PRACTICAL WIRELESS

DECEMBER 1974

25p

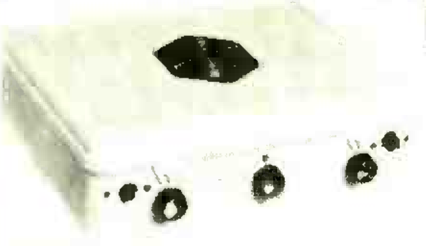
FREE PW SCREWDRIVER

PW 'KEMPTON' CAR STEREO CASSETTE PLAYER PART 1

Also:-

INEXPENSIVE CAPACITY BRIDGE

THIRD SECTION OF P.W. BUYERS' GUIDE 74/5



NEW EDU-KIT MAJOR

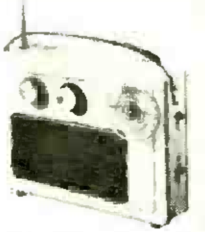
Completely Solderless Electronic Construction Kit
Build these projects without soldering iron or solder

- ★ 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 P & P £1·85) (+ 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 50p. (Free with parts).

NEW ROAMER NINE

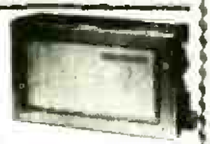


WITH V.H.F INCLUDING AIRCRAFT

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 9¼" × 7" × 2½" approx. Parts Price List and Plans 40p (Free with Parts).

Total Building Costs £6·95 P P & Ins. 44p (Overseas P & P £1·85) (+ 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 20p (Free with parts).

Total Building Costs £2·50 P P & Ins. 26p (+ 8% VAT 20p) (Overseas P & P £1·25)

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 20p (Free with parts).

Total Building Costs £2·75 P P & Ins. 26p (+8% VAT 21p) (Overseas P & P £1·25)

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" × 2½" approx. Parts Price List and Plans 20p. Free with parts.

Total Building costs £2·95 P P & Ins. 30p (+ 8% VAT 23p) (Overseas P & P £1·25)

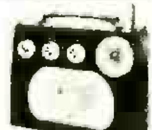
E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial. 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 30p. Free with parts.

Total Building Costs £3·60 P P & Ins. 30p (+ 8% VAT 29p) (Overseas P & P £1·25)

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 35p. Free with parts. Overseas P & P £1·60.

Total Building Costs £4·08 P P & Ins. 31p Overseas P & P £1·85 (+ 8% VAT 32p)

ROAMER EIGHT Mk I

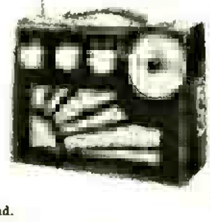


NOW WITH VARIABLE TONE CONTROL

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 50p (FREE with parts).

Total building costs £6·98 P P & Ins. 47p (+ 8% VAT 56p) Overseas P & P £1·85)

ROAMER TEN



WITH VHF INCLUDING AIRCRAFT

10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 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 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 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 £8·50 P P & Ins. 52p (Overseas P & P £1·85) (+ 8% VAT 68p)

"EDU-KIT"

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

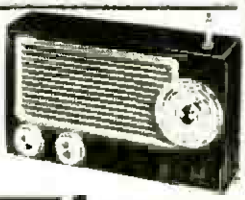
Five units including master unit to construct.

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 ⅜" 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 40p (FREE with parts).

Total building costs £5·50 P P & Ins. 33p (Overseas P & P £1·85) (+ 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 35p (FREE with parts).

Total building costs £4·48 P P & Ins. 33p (+ 8% VAT 36p) (Overseas P & P £1·25)

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 35p (FREE with parts).

Total building costs £3·98 P P & Ins. 31p (Overseas P & P £1·85) (+ 8% VAT 32p)

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★ Callers side entrance "Lavells" shop.
★ Open 10–1, 2.30–4.30. Mon.–Fri. 9–12 Sat.

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Tel.: 0234 52367. Reg. No. 788372.

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PRACTICAL WIRELESS

VOL. 50 NO. 8
ISSUE 814
DECEMBER 1974

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

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● NEWS & COMMENT

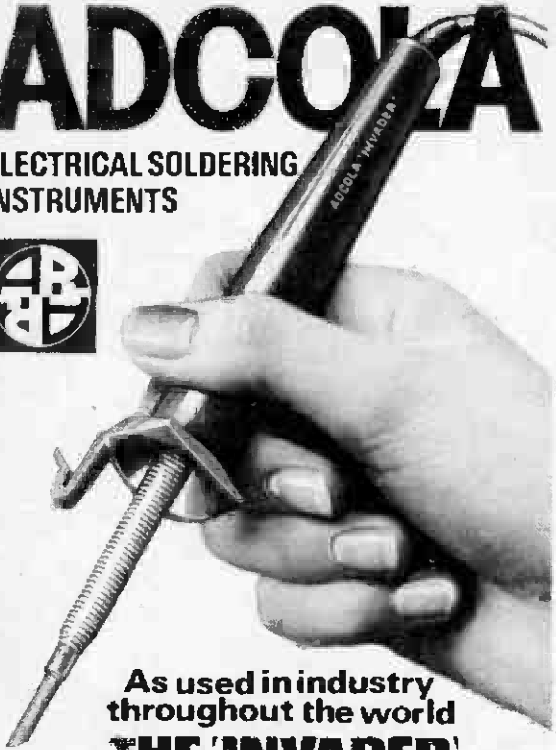
● CONSTRUCTIONAL

● OTHER FEATURES

FREE PRACTICAL WIRELESS SCREWDRIVER (page 702)
PLUS BUYERS' GUIDE to Radio and Electronic Components—PART 3

ADCOLA

ELECTRICAL SOLDERING INSTRUMENTS



As used in industry throughout the world

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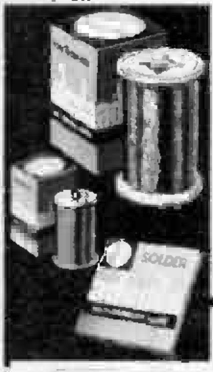
BRITISH MADE, HAND BUILT, PRECISION INSTRUMENT

'Invader' low leakage, high efficiency professional soldering instruments as used in industry worldwide, and why not you! Precision designed handle moulded of flame resistant material (SE1) and european safety standards. Stainless steel construction throughout with elements precision wound, earthed at two points, test run and finally flash tested at 2,000 v A/c. Low cost internally fitted bits with large range of bit faces for your future use. Can you afford not to have the 'Invader'.

MODEL 706 £2·88.	646 £3·13.	1076 £3·22
⅛" Bit 19watt	$\frac{3}{16}$" Bit 23watt	⅛" Bit 27watt



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PWT

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☐I/C TIMER (Signetics)	NE555V	£0.78

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☐8 pin (Pk of 3) £0.50 14 pin (Pk of 3) £0.55

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☐LOCKFLEX RULE (RCF), 3m/10ft precision rule. Blade length lockable-power return. £0.93

☐SOLDERING IRON, 25 WATT (Antex), X25, 220/240V. Low leakage. 1/8" bit (interchangeable). £1.85
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☐TRIMMING KNIFE (RCF), New style, Retractable, 5 heavy duty blades. Ideal - co-axial cables. £0.65

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☐ELECTROLYTIC CAPACITOR,	2,200uF/50V	£0.57
☐ELECTROLYTIC CAPACITOR,	5,000uF/25V	£0.63
☐SILICON POWER TRANSISTOR,	2N3055	£0.60

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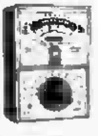
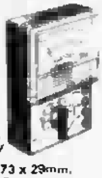
ASK LASKYS

and make no mistake

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. Resistance: 0/150k ohms Decibels: – 10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.
OUR PRICE £3.25 P&P 15p

AUDIOTRONIC Model ATMS

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.
OUR PRICE £3.95 P & P 20p

MODEL TH12

20,000 opv. Overload protection. Slide switch selector. 0/0.25/2.5/10/50/150/1000V DC. 0/10/50/250/1000V AC. 0/50uA/25/250mA DC. 0/3k/30k/300k/3 Megohms. –20 to +50dB
OUR PRICE £5.95 P&P30p

HIOKI 720X VOM

A versatile, accurate measuring instrument 20,000 opv. 0/5/25/100/500/1000V DC. 0/10/50/250/1000V AC. 0 50uA/250mA 0–20k/2 Megohms
OUR PRICE £5.97
P&P 30p

MODEL PL436

20,000 opv DC. 8000 opv AC. Mirror scale 6/3/12/30/120/600V DC. 3/30/120/600V DC. 60/600uA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. –20 to +46 dB.
OUR PRICE £6.97 P&P 30p

U4323 MULTIMETER

20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.6/2.5/10/50/250/500/1000V DC. 2.5/10/16/250/500/1000V 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.
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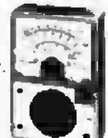
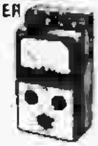
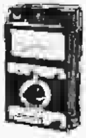
HIOKI 730X

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.

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 Resistance 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.
OUR PRICE £9.25 P&P 30p

U435 MULTIMETER

20,000opv 18 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 ohm. Size: 205 x 110 x 64mm. Supplied complete with leads, crocodile clips and steel carrying case.
OUR PRICE £8.75 P&P 30p

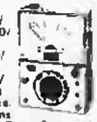
U4312 MULTIMETER

extremely sturdy instrument for general electrical use. 667ops. 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/1.5/6/15/150/600mA/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 £10.25 P&P 60p

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 fuse.
OUR PRICE £13.50 P&P 30p

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
Case for above £1.75

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/1.5/3/15/30/150/300mA/6/12A. Resistance: 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 ops 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

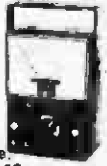
46 ranges, mirror scale. 50k/V DC 5ok/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistance: 10k/100k/1 Meg/10 Meg ohms. –20 to +81.5dB.
OUR PRICE £12.50 P&P 20p

HIOKI MODEL 700X

100,000opv. Overload protection. Mirror scale 0.3/0.6/1.2/1.5/3/6/12/30/60/120/300/600/1200V DC. 1.5/3/6/12/30/60/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/300mA/6/12A DC. 2k/200k/2M/20MOhms. –20 to +63dB.
OUR PRICE £14.95 P&P30p

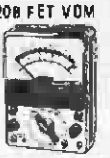
Model HT100B4 MULTIMETER

Overload protected, shock proof circuit. 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 resistance 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 £17.50 P&P 40p

MODEL AS.1000 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.
OUR PRICE £17.50 P&P 30p.

MODEL C7202EN

20,000 o.p.v. DC. 10,000 o.p.v. AC Mirror Scale. 0.25/50/250/500/1000/2500 V. DC. 10/50/100/500 1000 V AC DC Resistance X 10. x 1000 (30Ω centre scale) DC Current 50uA/2.5mA/250mA. –20 to +56dB
OUR PRICE £6.50 P & P 30p

KAMODEN HM7208 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
£21.00 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/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

TMK MODEL 117 FET ELECTRONIC VOLTMETER

Battery operated 11 Meg input, 26 ranges. Large 4½" mirror scale. Size: 149 x 117 x 60mm. 0.3–1200V DC. 3–300V RMS AC. 8–800V P.P. DC current 0.12–12mA. Resistance up to 2000MOhms. Decibels: –20 to +51dB. Supplied complete with leads and instructions.
OUR PRICE £18.50 P&P 20p

TMK 100K LAB TESTER

100,000opv. 6½" scale. Buzzer short circuit check. Sensitivity 100,000 opv DC. 5k/V AC. DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. current 10/100uA/10/100/2.5/10A. Resistance: 1k/10k/100k/10 Meg/100 Meg ohms. Decibels: –10 to +49dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.
OUR PRICE £19.95 P&P 30p

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

KAMODEN 72,200 Multitester

High sensitivity tester. 200,000 ops Overload protected. Mirror scale Ranges –0/.06/.3 3/30/120/600/1200V DC. 0/3 12/60/300/1200 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

U4317 MULTIMETER

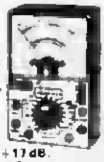
High sensitivity instrument for field and laboratory work. Knife edge pointer, 96mm. mirror scale. Overload protection. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current. 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 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 £16.50 P&P 40p

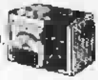
MODEL C7208FM

30,000 opv DC. 15,000 opv AC. 6/3/16/60/300/600 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

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

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.

LB3 TRANSISTOR TESTER

Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied.
OUR PRICE
£3.95 P&P 20p

LB4 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.
OUR PRICE
£4.50 P&P 20p

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 £10.50 P&P 30p

S100TR MULTIMETER TRANSISTOR TESTER

100,000ops. 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

ALL PRICES EXCLUDE VAT

Also see following pages

CI5 PULSE OSCILLOSCOPE

For display of pulsed and periodic wave forms in electronic circuits. VERT. AMP Bandwidth 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1–25; HOR. AMP. Bandwidth: 500kHz. Sensitivity at 100kHz VRMS/mm: 0.3–25. Preset triggered sweep 1–3000μsec. Free running 20–200 kHz at nine ranges. Calibrator pips 720 x 360 x 430mm. 115–230V AC.

OUR PRICE £43.00 Carr. paid

RUSSIAN C116 Double Beam OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2μsec 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 £19.95 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 6-volt battery. 100 micro-amp meter indication. Size 7½" x 5" x 2".

OUR PRICE £25.00 P&P 30p

TE16A TRANSISTORISED SIGNAL GENERATOR

5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handyman. 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-200 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 £17.50 P&P 50p

TE22 SINE SQUARE WAVE AUDIO GENERATOR

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

OUR PRICE £24.95 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 100kHz. 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 MG100 SINE SQUARE WAVE AUDIO GENERATOR

Range 19–220,000Hz Sine Wave 19–100,000 Hz Square Wave Output Sine or Square wave 10v. P. to P. Size 180 x 90 x 90mm Operation 220/240v. A.C.

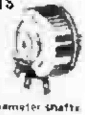
OUR PRICE £19.95 P&P 50p

SPECIAL BARGAIN! FERGUSON 3406 HI-FI SPEAKERS

High quality 2 way speaker systems. 25 Watts 4–8 ohms 40Hz–18kHz. Size: 560 x 340 x 255mm. approx. Wood grain finish with black fronts.

OUR PRICE £22.50 PR P&P £1

POWER RHEOSTATS



High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating.

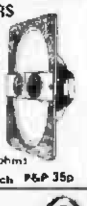
Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/25/50/100/500/1000/2500 ohms **£1.15** P&P 10p

50 WATT 10/50/100/250/500/1500/5000 ohms **£1.62** P&P 10p

100 WATT 1/5/10/25/50/250/500/2500 ohms. 100 Ohms **£2.34** P&P 15p

EMI LOUDSPEAKERS



Model 350 13 x 8" with single tweeter/crossover, 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.

OUR PRICE £7.50 each P&P 37p

Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms

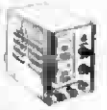
OUR PRICE £3.62 each P&P 35p

SPECIAL PURCHASE LIMITED QUANTITY! Tannoy 12" DR/8 Bass Speakers

8 ohms 30 watt Heavy duty, ideal for HI-FI P.A. Group

OUR PRICE £12.50. P&P 60p

PS200 Regulated POWER SUPPLY UNIT



Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 180 x 136 x 98mm

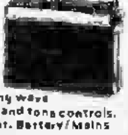
OUR PRICE £19.95 P&P 50p

AUDIOTRONIC LE-102A INTERCOM

Beautifully made and finished in two tone ivory/buff, the LE-102A is useful in the home, office or shop and is suitable for use as baby alarm. Wall or desk mounting 57mm speaker/mic gives clear 2-way communication with on/off and volume control on master unit. Operates on 9V batt. Approx. 60ft lead.

OUR PRICE £3.95 P & P 30p

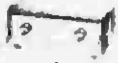
TRITON 4318 PORTABLE 8 TRACK CARTRIDGE PLAYER WITH MW/LW RADIO



Will play 8 track stereo cartridge monaurally. Channel selector switch. Covers medium and long wave bands. Volume and tone controls. Earphone socket. Battery/Mains operation.

OUR PRICE £11.95 P & P 50p

EA41 REVERBERATION AMPLIFIER



Self contained, transistorised, battery operated. Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverberation control. Beautiful walnut cabinet. 184 x 77 x 108mm.

OUR PRICE £7.50 P&P 30p

SPECIAL PURCHASES! RECORD DECK PACKAGE by Famous Manufacturer

GARRARD SP25 Mark III with G800 cartridge in luxurious plinth with cover.

OUR PRICE £13.95 P & P 75p

GARRARD SP25 Mark III Record deck fitted KS 40A cartridge

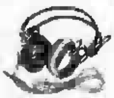
OUR PRICE £9.95 P & P 50p

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.

OUR PRICE £1.97 P&P 30p

DH02S STEREO HEADPHONES



Wonderful value and excellent performance combined. Adjustable head band. Impedence 8 ohms 20–12,000Hz. Complete with lead and plug.

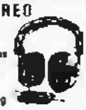
OUR PRICE £2.25 P&P 30p

TE1035 Stereo HEADPHONES

Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz–18kHz. Complete with cable and stereo jack plug.

OUR PRICE £2.60 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

BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms.

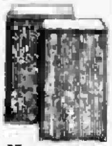
OUR PRICE £5.95 P&P 30p

HANIMEX HRC 3075 CASSETTE RADIO

Covers Medium and FM wave bands. Slider volume and tone controls. Battery/Mains operation. Will record direct from radio or through built in condenser microphone. Complete with batteries, earphone, and cassette.

OUR PRICE £24.30 P & P 50p

SPECIAL BARGAIN !! STEREOSOUND SPEAKERS



Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 368 x 220 x 190mm. 8 ohms. 8 watts RMS. 16 watts peak. Complete with Din lead.

OUR PRICE £12.95 PAIR P&P 50p

FM TUNER CHASSIS

6 transistor high quality tuner. Size only 153 x 101 x 63mm. 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.

OUR PRICE £8.95 P&P 20p

Stereo Multiplex Adaptor £5.95 extra

SPECIAL OFFER! SAVE OVER 50%

AMSTRAD 8000 2 Stereo amplifier 7 watts per channel rms. Inputs for tuner, tape, phono. Headphone socket. List price £29.95.

OUR PRICE £12.95 P & P 60p

SPECIAL OFFER! CONVERT YOUR STEREO SYSTEM TO 4D SOUND FOR UNDER £16

Exclusive offer of GOODWIN 4-CHANNEL CONVERTER and a pair of AD15 10 watt 8 ohm bookshelf speakers enables you to add 4D sound to your existing system. Complete with simple connection details. Normal retail value £25.50.

OUR PRICE £15.80 P & P £1

GOODWIN CONVERTER available separately £3.35 P & P 50p.

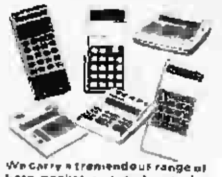
Model A1018 FM TUNER

6 transistor high quality unit—3 IF stages and double tuned discriminator. For use with most amplifiers. Covers 88–108MHz. Powered by 9V battery.

OUR PRICE £13.50 P&P 30p

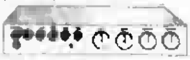
Stereo multiplex adapter £5.95 extra.

ELECTRONIC CALCULATORS



We carry a tremendous range of both pocket and desk calculators from as little as £9. Owing to the demand it is not possible to include them in this advertisement. So send for our latest price list or call into any branch.

SINCLAIR SYSTEM 2000 STEREO AMPLIFIER AND TUNER



2000 AMPLIFIER

Amplifier output 8 watts per channel RMS. Distortion less than 0.06%. Silicon transistors. Two pick-up plus radio and tape inputs, tape output and scratch filter. Excellent Value. List £39.95

OUR PRICE £27.50 P & P 60p.

2000 FM TUNER

Excellent selectivity and sensitivity. Twin dual-varicap tuning. 4 pole ceramic filter. 19 transistor stereo demodulator giving 40 dB seperation. Distortion 0.2% output. Fantastic Value. List £39.95

OUR PRICE £27.50 P & P 60p.

SINCLAIR IC12 INTEGRATED CIRCUIT AMPLIFIER

complete with printed circuit mounting board.

OUR PRICE £1.50 P & P 15p.

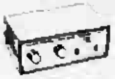
SINCLAIR Project 80 Modules

Z40 Power Amp.	£6.95	P & P 15p
Z60 Power Amp.	£7.45	P & P 15p
Stereo 80 Pre-Amp	£13.95	P & P 15p
Active Filter Unit	£7.45	P & P 15p
FM Tuner	£13.95	P & P 15p
Stereo Decoder	£8.95	P & P 15p
PZ5 Power Supply	£6.95	P & P 15p
PZ6 Power Supply	£8.95	P & P 30p
PZ8 Power Supply	£8.45	P & P 30p
Transformer for PZ8	£4.05	P & P 50p
IC20 Stereo Amp. kit	£7.95	P & P 15p
PZ20 Power Supply kit	£5.95	P & P 30p

SINCLAIR Project 80 Packages

2x Z40/Stereo 80/PZ5	£20.00	P & P 35p each
2x Z40 Stereo 80/PZ6	£31.30	
2x Z60/Stereo 80/PZ8	£33.85	

TE1021 Stereo Listening Station



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on off slide switch, stereo headphone socket.

OUR PRICE £2.25 P&P 15p

AUDIOTRONIC LOW NOISE CASSETTES

TYPE	5	10	25
C60	£1.57	£3.00	£7.08
C90	£2.24	£4.25	£10.00
C120	£2.73	£5.17	£12.24

AUDIOTRONIC 8 TRACK CARTRIDGES

TYPE	Each	5	10
40M	85p	£4.00	£7.50
80M	£1.15	£5.40	£10.25

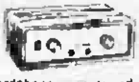
P&P Cassettes 3p, Cartridges 5p each. OVER 10 of either POST FREE!

MP7 MIXER-PREAMPLIFIER

5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 10k.

OUR PRICE £8.97 P&P 20p

AUDIOTRONIC AHA101 Stereo Headphone Amplifier



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

OUR PRICE £8.50 P&P 30p

HIGH QUALITY CONSTRUCTION KITS

JOSTY KIT

WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£5.61
AF25 Mixer	£3.29
AF30 Mono pre-amplifier	£3.20
AF35 Emitter amplifier	£2.42
AF80 0.5W mic. amplifier	£4.86
AF305 Intercom	£7.67
AF310 2 Mono Amplifier	£7.55
M160 Multivibrator	£2.18
M1302 Transistor tester	£6.33
M191 VU Meter	£5.37
M192 Stereo balance meter	£5.83
LF380 Quadraphonic device	£8.42
AT5 Automatic light control	£3.75
AT30 Photo cell switch unit	£6.68
AT50 400W triac light dimmer/speed control	£6.16
AT56 2,200W triac light dimmer/speed control	£6.75
AT60 1 channel light control	£10.82
AT65 3 channel light control	£18.82
GU330 Tremolo unit	£6.10
HF61 Diode detector	£3.07
HF65 FM transmitter	£3.21
HF75 FM receiver	£3.66
HF310 FM tuner	£16.32
HF325 Deluxe FM tuner	£26.33
HF330 Decoder (HF310/325)	£10.55
GP310 Stereo pre-amplifier for use with 2 x AF310	£22.90
GP312 Circuit board	£10.02
GP304 Circuit board	£9.33
HF380 Iw/vhf aerial amplifier	£6.02
HF395 broadband aerial amp.	£7.10
NT10 Stabilised power supply 100mA, 9V	£6.27
NT300 Stabilised p. supply	£13.16
NT310 Power Supply 240 V AC or 2 x 18 V D.C. at 2 amps	£5.64
NT305 Voltage converter	£5.64
NT315 Power supply 240V AC to 1.5/15V DC 500mA	£12.06

Amateur Electronics by Josty-Kit, the professional book for the amateur—covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 listed below.

OUR PRICE £3.30 (No VAT) P&P 25p plus VAT.

AE1 100mW output stage	£1.55
AE2 Pre amplifier	£1.32
AE3 Diode receiver	£2.05
AE4 Flasher	£1.26
AE5 Astable multi-vibrator	£1.14
AE6 Monostable multivibrator	£1.11
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50-0-50uA	£3 75		
100-0 100uA	£3 70		
1mA	£3 66		
5mA	£3.66		
10mA	£3.86		
50mA	£3.66	10V DC	£3.66
100mA	£3.86	20V DC	£3.66
500mA	£3.86	50V DC	£3.65
1A DC	£3 85	300V DC	£3.65
5A DC	£3 85	15V AC	£3.75
10A DC	£3 65	300V AC	£3.75
5V DC	£3.85	VU Meter	£3.90

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

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100uA	£4 60		
500uA	£4 30		
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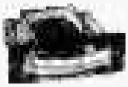
100-0-100uA	£4 48		
1mA	£4 30		
1A DC	£4 30		
5A DC	£4 30		
20V DC	£4 30	150V AC	£4 46
50V DC	£4 30	300V AC	£4 45
300V DC	£4 30	VU Meter	£4.90

EDGWISE MODEL PE70
Size: 90 x 34mm



50uA	£4.15
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500uA	£3 90
50-0-50uA	£4.10
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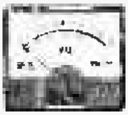
15V DC	£7 60	1/5A DC	£8 60
		1A/15A DC	£8 60

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm



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50-0-50uA	£5.40		
100-0-100uA	£5 35		
500-0-500uA	£5 30		
1mA	£5 20		
1-0-1mA	£6.20		
5mA	£5.20		
10mA	£6.20		
50mA	£5.20		
100mA	£5 20	300V DC	£5 20
500mA	£5 20	15V AC	£5 30
1A DC	£6.20	300V AC	£5.30
5A DC	£5 20	S Meter 1mA	£5 20
15A DC	£5 20	VU Meter	£5 55
30A DC	£5.40	1A AC	* £8 20
10V DC	£5 20	5A AC	* £5 20
20V DC	£5.20	10A AC	* £5 20
50V DC	£5.20	20A AC	* £5 20
150V DC	£5.20	30A AC	* £6 20

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CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

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100uA	£4 25		
200uA	£4 20		
500uA	£4.18		
50-0 50uA	£4 26		
100-0-100uA	£4 20		
1mA	£4.10		
5mA	£4.10		
10mA	£4 10		
50mA	£4 10	10V DC	£4 10
100mA	£4.10	20V DC	£4 10
500mA	£4 10	50V DC	£4.10
1A DC	£4 10	300V DC	£4 10
5A DC	£4 10	15V AC	£4 29
10A DC	£4.10	300V AC	£4 20
5V DC	£4.10	VU Meter	£4 40

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

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200uA	£3.10		
500uA	£3 00		
50.0-50uA	£3.15		
100.0 100uA	£3.10		
500.0 500uA	£2.95		
1mA	£2.96		
5mA	£2 96		
10mA	£2.95		
50mA	£2.96		
100mA	£2.95		
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5A DC	£2 96	VU Meter	£3.40
10V DC	£2 95	1A AC	* £2.95
20V DC	£2 96	5A AC	* £2.95
50V DC	£2 96	10A AC	* £2.95
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15V AC	£3 05	30A AC	* £2 96

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200uA	£3.00		
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100-0 100uA	£3.00		
500 0 500uA	£2.80		
1mA	£2 80		
1-0 1mA	£2.80		
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10mA	£2 80		
20mA	£2 80		
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150mA	£2 80	100V DC	£2 80
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5A DC	£2 80	150V AC	£2 90
10A DC	£2 80	300V AC	£2 90
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15V DC	£2.80	VU Meter	£3 20

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Size: 59 x 46mm

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1mA	£3.30		
5mA	£3.30		
10mA	£3 30		
50mA	£3.30	10V DC	£3.30
100mA	£3.30	20V DC	£3.30
500mA	£3 30	50V DC	£3 30
1A DC	£3 30	300V DC	£3 30
5A DC	£3 30	15V AC	£3 45
10A DC	£3 30	300V AC	£3 45
5V DC	£3 30	VU Meter	£3.85

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Size 86 x 78mm

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100 0 100uA	£3 80		
500 0 500uA	£3 70		
1mA	£3 70		
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5mA	£3 70		
10mA	£3 70	[illegible]	£3 70
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100mA	£3 70	50V AC	£3 80
500mA	£3.70	150V AC	£3 80
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5A DC	£3 70	500V AC	£3 80
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20A DC	£3 80	1A AC	* £3 70
30A DC	£3 85	5A AC	* £3 70
50A DC	£4 05	10A AC	* £3 70
5V DC	£3 70	20A AC	* £3 70
10V DC	£3 70	30A AC	* £3 70
15V DC	£3.70	50mA AC	* £3 70
20V DC	£3.70	100mA AC	* £3 70
50V DC	£3.70	200mA AC	* £3 70
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Size 80 x 80mm

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1mA	£4 20
1A DC	£4 20
5A DC	£4.20
20V DC	£4 20
50V DC	£4.20
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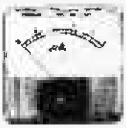
VU Meter	£4.70

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



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500uA	£3 35		
50-0-50uA	£3 50		
100-0-100uA	£3 45		
1mA	£3 30		
5mA	£3.30		
10mA	£3.30		
50mA	£3.30		
100mA	£3.30		
500mA	£3.30		
1A DC	£3.30		
5A DC	£3.30	S Meter 1mA	£3.30
10V DC	£3.30	VU Meter	£3.80
20V DC	£3.30	1A AC	* £3 30
50V DC	£3.30	5A AC	* £3 30
300V DC	£3 30	10A AC	* £3 30
15V AC	£3.40	20A AC	* £3 30
300V AC	£3.40	30A AC	* £3 30

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Size: 80 x 80mm

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100uA	£3 95		
500uA	£3 65		
50-0-50uA	£3 95		
100-0-100uA	£3 90		
500-0-500uA	£3 60		
1mA	£3 60		
1-0-1mA	£3 60		
5mA	£3 60		
10mA	£3.60		
50mA	£3.60	300V DC	£3 60
100mA	£3 60	30V AC	* £3 60
500mA	£3 60	50V AC	* £3.60
1A DC	£3 60	150V AC	* £3 60
2A DC	£3 60	300V AC	* £3 60
5A DC	£3.60	500V AC	* £3 60
10A DC	£3 60	VU Meter	£4 10
15A DC	£3.60	1A AC	* £3 60
30A DC	£3.60	5A AC	* £3 60
50A DC	£3.80	10A AC	* £3 60
5V DC	£3.60	20A AC	* £3.60
10V DC	£3.60	30A AC	* £3 60
15V DC	£3.60	50A AC	* £3 60
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½	CF	22–1M	1	0·75	0·60	0·55	5·5x16
⅛	MF	10–2M7	2	1·54	1·32	1·1	3x7
½	MF	10–2M2	2	1·43	1·21	0·99	4·2x10·8
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4·7µF	63V	6½p	150µF	16V	6½p
6·8µF	63V	6½p	150µF	63V	15p
8·0µF	40V	6½p	220µF	6·4V	6½p
10µF	16V	6½p	220µF	10V	6½p
10µF	25V	6½p	220µF	16V	8p
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16µF	40V	6½p	470µF	6·4	9p
22µF	25V	6½p	470µF	40V	20p
22µF	63V	6½p	680µF	16V	15p
32µF	10V	6½p	680µF	40V	25p
33µF	16V	6½p	1000µF	16V	20p
33µF	40V	6½p	1000µF	25V	25p
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250V: 0·05µF, 0·1µF, 6p. 0·25, 6p. 0·5µF, 7½p. 1µF, 9p. 500V: 0·025, 0·05, 6p. 0·1, 6p. 0·25, 7½p. 0·5, 9p. 1000V: 0·01, 11p. 0·022, 13p. 0·047, 0·1, 15p. 0·22, 23p. 0·47, 34p.

Integrated Circuits

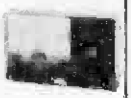
µA709C	49p
µA741C	50p
µA723C	98p
ZN414	£1·30

Screened Wire, Metre	6½p
Twin Screened Wire, Metre	12p
Stereo Screened Wire, Metre	12p
Connecting Wire, All colours, Metre	2½p
Neon Bulb, 90V Wire Ended	5 for 24p
Panel Neon, 240V Red, Amber, Clear	20p

ZENER DIODES
Low cost 400mW Tol ± 7%
All values E24 series 3V-30V

1-24	25-99	100-499	1000—
9p	7½p	6½p	5½p

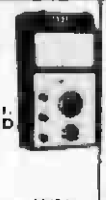
MULTIMETER U4323



22 Ranges plus AF/IF Oscillator 20,000Ω/Volt.
Vdc—0·5—1000V in 7 ranges
Vac—2·5—1000V in 6 ranges
Idc—0·05—500mA in 5 ranges
Resistance—5Ω—1MΩ in 4 ranges.
Accuracy—5% of F.S.D.
OSCILLATOR—1 KHz and 465 KHz (A. M.) at approx. 1 Volt.
Size—160 x 97 x 40mm
Supplied complete with carrying case, test leads and battery.
PRICE £8·30 net p & p 25p.

U4323

MULTIMETER U4341



27 Ranges plus Transistor Tester.
16,700Ω/Volt. Overload Protected.
Vdc—0·3—900V in 8 ranges.
Vac—1·5—750V in 6 ranges.
Idc—0·06—600mA in 5 ranges.
Iac—0·3—300mA in 4 ranges.
Resistance—2KΩ—2MΩ in 4 ranges.
Accuracy—dc—2½%, ac—4% of F.S.D.
hfe—10—350 in 2 ranges.
Size—115 x 215 x 90mm.
Complete with steel carrying case, test leads, and battery.
PRICE £11·30 net p & p 30p.

U4341

NEW CAPACITOR KITS

C280 Kit—PC Mounting polyester 250V. 5 of each value: 0·01 0·022, 0·047, 0·1, 0·22µF. 2 of 0·47, 1µF. £1·30 net.

C296 Kit—Tubular polyester. 400V. 5 of each value: 0·01, 0·022, 0·047, 0·1, 0·22µF. 2 of 0·47µF. £1·30 net.

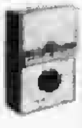
Ceramic Kit—square plaquette 50V. 5 each value: 22, 33, 47, 100, 220, 330, 470, 1000pF, 2200, 4700pF, 0·01µF. £1·30 net.

250V Paper kit—Tubular metal case. 3 of each value: 0·05, 0·1, 0·25, 0·5, 1µF. 90p net.

500V Paper Kit—Tubular metal case. 3 of each value: 0·025, 0·05, 0·1, 0·25, 0·5µF. 90p net.

1000V Paper Kit—Tubular metal case. 3 each value: 0·01, 0·025, 0·05, 0·1µF. £1·10 net.

MULTIMETER U4324



34 Ranges. High sensitivity.
20,000Ω/Volt. Overload protected.
Vdc—0·6—1200V in 9 ranges.
Vac—3—900V in 8 ranges.
Idc—0·06—3A in 6 ranges.
Iac—0·3—3A in 5 ranges.
Resistance—25Ω—5MΩ in 5 ranges
Accuracy—dc and R—2½% of F.S.D.
ac and db—4% of F.S.D.
Size—167 x 98 x 63mm.
Supplied complete with storage case, test leads, spare diode, and battery.
PRICE £9·95 net p & p 25p.

U4324

MULTIMETER U4313

33 ranges. Knife edge with mirror scale.
20,000Ω/Volt. High accuracy. mVdc—75mV.
Vdc—1·5—600V in 9 ranges.
Vac—1·5—600V in 9 ranges.
Idc—60—120 microamps in 2
Idc—0·6—1500mA in 6 ranges.
Iac—0·6—1500mA in 6 ranges.
Resistance—1KΩ—1MΩ in 4 ranges.
db scale—−10 to +12db.
Accuracy—dc—1½%, ac—2½%
Size—115 x 215 x 90mm.
Complete with steel carrying case, test leads, and battery.
PRICE £13·40 net p & p 30p.

U4313

S-DeC

S-DeC	£2·14
T-DeC	£3·92
µDeC "A"	£4·30
µDeC "B"	£7·53

ANTEX

CCN240	£2·43
CN240	£2·01
X25	£2·01

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2" scale
100µA
500µA
1mA
5mA
10mA
50mA
100mA
500mA
1A
All at £3·75

Dalo Pen	98p
"expert" solder gun	£6·56
Wire pack 5 x 5mtrs.	27p
Diode pack (Ge) 50 for	25p
Jackson "00" 365pF	98p
C804, 5pF, 10pF, 15pF	83p
20pF, 25pF, 50pF	89p
60pF, 75pF, 100pF	98p
Dilecon 100, 300, 500pF	£1·15
LED. TIL 209	5 for £1
Panel l/holder 4 colours	22p
R'ry Sw'chs. 1P12W, 2P6W, 3P4W, 4P3W 6P2W	30p

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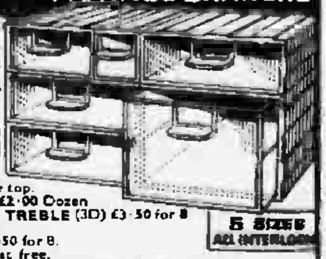

5 SIZES ALL INTERLOCK

SINGLE UNITS (5"×2½"×2½") £2·00 Dozen
DOUBLE UNITS £3·50 Dozen. **TREBLE** (3D) £3·50 for 8
DOUBLE TREBLE £4·90 for 8.
EXTRA LARGE SIZE (6D1) £4·50 for 8.
Carriage 40p. Orders over £10 post free.
QUANTITY DISCOUNTS! 5% in £1 for orders over £15 7½% over £30, 10% over £50. Quotations for large quantities.
PLEASE ADD 8% VAT TO TOTAL REMITTANCE.

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BD2 Chassis/SAU2 £32·50
SAU2 £14·25
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4000DB Reel to Reel Dolby £149·50
1721L Special Offer £77·95
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CS33D £79·95
Akai CR81D 8-track Rec. player £73·95

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Chassis Speakers
EMI (Plain) 13in x 8in, 3, 8 or 15 ohm Bass unit £2·30
with Single Tweeter (only 8ohm) £2·45
with Twin Tweeter £3·95
Type 350 Kit 15 watt 8 ohm £8·25
13in x 8in Bass unit 15 watt 8 ohm £4·95
8in x 5in 5 watt 3, 8 or 15 ohm £1·50
8in x 5in 10 watt Dualcone 8 ohm £2·50
6½" 10 watt 8 ohm £2·65
8in 10 watt 8 ohm £3·90
12in 20 watt 8 ohm £6·95
Fane 8in 4 or 15 ohm £2·25
Fane 7in x 4in 3 or 8 ohm £1·20
Elac 8in 8 ohm Dualcone £2·50
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Baker Group 25 12in 8 or 15 ohm £7·95
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Denton 1 pr. £26·75
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Linton 2 pr. £38·95
Glendale 3 pr. £58·95
Kingsdale 3 ea. £60·95
Dovedale 3 ea. £42·95

KITS
Linton 2 £19·50
Glendale 3 £33·95
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SPEAKER CABINETS IN KIT FORM (Teak Veneer)
12in x 8in x 6in (8 x 5 or 7 x 4 cutout) £2·50
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18in x 11in x 9in (8" x ½" or 13 x 8) £4·50
22in x 14in x 9in (12" & ½" or 13 x 8) £6·25

TWEETERS & CROSSOVERS
EMI 3½" c/magnet in 3 or 8 ohm £1·25
Cone Tweeter 10 watt 8 or 15 ohm (K2006) £2·50
Cone Tweeter 3 watt 8 ohm (K2003) £1·55
Horn Tweeter 8 ohm (K2007) £6·50
Dome Tweeter 8 ohm (K2011) £5·50
2-way Crossovers (CN23, CN28, CN216) £1·20
3-way Crossover (CN38) £2·75

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.	1·75	1·25
BSR		
X5M or X5H cryst. comp.	1·75	1·25
SX6M or SX6H cryst. ster.	2·00	1·25
SC5M ster./ceram	2·75	1·25
SONOTONE		
9TAHC or 9TAHC/G (Diam.)	1·85	1·25
3509 Magnetic	1·90	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	4·75	3·45
M55E	5·50	4·25
M75ED Type 2	10·75	6·99
M15EJ Type 2	8·75	4·99
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Condenser Mic. 600 ohm uni-dir £9·50
Cassette Stick Mic. with R/Control £1·60
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Sansui SS10 £14·20
Headphone adaptor (Junction box) £2·50
extension lead 2ft curly £1·35

CASSETTES

	C40	C60	C90	C120
Low Noise	—	35p	45p	55p
Philips	—	55p	75p	110p
Memorex	65p	75p	110p	155p
Ampex (360)	45p	55p	70p	99p
Ampex (20·20+)	59p	65p	99p	135p
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Casette Head Cleaner 45p
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BIB Stereo Test Cassette £2·15
Cassette Racks (hold 6) £0·45
Cassette Rotating Racks (hold 20) £3·50
Cassette Carrying Case (BIB) (hold 12) £1·60

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 & CASSETTES

	Stnd	LP	DP	Cases
5"	55p	65p	1·00	20p
5¾"	65p	86p	1·35	25p
7"	80p	110p	1·85	30p
High frequency Ampex				
5"	—	1·40p	1·55p	
7"	—	1·90p	2·95p	

AKAI Metal Reel 7" £1·99

CALCULATORS
Sinclair Cambridge Build £19·95
Scientific £29·95

SINCLAIR PROJECT 80
Stereo Pre-amp. £11·95
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MA5003 Head Set Radio LW £7·95
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VTR165 LW/MW/VHF £22·00
VTR127 LW/MW/VHF £15·50
VTR178 VHF/MW/2SW/AIR M/Batt £27·50
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CLOCK RADIOS
Bush CR128 LW/MW £13·40
Bush CR232 MW/VHF £24·95
Murphy MV5600 MW/VHF £22·95

CASSETTE RECORDERS
Murphy BA206 £16·95
Bush TP66 M/Batt £25·75
Murphy BA200 M/Batt £22·75
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RADIO CASSETTES (Mains/Batt.)
Micado 8155 AM/FM £25·95
Murphy BA209 MW/VHF £33·50

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Bush SPR58 £29·50
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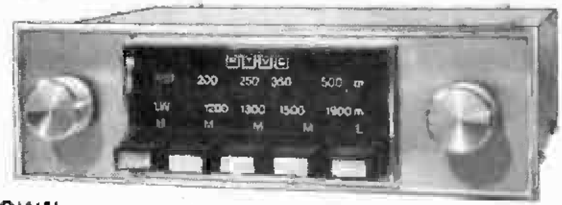
R T V C FOR AUDIO ON A BUDGET

PUSH BUTTON CAR RADIO KIT

The Tourist II



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.

