PRACTICAL WIRELESS

MAY 1975

30p

NEW the All Electric Wireless

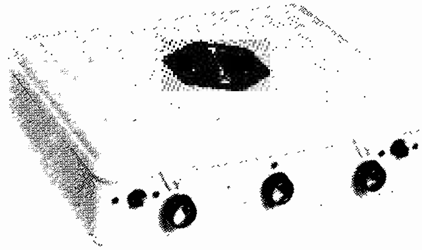
FIRST TIME PUBLISHED

PW APOLLO series PART 1

TRIPLE VARICAP MEDIUM WAVE TUNER/RECEIVER

also:

CAR WIPER DELAY UNIT
MODEL TRAIN CONTROLLER



NEW EDU-KIT MAJOR

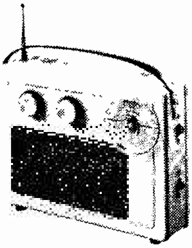
Completely Solderless Electronic Construction Kit
Build these projects without soldering iron or solder

- ★ 4 Transistor Earpiece Radio.
- ★ Signal Tracer.
- ★ Signal Injector.
- ★ Transistor Tester NPN-PNP.
- ★ 4 Transistor Push Pull Amplifier.
- ★ 5 Transistor Push Pull Amplifier.
- ★ 7 Transistor Loudspeaker Radio MW/LW.
- ★ 5 Transistor Short Wave Radio.
- ★ Electronic Metronome.
- ★ Electronic Noise Generator
- ★ Batteryless Crystal Radio.
- ★ One Transistor Radio.
- ★ 2 Transistor Regenerative Radio.
- ★ 3 Transistor Regenerative Radio.
- ★ Audible Continuity Tester.
- ★ Sensitive Pre-Amplifier.

Total Building Costs £7·23 P P & Ins. 44p (Overseas Seamail P & P £2·35) (+ 8% VAT 57p)

Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way connectors ● 2 Volume controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 55p free with parts.

NEW ROAMER NINE

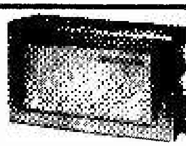


WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors, 9 Tuneable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9½" × 7" × 2¾" approx. Parts Price List and Plans free with parts.

Total Building Costs £6·95 P P & Ins. 44p (Overseas Seamail P & P £2·35) (+ 8% VAT 55p)

POCKET FIVE

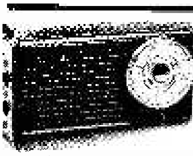


NOW WITH 3" LOUDSPEAKER

3 Tunable wavebands. M.W. L.W. and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5½" × 1¼" × 3½" approx. Plans and Parts Price List free with parts.

Total Building Costs £2·50 P P & Ins. 36p (+8% VAT 20p) (Overseas Seamail P & P £1·70)

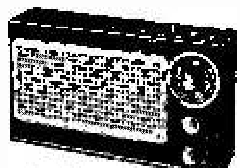
TRANSONA FIVE NOW WITH 3" LOUDSPEAKER



Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List free with parts.

Total Building Costs £2·75 P P & Ins. 36p (+8% VAT 21p) (Overseas Seamail P & P £1·70)

NEW Everyday Series



Build this exciting New series of designs

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" × 5½" × 2¾" approx. Parts Price List and Plans free with parts.

Total Building costs £2·95 P P & Ins. 36p (Overseas Seamail P & P £1·70) (+ 8% VAT 23p)

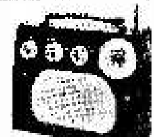
E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans free with parts.

Total Building Costs £3·60 P P & Ins. 36p (Overseas Seamail P & P £1·70) (+ 8% VAT 29p)

E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1. SW2, SW3. powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans free with parts.

Total Building Costs £4·08 P P & Ins. 38p (Overseas Seamail P & P £2·00) (+ 8% VAT 32p)

ROAMER EIGHT Mk I

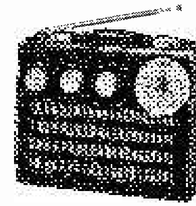


NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Chrome plated Telescopic aerial can be angled and rotated for peak short wave listening. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4" 2 watt ferrite magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans free with parts.

Total building costs £6·98 P P & Ins. 47p (Overseas Seamail P & P £2·50) (+ 8% VAT 56p)

ROAMER TEN Mk 2



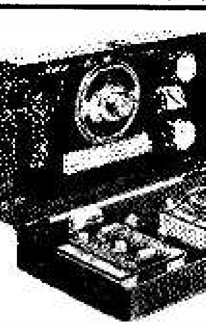
WITH VHF INCLUDING AIRCRAFT

Now with free earpiece and switched socket. 10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeaker. 9 Tunable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Built in Ferrite Rod Aerial for MW/LW. Chrome plated 6 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Controls. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 50p free with parts.

Total building costs £9·50 P P & Ins. 52p (Overseas Seamail P & P £2·50) (+ 8% VAT 76p)

"EDU-KIT"

Build Radios, Amplifiers, etc., from easy stage diagrams.



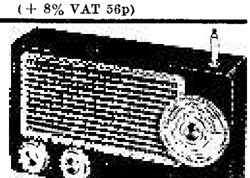
Five units ncluding master unit to construct.

Components include:

Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone 3" Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans free with parts.

Total building costs £5·50 P P & Ins. 35p (Overseas Seamail P & P £2·35) (+ 8% VAT 44p)

TRANS EIGHT 8 TRANSISTORS and 3 DIODES



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans free with parts.

Total building costs £4·48 P P & Ins. 40p (+ 8% VAT 36p) (Overseas Seamail P & P £2·00)

ROAMER SIX CASE AND LOOKS AS TRANS-EIGHT

6 Tunable Wavebands: MW, LW, SW1, SW2. Trawler band plus an extra Medium waveband for easier tuning of Luxembourg, *etc.* Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Plans and parts price list free with parts.

Total building costs £3·98 P P & Ins. 40p (Overseas Seamail P & P £2·00) (+ 8% VAT 32p)

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PRACTICAL WIRELESS

VOL. 51 NO. 1
ISSUE 819
MAY 1975

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

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We regret that we are unable to supply back numbers of Practical Wireless. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of *Practical Wireless* and *Television* only can be published in our CQ Column.

● NEWS & COMMENT

● CONSTRUCTIONAL

● OTHER FEATURES

RSC 100watt DISCO SYSTEM

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 stylii. 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

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) Carr. £2·50

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 Rexine 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.

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'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

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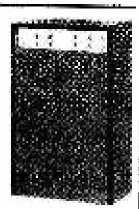
Incorporating Tremolo and 13" × 8" or 10" Speaker. Output 10 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity. Terms: DEPOSIT £6·73 and 8 monthly payments £3·00 (Total £30·73) Carr. free **£26·73**

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

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).

HIGH QUALITY LOUDSPEAKER UNITS

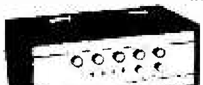
ALL TWO TONE VYNIDE AND VYNAIR FINISH

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 12" 25 WATT 13,000 lines 15 ohms Terms for Pairs. Dep £3·88 & 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**

FAL PHASE 50 Mk. III AMPLIFIER 50 WATT

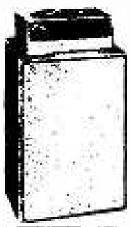


Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective Circuitry against serious output overloading. Output for Speaker/s 8 to 15 ohms. Size 17" × 7" × 7½". 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £8·60 & 8 monthly payments £5·75. Total £54·60. Carr. Free **£48·60**

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

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

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

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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 15Ω speakers. Send SAE for leaflet. Terms: Dep £5·58 & 8 mthly pymts £3·58 (Total £34·22) Carr. 75p **£29·95**

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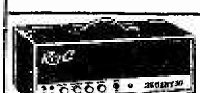
REGENT '50' AMP.



As supplied with Regent 50x or 50B. Terms: DEP. £5·11 and 8 mthly pymts £5·11 (Total £45·99) Carr. £1 **£39·95**

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12 watts for miniature jobs
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AF114/5/6/7	0·13
AF118	0·35
BC107/8/9	0·09
BC147/8/9	0·07
BC157/159	0·13
BC158	0·11
BC182/3/4	0·10
BC212/3/4	0·11
BCY70/1/2	0·12
BD131/132	0·35
BF194/5/6	0·10
BFY50/1/2	0·15
MJE370	0·62
MJE371	0·73
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2N3054	0·42
2N3055	0·44
2N3702/3/4	0·10
2N3705/6	0·10
2N3707/8/9	0·08
2N3819	0·24
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TIP30a	0·54
TIP31a	0·61
TIP32a	0·74
TIP41a	0·68
TIP42a	0·74

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748C DIL	0·26
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7432/3	0·36
7438	0·27
7441/2AN	0·75
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7473/74	0·32
7475	0·47
7480	0·44
7482	0·75
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7484	0·90
7486	0·37
7490	0·47
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Build yourself a quality 20000 opv. multimeter and save money. Complete kit with meter scale, movement and rotary range selector ready mounted in cabinet. All parts, batteries, test prods and instructions. Ranges: 0/0.6/6/30/120/600/1200V D.C. 0/6/30/120 600/1200V A.C. Current: 0/0.6/6/60/600mA. Resistance: 0/10/100K/1/10 Meg ohms. Decibels: –20 to +63db. Size: 90 x 150 x 35mm.
OUR PRICE £7.95 P&P 30p.

AUDIOTRONIC Model ATM1
Top value 1,000 opv pocket multimeter. Ranges:– 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistence: 0/150k ohms. Decibels: –10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.
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AUDIOTRONIC MODEL ATM5
Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC, (2500 opv). 0-6/30/300/600V DC, (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. –10 to +16dB. Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm.
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MODEL C7202EN
20,000 o.p.v. DC. 10,000 o.p.v. AC Mirror Scale. 5/25/50/250/500/1000/2500 V. DC. 10/50/100/500/1000 V. AC. DC Resistance x10, x1000 (30Ω centre scale) DC Current 50uA/2·5mA/250mA. –20 to +68 dB.
OUR PRICE £6.95 P & P 30p

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U435 MULTIMETER
20,000opv. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.
OUR PRICE £8.75 P&P 30p

MODEL C7208FM
30,000 opv DC. 15,000 opv AC. 6/3/15/60/300/600/1200 V. DC. 6/30/120/600/1200 V. AC. DC Resistance x1, x10, x100, x1000 (50Ω centre scale) DC Current 30uA/3/30/600mA. –20 to +63dB.
OUR PRICE £8.95 P & P 30p

U4324 MULTIMETER
High sensitivity, overload protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: –10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
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U91 Clamp VOLT AMMETER
For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.
OUR PRICE £14.00 P&P 30p

HIOKI 730X
30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/μA/30mA/300mA. 2K/200K/2 Meg Ohm. –10 to +63 dB.
OUR PRICE £7.50 P&P 30p.

U4323 MULTIMETER
20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: x 10, x 100, x 1,000, x 10,000 (50Ω, 500Ω, 5kΩ, 50kΩ centre scale) Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £8.00 P&P 30p

U4312 MULTIMETER
extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £10.75 P&P 50p

HIOKI 750X VOLT-OHM-MILLIAMETER
43 ranges: 0–0.3/0.6/1.5/3/6/12/30/60/150/300/600/1,200V DC. 0–3/6/15/30/60/120/300/600/1,200V AC. Current: 0–30/60uA/1.5/3/15/30/150/300 mA/6/12A. Resistence: 0–3/300k/3/30Mohms. Decibels: –10 to +17dB. Output:– 0–3/6/15/30/60/120/300V. Accuracy ± 3% DC, ± 4% AC. Sensitivity: 50,000 opv DC, 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 153mm.
OUR PRICE £11.95 P&P 40p

TMK MODEL TW50K
46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistence: 10k/100k/1 Meg/10 Meg ohms. –20 to +81.5dB.
OUR PRICE £12.50 P&P 20p

MODEL C7080EN
Giant 6" mirror scale. 20,000 opv. 0/0.25/1/2.5/10/50/250/1000/5000V DC. 0/2.5/10/50/250/1000/5000V AC. 0/50uA/1/10/100/500mA/10A DC. 0/2k/200k/20 Meg. –20 to +50dB.
OUR PRICE £19.95 P&P 35p

MODEL 500
30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.
OUR PRICE £13.95 Carr. paid

MODEL AS.100D VOM
100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12 Amp. 0/2K/200K/2M/200 Meg Ohm. – 20 to +17 dB.
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KAMOODEN HM720B FET VOM
Input impedence 10 Megohms. Ranges:– 0/.25/1/2.5/10/50/1000V DC. 0/2.5/10 50/250/1000V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms
OUR PRICE £22.50 P & P 40p

KAMODEN 360 MULTIMETER
High sensitivity. DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/1/10/100M ohms. Decibels –20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with, test leads etc.
OUR PRICE £17.50 P & P 40p

Model HT100B4 MULTIMETER
Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1-/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence 0–20/200k/2/20 Meg. ohms. DC current:– 10/250uA/2.5/25/250 mA/10A. AC current:–0–10A. –20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
OUR PRICE £19.50 P&P 40p

370WTR MULTIMETER
Features AC current ranges. 20,000opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50uA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: –20 to +62dB.
OUR PRICE £19.95 P&P 30p

U4317 MULTIMETER
High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. Overload protection. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: –5 to +10dB Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.
OUR PRICE £17.00 P&P 40p

KAMODEN 72.200 Multitester
High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges:–0/.06/.3 3/30/120/600/1200V DC. 0/3 12/60/300/11200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. –20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £22.50 P&P 30p

MODEL AF.105 VOM
50.000 opv. Mirror scale. Meter protection. 0/·3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30μA/6/60/300 mA/12 Amp. 0/10K/1m/10m/100 Meg Ohms. –20 to +17 dB.
OUR PRICE £12.50 P&P 30p.

LB4 TRANSISTOR TESTER
Tests PNP or NPN transistors. Audio indication. Operates on two 1,5V batteries. Complete with instructions etc.
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KAMODEN TT35 TRANSISTOR TESTER
High quality instrument to test reverse leak current and DC current. Amplification factor of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.
OUR PRICE £17.50 P & P 40p

U4341 Multimeter & Transistor Tester
27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £11.00 P&P 30p

S100TR MULTIMETER TRANSISTOR TESTER
100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA/6/12A DC 0/10k/1 Meg/100 Meg. –20 to +50dB, 0,01–0,2 MFD
Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.
OUR PRICE £19.95 P&P 25p

SWR METER Model SWR3
Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%, Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.
OUR PRICE £4.25 P&P 30p

C15 PULSE OSCILLOSCOPE
For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1–25; HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3–25 Preset triggered sweep 1–3000usec. Free running 20–200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115–230V AC.
OUR PRICE £44.00 Carr. paid

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Also see following pages

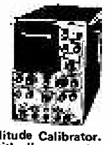
SINCLAIR DM2 DIGITAL MULTIMETER

Will measure AC and DC volts, AC and DC current, and resistance in a total of 20 ranges. The large light emitting diode display will read up to 1999 and automatically indicate polarity. Indication of positive and negative overload is also provided. The instrument is fitted with a combined carrying handle and bench stand and sockets are provided for the connection of an external power supply.

RANGES:
DC VOLTS: 1v, 10, 100v, 1000v.
AC VOLTS: 1v, 10v, 100v, 1000v.
DC CURRENT: 1mA, 10mA, 100mA, 1000mA.
AC CURRENT: 1mA, 10mA, 100mA, 1000mA.
RESISTANCE: 1k, 10k, 100k, 1000k.

OUR PRICE £59.95 P & P 50p

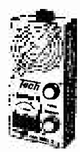
RUSSIAN CI16 Double Beam OSCILLOSCOPE



5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base, 50Hz—1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.

OUR PRICE £87.00 Carr. paid

MODEL TE15 GRID DIP METER



Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz—280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.

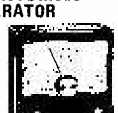
OUR PRICE £17.50 P&P 30p

TRANSISTORISED L.C.R. A.C. BR/8 MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Resistance: 6 ranges: 0.1 ohm-11.1 megohm ± 1% Inductance: 6 ranges: 1 microhenry-111 henries ± 2% Capacity: 6 ranges: 10pf-1110 mfd ± 2% Turns Ratio: 6 ranges: 1:1/1000-1:11100 ± 1% Bridge Voltage at 1,000cps. Operated from 9-volt battery. 100 micro-amp meter indication. Size 7½" x 5" x 2"

OUR PRICE £27.50 P&P 30p

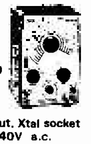
TE16A TRANSISTORISED SIGNAL GENERATOR



5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.

OUR PRICE £8.97 P&P 30p

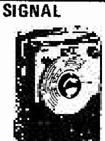
TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xtal socket for calibration. 220/240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm.

OUR PRICE £19.95 P&P 50p

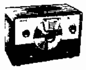
ARF 300 AF/RF SIGNAL GENERATOR



All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P-P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

OUR PRICE £37.50 P&P 50p

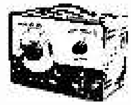
MODEL TE20 RF SIGNAL GENERATOR



Six bands, 120kHz—260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105—125V, 220—240V AC. Size: 193 x 265 x 150mm. Complete with test leads etc.

OUR PRICE £18.95 P&P 50p

TE22 SINE SQUARE WAVE AUDIO GENERATOR



Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.

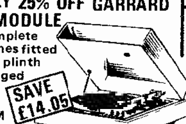
OUR PRICE £24.95 P&P 50p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter

Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3/7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.

OUR PRICE £52.00 P&P 50p

NEARLY 25% OFF GARRARD 865B MODULE



This complete unit comes fitted in white plinth with hinged cover, shure M756SM magnetic cartridge. This 2-speed belt drive deck comes with many features. Bias control, low-resonance arm. Todays value £50.00.

OUR PRICE £35.95 P & P £1

BATTERY/LEVEL PANEL INDICATOR

250 uA 18mm · 18mm Panel mounting.

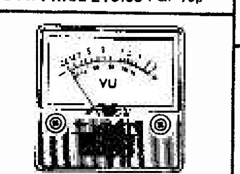
OUR PRICE 75p

P&P 15p Discounts for quantity.

NEW GOLDRING G102 KIT

Belt-drive 2-speed turntable in kit form complete with pick up arm and head shell.

OUR PRICE £16.95 P&P 75p



VU METER TYPE 3

Size: 33mm · 20mm.

£1.25 P&P 15p

T.T.C. SPRITE STEREO HEADPHONES

Feather weight (5oz) Dynamic stereo headphones providing high quality reproduction at a budget price. Soft removable earpads and adjustable headband. Speaker size: 28mm. Impedance: 8 ohms. Frequency response: 30—13000 Hz.

OUR PRICE £1.95 P&P 30p

SDH8V MONO/STEREO HEADPHONES

Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz—18kHz. Complete with 10ft. coiled lead and jack plug.

OUR PRICE £4.97 P&P 30p

AUDIOTRONIC HEADPHONES

LSH20 Individual volume controls. Mono/stereo switch. 40-19,00 Hz. 8 ohms.

OUR PRICE £4.50 P & P 50p

LSH30 Individual tone and volume controls. Mono/stereo switch. 30-20,000 Hz. 8 ohms.

OUR PRICE £7.00 P & P 30p

LSH40 Two-way speaker system. Individual volume controls. 20-20,000 Hz. 8 ohms.

OUR PRICE £8.50 P & P 30p

RANK AUDIO RA 210T STEREO AMPLIFIER

7½ · 7½ watts rms. Inputs for magnetic phono, tuner, tape and aux. Separate base, treble, balance and volume controls. Headphone socket. Teak case. Unrepeatable offer.

OUR PRICE £17.50 P&P 50p

SUPERB QUALITY LOW PRICES

AUDIOTRONIC DIGITAL CLOCK RADIOS

AOC22 24-hour clock radio, covering MW/FM wavebands. 180-minute sleep timer. Choice of Grey or White cabinet.

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ADC33 Deluxe 24-hour clock radio covering MW/FM wavebands. 180-minute sleep timer. Buzzer alarm. Tone control.

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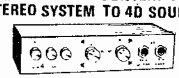
SPECIAL OFFER! CONVERT YOUR STEREO SYSTEM TO 4D SOUND



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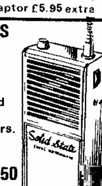

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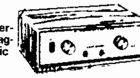

All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.

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100-0-100uA	£3.80	300V AC	£3.85
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5mA	£3.75		
10mA	£3.75		
50mA	£3.75		
100mA	£3.75		
500mA	£3.75		
1A DC	£3.75		
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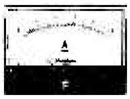
Size: 100 x 80mm



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500uA	£4.40	VU Meter	£5.00
50-0-50uA	£4.60		
100-0-100uA	£4.55		
1mA	£4.40		
1A DC	£4.40		
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1A DC	£7.80	5V/15V DC	£8.80
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5V DC	£7.80		
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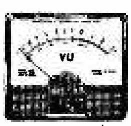
Size: 120 x 110mm



50uA	£5.60	300V DC	£5.40
100uA	£5.55	15V AC	£5.45
200uA	£5.50	300V AC	£5.45
500uA	£5.40	S Meter 1mA	£5.35
50-0-50uA	£5.55	VU Meter	£5.70
100-0-100uA	£5.50	1A AC	* £5.35*
500-0-500uA	£5.35	5A AC	* £5.35*
1mA	£5.35	10A AC	* £5.35*
1-0-1mA	£5.35	20A AC	* £5.35*
5mA	£5.35	30A AC	* £5.35*
10mA	£5.35		
50mA	£5.35		
100mA	£5.35		
500mA	£5.35		
1A DC	£5.35		
5A DC	£5.35		
15A DC	£5.35		
30A DC	£5.55		
10V DC	£5.35		
20V DC	£5.35		
50V DC	£5.35		
150V DC	£5.35		

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

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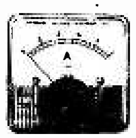
200uA	£4.30	50V DC	£4.20
500uA	£4.25	300V DC	£4.20
50-0-50uA	£4.35	15V AC	£4.30
100-0-100uA	£4.30	300V AC	£4.30
1mA	£4.20	VU Meter	£4.50
5mA	£4.20		
10mA	£4.20		
50mA	£4.20		
100mA	£4.20		
500mA	£4.20		
1A DC	£4.20		
5A DC	£4.20		
10A DC	£4.20		
5V DC	£4.20		

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm

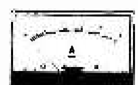
50uA	£3.30	300V AC	£3.15
100uA	£3.25	S Meter 1mA	£3.05
200uA	£3.20	VU Meter	£3.50
500uA	£3.10	1A AC	* £3.05*
50-0-50uA	£3.25	5A AC	* £3.05*
100-0-100uA	£3.20	10A AC	* £3.05*
500-0-500uA	£3.05	20A AC	* £3.05*
1mA	£3.05	30A AC	* £3.05*
5mA	£3.05		
10mA	£3.05		
50mA	£3.05		
100mA	£3.05		
500mA	£3.05		
1A DC	£3.05		
5A DC	£3.05		
10V DC	£3.05		
20V DC	£3.05		
50V DC	£3.05		
300V DC	£3.05		
15V AC	£3.15		

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm



50uA	£3.20	20V DC	£2.85
100uA	£3.15	50V DC	£2.85
200uA	£3.10	100V DC	£2.85
500uA	£2.90	150V DC	£2.90
50-0-50uA	£3.15	300V DC	£2.90
100-0-100uA	£3.10	500V DC	£2.95
500-0-500uA	£2.85	750V DC	£2.95
1mA	£2.85	15V AC	£2.95
1-0-1mA	£2.85	50V AC	£2.95
2mA	£2.85	150V AC	£2.95
5mA	£2.85	300V AC	£2.95
10mA	£2.85	500V AC	£3.10
20mA	£2.85	S Meter 1mA	£2.85
50mA	£2.85	VU Meter	£3.30
100mA	£2.85		
150mA	£2.85		
200mA	£2.85		
300mA	£2.85		
500mA	£2.85		
750mA	£2.85		
1A DC	£2.85		
2A DC	£2.85		
5A DC	£2.85		
10A DC	£2.85		
3V DC	£2.85		
10V DC	£2.85		
15V DC	£2.85		

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm



50uA	£3.60	10V DC	£3.40
100uA	£3.55	20V DC	£3.40
200uA	£3.50	50V DC	£3.40
500uA	£3.45	300V DC	£3.40
50-0-50uA	£3.55	15V AC	£3.55
100-0-100uA	£3.50	300V AC	£3.55
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10mA	£3.40		
50mA	£3.40		
100mA	£3.40		
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5A DC	£3.40		
10A DC	£3.40		
5V DC	£3.40		

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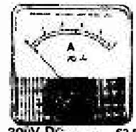
CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm



50uA	£4.05	300V DC	£3.80
100uA	£3.95	15V AC	£3.90
200uA	£3.90	50V AC	£3.90
500uA	£3.85	150V AC	£3.90
50-0-50uA	£3.95	300V AC	£3.90
100-0-100uA	£3.90	500V AC	£4.00
500-0-500uA	£3.80	S Meter 1mA	£3.90
1mA	£3.80	VU Meter	£4.20
1-0-1mA	£3.80	1A AC	* £3.80*
5mA	£3.80	5A AC	* £3.80*
10mA	£3.80	10A AC	* £3.80*
50mA	£3.80	20A AC	* £3.80*
100mA	£3.80	30A AC	* £3.80*
500mA	£3.80	50mA AC	* £3.80*
1A DC	£3.80	100mA AC	* £3.80*
5A DC	£3.80	200mA AC	* £3.80*
10A DC	£3.80	500mA AC	* £3.80*
15A DC	£3.80		
20A DC	£3.90		
30A DC	£3.95		
50A DC	£4.15		
5V DC	£3.80		
10V DC	£3.80		
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20V DC	£3.80		
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150V DC	£3.80		

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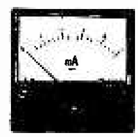
Size: 80 x 80mm



50uA	£4.60
100uA	£4.55
500uA	£4.30
50-0-50uA	£4.55
100-0-100uA	£4.50
1mA	£4.30
1A DC	£4.30
5A DC	£4.30
20V DC	£4.30
50V DC	£4.30
300V DC	£4.30
300V AC	£4.40
VU Meter	£4.80

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm

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100uA	£3.60	VU Meter	£3.90
500uA	£3.45	1A AC	* £3.40*
50-0-50uA	£3.60	5A AC	* £3.40*
100-0-100uA	£3.45	10A AC	* £3.40*
1mA	£3.40	20A AC	* £3.40*
5mA	£3.40	30A AC	£3.40*
10mA	£3.40		
50mA	£3.40		
100mA	£3.40		
500mA	£3.40		
1A DC	£3.40		
5A DC	£3.40		
10V DC	£3.40		
20V DC	£3.40		
50V DC	£3.40		
300V DC	£3.40		
15V AC	£3.50		
300V AC	£3.50		

BAKELITE MODEL MR 65 Size: 80 x 80mm

25uA	£5.40	300V DC	£3.90
50uA	£4.10	30V AC	* £3.70*
100uA	£4.05	50V AC	* £3.70*
500uA	£3.75	150V AC	* £3.70*
50-0-50uA	£4.05	300V AC	* £3.70*
100-0-100uA	£4.00	500V AC	* £3.70*
500-0-500uA	£3.70	VU Meter	£4.20
1mA	£3.70	1A AC	* £3.70*
1-0-1mA	£3.70	5A AC	* £3.70*
5mA	£3.70	10A AC	* £3.70*
10mA	£3.70	20A AC	* £3.70*
50mA	£3.70	30A AC	* £3.70*
100mA	£3.70	50A AC	* £3.70*
500mA	£3.70	500mA AC	* £3.70
1A DC	£3.70	50mV DC	£3.85
2A DC	£3.70	100mV DC	£3.85
5A DC	£3.70		
10A DC	£3.70		
15A DC	£3.70		
30A DC	£3.70		
50A DC	£3.90		
5V DC	£3.70		
10V DC	£3.70		
15V DC	£3.70		
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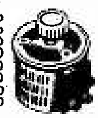

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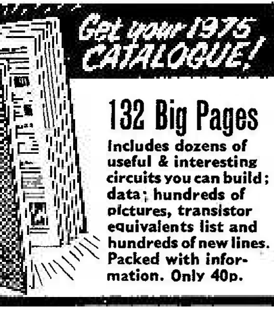

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3W 0·22 Ω. 0·27 Ω. 0·33 Ω. 0·47 Ω: 10%, 1 Ω 5% **17p** each
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E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades.
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Rotary miniature carbon track ¼" spindle.
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Axial lead electrolytic

Mfd	V	Price	Mfd	V	Price	Mfd	V	Price
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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

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BC142	23p	WOO5	30p
BC143	26p	WO4	33p
BC147	10p	1N914	4p
BC148	10p	1N4001	6p
BC149	12p	1N4002	6½p
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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
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MP	£1·20	2N2926 Or	10p
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BD139	49p	Gn	13p
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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

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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 **36p** each
Slide Sub-min DPDT **9p**
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Push to make Non-locking SPST **14p**
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Marks the end of the old-fashioned thumb-wheel switch With 7-segment type read-out. Full details in our catalogue. **£1·38**

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

JACK PLUGS
¼in. Std. Mono Plastic Barrel **13p**
¼in. Std. Mono Metal Barrel **24p**
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2·5mm Plastic Barrel **9p**
2·5mm Metal Barrel **15p**
3·5mm Plastic Barrel **9p**
3·5mm Metal Barrel **15p**

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2·5mm Open-type metal **9p**
3·5mm Open-type metal **9p**
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¼" Std. Mono Moulded with 2 break contacts **14p**
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Plastic-topped Plug **6p**
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LT700 min. output. Pri. 1k2; Sec. 5 Ω 200mW **50p**
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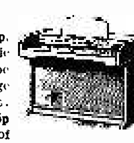
FULL CONSTRUCTIONAL DETAILS IN OUR LEAFLETS



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 **5p** 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.
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*Reverberation Driver Module **£5·34**
* S.A.E. please for full details: leaflet MES 24.
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AC113	0·20
AC115	0·22
AC117K	0·32
AC122	0·13
AC125	0·18
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	0·53
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	0·28
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	0·39
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	0·73
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	0·13
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	0·28
2N930	0·28
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

DTL 930 SERIES LOGIC I.C's

Type	Price 1	25	100+
BP930	15p	14p	13p
BP932	16p	15p	14p
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

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

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All indicators 0·9 + Decimal point. All side viewing. Full data for all types available on request.

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μA.7812/L130 12V (Equiv. to MVR12V) £1·35
μA.7815/L131 15V (Equiv. to MVR15V) £1·35
μR7818 £1·35

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Type	Quantities 1 £ p	25 £ p	100+ £ p	Type	Quantities 1 £ p	25 £ 0	100+ £ p	Type	Quantities 1 £ p	5 £2p	100+ £ p
7400	0·15	0·14	0·13	7448	1·10	1·07	1·05	74122	0·70	0·68	0·65
7401	0·15	0·14	0·13	7450	0·15	0·14	0·13	74123	0·75	0·73	0·70
7402	0·15	0·14	0·13	7451	0·15	0·14	0·13	74141	0·85	0·82	0·79
7403	0·15	0·14	0·13	7453	0·15	0·14	0·13	74145	1·30	1·25	1·20
7404	0·15	0·14	0·13	7454	0·15	0·14	0·13	74150	1·50	1·40	1·30
7405	0·15	0·14	0·13	7460	0·15	0·14	0·13	74151	1·10	1·05	1·00
7406	0·39	0·34	0·31	7470	0·32	0·29	0·27	74153	1·20	1·10	1·00
7407	0·39	0·34	0·31	7472	0·32	0·29	0·27	74154	1·70	1·65	1·60
7408	0·25	0·24	0·23	7473	0·41	0·39	0·35	74155	1·20	1·15	1·10
7409	0·25	0·24	0·23	7474	0·41	0·39	0·35	74156	1·20	1·15	1·10
7410	0·15	0·14	0·13	7475	0·60	0·58	0·56	74157	1·00	0·95	0·90
7411	0·25	0·24	0·23	7476	0·44	0·43	0·42	74160	1·40	1·35	1·30
7412	0·28	0·27	0·26	7480	0·60	0·58	0·85	74161	1·40	1·35	1·30
7413	0·32	0·31	0·30	7481	1·10	1·05	1·00	74162	1·40	1·35	1·30
7416	0·30	0·29	0·28	7482	0·90	0·85	0·80	74163	1·40	1·35	1·80
7417	0·30	0·29	0·28	7483	1·20	1·15	1·05	74164	1·80	1·75	1·70
7420	0·15	0·14	0·13	7484	1·00	0·97	0·95	74165	1·80	1·75	1·70
7422	0·30	0·29	0·28	7485	1·60	1·55	1·50	74166	1·60	1·53	1·50
7423	0·40	0·39	0·38	7486	0·35	0·34	0·33	74174	1·60	1·53	1·50
7425	0·40	0·39	0·38	7489	4·00	3·75	3·50	74175	1·10	1·05	1·00
7426	0·40	0·38	0·36	7490	0·65	0·63	0·60	74176	1·25	1·20	1·15
7427	0·40	0·38	0·36	7491	1·10	1·05	1·00	74177	1·25	1·20	1·15
7428	0·45	0·42	0·40	7492	0·74	0·71	0·64	74180	1·25	1·20	1·15
7430	0·15	0·14	0·13	7493	0·74	0·71	0·64	74181	3·95	3·85	3·75
7432	0·40	0·38	0·36	7494	0·85	0·82	0·75	74182	1·25	1·20	1·15
7433	0·42	0·40	0·38	7495	0·85	0·82	0·75	74184	1·80	1·75	1·70
7437	0·35	0·32	0·30	7496	0·96	0·93	0·86	74190	1·95	1·90	1·85
7438	0·35	0·32	0·30	74100	1·50	1·45	1·40	74191	1·95	1·90	1·85
7440	0·15	0·14	0·13	74104	0·60	0·58	0·55	74192	1·95	1·90	1·85
7441	0·74	0·71	0·64	74105	0·60	0·58	0·55	74193	1·95	1·90	1·85
7442	0·74	0·71	0·64	74107	0·44	0·42	0·40	74194	1·30	1·25	1·20
7443	1·20	1·15	1·10	74110	0·60	0·55	0·50	74195	1·10	1·05	1·00
7444	1·20	1·15	1·10	74111	0·90	0·88	0·85	74196	1·20	1·15	1·10
7445	1·60	1·55	1·50	74118	1·00	0·95	0·90	74197	1·20	1·15	1·10
7446	1·20	1·15	1·10	74119	1·50	1·40	1·30	74198	2·75	2·70	2·65
7447	1·10	1·07	1·05	74121	0·50	0·48	0·45	74199	2·50	2·40	2·30

Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C.'s in booklet form, **Price 35p.**

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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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U 5	60 200mA Sub-Min. Silicon Diodes	0·54
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U45	7 3A SCR, TO66 up to 600PIV	1·08
U46	20 Unijunction transistors similar to TIS48	0·54
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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

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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			
UIC45	=5×7445	0·54	UIC86	=5×7486	0·54	UICX1	=25 Assorted 74's	£1·65

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

1975 CATALOGUE NOW READY 10p

NEW LOW PRICED TESTED S.C.R.'s

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	0·88	1·03	1·93
600	0·59	0·68	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

2N3055
115 WATT SIL POWER NPN
45p EACH

2 Amp. BRIDGE RECTS.

50 v RMS	35p	each
100 v RMS	40p	,,
200 v RMS	45p	,,
400 v RMS	50p	,,
1,000 v RMS	55p	,,

Size 16 mm × 16 mm.

