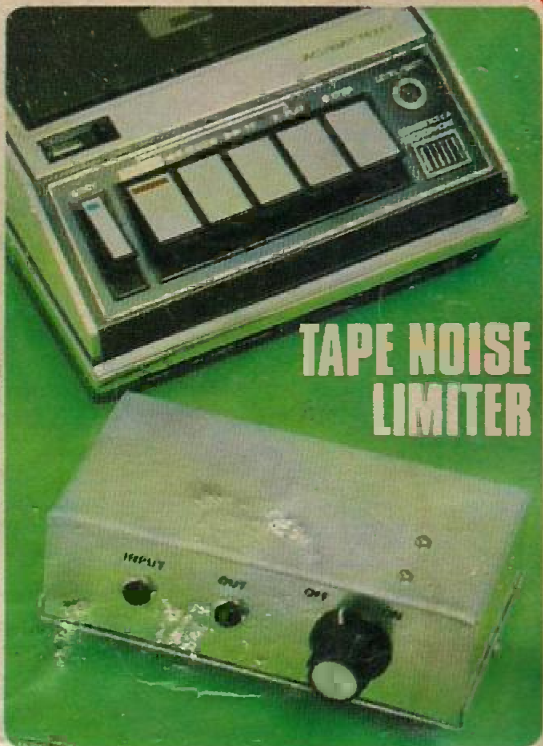
An exciting hobby.... for everyone

everyday electronics

NOV. 74
20p



THESE EASY TO BUILD PROJECTS

Plus-Special Feature

SOLDERING for BEGINNERS

PRACTICE • THEORY
POPULAR FEATURES

ELECTRONICS MADE EASY!

TELEPHONE REMOTE MONITOR

NEW EDU-KIT MAJOR

COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT.

BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER.

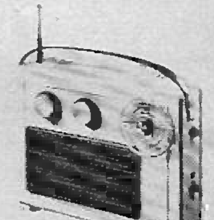
★ 4 Transistor Earpiece Radio ★ Signal Tracer ★ Signal Injector ★ Transistor Tester NPN-PNP ★ 4 Transistor Push Pull Amplifier ★ 5 Transistor Push Pull Amplifier ★ 7 Transistor Loudspeaker Radio MW/LW ★ 5 Transistor Short Wave Radio ★ Electronic Metronome ★ Electronic Noise Generator ★ Batteryless Crystal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

★ 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).

Total Building Costs £7·23 P P & Ins. 44p. (Overseas P & P £1·85p.) (+ 8% VAT 57p)

NEW ROAMER NINE

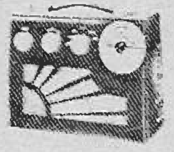
WITH V.H.F. INCLUDING AIRCRAFT



Nine Transistors. 9 Tunable 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 control. Attractive all white case with red grille and carrying strap. Size 9½" × 7" × 2½" approx. Parts Price list and Plans 30p (FREE with parts)

Total Building Costs £6·95 P P & Ins. 44p. (Overseas P & P £1·85p) (+ 8% VAT 55p)

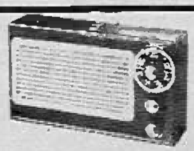
ROAMER TEN



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 600 mw Transistors. Car Aerial and Tape Recording Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

Total building costs £8·50 P. P. & Ins. 52p (Overseas P. & P. £1·85) (+ 8% VAT 68p)

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 15p. Free with parts.

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

E.V. 6 Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts price list and Plans 15p. Free with parts.

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

E.V. 7 Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" loudspeaker. Parts price list and easy build plans 20p. Free with parts.

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

"EDU-KIT"

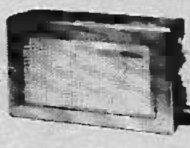
Build Radios, Amplifiers, etc. from easy stage diagrams. Five units including master unit to construct

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine 3" Tone Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¾" 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 25p (FREE with parts).

Total Building Costs £5·50 P P & Ins. 33p (Overseas P & P £1·85) (+ 8% VAT 44p)

POCKET FIVE

Now with 3" loudspeaker

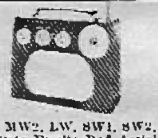


3 Tunable wavebands M.W./L.W. and Trawler Band. 7 stages. 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive Black and Gold Case. Size 5½" × 1½" × 3½" approx. Plans and parts price list 15p. (Free with parts).

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

ROAMER EIGHT Mk 1

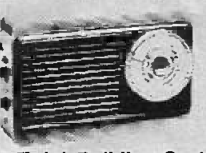
NOW WITH VARIABLE TONE CONTROL



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 Loudspeakers. 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 25p (FREE with parts).

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

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 15p (Free with parts).

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

ROAMER SIX

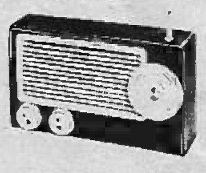
Case and looks as Trans-Eight

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3, 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 25p (FREE with parts).

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

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 25p (FREE with parts).

Total Building Costs £4·48 P P & Ins. 33p (Overseas P & P £1·25) (+ 8% V.A.T. 36p)

- Callers side entrance "Lavells" Shop
- Open 10-1, 2.30-4.30 Mon.–Fri.—9-12 Sat.

RADIO EXCHANGE CO

61a HIGH STREET, BEDFORD, MK40 1SA Tel. 0234 52367

Reg. no. 788372

I enclose £............ for..............................

Name..............................

Address..............................

....

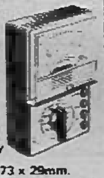
(Dept. E.E.11.)

ASK LASKYS

and make no mistake

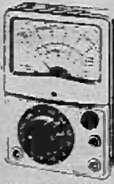
AUDIOTRONIC Model ATM1
Top value 1,000 opv pocket multimeter. Ranges: 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistance: 0/150k ohms. Decibels: −10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.

OUR PRICE £3.25 P&P 15p

AUDIOTRONIC Model ATM5
Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC, (2500 opv). 0-6/30/300/600V DC, (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. −10 to +16dB. Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm.

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&P 30p

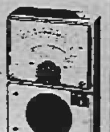
HIOKI 720X VOM
A versatile, accurate measuring instrument. 20,000 opv. 0/5/25/100/500/1000V DC. 0/10/50/250/1000V AC. 0–50uA/250mA. 0–20k/2 Megohms.

OUR PRICE £5.97
P&P 30p

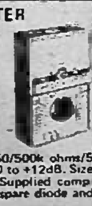
MODEL PL436
20,000 opv DC. 8000 opv AC. Mirror scale :6/3/12/30/120/600V DC. 3/30/120/600V DC. 60/600μA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. −20 to 46 dB.

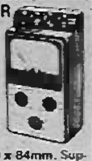
OUR PRICE £6.97 P&P 30p.

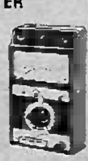
U4323 MULTIMETER
20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance x 10, x 100, x 1,000, x 10,000 (50Ω, 500Ω, 5kΩ, 50kΩ centre scale) Battery operated. Size: 160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

OUR PRICE £7.70 P&P 30p

HIOKI 730X
30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/μA/30mA/300mA. 2K/200K/2 Meg Ohm. 10 to 63dB.

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 60/120/600/1200V AC. 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. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.

OUR PRICE £8.75 P&P 30p

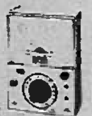
U4312 MULTIMETER
extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge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

OUR PRICE £10.25 P&P 50p

U91 Clamp VOLT AMMETER
For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.

OUR PRICE £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
Leather 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/1.5/3/15/30/150/300 mA/6/12A. Resistence: 0- 3/300k/3/30Mohms. Decibels: −10 to +17dB. Output: 0–3/6/15/30/60/120/300V. Accuracy ± 3% DC, ± 4% AC. Sensitivity: 50,000 opv DC, 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 153mm.

OUR PRICE £11.95 P&P 40p

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

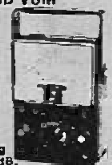
OUR PRICE £12.50 P&P 20p

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/3/6/30/60/150/500mA/6/12A DC. 2k/200k/2M/20MOhms. −20 to +63dB.

OUR PRICE £14.95 P&P 30p

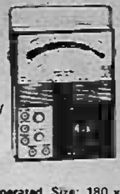
Model HT100B4 MULTIMETER
Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1-/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence 0–20/200k/2/20 Meg. ohms. DC current.– 10/250uA/2.5/25/250 mA/10A. AC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

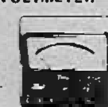
OUR PRICE £17.50 P&P 40p

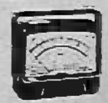
MODEL AS.100D VOM
100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12 Amp. 0/2K/20K/200K/2M/200 Meg Ohm. −20 to 17dB.

OUR PRICE £17.50 P&P 30p.

MODEL C7202EN
20,000 o.p.v. DC. 10,000 o.p.v. AC Mirror Scale. 5/25/50/250/500/1000/2500 V. DC. 10/50/100/500/1000 V. AC. DC Resistance x 10, x 1000 (30Ω centre scale) DC Current 50uA/2.5mA/250mA. −20 to +68 dB

OUR PRICE £6.50 P & P 30p

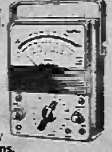
KAMODEN 360 MULTIMETER
High sensitivity, DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/10/100M ohms. Decibels −20 to +62dB. Battery operated. Size: 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 4¾" mirror scale. Size: 149 x 117 x 60mm. 0.3– 12000V DC. 3–300V RMS AC. 8–800V P-P. DC current 0.12–12mA. Resistence 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. Resistence: 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 opv Overload protected. Mirror scale. Ranges: −0/.06/.3/3/30/120/600/1200V DC. 0/3/12/60/300/11200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC. 0/12A AC. −20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.

OUR PRICE £22.50 P&P 30p

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

OUR PRICE £16.50 P&P 40p

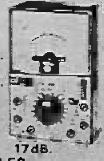
MODEL U4311 Sub-standard Multi-range Volt-Ammeter
Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /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

ALL PRICES EXCLUDE VAT

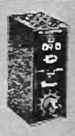
MODEL C7208FM
30,000 opv DC 15,000 opv AC. 6 3 15 60 300 600 1200V DC 6 30 120 600 1200V AC DC Resistance x 1, x 10, x 100, x 1000 (50Ω centre scale) DC Current 30uA 3 30 600mA 20 to 63dB.

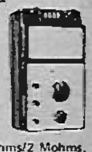
OUR PRICE £8.95 P & P 30p

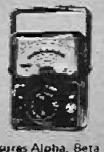
MODEL AF.105 VOM
50,000 opv. Mirror scale. Meter protection. 0 3 3 12 60 120 300 600 1200V DC. 0 6 30 120 300 600 1200V DC. 0 30μA 6 60 300 mA 12 Amp. 0 10K 1m 10m 100 Meg Ohms. 20 to 17dB.

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

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
100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA/6/12A DC. 0/10k/1 Meg/100 Meg. −20 to +50dB. 0.01 0.2MFD. Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.

OUR PRICE £19.95 P&P 25p

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

OUR PRICE £43.00 Carr. paid

RUSSIAN CI16 Double Beam OSCILLOSCOPE
5 MHz pass band. Separate Y1 and Y2 ampifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.

OUR PRICE £87.00 Carr. paid

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

Also see following pages

SEW PANEL METERS

SEW PANEL METERS ARE STOCKED AT OUR 3 LISLE ST., 311 EDGWARE RD., & 152 FLEET ST., BRANCHES or order by post.

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

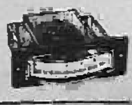
CLEAR PLASTIO MODEL SD640
Size: 85 x 64mm

50uA	£3.80	10V DC	£3.65
100uA	£3.75	20V DC	£3.66
200uA	£3.70	50V DC	£3.65
500uA	£3.65	300V DC	£3.66
50-0-50uA	£3.75	15V AC	£3.75
100-0-100uA	£3.70	300V AC	£3.75
1mA	£3.66	VU Meter	£3.90
5mA	£3.65		
10mA	£3.66		
50mA	£3.66		
100mA	£3.65		
500mA	£3.65		
1A DC	£3.65		
5A DC	£3.65		
10A DC	£3.65		
5V DC	£3.66		

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4.60	150V AC	£4.45
100uA	£4.50	300V AC	£4.45
500uA	£4.30	VU Meter	£4.90
50-0-50uA	£4.50		
100-0-100uA	£4.45		
1mA	£4.30		
1A DC	£4.30		
5A DC	£4.30		
20V DC	£4.30		
50V DC	£4.30		
300V DC	£4.30		

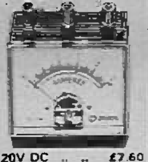
EDGWISE MODEL PE70
Size: 90 x 34mm



50uA	£4.16
100uA	£4.10
200uA	£4.05
500uA	£3.90
50-0-50uA	£4.10
100-0-100uA	£4.05
1mA	£3.85
300V AC	£3.95
VU Meter	£4.30

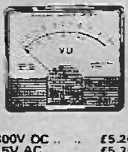
MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.



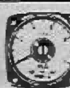
50uA	£8.50	20V DC	£7.60
100uA	£7.90	50V DC	£7.60
50-0-50uA	£7.90	300V DC	£7.60
1mA	£7.60	500mA/5A DC	£8.60
1-0-1mA	£7.60	5V/50V DC	£8.60
1A DC	£7.60	5V/15V DC	£8.60
5A DC	£7.60	1/5A DC	£8.60
5V DC	£7.60	1A/15A DC	£8.60
10V DC	£7.60		
15V DC	£7.60		

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



50uA	£5.45	300V DC	£5.20
100uA	£5.40	15V AC	£5.30
200uA	£5.35	300V AC	£5.30
500uA	£5.25	S Meter 1mA	£5.20
50-0-50uA	£5.40	VU Meter	£5.55
100-0-100uA	£5.35	1A AC	* £5.20
500-0-500uA	£5.20	5A AC	* £5.20
1mA	£5.20	10A AC	* £5.20
1-0-1mA	£5.20	20A AC	* £5.20
5mA	£5.20	30A AC	* £5.20
10mA	£5.20		
50mA	£5.20		
100mA	£5.20		
500mA	£5.20		
1A DC	£5.20		
5A DC	£5.20		
15A DC	£5.20		
30A DC	£5.40		
10V DC	£5.20		
20V DC	£5.20		
50V DC	£5.20		
150V DC	£5.20		

240° Wide Angle 1mA METERS

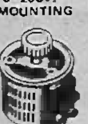


MW1-6 60 x 60 mm
£6.50 P & P 15p
MW1-8 80 x 80mm
£6-90 P&P 15p

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. Input: 230V 50/60Hz. Output 0–260V.

MODEL S260 BENCH MOUNTING



		P&P
1A	£10.50	50p
2.5A	£12.00	50p
5A	£17.50	60p
8A	£30.35	£1.00
10A	£33.75	£1.00
12A	£35.40	£1.00
20A	£85.00	£1.50
25A	£95.00	£1.50
40A	£120.00	£1.50

MODEL S260B PANEL MOUNTING
2.5A £12.00 50p

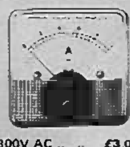
ALL PRICES EXCLUDE VAT

*Items with asterisk are Moving Iron type, all others are Moving Coil

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

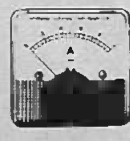
50uA	£4.30	10V DC	£4.10
100uA	£4.25	20V DC	£4.10
200uA	£4.20	50V DC	£4.10
500uA	£4.15	300V DC	£4.10
50-0-50uA	£4.25	15V AC	£4.20
100-0-100uA	£4.20	300V AC	£4.20
1mA	£4.10	VU Meter	£4.40
5mA	£4.10		
10mA	£4.10		
50mA	£4.10		
100mA	£4.10		
500mA	£4.10		
1A DC	£4.10		
5A DC	£4.10		
10A DC	£4.10		
5V DC	£4.10		

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



50uA	£3.20	300V AC	£3.05
100uA	£3.15	S Meter 1mA	£2.96
200uA	£3.10	VU Meter	£3.40
500uA	£3.00	1A AC	* £2.95
50-0-50uA	£3.16	5A AC	* £2.95
100-0-100uA	£3.10	10A AC	* £2.96
500-0-500uA	£2.96	20A AC	* £2.95
1mA	£2.95	30A AC	* £2.96
5mA	£2.95		
10mA	£2.95		
50mA	£2.95		
100mA	£2.95		
500mA	£2.95		
1A DC	£2.96		
5A DC	£2.95		
10V DC	£2.95		
20V DC	£2.95		
50V DC	£2.95		
300V DC	£2.95		
15V AC	£3.05		

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



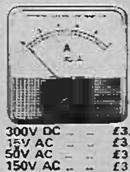
50uA	£3.10	20V DC	£2.80
100uA	£3.05	50V DC	£2.80
200uA	£3.00	100V DC	£2.80
500uA	£2.85	150V DC	£2.80
50-0-50uA	£3.06	300V DC	£2.85
100-0-100uA	£3.00	500V DC	£2.85
500-0-500uA	£2.80	750V DC	£2.90
1mA	£2.80	15V AC	£2.90
1-0-1mA	£2.80	50V AC	£2.90
2mA	£2.80	150V AC	£2.90
5mA	£2.80	300V AC	£2.90
10mA	£2.80	500V AC	£3.00
20mA	£2.80	S Meter 1mA	£2.80
50mA	£2.80	VU Meter	£3.20
100mA	£2.80		
150mA	£2.80		
200mA	£2.80		
300mA	£2.80		
500mA	£2.80		
750mA	£2.80		
1A DC	£2.80		
2A DC	£2.80		
5A DC	£2.80		
10A DC	£2.80		
3V DC	£2.80		
10V DC	£2.80		
15V DC	£2.80		

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

50uA	£3.50	10V DC	£3.30
100uA	£3.45	20V DC	£3.30
200uA	£3.40	50V DC	£3.30
500uA	£3.35	300V DC	£3.30
50-0-50uA	£3.45	15V AC	£3.45
100-0-100uA	£3.40	300V AC	£3.45
1mA	£3.30	VU Meter	£3.65
5mA	£3.30		
10mA	£3.30		
50mA	£3.30		
100mA	£3.30		
500mA	£3.30		
1A DC	£3.30		
5A DC	£3.30		
10A DC	£3.30		
5V DC	£3.30		

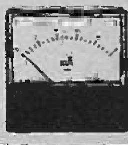
POSTAGE & PACKING 15p

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



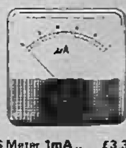
50uA	£3.96	300V DC	£3.70
100uA	£3.85	15V AC	£3.80
200uA	£3.80	50V AC	£3.80
500uA	£3.75	150V AC	£3.80
50-0-50uA	£3.85	300V AC	£3.90
100-0-100uA	£3.80	500V AC	£3.80
500-0-500uA	£3.70	S Meter 1mA	£4.10
1mA	£3.70	VU Meter	£3.70
1-0-1mA	£3.70	1A AC	* £3.70
5mA	£3.70	5A AC	* £3.70
10mA	£3.70	10A AC	* £3.70
50mA	£3.70	20A AC	* £3.70
100mA	£3.70	30A AC	* £3.70
500mA	£3.70	50mA AC	* £3.70
1A DC	£3.70	100mA AC	* £3.70
5A DC	£3.70	200mA AC	* £3.70
10A DC	£3.70	500mA AC	* £3.70
15A DC	£3.70		
20A DC	£3.80		
30A DC	£3.85		
50A DC	£4.05		
5V DC	£3.70		
10V DC	£3.70		
15V DC	£3.70		
20V DC	£3.70		
50V DC	£3.70		
150V DC	£3.70		

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm



50uA	£4.50
100uA	£4.45
500uA	£4.20
50-0-50uA	£4.45
100-0-100uA	£4.40
1mA	£4.20
1A DC	£4.20
5A DC	£4.20
20V DC	£4.20
50V DC	£4.20
300V DC	£4.20
300V AC	£4.30
VU Meter	£4.70

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



50uA	£3.70	S Meter 1mA	£3.30
100uA	£3.50	VU Meter	£3.80
500uA	£3.35	1A AC	* £3.30
50-0-50uA	£3.50	5A AC	* £3.30
100-0-100uA	£3.45	10A AC	* £3.30
1mA	£3.30	20A AC	* £3.30
5mA	£3.30	30A AC	* £3.30
10mA	£3.30		
50mA	£3.30		
100mA	£3.30		
500mA	£3.30		
1A DC	£3.30		
5A DC	£3.30		
10V DC	£3.30		
20V DC	£3.30		
50V DC	£3.30		
300V DC	£3.30		
15V AC	£3.40		
300V AC	£3.40		

BAKELITE MODEL MR 65 Size: 80 x 80mm

25uA	£5.25	300V DC	£3.60
50uA	£4.00	30V AC	* £3.60
100uA	£3.95	50V AC	* £3.60
500uA	£3.65	150V AC	* £3.60
50-0-50uA	£3.95	300V AC	* £3.60
100-0-100uA	£3.90	500V AC	* £3.60
500-0-500uA	£3.60	VU Meter	£4.10
1mA	£3.60	1A AC	* £3.60
1-0-1mA	£3.60	5A AC	* £3.60
5mA	£3.60	10A AC	* £3.60
10mA	£3.60	20A AC	* £3.60
50mA	£3.60	30A AC	* £3.60
100mA	£3.60	50A AC	* £3.60
500mA	£3.60	500mA AC	* £3.60
1A DC	£3.60	50mV DC	£3.75
2A DC	£3.60	100mV DC	£3.75
5A DC	£3.60		
10A DC	£3.60		
15A DC	£3.60		
30A DC	£3.60		
50A DC	£3.80		
5V DC	£3.60		
10V DC	£3.60		
15V DC	£3.60		
20V DC	£3.60		
50V DC	£3.60		
150V DC	£3.60		

ASK LASKYS about Hi fi

CALL INTO YOUR NEAREST LASKYS BRANCH OR SEND COUPON BELOW FOR NEW 16 PAGE HI-FI PRICE LIST

CENTRAL LONDON

481 OXFORD ST.	01-493 8641
3 LISLE ST. WC2	01-437 8204
34 LISLE ST. WC2	01-437 9155
118 EDGWARE RD. W2	01-723 9789
193 EDGWARE RD. W2	01-723 6211
207 EDGWARE RD. W2	01-723 3271
311 EDGWARE RD. W2	01-262 0387
346 EDGWARE RD. W2	01-723 4453
382 EDGWARE RD. W2	01-723 4194
109 FLEET ST. EC4	01-353 5812
152/3 FLEET ST. EC4	01-353 2833
10 TOTTENHAM CT. RD.	01-637 2232
27 TOTTENHAM CT. RD.	01-636 3715
33 TOTTENHAM CT. RD.	01-636 2605
42/45 TOTTENHAM CT. RD.	01-636 0845
257/8 TOTTENHAM CT. RD.	01-580 0670

ESSEX

86 SOUTH ST. ROMFORD 20216
205/206 CHURCHILL WEST, VICTORIA CIRCUS, SOUTHEND 0702 612241

KENT

53/57 CAMDEN RD., TUNBRIDGE WELLS 0892-23242

LEICESTERSHIRE

45 MARKET PLACE, LEICESTER 0533-537678

NORTHAMPTONSHIRE

73 ABINGTON STREET, NORTHAMPTON (Opening late October)

STAFFORDSHIRE

30 WULFRUM WAY, WOLVERHAMPTON (Opening late September)

SURREY

1046 WHITGIFT CENTRE, CROYDON 01-681 3027
27 EDEN ST. KINGSTON 01-546 7845
38/40 EDEN ST., KINGSTON 01-546 1271
32 HILL ST. RICHMOND 01-948 1441

WARWICKSHIRE

116 CORPORATION ST., BIRMINGHAM 021-236 3503

ALL BRANCHES OPEN FROM 9am to 6pm MON. TO SAT.

West End Service Centre
87 Tottenham Court Rd W.1.

BARCLAYCARD & ACCESS
Phone your order to 01-200 0037 or call into any branch

OUR CUSTOMER SERVICES DIVISION at head office will answer all your enquiries—just ring 01-200 1321

EXPORT Personal exports arranged for overseas visitors. Goods specially packed, insured and despatched to all parts of the world at minimum cost exclusive of VAT. Payment by bank transfer, certified cheque, postal order or money order in any currency.

NO DEPOSIT TERMS available on most goods for personal callers

CHEQUES TO THE VALUE OF £30 ACCEPTED FROM PERSONAL SHOPPERS WITH BANKERS CARD. IN OTHER CASES AND FOR AMOUNTS IN EXCESS OF £30, PLEASE ALLOW TIME FOR CLEARANCE. BANKERS DRAFTS ACCEPTED

All prices correct at 11.9.74 but subject to change without notice E.&O.E.

A member of the Audiotronic Group of Companies

FOR MAIL ORDER

We offer a speedy and efficient service by mail order. Remember to add 8% VAT to total value of goods including post and packing

TO LASKYS CUSTOMER SERVICES DIVISION
Audiotronic House, The Hyde, London NW9 6JJ. Tel 01-200 1321

Please send me the following items

TOTAL PURCHASE PRICE (inc. P&P and VAT)

HI-FI PRICE LIST — TICK HERE

I enclose cheque postal order money order

I wish to pay by Barclaycard/Access and my number is

NAME

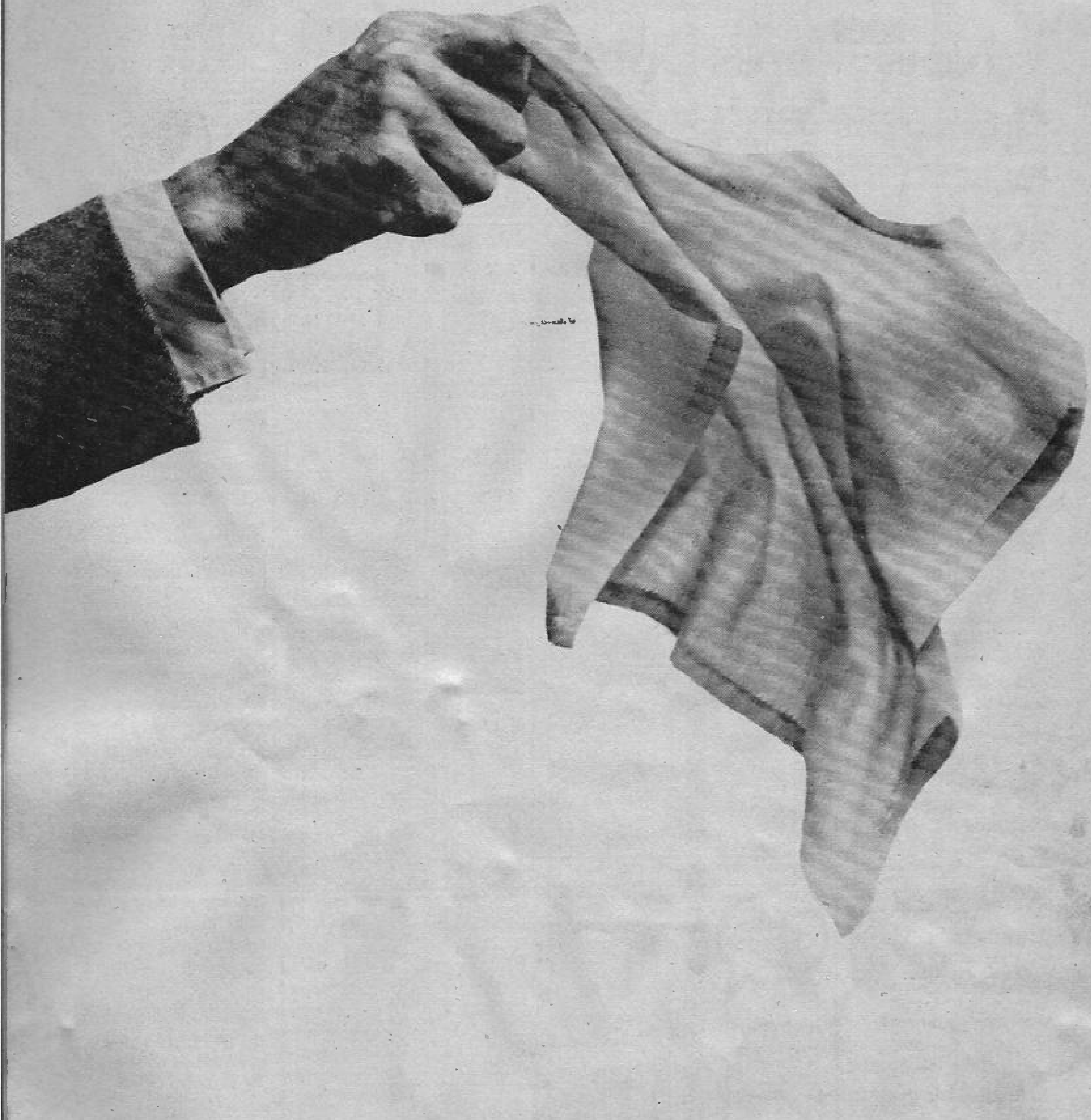
ADDRESS

Signature

Registered in England No. 347947 at 12 Lower Grosvenor Place London SW1 0EX

EE11

Goodbye to the long wait



for electronic components.

Now there's Doram–a completely professional electronics service for the amateur.

7-day service.

If you've been buying electronic components long you'll know all about the long wait.

Somehow the things you really need never turn up on time.

Well, OK, now things have changed. Now there's Doram.

Doram is a brand-new deal for serious amateurs. It's a complete door-to-door components service operated by mail order.

Millions of components.