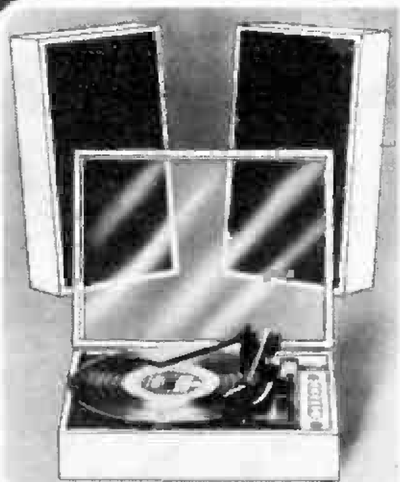
Car Radio Kit £7.70 + 55p p & p

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 II
Price £6.60 + 55p p & p.

Technical specification:
(1) **Output** 4 watts R.M.S. 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 live 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

Speaker including baffle and fixing strip **£1.65+23p. p&p.**
Car Aerial Recommended — fully retractable and locking **£1.37+20p. postage & packing**



*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 ceramic 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** + £1.60 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. **£3.85.**

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. **£7·64 + 55p. p&p**

8TRACK 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 eleswhere at £24.00 approx. Yours for only
£11.95 + 90p p & p.

COMPLETE* STEREO SYSTEM

System 1. £51·00

40 Watt Amplifier. Viscount III – R102 now 20 watts per channel.
System I includes:
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. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K, equalised within ±1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter 12dB per octave. *Signal to noise ratio:* (all controls at max.) −58dB. Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″.
Garrard SP 25 Mk III deck with magnetic cartridge, de luxe plinth and hinged cover.
Two Duo Type II matched speakers – Enclosure size approx. 17½″ × 10¾″ × 6″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter. 10 watts handling.

Complete System £51·00

System 2. £69·00

Viscount III amplifier (As System I)
Garrard SP 25 Mk III deck (As System I)
Two Duo Type III matched speakers – Enclosure size approx. 27″ x 13″ x 11½″
Finished in teak veneer. Drive units 13″ x 8″ bass driver, and two 3″ (approx.) tweeters.
20 watts R.M.S., 8 ohms frequency range — 20 Hz to 18,000 Hz.

Complete System £69·00

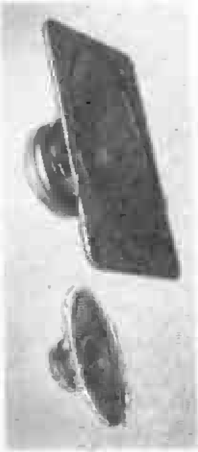
PRICES: SYSTEM 1	
Viscount III R102 amplifier	£24.20 + £1 p & p
2 Duo Type II speakers	£14.00 + £2.20 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p
total: £59.20	

Available complete for only:
£51·00
+ £3.50 p & p

PRICES: SYSTEM 2	
Viscount III R102 amplifier	£24.20 + £1 p & p
2 Duo Type III speakers	£39.00 + £4.00 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p
total: £84.20	

Available complete for only:
£69·00
+ £4.00 p & p

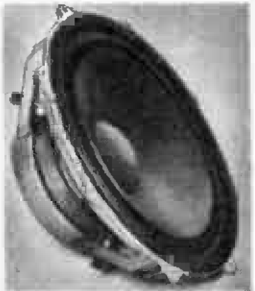
EMI SPEAKERS AT FANTASTIC REDUCTIONS



20 WATT SPEAKER SYSTEM

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

OUR PRICE £6.60. Complete +90p p & p.



15″ 14A/780 BASS UNIT

Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3″ voice coil.

Recommended retail price £40·80.
OUR PRICE £18·70 + £1·50 p&p

950 KIT

Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19″ × 14″ (approx.) high efficiency Bass Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each 3½″ dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms Bass coil 2″, others 0·5″.
Recommended list price £44·00

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FOR DISCO PAGE AND DETAILS OF HOW TO ORDER – TURN OVER...

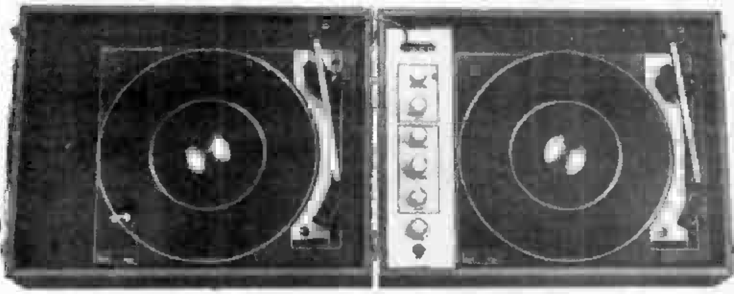
PORTABLE DISCO CONSOLE

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. single play professional series decks, fitted with crystal cartridges.

The turntables are designed and precision engineered. They combine clean modern styling with superb reproduction. Their many special features include square section aluminium tonearms, (high precision low mass design fully counterbalanced, with calibrated stylus pressure control for perfect tracking), and conveniently grouped easy to read linear controls. The turntables have viscous cueing devices which allows the tonearms to be placed or lifted at any point on the record.

The two lightweight cartridge shells have slide-in-holders to facilitate easy inspection of needles and 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 – $17\frac{3}{4}$" × $13\frac{3}{4}$" × $8\frac{3}{4}$" (approx.)
Unit Open – $35\frac{1}{2}$" × $13\frac{3}{4}$" × $4\frac{1}{4}$" (approx.)
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.

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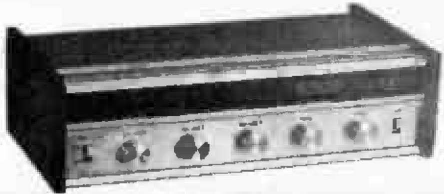
DISCO 50

45 WATT R.M.S. MONO DISCOTHEQUE AMPLIFIER
Ideal for Disco Work. Output Power: 45 watts R.M.S. Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K. Size: $19\frac{3}{4}$" × $10\frac{1}{2}$" × 8" (approx.) Amplifier £27.50 + £1.50 p. & p.



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Outputs 20 watts R.M.S. 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.

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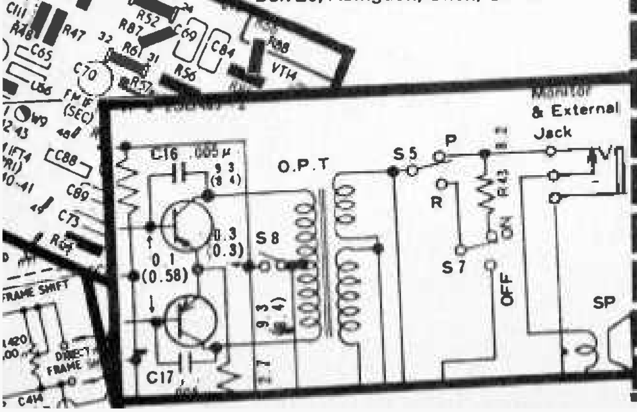

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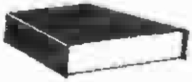

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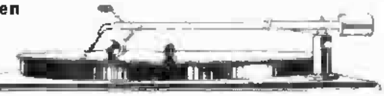

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Type	Amps.	Price	P & P
MT50/½	½	£1·93	30p
MT50/1	1	£2·42	35p
MT50/2	2	£3·80	40p

CARTRIDGES
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GP91-1SC 200mV at 1·2cm/sec £1·8
GP93-1 280mV at 1cm/sec £1·8
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J-2006S Stereo/Hi Output £1·7
J-2105 Ceramic/Med Output £1·9
J-2203 Magnetic 5mV/5cm/sec. including stylus £4·9
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AL10/AL20/AL30 AUDIO AMPLIFIER MODULES

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po – 3 WATTS f=1KHz	0·25%
LOAD IMPEDANCE	—	8 – 16 Ω
INPUT IMPEDANCE	f=1KHz	100 k Ω
FREQUENCY RESPONSE ± 3dB	Po=2 WATTS	50 Hz – 25KHz
SENSITIVITY for RATED O/P	Vs=25V. Rl=8Ω f=1KHz	75mV. RMS
DIMENSIONS	—	3" × 2½" × 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL = 8Ω f = 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL 10	3 watts	RMS	£2·19
AL 20	5 watts	RMS	£2·60
AL 30	10 watts	RMS	£3·01

PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20) £4·35
PA 100. (Use with AL30 & AL60) £13·15

POWER SUPPLIES

PS 12. (Use with AL10, AL20, AL30) 68p
SPM 80. (Use with AL60) £3·25
FRONT PANELS FP 12 with Knobs £1·10

TRANSFORMERS

T461 (Use with AL10) £1·38 P & P 15p
T538 (Use with AL20, AL30) £1·93 P & P 15p
BMT80 (Use with AL60) £2·15 P & P 25p

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 Pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm

Frequency response— 20Hz – 50KHz (– 3dB)
Bass control— ± 12dB at 60Hz
Treble control— ± 14dB at 14KHz
*Input 1. Impedance 1 Meg. ohm
Sensitivity 300mV
†Input 2. Impedance 30 K ohms
Sensitivity 4mV

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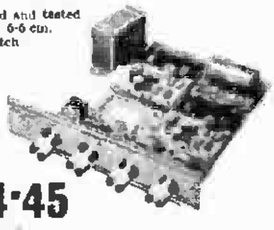
The STEREO 20



The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 6·6 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls. Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 100mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic Distortion- Bass control ±12dB at 50Hz typically 0·25% at 1 watt. Treble cut ±14dB at 14kHz.

£14·45

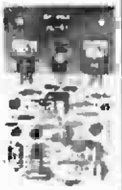
TC20 TEAK VENEERED CABINET

For Stereo 20 (front board undrilled) size 16¼" x 8¼" x 3", £3·95, plus 30p postage

SHP80 STEREO HEADPHONES

8-16 ohms impedance. Frequency response 20 to 20,000Hz Stereo/mono switch and volume controls £4·95

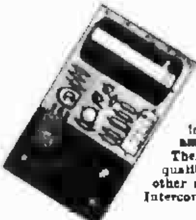
NOW WE GIVE YOU 50w PEAK (25w R.M.S.) *PLUS* THERMAL PROTECTION! The *NEW* AL60 Hi-Fi Audio Amplifier FOR ONLY £3.95



- Max Heat Sink temp. 90°c.
- Frequency Response 20Hz to 100KHz
- Distortion better than 0·1% at 0·1KHz
- Supply voltage 15-50 volts
- Thermal Feedback
- Latest Design Improvements
- Load—3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F enthusiast.

STABILISED POWER MODULE SPM80



SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address Intercom Units, etc. Handbook available 10p **PRICE £3·25**

TRANSFORMER BMT80 £2·15 p. & p. 28p

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch; volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz — 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	3·25 mV into 50K Ω
2. Radio, Tuner	75 mV into 50K Ω
3. Magnetic P.U.	3 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20 KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than – 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £13·15

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £25.30 FREE p. & p.

MK 60 AUDIO KIT

Comprising: 2 x AL60, 1 x SPM80, 1 x BTM80, 1 x PA 100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets. Complete Price: £28·75 plus 30p postage

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16¼" x 11¼" x 3½", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets etc. Kit price: £9.95 plus 30p postage

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DM70	0·61	ECL83	0·68	EY501	1·08	PL82	0·48	30C1/PCF80	0·54
DY51	0·80	ECL86	0·64	GZ34	0·77	PL83	1·09	30C15/PCF800	1·01
DY86/7	0·41	EF80	0·42	PC86	0·95	PL84	0·87	30C17	1·01
DY802	0·46	EF83	0·98	PC88	0·95	PL504	0·89	30C18/PCF805	1·00
EABC80	1·03	EF85	0·42	PC97	0·42	PL508	1·19	30F5/PF818	1·03
EB91	0·64	EF86	1·15	PC900	0·36	PL509	1·66	30FL1/PCF800	0·80
EBC81	0·79	EF89	1·14	PCC84	0·54	PL802	1·89	30FL2	0·80
EBF80	0·58	EF91	0·80	PCC88	0·86	PY33	0·65	30FL12	1·13
EBF83	0·59	EF92	1·37	PCC89	0·64	PY81/800	0·49	30FL14	0·94
EBF89	0·53	EF95	1·46	PCC189	0·80	PY82	0·58	30L1/PCC84	0·54
EC86	0·73	EF183	0·60	PCF80	0·54	PY88	0·56	30L15/PCC805	1·03
EC88	0·76	EF184	0·60	PCF82	1·23	PY500A	1·02	30L17	0·89
EC90	0·86	EH90	0·66	PCF86	0·64	PY800	0·49	30P4MR	1·27
EC97	0·60	EL34	0·92	PCF200	1·00	PY801	0·49	30P12/PC801	1·01
ECC81	0·47	EL36	1·01	PCF201	1·01	U26	0·88	30P19/PC802	0·89
ECC82	0·44	EL81	0·85	PCF801	0·64	U191	0·88	30PL1/PCL801	1·04
ECC83	0·47	EL84	0·47	PCF802	0·70	U193	0·64	30PL13/PCL800	1·15
ECC84	0·64	EL85	0·86	PCF806	0·64	UABC80	0·90	30PL14/PCL88	1·34
ECC85	0·71	EL86	0·92	PCH200	1·14	UBC81	0·71	30PL15	1·18
ECC88	0·84	EL91	0·00	PCL82	0·56	UBF89	0·58		
ECC189	0·88	EL95	0·70	PCL83	0·64	UCC85	0·59		
ECF80	0·57	ELL80	2·00	PCL84	0·60	UCH81	1·12		
ECF82	0·66	EM84	1·19	PCL85	0·64	UCL82	0·70		
ECF86	0·68	EM87	1·10	PCL86	0·64	UCL83	0·70		
ECH81	1·15	EY51	0·79	PCL805/85	0·64	UF89	0·80		
ECH83	0·94	EY86/7	0·40	PD500	1·88	UL84	0·82		
ECH84	1·02	EY88	0·72	PFL200	0·88	UY85	0·64		
ECL80	0·67	EZ80	0·64	PL36	0·89	6/30L2/ECC804	0·98		
ECL82	0·60	EZ81	0·38	PL81	0·77	6F23/EF812	1·03		
				PL81A	0·89				

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A21	0·76	EF39	1·25	N78	3·50	PY500	1·10	6F28	0·75
A231	0·60	EF80	0·35	OA2	0·45	PY81/800	0·50	6J5M	0·65
CBL31	1·40	EF85	0·45	OB2	0·45	PY801	0·65	6J5G	0·20
CL33	1·60	EF86	0·50	PC86	0·65	SP41	3·00	6J6	0·35
CY31	0·60	EF89	0·35	PC88	0·65	SP61	0·85	6J7G	0·30
DAF91	0·40	EF91	0·40	PC97	0·55	T41	1·00	6J7M	0·65
DAF96	0·60	EF92	0·50	PC900	0·55	U14	0·75	6K8GT	0·80
DCC90	1·35	EF95	0·45	PCC84	0·45	U25	1·00	6K7G	0·35
DF91	0·40	EF98	0·80	PCC88	0·62	U26	0·85	6K7M	0·45
DF96	0·60	EF183	0·40	PCC89	0·55	U191	0·75	6K8G	0·45
DK91	0·50	EF184	0·40	PCC189	0·55	UABC80	0·40	6K8M	0·70
DK92	1·00	EL32	0·80	PCF80	0·40	UAF42	0·75	6K25	1·00
DK96	0·75	EL33	2·00	PCF82	0·42	UBC41	0·60	6L6G	0·55
DL92	0·50	EL34	0·70	PCF86	0·65	UBC81	0·50	6Q7G	0·40
DL94	0·48	EL36	0·80	PCF801	0·60	UBF80	0·50	6Q7M	0·60
DL96	0·55	EL37	2·50	PCF802	0·55	UBF89	0·50	6SL7GT	0·55
DY86	0·42	EL41	0·90	PCF805	0·90	UCC85	0·50	6SN7GT	0·55
DY87	0·45	EL42	1·65	PCF806	0·80	UCH42	0·80	6SQ7GT	0·40
DY802	0·47	EL84	0·35	PCF808	0·90	UCH81	0·50	6U5G	1·25
EABC80	0·38	EL95	0·60	PCL82	0·45	UCL82	0·40	6V6G	0·30
EAF42	0·70	ELL80	2·00	PCL83	0·70	UCL83	0·70	6V6GT	0·60
EB91	0·25	EM80	0·55	PCL84	0·60	UF41	0·75	6X4	0·45
EBC33	1·00	EM81	0·60	PCL85	0·60	UF89	0·30	6X5G	0·45
EBC41	0·75	EM84	0·40	PCL86	0·50	UL41	0·85	6X5GT	0·55
EBC81	0·40	EM85	1·00	PCL805/85	0·60	UL84	0·50	7B6	0·80
EBF80	0·40	EY51	0·45	PD500	1·50	UY41	0·65	7B7	0·80
EBF83	0·40	EY86	0·45	PEN45	0·65	UY85	0·45	7C5	1·30
EBF89	0·32	EZ40	0·60	PL36	0·63	VR105/30	0·40	7C6	1·00
EBL31	2·00	EZ41	0·75	PL81	0·55	VR150/30	0·45	7H7	0·80
ECC81	0·45	EZ80	0·30	PL82	0·50	OA2	0·45	7R7	0·60
ECC82	0·38	EZ81	0·31	PL83	0·50	OB2	0·45	7S7	2·25
ECC83	0·38	GY501	0·90	PL84	0·50	1R5	0·50	7Y4	0·80
ECC84	0·35	GZ30	0·65	PL500	0·85	1S5	0·40	12AT6	0·45
ECC85	0·45	GZ32	0·55	PL504	0·85	1T4	0·40	12AT7	0·45
ECC88	0·50	GZ34	0·75	PL508	0·90	3S4	0·50	12AU6	0·50
ECH35	1·50	GZ37	1·25	PL509	1·55	3V4	0·85	12AU7	0·38
ECH42	0·85	HN309	1·50	PL802	1·00	5R4GY	1·00	12AX7	0·88
ECH81	0·35	KT61	2·00	PX4	3·50	5U4G	0·56	12BA6	0·50
ECH83	0·50	KT66	2·50	PX25	3·50	5Y3GT	0·65	12BE6	0·60
ECL80	0·60	KT81 (FC5)	1·30	PY33	0·63	5Y4G	0·60	30C1	0·40
ECL82	0·48	KT81	1·75	PY81	0·45	5Z4G	0·65	30C15	1·00
ECL83	0·75	KT88	2·90	PY82	0·45	6/30L2	0·90	30C17	1·00
ECL86	0·55	KTW61	1·50	PY83	0·50	6AK5	0·45	30C18	0·90
ECLL800	3·50	MU14	1·00	PY88	0·50	6AM5	1·00	30F5	1·00
EF37A	1·20					6AQ5	0·50	30FL1	1·00
						6AS7G	1·00	30FL2	0·75
						6AT6	0·60	30FL14	0·90
						6AU6	0·40	30L15	0·85
						6BA6	0·38	30L17	0·95
						6BE6	0·45	30P4MR	1·30
						6BH6	0·75	30P12	1·00
						6BJ6	0·75	30P19	0·95
						6BQ7A	0·65	30PL1	0·95
						6BR7	1·20	30PL13	1·10
						6BR7	1·40	30PL14	1·10
						6BW6	1·00	35W4	0·60
						6BW7	1·00	35Z4GT	0·70
						6C4	0·40	50CD6G	1·20
						6CD6G	1·25	807	1·00
						6CH6	1·50	813ITT	14·00
						6CW4	1·00	813USSR	8·00
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AAZ13	0.10	BF115	0·22	OC20	2·00	ZTX503	0·16	2N2904A	0·25
AAZ15	0·10	BF167	0·25	OC23	1·25	ZTX531	0·25	2N2905	0·32
AC107	0·35	BF173	0·28	OC25	0·40	ZTX550	0·18	2N2905A	0·25
AC126	0·25	BF179	0·33	OC28	0·70	1N914	0·08	2N2906	0·20
AC127	0·25	BF180	0·35	OC35	0·55	IN4001	0·6	2N2926	0·10
AC128	0·20	BF181	0·35	OC36	0·65	IN4002	0·7	2N3053	0·20
AC176	0·25	BF194	0·12	OC42	0·40	IN4003	0·8	2N3055	0·60
AC187	0·20	BF195	0·13	OC44	0·13	IN4004	0·8	2N3525	0·80
AC188	0·20	BF197	0·15	OC45	0·12	IN4005	0·10	2N3614	0·59
ACY21	0·22	BF200	0·32	OC71	0·15	IN4006	0·12	2N3615	0·65
ACY39	0·65	BF861	0·26	OC72	0·26	IN4007	0·12	2N3702	0·11
AD140	0·60	BF898	0·25	OC76	0·30	IN4009	0·08	2N3703	0·12
AD149	0·60	BFX29	0·28	OC77	0·55	1N4148	0·08	2N3704	0·14
AD161	0·39	BFX88	0·22	OC81	0·28	1R921	0·07	2N3705	0·12
AD162	0·39	BFY50	0·20	OC81D	0·28	IS2033	0·20	2N3706	0·10
AF115	0·25	BFY51	0·20	OC81Z	0·45	IS2051A	0·10	2N3707	0·13
AF116	0·25	BFY52	0·20	OC83	0·25	IS2100A	0·20	2N3708	0·07
AF117	0·20	BFW10	0·61	OC140	0·65	IS3010	0·25	2N3709	0·10
AF186	0·40	BY100	0·15	OC170	0·25	2N696	0·15	2N3710	0·11
AF239	0·44	BY126	0·14	OC171	0·30	2N697	0·15	2N3711	0·11
ASY27	0·30	BY127	0·15	OC200	0·55	2N708	0·10	2N3819	0·35
ASY29	0·25	BZX61 series	0·20	OC201	0·90	2N706A	0·12	2N3820	0·60
BA102	0·25	BZY88 series	0·10	OC202	0·90	2N1131	0·25	2N3823	0·50
BA115	0·10	CR81-05	0·30	OC203	0·55	2N1132	0·25	2N3903	0·15
BC107	0·12	CR81-40	0·45	OCP71	1·00	2N1302	0·15	2N3904	0·20
BC108	0·12	CR83-05	0·40	ORP12	0·55	2N1303	0·18	2N3905	0·25
BC109	0·12	CR83-40	0·55	ORP60	0·45	2N1304	0·22	2N3906	0·15
BC113	0·15	MJE340	0·50	T1005	0·20	2N1305	0·22	2N4058	0·15
BC117	0·21	MJE370	0·68	TIC44	0·29	2N1306	0·28	2N4059	0·10
BC143	0·80	MJE520	0·65	TIC226D	1·50	2N1307	0·28	2N4060	0·13
BC147	0·12	MJE2955	1·10	TIL209	0·25	2N1308	0·28	2N4061	0·12
BC148	0·10	MJE3055	0·75	ZTX107	0·12	2N1309	0·30	2N4062	0·14
BC169C	0·14	MPF102	0·40	ZTX108	0·10	2N1613	0·20	2N4289	0·20
BC182	0·12	MPF103	0·36	ZTX300	0·14	2N1614	0·45	3N141	0·81
BC182L	0·12	MPF104	0·36	ZTX301	0·14	2N2147	0·75	40360	0·40
BC184L	0·13	MPF105	0·46	ZTX302	0·20	2N2160	1·00	40361	0·45
BCY32	1·20	NKT404	0·60	ZTX304	0·24	2N2369A	0·15	40362	0·40
BCY33	0·23	OA5	0·60	ZTX500	0·15	2N2646	0·50	40430	0·85
BCY34	0·45	OA10	0·40						
BCY70	0·15	OA79	0·10						
BCY71	0·20	OA81	0·10						
BCY72	0·15	OA91	0·7						
BCZ11	0·65	OA200	0·08						
BD121	1·00	OA202	0·10						
BD124	0·80								
BD131	0·45								

SN7400	0·20	SN7425	0·37	SN7473	0·44	SN74107	0·51	SN74157	1·09
SN7401	0·20	SN7427	0·37	SN7474	0·48	SN74110	0·57	SN74170	2·88
SN7402	0·20	SN7428	0·48	SN7475	0·59	SN74111	0·86	SN74174	1·80
SN7403	0·20	SN7430	0·20	SN7476	0·45	SN74118	1·00	SN74175	1·29
SN7404	0·20	SN7432	0·37	SN7480	0·60	SN74119	1·98	SN74176	1·44
SN7405	0·20	SN7433	0·48	SN7482	0·67	SN74121	0·57	SN74180	2·30
SN7406	0·40	SN7437	0·48	SN7483	1·20	SN74122	0·80	SN74181	2·30
SN7407	0·40	SN7438	0·48	SN7484	1·00	SN74123	1·44	SN74192	2·30
SN7408	0·25	SN7440	0·20	SN7486	0·50	SN74141	1·00	SN74193	2·30
SN7409	0·23	SN7441AN	0·85	SN7490	0·74	SN74145	1·44	SN74194	1·72
SN7410	0·20	SN7442	0·85	SN7491AN	1·10	SN74150	2·30	SN74195	1·44
SN7411	0·23	SN7450	0·20	SN7492	0·75	SN74151	1·15	SN74196	1·53
SN7412	0·28	SN7451	0·20	SN7493	0·75	SN74154	2·30	SN74197	1·58
SN7413	0·30	SN7453	0·20	SN7494	0·85	SN74155	1·15	SN74198	3·16
SN7416	0·30	SN7454	0·20	SN7495	0·85	SN74156	1·15	SN74199	2·88
SN7417	0·30	SN7460	0·20	SN7496	1·00				
SN7420	0·20	SN7470	0·33	SN7497	4·32				
SN7422	0·28	SN7472	0·38	SN74100	2·16				
SN7423	0·40								

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As featured in the May 1973 issue of 'Practical Electronics'. Superb Hi-Fi tuner Kit now available from Electro Spares. Including cabinet and all components – pre-set Mullard modules for R.F. and I.F. circuits Motorola I.C. Phase Lock Loop Decoder for perfect stereo reception. No alignment needed. Guaranteed first time results – or send it back, and we'll return it in perfect order (for a nominal handling charge) Electro Spares price only £28.50 inc. VAT and p & p.

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★ Price List only. Please send S.A.E. (preferably 9 x 4 minimum) for full details.

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500 assorted resistors £1.35, 2500 £4.70. 150 poly, ceramic, mica etc capacitors 80p. 15 different trimmers airspaced and compression, up to 1250pF £1.

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100 sq. ins. assorted sizes and pitches (no tiny pieces) £1·10, approx 8 bits.

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Polished wooden cabinet 14 x 13 x 9" containing a sensitive (20μV) 4 valve amplifier with tone & volume controls. Gives 3 watts output to the 7 x 4" 3Ω speaker. Also a non-standard tape deck. Supplied in good working condition with circuit. Standard mains operation. £4.50. Suitable cassette £1·10. Spare head 33p. Tape (ex-computer) 75p. Amplifier chassis only, complete and tested (2xECC83, EL84, EZ80) and speaker £3.

VERSATILE POWER UNIT

Contains mains transformer, 2A thermal cut-out and bridge rectifier. Will give 1·7-10·5V output with 2 extra capacitors (supplied) £1.20 Also available as model garage with switch, lamp, jack plug etc. (Used for 'Hot Wheels') £1.70.

LEO III COMPUTER

Arriving late-October. All parts available, including 3000 reels tape, ½" decks, power units, etc.

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Contained in steel case 5½ x 5 x 3½" are 2xGET118 transistors on heat sinks, 3 pot cores, 2 30V zeners, 4 audio transformers, 1% resistors & caps. With circuit diagram £1.

7lb BARGAIN PARCELS

Hundreds of new components—Pots, resistors, capacitors, switches, + PC boards with transistors and diodes, and loads of odds and ends. Amazing value at only £2.30.

COMPUTER PANELS

3lbs asstd £1.40, 7lbs £2.65, 56lbs £15. Pack containing 500 components with at least 50 transistors 95p. 12 High quality panels with power transistors, trimpots, IC's etc £2.50. Thousands of boards at shops for callers from 5p.

SLOTMETER

Ex-Pay TV, takes 10p pieces, has 3 digit mechanical counter, coin counter, Sangamo-Weston impulse movement, nylon gearing, switch, etc. Only £1·20. Impulse movement only, 40p.

MISCELLANEOUS

Transformer, Mains pri 16-0-16V with 9V tap sec 1½A £2. Post office 4 digit counters 60p. Balanced armature earpieces, use as mic or spkr 20Ω impedance 30p. 2N3055 38p. Multimeters: good range in stock from £3·50.

All prices shown include 8% VAT and postage (mainland only) SAE list, enquiries.

GREENWELD ELECTRONICS (PW9)

Mail order dept., wholesale/retail shop 51 SHIRLEY PARK ROAD, SOUTHAMPTON. Tel 0703 772501. Other retail shops at 21 Deptford Broadway SE8, Tel 01-692 2009 and 38 Lower Addiscombe Road, Croydon. Callers Welcome.

Tele-Tennis

As described in Practical Wireless

Play the game that's sweeping the nation. You've seen it in pubs, clubs and arcades—now you can play it in the comfort of your own home.

Plugs into the aerial of your V.H.F. 625 Black & White or Colour television. No internal connections to your T.V. set. Does not interfere with other T.V. programmes. Built from 6 neat sub-sections, purchase a complete kit or sub-section at a time.

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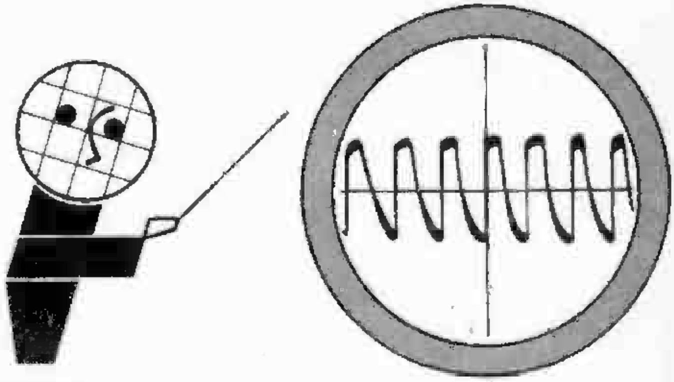

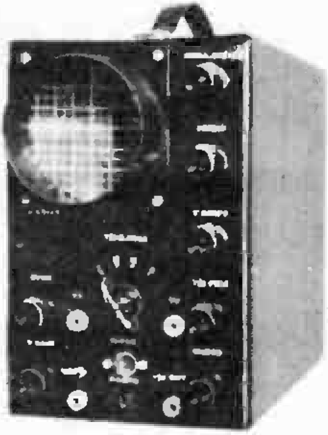

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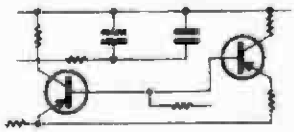

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CHIPS UNLIMITED!

WE have, from time to time, taken a peep at the pocket calculator market. It has been currently estimated that the world-wide production of chips for electronic calculators for 1974 will be of the order of 28 million units. This exploding market is one of the few fields in which prices are constantly dropping. If the present growth rate continues, it is estimated that there will be an electronic calculator shortage within two years!

There exists a veritable jungle in both price and selection. The prolific arrays of pocket calculators that are available to the consumer that dominate the windows and counters of our local high street shops are indeed bewildering. There appears to be a greater variety of pocket calculators than transistor radios!

A price war has emerged amongst major manufacturers—prices being slashed overnight and indeed putting many retail distributors and 'special offer' organisations on the spot! A recent overnight price reduction by a major manufacturer caused considerable embarrassment to many of his trade and retail outlets. This sort of fiasco is being repeated over and over again. Where will it all end?

One enterprising calculator manufacturer determined to display his 'chips' to members of the public has opened up a 'mobile shop' at a London main line railway station. By all reports, he is doing *fantastic* business.

What of the 'domestic' pocket calculator? Rumour has it that a basic calculator especially designed for the housewife may be launched. If so, this could be just the thing for calculating and analysing those shopping expeditions to the supermarket. The shopper would be able to check his totals at any time and at the till check-out point. I can foresee many red-faced supermarket managers attempting to explain away the differences that may occur between store and customer calculated totals.

The pocket 'memory' calculator with its inherent potential as a pocket computer, with the ability to recall stored information at the press of a button could be just around the corner!

What of the future? The pocket calculator could become as prolific as the ball-pen—a must for everyone.

However, the pessimists (optimists, if you prefer) are chanting 'Beware, Big Chip is watching you!' (shades of 1984). They could however be forecasting our future.

There is no doubt that the calculator chip has, in many ways, dramatically changed our whole way of life. The question is: are we all in the hands of the Big Chip?

LIONEL E. HOWES—Editor.

We're off to a good start in the New Year with our three part series on Model Control by Radio and we tell you how to get your licence for this most interesting of hobbies. Do you sometimes wish you had a small audio amplifier around for testing purposes? Our 2 watt IC audio amplifier will fill the bill. The Special Pre-publication Book Offer ought to appeal to many of our readers for all the useful information contained in Radio Servicing Pocket Book, a new 3rd edition. Finally, you won't want to miss the fourth and final part of the PW Buyers' Guide 1974/75. All in the January issue of Practical Wireless.

NEWS...

From Partridge . . .

AN ever increasing number of people are living in space restricted environments. Either through sheer lack of external facilities for the erection of aerials, the inability to receive radio signals inside ferro concrete walls, or the existence of local government legislation preventing the use of outdoor space for aerials, there are ever growing numbers of frustrated readers unable to pursue their hobby of Amateur Radio or Short Wave Listening.

For many years now Partridge Electronics Ltd., of Broadstairs, Kent have specialised in equipment designed to overcome this problem. Five years ago they published a reproduction of a World Record Certificate awarded to American Radio Amateur W6TYP. This was achieved by Mr. Art Child of San Francisco using the Partridge system operated from a hotel room at the foot of San Francisco's famous Nob Hill.

Partridge have now developed a device known as A.G.T.U., an Aerial Tuning Unit which also incorporates an Artificial Earth (or ground). This overcomes the only remaining problem of the high-rise apartment or flat dweller having no access at all to natural earth.

ON THE COVER...

PW's MINIATURE SCREWDRIVER

Don't despise this very useful workshop aid because it seems to be so small! How many times have you found that your 'small' screwdriver is just too wide or too thick for the grubscrew in a knob or the adjusting slot in a subminiature potentiometer?? The more you use it the more uses you will find for our little present!

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

Harrogate Fair

AUDIO '74 or the Northern International High Fidelity Festival at Harrogate was the biggest and best-attended ever. In 1970 there were only 50 exhibitors. 1972 saw 70 firms exhibiting their wares and this year over 90 companies decided to show their faces.

Over the last couple of years, there has been a marked increase in the amount of quadraphonic equipment on show. It is a pity that there seems to be little or no agreement on the kind of system to be favoured for quadraphonic reproduction.

We hope to include a short report on "Audio '74" in a future issue.

BBC tape deal

A CONTRACT to supply the BBC with more than 100,000 reels of TS Scotch 262 recording tape for stereo broadcasting has been awarded to 3M United Kingdom.

The contract, which is due to run until next June, is in addition to the 70,000 reels supplied to the BBC last year after close liaison between the Corporation's sound engineers and technicians from 3M's magnetic tape facilities at Gorseinon, near Swansea, and Caserta in Italy.

BEAB approval list

THIS list covers the first category of audio products in the BEAB Approval Scheme which have successfully met the requirements of the British Safety Standard BS.415: 1972.

Decca Radio & Television with the Decca DS623, ITT Consumer Products Ltd. (ITT KP 820, KP 821, KA 1026, and RGD PA 30, P 83). Pye Limited (Pye 5000 and Invicta 8040). Sony (UK) Limited (Sony HMW-20). Rank Radio International Ltd. (Bush A 1005, A 1016, BS 3013, Dansette A 4005, A 4016, and Murphy MS 3014). Thorn Consumer Electronics Ltd. (HMV 2046, Ferguson 3047, Marconiphone 4047, 4049, Ultra 6046, 6048.

Computer club

NOW moving into its second year of existence the Amateur Computer Club of Basildon, Essex has now formulised its activities into a constitution and elected officers for the year.

The club now has a firm membership of over 200 with a regular newsletter forming the nucleus of the club.

After two Annual General Meetings in London and committee meetings the start of a club activity schedule has emerged. The first of which was an open afternoon on the 25th May, 1974, at the Galdor Centre, 52 Brighton Road, Surbiton, Surrey.

The people at the Galdor Centre own and run an ICL 1301A computer (1960 vintage) which they have installed and made working to provide them and similarly interested persons with computer time at "materials only" cost.

Further activities are being arranged and will be announced in the newsletter which has also provided a unique forum for the airing of ideas and introducing basic principles to the beginner.

Articles in the newsletter have covered transistor working, design and operation of a digital core store, digital computer elements. computer software, software routines, descriptions of various computer systems both working and under design/development, news information items and computer games!

Club members are contributing articles to the newsletter resulting in some cross fertilisation of ideas among the members, which is one of the most important objectives of the club.

New members and ideas are very welcome, membership is £1·00 per year (that includes the near monthly newsletter) and applications should be directed to *Mike Lord, 7, Dordells, Basildon, Essex.*

Heathrow computer

CABLE and Wireless Ltd. have installed a new computer-based departure control system for airline passengers at London Airport. Japan Air Lines will use the system named "Lopac" which has been jointly developed by C & W and Scientific Control Systems Ltd.

Apart from speeding passengers' baggage check-in procedure, the system also allows for productivity expansion.

Lopac, incidentally, stands for Load Optimisation and Passenger Acceptance Control.

PW TOOL KIT OFFER

We apologise to our readers for the delay in dealing with their orders. The overwhelming demand created problems with delivery. If any readers have not received their tool kits, or a suitable alternative, would they kindly contact the Editor.

Javelin move

JAVELIN Electronics have closed down their City offices and moved to Javelin House, Second Way, Exhibition Grounds, Wembley, Middlesex HA9 OUA. (01-903-6821).

The new building contains the service department, a dealers' advice centre and a customer relations department.

Sansui 4-channel

THE sponsors of the "QS" 4-channel system, Sansui, are making moves to persuade artists in the UK to record material using their system.

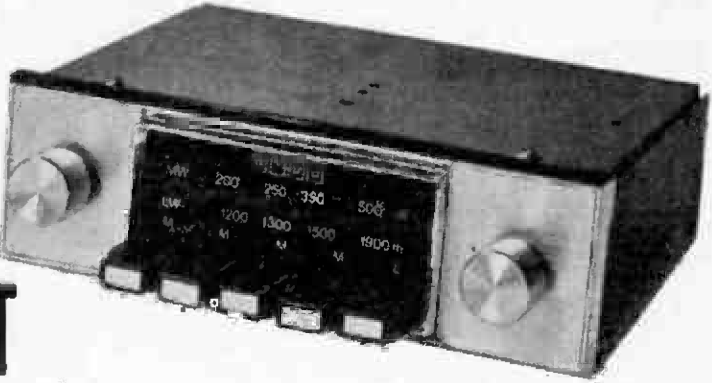
The "QS" regular matrix system has been accepted by the American and Japanese Recording Industries Associations and over 20 record manufacturers are producing software in the system.

It has been stated that at least one commercial radio station in the United Kingdom is thinking of using "QS" which has now been adopted by all f.m. stations in Japan.

SPECIAL PRODUCT REPORT

RT-VC

TOURIST II CAR RADIO KIT



I MUST confess from the start that I am not entirely unfamiliar with the RT-VC car radio having bought an earlier version some time ago. I spent a couple of evenings leisurely soldering the bits and pieces to the printed circuit board and putting the thing together, following the instructions most meticulously. On connecting it up to a 12 volt battery in the workshop the radio worked first time and with a tweak of the oscillator capacitor the calibration was done.

The set soon disappeared into the innards of my daughter's Triumph Herald. I was about to say 'never to be seen or heard of again' but that would be patently untrue since the radio is simple but elegant in appearance and can certainly be heard! Subsequently, the set came out for a further fiddle on the oscillator trimmer to enable London's Capital Radio to be tuned in right at the low frequency end of the medium wave band. A big improvement on the sideband splash that had been tolerated up to then!

This latest Tourist Two car radio kit has taken all the fun out of the home construction of kits and one would be hard pushed to say, with a clear conscience, that 'I made it myself'. Admittedly the earlier version of the PCB had a few components plus the audio IC already soldered in position but I suspect that RT-VC did this so that they could say 'look at our soldering . . . now you do the same'. In fact, they insisted that the constructor's soldering was as good as theirs before accepting back any kits for servicing or checking . . . and quite rightly so.