D1699 NPN SILICON DUAL TRANSISTOR
(Similar to 2N2060)

1	25	100+
0·28	0·26	0·23

LINEAR INTEGRATED CIRCUIT PAKS
MANUFACTURERS FALL-OUTS

ULIC709	10 × 709	0·54
ULIC710	7 × 710	0·54
ULIC741	7 × 741	0·54
ULIC747	5 × 747	0·54
ULIC748	7 × 748	0·54

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ALL ITEMS SUBJECT TO MANUFACTURERS INCREASE AND AVAILABILITY
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JOSTY KIT
High Quality Construction Kits, stocked at all branches Send for catalogue!

AMPLIFIERS

Rotel RA211	£43·95
RA311	£54·95
RA611	£86·95
Sansui AU101	£48·25
AU505	£74·95
Sinclair 4000	£50·00
Linton Mk. II	£59·95

TUNERS & RECEIVERS

Sinclair 4000 Tuner	£43·95
Rotel RT222	£42·75
Pioneer SX434	£99·00
Rotel RX150A Tuner/ Amp.	£59·95
Rotel 152	£69·95
Sansui	
210 AM/FM/MPX	£75·50
310 AM/FM/MPX	£99·50
441 AM/FM/MPX	£91·95

RECORD DECKS (Ins. 50p)

Garrard SP25 MkIV	£15·25
BSR MP60	£12·95
BSR Invicta P & C/SC7M	£9·95
Garrard	
SP25 MkIV P & C G/800	£25·00
Goldring GL78 P & C/ G800E	£59·95
Rank Domus BD 2000/ Rex 999 Cart.	£50·00
Connoisseur	
BD1 Kit	£13·50
BD2 Chassis/SAU2	£32·50
SAU Arm	£14·25
SCU1 Cartridge	£5·95
Pioneer PL12D	£43·50

TAPE DECKS (Insurance 2·00)

Akai	
4000DS Reel to Reel	£93·95
4000DB Reel to Reel Dolby	£149·50
GXC36D	£83·00
GXC38D	£103·95
CS33D	£79·95
Akai CR81D 8-track Rec. player	£73·95
GXC82D	£93·95

SPEAKERS

Chassis Speakers

EMI (Plain) 13in x 8in, 3 or 8 ohm Bass unit	£2·30
with Single Tweeter (only 8 ohm)	£2·45
Tweeter and Crossover 3, 8 or 15 ohm	£4·25
Type 350 Kit 15 watt 8 ohm	£8·25
13in x 8in Bass unit 15 watt 8 ohm or 15 ohm	£5·45
8in x 5in 5 watt 3, 8 or 15 ohm	£1·70
8in x 5in 10 watt Dualcone 8 ohm	£2·95
6½" 10 watt 8 ohm	£2·65
8in 10 watt 8 ohm	£4·50
12in 20 watt 8 ohm	£6·95
8in 4 or 15 ohm	£2·25
7in x 4in 3 or 8 ohm	£1·30
Elac 6½" 8 ohm 10 watt	£2·65
Elac 8in 8 ohm Dualcone	£2·70
Elac 10in 8 ohm Dualcone	£3·75
Baker Group 25 12in 8 or 15 ohm	£8·25
Adastra 'Top 20' 12in 25 watt 8 or 15 ohm	£8·25
Adastra 'Hi-Ten' 10in 10 watt 8 or 15 ohm	£3·70
Also 5in 8 ohm speaker	£0·95
2½in 8 or 64 ohm speaker	60p

WHARFEDALE SPEAKER BARGAINS

Denton 1 pr.	£26·75
Denton 2 pr.	£32·00
Linton 2 pr.	£40·75
Glendale 3 pr.	£60·95
Kingsdale 3 ea.	£64·95
Dovedale 3 ea.	£44·95

KITS

Linton 2 pr.	£20·95
Glendale 3 pr.	£35·95
Dovedale	£55·50

SPEAKER CABINETS IN KIT FORM (Teak Veneer)

(Ins. 50p. per pair)

12in x 8in x 6in (8 x 5 or 7 x 4 cutout)	£3·25
14in x 12in x 9in (10", 8 x 5, 8", 6½" & 3½")	£4·25
18in x 11in x 9in (8" x ½" or 13 x 8)	£5·25
22in x 14in x 9in (12" & ½" or 13 x 8)	£6·95

TWEETERS & CROSSOVERS

Cone Tweeter 10 watt 8 or 15 ohm (K2006)	£2·95
Cone Tweeter 3 watt 8 ohm (K2003)	£1·55
Horn Tweeter 8 ohm (K2007)	£6·50
Dome Tweeter 8 ohm (K2011)	£5·75
2-way Crossovers (CN23, CN28, CN216)	£1·40
3-way Crossover (CN38)	£2·85

CARTRIDGES & STYLII

	Cart. £	D/D Styli £
ACOS		
GP91/2SC or 3CS (ster. comp)	1·10	1·25
GP93/1 or 95/1 ster. cryst.	1·35	1·25
GP94/1 or 96/1 ster. ceram.	1·75	1·25
GP101 cryst. comp.	90	—
GP104 ster. ceram.	1·95	1·25
BSR		
X5M or X5H cryst. comp.	1·95	1·25
SX6M or SX6H cryst. ster.	2·10	1·25
SC5M ster./ceram.	2·85	1·25
SONOTONE		
9TAHC or 9TAHC/G (Diam.)	1·95	1·25
3509 Magnetic	1·95	1·25
AUDIO TECNICA		
AT55	1·95	—
EMPIRE 999 REX	3·95	—
GOLDRING		
G850	2·95	1·95
G800	3·95	1·95
G800H	3·95	1·95
G800E	6·99	3·95
SHURE		
M44G	4·95	3·95
M55E	6·25	4·95
M75ED Type 2	11·75	8·25
MJ5EJ Type 2	9·75	6·25
V15 Type 3	32·25	—

MICROPHONES

UD130 50K/600 ohm uni-dir. ball metal	£6·75
UD147	£9·25
Condenser Mic. 600 ohm uni-dir	£9·50
Cassette Stick Mic. with R/Control	£1·65
Cass. Stiek Mic. with R. control (Philips type)	£2·00
Mic-Mixers Mono/stereo	£5·50

HEADPHONES

Rotel	
RH430	£4·75
RH 630	£7·75
RH 700	£11·50
Koss	
K711	£11·50
KRO711	£10·95
K6	£13·00
K6LC	£14·95
KO727B	£16·75
KO747	£21·50
HV1	£21·95
PRO4AA	£29·25
PRO54	£29·95
K6LCQ	£26·00
Sansui SS10	£16·75
*Headphone adaptor (Junction box)	£2·75
extension lead 2ft curly	£1·50

CASSETTES

	C40	C60	C90	C120
Low Noise	—	35p	45p	55p
Philips	—	55p	75p	110p
Memorex	65p	79p	110p	155p
Ampex (360)	45p	55p	75p	99p
Ampex (20-20+)	59p	65p	99p	135p
Chromium Dioxide	—	99p	140p	—

Casette Head Cleaner	45p
Ampex Head CleanerDemag	£1·65
BIB Stereo Test Cassette	£2·15
Cassette Racks (hold 6)	£0·45
Cassette Rotating Racks (hold 20)	£3·50
Cassette Carrying Case (hold 18)	£1·95

8-Track Cartridge Blanks

	C40	C64	C80
Ampex	80p	95p	£1·10

8-track H/Cleaner Demagnetiser	£1·90
8-track Carrying Cases (BIB)	£1·65

TAPES

	Stnd	LP	DP	Cases
5"	55p	65p	1·00	20p
5¾"	65p	86p	1·35	25p
7"	80p	110p	1·85	30p
High frequencyAmpex				
5"	—	1·40p	1·55p	
7"	—	1·90p	2·95p	
AKAI Metal Reel 7"			£2·10	

CALCULATORS

Sinclair Cambridge Build	£12·95
Sinclair Cambridge with memory	£17·95
Scientific	£19·95

SINCLAIR PROJECT 80

Stereo Pre-amp.	£12·95
Active Filter Unit	£7·25
Z40 15 watt Amp	£5·75
Z60 25 watt Amp	£7·25
P25 Power Supply for 240	£5·45
P26 Power Supply for 240	£8·45
P28 Power Supply for 260	£8·25
FM Tuner	£12·95
Stereo Decoder	£8·45
Q16 Speaker	£7·75
IC20 Stereo Amp. Kit	£7·45
PZ20 Power Kit	£5·25

PORTABLE RADIOS

Vega Jade	£5·95
Vega Sapphire	£8·75
Vega VEF206	£15·50
Selena LM/MW/FM/5SW	£20·95
Murphy	
B833 MW/VHF	£9·95
BA838 LW/MW/VHF M/Batt	£18·50
MA5003 Head Set Radio LW	£7·95
Bush	
VTR165 LW/MW/VHF	£22·00
VTR127 LW/MW/VHF	£15·50
VTR 175 LW/MW/VHF	£13·95
VTR188 LW/MW/VHF/ 2SW M/Batt	£31·95
BY5661 LW/MW/VHF	£14·95

CLOCK RADIOS

Bush CR128 LW/MW	£13·60
Bush CR232 MW/VHF	£24·95
Murphy MV5600 MW/VHF	£22·95
Vega Signal 2 wave band	£9·95

CASSETTE RECORDERS

Bush TP66 M/Batt	£25·75
Murphy BA200 M/Batt	£22·75
Bush BT8504 (miniature)	£25·50
Mains Battery Cass.	£15·50

RADIO CASSETTES (Mains/Batt.)

Murphy BA209 MW/VHF	£33·50

STEREO RECORD PLAYER & SYSTEM

Bush A1005	£56·50
Hanimex HRC5060 8-track AM/FM/MPX+Speaker	£116·95

CAR AUDIO

Hitachi Car Radio	
WM702R LW/MW	£16·50
KM1510 LW/MW/VHF	£32·50
Hitachi Car Cassette C5114	£45·00
Hitachi AM/FM & Cassette CSW 217	£57·00
Battery Eliminators 240 in 6, 7·5 or 9 volt output	£2·95

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4 New Market St tel 0532 42708
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15 Whitechapel tel 051·236 0738

MAINS TRANSFORMERS

All models 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	500mA	1·00
12v	1 amp	1·00
6·5v–0–6·5v	1 amp	1·35
18v	1 amp	1·25
20v	1 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 amp	3·50
25v	1½ amp	1·95
50v 2 amp & 6·3v 1 amp		5·50
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
Charger Transformers		
6v and 12v	2 amps	1·25
6v and 12v	3 amps	2·25
6v and 12v	5 amps	3·50
EHT Transformer 5Kv at 23mA (intermittent)		5·50

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XNII Price **99p** each, 10 for **£9**

OIL PUMP

Driven by Redmond Motor of approx. 1/20th horse power, pump originally intended for oil-fired boilers etc, with normal inlet and outlet pipes and unions. **£2·15** plus 30p post and insurance.

LIGHT DIMMER KIT

For dimming up to 250w without heat sink or 750w with heat sink. This comprises quadrac variable control potentiometer, condenser, resistors, tag strip for mounting and data. Price **£1·50.**

RELAY BARGAIN

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

AM/FM TUNER

Unit made by the American GEC company, 8 transistor, all-wired ready to work. Complete with tuner condenser, needs only scale and pointer. Tunes AM range 540 to 1620 KHz. FM range 88 to 108 MHz. Switches for on-off and AFC. Output for MXP or direct. Special snip price **£5** plus 30p post. Three or more post free.

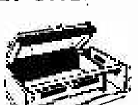
7 WATT STEREO AMPLIFIER

Again by the American GEC company. This has exceptionally good tone quality. Is complete with pre-amp and treble base, volume and balance controls. Also has mains smoothing circuit and rectifiers so requires only mains transformer. Output for 15 ohm speakers. Inputs for tuner, pick-up, mike, etc.
Special snip price **£6** plus 30p post. Three or more post free.

WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts and instructions to make. **£2·75.**

PORTABLE CABINET OFFER



A nicely made portable cabinet, soft padded black finish intended for portable stereo system. Dimensions as sketch. With motor board cut out for Garrard SP 25. This was obviously a very costly cabinet originally made for a de-luxe record player. Offered at **£1·95** plus £1 carriage free if bought with the Garrard or BSR record decks.

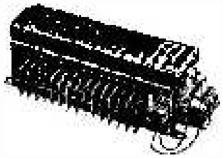
CAR CASSETTE POWER SUPPLY

To give stabilized output of 6 or 9v, complete kit contains 2 transistors—zener diode—vero board panel resistors and plastic case to house it with constructional data. **£2·50.**

PLAY YOUR 8-TRACK CASSETTE FROM MAINS

12v. 700mA unit all assembled and in neat plastic case with mains lead and terminals, full wave rectifier and transformer has overload protection and is double insulated. **One of today's best buys at £2·60 + 35p VAT.**

HONEYWELL PROGRAMMER



This is a drum type timing device, the drum being calibrated to equal divisions for switch-setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips, thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control. Boiler firing. Dispensing and Vending machines. Display lighting animated and signs. Signalling, etc. Price from makers probably over £20 each. Special snip price **£8·50** plus 25p post and insurance. Don't miss this terrific bargain.

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc.
24in × 18in **£1·90**
13in × 0in **£1·50**

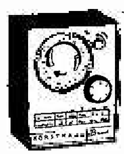
THIS MONTH'S SNIP

High compliance 8" round speakers suitable for 8–12 ohm outputs, these speakers have rubber mounted diaphragms and will handle up to 12·5 watts. Made originally for an expensive Decca hi-fi outfit, we offer at **£3·95** each or **£7·75** a pair plus 40p each postage.

STEREO RADIO CABINET

Long, Low and Modern. Teak veneered with sliding front and tapered legs. Speaker spaces each end. Size approx. 4ft 2in × 13in × 15in. Probably cost over £20·00 to make. Our price **£8·10** each.

HORSTMANN 24-HOUR TIME SWITCH



With 6 position programmer. When fitted to hot water systems this could programme as follows:

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact, there is no limit to the versatility of this Programmer. Mains operated. Size 3in × 3in × 2in deep. Price **£4·35** as illustrated but less case.

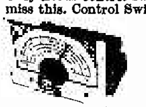
TAPE DECK

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 in good order. Price **£1·95** plus £1 post and insurance.

TANGENTIAL HEATER UNIT

This heater unit is the very latest type, most efficient and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. 2kW Model **£2·75.** Don't miss this. Control Switch **44p** plus VAT. P.&P. 40p.

SHORTWAVE CRYSTAL SET

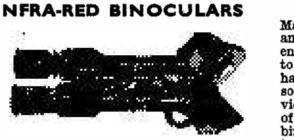


Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19.25.31.39 metre bands—Kit contains chassis front panel and all the parts. **£1·25**—crystal earphone **50p.**

SPIT MOTOR

200-250V Induction motor, driving a Carter gearbox with a 1¼" output drive shaft running at 5 revs p.m. Intended for roasting chickens, also for driving models—windmills, coloured disc lighting effects, etc. **£2·50** plus 20p post and ins.

INFRA-RED BINOCULARS

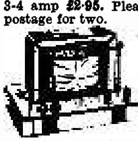


Made for military purposes during and immediately after last war to enable snipers, vehicle drivers, etc. to see in the dark. The binoculars have to be fed from a high voltage source (5KV approx.) and providing the objects are in the rays of an infra-red beam, then the binoculars will enable these objects to be seen. Each binocular eye tube contains a complete optical lens system as well as the infra-red cell, technical data on which is available. The binoculars are unused, believed to be in good working order. In fact they were never issued and are still in original cases, but since they were made a long time ago, they can hardly be called new. Sold without guarantee. Price **£16·50** per set + £1 carriage.

BATTERY CHARGERS

Famous Atlas in metal case with meter, output leads terminated by crocodile clips. For 6 or 12v charging simply by changing plug on front panel. Ready built new and still in maker's original packing. Two models: 1½ amp **£1·99** and 3-4 amp **£2·95.** Please add 40p postage for one and 75p postage for two.

12 VOLT 1½ AMP POWER PACK



This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mF smoothing. Price **£2·50** plus 20p post & packing. Heavy Duty Mains Power Pack. Output voltage adjustable from 15–40V in steps—maximum load 250W—that is from 6 amp at 40V to 15 amp at 15V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage adjustment is very quick—simply interchange push on leads. Silicon rectifiers and smoothing by 3,000mF. Price **£6·95** plus £1·00 post.

TERMS:—ADD 8% 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. PW), 102/103 TAMWORTH ROAD, CROYDON CRO IXX

NEW ITEMS THIS MONTH

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

Laboratory volt meter, BS1. This is the conventional square case, size 7" × 7" × 3½" with a leather carrying handle and rubber feet for horizontal and vertical standing. The meter is intended for horizontal use on the bench and has a mirrored scale. Hefty terminals along the top select the 3 ranges 0-150v, 0-300v and 0-600v D.C. Price **£6** plus £1 post and insurance.

Laboratory amp meter, companion instrument to the above, but to read 0-20 amps 50 cycles, **£5** plus £1 post and insurance.

Soil heating transformer, 4v, 5v or 6v output, very heavy duty secondary rated at 250 amps, price **£20** plus carriage £2 first 100 miles then £1 per 100 miles extra.

7 watt stereo/mono amplifier with usual switching and controls, in attractive teak style case, **£9.**

3 core lead, 7' 6" long, ribbed, virtually non-kinkable 23/36 conductors, so OK for 8 amps. Price **10p** each.

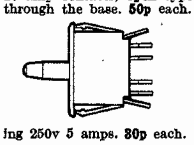
0-1 mA meter 2¼" square, flush mounting, English make ex equipment but perfect. **£1·75.**

0-100 microamp meter, as the above, but **£2·25.**

Solenoid 4-6v, size approx. 1" × 1" × 4" thick, twin coils give excellent pull. Mounted in frame but easily removeable from this frame, fitted with lever giving approx. ·4" push or pull. Price **30p** each.

Cold cathode tube Swiss made "Elasta" type no. ER 12A. We have no technical information on this tube and if any reader has this we will be obliged for any information. Price of the tubes **30p** each.

AC mains operated relay with single changeover 10 amp contacts, open type single screw fixing through the base. **50p** each.



Push switch, metal body and metal push, normally on. These are replacements in many "break glass" fire alarms. Made by Arrow, contact rating 250v 5 amps. **30p** each.

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 **£1·50.**

Push switch, double pole changeover contacts rated at 10 amps 250 volts made by the American Honeywell Co. A very reliable and robust switch with plenty of applications. Oblong plastic body, snap fitting into a hole size 1¼" × ¾". Offered at only a fraction of its proper price, namely **20p** each.

Ditto but single pole changeover, fits into a hole size 1" × ½". Price **15p** each.
(Note: the two switches above do not require a knob as they have a polished and tapered plunger).

Ditto, but dished knob. **10p** extra with knob.

Two new speakers, 5" round 8 ohm impedance 5 watt output, **£1·25** plus 20p post and 5" mid-range 12 watt speaker, **£4** plus 40p post. (This is a GOODMANS speaker don't miss it).

AM/FM tuning condenser as fitted to many Japanese and Hong Kong portables, this has two main tuning sections and four trimmers, approx. size 1" × 1" × 1". **60p** each.

Battery charger kit comprising 2 amp transformer, 2 amp full wave rectifier and 2 amp meter suitable for charging 6v or 12v. Special bargain price **£1·50** the kit plus 30p post.

MacDonald record auto-changer with cueing arm and ceramic stereo cartridge. This is a very superior auto changer and one we can thoroughly recommend. Limited quantity, special price **£7·35** plus £1 post and insurance. Plinth and cover (the plinth has to be modified very slightly) available, price **£4·95** plus £1 post, or if you buy both together you can get a discount of £1.

Instrument case measures 18" × 12" × 12". This is a very well-made case built up on an angled framework specially designed for instruments which has rounded corners and edges. Into this framework fits the 6 panels. All panels are louvred for ventilation, side panels are also fitted with handles which drop down and in the down position are almost flush; the bottom panel has four rubber feet, the back panel has aperture for leads voltage adjustment panel and fuses, the front panel you provide yourself. These instrument cases would probably cost around **£15** each. We have approx. 100, not new but in very good condition and offer them at **£3** each plus carriage.

Battery condition testers. This is another item which has been set out of stock temporarily but we are pleased to say in stock again. Price now £3·50.

RTVC *COMPLETE STEREO SYSTEM

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. $13\frac{3}{4}$"×9"×$3\frac{1}{4}$".
Garrard SP 25 deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers – Enclosure size approx. $19\frac{1}{4}$"×$9\frac{1}{2}$"×$7\frac{3}{4}$" in simulated teak. Drive unit 13"×8" with 3" tweeter. 15 watts handling.
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"×$11\frac{1}{2}$" 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.

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

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: £74.00	

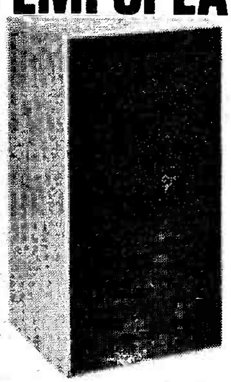
Available complete for only: £62.00 +£5.50 p & p

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: £87.00	

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

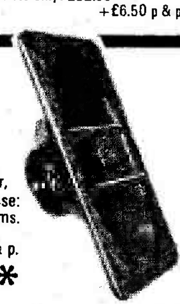
EMI SPEAKERS AT FANTASTIC REDUCTIONS



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



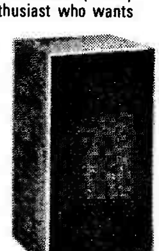
System consists of a 13"×8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)
Complete with crossover Components and circuit diagram **£5.50** +£1 p & p.

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 – $1\frac{1}{2}$". 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, $3\frac{1}{4}$" 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"×$9\frac{1}{2}$" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.

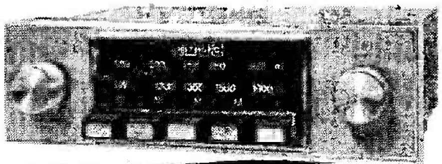


£18.95 pair complete Complete with crossover Components and circuit diagram
+£4.50 p & p.

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"×$5\frac{1}{2}$"×$3\frac{1}{4}$" approx.
£5.95 +£1 p & p.

PUSH BUTTON CAR RADIO KIT– THE TOURIST TT*



NO SOLDERING REQUIRED

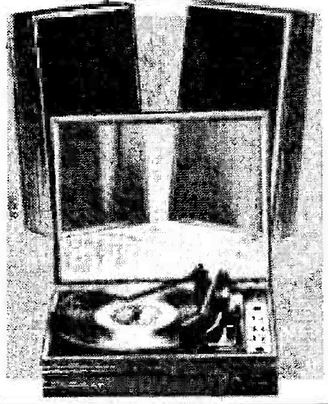
NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

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.

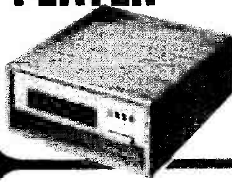
Extras if required. Optional Diamond Styli £1.37.
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. £5.00.

*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.

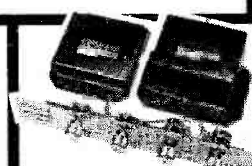
*8 TRACK HOME CARTRIDGE PLAYER



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*

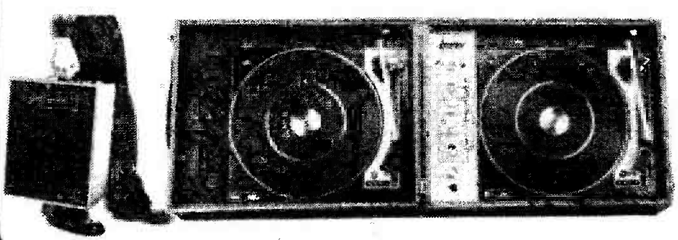


For the man who wants to design his own stereo – here's your chance to start, with Unisound – pre-amp, power amplifier and control panel. No soldering – just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic 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 – 17¾"×13¾"×8¾" (app.)
Unit Open – 35¾"×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 March 1975 and subject to change without notice.
All prices include V.A.T. at 8% rate.

RTVC

21C HIGH STREET, ACTON, LONDON W3 6NG
323 EDGWARE ROAD, LONDON W2
Personnal Shoppers **EDGWARE RD**: 9 a.m.–5.30p.m. Half day Thurs.
ACTON: 9.30a.m.–5p.m. Closed all day Wed.

Fact~not Fiction

THE varicap silicon junction diode, with its variable capacity effect, has been with us for many years. There is widespread use of these devices in tuner heads for domestic VHF/FM and TV and UHF TV for automatic frequency control (AFC) and/or electronic tuning. The use of low-cost varicap diodes has been restricted to these applications because of the limited capacity swing they offer.

Numerous manufacturers with an eye on the market potential of this device, have been actively engaged in the development of varicaps that fulfil the special requirements of long and medium waveband receivers.

In recent months these long-awaited devices have been released by Motorola in several combinations. The MVAM1 *triple* varicap package forms the "heart" of the "PW Apollo" Triple Varicap Medium Wave Tuner/Receiver appearing in this issue.

Thus overnight, electronic tuning for long and medium waveband receivers is **fact** and **not fiction** for the home constructor. To this end, a new-style slider potentiometer was commissioned for the PW "All Electric Wireless" to simplify the tuning arrangements.

Remote control tuning is no problem. During tests on the prototype PW receiver, remote control tuning was achieved with the slider potentiometer connected to the receiver chassis via 30 metres (100 feet approx.) of cable!

The "PW Apollo" series will reveal, month by month, a number of fascinating applications utilising this new unique varicap package. Just to whet your appetite, this triple (or double) varicap device could be used in conjunction with a general coverage receiver and oscilloscope to give a spectural display of radio signals. Also, how about an electronic remote tuning car radio with the AM/FM radio unit tucked away safely in the car boot?

The applications of this new varicap package are numerous and we prophesy that it will bring about many radical changes and new ideas in electronic technology. The PW "All Electric Wireless" could set the trend and be the forerunner of a multitude of receiver designs that will now permeate our exploding technology.

Begin reading the facts in the "PW Apollo" series, Part 1 on page 44.

LIONEL E. HOWES, Editor.

Bentley Acoustic Corporation Ltd.

Following complaints from readers we have now received an undertaking from Bentley Acoustic Corporation Ltd., that their practice of deducting expenses from refunds made to readers has now ceased and we are assured that all future refunds will be made in full.

NEWS...

Write to them

THIS year seems to have got off to a relatively slow start when it comes to news of the latest happenings in the electronics world. The PW office usually receives a mountain of press releases that take a fair time to sort out. However, after thumbing our way through the correspondence that has arrived, and we must add, throwing out that more applicable to Nuclear Research Stations and the like, we've come up with the following pot-pourri of news, forthcoming events and a few noteworthy new components. It should be pointed out however, that the following are in a shortened form designed to 'whet the appetite'. If, therefore, more information is required, an address and sometimes the phone number of the firm concerned is given with the story. Write to them, not to PW!

Mail order success

DURING the last few months of last year, Chromasonic Electronics of North London (see advert. in this issue) announced their intention to start a return-of-mail service. In the months following, the firm states, not one letter received by 3pm has been left over for processing on the following day. They add that, in addition, telephone enquiries for technical or product price information are not discouraged, as is the case with many firms. Data sheets for semiconductors are also available and cost 6p, A4 size, plus postage.

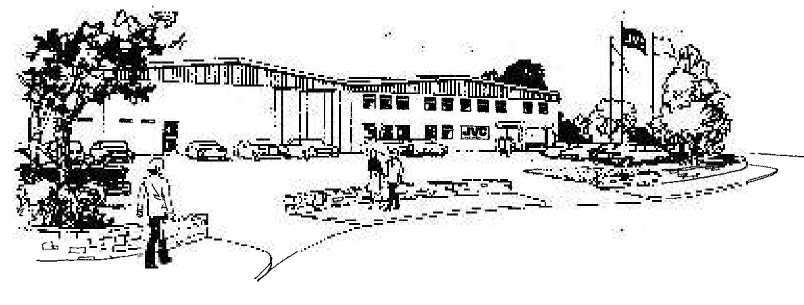
Knowledge

IF any reader, thirsting for knowledge, wishes to attend an 'all in' three day symposium covering a wide range of test gear and techniques, then why not attend 'Test 75' at the University of Kent between July 7th and 10th. Cost is around £45 and correspondence should be sent to the Symposium Secretary, SERT, Faraday House, 8-10 Charing Cross Rd, London WC2H 0HP. Tel: 01-240 1152.

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

JVC moves

WE start with the news that JVC (UK), distributors of Hi-Fi and television products, have transferred to new premises. The move due to 'enormous growth since 1969' took place earlier this year with a new showroom, sales department, warehouse and service department. Location is now in the Eldonwall Trading Estate, Staples Corner, 6-8 Priestly Way, London NW2 7AF. Tel: 01-450 2621.



JVC's new premises in North London.

Hey Wack!

ANYONE out there live in Liverpool or surrounding district—Yes? Well, as from the 24th January BBC Radio Merseyside (95·8MHz) has been utilizing slant polarization. This, according to the BBC Engineering Department, is to improve reception for portable receivers and VHF car radios.

Another calculator

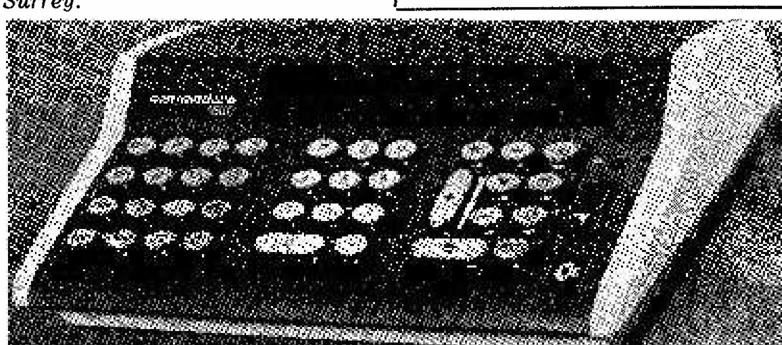
RECENTLY many companies have been jumping on the calculator bandwagon and although there is now a bewildering number to choose from, here's just one more!!! It's a desk-top model, designated the CBM1500 and hailing from the States. Functions include sin, cos, tan, arc, pi, and roots as well as straightforward numbers. A memory is also included. Price is around the £70 mark and it can be obtained from *Guildford Tapes & Calculators, 1a Onslow St., Guildford, Surrey.*

Radio notes

A QUICK note here for the amateur radio enthusiast. The Midland Amateur Radio Society will be staging the North Midlands Mobile Rally at Drayton Park, Tamworth, on Sunday 20th April. Further information from *A. Walton (G3ZKQ), Birmingham and Midland Institute, Birmingham 3.*

More Beeb cut-backs

ALTHOUGH possibly of more interest to the readers of our sister magazine, Television, it has come to our notice that the BBC, 'due to its financial position,' and the need to 'Save it', has found it necessary to curtail the BBC-2 trade test transmissions. Each weekday for about $5\frac{1}{2}$ hours, installers, dealers and servicemen will be at a considerable inconvenience, particularly those installing new aerials and receivers. With the tremendous influx of cash due from the recent TV licence fee increase, one wonders what the BBC will do with all that extra money!



New desk-top calculator, the CBM1500 from Guildford Tapes & Calculators.

Radio Society get-together

THE RSGB 21st National VHF convention is to be held at the Winning Post Hotel, Whitton, Twickenham, Middlesex, on the 10th and 11th of May.

The programme comprises lectures and demonstrations on amateur space communications, microwaves and VHF propagation. Starting at 11am on the 10th, the lecture sessions are on Saturday afternoon and Sunday morning, with the Saturday evening taken up with a dinner dance.

The whole event costs £3 per person, or 80p for lectures and trade show only. Further details from *RSGB, 35 Doughty Street, London WC1N 2AE, marking the envelope 'VHF Convention'.*

Summer school

ESSEX University will be holding its annual Electronics Summer School for the week of July 7-11th and comprises two courses running simultaneously. The first course, ESS 8—Linear Circuit Design, is concerned with the use of transistors and operational amplifiers in linear applications. The second, ESS 9—Digital Circuit Design, concentrates on the use of the transistor as a switch and develops designs using integrated logic circuits.

A full laboratory programme backs up the topics covered in lectures, and tutorials are held to discuss the design for the practical sessions. Further information from *Bob Mack, Dep. of Electrical Engineering Science, University of Essex, Colchester, CO4 3SQ.*

Model Train Controller

JOHN LEWIS

SPEED controllers available to the general public are either mains or battery powered, both suffering inherent design faults. One of the overiding faults centres on the fact that it is based on a variable resistor placed between the supply and the tracks. It therefore follows that any control action which varies the speed of the train, also varies the current available to the motor and consequently the torque or pulling power. This is satisfactory at high speeds but at lower ones problems arise since it is here that one requires more pulling power in order to get the train started. What usually happens is that the control has to be well advanced before any movement occurs and then quickly turned back once the train is moving. This of course results in erratic and unrealistic motion of the train.

The author realised that this problem could be overcome by the use of a square wave of constant frequency and amplitude, but with a variable mark/space ratio. Fig. 1 shows what is meant. When the mark/space ratio is 50%, the time that the voltage is ON is the same as the time that the voltage is OFF, giving an average value of the voltage as shown. If the mark/space ratio is altered so that the ON time is increased, the average value of the voltage will rise and hence the train will speed-up. Conversely if the mark/space ratio is decreased the train will slow down. The motor integrates the pulses and interprets them as changes in voltage rather than current thus giving maximum torque at the required speed. In fact, with this arrangement it is possible to control the train from flat-out down to literally inching round the track, greatly increasing the realism.

THE INTEGRATED CIRCUIT

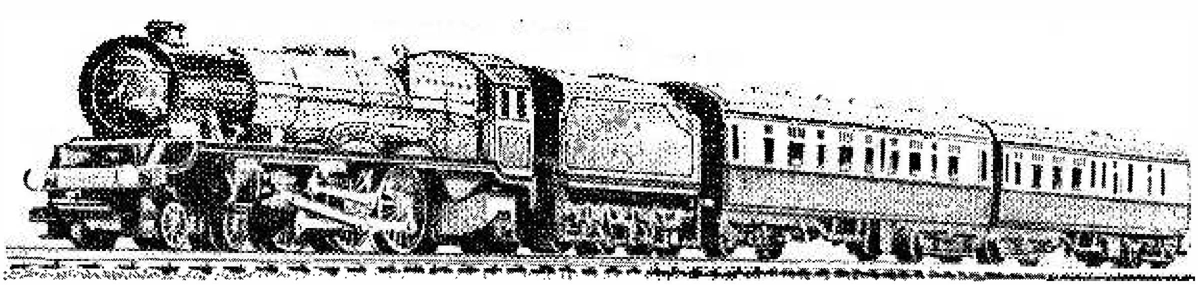
The controller is based on the inexpensive 555 integrated circuit. Basically it can be used either as a monostable or an astable circuit as shown in Fig. 2. For those who are not familiar with its operation Fig. 3 may help. Internally there is the equivalent of two voltage comparators, a flip flop and an output stage. The comparator connected to pin 2 responds to a voltage of $\frac{1}{3}V_{cc}$, whilst the comparator on pin 6 responds to $\frac{2}{3}V_{cc}$. These comparators change the state of the flip-flop and hence the output.