You just buy the Doram catalogue for 25p (that's a yearly reference book for the price of a pint of lager) and then you order from it.

We can offer you stocks of millions of components. With a choice of over 4,000 different lines.

And we're so confident of our service that if we can't supply the part you want within 7 days of receiving your order, we'll give you your money back. Immediately.

So you know just where you stand. You'll never waste time hanging around while we re-order.

No-quibble guarantee.

It's just about impossible to buy a defective part from us. Because our checking is so pains-taking.

But even if the unthinkable does happen–and you're unlucky–then we'll still make you happy quickly.

Because we offer a no-quibble replacement part service.

And our guarantee is guaranteed by the fact that we belong to the biggest electronics distribution Group in Britain.

All the goods supplied are branded goods. Produced by big-name manufacturers like RS, Mullard, SGS-ATES, Ferranti, Siemens etc.

£5 Vouchers.

As an added incentive we're giving free purchase vouchers away. To the first 50 catalogue buyers whose applications are pulled out of the sack at 12 noon on the 31st October 1974.

At that time, at the Amateur Radio Traders Exhibition at Granby Hall, Leicester, comedian Brian Rix will open our correspondence sack and make the winning selections.

The first voucher out will be a £10 voucher. The next 49 will be £5 vouchers.

All catalogues will be despatched upon receipt of coupon and remittance; coupons will then go into the correspondence sack for the draw.

So don't delay. Use the coupon. Send today for your first Doram catalogue. It can make your life a whole lot easier. And you could win a voucher if your order is one of the first 50 out on October 31st.

FREE £5 VOUCHER FOR FIRST 50 CATALOGUE BUYERS DRAWN OUT OF THE POST BAG ON OCTOBER 31st.

I ENCLOSE 25p*. PLEASE SEND ME THE NEW DORAM CATALOGUE.

*This will be refunded on orders of £5 (less VAT) or more received by us before 31st March, 1975.

Name ____________________

____

____

Address ____________________

____

____

____

EE/11/74

Doram Electronics Ltd.,
PO Box TR8,
Wellington Road Industrial Estate,
Wellington Bridge, Leeds LS12 2UF.

Doram

Now-two fascinating ways to enjoy saving money!

NEW! Sinclair Scientific kit £19.95 (INC. VAT)

Britain's most original calculator now in kit form
The Sinclair Scientific is an altogether remarkable calculator.

It offers logs, trig, and true scientific notation over a 200-decade range – features normally found only on calculators costing around £100 or more.

Yet even ready-built, the Sinclair Scientific costs a mere £32.35 (including VAT).

And as a kit it costs under £20!

Forget slide rules and four-figure tables!
With the functions available on the Scientific keyboard, you can handle *directly*

sin and arcsin,

cos and arccos,

tan and arctan,

automatic squaring and doubling,

$\log_{10}$, anti$\log_{10}$, giving quick access to x^y (including square and other roots),

plus, of course, addition, subtraction, multiplication, division, and any calculations based on them.

In fact, virtually all complex scientific or mathematical calculations can be handled with ease.

So is the Scientific difficult to assemble?
No. Powerful though it is, the Sinclair Scientific is a model of tidy engineering.

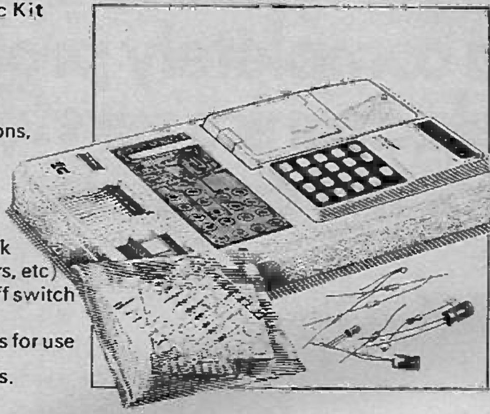
All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our Service Department will back you throughout if you've any queries or problems.

Of course, we'll happily supply the Scientific or the Cambridge already built, if you prefer – they're still exceptional value. Use the order form.

Components for Scientific Kit (illustrated)

1. Coil
2. LSI chip
3. Interface chips
4. Case mouldings, with buttons, windows and light-up display in position
5. Printed circuit board
6. Keyboard panel
7. Electronic components pack (diodes, resistors, capacitors, etc)
8. Battery assembly and on/off switch
9. Soft carrying wallet
10. Comprehensive instructions for use

Assembly time is about 3 hours.



Features of the Sinclair Scientific

● **12 functions on simple keyboard**
Basic logs and trig functions (and their inverses), all from a keyboard as simple as a normal arithmetic calculator's. 'Upper and lower case' operation means basic arithmetic keys each have two extra functions.

● **Scientific notation**
Display shows 5-digit mantissa, 2-digit exponent, both signable.

● **200-decade range**
10^{-99} to 10^{+99}.

● **Reverse Polish logic** Post-fixed operators allow chain calculations of unlimited length – eliminate need for an = button.

● **25-hour battery life**
4 AAA manganese alkaline batteries (e.g. MN2400) give 25 hours continuous use. Complete independence from external power.

● **Genuinely pocketable**
4 1/3" x 2" x 11/16". Weight 4 oz. Attractively styled in grey, blue and white.

everyday electronics

PROJECTS... THEORY...

THE CONSTRUCTIONAL BUSINESS

Our business is to make the path easy for anyone who wishes to take up the hobby of building electronic projects. The designs we offer to the private constructor are simple and should present little difficulty even to the novice, since it is largely a question of just following the fully detailed diagrams which accompany the text.

The building of electronic circuits is no complicated operation, involving elaborate tools and equipment. Quite the contrary, in fact.

Come to think of it, *construction* is perhaps not quite the ideal term to use in connection with electronics, for it usually conjures up visions of building operations conducted on the grand scale.

Bearing in mind the minute scale of components employed in electronics a rather more diminutive term might be appropriate to describe the more elegant operation of building, assembling, or putting together of an electronic circuit. But no suitable alternative comes to mind, so we are stuck with construction as the general and convenient term for describing this kind of operation.

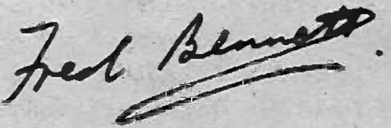
All this is of no real consequence, *except* in as much as the word may help create a wrong impression, and distract from the delicate nature of the work involved in assembling an electronic circuit. Most seriously, it might cause newcomers to overlook one particular and special skill which does have to be applied in order to make a successful job in electronics, no matter how simple construction may seem, when viewed superficially.

THE ART OF SOLDERING

We are referring to soldering. Every electronic circuit depends upon soldered connections. The success or failure of a whole project rests in the quality of each joint made by the constructor. Thus in the final analysis it is the skill of the individual that determines the result obtained.

Soldering is a technique, perhaps better described as an art, which is fundamental to all practical work in electronics. Apart from the need for good soldering from a functional point of view, the overall appearance of the finished project is governed in large measure by the standard of this work. This is where the individual can shine and provide permanent proof of his ability as a craftsman with the soldering iron.

With present day small-size components, soldering is an exacting operation, and requires careful practice to acquire the necessary skill. We are devoting two and a half pages this month to this all important subject. Our advice to all newcomers is to master the art of soldering before tackling a complete project. Learn how to recognise a good joint and a dry joint and thus avoid disappointments and frustrations in those first attempts in the constructional business.



Because of prevailing production problems, no firm publishing date can be announced for the December issue. Readers are advised to check regularly with their local supplier from mid-November onwards.

Everyday Electronics Fleetway House, Farringdon Street, London, E.C.4. Phone: *Editorial* 01-634-4452; *Advertisements* 01-634-4202.

EASY TO CONSTRUCT
SIMPLY EXPLAINED

VOL. 3 NO. 11 NOVEMBER 1974

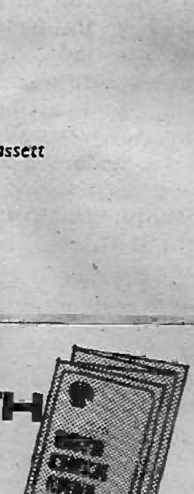
CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Publisher's Annual Subscription Rate, including postage Inland £2.95, Overseas £3·00. International Giro facilities Account No. 5122007. State reason for payment "message to payee". Address to Everyday Electronics, Subscription Department, Carlton House, Great Queen Street, London, WC2E 9PR. Binders for volumes 1 to 3 (state which) and indexes for volume 1 and 2 available for £1.25 and 30p respectively, including postage, from Binding Department, at the above address.

We are unable to supply back copies of Everyday Electronics or reprints of articles and cannot undertake to answer readers' letters requesting designs, modifications or information on commercial equipment or subjects not published by us. An s.a.e. should be enclosed for a personal reply. Letters concerning published articles should be addressed to: The Editor, those concerning advertisements to: The Advertisement Manager, both at the address shown opposite.

FREE NEXT MONTH DATA CHECK CARD



TAPE NOISE LIMITER

By R.A. PENFOLD

Improve the performance of your cassette tape recorder with this inexpensive, ready to build device.

INEXPENSIVE portable cassette tape recorders are extremely popular, but suffer two main disadvantages when compared with reel to reel machines. They usually have only a rather limited output power, driving a small internal loudspeaker, and the noise level is rather high.

The first of these is easily overcome by connecting the unit to an amplifier having a higher output power, and driving a large loudspeaker during playback. The second cannot be entirely overcome, but a worthwhile improvement can be made by connecting the unit described in this article, between the output of the recorder, and the amplifier input.

PRINCIPLE OF OPERATION

Most of the noise encountered during playback consists of "tape hiss", or "tape noise" which it is also termed. This is at a comparatively high level due to the slow tape speed which must be used, in order to give a reasonable playing time from the limited length of tape which can be put into a cassette.

The noise consists mainly of very high frequencies, and the normal way to reduce it is to turn back the tone control, so as to reduce the treble response. This can reduce the hiss to a very low level, but of course, the high frequencies on the recording are largely lost.

One should bear in mind that the noise level of most of these recorders is about −40dB (one hundredth of the level of a fully modulated signal), which is not noticeable on loud passages, but is nearly as loud as the signal itself on quiet passages.

Therefore, if a device were connected between the recorder and the amplifier, which reduced the treble response of the set on low level signals, but gave no treble cut on strong signals, a much improved signal would be obtained.

On low level signals the treble cut would reduce the annoying tape hiss, and on high level signals where this would not be noticed, the full response of the equipment would be available. This is the principle on which this circuit operates.

CIRCUIT DESCRIPTION

A circuit diagram of the unit is shown in Fig. 1. Resistors R1 and R2 form a potential divider across the supply, and produce a low voltage supply for the field effect transistor, TR1. With only a small supply potential such as this, the d-s connections of the f.e.t. act as a simple resistor. With the gate terminal tied to earth via R4, its resistance is very low, at about 100 ohms, or even less.

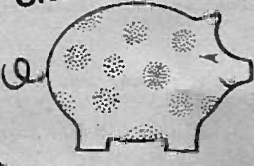
Resistor R3, together with the d-s resistance of TR1, R5, and C3, forms an attenuator. The basic circuit of an attenuator is shown in Fig. 2 (a).

If one ignores the impedances of the circuits connected at the input and output, the mathematics of the attenuator is very simple. For instance, if both resistors (R_a, R_b) had a value of 1 kilohm, the attenuation factor would be $(1+1)/1=2$ (i.e. every two volts at the input produces one across the output). Another way of looking at it is to invert the formula, and this gives the output as a fraction of the input ($\frac{1}{2}$ in this case).

Shown in Fig. 2(b) is the effective circuit of the attenuator in the Tape Noise Limiter. This is slightly more complicated, but operates in the

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS including V.A.T.



£1.85 excluding case

*Based on prices prevailing at time of going to press

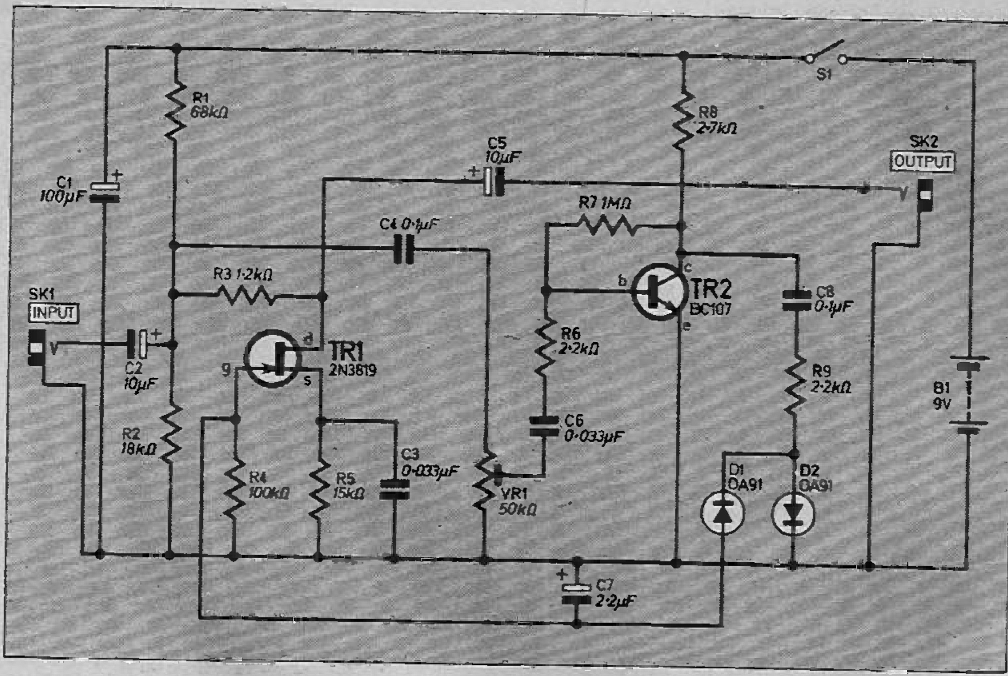


Fig. 1. The complete circuit diagram of the Tape Noise Limiter.

same manner. The main complication is C3, as its reactance (its resistance to a.c.) varies with frequency. As is shown in Fig. 2(b), it has a reactance of approximately 50 kilohms at 100Hz, but of only approximately 500 ohms at 10kHz.

This means that the attenuation factor of the circuit changes with frequency. If one calculates the attenuation factor of the circuit at 100Hz, and 1kHz, it will be found to be a little over one, which is barely noticeable.

If it is calculated for 10kHz, it will be found to be almost exactly three, which is of course considerable, and will increase still further at high frequencies. This gives the required treble cut.

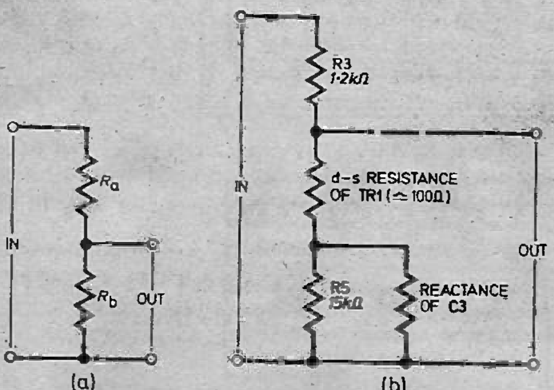


Fig. 2(a). Circuit of a simple attenuator where attenuation factor is defined by $(R_a + R_b)/R_b$ and (b) the circuit of the attenuator in the noise limiter.

Some of the input signal is fed via C4, VR1, C6, and R6, to the base of TR2. This is a high gain common emitter amplifier, and the amplified signal is fed from TR2 collector, via C8 and R9, to a voltage doubling rectifier circuit, D1, D2, and C7. The resultant negative d.c. bias is fed to the gate of TR1.

On low level signals, this bias voltage will have little or no effect, but on strong signals it will be large enough to cause the resistance of TR1 to be greatly increased, to as much as a few megohms. Components C3 and R5 are virtually switched out of circuit, and the treble cut is thus removed.

The tape hiss is less noticeable in the presence of high frequencies, than in the presence of low or middle frequencies; C4, C6, and C8 are given rather low values, so that the circuit responds more readily to high frequencies.

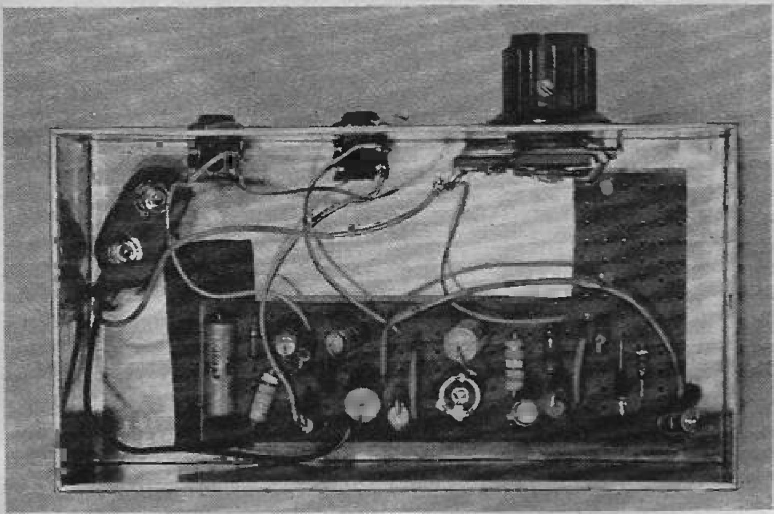
Capacitor C2 is the input coupling capacitor, and C5 the output coupling capacitor; C1 is the supply decoupling capacitor. Power is derived from a 9 volt battery (PP3) via on/off switch S1.

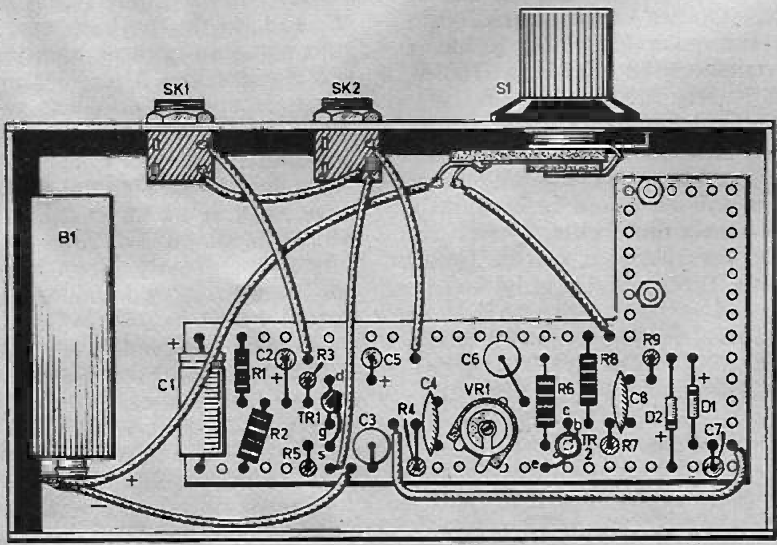
CASE

The unit is housed in a commercially available aluminium case type AB7 measuring 135×75×40mm, which has a removeable lid; the box is used upside down, and the lid becomes the base.

One of the 135×40mm sides is used as the front panel, and this should be drilled as indicated in Fig. 3 and components SK1, SK2, and S1 mounted in position as shown.

TAPE NOISE LIMITER





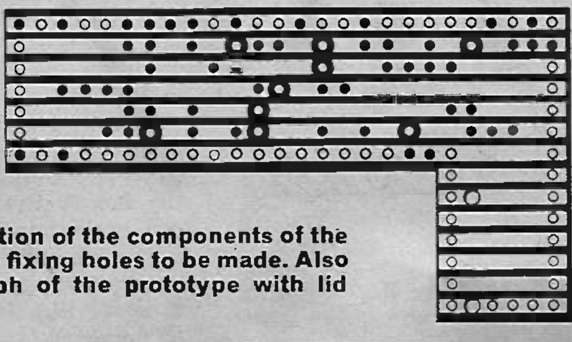


Fig. 3. The layout and connection of the components of the Veroboard and the breaks and fixing holes to be made. Also shown at top is a photograph of the prototype with lid removed

Components....

Resistors

R1	68kΩ	R6	2·2kΩ
R2	18kΩ	R7	1MΩ
R3	1·2kΩ	R8	2·7kΩ
R4	100kΩ	R9	2·2kΩ
R5	15kΩ		

All ¼ watt carbon ± 10%

Potentiometer

VR1 50kΩ sub-miniature preset, horizontal type

Capacitors

C1 100μF elect. 10V
C2 10μF elect. 10V
C3 0·033μF
C4 0·1μF
C5 10μF elect. 10V
C6 0·033μF
C7 2·2μF elect. 10V
C8 0·1μF

SEE SHOP TALK

Semiconductors

TR1 2N3819 *n* channel f.e.t.
TR2 BC107 silicon *npn*
D1, D2 OA91 (2 off)

Miscellaneous

B1 PP3 9V battery
SK1, 2 3·5mm Jack socket (2 off)
S1 s.p.s.t. rotary switch
Veroboard: 0·15in. matrix (see Fig. 3); battery clips for PP3; aluminium case 135 × 70 × 40mm with removeable lid, type AB7; control knob; connecting wire; 6BA fixings.

COMPONENT PANEL

The components are accommodated on a piece of 0·15in. matrix Veroboard and are positioned as detailed in Fig. 3. Begin construction by cutting the board to shape and making the breaks along the underside as shown. Drill the two 6BA clearance holes (No. 31 drill) for mounting purposes.

The board is to be mounted along the inside of the top of the case. Use the board as a template and mark the positions of the mounting holes on the case, and then drill these, again using a No. 31 drill.

Now position and solder the components to the Veroboard as detailed in Fig. 3. Leave the transistors and link wire until last. The link should be made with insulated wire.

Solder the negative battery lead to the board and then solder all the flying leads to the board; the leads should be about 70mm long insulated wire. The board should now be mounted in the case by means of two 12mm long 6BA nuts and bolts. Metal spacers about 6mm long should be interposed between board and case to eliminate possibility of short circuiting between the two. If necessary some insulation tape can be placed along inside top of the case as well.

Finally, wire up the flying leads to the case mounted components as shown in Fig. 3.

There is a space for the battery on the extreme left hand side of the case. Some foam rubber can be glued to the base plate opposite the battery, so that it is firmly held in place when the base plate is screwed into position.

ADJUSTMENT AND USE

Most cassette recorders have a 3·5mm jack socket at the output; a screened lead having a 3·5mm jack plug at each end will be required to connect the recorder to the limiter. A second screened lead will be required to make the connection between the limiter and the amplifier. This will have a 3·5mm jack plug to connect to the limiter, and a plug at the other end to suit the amplifier input socket.

The "tape" or "radio" input of most amplifiers or record players has a fairly high input impedance (50 to 100 kilohms), and should be used. The unit can be used with amplifiers having fairly low input impedances (5 to 10 kilohms), although it may be very slightly less effective.

It can also be used with transistor m.w. tuners, and can make quite a large reduction in adjacent channel interference after dark.

Potentiometer VR1 adjusts the level at which the treble cut is removed. The best way to find the correct setting for this is to experiment a little using various settings. If this is set too high, tape hiss will be heard on low level signals. It should be set as high as possible (as far in an anticlockwise direction as possible), without this becoming evident.

If a tone control is fitted to the recorder, this should of course be set near, or at maximum treble. ▣

We would like to thank LASKYS for the loan of the cassette recorder shown on the front cover.

Photograph of the completed prototype Tape Noise Limiter.

ULTRASONICS

By J. B. DANCE

ULTRASONIC waves can be generated by electronic equipment and have a wide variety of industrial applications, such as in signal and warnings systems and in the detection of flaws in metal. They can be employed to clean objects or to kill bacteria. In addition, they can be used in medical diagnosis to produce pictorial scans of parts of the body.

The Dawe Instruments ultrasonic leak detector shown in use.

ULTRASONIC WAVES

Ordinary sound waves consist of pressure waves in some other medium. The human ear is sensitive to sound waves which have a frequency between some lower limit of about 20Hz and an upper limit of about 15 to 20kHz. Vibrations which have a frequency below the lower limit are "felt" rather than heard and are known as "infra-sound".

Ultrasonic frequencies are above the limit of human hearing. Young people can hear somewhat higher frequencies than older persons, but in general any vibrations above 20kHz are referred to as ultrasonic. The term supersonic is sometimes used instead of ultrasonic, but nowadays it is normal practice to reserve the term supersonic for velocities exceeding that of sound in air.

VIBRATIONS

Ultrasonic waves and sound waves can be generated by a vibrating object. For example, the vibrating cone of a loudspeaker generates sound pressure waves in air (see Fig. 1) which can travel to a receiver. The waves cause the latter to vibrate.

The receiver may be a human ear, in which case the eardrum will vibrate and the vibrations will be passed to small bones in the middle ear and hence to the brain. If the receiver is a microphone, the waves cause its diaphram to vibrate and hence to generate an electrical signal corresponding to the pressure of the air waves.

A fairly large vibrating object is required to generate low frequency sound waves of a fairly high intensity, but smaller vibrating objects can be used to generate higher frequencies. Thus a high frequency tweeter speaker is smaller th..n

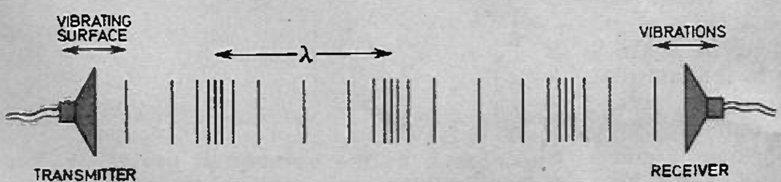


Fig. 1. An ultrasonic wave passing from a transmitter to a receiver. The regions of high pressure are shown by closely spaced vertical lines. The pattern moves from left to right with the wave.

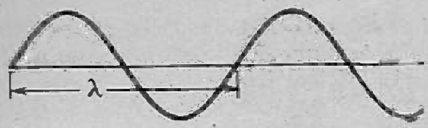


Fig. 2. The wavelength λ is the length of one cycle.

a bass woofer speaker. Ultrasonic transducers are much smaller still—typically 2cm in diameter.

Devices which convert electrical signals into an ultrasonic wave or a wave into an electrical signal are known as ultrasonic transducers.

PRODUCTION

There are two main ways in which electrical signals may be converted into ultrasonic vibrations. One employs the piezo-electric effect, whilst the other uses magneto-striction.

The piezo-electric effect (discovered in 1880) occurs when an electric voltage is applied across the faces of a crystal such as a quartz. Small changes in the dimensions of the crystal occur. If the applied voltage has a frequency equal to the resonant frequency of the crystal, the movement of the latter can generate ultrasonic waves. Ceramic materials which show the piezo-electric effect are often used for generating fairly low frequency ultrasonic waves in air (perhaps 40kHz), but very high frequency ultrasonic waves are normally generated in a solid or a liquid.

The magneto-strictive effect was first observed by Joule in 1847. It occurs when a ferro-magnetic material such as iron or nickel is placed in a coil carrying an alternating current at the frequency concerned. The magnetic field generates small changes in the length of the magnetic material which in turn give rise to the ultrasonic vibrations.

Piezo-electric materials are liable to fracture at high amplitudes, but magneto-strictive devices do not suffer from this effect.

Ultrasonic waves are also generated at low amplitudes by friction between many types of surface. For example, brushing one's hair or rubbing one's hands together will generate high frequency vibrations.

VELOCITY

The velocity of sound and ultrasonic waves is determined by the elastic properties of the medium through which they are travelling. Ultrasonic waves travel at the same velocity as sound waves in a given medium.

The wavelength of a vibration, λ, is the distance between two peaks (or two troughs) of the pressure wave shown in Figs. 1 and 2. If the frequency of the vibrations is fHz, the wave travels f wavelengths per second. The velocity v is therefore equal to $f\lambda$.

One can write this equation as wavelength = velocity/frequency. The velocity of sound and ultrasonic waves in air is about 330 metres per second at normal temperatures. Thus a 330Hz sound wave has a wavelength of 1m. Typical wavelengths at various frequencies are shown in Table 1.

In water and many other materials the velocity is greater than in air and therefore the wavelength at a specific frequency is correspondingly greater.

DIFFERENCES FROM SOUND WAVES

Waves can bend around objects which have dimensions comparable with the wavelength concerned; this is, they can be diffracted. We can hear a musical instrument in a neighbouring room when the door connecting the rooms is open, since the waves bend at the edge of the door-way.

Ultrasonic waves (like light waves) have a much smaller wavelength than the door-way. Thus if the instrument is replaced by an ultrasonic transmitter, the observer will not detect any waves other than those which have undergone reflection at the wall.

In other words, ultrasonic waves (like light waves) tend to travel in straight lines.

Ultrasonic waves are attenuated by a much greater factor than sound waves as they pass through a given distance in air. The waves from a small ultrasonic transducer operating at 40kHz can be detected up to about 10 to 20m away in air. However, the attenuation increases greatly with frequency and 1MHz ultrasonic wave cannot travel, through an appreciable distance in air.