Now, alas, the PCB comes completely assembled and the soldering iron remains cold and unwanted! A pair of long nosed pliers and a small screwdriver are all the tools required with this new kit and the remaining assembly work is child's play. In the words of RT-VC 'the kit can be assembled in less than two hours by anyone who has the ability to wire a normal household three pin plug'.

Assembly

The assembly instructions are extremely detailed and I cannot think of any point that would arise that isn't dealt with already. RT-VC's guarantee says 'If, after receiving your Tourist kit, you feel that its construction is not within your capabilities we will refund you the full price of the goods, less post and packing, upon the return of all parts supplied on the condition that no constructional work been attempted and all parts are received in the same condition as dispatched'. I hope that the formidable appearance of the assembly instructions, fault-finding guide, installation instructions and six annotated photographs will not have the opposite effect and frighten off the prospective constructor!

Having completed the assembly you will want to know the polarity of your car's electrical system. If it is negative earth then the set is ready to go but if it is a positive earth then you have to change over two of the push-on tag connectors. Not very difficult! Should you decide ever to transfer the radio to a car of opposite polarity the change back can be made more quickly than it takes to tell.

Installation

RT-VC recommend a check-out of the set with the car battery before final installation in the car. Calibration takes a moment and the aerial trimmer is adjusted using the aerial that is to be fitted to the car. If all is well, and I'd be surprised if it wasn't, installation can now begin. RT-TV's instructions on this aspect are, again, as complete as they

SPECIFICATION

Tuning Range:- Medium Waves 185 to 555m (1620 to 540kHz)
Long Waves 1153 to 2000m (260 to 150kHz)

Sensitivity:- Better than 15μV at 1MHz

Output:- 4 watts to 4 ohm speaker

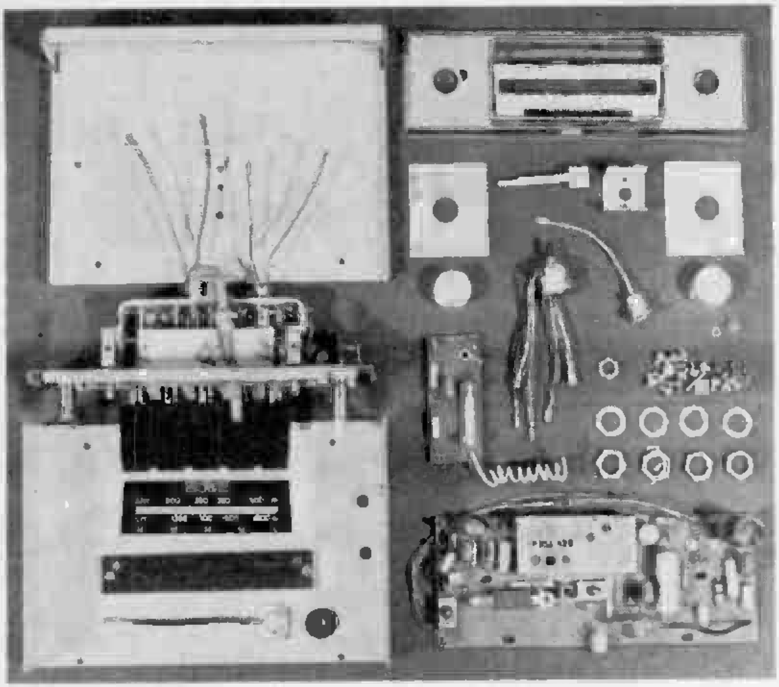
Controls:- Push-buttons (4 MW 1 LW), manual tuning control, volume/on-off

Dimensions:- 7" wide 2" high 4½" deep approx.

The supply voltage is nominally 12 volts. The polarity, relative to the case, can be changed over internally simply by reversing two push-on tags. The circuit is protected by an internal fuse and a VDR (voltage dependent resistor) against static discharge.

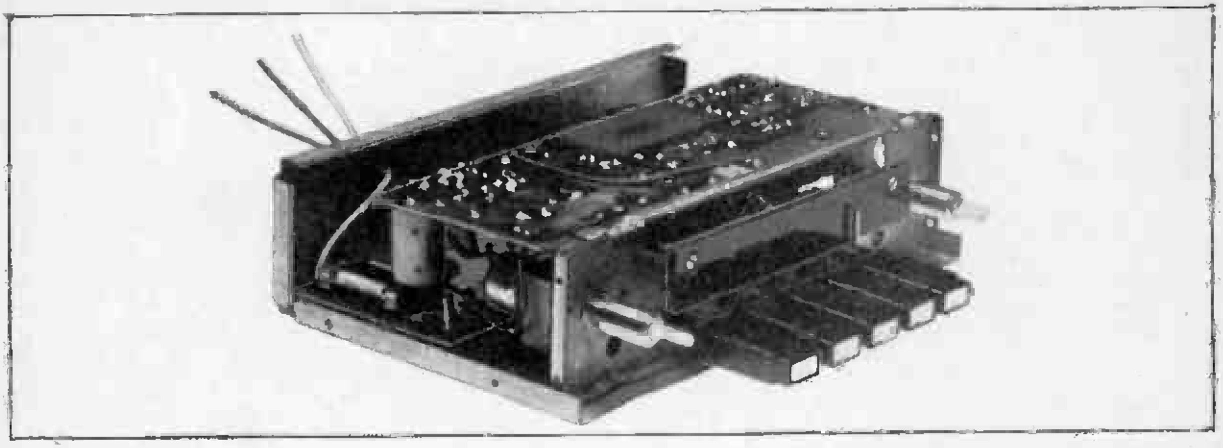
Prices:- Car Radio Kit £7·70 +55p P/P. Speaker, including baffle and fixing strip £1·65 +23p P/P. Car Aerial, fully retractable and locking £1·37 +20p P/P.

Radio and TV Components (Acton) Ltd., 21 High Street, Acton, London, W3 6NG



The contents of your kit will look like this, left. Between the metal casing is the permeability tuning unit and pushbutton assembly. Bottom right shows the complete PCB which is fully tested before despatch.

If the simple instructions are followed the almost finished set should look like that in the photograph below. Only the dial, escutcheon and knobs remain to be fitted plus the cover.



can be and cover every contingency. There is one point here that might be stressed. If you use the aerial available from RT-VC the feeder is about 4' 6" long and the aerial trimmer works perfectly, peaking signals as it should do, when the overall performance is excellent. However, if you need to fit the aerial to the car in such a position that requires the feeder to be extended then this must be done using a special extension lead otherwise performance will definitely be impaired. Using ordinary coaxial cable just will not work. This point is fully covered in the instructions.

Apart from the manual tuning over both bands, four of the push-buttons can be set very easily to any desired stations on the MW band, the fifth push-button selecting a station on the LW band, usually BBC Radio 2, the band change being automatically effected by the action of the push-button. If, for some strange reason, the set does not work at all, or unsatisfactorily, then the Fault Finding Guide will come to your aid and the answer found very quickly.

Interference

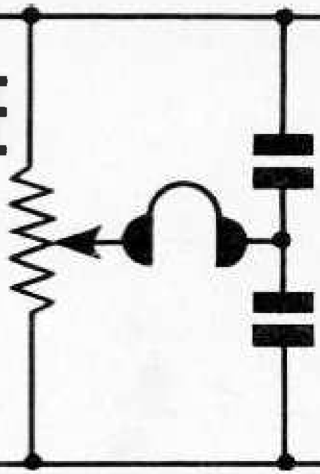
Having completed the installation and tested the radio to your satisfaction there is a chance that you will suffer a slight set-back when starting the car, because of interference to the radio from the various bits of electrical equipment. Generally, unless the car is a real old 'banger', normal suppression capacitors and other devices will be fitted to the car already and little trouble will arise. However, this matter is dealt with fully in the notes and if the logical sequence of checking is followed a rapid solution will be found.

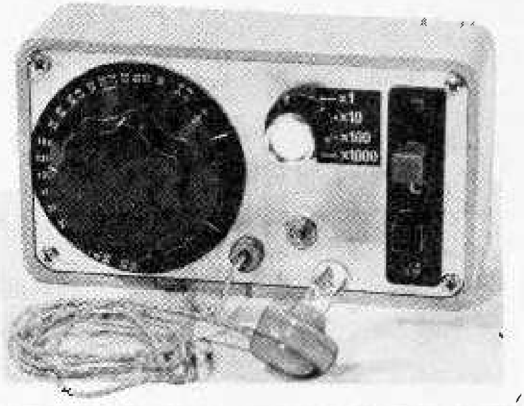
Conclusions

A very well designed kit with all the bugs ironed out long ago. Being a bit of a fiddler myself I would have liked the oscillator and aerial trimmer capacitors to be accessible from the outside of the case when the radio is installed in the car. I compromised by very carefully marking out and drilling two holes in the top cover of the case above the trimmers, sticking a bit of Sellotape over the holes when I had done fiddling. I wouldn't expect RT-VC to do anything about this point but I thought I'd mention it, got to complain about something!

Finally, I don't know how RT-VC do it at the price but I understand it is due to the purchasing in volume of proven components and direct retail sales. Certainly they are not contributing to the present inflationary movement!

INEXPENSIVE CAPACITY BRIDGE





ERIC DOWDESWELL G4AR

TEST gear is often conspicuous by its absence from the amateur's workshop, possibly because such equipment can be expensive to buy but, more likely, because it is not a justifiable outlay considering the relatively few occasions on which it would be used.

The capacity bridge described here is very cheap to make, will measure capacities from as low as 2pF and up to about 10μF and will be found to be quite adequate for general workshop use. Over a period the constructor manages to collect unto himself a quantity of capacitors that have had their markings removed in one way or another. This bridge will enable them to be measured, checked and used again. Incidentally, it is a very wise man who checks the value of every component before using it, regardless of colour code or marking, saving a lot of time and temper.

It is not everyone who has good eyesight and even slight colour blindness can cause confusion with colour coded components, generally with blues, browns and greens, which can lead to wrong values of resistors and capacitors being fitted to PCBs etc. This bridge will eliminate any such problems especially if it is used as a matter of routine.

The dial is simple and easily calibrated and used in conjunction with a four step multiplier switch. The consumption of the bridge is very low and the internal 9 volt battery will last a very long time.

DESIGN

As you may have guessed, a bridge circuit is used, what else! and was last seen in the Take 20 series in this magazine. In essence, the collector load resistor of the second transistor of an audio oscillator forms two sides of the bridge, Fig. 1, and, in practice, is a potentiometer. The other two sides of the bridge comprise a capacitor Cs of known value and Cx, the capacitor under test. If these capacitors have the same value then, for the bridge to balance, R1 will equal R2. A detecting device 'D' placed across the bridge will indicate a null in the audio tone under these conditions. If Cx is any other value then the bridge is unbalanced and 'D' will indicate this. Balance can be restored if the ratio of R1/2 is adjusted to have the same ratio as Cs/Cx.

In the practical circuit, Fig. 2, Cs is in the form of a four position multiplier switch with capacitors of 100pF, 1000pF, 0·01μF and 0·1μF all of close tolerance, the switch being marked x1, x10, x100

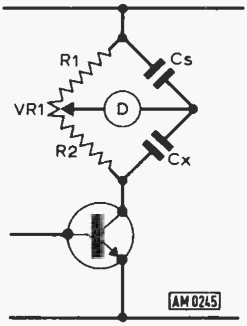


Fig. 1: This circuit illustrates how the collector load resistor of an audio oscillator is used as part of a capacity measuring bridge.

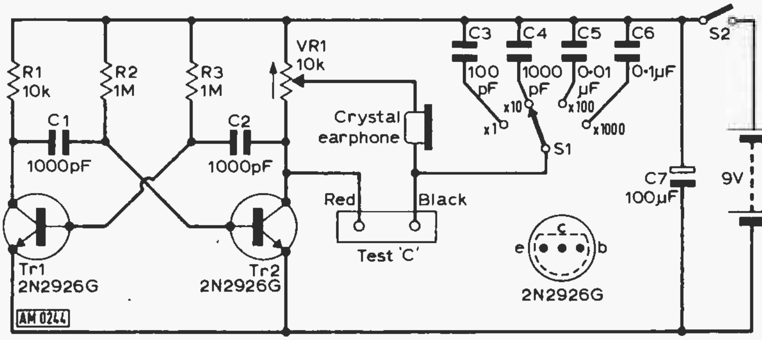
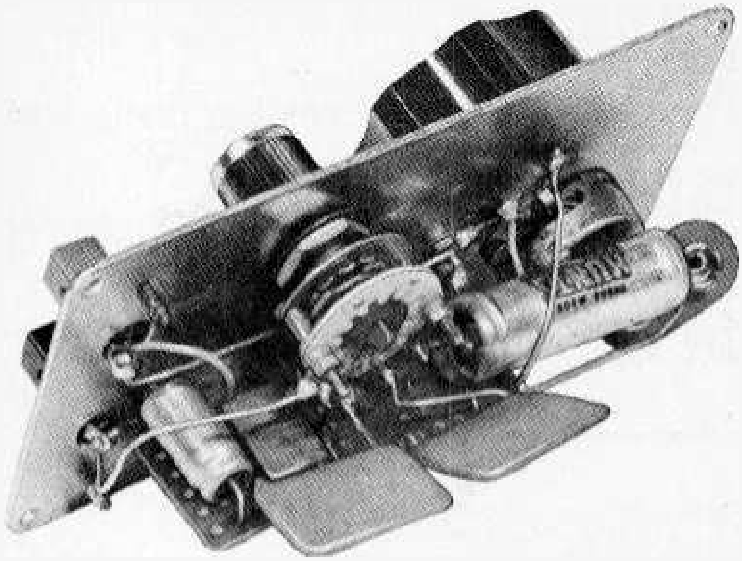


Fig. 2: Complete circuit of the capacity bridge derived from the basic circuit of Fig. 1. Other types of transistor such as BC109, BC149, BC169 can be used if due note is taken of lead-out connections.



In this inside view of the bridge the capacitors have been moved away from the switch S1 to show the circuit board.

and x1000. The capacitor under test is connected to the two terminals. Transistors Tr1 and Tr2 form a multivibrator circuit running at about 1kHz but the actual frequency is not of any great importance.

The detector is a simple crystal earphone of very high impedance, this factor contributing very significantly to the excellent performance of the bridge, the minimal damping imposed by the earphone providing a deep sharp null at balance.

CONSTRUCTION

The bridge is housed in a heavy plastic box with all the components mounted on an aluminium panel. The oscillator components, with the exception of the potentiometer VR1, are assembled on a small piece of Veroboard as in Fig. 3. The bottom rail of the board is soldered to a tag bolted to the panel, providing adequate support for the board.

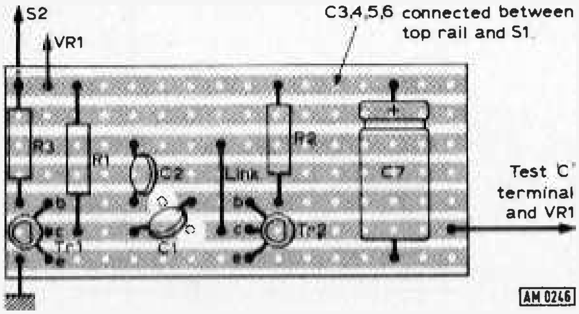


Fig. 3: Components comprising the audio oscillator are mounted on Veroboard as shown above.

The test terminals are spring loaded, their soldering tags passing through $^3/_8$in. holes drilled in the panel. The holes are purposely large to reduce self capacity. An alternative might be to use feedthrough insulators terminated on top of the panel with miniature crocodile clips on stiff leads. Whatever arrangement is used it is essential that a capacitor can be connected to the bridge and removed again very easily.

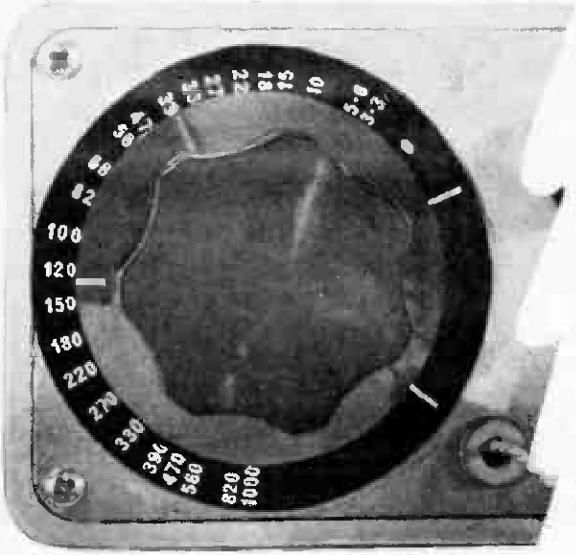
The potentiometer is a very ordinary linear carbon one with a plastic spindle, which, again, reduces self capacity but one with a metal spindle would probably work just as well. The dial was made from a disc of card held under the potentiometer fixing nut together with a pointer knob of such a size as to allow a single range of calibration figures to be marked on the dial. The dial is marked in the 'preferred' range of values corresponding to the standard markings on capacitors.

The crystal earphone is wired directly into the circuit, which again helps to reduce capacity. A combined phone jack and on/off switch was contemplated but a switch and isolated jack could not be found. If any doubt exists as to whether an earpiece is crystal or magnetic it can be checked with an ohmmeter. A magnetic one will show very low resistance whereas a crystal one will show, effectively, an open circuit. Just to make sure that you havn't got an open circuited magnetic earphone put it in the ear and check again with the meter when clicks should be heard even though the meter indicates an open circuit.

The multiplier switch used here is a miniature ceramic one but the more common plastic or paxolin wafer type will suffice. However, if the switch chosen has been used before it must be very thoroughly cleaned before using it in this bridge, for reasons which will be noted later. The standard capacitors C3 to C6 are wired directly between the switch tags and the top 9 volt rail on the circuit board. If a standard size switch is used it will be necessary to move the board down from the position shown in the prototype. It is a good idea anyway, with any project, to shuffle the components around for best positioning before drilling panels etc.

CALIBRATION

After the small amount of wiring is completed and checked, fit the PP3 battery and switch on when the audio tone should be heard in the earphone. The volume should be adjustable from maximum to zero using the potentiometer. Adjust the position of the knob on the potentiometer spindle so that the ends of its travel are positioned as shown in the photograph of the bridge. Mark these positions on the dial with a sharp pencil. With the multiplier switch on x1 a null should be found near the top of the dial, if the potentiometer has been wired as shown in Fig. 2. This represents the zero position of the bridge without any external test capacitor. Mark this point on the dial.



Close-up of the dial of the bridge. Note that the limits of travel of the potentiometer are also marked.

With a 100pF 1% capacitor connected to the terminals and multiplier on x1 find a new null at about mid position on the dial, then mark it. Turn multiplier to x10 and locate null not far inside the 0 mark. This is marked 10. Note that we have been able to find two points on the dial for one capacitor, using the multiplier. This feature can be used to cross check dial readings.

Change the test capacitor for one of 100pF 1% and mark the null at the bottom end of the dial. Switching to x10 should locate the null at the 100 point, already marked. The remainder of the calbration is done using 1% or 2% capacitors in the preferred range of 120, 150, 180, 220, 270, 330, 390, 470, 560, 680 and 820pF. The x1 multiplier is used to mark the remaining points between 100 and 1000pF and x10 for the points between 10 and 100pF.

TOLERANCES

For a general purpose bridge the cheaper 5% tolerance capacitors are quite adequate for calibration purposes but instead of having to buy the thirteen preferred values it is possible to make do with eight only, the missing values being obtained by paralleling certain capacitors as shown in the Table. There are probably other combinations possible by connecting capacitors in series or even series parallel!

The calibration can be completed with a fine ball point pen or a more fancy dial constructed, as shown in the photograph. As the end points of the potentiometer travel have been marked the dial can be removed for finishing or copying and then replaced without losing calibration.

CALIBRATION CAPACITORS (pF)

100	220	470
120	270*	560*
150	330*	680*
180	390*	820
	1000	

The capacitors marked * may be obtained by connecting other values in parallel, as follows:—

270 120 + 150   330 150 + 180
390 220 + 180   560 220 + 180 + 150
680 220 + 180 + 150 + 120

EXTENDING RANGE

As shown, the maximum capacity indicated on the dial is 1000 x 1000pF or 1μF but it was later found possible to extend this range to 10μF enabling small value electrolytic capacitors to be checked, although it should be remarked that there is no polarising voltage applied to the capacitor under test. Nevertheless the bridge has been found very useful for this purpose.

The accuracy of this extension to 10μF will depend upon the accuracy of a 1μF capacitor that is required for calibration. Again, a 5% tolerance will do as a 1% capacitor of this value is rather expensive. Connect across the test terminals and locate a null near to the bottom end of the travel, past the 1000 mark. The multiplier should be on x1000. The point can be marked 10nF for simplicity. Only two or three intermediate points are required such as 2200, 4700 and 6800.

IN USE

Normally the null will be very deep and sharp. In my own case, the audio tone actually disappears at the null point and I generally consider my hearing

★ components list

Resistors
R1 10kΩ 10% ¼ or ½W   R2/3 1MΩ 10% ¼ or ½W
VR1 10kΩ linear carbon potentiometer. See text

Capacitors
C1 1000pF 10%
C2 1000pF 10%
C3 100pF 1% SM
C4 1000pF 1% SM
C5 0·01μF 1% SM or Polystyrene
C6 0·1μF 1% Polystyrene
C7 100μF 16V electrolytic
Calibration Capacitors:—see text and table

Miscellaneous
Tr1/2 2N2926G. Crystal earphone. Battery 9V PP3, battery clips. On/off switch. Veroboard 0·15in. matrix, approx. 2½ x 1½in. Knob and dial. Terminals (2). Case and panel 5 x 2½ x 1½in. deep (Stella 99 series, from E. R. Nicholls 46 Lowfield Rd., Stockport, Cheshire.) S1, Single pole 4-way wafer switch.

to be better than average. If the null is not deep and seems to be undefined then the capacitor is probably leaky although it may be of the order of a few megohms. The effect can be simulated by connecting a high value resistor across a known good capacitor and testing the combination on the bridge. The lower the resistance the poorer will be the null. In the long run it is better to destroy such leaky capacitors at the time of testing rather than to leave them around to be used in equipment where the leakage might prove highly detrimental to the operation of a circuit.

AUDIO OSCILLATOR

The bridge can also be used as a source of audio tone for testing amplifiers and suchlike, the output being taken from the test terminals and adjustable from zero to maximum output with the potentiometer. The waveform is very rough, of course, coming from a multivibrator but quite adequate for general audio testing. If a Morse key is connected across the on/off switch the unit can be used as a Morse code practice set. A second crystal earpiece can be connected across the test terminals and, if two keys are connected in parallel, two-way simulated signalling will be possible. ■

PW TECHNICROSS PUZZLE No. 7

presented last month

[1]I		[2]A		[3]S	[4]H	O	[5]R	T	[6]W	A	[7]V	E
[8]M	A	P	S		I		H		I		E	
P		P			[9]S	P	I	N	N	E	R	S
[10]E	R	A	S	[11]E	S		N		D		A	
D		R		W		[12]S	E	T		[13]C		[14]E
[15]A	M	A	Z	E		T			[16]C	O	I	L
N		T		[17]S	C	A	N	[18]S		N		E
[19]C	H	U	M			F		[20]A	S	D	I	C
E		S		[21]V	[22]H	F		S		E		T
	[23]G		[24]T		U		[25]S	H	I	N	E	R
[26]F	E	R	R	A	N	T	I			S		O
	N		A		C		G		[27]L	E	A	D
[28]H	E	A	D	P	H	O	N	E		R		E

HOTLINES ON RECENT DEVELOPMENTS

MEASUREMENT

IT never ceases to amaze me that measurement in electronics gets more and more sophisticated as every day passes. On reflection this must be so because as the very latest devices are born, some means must be to hand with which to measure, accurately, their performance. At the recent International Microwave Exhibition at Montreux, for example, there were switches shown which could switch at 26GHz—that's twenty-six thousand million times every second! I might add that the man on the stand eagerly told me, "... and of course we're working on higher frequencies right now".

While frequency must be measured accurately, what about time? Latest to come to my attention is a time interval counter which is soon to be launched in America. The amazing thing about this one is that it has a resolution of 100 Femtoseconds. If you are not impressed then let me add that a Femtosecond is 0·001 of a picosecond and a picosecond is one millionth of a microsecond which, of course, is one millionth of the common or garden everyday household second. For the technical/boffin types it's 10^{-15} seconds. Just think if every Amateur radio station had one of these, it could tell its transmission frequency to a fraction of a cycle even at v.h.f.

TIMED CALCULATION

Electronic calculators and digital wrist watches always create interest but now I really have heard it all. The ultimate is about to be launched onto the market, something that will satisfy even the most pedantic of tiros. It's a digital wrist watch and calculator combined! The calculator part has a nine digit readout and offers forty functions. When it's not used as a calculator it functions as a digital watch. There are only 20 buttons on the calculator and here the designers have introduced a very crafty dodge.

Although only twenty buttons are employed (because of space considerations) there's a "shift key" which, when activated, gives the twenty buttons other functions thus giving a 40 button capability. This shift key acts something like the shift key on a typewriter which allows the same keys to be either capital letters or small, lower case letters. The watch/calculator measures about 1·5in x 1·5in x 0·5in. deep. The first models are rumoured to be priced at around £200–£250 but they're not available yet and probably won't be for some time. The buttons, incidentally, are depressed with a small probe, or tip of a ballpoint pen as far as I can ascertain. Information is rather scant because this is a state of the art unit and the information is red hot.

SOLID-STATE C.R.T?

A colleague in Washington reports that the US Army may soon lay its hands on a liquid crystal display which gives an 84-character output. It also might be used as a liquid crystal cathode ray tube. At present the company doing the development is waiting to get a Government grant with which to continue work. It is also rumoured that the prototype device is coupled up to a miniature warfare computer. If this development is well funded, it could be another avenue of development for the solid state c.r.t. for television receivers.

SOLID-STATE CAMERA

At the other end of the television signal—the camera, developments are pressing on with solid state sensors which will replace the vidicon camera tubes. This was highlighted at the recent conference on charge coupled devices (c.c.ds) which took place at Edinburgh University. Of great interest was mention (plus photograph) of a miniature entirely solid state television camera which was constructed by Bell Labs at Murray Hill, New Jersey. Another interesting fact about this television camera is that it is battery operated. The size was not mentioned but from objects in the photograph which include a ruler, it is judged to be of the order of 11cm x 6cm.

The camera uses a chip sensor which has 256 x 220 element array gives excellent results using NTSC scan rates and the author claims that television image sensors with 525 and 625 line capability are now a viable product. It must be remembered that solid state cameras will not come in over night. At present, users of the "valve" type camera tubes have only to plug in a component and it works whereas these solid state items are still being developed. However, with the world shortage of silver and the search for some other means of photography, it isn't too difficult to see the amateur photographer of the future holding a tiny solid state twin lens reflex which records directly onto tape which can then be played back on the television receiver at home.

These CCD devices are well worth watching. New applications are coming up and are being enthusiastically worked on. To date they are being used in TV applications, infra red cameras, delay lines, telecommunications, memories for computers and are even employed to generate a s.s.b. signal.

IT'S SIMPLE!

The servicing of televison sets has taken a step nearer to being automated. Grundig colour television receivers are currently manufactured in modular form. A number of modules are used in a plug-in fashion, each unit looking after a specific function within the receiver.

The offending module (in the case of malfunction) is simply unplugged and either repaired immediately or just replaced and then repaired at leisure in the workshop.

Some 75% of the colour television circuitry is catered for in this way. Now, Grundig has taken care of the other 25% by adding a simple socket to the receivers. A small diagnostic unit is then simply plugged in. The circuitry is featured on the lid of the diagnostic box, and l.e.ds mounted in this circuit diagram illuminate to pinpoint any fault.

Ginsberg

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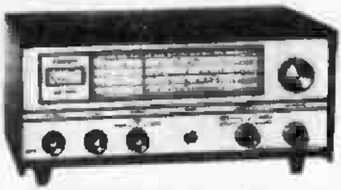

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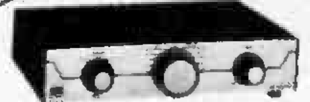

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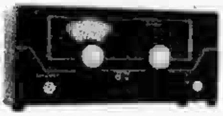

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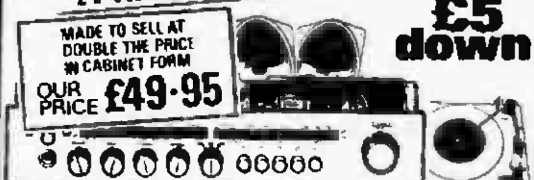

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MAKE YOUR OWN PCBs

JOHN JACKSON

For the amateur, printed circuit boards have good and bad points. They are neat, reduce free wiring, make assembly mistakes less likely and can support large items such as transformers. On the other hand, they take time to make and subsequent modification to them can be difficult.

Ready-made "universal" printed circuit boards may have no copper where it is required, will have it where it is not needed and mistakes during soldering are easy as different areas look alike. The design and preparation of individual boards is easy and the materials readily available.

DESIGN

The method used successfully for many projects is as follows. A fairly large copy of the circuit is drawn on thin paper, such as that used for typing (thin paper saves time later). All component junctions are ringed, as shown dotted in Fig. 1, to give the basic copper plan. Beneath this is drawn an outline, the size of the intended circuit board and, using components to check spacings, the basic plan is adapted to give a full size layout, Fig. 2.

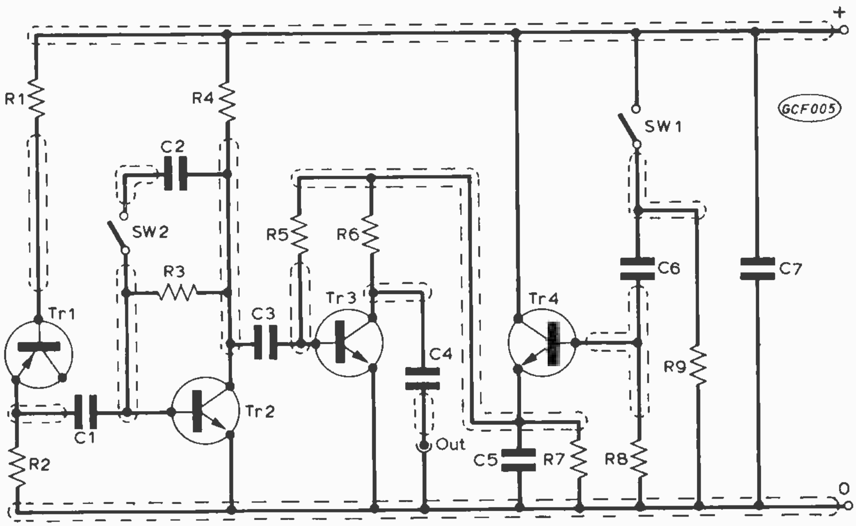

Fig. 1: This circuit, used to demonstrate the production of a printed circuit board, is of a Gunshot Simulator that appeared in the April 1972 issue of PW in the Take-20 series.

In the final layout it is advisable to keep input and output points apart and wires leaving the board are better near the edges. Fixing holes must be taken into account and copper should not be too close to these, to prevent shorting to metalwork. To avoid missing a component, a list can be made with each component written once for each wire: R1,1, R2,2, . . . Tr1.1.1. A number can be crossed off each time a connection is allowed for.

A negative of the plan must now be made. This is easily done by turning the paper over and drawing over the lines that should be visible. This plan is the master diagram, see Fig. 3.

It is possible to forget to reverse the plan, which is not serious with transistor circuits, but it will be tricky reversing a nine-pin valve-holder to match!

PREPARING THE BOARD

Copper laminate may be backed by fibreglass or SRBP, the latter being cheaper. Areas requiring copper, the "fields", are covered with resist and the unwanted metal is etched away. Resist can be from a purpose-made pen, such as a "Dalo" or use can be made of nail lacquer or paint (thinned enamel or cellulose).

First the board must be cut to size, with a hacksaw having a fine blade, cutting with the copper side up. After filing off any burred edges the copper must be thoroughly cleaned of grease or tarnish, using scouring powder on cotton wool. After rinsing and drying on a soft cloth the copper is ready for the resist and the board must be held only at the edges, as any grease may cause the resist to flake off and prevent areas from etching.

The board is then stuck beneath the master diagram, with a piece of Sellotape to reduce handling,

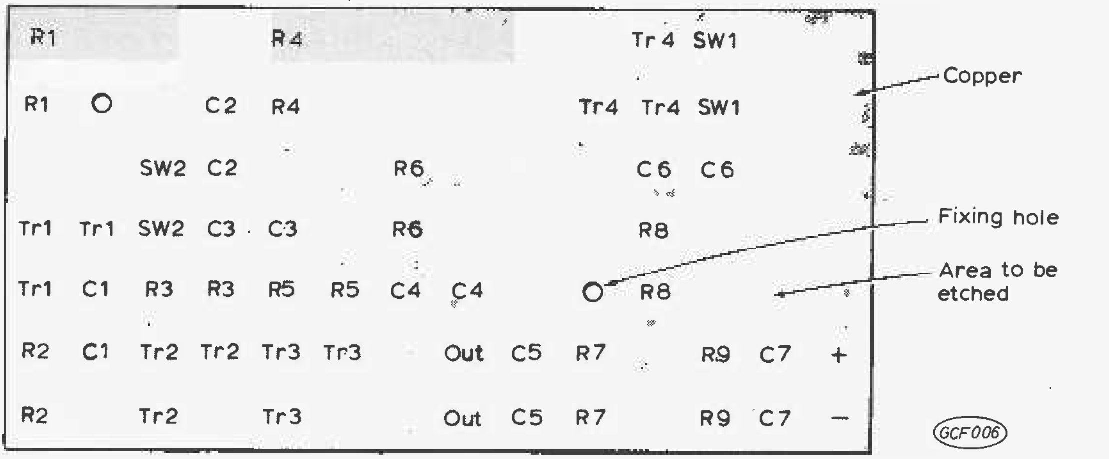

Fig. 2: The dotted areas of Fig. 1 are transferred to the paper master as shown here, the final layout depending upon the sizes of the components to be used. The copper will be on the other side of the board, which is shown here twice final size.

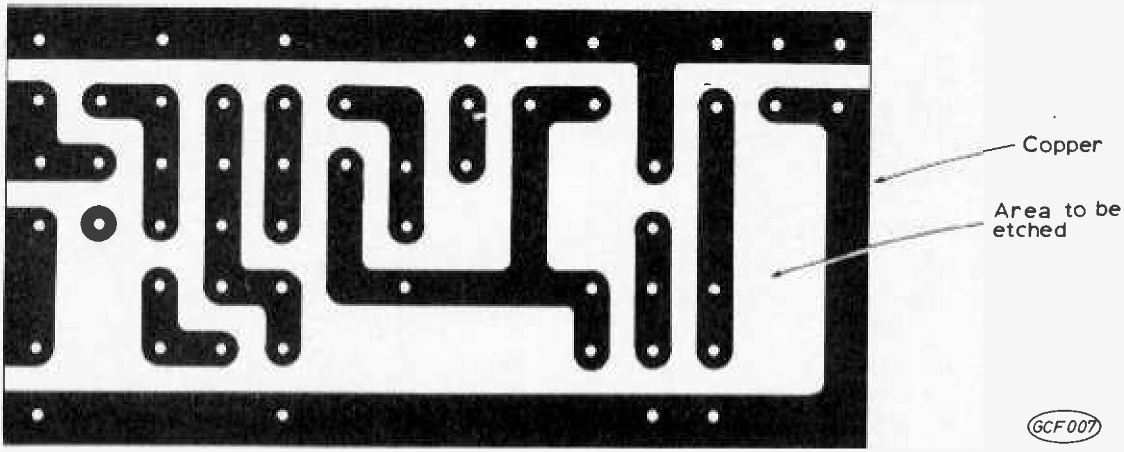

Fig. 3 When the layout is finalised it must be reversed on to the board as shown here, complete with the holes required, drilled after etching.

and a piece of carbon paper in between, carbon side down against the copper surface. Draw over the master with a pencil which will leave the outlines on the copper. Remove master and carbon paper after which the resist can be painted on the areas of copper which are to be retained. While the resist dries the etching solution can be prepared.

ETCHING

Ferric chloride is used which can be bought from advertisers in this magazine. One pound will etch many boards. A suitable strength is about one tablespoon per fluid ounce of water. The crystals should be added to the water, not vice versa, and this should be done with care as a lot of heat is generated. The solution may attack skin if splashes are not rinsed off and it will stain cloth and wood, so work over newspaper. The solution must be used in a non-metal dish, a saucer is ideal, and after use it can be stored in an old bottle with a plastic top.

If the prepared board is carefully levered off the paper, the Sellotape can be used as a handle. The board is placed gently on the etching solution **copper side down.** Surface tension will support it and the insoluble etching product can sink to the bottom, no agitation being necessary. After five minutes or so lift the board and see that all the copper shows pink. Greasy finger marks show brown and unetched. If all is well, allow the process to continue, taking roughly twenty minutes. When all the unwanted copper has gone the board should be thoroughly rinsed with water and then the resist can be removed. "Dalo" or nail varnish will come off with nail varnish remover (acetone) while paint will require white spirit or stripper. A final wash with soapy water will leave the board ready for drilling.

DRILLING AND SOLDERING

Drilling should be done with as fine a drill as possible, for a hand drill this will be about 1/16in. dia. The slow speed on an electric drill is suitable but only gentle pressure must be used or the board will crack. It will be helpful to mark all the holes with a sharp point (a centre punch will not do) first, then hold the board in front of a piece of wood, in a vice, and drill all the holes. Any burrs can be removed with a larger drill. The board is now ready for use.

The bond holding the copper to the board material is strong but too much applied heat may cause the copper to peel off. As usual, resistors and other passive components should be soldered before semiconductors, though connecting wires should be left until last. ■

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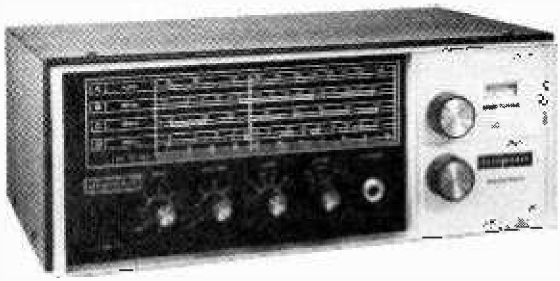

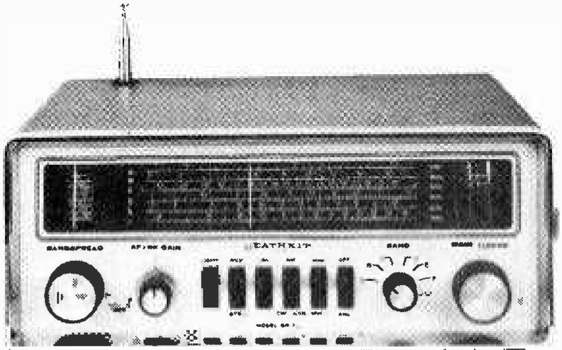

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ADD-ON Beat Frequency Oscillator

F.G.RAYER G3OGR

THIS receiver accessory allows the reception of CW (Morse) and SSB (single sideband) signals particularly with receivers whose coverage includes any of the amateur bands. These bands are given below for the guidance of listeners who have not so far paid much attention to them.

160	metres	or	1·8	to	2·0MHz
80	metres	or	3·5	to	3·8MHz
40	metres	or	7·0	to	7·1MHz
20	metres	or	14·0	to	14·35MHz
15	metres	or	21·0	to	21·45MHz
10	metres	or	28·0	to	29·7MHz

Short wave broadcasts use AM (amplitude modulation) and an envelope detector in the receiver demodulates this but this detector cannot provide the wanted audio output with CW or SSB signals. CW will be heard as an intermittent clicking and SSB as an unintelligible sound varying at syllabic rate. To receive CW a signal from the beat frequency oscillator is combined with the carrier, provided by the CW transmission, the difference in frequency between BFO and CW signals providing an audio output after detection. As a superhet receiver converts all incoming signals to a frequency of, usually, about 470kHz (the intermediate frequency) the BFO is adjustable around this frequency. So if the BFO is set to 469kHz or 471kHz the CW is heard as a 1kHz audio tone.

With SSB the carrier and one sideband are suppressed before transmission. When the BFO is adjusted to occupy the position of the missing carrier the transmission can be resolved and the detector provides intelligible speech.

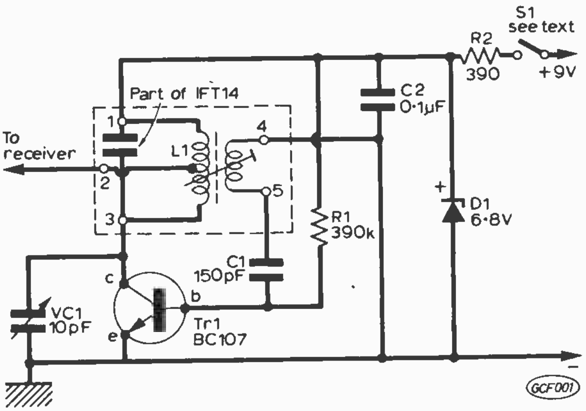


Fig. 1 : Circuit of the simple beat frequency oscillator.