If we look at the astable application which is the one used in this controller we see that both pin 2 and pin 6 are connected to the capacitor and so sense the voltage across it. The capacitor charges up via resistors R1 and R2 and when the voltage across it reaches $\frac{2}{3}V_{cc}$ the comparator on pin 6 will trigger and the flip-flop changes state, driving the output low. At the same time as this occurs, pin 7 is effectively shorted to earth and the capacitor now starts to discharge through R2. When the voltage across C2 reaches $\frac{1}{3}V_{cc}$ the comparator on pin 2 will be triggered, the flip-flop reset with the output going high and the earth to pin 7 removed. This means that C2 can start recharging again. The cycle repeats itself with the frequency being dependent on the values of C2, R1 and R2.

To calculate the frequency the formula

$$f = \frac{1{\cdot}44 \times C2(\mu F)}{R1(k\Omega) + 2R2(k\Omega)}$$

is used. It can be seen that the values of R1 and R2



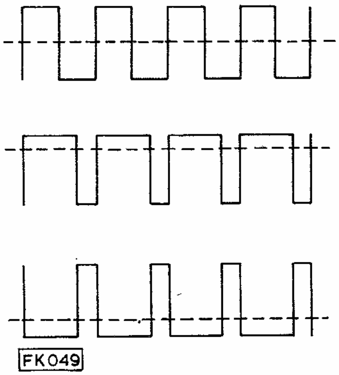


Fig. 1: Square waves of constant amplitude and frequency but with variable mark/space ratios.

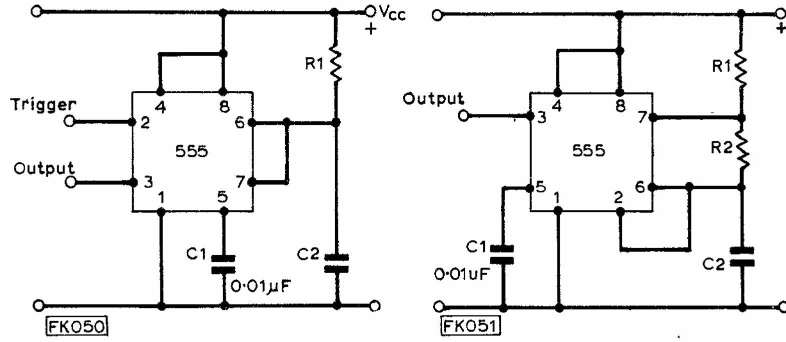


Fig. 2: The 555 integrated circuit connected in monostable and astable modes respectively.

will determine the time for which the output is either high or low. If R1 equals R2 then the charge up time will be twice that of the discharge time, since the capacitor charges up through both R1 and R2 but only discharges via R2. By choosing appropriate values one can get a mark/space ratio of 50% or more with the circuit shown. If a diode is added across pins 6 and 7 a duty cycle of less than 50% can be obtained, and if R1 and R2 are replaced with a variable resistor one can get a wide range of mark/space ratios.

The other feature of the IC is the reset available on pin 4, provided that the potential on this pin is maintained at more than 1V the circuit will operate normally. However if the potential falls to zero then the IC is inhibited and no output is obtained. It was decided to use this facility as an automatic short circuit protection.

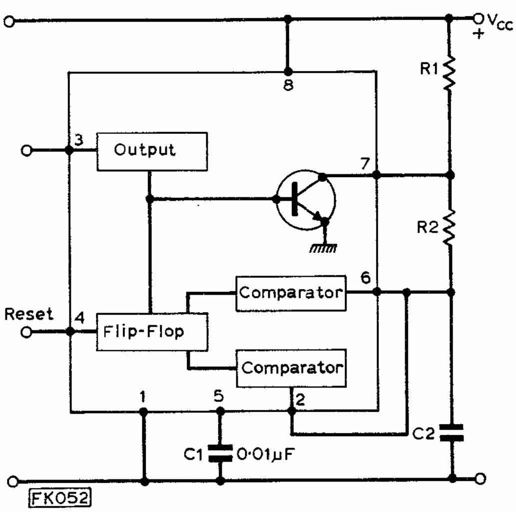


Fig. 3: Diagram of the 555 showing internal arrangement and external biasing components.

FINAL CIRCUIT

The final circuit can be seen in Fig. 4. The 555 is connected in the astable mode, with the diode added between pins 6 and 7. Using the values of C1 and VR1 shown a nominal frequency of 144Hz is obtained though the values could be altered should one wish to experiment with other frequencies of operation. The resulting square wave at pin 3 is used to drive

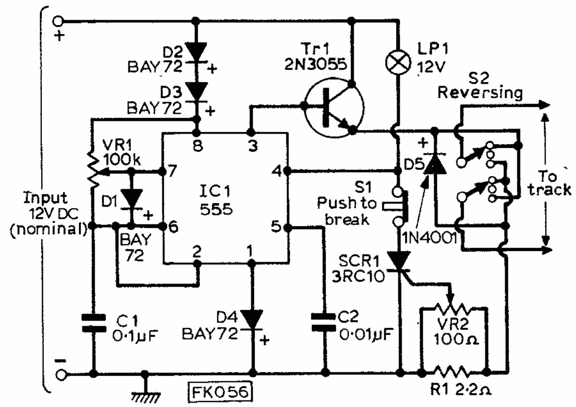


Fig. 4: Complete circuit of controller, showing automatic cut-out system, speed control potentiometer VR1 and reversing switch.

the base of the output transistor Tr1 while the output from its emitter is taken to the track via a reversing switch S2.

The return path of the current is through R1, a low value resistor which forms the sensing element of the short circuit protection. When the current flows through R3 a voltage drop is produced across this resistor depending on the current flowing, and is tapped off by VR2. This voltage is then applied to the gate of the thyristor SCR1. Without going into too much detail it will be remembered that a thyristor behaves like an open circuit switch passing negligible current until a suitable positive potential is applied to its gate. When this happens it turns on and conducts in a manner similar to a diode. The gate loses all control at this point and the thyristor stays on even though the gate bias is removed. The amount of potential required to trigger the thyristor varies from type to type and this is catered for by VR2.

If a short does occur on the track the current passing through R1 will increase, resulting in a higher voltage drop, and consequently the turning on of the thyristor. This lights the bulb, LP1, which indicates that something is wrong. With LP1 coming on the potential at the top of the thyristor drops from V_{cc} to almost zero, and since pin 4 is connected to this point the IC will be inhibited, and its output will drop, thus cutting off the power to the track. A push button S1, is provided to reset the circuit once the short has been removed. The diode D4 ensures

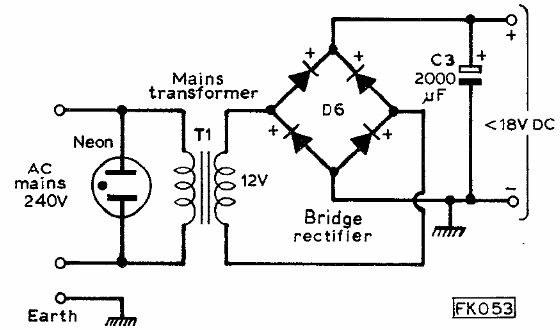


Fig. 5: Optional power supply, utilizing full-wave bridge rectification. Output must be less than 18V DC.

that the voltage presented at pin 4 is low enough to inhibit the IC, by raising the negative point of the IC, 0·6V above the negative rail voltage. The sensitivity of the protection circuit can be adjusted by VR2 enabling it to trigger should the train be excessively loaded. Once a fault has been cleared the reset button is pressed and the train will restart. On the prototype, VR2 was a normal pot, although obviously a skeleton preset would do the same job.

POWER SUPPLY

The circuit will work from any commercially produced 12V-18V DC supply which is adequately smoothed. If there are any doubts about the smoothness of the supply, include a 2000µF capacitor of at least 25V working across the output.

If required a simple DC power supply can be easily built and a suitable one is shown in Fig. 5.

SAFETY

Since the circuit is certainly going to be used by children, great care must be taken to ensure that it is electrically safe. Check that all main leads and transformer terminals are adequately insulated and the whole should be enclosed in a metal box which is earthed. On the prototype no mains switch was incorporated, only a neon indicator. The reasoning behind this is that it ensures that the controller is

★ components list

Resistors

R1	2·2Ω 3W
VR1	100kΩ linear potentiometer
VR2	100Ω Trim potentiometer or skeleton type

Capacitors

C1 0·1µF C2 0·01µF C3 2000µF 25V

Semiconductors

Tr1	2N3055
IC1	555—Signetics or Motorola
SCR1	3RC10 or any general purpose thyristor rated at 0.5A and 25PIV.
D1, D2, D3, D4	BAY72 or 1N914 or any general purpose silicon diode
D5	1N4001
D6	Bridge rectifier—any general purpose type rated at least 2A

Miscellaneous

LP1	12V indicator lamp
S1	switch—push to break
S2	switch—toggle DPDT centre off.
T1	Transformer—nominal 12V, 1·5A. Possible to use filament transformer and connect the two 6·3V windings in series.

Mains neon. Mains cable clamp and solder tag. Metal box approx. 185 x 115 x 75mm (7¼ x 4½ x 3in.) Veroboard 0·1in. pitch 76 x 31mm (3 x 1¼in).

switched off and unplugged from the mains when not in use, and not merely switched off internally. However, opinions will differ and a suitable switch can be easily incorporated if desired. It is worth mentioning here the diodes D2 and D3 shown on the circuit diagram. In the prototype the power supply gave 19V under no-load conditions and the maximum working voltage of the 555 is 18V. Rather than mess around with a zener diode etc., it was decided to drop 1·2V just by using these diodes. Thus these and D4 ensure that the IC is actually running at 17·2V. If the supply is less than 18V under no-load conditions, D2 and D3 can of course be omitted. D5, which is across the reversing switch S2 is there to suppress the negative-going spike produced by the motor at the end of each pulse, which could damage Tr1.

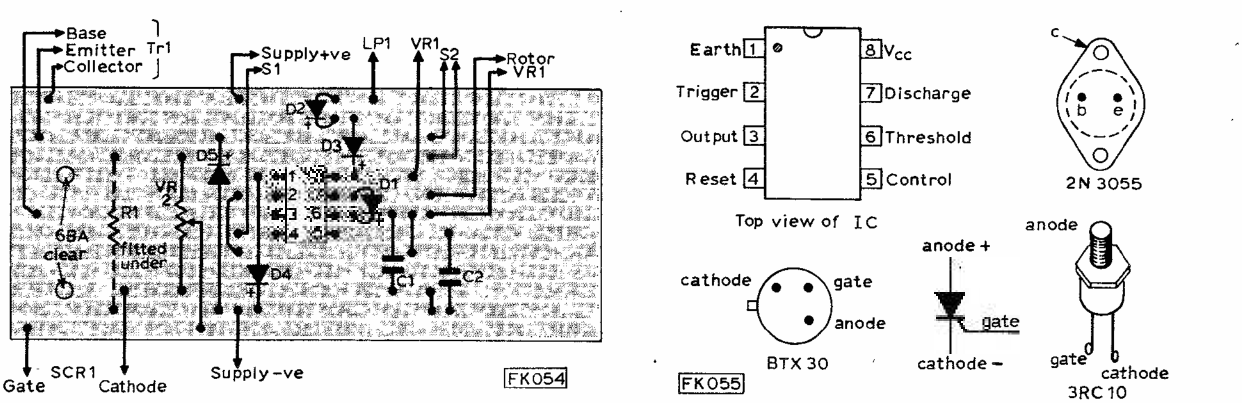


Fig. 6: Component layout on Veroboard, showing track breaks and external connections. Tr1 (2N3055) and SCR1 (3RC10) shown to the right must be fitted using insulating washers. Connections to the collector of Tr1 and anode of SCR1 are via solder tags.

continued on page 34.

Dear Sir,

letters

Oily waves

I feel I must write and protest at the tone of your editorial of March 1975 *Practical Wireless.*

I fail to see why you appear so "anti" about exchanges between North Sea oil rigs and their bases. Apart from 1625 kHz which is used by Ekofisk to work into Stavanger, all other off-shore installations work directly into British or Continental coast radio stations in the Maritime Service. The stations heard in the 80 metre band are exchanging traffic on ISB with Humber Radio or Wick Radio, or on SSB with Cullercoats or Stonehaven radio and thence by land line to shore based subscribers.

All these communications are taking place at the rate of 36p per minute and represent revenue to the Ministry of Post and Telegraphs. I fail to understand why any off-shore station should be expected to continually identify itself when the call is being monitored and charged by a coast station Radio Operator?

Life off-shore can be arduous and dangerous and the many oil rig and barge workers who may phone their wives during the evening should be entitled to a little privacy during the QSO. . . . . they're paying enough for it!—**Stan Crabtree** G3OXC (Radio Operator, FORTIES ALPHA).

PW PSU mod

Having constructed a bench power supply unit to the same basic design as that described in PW, September 1973 by J. Lewis, B.Sc., I feel the following observation may be of use to your readers.

The author comments in the final paragraph: "a residual ripple . . . could be eliminated by adding a 100μF capacitor. . ." I found that even a 1000μF made little difference when used with a particular piece of equipment which was sensitive to hum on the supply rails; I therefore added, to the circuit of Fig. 9 in the article, a 10μF 64V electrolytic, between pins 3 and 4 of the NE550A (negative to pin 4) thereby providing AC negative feedback and substantially reducing the hum (100Hz ripple).

I consider that a larger value would produce a greater improvement, but my unit is now sufficiently ripple free for my requirements.—**P. J. Brent** (Scotland).

Natural scale

I'm surprised at Mike Hughes! In his article on the PW Easybuild Electronic Organ, he states that "organ purists will wince" at the use of the equal temperament scale. This scale has been in use on keyboard instruments since the time of Bach. In fact it is in use in all musical instruments which are "pre-tuned" such as the clarinet, trumpet, oboe etc.

The idea behind the equal temperament scale is quite simple. The relationship between a note and the one an octave above, is that the higher note has twice the frequency of the lower. A violinist, in order to achieve this will in fact halve the length of his string. The frequency ratio for notes a fifth apart is 2:3. For notes a third apart it is 4:5 and so on.

In the equal tempered scale, as Mike Hughes says, there is an exact mathematical ratio between each half tone in the scale. This ratio is 1:0594, and since there are twelve half tones to the scale, $1{:}0594^{12}=2$. This makes the frequency ratio of the third 1:1·259 and not 1:1·25 as on the natural scale. Similarly the fourth ratio is 1:1·34 and not 1:1·33. The fifth becomes 1:1·498 instead of 1:1·5.

These differences are not enough to be noticed in ordinary circumstances, but violinists, and singers etc, when playing on their own, will play in the natural scale; and when with the piano or organ etc. will play equal tempered.

Incidentally, Bach was the first to write specifically for the equal tempered system in his "Well Tempered Clavier." — **P. G. Quartermain** (Sussex).

Cramped bands

Your editorial 'Thou shalt not listen' draws timely attention to a problem which is becoming increasingly frustrating to the DX listener. For about one year now, I have been very interested in long range reception on UHF TV and VHF radio.

I find that the ordinary VHF set offers good scope for DX work, except that the 88-108MHz band is cluttered with taxi and police signals. So much of the band is given over to these, that the broadcast band is "bunched" to such an extent that many stations use the same frequency, and others are so close to each other that the nearer ones eclipse the more distant.

Even with a six-element array, I cannot now receive Radio Humberside because it is obliterated by Radio Piccadilly; RTE Kippure is wedged between Radio Merseyside and Radio Manchester and can only be heard by using screening. Radio Sheffield, on its lower frequency, is jammed by taxi calls, and on its higher frequency is jammed by the police.

Recently I picked up an interesting signal in Dutch. After waiting a long time for station identification, I was frustrated by a taxi firm which drowned out the station identification when it did come. (I still don't know which station I was listening to!)

All these problems could easily be solved by allocating the whole 88-108MHz band to broadcasting. Surely the police do not enjoy being overheard and would prefer to be on a virtually inaccessible band?

Which raises another question; What is to happen to Bands I and III when the 405 line TV service is phased out in a few years time? My own suggestion is that these channels should be allocated to educational television; schools broadcasts during the day and Open University in the evening.—**John T. Haines** (Lancs).

Ouch!

I thought you might be interested in the specification of a transistor radio seen in a mail order catalogue;

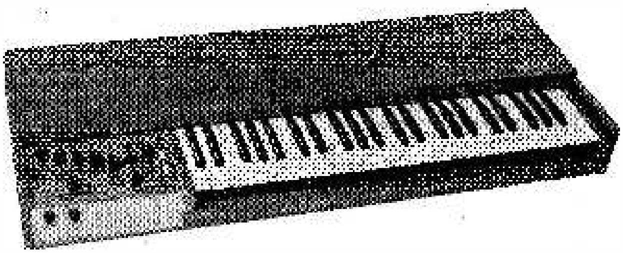
"clear reception on 3 wavebands VHF/MW/LW. Clear 2½in. dynamic speaker giving 300kW output. Complete with earphone." —**R. Rix** (Norfolk).

PW 'Easybuild' ELECTRONIC ORGAN

PART 3

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

This, the third part of the PW Easybuild Organ, carries on from the April issue, and covers in detail the keyboard wiring and the testing of the main PCB.



8FT PITCH

Readjust VR6 for maximum and adjust the pre-set VR5 until the signal level of the square wave output approximately matches that of the spike signal. To complete this rough setting up of the 8ft tones set the triangular wave slider VR8 to maximum. The sound should be more mellow but of similar amplitude to the square wave signal. Now adjust the pre-set control across the 8ft integrator VR7. Adjustment to its full extreme in one direction will have no effect but if its value is reduced to zero ohms the amplitude of the signal will fall abruptly to a very low level. Set it to the point just before the signal level starts to fall off which will prevent nasty keying noises when this tone is used. Now try mixing the different waveforms together to hear the general effect of the three signals in various proportions. Do not expect too much at this stage because we have yet to line up the 16ft. pitch.

16FT PITCH

Exactly the same procedure should be adopted by placing the lead from the 16ft. input pin on to a mid-frequency tone pad. Start with the spike waveform by advancing VR10 and adjust the preset VR9 until the level is approximately similar to the equivalent tone at 8ft pitch. Advance VR12 and use VR11 to set the level for the square wave. Finally, advance VR14 and adjust VR13 in exactly the same way as for the integrator pre-set at 8ft. pitch. Now experiment by connecting the 8ft. and 16ft. inputs to identical notes an octave apart at the same time, and listen to the full effect of the different tone colours produced by the main controls. When they are all advanced to maximum the loudspeaker might overload, in which case use the pre-set VR15 as a master control. Ideally the loudspeaker should be just on the edge of overloading when the volume control is at maximum. More will be said about this when dealing with the phono output.

CALIBRATION

Check that the vibrato control functions correctly and roughly tune the master oscillator so that the organ is set to international pitch. Do this by adjusting C7 while listening to the tone from leadout number 23 (this should be International A at 440Hz), and can be checked against a piano (the A immediately above middle C) or against the BBC's morning radio test transmission.

When tuning, the tune control should be set midway. It may be that C7 has to be almost fully compressed to get the organ in tune. When correctly set up the tune control should shift the frequency by about one full tone, but this will vary slightly from one unit to another, depending on the internal capacitance of D1 and D2.

A wider degree of tune can be produced by reducing the value of R6 to about 4·7kΩ but this is not recommended because the vibrato effect will be too fierce when VR2 is set to its lowest frequency position.

The bulk of the electronics is now finished, the next stage is the assembly of the keyboard contacts and the wiring associated with them. This is a very repetitive operation and calls for a reasonable amount of patience and care.

KEYBOARD

Make sure that the correct components have been obtained. A 49 note C to C keyboard as specified will be required, together with 49 contact blocks. These blocks are very delicate and should be handled carefully to ensure that the fine gold-plated contact wires are not bent. Each block comprises four wires held in position by the phenolic laminates and rivets. Fig. 10 shows such a block and the dotted lines show the disposition of the wires as they run through the centre.

For the purposes of description each wire should be designated with a letter 'a', 'b', 'c', and 'd'. Wires 'a' with 'b' form one contact pair and 'c' with 'd' the other; in every instance the pair a/b will be used to route signals into the 8ft busbar and c/d into the 16ft busbar.

The contacts are actuated when a key is pressed and the action can be checked by careful inspection of the underside of the keyboard. When a note is depressed the key pushes a small plastic actuating link out from under the keyboard. This is designed to push the wires 'a' and 'd' of each contact block into electrical contact with their corresponding 'b' and 'c' wires. One of the jobs that has to be done is to fix each contact block into position so that this simple mechanical action can be effected.

PALLADIUM BUSBARS

The blocks are so designed so that when a key is **not** pressed the signal coming from the tone generator is shorted to earth. To avoid the problems of connecting a separate earth lead to each switch assembly, use is made of an earth busbar. Each block has a small hole positioned near its "nose" and if inspected carefully it will be seen that the wires 'a' and 'd' exactly centre on the hole.

The keyboard suppliers will provide a special rod made from palladium which is designed to run through this hole, and through the equivalent holes of all the other contact blocks. This rod forms the earth busbar and it should be clear that under normal circumstances wires 'a' and 'd' are kept in contact with the rod by their own springiness. When it comes to inserting the rod, make sure that 'a' and 'd' wires are displaced **towards** their 'b' and 'c' counterparts so that the rod passes through the hole without hindrance and is on the correct side of the wires. Four palladium rods should have been obtained, each of which is about the length of one of the keyboard octaves.

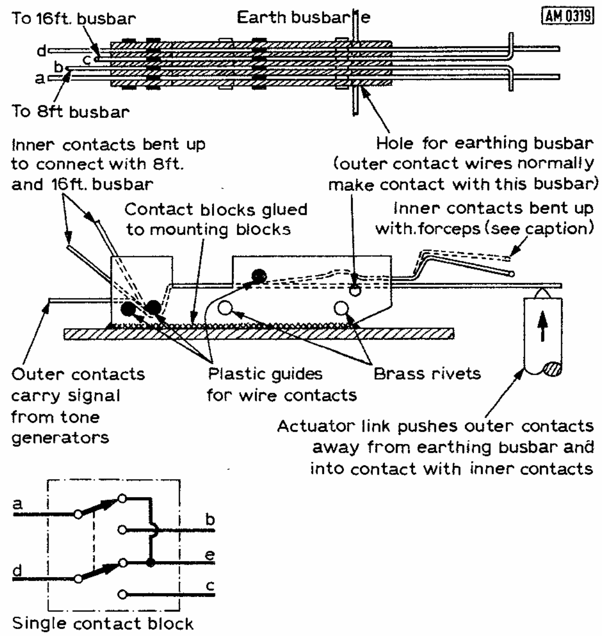
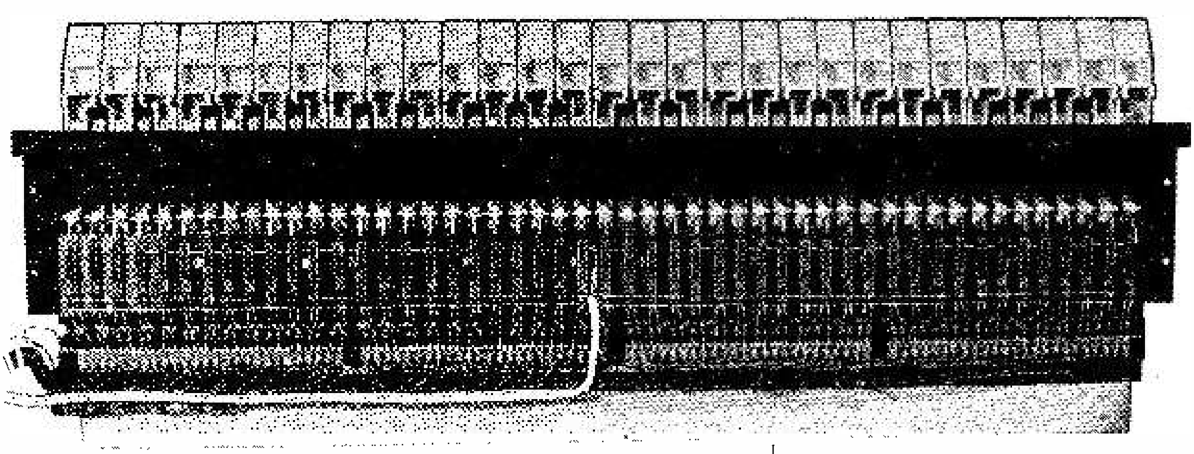


Fig. 10: Details of the keyboard switch assemblies (Kimber Allen) **NOTE.** *It is important, when a key is operated, that the outer contacts of the assembly break from the earth busbar before they make contact with the 8ft or 16ft busbars. These are adjusted by bending the "cranked" contacts away from the outer ones, with a pair of forceps, while operating each note in turn.*

To make assembly easier, four SRBP plates (also obtainable from the keyboard suppliers) should be obtained. The contact blocks are glued on to these before the sub-assembly is screwed to the keyboard sub-frame.

KEYBOARD WIRING

The equivalent of 98 tag posts are required (strips with tags rivetted on 6mm (¼in) centres will do nicely) and these are used to terminate the 60 signal wires coming from the numbered positions on the main printed circuit board. Ideally there should be



Photograph of complete underside of organ keyboard, showing details of switch positioning, wiring and keyboard resistors.

one strip carrying 26 tags and three strips carrying 24 tags each. The tags are also used for routing the signals under the keyboard for the two pitches.

In principle a signal from the tone generator is terminated at one of the tag posts and a 100kΩ resistor feeds from that tag to the 'a' wire of the adjacent contact block. A connection is also made from that same tag post to the tag post for the same note an octave **higher**, but for this higher note key, the tag post corresponding to the 'd' contact wire should be used. A 100kΩ resistor bridges across from this latter tag to the 'd' contact. This looping from one octave to the next is how the signals are routed from the tone generator to give notes one octave apart (on the two pitches) when a single key is pressed.

A glance at the underside wiring diagram Fig. 11 and wiring schedule will show the general principle. The wires coming straight from the tone generator board go (in every case except the bottom octave) to the 8ft pitch contacts and the loop connections to the 16ft contacts of the identical note an octave higher. The bottom octave is slightly different because there is, of course, no lower octave from which to do the looping for the 16ft pitch connections. Instead there are eleven extra wires coming from the main board to look after the 16ft pitches for all this bottom octave **except for bottom 'c'.**

There are not quite enough notes to provide a 16ft pitch for the lowest C on the keyboard so the 8ft and 16ft contacts are simply looped together for this note. This is a slight nuisance but is a sacrifice one has to make for simplicity and low cost.

The wiring in Fig. 11 might look a little frightening but in actual fact it is very simple and only needs care and patience in the routing of the wires.

CONTACT ASSEMBLY

Before any thoughts of wiring however, the contacts must be assembled. To do this, turn the keyboard upside down and place the four SRBP plates exactly butting againt each other on the wide flat portion of the keyboard sub frame; between the trough where the key pivots and the apertures for the actuator links. Slide the plates from side to side until the butt joint between the centre two plates **exactly** corresponds to the centre of the actuator link for the central 'C' of the keyboard. This should position the boards symmetrically about the midpoint of the keyboard.

Having obtained this poition use a pencil to make marks on the boards which correspond to the centre lines of every actuating link of the keyboard. Use a set-square to project these marks across the board at every position and pencil in a centre line, this will mark where the contact block has to be glued into place. Draw another line 9·5mm (3/8in) from the edge of the boards furthest away from the actuators which will act as a guide for positioning the blocks so that they line up with each other. This prevents problems when feeding the earth bus bar through the holes!

Using an epoxy resin glue (preferably the fast-setting variety) put a small smear of glue on the side of each contact block opposite the side having the rectangular notch and position each block

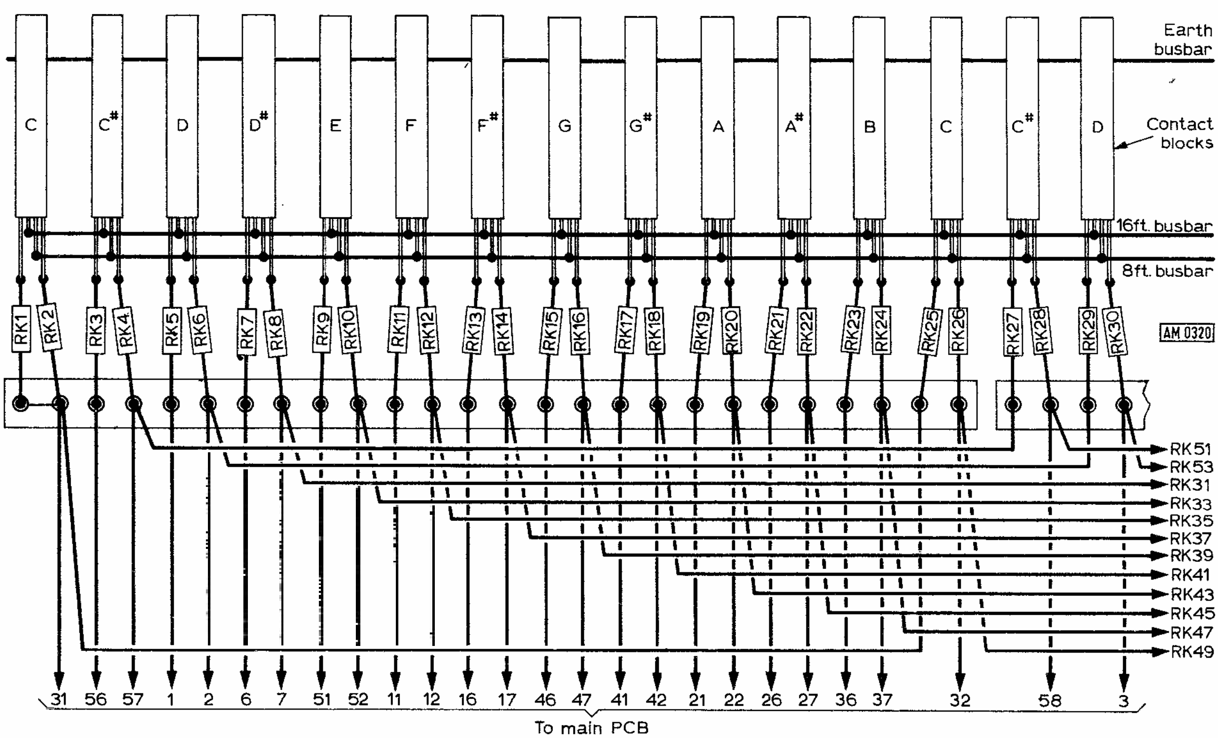


Fig. 11: Details of keyboard switch wiring, showing looping arrangements from one octave to another. This diagram shows only the bottom octave and the first two notes of the second octave, and therefore should be used in conjunction with the wiring schedule opposite.

Keyboard Resistors	PCB connections	Other keyboard connections	Note	Octave
RK1	31	RK25	C 16ft	*
RK2	31	RK25	C 8ft	*
RK3	56	—	C♯ 16ft	
RK4	57	RK27	C♯ 8ft	
RK5	1	—	D 16ft	
RK6	2	RK29	D 8ft	
RK7	6 cut wires to 460 mm (1ft 6in)	—	D♯ 16ft	
RK8	7	RK31	D♯ 8ft	
RK9	51	—	E 16ft	
RK10	52	RK33	E 8ft	
RK11	11	—	F 16ft	
RK12	12	RK35	F 8ft	Bottom
RK13	16	—	F♯ 16ft	octave
RK14	17	RK37	F♯ 8ft	
RK15	46	—	G 16ft	
RK16	47	RK39	G 8ft	
RK17	41	—	G♯ 16ft	
RK18	42	RK41	G♯ 8ft	
RK19	21	—	A 16ft	
RK20	22 cut wires to 610mm (2ft)	RK43	A 8ft	
RK21	26	—	A♯ 16ft	
RK22	27	RK45	A♯ 8ft	
RK23	36	—	B 16ft	
RK24	37	RK47	B 8ft	
RK25	—	—	C 16ft	
RK26	32	RK49	C 8ft	Middle 'C' at 8ft pitch
RK27	—	—	C♯ 16ft	
RK28	58	RK51	C♯ 8ft	
RK29	—	—	D 16ft	
RK30	3	RK53	D 8ft	
RK31	—	—	D♯ 16ft	
RK32	8	RK55	D♯ 8ft	
RK33	—	—	E 16ft	
RK34	53	RK57	E 8ft	
RK35	—	—	F 16ft	
RK36	13	RK59	F 8ft	
RK37	—	—	F♯ 16ft	
RK38	18 cut wires to 760mm (2ft 6in)	RK61	F♯ 8ft	Second
RK39	—	—	G 16ft	octave
RK40	48	RK63	G 8ft	
RK41	—	—	G♯ 16ft	
RK42	43	RK65	G♯ 8ft	
RK43	—	—	A 16ft	
RK44	23	RK67	A 8ft	International 'A' at 8ft pitch
RK45	—	—	A♯ 16ft	
RK46	28	RK69	A♯ 8ft	
RK47	—	—	B 16ft	
RK48	38	RK71	B 8ft	
RK49	—	—	C 16ft	Middle 'C' at 16ft pitch
RK50	33	RK73	C 8ft	

Keyboard Resistors	PCB connections	Other keyboard connections	Note	Octave
RK51	—	—	C♯ 16ft	
RK52	59	RK75	C♯ 8ft	
RK53	—	—	D 16ft	
RK54	4	RK77	D 8ft	
RK55	—	—	D♯ 16ft	
RK56	9	RK79	D♯ 8ft	
RK57	—	—	E 16ft	
RK58	54	RK81	E 8ft	
RK59	—	—	F 16ft	
RK60	14	RK83	F 8ft	
RK61	—	—	F♯ 16ft	
RK62	19	RK85	F♯ 8ft	
RK63	— cut wires to 910mm (3ft)	—	G 16ft	Third
RK64	49	RK87	G 8ft	octave
RK65	—	—	G♯ 16ft	
RK66	44	RK89	G♯ 8ft	
RK67	—	—	A 16ft	International 'A' at 16ft pitch
RK68	24	RK91	A 8ft	
RK69	—	—	A♯ 16ft	
RK70	29	RK93	A♯ 8ft	
RK71	—	—	B 16ft	
RK72	39	RK95	B 8ft	
RK73	—	—	C 16ft	
RK74	34	RK97	C 8ft	
RK75	—	—	C♯ 16ft	
RK76	60	—	C♯ 8ft	
RK77	—	—	D 16ft	
RK78	5	—	D 8ft	
RK79	—	—	D♯ 16ft	
RK80	10	—	D♯ 8ft	
RK81	—	—	E 16ft	
RK82	55	—	E 8ft	
RK83	—	—	F 16ft	
RK84	15	—	F 8ft	
RK85	—	—	F♯ 16ft	
RK86	20 cut wires to 1·22m (4ft)	—	F♯ 8ft	Top
RK87	—	—	G 16ft	octave
RK88	50	—	G 8ft	
RK89	—	—	G♯ 16ft	
RK90	45	—	G♯ 8ft	
RK91	—	—	A 16ft	
RK92	25	—	A 8ft	
RK93	—	—	A♯ 16ft	
RK94	30	—	A♯ 8ft	
RK95	—	—	B 16ft	
RK96	40	—	B 8ft	
RK97	—	—	C 16ft	
RK98	35	—	C 8ft	

Main PCB to keyboard wiring schedule. Refer to Fig. 11 to begin with, in order to start the process going. Once begun, the wires going to the PCB, and the loop wires between tags, will follow in a logical sequence, as the wiring schedule above shows.