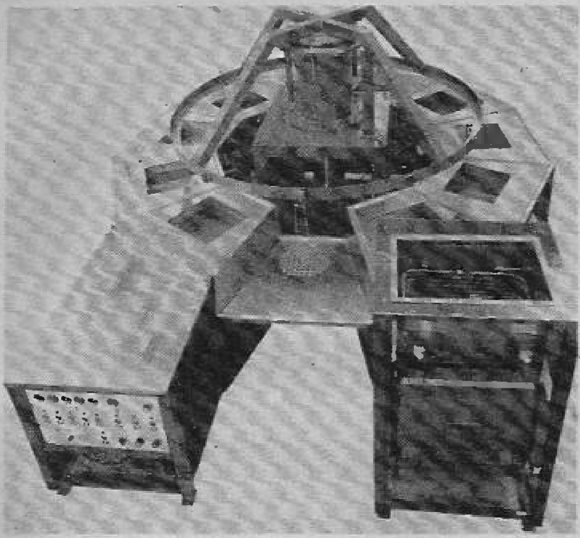
LONGITUDINAL WAVES

Unlike light waves, sound and ultrasonic waves cannot travel through a vacuum. They are pressure waves in a solid, liquid or gaseous medium. The particles of the medium move backwards and forwards along the direction of travel of the wave; these waves are therefore known as longitudinal waves.

In the waves on the surface of water, the particles move in a direction which is perpen-

Table 1. Wavelengths in air.

Frequency	Wavelength	
10Hz	33m	Infra-sound
33Hz	10m	sound
100Hz	3·3m	sound
330Hz	1m	sound
1kHz	33cm	sound
3·3kHz	10cm	sound
10kHz	3·3cm	sound
33kHz	1cm	ultrasonic waves
100kHz	3·3mm	ultrasonic waves
330kHz	1mm	ultrasonic waves
1MHz	0·33mm	ultrasonic waves



A multi-tank cleaning system manufactured by Dawe Instruments Ltd. for cleaning hypodermic needles at the final production stage. The needles are automatically transferred from each tank to the next.

dicular to the direction of travel of the wave. Such waves are known as transverse waves. Light and radio waves are other examples of transverse waves.

Transverse waves show polarization and therefore we get optimum results if we use an aerial for television or f.m. radio signals when the direction of polarization of the wave (horizontal or vertical) matches that of the aerial. Ultrasonic waves, being longitudinal, show no polarization and therefore one can rotate the receiving transducer (whilst keeping its face pointing at the source) without producing any appreciable change in the received signal strength.

ULTRASONICS IN NATURE

Although human beings cannot hear frequencies above 20kHz, many animals can detect them. For example, dogs can be called by the use of a "silent" whistle which emits ultrasonic waves. Even dogs cannot hear very high frequency ultrasonic waves.

The bat uses the ultrasonic waves it emits to enable it to avoid objects in its flight path. The ultrasonic frequencies are emitted by the bat in short pulses of about 1/200 second in duration. The bat has a system for detecting the time interval between the emission of a pulse and the time at which the wave reflected from an object returns to the animal. This interval is proportional to the distance of the object.

The bat uses frequencies in the range 30kHz to 100kHz. A resting bat may emit 5 to 10 pulses per second, but when flying in the open the frequency is increased to 20 to 30 pulses per second. When the bat is flying near other objects, the pulse rate may rise to over 50 per second.

The phase difference between the reflected waves arriving at the two ears of the animal provides some information on the direction of the reflecting object.

MEDICAL APPLICATIONS

Complex equipment known as the Diasonograph or Diagnostic Ultrasonic Scanner can be employed to find the position of structures, inside the body and to form an image of them on an oscilloscope screen. Many regions of soft tissue can be examined in this way when radiological techniques would provide insufficient constrast.

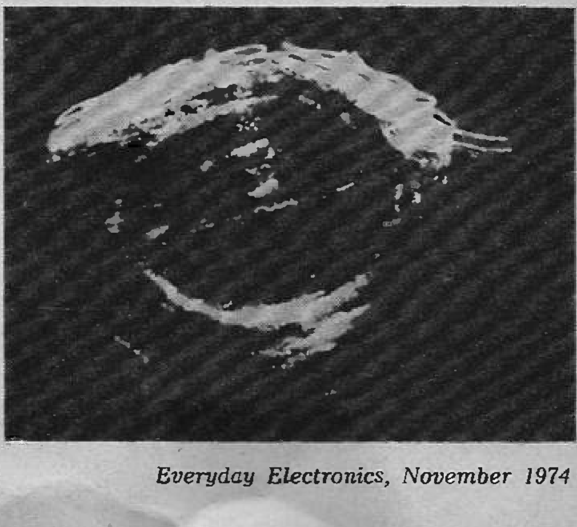
The equipment generates very low power ultrasonic waves at frequencies of the order of 500kHz to 10MHz. These high frequencies are employed because the wavelengths are less than 1mm and high resolution can therefore be obtained. The emitting transducer is placed in contact with the external skin of the patient, good contact being maintained by a film of liquid (such as olive oil). The direction at which the ultrasonic beam enters the patient can be accurately controlled.

The Diasonograph emits ultrasonic pulses with a typical frequency of 600 pulses per second. Echoes are detected from any discontinuities in the tissue material through which the beam passes. For example, bone reflects waves from its surface. The time which elapses between the transmission of an ultrasonic pulse and the reception of the echo provides a measure on the distance of the discontinuity from the transducer.

The probe moves over the skin of the patient emitting its rapid pulses and the echoes build up an image of the tissue structure inside the patient.

The Diasonograph can be used to examine organs such as the eye or the kidneys, to detect

Ultrasonic picture of a baby's head showing part of the brain (centre) *(Queen Mother Hospital, Glasgow)*



The Wells-Krautkramer ultrasonic flaw detector which can examine steel from depths of 10mm to 5m. A recorder is shown at the top.

liver, heart or brain damage, etc. It is especially useful for producing an image of an unborn baby inside its mother. An image of the gestation sac can be made only a few weeks after conception and the heart movement can be detected from the seventh week. Later the size and position of the baby's head can be measured to an accuracy of 1mm. The size of the head provides an accurate measure of foetal maturity.

Ultrasonic examination before birth is especially useful when a multiple birth is expected. It was, for example, used to examine the Rosenkowitz sextuplets which were born in Cape Town in January 1974. The echoes are displayed as bright dots on a cathode ray tube screen.

The Diasonograph can be used for the display of moving structures, such as the mitral valve of the heart. Successive movements are displayed in slightly different positions on the screen. The pattern of movement can be used as an indicator of the severity of rheumatic heart disease, but this is only one example of the applications of the time display technique.

The Diasonograph presents no ionising radiation hazard to the patient, but it is important to keep the power level to a minimum to prevent the waves breaking up cells in the body. Normally a beam having a power level in the microwatt range is quite adequate. Ultrasonic techniques are certainly much safer than radiological techniques which can cause chromosome damage—especially when rapidly dividing cells (such as in a baby) are present. Ultrasonic examination is relatively quick, the only patient preparation required being a light coating of olive oil over the area to ensure good contact with the probe.

BLOOD FLOW

Another ultrasonic technique has been developed to measure the rate of blood flow in arteries or veins. For example, a probe may be placed on the patient's wrist above the radial artery with a little oil or grease for good coupling. The frequency is typically 5MHz.

Each pulse from the heart drives blood along the artery into the hand. The blood is moving towards the probe and the reflected ultrasonic signals will have a higher frequency owing to the normal Doppler shift effect from a moving object. The reflected signal is made to beat with the transmitted frequency to produce an audible signal which can be fed to earphones or a loudspeaker.

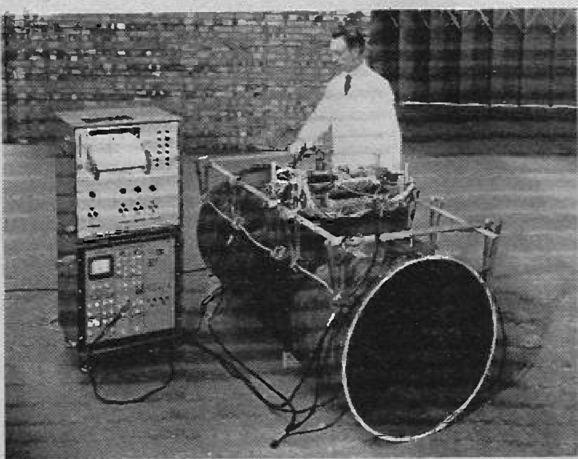
The sound of the beat notes can inform the experienced practitioner of the condition of the arteries of the patient. The technique can be used in the diagnosis of arterio-sclerosis, blocked arteries, etc.

BIOLOGICAL EFFECTS OF ULTRASONICS

Ultrasonic waves produce two effects on biological organisms. The first is purely a heating effect due to the energy contained in the wave, whilst the second effect is due to the breakdown of cell walls in the organism.

If some blood is subjected to a high power ultrasonic beam at a frequency of the order of 1MHz, the cells will be broken open and the red corpuscles destroyed. It will no longer be possible to remove the red cells by using a centrifuge.

The Wells-Krautkramer ultrasonic weld scanner which automatically passes the scanning head along the weld.



Liquids can be sterilised by a high frequency ultrasonic beam, since the cell walls of the bacteria are broken open. The power level may be 1kW per square inch.

INDUSTRIAL APPLICATIONS

One of the most common applications of ultrasonics in industry is for the detection of flaws and cracks in metal ingots or castings. A probe containing an ultrasonic transmitter and receiver is placed on top of the metal, as shown in Fig. 3(a), good contract being obtained by means of a thin film of oil.

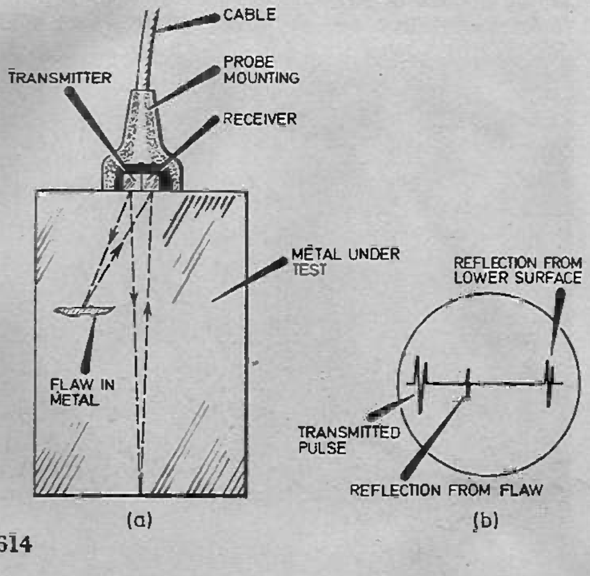
Ultrasonic waves are reflected from the flaw back to the receiver. They are also reflected from the bottom surface of the metal. The time between the transmitted pulse and the arrival of the echo at the receiver is a measure of the depth of the flaw from the top surface.

An oscilloscope may be employed to provide the type of display shown in Fig. 3(b). Any signals reflected from the flaws in the metal appear as blips on the trace between the pulse at the instant of transmission and the echo from the lower surface. In some instruments a trace similar to that of Fig. 3(b) can be obtained on a pen recorder; alternatively the oscilloscope trace can be photographed.

The principle of operation may be compared with that of a miniature radar system. If the flaw in the metal must be located very accurately, short wavelength, high frequency radiation should be used (perhaps 20MHz). The pulse repetition frequency is often variable over a wide range.

Ultrasonic instruments operating on similar principles are employed for checking concrete structures for cracks and for testing the quality of bricks, etc. They will also detect cracks and rotting in the wooden beams of old property.

Fig. 3. Principle of operation of an ultrasonic flaw detector (a) the transmitter and path of the wave (b) an oscilloscope display of the result.



Some insurance companies use similar techniques for estimating frost, fire and bomb damage in buildings.

Specially designed fault locators are used in the testing of welded seams in plates and tubes. The equipment scans the weld automatically. In a typical case the test rate is about 6 inches per minute for thicknesses of 0·5 to 3 inches. Special types of equipment can examine steel tubes up to 50 feet in length and weighing up to 45 tons.

Flaws in very small objects may be detected by placing the object in de-aerated water and putting the probe in the water above the sample.

THICKNESS GAUGES

The same principle can be employed in ultrasonic thickness gauges; the time taken for the reflected signal from the far side of the specimen to reach the receiver is a measure of the thickness. This technique may be used to measure the thickness of most metals and plastic materials. Suitable probes can be designed for use when the sample is at high temperature.

One type of industrial thickness gauge, the Baugh and Weedon P.A.1040, can measure thicknesses from 1/100 inch to 10 inches. The result is displayed in digital form with 1 per cent accuracy, the range selection being automatic. Other instruments use a conventional analogue meter display.

Thickness gauges of this type are very useful when it is possible to have access to only one side of the surface. The method is ideal for the measurement of the thickness of the hull of a ship or of a metal pipe. The surfaces of such items may be affected by corrosion.

PLASTIC ASSEMBLY

Ultrasonic energy has been used since the early 1960's for the welding or sealing of plastics to plastics, the "staking" of metal or other materials to plastics and for the insertion of metal parts into plastics.

In each case the parts to be assembled are held together under pressure whilst ultrasonic vibrations force the parts to rub against each other. Highly localised frictional heating occurs at the interface of the materials so that the plastic melts within a very short time and flows into the area of the joint under the applied pressure. When the ultrasonic generator is switched off, the material solidifies to give a high bond strength.

Ultrasonic assembly is widely used throughout the plastics industry, millions of items being manufactured each year by this technique. A single ultrasonic transducer is often employed to deliver over 1kW of power into a thermoplastic load. The frequency is typically 20kHz. The energy is applied to the work by a tool known as a "welding horn". This acts as a transformer which matches the source to the load so that maximum power reaches the latter. The joint may be up to 10 inches from the end of the horn.

If one wishes to fix a piece of metal into plastic, one can drill a hole in the latter which is slightly larger than the diameter of the metal. The metal is inserted under pressure with the application of ultrasonic energy so that the plastic melts around it. The hole guides the metal into position. The volume of the plastic which melts is quite small and there is no danger of the plastic fracturing. The whole assembly is free from stress. The ultrasonic energy can be applied either to the metal or to the plastic.

A typical example of this technique is the insertion of screwdriver blades into plastic handles.

Plastic toys can be made far more easily by welding the parts together with ultrasonic energy than by the use of solvents. Plastic car reflectors are also made by ultrasonic techniques.

Layers of plastic material can be welded together by the use of an ultrasonic "sewing machine".

ULTRASONIC CLEANING

Baths containing an ultrasonic transducer fixed to their base can provide intense mechanical agitation throughout their volume. A phenomenon known as "cavitation" occurs in which huge numbers of cavities of vapour are formed during the low pressure part of the wave. These cavities collapse violently as the pressure increases during the next half cycle.

The collapse of these bubbles produces an intense scrubbing action on surfaces immersed in the liquid. The bath may be quite small (perhaps ½ pint capacity) or it may contain many gallons. The frequency is typically 25 to 50kHz.

ULTRASONIC DETECTORS

Equipment which can detect ultrasonic waves is extremely useful for the rapid detection of leaks in vacuum and pressure pipes. Any such leaks result in the emission of waves at frequencies of the order of 40kHz. Leaks in pressurised telephone cables can be found far more readily using an ultrasonic detector than by the former method of applying soap solution. The presence of a leak is normally indicated by a sound in a pair of headphones (see heading photograph).

Worn bearings can be detected, since they emit ultrasonic energy in proportion to the amount of wear. They can be replaced before major damage occurs. Troubles in large engines, generators and turbines often show themselves by the emission of ultrasonic waves long before excessive vibration and noise occurs.

Electrical sparking on power line insulators can cause severe interference with radio and television reception. The approximate location of the interference is most easily found with a directional radio receiver, but the exact point at which the sparking is occurring is detected by means of the ultrasonic waves emitted with each spark. High voltage transformers are routinely tested by ultrasonic detectors.

Ultrasonic detectors can also be used to pinpoint defects in hydraulic systems, such as faulty valves. They are used to locate leaks in the pneumatic braking systems of large vehicles.

MISCELLANEOUS APPLICATIONS

A metal rod vibrating vertically at an ultrasonic frequency can be used to "drill" through a glass plate. The rod does not rotate and therefore the hole made in the glass need not be circular.

Ultrasonic soldering irons are available. The bit is heated electrically in the normal way, but it also vibrates at an ultrasonic frequency. This vibration removes oxide films from the metal surfaces and thus permits the soldering of metals such as aluminium.

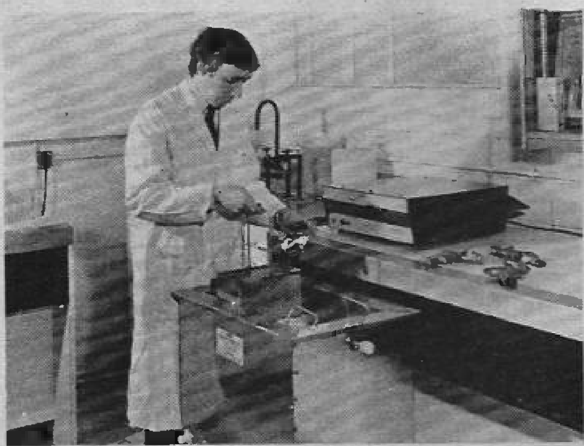
Ultrasonic power can be used to "homogenise" immiscible liquids such as mercury and water. This property is used in the alloying of certain metals and in the preparation of photographic emulsions.

Smoke and dust particles can be coagulated by an ultrasonic beam so that the particle size is adequate for them to be easily removed by filtration.

Small transducers can be obtained which enable an ultrasonic signalling system to be constructed for distances of up to about 20 metres. These devices can also be used in intruder alarms, for detecting leaks in car door sealing, etc.

Articles describing the construction and use of a simple ultrasonic remote control system will be featured in this magazine in the December '74 and January '75 issues. ▣

A Dawe Instruments ultrasonic cleaning bath in use.



"and I followed all the instructions!"

. . . perhaps you should study . . .

SOLDERING for BEGINNERS

By PHIL ALLCOCK

Good soldered joints are essential to the success of any electronic project and so the following article has been prepared to assist beginners who have never used a soldering iron before.

A soldered joint normally provides two functions—mechanical support and electrical connection. Solder by itself is rather weak since it contains a high proportion of lead, therefore a joint should always be arranged so that it is not dependent on the solder for the whole of its mechanical strength.

MATERIALS INVOLVED

Usually in electronic work we are concerned with joining together metals such as copper, tin, gold or silver coated wires and printed circuit track and for all of these tasks the most common solder used contains 60 per cent tin and 40 per cent lead. The melting point of this solder is about 190 degrees centigrade and so the temperature of the soldering iron used must be greater than this.

If an electric soldering iron is switched on and solder is repeatedly applied to the bit the solder will not melt until the tip reaches the necessary temperature, and at first the solder will have a dull surface appearance and a pasty consistency. As the temperature rises further, the solder "flows" more easily and smoke is given off from the resin flux which is contained in cores within the solder.

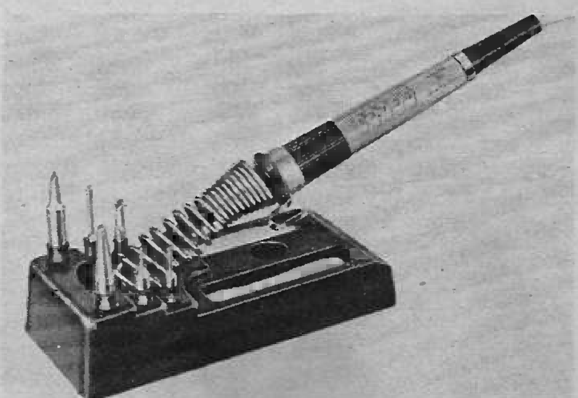
If the iron temperature is excessive the flux may tend to "spit" and the shiny surface of the molten solder will turn dull after a short time due to the formation of oxides. The resin cores in modern solder act as the flux and no additional flux is required. Under no circumstances should acid or other corrosive fluxes be used for electronic work.

SOLDERING IRONS

Experienced workers often have two or more irons to cover the various applications that arise but for the beginner a conventional electric iron of about 25 watts rating is about ideal. The bit diameter at the tip should be not more than 5mm and the bit should be of the replaceable type as it "wears away" during use, due to the copper slowly dissolving in the molten solder. A useful extra is a soldering iron stand which also affords protection from accidental contact and burns. A soldering iron can inflict a nasty and painful burn if you happen to rest your hand or arm on it!

Soldering guns and gas heated irons are in general unsuitable for beginners. Irons with

Photogragh of an Antex soldering iron with stand and various bits.



An Adcola soldering kit complete with solder spare bits and stand.

temperature controlled long-life iron bits are available but are more expensive and best suited to experienced workers.

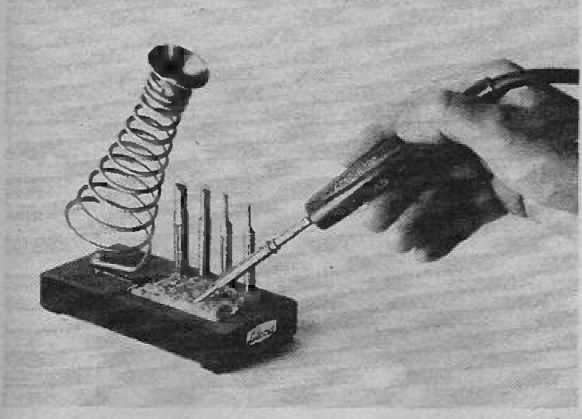
Always use *resin cored* solder which is available on reels of various sizes and comes in a range of thicknesses. The usual gauges preferred are 18 to 22s.w.g. and the finer gauge of 22s.w.g. is excellent for modern printed circuits. integrated circuits and Veroboard.

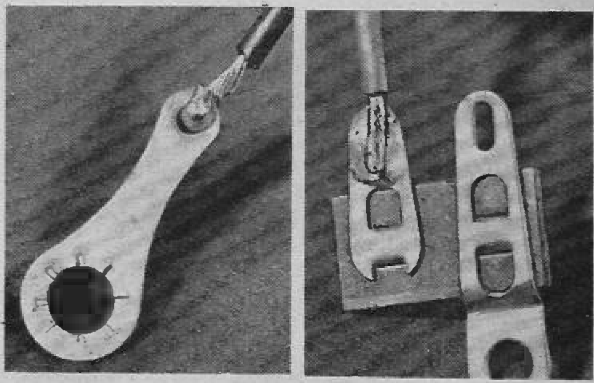
TINNING

For a good soldered joint the surfaces should be tinned (Fig. 1). This is done by heating the material, say a copper wire, with the soldering iron and touching the solder on to the wire surface. If the copper surface is dirty or greasy the solder will not make a good thermal contact and will not melt easily. Even when it does melt the solder will not *flow* on a dirty surface and will tend to form into a small globule, Fig. 2.

As copper oxidises very easily when heated, even by starting with a clean surface it is possible for new oxide to hinder the tinning process. To prevent this we use a flux contained in cores within the solder so that the solder and

The Litesold Conqueror iron with stand and spare bits and stand.





Two examples of bad joints. The photograph on the left shows a dry joint to a tag (see Fig. 2a). While that on the right a dry joint caused by moving the wire before the joint is solid.

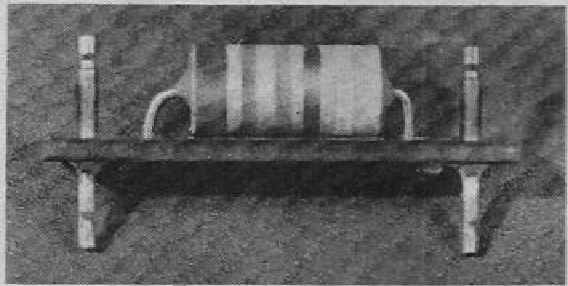
flux are applied simultaneously in the right proportions.

Some components and leads may be pre-tinned by the manufacturer but if these are dirty or greasy it usually pays to scrape the surface clean and tin again.

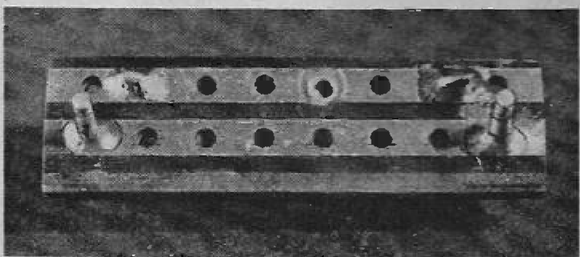
A problem that often results in poor soldering is surface contamination of printed circuits and Veroboard due to the effects of handling and moist fingers, etc. The cure here is to thoroughly scrub, wash and dry the board before use. A heated hair dryer is useful for drying the boards before use.

MAKING THE JOINT

When both surfaces have been tinned they



Two photographs showing how to afix a resistor and insert connecting pins. The soldered joints show how a good joint should look.



SOLDERING for BEGINNERS

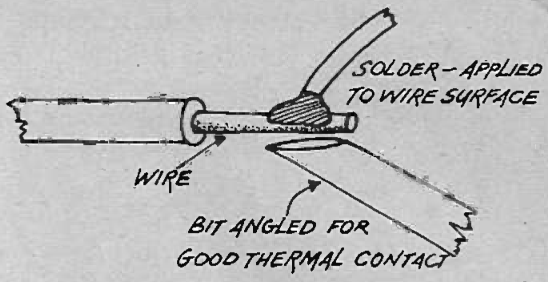


Fig. 1 Tinning a wire.

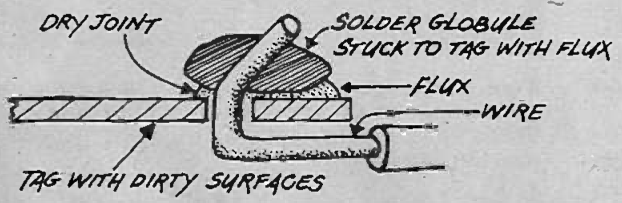


Fig. 2a A dry joint.

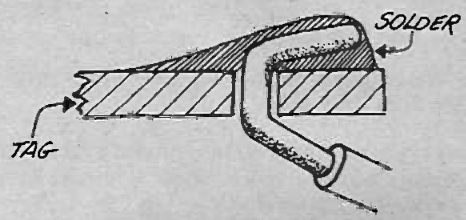


Fig. 2b. A good joint.

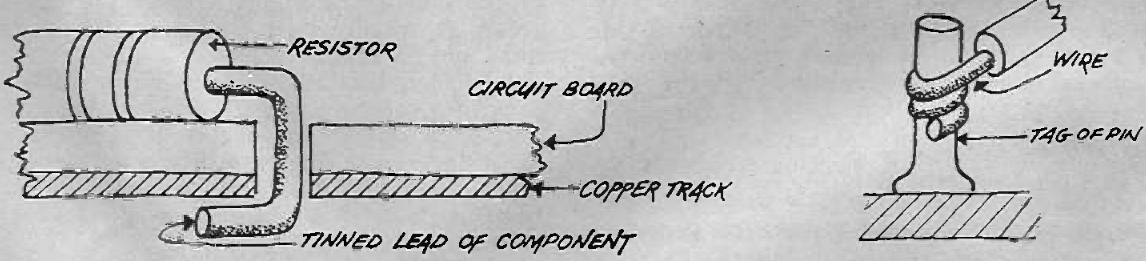


Fig. 3. Examples of good mechanical contact prior to soldering.

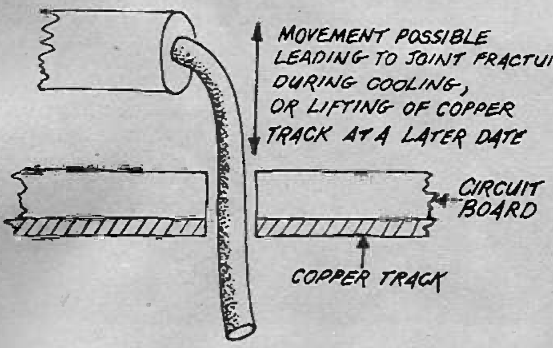


Fig. 4 Example of bad mechanical contact.

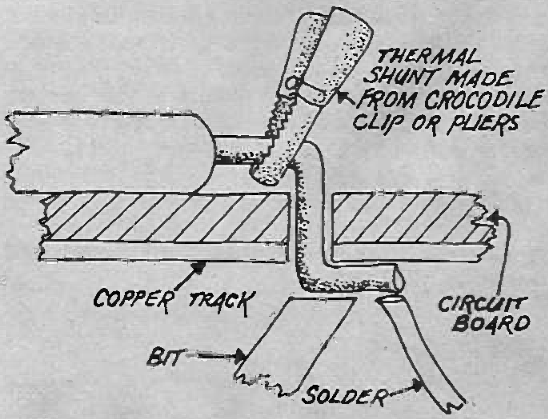


Fig. 5. Illustrating use of a heat shunt with sensitive components (e.g. diodes or transistors).

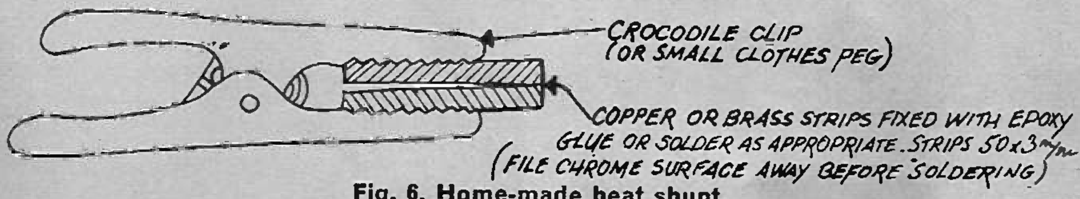


Fig. 6. Home-made heat shunt.

should be placed in contact in such a way that the *area of contact* is as large as possible (Fig. 3). Wires may be twisted together or bent round, or over, the item to which they will be attached. The soldering iron, carrying a *small* amount of fresh solder, is applied to the parts, to re-melt the solder on the tinned surfaces, and at the same time a small amount of cored solder is applied to the heated joint.