BFO CIRCUIT

This is shown in Fig. 1. The frequency is determined by the coil L1, with fine manual adjustment by the variable capacitor VC1. The coil is suitable for receivers with an intermediate frequency of about 455kHz to 470kHz but the actual frequency need not be known. Windings must be in the phase shown, to secure oscillation.

It is quite a good plan to operate the BFO from its own 9V battery, the zener voltage regulator is not then necessary as satisfactory results can be obtained without it. But if current is taken from the battery running the receiver the current drawn by the receiver will vary considerably, especially at high volume level, so that stable operation of the BFO is impossible. In these circumstances, the zener is required for satisfactory reception.

ASSEMBLY

The components are assembled on a small piece of perforated board, Fig. 2, with wiring underneath. The two points MC are ½in. 6BA bolts, with tags, providing the chassis or negative return.

A piece of aluminium about 3x1¾in is bent at right-angles about 1¾in from one end. The pitch capacitor VC1 is fitted to the smaller flange. The other flange is drilled for the two 6BA bolts mentioned, so that the wired board can be locked in place, with leads and joints clear of the metal. Connect the variable capacitor fixed plates to pin 3 on L1, and the moving plates to one MC tag, Fig. 2.

★ components list

R1	390kΩ	VC1	10pF (Jackson C804)
R2	390Ω	Tr1	BC107
C1	150pF	L1	Denco IFT14
C2	0·1μF	D1	Zener diode 6·8V

Perforated board, about 1⅝ x ⅝in. Knob. Metal case, see text. On/off switch, see text.

TESTING THE BFO

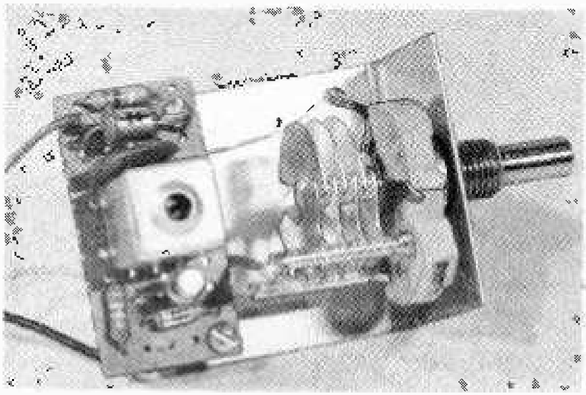
Set VC1 half open. Tune in any AM signal on the receiver. Place an **insulated** lead from pin 2 of L1 near the IF circuitry of the receiver. Connect the BFO to the 9V supply to be used. Rotating the core of L1 with a trimming tool should result in a setting being found where an audio tone arises. Set the core to the central or zero-beat position. If the core is rotated either way from this position an audio tone will be produced, rising in pitch as the core is turned.

Rotating VC1 should now give a similar result. That is, a rising audio tone as the capacitor is rotated either way from the central or zero-beat position.

The BFO is not used for AM reception and slight re-setting of the core may be necessary after the unit is fitted in its case, if it is found that VC1 comes at the fully open or fully closed position.

BFO LOCATION

The BFO unit is only about $2\frac{1}{4}$x$1\frac{3}{4}$x$1\frac{1}{2}$in so it may be fitted in almost any receiver, especially home-constructed types. A reasonably large control knob is best on VC1 and an on-off switch is necessary in the battery positive lead to the unit.



The unit itself is very small indeed so it can be fitted into a convenient corner in any receiver requiring a BFO.

It may be preferred to have the BFO as an external unit, with its own battery, when it can then be used with any receiver. To avoid troublesome hand-capacity effects, the unit must be in a metal box. A box about 6x3x$2\frac{1}{2}$in with a backplate fixed with self-tapping screws will be suitable. This will also take a 9V battery and switch.

COUPLING TO RECEIVER

A short insulated lead from pin 2 of L1, placed near the receiver or near the receiver IF stages, should normally give suitable coupling which is not too critical. Much looser coupling to the earlier IF

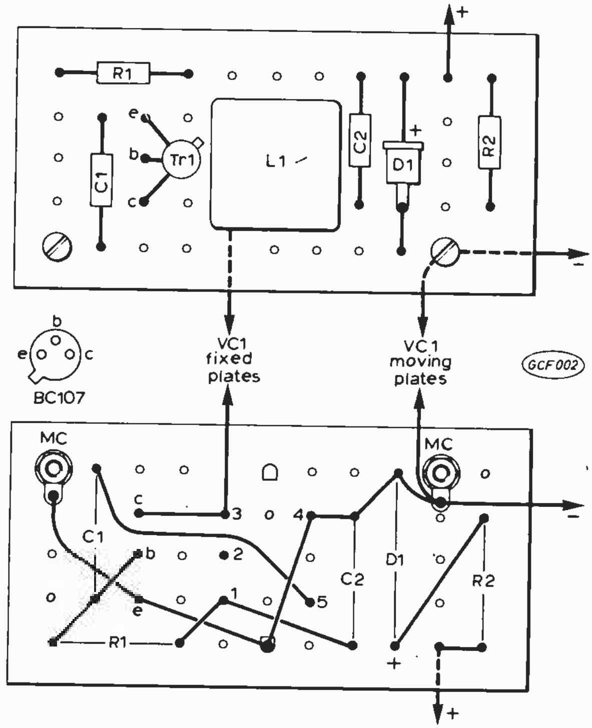


Fig. 2: Layout of components on top of the Veroboard and wiring beneath.

circuits will be required than to those at the diode end of the IF amplifier.

If coupling is too close, receiver sensitivity will fall off considerably when the BFO is switched on. Should coupling be too weak, strong SSB or CW signals will be difficult to resolve, while weak SSB or CW will be resolved easily. However, it should be an easy matter to move the lead from the BFO, or to cut it down, until results are satisfactory.

RECEIVING CW and SSB

Morse signals should be found easily in the amateur and other bands and VC1 is simply rotated to produce a suitable audio tone. In some cases rotating VC1 one side of the zero position may be found to give better reception than the other side.

To receive SSB, first tune in an amateur SSB signal, probably on 80m, with the BFO off. Switch the BFO on and rotate VC1 slowly until intelligible speech is produced. This requires quite careful adjustment. If the signal cannot be resolved, turn VC1 the other side of the zero position. This alternative position will in any case be necessary on the HF bands, where the upper sideband is usually employed compared to the lower sideband transmitted on the LF bands.

If the receiver is fitted with RF and audio gain controls, the audio gain should be near maximum and the RF control advanced as necessary, for best results on SSB.

VC1 need not be 10pF but larger values give more critical adjustment while smaller values may not give enough range of adjustment. Where the receiver has a fine tuning control this can be used for tuning SSB or CW signals, but if the receiver tuning does not allow very critical adjustment, VC1 can be used for this purpose, after locating the wanted signals. ■

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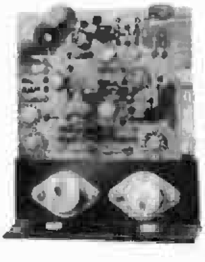

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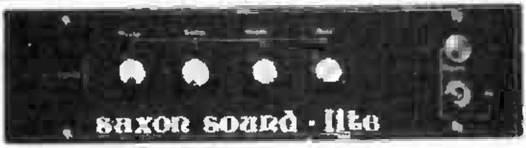

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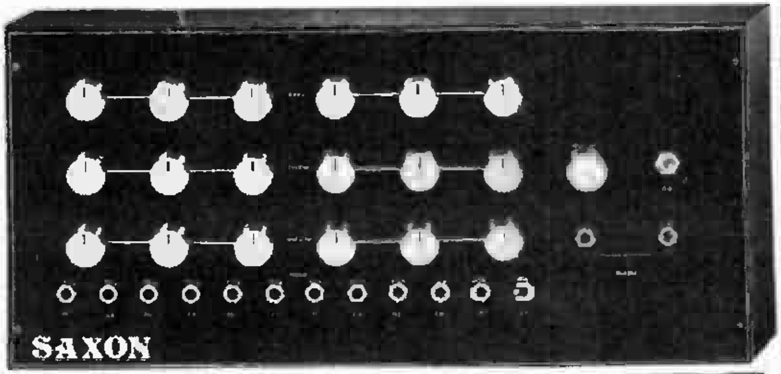

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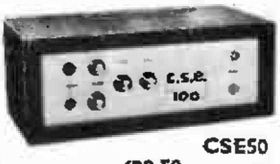

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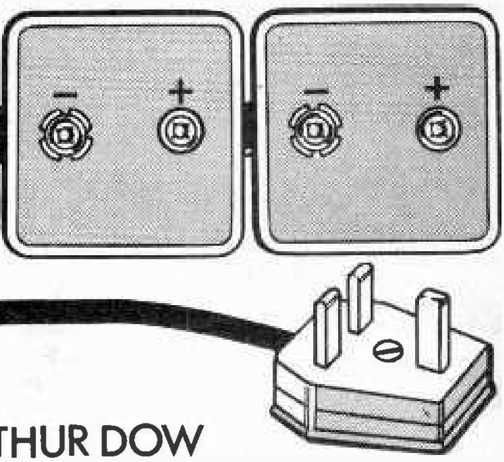

ARTHUR DOW

AS we go through the Age of Apollo with everything rocketing upwards the prices of dry batteries are no exception. The common PP7 9 volt battery, for example, costs around 33p at the moment and many transistor radios use two of these. Their useful life in a radio is very variable but one factor, above all else, determines how economical they are likely to be in the long run: the sensible use of the volume control.

Just about all transistor radios use output stages designed to operate in what is known as "Class B" conditions, where the current consumption is very low with no signal, rising as the signal input is increased so that low volume levels mean low battery consumption and longer battery life.

At 66p for a pair of PP7s it is immediately obvious that a mains operated power supply unit is going to pay for itself very quickly indeed, after which the cost of the electricity to operate the set is negligible. Taking a month as a typical life span for the batteries the cost of this power supply unit at under £3 could be written off in about four months. For our Senior Citizens and others similarly placed this is no mean saving.

Design

While power units for radios requiring 6 or 9 volts are common enough, units to replace 2 × PP7 batteries (18 volts) seem hard to come by. In the author's case, an Ultra 6142 LW, MW and VHF portable, it seemed logical to make up a power supply unit to fit in the same space as the batteries, so what better than to use the tin cases from a pair of defunct PP7s?

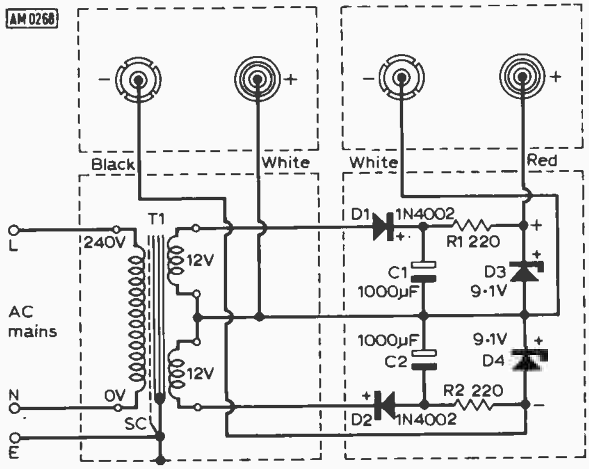

Fig. 1: Circuit of the power unit together with the connections to the terminals of the retained battery tops.

In the final circuit used, Fig. 1, one tin box carries the mains transformer T1, the 12 + 12 volts secondary windings going to the rectifier diodes D1 and D2, smoothing capacitors C1 and C2 and the zener diodes which stabilise the output voltage at 9·1 + 9·1 volts, all contained in the second box. The tops of the boxes carrying the terminals are retained and accept the original battery clips so that no alterations whatsoever need to be made to the radio set itself, a very important consideration. At any time the power unit can be slipped out of the set and normal batteries fitted back in a few seconds. In any other set a check ought to be made to with a voltmeter to ensure that the two batteries are, in fact, in series, requiring 18 volts. Otherwise, as long as the original battery polarities are adhered to, there should be universal use for this type of power unit.

Construction

Initially, two old PP7 type batteries are dealt with as follows: Mark the tops with the + and − signs, as shown on the side of the case, against the respective terminals. Cut across the corners at the top with a pair of sidecutters and ease back the edges until the top can be lifted out complete with battery. Cut the connecting wires or thin metal strips fairly close to the terminals and throw out the battery.

A hole of about $\frac{5}{16}$in diameter is made in corresponding positions in each case and the two cases held together with a rubber grommet, Fig. 2, noting the polarity markings on the cases. Another hole is made for the mains lead to enter, again via a grommet. The position of this hole will be dictated by the position of the batteries in the set. In the Ultra 6142 a slot was filed at the bottom of one side of the cabinet, adjacent to the battery compartment, from which the mains lead was led out.

Next, all the components, with the exception of the transformer, are soldered on to the small piece of veroboard, Fig. 3, and lead-out wires attached. Some sort of colour coding for the wires is an advantage to avoid wiring errors. The board is fitted across the diagonal of one box and a couple of spots of adhesive will hold it in place. Be particularly careful that the polarity of the four diodes and the smoothing capacitors is carefully observed. The wires from the board are passed through the grommet with the exception of the one white and one red wire which are soldered to the + and − terminals on one of the battery tops.

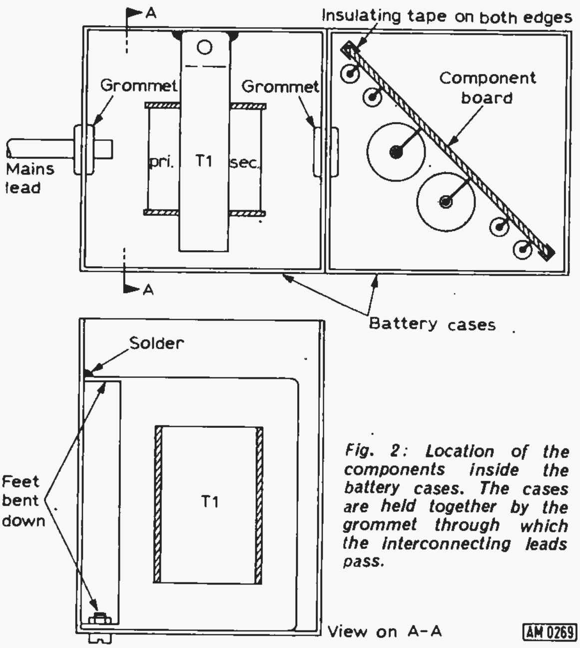

Fig. 2: Location of the components inside the battery cases. The cases are held together by the grommet through which the interconnecting leads pass.

The mains transformer has two mounting feet which must be bent down, Fig. 2, one being fixed to the bottom of the box with a 6BA nut and bolt and the other soldered to the box just below the top. But, before fixing the transformer finally, feed a few inches of the mains lead through the grommet and connect to the primary winding taking the earth lead to the transformer's "screen" connection and to the case. Put a few turns of narrow insulation tape on the end of the mains lead inside the box to prevent the lead being pulled out. This may not be the best arrangement but space is rather limited inside the box. The wires from the board may now be connected to the transformer secondary with a white wire and a black wire going to the terminals on the second battery top, again noting the correct polarity. The transformer may now be dropped into the case and finally fixed into position. Some insulation tape was stuck across the core of the transformer at the top to prevent any possibility of a short circuit of the terminals immediately above. Likewise some tape was put across the top edge of the board in the other box.

Testing

Before replacing the tops in the cases it is a good idea to try out the power unit for correct operation. After checking the wiring again and the polarity of the various components connect a DC voltmeter across the red and black terminals. Select a voltmeter range of, say, 50 volts initially. Switch on the mains, when a reading of about 18 volts should be

★ components list

R1/2	220Ω 5% ½ watt	
C1/2	1000μF 25V	
D1/2	1N4002	
D3/4	9·1V zener (BZY88C9V1)	
T1	Transformer 240V/12V (Douglas MT111CS)	12V

Veroboard. Grommets. Battery cases. Mains lead.

obtained, with 9 volts between the white wires and either black or red.

If everything appears correct put some insulating tape over the connections to the terminals and put the tops back into the cases finally turning over the edges of the cases to hold the tops in position. If thought necessary, the unit can be checked on the radio itself before fitting the tops back, connecting the battery leads from the set on to the power unit terminals. If there is something wrong it can be attended to now instead of having to open up the cases again. As a further check, the voltage across each of the smoothing capacitors should be about 16 volts.

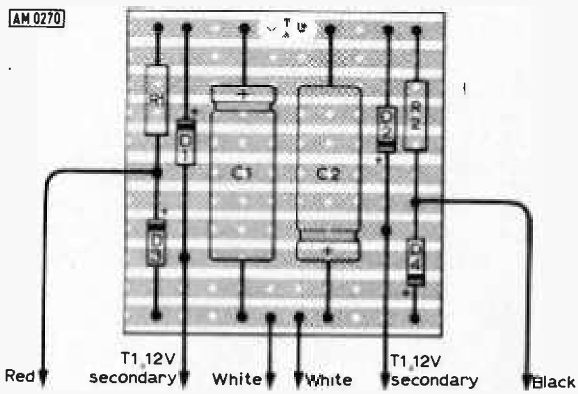

Fig. 3: Layout of components on small piece of Veroboard. Protect vertical edges and top with insulating tape or similar.

Notes

It should be remembered that the on/off switch on the radio set itself still only controls the DC output of the power unit to the set and not the mains input. Although the set consumes very little power from the mains it is still good practice to switch off the mains side when the set is not being used. The set switch can be left on permanently and operation of the set controlled by a switch at the mains outlet point.

The miniature mains transformer specified has a secondary current rating of 250mA which is far in excess of the 20/30mA which will be drawn by the average set. However, since it costs only a matter of a few pence more than the sub-miniature transformers rated at around 30/50mA the additional safety factor was thought to be well worth while. The light loading of the transformer will also assist the output voltage regulation of the unit. ■

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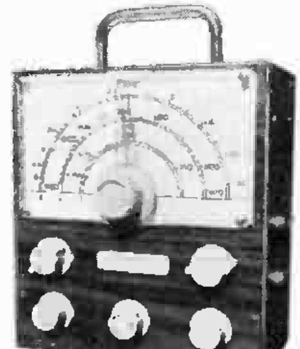

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ENVIRONMENT

The supply voltage, although nominally 12V, is likely to vary considerably under the loading conditions imposed by windscreen wipers and heaters, lights, etc. As a result we must produce a unit capable of working safely up to a possible maximum of around 15·5V, yet also maintaining a satisfactory performance down to 10V. For the amplifiers this is not too difficult—achieving a constant speed for the tape transport is not so straightforward.

Because a negative earth system is more or less universal on modern cars, the unit has been designed for this. Conversion to positive earth working is very simple, however, and will be described later: no change of components is required. Operation on 6V systems is not possible.

The construction of the tape-transport mechanism itself would of course be beyond the resources of the majority of our readers. It is therefore necessary to use a commercial mechanism. The one specified in the components list incorporates facilities for electronic speed control and also auto-stop and cassette ejection at the end of the tape. This feature is very necessary in a car where the machine must "look after itself" if the driver is fully occupied in manoeuvring his vehicle.

Interference from the car's electrical system seems to be worse with the modern alternator and solid-state regulator than it was with their predecessors. Power supply filtering and comprehensive screening are essential if the tape-head output, which is less than 500μV, is not to be completely submerged in the hash.

Acoustic noise levels in the passenger compartment vary considerably from one car to another. The amplifiers used here provide over 3W rms output into 4Ω loudspeakers from a 12V supply: this should be adequate for pretty well any car.

* *Hamilton Electronics Ltd.*

TAPE AMPLIFIER

The amplifier system can be conveniently divided into three parts, a low-noise preamplifier, an equalisation section and a power amplifier. Silicon transistors are used in all but the power output stages.

A stereo cassette carries four tracks recorded on a tape only $\frac{1}{8}$in wide and running at 1$\frac{7}{8}$in/sec. Hence the very low output level from the tape head. The amplifier input stage must therefore be designed for very low-noise performance. The technique adopted here uses complementary npn and pnp transistors, with the collector current of the first stage providing the base current of the second. The first transistor is thus operating under "starvation" conditions—a factor which greatly assists in the reduction of transistor noise.

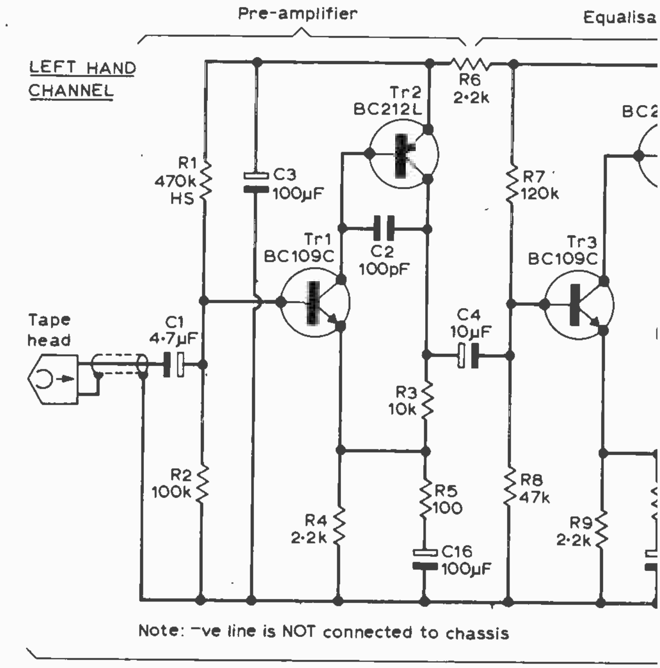


Fig. 1: Circuit of one channel o

some may not. It is a chance that the buyer takes.

Before you solder into the circuit, make sure that you know or can obtain the correct connections for the specimen you have obtained. Do not overheat; use a small soldering iron (15 watts max.) and hold the wire being soldered with wiring pliers. If you are experimenting leave the wires long. Only shorten them when you wish to fit them in permanently or in u.h.f. work, where the length may be critical.

Some transistors require heatsinks. Take care and observe instructions regarding fitting, insulating washers and position.

Transistor holders are available for many types and like i.c.s they are worth using in experimental projects, but it is always better to solder in for permanent use.

TRANSISTOR MOUNTING PADS

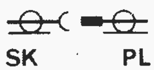
These often-neglected but very cheap little components are recommended to give some measure of protection against accidental knocks to the transistor when handling, and further provides a "seat" for the transistor to keep it clear of the component assembly board, so ensuring that the wires are properly protected and insulated.

TRIACS

When triggered, triacs will pass forward and reverse current; hence their use with a.c. The triggering voltage and current is important to achieve successful firing. Observe the main terminal connections mt1 and mt2 with respect to the gate. Note that the triac does not isolate the high secondary voltage from the low trigger voltage. If used with a.c. mains supplies it is wise to employ an isolating 1:1 transformer for the trigger signal.

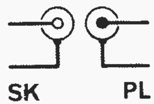
PLUGS AND SOCKETS OR CONNECTORS

Socket (SK) plug (PL) for single core screened wire



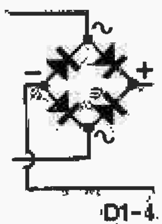
Single plug and socket

Socket (SK) plug (PL) for coaxial cable (not BS)

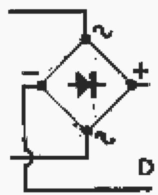


BRIDGE RECTIFIERS

Bridge rectifier. The signs may not always be shown



Simplified symbol for a bridge rectifier. The diode symbol must be shown pointing to the + terminal



CHOOSING COMPONENTS

CAPACITORS

Markings usually identify the capacitance and sometimes the working voltage and/or tolerance. Colour coded capacitors can be identified by reference to the Practical Wireless Datacard No. 2 which was provided in the October 1973 issue.

Capacitance

microfarads shown as μF, mF, mfd,

nanofarads shown as nF, n, k, or kpf=1/1,000μF=1,000pF.

picofarads shown as pF, p, $\mu\mu$F, mmfd=one millionth of 1μF=1/1,000nF.

Voltage also known as the working voltage and shown as a number of volts d.c. (VWDC) or V d.c. or V a.c.

This value represents the *maximum* safe recommended voltage that should be applied to its terminals. There is no different effect in applying a lower voltage, but the stated voltage should not be exceeded.

It is quite common now for "preferred value" components to be supplied as substitutes, for example 0·47μF instead of 0·5μF or 0·022μF instead of 0·02μF and so on. There is usually no detrimental effect by substituting in this way with near alternatives, as long as the specified voltage is not exceeded.

When using capacitors for a.c. mains (200 to 250V) such as for interference suppression, either a 270V (minimum) a.c. type or a 1,000V (minimum) d.c. type should be used.

Dielectric

The insulating material between the metallic foil or plates gives the

CAPACITANCE CODE (BS 1852)

Capacitors can be marked with their nominal value using figures and letters in place of the conventional colour code. The three multiplier letters in common use are:—

p = 10^{-12} n = 10^{-9} μ = 10^{-6}

of the capacitance in FARADS.

Nominal value	Becomes
1pF	1p0 (mult x 1)
330pF	330p (,,)
1000pF	1n0 (mult x 1000)
4700pF	4n7 (,,)
10000pF	10n (,,)
1μF	1μ0 (mult x 1000000)
6·8μF	6μ8 (,,)

capacitor specific properties (see text book on the subject). Generally the most suitable for r.f. applications are ceramic or silver mica types; for a.f. and h.f. use one of the plastic types; for space saving and smoothing, electrolytic types can be used, or tantalum types which, although more expensive, are more stable and reliable over long periods of use. Electrolytic capacitors break down after a few years and are number one suspect of capacitor failure symptoms. Paper types are now being superseded by plastics.

COILS

Ready made coils are usually designed for a specific application, hence they seldom carry any characteristic markings other than the makers code number. Unless their properties are known or can be measured accurately, there is little value in unmarked coils. If buying coil formers or bobbins for winding your own coils, check that you order or ask for all parts, especially if a brass or dust iron slug is to be used to adjust the inductance in a tuned circuit.

DIODES

Because of the very small size of many diodes it is not always possible to mark them with the full type number. Some are marked with very small lettering that needs a magnifying glass to read it. One end of the diode body is usually marked with a + sign or a band of distinguishing colour, or maybe black or white; this indicates the cathode terminal.

Special types include "Varicap" or similar variable capacitance diodes. The capacitance effect changes with a change in the applied voltage. This type is now frequently used in radio and television tuners.

Zener diodes limit the applied voltage to the specified level and are very useful for regulating low voltage d.c. supplies.

FERRITES

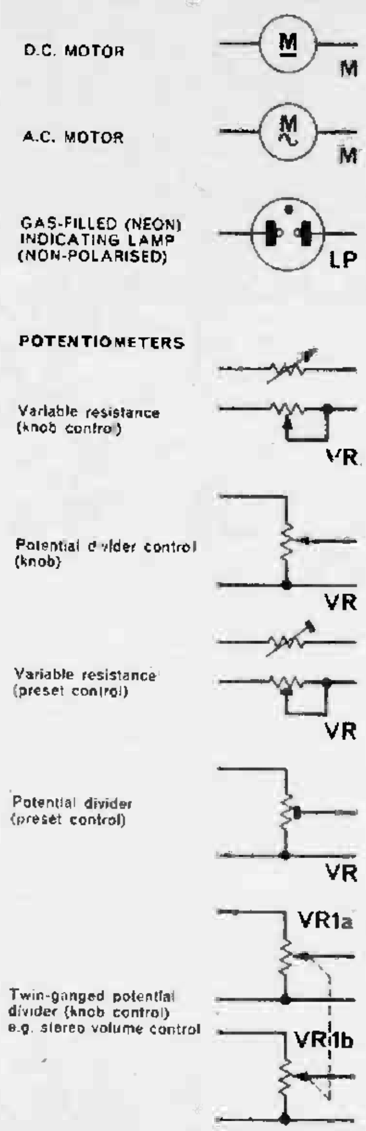
Often the cause of some misunderstanding, "ferrite" is a term now loosely applied, even mistakenly, to some kinds of dust iron materials and ceramic cores. Their properties are quite specific. Ferrite beads (used for suppressing parasitic oscillation) pot cores, rods and toroids are specifically designed to be most effective over a pre-determined frequency range. For more detailed information consult manufacturers' literature. When ordering pot core assemblies make sure that you ask for all the necessary parts, which usually include *two* halves of the pot, the bobbin, the clamps and tag strips.

HEATSINKS

Heatsinks vary enormously in size and shape. If they are cast or moulded in aluminium alloy they should be painted matt black, but if electrical connection is required to the transistor casing, make sure that the contact area is free from paint. Insulation from the transistor casing must, where required, be carefully achieved with the correct insulating washer and nylon fixings. Any rough edges on drilled holes *must* be removed. Other heat sinks are made from copper; alternative metals are not always suitable because of inferior heat conductivity properties.

INTEGRATED CIRCUITS

In the limited space available it is not possible to give detailed suggestions on all types available; however, here are a few hints to observe.



high, so many thousands of transistors (and other semiconductor devices) find their way into a scrap yard or on to the open market. In spite of precautions taken to minimise the number that are released, several do slip through, sometimes with makers' names on them. However, experts can often identify the source by internal inspection.

Sub-standard devices may turn out to be very good bargains; in a lot of cases they can be used, particularly for experimenting with one-off projects, but it is unwise to specify such devices for wide-spread adoption in a particular project because of the variations outside the specified characteristic range. They usually appear on the market as unmarked, re-marked or recoded types. In the latter case, a firm may have measured a batch and re-classified them, in which case you should identify the coding and obtain the correct specification from the supplier.

Unmarked devices cannot be classified unless they are measured under normal operating conditions and with a proper instrument. For the low prices often asked, the buyer can expect to have a very mixed batch; some may be usable and

Directory entry on page 40

tolerance. Thyristors can be obtained at low cost and in these circumstances it is wise to measure the triggering voltage and current required to fire it. Also the "release" voltage should be measured.

TRANSFORMERS

Well made transformers are usually wound on cheeked bobbins. Cheap versions have no cheeks and often have flying leads connected to the windings.

Satisfy yourself that the physical size is large enough to handle the current expected to be passed through the windings, otherwise saturation of the core and subsequent overheating could occur. This applies particularly to mains transformers and valve output transformers.

Mains transformers with a screen between the primary and secondary windings are recommended, to reduce problems from mains borne interference and high frequency transference. This screen must be earthed with the laminations.

TRANSISTORS

Many problems arising from the purchase of transistors are due to misunderstandings about their characteristics.

Transistors are made first, then measured and classified according to test measurements made on them. The result is a wide spread of characteristics, particularly on the gain (h_{FE}) and leakage current (I_{CO}).

Published data often give the range of gain for a particular type number. If transistors made for that type number have characteristics outside the quoted figures, then they are either classified into another appropriate type number or rejected. The reject rate is fairly

PANEL METERS

Ammeter (current)

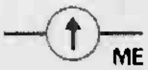
Voltmeter (voltage)

Wattmeter (power)

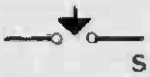
Frequency meter

Ohmmeter (resistance)

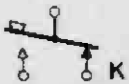
Galvanometer or centre-zero balance meter



SINGLE-POLE ON-OFF MICROSWITCH OR LIMIT SWITCH



MORSE KEY



To be reasonably certain of getting a good specimen look for the manufacturer's official trade mark as well as type number. Some specimens may not carry all this information so you are entitled to ask for a full specification. Some sub-standard or "out-of-spec." items do appear and in many cases are usable. However, it does happen that a fault may be present on one of the pin connections. If it is otherwise functional it could be used if the fault does not interfere with your application. For example, you may buy a 7400 quad gate i.c. This device was designed to contain four gates, but if one gate is faulty you may still be able to use the other three.

It can sometimes occur that an assumed first grade i.c. may have an intermittent or faulty internal connection. If the device has been properly used in the circuit then the buyer could expect the supplier to replace it, unless it was declared as faulty at the time of purchase.

However, a problem arises immediately if the device has been soldered and there is no way of proving that the fault could have been there before it was soldered in or may have resulted from clumsy or overheated soldering. It is always wise to use i.c. holders for this reason and to make removal of the i.c. from the board easier. You cannot expect the supplier to replace a faulty i.c. if it has not been operated as recommended by the manufacturer.

Unmarked i.c.s or unidentifiable i.c.s are seldom worth having unless the supplier can offer some clue to the originally intended function. Even with test equipment it is almost impossible to ascertain the properties of such devices.

Whatever i.c.s you buy always ask for a data sheet or obtain a copy from the manufacturers or distributors. This is most valuable for pin connection identification as well as giving the expected specification.

A golden rule is never to solder in, until you are satisfied that you have the correct device in the correct position; i.c.s can be very costly and difficult to replace.

PRINTED CIRCUIT BOARDS

P.C.B.s are mainly of two kinds: glass fibre board and s.r.b.p.

Glass fibre board is more expensive but is superior to s.r.b.p. board, being more rigid and stable. Slight bending or flexing of any board can lead to the copper cracking, especially where it is in narrow strips. Small soldering irons (15 watt maximum) should be used; larger irons can melt the copper away.

Most unetched board is unprotected and not tinned so the copper must be thoroughly cleaned before etching and again before soldering. A washing-up scouring pad or powder can be used with care. When cutting the board always use a fine toothed hacksaw. Glass fibre tends to blunt the blade more rapidly than s.r.b.p.

Double-sided board is sometimes used where it is important to have a "ground-plane". The copper on one side is etched to suit the circuit and, on the other (ground-plane) side, the copper can be carefully etched or peeled away from holes to avoid short-circuits. All components should be mounted just clear of the copper on the "ground-plane" side to avoid short circuits.

Kits are available for etching p.c.b.s yourself. Read and follow the instructions carefully and do not leave the bottle of solution open. Some component suppliers do arrange to supply ready-etched boards for specific purposes and some are able to supply etched boards to individual design requirements.

Magazines usually publish the printed circuit patterns for their projects where applicable so that constructors can etch their own boards. Adequate copper must be allowed where holes are required to ensure a satisfactory soldered connection. Any modifications to the board after etching can easily be done by either peeling away copper carefully with a sharp penknife or adding link wires as necessary.

POTENTIOMETERS

Potentiometers are made in various styles: Apart from the overall resistance value, the other properties to quote are: carbon track or wirewound; logarithmic or linear track resistance. Skeleton preset types have open unprotected carbon tracks and can be obtained for vertical or horizontal mounting on p.c.b.s. Log types are most commonly used for volume controls. The maximum power rating of all potentiometers determines the current that can be safely handled, and in particular with d.c. voltage control, this rating should never be exceeded.

RESISTORS

A look at the directory classification will show many different groups. The following information should be provided when ordering:

(a) Construction material e.g. carbon film, etc.
(b) Resistance in ohms, kilohms (Ω x 1,000) or megohms (Ω x 10^6).
(c) The tolerance, e.g. 1%, 2% etc.
(d) The power rating, e.g. ⅛, ¼ watt etc.

continued on p33

Some of the high stability types are more expensive and are used where low thermal noise and close tolerance are important factors to the application. The power rating quoted is an indication of the maximum current that can be handled by the resistor in conjunction with the applied voltage, and should be adequate for the application.

SWITCHES

Wafer switch assemblies are obtainable in kit form and it is essential to ask for every part down to the last nut. The wafer specifies the switching mode, which is described later.

Common abbreviations used for switches are:

SP = single pole (one switch).
DP = double pole (two switches operated simultaneously).
3-pole = three switches operated simultaneously, etc.
ST = single throw or on-off function.
DT = double throw or changeover function.
4-pole, 3-way four switches each having three outlets and operated simultaneously, usually on a wafer.
CO = changeover.
MB = make before break.
BM = break before make.
Centre-off applies where a toggle or lever switch has two outlets and a central neutral position.

THYRISTORS & TRIACS

Thyristors can behave in various ways if they are not up to manufacturers' published specification. In some applications such low cost specimens may appear to function, but in others they may be unreliable. The most common defect is the triggering level which may be outside the manufacturer's quoted

MARKING OF CAPACITORS (pF) AND RESISTORS (Ω)

PREFERRED VALUES. The common range of twelve values is known as the E12 Series:—
1·0 1·2 1·5 1·8 2·2 2·7 3·3 3·9 4·7 5·6 6·8 8·2 together with their decades such as 47 470 4700 47000 etc.

The E12 Series can be expanded to the E24 Series by adding the following intermediate values:—
1·1 1·3 1·6 2·0 2·4 3·0 3·6 4·3 5·1 6·2 7·5 9·1 and their decades.

RESISTANCE CODE (BS 1852)

Increasing use is being made of the British Standards (BS 1852) method of marking resistors with their value and tolerance using figures and letters only instead of a colour code. The multiplier is represented by a single letter:—

R = x1 K = x1000 M = x1000000

which replaces the decimal point when indicating the value of the resistor, thus:—

15Ω	15R	(multiplier = x1)
330Ω	330R	(,, = x1)
5·6Ω	5K6	(multiplier = x1000)
47kΩ	47K	(multiplier = x1000)
1·2MΩ	1M2	(mult = x1000000)
18MΩ	18M	(mult = x1000000)

TOLERANCE. The marking indicating the nominal value of the resistor has a single letter added to it representing the tolerance figure:—
F = ± 1% G = ± 2% J = ± 5%
K = ± 10% M = ± 20%

Examples:—

2M2F	signifies	2·2MΩ 1%
1K8G	,,	1·8kΩ 2%
120KJ	,,	120kΩ 5%
15RK	,,	15Ω 10%
6R8M	,,	6·8Ω 20%

ASSETTE

LAYER

ANCIS *

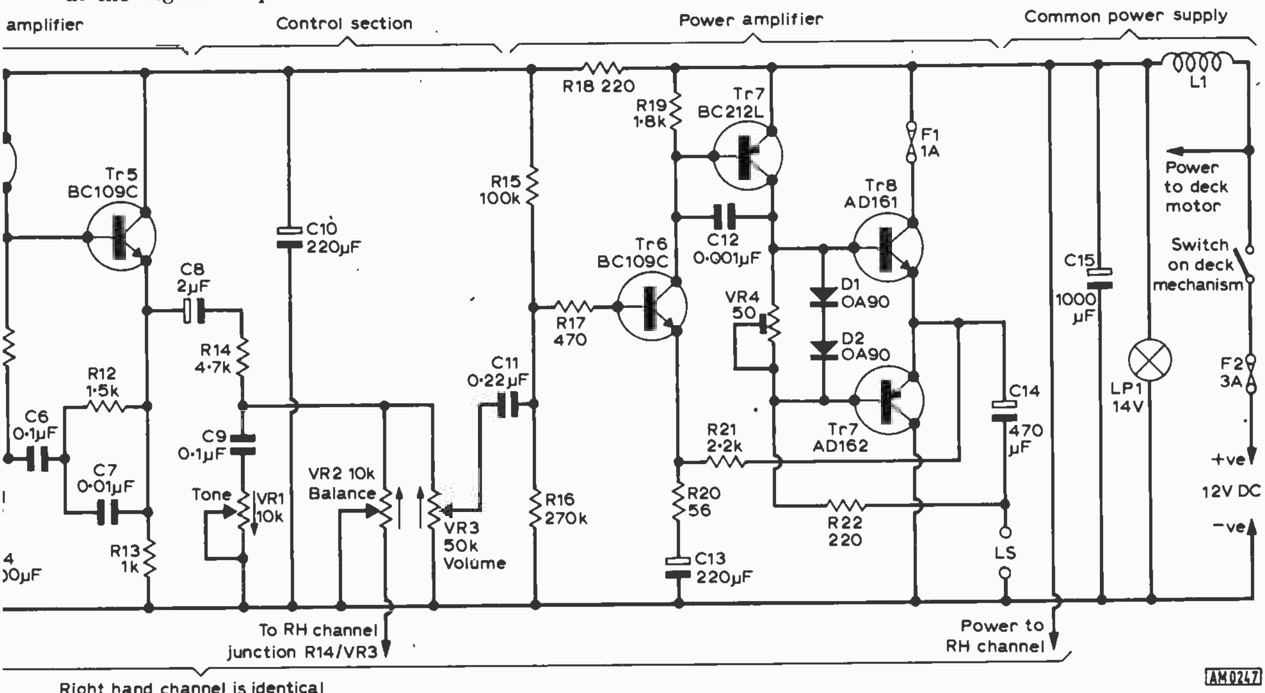
Transistor gain will vary from sample to sample and will also change with the supply voltage. To overcome these problems, negative feedback is used to stabilise the gain of the preamplifier.

The preamplifier has now raised the signal from the tape to a more reasonable level, but it still has a "Velocity characteristic"—that is, for every doubling of the recorded frequency the output level also doubles. This is because the tape head output level is proportional to the rate of change of magnetic flux due to the tape moving past the head. For a constant recorded amplitude, an increase in pitch of one octave (doubling of frequency) will cause the flux to change at twice the rate, and hence the output doubles also. It continues to double with each octave rise until tape head losses become significant at the higher frequencies.

At the time of recording, the higher frequencies are pre-emphasised or boosted relative to the low and middle frequencies. This means that the signal-to-noise ratio of the tape is improved, since tape noise is predominantly at high frequencies.

From the foregoing it is obvious why we need to have an equalisation amplifier. This has a characteristic which is the inverse or "dual" of the overall tape curve. The output of this section has a flat frequency response over the audio range.

At this point the signal is suitable for feeding into the power amplifier, which uses a conventional complementary-symmetry circuit. The output voltage can swing between the two supply rails, less the residual voltage drop across each output transistor, say about $12-2=10$V. The rms equivalent of this peak-to-peak voltage is approximately 3·6V which will produce about 3·25W using a 4Ω loudspeaker.



e amplifier board, plus common power supply. NOTE.—The AD162 should be Tr 9.