** Due to divider limitations, this note is the same on both 8ft and 16ft pitches.*

exactly on the centre lines already drawn. Do not try glueing the block corresponding to the central "C" of the keyboard at this stage because it wll be straddling a joint between two of the boards. NOTE; if fast-setting epoxy is being used do not mix up too much at a time because it will be found that it takes about ten minutes to position the twelve contacts on each board and the glue will be starting to go off as the first board is finished.

Set the contact assemblies to one side for the glue to harden. When they are really firm, drill a hole between the outer pair of contacts on each board to take self-tapping fixing screws. Next, offer the boards up to the keyboard so that the 'a' and 'd' wires of each contact block exactly rest over their corresponding actuating links. Press the boards down against the restraining action of the springiness in the contact wires and mark through the screw holes on to the metalwork of the keyboard frame. Again remove the boards and **very carefully** drill self-tapping holes in the metal where marked; do not allow the drill to break through the metal in an uncontrolled manner as damage may be caused to the underside of the plastic-covered keys.

Before screwing the contacts into place butt the two centre boards together on a flat surface and glue the final contact block **across** the butt joint. For added rigidity it is worth running a thin fillet of resin down each side of this block. Let this set really hard and then carefully screw the two central boards into place under the keyboard.

CONTACT EARTHING

Take two of the palladium rods and by carefully lifting each pair of 'a' and 'd' contacts, pass the rods through the earth busbar holes of the blocks that are in position—work from either end for each rod. Where the rods meet near the centre let them overlap by about 6mm (¼in) and solder them together. If necessary trim off the end of each rod so that they protrude by about 13mm (½in) from the two extreme end contact blocks. Now screw the remaining two contact assemblies into position and insert the final two palladium rods from either end. Again, let them overlap the ends of the rods already in place and solder them together.

Now put bends in the shorter ends of the 'b' and 'c' wires for each contact block. The 'c' wire should be bent upwards until it is almost vertical and the 'b' wire up through about 45°. It will now be possible to get the test probes of a continuity test meter (ohms range on a multimeter) across the contact connections to test each one. This test is very important because clearing up problems at this stage will greatly simplify tests later on.

Although the keyboard must be kept upside down, make absolutely sure that none of the keys are depressed (use books to stand the keyboard off the working surface). Check that there is continuity between every 'a' and 'd' wire and the earth busbar. If any of them show open circuit, gently bend up the end of the contact wire that rests on the actuating link, so that the wire will settle itself further down inside the block assembly to touch the earthing bar.

Next, check that when a key is pressed there is continuity between the corresponding pairs of a/b and c/d contacts. Of course, continuity should be broken when the key is released. Ideally, contact should be made when the key is depressed just over half of its total travel and the wires 'b' and 'c' carefully bent to allow this to happen. To make the organ easier to play each key should make contact at exactly the same degree of depression as its neighbour.

This completes the assembly and initial tests of the contacts. There is one more test to come but this must be reserved until some signals are available.

TAGSTRIP ASSEMBLY

Proceed to solder in the 8ft and 16ft busbars. These are simply lengths of straight tinned copper wire soldered to every contact block's 'b' or 'c' connection. One wire runs from the 'b' wire of the central "C" block and is soldered to every 'b' wire for the higher notes (this is the 8ft busbar for the top two octaves). Similarly another wire is run from the 'c' connection of the same block to all the higher note 'c' connections (16ft busbar for the top two octaves). Likewise two busbars run from the "B" below central "C" for 16ft and 8ft pitches for the bottom two octaves, a study of Fig. 12 should make these connections clear. Make sure that every connection is well made and that there are no dubious or dry joints.

It now remains to assemble the tag strips into position. The lengths of the strips should be such that there is a tag available for every 'a' and 'd'

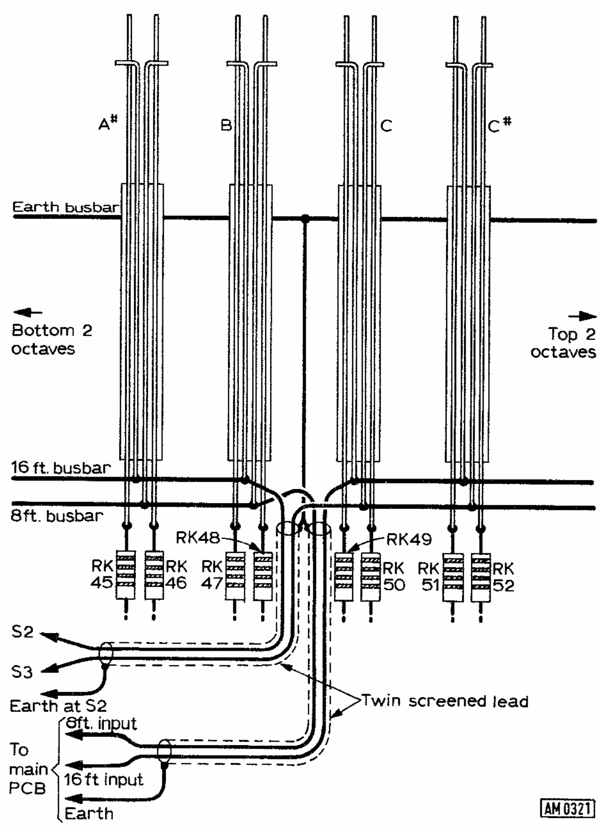


Fig. 12: Diagram showing orientation of contact blocks, busbars and wiring for the split keyboard switches.

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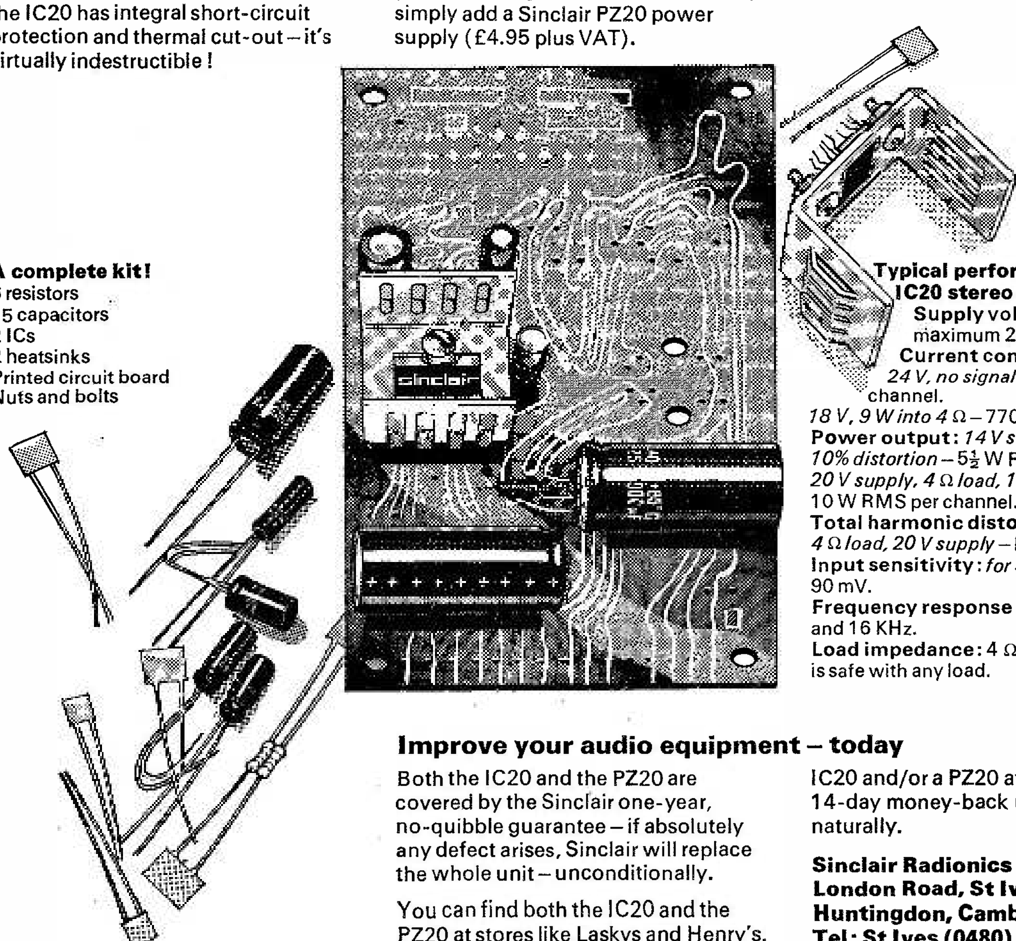

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wire of all the contact blocks and ideally they should be in an exactly corresponding position on the opposite side of the pivot trough of the keyboard. In practice it is unlikely that tag strips having the correct pitch will be available but for the prototype it was found that standard **"miniature"** tag strips having 6mm ($\frac{1}{4}$in) pitch would do, provided they were broken up into approximately octave lengths, the accumulative error in the pitch being taken up with a gap at the octave breaks.

One strip, to correspond to the bottom octave, should carry 26 tags and be centrally located between the "C" and the "C" an octave higher. A length of insulating strip (an old piece of blank Veroboard will do) should be cut and stuck with epoxy resin to the underside of the tag strip and, when set, the whole assembly should be glued into position opposite the contact blocks for the bottom octave. The ledge between the edge of the hinge and the pivot trough is an ideal place to stick the strips. The next three octaves should be dealt with by using strips each carrying 24 tags.

When all the tags are firmly glued into position all 98 keyboard resistors between the tags and their corresponding contact wires can be soldered in. All the resistors are 100kΩ and if an ohmeter is available it's just as well to check each one before it is used. When using a large quantity of the same component there is always a chance that there may be an odd one out.

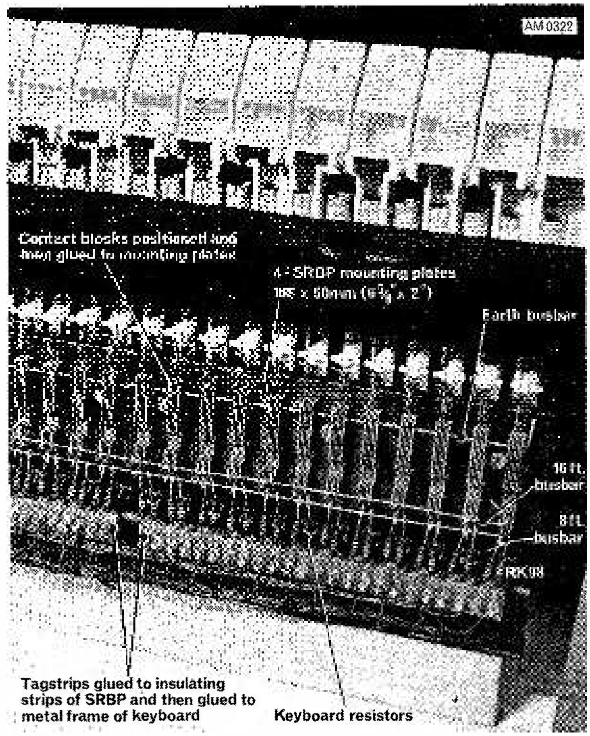

Fig. 13: Annotated photograph of prototype organ, showing close-up view of actual keyboard wiring and switch block assemblies.

LOOP WIRING

Now comes the tedious bit. All the loop wires between the tags an octave apart must be connected up. Be very careful to start-off correctly by **triple checking** the following procedure.

Start by linking the two tags associated with bottom "C" and then run a lead of fine flexible insulated wire from the right hand pin of that pair to the left hand pin of the pair going to "C" an octave higher (i.e. from RK2 to RK25). Next, go from the right hand tag of bottom C♯ to the left tag of C♯ an octave higher (i.e. from RK4 to RK27). As long as the procedure is started off correctly there is little chance of error because the procedure is repetitive. There are no links to be made from top C♯ to higher frequency notes or any other notes in the topmost octave apart from C itself.

When making these loops cut the wires to exactly the right length and strip off exactly the right amount of insulation each time, then it will be found that the wires tuck down together very neatly. At the same time try to connect to the tags as far down them as possible (near to the insulating board) because there is still another wire to connect to most of the tags and space will be required to solder. Once the loops are in place the wires can be tied together to make the loom more robust, using waxed twine or alternatively black crochet thread.

PCB WIRING

The main wiring loom that runs from the printed circuit board to the keyboard has now to be constructed. Put the keyboard to one side and clear a nice amount of room to carry out the following wiring very methodically. First cut twelve 1·22m (4ft) lengths of fine connecting wire. Strip off 6mm ($\frac{1}{4}$in) of insulation from one end of each piece. Pick up the lengths one at a time and with the first piece insert it through the hole numbered 35 on the PCB (insert it from the top side of the board) and solder it into place very carefully, taking care not to bridge any of the fine tracks with solder blobs. Cut off any excess wire at the joint.

This wire will, eventually, be connected to the tag going to the topmost "C" of the keyboard (at RK98); refer to the wiring schedule where it can be seen that the wire going into this point is numbered "35" to correspond with the printed board designations. Using sellotape and a small piece of paper make a flag carrying the number 35 and fix it to the free end of this wire. Take the next piece of wire and solder it to output 40 of the PCB and do likewise. Continue in this way, refering to the wiring schedule for details of which outlet the wire should go to and make sure that **every wire** has a correctly numbered flag on it.

Next, cut off twelve 910mm (3ft) lengths of wire and continue with the same procedure for the next octave down. When these are complete, cut a dozen wires each of 760mm ($2\frac{1}{2}$ft) in length, then 610mm (2ft) and finally 460mm ($1\frac{1}{2}$ft) for the bottom twelve notes. By the time the last dozen connections to the board are reached it will be found that the wires might tend to twist together. Try to avoid this happening. A good way is to let the wires dangle over the edge of the table and make sure that they all run parallel from the board.

When this has been done, double check the wiring and ensure that there are no short circuits across the lead-outs on the board (use the ohmeter as described in Part 2). As a check on the wiring, take each of the free ends of the wires in turn, bare them, one at a time, and check continuity between that wire and the numbered contact on the board that corresponds to the flag on the wire. Any dubious connections **must** be rectified.

Do not, at this stage, attempt to connect the free ends of the wires to the keyboard. Tie the groups of wires together into bundles of 12, corresponding to their different lengths, and then carefully put the board to one side and start building the cabinet. Final wiring is done when all the component parts are properly positioned within the final enclosure.

NOTES

On some main PCB layouts supplied by PW, it may appear that pins 1 and 2, reading clockwise, of IC5 are shorted together. This is incorrect, so on the PCB itself, very carefully run a sharp knife between the track of pin 1 and pad of pin 2 to clear.

The author has pointed out that the decoupling effect of R12 is excessive and can cause a supply line drop to the divider circuitry. This gives rise to apparent instability of the dividers at some settings of the Vibrato and Tune controls. It is therefore suggested that R12 be reduced to 10Ω or short circuited completely to overcome this problem.

In the components list published March 1975 values of VR7 and C5 were incorrectly stated. They should have read:—

VR7	*220kΩ miniature vert. preset.*
C5	*2200pF*

The keyboard resistors designated R31-R128 in the components list, have been redesignated RK1-RK98 to simplify the description of the keyboard wiring.

Watford Electronics, 35 Cardiff Rd, Watford, Herts., have brought it to our attention that they are able to supply the complete semiconductor complement including the divider IC's AY-1-5051.

SCS Components of Northfield Industrial Estate, Beresford Avenue, Wembley, Middlesex, HA0 1YY, have informed us that as they are distributors for many semiconductor manufacturers, they too are in a position to supply the IC's for the Easybuild Organ. Telephone number for SCS components is 01-903 3168.

Just a quick reminder now for those readers interested in constructing their own PCB. PW is offering a full-size paper drawing of the 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,** *and enclosing a PO or cheque for 25p and a 10 x 8in size S.A.E.*

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MODEL TRAIN CONTROLLER—*continued from page 24.*

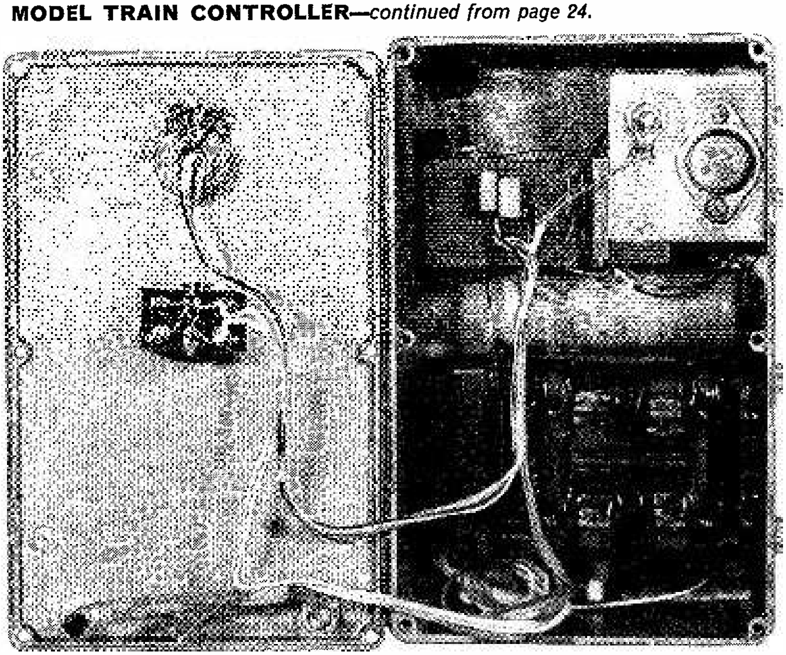
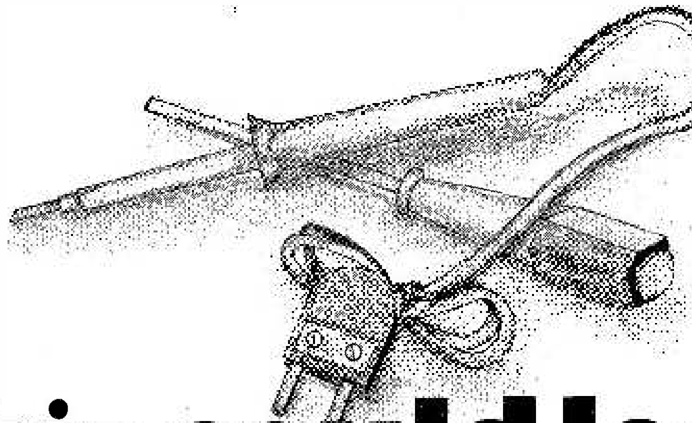


Fig. 7: Interior view of control box showing position of transformer, veroboard, output transistor, and, in the lid, the warning lights, reversing switch and control potentiometer.

LAYOUT

Component layout of the prototype is shown in Fig. 6, while Fig. 7 shows the diecast box, although any form of metal enclosure could be used. For children's use it was decided that the knob on VR1 should be as large as possible so that little fingers could grasp it easily. After some use the reversing switch was replaced by a similar switch only this one had a centre off position making train driving much easier. With a little practice one can accelerate smoothly away from rest with quite large loads or even inch forwards and backwards with no difficulty.



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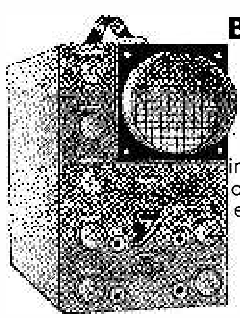

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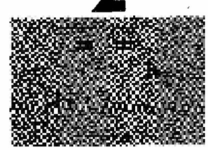

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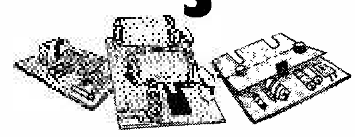

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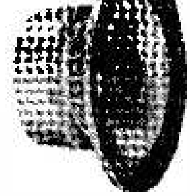

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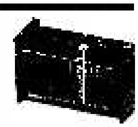

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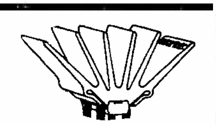

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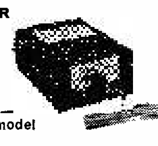

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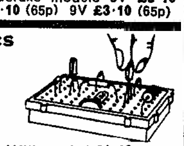

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HAVE you ever driven a car in heavy mist or spotty rain (typical British weather!), and found that instead of providing a clear view the wipers merely smear the windscreen, making visibility even worse than ever? The reason for this is, that the average car's windscreen wipers may function well in heavy rain, but when it is only raining lightly not enough rain lands on the windscreen between one sweep of the wipers and the following one to lubricate the wiper blades as they travel across the screen.

The Car Wiper Delay Unit described here solves this problem and provides clear visibility in all types of rain. The wipers are allowed to sweep across the screen at their normal speed, but a delay is introduced in between wiper sweeps, where the delay can be adjusted to suit the prevailing weather.

The circuit is suitabl o all vehicles, whether positively or negatively earthed, equipped with electrically driven self-parking wipers (i.e. virtually all vehicles, but apologies to owners of 100E's with vacuum driven wipers!)

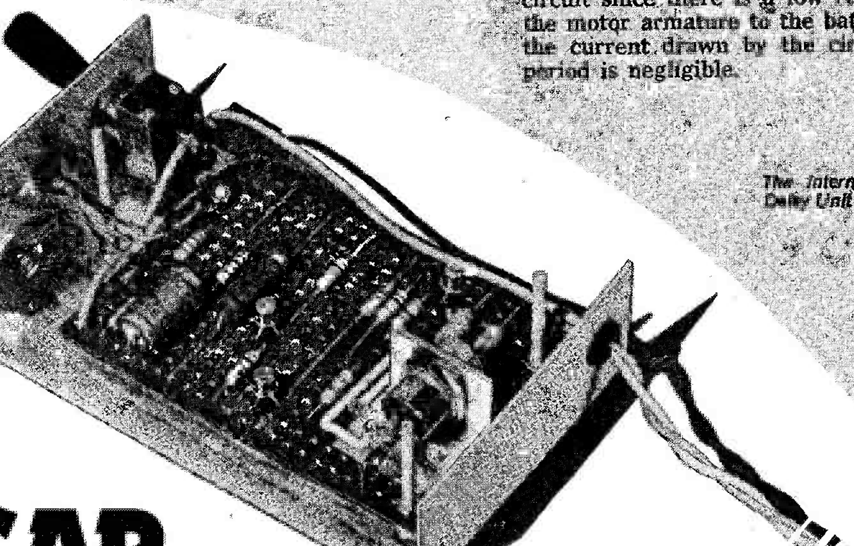
CIRCUIT DESCRIPTION

The circuit is connected across the existing wiper switch as shown in Fig. 1, which shows the arrangement for a vehicle having a negative earth.

The wiper motor is normally connected via the ignition switch to the live terminal of the car battery, so that when the wiper switch is closed the other motor lead is earthed and the wipers are brought into operation.

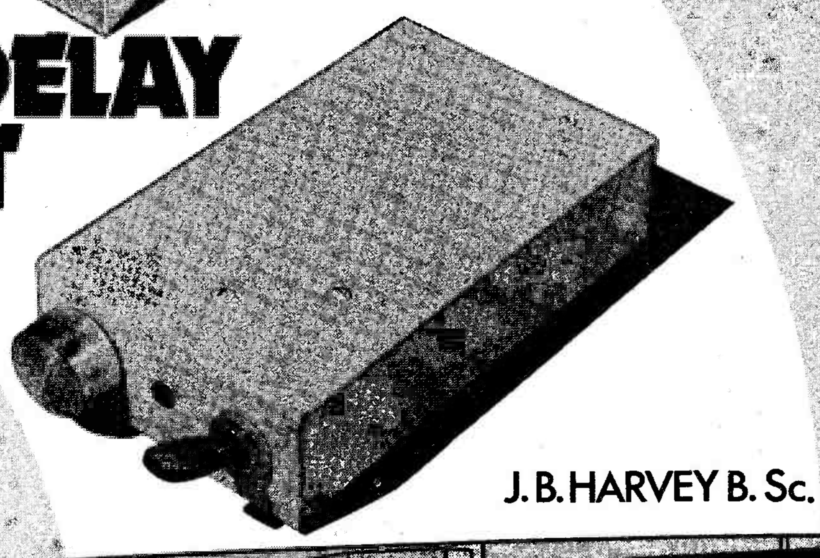
A rotary switch is connected to the wiper mechanism which ensures that when the wipers are switched off the motor continues to run until the wiper blades are arked. This self-parking mechanism operates in conjunction with the Wiper Delay Unit and enables a cheap thyristor to be used in place of the relay which is usually found in simple timing circuits.

When S1 is closed, 12 volts appears across the circuit since there is a low resistance path through the motor armature to the battery live terminal and the current drawn by the circuit during the delay period is negligible.



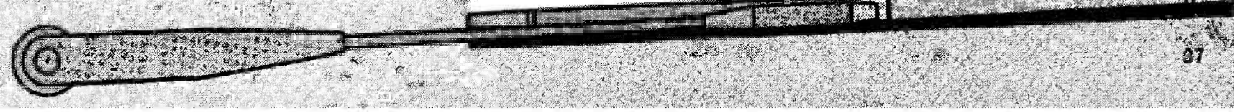
The internal view of the Car Wiper Delay Unit is shown left

CAR WIPER DELAY UNIT



The completed unit with the cover fitted is shown right

J. B. HARVEY B. Sc.



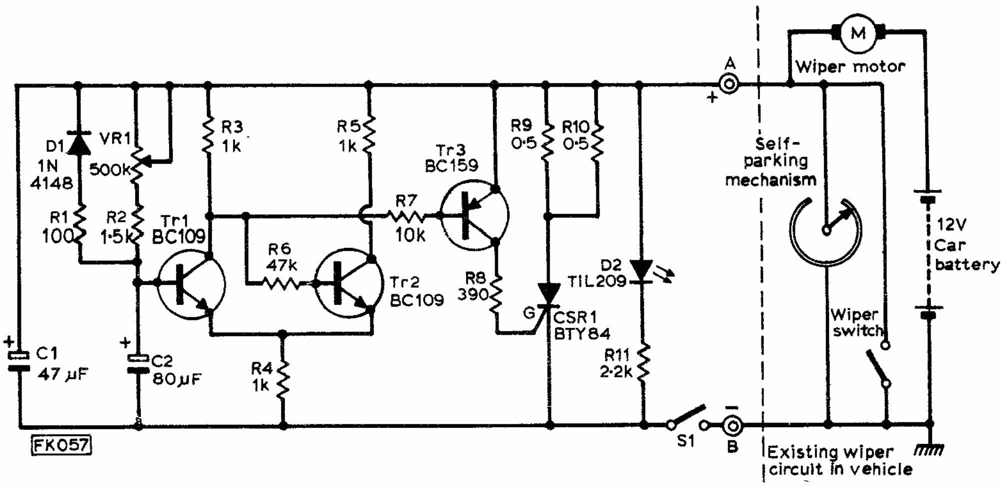


Fig. 1: The circuit diagram of the Car Wiper Delay Unit. The circuit to the right of the dotted line is typical for a car with negative earth and the wiper switch in the earth lead

The voltage across C2 is initially zero but rises exponentially due to the charging current through VR1 and R2. This voltage is monitored by the level detecting circuit consisting of Tr1 and Tr2.

SCHMITT TRIGGER

This part of the circuit is known as a "Schmitt trigger" and operates as follows. Initially Tr1 is cut off, since the voltage on C2 is low. Tr1 collector is high and is coupled via R6 to Tr2 base, so that Tr2 is turned hard on.

Since R4 and R5 are equal, the voltage at the junction of the two emitters is half the supply voltage i.e. 6 volts. Now when the voltage on the base of Tr1 approaches $(6+V_{be})$ volts, i.e. 6·6 volts, Tr1 begins to conduct. Its collector voltage falls and Tr2 is turned off, causing Tr1 to conduct even harder until it is saturated.

The negative going voltage at the collector of Tr1 is applied via R7 to the base of Tr3, which amplifies the current available to drive the gate of the thyristor CSR1; thus the thyristor conducts and the wiper motor operates. R9 is included to protect the thyristor against current surge when the motor first conducts.

THYRISTOR OPERATION

When a thyristor is made to conduct it will continue to do so even if the gate current is removed until the anode current falls below a threshold known as the "holding current". Consequently if the Delay Unit were being used to drive, say, a lamp then the lamp would remain on until the current were interrupted by opening S1, and similarly if the wipers were not of the self-parking variety then they would continue to function. However, at this point the self-parking mechanism comes to the rescue.

A fraction of a second after the thyristor conducts the self-parking switch makes contact, shorting out points A and B. The switch thus diverts the motor current from the thyristor and removes the gate current, turning off the thyristor but allowing the wipers to complete one sweep of the windscreen. In addition C2 discharges through D1 and R1 in readiness for the next delay period. (R1 limits the discharge current to a safe value for D1.)

At the end of the sweep the self-parking mechanism switches off the wiper motor, 12 volts is restored across the circuit and the cycle of events is repeated.

Capacitor C1 is included to protect the circuit against possible voltage spikes from the car's ignition circuits, although no trouble has been experienced in the prototypes.

DELAY PERIOD

The delay period is determined by the time taken for the voltage on C2 to reach 6·6 volts, and is approximately equal to $0{\cdot}7\times CR$ (C in farads, R in ohms). Thus with the components specified the maximum delay is 28 seconds.

A delay of several minutes may be obtained by increasing C2; e.g. 500 µF gives three minutes. However, such a long delay is rarely required and adjustment in the most useful range of approximately one to ten seconds becomes very critical. VR1 should not be increased in value to obtain a greater delay since there may then be insufficient base current to turn on Tr1.

★ components list

Resistors

R1	100Ω	R7	10kΩ
R2	1·5kΩ	R8	390Ω
R3	1kΩ	R9	0·5Ω 3W
R4	1kΩ	R10	0·5Ω 3W
R5	1kΩ	R11	2·2kΩ
R6	47kΩ		

All resistors 5% ¼W except where stated
VR1 500kΩ linear

Capacitors

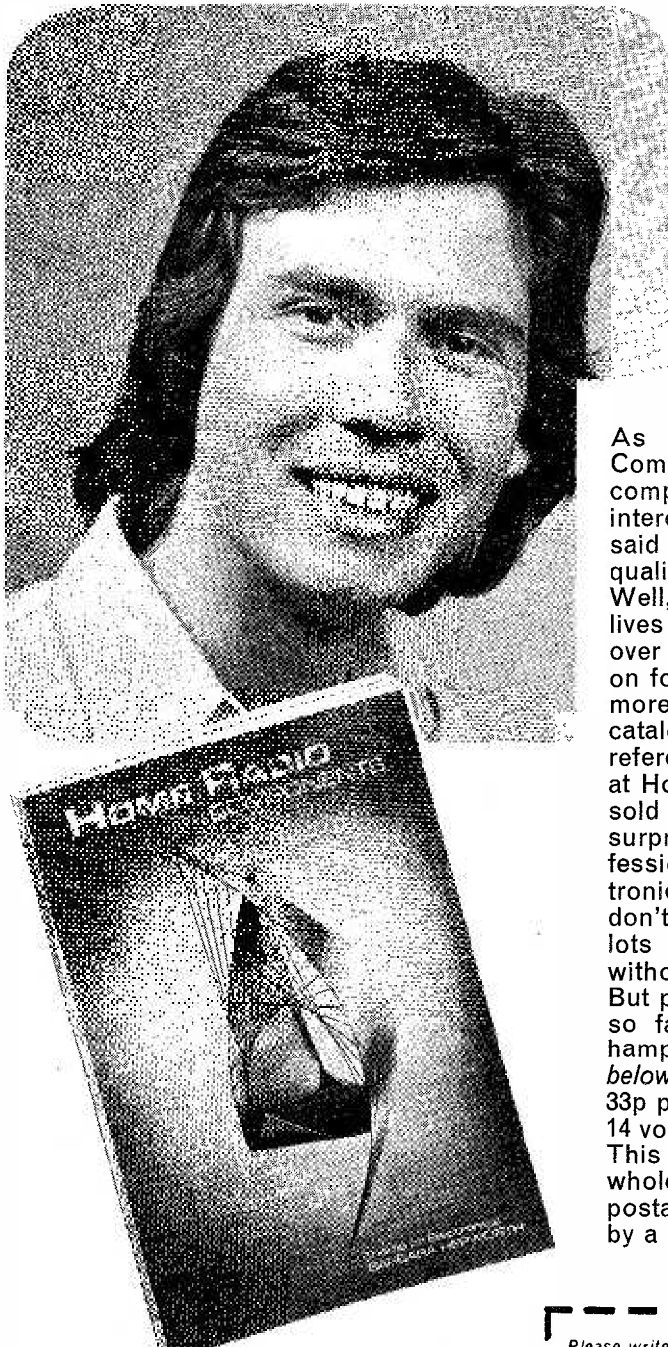
C1 47µF 25V elect.
C2 80µF 25V elect.

Semiconductors

Tr1 BC109 (or BC149)
Tr2 BC109 (or BC149)
Tr3 BC187 (or BC159)
D1 1N4148
D2 TIL209 light emitting diode
CSR1 BTY84 100V 12A (Henry's Radio)

Miscellaneous

Veroboard 63 x 95mm (2½ x 3¾in), 0·15in matrix.
S1 Single pole on/off switch
Knob. Materials for case and heatsink.



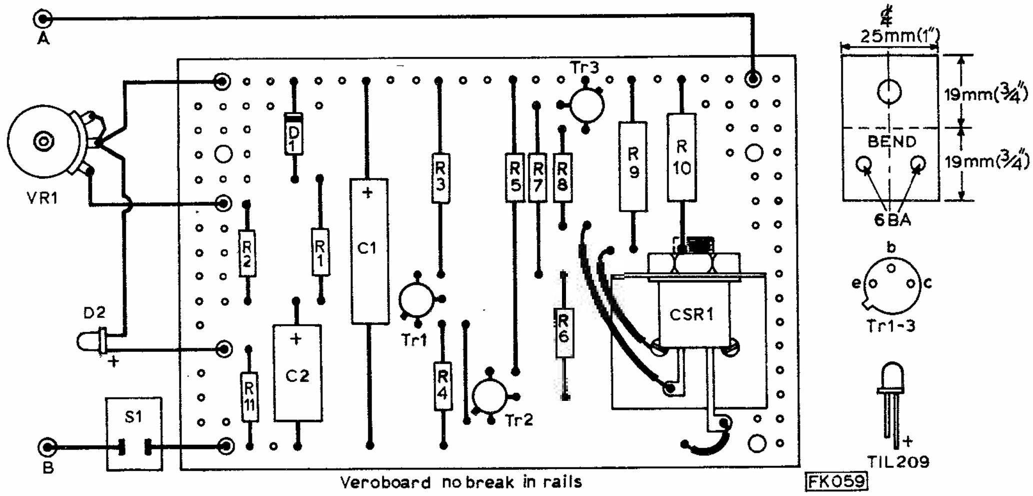


Fig. 2: Layout of the components on the Veroboard panel and interwiring details. The copper strips run horizontally. The connection to the thyristor anode is made via a solder tag on the heatsink

An indicator is optional, but useful to show when the Wiper Delay Unit is in operation: a small red light-emitting diode D2 was used in the prototype. LEDs have now become comparable in price to a bulb plus bulb-holder and are widely advertised; the one used in the prototype came complete with a little plastic clip for panel mounting.