This extra solder should flow easily and once this has occurred the iron is removed and the joint allowed to cool naturally. The joint must not be disturbed as the solder cools down since this tends to fracture the solder as it solidifies and a "dry joint" results. This is usually apparent by the surface, which appears crystalline or dull rather than bright.

The making of good joints requires practice so do not be upset if your first attempts are not correct. Always keep your iron clean and remove excess solder by wiping the tip on a moist piece of felt at regular intervals. Never allow your bit to become contaminated with excess flux or flakes of oxide from the bit surface. As the bit "wears away" restore the shape of the tip by filing (with the iron cold) and then re-tin the tip as the iron warms up. Always replace worn tips and never allow the bit to seize up—this makes replacement difficult later on.

Remember that most electronic components can be permanently damaged by excessive heating. Use a pair of pliers or other heat shunt to protect sensitive components such as diodes and transistors (see Figs. 5 and 6). It is usually safe to take (say) 2-3 seconds for a normal joint with an iron at the correct temperature. If your joints take much longer than this examine your technique and check that your surfaces and iron are clean.

The sketches and photographs illustrate the main points and should be studied carefully before trying out your first few joints. Remember, practice makes perfect—never be satisfied with a poor joint. ■

REMEMBER

Clean both surfaces—avoid greasy hands on printed circuit boards.
Tin surfaces—use a minimum of solder.
Arrange a good mechanical contact area.
Clean iron bit—"wet" bit with solder.
Apply iron to the joint to heat both parts.
Apply solder to joint, not to iron. (A small amount of fresh solder, on the bit, helps to give good thermal contact with the joint).
Use a heat shunt as required.
Remove iron when solder flows freely—avoid excess heating.
Allow joint to cool without movement.
Examine joint for quality.
Remove surplus solder from bit.

READERS' LETTERS

Mathematical Error

In the *For Your Entertainment*, column Sept. '74, Adrian Hope gives the result of the calculation 11−2+4×2 on an electronic calculator as 26. However, this is the wrong result!

As any schoolboy will tell you, multiplication and division take precedence over addition and subtraction (i.e. are performed first), so the correct answer to the above sum is 17.

To obtain this result from the calculator, one would have to arrange the calculation to 4×2+11−2 which is contrary to Mr. Hope's idea of entering the calculations in the order written.

I have yet to be convinced that there is a better system than the "reverse polish" one used by several manufacturers, whereby the operation is entered after the figures; the calculation becomes 11+2−4+2×+.

Dr. I. K. Livingstone
Harringay, London

When I went to school the rule was that multiplication and/or division had to be worked out before addition or substraction and could be considered as "bracket" operations.

Thus Adrian Hope's free flow logic example 11−2+4×2 should according to the rules be interpreted as 11−2+(4×2)=9+8=17.

Not 10 or 26, the answers he obtains; to get the answer 26 the sum would have to be (11−2+4)×2.

Unfortunately it matters not if you use a calculator or pencil and paper if you don't know the rules, you wont get the right answer.

W. G. Jenner
Bulkington, Warks.

We thank you for your mathematical observations and reminding us of a basic mathematical rule that multiplication (and division) should be carried out before addition and subtraction in a sum.

As the sum was originally printed, the answer is of course a wrong one. Brackets enclosing the first three digits were omitted in error, which is obvious from the text. The correct way of writing the intended sum is (11−2+4)×2.

Announcement

I would be grateful if you would announce that a Radio Amateur's Course is being run at the South Gwent College of Further Education, Nash Road, Newport, on Wednesday evenings from 6.30 p.m. to 9.30 p.m.

Associated with this course is a Radio Constructors' Course on Tuesday evenings.

D. A. R. Dobbins
Vice Principal

TELPHONE REMOTE MONITOR

By Alistair MORGAN

Draws one's attention to a remotely situated "ringing" telephone.

When a telephone is installed in your home it can become something of an inconvenience in that the bell is not always audible.

This becomes especially apparent if (after one has had much trouble from the wife!) the hobbyist decides to remove his treasures from the kitchen table to the garden shed and alas, away from the phone.

The "Telephone Remote Monitor" described here will mean an end to all those moments of thinking "is that the TV or our phone," more so if you have a large house or where an occupier is hard of hearing.

It must be stressed that the Post Office will not allow tampering of any kind with their installations, the idea therefore had to be based on a system which does not contravene their wishes. It was decided to "pick up" the rings with a microphone and turn the received signal via an amplifier and slave relay into an electronic switch.

The switch can then be used to operate a lamp, bell or any device suitable to the user.

CIRCUIT DESCRIPTION

The circuit diagram of the unit is shown in Fig. 1.

Signals received at the input socket SK1 from the microphone MIC1 are fed into the amplifier via capacitor C1. The amplifier proper is a two-stage d.c. coupled circuit in the common emitter mode, whose output operates a relay, which in turn can switch on lamps, bells or any other transducer the user employs.

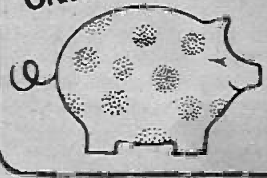
The load in the collector circuit of common emitter amplifier TR1 is a 2·5 kilohm potentiometer, and as it is directly coupled to the base circuit of TR2 it also governs TR2 base/collector current. As the resistance of this potentiometer is reduced the collector current in TR2 increases, thus providing us with a "sensitivity" control to facilitate final setting up.

The relay employed here has a coil resistance of 700 ohms, but this can vary from 500 to 1,000 without complication, as the operating current of TR2 is ample. Diode D1 is wired in parallel with this coil to stop any back e.m.f. affecting TR2.

Due to the basic "on/off" function of our amplifier an elaborate power supply is not required. Therefore, the 8 volt a.c. output from the transformer (T1) is earthed at one end, the other being fed to the anode of a BY127 rectifier. The half-wave output at the cathode of this diode is then simply applied to the 2,000μF smoothing capacitor C2. If required a 240 volt neon could be wired in parallel with T1 primary to provide an on/off indication.

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS including V.A.T.



£3.60 excluding case

*Based on prices prevailing at time of going to press

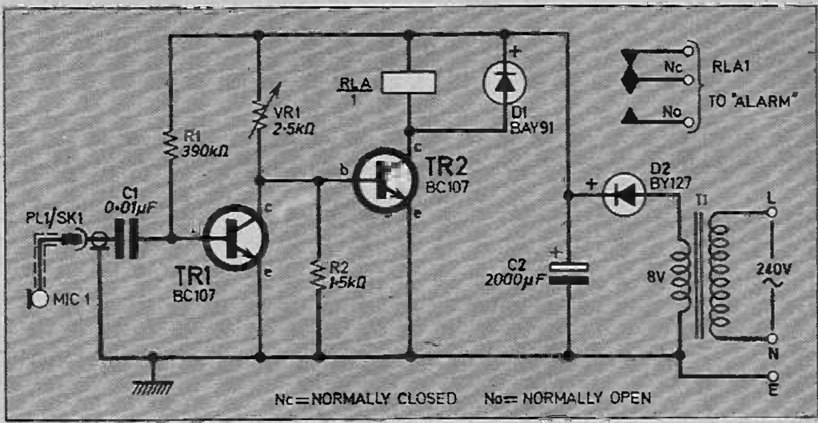


Fig. 1. The circuit diagram of the Telephone Remote Monitor.

THE MICROPHONE PLATFORM

The microphone was mounted on a platform of 25mm plywood cut to suit the base outline of the telephone and then stained and polished to match the telephone table. Details of the platform are given in Fig. 2.

CIRCUIT CONSTRUCTION DETAILS

The circuit board is made from a small piece of 0·1in matrix Veroboard 16 holes by 9 strips; the size and number of components permit such small dimensions. The copper track covering the last 3 rows was removed to allow insulated fixing to the case.

All components are mounted as shown, and 6 lengths of wire fixed to allow connection to other components separate from the board. Care must be taken to ensure no heat is allowed to reach the semiconductor devices, also care must be taken to wire in the diodes, transistors and C2 with correct polarity.

The mounting hole is drilled for 6BA clearance. The wiper of VR2 contact is cut short and a short length of sleeved wire used to reach the connection to the base of TR2. The four flying leads to various other components are initially cut at a reasonable length and later cut to appropriate lengths. Due to the shortness of input leads these can also be single connecting wire—screened lead was not found essential inside the case.

Ensure on final assembly that the board is sufficiently raised from the floor of the box to prevent shorting. When all components are fitted in the box and wiring is taking place ensure a good earth from the mains plug to the case.

Components....

SEE SHOP TALK

Resistors
R1 390kΩ
R2 1·5kΩ
¼W ±10% carbon

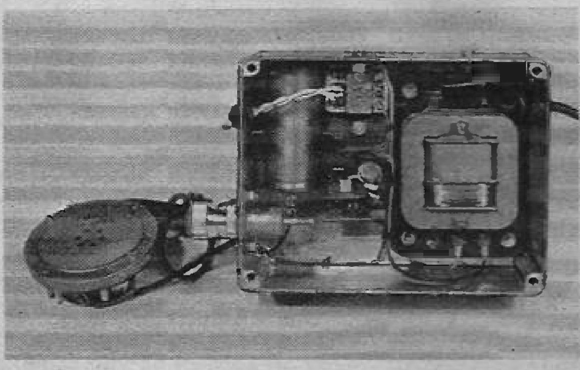
Capacitors
C1 0·01μF
C2 2,000μF elect. 12V

Semiconductors
TR1 BC107 silicon *npn*
TR2 BC107 silicon *npn*
D1 BAY91 or similar small silicon diode
D2 BY127

Miscellaneous
MIC1 moving coil or balanced armature microphone (40 to 300 ohms)
PL1/SK1 co-axial plug and socket
VR1 2·5kΩ skeleton preset potentiometer
RLA1 6V to 12V operated relay, coil resistance 500 to 1000 ohms, with at least one set of normally open contacts.
T1 mains to 8V bell transformer.
Metal box approx. 115 x 90 x 55 mm, 6BA fixings, connecting wire, screened lead—length as required, Veroboard 16 holes by 9 strips, mains lead and fused three pin plug (1 amp fuse).

SETTING UP PROCEDURE

When the construction is complete, it is a good idea to carry out a few d.c. checks to make sure nothing is wrong.



The completed prototype with lid removed.

TELPHONE REMOTE MONITOR

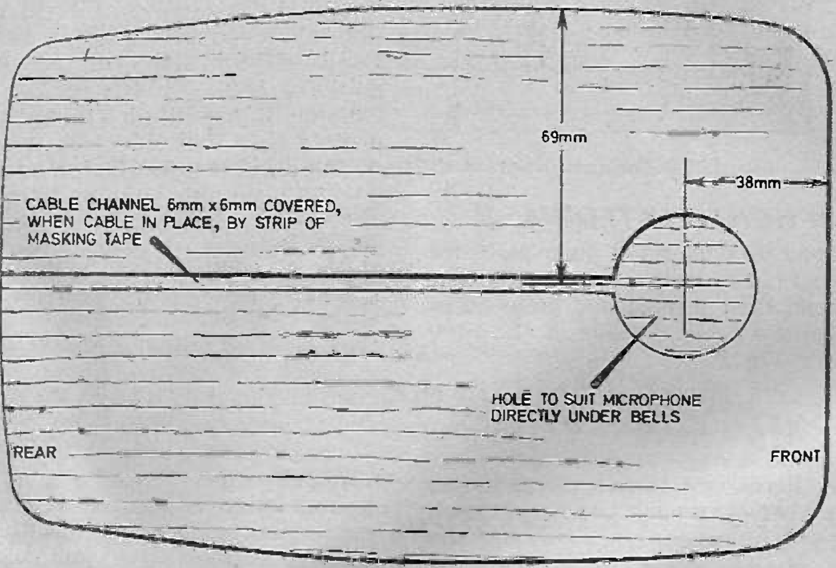


Fig. 2. Details of the wooden telephone platform.

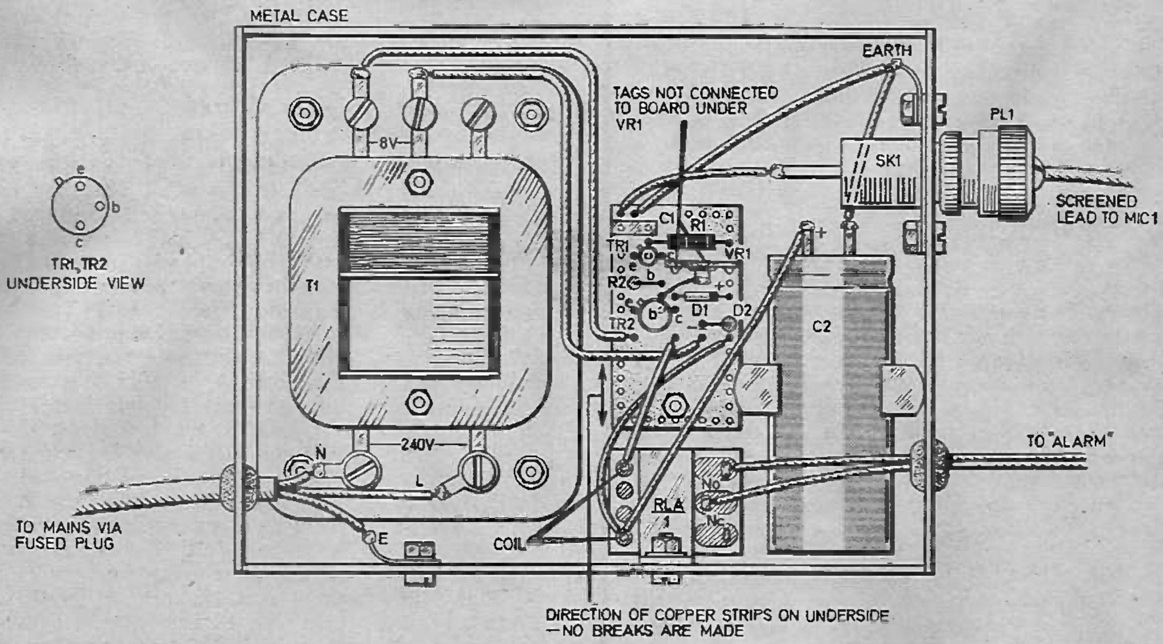
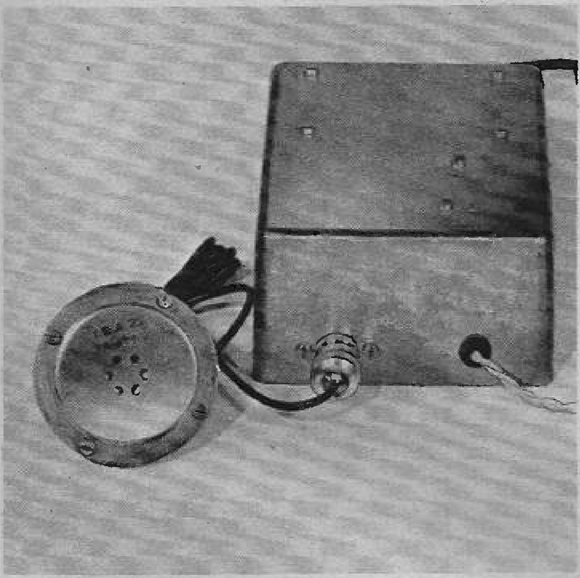


Fig. 3. Layout of components on the Veroboard and complete wiring up details within the case.



Wire the microphone to a piece of coaxial cable, the length you will require, and terminate the other end to the co-ax plug. Turn VR1 to maximum and plug in the microphone.

Plug the unit into the mains supply, and if you have incorporated a neon indicator, check that it is glowing. Measure the voltage at the positive terminal of the smoothing capacitor, with respect to earth. This should be around 11 volts (the transformer secondary is rated at 8 volts but the capacitor charges to the peaks).

Adjust the slider of VR1 to a point at which the relay will be heard to switch. Connect a small battery and lamp in series with two normally open contacts on the relay. With the lamp on, slowly rotate VR1 until it just goes out, making sure that the relay is not "chattering." At this stage it is possible to blow into the microphone causing the lamp to glow in sympathy.

The unit is now ready for use. With the microphone fixed in its housing and the metal box finished in the painted shade of your choice the monitor is both useful and discreet. ▣

...Counter Intelligence

BY PAUL YOUNG

A retailer discusses component supply matters.

COMPETITION

I KNOW many of my fellow component sellers tremble at the arrival of a new competitor and quite needlessly! I do not myself, I welcome the newcomers. This is not being complacent, I have always understood that a little fair and healthy competition is a good thing, keeps us on our toes so to speak. Not that the majority of my colleagues are not on their toes already, they are, but a far greater danger than another rival, is the attraction of another hobby.

Now I think that electronics is one of the most facinating hobbies in the world, and we shall only lose supporters if they suffer from frustration. I need hardly say that the most likely cause of frustration will be difficulty in supplies. A bigger choice of suppliers means less likelihood of this occurring.

After all I am always telling my readers, that they will not get all their requirements from one source and despite the profusion of wonderful names that appear in the journals, like Trannies and Trampus and Ziggies, none of my friends have reported a falling off in business. All of which bears out my contention.

NEWCOMERS

There are I notice, two newcomers which I find most interesting. One is Tandy, the other Doram Electronics. The group behind Tandy is "The Radio Shack" of America, and they in effect sell a franchise. One could almost say, that Tandy is to the electronic components trade what the Wimpy Bar is to the restaurant business.

I have several friends in different parts of the country and most of them report a Tandy opening near them, indeed one has just opened up within about two miles of us. Having heard so much about them, I naturally went along and had a look. They have a very impressive catalogue and their goods are nicely presented. Their wares all seem to be pre-packed and if I venture any criticism it is that their prices seem rather high. Certainly 6 yds of single microphone cable for £2·88 plus V.A.T. seems excessive.

However I have no doubt they will put that right, perhaps even before this article goes into print.

My other newcomer is even more intriguing because Doram Electronics is our old friend Radiospares or R.S. Components in a new guise. Why I am tantalized, is because a few years ago, their directors were even considering the same course of action, and I was particularly flattered, that they came to ask me my opinion. For the record, what I told them was this. "With your excellent organisational ability if anyone can make a success of this venture your firm can, but I think you might come unstuck". The directors thanked me politely and said they had reached the same conclusions.

DOWNFALL

When I made my prognostication, the I.T.T. business was very much in my mind. They had had the same idea and produced a splendid catalogue running to over 1,600 pages, but in just over two years they wound it up. However, I feel sure my R.S. friends will make a success of Doram Electronics, the only thing that puzzles me, that they should have thougbt it worth their while.

I wonder, do they really think that the floors of electronic component dealers are covered in gold, and that we swop our Rolls for a new one every time the ash trays are full? For a firm with a turnover exceeding the six million mark, can it boost the turnover all that much? I doubt it, but in the meantime you the hobbyist will benefit and I trust we will not suffer, and so, to "The Rivals", welcome!

WINDSCREEN WIPER CONTROLLER

By Eric MOORE

A simple circuit to provide timed delay of wiper operation.

THE circuit described in this article has proven itself very useful—indeed almost a necessity—in a climate such as our own where drizzle and fog occur frequently. Driving in drizzle and fog means that the car windscreen wipers have to be switched on and off repeatedly or left on causing rubbing and scraping which in time causes annoyance and distraction.

The circuit shown in Fig. 1 has worked satisfactorily for over six months and has coped with the worst weather without requiring any attention at all. The system is suitable only for cars which have self parking, single or two-speed wipers.

CIRCUIT

In order to keep the explanation short the internal description of the NE555 has been simplified so as to show the basic principle of operation.

The two resistors R_x and R_y (Fig. 1) make up a potential divider holding input *a* of the comparator at a constant voltage. The output of the comparator is zero therefore the two transistors *TR1* and *TR2* are switched off.

As the capacitor C1 charges via VR1, VR2 and VR3 the voltage on input *b* of the comparator approaches the voltage on *a*; when *a* and *b* are

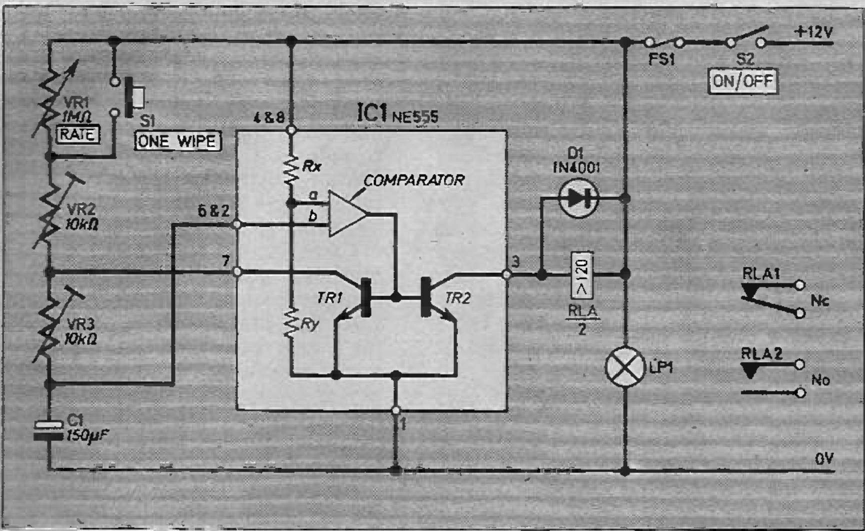


Fig. 1. Circuit diagram of the Windscreen Wiper Controller. Circuitry of IC1 is representative only.

equal then the comparator gives an output to *TR1* and *TR2*, the two transistors swing over to the conducting state, the relay RLA operates and the capacitor begins to discharge.

The discharge time, hence the relay hold on time, is a function of (VR3×C). The comparator senses that the two inputs are not equal and returns to the original state. The rest time between pulses is governed by (VR1+VR2+VR3)×C1.

Variable resistor VR1 sets the pulse rate of the circuit; VR2 merely sets the fastest running speed and should be set to give a speed equal to or slightly slower than the car's wipers. The hold on time of the relay is determined by VR3 as previously described.

It was found that if for some reason an extra wipe was required eg., a passing car wets the screen—a push-button can be connected in parallel with VR1, which shorts it out and provides a single wipe after a short delay (S1).

CONSTRUCTION AND SETTING UP

Assemble the circuit on a piece of 0·1in matrix Veroboard as shown in Fig. 2 and mount the circuit in a diecast box along with VR2 and VR3. Use a socket to mount IC1 and plug in the i.c. after checking all wiring. The setting up of the circuit can thankfully be done before installation in the car. Set all the presets to about half travel, wire in the control panel (Fig. 4) and set VR1 to its lowest resistance. Make sure the relay is connected between pin 3 (IC1) and the positive rail. Connect a 12V battery, observing polarity, the relay should be clicking in and out slowly.

First adjust VR3 so that the hold on time is around ½ second, as this is all the time needed to start the wipers. Next adjust VR2 until the relay is operating approximately as fast as the car's wipers. The unit can now be fixed into position.

INSTALLATION AND WIRING

A convenient place under the bonnet, close to the wiper motor if possible, should be found to house the unit.

The only components inside the cab of the car are VR1, which can be calibrated directly in time, S1, LP1 and S2. These can be mounted on a single panel and wired to the control box as shown in Fig. 4.

To wire the system into the car first look in the handbook and see whether the system employs a permanent magnet or field coil motor, i.e. three- or two-wire connection to the motor. Two-speed motors are dealt with later.

For the two-wire system simply connect to the two wires from the panel switch (wiper switch) and connect to the normally open contacts of the relay.

For the three-wire system identify the ground wire on the back of the wiper switch. Switch on the ignition and switch on the wipers. Pull off one of the other two wires until the one is found which does not interfere with the running of the wipers, mark it as being the normally closed wire. To check that the correct wire has been found switch off the wipers and observe their position on the windscreen when they come to rest. If the correct wire has been chosen then they will stop at any position on the screen i.e., the self-parking facility has been removed.

Components....

SEE **SHOP TALK**

Capacitor
C1 150µ elect. 15V

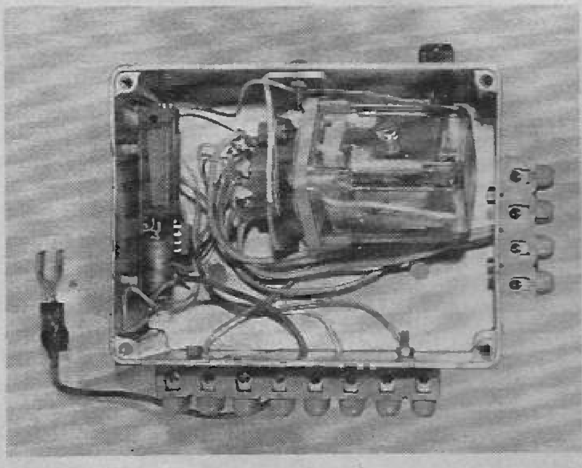
Potentiometers
VR1 1MΩ linear carbon
VR2 10kΩ multiturn preset
VR3 10kΩ multiturn preset
(Skeleton or t.v. type could be used)

Switches
S1 s.p.s.t. push to make push button
S2 s.p.s.t. toggle switch

Integrated Circuit
IC1 NE555 timer and holder

Miscellaneous
LP1 12V 0·1 amp panel mounting lamp and holder
FS1 1 amp fuse and holder
RLA2 12-24V, 110Ω (minimum) relay with one set of normally open and one set of normally closed contacts rated at 7 amps or two sets of each rated at about 5 amps. Die cast case 115 x 90 x 55mm, connecting strips 4-way and 6-way, 4BA fixings, heavy (10 amp) connecting wire for relay contact wiring, ordinary connecting wire, aluminium if required for dash mounted panel. Veroboard 12 holes by 24 strips, 0·1 in. matrix.

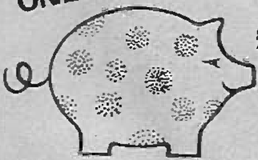
Photograph of the construction and wiring of the prototype unit.



WINDSCREEN WIPER CONTROLLER

FOR GUIDANCE ONLY

**ESTIMATED COST*
OF COMPONENTS**
including V.A.T.



**£4.50
excluding case**

*Based on prices prevailing at time of going to press

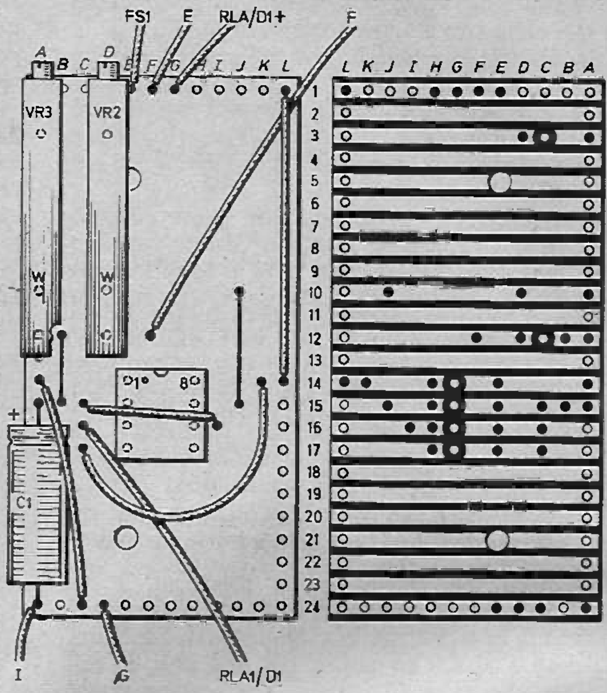


Fig. 2. Layout and wiring of the components mounted on the Veroboard.

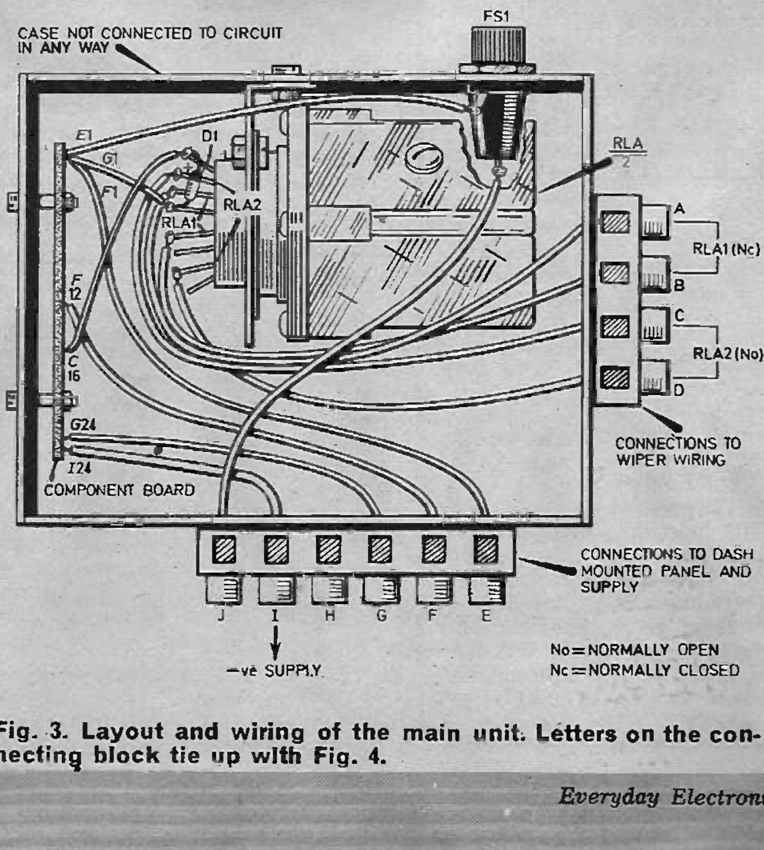


Fig. 3. Layout and wiring of the main unit. Letters on the connecting block tie up with Fig. 4.

