 1040; VA 1055; VA 1056; VA 1058; VA 1066; VA 1067; VA 1077; VA 1098; VA 1100.

POLYESTER CAPACITORS: Axial lead type. (Values are in μf).
400V: 0·001, 0·0012, 0·0015, 0·0018, 0·0022, 0·0033, 0·0047, 0·0068, 0·01 3p; 0·015, 0·022, 0·033, 0·047, 0·068, 0·1 4p; 0·15, 0·22, 7p; 0·33, 10p; 0·47, 13p; 160V: 0·1, 0·15, 4p; 0·22 5p; 0·33 6p; 0·47 9p; 0·68 10p; 1·0 13p. 250V: 0·22 6p; 0·33 8p; 0·68 12p; 0·47 9p; 2·2 18p.

POLYESTER RADIAL LEAD P.C. TYPE (Values are in μf).
250V: 0·01, 0·015, 0·022, 3p; 0·033, 0·047, 0·068, 3½p; 0·1 4p; 0·15 4p; 0·22, 0·33 5p; 0·47 7p; 0·68 10p; 1·0 11p; 1·5 20p; 2·2 22p.

FEED THROUGH CAPACITORS
1000pF/350V 8p

ELECTROLYTIC CAPACITORS. Axial lead type (Values are in μf)
63V: 0·47, 1·0, 1·5, 2·2, 3·3, 4·7, 6·8, 10, 15, 20, 22, 47, 68, 6p. 100, 12p. 40V 100, 6p. 50V: 1000, 42p. 30V: 3500, 41p. 25V: 10, 68, 150, 6p; 220, 11p; 470, 13p; 680, 18p; 1000, 24p; 2200, 34p. 3000, 39p; 4700, 47p. 16V: 40, 125, 250, 6p. 16V: 1000, 1500, 16p. 10V: 4, 100, 5p; 540, 10p; 1000, 14p; 2200, 18p.

POTENTIOMETERS (AB) Carbon Track, 0·25W Log & 0·5W Linear values

1KΩ–2MΩ single gang	14p
5KΩ–2MΩ single gang D/P switch	32p
2KΩ–2MΩ dual gang stereo	45p

SLIDER POTENTIOMETERS
0·25W log and linear values

5KΩ–500KΩ single gang	35p
10KΩ–500KΩ Dual gang	50p
KNOBS for above Black or Silvered	8p

PRESET POTENTIOMETERS

0·1W 50Ω–1MΩ Vertical only	5p
0·25W 100Ω–2MΩ Horizontal	6p
0·25W 1KΩ–2MΩ Vertical	6p

TANTALUM BEAD CAPACITORS
25V: 0·1μF, 0·2, 0·47, 1·0, 2·2, 4·7, 6·8
35V: 0·1μF, 0·2, 0·47, 1·0, 2·2, 4·7
20V: 10μF; 16V: 22μF; 10V: 33μF, 22μF.
6V: 33μF, 47μF; 3V: 47μF, 100μF.
Price: 10p each.

MYLAR FILM CAPACITORS

100V: 0·001, 0·002, 0·005, 0·01μF	3p
0·015, 0·02, 0·04, 0·05μF	4p
0·15, 0·2 50V: 0·47μF	6p

CERAMIC CAPACITORS
50V d.c. Plaquette body 25mm leads.

Range: 5pf–10,000pf	2p
0·015μf, 0·022μf, 0·033μf, 0·047μf	3p

QUALITY RESISTORS. ERIE MAKE
Small Size, High Stability, Low Noise

Type	Pwr	Tol.	Range	Val.	PRICE 1-99	100-499	500+
Carbon	¼W	5%	2·2Ω–10M	E24	1p	0·8p	0·7p
Carbon	½W	5%	2·2Ω–10M	E12	1p	0·8p	0·7p
Carbon	1W	5%	2·2Ω–10M	E12	2·5p	2p	—

Quantity price applies to resistors of each value not mixed.