A bulb could, of course, be used instead, but note that since the indicator will turn off during the course of each wiper sweep, the bulb or LED should be run at a reduced current to avoid distraction at night: hence the high value for R11.

CONSTRUCTION

The circuit may conveniently be constructed on a $3\frac{3}{4} \times 2\frac{1}{2}$in piece of 0·15in pitch Veroboard. If the layout in Fig. 2 is used then no track breaks will be necessary to accommodate the circuit, although care must be taken to ensure that any nuts and bolts used do not make contact with the tracks.

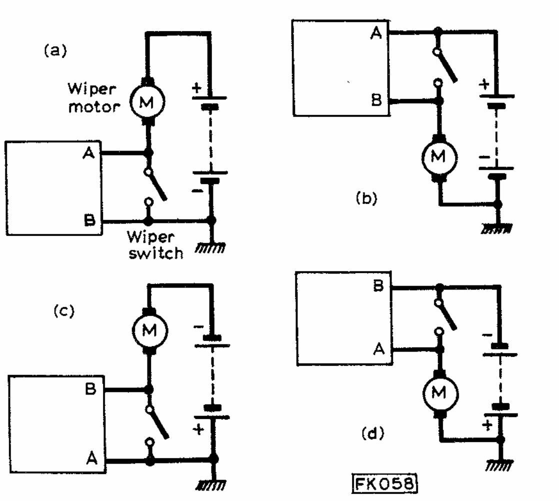


Fig.3: Connections for the four types of wiper arrangements Negative encountered. (a) Negative earth, wiper switch in earth lead (b) normally earth, wiper switch in live lead (c) Positive earth, wiper switch in earth lead (d) Positive earth, wiper switch in live lead.

The thyristor is mounted on the board using a small bracket. Note that although the wiper motor typically draws 5A the thyristor and R9, R10 run quite cold, because they only conduct for a fraction of a second during each wiper sweep, the self-parking switch taking over for the rest of the sweep.

The thyristor specified is rated at 12A which is over twice the current drawn in this circuit. However it is readily available for less than 50p which is considerably cheaper than any thyristor in the 5A range, with the added bonus of substantial overload protection.

INSTALLATION

The method used to install the completed circuit will depend on the vehicle for which it is intended. The prototype was mounted in a simple box formed from two pieces of aluminium sheet and sprayed with aerosol paint to match the car: if this is done then it is a good idea to rough up the aluminium surface with fine glasspaper to improve paint adhesion. Alternatively the controls may be mounted directly onto the dashboard and connected to the circuit board by flying leads.

The circuit should be constructed so as to be entirely isolated from the car chassis, the earth connection being provided by a single lead from point A or B, depending on the polarity of the car's electrical system.

In view of the current drawn fairly thick wire should be used to connect up the Wiper Delay Unit to the vehicle. The circuit is identical for systems of either polarity, only the connections being different (see Fig. 3). Thus it is not necessary to construct another circuit if you exchange your elderly positively earthed car for a newer model with a negative earth. Neither is it necessary to have one side of the circuit at chassis potential: so long as the circuit is fully isolated from the chassis it may be used with a vehicle whose wiper switch is connected to the live side of the wiper motor, provided of course that the wipers are self-parking.

The circuit will work without modification in vehicles using 6 volt or 24 volt electrical systems, the delay time being almost independent of supply voltage.

HOTLINES ON RECENT DEVELOPMENTS

WATCH OUT

A few Ginsbergs' back I mentioned that it might be prudent to wait for a while if you were intending to purchase a digital watch. I advised this on inside information that a big digital watch price war was imminent in the US. Seems I was right. At a recent trade show, some watches were offered at $75 (that's about £30 if you reckon $2·5 to the £1). Bowmar has already introduced a two button watch with an led readout which gave the date in addition to the more usual hours and minutes. Note:—Bowmar is currently filing for bancruptcy in the US and rumours of a $20 million loss are circulating and and have already been reported in print in the States.

Keep an eye out for Timex who are already well-known for low-priced time pieces. They already have a liquid crystal watch with a less than $90 price tag. I still say hang on—they should go a lot lower yet (more inside information; besides, remember calculators!).

ERE EAR!

How many times have you come across the sentence "Have you heard . . .", or "Did you hear about . . . etc etc. Sad to say many human beings haven't heard—they're deaf. Way down in the inner ear are minute hair cells each of which "tunes" to different frequencies. Its a simple case of no hairs no hearing, or maybe the hairs are damaged or useless. Then, someone remembered that all the ear does, hair cells and all, is to feed minute electrical signals to the auditory nerve and hearing is established. Somewhere along the line it was reasoned that if only those minute signals could be correctly fed to the auditory nerve, the brain would never know what was sending them. Provided they were right, the brain would believe that it was receiving them from its old friend the ear.

Enter electronics. A system was devised for sending the necessary impulses to the auditory nerve. The results were successful yet disappointing. The upper frequency limit appeared to be around 300Hz and that certainly wouldn't fool the brain. It wouldn't even permit the interpretation of speech.

Then, some scientists at Stanford University took an interest, and they've come up with—yes, you've guessed it, an electronic earhole; and it looks like being a winner. What was needed, they claimed, was not a single electrode, but four electrodes. The new circuit, a mixture of thick film and CMOS, promises to offer to the brain, frequencies up to 4kHz. Now this isn't good enough for listening to hi fi, but it does cover all the speech frequencies and if you've previously lived in a completeley silent world that 4kHz upper limit is really something.

The tiny circuit is implanted but no electrodes are inserted through the skin. Instead, the inputs to the implant are sent over a minute radio link. The link also supplies the few milliwatts of power needed by the circuitry on the implant itself. The information as to which electrode receives which impulses, their amplitude, duration etc. is sent in using an ultrasonic link.

Externally, the "patient" carries a package which houses the microphone, ultrasonic link, the coding circuitry etc. By the end of this year the scientists hope to have the first "patient" hearing. It would, of course, be so easy to finish this story with a funny line, but I think a sincere round of applause would be much better.

ELECTRONIC FRANKENSTEIN

Still talking matters medical, I'm very interested to hear about Bell Labs and its involvement with lead poisoning. The Labs have come up with a very quick and easy way to check for lead poisoning and the instrument only takes one minute to perform the necessary tests. It requires only a tiny drop of blood, too. Once inside the machine, the blood sample is illuminated by a beam of blue light and the light emission is carefully measured. If excessive amounts of lead are present the blood will give off a red light which is of a specific frequency. The redness, or rather its intensity, is shown on a digital meter. Strangely, the red light comes from a substance which the blood's haemoglobin makes, when lead is present, called zinc protoporphyrin. The instrument is so sensitive that it can detect down to five trillionths of a gram of zinc protoporphyrin in the single drop of blood required for the sample.

A very interesting aspect of this story is just why Bell Labs is bothering with human blood? Just what has blood got to do with electronics?

According to Bell, the scientists are extremely interested in understanding the electronic properties of large molecules. This interest extends to those molecules which control complicated metabolic and neurological processes in biological systems. Pity Baron Frankenstein isn't still alive unless . . .!

TIMER I.C.

It looks like another IC has arrived just to confuse the electronics-orientated amateur photographer, especially if he intends making up an electronic timer. Perhaps one of the most popular is the Signetics 555 chip. Now, Ferranti has launched its ZN1034E. The IC is a mixture of digital and linear technology all on the same chip. The company claims that only three external components are required and that accurate time periods provide ranges from milli-seconds to weeks.

The chip contains an oscillator whose frequency is determined by an external capacitor and resistor. Output from the oscillator is fed to a divide-by-12 digital divider which can provide timing intervals up to 7,500 times the original time constant of the external capacitor and resistor. At 5V the chip consumes a modest 5mA and has a regulator built in. Temperature stability is claimed to be less than 0·01%/°C. The price of a one-off is £2·99p from one of the company's many distributors—NOT from Ferranti direct.

Ginsberg

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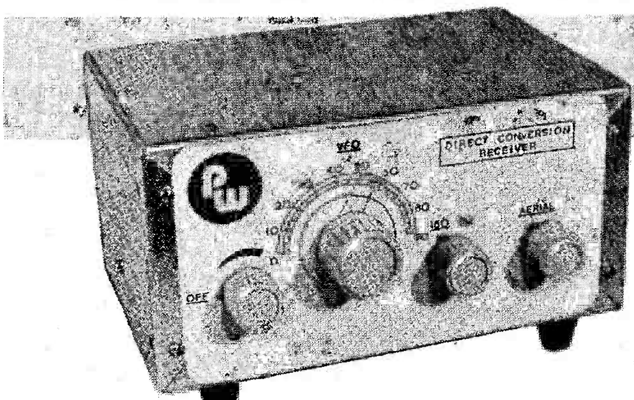
Also

DIRECT CONVERSION RECEIVER



Although direct conversion receivers have been around for a long time published designs have been few. Ours covers the 160 and 80m amateur bands but the range can be extended quite easily.

and Repairing Hi-Fi Amplifiers

As the author points out, there is a right way and a wrong way to service solid state audio amplifiers, and the wrong way can prove expensive! We indicate the right way.

DON'T MISS THIS ISSUE!~ON SALE IN MAY

PW APOLLO series Part 1

TRIPLE VARICAP MEDIUM WAVE TUNER/RECEIVER

W. POEL *

THE variable capacity effect in silicon junction diodes has been known and exploited for some years. So far the use of varicap diodes has been restricted to UHF and VHF applications owing to the low capacitances of the available diodes. Now, for the first time, Motorola have developed an integrated circuit consisting of three varicap diodes whose capacitance values make them suitable for use at MW and SW frequencies.

This article describes a tuner which can be built using the new device. Various methods will be suggested for obtaining the tuning voltage so that the complete receiver can be used in a number of different ways including a domestic tuner amplifier, a portable receiver and a car radio.

VARICAP DIODE THEORY

The semiconductor diode is made up from two types of semiconductor material: one known as p-type which has a deficiency of free electrons (or an excess of "holes") and the other known as n-type which has an excess of free electrons.

When the two types are brought into contact an energy exchange takes place as the materials try to establish an electrical equilibrium. Some of the electrons move across the junction to fill the holes. This action produces an area devoid of free electrons or holes which is known as the depletion layer. With each side of the barrier at an opposite charge to the other, each side can be viewed as the plate of a capacitor with the depletion layer forming the dielectric (see Fig. 1.1).

If a reverse bias is placed across the diode, charges will be drawn away from junction increasing the width of the depletion layer. In other words the plates of the capacitor will be moved apart, thus decreasing the capacitance. The diode may therefore be viewed as a voltage variable capacitor.

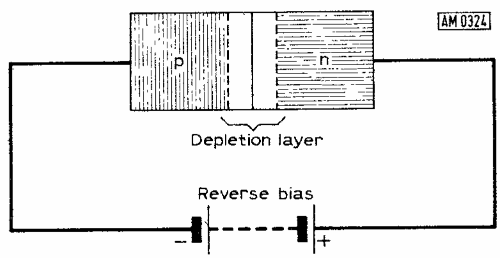


Fig. 1.1: As the reverse bias across a diode increases the width of the depletion layer increases and hence the junction capacitance decreases.

All diodes exhibit this effect, the actual capacitance depending on the doping of the semiconductor material during manufacture and the area of the junction. A "varicap" diode is simply one where the degree of doping and geometry of the diode have been controlled to give predictable and repeatable capacitance variations as the bias is varied.

* *Ambit International.*

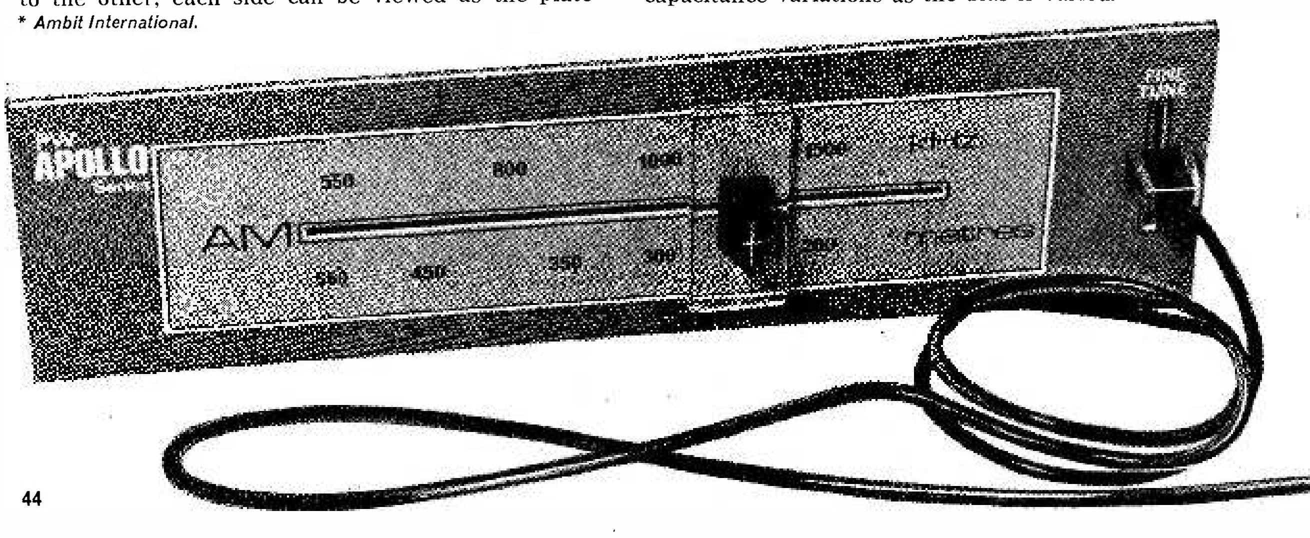


Fig. 1.2 shows how the MVAM1 would be applied to a typical superhet tuner. Each diode will exhibit approximately the same capacitance swing, and since the oscillator will be running at the signal frequency plus the intermediate frequency according to conventional superhet practise, it will be necessary to reduce the effective capacity swing in the oscillator section so that it will track at $f_{sig}+f_{if}$.

This is simply achieved by inserting a padder capacitor in series with the tuning diode, the exact value being determined by the value of the inductors employed in the various tuned circuits.

Some tracking error will be inevitable, but this can easily be kept to a tolerable level by careful design of coils.

To set the ends of the ranges for the diodes, a preset resistor is included at each end of the tuning slider.

The slider potentiometer is simply used to tap off a voltage which is applied to the diodes. It is not advisable to employ too low a bias voltage since the Q and cross modulation factors may be adversely affected.

VARICAP DIODES FOR MW

The main limitation in the application of varicap diodes to lower frequencies (3 to 30MHz) has been the high cost of devices that are capable of giving a wide capacitance range. The well-known VHF diode, the BB104 has a maximum capacitance ratio of only 2·8 as the reverse bias is varied from 3 to 30V, the total capacity swing being about 55pF. This is completely inadequate for MW operation where swings of about 260pF are required.

Another crucial factor in producing varicap diodes for MW operation is the matching of the diodes to provide accurate tracking of the various stages (aerial, RF, and oscillator). The wide capacity swing means that very close tolerance has to be observed throughout the manufacturing process, causing prices to be high.

Because of the very large potential market for low cost, high capacitance varicap diodes several manufacturers have been trying to develop a suitable production process. Recently Motorola have produced two integrated circuits: the MVAM1 consisting of three matched diodes; and the MVAM2 which contains two.

The MVAM1 consists of three diodes with swings of greater than 400pF per diode and a capacitance ratio of 26 as the bias voltage is changed from 1 to 25V. They are matched to within ±1·5% over the entire range. Price is under £3.

The availability of these diodes means that the designer is no longer constrained by the mechanics of cord drives, scale gearing, etc.

To complete the innovation of electronic tuning, a new style of long throw slider potentiometer has been produced to simplify tuning and scale arrangements. A cursor can be attached to the wiper of the potentiometer to give a direct reading of stations without the need for complicated mechanisms.

VARICAP TUNER OPTIONS

Items such as preset station selectors, be they push-button or touch sensitive switches, can be employed in exactly the same way as they might be used at VHF.

Remote tuning is no problem: the tuning voltage can be fed down a long cable to a remote receiver with no adverse effect since it is strictly DC. Thus the receiver may be placed in a convenient spot where it is shielded from interference whilst the controls are close at hand.

Some of the other applications for the triple varicap diodes are in sweep generators and spectrum analysers, in self-tuning AM/FM receivers with band scanning and station hold facilities, and in transmitter low power stages, specifically in the oscillator where synthesis techniques are used.

MW TUNER

In order for the enthusiast to experiment with the new device a simple IC receiver will be described in detail. This requires a power supply of 9 to 12V plus a separate tuning bias for the varicap of up to 25V. Various power supplies will be described, the particular one that is chosen being up to the user.

The circuit of the tuner board is shown in Fig. 1.3. The IC used is available under various type numbers depending on manufacturer, NE546, LM1820, μA720, or CA3123E, and provides all the active components for a superhet receiver.

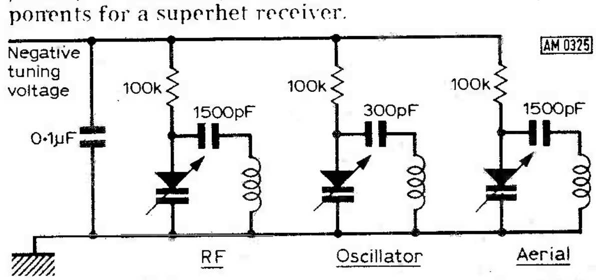


Fig. 1.2: The MVAM1 may be used with a conventional superhet circuit to control the tuned frequencies of the aerial, RF and oscillator stages.

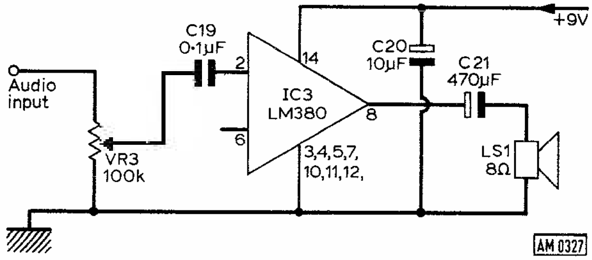


Fig. 1.4: A simple audio amplifier which can be used with the tuner.

A tuned RF stage is used which enhances selectivity and helps reception in the evening when local stations suffer from interference on adjacent frequencies from continental stations.

After the RF stage there is a conventional mixer stage followed by a ceramic filter which enhances IF selectivity. The IF amplifier then feeds into a detector transformer with a conventional silicon diode to detect the AM envelope. The audio output can then be fed into an external power amplifier or a simple amplifier can be incorporated into the design, a suggested circuit being shown in Fig. 1.4.

It is not recommended that substitutes for the specified coils be used.

CONSTRUCTION

When using ICs that operate in a linear mode at RF frequencies, it is virtually essential to use a printed circuit board if instability and associated problems are to be avoided. A suitable layout is shown in Figs. 1.5 and 1.6. On no account should Veroboard be used. Use a soldering iron of not more than 25W and avoid prolonged heating of IC pins.

The prototype which can be seen in the photographs was built as a battery-operated radio with the option of either pushbutton or remote slider tuning control. The pushbutton unit consists of six independently variable preset potentiometers one of which is selected when a pushbutton is pressed. The common wiper output is taken to the tuning voltage input on the board via a changeover switch S2 used to select the remote slider potentiometer.

An internal 2W amplifier is incorporated within the case using the LM380 IC and its associated components (See Figs. 1.7 and 1.8). The speaker is mounted in the lid of the case.

An output socket is fitted at the back of the case to allow the connection of the remote slider tuner. The two outer connections to the slider can be commoned with the outer connections to the pushbutton unit but the wiper of the slider must be selected by the changeover switch. Twin-core screened cable was used to connect the slider potentiometers and the main unit.

A metal case was used since the radio was to be used with an external aerial via the coaxial socket on the back of the case. Should the constructor wish to use a ferrite rod aerial, the box must, of course, be plastic. Details of a suitable ferrite rod aerial, which is simply connected in place of the aerial coil T1, are given in Fig. 1.9.

The volume control and the on/off switch are the only controls mounted on the front panel.

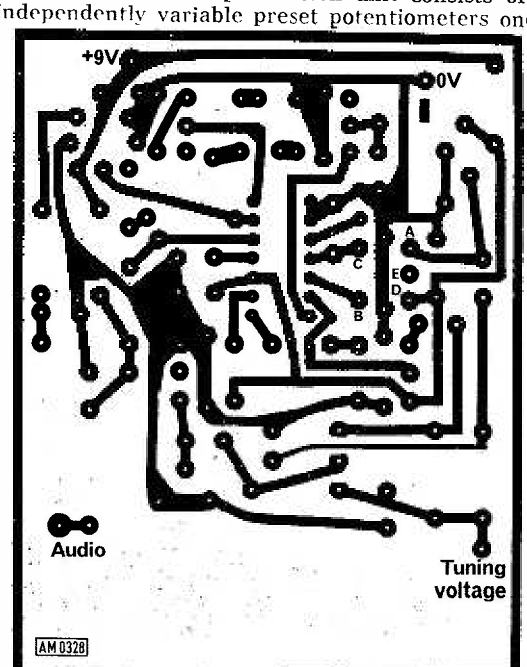
A complete interwiring diagram for the receiver is shown in Fig. 1.10.

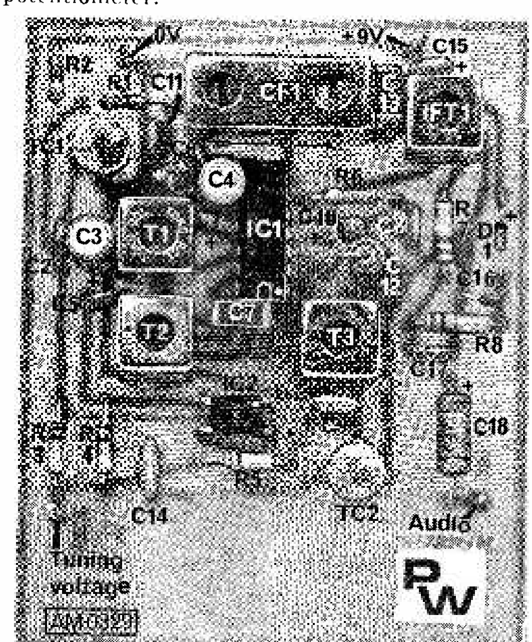
Should the constructor wish to use an external amplifier the output can be taken directly from the tuner board take-off point.

Ordinary rotary potentiometers can, of course, be used in place of the slider pots, but tuning is more difficult.

TUNING VOLTAGE

In the circuit shown, a negative voltage is required for the diodes, so with the standard procedure of negative earth, this poses a few problems. Since the varicap diodes are reversed biased, the only current that flows is that through the tuning potentiometer.





Figs. 1.5 and 1.6: Full size printed circuit board layout for the tuner with component locations. The external aerial lead is connected on the reverse side of the board directly to T1 (E) to avoid stray pick-up.

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So next time you want to buy a VHF tunerhead, a complete FM tunerset, or just one IC- wouldn't you like some tecknowledgey to help you make certain that you are as well up in modern electronic technology as a component/information service that is as well informed as *AMBIT* ?

The ELECTRIC WIRELESS

The new Motorola varicap developments, the MVAM 1 & 2, represent the biggest advance in AM radio design since the introduction of the semiconductor. AMBIT has both types available, plus the sort of coil and filter backup that can only be available through the world's largest manufacturer of consumer radio inductors and filters. TOKO of course.
APOLLO PROJECT: the semiconductors: MVAM1, CA3123E, IN4148 package price £4.00
the coils and filter: YHCS11100AC2, 6A6371, Y18576AQ, CFU050D package price £1.40
the PCB: 75p the complete kit for the radio module: £8.00
the unique long slider: £3.00 the push button unit o/a
When you buy from AMBIT, we will keep you informed of all the latest developments in this new varicap technology.

and the rest:

Larsholt 7252 FM tunerset, a unique 'antenna to audio' system with a spec that includes 1uV for 26dB S/N muting, AFC, AGC, scan tune and lots more. Built and tested for £20.

TOKO EF5603 tunerhead. The very best from the range, with four signal frequency tuned circuits and MOS input stage. Built and tested for £8.40
TOKO EC3302. A low cost, but high performance varicap tunerhead with AFC compatible with any quad. det. IC IF system. Built and tested for £5
Larsholt 8319, the 'head' section of the 7252 tunerset; with AFC, AGC varicap control, dual MOSFET. Top quality Danish make for £7.74.
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Accessories for varicap FM radios: Illuminated edgewise panel meters scaled 88-104 (frequency) and with 0-10 (sig.Strength). £2.35ea £4.50pr.

A brief selection from the main information folder:

We haven't got space here to go into detail, so use our new short form list service, for a full list for the price of a stamp. Coils for everything from audio to VHF, and plenty of stock from our 'by return' service.
Also linears, and other top technology electronic parts. Magnifier time:
CA3089E including det.coil £1.94.
CA3090AQ inc coil (2mH) £3.75.
8038CC Siggeh chip and VCO £3.10.
MC1310P PLL decoder only £2.20.
7800 voltage regs - see lists for gen.
TOKO 455kHz mech filters £1.45.
Ceramic filters for 455kHz 50p, and for 10.7MHz 40p each.
Linear phase filters BBR3125N for true 'no distortion' 10.7MHz IF amps £1.35 each, or £2.50 per pair.
Also 560 series PLL, LM380/381, TBA810, TBA651, CA3123E, 1496, CT7001 clock chip, plus some IC accessories and hardware to make the service complete.

Terms: CWO please. All prices EXCLUDE VAT. P&P 15p per order. Min.Invoice £5.00. Min CWO £1.00
Catalogue (complete with stacks of data) 40p. OR send us an SAE for short form list and summary (FOC)
All enquiries to be accompanied by an SAE please. Please avoid burdening our phone service with requests that can be easily dealt with via post. All our goods are brand new and manufacturers first quality types. We sell no 'seconds' at all.

FROM.....ambit

AMBIT international 37 High Street, Brentwood, Essex. CM14 4RH tel:0277 216029 tlx: 995194

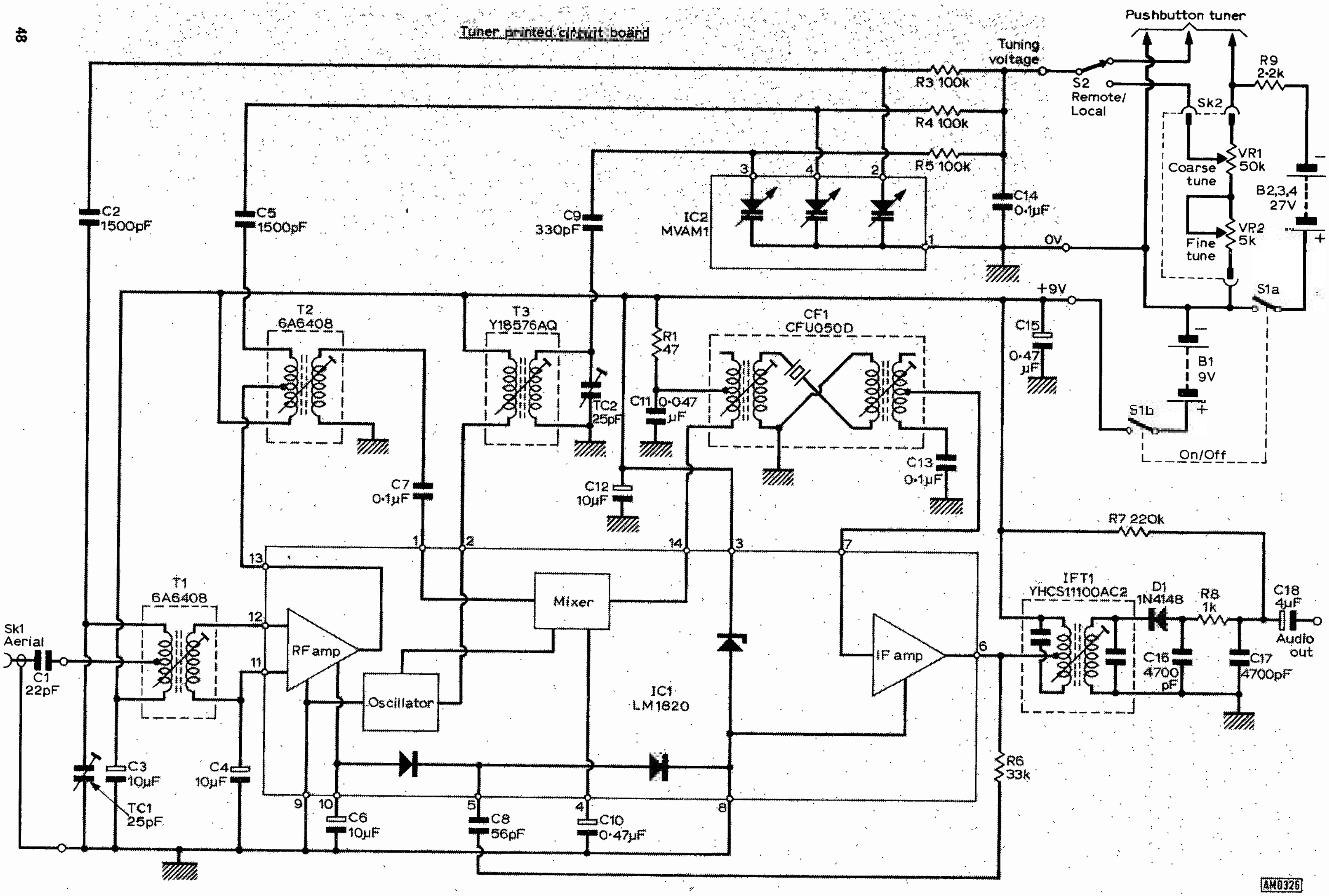


Fig. 1.3: Complete circuit diagram of the tuner section of the Apollo. Note that a 20kΩ preset or fixed resistor is required at the end of the remote tuner potentiometers, to control the tuning range. T1 may be replaced with a ferrite rod aerial (see text).

★ components list

TUNER

Resistors

R1	47Ω	R5	100kΩ
R2	330Ω	R6	33kΩ
R3	100kΩ	R7	200kΩ
R4	100kΩ	R8	1kΩ
All ±5% ¼W		R9	2·2kΩ

VR1 50kΩ 150mm linear slider Rivlin type WS 150 (Ambit)
VR2 5kΩ linear slider

Capacitors

C1	22pF	C10	0·47μF 35V tantalum
C2	1500pF	C11	0·047μF
C3	10μF 25V	C12	10μF 16V
C4	10μF 25V	C13	0·1μF
C5	1500pF	C14	0·1μF
C6	10μF 16V	C15	0·47μF 35V tantalum
C7	0·1μF	C16	4700pF
C8	56pF	C17	4700pF
C9	330pF	C18	4μF 40V

TC1 5—25pF miniature trimmer
TC2 5—25pF miniature trimmer

Semiconductors

D1 1N4148 or similar small signal diode
IC1 LM1820N (or CA3123E, μA720 or NE 546)
IC2 MVAM1 (Ambit)

Inductors

T1 Toko 6A6408 (or ferrite rod, see text)
T2 Toko 6A6408
T3 Toko Y18576AQ
IFT1 Toko YHCS11100AC2
CF1 Toko CFU050D
} (Ambit)

Miscellaneous

Sk1 Coaxial socket
Sk2 5-pin 180° DIN socket
S1 DPDT toggle switch
S2 Single pole changeover switch
B1 9V PP7
B2-B4 9V PP3 (3 off)
Printed circuit board
Six-way pushbutton varicap TV tuner unit, Imperial Metal Industries type 9932. Knob, twin-core screened cable, case.

AUDIO AMPLIFIER

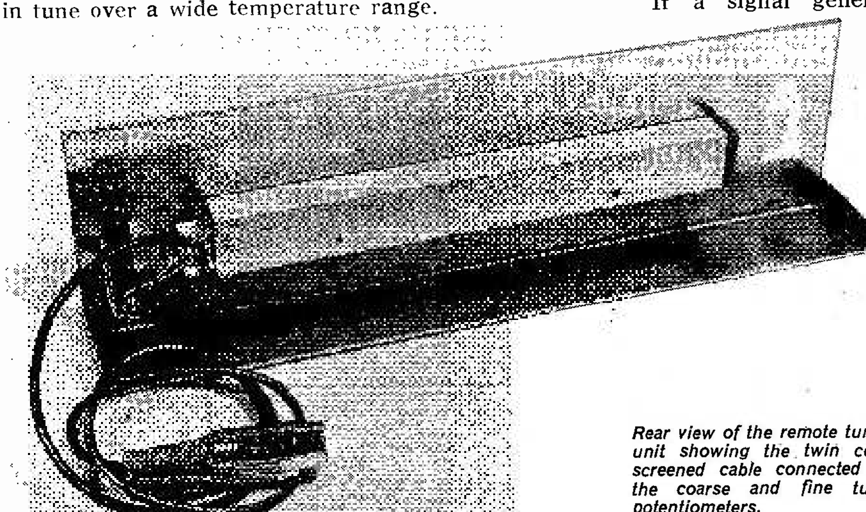
VR3 100kΩ linear carbon
C19 0·1μF
C20 10μF 16V
C21 470μF 16V
IC3 LM380
LS1 8Ω 3in speaker
Printed circuit board

If a 50kΩ potentiometer were used then with a 27V supply the current would be 500μA. This makes it quite feasible to use three PP3 batteries for the tuning bias, the use of batteries also alleviating the problems of smoothing and decoupling.

If the whole unit were to be run from the same set of batteries then the fluctuations in volume would cause variations in the supply voltage which would, in turn, affect the tuning voltage.

The most elegant method of supplying the necessary voltages is by using the 78 series of three-terminal voltage regulators. These are ICs which take the unregulated supply and turn it out at a predetermined voltage. In the circuit given, (Fig. 1.11) the main module supply is regulated by the 78L12, which is a 100mA low cost three pin 12V regulator, and tuning voltage by the 7924.

The overall stability is excellent, the set staying in tune over a wide temperature range.



Rear view of the remote tuner unit showing the twin core screened cable connected to the coarse and fine tune potentiometers.

SETTING UP

With all the components in place, check for solder bridges, dry joints, etc. Connect the audio amplifier, and then, having tested the voltages beforehand, connect the tuning supply and the main supply.

Set the tuning potentiometer to midway and adjust T1 (or slide the ferrite rod into the aerial coil) until some noise is heard from the AF section. (Holding on to the coil on the ferrite rod will assist in this procedure, as the effect of hand capacity will enhance the sensitivity.)

Although the IF coils are very nearly aligned, it may be necessary to adjust the tuning poteniometer until a strong local station is heard, then peak the detector coil by a slight turn of the core. Then trim the ceramic filter input and output transformers—this will need only a fraction of a turn.

If a signal generator covering IF frequency (470kHz) is available then loosely couple the output to the circuit and peak for maximum.

To align the RF and aerial stages tune to the low frequency end of the medium wave and either find a station or, using the generator, slide the coil along the ferrite rod (or trim T1) for maximum output. A means of metering this is to monitor the voltage between the detector diode and earth, using a high impedance voltmeter. Note that the voltage goes increasingly negative with increasing signal.