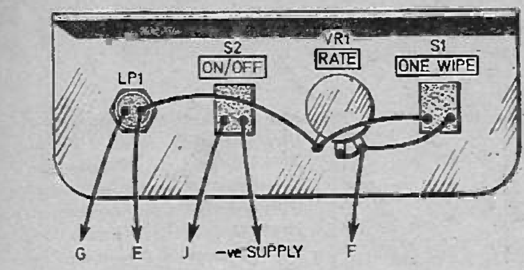


Fig. 4. Layout and wiring of control panel.

Next insert the normally closed relay contacts between the normally closed wire and the tag from which it was removed on the switch. Then insert the normally open contacts of the relay across the two remaining tags/wires.

TWO SPEED WIPERS

If the car is fitted with a two-speed field coil motor there may be three wires from the motor, however none of these will disconnect the self-parking only. In this case connect the normally open contacts across that tag/wire which affects both speeds (i.e., stops the motor completely when removed) and that which affects the fast speed only.

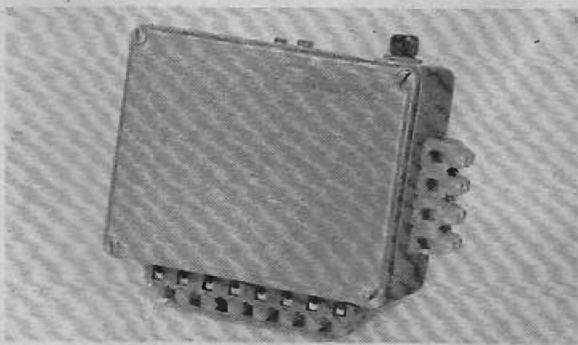
Cars with two-speed permanent magnet motors will have four wires connecting the motor. The procedure is the same as for the three-wire system mentioned previously except that the "two remaining tags/wires" will now be three and the necessary pair will need to be found by the following process.

Connect one contact to the tag/wire which prevents all motor operation when removed and the other to the tag/wire that prevents fast-speed operation only.

Connect the positive and negative wires from the unit to earth and the ignition switch, observing correct polarity, and switch on.

The control cannot be damaged by switching on the wiper switch whilst the control is in operation. The wiper switch will simply override the control.

The system cannot be used with some cars fitted with wipers the speed of which is continuously variable. ▣



Ruminations
By Sensor

Don't abandon ship

A SCANDINAVIAN company is manufacturing an equipment for use in small sea-going craft, particularly fishing boats, which gives the skipper a visual indication of the stresses and strains upon his vessel. I gather that the information is presented on a small screen located on the bridge to which signals from sensors in strategic positions throughout the vessel are routed.

The purpose of the installation is to present the skipper with an accurate picture of the effect of wind and waves at any given moment. He can thus change course, or speed required, so as to operate most effectively, without jeopardising his craft. The equipment is said to be both cheap and reliable.

The system takes some of the guesswork out of sailing—although it is hardly fair to describe a skilled seaman's knowledge of the effects of bad weather upon his ship as "guesswork". But nevertheless, listening to the creaks and groans of a small craft in heavy weather and interpreting these sounds and vibrations in the light of his experience, has been the skippers only method of staying afloat and profitable until now.

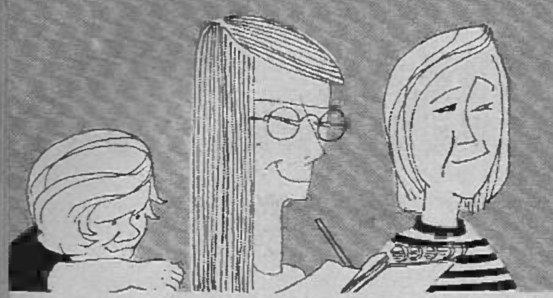
For some years now, large aircraft have carried bad weather radar for the purpose of warning the pilots of what lies ahead so that he may change course to avoid it. I do not know of any stress-monitoring equipment currently in use in commercial aviation, but there may be such.

Home James

It is reasonable to suppose that the systems I have described could be coupled into a small computer together with data concerning economic speed, desired course, estimated time of arrival, maximum working stress and other necessary parameters so that a suitable course would be computed automatically. It would then be just a small matter of feeding this computed course into an automatic pilot and sitting back with a chocolate biscuit and a stewardess for company.

Of course the more complex the system becomes the more prone it is to breakdown and the more limited it's use due to the cost factor. There are probably few fishing boat skippers who would allow a bundle of electronics to take the helm although they might be reluctant to leave port with a defective radar set, for radar has proved its value over the years. The simple system is obviously right for the small craft, the sophisticated all singing all dancing version is perhaps appropriate for the expensive jet airliner.

Anything which makes life safer and more comfortable for those who sail the seas or fly in the sky in adverse weather conditions, is to be welcomed.



Physics is FUN!

By Derrick DAINES

HOME-MADE ELECTROSCOPE

Last month we did some experiments with static electricity and found that a charged plastic film will make your hair stand on end. Now we will find it rather inconvenient to stick our head into something every time we wish to test for the presence of static electricity! What we need is a simple gadget that will test for us. It is proposed to describe two; a simple one and one more sensitive one.

Find a small metal tin—tobacco tin, pill tin, or similar—and in the centre of the lid punch a small hole with a nail.

Through this hole pass a piece of stiff wire about 15mm long, with a small bend at the end, see Fig. 1. Now solder the wire securely to the underside of the lid so that when the lid is replaced on the tin, the wire sticks straight up.

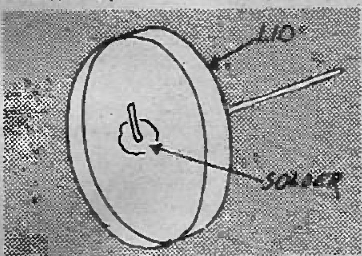


Fig. 1. Fixing a piece of stout wire to tin lid.

Cut some narrow strips of tissue paper and stick them across the top of the wire, this way and that, so that they form a tuft hanging down 8mm or so. Uhu glue or balsa cement are ideal. The electroscope is now ready, Fig. 2.

Lay a piece of plastic film on the table, rub it vigorously with a woollen cloth, then stand your electroscope on it. Nothing happens! However, if you pick up the film with the electroscope on it, the tufts will fly apart, just as your hair did, and can be used

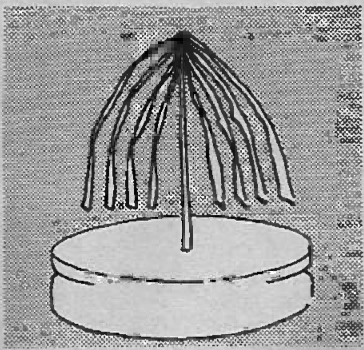


Fig. 2. Shows the strips of tissue paper attached to the stout wire.

at any time to indicate the presence of static electricity.

This must give us cause for thought— clearly, we must revise our opinions to what actually happened when we passed an electrified film above our heads. If you will repeat the experiment you will see that the individual hairs of the head are not simply lifting up towards the charged film, but are also moving *away from each other*.

Remembering that like poles repel, we can say that because the tufts on the electroscope (and the hairs of the head) are repelling each other, all must have the same electrical charge.

The thoughtful reader will point out that the hairs of the head have not been rubbed, nor are they in contact with anything that was rubbed, as is the electroscope, but I will leave you to puzzle over that one while I describe the other electroscope.

For this you need a larger tin screwed to a wooden block.

Next obtain a small glass phial such as tablets are sold in, with a small cork to fit, and some of the aluminium foil that is found in cigarette packets, Wrapping foil will also do, but as it is not so thin, the electroscope will not be so sensitive.

Carefully remove the tissue backing from the foil and cut two fine strips 35mm long and about 3mm wide. Cut the cork down the centre and sandwich the strips of foil between the two halves of the cork, including a 50mm length of stiff wire. Fig. 3.

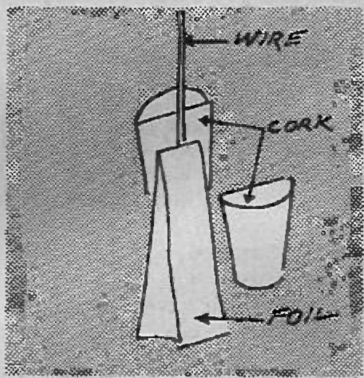


Fig. 3. Making the cork assembly for the second electroscope.

Now place the cork in position so that the foil strips hang inside the phial and the wire sticks out.

Drill or punch a hole in the protective tin big enough to take the phial and glue it into place. The electroscope is now ready and the two leaves of aluminium strip will move apart whenever a static charge is brought anywhere near the wire. Fig. 4.

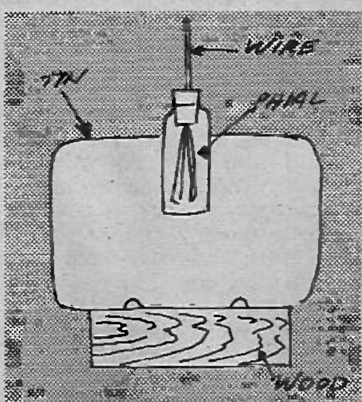
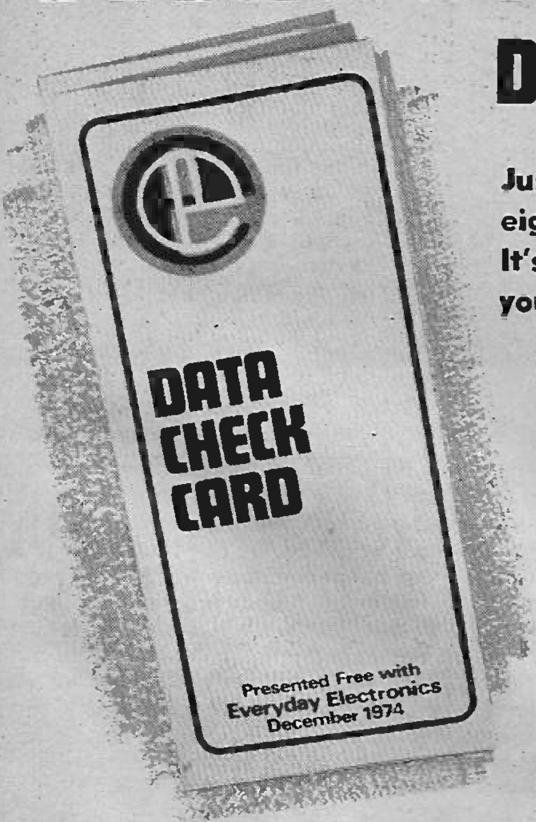


Fig. 4. The completed, more sensitive electroscope.

FREE! NEXT MONTH...

DATA CHECK CARD



Just the information you need on a handy eight page, three fold pocket check card. It's inside next month's issue, make sure of yours—place an order at your newsagent now.

ULTRASONIC REMOTE CONTROL

A control system that will switch almost anything on and off from a remote position by means of an ultrasonic transmitter and receiver. Battery operated, requires no licence and no interconnecting wires.

ACROSS THE RIVER

A great game for youngsters, solve the farmer's problems with our simple unit.

everyday electronics

DEC. ISSUE ON SALE MID NOV.

BATTERY ELIMINATOR

BY R.A. PENFOLD

A very simple unit to replace the battery in your transistor radio.

In many households, mains powered broadcast receivers have now been replaced by the larger type of battery powered transistor portable receiver. These have the advantage of being relatively small, and inexpensive to buy, as there are no trailing wires are easily transported from one room to another. They can of course be used away from home, as they arc independent of mains power.

The main disadvantage of these sets is that they are relatively expensive to run. A modern transistor receiver requires only a couple of watts of power, and if run from the mains would cost only about one penny (1p) per 500 hours to run.

Battery operation would cost many times more than this. This is especially so if the set is only used occasionally, as the battery will have a limited life (shelf life), regardless of whether it is used or not.

This article describes a 9 volt mains power unit which is the same size as the popular PP7 battery, and will fit into the battery compartment of any radio which uses this battery or a similar size battery such as the PP9. This enables the set to be inexpensively run from the mains.

Since the power unit simply plugs into the receiver in the same way as a battery, if at any time it is required to use the set on battery power, say to take on holiday, the eliminator is merely swopped for a battery.

The only modification required to the receiver with which it is to be used, is to cut a small notch in the back of the set, through which the mains lead can pass.

Obviously, in order to be economically viable the unit must have a reasonably low initial cost, or the advantage of cheap mains power is lost. This has been achieved, as the total cost of the prototype was about the same as a 9 to 10 month supply of batteries. Therefore, after about a year of use, the initial cost should have been more than recovered.

For anyone involved in the design or construction of battery operated equipment, a small mains power supply unit such as this is very handy to have around for testing purposes.

THE CIRCUIT

A circuit diagram of the Battery Eliminator is shown in Fig. 1.

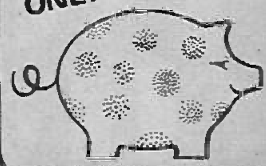
Transformer T1 is a mains type with an 18 volt centre tapped secondary. Therefore between the centre tap and each extreme of the secondary winding there is a voltage of 9 volts; this can be considered as two 9 volt windings in series.

Diodes D1 and D2 are arranged to provide full-wave rectification.

If we consider the output from the upper secondary of T1, this will give an a.c. output, as shown in Fig. 2(a). Diode D1 will allow positive pulses to pass. but will block negative ones. The

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS including V.A.T.



£1.70

*Based on prices prevailing at time of going to press

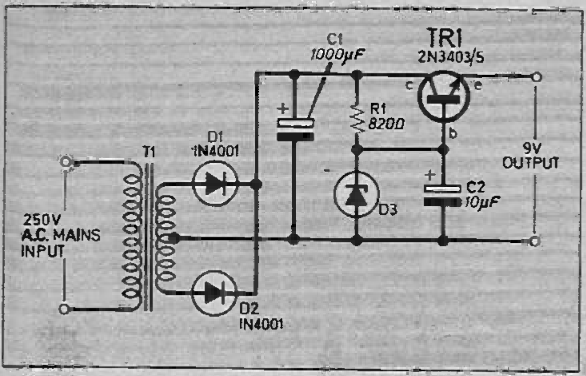


Fig. 1. The circuit diagram of the Battery Eliminator.

output from D1 will therefore be shown in Fig. 2(b).

Diode D2 will rectify the output from the lower secondary in the same way, but there is a slight difference, since this winding goes in the opposite direction, downward away from the centre tap.

The output from D2 is shown in Fig. 2(c), and the combined output of D1 and D2 in Fig 2(d).

While this output is d.c., it is a pulsating d.c., and is not suitable to power a radio in this form. Capacitor C1 is a smoothing capacitor.

A capacitor has the ability to store an electrical charge, and C1 therefore charges up on the peaks of the output from D1 and D2, and discharges during periods of low output. This gives an output as shown in Fig. 2(e), which is almost level d.c., with only a small ripple content.

Components....

Resistor
R1 820Ω
½W ± 10% carbon

SEE
SHOP TALK

Capacitors
C1 1000μF 16V elect.
C2 10μF 16V elect.

Semiconductors
D1 IN4001
D2 IN4001
D3 BZY88C10, 10 volt 400mW Zener
TR1 2N3403 or 2N3405 silicon *npn*

Miscellaneous
T1 Mains/9-0-9V 100mA secondary Veroboard, 0·1in. matrix 20 strips x 17 holes; connecting wire; hardboard for case; exhausted battery (for connector plate); length of mains lead; fused mains plug.

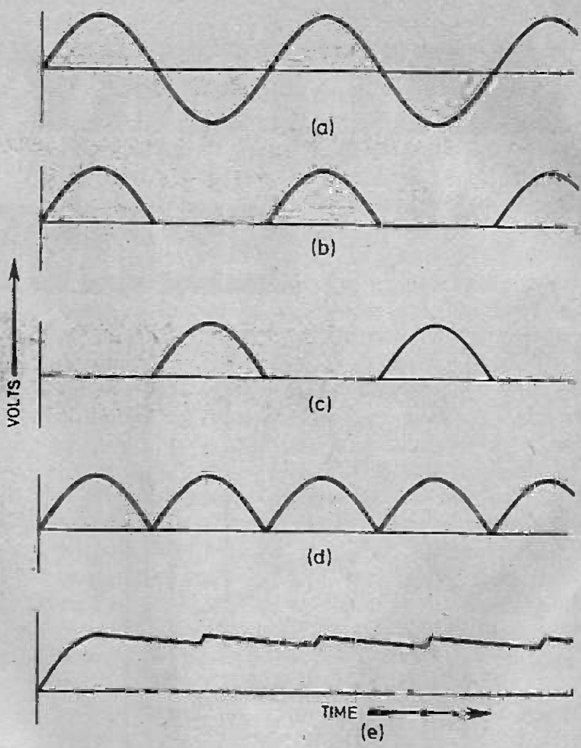


Fig. 2. Waveforms at different parts of the circuit —see text for details.

The output from the mains transformer is 9 volts r.m.s. and the peak value of the output is nearly 50 per cent more than this. The unloaded output across C1 will be about 13 volts, which is too high to connect to piece of equipment intended for 9 volt operation.

Under load conditions this voltage will drop, but most transistor radios use class B output stages, which under quiescent conditions have a very low current consumption, and would cause little voltage drop.

A simple method is used to reduce the output voltage under low load conditions; R1 and D3 form a simple shunt regulation circuit, and give a stabilised potential of 10 volts at the base of TR1 which is used in the emitter follower configuration. The output potential of this type of circuit is the same as that at the input, minus about 0·7 volts for a silicon transistor, as is used here.

By stabilising the input voltage at the base of TR1, the output at its emitter will also be stabilised.

The output impedance of an emitter follower is low, and so the circuit will easily supply the required current (about 100mA maximum). Capacitor C2 is required to smooth noise spikes produced across D3, as these would otherwise appear across the output.

The output voltage will be about 9·3 volts (10V−0·7V), although this is subject to slight variation due to the tolerance of the Zener diode.

BATTERY ELIMINATOR

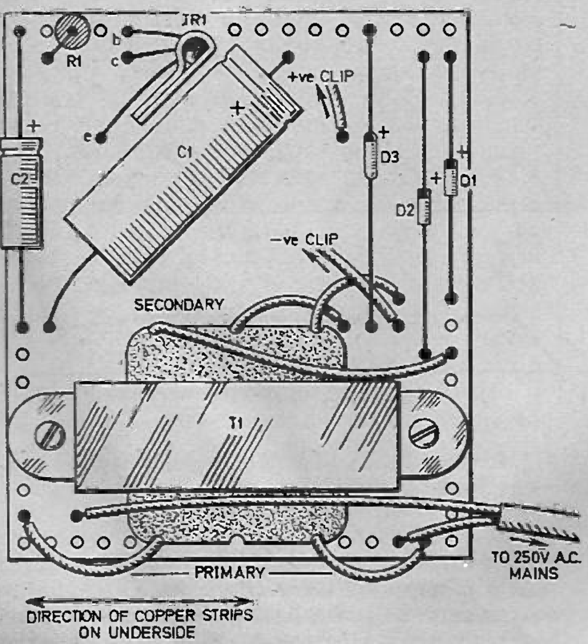
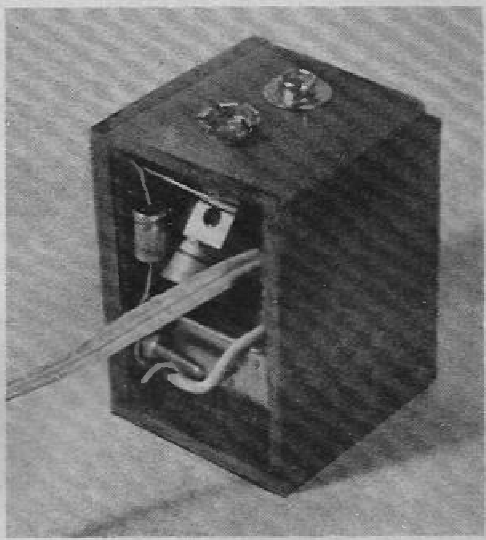
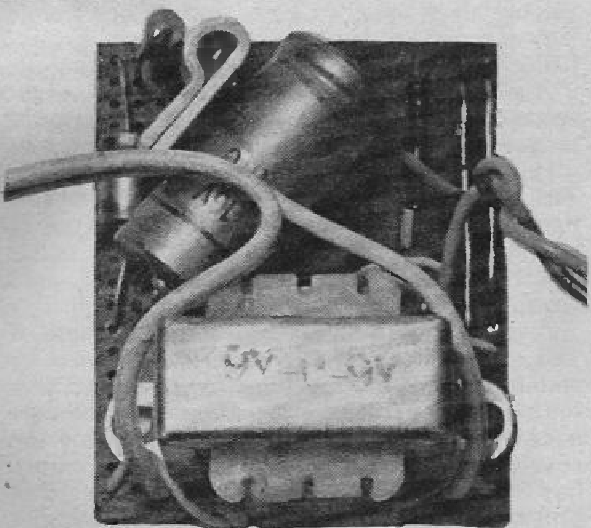


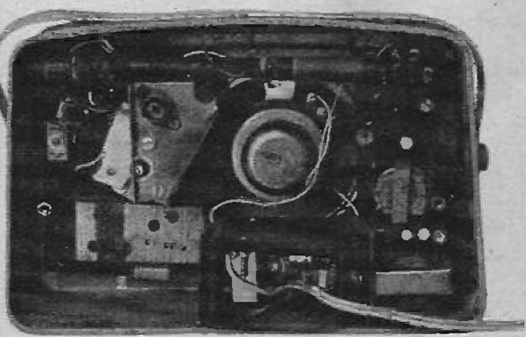
Fig. 3. The layout of the components on the topside of the Veroboard. There are no breaks on the underside.



The prototype unit in case ready for fitting into the radio cabinet.



Photograph of the completed prototype component board.



The prototype unit fitted in the battery compartment of the radio.

This is about the same voltage as is given by a fresh battery.

An added bonus of the stabilisation circuit is that it will virtually eliminate the ripple present on the voltage across C1, giving an almost pure d.c. at the output.

CONSTRUCTION

All the components are mounted on 0·1in matrix Veroboard size 20 strips by 17 holes as illustrated in Fig. 3. There are no breaks in the copper strip on the underside.

Two of the holes in the panel are enlarged using a No. 31 twist drill, to enable them to accept 6BA mounting bolts for T1.

The transformer flying leads are cut to length, and soldered to the appropriate points on the panel. The remaining components should then be mounted and soldered into position.

A soldering iron with a miniature bit is really required for use with 0·1in matrix board, and even then care must be taken not to short circuit adjacent copper strips with any excess solder. Remember to use a heatshunt when soldering TR1 in place.

A mistake in the wiring could easily cause damage to one or more of the components, and the completed component assembly should be thoroughly checked for mistakes and short circuits before it is connected to the mains.

CASE DETAILS

In order to leave no exposed mains wiring, and to make the unit a snug fit inside the battery compartment of the radio, the device should be housed in a wooden case built to the same dimensions as the battery it is to replace. Hardboard pinned and glued will make a suitable case.

The component panel is secured to one face of the case by means of the transformer mounting bolts. The top of the case is salvaged from an exhausted battery top (the part containing the connectors). With the component panel fitted in place the appropriate two wires should be soldered to the connectors and the top panel secured. The mains lead should be led out through a hole in one of the side panels.

Most battery operated receivers have a removeable back, or a battery compartment with a removeable back, in order to facilitate battery changing. This back should be removed and a small notch made at a strategic point in one edge, through which the mains lead can pass when the back is replaced. The notch is easily made using a file, or a fret saw.

The Battery Eliminator then just plugs into the receiver in place of the battery. The unit gives a very pure output, and when the prototype was tested, no mains hum was audible on the output from the receiver. ■

Photo-cells

First of all, my apologies for what might seem a rather open ended question. I took up an interest in electronics a long time ago and amongst other things learned a bit about how to use photo-cells — which were quite large devices in vacuum tubes. Nowadays these do not seem to be used at all and a new range of cells has appeared. Could you, briefly, outline the advantages and differences between the new cells and the old types?

The type of cell you were familiar with was of the photo emissive type. When light fell on a plate of selenium inside the vacuum tube the metal would give off a few electrons. There was a second electrode in the tube (usually a single rod) which was maintained at a high voltage and this would attract the discharged electrons. As the electrons hit the rod they would give rise to a small electric current that could then be amplified. You needed a high voltage and quite a high degree of amplification for low light levels —the main drawbacks of these old devices. However they had the distinct advantage of having a very fast response.

The most common modern device is photo-resistive cell which operates on an entirely different principle. It contains a material called cadmium sulphide which is deposited between two electrodes. In the dark cadmium is a poor conductor of electricity but under the stimulus of light free current carriers are released and the material conducts more freely.

The range of resistance variation is quite dramatic (from a few megohms down to a few hundred ohms) and at low resistance levels the cell can pass a reasonable current—certainly enough to operate a small relay with no extra amplification. Because it is solid there is little danger of breaking the device and, of course it will operate at any voltage below a certain maximum rating. Its disadvantage is that it is slow to respond and hence cannot be used in applications such as detecting the audio signal from a film soundtrack.

A faster acting modern device, which needs a slightly more complicated circuit to make it work, is the photo-diode (sometimes called a photo-voltaic cell). There is a forward voltage drop across a silicon *pn* junction (typically 600mV) and this can be made to vary in level by a small amount under the action of light. This voltage is detected and amplified.

for your Entertainment...

By Adrian Hope

Every year the Association of Professional Recording Studios holds a two-day exhibition in London. Although only professional equipment is on show and entrance is restricted to broadcasters, studio engineers and press concerned with professional recording, there are always a few exhibits of wider interest.

It is also one of the most pleasant exhibitions to wander round, because the only sounds being played are over headphones and although a few exhibitors have impressive banks of high-power loudspeakers on display, they are mercifully silent. What a change it all makes from the annual cacophony at Olympia.

CHANGED ATTITUDE

The exhibition also makes an interesting social comment. Nothing on sale at the exhibition is cheap, with most multi-track tape decks and studio mixing consoles costing many thousands of pounds a time. The company representatives selling them are usually conventionally dressed and it is fascinating to watch them greeting long-haired, bearded youngsters in jeans as bread and butter customers.

Gone are the days when only a man in a suit, a starched collar and a club tie had money to spend. Nowadays it is more likely to be the long-haired studio engineer who will have a cheque book and £30,000 cash to spend.

As someone who was once refused a job with BP because I had no parting in my hair, I am the first to welcome the disappearance of a few arbitary prejudices. It may also come as a comfort to older readers with electronically talented children, who regularly fail their school exams, to learn that a disgraceful ignorance of Latin or Greek is no longer an all-time bar to a creative career in broadcasting or recording.

DUPLICATING

But I digress, although relevantly I hope. This year the Japanese firm, Otari, was showing some tape duplicating equipment which is being handled for them in this country by Industrial Tape Applications.

As most people realise, it takes far longer, and thus costs far more, to duplicate tapes than to press discs. It also costs more to produce a cassette or cartridge than a flat piece of vinyl. So it is small wonder that cassettes and cartridges still cost more than discs. The real wonder is that cassettes and cartridges don't cost even more than they do.

One way of bringing the price down is to speed up duplication and there are various techniques around for doing this.

Clearly it would be grossly uneconomical to duplicate tapes on the simplest one to one basis—it would take an hour to dub a C60 or two hours to dub a C120. The first step is to dub all four cassette tracks at the same time, two running backwards and two running forwards. Of course it makes no difference which way the tapes are dubbed because the final product will still be an accurate replica of the original.

The next step to economy is to use several (usually up to 10) slave machines copying from one master machine. This way ten tapes are produced in the time taken to produce one, and by dubbing all four tracks at once, the total length of time is halved. But this is still uneconomical.

HIGH SPEED

The answer is to run the tape at high speed through the player and at commensurately high speed through the slaves. This will reduce the time taken to dub and again (because the *relative* speeds are the same), the final products will be accurate replicas of the original.

There are also techniques of copying the tapes by a magnetic sandwich method (putting master and blank tapes together and blasting a magnetic field through to imprint a replica of the original on the blank) but that would be another digression in the present context.

The problem with dubbing at high speed is that the tape becomes unmanageable and the audio frequencies involved become extremely high.

If, for instance, the audio range recorded on the original master tape is 40Hz to 15kHz, then to double the playback speed and double the recording speed (to produce a correct speed replica) will involve handling frequencies of 80Hz to 30kHz. These may be manageable frequencies, but double the speed again and the quality of electronic engineering required starts to look worrying.

The Otari duplicator uses a playing machine which runs 1 inch wide master tape round at the staggering speed of 240 inches per second. This is incidentally the kind of speed that tape was run at around 15 years ago when someone first had the bright idea of using ordinary tape machines to record video.

To cope with the high frequencies needed to record television they used massive spools and ran the tape through at frighteningly high speed. The machine shook like a spin dryer, behaved like a gyroscope and cut off any fingers that happened to get too close. Mercifully helical scanning for video was invented and high linear tape speeds were no longer necessary.