JACKSONS DIELECTRIC TUNING CAPACITORS

100pf	80p
300pf	88p
500pf	95p

JACK PLUGS / **SOCKETS**

	Screened chrome	Plastic body	Open metal	Moulded with break contacts
2·5mm	10p	8p	8p	
3·5mm	14p	10p	8p	
Standard Mono	17p	13p	13p	17p
Standard Stereo	30p	18p	15p	25p

	Plugs	Sockets	Couplers
DIN 2PIN LOUDSPEAKER TYPE. 3, 4, 5 (180° & 240°) 6PIN	12p	8p	15p
CO-AXIAL (TV)	10p	8p	15p (f.f.)
PHONO assorted colours	8p	5p (sgl.) 7p (dbl.) 10p (trpl.)	9p
BANANA	7p	7p	—

PANEL METERS
60mm x 46mm x 35mm requires 1½" hole

FULL SCALE

ME 6	0–50μA
ME 7	0–100μA
ME 8	0–500μA
ME 9	0–1mA
ME 10	0–5mA
ME 11	0–10mA
ME 12	0–50mA
ME 13	0–100mA
ME 14	0–500mA
ME 15	0–1 amp
ME 16	0–50V AC
ME 17	0–300V AC
ME 18	"S" Meter
ME 19	"VU" Meter

Price £2·65, p & p 10p

SWITCHES

TOGGLE: SPST 18p
DPDT 22p

SUB-MIN TOGGLE
SP changeover 45p
SPST on/off 40p
DPDT 6 Tag 64p

SLIDE:
1A DP 250V 10p
1A DP 250V C/O 12p
½A DP 250V 9p

PUSH BUTTON: Miniature push to make or break non locking 15p
ROCKER (white): 10A 250V SP changeover centre off 25p
ROCKER: Illuminated (white) incorporates neon, lights when on 3A 240V 45p
ROTARY SWITCH: 1 pole/12way 2p/6w, 2p/2w, 2p4w, 3p/3w 3p/4w, 4p/2w, 4p/3w 24p

DIL SOCKETS
8 pin 14p
14 pin 14p
16 pin 15p

HEAT SINKS
TO5/5F 10p
TO18/18F 10p
TO66/TV2 20p
TO3/TV3 20p
Insulation Kit (Mica & 2 washers) 6p

TRANSFORMERS MAINS
Primary 220–240V

6–0–6 (miniature)	100mA	90p
9–0–9 (miniature)	100mA	90p
12–0–12 (miniature)	100mA	90p
0–12, 0–12V (MT 150)	150mA	160p
0–6, 0–6V (MT 280)	280mA	165p
24–0–24V	500mA	220p
30-24-20-15-12-0	2A	340p
Pulse Transformer PT ATA		85p

VEROBOARD

	Pitch 0·1 (copper	0·15 clad)	0·15 (plain)
2½x3¾"	32p	24p	15p
2½x5"	35p	35p	18p
3¾x3¾"	35p	35p	—
3¾x5"	40p	41p	29p
2½x17"	105p	78p	60p
3¾x17"	145p	115p	75p
4¾x17"	185p	—	110p
Pkt of 36 pins			22p
Spot face cutter			52p
Pin insertion tool			72p

LAMP HOLDERS AND LAMPS
LES HOLDER Dome shaped, Red, Blue, Green, Yellow, White 14p
LES BULBS 6v and 12v 7p
MES HOLDERS Chrome cover, Red or Amber, Jewelled top 28p
MES BULBS 3·5V 12V 7p
NEON: RED round top 250V 21p
NEON: ½" square top, red, green, Req. ⅜" hole 21p

KNOBS (fits ¼" shaft, with grub screw except K2 and K8)

K1 Black or white pointer type	10p
K2 Slim silvered aluminium	10p
K3 Black 1¼" with chrome rim	15p
K4 Black serrated. Metal top with line indicator 33m diam.	18p
K5 Black fluted metal top and skirt calibrated 0–10. 37mm dia.	20p
K6 PK2 as K5 with pointer on skirt	20p
K7 Black, knurled, tapered. Metal top & skirt. Calib. 0–10, 30mm	20p
K8 Black or silvered for slider pot	9p