★ components list

AMPLIFIERS

Resistors

R1	470kΩ	R9	2.2kΩ	R17	470Ω
R2	100kΩ	R10	10kΩ	R18	220Ω
R3	10kΩ	R11	47Ω	R19	1·8kΩ
R4	2·2kΩ	R12	1·5kΩ	R20	56Ω
R5	100Ω	R13	1kΩ	R21	2·2kΩ
R6	2·2kΩ	R14	4·7kΩ	R22	220Ω
R7	120kΩ	R15	100kΩ		
R8	47kΩ	R16	270kΩ		

R1 is ½W High Stability. R22 is 1W 5% Remainder are ½W 5% carbon.

Potentiometers

VR1 10kΩ log (ganged with other channel)
VR2 10kΩ lin.
VR3 50kΩ log (ganged with other channel)
VR4 50Ω horizontal preset

Capacitors

C1	4·7μF 6V Tant.	C9	0·1μF Cer.
C2	100pF Cer.	C10	220μF 16V
C3	100μF 16V	C11	0·22μF 10V Tant.
C4	10μF 10V	C12	0·001μF Cer.
C5	100μF 6V	C13	220μF 10V
C6	0·1μF Poly.	C14	470μF 16V
C7	0·01μF Poly.	C15	1000μF 16V
C8	2μF 10V	C16	100μF 6V

Tant — Tantalum bead Cer — Disc ceramic
Poly — Polyester Remainder electrolytic

Semiconductors

Tr1, Tr3, Tr5, Tr6 BC109c
Tr2, Tr4, Tr7 BC212L
Tr8 AD161, Tr9 AD162 matched pair
D1, D2 OA 90

NOTE—The above components are for one channel only. All except C15 and VR2 are duplicated for the second channel.

Miscellaneous

L1 2A suppressor choke; LP1 14V lamp;
F1 1A fuse with chassis-mounting holder (two required);
F2 3A fuse with in-line holder;
Cassette mechanism, Lenco FFR, Stereo with D.C. motor;
Veroboard 6·75 x 2·5in, 0·1in pitch; DIN connectors for loudspeaker outputs; 4Ω loudspeakers; metal case; mounting kits for Tr8, Tr9; knobs, etc.

MOTOR CONTROL BOARD

Resistors

R51	2·2kΩ	R56	15Ω	R61	100kΩ
R52	6·8kΩ	R57	820Ω	R62	2·7kΩ
R53	8·2kΩ	R58	560Ω	R63	680Ω
R54	1·5kΩ	R59	680Ω	R64	120Ω
R55	3·9Ω	R60	4·7kΩ		

R55, R56 are ½W, remainder ¼ W ± 5%
VR51 1kΩ miniature preset.

Capacitors

C51, C52 22μF 25V Electrolytic

Semiconductors

D51—D53 BA100
Tr51, Tr54 BC109 Tr52 AD162 Tr53 AC128

Miscellaneous

Mounting kit for Tr52; pcb.

The use of class B output with output transformers could, with correct design, yield 10 watts per channel if needed. However, we have to consider the size, weight and economics of the machine, as well as the problems of obtaining specialised components. The complementary output stage produces as much power as is likely to be needed for practical purposes, and all components are easily obtainable.

PREAMPLIFIER

The circuit of the complete unit is shown in Fig. 1. It will be seen that the signal from the tape head is coupled to the base of transistor Tr1 via capacitor C1. The biasing of Tr1 base is set by R1 and R2. Resistor should be R1, a low-noise, high-stability type, but R2, the lower leg of the bias divider is effectively by-passed by the low impedance of the head so far as audio is concerned, and is a normal carbon type.

The collector of Tr1 connects directly to the base of the complementary pnp transistor, Tr2. The base current of Tr2 and the collector current of Tr1 are therefore the same.

We can now consider the DC stabilising action of the circuit. If the current in Tr1 increases, so does the base current of Tr2. This change is amplified by Tr2 so that its collector current increases. Thus, more current flows through R3, which in turn connects to R4. The voltage drop across R4 is almost entirely due to the current flow via R3, rather than current in Tr1 which is operating under "starvation" conditions. An increase in the collector current of Tr2 therefore causes the emitter of Tr1 to move positively towards the supply rail. This is equivalent to a negative shift of its base bias and the collector current of Tr1 is so reduced. The change is amplified by Tr2 and this heavy DC feedback action stabilises the working point of the complete preamplifier.

We do not need such heavy AC feedback—in fact appreciable AC gain is required. By decoupling R4 completely, a very high gain could be obtained, but it would be unpredictable and unstable. By introducing R5, the gain of the stage is set at about 100 by the ratio R3:R5 and is almost independent of voltage, temperature and transistor variations. The output from the preamplifier is therefore about 50mV. The supply to the preamp is decoupled by R6 and C3, and the output is coupled to the equalisation amplifier via capacitor C4.

EQUALISATION

The biasing method and stabilisation technique is the same as that employed in the preamplifier. However, an extra emitter-follower output stage is added which feeds both the Tone and Volume controls and the equalisation network comprising R11, C6, R12 and C7. The basic amplifier without equalisation would provide a gain determined by the ratio R10: R11, in this case, 200.

It is essential that the feedback network, which operates into the low impedance R11, should be fed from a low impedance source. If this were not the case, the response correction would be hopelessly inaccurate, as the network loads the source.

It will now be seen why Tr5, the emitter-follower stage, is included. It is DC coupled to Tr4 and provides a low impedance output. Basic correction for the velocity characteristic of the tape is provided by R12 and C6; C7 provides extra feedback to compensate for the tape pre-emphasis.

The equalised signal, which has now been amplified to around the 250mV level, is conveyed via C8 to R14 which is included to increase the impedance "seen" by the tone and balance networks. Resistor R14 forms the upper leg of a divider network, whose lower leg is formed by the Balance control VR2. This control operates differentially upon the two stereo channels, so that increased attenuation of one simultaneously results in an increase of output from the other. The tone control network consists of C9 and VR1. This is a simple "top cut" network which is adequate for use in the car.

Finally we come to the Volume control, VR3, which taps off the required output to drive the power amplifier.

POWER AMPLIFIER

The power amplifier consists of four transistors, Tr6, Tr7, Tr8 and Tr9. The latter two are complementary output transistors mounted on the backplate of the machine, which serves as a heat sink.

The action of the driver stage is similar to that of the previous amplifier. Transistor Tr6 has its base level set by R15 and R16. In this case, the level set is approximately half-way between the 12V rail and earth. Capacitor C12 is included to prevent RF instability, as is R17. The collector of Tr7 feeds the base of Tr8 directly, and the base of Tr9 via D1 and D2 and VR4, before reaching the collector load resistor R22.

Potentiometer VR4 sets the forward bias applied to the output transistors. In order to compensate for changes in temperature, diodes D1 and D2 are shunted across VR4. As the output transistors are germanium types, germanium diodes are used. When the temperature increases (a condition which would cause increased conduction in Tr8 and Tr9) the impedance of the diodes falls, so decreasing the forward bias and stabilising the working conditions.

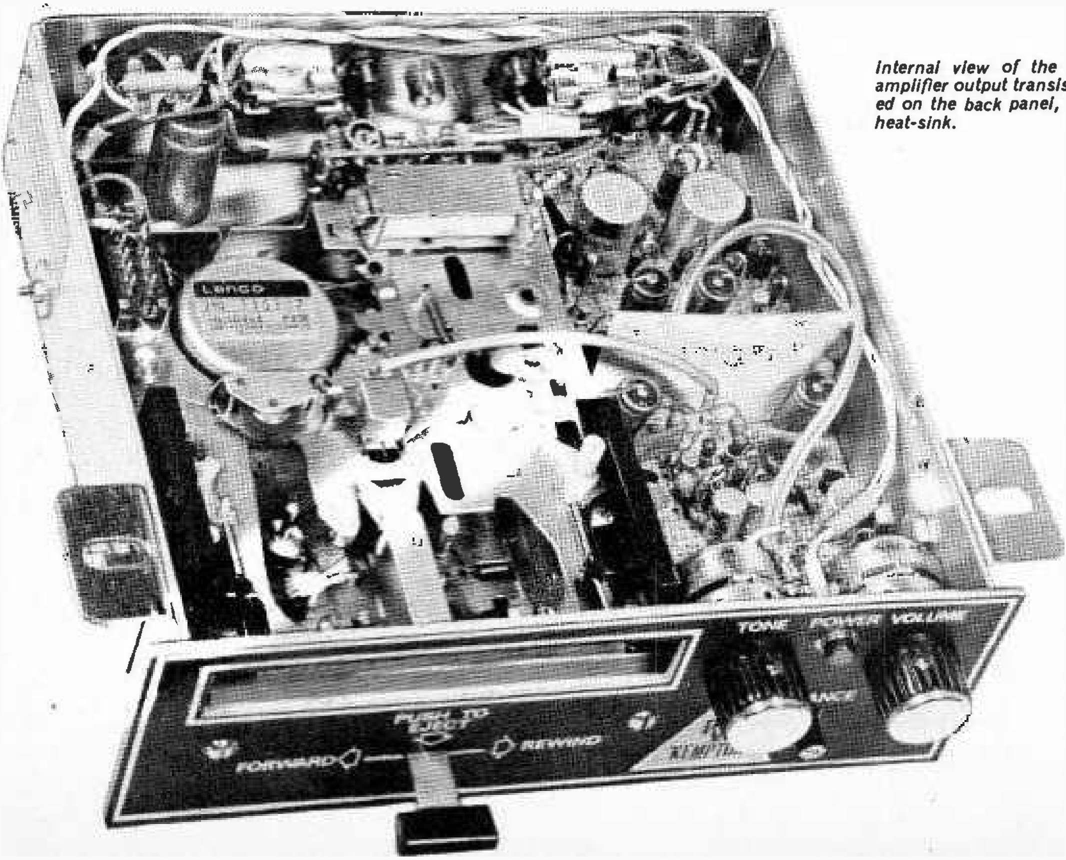
The emitters of Tr8 and Tr9 are connected via R21 to the emitter of Tr6, giving overall stabilisation of the DC working point of the amplifier. The emitter of Tr6 is decoupled by C13, and R20 is included to provide AC feedback in the ratio R21:R20, so stabilising the gain at around 40. If we consider a level of 200mV coming in from the volume control, this means we are just inside the overload point of the amplifier. The audio signal is coupled to the speaker via C14.

The loudspeaker also completes the DC return for R22. The audio output signal is in phase with that at the collector of Tr7 and hence there is positive feedback. This raises the input impedance of the output stage and enables the small transistor Tr7 to drive the output pair fully. This technique is known as "boot-strapping."

The output pair operate in class B. Forward bias is needed to prevent cross-over distortion, and VR4 is set up to provide a 10mA quiescent current measured at the fuse-holder. The fuse is connected in series with the collector of Tr8, to protect the output stage from conditions of gross overload.

The incoming supply from the vehicle is filtered by L1 and decoupled by C15. Power to the deck motor and panel light are also fed from this part of the circuit. The on-off switch is included as part of the tape deck mechanism.

The second part of the article describes the motor control circuitry and construction of the circuit boards.



Internal view of the prototype. The amplifier output transistors are mounted on the back panel, which acts as a heat-sink.

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7. Electronic components pack (diodes, resistors, capacitors, etc)
8. Battery assembly and on/off switch
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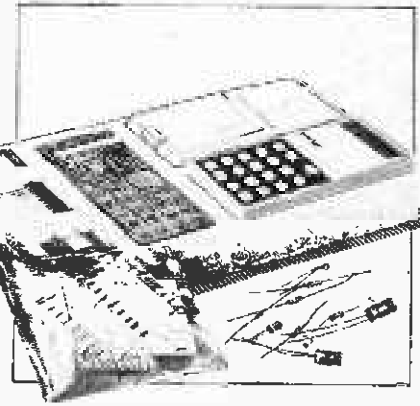
Assembly time is about 3 hours.



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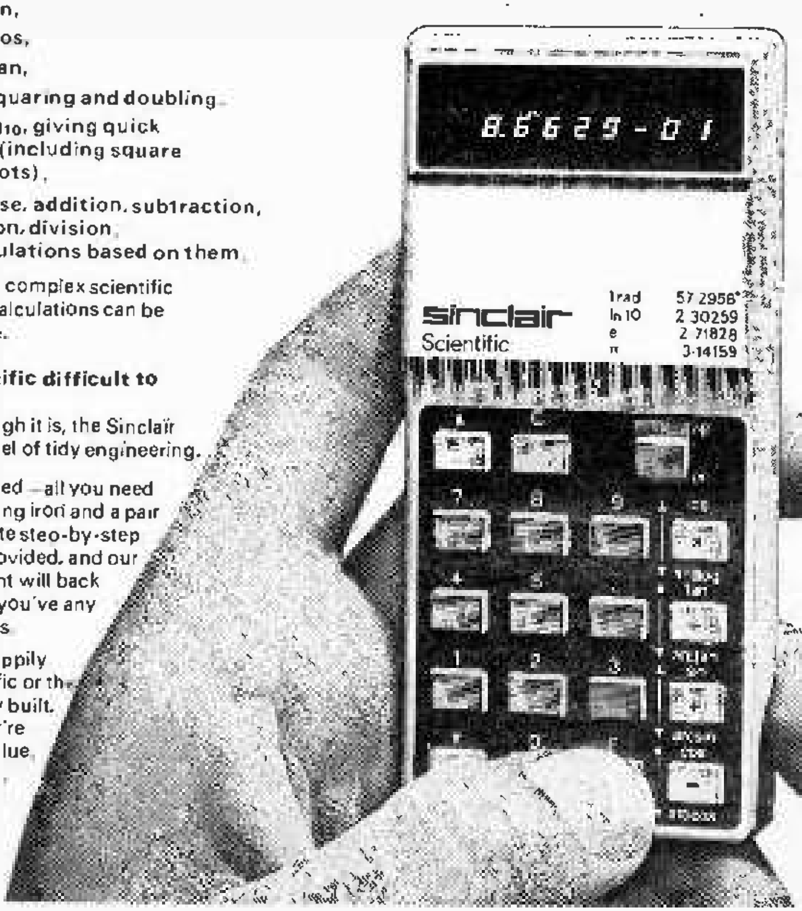

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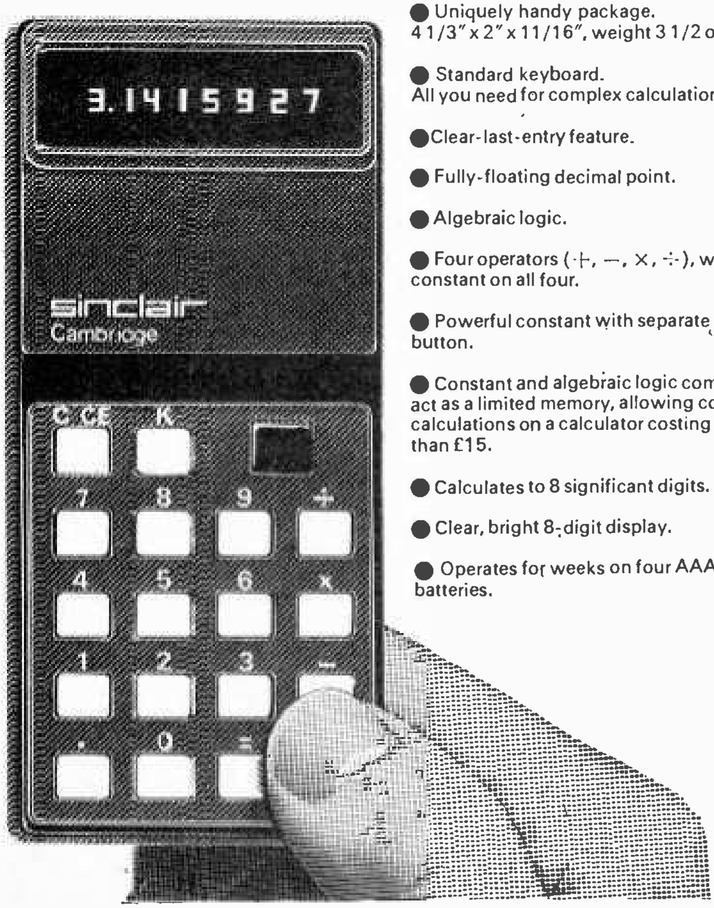

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TAKE 20

DAVID ANDREWS

No. 66 IC PHOTO TRIGGER

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

ONCE again we turn to that very useful integrated circuit, the SN7400, for a low-cost novel application, acting as the sensing circuitry for a photo detector. There are innumerable applications for this type of circuit. This particular one will operate in a multitude of roles without change to circuit layout or component values and possible uses range from burglar alarms to process control and object counters.

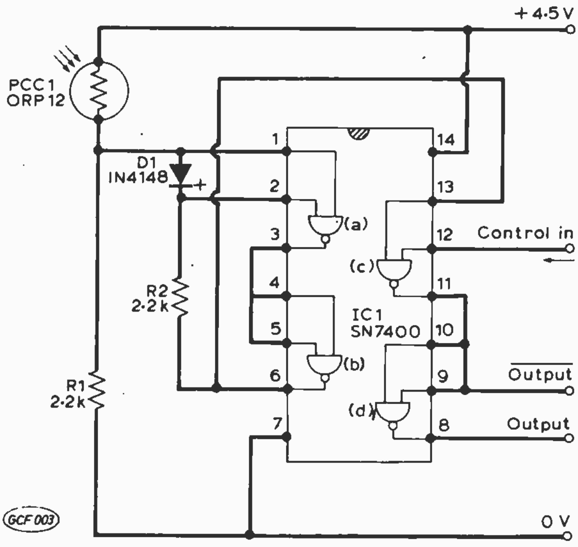


Fig. 1: Circuit of the photo trigger using an SN7400.

Photo detector

The photo detector itself is a photo-conductive cell, PCC1, which forms part of a potential divider circuit with R1. When the cell is illuminated the potential at the junction of these two components rises to some positive level, the actual level depending on the degree of illumination and on the value of R1. As long as this potential exceeds +3V, with the power supply of 4·5V the circuit will work satisfactorily. To achieve this level it is necessary to use a reasonable level of light such as the focussed beam of a small torch. In the absence of illumination PCC1 becomes a very high resistance and the potential referred to falls towards zero.

The potential is applied to the input of a trigger circuit comprising ICI (a) and (b). Positive feedback is achieved by R2 in conjunction with D1. Even though the controlling potential may rise slowly the regenerative feedback action causes the output of gate (b) to change rapidly and the change occurs as the input voltage moves around the +2·5V level. There is a certain amout of hysteresis built in and this is set by the value of R2.

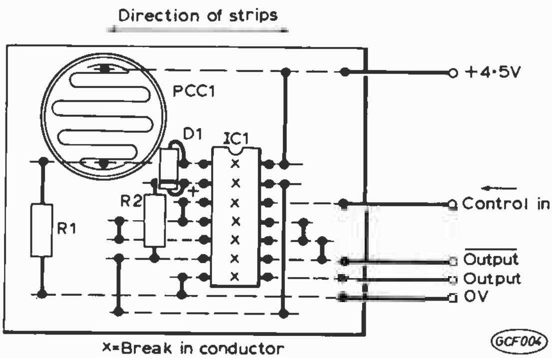


Fig. 2: Simple layout of the circuit using Veroboard.

The sense of the signal at the output of gate (b), pin 6 of the integrated circuit, is such that it rises to +5V when the cell is illuminated and falls to zero volts when the cell is obscured. We could have left the circuit at that stage and have said that the output was at pin 6; however we can make use of the other two gates within the integrated circuit to make the device more versatile.

Control operation

Firstly we introduce a control operation by means of gate (c). The control signal should come from a source impedance of 2kΩ or less and should be a DC level of either OV or +4·5V. A control signal of OV will hold the output of gate (c) at +4·5V irrespective of what the photo detector might be sensing. We call the output signal at pin 11 the $\overline{\text{OUTPUT}}$ (NOT 'output') and use the final gate in the package (d) to invert this, thus, for the conditions stated, when the control signal is at OV the final output at pin 8 will be OV irrespective of the illuminating conditions. If the control signal is switched to +4·5V the output at pin 8 will be +4·5V when the cell is illuminated and OV when it is obscured. The $\overline{\text{OUTPUT}}$ signal at pin 11 will be the opposite of this.

Audio square wave

If desired, the control signal could be an audio frequency square wave. When the cell is in darkness the output at pin 8 will be zero volts but when illuminated the audio frequency will appear at the output. Should the control facility not be required pin 12 can be permanently wired to the positive supply rail. An advantage of having the complementary pair of outputs is that one can select the "bias" of the system; this is particularly useful if the output signals are to drive relays which may be required to be biassed either "ON" or "OFF". ■

PW SANDOWN

PART 3

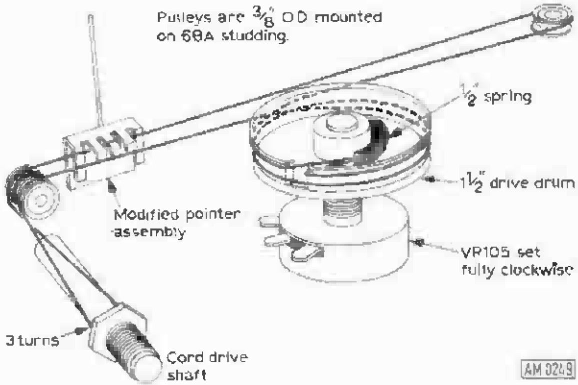
J. R.W. AMES B Sc
&
M.J. CAREY B Sc

f.m. stereo tuner

CONTROL PANEL

The layout of the prototype control panel is shown in the photographs. Since all functions are DC controlled the layout is not critical and can be altered to suit your own requirements. Also, as mentioned earlier, any features which you do not require may be omitted.

The manual tuning drive was constructed on a framework built mainly of aluminium angle, as shown in Fig. 8a. Details of the drive-cord arrangements are given in Fig. 8b.



▲ *Fig. 8b: Drive cord stringing arrangements. The pointer assembly is modified by trimming the ends of the carriage to clear the pulley mountings and also inverting the pointer on the carriage.*

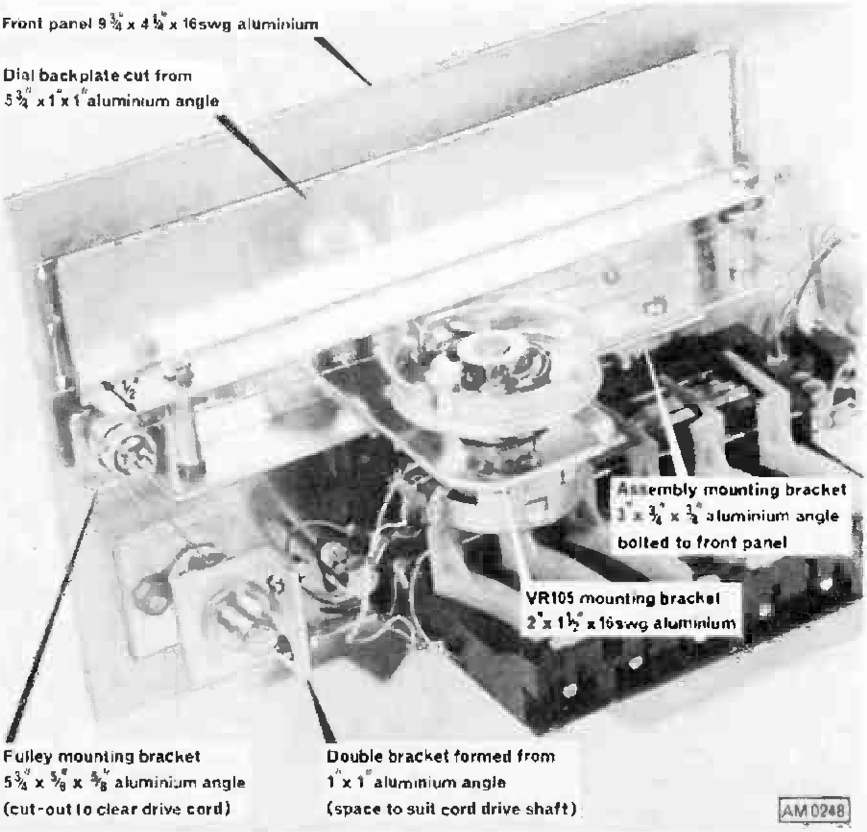


Fig. 8a: Construction of the prototype tuning and dial drive.

TABLE 2
Voltage analysis

Meter 20kΩ/Vdc—negative lead to OV rail, all readings in volts. No aerial connected.

H.T. Supply at C303 13V.

Transistors

	s*	g1	g2	d
Tr 101	0·1	0	4·5	13
Tr 102	0·4	0	1·4	13

	e	b	c
Tr 103	7·2	6·5	0
Tr 201	7·2	6·5	0·9
Tr 202	5·8	6·5	12·1

* Subject to wide variations between transistors.

Integrated circuits

	Pin	Reading
IC 201	1, 2, 3	1·9
	6	5·5
	10	5·8
	13	†
	15	4·5

	Pin	Reading
IC 202	1	2·3
	6	2·1
	9, 10	6·4
	12	13

† See Table 4.

INITIAL TESTING AND SETTING UP

Before any RF adjustments are made it is wise to check the DC conditions at each stage in turn. A construction error or a faulty component is likely to produce an incorrect voltage in an associated part of the circuit. Table 2 shows the voltages to be expected at important points in the circuit when measured with a 20,000 ohms per volt meter, on the range most appropriate to the voltage to be measured.

Switch on and check the voltages appearing in the front end and oscillator stages. If they are correct connect the meter, on its 2·5V or 3V range, to the positive end of VR104 which should be adjusted until a reading of 2·0V is obtained with VR105 at minimum and S101 switched to Manual.

Now solder in R205 to apply power to the IF section and check the voltages against Table 2. Follow the same procedure with the demodulator and stereo decoder integrated circuits to complete the initial testing. The voltage appearing at pin 15 of IC201 indicates the strength of the signal at its input. A high reading here could indicate that a programme is being received or that there is some instability in the IF section. If rocking the tuning control does not reduce this voltage to the correct level, check that all the IC201 decoupling capacitors and the link joining the top and bottom earth planes are in place.

ALIGNMENT

When all the DC tests have been completed satisfactorily you are ready to move on to the final stage of construction, aligning the receiver. Connect two lengths of screened wire to the Left and Right audio output pads ready for attachment to the output socket. Remove the temporary earth wire and mount the receiver in the die-cast box. The earth connection is now made via the mounting stud in the power supply section of the pcb.

Connect a short length of wire from the centre pin of the aerial socket to L101, as shown in Fig. 7, and solder the audio output leads to the 5-pin DIN socket (Fig. 9). If your audio amplifier is earthed via its mains plug, avoid hum loops by breaking the earth connection between the tuner and the amplifier (which is made by the screen of the audio connecting lead) at a convenient point.

RF/IF ALIGNMENT

The method of alignment adopted depends on the facilities available to the constructor. Two methods are therefore proposed; the first requires the use of a VHF signal generator but the second needs only another, aligned, FM tuner.

FIRST METHOD

Short out the oscillator coil, L106, with a crocodile clip and connect the signal generator to the 'hot' end of L104. The output level of the generator should be set to about 1mV and the frequency set to the nominal centre frequency of the particular ceramic filter used. The filters are graded into batches of varying centre frequency, each frequency being identified by different colours. Table 3 lists the frequencies and their corresponding colours.

If a signal strength meter is not included a high impedence multimeter should be connected to pin 13 of IC201. By varying the frequency of the generator slightly about the nominal value it should be possible to detect a deflection on the signal strength meter or the multimeter. Once this has been found the core of the mixer load coil, L105, should be adjusted until maximum deflection is obtained. This circuit has a low Q so the peak is very broad.

Leaving the generator frequency unchanged remove the dustcore of L202. The tuning meter should now show only a slight deviation from the null position. Screwing in the core will make the tuning meter give a large deflection to the right, pass through the null position and deflect to the left before returning to the null.

This demonstrates the S-shaped curve of the detector, the correct position for the core being that which resulted in the null between the two large deflections. Slight variation of the generator frequency on either side of the null should now produce deflections of the tuning meter to the left and right.

To align the front end, first remove the clip from the oscillator coil and set the tuning voltage to the low end of its range. Sweep the generator frequency slowly over the range 80-100MHz when a deflection should be observed on the tuning meter or multimeter. Once this has been located, set the generator to 88MHz and separate or push together the turns on the oscillator coil to produce a maximum deflection again. Then transfer the signal generator to the tuner input and maximise the deflection by adjusting L101, 102, 104. As the signal strength reading increases, the output of the signal generator should be backed off to avoid overloading or oscillator pulling.

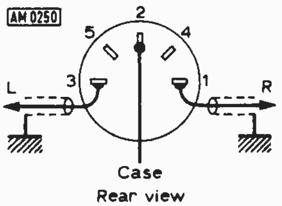
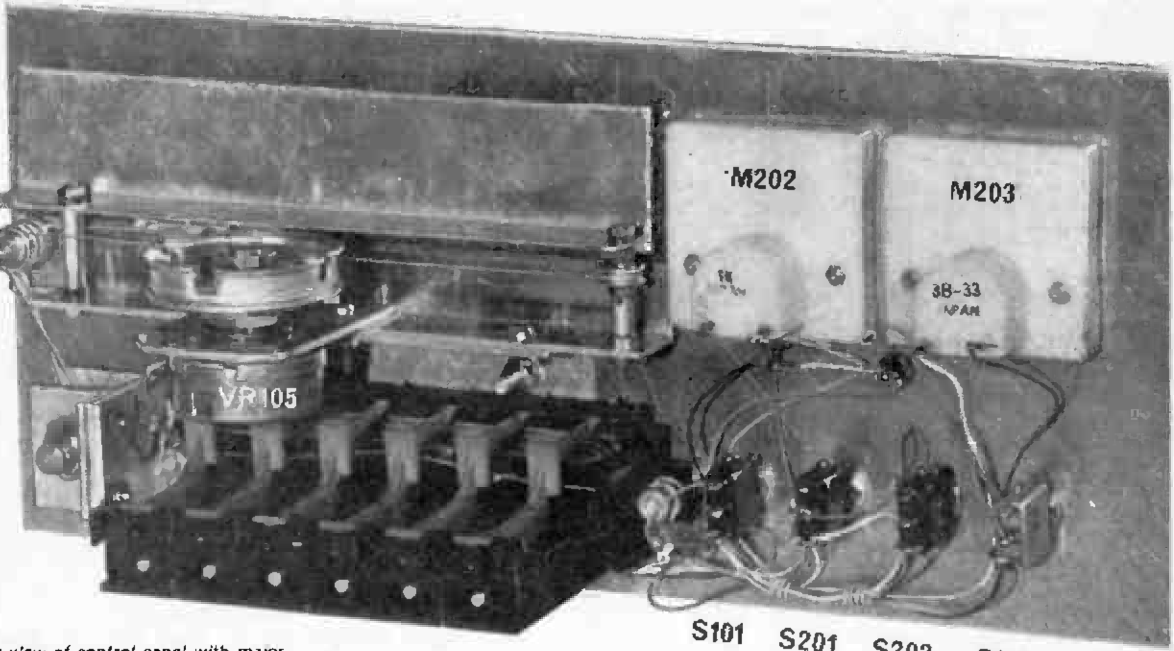


Fig. 9: Audio output connections to match DIN Standard amplifier input socket.



Rear view of control panel with major components identified.

Next change the tuning voltage to maximum, increase the generator frequency to 105MHz and restore its output to 1mV. Vary the generator frequency about 105MHz until a signal strength meter deflection is obtained and bring this to a peak at this frequency by adjustment of VR101-103. The alignment at the bottom end of the scale does not have to be altered as the two adjustments do not interact when done in the manner described.

SECOND METHOD

This method may be used by those who do not have access to an RF signal generator. A second FM tuner, which must have an IF of 10·7MHz and a tuning meter, is used both as a signal generator and as a monitor to check the frequency of the local oscillator of the tuner which is being aligned. Connect a loop of wire to the aerial input of the second tuner and place it in the proximity of the oscillator of the first. Set VR105 to its low-voltage end and adjust L106 until the local oscillator appears as a carrier at 98·7MHz on the scale of the second tuner.

Now reverse the situation with the wire loop feeding the first tuner and the second tuner set to 88MHz. Adjust the tuning control of the first tuner until the tuning meter (or a multimeter connected as in the previous section) gives a deflection, indicating that the local oscillator of the second tuner is being received. L105 is now adjusted to maximise the response and L202 is adjusted as described in the previous section.

It now remains to align the RF circuits. Disconnect the wire loop and connect a good FM aerial. The sensitivity of the tuner is such that some stations will be received even if the RF stages are not correctly aligned. Set VR101-103 to maximum voltage and tune in a signal near the bottom of the band (the local Radio 2 transmitter will usually be the most suitable). Now adjust L101, 102, 104 to produce maximum response on the signal strength meter. Adjust the presets VR101-103 with a signal towards the top of the band, a local radio station for example.

DECODER ADJUSTMENTS

The alignment of the stereo decoder is very simple and requires no special equipment. With the receiver tuned to a stereo transmission the core of L203 is screwed in until the stereo indicator illuminates. The lamp will now remain illuminated over a range of several turns of the core and the correct setting is at the middle of this range.

The precision of this setting may be increased by use of the BBC test tone transmissions on Radio 3 each evening after the end of normal broadcasting. These transmissions include a tone in one channel only. With the tuner connected to an amplifier and speakers, the speaker of the channel with the tone should be disconnected and the setting of L203 varied to give minimum signal in the other channel.

USING THE TUNER

We would like to conclude this series of articles with a description of the tuner in use so that constructors can check the operation of their receivers and get the best use out of them.

The operation of the tuning meter is straightforward. The centre-zero meter should give a slight deflection to the left (low frequency) with no signal present. As the receiver is tuned through a transmission from the low frequency side the meter will deflect strongly to the left, pass through zero and then deflect to the right. The correct tuning point is at the central zero. For maximum accuracy, tuning should be carried out with the AFC off.

If the centre-zero tuning meter is omitted from the tuner the signal strength meter may be used as a tuning indicator by simply tuning for the maximum deflection. This method is, however, not as accurate. Table 4 shows the voltage at pin 13 of

—continued on page 742

I.C. OF THE MONTH

Number 49 — **SGS TBA 790 AUDIO POWER AMPLIFIER**

The TBA 790 is an audio power amplifier integrated circuit available in various forms which have absolute maximum voltage ratings of 12, 15 and 18V and respectively providing maximum output powers of 1·2, 2·2 and 3·45W into an 8 ohm loudspeaker.

The TBA 790KSD

In this article we will discuss the TBA 790KSD device which has an 18V, 3·45W rating, having the type of encapsulation shown in Fig. 1. The bracket is permanently attached to the back of the device, acting as a small heat sink. The bracket contains two holes, tapped 6BA, by which it can be fastened to a larger additional heat sink. For most applications at normal room temperatures the additional heat sink is not required. However, the constructor will often find it convenient to bolt the device to a sheet of metal and this will help to cool it.

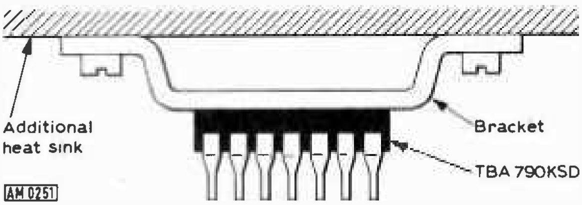


Fig. 1. The integral bracket of the IC provides the normal heat sink for the TBA 790 series.

The pins of this IC are in the quad-in-line configuration, the connections being shown in Fig. 2. Constructors are advised to solder directly to these pins, partly because sockets for quad-in-line devices are not easily obtainable and partly because the use of a socket renders spurious feedback more likely.

Circuit

A simple circuit for the use of the TBA 790 is shown in Fig. 3. The input impedance of the device itself is very high, typically 50 MΩ, and the circuit input impedance is therefore normally determined by R1. The high input impedance enables the circuit to be used with ceramic record player cartridges.

As the value of R2 is reduced, the amount of negative feedback decreases and the gain rises, being equal to 8000/R2. Thus if R2 is 100 ohms, the voltage gain is 80 or 38dB. R2 should not be less than about 39 ohms where the voltage gain is 200

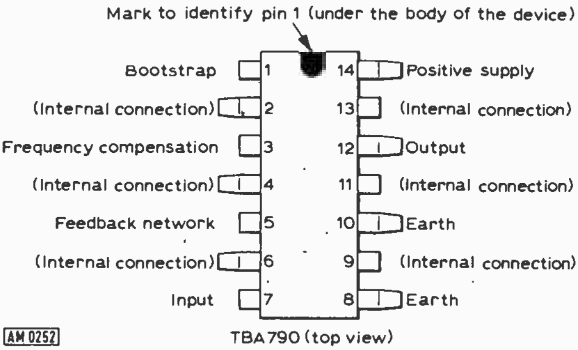


Fig. 2: Pin connections for the TBA 790. The heat sink is omitted for clarity.

or 46dB, since instability is likely at very high gain. The value of R2 should not, generally, be greater than about 200 ohms.

Frequency compensation

The components C2 and C3 provide frequency compensation. Ideally their values should be chosen according to the graph of Fig. 4, although these values are by no means critical. One should therefore estimate the gain required and then ascertain the value of R2 in Fig. 3. The value of C3 can then be read from the left hand side of Fig. 4 and the value of C2 from the right hand side of Fig. 4.

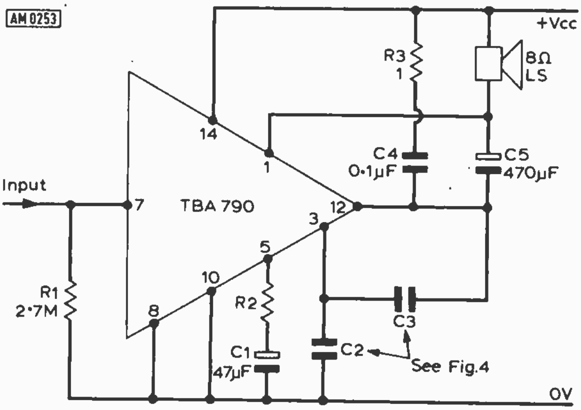
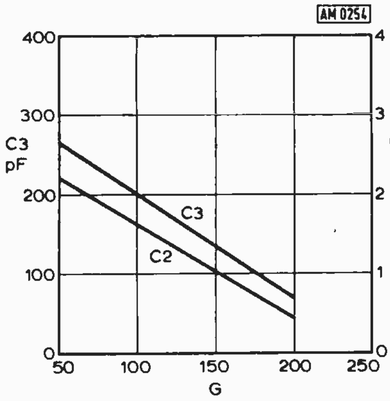
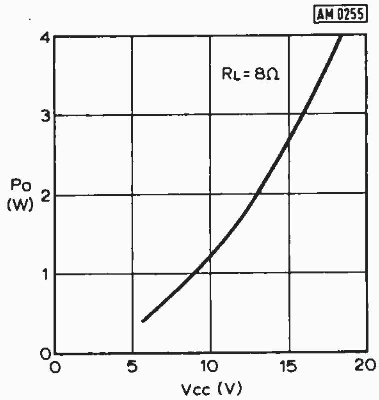


Fig. 3: Basic circuit of the TBA 790 as an audio amplifier.





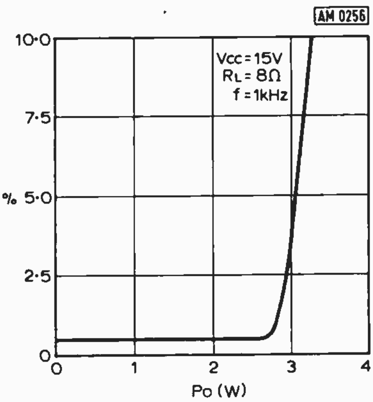
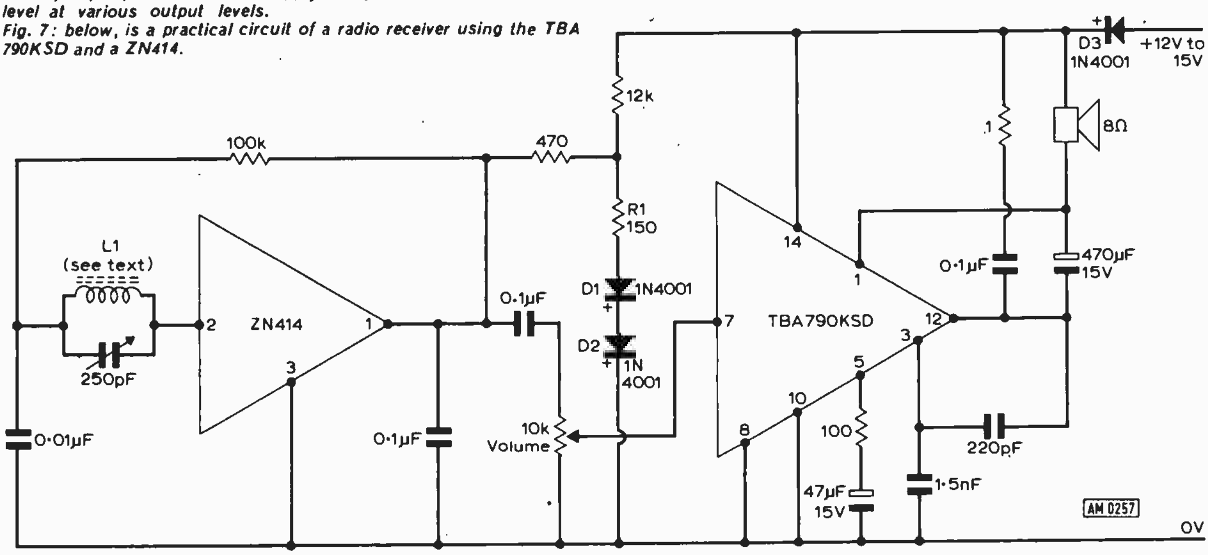


Fig. 4: above, graph for selecting values of C2 and C3 in Fig. 3. Fig. 5: centre, output power related to supply voltage. Fig. 6: right, distortion level at various output levels.