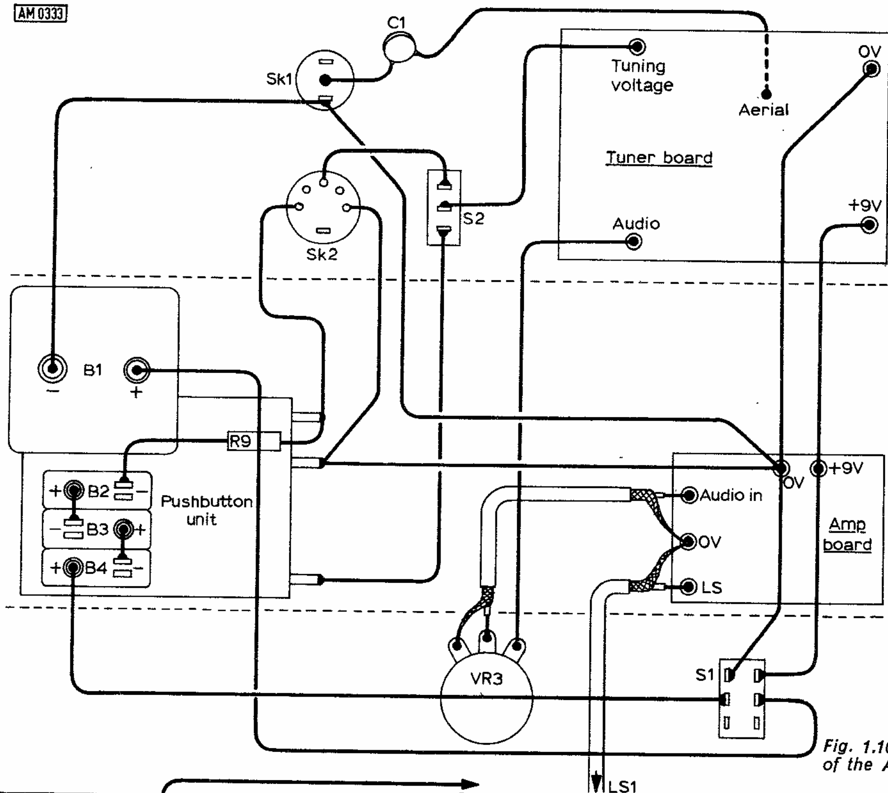
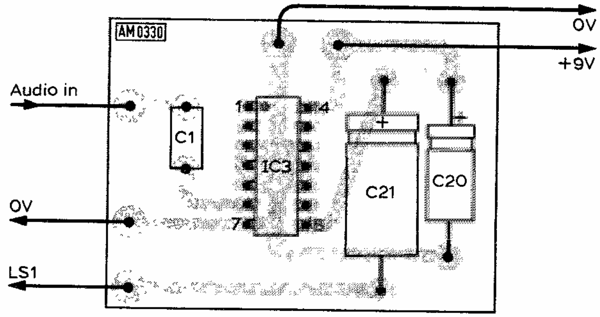


Fig. 1.10: Interwiring diagram of the Apollo receiver with an external aerial.



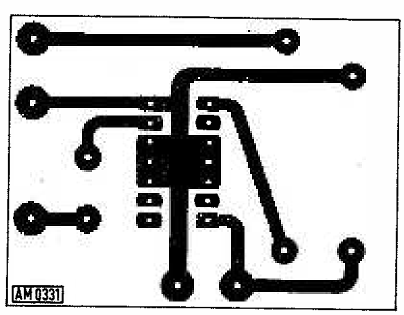


Fig. 1.7: Full size printed circuit board layout for the amplifier and Fig. 1.8 component location.

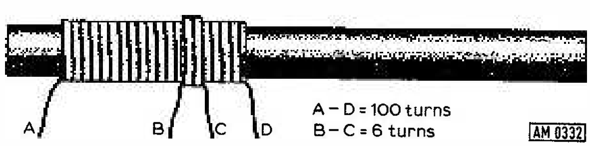


Fig. 1.9: Ferrite rod aerial winding details. The four leads are connected to the corresponding points on the tuner board and the external aerial connection (E) is not used.

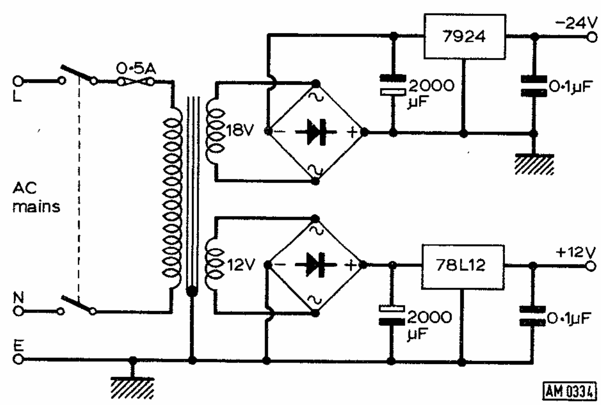


Fig. 1.11: A mains operated supply which will power the tuner and amplifier boards and give the required negative tuning voltage.

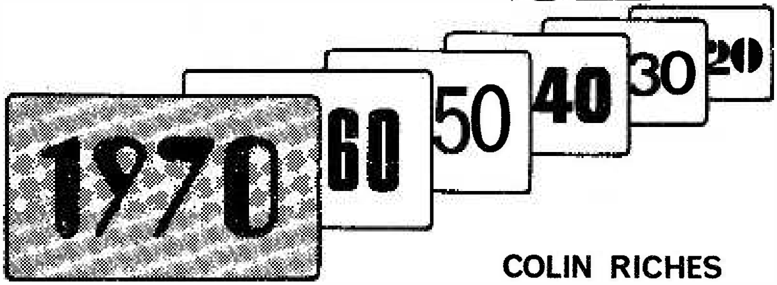
Trim the core in the RF stage transformer and then reset to the high frequency end of the MW band. Having established a signal, trim the capacitor in the aerial circuit for maximum. For this tuner the scale should be arranged so that the low end of the frequency range just covers 550kHz, and the high end covers 1500kHz.

Reference to your local papers should reveal the frequencies of local radio stations and these may then be used to provide markers. Alternatively, the signal generator or frequency counter may be used for calibration.

The actual frequency being received will be 470kHz less than the oscillator, in conventional superhet fashion.

NEXT MONTH THE USE OF THE TRIPLE VARICAP IN SWEEP OSCILLATORS WILL BE DISCUSSED

GOING BACK...



COLIN RICHES

Sir Oliver in his laboratory c. 1920.

Sir Oliver Lodge

EXPERIMENTS made by Hertz in the 1880's into the field of electromagnetic radiation through the ether inspired Lodge, who had already obtained repute as an eminent physicist. He amplified and developed the results obtained by Hertz and really pioneered work on coherers.

The detection of wireless signals using the coherer principle was largely due to Oliver Lodge, who in 1889 experimented with two metal spheres which were sited so close to each other that they were separated by a minute film of air.

When current was applied the passage of the spark made the spheres 'cohere'. All it needed to restore the spheres to their original highly resistive condition, was a slight mechanical shock or jolt.

Various pastes, liquids and metal filings were used in later coherers and in 1890 Lodge used an electric bell in circuit to obtain the 'de-coherence' by vibrating the coherer itself.

In 1890 Lodge published his findings from experimenting with syntonic leyden jars and described the principle of tuning. What did not occur to Lodge at this time was the development of 'over the air' signalling as a serious competitor to the telegraph and telephone.

Marconi said years later that at that time there was no known method of creating electrical impulses powerful enough to project them any distance through the ether.

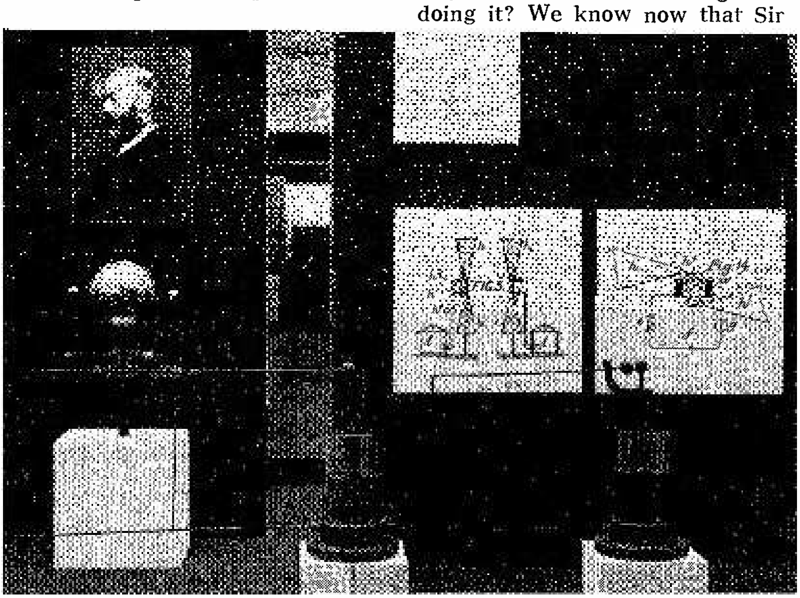
It had seemed to him that if the radiation could be increased and controlled (ie: tuned) it would be possible to signal across space for quite a distance.

Marconi's main problem was, that since the idea was so simple, why had no one else thought of doing it? We know now that Sir Oliver had, in fact, missed the correct answer by a fraction.

1895 saw Lodge working with Dr. Alexander Muirhead and together they developed the Lodge-Muirhead system of wireless telegraphy.

The Lodge-Muirhead coherer which must have been amongst the most sensitive made, consisted of a sharp-edged steel wheel which just touched the surface of a pool of mercury covered with a thin film of oil. The wheel was driven by clockwork. High frequency oscillations were enough to break down the oil film while the continuously rotating wheel ensured that decoherence took place as soon as the signal stopped.

In 1897, Lodge and Muirhead patented several of their ideas and in 1911, the Marconi Company acquired them. In that year, Sir Oliver was made a scientific adviser to the Marconi Co.



This Science Museum photo shows the display devoted to Sir Oliver in their radio gallery.

Points arising . . .

REACTION TIMER

April 1975. In the circuit diagram Fig. 1 page 1098, R3 should be shown as 27kΩ and R4 as 47kΩ. The component list is correct.

PW 'ASCOT' CASSETTE DECK

Part 3 April 1975. Note:—Fig. 5 Part 2 'collector' should read 'emitter'.

PRODUCTION LINES

colin riches

W.K.F. ELECTRONICS

In the March 1975 issue of Practical Wireless, we stated that printed circuit boards could be supplied at the price of 70p irrespective of size, etc.

This needs clarification. The 70p charge only applies to single page size (6in. x 8½in.) p.c.b.'s on SRBP and not fibre glass.

W.K.F. Electronics are prepared to quote separately for sizes larger than our single page size, i.e. Practical Wireless Electronic Organ main board £5·50 in fibre glass, with power supply board. All boards are fully drilled and roller tinned.

Prices do not include postage and packing charges. As postal charges have once again been increased (and this applies to all mail order products) please add extra for postage—allowing approximately 10p per p.c.b. *W.K.F. Electronics, Welbeck Street, Whitwell, Worksop, Notts.*

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 + 5p postage.

"EUROPA B"

The Solid State Modules "Europa B" is a 10 metre to 2 metre s.s.b. transverter. It is an updated version of the very successful "Europa". It is a linear transmit and receive converter for use with either a separate transmitter and receiver or transceivers. Any transmission mode fed into the unit is re-transmitted on 2m. When used with Musen, Sommerkamp or Yaesu gear the "Europa B" takes its power supply direct from the accessory socket on the h.f. equipment. When used in conjunction with other gear, the required voltages may be taken from the h.f. equipment or S.S.M.'s matching p.s.u.

The "Europa B" has a slightly different front panel, round knobs and an internal aerial change-over relay. An SO 239 aerial socket is fitted.

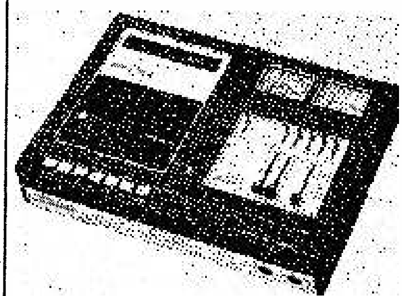
The specification of the "Europa B" includes some of the following features: dual-gate MOSFETS in the receive converter, bipolar transistor oscillator chain; valves in transmit converter; low receive noise figure; ten times more accuracy on frequency because of the much closer tolerance crystal used in the oscillator section; 200W p.e.p. input; transmit drive requirement 100mW and receive converter gain —30dB.

Price, with valves is £88. Without valves £74. Valves required are: 2 off QQV03/10 and 1 off QQV06/40A.

Further details may be obtained from *Solid State Modules, 63 Woodhead Road, Solid, Lockwood, Huddersfield HD4 6ER.*

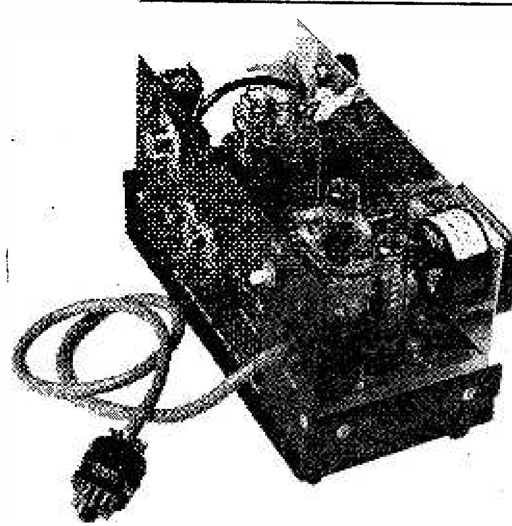
TELEFUNKEN CASSETTE DECK

The Telefunken MC3300 HiFi is a stereo cassette deck to DIN 45500 standard. It embodies the Dolby system for noise suppression, has an Electro CrO_2 tape selector, HNS audio head, i.e. maximum band modulability and automatic stereo recording level control with manual override. Speech/music changeover switch is coupled with Radio/microphone input selector. Features



include: 2 extra large illuminated peak voltage meters, also operational during playback. 3 slide controls for record left, record right and headphone volume. Headphone socket, speaker switch. Illuminated signals for record, playback, forward and rewind, stop, Dolby and CrO_2. 5 rocker switches for electrical function selection. Electronically governed d.c. motor. 3 digit memory counter (memory can be cut out). Electronic end-of-tape and interference detector with stop feature.

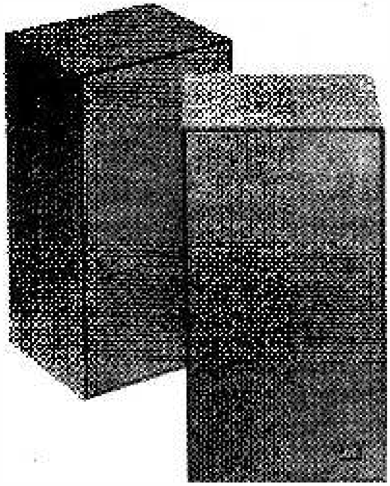
Frequency range with chromium dioxide tape is said to be 30-15000 kHz. Signal to noise ratio with chromium dioxide tape >57dB; Noise Suppression Dolby JC; wow and flutter; before tape $<\pm 0{\cdot}18\%$ and playback $<\pm 0{\cdot}12\%$. Recommended Retail Price is £215·00 *AEG-Telefunken (UK) Ltd., Bath Road, Slough, SL1 4AW.*



JVC SPEAKERS

Model SK8, recently added to JVC's speaker range is designed for systems handling up to 25W r.m.s.

The cabinet houses an 8in. free-edge woofer and a 1in concave dome tweeter. An acoustic suspension principle is used to achieve a frequency response of 35Hz to 20kHz. Crossover frequency is 2·5kHz and fundamental resonance frequency 67Hz. Sound pressure level is quoted as 88dB/W (8Ω) at 1M. The SK8's are $17\frac{1}{2}$in. high, $9\frac{3}{16}$in. wide and $8\frac{1}{16}$in. deep. Recommended retail price is £38·50 each plus VAT. Further information may be obtained from *JVC (UK) Limited, Eldonwall Trading Estate, 6/8 Priestley Way, London, N.W.2.*



"DINO" MULTIMETER

The "Dino" multimeter, like the Dolomiti and Cito multimeters hails from the Chinaglia stable.

This 38-range meter has a basic sensitivity of 200kΩ/V d.c. and 20kΩ/V a.c.

The d.c. current ranges extend from 5μA right up to 5A, the voltage ranges from 100mV to1·5kV, and the resistance ranges allow identification from 0·2Ω up to 1kMΩ. Indeed, in the one package this instrument provides most of the measuring requirements needed for modern semiconductor technology. A.C. ranges extend from 5mA to 5A and 5V to 1·5kV, whilst there are six dB ranges.

The Dino is built to the usual high Chinaglia standards with shock-proof ABS case, Class I, 40μA, 2·5kΩ movement mounted in sprung jewels and using a core-magnet system. Protection diodes guard the movement against overload. A full-view instrument face combined with anti - parallax mirror help avoid ambiguity of reading. Range switching is achieved using a simple five-position rotary switch in conjunction with separate range sockets for each selection.

A second version of the instrument is available with all the normal ranges, test leads and case, and with an additional internal universal signal injector. The USI version provides a modulated r.f. output rich in harmonics right up into the u.h.f. zones, making the instrument a simple dynamic analysis equipment capable of injecting a signal and observing the result.

A further optional extra is a 30kV probe to complete the TV servicing facility.

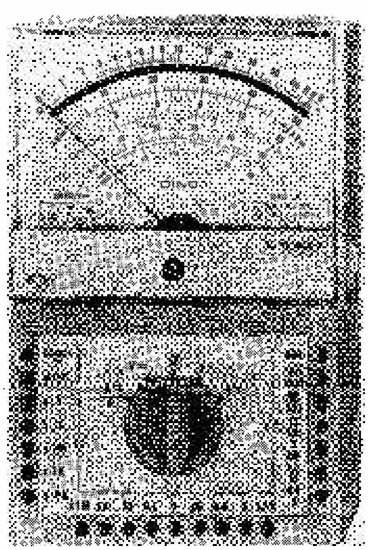
For further information contact *Alberto Coniglio, Chinaglia (U.K.) Ltd., 19 Mulberry Walk SW3 6DZ. Tel. 01-352 1897.*

SELF-ADHESIVE CABLE CLIPS

Special Products Distributors Ltd. who market a wide range of tools and equipment inform us that they can supply self-adhesive wiring clips. They grip instantly on any smooth surface to give a strong and permanent fixing—ideal for workshop and radio shack wiring! Insulation of the adhesive pad is said to break down at between 2·5 and 3kV. Price of the clips is £1·40 + VAT per hundred (size A)—up to $\frac{1}{4}$in dia. Size B £1·80 + VAT per 100 for $\frac{3}{8}$in dia. wires. Further gen on these and other products from *Special Products Distributors Ltd., 81 Piccadilly, London W1V 0HL.*

TELE-TENNIS KITS

Marshalls, who have branches in London and Glasgow tell us that they can now supply complete Tele-Tennis kits for £37, plus VAT and postage.—*A. Marshall and Son (London) Limited, Dept. P.W., 42 Cricklewood Broadway, London NW2 3HD (Tel. 01-452 0161).*



NEW CATALOGUES

Arrow Electronics have announced the 6th edition of their mail order catalogue. It contains details and prices of components, etc. ranging from neons to nuts and bolts and resistors to Mullard modules. For your free copy, send to *Arrow Electronics Ltd., 7 Coptfold Road, Brentwood, Essex CM14 4BN.*

The Studio Electronics catalogue has special emphasis placed on quadraphony and contains details of various electronic musical instruments. For a free catalogue, write to *Studio Electronics Ltd., P.O. Box 18, Harlow, Essex CM18 6SH.*

The 1975 Home Radio catalogue is now available. It contains a wealth of information on components and prices and is well-worth having on the bookshelf.—*Home Radio (Components) Ltd., 234-240 London Road, Mitcham, Surrey CR4 3HD.*

A new catalogue from Elvins gives details of prices of electronic organ components and kits. Send a stamped addressed envelope for a copy of the catalogue to *Elvins Electronic Musical Instruments, 12 Brett Road, Hackney, London E8 1JP.*

BBC CASSETTES

Latest cassette releases from the BBC include "Show of the Week" (includes Baby We Can't go Wrong—Cilla Black, Angel of the Morning—Olivia Newton-John). It's a stereo cassette RMC 4014. Bang on a Drum is a kiddies tape (stereo MRMC 004) which includes songs from Play School and Play Away.

Stereo MRMC 018 "Hits on a Harp" is David Snell playing popular numbers on a harp. It's a very pleasing sound and makes terrific background music.

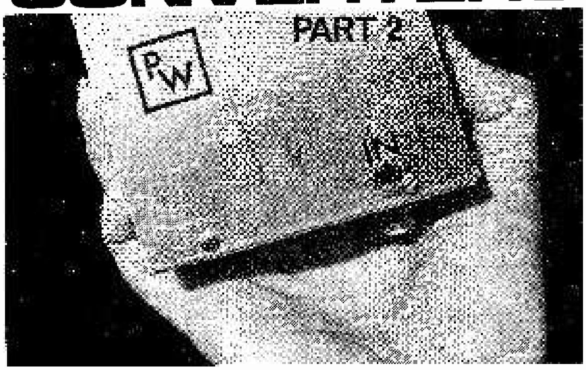
RMC 4017 is a "Top of the Pops" stereo cassette which contains BBC TV's best of the pops available over recent months.

Finally, one for Dickens fans (MRMC 021)—one track features Ebenezer Scrooge (Patrick Magee) and supporting cast in a special dramatisation. The other side is Abel Magwitch (John Hollis)—the convict in Great Expectations. Both tracks, which feature full supporting cast, are ideal for introducing younger children to Dickens and should also hold the interest of older children (and Mums and Dads) who already know the stories.—*BBC, London W1A 1AA.*

2 VHF CONVERTERS

G. SEVERN

PART 2



CRYSTAL CONTROLLED CONVERTER

This employs a crystal oscillator and multiplier chain, RF stage and mixer. The crystal control results in frequency stability otherwise not obtainable combined with reliable read-out of frequencies on a calibrated receiver. As the oscillator frequency is fixed the receiver operates as a tunable IF. A screened communications type receiver with screened aerial input socket is thus almost essential, otherwise short wave transmissions over the tunable IF range will break through at considerable volume. A converter of this type is generally used for specialised reception over a narrow band, such as 144 to 146MHz, but it can be employed for some other freqencies.

In each case, reception can be in any mode catered for by the main receiver. The usual communications receiver will permit CW, AM and SSB reception which will be of advantage for 2m amateur signals. Few receivers will permit proper FM reception, though some will give "slope detection" of FM signals, which may be suitable for speech.

CIRCUIT

The aerial input goes to L1, with a tapping for impedance matching. A second tap supplies the source of the grounded gate FET RF stage Tr1, Fig. 4. This stage has less gain than a grounded source stage, does not need neutralising and is capable of broader band coverage. Coils L2 and L3 couple signals to the gate-protected mixer Tr2. The use of three signal-frequency circuits (L1, L2 and L3) helps remove spurious responses.

The oscillator Tr5 uses a 35MHz crystal doubling in each of the grounded base stages Tr4 and Tr3, so that L6 is tuned to 140MHz. This arrangement is intended for reception of 144-146MHz amateur band signals, tuning over the range 4-6MHz on the receiver. L4 in the mixer drain circuit is resonant near 5MHz and L5 couples the output to the receiver, with a screened co-axial lead.

In converters of this type various output frequency ranges may be chosen. An output of 4-6MHz is likely to give quite open tuning with any receiver while a higher frequency, such as 14-16, 24-26 or 28-30MHz may be preferred where the receiver is efficient on these ranges and the scale is sufficiently open. A frequency sector which requires bandswitching the receiver is probably best avoided. Where an output other than 4 to 6 MHz is planned, the crystal, L10, L8, L6 and L4 must be modified to suit. The output frequency (L4) will be the difference between the signal frequency (L1 to L3) and final oscillator frequency (L6).

As the oscillator chain consumes about 20mA the converter is run from an external battery. Its main advantage lies in the frequency stability of this type of oscillator, avoidance of hand capacity and similar effects and the ability to re-tune on the receiver to a specific frequency.

RF MIXER BOARD

This board is shown in Fig. 5. Two tags MC fixed with ½in. 6BA bolts provide connecting points to the metal case. All connections between components should be as short as possible, noting that the "Tetfer" trimmers have tags which fit the 0·15 matrix board. Veropins are placed for L1, L2 and L3, the coils being wound with 20swg tinned copper wire, Fig. 6.

Coil L4 has 60 turns of 32swg enamelled wire wound in two layers, 40 turns being close wound, followed by 20 turns on a layer of tape. A further layer of tape is put on and L5 wound on top, Fig. 6.

★ components list

CRYSTAL CONTROLLED CONVERTER

Resistors

R1	270Ω	R6	100kΩ	R11	150Ω
R2	390Ω	R7	39Ω	R12	56kΩ
R3	120kΩ	R8	150Ω	R13	5·6kΩ
R4	560Ω	R9	68Ω		
R5	220Ω	R10	100Ω		

All 5 or 10% $\frac{1}{3}$ or $\frac{1}{4}$W

Capacitors

C1	1000pF	C8	1000pF
C2	1000pF	C9	1000pF
C3	100pF	C10	1000pF
C4	0·047μF	C11	1000pF
C5	10pF	C12	22pF
C6	3·3pF	C13	1000pF
C7	0·01μF	C14	10pF

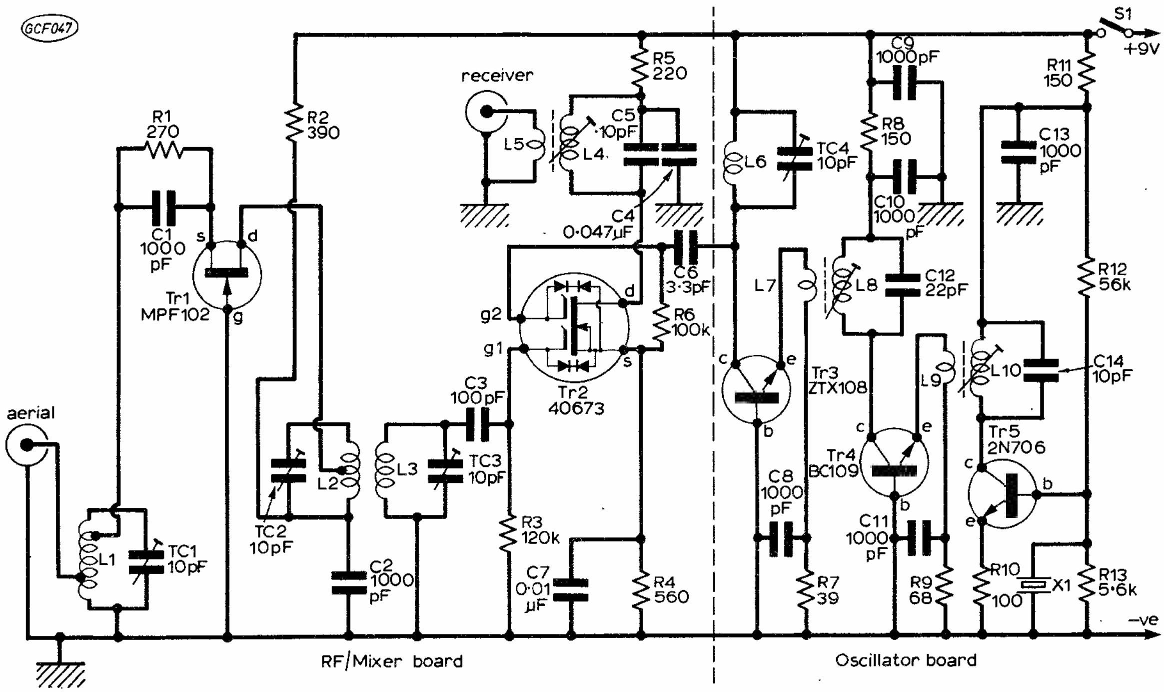
Tubular or disc ceramic preferred.
TC1/2/3/4 10pF trimmers (Jackson 'Tetfer')

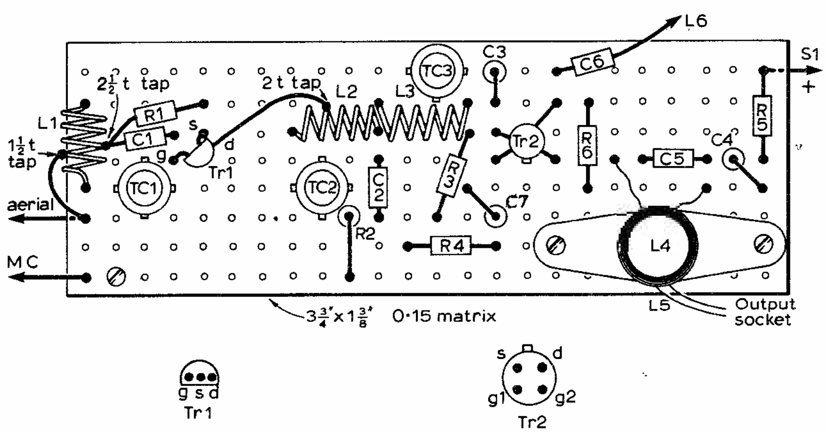
Semiconductors

Tr1	MPF102	Tr4	BC109
Tr2	40673	Tr5	2N706
Tr3	ZTX108		

Miscellaneous

Formers $\frac{5}{16}$in. dia. (2) with cores (for VHF use). Former $\frac{7}{16}$in. dia with core (L4/L5). Veroboard $3\frac{3}{8} \times \frac{7}{8}$in. and $3\frac{3}{4} \times 1\frac{3}{8}$in. 0·15in. matrix. Universal chassis 5 × 4 × 2in. with extra 5 × 2in. flanged plate and 5 × 4in. flat plate (Home Radio) Co-axial sockets (2) On/off switch. X1, crystal 35MHz (wire leadouts) (Senator Crystals, 36 Valleyfield Rd., London, SW16 2HR).





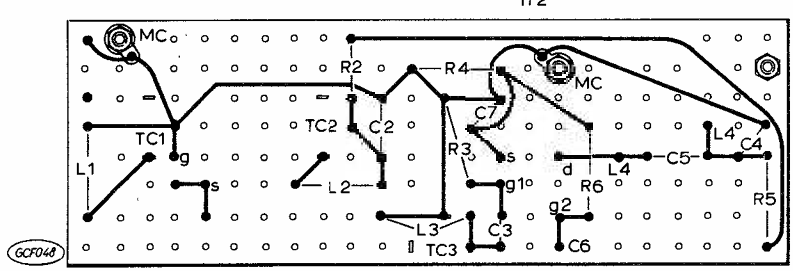
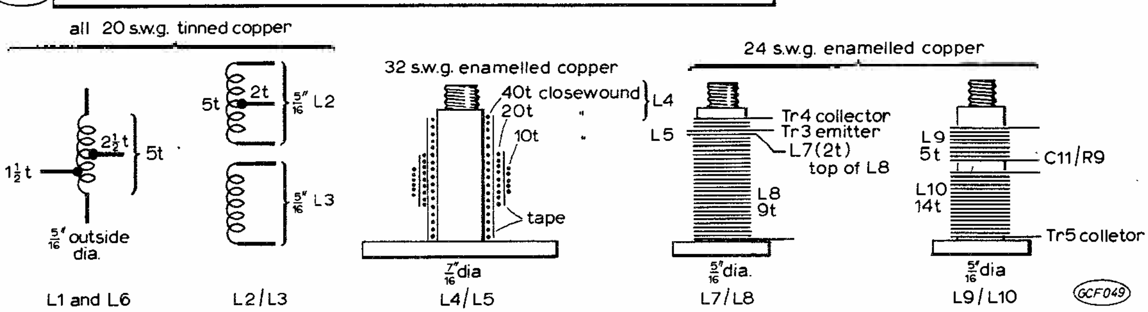
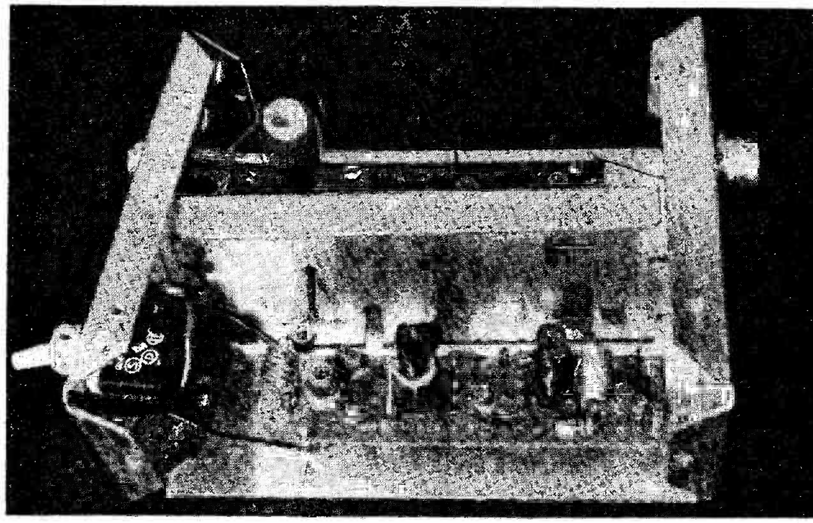
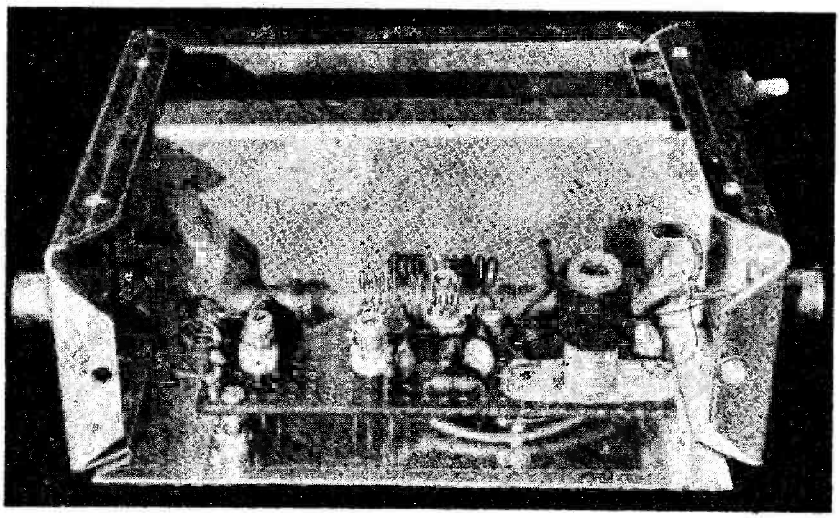


Fig. 4; above, is the more complicated circuit for the crystal controlled converter, constructed on two boards.
Fig. 5; left, shows the RF/mixer circuit board, with the transistor lead-out connections. The second board is illustrated in Fig. 7.
Fig. 6; below, gives winding information for the coils required in the converter.





The board shown here is the oscillator and multiplier stages of Fig. 7.



View of the RF/Mixer board of Fig. 6.

Note:—In Fig. 1, [illegible], the symbols G1 and G2 on Tr1 should be reversed. Layout shown in Fig. 2 is correct.