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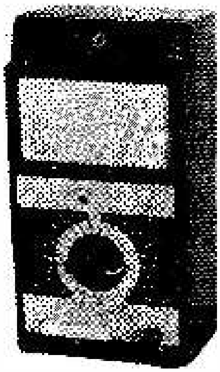
AC/DC MULTIMETERS



TYPE U4313	TYPE U4315
39 ranges: 600μA to 1·5A A.C., 60μA to 1·5A D.C., 1·5V to 600V A.C., 75mV to 600V D.C. Resistance up to 1MΩ Capacity up to 0·5μF Level up to 12db	42 ranges: 500μA to 2·5A A.C., 50μA to 2·5A D.C., 1V to 1000V A.C., 75mV to 1000V D.C., Resistance up to 1MΩ Capacity up to 0·03μF Level up to +2db.
Accuracy: 1·5% D.C., 2·5% A.C.	Accuracy: 2·5% D.C., 4% A.C.
Sensitivity: 20kΩ/V D.C., 2kΩ/V A.C.	Sensitivity: 20kΩ/V D.C., 2kΩ/V A.C.
Mirror scale: 86mm long	Plain scale: 86mm long
Dimensions: 115 x 215 x 90mm	Dimensions: 115 x 215 x 90mm.
PRICE, incl. steel carrying case, leads and manual **£13·80***	PRICE, incl. steel carrying case, leads and manual **£10·00***

OUR NEW **1975 ILLUSTRATED CATALOGUE/PRICE LIST** covering VALVES, TUBES, SEMICONDUCTORS, PASSIVE COMPONENTS AND TEST EQUIPMENT IS NOW READY. PLEASE SEND **£0·20** FOR YOUR COPY.

LINEAR INTEGRATED CIRCUITS

— Please note reductions in prices —

Mullard TAA263. Direct coupled three stage low level amplifier for use from DC to 600 kc/s. Supply voltage 6-8v. Typical power gain 77 db into 150Ω load. Output power 10mW. TO72 four-lead encapsulation **£0·65***

Mullard TAA293. Medium frequency amplifier with frequency response of 600kc/s. Nominal supply voltage 6v. Typical power gain 89db. Maximum power dissipation 160 mW. Power output 10 mW. into 150Ω load. TO74 ten lead-encapsulation **£0·65***

Mullard TAA320. Metal oxide silicon low frequency pre-amplifier consisting of a MOST stage followed by a bi-polar transistor. Gate to source voltage 9–14v. Total power dissipation 200 mW. Drain current 1 μA. Output conductance 0·65 mmho. TO18 3-lead encapsulation **£0·60***

Type 741 Operational Amplifiers, 8-dual-in-line encapsulation **£0·30***

L.E.D. TYPE HP5082/4850

Red Light GASP Light Emitting Diodes giving bright diffused light of 0·8 mcd at forward voltage of 1·6V and DC current of 20 mA. Plastic wide angle lens 0·200in. diameter. Ideal for panel lights, etc. Price for 12 pieces **£1·75** incl. VAT and p.&p

* **ALL PRICES EXCLUSIVE OF V.A.T.** WHEN REMITTING CASH WITH ORDER PLEASE ADD £0·50 PER MULTIMETER AND £0·15 IN £ FOR OTHER ITEMS—SUBJECT TO A MINIMUM CHARGE OF £0·20—TO COVER HANDLING AND POSTAGE. NO C.O.D. ORDERS ACCEPTED.

TTL 74 I.Cs.

7400	13p	7441	65p	7485	140p
7401	14p	7442	65p	7486	34p
7402	14p	7447	75p	7489	270p
7403	16p	7448	70p	7490	40p
7404	16p	7450	15p	7491	80p
7405	14p	7451	16p	7492	50p
7408	16p	7453	16p	7493	40p
7410	13p	7454	22p	7494	75p
7413	32p	7470	30p	7495	70p
7414	60p	7472	25p	7496	78p
7416	30p	7473	32p	74107	45p
7420	14p	7474	32p	74121	34p
7422	25p	7475	32p	74141	65p
7425	30p	7476	32p	74142	250p
7427	37p	7480	65p	74154	150p
7430	14p	7481	95p	74164	120p
7432	25p	7482	76p	74192	120p
7437	27p	7483	95p	74193	120p
7440	16p	7484	95p		