Fig. 7: below, is a practical circuit of a radio receiver using the TBA 790KSD and a ZN414.



Power supply

The maximum output power which can be obtained from the TBA 790KSD at various supply voltages is shown in Fig. 5 where an 8 ohm loudspeaker is employed. In general it is wise to regard the maximum power supply voltage as about 16V to allow a small margin of safety.

It can be seen that an output of just under 2W can be obtained when the device is used in a 12V car radio, although more than 2W should be obtainable when the battery is being charged.

The quiescent current is only about 10mA at 15V or 7mA at 10V, but it will rise to around 1 to 3A when 3W is being delivered to an 8 ohm speaker. The efficiency (output power/input power) is typically 65 per cent at the 2·7W level.

The circuit shown has a frequency response which is 3dB down at about 70Hz and at about 12kHz. The use of a capacitor of larger value for C5 of Fig. 3 will extend the bass response, whilst the high frequency response can be altered by changing the value of C2 or C3.

The components R3 and C4 of Fig. 3 compensate for the speaker inductance.

The total harmonic distortion is plotted as a percentage against the output power in Fig. 6 for a 15V supply and an 8 ohm speaker. It can be seen that the total harmonic distortion is fairly constant at a fraction of a per cent until the power exceeds about 2·6W. It then rises rapidly with the onset of clipping to about 10 per cent at 3·4W.

Typical use

The writer has used the TBA 790SKD as the output stage of a very simple radio receiver employing the well known Ferranti ZN414. The circuit is shown in Fig. 7. The voltage gain of the audio amplifier has been set at about 80 which has been found to provide good volume. The two diodes D1 and D2 are forward-biased silicon diodes which stabilise the ZN414 supply voltage. If these diodes are replaced by a resistor, the receiver will not function satisfactorily over a range of supply voltages. The gain of the ZN414 circuit can be adjusted by altering R1, reducing it in value or removing it altogether if the ZN414 stage oscillates.

The diode D3 in the supply lead is included to prevent the destruction of the TBA 790 if the power supply is accidentally connected with the wrong polarity. It may be omitted if desired.

The coil L1 consisted of about 80 turns of 28 SWG enamelled copper wire close wound on a 4in. long ferrite rod. A long-wave coil of around 220 turns of much finer wire could be placed at the other end of the rod and switched into circuit to replace L1 if long wave reception is required. ■

EXPERIMENTAL WORKSHOP

M. J. HUGHES M.A.

LEARNING BY PRACTICAL PROJECT STEPS

PART 13—PHASE SHIFT CIRCUITS

THERE is more to a top cut filter than an attenuation factor, as described last month. Apart from the potential divider effect of the resistor and total circuit impedance on the input voltage, the circuit introduces what is called **Phase delay.** This means that when a sine wave signal is applied to the input we will see an attenuated sine-wave at the output but the peaks and troughs of the wave will not occur at the same instances of time. To confuse the issue, the time discrepancy between input and output depends on the frequency of the signal we apply. This is not an easy feature to demonstrate without an oscilloscope but we hope the following experiment, coupled with a bit of thought, might clarify the situation a little.

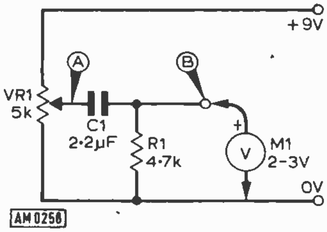


Fig. 90: Experiment to show phase shift in a top cut filter.

In Fig. 90 we shall simulate an AC input signal by moving the wiper of VR1. Because we are limited to slow movements (low frequencies) we shall have to use a suitable high value capacitor for C1 so that useful signals can be measured on the meter M1. This meter must be sensitive, 20,000 ohms per volt, and switched to a low DC voltage range, about 2 or 3 volts. The voltage at "A" will be set by the potentiometer and can be anything in the range of 0 to +9V. We can, with a bit of manual dexterity, make this voltage follow a near sinusoidal pattern; to do this, start with the wiper at minimum voltage and rotate it, slowly at first, reaching a maximum speed of rotation at the half way point, then start to slow down gently until you reach the top end of its track. You should aim to slow down progressively, so that you don't suddenly stop when you reach the top. Having reached the top, peak positive voltage, immediately start turning the knob the other way, slowly at first, speeding up to the halfway point and then slowing down as you reach the bottom end, again without an abrupt stop. This needs a bit of practice but it is not as difficult as it might at first appear. If you manage to do this satisfactorily the voltage at the wiper should approximate to a sine wave and if repeated over and over again should produce a waveform something like that shown in Fig. 91.

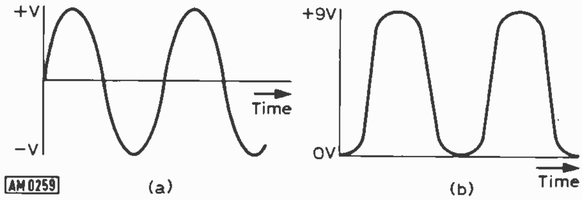


Fig. 91: (a) Ideal sine wave oscillating about zero volts. (b) Approximate waveform from Fig. 90, oscillating between zero and +9V.

The thing to do now is to monitor the voltage at point "B" on the circuit as you go through the "sine wave" cycle. Initially make the cycle stretch over about two seconds and watch the meter closely. During the slow portion of the rising waveform the meter will read virtually nothing but as you speed up at the halfway point the meter voltage will rise. As you pass the halfway point and slow up towards maximum you should see that the meter voltage

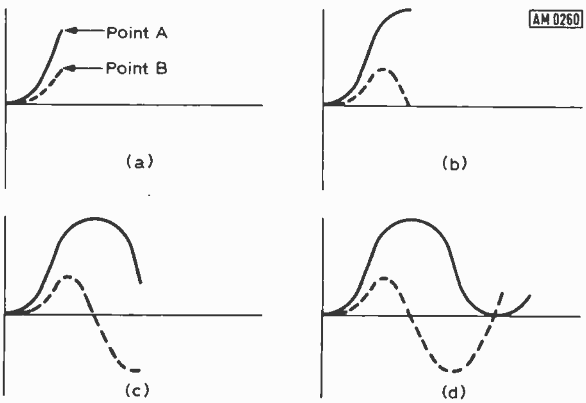


Fig. 92: Progressive construction of waveform obtained in Fig. 91 (b).

starts to fall back to zero and reaches zero just as you reach maximum voltage. The voltage you see on the meter should be proportional to the rate at which the input signal was changing. If you had an oscilloscope the output voltage would trace out the line shown in the progressives of Fig. 92.

When you turn the potentiometer in the opposite direction, describing the negative half of the input sine wave, the meter will try and read backwards so reverse its leads and you will find that a similar effect is produced in a negative direction. If you repeat this cycle many times you can imagine that the voltage at point B has the same sinusoidal shape as that at A but it is reduced in amplitude (attenuation by top cut filter action) and it reaches a positive peak as the input voltage is going through the centre part, the fast moving part, of its positive going swing. The voltage at B is zero when A is peak positive, maximum negative when A is moving in a negative direction and zero again when A is at its peak negative, zero volts, level. The final trace in Fig. 92 clearly shows that the voltages at B are out of step with those at A by a quarter of a wavelength.

Because a complete wavelength of a sinewave is a cyclic event we sometimes say it corresponds to a 360° cycle hence we can say a quarter of a wavelength is 90°. Using this nomenclature we can say there is a 90° phase shift between the input and output signals for this circuit, at the low frequencies we are considering.

If you had a signal generator instead of a potentiometer as an input signal and a double-beam oscilloscope monitoring the voltages at A and B you would see this more clearly. You would also see that if the frequency of the input signal were increased the amplitude of the output would increase but the phase shift would also start to reduce. As the input signal frequency becomes very high the phase difference approaches zero and the output becomes an almost exact replica of the input, both in phase and amplitude.

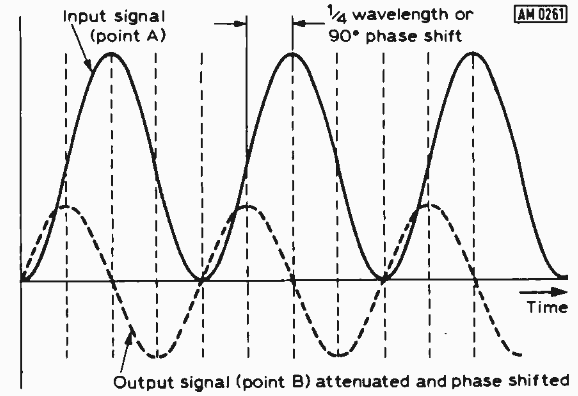


Fig. 93: Curves showing 90 phase shift of LF signal through top cut filter.

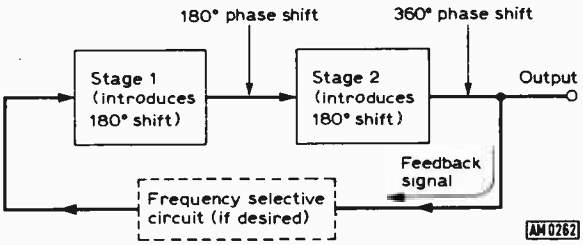
We can thus say for a top cut filter:—

1. At very low frequencies we get 90° phase shift and heavy attenuation, Fig. 93.
2. At very high frequencies we get no phase shift and little attenuation.
3. At intermediate frequencies we get a graded scale of phase shift (between 0° and 90°) and graded attenuation, depending on the frequency we choose, and, of course, on the values of the components in the filter.

This phase shift effect can be put to good service in certain types of oscillators. To obtain oscillation all we need is an amplifier with frequency selective positive feedback. This means that we have to take the output of the amplifier and at a certain frequency feed it back to the input with a phase relationship that enhances the output.

We have seen several examples of the opposite effect in amplifier stages, previously described in this series. Negative feedback was achieved by feeding the signal from the collector of a transistor back to its base. A single transistor stage, in grounded emitter configuration, has 180° phase shift between its input and output, when the input moves positive the output moves negative and vice versa. To get positive feedback we must arrange to feed back a signal that is in phase (i.e. having zero or 360° or any multiple of 360° phase shift).

One simple way of doing this is to use two transistor stages, one cascaded into the next. The output of the second stage will be 360° out of phase with the input to the first and this is equivalent to there being no overall phase shift. If we feed the output signal back to the input the circuit will oscillate at a frequency set by any frequency dependent components, capacitors or inductors, that form part of the loop, from input to output and back to the input again. If there are no such frequency sensitive devices and the amplifier is DC coupled then the oscillator becomes locked in one or two possible states (it tries to oscillate at zero frequency!!). This circuit is, in effect a bistable which has been described in a previous part.



This block diagram shows concept o an oscillator, producing zero phase shift, gain and frequency selective feedback.

For regenerative feedback to occur, a pre-requisite for oscillation, it is necessary for the gain of the amplifier to equal or exceed any signal losses in the feedback path. Positive feedback alone is not sufficient. We can turn the two transistor stage into a free running oscillator as shown in Fig. 94. The capacitors determine the frequency and, if looked at from a different view point, this circuit is very similar to a free running (astable) multivibrator. Changing the value of the capacitor in the feedback loop changes the frequency of oscillation; you can try this and, with the values given, the frequencies should be in the mid-audio range. Layout shown in Fig. 95.

If we accept that we can get 90° phase shift from a simple RC filter it might seem that two such filters cascaded into one another Fig. 96(a) would give us 180° phase shift. This would be true of signals of zero frequency but, apart from zero frequency being a rather impracticable concept when dealing with oscillators, the attenuation would be infinite and no measurable signal would be seen at the output. If, however, we extend the logic a little and consider three such filters connected together (Fig. 96(b)) there will be a specific frequency that undergoes 60°

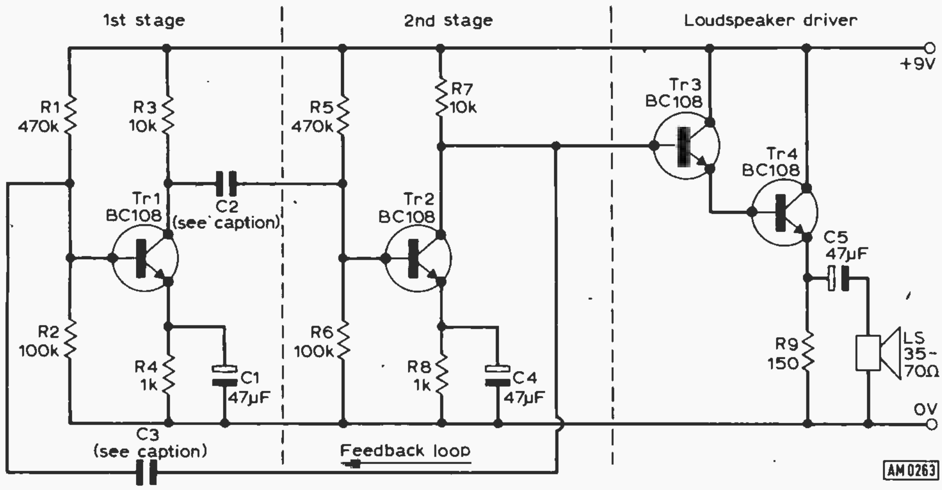


Fig. 94: Two stage amplifier converted to an oscillator, frequency being determined mainly by C2 and C3.

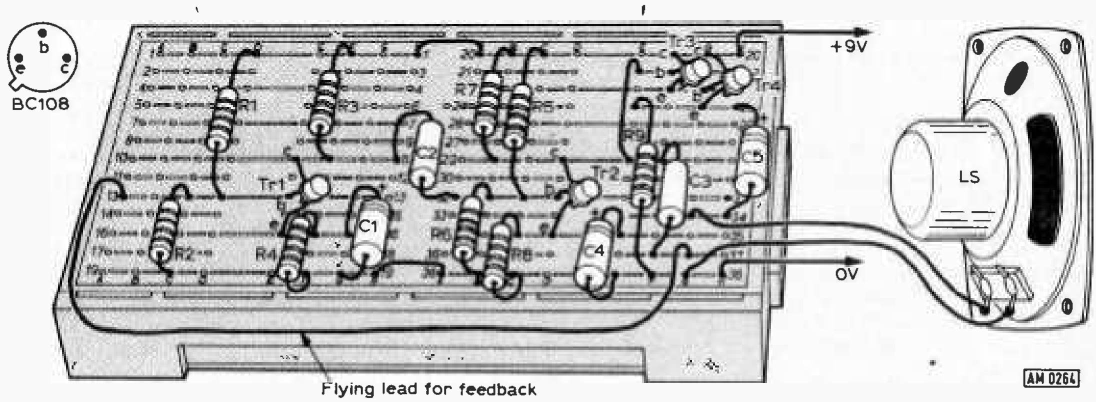


Fig. 95: Layout for Fig. 94. Try values of 1000pF to 0·47μF for C2 and C3 in any combination.

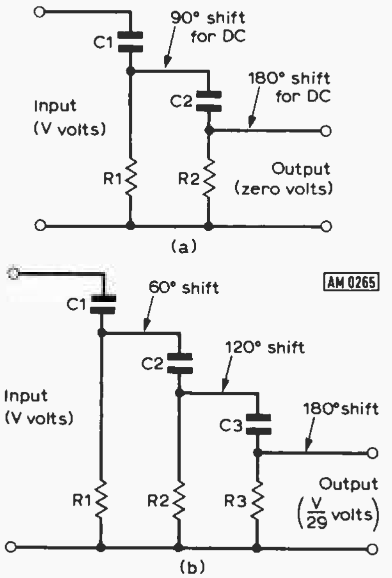


Fig. 96: (a) Two stages cascaded as shown will give theoretical 180° phase shift at zero frequency. (b) With three stages each stage will give 60° shift at a certain frequency giving 180° shift overall.

phase shift through each of the three stages. Three lots of 60° shift give 180° shift overall but this time we are no longer dealing with zero frequency; it will be a finite frequency and although there will be considerable attenuation it will certainly not be infinite and we can guarantee at least some measurable signal at the output for this particular frequency.

It can be shown that if each of the resistors in the three stage filter have values R (in ohms) and the capacitors are of equal value C (in farads) the frequency that is subjected to 180° phase shift is given by:—

$$f = \frac{1}{2\pi CR\sqrt{6}}$$

Because of the inter-relationships of impedance, reactance and frequency the attenuation for this circuit at this particular frequency is always a factor of 29.

We can now conceive using this network to replace the second transistor in our experimental circuit, to give 180° phase shift instead of the second transistor and simultaneously determine the frequency at which this phase shift occurs. By using this network in the feedback path of a single transistor stage we should be able to get regenerative feedback at a predetermined frequency provided that the voltage gain of

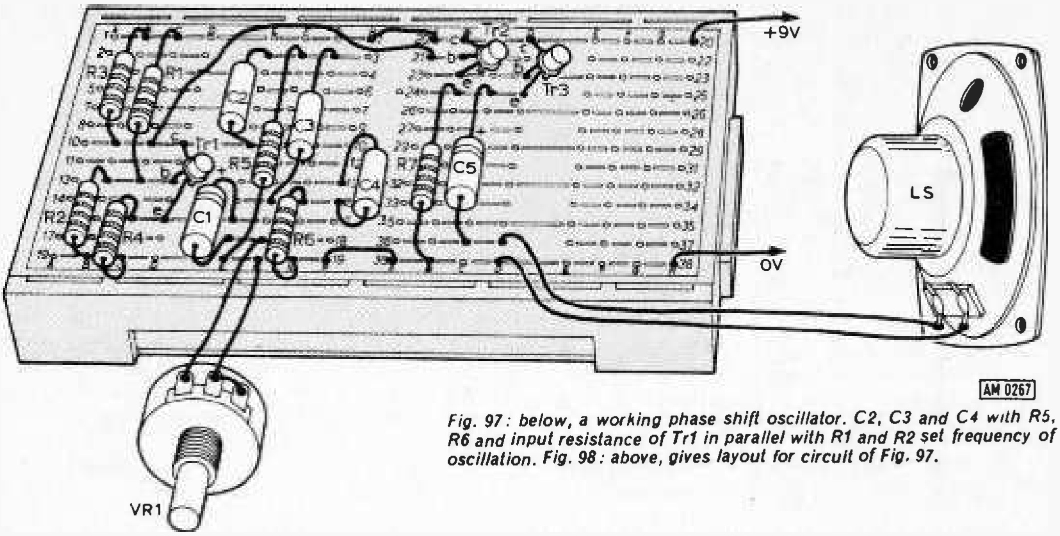
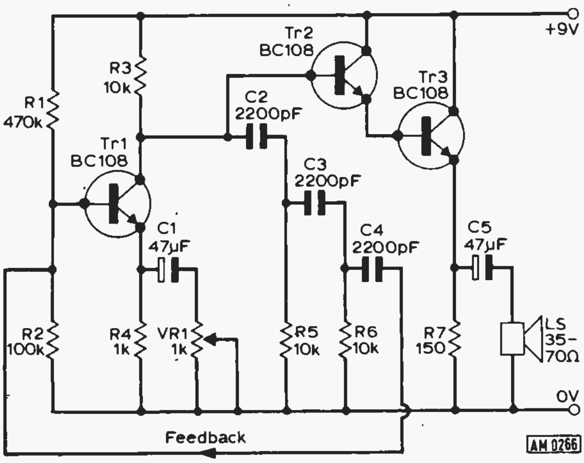


Fig. 97: below, a working phase shift oscillator. C2, C3 and C4 with R5, R6 and input resistance of Tr1 in parallel with R1 and R2 set frequency of oscillation. Fig. 98: above, gives layout for circuit of Fig. 97.



the single transistor stage exceeds 29. Ideally the gain of the amplifier should be greater than, but as near to 29 as possible, otherwise clipping will occur and providing the gain is just right the oscillator will produce a very pure sinusoidal output waveform. VR1 introduces a controllable amount of negative feedback and thus sets the gain of the amplifier, Fig. 97. Start with this set to maximum resistance and no oscillations will be heard in the loudspeaker; as it is reduced in value a pure note will be heard and reducing its value to zero will provide zero negative feedback, maximum gain, and some distortion might be heard in the loudspeaker as clipping starts to occur. The latter effect will depend on the transistor latent gain. Layout is given in Fig. 98.

This is a very useful and simply made oscillator for audio and sub-audio frequencies and is sometimes used for generating low frequency vibrato signals in electronic organs as it has a comparatively pure signal content. The only problems are that the gain of the amplifier needs setting carefully for optimum performance and that it is rather difficult to change its frequency of operation with a variable control. Small changes in frequency can be provided by varying the value of one or two of the resistors in the feedback loop by small amounts. The best way of setting the frequency to a predetermined value is to leave the resistors fixed and substitute different sets of capacitors in the feedback circuit.

Phase shift has many other useful applications in electronics and it can be obtained in other ways. Under some circumstances it can be detrimental and is sometimes encountered unexpectedly in audio amplifiers giving rise to undesirable spurious oscillations.

Next month: Some more applications of positive feedback.

P.W. SANDOWN—*continued from page 735*

IC201 measured for various signal strengths for a typical tuner. This information may be used to calibrate the signal strength meter if required, although quite wide variations can be expected between tuners.

With the muting or squelch switched off there is considerable inter-station noise and the usual distorted output as the signal enters the edge of the tuner passband. With the squelch in operation the background should be silent until a noise-free signal is received. It should normally be left on unless a weak signal is being received.

TABLE 3
Filter centre frequencies

Colour code	Centre frequency (MHz)
Orange	10·625
Yellow	10·665
Green	10·700
Blue	10·735
Violet	10·775

TABLE 4
Signal strength meter indication

Voltage at Pin 13, IC201 (v)	Approx. signal level at aerial socket
0·15–0·3	0
0·4	1µV
1·3	10µV
2·0	100µV
3·0	1mV
4·6	10mV

The stereo defeat facility automatically inhibits the decoder when the signal falls below the level required for noise-free stereo. Alternatively the tuner can be held in the mono or the stereo mode independent of the signal level by moving the mode switch R203 to the appropriate position. ■

PRODUCTION LINES

colin riches

EKCO ZU540

Sound Project ZU540 from Ekco is a tuner-amplifier/turntable/Dolby cassette tape recorder unit.

The Dolby noise reduction system operates on both record and playback. The v.h.f. varicap tuner employs 4 push-button pre-selectors plus free tuning and a built-in stereo decoder with beacon indicator.

The transcription-type 2-speed record player uses a Philips GP400 magneto-dynamic cartridge with a 15 micron diamond stylus.

There is a facility for using chrome dioxide tapes on the recorder and there is an automatic level control with a manual override.

An electronic tape-end auto stop allows for automatic 'pop-up' disengagement of the cassette keys.

Output power is quoted as 20W per channel into 4Ω.

I have tried out this unit and found it to give excellent quality reproduction through the DX181 speakers which come with the system.

I cannot give full details of the impressive specification in the limited space I have here but please write to Pye Limited, P.O. Box 49, Cambridge if you would like further details.

BANISH THE IRON!

Banish the soldering iron—that's what Radio and TV Components have done with their latest car radio kit.

All the electrical connections are made through colour-coded press-on tags and R and TV Ltd. claim that a complete novice can build it in under two hours.

The "Tourist TT" has five push-buttons which can be tuned to any pre-selected station. Four operate on m.w. and one on l.w.

This new radio kit developed from the firm's very successful and efficient "Tourist" radio, utilises an i.c. and a p.c. board allied to tested sub-assemblies. Constructing the kit is simply a matter of fixing the various component assemblies to the chassis using the screws provided.

The kit features permeability tuning and long-wave coils to ensure good sensitivity and selectivity on both bands. The r.f. sensitivity at 1MHz is said to be better than 15μV and power output into a 3Ω speaker is claimed to be better than 4W.

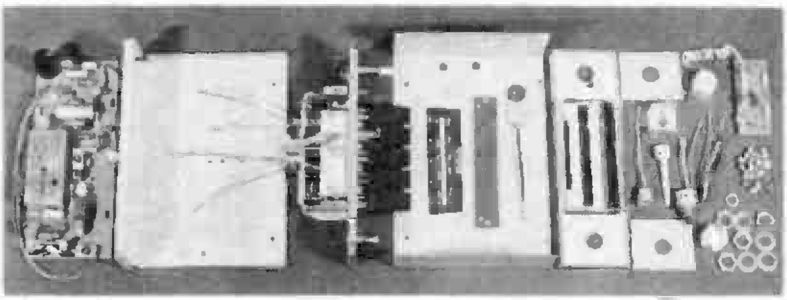
Both the tuner and the i.f. module are pre-aligned and the kit is suitable for 12V positive or negative operation.

The kit comes complete with step-by-step assembly instructions and instructions for installing the radio into the car itself.

This excellent kit is available by post or direct from Radio and TV Components Ltd., 21 High Street, Acton, London, W.3. The price is £7 plus VAT. Postage and packing cost 55p.

Extras available are a speaker with baffle and fitting strips, at £1·65 (post and packing 23p) and a retractable, matched locking aerial for £1·37 (20p postage and packing).

We are publishing a Special Product Report on the "Tourist TT" car radio on page 704 of this issue of Practical Wireless.



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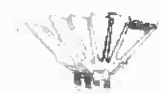

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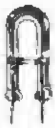

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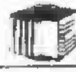

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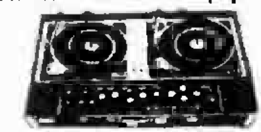

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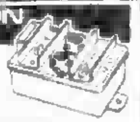

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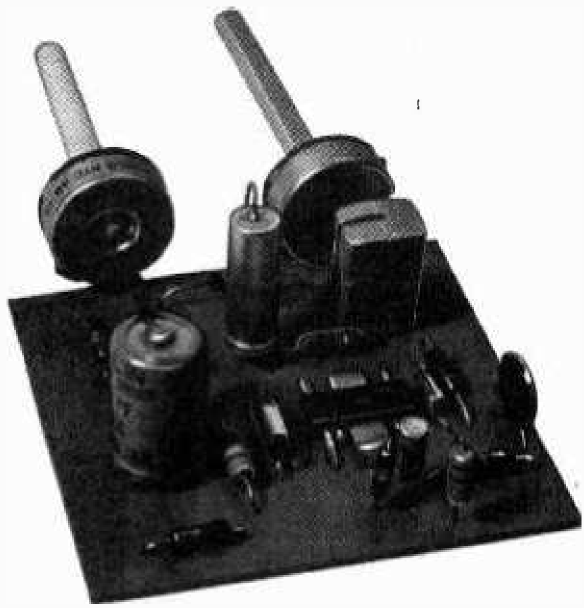
A 2 WATT AUDIO IC Amplifier

R.A.PENFOLD



IN the medium power range there is now a wide variety of i.c. audio amplifiers available, with power outputs ranging from 1 to 6 watts r.m.s. As with the majority of semiconductor devices, the prices of these have dropped in recent years and most now represent very good value for money.

This article describes an amplifier based on such an i.c., the Motorola MFC9020, which gives a maximum output power of 2W r.m.s. into a 15Ω load. A peak power of about 4W is available. In the configuration used here the device has a typical distortion level of approximately 0·5% at full output at 1kHz, with an input sensitivity of 250mV r.m.s.

The prototype was made for use as a tape recorder monitor amplifier, but as the input impedance is high it is also suitable for use in simple record playing equipment in conjunction with a crystal or ceramic cartridge. With the addition of a suitable preamplifier it would of course be suitable for many other applications.

The unit has built-in volume and simple tone controls. A circuit of a simple mains power unit for the amplifier is provided.

A diagram of the internal circuit of the MFC9020 is shown in Fig. 1. Basically this is divided into two sections. The first four transistors form a differential amplifier while the other five form a fairly conventional complementary class B output stage.

Operation of the differential amplifier is quite simple. For high gain and input impedance this uses two darlington pairs. The first is used in the emitter follower mode, and the output of this stage is developed across the emitter resistor. The second darlington pair operates as a grounded base amplifier to the signals appearing across the emitter resistor. No voltage amplification is provided by the emitter follower stage which provides the circuit with a high input impedance and has a low enough output impedance to drive the grounded base stage. The grounded base stage does provide a degree of voltage amplification.

Neither an emitter follower, nor a grounded base stage provides any phase change to the signal, and so the input to pin 7 is in phase with the output at pin 5. There is a second input to the circuit at pin 8. For an input at pin 8 the second darlington pair will operate as a common emitter amplifier, with the amplified and inverted output appearing at pin 5. Thus pin 7 is a non-inverting input and pin 8 is an inverting input.

OUTPUT STAGE

This is quite conventional, the only unusual feature being that two transistors are used in the upper section, and three in the lower, rather than the more usual two in each section. The two silicon diodes connected across the two inputs to the two sections of the output stage operate as low voltage zeners, and provide a suitable bias for the output transistors to reduce cross-over distortion to an unnoticeable level. The diodes also provide temperature stabilisation of the output stage.

Under normal operating conditions the output stage is biased to give about half the supply potential at the output (pin 3). The two upper transistors operate as another darlington pair in the emitter follower mode, providing current amplification to positive-going half cycles. The lower three transistors consist of another darlington pair, this time in the common emitter configuration, driven by a pnp common emitter amplifier. There is 100% negative feedback between pin 3 and the emitter of

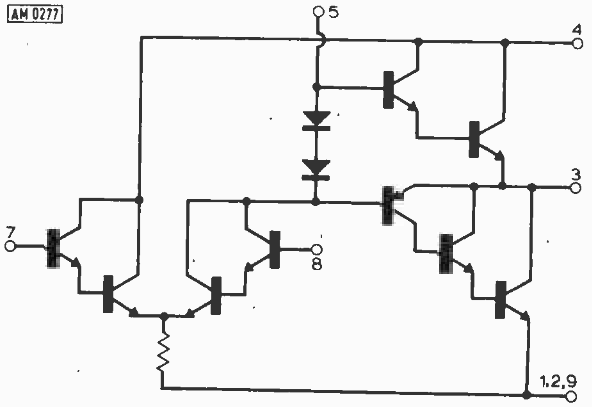


Fig. 1: Internal circuit of the MFC9020.

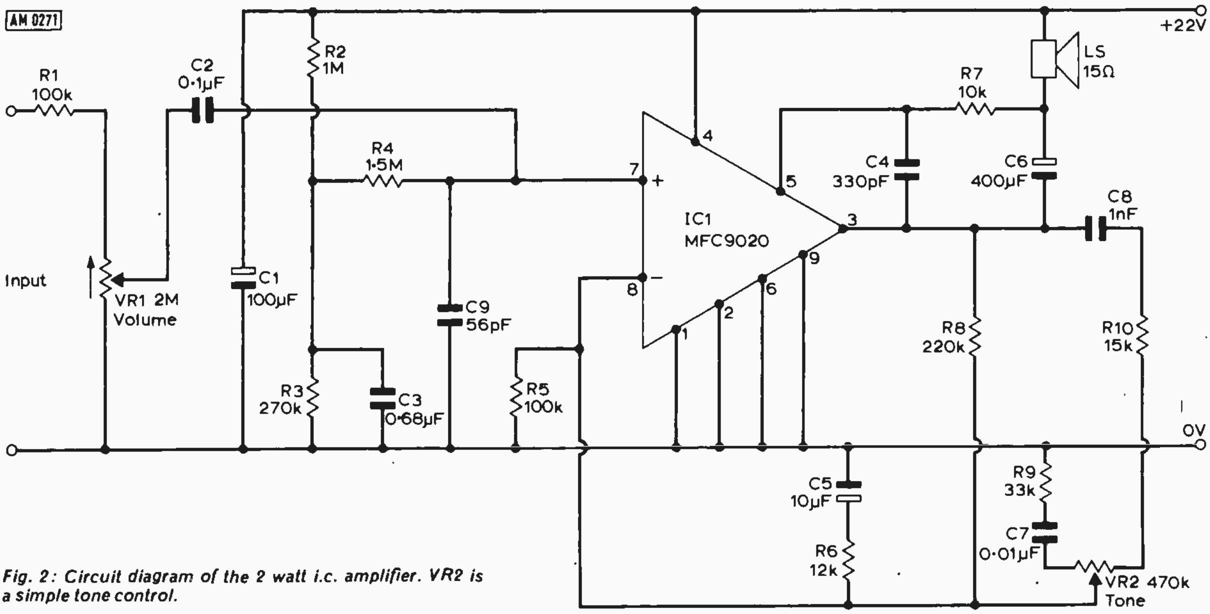


Fig. 2: Circuit diagram of the 2 watt i.c. amplifier. VR2 is a simple tone control.

the first of these three transistors, and this forms what is termed a compound amplifier. Like an emitter follower, a compound amplifier provides no voltage gain, but has a high current gain. It also has the input and output signals in phase. These three transistors amplify negative-going half cycles. Due to the high current amplification of the output stage, the output at pin 3 is at a very low impedance. and can directly drive the loudspeaker via a d.c. blocking capacitor.

AMPLIFIER CIRCUIT

A circuit diagram of a practical amplifier using the MFC9020 is shown in Fig. 2. The input is taken via R1 to the volume control, VR1. C2 couples the signal from here to the non-inverting input of the i.c. This input is biased via R4 from a potential divider across the supply, R2-R3. C1 and C3 are decoupling capacitors.

The inverting input is biased from the output of the i.c. by the potential divider, R5-R8. This introduces negative feedback and helps to give a stable biasing arrangement, though it seriously reduces the sensitivity of the circuit. C5 and R6 are therefore used to decouple some of the a.c. feedback and so provide increased sensitivity.

A simple treble boost and cut tone control is provided in the feedback network. This consists of VR2, C7, C8, R9, and R10. With the slider of VR2 towards the right, R10 and C8 are in effect shunting R8. The impedance of R10-C8 is frequency dependent, and reduces as frequency increases. The negative feedback in the circuit will therefore increase with frequency, causing the response of the amplifier to drop at high frequencies. With VR2 in this position the circuit is given top cut.

With the slider of VR2 at the other end of the track, C8 and R10 are in effect cut out of circuit due to the high value of VR2. However, R9 and C7 are now shunted across R6 and C5. Again, the impedance of these will be frequency dependent, but as they are connected across the other section of the potential divider, the feedback will be increased as frequency increases. This gives treble boost. R9 and R10 are required to limit the effect of VR2 to a certain extent, in the interest of good stability.

Capacitors C4 and C9 are required for good stability. C6 couples the output to the loudspeaker. R7, which is the load resistor for the differential amplifier, is connected to the positive supply via the L.S. so as to give bootstrapping to the circuit.

The input impedance of the amplifier varies with the setting of VR1, but is about 2·1MΩ at minimum sensitivity, reducing to about 700kΩ at maximum sensitivity.

★ components list

AMPLIFIER

Resistors, ¼ watt, 5%

R1	100kΩ	R6	12kΩ
R2	1MΩ	R7	10kΩ
R3	270kΩ	R8	220kΩ
R4	1·5 MΩ	R9	33kΩ
R5	100kΩ	R10	15kΩ
VR1	2 MΩ log.	VR2	470kΩ lin.

Capacitors

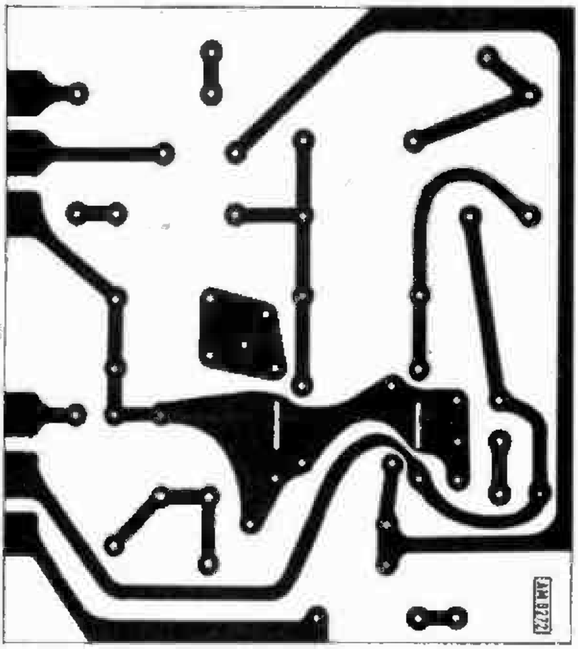
C1	100µF 25v	C5	10µF, 10V
C2	0·1µF	C6	400µF, 25V
C3	0·68µF	C7	0·01µF
C4	330pF polyester	C8	0·001µF polyester
		C9	56pF polyester

Miscellaneous

Motorola MFC9020 (available from SCS Components); Materials for p.c.b., 15Ω loudspeaker, rated at 2 Watts r.m.s. or more; Wire, solder, etc.,

POWER SUPPLY

R11 390Ω, ½W, ± 10%. C9 1000µF 50V C10 500µF 25V Tr1 MJE340 D1-D2 1N4001 D3 22V, 1W zener. T1 Mains transformer 20-0-20V 250 mA secondary. S1 d.p.s.t. F1 250mA.



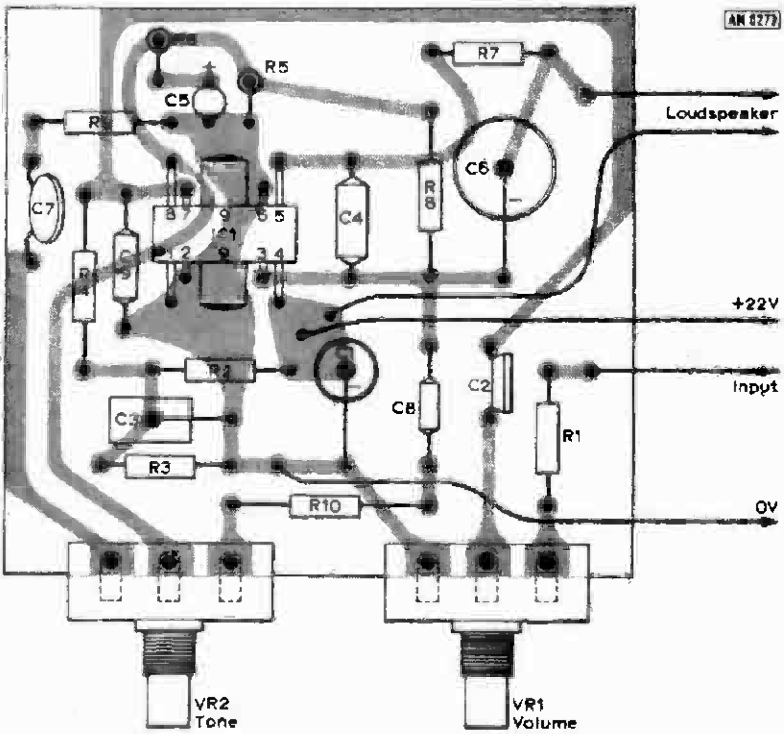


Fig. 3: above, shows the PCB layout actual size. Note that this is turned through 90° compared with Fig. 4.

Fig. 4: left, shows the layout of components on the PCB. The tags of VR1 and VR2 are soldered to the underside of the board.

CONSTRUCTION

A printed circuit board measuring $3\frac{1}{4} \times 3$in. is used and this carries all the components except the loudspeaker. Fig. 3 shows the pattern of the copper side of the p.c.b., and also the drilling points. Fig. 4 shows the component layout on the board.

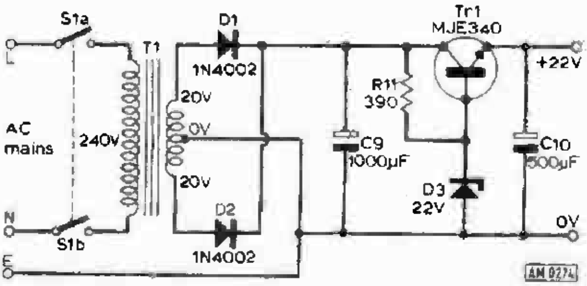
The integrated circuit requires two $\frac{1}{4}$in. long slots in the p.c.b. into which its heat tabs fit. These are cut using a coping saw or a fret saw. Although potentiometers with pins which fit into p.c.b. mounting holes are manufactured, these would not seem to be widely available to the amateur, and this p.c.b. has therefore been designed to accept ordinary potentiometers with tag connections. The tags are taken under the edge of the p.c.b., and soldered to the copper backing.