This coil is then connected to the co-axial output socket and metal box utilizing a screened lead to keep down the strength of unwanted signals in the 4 to 6MHz range.

OSCILLATOR BOARD

The oscillator and multipliers are wired as in Fig. 7. All connections should be very short, including chassis returns such as to the base of Tr4 and Tr3 and from C11 and C8 to base. Coil winding information is given in Fig. 6.

CASEWORK

Cut $\frac{3}{8}$in. from each flange of a 5 x 2 in. flanged plate so that this will fit inside the box ends. The 5 x 2in. screen is bolted centrally to the 5 x 4in. flat plate and the two 4 x 2in. flanged ends are fixed using bolts or self-tapping screws. Co-axial input and output sockets and on/off switch are fitted to these ends.

The flat plate is drilled for the bolts "MC" of the RF Mixer and oscillator boards. Each bolt has two extra nuts so that they can be locked tightly, with adequate clearance under the boards. A lead passes from C6 through a hole in the screen to L6. The box sides and top are added only after the converter is tested and adjusted.

OSCILLATOR ADJUSTMENT

The easiest method of adjustment is to place an indicating wavemeter set to 35MHz near L10, and aligning the core of L10 until a deflection shows that oscillations are present. Set the core of L10 a little off the peak giving maximum RF or the oscillator may not start every time it is switched on.

Move the wavemeter set to 70MHz, near 18 and adjust the core for maximum indication. Repeat the same procedure at 140MHz with the trimmer TC4 and the wavemeter near L6. Later, L10, L8 and TC4 can be readjusted slightly for best results. The doubler chain output, with optimum tuning, is excessive for best results, causing unnecessary background noise. This is cured by slightly de-tuning for best reception.

—continued on page 58

TAKE 20

DAVID ANDREWS

No. 70 LED FLASHER

A series of simple transistor projects, using not more than twenty components.

THIS month's project came about after a request from a young lady for "something to liven up her appearance" at a New Year's Eve fancy-dress party. She wanted a gadget to cause small lights to flash on and off about her person but, for obvious reasons, whatever it was had to be small enough to be secreted away somewhere in her costume!

We offer the circuit for the benefit of other forward-thinking young ladies and anyone else who is interested in a very economic and novel twist to a well proven idea.

Circuit

To cut down on current consumption, and to prevent any possible overheating of the fine wires, which had to run around the lady's anatomy, it was decided to use general purpose LEDs which would give a good light output for currents of the order of 5 to 20mA. Quite clearly the project called for a multivibrator and after some thought transistors were ruled out, the main reason being that the final encapsulation would be too thick whereas a dual-in-line package integrated circuit, while taking up more or less the same area, would give a much thinner package for the end product.

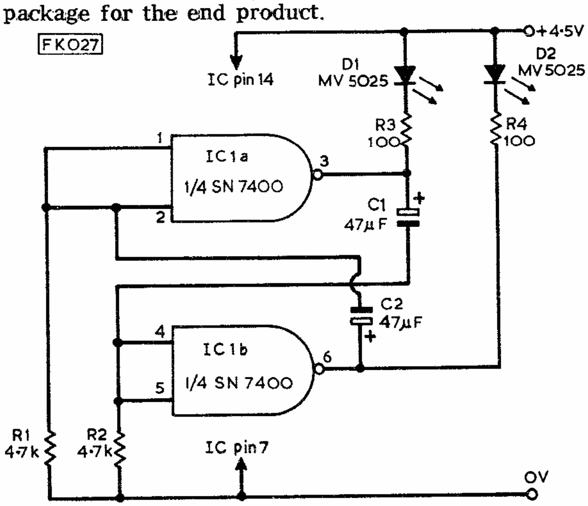


Fig. 1: Basic circuit using two gates of the IC.

By using a standard quad two input NAND gate (SN7400) it was found possible to make two such flashers from the single chip and by benefitting from the use of solid tantalum capacitors the whole circuit was housed on a piece of Veroboard approximately 1½ x 1in. The batteries (4·5V required) were three SP11 types soldered together in series, with ample interconnecting leads so that they could be discretely tucked away in various parts of the clothing without contributing too much to the bulk of the equipment.

The layout we are giving in this article is slightly larger than the prototype because we have included the LEDs on the same board and have laid out all the resistors horizontally, for clarity. Any other would-be party-goers could run pairs of 32 SWG enamelled copper wire from the board to the individual LEDs which can be sewn into the clothing.

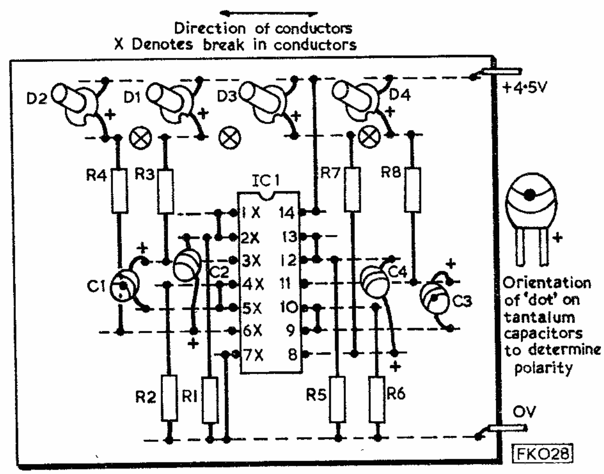


Fig. 2: Layout for complete unit with four LEDs.

The basic circuit for one of the flashers is shown in Fig. 1. Two of the gates from the package are cross coupled with capacitors C1 and C2 to form the multivibrator. Timing is controlled by these capacitors and the resistors R1 and R2 returned to the earth rail. To get reasonably low flashing speeds it is necessary to use large values of capacitance because it is undesirable to increase the values of R1 and R2 above that specified. With the values given the cycle lasts for approximately half a second. To alter the speed increase or decrease the values for C1 and C2 and leave the resistors as they are.

Initially it had been expected that it would be necessary to feed the output of each side of the multivibrator into each of the two remaining gates on the chip to act as buffers but after experimentation this was not found to be necessary. There was sufficient current available to drive the LEDs direct

★ components list

R1	4·7kΩ	R8	100Ω (see text)
R2	4·7kΩ	C1/C4	47µF 6V tantalum (see text)
R3	100Ω (see text)	D1/4	MV 5025 (or G.P. Light emitting diode)
R4	100Ω (see text)	IC1	SN7400
R5	4·7kΩ	Piece of veroboard	
R6	4·7kΩ		
R7	100Ω (see text)		

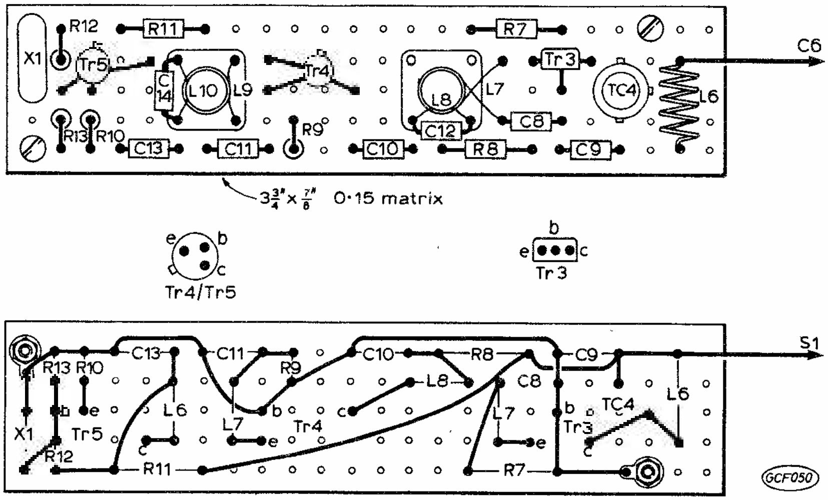
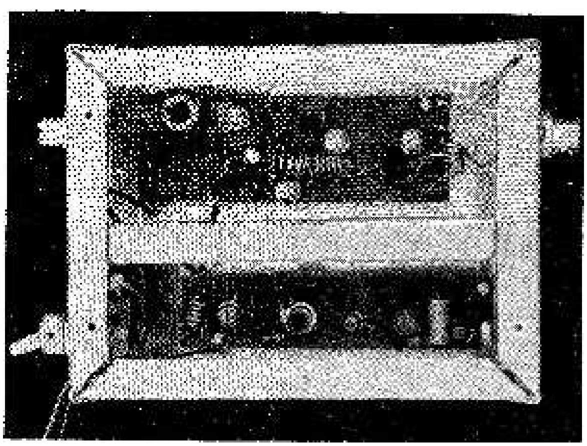


Fig. 7. The two sides of the crystal oscillator / multiplier board.

RF SECTION

If any equipment is available providing a signal in the 2m band, adjust TC1, TC2 and TC3 for best reception of the signal. Peak the core of L4 at about 5MHz or at the wanted part of the frequency band. If no tuning-up signal is available, set these trimmers about half open and try to locate a 2m transmission. In many areas it will probably be necessary to do this at week-ends or other times when the band is known to be active. Once a signal is heard, trim for best volume. It could be necessary to stretch or compress L1, L2 or L3 a little, if any trimmer comes at the limit of its travel. If necessary L4 may be peaked by temporarily placing an aerial near the drain lead of Tr2 and setting the core of L4 for best volume with a 4 to 6MHz signal.

With a 35MHz crystal and L6 operating at 140MHz the 4MHz point on the receiver dial will be 144MHz,



Finished converter with boards mounted either side of screen.

while 4·5MHz is 144·5MHz, 5MHz is 145MHz and so on. The band 4MHz to 6MHz thus tunes 144MHz to 146MHz.

The oscillator section requires about 20mA and the RF/Mixer about 10mA, so a PP9 or similar battery is suitable.

Though the need to avoid breakthrough of 4-6MHz signals has been mentioned, it should be repeated that complete screening in the way described is necessary.

For maximum possible efficiency the positions of the coil tappings can be the subject of experiment. A small coupling capacitance made from a length of twin insulated wire can also be added between the top ends of L2 and L3. However, good results should be obtained without this, and with the tappings as shown. PW

TAKE 20—*continued from page 56*

without there being any significant influence on the running of the multivibrator.

The current through the diodes has, of course, to be limited through R3 and R4. The values given, 100 ohms, provide maximum light output but the current consumption of the circuit as shown is about 20mA. This can be reduced significantly by increasing the values of the two limiting resistors but at the expense of light output.

Construction

The layout, shown in Fig. 2, shows two such flashers on the single layout. The designations in Fig. 1 refer to the left-hand pair of gates of the integrated circuit. The right-hand pair are connected to an identical circuit, even the timing capacitors are the same, but alternative values for C3 and C4 can be substituted.

When using the tantalum capacitors make sure they are connected with the correct polarity. Alternately, use conventional electrolytics but they will take up considerably more space on the board and modify the layout accordingly. Likewise take very great care to wire the LEDs with the correct polarity, particularly if they are on the ends of flying leads! With the type specified the cathode (end connecting to the limiting resistor) is identified by a very small indent at the base of the encapsulation, which can be felt with the finger nail.

For the more adventurous extend the circuit to give three pairs of flashing lights using a standard hex inverter. Notice that each of the gates used in this circuit is operating as a straightforward inverter with the pairs of inputs shorted together.

All the components are readily available from *PW* advertisers but we regret we are unable to supply the name and address of the young lady who inspired the project! PW

Wire Wound Resistors. Our selection of mixed values. 30 for **£1·50**, 100 for **£4·00**.

Audio Amplifier Module. Mullard LP1173, output power. nominal 10 watt, supply voltage +24 volt, with data and circuit, **£2·50.**

Ferguson Stereogram chassis Model 3357, all transistor, medium long, VHF/FM. 3 watts per channel S/M. with connection data, less tuning scale, **£20.** Post paid.

Crystals HC6U: 52·03333 MHz: 52·02500: 52·01667: 51·56667: 51·58330: 37·76250: 37·75000: 12·895·8: 12·891·6: 12·700 0: 9·456·25: 9·455·55: 9·533·33: 9·531·94: 9·530·55: 9·080·62: 9·087·5 **50p** each.

Electrolytics. 32/32/32μF, 225v. 2" × 1½" **35p**: 80μF 150vt 1½" x 1" **20p**; 2000μF 30v. 2½"×1" **25p**: 2000μF 35v 3"×1" **30p**: 470μF 100v 3": 1¼" **25p**: 2000/2000μF 25v 2" x 1½". **35p**: 700μF 200v 3½" x 1½" **30p**: 16/16μF 275v 1¾" x 1" **20p**: 40/40/20μF 275v 3" x 1" **20p**: 4500/300/900μF 30v 2½" x 1½" **50p**: 2500μF 40vt 2½" x 1½" **40p**: 4000μF 18v 2" x 1" **20p**: 470μF 25v 1½" x ½" **15p**: 4,000μF 25v 3" x 1½" **40p.**

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P-C Boards (not computer panels) 1 off 6 transistor single wave band. 1 off 4 transistor audio. 1 off 3 transistor **£1·60**, three boards.

Repanco Transformers AF1, AF2, TT45, 46, 47, 49, 53, 55. **20p** each.

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Circuit Diagram supplied with VHF tuner **£3·25.**

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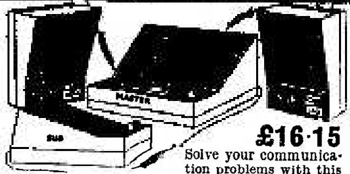

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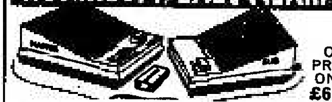

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9·0	1·0	1·66
12·0	1·5	1·90
12·0	3·0	2·74
6-0-6	0·5	1·78
9-0-9	0·5	1·78
9-0-9	1·0	2·03
10-0-10	2·0	2·73
12-0-12	1·0	2·02
12-0-12	2·0	2·85
12-0-12	3·0	3·93
15-0-15	1·0	2·62
18-0-18	2·0	3·93
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	30 watts	2·62
	50 ,,	3·33
	100 ,,	4·76
	150 ,,	6·07
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	600 ,,	15·47

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Single sided s.r.b.p. sq ft 0·50
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Double sided fibre glass sq ft 0·90
cut in multiples of 6" ie 6×6, 6×12, 12×12, 12×18
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1lb ferric chloride 0·50

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3" Goodmans 8 ohm tweeter 51C4D 1·43
3" Audax 8 ohm tweeter 6·5TWBi8 1·55
5" Audax 8 ohm bass HIFI3E8 4·17
5" EMI 8 ohm bass 3472BW 5·36
5" EMI 8 ohm 14A/564B 1·19
6½" EMI d/cone 8 ohm 93850CC 4·64
7 x 4 EMI 15 ohm 99950AN 1·79
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13 x 8 EMI 25 watt 8 ohm 92390GF/H 10·12

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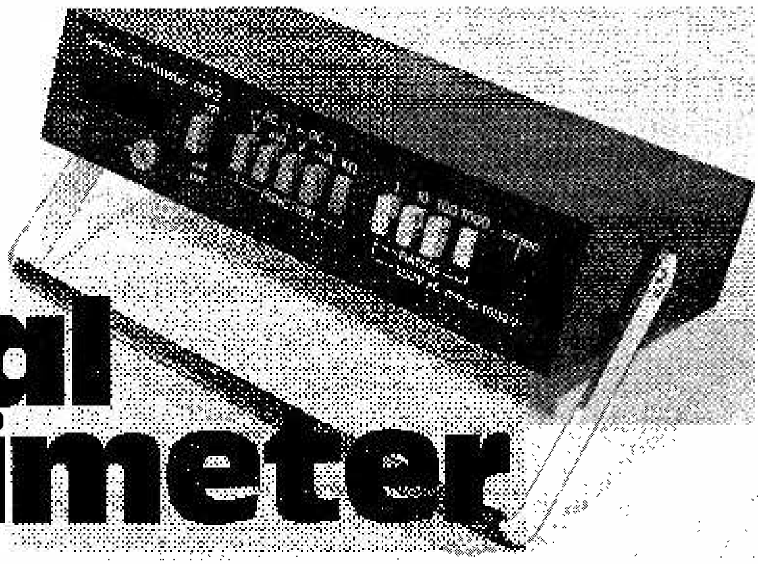
0·01mfd @ 160v tubular polyester 0·04
0·04mfd @ 600v 0·04
0·0033mfd @ 1500v 0·0[illegible]
250ml plastic bottles for etching solution 0·15
250v C280 capacitors
0·01, 0·015, 0·022, 0·047 0·02
0·1 0·03
0·33 0·06
1·0 0·12
2·2 0·20

Electrolytics. Tubular with axial leads except where stated.

Mfd	Volts	Pence	
47	4	7	
100	4	7	
330	4	7	
33	6·3	7	
68	6·3	7	
470	6·3	9	
1000	6	11	single end p/c fitting
22	10	7	
25	10	7	
47	10	7	
100	10	7	
220	10	7	
330	10	9	
15	16	7	
33	16	7	
68	16	7	
220	16	9	single end p/c fitting
330	16	12	
1000	16	20	
10	25	7	
22	25	7	
47	25	7	
100	25	7	
150	25	9	
200	25	11	
470	25	15	
1250	25	24	single end can
5000	25	65	single end can
1000+1000	30	32	single end can
2500	30	40	single end can
6·8	40	7	
15	40	7	
100	40	9	
1000	50	35	single end can
1	63	7	
2·2	63	7	
4·7	63	7	
10	63	7	
15	63	7	
22	63	7	
32	63	9	
800	63	32	single end can
2500	63	85	single end can
4700	63	145	single end can

SPECIAL PRODUCT REPORT

sinclair



DM2 digital multimeter

NOT very many years have passed since the appearance in this country of the first digital multimeter selling at under £100. Now a number are available at around £60—quite a drop even if you don't take into account the intervening fall in the value of the pound. As in the case of pocket calculators, the main factor behind this fall in price lies in the adoption of LSI techniques for the heart of the circuitry.

One of this new generation of digital multimeters is the DM2 by Sinclair Radionics—their second venture into the field. In common with most of the lower priced digital meters it uses an integrating converter, in this case one based on the dual-slope technique which offers a number of advantages over the simple system. A description of the basic principles of the dual-slope integration d.v.m. would probably be of interest to those not already familiar with them.

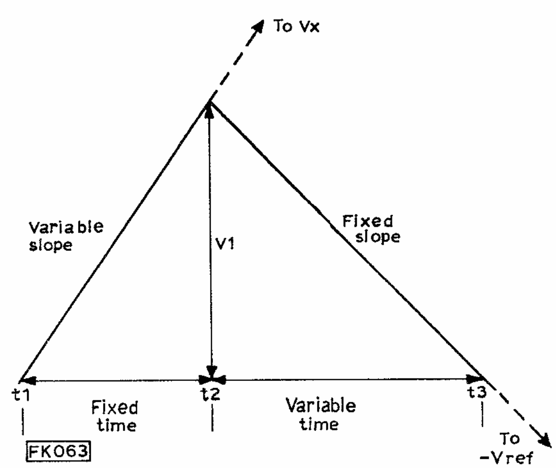


Fig. 1: The dual-slope integration technique.

Dual slope integration

The unknown voltage V_x is applied to a voltage-to-current converter whose output charges a capacitor over a fixed time $t1/t2$, see Fig. 1, controlled by a standard frequency oscillator. The voltage $V1$ attained by the capacitor at the end of this fixed time is proportional to the unknown voltage V_x.

At time $t2$, the capacitor is disconnected from V_x and connected instead to a reference voltage of the opposite polarity, $-V_{ref}$. It will then discharge at a rate set by $-V_{ref}$ until its voltage reaches zero again at time $t3$. The period $t2/t3$ is thus proportional to $V1$, which was in turn proportional to V_x, so by measuring that period we will have an indication of the unkown voltage. The measurement is simply performed by feeding the output of the standard frequency oscillator to a digital counter via a gate which is arranged to open at time $t2$ and close again at $t3$. By suitable scaling the counter will indicate directly the applied voltage.

Because the same oscillator both controls the charge period and measures the discharge time, its actual frequency is not important—the only requirement is that it should not change during the measurement. For similar reasons, the value of the capacitor is not critical; it just needs to have good short-term stability. Thus temperature changes and long-term drifts have little effect on the instrument's accuracy.

Operating speed

Since integration by its very nature and definition takes time, integrating meters are not fast in operation. They are therefore unsuitable for applications where a rapidly fluctuating input is to be monitored, for instance where a control is to be set quickly to produce a certain voltage reading, or in data-logging systems where successive sampling of a number of input levels is required. To this cloud there is a silver lining, however, for this slow response will integrate out noise spikes which can upset faster reading instruments.

The Sinclair DM2 is a 3½ digit instrument. For the benefit of those readers unversed in d.v.m. terminology, this means

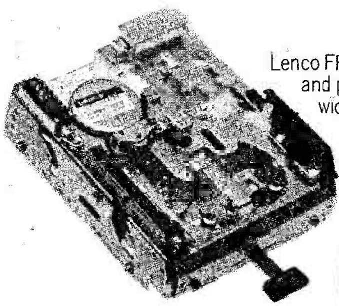
How to order the cassette unit for your Kempton or Ascot player.

As a reader of Practical Wireless, you can get the cassette mechanism for your car stereo player direct from Goldring.

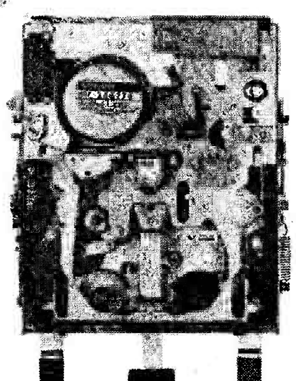
The units for both the PW Kempton and Ascot are made by Lenco and based on the famous STAAR design, with wow and flutter reduced to 0.3% max.

All you have to do is send the coupon to us, with a cheque or PO made out to Goldring Ltd. Be sure to state which unit you need. For the Kempton, it's Lenco FFR at £18.90; for the Ascot, it's Lenco CRV at £19.98. Prices include packing, carriage and VAT.

The units are also available from selected distributors.



Lenco FFR for the Kempton. Robust and precision engineered, it's widely used in industry and by Europe's largest car stereo manufacturer.



Lenco CRV for the Ascot. A record/replay unit made to hi-fi standards. Features of the Ascot Player include dynamic noise reduction, auto-stop and cassette ejection at end of play.

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Please send me: Lenco FFR at £18.90

Lenco CRV at £19.98

I enclose PO, cheque for £ ______

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Goldring

TELEVISION

IN THE MAY ISSUE

AUTOMATIC TRANSISTOR TESTER
Most simple static transistor testers suffer from various disadvantages. If the collector current for a particular base current is measured to obtain a gain reading, for example, the fact that a transistor's gain varies appreciably according to its collector current is not taken into account. Also, with this technique the calibration will not hold as the battery ages. It is much more satisfactory to measure the base current required to produce a fixed collector current. In most designs using this principle however the base current has to be manually set by means of a potentiometer, a critical adjustment and one that has to be done for each transistor tested. In the design to be featured this month the base current automatically adjusts to provide 1mA collector current. Both npn and pnp devices can be tested for gain, shorts and open-circuit. Diodes can also be tested. Including full constructional details.

FOREIGN SET FAULTS
Dewi James reports on faults encountered in some well known imported TV sets, both colour and monochrome, with notes on the circuitry used where this is unusual.

MOSFET BAND I PREAMP
Because of their excellent cross-modulation performance field effect transistors are ideal for use in preamplifiers in locations where strong local signals are present. A dual-gate m.o.s.f.e.t. is used in this design, its low feedback capacitance making neutralisation unnecessary. Another advantage is the incorporation of gate protection diodes. Trimmers are used for tuning so that the bandwidth can be narrowed for maximum gain or widened by stagger tuning for high-definition or colour reception.

LIQUID CRYSTAL DISPLAYS
The use of liquid crystal display devices for digital readouts is now quite common. Ian Sinclair describes the principle of this type of visual display and the present state of the art.

PLUS ALL THE REGULAR FEATURES

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(Name of Newsagent)

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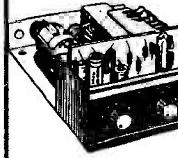
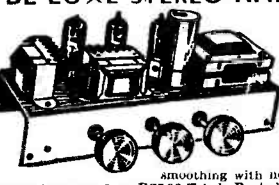
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz-30KHz ± 3dB. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £12·50. P. & P. 50p.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:- 2 × ECL86 Triode Pentodes, 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **£10·75. P.&P. 50p.**

POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3¼" × 2¼". Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested. **PRICE £5·20 P. & P. 35p.**

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £1·30 yd. length. P. & P. 15p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER
A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer. P. & P. 40p BARGAIN PRICE **£4·20**

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High grade mains transformer with grain orientated lamination. Primary 200/240 Secondary 18·5 volts at 0·6 amps and 4·6 volts at 0·3 amps. Size 2" h × 2½" w × 2" d overall. £1·35 plus 25p P. & P.

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

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9–0–9 at 500 mA. £1·25. P. & P. 25p. Pri. 200/240v. Sec. 12–0–12 at 1 amp. £1·40. P. & P. 26p. Pri. 200/240v. Sec. 10–0–10 at 2 amp. £2·00. P. & P. 35p.

3 VOLT RELAY
100 m/A single pole normally closed. 2 for 60p + 15p P.& P.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz–25KHz. Gain 26dB. Solid encapsulation size 1⅛" × 1¾" × ¾". Brand new complete with instructions. Price 1·20p. P. & P. 15p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY 40p. Post 5p.

3 Reference Encyclopedias for Electronic Engineers and Designers, covering between them transistor characteristics, diode and transistor equivalents. Many thousands of up to date European types listed.
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NEW ISSUE
Thyristor, Triac, Diac etc. encyclopedias £1·00, Post Free

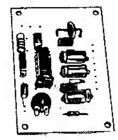
8 pole 3 way 2 bank low loss Yaxley type switches 1½" sections. Standard spindle. 2 switches 64p + 10p P. & P.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER

Enjoy fabulous stereo radio at this fabulous low introductory price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-gain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12" wide × 8" deep by 2¾" high. Supplied ready built, fully tested and fully guaranteed (not available in kit form).
Price £23·00 Post and Packing 50p.

STEREO-DECODER



SIZE 2" × 3" × ½" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£5·40** plus 10p. P. & P. Stereo beacon light if required **40p** extra.

SPECIAL BARGAIN OFFER!
Limited number of BSR C123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. **Brand new. ONLY £8·00 + p. & p. 60p.**

LATEST Hi Sensitivity Uni-directional slim-line condenser microphone as used by many professionals. Very low acoustic feedback. Available hi impedance or low impedance. State which required. **£13·50** plus 25p P. & P

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·46,** P. & P. 15p.
CERAMIC STEREO CARTRIDGE. Universal Mounting brackets and turnover stylus. 70mV per channel output. ONLY **£1·75** + 15p P. and P.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2·27** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£2·76,** P. & P. 15p.
LATEST RONETTE T/O STEREO / COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. **£1·60** P. & P. 15p.
LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·47,** P. & P. 15p.

QUALITY RECORD PLAYER AMPLIFIER MK. II
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE **£5·50,** P. & P. 50p.
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£6·70,** P. & P. 60p.

HI-FI LOUDSPEAKER SYSTEM MK II
Beautifully made, simulated teak finish enclosure with atttactive slatted front. Size 16½" high × 10¼" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. **AVAILABLE IN NOMINAL** 4 Ohm. 8 Ohm or 16 Ohm impedance (state which).
OUR PRICE £9.50 each Carr. 90p
Cabinet Available Separately £5·00. Carr. 90p
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter **£8·00.** Carr. 90p.

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E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms. **£1·80** + 20p. P. & P.

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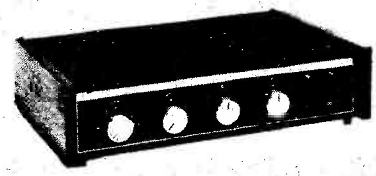
Size 11¾" × 14⅜" × 1⅛" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£6·60** each. P. & P. 34p.
NOW ALSO AVAILABLE: 8", 10 watts. r.m.s. 20 watt peak 40Hz–20,000Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars. **£4·32** + 25p P. and P.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise, level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp. Overall Size 12"w. × 8"d. × 2¾"h.

Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

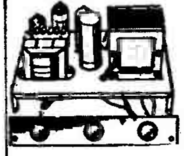
AMPLIFIER KIT .. .. **£12·96** P. & P. 30p
(Magnetic input components 33p extra)

POWER PACK KIT .. .. **£4·32** P. & P. 40p
CABINET .. .. .. **£4·32** P. & P. 40p
(Post Free if all units purchased at same time)
Full after sales service

Also available ready built and tested **£28·08.** Post Free.

Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc. and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.

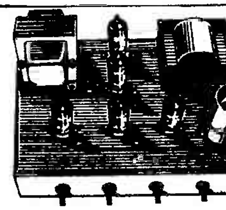
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4¾"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£6·50.** P. & P. 45p.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc **£5·50** P. & P. 45p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 15p + SAE (Free with parts)' All parts sold separately. ONLY **£10·25** P. & P. 60p. Also available ready built and tested **£14·00** P. & P. 70p.

HI-FI STEREO HEADPHONES
Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30-15,000Hz. Matching impedance 8–16 ohms. Easily converted for Mono. PRICE **£3·50,** P. & P. 25p.

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AC 126	AF 178	BSY 38	OAZ 200	OC 206	2N 3054
AC 127	AF 186	BSY 95A	OC 22	SX 754	2N 3055
AC 128	AFZ 12	BYZ 16	OC 25	ZR 11	2N 3391
AC 176	ASY 26	CRS 1/10	OC 26	ZR 21	2N 3730
ACY 18	ASY 27	CRS 1/20	OC 28	1N 23A	2N 3819
ACY 19	ASY 28	CRS 1/30	OC 29	1N 25	2N 4038
ACY 20	BC 108	CRS 1/40	OC 35	1N 32A	2N 4058
ACY 28	BC 118	CRS 3/10	OC 36	1N 38A	2N 4061
ACY 39	BC 119	CRS 3/20	OC 42	1N 43	2N 4785
ACY 40	BC 136	CRS 3/30	OC 44	1N 70	2N 5295
AD 149	BC 137	CRS 3/40	O 45	1N 277	3N 128
AD 161	BC 148A	CRS 25/C25	OC 70	1N 415C	3N 154
AD 162	BC 172	GET 115	OC 73	1N 4148	3N 159
ADZ 11	BC 172A	GET 116	OC 78	2N 456A	2S 303
ADZ 12	BC 212A	GEX 66	OC 78D	2N 708	404
AF 114	BCY 31	NKT 222	OC 81	2N 918	2082
AF 115	BCY 33	OA 5	OC 82	2N 1304	40250
AF 116	BCY 72	OA 47	OC 82D	2N 1305	40251
AF 117	BF 115	OA 70	OC 82DM	2N 1307	0668
AF 118	BF 167	OA 71	OC 83	2N 1309	
AF 124	BF 185	OA 73	OC 139	2N 2062	
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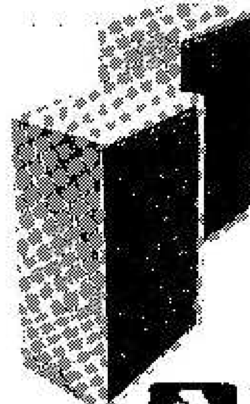

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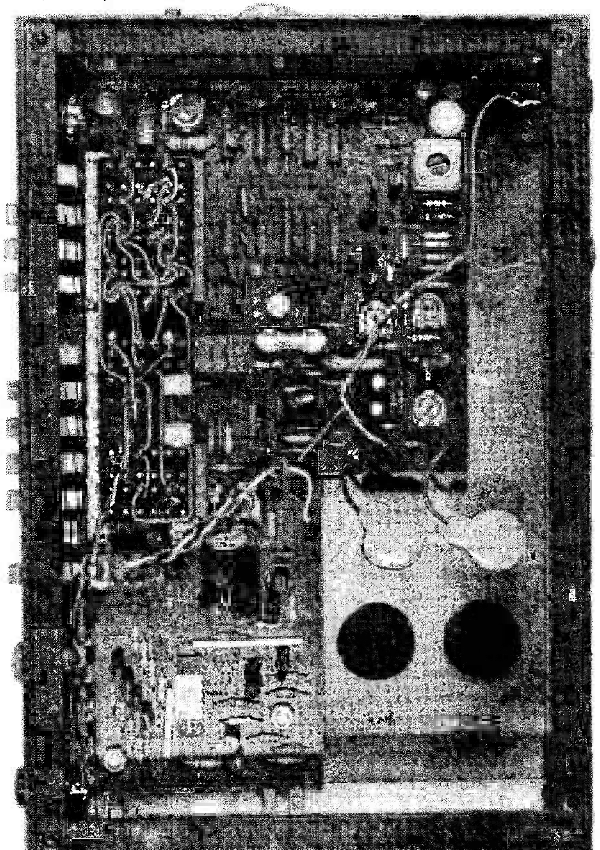
it has a four-digit display of which the first (most significant) digit can only be 0 or 1. A variation of this can occur where, as in the DM2, the leading (left hand) zero is suppressed to avoid displaying unnecessary information which might confuse the operator, In this case the first digit is either a blank or a 1. The result in either case is to extend the indication range of the instrument from 0—999 to 0—1999, a very useful extension requiring the minimum of additional circuitry.

The readout in the DM2 uses four 8mm (0·3in.) 7-segment l.e.d. displays; the necessary decoder and driver circuits are included in the custom LSI chip. Two sets of push-buttons select the five functions—a.c. voltage and current, d.c. voltage and current, and resistance—and the four range multipliers from 1 to 1000. Automatic dual-polarity operation is incorporated, as is automatic over-range and overload indication. In each case the relative information appears in the l.e.d. display on otherwise unused segments of the most significant digit.

Power supply

For convenience and portability, the instrument is battery powered, up to 60 hours of use being obtained with a single standard PP9 or equivalent. Sockets are provided at the rear of the instrument for an external power supply. This must provide a stable 9V with a current capability of 70mA average, 150mA surge. One minor criticism is that these sockets are unlabelled as to function or input requirements*. An instrument which is so easily operated is likely to be quickly separated from its operating instruction leaflet, which clearly

** Sinclair tell us that these sockets will be clearly identified in future production.*



This photograph shows the uncluttered interior layout. Interconnections on the push-button switch banks are made via a small subsidiary p.c.b.

★ Maker's specification

D.C. VOLTAGE

Range	Resolution	Accuracy
1V	1 V	0·3% ± 1 digit
10V	10mV	0·5% ± 1 digit
100V	100mV	
1000V	1V	

A.C. VOLTAGE

Range	Accuracy
1V	1·0% ± 2 digits
10V	
100V	2·0% ± 2 digits
*1000V	

D.C. CURRENT

Range	Resolution	Accuracy
†100μA	0·1μA	2·0% ± 1 digit
1mA	1μA	0·8% ± 1 digit
10mA	10μA	
100mA	100μA	
1000mA	1mA	2·0% ± 1 digit

A.C. CURRENT

Range	Accuracy
1mA	1·5% ± 2 digits
10mA	
100mA	
1000mA	2·0% ± 2 digits

RESISTANCE

Range	Measuring Current	Accuracy
1kΩ	1mA	1·0% ± 1 digit
10kΩ	100μA	
100kΩ	10μA	
1000kΩ	1μA	
†10MΩ	0·1μA	2·0% ± 1 digit

* Maximum input on a.c. voltage is 500V.
† Additional ranges obtained by special switching combinations.