The way that the Otari inventors have overcome the problem of handling tape at such high speed is to forget about take-off and take-up reels altogether. A continuous loop of master tape simply stacks up in a closed bin like film on a cutting room floor. Photo-electric gadgetry senses the

ELECTROVALUE

APPOINTED STOCKISTS FOR SIEMENS QUALITY PRODUCTS

Present top quality electronic components for price-minded buyers

112 p. CATALOGUE · FREE POSTAGE (U.K.) · ATTRACTIVE DISCOUNTS · SPECS. GUARANTEED

A 100 OF THE BEST
From our transistor stock

2N1307	47p	BC149C	14p
2N2646	51p	BC158B	15p
2N3053	28p	BC159	15p
2N3054	60p	BC167B	13p
2N3055	60p	BC168B	12p
2N3702	11p	BC169B	12p
2N3703	10p	BC169C	13p
2N3704	11p	BC179B	26p
2N3705	10p	BC182L	26p
2N3794	18p	BC184L	26p
2N3819	25p	BC212L	12p
2N4062	11p	BC214L	14p
2N4443	52p	BC257A	14p
2N5052	42p	BC259B	14p
2N5163	20p	BC758	30p
2N5459	32p	BD130	90p
40361	48p	BD131	48p
40362	44p	BD132	52p
40602	46p	BD135	37p
40636	£1·36	BD136	39p
40669	£1·10	BDY20	83p
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	£1·92	C106B1	42p
AD136	£1·11	C106D1	62p
AD149	65p	C1406	78p
AD161	42p	MJ481	£1·20
AD162	40p	MJ491	£1·35
AF200U	70p	MJ2955	80p
AF239	60p	MJE371	89p
B1906	36p	MJE521	81p
BA138	31p	MJE2955	£1·12
BB103	24p	MJE3055	68p
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	18p	WO2	30p
BC109C	18p	ZTX300	14p
BC147A	12p	ZTX304	23p
BC147B	13p	ZTX500	14p
BC148B	12p	ZTX504	45p

100s MORE IN CATALOGUE 7

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	0·9 nett
C	1/2	4·7–10M	1·3	1·1	0·9 nett
C	3/4	4·7–10M	1·5	1·2	0·97 nett
C	1	4·7–10M	3·2	2·5	1·92 nett
MO	1/2	10–1M	4	3·3	2·3 nett
WW	1	0·22–3·9Ω	11	10	8
WW	3	1–10K	9	8	6
WW	7	1–10K	11	10	8

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 ¾W 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 MO ½W 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

POTENTIOMETERS
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 each 6p

SLIDER
Linear or log mono 4·7K to 1 meg. in all popular values each 30p
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 £2·91	1000/50 41p
5000/25V 62p	2000/50 57p
	5000/50 £1·18

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 24p

SILVERED MICA. *Working voltage 500V d.c.*
Values in pFs—2·2 to 820 in 32 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, 3·5/16V 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. 20p

POLYCARBONATE
Type B42540 Working Voltage—250V
Values in mF:
0·0047; 0·0068; 0·0082; 0·01; 0·012; 0·015 ea. 3p
0·018; 0·022; 0·027; 0·033; 0·039; 0·047; 0·056; 0·068; 0·082; 0·1 ea. 4p

CERAMIC PLATE
Working voltage 50V. d.c.
In 26 values from 22pf to 6800pF, ea. 2p

ELECTROLYTIC CAPACITORS
Axial Lead

qF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	11p	8p
1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	—	—	—	8p	9p	8p	8p
22	—	—	8p	—	9p	8p	8p	10p
47	8p	—	9p	8p	8p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
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	39p	44p	58p	—	—	—
10,000	42p	46p	—	—	—	—	—	—

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
CN340 £1·95 Spare bits 32p
CCN240 £2·30 Spare bits 40p

DESOLDER BRAID
6 ft strip 66p

WAVECHANGE SWITCHES
1 pole 12 way; 2 pole 6 way
3 pole 4 way; 4 pole 3 way each 29p
TAG STRIP 28 way 11p

NUTS, SCREWS, etc.
in lots of 100 each
4BA NUTS 28p: 6BA NUTS 28p
½" 4B Screws 28p: ½" 6BA Screws 24p
Threaded pillars 6BA, ½" hexagonal £1·68
Plain spacers ½" round £1·12
Other sizes available

ENAMEL COPPER WIRE in 2 ounce reels
16, 18, 20, 22 SWG 34p
24, 26, 28, 30 SWG 40p
32, 34 46p: 36, 38, 40 5p

DIN CONNECTORS

	Socket	Plug
1 way loudspeaker	10p	12p
3 way audio	10p	12p
5 way audio 180	12p	15p
5 way audio 240	12p	15p
6 way audio	13p	15p

EV CATALOGUE 7
2nd printing—Green and yellow Cover
112 pages, thousands of items; illustrations; diagrams; much useful technical information. The 2nd printing has been updated as much as possible on prices. It costs only 25p post free including refund voucher for 25p for spending when ordering goods list value £5 or more.

QUALITY GUARANTEE
All goods are sold on the understanding that they conform to manufacturers' specifications and satisfaction is guaranteed as such—no rejects, 'seconds' or substandard merchandise is offered for sale.

Prices quoted do not include V.A.T. for which 8% must be added to total nett value of order. Every effort is made to ensure the correctness of information and prices at time of going to press. Prices subject to alteration without notice.

ELECTROVALUE LTD

All postal communications, mail orders etc. to Head Office at Egham address, Dept. EE11. S.A.E. with enquiries requiring answers.

28, ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB
Telephone Egham 3603 Telex 264475 Shop hours 9–5.30 daily: Sat. 9–1 p.m.

NORTHERN BRANCH: 680, Burnage Lane, Burnage, Manchester M19 1NA
Telephone (061) 432 4945 Shop hours 9–1 p.m. 2–5.30 daily: Sat. 9–1 p.m.

U.S.A. CUSTOMERS are invited to contact ELECTROVALUE AMERICA, P.O. Box 27, Swarthmore PA 19081.

beginning and end of each loop run and controls the ten slave machines.

TELEVISION FREQUENCIES

The master playback machine (running at 240 inches per second) is reproducing tape originally recorded at $7\frac{1}{2}$ inches per second and is thus playing back at 32 times the original recording speed. This means that an original audio frequency range of 40Hz to 15kHz becomes a reproduced band of 1·28kHz to 480 kHz which is around 0·5MHz.

In other words the audio frequencies on the original tape have become television frequencies during reproduction, and T.V. engineering and electronic standards start to apply.

So that the copy tapes produced on the master machines will be the necessary exact replicas, the $\frac{1}{8}$ inch cassette tape (which incidentally runs between large open reels and is later automatically cut up and loaded in cassettes) must also run at 32 times its correct speed ($1\frac{7}{8}$ i.p.s.) which is 60 inches per second.

Think for a moment about running $\frac{1}{8}$ inch wide cassette tape reliably at 60 inches per second and you will have another insight into the problems involved in copying. So next time you buy a cassette or cartridge and moan about its price, spare a thought for how it was made.

New products and component buying for constructional projects

SHOP TALK

By Mike Kenward

A PARTICULAR component buying problem came to light from past projects. It is a problem that we were not aware of and concerns diecast cases. A reader phoned us in early September to ask where he could buy a diecast case, we of course said almost anywhere. However, he had already checked most of the larger suppliers and all to no avail.

Some suppliers probably still sell these cases but they seem to be rare. However, if readers do have difficulty they can get them from Doram at prices ranging from 55p to £1·14 for the various sizes.

Tape Noise Limiter

Quite often we get a project where we say all components are readily available and sometimes readers write to us saying "I cannot get these parts in my area" or "where can I buy these parts near . . . . ?" The point is that we cannot check all suppliers for availability, we can only check those suppliers who provide us with catalogues (most advertisers) and we can only check them at the time this column is written—about five weeks before you read it.

If a particular item is listed in most of the catalogues then we say it is readily available, unfortunately, component shortages may alter this situation for short periods. Anyway, having said all that, all components for the *Tape Noise Limiter* should be readily available.

To amplify the point a little, we are also unable to provide a "directory" of suppliers, e.g. some readers write to ask if we can supply the name of their nearest stockist of particular components. This is simply impossible as we may not even know of all the suppliers in their area, we can only keep tracks on those suppliers that advertise in our issues or in other "electronic publications."

Telephone Monitor

Woolworths, the best place to get components—well not usually, but they do sell bell transformers quite cheaply, and that's just what is needed for the *Telephone Remote Monitor*. The only other parts likely to cause problems in this unit are the relay and microphone.

The relay should be available from the larger suppliers—most will have something to do the job but prices do vary considerably. As for the microphone, you will have to hunt around for the cheapest—telephone inserts are suitable and one was used in the original. Or you could use a 75 or 80 ohm miniature loudspeaker; although this is just under the specified impedance you can get away with it.

The alarm system used for this project is a matter of choice—bell, lamp or buzzer can be used.

Windscreen Wiper Control

Some of the parts used by the author in the prototype *Windscreen Wiper Control* are rather expensive and the shrewd reader can save a few pence by careful buying—the cost box reflects these savings in part. The relay is the first item that should be carefully looked at—any type that will meet the specification should be considered. The original was an R.S. type costing over £2 (suppliers, Doram). Similar, non plug-in, relays are available for about £1·25. The contacts should be rated at about 7 amps but two 5 amp contacts wired in parallel will suit.

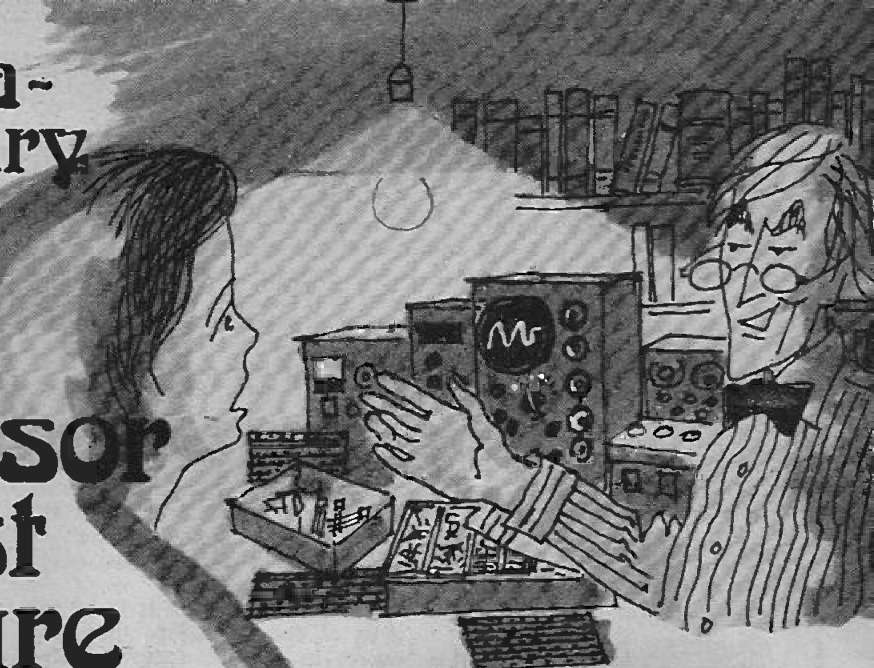
The second saving can be made by using skeleton preset or t.v. type preset potentiometers instead of the multiturn type which cost about 60p or more each. However, the multiturn types are easy to mount, provide a neat finished appearance and are easily adjusted.

Battery Eliminator

Only one component in the *Battery Eliminator* requires special mention—the 2N3403, 4 or 5 transistor specified. This device is rather unusual in that it has a heatsink attached. A look through the advertisements should locate suppliers.

The case for the prototype unit was home made from hardboard but if required it may be possible to find a suitable plastics case—the size is critical.

The Extraordinary Experiments of Professor Ernest Eversure



by Anthony John Bassett

Professor Ernest Eversure, or the Prof. as his friends call him, has been experimenting in electronics for more years than anyone can remember and we thought that you might like to hear of, and perhaps repeat, some of his extraordinary experiments. Anthony J. Bassett will be recounting some of the experiments every month so why not follow the Prof's work and learn along with young Bob, his friend.

"COME on, Prof., quickly," said Bob. "Let's get out of here!" but to his surprise, the Prof. was walking calmly towards the strange piece of equipment. It shuffled to a halt in front of the Prof. The dial readings all changed, and a different set of lights began to flash. The machine emitted a strange sounding series of clicks and whistles. Amazingly, the Prof. pursed his lips and clicked and whistled back at the machine, which promptly turned around and trundled off.

"One of my latest experimental robots," remarked the Prof.

"What was all that clicking and whistling?" asked Bob.

"That is a form of audible communication which enables me to hold a conversation with the robot, exchanging information and giving it my instructions."

Bob was about to ask the Prof. how the robot worked, and what instructions he had given it, but the Prof. began once more to talk about how Bob can make his own components. He pointed out to Bob that the resistor he had just made was of unknown value. Even though he had just made a resistor, which functioned quite well in the Note Generator, neither the Prof. nor Bob knew how many ohms the resistance was!

"We can alter the resistance quite easily," said the Prof. "To make it higher, just remove some of the carbon track." He switched on the oscillator once more, and a musical note came again from the earpiece at a constant pitch. The Prof. removed a tiny portion of the carbon track by rubbing it gently with very fine emery cloth or sandpaper. The pitch of the note became lower. "To make the resistance lower," said the Prof., "we must add more carbon to the track. This can be done by putting on more graphite paste. To make smaller alterations in the value of the resistor, rub it gently with a soft graphite pencil or a lump of artist's graphite. If you put too much extra graphite on the resistor in this way, it can be removed by rubbing with a typist's eraser.

Bob found a soft lead pencil and asked: "Does this pencil contain graphite, Prof?"

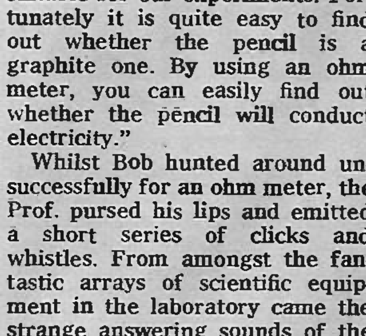
The Prof. replied: "I know that some black pencils are made of almost pure graphite, and others are made of coloured wax compositions which are entirely unsuitable for our experiments. Fortunately it is quite easy to find out whether the pencil is a graphite one. By using an ohm meter, you can easily find out whether the pencil will conduct electricity."

Whilst Bob hunted around unsuccessfully for an ohm meter, the Prof. pursed his lips and emitted a short series of clicks and whistles. From amongst the fantastic arrays of scientific equipment in the laboratory came the strange answering sounds of the robot.

"The robot will bring an ohm meter," the Prof. told Bob.

While they waited for the robot to locate an ohm meter from the huge selection of equipment, Bob

Altering the value of the Prof's resistor.



Henry's

TRANSISTORS, VALVES AND SEMI-CONDUCTOR DEVICES · ANY QUANTITIES
UK'S LARGEST STOCKISTS

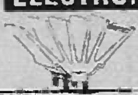
FREE NEW '74/75 SEMI-CONDUCTOR AND VALVE LISTS Ref No. 36 on request

CASH & CARRY PRICES
For CALLERS or BY POST

G.B. Carr/Pack 15p per item.

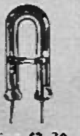
Ref. No.		Price
1	D1203 Telephone Amplifier—Suction	£4·95
2	D1201 Telephone Amplifier—Cradle	£7·50
3	T1206 2 Station Intercomm	£4·95
4	T1306 3 Station Intercomm	£9·95
5	T1406 4 Station Intercomm	£12·50
6	TAIA 2 Station Telephones Intercomm	£13·50
7	W1.2 2 Station Wireless Intercomm	£18·20
8	DP303 Door Phone Intercomm	£7·00
9	PK3 ETCH your own printed circuits	£2·25
10	EA41 Reverberation amplifier	£11·75
11	US50 Ultrasonic switch	£12·75
12	XP4002 Photoelectric alarm system	£13·50
13	Solid state tachometer	£11·30
14	Power dash transistor assisted ignition	£13·50
15	Car auto lock	£2·75
16	4 amp 6-12 volt battery charger	£4·85
17	FF21 Car radio/tape quad adaptor	£4·68
18	Fully disappearing car aerial	£2·00
19	Electric disappearing car aerial	£7·80
20	ET (F1009) Morse Code Key/Buzzer	£1·70
21	VH105 aircraft band convertor	£4·50
22	LM300 50K Disco mic.	£12·95
23	DF50B 50K Communications mic.	£5·75
24	Car lighter plug 12v voltage adaptors 300mA (state 6/7½/9 volt)	£1·95 ea.
25	STC time delay module	£1·50
26	Gravenire 931A photo electric unit (with data)	£3·50
27	3 ch. 3 x 500 watt sound to light	£21·50
28	3 ch. 3 x 1000 watt sound to light plus overide	£41·25
29	150w. light display projector with wheel	£23·50
30	MM1 (B2005) 4 channel 9 volt mixer	£4·20
31	MX100 deluxe 4 channel mixer	£6·78
32	H67 (G1320) Stereo headphone amplifier	£10·50
33	MP12 6-CH. Slider control mixer	£27·95
34	RE 208 stereo phone adaptor	£2·25
35	MD802 stereo phones	£2·20
36	CIS200 stereo phones	£2·75
37	CIS 250 stereo phones	£6·50
38	G1301 and G1305 stereo phone controls	£2·95
39	Car stereo speakers in pods. Special offer	£2·95 pr.
40	Crystal lapel microphone	£0·60
41	E1052 car speakers front/rear fadar	£1·00
42	Bib Groove Clean (Ref. No. 42)	£1·76
43	Bib Record care kit (Ref. No. 43)	£2·20
44	Bib cassette recorder care kit (Ref. No. 26A)	£1·96
45	Bib cassette Tape splicing kit (Ref. No. 24)	£1·64
46	BASF reel-reel Hobby Box	£2·40
47	2000 OHM Headphones	£1·50
48	4000 OHM Headphones	£1·55
49	Cassette Recorder Mic. (2½ x 3½mm Plugs)	£1·85
50	420 ES Microscope	£5·70
51	UP050 Low cost 9 volt eliminator	£2·25
52	RE 527K Tape Head Demagnetiser	£1·70
53	Cambridge pocket calculator	£16·95
54	BC808 % Pocket calculator	£21·95
55	BC817 Memory pocket calculator	£28·95
56	BCM 850 % and memory calculator	£33·25
57	Sinclair scientific calculator	£22·50
57A	Sinclair Cambridge Memory	£23·95
58	Antex soldering iron kit (SKI)	£3·30
59	Bib record care kit (Ref. No. 59)	£1·17
60	5pc Chassis punch kits	£5·50
61	Longs desoldering tool	£3·50
62	1 amp in line mains suppressors	£2·50
63	BSS2 (E1013) 7 way stereo speaker switch	£2·20
64	Weller 8200D-PK expert gun kit	£6·20
65	'S' Dec breadboard	£1·98
66	'2' Dec breadboard	£4·29
67	'4' Dec breadboard	£7·50
68	'T' Dec breadboard	£3 65
69	Instant head soldering gun	£2 30
70	40 watt soldering iron	£1 90

ELECTRONIC COMPONENTS



(Post/Packing 15p per 1-6 items GB unless stated)

Ceramic Filters Miniature 10·7 MHZ filters 40p pair.
IC IF Unit CA3089 10·7 MHZ IC £2·94
Sinclair 6 w. IC IC12 with data and PC board £2·10 **Radio IC Chip** ZN414 Radio IC with circuit £1·20
Stereo Cassette Tape Head Replacement for most recorders £2·20
Strobe Tubes ZFT8A (similar to 4A) £4·00 ZFT12A £5·00



7 segment indicators 3015F with data £1·70 ea
Spring delay units HR42 9" twin spring £3·30 pp 20p HR16" twin spring £6·85 pp 25p
IC Clock MM 5314 single chip clock with CCT £9·00
Ultrasonic transducers with data/circuits £5·90 pr

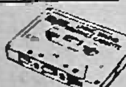
Fibre optics 0·01" diam. mono filament £5·50 per 100 metres
0·13" diam. 64 fibres £1 per metre
15m diam mares tails £10·50 each
Radio Control XTALS Matched pair for 465 KHZ IF £2·00 pr. for all supernet trans. RX's
Handsets Lightweight telephone handsets brand new complete with diagrams for intercomms £3·00 pr.

MARRIOT TAPE HEADS

'17' High Impedance	£2·50
'18' Med. Impedance	£3·50
'36' Med. Impedance	£5·00
Erase Heads for '17' '18' and '36'	75p
'63' 2 track mono. High Imp.	£1·75
'43' Erase Head for '63'	75p
Stereo Cassette Head	£1·20
Boben UL90 Erase	£1·50

(Post, etc. 15p any quantity)

QUALITY CASSETTE TAPES



"Living Sound" made specially for Henry's by EMP Tapes Ltd. 5 screw type with library case Post paid (GB)

	3 for	6 for	10 for	25 for
C60	£1·10	£2·00	£3·15	£7·50
C90	£1·47	£2·85	£4·65	£11·37
C120	£1·83	£3·54	£5·60	£14·00

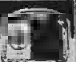
SPECIAL OFFER CASSETTE STORAGE

Rotating unit up to 32 cassettes stackable £3·60 pp 15p
Car unit with bracket for 10 cassettes £2·80 pp 10p

ELECTRONIC COMPONENTS & EQUIPMENT

More selection — bigger stocks of electronic components and equipment for supply purpose. Let us quote for your requirements
(Please enclose large SAE with all enquiries)

BUILD IT YOURSELF



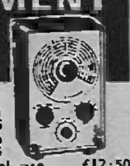
MW/LW Portable radio £7·98 pp 32p
MW/LW Radio tuner £5·25 pp 20p
9 volt regulated power supply £2·15 pp 15p
15 watt inverter £5·20 pp 30p
40 watt inverter £6·80 pp 40p
Sinclair micromatic radio £2·25 pp 15p
Sinclair Cambridge Calculator £13·84 post paid

MULTI-KITS

Ready to use and use again. Educational and practical All transistor circuits with full handbacks.

10 in 1, 10 projects £5·95 Post 20p
50 in 1, 50 projects £13·95 Post 25p
150 in 1, 150 projects £21·50 Post 30p
Radionic X 20, 20 (Elec.) Projects £4·95 Post 20p
Radionic X 40 40 (Radio) Projects £9·45 Post 20p

TEST EQUIPMENT
MULTI-METERS

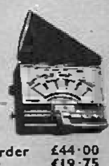


(carr./packing 35p)

U4324, 20k/V with case	£9·25
U435, 20k/V with steel case	£8·75
U4313, 20k/V with steel case	£12·50
U4317, 20k/V with case	£16·50
U4341, 33k/V + transistor tester steel case	£10·50
U4323, 20k/V plus 1KHZ 465KHZ OSC with case	£7·70
ITI-2, 20k/V slim type	£5·95
THL33D (L33DX) 2k/V Robust	£7·50
TP55N, 20k/V (Case £2·00)	£8·25
TP10S 2K/V	£6·25
TW20S 20K/V	£10·00
TW50K 50K/V	£11·25
EP10KN 10K/V	£9·95
AF105 50k/V Deluxe (case £1·90)	£12·50
S100TR 100k/V Plus trans. tester	£22·50

General Test Equipment

(† carr/pack 50p. *carr./pack 30p unless stated)
New Revolutionary Supertester 680R
680R Multi-tester £18·50



Accessories

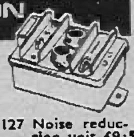
Transistor tester	£11·00
Electronic volt.	£18·00
Ampclamp	£11·95
Temp. probe	£11·95
Gauss meter	£11·95
Signal injector	£5·95
Phase Sequence	£5·95
EHT Probe	£5·95
Shunts 25/50/10A	£4·50

†3100 IMA Stripchart recorder	£44·00
†TE40 AC Multi voltmeter	£19·75
†TE15 Grid dip meter 440KHZ-28MHZ	£19·95
†TE65 28 Range valve voltmeter	£22·50
†Tk20D RF Generator 120-KHZ 500MHZ	£18·95
†Tk22D AF Gen 20HZ-200KHZ	£19·95
*HM350 In circuit transistor tester	£19·50
*C3025 Deluxe meter 1—300 MHZ	£6·95
*TT145 Compact transistor tester	£14·75
†G3-36 R/C osc. 20HZ-200 KHZ	£19·75
*C3042 SWR Meter	£5·75
*SE350A Deluxe signal tracer	£12·95
*SE400 Mini-lab all in one tester	£15·50
CI–5 Scope 500,000 KHZ (carr. £1)	£43·00
*C3043 5 CH F/A meter 1—300 MHZ	£5·75
Resistance sub box } Post, etc. 20p	£2·40
Capacitator } Post, etc. 20p	£2·10
2 amp var. transformers (carr. £1)	£6·55
Radio activity counter 0–10 (carr. £1)	£9·97
Mains unit for above (carr. 50p)	£3·75

PA-DISCO-LIGHTING Equipment

Without doubt UK's best range of modular and complete equipment. Lighting, mixing, microphones, accessories, speakers, amplifiers, lenses, etc., etc FREE stock lists (Ref. No. 18) on request
CALL IN AND SEE FOR YOURSELF AT HENRY'S DISCO CENTRE 309 EDGWARE ROAD 01-723 6963

AMTRON KITS



310	Radio control reciever £3·29
300	4-channel R/C trans £6·61
345	Superhet R/C receiver £6·61
65	Simple transistor tester £1·66
115	8watt amplifier £4·50
120	12watt amp £4·73
125	Stereo control unit £6·61
127	Noise reduction unit £9·55
157	Private TV loop Trans. £4·95
130	Mono control unit £4·16
605	Power Supply for 115 £5·31
610	Power supply for 120 £5·31
615	Power supply for 2 x 120 £6·64
230	AM/FM aerial amplifier £3·29
240	Auto packing light £6·90
275	Mic. preamp £6·98
525C	120-160 MHZ VHF tuner £11·31
570S	LF generator 10Hz-1mHz £21·45
575S	Sq. wave generator 20Hz-20Khz £19·77
590	SWR meter £9·47
630	STAB Power supply 6-12v 0·25-0·1A £9·24
690	DC motor speed Gov. £3·31
700	Electronic Chaffinch £7·92
707	Windscreen wiper timer £7·97
760	Acoustic switch £12·57
780	Metal Detector (electronics only) £10·91
790	Capacitive Burgular alarm £7·92
835	Guitar preamp. £4·99
840	Delay car alarm £6·99
875	CAP. Discharge ignition for car engine(–Ve Earth) £13·19
80	Scope Calibrator £2·65
255	Level indicator £6·98
525	120-160mHz VHF timer £11·31
715	Photo cell switch £8·97
795	Electronic continuity tester £4·97
860	Photo timer £15·51
235	Acoustic Alarm for driver £8·61
465	Quartz XTAL checker £9·90
220	Signal injector £2·65
390	VOX £13·62
432	Testakit £21·83
670	Buffer Battery Charger £7·59

8% TO BE ADDED TO ALL ORDERS
(Export VAT FREE)

HENRYS ELECTRONICS & HI FIDELITY CENTER NOW OPEN IN BRUSSELS, BELGIUM prices, VAT, stock etc subject to Belgian regulations

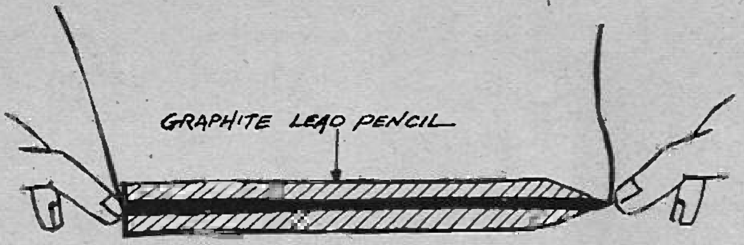
FOR MORE ELECTRONICS, SEE BACK PAGE

Henry's RADIO
EDGWARE ROAD, W2

Electronic Centres
404-406 Electronic Components & Equipment 01-402 8381
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road, London W2 1BW

Hi Fi and Electronics Centres Open 9 am - 6 pm

Prices correct at time of preparation. Subject to change without notice. E.&O.E.



A graphite pencil can be used as a resistor by connecting a wire to each end.

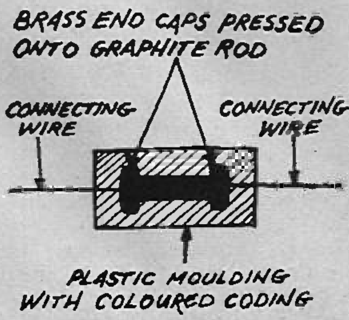
disconnected the Prof's. experimental resistor from his oscillator, and connected the two wires of the oscillator to the ends of the graphite pencil. A high pitched note immediately sounded from the earpiece. "It's graphite!" he exclaimed, "This pencil is acting as a resistor!"

"This is because there is a continuous length of graphite from one end of the pencil to the other," said the Prof., "and because of this, a word of warning, always keep pencils, or anything which might carry current, away from mains live wires, because if you touch a live wire with a conductor, electricity can flow along it and give the person holding it a dangerous shock. It is quite safe to connect a pencil to your oscillator, however, because only a low voltage is present from the battery."

Bob picked up several pencils and tested them with the oscillator. Each one produced a different note. "Prof! I've just discovered that the harder pencils produce a lower note than the soft ones! The 5B pencil produces an extremely high note, the 8H pencil produces the lowest one, and the others are in order between!"