POWER SUPPLY

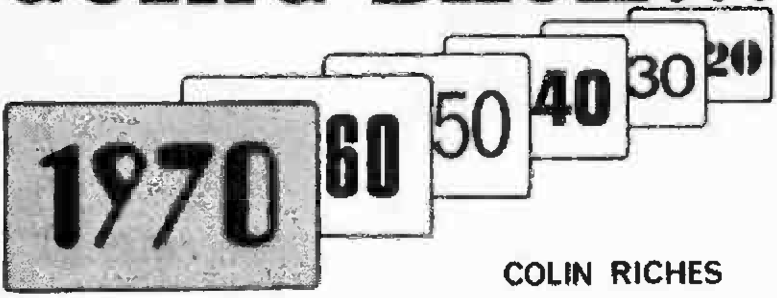
The amplifier requires a supply of approximately 20-22V. As the i.c. has a maximum supply voltage rating of 24 volts, it would be difficult to find a suitable unregulated power supply circuit considering that the amplifier has a class B output stage. This is because the supply should not rise to more than 24V under quiescent conditions, with a current consumption of perhaps only 10mA, and yet maintain about 21 volts under full load conditions with the current consumption peaking as high as 500mA.

It is more practical to use a simple stabilised circuit as shown in Fig. 5. This is a fairly standard configuration, using a zener diode stabilisation circuit feeding an emitter follower. This uses few components, and can easily be constructed on a small tagstrip or connector block. The MJE340 can be mounted on a strip of aluminium which will act as a heat sink and can be bent to form a suitable mounting bracket for the component. ■

Fig. 5: below, is a circuit of a suitable stabilised mains power supply unit for the amplifier.



GOING BACK...



COLIN RICHES

Story of the P.S.U.

WHILE reading through one of my favourite vintage radio reference books, the BBC Year Book of 1930, I noticed a page devoted to telling listeners about power supplies for their receivers. It certainly was intended as a serious article then but these days one cannot help but smile when one reads about a BBC warning on making a direct connection between a receiver and the mains supply. So, below are a few pointers which listeners should have taken note of in the days 10 years or so before World War II.

"No receiver can give really good quality reproduction if the power supply to it is inadequate. Since broadcast receivers first came into use by the general public there has been a tendency to gradually increase the power supply to the last stage of amplification. Electric light supply mains provide a constant and convenient source of power for wireless receivers, but in no circumstances should the mains be connected direct to the receiver without the use of an intermediary mains-unit.

A year ago, the BBC drafted a pamphlet which describes the many ways in which electric light supplies can be utilised for wireless receivers. The publication of this pamphlet has been delayed owing to the fact that a number of bodies, such as the Institution of Electrical Engineers, the British Engineering Standards Association and the Radio Manufacturers' Association, are all interested in its contents and the BBC naturally is anxious to conform with their views and wishes. It will however be published as soon as possible.

The BBC wishes to take this opportunity to warn listeners most seriously against the direct connection of their receivers to supply mains, and also strongly recommends that no listener who is unaquainted with handling power and electric light circuits should attempt the home construction of a mains-unit. It is a far more difficult matter to build a safe and satisfactory mains-unit than it is to build a valve receiver. Owing to the danger to life if a number of improperly designed and constructed mains-units come into use by the listening public, the Institution of Electrical Engineers, in collaboration with the other bodies concerned, has drawn up a set of regulations which governs the use of electric power supplies to wireless receivers. One set of regulations, by the I.E.E. has already been published but new and more detailed regulations are now under consideration. These new regulations, if agreed, will be written in formal technical language and it is thought that many listeners will not be able to follow them conveniently. It is therefore probable that in its mains-unit pamphlet, the BBC will print an explanation written in more simple terms.

In conclusion, listeners are reminded that they are likely to have some difficulty in the future with electricity supply contractors, fire insurance authorities and other similar bodies, if they are using a mains-driven receiver which does not conform with the agreed regulations."

I suppose it is a matter of familiarity breeding contempt since electronic enthusiasts have been successfully assembling mains operated equipment and power supply units for a very long time now without any serious losses among their numbers from electric shock!

These interesting photographs show some "mint" items of vintage radio equipment kindly provided by Mr. Ken H. Rann of Lancing, Sussex.

It's rather unusual to locate brand new components but new items in their original boxes are interesting items indeed!

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

THIS month I am glad to be able to give a plug for the West of Scotland Amateur Radio Society. Publicity and QSL Manager Graham Bleakley reports a thriving membership of 80 and space for many more and promises a warm welcome for SWL's, young or old. In the past the club has concentrated more on the interests of the licenced amateur so it is very good to hear that the SWL is actually being welcomed! It is an unfortunate fact that many clubs catering for the licenced chap tend to spurn the SWL who goes along once, gets the cold shoulder and then decides to drop the idea of pursuing the hobby. The fact that the SWL of today is the licenced amateur of tomorrow seems to escape notice. The SWL is also only too pleased to be a general dogsbody around the club, taking on tasks that no-one else wants to do, especially on Field Day events. SWL's in the Glasgow area are invited along to 81 Virginia Street, Glasgow every Friday evening at 8pm to sample the Morse classes, junk sales, films, library and lectures etc. More details from Secretary K. Drinkwater at that address.

Steve Blake (Aylesbury) joined the flock with a report of 40m doings including a nice collection of ZL's on SSB. Hope Steve will favour me with some details of his gear in his next log. **Michael Crimes** (Exeter) has forsaken VHF now that he can really hear the DX on his shiny new Yaesu FR50B coupled to 132ft of wire via an ATU. Like several other reporters he is a little disgusted with the antics of the Italian boys especially when a rare call pops up.

Michael Green A8088 (Northwich, Cheshire) refutes any suggestion that the 4m band only comes alive in contests and submits a long list of G's heard in one evening on his home-made converter plus CR100 and 4-element beam at only 12ft. Regular **John Porter** (Baslow, Derbys) is glad to have left the classroom for an OND course at Chesterfield Tech. His Trio 9R59DS was not allowed to get cold, evidenced by the list of DX from 15 to 160m. **Andrew Darragh** (Wetherby, Yorks) sends his first log and promises more. Last reported in 1968 it seems, getting married in the interim, now 'back on the rails' and I should jolly well think so! A Geloso converter puts signals into an AR88 from a 12AVQ trapped vertical and nine radials per band!!! He must be located in the centre of the racecourse up there!

Alan Rae (Glasgow) found a few nice calls on 20m thoughtfully omitting the lists of W's that are not of much interest to anyone. **Tim Charles** (Colchester) in again with six pages of notes and calls gives the impression that he never goes to sleep! His long wires suffered in the gales but one would never think so! Interesting catch was F9LC on 7MHz with two watts of SSB and over S9 at that. I'm a bit put out to hear Alan had to look up ST2 in the prefix list since yours truly was ST2AR for 15 years! Incidentally, I've just had the very great pleasure of meeting ST2AS in London. I'm glad to say that I started him off as a SWL some years ago when he was a medical student and now he is Dr. Ibrahim, opthalmic surgeon and the only active ST2 for some years past.

Bernard Hughes (Worcester) also stuck at 20m SSB which seems a pity with a lovely FR500SDX! The other bands are quite lively too, OM! Bernard keeps a record of the number of countries heard on each band and wonders if anyone is interested in seeing a totals table in this column from time to time? **Paul Barker** (Sunderland) is another of the sleepless brigade! Three pages of rare ones from 15 to 80m including several on SSTV but nothing exceptional this month, he says!

Max France (Warrington, Lancs) now has an RA1 but still prefers his old R107 for sorting out the DX on 80m. Back to school means less burning of the midnight oil however, so it looks as if 20m will be favourite for some time now, with a picture rail aerial. Ought to be good for SSTV!

Log extracts

Max France:—80m PQ0NS PZ0CJ VS6DO ZL2CB 5Z4LW 6Y5BM **20m** VP8NS XV5AB XW8GV.

Paul Barker:—15m CX2AAO (1700) **20m** JW5DQ KH6IAG KL7MF KX6LP VS6FB ZD3U ZK1DJ 4W1GM **20m SSTV** CT1TX 16RME K1LEM LU4CN.

Bernard Hughes:—20m HK0BKX KM6DZ TR8VE YK1KAS 4W1GM.

Tim Charles:—80m ZL3NC ZJ4AU **40m** CE5BMN YA2KL ZL1AUL ZL2ALR ZL3PW **20m** HK4SAJ HK0BKX JY5UMC KC6BL TG5YD XZ1AB **2m** DC3GEC DC4JHA.

Alan Rae:—20m CR3AX HK3CKW K3CI/OE K7RSC.

John Porter:—15m EA8JP PY8RW **20m** CT3AT EA9FB FY7AU KV4AD TG9VN TR8SS ZB2CH 8R1CB TI2AJF.

Steve Blake:—40m EA9AI HC0HM KZ5PW M1C SV1DO TU2DO VK7GK XE3U ZL3AR ZL4GN ZL4KS 8P6AG.

Michael Crimes:—20m CR4BS DU1XK ET3USE HZ1AB ST2AY VP1MT VP2DH 4W1GM.

Andrew Duragh:—15m CX2XC VQ9MC VU2DK ZP5NT 7P8AQ **20m** AC3PT CR3ON DU2EF FC2CD HR2JAG JY9GR KC4AAC KG4AM ST2AY TA2QR VK9XX VP8HA VS5MC ZD7SD 8R1CB.

CW stations in bold, remainder SSB. Please note that logs should be in alphabetical order for every band.

BROADCAST BANDS

MEDIUM WAVE BROADCASTS

by Charles Molloy

ROY PATRICK reports again from Derby. With his Trio 9R59DS communications receiver he has logged Dakar, Senegal on 764kHz; Amman, Jordan on 800kHz; Rio de Janerio, Brasil on 980kHz; Cluj, Romania on 1151kHz; Tripoli, Libya on 1250kHz; Conakry, Republic of Guinea on 1403kHz. Roy sends a mobile report of reception in North Wales. The receiver is a National RF 1400 portable connected to a car aerial and his daytime reception includes BBC Radio Merseyside on 1484kHz; BBC Radio Cumberside 1457kHz; Piccadilly Radio in Manchester on 1151kHz; Manx Radio, Isle of Man on 1295kHz (good signal) and 1594kHz (weak). After dark Tunis was heard on 962kHz and the Voice of Tangiers at 2000hrs in Arabic on 1232kHz.

M. J. Clarke (Warley) is a self confessed local radio enthusiast. Using a Philips RL210 portable receiver he has pulled-in BBC Local Radio outlets at Blackburn on 845kHz; Stoke on 1052kHz; Derby on 1115kHz and Birmingham on 1475kHz together with IBA Capital Radio on 557kHz and Birmingham on 1151kHz.

Timothy James (Southampton) has been tuning around the medium waves with his Fidelity RAD16. He reports hearing Capital Radio (London) on 557kHz; Radio Solent on 998kHz; Radio Medway on 1034kHz; Radio Sweden on 1178kHz and Radio Brighton on 1484kHz.

Peter Kirkbride (Kenilworth, Warwickshire) still enjoys "scanning the medium waves" with his 20 year old Bush valve receiver. He mentions reception of AFN Frankfurt on 872kHz and Munich on 1106kHz; Radio Sweden on 1178kHz; Radio Tirana, Albania on 1394kHz. Peter asks if it is possible to pick up North America using this receiver. Provided that a good outdoor aerial is used it should be possible to hear a few of the stronger trans-atlantic signals when conditions are good for reception of this area. Try after 2330hrs GMT for CJON St John's, Newfoundland on 930kHz; CBA in Moncton, New Brunswick on 1070kHz and WNEW in New York City on 1130kHz.

Mike Larvin (Redcar, Cleveland) has a Pye 1403D and an ITT Weekend Automatic Radio. Both are portable receivers and although neither has a socket for an external aerial for the medium waveband and external aerial 25m long and 20ft high is pressed into use by means of the following ingenious device. "I use a 6 inch ferrite slab wound with 75 turns of 20-30 SWG wire one end of which is connected to a good earth and the other to the aerial". The slab is brought near the receiver until peak signals occur, coupling being by induction between the slab and the receiver's internal aerial. Mike's log includes WKBW Buffalo NY on 1520kHz at 0230hrs GMT; BBC Relay Stations in Cyprus on 638kMz and 1322kHz; AFN stations in Germany on 872kHz (Frankfurt), 935kHz (Berlin), 1106kHz (Munich), 1142kHz Stuttgart); Budapest, Hungary on 1340kHz at 2245hrs; Norte, Portugal on 755kHz and 1061kHz. A total of 23 BBC local outlets were heard as well as London Broadcasting on 719pHz and Metropolitan Radio (Newcastle) on 1151kHz with Radio Clyde and Piccadilly Radio in the background.

Clive Barwood (Grimsby) is another local radio enthusiast. He uses an Ekco Mariner 6 valve domestic receiver connected to an outdoor aerial 75 ft long and 25ft high. He reports hearing Capital Radio 557kHz; IBA Birmingham 1151kHz; Metro Radio also on 1151kHz; Manx Radio 1294kHz and BBC Radios at Stoke 1502kHz; Cleveland 1546kHz and Leicester 1594kHz.

SHORT WAVE BROADCASTS

by Derek Bell

HELLO there! my name is Derek Bell and our editor has invited me to take over Malcolm Connah's Short Wave News column for a spell. May I say that I hope all readers will give me the same help and friendship that they gave Malcolm. All columnists must rely on the help of their readers, especially in this sort of column, since it could be said that the readers write the column with their contributions. I hope also that in your letters you will pop in a line or two telling me what you would like to see included in this feature.

Having said all that I will declare the meeting open with the first log. This is from another first timer, namely **David Lovatt** of Cheadle, Staffs, and he reports the following:—

5980 SBC in English at 2130
5990 Prague in English at 2131
6010 Budapest at 2136
6800 Pekin S/on at 2030
7200 Deutsche Welle at 2031
15350 Peace and Progress at 0920

This is a shortened version of a superb log from our thirteen year old correspondent who is equipped with an Ultra domestic valved receiver and a 60 ft aerial suspended 20 feet above terra firma.

Christopher Hall of Birmingham has the other sort of aerial, a 4-ft telescopic one, bolted to his Bush VTR178 Multiband. Using this line-up he reports an impressive list of catches the cream of which is as follows:—

6185 R. Norway in English at 1200
9770 R. Australia at 1600
11955 B.B.C. Malaysia relay in English at 1500

I was interested in your comments at the end of your letter Christopher. As far as DX clubs go one must rely on the adverts they place in various magazines so "yer pays yer money and takes yer choice" in other words! Your request for the latest information on equipment for the BC stations however brings forth the information that Uganda is pressing ahead with a new SW transmitter setup that will bring the voice of Uganda blaring out loud and clear. Recently a member of Radio Nederlands staff went on record as saying that they are to increase the power of their transmitters, another victim I fear of the "power game".

From the biggest to the smallest now, **Paul Heath** says his equipment "is somewhat joked about". This Heath kit (sorry about that!) is a home-built HAC one valver plugged in to various "out board motors" namely an ATU and feeding out through a transistor amplifier. Well Paul, let them laugh!, you pulled in a fine list, as is shown below:—

9005 Voice of Iran at 2020
9625 R. Jerusalem at 2000 (This is R. Israel, Paul)
9655 R. Damascus at 0830
9670 A.W.R. Portugal at 0945

You remark Paul, that you have received QSLs from only a couple of stations but that "there are more to come". Well OM, this is purely a matter of being patient. Radio Tirana, for instance, has been known to take 125 days to deliver, while Polish Radio Warsaw has taken only seventeen. Your logging of Damascus on 9655 was fortunate since Damascus is a notorious "wanderer" having been heard as far off frequency as 9630.

My final letter for this month is written by **Robert Hill** who hails from Hough, near Crewe, and he reports that he heard:—

9005 R. Tehran in English at 2015
9480 R. Tirana in English at 1830
9550 R. Finland in English at 1605.
11775 R. Bucharest in English at 1300

Having Crewe as a QTH seems to me to pose some unusual problems, I imagine it is possible that with all the QRM around from electric railways DXing is rather difficult. I would be interested to find out if I am right.

Well folks, that winds up my first venture into the pages of Practical Wireless. I hope that having read it you will feel that you want to write in with your logs (see address box) so I look forward to hearing from you, best 73s to you and yours.

BROADCAST BANDS

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

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

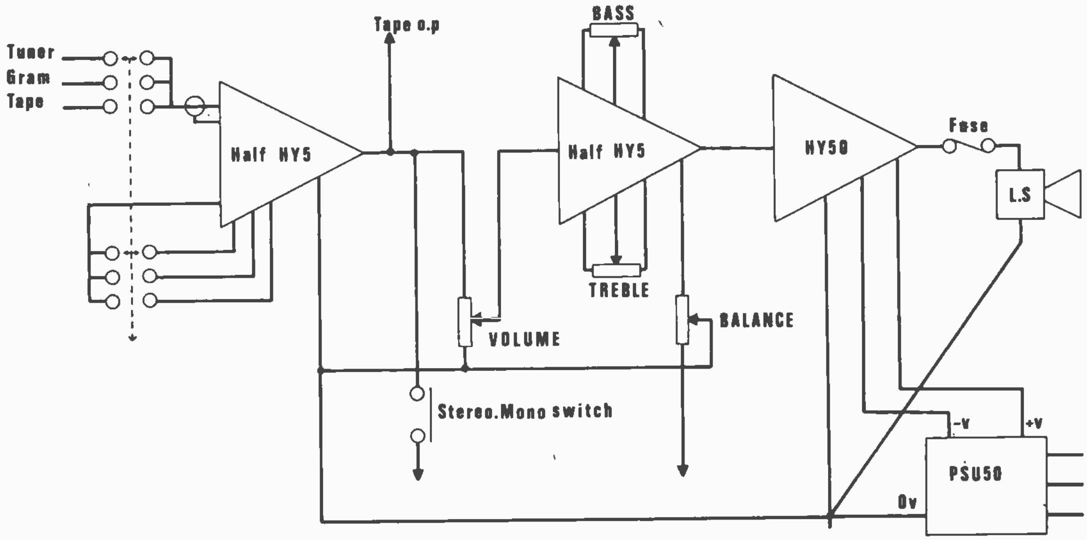
AMATEUR BANDS

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

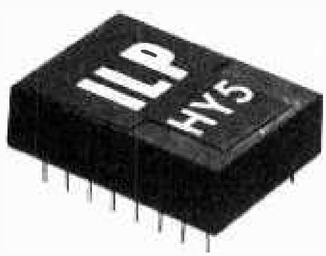
A reprint of the P.W. **Tele-Tennis** series is being prepared and will be available shortly. *Further details in the January 1975 issue of Practical Wireless.*

I.L.P. (Electronics) Ltd

SHEER SIMPLICITY!



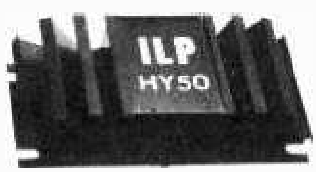
MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN



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

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

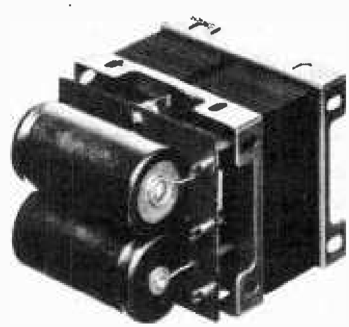
PRICE £4·50 + 36p VAT P. & P. free



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

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

PRICE £5·98 + 48p VAT P. & P. free



The PSU50 can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: 50V (25-0-25V). **Input Voltage:** 210–240V.
Size: L.70. D.90. H.60mm.

PRICE £5 + 40p VAT P. & P. free

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BSR HI-FI AUTOCHANGER

STEREO AND MONO

Plays 12", 10" or 7" records Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13½ × 11½in.
Above motor board 3¼in.
Below motor board 2½in.
With STEREO/MONO CARTRIDGE **£6·95** Post 45p.

PORTABLE PLAYER CABINET

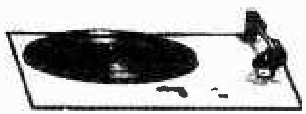
Modern design. Size 18" x 15" x 7" rexine covered. Large front grille. Hinged Lid. Chrome fittings. Motor board cut for BSR deck. Few only in red. **£4·50** Post 45p.

SOLID MAHOGANY PLINTH

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Size 12¼ × 14¾ × 7½in. **£5·95** Post 45p

BSR JUNIOR SINGLE PLAYER

Heavy duty 4-speed motor with separate pick-up arm fitted LP/78 turnover mono compatible cartridge. **£4·95** Post 25p



R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop. stereo/mono cartridge. Base-plate. Size 11in × 8½in. Turntable. Size 7in diameter. A/C mains. 220/250V motor has a separate winding 14 volt to power a small amplifier.
3 speeds plays all size records. **£5·50** Post 25p

COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 13½ × 10 × 3½in. Player unit clips to loudspeakers making it extremely compact. Overall size only 13½ × 10 × 8½in. 3 watts per channel, plays all records 33 rpm 45 rpm. Separate volume & tone controls 240v AC mains

Attractive Teak finish Weight 13lbs.
Bargain Price **£25** 85p carriage

SPECIAL OFFER! SMITH'S CLOCKWORK 15 AMP TIME SWITCH 0-60 MINUTES

Single pole two-way Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights etc. Variable knob Turn on or off at full or intermediate settings. Fully insulated. Makers last list price £4·50. Brand new and fully guaranteed. OUR PRICE **£1·95** Post 25p.

CASSETTE RECORDER MOTOR ONLY. ` Volt. Will replace many type's £1·25.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in sides 6 × 4in 45p; 8 × 6in 53p; 10 × 7in 65p; 12 × 8in 65p; 14 × 9in 90p; 16 × 6in 90p; 12 × 3in 50p; 16 × 10in £1.
ALUMINIUM BOXES 3 × 3 × 3in. 60p. 4 × 4 × 4in. 70p. 6 × 4 × 4in. 80p. 9 × 4 × 4in. £1. 12 × 4 × 4in. £1·30.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in 12p; 8 × 6in 19p; 14 × 3in 2up; 10 × 7in 24p; 12 × 5in 25p; 12 × 8in 34p; 16 × 6in 34p; 14 × 9in 40p; 12 × 12in 47p; 16 × 10in 60p.
S.R.B.P. PAXOLIN PANEL 10 × 8in 30p.

1¼inch DIAMETER WAVECHANGE SWITCHES, 45p. EA. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way,. 1 p.l 2-way, or 4 p. 2-way, or 4 p. 3-way.
TOGGLE SWITCHES, sp. 20p; dp. 25p; dp. dt. 30p.

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode. Printed Circuit Bridge Rectifiers and Double Wound Mains Transformer. Input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less.
PLEASE STATE VOLTAGE REQUIRED. **£2·20** Post 20p
Details S.A.E. Size 3¼ × 1½ × 1½in.

R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape P.U., Guitar, etc. Can be used with Battery 9-12v. or H.T. line 200-300V. D.C. operation. Size 1¾" × 1½" × ¾". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **99p** Post 10p

NEW TUBULAR		ELECTROLYTICS		CAN TYPES	
2/350V	14p	250/25V	14p	16+16+16/275v	45p
4/350V	14p	500/25V	20p	50+50/300V	50p
8/350V	18p	1000/25V	35p	32+32/250V	20p
16/350V	22p	1000/50V	47p	32+32/450V	60p
32/500V	50p	8+8/450V	22p	100+50+50/350V	85p
25/25V	10p	8+16/450V	25p	32+32+32/350	65p
50/50V	10p	16+16/450V	40p	32+32+32/350	65p
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LOW VOLTAGE ELECTROLYTICS.
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500mF 12V 15p; 25V 20p; 50V 30p.
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2000mF 6V 25p; 25V 42p; 50V 57p; 4700/63V 95p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.
CERAMIC 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 4p; 0·5 13p; 1mF or 2mF 150V 15p.
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MICRO SWITCH sub min 25p.
TWIN GANG. "0-0" 208pF+176pF. £1·10.
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SHORT WAVE SINGLE. 10pF, 30p; 25pF, 55p; 50pF, 55p.

ELAC 9 × 5in. HI-FI SPEAKER. TYPE 59RM. THIS FAMOUS AND WIDELY USED UNIT NOW AVAILABLE AT BARGAIN PRICE £2·95.
10 WATT, 8 OHM. CERAMIC MAGNET.

NEON PANEL INDICATORS. 250V AC/DC Amber, 30p.
RESISTORS. ¼ w., ½ w., 1 w., 20%, 1p; 2 w. 5p. 10 Ω to 10M.
HIGH STABILITY. ½ w. 2% 10 ohms to 6 meg., 10p. Ditto 5%, Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS. 5 watt, 10 watt, 15 watt, 10 ohms to 100K, 10p each; 2w 0·5 ohm to 8·2 ohms 10p.
TAPE OSCILLATOR COIL. Valve type, 35p.
FERRITE ROD 8" × ⅜" 20p; 6 × ⅜" 20p; 3 × ⅜" 10p

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ALL POST 25p each

Eagle MT12 12-0-12v 50MA 90p
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3 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £6·00
5 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £9·75
3, 5, 8, 10, 13 or 5-0-5 v. 5 amp. £1·80. 6-0-6 v. 500 mA 90p. 9 v. 1 amp 95p. 12 v. 300 mA 75p. 12 v. 500 mA 85p. 12 v. 750 mA 95p. 48 v. 2 amp. tapped 12 v. or 36 v. £2·00. 20V 3 amp. £2·00.
AUTO TRANSFORMERS. 115v to 230v or 230v to 115v. 150w. £3·00; 500w. £6·75; 750w. £13·50; 1000w. £16·50.
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FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1½ amp. 40p; 2 amp. 55p; 4 amp. 85p.

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Primary 0-110-240v. Secondary 0-240v. 3 amps. 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make. (Value £19) OUR PRICE **£12** Carr. 95p
Suitable for outside use.

SET OF 3 MOTORS FOR COLLARO STUDIO 115 volt TAPE DECK £1·50 Post 50p.

VOLUME CONTROLS
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 and colour, **10p** per yd

Wirewound controls 1½in. diam. 3 watts. 10 ohms to 100K British made with long spindles ¼in. dia 30p ea.
DUAL CONCENTRIC POT 500k LOG + 500k LIN D.P. switch. Inner spindle 3½in; outer spindle 2½in. 75p.

E.M.I. 13½ × 8 in. 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 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·75** Post 25p

Bookshelf Cabinet

16 × 10 × 9in. Fluted wood front. Teak Veneer **£6·60** Post 45p

E.M.I. 6½in. HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet Special Rubber cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosure Systems, etc. **£4**
Suitable cabinet 12 × 8 × 6 £4·00.
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ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3¼ × 3¼ × 2in. deep. Rating 10 watt, 8 ohm.
Crossover £1.25 Post 20p **£1·90**

GOODMANS 8 in. WOOFER

8 ohm 12 watt. Deep cone. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps. Ideal bass unit for Hi-Fi systems **£3·75**

LOUDSPEAKERS P.M. 3 OHMS. 7×4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8in. £1·75; 10 × 6in. £1·90; 10in. £2·00.
SPECIAL OFFER LOUDSPEAKERS! All Brand New. 3 ohm, 2½in; 2½in; 3½in; 5in. 8 ohm, 2½in; 2½in; 5in × 3in; 5in. 15 ohm, 3½in; 5in; 6×4in; 5in×3in; 7×4in; 8×5in. 25 ohm, 2½in; 3in; 3in; 5 × 3in; 5in. 35 ohm, 2in; 3in; 5in. 80 ohm, 2½in; 2½in. 120 ohm, 3in. **£1** EACH.

LOUDSPEAKER VOLUME CONTROL 15 ohm 10 watt with 1in long threaded bush for wood panel mounting 65p.

RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. diameter 4W £2·50, 10in. diameter 5W £2·75: Post 25p. 12in. diameter, 6W, £3·30; 3 or 8 or 15 ohm models.
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DECCA DOME TWEETER

18,000 cps. 25 watts. 8 ohm. Price **£3·30.**

ELECTRO MAGNETIC PENDULUM MECHANISM

1·5v d.c. operation over 250 hrs. continuous on SP2 battery. fully adjustable swing and speed. Ideal displays teaching electro magnetism or for metronome: strobe etc. 95p, Post 20p

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2 Stage Triode Pentode valve. 3 watts 3 ohm output. Volume on/off and tone controls AC mains. Complete and tested. With Loudspeaker. **£4·50** Post 25p.

WEYRAD COILS

P50/1AC-60p.	RA2W 85p.	Twin Gang £1·10.
P50/2CC-40p.	OPT1 65p.	Printed Circuit 85p.
P50/3CC-40p.	LFDT4. 65p.	

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p
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BALANCED TWIN RIBBON FEEDER 300 ohms, 7p yd.
JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p
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VALVE HOLDERS 5p; CERAMIC 10p; CANS 5p.

FM/VHF AERIAL FEEDER CABLE

300 ohm suitable for stereo **7p** per yard.

BRITISH FM/VHF TUNING HEART

88 to 108 Mc/s British made. 3 Transistors ready aligned—requires 10.7 Mc/s IF. Complete with tuning gang. Connections supplied but some technical experience required.
SUITABLE I.F. STRIP £4·95.
Our Price **£3·95** Post 20p.

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RADIO COMPONENT

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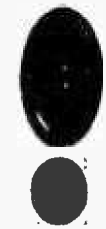
ALL OUR PRICES INCLUDE V.A.T.

E.M.I. WOOFER AND TWEETER KIT



£5·75 THE PAIR. Post 25p. (Available separately. Woofer £5·25; Tweeter £1·90).

Comprising a fine example of a Woofer 10¾ × 6¼in. with a massive Ceramic Magnet. 44oz. Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3½in. square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

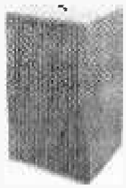
Impedance Standard	8 ohms
Maximum power	12 watts
Useful Response	25 to 18,000 cps
Bass Resonance	45 cps

SUITABLE ENCLOSURE 20 × 13 × 9in. MODERN DESIGN. TEAK WOOD FINISH. **£10·50** Post 75p

ELAC 8in. or 10 × 6in. HI-FI SPEAKER

Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts **£3.75**

TEAK VENEER HI-FI SPEAKER CABINETS
Fluted Wood Fronts



MODEL "A". 20 × 13 × 9in. For 12in. dia. 10in. speaker. **£10·50** Post 75p

MODEL "B". 16 × 10 × 9in. For 13 × 8in. or 8in. speaker. **£6·60** Post 45p

MODEL "B2" ditto. Triangular corner version.

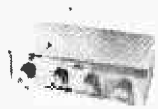
MODEL "C". 16 × 8 × 6in. For 8 × 5in. speaker. **£4·95** Post 35p

LOUDSPEAKER CABINET WADDING 18in. wide, 20p ft.

CALLERS ONLY—HI-FI CABINET BAKER RECOMMENDED 12 inch Enclosure 4 cubic ft. Size 30 × 20 × 12in. Teak Finished Fluted Front. £18·50

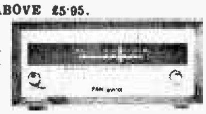
TEAKWOOD LOUDSPEAKER FRONT GRILLS Modernise your cabinets with the Groover look. Sizes—18¼" × 10¼"—75p. 10¼" × 7¼"—45p.

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£4·50**



STEREO VERSION OF ABOVE £5·95.

BARGAIN FM TUNER. 88-108 Mc/s Six Transistor. 9 volt. Printed circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4in. **£14**



BARGAIN FM TUNER. **£10** As above less cabinet.

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£3·50**

WAFER THIN HEATING ELEMENTS

OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10¼ × 8¼ × $\frac{1}{16}$in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photocopiers and print drying equipment.

Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in the greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

BAKER MAJOR 12" £8·50

Post Free

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

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£10·95**

Please state 3 or 8 or 15 ohms. Post Free

"BIG SOUND" BAKER SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups.

Useful response 30-13,000 cps. Bass Resonance 55 cps.

GROUP "25" 12in. 25 watt 3, 8 or 15 ohms. **£7·75** Post Free

GROUP "35" 12in. 35 watt 3, 8 or 15 ohms. **£8·50** Post Free

GROUP "50" 15in. 50 watt 8 or 15 ohms. **£17·80** Post Free

GROUP 50/12in. 50 watt 8 or 15 ohms **£12·95**

Group + PA Cabinets in stock. Callers only. Send for Leaflet.

MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

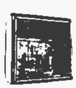
All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. Guaranteed. Details SAE. **£49** Carr. £1·00

NEW MODEL—MAJOR 50 WATT £39·95. Carr. £1. 4 inputs 2-way mixing. 2 outputs separate treble and bass controls.

CALLERS ONLY! DE LUXE 100 WATT VALVE AMPLIFIER CHASSIS 4 input 10 wide range controls. For Mikes, Discos, Organs Guitars, etc. 4, 8 & 15 ohm loudspeakers matching £69·00.

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£3·50** Post 20p

QUALITY LOUDSPEAKER ENCLOSURE



Teak veneered ⅜in thick wood cabinet. Size 18⅛in × 18⅛in × 8¼in. Weight 23lbs. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½inch Woofer. £7·50 Carr. 85p. Rosewood Version £8·50 Carr. 85p.

SPECIAL OFFER 95p. Post 25p. 100 Ohm 20 watt Rheostat 2½in diam. Cera micFormer. Screw Terminals ½in. diam. spindle.

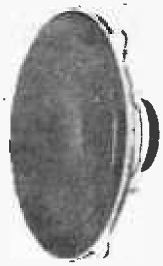
REVERSIBLE 4 POLE MOTOR

1,400 r.p.m. Reversible 42 Watt. spindle 1¼" × $^{7}/_{32}$", size 3½" × 3". As illustrated, 240v. AC mains. **£2·25** Post 35p

E.M.I. TAPE MOTOR 4 pole, 240 v. 135 mA. Size 3¼ × 2¼ × 2¼in. 1200 rpm. Spindle $\frac{5}{32}$in diameter. **£1·85** Post 30p.

BAKER HI-FI SPEAKERS
HIGH QUALITY -- BRITISH MADE

REGENT
12in. 15 watts



An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio. Amplifier, Hi-Fi or Television receiver.

Bass Resonance	45cps
Flux Density	12,000gauss
Useful response	45-13,000cps

3 or 8 or 15 ohm models.

£7·75 Post Free

DE-LUXE Mk II
12in 15 watts

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

Bass Resonance	30cps
Flux Density	14,000gauss
Useful response	25-16,000cps

8 or 15 ohms models.

£9·75 Post Free

SUPERB
12in. 20 watts

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

Bass Resonance	25cps
Flux Density	16,500gauss
Useful response	20-17,000cps

8 or 15 ohms models.

£13·80 Post Free

AUDITORIUM
12in. 25 watts

A full range reproducer for high power. Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Discotheques.

Bass Resonance	35cps
Flux Density	15,000gauss
Useful response	25-16,000cps

8 or 15 ohms models.

£12·95 Post Free

AUDITORIUM
15in. 35 watts

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

Bass Resonance	35cps
Flux Density	15,000gauss
Useful response	20-14,000cps

8 or 15 ohms models.

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Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables. 60p. Post Free.

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7410	20p	7491	£1·10
7413	31p	7492	82p
7420	20p	7493	82p
7430	20p	74100	£2·37
7441	81p	74121	45p
7442	81p	74122	88p
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7447	£1·45	74154	£1·82
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Minitron
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1 Pole 12 Way
2 Pole 2 Way
2 Pole 3 Way
2 Pole 4 Way
2 Pole 6 Way
3 Pole 4 Way
4 Pole 3 Way
22p each

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All types 1" and less diameter

Singles		Dual	
5K	Log or	5K	
10K	Lin Less	10K	
25K	Switch	25K	Less
50K	15p each	50K	Switch
100K		100K	45p each
250K	Double	250K	
500K	Pole	500K	
1M	Switch	1M	
2M	30p each	2M	

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Open Type Double Wound Continuously Rated, two hole fixing clamp with colour coded flying leads, varnish impregnated. Approx. size: 1¾" × 1½" × 1½" high Fixing centres: 2 5/32".

TR1 20–0–20v 100 m/a
TR2 12–0–12 v 100 m/a — All
TR3 9–0–9 v 100 m/a — 240 Volt
TR4 6–0–6 v 100 m/a — Primary
TR5 3–0–3 v 100 m/a
Our Price £1·23 each

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Heavy duty contacts 2·500 ohm coil. All new and unused D.P.D.T. mains relays 50p. Carr. Free. Special quantity £40 per 100 off.

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Brand new range of British made Relays. Size 1¼" × 1" × ¾". All two changeovers with 250v 1·5A contacts and suitable for fitting on ·1m Veroboard.

Type	Volts	Current	Ohms	
27/A	12v	17M/A	700	All
21/A	12v	28M/A	430	80p
12/A	6v	33M/A	185	each

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All types are standard 240 volt primary.
MT 102 ct. 0 = 19 = 25 = 33 = 40 = 50 at 500M/A £2·00 each
MT237cs 20–0–20 at 150M/A £1·25
MT241cs 20–0–20 at 30M/A £1·05
MT240cs 15–0–15 at 30M/A £1·05
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PP1 Switched 3 – 6 – 7½ – 9 volt 400M/A Transistor and Zener Stabilised On/Off Switch and Polarity Reversal Switch, in a black metal case £5·25 each.
PP2 Switched 6 – 7½ – 9 volt Battery Eliminator. Approx. size 2¾" × 2¼" × 3¼". Ideal for cassette recorders £2·75 each (philips type £3·00).
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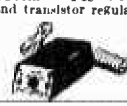

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	·1	·15	Plain ·15
2½ × 3¾	32p	24p	15p
2½ × 5	34p	34p	18p
3¾ × 3¾	34p	34p	
3¾ × 5	39p	45p	
17 × 2½	1·06p	77p	60p
17 × 3¾	1·45p	1·16p	75p
17 × 5	1·85p		1·10p

Pin insertion tool 72p
Spot face cutter 52p
Pkt. 36 pins (state ·1 or ·15) 25p

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2½" 8 ohm 50p
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2½" 80 ohm 50p
5" 8 ohm ceramic £1·25
6½" 8 ohm dual cone ceramic £2·50
10" 8 ohm dual cone ceramic £3·75
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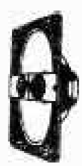
8" × 5" 8 ohm Permanent Magnet £1·60
•EMI 13" × 8" 450 Kit 3 — 8 — 15 ohm £3·75
•EMI 13" × 8" 350 Kit 8 ohm £7·50



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•Pop 25/2 30 watt 150 ohm 12" £8·29
•Pop 55 60 watt 8/15 ohm 12" £14·50
•Pop 50 50 watt 15 ohm 12" £11·99
•Pop 60 60 watt 8/15 ohm 15" £15·70
•Pop 100 100 watt 8/15 ohm 18" £28·70
• Carr. on L/S over 13 × 8 and 12" 50p per L/S.

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Four-sided with corner plates. All are 2½" deep.

6" × 3"	42p	12" × 5"	66p
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8" × 6"	57p	14" × 9"	99p
10" × 7"	70p	16" × 6"	90p
12" × 3"	57p	16" × 10"	£1·15

ALUMINIUM BOXES

Metal project boxes give your work a professional finish

	L	W	H	
AB7	2¾	5¼	1½	40p
AB8	4	4	1½	40p
AB9	4	2¾	1½	40p
AB10	4	5¼	1½	46p
AB11	4	2½	2	40p
AB12	3	2	1	35p
AB13	6	4	2	55p
AB14	7	5	2½	66p
AB15	8	6	3	85p
AB16	10	7	3	96p
AB17	10	4½	3	85p
AB18	12	5	3	95p
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ABS PLASTIC BOXES

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.

1005 = 105mm × 73mm × 45mm = 51p
1006 = 150mm × 75mm × 47mm = 66p
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Components galore for the experimenter Ex Computer boards with Resistors, Capacitors and useful Transistors—at least 4 transistors per board. Five boards £1·00.

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Size 59mm × 46mm × 35mm these meters require a 38mm hole for mounting.

ME6 = 0 to 50 micro amp Full Scale
ME7 = 0 to 100 micro amp Full Scale
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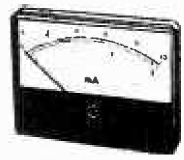
ME9 = 0 to 1 m/a Full Scale
ME10 = 0 to 5 m/a Full Scale
ME11 = 0 to 10 m/a Full Scale
ME12 = 0 to 50 m/a Full Scale
ME13 = 0 to 100 m/a Full Scale
ME14 = 0 to 500 m/a Full Scale
ME15 = 0 to 1 amp Full Scale
ME16 = 0 to 50 volts A.C. Scale
ME17 = 0 to 300 volts A.C. Full Scale
ME18 = "S" Meter
ME19 = "VU" Meter

OUR PRICE £3:00



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The easiest and quickest way of punching holes in sheet metal (up to 1·625mm Mild Steel)

DECON DALO 33PC ETCH RESIST PEN

The Decon Dalo 33PC is a unique instrument for the professional and amateur electronics engineer, enabling him to prepare in minutes a perfect printed circuit board
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SPEC:- ★ 5 section
★ extended length 100cm
★ Length under fender 40cm
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Supplied complete with fixing bracket and control switch £6·75

SIZE	PRICE	
⅜"	68p	Key "T" 6p
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9/16"	83p	
⅝"	83p	
11/16"	88p	
¾"	88p	
13/16"	90p	
15/16"	98p	Key "B" 10p
1"	98p	
1 1/16"	98p	
1⅛"	£1·03	
1 3/16"	£1·05	Key "B" 10p
1 7/32"	£1·10	
1¼"	£1·25	
1⅜"	£1·43	
1½"	£1·50	
2"	£2·05	Key "C" 13p
2 3/32"	£2·30	
2¼"	£4·10	Key "E" 20p
2½"	£5·25	
3"	£8·10	

1" SQUARE PUNCH complete with key £2·10

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NE555	Timer I.C.	78p
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7805	Regulator	£1·49
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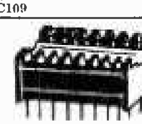
TIP 30A		63p
BC107		10p
BC 108		10p
BC109		10p



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D.I.L.
8 pin
14 pin 14p
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12-0-12 volt 500m/a
240 volt primary transformer bargain.
approx size = 60mm x 40mm x 50mm
fixing centres = 75mm
Our Price = £1·20.