TYPICAL TEMPERATURE COEFFICIENTS

D. ranges	0·03% per °C
A.C. ranges	0·05% per °C
Resistance ranges	0·05% per °C

OPERATING TEMPERATURE RANGE
0 °C to + 50 °C

SIZE

Height	56mm (2·2in)
Width	225mm (8·8in)
Depth	155mm (6·1in)

excluding knobs, feet and handle

WEIGHT
1kg (2·2 lbs) excluding battery

warns that no more than 10V must be applied. This omission would seem to be a potential source of damage. A separate a.c. mains power unit giving a suitable 9V supply is available from Sinclair.

The basic measurement range of the instrument is 1V d.c., giving a resolution of 1mV with over-range to ±1·999V. A m.o.s.f.e.t. operational amplifier input stage achieves an input impedance of 100MΩ on this range; the voltage divider chain reduces this to 10MΩ on the other d.c. voltage ranges. A mean averaging a.c. to d.c. converter is used for the a.c. voltage and current ranges. Its frequency range is 20Hz–3kHz on voltage ranges up to 100V, 20Hz–1kHz on the 1000V and current ranges.

The DM2 can safely withstand a considerable overload on the lower voltage and current ranges, while fuse protection is incorporated for the current and resistance ranges.

continued on page 70

ON THE AIR

by Eric Dowdeswell G4AR

JUST a few words this month on the log extracts that appear at the end of this feature. Probably the majority of listeners to the amateur bands get drawn into the exciting race of hearing, and getting confirmation, of as many different countries as possible, thereby qualifying for various certificates and awards. The log extracts given here are designed to highlight the more unusual stations and prefixes that appear on the bands and thus enable vacancies to be filled in our 'wanted' list, be they countries or prefixes. Modern DXpeditions frequently take unto themselves a special call sign to make their appearance doubly attractive.

To those of you who are kind enough to send in logs for this column may I ask that you restrict your entries to stations that come within the above category? Six a month would be exceptional!

John Porter (Baslow, Derbys) concentrated on 20m CW and I wonder if John has noticed that his best DX tends to be in a north/south line as befits his east/west dipole. Could be missing something good off the ends! **Tim Charles** (Colchester) tells us about TI2CF due on from the Cocos Isles, for a rare one, with SSB on the usual bands plus CW on Top Band! Don't laugh, it's not impossible! Not long ago KV4FZ managed to work all continents (WAC) in eight hours on this band! Tim also mentions that the Gambia has dropped ZD3 in favour of C5.

Paul Heath (Wolverhampton) bemoans the "pretty hopeless reception other than 80m" but with an R1155 I'd tend to suspect the receiver rather than conditions! Paul is in the process of doing some rewiring to it so let's hope for better things. **Mike Green** (Northwich) suggests that Max France might do better with Oscar if he used crossed dipoles instead of verticals. Agreed, but even better is some simple way of tracking the satellite, perhaps a handheld aerial, in order to increase the period of reception. **Andrew Swiffin** A8603 (Cheadle) has now got a crystal-controlled converter for the HF bands, feeding into a PW design as a tuneable IF. This is a very efficient way of ensuring success on these frequencies if the main receiver is not too hot.

Paul Broadhurst (Near Clevedon) stuck to 80m and found A51TY in Bhutan and YB0AAG in Djarkarta for a couple of interesting prefixes. His 150ft wire feeds a Trio 9R59DS and PR40 preselector. **Steve Blake** (Aylesbury) has moved to "join the men up on VHF"! Hey, that's not nice at all! A 6-element Yagi feeds a converter into his Codar CR70A at 28 to 30MHz.

Graham Bleakley QSL/Publicity bod for the West of Scotland ARS GM4AGG reports demolition of the club's premises so write to him at 82 Ash Road, Cumbernauld, Dumbartonshire for current details of venues and club meetings. **Alan Rae** (Glasgow) has now got his Morse up to a decent speed and found some goodies that he had previously missed. Those who take the trouble to learn the code are rewarded with a completely new world of interest, virtually another language. **Roger London** A8673 (London SE2) was one of several who copied the jungle outfit of HP1XJS/P/HP7 for an unusual catch, this time on 15m SSB.

Peter Walton (Llanfair P. G., Gwynedd) at 12 years of age is our latest recruit, with an Eddystone 358 and 85 ft of wire. **Stephen Budd** A8713 (Worthing) was worried at not being able to give me the frequencies of stations to better than 10kHz on his AR88. Not to worry Steve, since very few stations are crystal controlled nowadays. Listen for the sudden rise in the QRM, the DX will be underneath, in what was a quiet slot a few minutes previously! Again from **Tim Charles**, "phew, 45 minutes to copy out the log." This time I can't say that there are any ordinary ones in his list, ranging from 160 to 2m, with the exception of 10 and 15m. He likes to listen through the GB3PI repeater on 2m but finds it jammed up whenever there is a lift in conditions.

Graham Nicholls G4DLB (Banbury) has stuck to working stuff on 2m and 70cm on CW, SSB and FM and enjoyed the recent good conditions enabling him to get into SM on 2m and PA0 on 70cm. **M. C. P. Bennett** (Slough) mentions the CG3 stations, normally VE3, in Listowel, Canada, celebrating some town event! Any more candidates for the "How stupid can you get" competition??

Log extracts

M. Green:— 80m HK3LT ZL1BCC 5U7AH **20m** TU2DP VP8HZ JY9CR (POB 2788 Amman) **15m** A4XFE HZ1AT VQ9BP

J. Porter:— 80m A2CCY 8P6ES **20m CT2BP PJ3SF ZD8TM 5T5FP 15m** ZD8TM

A. Doherty:— 80m HC2YL VQ9M PZ1AE **20m** VK9ZQ 8P6ES **15m** EP2SN KV4AD **80m** TA3HB VP9GD XW8FA YB0ABV 5U7AH

A. Swiffin:— 80m PJ3DO VU2DGD **20m** CT3AR EA9FB VE8RCS

P. Broadhurst:— 80m A51TY CT2AE YB0AAG 5B4BC 9G1DY

S. Blake:— 2m F1DJR GI8EWM GM8FFX SM6DKU

P. Barker:— 80m A4XVB **20m** PZ5FB TA2SC TJ1AD VS5MC **20m (SSTV)** DJ4SS EA4DT HA2KRB I8MGQ OH5RM YU2CDS

A. Rae:— 160m PY1RO 80m AP2KS ZB2CF ZL4KF

S. Budd:— 80m 7X0EEG **20m** CR4BS FL8DA JY9CR VQ9BP 4W1GM **15m** WB2POJ/VQ9

G. Nicholls:—2m worked ON5NY OZ1OF SM7AED **70cm worked** G3KMS GW3UCB/P

M. Bennett:— 80m A4XVC ET3ZU HK4WWB VS5MC 9M2BU **20m** EL5G HR6SWA HV1CN HV3SJ TU2EP **15m** A4XFU HZ1AT TJ1AD

M. Sole:— HZ1TA M1I PY6AHM TR8DG XU1DX ZL3PE 3V8BU **40m** ZL1AQ

T. Charles:— 160m KV4FZ KZ5WA VE1WE ST2AY W2KH WA4GTB W6UD WB8APH 80m FL8DN HC2TR KZ5WA **KL7DRT KS4IZ** TG8KT XE3LK YS2HM ZL1BEA 5N2ESH 5T5DY 8R1AG **40m CO2NV XE6WHK ZD3P ZL1FM 20m** C5AR (Gambia) KC4AZ VP8NP XT2AE **2m** DC2BE GC4ASO SM6FBQ

Stations SSB except those in bold which are CW.

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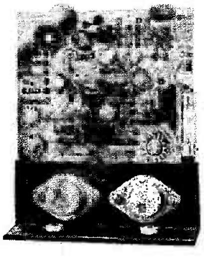

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MT70	Transformer or above	**£5·50**	Carriage 60p

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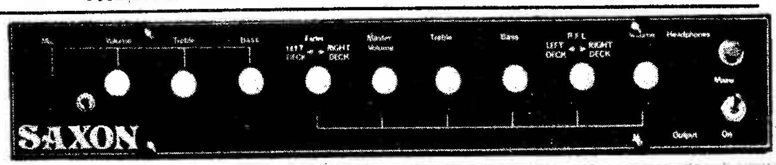

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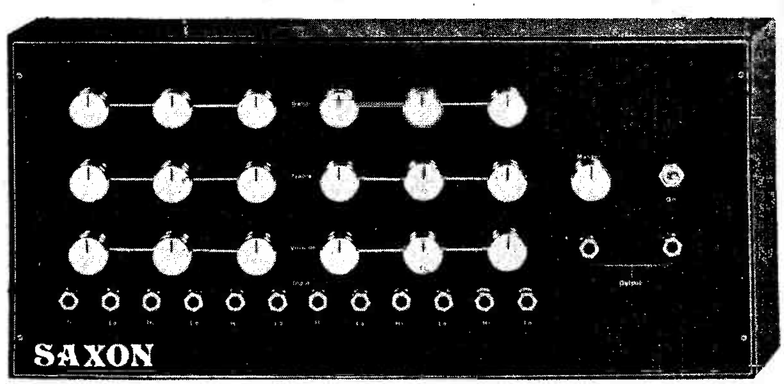

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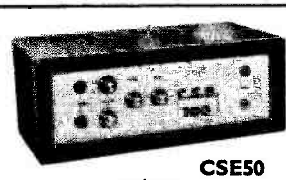

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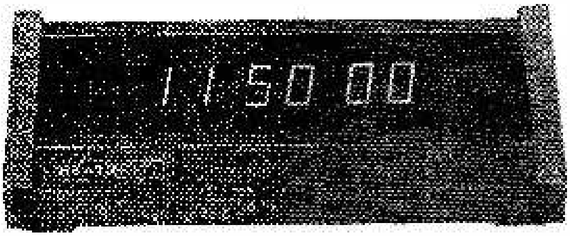

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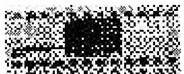

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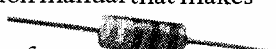

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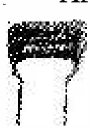

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ON THE AIR

MEDIUM WAVE DX
by CHARLES MOLLOY

"THE Newfoundland station CJON on 930kHz was my first Transatlantic DX contact ever, on November 9th. In January reception was fairly consistent and only on three of the nights that I stayed up to 0200 was the station unreadable" writes **Steve Whitt** from NW London. Steve uses an HRO communications receiver with a 40ft outdoor aerial to pull in his medium wave DX which includes CBM in Montreal on 940kHz with a news bulletin and WNEW in New York City on 1130kHz with a basketball commentary. Transatlantic reception in the UK starts about six hours after sunset and even during the summer months reception is possible for an hour before sunrise.

Roy Patrick reports again from his new QTH at Mackworth in Derby with a fine log of reception from both North and South America, West Africa and the Middle East. His receiver is a Trio 9R59D and he logged Morocco on 818kHz CJCH in Halifax, Nova Scotia on 920kHz at 0215, CJON St. John's on 930kHz at 0145, Radio el Mundo in Buenos Aires, Argentina on 1070kHz at 0240, Voice of America in Rhodes on 1259kHz with sign-on at 0300, Kuwait with Arabic music at 0250 on 1345kHz and Conakry in Guinea on 1403kHz at 0020. Roy mentions hearing a broadcast in Arabic on 1205kHz which is almost certain to be Radio Sanaa in the Yemen Arab Republic, a fine catch.

Harold Emblem of Mirfield in Yorkshire is still active on the medium waves with his Eddystone 730 receiver and medium wave loop aerial. He has logged four Canadian stations, CBN St. John's in Newfoundland on 640kHz, CBH in Halifax, Nove Scotia on 860kHz, CJON St. John's on 930kHz and CHNS in Halifax on 960kHz together with Radio Sahara in Spanish Sahara on 656kHz. Others include Radio Andorra on 701kHz, Bagdad on 760kHz, Yerevan, Armenia on 863kHz, Rajkot, India on 1070kHz and Conakry, Guinea on 1403kHz. Harold reports hearing Tashkent, Uzbekistan well at 0300hrs on 908kHz over Thourah, Iraq on the same frequency.

Fred Dinning of Dunlop, Ayrshire has sent an outstanding log of North American DX. Using his SP600 receiver, 6000ft(!) Beverage aerial and medium wave loop he logged 72 stations in Canada and the United States between 0300 and 0800 during the first week of January. The most notable logged are WMAQ in Chicago on 670kHz, WOR in New York City on 710kHz, WSB Atlanta, Georgia on 750kHz, WJR in Detroit on 760kHz, WBBM Chicago on 780kHz; WGY Schenectady, NY on 810kHz, WBAP Fort Worth in Texas on 820kHz, WCCO Minneapolis on 830kHz, WHAS Louisville, Kentucky on 840kHz, KOA Denver, Colorado on 850kHz, WWL New Orleans on 870kHz, WLS Chicago 890kHz, WCFL Chicago 1000kHz, KDKA Pittsburg on 1020kHz, WHO Des Moines on 1040kHz, CHUM Toronto on 1050kHz, KING Seattle on 1090kHz, KMOX St. Louis 1120kHz, KSL in Salt Lake City on 1160kHz and WOAI San Antonio, Texas on 1200kHz. Fred's log is an indication of the improved conditions on the medium waveband now that we are approaching the minimum of the sunspot cycle, expected in 1976. Medium wave DXers can confidently look forward to a return of the outstanding DX of ten years ago when a few of the more common North Americans were, on occasion, heard in this country on transistor portables.

SHORT WAVE BROADCASTS
by Derek Bell

WE have been set a challenge this month by **John Godwin** from Rugeley. He wants us to try for, as he puts it, "the elusive ZL3" this is a 7½kW station in New Zealand. Mr. Godwin's method is to try Radio Australia on the 25m band to see if the path is open. Then he tunes 15kHz higher to 11780 and listens for a very weak signal. John reports that it usually has rapid flutter and that he has to have everything screwed up tight on his pre-war HRO receiver and dare not even breathe too deeply for fear of losing it! The best time is 0845 to 0930 and the address for a QSL is: New Zealand Broadcasting Corp., P.O. Box 2396, Wellington 1 N.Z., but please send two International Reply Coupons to pay for the return postage.

"Nothing special here but the best I can get." So says **Eric Chowanietz** of Braunstone, Leicester. He then goes on to list the following:

T.R.T. Voice of Turkey on 11880 at 2300
Radio Cairo on 9700 at 2245
Radio Finland on 9555 at 1620.

All this on a Fidelity Comet transistor set. Reader **Bob Stone** from Plymouth writes to enquire if any one knows of a "Radio Dominicana" on 5967. The only one I can trace is Radio TV Dominicana of Santo Domingo in the Dominican Republic. The trouble is that as far as I can see their only outlet is on the medium wave. **Christopher Hasman** is the proud new owner of a Bush VTR178 and he takes us into the realms of inner space by logging the last Russian space flight between 121 and 146 MHz. This was achieved using a BBC1 TV aerial. Christopher also informs us that the US-Soviet joint flight in July will be using the same frequencies. However, sadly, the TV aerial has gone back to its rightful owner and Christopher is appealing for help.

An example of the "giveaway" comes from **Frank Allen** of Ilfracombe. On his QR666 he logged and QSLed Radio Pyongyang on 6576 at 2000 and they replied by sending two ten-inch double sided LP records of an opera based on a hospital at war, along with a multitude of books and stamps. The QR666, by the way, is the replacement for the phased out Trio 9R59DS and costs a lot more than the old workhorse! A self-confessed crystal-set addict is **Andrew McIntee** of The Schoolhouse, Craichie, Forfar. This gallant Scot owns three of them and has pulled in, among others:

Radio Messiah on 6050 at 1915.

This is a new one on me, can anyone give some more gen. **Arthur Bell** is no relation, honestly, but by chance he picked up PW and got hooked on the SW page. Being, as he says, a greenhorn he admits to being all at sea with the frequency figures. These are always in megahertz, Arthur, and the times are always twenty-four hour clock and given in Greenwich time **only**. The hertz equals one cycle per second, thus a megahertz equals the old megacycle.

The metre band system used by some stations, covers a small segment of the spectrum. For example, the twenty metre amateur band runs from 14 to 14·350 MHz or over 350kHz. Regarding a list of stations of the world, the "Radio and TV Handbook" published by BillBoard Publications should fill the void. Finally, I can say, Arthur, that to log Radio Australia on an Astrad 17 is pretty good going!

A letter that came some time ago but unfortunately had to be held back was from **G. E. W. Hewlett.** This gentleman has been DXing since (would you believe) 1928! He built a one-valve receiver and later added it to another rig in order to improve them both. This was done by plugging the first set, as an RF amplifier, into the detector valve socket of the second. As a result of this a QSL came from VK3LR, or, as it later became, Radio Australia. Since then Mr. Hewlett has become a confirmed radio fan "down under" and can quote, at the drop of a hat, all the times and frequencies of this far-away station. In fact, Mr. Hewlett sometimes spends up to eight hours a day monitoring the VK's.

My enquiries recently about FEBA in the Seychelles seem to have borne fruit. I have beside me a logging by **Roy Wooden** of Staines who reports FEBA on 11715 and says that it puts out English on Tuesdays and Wednesdays from 1745 to 1800. However, Roy advises us to get in soon as the service to the Middle East will be phased out and more emphasis will be placed on the Far Eastern, South African and Indian Ocean islands, with, perhaps, the loss to us here in Europe of this signal.

Having written the above about "us here in Europe", I was surprised to have in the mail an air letter from **David Samuel** in Johore Baru, Malasia. David comes to the aid of our recent enquirer who had a daughter in Thailand and sends the tip that perhaps she listens to the BBC World Service from the Malasia relay. Many thanks David for the welcome gen. Another reply to an enquiry comes from **John Dipré** of Stoke Newington, London. He would like to help our reader who was suffering from "anaemia" of the 60m band so, if Glenn Tobin is interested, John will make all as clear as crystal for him. John reports thirteen different countries on the band using a VEF204. Among them Honduras, Costa Rica, Togo and the Sudan. Pass your secret on, John, and we will all share it!

From the steel town of Sheffield comes **David Williams** to give us the low-down on the 2·5, 5, 10 and 15MHz fixed frequency time signals. He writes that the United States Bureau of Standards puts out signals on these frequencies from stations in Hawaii and Washington with IDs. on the hour. The voice ID from Hawaii is a woman (or xyl, as they say) and a man from Washington. Turning now to station news Radio Portugal recently announced that they are to stop QSLs until further notice, but that they hope to start a DX show soon, while Radio Baghdad has started to send out copper emblems with some of their QSLs. The one and only "Happy Station" on Sunday from Radio Nederland, has announced an alternate frequency of 5965, the old ORTF slot. RN has also been testing on 5955 from 0930 to 1050 and would like reports. A new DX show starts soon on Liverpool's local "Radio City." This station moves into VHF in February and the DX show is on the late night show, alternate Sundays, in the "wee small hours."

—continued from page 65

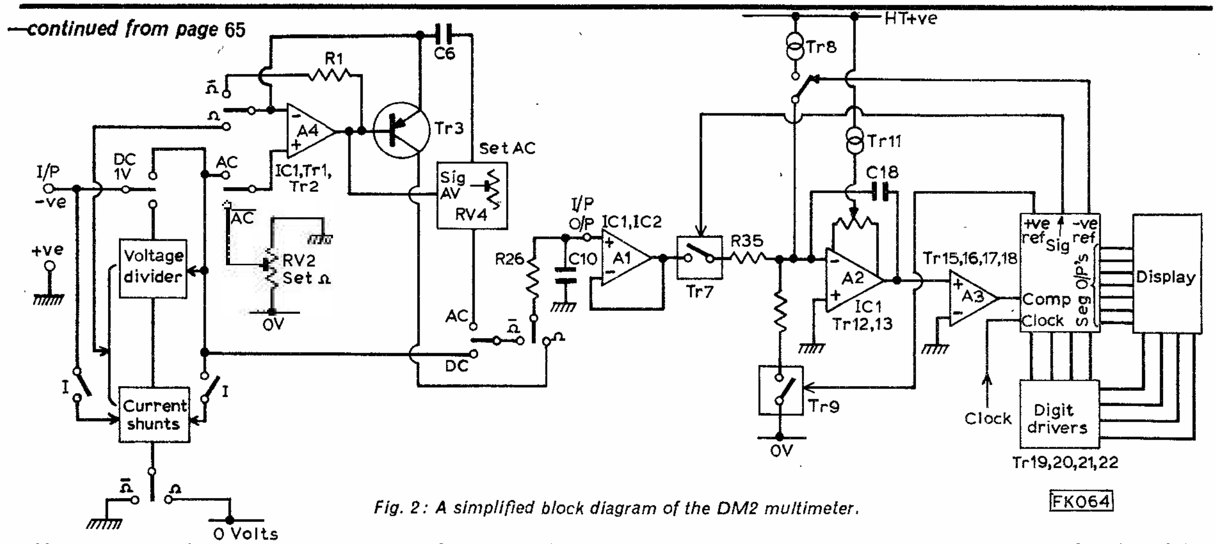

Fig. 2: A simplified block diagram of the DM2 multimeter.

Your reviewer has been using a DM2 for about three months for servicing and experimentation and has found it reliable and easy to use. The display is quite bright and is fitted with a violet filter to improve its contrast. Even so, if your workbench is near a window or has a good bench-lamp you will find that you need to tuck the meter away in a shady corner for easy reading.

Complete screening of the instrument is provided by the case, based on robust aluminium extrusions. The dual purpose handle/bench stand is useful, as is the optional carrying case which allows the DM2 to be used slung around the neck.

In the absence of any suitable instruments for comparison, I cannot really comment upon the accuracy of readings obtained except to say that a selection of 1% resistors checked out well and other results were always "as expected".

Sinclair offer their usual year's guarantee on the DM2. As they put it, "If it stops working, send it back and we repair or replace it free of charge."

The Sinclair Multimeter DM2 is available from retailers or direct from Sinclair Radionics Ltd., London Road, St. Ives, Huntingdonshire PE17 4HJ. Recommended retail prices are as follows:—

DM2 complete with battery and test leads £59 + VAT
Carrying case £5 + VAT
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0–100 micro A.	580	0–100 micro A.	730
0–500 micro A.	170	0–500 micro A.	200
0–1 mA	170	0–1 mA	200
0–5 mA	170	0–5 mA	200
0–10 mA	6	0–10 mA	6
0–50 mA	0·5	0–50 mA	0·5
0–100 mA	0·5	0–100 mA	0·5
0–500 mA	0·5	0–500 mA	0·5
0–1 AMP	0·5	0–1 AMP	0·5
0–2 AMP	0·5	0–2 AMP	0·5
0–25 Volt	15K	0–25 Volt	15K
0–50 Volt	50K	0–50 Volt	50K
0–300 Volt	300K	0–300 Volt	300K
"g" Meter	170	"g" Meter	200
VU Meter	5250	VU Meter	5250

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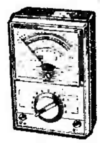

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VA (watts)	Ref No.	Price Cased £	Price Plugs 2 Pin + 1 Earth	Price Open £	Post £
60	149	7·35	0·80	4·00	0·38
100	150	8·22	0·80	4·60	0·52
200	151	10·20	0·80	7·40	0·52
250	152	11·68	0·80	8·88	0·65
350	153	14·10	0·80	10·80	0·80
500	154	15·68	0·80	12·38	1·00
750	155	24·63	1·00	18·72	1·20
1000	156	32·19	1·00	26·50	1·20
1500	157	38·18	1·00	30·34	O.A.
2000	158	45·20	2·40	34·68	O.A.
3000	159	66·50	2·40	53·35	O.A.

12 & 24 Volts Prim. 200–240V.

Amps 12V	Amps 24V	Ref. No.	Price £	Post £
0·3	0·15	242	1·34	0·22
0·5	0·25	111	1·38	0·22
1	0·5	213	1·58	0·22
2	1	71	2·09	0·22
4	2	18	2·58	0·38
6	3	70	3·80	0·42
8	4	108	4·20	0·52
10	5	72	4·80	0·52
12	6	116	5·01	0.52
16	8	17	6·22	0·52
20	10	115	9·47	0·69
30	15	187	11·95	0·97
40	20	232	13·26	1·00
50	30	226	15·30	1·10

30 Volts

Prim. 200–240V. Sec. 12, 15, 20. 24, 30V.

Amps	Ref. No.	Price £	Post £
0·5	112	1·72	0·22
1	79	2·21	0·38
2	3	3·26	0·38
3	20	4·10	0·42
4	21	4·68	0·52
5	51	5·80	0·52
6	117	6·50	0·52
8	88	8·50	0·67
10	89	8·97	0·67

AUTO TRANSFORMERS

VA Watts	Ref. No.	Price Cased £	Price Plugs 2 & 3 pin	Price Open £	Post £
Tapped at 115, 220, 240 Volts					
20	113	3·00	0·15	1·55	0·30
Tapped at 115. 200, 220, 240 Volts					
150	4	5·80	0·15	3·98	0·39
200	65	6·40	0·15	4·50	0·40
300	66	7·27	0·15	5·28	0·52
500	67	9·99	0·15	8·29	0·67
750	83	12·56	0·75	9·76	0·82
1000	84	15·70	0·75	12·40	0·82
1500	93	19·88	0·75	16·58	1·50
2000	95	30·10	1·44	22·05	1·50
3000	73	43·58	1·90	32·00	1·90

50 Volts

**Prim. 200–240V.
Sec. 19. 25, 33. 40. 50V.**

Amps	Ref. No.	Price £	Post £
0·5	102	2·33	0·30
1	103	3·00	0·38
2	104	4·57	0·42
3	105	5·20	0·52
4	106	6·89	0·52
6	107	11·17	0·67
8	118	14·19	0·97
10	119	15·47	0·97

60 Volts

**Prim. 230–240V.
Sec. 24. 30, 40, 48. 60V.**

Amps	Ref. No.	Price £	Post £
0·5	124	2·08	0·38
1	126	2·96	0·38
2	127	4·63	0·42
3	125	6·84	0·52
4	123	7·94	0·67
5	40	8·86	0·67
6	120	10·15	0·82
8	121	13·58	1·00
10	122	18·15	1·00
12	189	16·00	1·10

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Volts Sec. 1	Volts Sec. 2	Milliamps Sec. 1	Milliamps Sec. 2	Ref. No.	Price £	Post £
3–0–3	—	200	—	238	1·23	0·10
0–6	0–6	500	500	234	1·30	0·10
0–6	0–6	1000	1000	212	1·93	0·22
9–0–9		100	—	13	1·23	0·10
0–9	0–9	330	330	235	1·43	0·10
0–8–9	0–8–9	500	500	207	1·75	0·22
0–8–9	0–8–9	1000	1000	208	2·80	0·30
15–0–15	—	40	—	240	1·23	0·10
0–15	0–15	200	200	236	1·80	0·10
20–0–20	—	30	—	241	1·28	0·10
0–20	0–20	150	150	237	1·30	0·10
0–15–20	0–15–20	500	500	205	2·47	0·38
0–20	0–20	300	300	214	1·72	0·22
0–20	—	3500	NO SCREEN	1116	3·00	0·40
20–12–0–12–20	—	700 (D/C)	—	221	2·31	0·30
0–15–20	0–15–20	1000	1000	206	3·22	0·38
0–15–27	0–15–27	500	500	203	2·73	0·38
0–15–27	0–15–27	1000	1000	204	3·52	0·38

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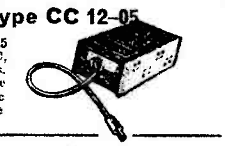

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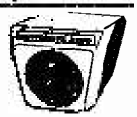

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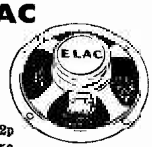
5 K. ohms to 2 Meg. LOG or LIN. L/S 20p. D.P. 35p. STEREO L/S 55p. D.P. 75p. Edge 5K.S.P. Transistor 25p

80 Ohm Coax 5p. yd.
BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £2; 60 yd. £3. FRINGE LOW LOSS Ideal 625 & colour **10p yd.**

8in or 10 x 6in ELAC HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 c/s. Bass resonance 55 c/s. 8 ohm 10 watt. **£3·75** Each Post 52p
10 inch 12 watt Twin Cone, 8 ohm £4·50

E.M.I. 13½ × 8in. SPEAKER SALE!

With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4·50** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45–60 c/s. Flux 10,000 gauss. State 3 or 8 or 15 ohm. Post 25p **£2·95**

BOOKSHELF CABINET Size 16 × 10 × 7 in. teak finish **£6·60** Post 45p

E.M.I. 13 × 8 in. BASS WOOFER. 20 WATTS RUBBER CONE SURROUND. £5·50 Post 25p.

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ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 12p; 8 × 5in. 19p; 14 × 3in. 20p; 10 × 7in. 24p; 12 × 5in. 25p; 12 × 8in. 34p; 16 × 6in. 34p; 14 × 9in. 40p; 12 × 12in. 47p; 16 × 10in. 60p

SPECIAL OFFER

100 ohm 20W Rheostat 2½in. diam. Ceramic Former, screw terminals, ¼in. diam. spindle. 95p, post 25p.

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ELAC 9 × 5in. HI-FI SPEAKER. TYPE 59RM. THIS FAMOUS AND WIDELY USED UNIT NOW AVAILABLE AT BARGAIN PRICE 10 WATT, 8 OHM. CERAMIC MAGNET. **£2.95**

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Woofer 10½ × 6½in. Ceramic Magnet, 44oz. 13,000 lines, Tweeter 3½in. square, 10,000 lines. Crossover condenser full instructions supplied. Impedance 8 ohms. Power 12 watts. **£5·75** Post 45p.

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16/350V	25p	100+100/275V	65p	32+32/450V	60p
32/450V	35p	150+200/275V	70p	32+32+32/350V	65p
32/500V	50p	8+8/450V	22p	32+32+32/450V	85p
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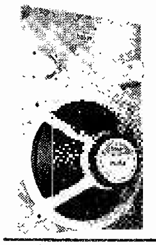

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3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

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For 12in. or 10in. dia. speaker 20 × 13 × 9" £10·50 Post 75p
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LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft

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The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3½ × 3½ × 2in. deep. Rating 10 watt, 8 ohm
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40P1	PNP	15	15	20p
40P2	PNP	40	40	30p

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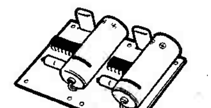

SS-103-3

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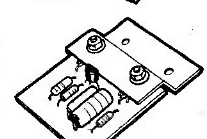

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POWER AMPLIFIERS

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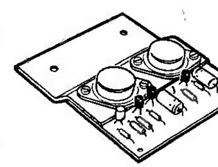
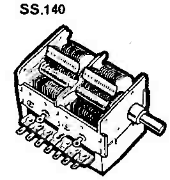


SS.140



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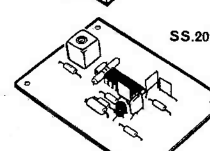
SS.201



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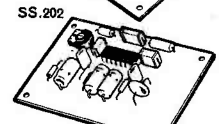

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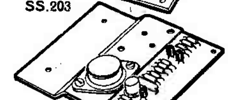

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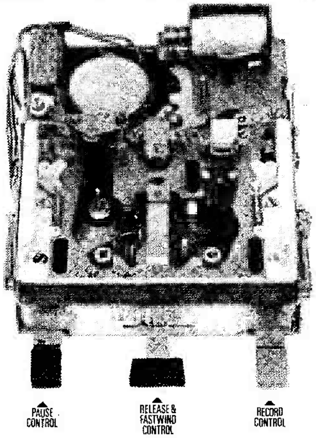

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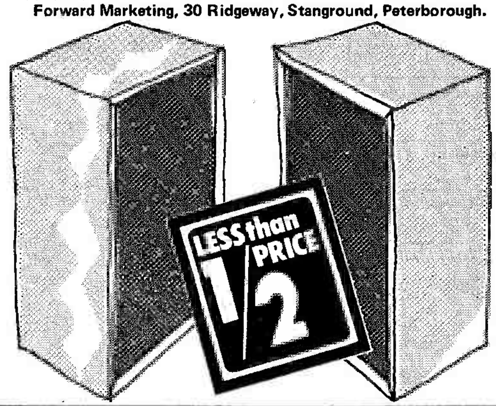

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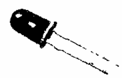
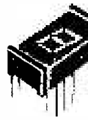

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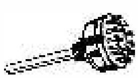

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All types 1" and less diameter

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5K	Log or	5K	
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50K	15p each	50K	Switch
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250K	Double	250K	
500K	Pole	500K	
1M	Switch	1M	
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9 volt. High impedance input. Gold finish with four black plastic chrome tipped level control knobs. On/Off switch and stereo/mono switch. 4 Input sockets.
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Gain	Approx 3.DB
Max Input Sig	1 volt
Max Output Sig.	.. 1·3 volt
Noise Ratio	= —60DB
Supply	= 9 volt

OUR PRICE — **£5·25p**

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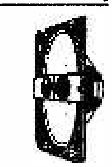

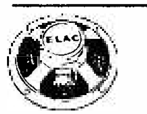

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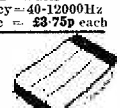

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AB13	6	4	2	69p
AB14	7	5	2½	84p
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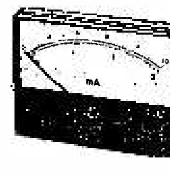

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ME10	0 to 5 m/a Full Scale
ME11	0 to 10 m/a Full Scale
ME12	= 0 to 50 m/a Full Scale
ME13	= 0 to 100 m/a Full Scale
ME14	0 to 500 m/a Full Scale
ME15	= 0 to 1 amp Full Scale
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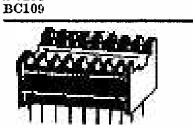

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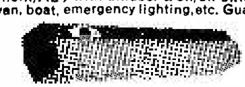

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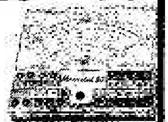

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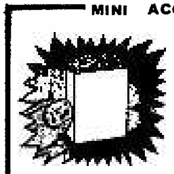

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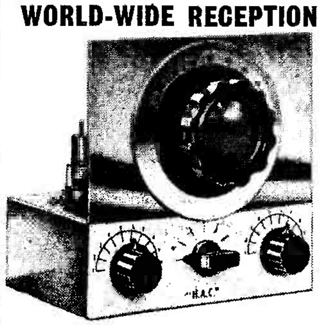

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07	20	1	8	7·0 x 6·0 x 6·0	2·80	38
149	60	3	12	9·9 x 7·7 x 8·6	4·37	45
150	100	5	8	9·9 x 8·9 x 8·6	4·89	45
151	200	8	0	12·1 x 9·3 x 10·2	8·13	53
152	250	13	12	12·1 x 11·8 x 10·2	9·83	73
153	350	15	0	14·0 x 10·8 x 11·8	11·88	73
154	500	19	8	14·0 x 13·4 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	*

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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	*

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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

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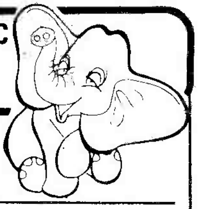

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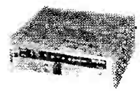

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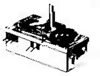

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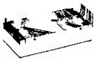

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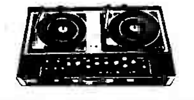

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