"The results of this simple experiment are very interesting," observed the Prof., "because you can now demonstrate one method which is used by resistor manufacturers to determine the values of the resistors they produce. Graphite is normally a soft black solid, and lumps of pure graphite are so soft that when they are rubbed on paper, some of the graphite rubs off and marks the paper. For harder pencils, the graphite is mixed with finely powdered clay, and this gives it higher electrical resistance. This is why the hard pencils give a lower note with your oscillator. Resistor manufacturers use the same principle to produce different values of carbon composition resistor."

"If you examine the construction of a commercially made carbon composition resistor, you will easily notice that it is very similar to the construction of a graphite pencil. Both consist of a graphite rod inside a tube. The resistor has small metal caps on the ends of the rod, so that connecting wires can be attached by soldering, welding or crimping. By changing the proportion of clay which is mixed with the graphite, the value of the resistor in ohms can be altered."



Basic construction of a commercial carbon composition resistor.

Bob had drawn a thick black pencil line on a piece of paxolin, and whilst listening to the Prof., he had gone over it several times using a soft graphite pencil. Now he applied the two wires which he had used to connect the oscillator to the pencils, to the ends of the pencil line. A series of clicks came from the earpiece.

Bob moved the two wires closer together, whilst keeping them in contact with the pencil line. The clicks sounded at a faster and faster rate until the result was a low, buzzing note. As he moved the wires even closer to each other, the pitch of the note became higher and higher. By connecting the wires to different parts of the graphite pencil track on the paxolin, Bob found that he could produce different musical notes.

"Fantastic!" he exclaimed. "This gives me an idea for the School Science Fair!"

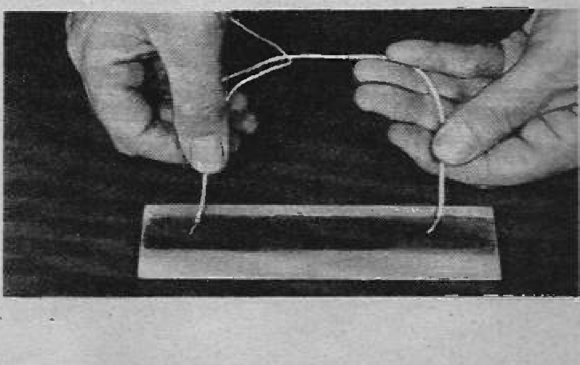
He began trying to play a tune!

Just at that moment the Prof's. experimental robot, which he had earlier sent to find an ohm meter, appeared from another part of the laboratory. As it approached, Bobs attempts to play a tune with his oscillator began to have a remarkable effect on the robot! What he had not noticed, was that his efforts were producing a series of clicks and whistles very similar to those sounds which the Prof. had earlier used to give his instructions to the robot!

As the robot approached to deliver the ohm meter to the Prof., each note of Bob's oscillator caused peculiar and somewhat sinister movements. The Prof. watched with awed fascination as the big metal robot drew nearer and nearer. The reader may well imagine that the clicks and buzzes from the oscillator were not giving the robot the proper instructions at all! Could it be that the tune he was playing might drive the powerful robot berserk?

Continued next month!

A type of variable resistor that Bob made by drawing with a graphite pencil on a piece of paxolin.



DOWN TO EARTH

By GEORGE HYLTON

"The man in my local component shop finds the turns ratio of a transformer by comparing the resistances of the primary and the secondary windings. Does this work?"

No, it doesn't. At least not in most cases. The one case in which it does work, in theory, anyway, is when the turns ratio is unity: i.e. when it's a "1 to 1 transformer". This is a good point from which to start so let's look at the problem in a simplified form. Suppose a transformer has a one-turn primary and a one-turn secondary, giving unity turns ratio. If the turns are the same length and made from the same thickness of wire then they must have the same resistance, so in this case the resistance ratio is the same as the turns ratio.

CONSTRUCTION

In a good transformer the primary and secondary should together fill the bobbin which holds the windings, and the space should be divided equally between them. A cross-section of our one-turn design is then as shown in Fig. 1a. Here the bobbin is of the two-slot kind with a central partition to insulate primary from secondary. However, we aren't interested in the bobbin itself so from now on I'll leave it out and just show the windings.

You'll have noticed that we have used square wire. That's best, in this case, because it fills up the space completely, as a good winding should. We will use whatever shape of wire does so, in this article—even if there's no such wire in real life. Changing to round wire doesn't affect the argument. But it's not so easy to visualise what's up when, as in Fig. 1b, the primary is given two turns by using rectangular wire—made by splitting a length of the original square wire down the middle!

Now, each turn of this rectangular wire has half the cross-sectional area of the square, so each turn has twice the resistance. Since there are two turns, each with twice the resistance, the total resistance is four times the resistance of the square turn. So the resistance ratio (primary to secondary) is 4, or, if you insist 4 to 1. This is twice the turns ratio, so the component shop's method doesn't work now.

In Fig. 1c, the wire is split again, giving four turns, each of four times the original "square" resistance, that is 16 times the secondary resistance when the turns ratio is 4. Now, 16 is 4 squared and 4 is 2 squared. If you try splitting the primary into other numbers of turns, say 3 or 8 you'll find that the resistance ratio is always the square of the turns ratio. So the shopkeeper says the ratio is 100 to 1 when it's really only 10 to 1!

PRACTICAL TRANSFORMERS

You ought to be able to find the turns ratio, by taking the square root of the resistance ratio. Unfortunately it still doesn't work. The reason is that real transformers aren't like Fig. 1. Most bobbins aren't divided. The windings are put one on top of the other, e.g. as in Fig. 2.

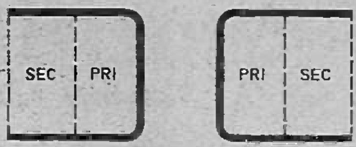


Fig. 2. Practical transformer bobbin showing secondary wound over primary.

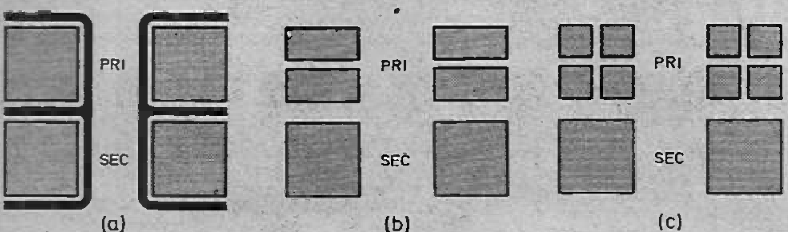
Here the primary turns, being on the inside of the bobbin, are shorter than the secondary turns, which are on the outside. So even if primary and secondary are wound with the same wire, and have equal numbers of turns, the primary has a lower resistance. So the rule doesn't work, in practice, even for a 1 to 1 transformer.

If the turns ratio is unequal, the insulation on the winding which uses the thinner wire wastes a greater proportion of the space and leaves less room for the conductor, and this further distorts the picture. In many transformers, the winding space isn't equally divided between primary and secondary, as it should be, and this upsets the resistance ratio too. So even the square root of the resistance ratio is a pretty poor guide to the turns ratio in practice.

That being so, how do you measure the turns ratio?

For audio transformers (and most mains transformers) the best method of all is to use a bridge (Fig. 3). The potentiometer is set for balance (sound in phones vanishes). Then the turns ratio (*L1* to *L2*) is the same as *R1*/*R2*. If the bridge won't balance, reverse the connections to one winding.

Fig. 1. Cross section of various side-by-side wound transformer bobbins.



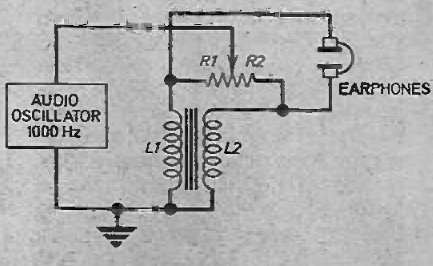
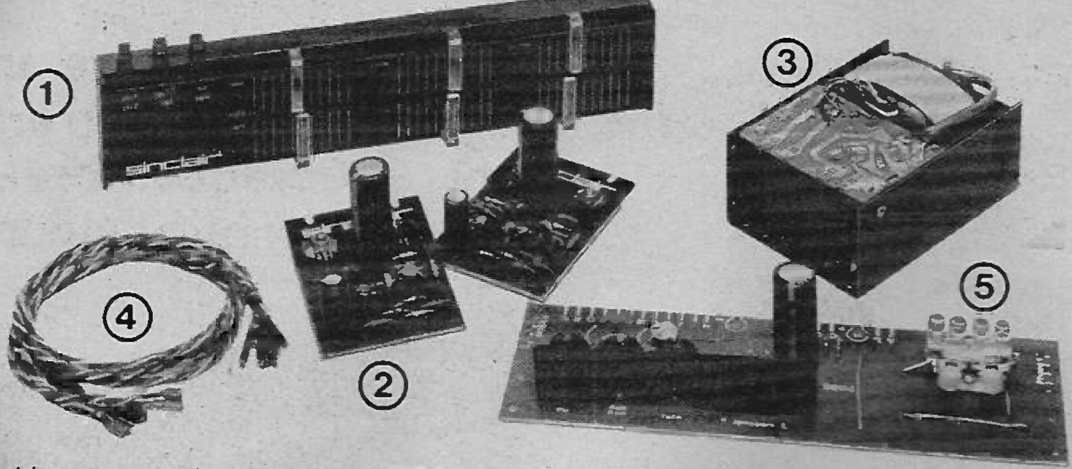


Fig. 3. A bridge method for determining turns ratio.

Forward with Project 80 into



Everything you want in one pack to build the world's most advanced modular hi-fi WITHOUT SOLDERING

1 Stereo 80 Control Unit
For mag. and ceramic cartridges, radio and tape.

2 Project 80 power amplifiers
Two Z.40s to give 8/8 watts R.M.S. output per channel.

3 Power supply unit
One PZ.5.

4 Connecting wires
All wires plus nuts, bolts, screws etc.

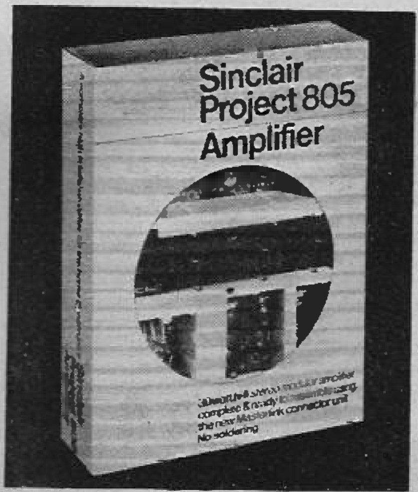
5 Project 805 Masterlink
For input and output connections.

6 Mains switch block and instructions manual (not illustrated).

This is Project 80 made even easier to build

You have seen how the marvellously compact Project 80 modules (only 2" high × ½" deep) are so adaptable and easy to install. Now, with Project 805, this wonderful system is made easier still to put together. In this, you have not only all the Project 80 modules in one pack for building an 8/8 watt R.M.S. hi-fi amplifier – there is also a loom of colour coded wires cut to length and tagged for clipping on so that you don't even have to solder! Input and output connections go via the 805 Masterlink panel. With the explicit stage-by-stage large 32 page instructions manual included, it becomes easy for anyone, no matter how inexperienced to install an ultra-modern assembly so advanced in appearance and design that it sets brand new concepts in domestic hi-fi – and of course, you can convert to quadraphony just whenever you wish by adding 805SQ. Only Sinclair know-how and manufacturing facilities could hope to bring you such quality and versatility.

TAGGED WIRES CUT TO LENGTH·NO SOLDERING



Project 805

the complete ready·to·build hi·fi STEREO AMPLIFIER

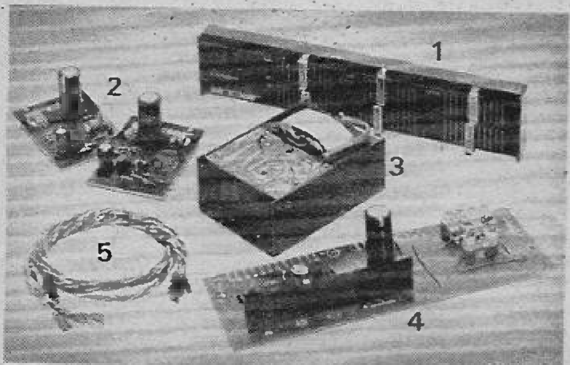
Project 805 comprises a Stereo 80 Pre-amp/Control Unit with input for both magnetic and ceramic cartridges, radio, tape; separate bass and treble cut/lift, and volume controls 2 × Z.40 power amplifiers, PZ.5 power unit, 805 Masterlink, wire loom, instructions manual, etc. down to nuts, bolts and washers.

£39.95
+£3.20 VAT (R.R.P.)

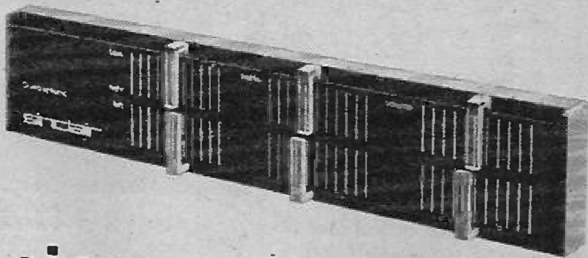
sinclair

SINCLAIR RADIONICS LTD
London Rd, St. Ives, Huntingdon PE17 4HJ
Telephone St. Ives (0480) 64646

true quadraphonics... NOW!



The most effective and economical way to enjoy this spectacular break-through in hi-fi listening



1. Project 80SQ decoder with controls.
2. Two Z.40 power amplifiers.
3. PZ.5 power pack
4. Project 80Q Masterlink unit.
5. Wire loom, with clip-on tags – NO SOLDERING!
6. (Not illustrated) Instructions manual, nuts bolts, washers, etc.

Add a fourth dimension to your stereo sound

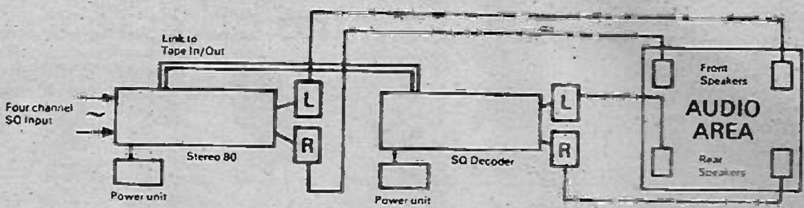
Project 80SQ Decoder (available separately)

£18·95 + £1·52 VAT

It's so simple to convert to quadraphonics when you already have Project-80, or are about to start with Project 805. Project 805SQ is a complete add-on system at the heart of which is the Project 80SQ decoder. It uses the CBS.SQ matrix principle, by now the widest used method of containing four sound channels within the groove of the record. Project 805SQ includes two power amplifiers, power supply unit, connecting wire loom, 805Q Masterlink, switch block and instructions manual. The 80SQ decoder (also obtainable separately) has independent tone and volume slider controls on the two rear channels for matching true four channel sound to domestic environment. Project 805SQ is money saving too since you do not have to scrap existing Project 80 equipment to enjoy the newest and most exciting form of home listening in the entire history of sound, and your Project 80 quadraphonic assembly is compatible with stereo and mono records.

- Frequency response ± 3db 15 Hz–25kHz
- Rated output 100mV
- S/N ratio 58d8
- Distortion 0·1%
- Power requirements 22-35 volts
- Phase shift network 90° ± 10° 100 Hz-10kHz
- Adaptable to discrete (CD4) use

Project 805SQ



The output from any good stereo cartridge feeds into Stereo 80 and passes via the tape outlet to the 80SQ decoder. Here the signal is separated into its constituent 4 channels, those for the front being accepted by the Stereo 80, those for the rear going from the decoder to the two additional power amplifiers and speakers.

£44.95

+£3.60 VAT (R.R.P.)

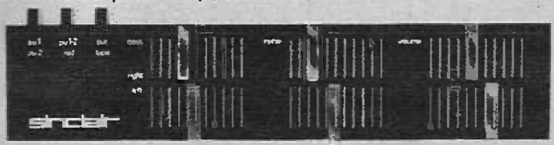
Guarantee If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair Appointed Stockists also offer this guarantee. Should any defect arise in normal use within 2 years, we will service it without charge. For damage arising from mis-use a nominal charge will be made.

All Project 50 modules, Project 805 and Project 805SQ are obtainable from your local Sinclair stockist or direct, post free, in case of difficulty

The Project 80 programme to date

KEEP THIS PAGE FOR HANDY REFERENCE ***USE THE PRIORITY ORDER FORM IN CASES OF DIFFICULTY***

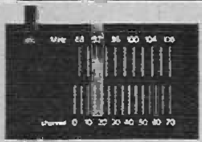
Stereo 80 pre-amp/control unit



260 × 50 × 20mm (10½ × 2 × ¾ ins.) separate slider controls on each channel for treble, bass and volume. INPUTS – Mag. P.U 3mV (RIAA corrected) ceramic – 300mV. Radio 100mV. Tape 30mV. S/N ratio 60dB. Frequency range – 20Hz to 15KHz ± 1dB. OUTPUTS – 2·5V rms max (30V. supply) and tape plus AB monitoring. PRESS BUTTONS for P.U., Radio and Tape. Operating power – 20 to 35V. Black case with white indications

£13.95 + £1.12 VAT (R.R.P.)

Project 80 F.M. tuner



Size 85 × 50 × 20mm (3½ × 2 × ¾ ins.). Tunes 87·5 to 108MHz. DETECTOR – I.C balanced coincidence (I.C equivalent to 26 transistors) Distortion – 0·2% at 1KHz for 30% modulation. SENSITIVITY – 5 microvolts for 30dB quieting. Output – 300mV for 30% modulation. Aerial imp. – 75 Ω or 240-300 Ω. Dual Varicap tuning. 4 pole ceramic filter. Switchable A.F.C. Operating power 23-30 volts.

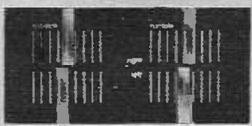
£13.95 + £1.12 VAT (R.R.P.)

Project 80 stereo decoder

Size 47 × 50 × 20mm For adding to Project 80 FM tuner. With one I.C equal to 19 transistors, and LED indicator which glows on tuning in stereo signal.

£8.95 + 72p VAT (R.R.P.)

Project 80 active filter unit (A.F.U.)



Size 108 × 50 × 20mm. Useful where there is need to eliminate unwanted high frequencies (scratch, whistle, etc) or low (rumble). Voltage gain – minus 0·2dB. Frequency response (filter at zero) 36Hz to 22KHz. H.F cut (scratch) variable from 22KHz to 5·5KHz 12dB/octave slope. L.F cut (rumble) – 28dB at 28Hz, slope 9dB/octave.

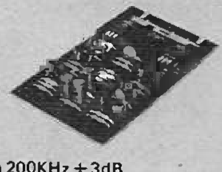
£7.45 + 60p VAT (R.R.P.)

Project 80 power amplifiers

Intended for use in Project 80 installations, these modules readily adapt to an even wider range of applications. Both incorporate built-in protection against short circuiting and risk of damage from mis-use is greatly reduced

Z.40
Size – 55 × 80 × 20mm
9 transistors
Input sensitivity – 100mV
Output – 12 watts RMS continuous into 8 Ω (35v)
Frequency response – 10Hz – 100KHz ± 1dB
S/N ratio – 64dB
Distortion – 0·1% at 10 watts into 8 Ω at 1KHz
Power requirements – 12 to 35 volts

£5.95 + 48p VAT (R.R.P.)



Z.60
Size – 55 × 98 × 20mm
12 transistors
Input sensitivity – 100-250mV
Output – 25 watts RMS continuous into 8 Ω (50V).
Distortion – 0.02% at 10W/8 Ω/1KHz
Frequency response – 10Hz to more than 200KHz ± 3dB
S/N ratio – better than 70dB
Built-in protection against transient overload and short circuiting
Load impedance – 4 Ω min; max. safe on open circuit

£7.45 + 60p VAT (R.R.P.)

Power-supply units

PZ.5 Unstabilized. 30 volts. Suitable for Z.40 assemblies, etc. **£5.95** + 48p VAT (R.R.P.)

PZ.6 Stabilized. Output voltage adjustable between 20 and 50 volts approx. Protecting fuse. **£8.95** + 72p VAT (R.R.P.)

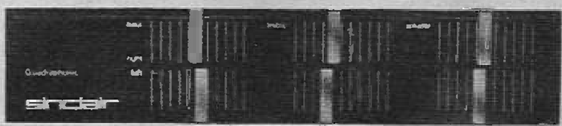
PZ.8 Stabilized. Output adjustable from 20 to 60V. approx Re-entrant current limiting makes damage from overload or even shorting impossible. Without mains transformer.

£8.45 + 68p VAT (R.R.P.)

Project 805 (previous pages) **£39.95** + £3.20 VAT (R.R.P.)

Project 805SQ quadraphonic add-on kit **£44.95** + £3.60 VAT (R.R.P.)

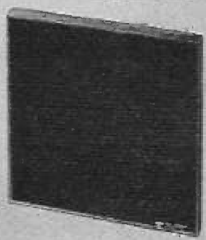
Project 80SQ quadraphonic decoder



Size 260 × 50 × 20mm, matching Stereo 80 in style. Connects with tape socket on stereo 80 or similar facility on any stereo amplifier. Frequency response 15Hz to 25KHz ± 3dB. Distortion 0·1%. S/N ratio 58dB. Rated Output – 100mV. Separate bass and treble slider controls on each channel, also volume. Phase shift network 90° ± 10° 100Hz to 10KHz. Operating power – 22-35V.

£18.95 + £1.52 VAT (R.R.P.)

Sinclair Q.16 loudspeaker



An original and uniquely designed speaker of outstanding efficiency. Balanced sealed sound chamber and special driver assembly. Loads up to 14 W./R.M.S. 8 ohms imp. Size 248mm square × 120mm deep. Pedestal base. All-over black front, teak surround.

£8.95 + 72p VAT (R.R.P.)

sinclair

Sinclair Radionics Ltd.,
London Road St. Ives
Huntingdonshire PE17 4HJ
Telephone St. Ives (0480) 64311
R.O. St. Ives: Reg No. 6994583 Eng.

USE THIS PRIORITY ORDER FORM IN CASES OF DIFFICULTY

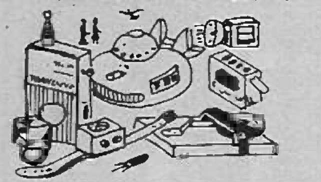
To Sinclair Radionics Ltd.
Please send, (carriage paid in U.K.)
. . . .
. . . .
. . . .
For which I enclose £ . . . . cash/cheque/money order INCLUDING V.A.T.

NAME . . . .

ADDRESS . . . .
. . . .
. . . .

EXPERIMENTER PRINTED CIRCUIT KIT BUILD 60 INTERESTING PROJECTS

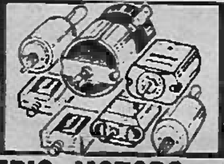
CONTENTS: (1) 2 Copper Laminate Boards 4½in. × 2½in. (2) 1 Board for Matchbox Radio. (3) 1 Board for Wristwatch Radio, etc. (4) Resist. (5) Resist Solvent. (6) Etchant. (7) Cleanser/Degreaser. (8) 16-page Booklet Printed Circuits for Amateurs. (9) 2 Miniature Radio Dials SW/MW/LW. Also free with each 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.

ONLY £1 FOR 7



ELECTRIC MOTORS

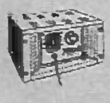
7 powerful battery motors as used in racing cars and power models. Output and types vary to make them suitable for hundreds of different projects—tools, toys, models, etc. All brand new, reversible and for 1½ to 12v. Bats., wiring diagrams included. Post and VAT 30p.

FREE Details of how to make miniature power station.

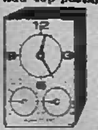
BSR TAPE DECK TWIN CHANNEL

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 quantity— 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.

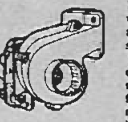
Radio from mains	£1·20
Cassette from mains	£1·50
Cassette or radio from car (stabilized)	£2·10

AMPLIFIER PANELS

Very nice looking, polished black presephan with fixing holes. 6 phono sockets and changeover slide switch and is printed as sketch. Price is 30p.

RADIO STETHOSCOPE

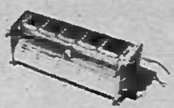
Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece, £2·20—twin stethoset instead of earpiece 83p extra—post and ins. 20p.



CENTRIFUGAL BLOWER

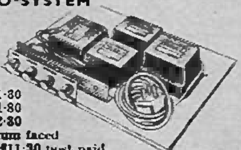
Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½" × 4½" × 4". When mounted by flange, air is blown into the equipment but to suck air out, mount 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	£1·80
1 Unilex Pre-Amp	Ref. EP.9001	£1·80
1 Unilex Power Unit	Ref. EP.9002	£2·80

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. 2½" x 1½" x 4½". 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.

MORSTMANN 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.

DIMENSIONS

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 × ⅞" diameter. Ideal for hand held fan, propellor driven model etc. 20p each, 10 for £1·80.

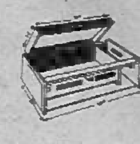
LUMINOUS ROCKER SWITCH ON/OFF

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

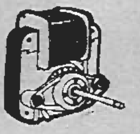
Make and break 20A a.c. with the sensor probe coupled by a 2 feet capillary covering range of 10-100°C—complete with large engraved control knob. Price 88p.

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.

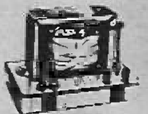
2.

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 R-A elliptical 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.

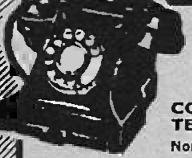
TERMS:—
Add 8% V.A.T.
Send postage where quoted—other items, post free if order for these items is £6·00, otherwise add 30p.

J. BULL (ELECTRICAL) LTD.
(Dept. E.E.), 102/103 TAMWORTH RD., CROYDON CRO IXX.

56 Holcombe Vale

BI-PRE-PAK

SUPPLIERS OF SEMI-CONDUCTORS TO THE WORLD



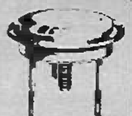
Telephone Corner

COMPLETE TELEPHONES
Normal Household Type

EX. G.P.O. only **99p** P & P 45p each

TELEPHONE DIALS
Standard Post Office type. Guaranteed in working order.
only **25p** POST & PACKING 15p

Tested and Guaranteed Paks



B79	4	1N4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, 1" long, ⅛" dia. High Speed P.O. type	50p
H35	100	Mixed Diodes, Germ, Gold bonded, etc. Marked and Unmarked.	50p
H38	30	Short lead Transistors, NPN Silicon Planar types	50p
H39	6	Integrated Circuits. 4 Gates BMC 962, 2 Flip Flops BMC 945	50p
H41	2	Sil Power transistors comp pair BD131/132	50p
H63	4	2N3055 type NPN Sil. power transistors. Below spec. devices	50p
H64	4	3819 N Channel FETs 2N3819 in plastic case	50p

Unmarked Untested Paks

B1	50	Germanium Transistors PNP, AF and RF	50p
B66	150	Germanium Diodes Min. glass type	50p
B83	200	Transistors, manufacturers rejects, AF, RF, Sil. and Germs.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	100	Sil. Diodes sub. min. IN914 and IN916 types	50p
H34	15	Power Transistors, PNP, Germ, NPN Silicon TO-3 Can.	50p
H67	10	3819N Channel FETs plastic case type	50p

Make a rev counter for your car

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system. **£1·00p each**

Electronic Transistor Ignition £6·00

Complete kit p. & p. 11p

Now in kit form, we offer this "up-to-the-minute" electronic ignition system. Simple to make, full instructions supplied with these outstanding features. Transistor and conventional switchability, burglar proof lock-up and automatic alarm, negative and positive compatability.

£2·50 p.p. 35p Per instrument
Extension Telephones
Ideal for childrens toys **70p** each P. & P. 25p.

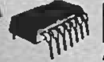
New X Hatch

Our new vastly improved Mark Two Cross Hatch Generator is now available

Essential for alignment of colour guns on all colour T.V. receivers. Featuring plug in IC's and a more sensitive sync. pick-up circuit. The case is virtually unbreakable—ideal for the engineer's toolbox—only measures 3" x 5½" x 3".

Ready built unit only **£9·95** Complete kit **£7·95**

(Includes p. & p. but no batteries)



LM380 AUDIO IC

We have just received a large consignment of LM380 IC's. These are specially selected to a higher grade and are marked with the number SL60745.
This fantastic little 3watt audio IC only requires two capacitors and two potentiometers to make an amplifier with volume and tone control. The quality is good and has to be heard to be believed.

Our special price **£1·00ea** complete with data and projects book

Over 1,000,000 Transistors in stock

We hold a very large range of fully marked, tested and guaranteed transistors, power transistors, diodes and rectifiers at very competitive prices. Please send for free catalogue.

Our very popular 4p transistors

TYPE "A" PNP Silicon alloy, TO-5 can
TYPE "B" PNP Silicon, plastic encapsulation
TYPE "E" PNP Germanium AF or RF
TYPE "F" NPN Silicon plastic encapsulation
TYPE "G" NPN silicon similar ZTX 300 range
TYPE "H" PNP silicon similar ZTX 500 range

8 RELAYS FOR VARIOUS TYPES P & P 27p **£1·00p**

UHF TV Tuner Units

Brand new by a famous manufacturer

Data supplied **£2·50**

Plastic Power Transistors

NOW IN TWO RANGES

These are 40W and 90W Silicon Plastic Power Transistors of the very latest design, available in NPN or PNP at the most shatteringly low prices of all time. We have been selling these successfully in quantity to all parts of the world and we are proud to offer them under our Tested and Guaranteed terms.