DIL Sockets by Texas

8 pin **12p**, 14 pin **13p**, 16 pin **14p**
Mica + 2 bushes for TO3 & TO66 **5p**

LINEAR I.C's

CA3046	Transistor Array	50p
CA3048	4 independent Amplifiers	230p
ICL8038	VCO Fun. Gen. 14 pin DIL	275p
LM301A	Op. Amp. with ext. comp.	36p
LM380	Audio Amplifier	90p
LM381	Stereo Pre Amp.	150p
LM3900	Ouad Op. Amp.	70p
MC1310	Colless FM Stereo Dec.	225p
MC1312	SQ Quadraphonic Dec.	220p
MC1314	SQ Quadraphonic Dec.	360p
MC1315	SQ Quadraphonic Dec.	430p
MFC4000	¼W Audio Amp.	50p
MFC6040	Electronic Attenuator	90p
MFC8070	Zero Voltage Switch	250p
NE536	FET Op. Amp.	250p
NE555	Timer 8 pin DIL	45p
NE556	Dual 555 14 Pin DIL	100p
NE560	PLL 16 Pin DIL	325p
NE561	PLL with AM Demod. 16 Pin	325p
NE562	PLL with VCO 16 Pin	325p
NE563	PLL FM/IF Demod. 16 Pin DIL	300p
NE565	PLL 14 Pin DIL	325p
NE566	Function Generator 8 Pin DIL	200p
NE567	PLL Tone Decoder 8 Pin DIL	250p
TBA570	AM/FM Radio receiver	160p
TBA800	5 Watt Audio Amp.	90p
TBA810	7 Watt Audio Amp.	100p
TBA820	2 Watt Audio Amp.	80p
ZN414	TRF Radio Receiver	110p

Data sheets on above I.C's **10p** each.

Popular Op Amps

709 OPA with ext. comp. 8/14 pin DIL **28p**
710 Diff. Comparator 14 pin DIL **35p**
741 OPA with int. comp. 8 pin DIL **25p**
747 Dual 741 14 pin DIL **70p**
748 OPA with ext. comp. 8 pin DIL **38p**

5001 12 Digit Calculator Chip 28 pin DIL **485p**
PC Keyboard 0–9, decimal, 4 function, C, K, keys. Size: 2·36″ x 3·76″ x 0·45″ **400p**

VOLTAGE REGULATORS (PLASTIC)

723 14 pin DIL **45p**

Data Sheets on Vol. Regs. 10p each

1amp	+Ve		−Ve	
5v	7805	140p	7905	250p
12v	7812	140p	7912	250p
15v	7815	140p	7915	250p
18v	7818	140p	—	—
24v	7824	140p	—	—

SCR-THYRISTORS

	50v	100v	400v	600v
1A	40p	42p	50p	70p
3A	43p	49p	75p	100p
7A	—	80p	84p	—
16A	—	82p	98p	—

Other
BT106 **140p**, C106D **45p**, MCR101 **25p**

Other

2N3525	91p
2N4444	185p
2N5060	40p
2N5062	45p
2N5064	50p

TRIACS

	100V	400V	500V
3A	85p	95p	120p
6A	88p	120p	150p
10A	109p	154p	165p
16A	145p	180p	200p