18 volt 500m/a
240 volt tapped 120 volt with screen.
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fixing centres = 75mm
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Loud buzzer mounted in a metal box complete with two U2 battery size holder.
Designed and can be used as a fire alarm but is ideal as a door or morse code practice buzzer.
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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 3257, all transistor, medium long, VHF/FM, 3 watts per channel S/M, with connection data, less tuning scale, £20.

Crystals HC6U: 52·03333 MHz: 52·02500: 52·01667: 51·56667: 51·58330: 37·76250: 37·75000: 12·395·8: 12·891·6: 12·700·0: 9·458·33: 9·456·25: 9·455·55: 9·533·33: 9·531·94: 9·530·55: 9·090·62: 9·087·5: 9·096·87: 50p each.

Electrolytics. 32/32/32μF, 325v, 2" × 1¼" 35p: 2000μF 30v, 2" × 1½" 25p: 2000μF 30v, 2½" × 1" 25p: 2000μF 35v 3" × 1" 30p: 470μF 100v 3" × 1½" 25p: 2000 2000μF 25v 2" × 1½" 35p: 30,000μF 25v 4½" × 2½" 50p: 700μF 200v 3½" × 1½" 30p: 16 16μF 275v 1½" × 1" 20p: 40 40 20μF 275v 3" × 1" 20p: 4500 900 900μF 30v 2½" × 1½" 50p: 4000μF 35v 3" × 1½" 40p: 200 100 50 100μF 325v 3" × 1½" 50p: 4000μF 16v 2" × 1" 20p: 470μF 25v 1½" × ½" 15p.

Matched pair of bookshelf speakers. Teak finish, size 12" × 8" × 5", 8 × 5 8" ohms ceramic, 5 watts RMS. Complete with din leads. £11·00 pair.

Thorn TV IF chassis. 950 series (less valves) £1·75.

UHF 625 transistor push button tuner (NSF Telefunken) as used on Decca MS2400. Brand new and boxed. £3·25.

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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.

Rank EVR Teleplayer colour translator panels, type and components on new panels listed as follows, £2·50, each panel. Z605—14 off BC148: 2 RCA ca3054 (ic): 1 crystal 4·433618 MHz—Z607—12 off BC148: 1 BC108: 1 BC158: 1 RCA ca3046 (ic). 1 RCA ca3045 (ic): Z608—23 off BC148: 2 BC158—Z612—12 off ME4103: 2 BC-251B: 1 BFY50.

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Edgewise Level meters, 200μA, size ¾" overall 50p.

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Die Cast Boxes, 4½" × 3½" × 3" 95p: 8½" × 5½" × 2" £1·20, 8½" × 5½" × 4" £1·70.

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BSR P128, similar to HT70 single play, with heavy die cast turntable, less cartridge £17·00.

Transistorised FM tuner head with A.M. gang, slow motion drive 88–108 Mcs. with circuit diagram, £2·30.

Mono Amp Transistorised (Mains) Ideal for record player 8 ohms 2 watts. £3·50.

Ferguson Stereogram Chassis. MW/LW VHF with tuning scale (5+5 watts sine wave) 15 ohms £28·50.

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All items post paid in GREAT BRITAIN

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EX COMPUTER PC PANELS

4 x 2in packed with semiconductors and top quality resistors, capacitors, diodes etc. Guaranteed min. 35 transistors, plus data 25 boards £1 (30p)

DURAL EXTRUDED HEATSINKS, 10D outline, black anodised, drilled for 4 x TO3 transistors 5 x 4 x 1⅛ 40p (15p)

Sim. to above but for 8 x TO3 5 x 8 x 1⅛ 70p (27p)

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30,000μ 25v	65p (22p)
4,000μ 70v, 3,600μ 40v 4 x 2"	55p (15p)
5,000μ 35v	40p (12p)
20A 100 piv Si recs.	4 for £1 (12p)
3A 100 piv Si recs	4 for 50p (8p)
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250 mixed capacitors	60p (11p)
150 mixed HI-STABS	60p (11p
200 Si planar diodes	60p (8p
QH bulbs 12v 55w	50p (7p)
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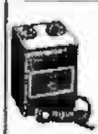
Buy a British Made battery eliminator for your car.

This unit enables you to run your cassette tape recorder from the car whilst travelling. It is easily fitted and comes complete with fitting instructions. Please state make of cassette, voltage and type of plug required.

ONLY **£2·65**

MAINS UNIT FOR TRANSISTOR RADIO ONLY



For single outputs, 6v or 9v **£2·42**

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All units are completely isolated from mains by double wound transformer ensuring 100% safety.

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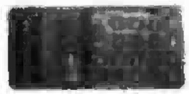

Cambridge Assembled £15·95 (£1·55)
Sinclair Scientific £22·45 (£2·05)
Executive with Memory £26·25 (£2·53)
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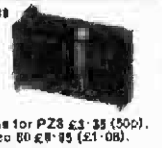
IC radio chip with data £1·20 (22p). Also available kit of extra parts to complete a radio £2·45 (42p). Send sae for free leaflet.

SINCLAIR PROJECT 80



AFU £5·95 (70p)
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Z60 £5·85 (70p)
Q16 £6·70 (77p)
PZ5 £4·20 (49p)
PZ6 £6·95 (82p)
PZ8 £6·95 (82p)
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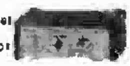
Tuner £9·95 (£1·08), Stereo 80 £8·85 (£1·08).
Project 805 £29·95 (£2·80).
Project 805SQ £33·95 (£3·10).

ECONOMICAL QUADRAPHONICS



Introducing the Nagoles QA10 self contained matrix quadraphonic synthesizer. Just feed the output of any stereo system (including Project 80 or 60) into it and hook on 4 speakers to obtain the latest experience in sound. Send sae for free leaflet. Only £10·15 (£1·10).

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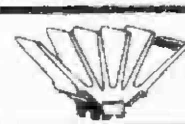


6W rms power. With 44 page booklet and printed circuit £1·80 (40p).

NEW SINCLAIR IC20

High power IC audio amplifier £8·45 (£1·05).

DELUXE KIT FOR THE IC12

Includes all parts for the printed circuit and volume, bass and treble controls needed to complete the mono version £1·70 (25p). Stereo model with balance control £3·70 (43p).

IC12 POWER KIT

Supplies 28V 0·5 Amps £2·77 (48p).

LOUDSPEAKERS FOR THE IC12

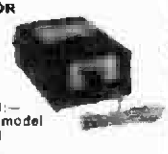
5" 8 ohm £1·20 (27p). 5" x 8" 8 ohm £1·85 (37p).

PREAMP KITS FOR THE IC12

Type 1 for magnetic pickups, mics and tuners. Mono model £1·40 (25p). Stereo model £2·50 (33p). Type 2 for ceramic or crystal pickups. Mono 70p (19p). Stereo £1·48 (24p).

SEND SAE FOR FREE LEAFLET ON KITS

BATTERY ELIMINATOR BARGAINS



The most versatile battery eliminator ever offered. Switched output of 3, 4½, 6, 7½, 9 and 12V at 500 mA £3·90 (70p).

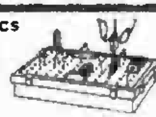
Other eliminators stocked:—

250mA:—3 way switched model giving 6, 7½ and 9V £2·25 (55p).

50mA:—6V £1·95 (40p), 9V £1·95 (40p), 7½V cassette type £2·50 (40p). Double 6V + 6V £2·50 (40p). 9V + 9V £2·50 (40p).

500mA:—Heavy duty deluxe models 6V £2·78 (55p). 7½V £2·78 (55p). 9V £2·78 (55p).

S-DECS AND T-DECS



S-DeC £1·98 (31p)
T-DeC £3·83 (47p)
μ-DeC A £3·99 (51p)
μ-DeC B £6·99 (81p)
IC carriers:—
16 dil: plain 81p (15p)
with socket £1·77 (25p)
10 TO5: plain 70p (15p). With socket £1·68 (24p).
Experiment guides:—A £1·50 (26p), B £1·77 (29p), C 90p (18p), D £2·40 (35p), E £4·28 (53p).

SWANLEY ELECTRONICS

PO BOX 68, SWANLEY, KENT BR8 8TQ.

Please add the sum shown in brackets after the price to cover the cost of post and new VAT. Official credit orders from schools etc. welcome. No VAT charged on overseas orders.

HUGE DISCOUNTS

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

*Full labour and material guarantees for 12 months

	List Price	RSC Price
WHARFEDALE DENTON	£42·31 Pr.	£29·95
WHARFEDALE LINTON	£52·39 Pr.	£38·95
LEAK 250 SPEAKERS	£65·48 Pr.	£42·00
LINEAR 202 AMPLIFIER	£39·23	£24·95
ROTEL RT222 AM/FM Tuner	£50·57	£38·95
ROTEL RT322	£73·16	£53·50
ROTEL RX150 A Tuner/Amp	£77·09	£54·95
LEAK 2000 Tuner/Amp	£165·70	£134·95
Wharfedale Denton Tun/Amp	£93·28	£59·95
RANK 150a Stereo System	£137·35	£79·95

Also Shure Cartridges, Basf Tape, Koss H/Phones, etc.
Prices of above correct at Oct 14 1974

AKAI TAPE UNITS

All £1 carr.

	Rec. Price	
GXC 36D	£110·72	£72·50
GXC 38	£147·19	£105·95
GXC 38D	£137·38	£97·95
GXC 46D	£157·59	£109·95
GXC 40T	£186·09	£135·95
GXC 75D	£199·90	£142·95
GXC 510D	£189·90	£135·95
GXR 82D	£122·65	£89·95
4000 DS	£130·12	£94·95
4000 DB(Dolby)	£196·27	£139·95
1721 L	£118·58	£84·95
CR 81D	£98·10	£69·95
CS33D	£105·81	£75·95

GOLDRING GL72 T/Table & G800 £29·95 (Approx. value £46) Carr. 75p
GOLDRING GL75 T/Table & G800 £34·95 (Approx. value £65) Carr. 85p
PIONEER PL12D T/Table on plinth & cover £41·75 List £61·90
BSR TD8S 8 track player. Special price £14·95

T/TABLES with MAGNETIC CARTRIDGE/PLINTH & COVER

GARRARD SP25 MK IV with G850 Special Price £19·95 (Carr. £1)
McDONALD MP60 with G800 or G850 „ „ £19·95 (Carr. £1)
RANK BD2000 Rec. Price £67·27 £48·95 (Carr. £1)

FANE HI-FI LOUDSPEAKERS AT APPROXIMATELY HALF-PRICE

UNREPEATABLE OFFER · BRAND NEW · BOXED · FULLY GUARANTEED for High-Fidelity NOT Group Disco use
Available by Mail Order only due to small quantities of some models. SAE for leaflets. Please state impedance required.

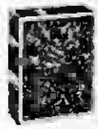
Model	Price	Model	Price	Model	Price	Model	Price	Model	Price	Model	Price	Model	Price	Model	Price
505	£2·73	806	£2·56	121/10	£3·17	138/10LR	£2·50	138/15TLR	£4·98	122/10TLR	£8·06	122/14ALR	£9·52	152/12A	£11·33
506	£2·61	1004	£4·37	121/10T	£3·37	138/10TLR	£2·63	101/10A	£4·27	122/12	£8·75	122/17	£10·28	152/14	£12·49
507	£1·08	1002	£4·19	121/11	£3·58	138/11	£3·65	101/14	£6·64	122/12A	£7·08	122/17A	£10·60	152/17	£14·86
508	·96	1005	£3·65	121/11T	£3·78	138/11LR	£3·87	101/14A	£8·71	122/12D	£8·88	122/17T	£10·59	153	£17·48
801	£3·93	1006	£3·50	121/15	£4·61	138/13	£3·83	122/10	£5·18	122/12T	£7·08	122/17LR	£10·98		
802	£3·69	1008	£2·93	121/15TLR	£5·33	138/13LR	£4·15	122/10A	£5·49	122/14	£9·47	122/17ALR	£11·31		
802T	£3·62	1001LR	£5·09	138/10	£2·18	138/15	£4·51	122/10TLR	£6·03	122/14A	£8·80	152/10	£9·26		
805	£3·25	1005LR	£4·37	138/10T	£2·31	138/15LR	£4·83	122/10T	£5·49	122/14LR	£9·19	152/12	£10·84		

Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. For speaker output impedances of 3 — 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs. COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£12·95** Carr. 40p
Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £18·95 or dep. £2·12 and 8 monthly payments £2·12 (Total £19·08).

HI-FI SPEAKER ENCLOSURES

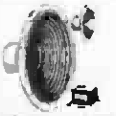
Teak veneer. Sizes approx. Carr. 50p. per enc.

ME8 13 × 9½ × 6½in. £3·95 } Both cut for 8in. speaker
JE8 16 × 11 × 9in. £5·95 }
SE10 25 × 16 × 9in. Cut for 10in. and Tweeter £6·95
SE12 25 × 16 × 9in. Cut for 12in. and Tweeter £8·95



AUDIOTRINE HI-FI SPEAKER SYSTEMS

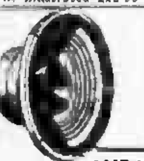
Consisting of matched 12in. 11,000 Gauss 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£6·95** Carr. 45p
OR SENIOR 15 WATT INCLUDING HF126 15,000 GAUSS SPEAKER **£8·50** Carr. 50p



AUDIOTRINE HIGH FIDELITY SPEAKERS

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

HF808T	8"	10W	£2·55	HF120D	12"	15W	£6·50
HF102D	10"	10W	£3·50	HF126	12"	16W	£7·95
HF120	12"	15W	£5·95	HF126D	12"	15W	£8·50

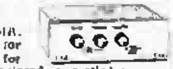


AUDIO FIDELITY MODEL 80 HI-FI SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 16 KHz. Gauss 10,000. Impedance 8-15 Ω. £4·50 ea. **£7·98** pr
MODEL 83 5" 15w. with parasitic Tweeter. Response 25 Hz to 18 KHz. Gauss 13,000 Imp 8-16 Ω. **£10·95** pr. £6·99 ea.

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

200-250v. AC mains operated. Response 30-20,000 c.p.s. — 3db. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 3mV. O/P rating I.H.F.M. Enclosed channelled case 9½ × 2½ × 5½in. Silver finish facia 10½ × 3½in. Complete kit, wiring diagrams and instructions. **£7·95** Carr. 40p. FACTORY BUILT £10·95



R.S.C. TA12 MKIII 6·5+6·5 WATT STEREO AMPLIFIER

Fully Transistorised. Hi-Fi o/p of 6·5 watts per channel. Optimum performance with any crystal or ceramic P.U. Cartridge, Radio Tuner, Tape Rec. etc. Input Sel. Switch, Bass, Treble, Vol. & Bal. Controls. COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS **£12·95** Carr. 40p.
Factory built with 12 mths guarantee **£16·61** Or in Teak Veneer housing **£19·55** Dep. £2·50 & 8 mthly pymts £2·60 (Total £23·30).

AUDIO FIDELITY FR1 SPEAKER KIT

Response 30Hz-15KHz. Rating 15 watts in sealed cabinet. Imp. 8-15 ohms. 8" Bass Unit with P.V.C. Cone surround for ultra low resonance. Pressure Tweeter. Printed Circuit Inductive/Capacitive Cross-Over. Damping Material. Screws. Terminal Panels. **£10·95** each. Carr. Free.
SPECIAL OFFER **£14·99** Pair Carr. 50p

HI-FI 8" x 5" 7 watt SPEAKERS **£1·25**

with parasitic Tweeter 8 ohm imp. Post and packing 20p

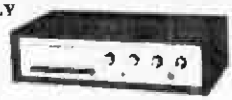
R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET
Only high grade components by leading manufacturers

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

Send S.A.E. for full descriptive leaflet.

For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz ± 1½ dB.



COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £4·90 extra. **£22·50**
Assembled unit in cabinet £42·50

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25 × 14 × 10in. approx.
★ Response 30-20,000 c.p.s. Impedance 15 ohms
Performance comparable with units at twice the cost
COMPLETE KIT **£25·95** Carr. 75p
Deposit £4·71 and 8 monthly payments £3·12 (Total £29·67)
Consists of (1) 12in. 15w Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance. (2) 3-way quarter section series cross-over system. (3) 8 × 5in. high flux middle range speaker. (4) Dome Pressure Tweeter. (5) Quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions.

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

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

MIDGET CLAMPED TYPE 2½ × 2¼ × 2¼in.
250v. 60mA. 6·3v. 2a. ... £1·50
250-0-250v. 60mA. 6·3v 2a ... £1·60

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

TOP SHROUDED DROP-THRO' TYPE
250-0-250v. 70mA. 6·3v. 2a., 0-5-6·3v. 2a. £2·25
250-0-250v. 100mA. 6·3v. 3·5a. ... £2·50
250-0-250v. 100mA. 6·3v. 2a., 6·3v. 1a. ... £2·75
250-0-350v. 80mA. 6·3v. 2a., 0-5-6·3v. 2a. £2·75
300-0-300v. 100mA. 6·3v. 4a., 0-5-6·3v. 3a. £3·75
300-0-300v. 100mA. 6·3v. 4a., 0-5-6·3v. 3a. £3·75
300-0-300v. 130mA. 6·3v. 4a., c.t. 6·3v. 1a.
Suitable for Mullard 510 Amplifier ... £4·50
350-0-350v. 100mA. 6·3v. 4a., 0-5-6·3v. 3a. £3·75
350-0-350v. 150mA. 6·3v. 4a., 0-5-6·3v. 3a. £4·50
FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 77p; 6·3v. 2a. 80p; 6·3v. 3a. £1·45p; 6·3v. 6a. £2·25; 12v. 1a. 80p; 12v. 3a. or 24v. 1·5a £2·25; 0-9-18v 1½a £1·95; 0-12-25-42v 2a £2·75.

CHARGER TRANSFORMERS 0-9-15v. 1½a. £1·75. 2½a. £1·95; 3a. £2·00; 5a. £2·45; 6a. £2·75; 8a. £3·00
AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v. 50-80 watts £2·50. 150 watts, £4·50 250 watts £5·50; 500 watts £8·50

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

SELENIUM RECTIFIERS F. W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 15v. 1a. 38p. 2a. 40p. 3a. 65p. 4a. 81p. 6a. 97p.

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

RSC 100watt DISCO SYSTEM

AT FANTASTIC LOW PRICES!

Units listed below
(a) DISCOMASTER TWIN TURNTABLE CONSOLE with integral 100W amplifier
(b) PAIR OF HI-FI HEADPHONES
(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 **£149·95**

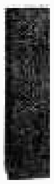
DEP. £19·95 & 19 fortnightly. payments of £7·87 (Total £169·48).

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. £4·22 (Total £84·96) **£75·00** Carr. £1·50

DISCOMASTER TWIN TURNTABLE POWER CONSOLE

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 £11·48 and 18 fortnightly payments £5·74 (Total £114·80) **£99·95** Carr. £2·50



R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

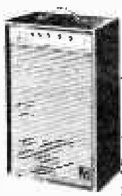
All types 15 Ohms covered in Rexine and Vynair

TYPE C132 30-40 WATTS Fitted two exceptionally efficient, low feedback howl characteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £3·95 and 8 m'thly payments £2·67 (Total £25·31) Carr. 65p. **£19·95**

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**

ALL RSC PRICES INCLUDE VAT

INTEREST CHARGES REFUNDED on Credit
Purchases settled in 3 months

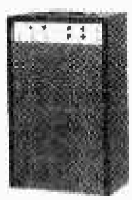


MINSTREL 8W GUITAR AMP.

Incorporating Tremolo and 13" × 8" or 10" Speaker. Output 8 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity.
Terms: Deposit £4·40 and 8 monthly payments £2·67 (Total £25·76) Carr. free **£19·95**

FANE CRESCENDO SPEAKERS

Full range available at all BRANCHES

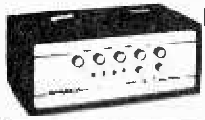


FAL MAESTRO

COMBINED 30W AMPLIFIER AND 12" LOUDSPEAKER

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.
Terms: Deposit £5·59 and 8 monthly payments £5·59 (Total £50·31) **£43·74** Carriage free

Also RSC PHANTOM '50' Rating 50w £49·95 Carr. £1·50



FAL PHASE 50 Mk. III AMPLIFIER 50 WATT

Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective Circuitry against serious output overloading. Output for Speaker/s 8 to 15 ohms. Size 17" × 7" × 7¼". 200–250v. A.C. mains. Output 50 watts music rating. Or deposit £5·75 & 8 monthly payments £5·75. Total £51·75. Carr. Free **£43·95**

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

'POP' 100 18" 100 Watt 14.000 gauss 8/15Ω **£29·95** Dep: £3·80 and 8 mthly payments £3·80 (Total £34·20)

'POP' 60 15" 60 Watt 14.000 gauss 8/15Ω **£16·95** Dep. £2·17 and 8 monthly payments. £2·17 (Total £19·53)

FOR BASS GUITAR, ELECT. ORGAN, ETC.

'POP' 50 12" 50 Watt 13.000 gauss 15Ω **£12·95** Terms for pairs Dep. £3·90 & 8 mthly pymts £3·16 Total £29·18 PAIR SUITABLE ALL PURPOSES

FANE POP '55'

12" 60 watt 15000 gauss 8-15Ω **£15·99**

PH50 Power Tweeter

50w when used with rec. filter provides improved vocal sound **£5·95**

FANE SPEAKERS 'POP' 25/2 12 in. 30 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). Carr. free **£8·95** CREDIT TERMS (PAIRS ONLY) Dep. £2·80 & 8 mthly pymts. £2·30 (Total £21·20).

GROUP EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK. III AMPLIFIER £43·95
PR. FANE POP 25/2 30W L/SPEAKERS £17·90
£61·85
Terms: Deposit £7·35 and 8 monthly payments of £7·35 (Total £66·15)
PACKAGE PRICE **£56·95** carr. £1·10

F.A.L. PHASE 50 MK.III AMPLIFIER £43·95
PR. FANE POP 50 L/SPEAKERS £25·90
£69·85
Terms: Deposit £22·00 and 12 monthly payments of £4·20 (Total £72·40)
PACKAGE PRICE **£63·95** carr. £1·10

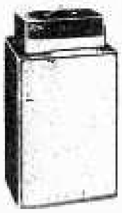
F.A.L. PHASE 50 AMPLIFIER £43·95
PAIR L12/20 SPKRS (in Cabinets) £25·90
£69·85
Terms: Deposit £22·00 and 12 monthly payments £4·20 (Total £72·40)
PACKAGE PRICE **£63·95** carr. £2·00

HIGH QUALITY LOUDSPEAKER UNITS

ALL TWO TONE REXINE AND VYNAIR FINISH
L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£43·00**
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 £3·32 & 8 mthly pymts £3·32 (Total £29·88) **£12·95** Carr. 55p.

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



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 £7·98. & 18 fortnightly payments of £3·99 (Total £79·80). Carr. £2·50 **£69·95**

REGENT 50B for Bass Guitar and general purposes. Or Dep. £9·18 & 18 fortnightly payments £4·59. (Total £91·80). Carr. £2·50 **£79·95**

GP30 AMPLIFIER

For Guitar, Vocal or Instrumental Group

A 4 input, 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/silver P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet.

Terms: Deposit £5·58 and 8 monthly payments of £3·58 (Total £34·22). **£29·95** Carr. 75p

COMPLETE PULSAR £99·95

'SOUND TO LITE' SYSTEM

Terms: Deposit £11·48 and 18 fortnightly payments £5·74.
(Total Credit Price £114·80). Super SL Unit. 1000 watt per channel. Manual override buttons, 2 spotbanks with 6 bulbs (3 sep. colours) 5 yd and 10 yd leads, fitted plugs. Units sold sep.

DISCO LIGHTING AT KEEN PRICES

FAL DISCO PRE-AMPLIFIER

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

TITAN 18" 100W SPEAKERS

15 ohms (List £33) Carr. 75p **£25·95**

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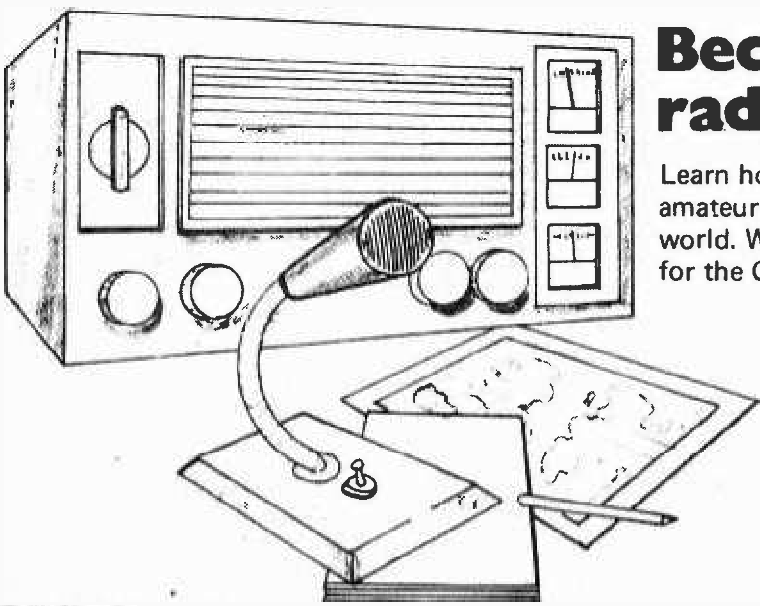
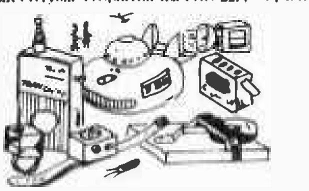
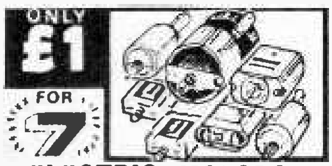


EXPERIMENTER PRINTED CIRCUIT KIT BUILD 60 INTERESTING PROJECTS
CONTENTS: (1) 2 Copper Laminate Boards 4½in. × 2½in. (2) 1 Board for Matchbox Radio. (3) 1 Board for Wristwatch Radio, etc. (4) Resist. (5) Resist Solvent. (6) Etchant. (7) Cleanser/Degreaser. (8) 16-page Booklet Printed Circuits for Amateurs. (9) 2 Miniature Radio Dials SW/MW/LW. Also free with each kit. (10) Essential Design Data Circuits, Chassis Plans, etc. for 60 TRANSISTORISED PROJECTS. Circuits to suit everyone's requirements. Price £1. post paid.



RECORD PLAYBACK HEADS (TRUVOX)
Individual prices of these are:
2 track record playback heads **50p** each.
4 track record playback heads **72p** each.
Erase heads are also available separately:
2 track **33p**; 4 track **55p**.
MV metal mounting shields **39p** each.
2 track-heads already fixed on heavy mounting plate with shield **£1·22**.

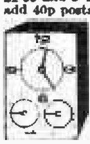


ELECTRIC MOTORS
7 powerful battery motors as used in racing cars and power models. Output and types vary to make them suitable for hundreds of different projects—tools, toys, models, etc. All brand new, reversible and for 1½ to 12v. Bats., wiring diagrams included. Post and VAT 30p.
FREE Details of how to make miniature power station.

BSR TAPE DECK TWIN CHANNEL
Mounted on a wooden plinth with amplifier. Not new, but unused. Originally intended for schools teaching system. The tape deck is perfectly standard and has the usual record, playback and fast rewind controls. Limited quanity—only **£8·50** plus £1 post and insurance.

BATTERY SWITCH

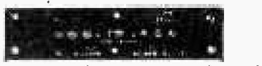
Famous Atlas in metal case with meter, output leads terminated by crocodile clips. For 6 or 12v charging simply by changing plug on front panel. Ready built, new and still in maker's original packing. Two models: 1½ amp **£1·99** and 3-4 amp **£2·95**. Please add 40p postage for one and 75p postage for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

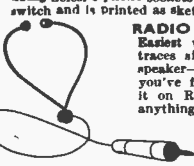
TIME SWITCH

Smith's mains driven clock with 15 amp switch, also notes showing how you can wake up with music playing, kettle boiling or come home to a warm house, warn off burglars, keep pets warm, halve your heating bills, etc. **£1·95.**

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. Resistor and rectifier **20p** extra.

BATTERY ELIMINATORS
Kit of parts comprising mains transformer, rectifier and necessary smoothing components with instructions, showing how to make up for 6v. 9v or 12v types.

Radio from mains	£1·20
Cassette from mains	£1·50
Cassette or radio from car (stabilized)	£2·10

AMPLIFIER PANELS

Very nice looking, polished black presaphan with fixing holes. 6 phono sockets and changeover slide switch and is printed as sketch. Price is **30p.**

RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece, **£2·20**—twin stethoset instead of earpiece **83p** extra—post and ins. 20p.

CENTRIFUGAL BLOWER

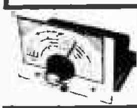
Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½" × 4½" × 4". When mounted by flange, air is blown into the equipment but to suck air out, mount it from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering, etc. etc. A real bargain at **£2·05.**

TANGENTIAL HEATER UNIT

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters. Comprises motor, impeller. 2kW. element allowing switching 1, 2kW. and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch, **£2·75.** Don't miss this. Control Switch, **44p.** P. & P. 40p.

MULLARD UNILEX STEREO SYSTEM

There is no doubt that it is a good system, we believe that for the money it is without comparison. We demonstrate gladly at our Tamworth Road depot. Prices of the individual items for this:—
1 Unilex Amplifier Ref. EP.9000 **£1·60**
1 Unilex Pre-Amp Ref. EP.9001 **£1·80**
1 Unilex Power Unit Ref. EP.9002 **£2·30**
1 Control panel kit with spun aluminium faced knobs **£3·30.** Or the complete outfit—**£11·30** post paid.
Pair of 15 ohm speakers made by E.M.I. are also available if required, **£3·30** the pair. No extra postage if ordered with the above, otherwise add 25p.

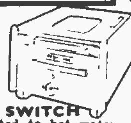
SHORTWAVE CRYSTAL SET

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 **33p.**

THIS MONTHS SNIPS

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 AMPLIFER
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.

DIGITAL DISPLAY UNIT 'DIGIVISOR'
A precision instrument consisting basically of a 12 volt lamp focused by a lens system to shine through a numbered scale onto a ground glass front screen, the number being selected by applying a different voltage of the coil. Overall size approx. 2¼" x 1½" x 4¼". Price **£3·50.**

TAPE DECK

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

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 **£3·85** as illustrated but less case.

WANT A CHEAP OSCILLOSCOPE
We offer this month a laboratory type instrument made by G.E.C. for their communications laboratory. In a steel case with carrying handle. It is mains operated and has its own internal time base and plenty of room to add another base if you wish. Probable cost of this instrument is in excess of £100. We offer this tested and in working order. **£17·50** plus £2 carriage for first 200 miles then £1 for each 100 miles after.

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.

TINY BATTERY MOTOR
Works off 1½ or 3v requires no on off switch as it will not draw current until it is spinning. Approx. ⅞" long × ½" diameter. Ideal for hand held fan, propellor driven model etc. **20p** each, 10 for **£1·80.**

LUMINOUS ROCKER SWITCH ON/OFF
Luminous Rocker switch on/off. Panel mounting, snaps into a 1" hole. Rated at 10A 250v. **15p** each or 10 for **£1·35.**

AUTOMATIC EMERGENCY LIGHTING
Power cut days will soon be upon us. Our simple kit makes any light a fail-safe light. Kit containing relay and rectifiers and data, only **65p** each. 10 or more **60p** each. Suitable case **40p** extra.

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.

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.**

MACLAREN THERMOSTAT
Make and break 20A a.c. with the sensor probe coupled by a 2 feet capillary covering range of 10-100°C—complete with large engraved control knob. Price **88p.**

WATERPROOF HEATING ELEMENT
13 yards length 35W. Self-regulating temperature control **55p** post free.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. **£4·30** plus 20p post and insurance.

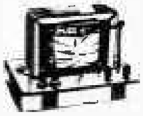
MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. Snip at **65p.** Postage 20p for first one then 10p for each one ordered.
1" stackmotor **94p.**
1½" stackmotor **£1·10.**

NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts. **8p** each 10 for **60p.** Plastic pushrod suitable for operating. **6p** each. 10 for **54p.**

AMPLIFIER IN CASE WITH SPEAKER
Marketed by British Relay under the name Luxistor. This is in a very neat looking cabinet and is ideal around the home or in the workshop for trouble shooting or for testing out a quick lash up. Size approx. 9½" x 6½" x 3½" deep. Input is via a matching transformer and volume control and amplifier may be powered by an internal 9v battery or an external 110v source. Speaker is an E-A eliptical 6" × 3½" 10,000 gauss. The amplifier proper is a Newmarket model ref. P.C.4. Price **£3·85** each. 10 for **£31·50.** Post and insurance 20p.

12 VOLT 1½ AMP POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mf/d/ smoothing. Price **£2·20** + p. & p. 20p.
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 **£6·33** plus 65p post.

HEADPHONE STEREO AMP.
With volume, balance and tone control. Output approx. 2 watt into 22 ohm speaker but will operate with reduced output into 16 ohm or 8 ohm headphones. Power supply 14v AC (We can supply suitable transformer—80p). The amplifier has all controls mounted and is ready to slip into a simple box. Price **£2·99** plus 50p post and insurance.

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.

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(Dept. PW), 102/103 TAMWORTH RD., CROYDON CRO IXX.

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2N3053	29p	BC159	15p
2N3054	60p	BC167B	13p
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40361	45p	BD131	41p
40362	44p	BD132	52p
40602	46p	BD135	37p
40636	£1·34	BD136	30p
40669	£1·10	BDY20	82p
AC128	17p	BF194	15p
AC151R	23p	BFR39	23p
AC153	27p	BFR79	23p
AC153K	37p	BFX29	33p
AC176	24p	BFX84	27p
AC176K	38p	BFY51	23p
AC187K	31p	BRY39	45p
AC188K	29p	BY164	51p
AD133	£1·82	C106B1	42p
AD136	£1·11	C106D1	62p
AD149	65p	C1406	75p
AD161	42p	MJ481	£1·20
AD162	40p	MJ491	£1·35
AF200U	70p	MJ2955	90p
AF239	64p	MJE371	81p
B1008	30p	MJE521	81p
BA138	31p	MJE2955	£1·12
BB103	24p	MJE3055	60p
BB105	34p	OA91	6p
BB109	18p	SD4	8p
BC107A	15p	TIP31A	70p
BC107B	15p	TIP32A	80p
BC108B	14p	TIP41A	80p
BC108C	14p	TIP42A	£1·00
BC109B	13p	WO2	20p
BC109C	13p	ZTX300	14p
BC147A	12p	ZTX304	23p
BC147B	13p	ZTX500	14p
BC148B	12p	ZTX504	45p

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BAXANDALL SPEAKER KIT
As designed by P. J. Baxandall and described originally in "Wireless World." Simple to assemble, fantastically good results and a greater money saver. Carries 10 watts RMS. 15 ohms impedance. Size 18in x 12in x 10 in. Complete kit, including pack-flat cabinet, £14·90.

The size and weight of this product obliges us to charge 70p part cost of carr. in U.K.

Equaliser Assembly, £2·30.

Loudspeaker Unit 59RM109, £2·45.

Cabinet Kit (to Baxandall design), £10·45.

Cross-over choke for additional woofer to above, £1·50.

DISCOUNTS
Available on all items except those shown with NETT PRICES 10% on orders from £5 to £14·99, 15% on orders £15 and over.

FREE POSTAGE
In U.K. for pre-paid mail orders. For mail orders for £2 list value and under there is an additional handling charge of 10p. Overseas orders – carriage charged at cost.

Giro A/C No. 38/671/4002

RESISTORS

Code	Watts	Ohms	1 to 9	10 to 99	100 up (see note below)
C	1/3	4·7–470K	1·3	1·1	0·8 nett
C	1/2	4·7–10M	1·3	1·1	0·8 nett
C	3/4	4·7–10M	1·5	1·2	0·97 nett
C	1	4·7–10M	3·2	2·5	1·82 nett
MO	1/2	10–1M	4	3·3	2·3 nett
WW	1	0·22–3·9Ω	11	10	9
*WW	3	1–10K	9	8	6
*WW	7	1–10K	11	10	8

* Add 40% for values under 12Ω.

Codes:
C = carbon film, high stability, low noise.
MO = metal oxide, Electrosil TR5 ultra low noise.
WW = wire wound, Plessey.

Values: All E12 except C ⅓W, C 1W and MO ½W.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

Tolerances:
5% except WW 10% ± 0·05Ω below 10Ω and ½W MO 2%.

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order). Prices for 100 up in units of 100 only.

ELECTROLYTIC CAPACITORS
Axial Lead

µF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	11p	8p
1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	8p
4·7	—	—	—	11p	—	9p	9p	8p
10	—	—	—	—	8p	9p	8p	9p
22	—	—	8p	—	9p	8p	8p	10p
47	8p	—	9p	9p	9p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	29p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	18p	23p	26p	37p	41p	—	—
4,700	26p	30p	30p	44p	58p	—	—	—
10,000	42p	44p	—	—	—	—	—	—

MINITRON DIGITAL INDICATORS
3015F Seven segment filament compatible with standard logic modules. 0–9 and decimal point; 9mm characters in 16 lead DIL £1·20
Suitable BCD decoder driver 7447 £1·15
3015G showing + or – & 1 & dec. pt. £1·20
LEDS (Light Emitting Diodes) 25p
Photo Cells, each 40p

ANTEX Soldering Irons
CN240 £2·15 Spare bits 32p
CCN240 £2·70 Spare bits 40p

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ROTARY, CARBON TRACK.
Double wipers for good contact and long working life

P.20 SINGLE linear 100 ohms to 4·7 megohms. each 14p

P.20 SINGLE log. 4·7 Kohms to 2·2 megohms. each 14p

JP.20 DUAL GANG lin. 4·7 Kohms to 2·2 megohms. each 48p

JP.20 DUAL GANG log. 4·7 Kohms to 2·2 megohms. each 48p

JP.20 DUAL GANG Log/antilog 10K, 22K, 47K, 1 megohm only. each 48p

JP.20 DUAL GANG antilog 10K only 48p

2A DP mains switch for any of above 14p extra.

Decades of 10, 22 and 47 only available in ranges above.

Skeleton Carbon Presets, Type PR, horizontal or vertical 6p each.

SLIDER

Linear or log mono 4·7K to 1 meg. in all popular values each 38p

STEREO, matched tracks, lin. or log in all popular values from 4·7K to 1 meg. 60p

Escutcheon plates, mono, black, white or light grey. each 10p

Control knobs, blk/wht/red/yel/grn/blue/dk. grey/lt. grey. each 7p

CAPACITORS
DALY ELECTROLYTIC *in cans, plastic sleeved*
1000mF/25V 28p 2200/100 £1·56
5000/100 £2·01 1000/50 41p
5000/25V 82p 2000/50 57p
5000/50 £1·13

POLYESTER TYPE C.280. *Radial leads for P.C.B. mounting. Working voltage 250V d.c.*
0·01, 0·015, 0·022, 0·033, 0·047, ea. 3p
0·068, 0·1, 0·15 ea. 4p
0·22 5p; 0·33 7p; 0·47 8p; 0·68 11p; 1·0 14p; 1·5 21p; 2·2 26p

SILVERED MICA. *Working voltage 500V d.c.*
Values in pF—2·2 to 820 in 22 stages ea. 6p
1000, 1500 7p; 1800 8p; 2200 10p; 2700, 3600 12p; 4700, 5000 15p; 6800 20p; 8200, 10,000 25p

TANTALUM BEAD
0·1, 0·22, 0·47, 1·0 mF/35V, 1·5/20V, 2·5/16V ea. 14p
2·2/16V, 2·2/35V, 4·7/16V, 10/6·3V ea. 14p
4·7/35V, 10/16V, 22/6·3V ea. 18p
10/25V, 22/16V, 27/6·3V, 100/3V, 6·8/25V, 15/25V ea. 29p

POLYCARBONATE
Type B42540 Working Voltage—250V
Values in mF:
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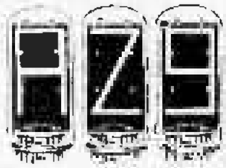

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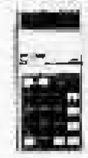

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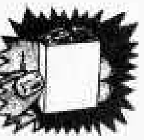

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33 ranges up to 3 Amps AC/DC; 1200V DC, 900V AC, 500kΩ, +12 db.

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Accuracy: ±2·5% DC; ±4% AC

Movement is protected by silicon diodes.

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PRICE: complete with test leads, instruction manual and fibre-board storage case £9·25. Packing & carr. £0·50.

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Sensitivity: 20,000Ω/V.

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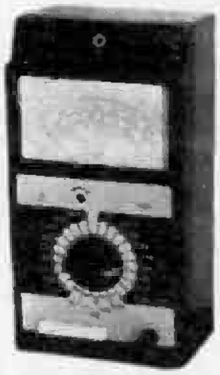

39 ranges:
600μA to 1·5A AC
60μA to 1·5A DC
75mV to 600V DC
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1MΩ, 0·5μF, 12db

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