Other
40430 **90p**, 40486 **85p**, 40669 **95p**

BR100 BI-DIRECTIONAL TRIGGER FOR SCR's and TRIACS **21p**

Transistors

AC126/7	11p	BC213	10p	OC28	55p	2N1893	27p	40362	43p
AC128	11p	BC214	13p	OC35	48p	2N2219	20p	40594	60p
AC176	11p	BD115	55p	OC36	52p	2N2221/2	20p	40595	75p
AC187	12p	BD124	75p	OC41/2	15p	2N2369	14p		
AC188	11p	BD131	42p	OC44/5	11p	2N2484	30p		
AD149	43p	BD132	45p	OC70/1/2	11p	2N2904	20p		
AD161	36p	BF115	22p	OC73	60p	2N2905	18p		
AD162	36p	BF167	23p	OC81/2	12p	2N2926RB	8p		
AF114/5	13p	BF173	25p	OC83/4	28p	2N2926O	8p		
AF116/7	13p	BF184	22p	TIP2955	70p	2N2926YG	9p		
AF139	41p	BF194	11p	TIP41A	65p	2N3053	18p		
AF239	44p	BF195	12p	TIP42A	72p	2N3054	45p		
BC107/8	9p	BF196	14p	ZTX300	12p	2N3055	49p		
BC109	10p	BF197	12p	ZTX500	15p	2N3442	140p		
BC147/8	7p	BFR39/79	28p	2N696	15p	2N3702/3	11p		
BC149	9p	BFX29/30	30p	2N697	13p	2N3704/5	11p		
BC157	13p	BFX84/5/6	25p	2N698	30p	2N3706/7	11p		
BC158	12p	BFX88	24p	2N706	12p	2N3708/9	9p		
BC159	14p	BFY50/1/2	15p	2N708	18p	2N3772	161p		
BC169C	12p	BRY39	34p	2N930	18p	2N3773	220p		
BC177	18p	MJE340	45p	2N1131/2	18p	2N3903/4	15p		
BC178	17p	MJE2955	95p	2N1302/3	17p	2N3905/6	15p		
BC179	18p	MJE3055	65p	2N1304/5	21p	2N4058	15p		
BC182/3	10p	MPSU06	58p	2N1306/7	28p	2N4060	13p		
BC184	11p	OC26	47p	2N1308/9	28p	40361	40p		
BC212	11p			2N1613	20p	2N4289	18p		
				2N1711	20p	40361	40p		

UJTS
TIS43 **25p**, 2N2160 **70p**, 2N2646 **35p**, 2N4781 **31p**

FETS
BF244 **36p**, MPF102/3 **31p**, MPF104/5 **31p**, 2N3819 **20p**, 2N3820 **57p**, 2N3823 **60p**, 2N5457 **31p**, 2N5458 **31p**, 2N5459 **31p**

MOSFETS
40603 **58p**, 40673 **58p**, 3N128 **75p**, 3N140 **85p**, 3N141 **75p**

DIODES

BY100	15p
BY126	12p
BY127	12p
OA47	7p
OA70	8p
OA79	7p
OA81	7p
OA85	9p
OA90	6p
OA91	6p
OA95	7p
OA200	6p
OA202	7p
IN914	4p
IN4001	5p
IN4004	6p
IN4007	7p
IN4148	4p

LED
TIL209 **16p**

ZENERS
3·3V to 33V
400mW **9p**
1·3W **18p**

A Tunnel
AEY11 **50p**

Varicap
BB105 **30p**

Noise
ZIJ **75p**

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	50V	100V	400V	600V
0·25A	—	20p	—	—
1A	22p	24p	27p	29p
2A	30p	35p	45p	48p
4A	—	55p	—	—
6A	55p	60p	—	—

C-MOS LOGIC I.Cs

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CD4001AE	19p
CD4002AE	19p
CD4009AE	67p
CD4011AE	21p
CD4013AE	63p
CD4016AE	63p
CD4017AE	163p
CD4018AE	229p
CD4022AE	169p
CD4023AE	21p
CD4024AE	116p
CD4027AE	91p
CD4028AE	140p
CD4029AE	196p
CD4046AE	202p
CD4047AE	137p
CD4054AE	196p
CD4055AE	196p
CD4060AE	229p
CD4071AE	26p
CD4081AE	26p
CD4510AE	120p
CD4511AE	250p
CD4528AE	120p

OPTO-ELECTRONICS

ORP12 **50p**, ORP60 **60p**, ORP61 **60p**, OCP70 **30p**, OCP71 **90p**, 2N5777 **40p**

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TIL209 with clip **16p**
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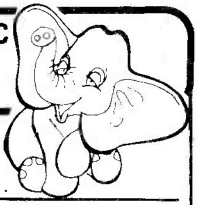

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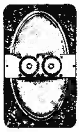

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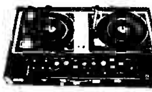

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