Range 1. VCE. Min 15. HFE Min 15.	1-12	13-25	26-50
40 Watt	20p	18p	16p
90 Watt	24p	22p	20p

Range 2. VCE. Min. 40. HFE Min 40	1-12	13-25	26-50
40 Watt	30p	28p	26p
90 Watt	35p	33p	30p

Please state NPN or PNP on order.

High Speed Magnetic Counters 4 digit (non-reset) 24V or 48V 4 x 1 x 1 in 33p p & p 5p.

INTEGRATED CIRCUITS
We stock a large range of I.Cs at very competitive prices (from 18p each). These are all listed in our FREE Catalogue, see coupon below.

METRICATION CHARTS now available
This fantastically detailed conversion calculator carries thousands of classified references between metric and British (and U.S.A.) measurements of length, area, volume, liquid measure, weights etc.
Pocket Size 15p Wall Chart 18p

LOW COST DUEL IN LINE I.C. SOCKETS
14 pin type at 15p each } Now new low profile
16 pin type at 17p each } type

BOOKS
We have a large selection of Reference and Technical Books in stock. Details are in our latest Catalogue. Send for it TODAY, using the coupon below. N.B. Books are void of V.A.T.
Send for lists of publications

Our famous P1 Pak

is still leading in value

Full of Short Lead Semiconductors & Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

Please ask for Pak P.1. only 50p

Please send me the FREE Bi-Pre-Pak Catalogue I enclose large SAE with 5p stamp

NAME ....

ADDRESS ....

....

Please add current VAT rate

MINIMUM ORDER 50p. CASH WITH ORDER PLEASE. Add 15p post and packing per order OVERSEAS ADD EXTRA FOR POSTAGE

BUY THESE GOODS WITH ACCESS

BI-PRE-PAK LTD
Co. Reg. No 820919

Dept.D. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX.
TELEPHONE: SOUTHEND (0702) 46344.

Marshall's

Everything you need is in our New Catalogue available now price 20p
(100 pages of prices and data)

A. Marshall (London) Ltd. Dept. EE
42 Cricklewood Broadway London NW2 3HD Telephone 01-452 0161/2 Telex 21492
& 65 Bath Street Glasgow G2 2BX Telephone 041-332 4133

Call in and see us 9–5.30 Mon–Fri
9–5.00 Sat
Trade and export enquiries welcome

Popular Semiconductors

2N456 0·75
2N456A 0·75
2N457A 1·35
2N490 3·16
2N491 3·58
2N492 3·99
2N493 4·20
2N696 0·22
2N697 0·16
2N698 0·40
2N699 0·45
2N706 0·14
2N706A 0·16
2N708 0·17
2N709 0·42
2N711 0·50
2N718 0·23
2N718A 0·28
2N720 0·50
2N721 0·55
2N914 0·22
2N916 0·28
2N918 0·32
2N929 0·30
2N1302 0·19
2N1303 0·19
2N1304 0·24
2N1305 0·24
2N1306 0·31
2N1307 0·22
2N1308 0·25
2N1309 0·36
2N1671 1·44
2N1671A 1·54
2N1671B 1·72
2N1671C 4·32
2N1711 0·45
2N1907 5·50
2N2102 0·50
2N2147 0·78
2N2148 0·94
2N2160 0·60
2N2192 0·40
2N2192A 0·40
2N2913 0·40
2N2193A 0·61
2N2194 0·73
2N2194A 0·30
2N2218A 0·80
2N2219 0·45
2N2219A 0·22
2N2220 0·24
2N2221 0·26
2N2221A 0·18
2N2222 0·20
2N2222A 0·25
2N2368 0·25
2N2369 0·37
2N2369 0·41
2N2646 0·55
2N2647 1·12
2N9042 0·22
2N2904A 0·24
2N2905 0·24
2N2905A 0·25
2N2906 0·19
2N2906A 0·21
2N2907 0·22
2N2907A 0·24
2N2924 0·14
2N2926 0·11
2N3053 0·32
2N3054 0·60
2N3055 0·75
2N3390 0·26
2N3391 0·23
2N3391A 0·29
2N3392 0·13
2N3393 0·13
2N3394 0·13
2N3402 0·18
2N3403 0·19
2N3440 0·59
2N3441 0·97
2N3442 1·69
2N3414 0·10
2N3415 0·10
2N3416 0·15
2N3417 0·21
2N3638 0·15
2N3638A 0·15
2N3639 0·27
2N3641 0·17
2N3702 0·11
2N3703 0·12
2N3704 0·14
2N3705 0·12
2N3706 0·09
2N3707 0·13
2N3708 0·70
2N3709 0·11
2N3710 0·12
2N3711 0·11
2N3712 0·96
2N3713 1·20
2N3714 1·33
2N3715 1·50
2N3716 1·80
2N3771 2·20
2N3772 1·80
2N3773 2·65
2N3779 3·15
2N3790 2·40
2N3791 2·35
2N3792 2·69
2N3794 0·10
2N3819 0·37
2N3820 0·38
2N3823 1·42
2N3900 0·21
2N3901 0·32
2N3903 0·24
2N3904 0·27
2N3905 0·24
2N3906 0·27
2N4036 0·63
2N4037 0·42
2N4058 0·16
2N4059 0·09
2N4060 0·11
2N4061 0·11
2N4062 0·11
2N4126 0·20
2N4289 0·84
2N4919 0·84
2N4920 0·99
2N4921 0·73
2N4922 0·84
2N4923 0·83
2N5172 0·12
2N5174 0·22
2N5175 0·26
2N5176 0·32
2N5190 0·92
2N5191 0·95
2N5192 1·24
2N5195 1·46
2N5245 0·43
2N5457 0·49
2N5458 0·45
2N5459 0·49
40361 0·48
40362 0·50
40363 0·88
40389 0·46
40394 0·56
40395 0·65
40406 0·44
40407 0·33
40408 0·50
40409 0·52
40410 0·52
40411 2·25
40414 3·55
40430 0·85
40583 0·23
40601 0·67
40602 0·46
40603 0·53
40604 0·56
40636 1·10
40669 1·00
40673 0·70
AC107 0·51
AC113 0·16
AC117 0·20
AC126 0·20
AC127 0·20
AC128 0·20
AC151V 0·25
AC152V 0·17
AC153 0·25
AC153K 0·25
AC154 0·20
AC176 0·18
AC176K 0·25
AC187K 0·23
AC188K 0·34
ACY18 0·24
ACY19 0·27
ACY20 0·22
ACY21 0·26
ACY28 0·20
ACY30 0·58
AD142 0·57
AD143 0·45
AD149V 0·06
AD150 0·63
AD161 0·45
AD162 0·45
AD161 pr
AD162 1·05
AF109R 0·40
AF115 0·24
AF116 0·25
AF117 0·20
AF118 0·55
AF124 0·30
AF125 0·30
AF126 0·28
AF127 0·28
AF139 0·39
AF170 0·25
AF172 0·25
AF178 0·55
AF179 0·65
AF180 0·58
AF186 0·46
AF200 0·35
AF239 0·51
AF240 0·72
AF279 0·54
AF280 0·54
AL102 0·75
AL103 0·70
BC107 0·16
BC108 0·15
BC109 0·19
BC113 0·15
BC115 0·17
BC116 0·17
BC116A 0·18
BC117 0·21
BC118 0·11
BC119 0·29
BC121 0·23
BC125 0·16
BC126 0·23
BC132 0·30
BC134 0·13
BC135 0·13
BC136 0·17
BC137 0·17
BC138 0·24
BC140 0·34
BC141 0·29
BC142 0·23
BC143 0·25
BC145 0·21
BC147 0·12
BC148 0·13
BC149 0·12
BC153 0·18
BC154 0·18
BC157 0·14
BC158 0·13
BC159 0·14
BC160 0·37
BC167B 0·13
BC168B 0·13
BC168C 0·11
BC169B 0·13
BC169C 0·13
BC170 0·11
BC171 0·13
BC172 0·11
BC182 0·12
BC182L 0·12
BC183 0·09
BC183L 0·09
BC184 0·11
BC184L 0·11
BC186 0·25
BC187 0·27
BC207 0·12
BC208 0·11
BC212K 0·10
BC212L 0·16
BC214L 0·21
BC237 0·09
BC238 0·09
BC239 0·09
BC251 0·20
BC252 0·18
BC253 0·23
BC257 0·09
BC258 0·09
BC259 0·13
BC261 0·20
BC262 0·18
BC263 0·23
BC300 2·12
BC301 0·34
BC302 0·29
BC303 0·54
BC307 0·10
BC307A 0·10
BC308 0·09
BC308A 0·12
BC308B 0·09
BC309 0·10
BC309A 0·10
BC309B 0·10
BC237 0·21
BC238 0·19
BC337 0·19
BC338 0·19
BCY30 0·64
BCY31 0·64
BCY32 1·15
BCY33 0·45
BCY34 0·49
BCY38 0·55
BCY39 1·50
BCY40 0·87
BCY42 0·28
BCY58 0·21
BCY59 0·22
BCY70 0·17
BCY71 0·22
BCY72 0·13
BCY87 3·54
BCY88 2·42
BCY89 0·97
BD115 0·75
BD116 1·00
BD121 0·75
BD123 0·32
BD124 0·67
BD131 0·40
BD132 0·50
BD135 0·43
BD136 0·49
BD137 0·55
BD138 0·63
BD139 0·71
BD140 0·87
BDY20 1·05
BF115 0·25
BF116 0·23
BF117 0·43
BF119 0·58
BF121 0·25
BF123 0·27
BF125 0·25
BF152 0·20
BF153 0·21
BF154 0·16
BF158 0·23
BF159 0·27
BF160 0·23
BF161 0·42
BF163 0·32
BF166 0·32
BF167 0·21
BF173 0·24
BF177 0·29
BF178 0·35
BF179 0·43
BF180 0·35
BF181 0·34
BF182 0·40
BF183 0·40
BF184 0·30
BF185 0·30
BF194 0·12
BF195 0·12
BF196 0·13
BF197 0·15
BF198 0·18
BF199 0·18
BF200 0·40
BF225J 0·19
BF237 0·22
BF238 0·22
BF244 0·21
BF245 0·33
BF246 0·58
BF247 0·23
BF254 0·16
BF255 0·17
BF257 0·46
BF258 0·59
BF259 0·55
BFS21A 2·30
BFS28 0·92
BFS61 0·27
BFS98 0·25
BFX29 0·30
BFX30 0·27
BFX44 0·33
BFX63 2·48
BFX68 0·30
BFX84 0·24
BFX85 0·30
BFX87 0·28
BFX88 0·25
BFX89 0·45
BFY18 0·52
BFY19 0·62
BFY20 0·50
BFY29 0·40
BFY50 0·23
BFY51 0·23
BFY52 0·21
BFY53 0·18
BFY90 0·75
BRY39 0·48
BU104 2·09
BU105 2·25
C106A 0·46
C106B 0·55
C106D 0·65
C106E 0·43
CA3020A 1·80
CA3046 0·70
CA3048 2·11
CA3089E 1·96
CA3090Q 4·23
CD4000 0·51
CD4001 0·51
CD4002 0·51
CD4009 1·07
CD4010 1·07
CD4011 0·51
CD4015 2·66
CD4016 1·02
CD4017 2·66
CD4020 2·96
CD4023 0·51
CD4024 1·90
CD4027 1·56
CD4028 2·34
CD4029 3·79
CD4041 2·11
CD4044 2·11
CD4047 1·65
CD4049 0·90
CD4050 0·90
LM301A 0·48
LM304A 2·03
LM309K 1·88
LM702C 0·75
LM709T099 0·48
8DIL 0·38
14DIL 0·40
LM723C 0·90
LM741T099 0·40
8DIL 0·40
14DIL 0·38
LM747 1·00
LM7488DIL 0·60
LM7805 2·52
14DIL 0·73
LM7805 2·00
MC1303p 1·26
MC1310 2·92
MC1458CP1 0·70
MJ480 0·90
MJ481 1·14
MJ490 0·98
MJ491 1·38
MJE340 0·45
MJE2955 1·12
MJE3055 0·68
MP8111 0·32
MP8112 0·40
MP8113 0·47
MPF102 0·30
MPSA05 0·25
MPSA06 0·26
MPSA55 0·26
MPSA56 0·27
NE555V 0·70
NE560 4·48
NE561 4·48
NE565A 4·48
OC23 1·35
OC28 0·76
OC35 0·60
OC42 0·50
OC45 0·32
OC71 0·20
OC72 0·25
OC81 0·25
OC83 0·24
ORP12 0·55
R53 1·20
RL54 0·15
SC35D 1·68
SC36D 1·46
SC40D 1·89
SC41D 1·32
SC45D 1·89
SC46D 1·96
SC50D 2·60
SC51D 2·39
SL414A 1·80
SL623 4·59
TAA263 1·00
TAA350 2·10
TAA621 2·03
TAA661B 1·32
TAD100 1·50
Filter 0·70
TBA271 0·64
TBA641B 1·25
TBA800 1·50
TBA810 1·50
TIL209 0·30
TIP29A 0·49
TIP30A 0·58
TIP31A 0·62
TIP32A 0·74
TIP33A 1·01
TIP34A 1·51
TIP35A 2·90
TIP36A 3·70
TIP41A 0·79
TIP42A 0·90
TIP2955 0·93
TIP3055 0·60
ZTX300 0·13
ZTX302 0·20
ZTX500 0·15
ZTX502 0·18
ZTX530 0·21

Integrated Circuits TTL (SN 7400 Series)

SN7400 16p
SN7401 16p
SN7401AN 38p
SN7402 16p
SN7403 16p
SN7404 24p
SN7405 24p
SN7406 45p
SN7407 45p
SN7408 25p
SN7409 33p
SN7410 16p
SN7411 25p
SN7412 28p
SN7413 50p
SN7416 45p
SN7417 30p
SN7420 16p
SN7423 37p
SN7425 37p
SN7427 45p
SN7430 16p
SN7452 45p
SN7437 35p
SN7438 35p
SN7440 16p
SN7441 85p
SN7442 85p
SN7445 1·59
SN7446 2·00
SN7447 1·30
SN7448 1·50
SN7450 16p
SN7451 16p
SN7453 16p
SN7454 16p
SN7460 16p
SN7470 30p
SN7472 38p
SN7473 44p
SN7474 48p
SN7475 50p
SN7476 45p
SN7480 75p
SN7481 1·25
SN7482 87p
SN7483 1·20
SN7484 95p
SN7485 1·58
SN7486 45p
SN7490 65p
SN7491 1·10
SN7492 75p
SN7493 65p
SN7493 65p
SN7494 85
SN7495 80p
SN7496 1·00
SN74100 2·16
SN74107 43p
SN74118 1·00
SN74119 1·92
SN74121 57p
SN74122 80p
SN74123 72p
SN74141 1·00
SN74145 1·44
SN74150 1·44
SN74151 1·10
SN74153 1·00
SN74154 1·66
SN74155 1·55
SN74157 1·00
SN74160 1·58
SN74161 1·58
SN74162 1·58
SN74164 2·01
SN74165 2·01
SN74167 4·10
SN74174 1·00
SN74175 1·29
SN74176 1·74
SN74180 1·44
SN74181 5·18
SN74190 1·95
SN74191 1·95
SN74192 2·05
SN74193 2·30
SN74196 1·58
SN74197 1·58
SN74198 3·16
SN74199 2·88

Diodes & Rectifiers

PIV	50	100	200	400	600	800	1000
1·5	0·08	0·09	0·10	0·11	0·12	0·15	0·20
3	0·15	0·17	0·20	0·22	0·25	0·27	0·20
10	—	0·35	0·40	0·47	0·56	—	—
35	0·84	0·92	1·18	2·15	2·52	3·05	4·20

Cathode Stud only. IN3766 (35 A 800pv) £3·65. IN3768 (35 A 1000pv) £4·20

IN34A 0·10
IN914 0·07
IN916 0·07
AA119 0·07
AA129 0·15
BA100 0·15
BA102 0·25
BA110 0·25
BA115 0·07
BA141 0·17
BA142 0·17
BA144 0·12
BA145 0·17
BA154 0·12
BY100 0·15
BY126 0·15
BY127 0·17½
BY140 1·00
BY237 0·12½
BYZ10 0·35
BYZ11 0·32
BYZ12 0·30
OA9 0·10
OA10 0·20
OA47 0·07½
OA70 0·07½
OA73 0·10
OA79 0·07
OA81 0·08
OA85 0·10
OA90 0·07
OA91 0·07
OA95 0·07
OA200 0·07
OA202 0·10

OPTO & LED's

Red, green and yellow
0·16 diameter 31p
0·20 diameter 33p
DL707 £2·35 or 4 for £8·00
Minitron £1·55

Bridge Rectifiers

Plastic	1A	2A	4A	6A
50	0·24	0·32	0·60	0·62
100	0·36	0·37	0·70	0·75
200	0·30	0·41	0·75	0·80
400	0·36	0·45	0·85	1·10
600	0·40	0·52	0·95	1·25

SCR's	100V	200V	400V	600V
½A	0·43	0·44	—	—
1A	0·45	0·50	0·60	—
1·2A	0·38	0·42	0·53	0·75
3A	0·47	0·53	0·60	0·90
4A	0·50	0·55	0·65	—

TELETENNIS KIT

This exciting new game is now available in kit form. Due to popular demand we are now able to offer a fantastic saving on list prices. Ideal game for whole family. No need to modify your TV set, just plugs into aerial socket.

Parts list as follows:
A Resistor Pack £1·00 p.p. 20p
B Potentiometer Pack £1·25 p.p. 20p
C Capacitor Pack £3·10 p.p. 20p
D Semiconductor Pack £14·50 p.p. 20p
E IC Sockets £4·00 p.p. 20p
F Transformer £1·15 p.p. 25p
G PCB's £7·50 p.p. 20p
H Switches £4·50 p.p. 20p
I UHF Modulator Kit (pre-assembled) £7·20 p.p. 20p

Special Prices—complete kit £42·00 p.p. 50p. Sections A–F incl. £23·50 p.p. 30p. Assembly instructions with complete kit or 30p on request.

P.C. Marker Pen Dalo 33PC
Price 87p Zeners 400MW 11p
1W 17p 3·3V-4V

Liquid Crystals—£13·00
Ex stock S.A.E. for details of CMOS battery operated clock kit using LCD's

Scorpio Car Ignition Kit—£11·50 + VAT
BSTBO246 £1·05 T'former £2·75
I 1440V £1·10

Resistors W	Tol	Price	Tant Beads Value	
⅛	5%	1p	·1/35	14p
¼	5%	1·5p	·22/35	14p
½	5%	2p	·47/35	14p
1	10%	2·5p	2·2/35	14p
2	10%	6p	4·7/35	18p
2½	5%	7p	10/16V	18p
5	5%	9p	47/6·3V	10p
10	5%	10p	100/3V	20p

Veroboard	Copper ·1	Copper ·15	Plain ·1	Plain ·15
2½x3¾	28p	20p	—	14p
2½x5	30p	30p	—	14p
3¾x3¾	30p	30p	—	—
3¾x5	34p	35p	—	24p
2½x17	£1·21	95p	76p	69p
Pins x 36	24p	24p		
Pins x 200	89p	92p		

Trade and Retail Supplied

Potentionmeters
Linear or Log

	Single	Double
Rotary Pots	18p	45p
Rotary Switched	28p	—
Sliders	50p	80p

Full range of Capacitors stocked. See catalogue for details

Presets Horizontal or Vertical
·1W 6p ·2W 6p ·3W 6p

Construction Kits
AV7 Aerial Amps £2·04
UH570 Transmitter £2·74
MUE7 Receiver for above £3·22
EW18 Electronics dice £6·53
EW20 Electro. Dice +Sen. £7·79

OUR NEW GLASGOW SHOP IS NOW OPEN

VAT all prices exclusive
p & p 15p Mail Order

The largest selection

EX COMPUTER BOARDS
Packed with transistors, diodes, capacitors and resistors—COMPONENT VALUE £1·50. 3 for ONLY 55p + p & p 30p

SPECIAL ONE as above PLUS Power Transistors ONLY 55p each + p & p 15p

PAXOLINE BOARDS 7½ × 9" approx. 4 for 30p + p & p 20p.

FIBRE-GLASS PRINTED CIRCUIT BOARDS
16½ × 4" approx. 2 for 55p

DECON-DALO 33PC Marker
Etch resistant printed circuit marker pen 99p each

VEROBOARDS
Packs containing approx., 50sq. ins. various sizes, all ·1 matric 55p

REPANCO CHOKES & COILS
RF Chokes

CH1. 2·5mH 29p CH2. 5·0mH 30p
CH3. 7·5mH 31p CH4. 10mH 33p
CH5. 1·5mH 28p

COILS
DRX1 Crystal set 31p DRR2 Dual range 45p

COIL FORMERS & CORES
NORMAN ¼" Cores & Formers 8p
⅜" Cores & Formers 10p

SWITCHES
DP/DT Toggle 36p SP/ST Toggle 30p

FUSES
1¼" and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A
QUICK-BLOW 5p ea.

EARPHONES
Crystal 2·5mm plug 42p
Crystal 3·5mm plug 42p
8 ohms 2·5mm plug 22p
8 ohms 3·5mm plug 22p

DYNAMIC MICROPHONES
B1223. 200 ohms plus on/off switch and 2·5mm and 3·5mm plugs £1·85

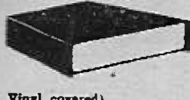
3-WAY STEREO HEAD-PHONE JUNCTION BOX
H1012 £1·87

2-WAY CROSSOVER NETWORK
K4007. 80 ohms Imp. Insertion loss 3dB £1·21

CAR STEREO SPEAKERS
(Angled) £8·85 per pair.

BI-PAK
CATALOGUE AND LISTS
Send S.A.E. and 10p.

INSTRUMENT CASES



(Black Vinyl covered)

No.	Length		Width		Height	Price
BV1	8"	×	5½"	×	2"	£1·10
BV2	11"	×	6"	×	3"	£1·45

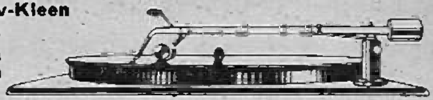
ALUMINIUM BOXES

BA1	5¼"	×	2¼"	×	1½"	42p
BA2	4"	×	4"	×	1½"	42p
BA3	4"	×	2¼"	×	1½"	42p
BA4	5¼"	×	4"	×	1½"	50p
BA5	4"	×	2¼"	×	2"	42p
BA6	3"	×	2"	×	1"	34p
BA7	7"	×	5"	×	2½"	70p
BA8	8"	×	6"	×	3"	90p
BA9	6"	×	4"	×	2"	58p

P & P 10p on each box

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen Model 42 £1·95
Chrome Finish Model 60 £1·50



Ref. B Stylus & Turntable Cleaning Kit 34p
Ref. 36A. Record/Stylus Cleaning Kit 33p
Ref. 43. Record Care Kit £2·42
Ref. 31. Cassette Head Cleaner 58p
Ref. 32. Tape editing Kit £1·68
Model 9. Wire Stripper/Cutter 83p
Ref. 46. Spirit level 62p
Ref. P. Hi-Fi Cleaner 31p
Ref. 32A. Stylus Balance £1·37
Ref. J. Tape Head Cleaning Kit 62p
Ref. 56. Hi-Fi Stereo Hints & Tips 42p
Ref. 45. Auto changer groove cleaner £1·08

ANTEX SOLDERING IRONS
X25. 25 watt £2·05
CCN 240. 15 watt £2·48
Model G. 18 watt £2·26
SK2. Soldering Kit £3·25
STANDS: ST3, Suitable for all models £1
SOLDER: 18SWG Multicore 7oz £1·61
22SWG 7oz £1·61. 18SWG 22ft 51p
22SWG Tube 38p

ANTEX BITS and ELEMENTS

Bits No.		
102	For model CN240 3/32"	42p
104	For model CN240 3/16"	42p
1100	For model CCN240 3/32"	42p
1101	For model CCN240 3/8"	42p
1102	For model CCN240 ¼"	42p
1020	For model G240 3/32"	42p
1021	For model G240 1/8"	42p
1022	For model G240 3/16"	42p
50	For model X25 3/32"	48p
51	For model X25 1/8"	48p
52	For model X25 3/16"	48p

ELEMENTS
ECN 240 £1·30 ECCN 240 £1·32
EG 240 £1·07 EX 25 £1·16

ANTEX HEAT SINKS 10p

V.A.T. included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0·55
C2	150	Capacitors mixed values approx. count by weight	0·55
C3	50	Precision Resistors 1%, 2% mixed values	0·55
C4	75	⅛th W Resistors mixed preferred values	0·55
C5	5	Pieces assorted Ferrite Rods	0·55
C6	2	Tuning Gangs, MW/LW VHF	0·55
C7	1	Pack Wire 50 metres assorted colours	0·55
C8	10	Reed Switches	0·55
C9	3	Micro Switches	0·55
C10	15	Assorted Pots & Pre-Sets	0·55
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Type	0·55
C12	30	Paper Condensers preferred types mixed values	0·55
C13	20	Electrolytics Trans. types	0·55
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·55
C15	5	Mains Slide Switches	0·55
C16	20	Assorted Tag strips & Panels	0·55
C17	10	Assorted Control Knobs	0·55
C18	4	Rotary Wave Change Switches	0·55
C19	2	Relays 6—24V Operating	0·55
C20	1	pack sheet of Copper Laminate 20 sq. ins	0·55

PLUGS AND SOCKETS

PLUGS		
PS 1	D.I.N. 2 Pin (Speaker)	0·11
PS 2	D.I.N. 3 Pin	0·13
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·16
PS 5	D.I.N. 5 Pin 240°	0·16
PS 6	D.I.N. 6 Pin	0·17
PS 7	D.I.N. 7 Pin	0·18
PS 8	Jack 2·5mm Screened	0·18
PS 9	Jack 3·5mm Plastic	0·12
PS 10	Jack 3·5mm Screened	0·18
PS 11	Jack ¼" Plastic	0·15
PS 12	Jack ¼" Screened	0·22
PS 13	Jack Stereo Screened	0·36
PS 14	Phono	0·10
PS 15	Car Aerial	0·22
PS 16	Co-Axial	0·15
INLINE SOCKETS		
PS 21	D.I.N. 2 Pin (Speaker)	0·14
PS 22	D.I.N. 3 Pin	0·20
PS 23	D.I.N. 5 Pin 180°	0·20
PS 24	D.I.N. 5 Pin 240°	0·20
PS 25	Jack 2·5mm Plastic	0·16
PS 26	Jack 3·5mm Plastic	0·16
PS 27	Jack ¼" Plastic	0·30
PS 28	Jack ¼" Screened	0·35
PS 29	Jack Stereo Plastic	0·30
PS 30	Jack Stereo Screened	0·38
PS 31	Phono Screened	0·18
PS 32	Car Aerial	0·22
PS 33	Co-Axial	0·22
SOCKETS		
PS 35	D.I.N. 2 Pin (Speaker)	0·08
PS 36	D.I.N. 3 Pin	0·11
PS 37	D.I.N. 5 Pin 180°	0·11
PS 38	D.I.N. 5 Pin 240°	0·11
PS 39	Jack 2·5mm Switched	0·12
PS 40	Jack 3·5mm Switched	0·12
PS 41	Jack ¼" Switched	0·20
PS 42	Jack Stereo Switched	0·30
PS 43	Phono Single	0·08
PS 44	Phono Double	0·10
PS 46	Co-Axial Surface	0·10
PS 47	Co-Axial Flush	0·20

LEADS
LS 1 Speaker lead 2 pin D.I.N. plug to open ends approx. 3 metres long (coded) 0·30

CABLES

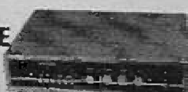
CP 1	Single Lapped Screen	0·07
CP 2	Twin Common Screen	0·11
CP 3	Stereo Screened	0·12
CP 4	Four Core Common Screen	0·23
CP 5	Four Core Individually Screened	0·30
CP 6	Microphone Fully Braided Cable	0·10
CP 7	Three Core Mains Cable	0·09
CP 8	Twin Oval Mains Cable	0·07
CP 9	Speaker Cable	0·05
CP 10	Low Loss Co-Axial	0·13

CARBON POTENTIOMETERS
Log and Lin
4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M

VC 1	Single less Switch	0·15
VC 2	Single D.P. Switch	0·28
VC 3	Tandem Less Switch	0·46
VC 4	1K Lin Less Switch	0·15
VC 5	100K Log anti-Log	0·46

HORIZONTAL CARBON PRESETS
0·1 watt 0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 4K7, 100K, 220K, 470K, 1M, 2M, 4·7M

IT'S NEW IT'S POWERFUL
(15 + 15w R.M.S.) *AND—*
IT LOOKS GOOD!
THE **LEGIONAIRE** STEREO AMPLIFIER



ORDER NOW— ONLY £39.95 p & p 50p.
Or write for full details

WORLD SCOOP
JUMBO SEMICONDUCTOR PACK
Transistors – Germ. and Silicon Rectifiers – Diodes – Triacs – Thyristors – I.C's and Zeners ALL NEW AND CODED.

APPROX 100 PIECES

Offering the amateur a fantastic bargain Pak and an enormous saving—identification and data sheet in every Pak.

Only £2 p. & p. 20p

RECORD STORAGE/ CARRY CASES
7" EP. 13½" x 7" x 8". (50 records) £2·10
12" LP. 13½" x 7½" x 12½". (50 records) £2·95

CASSETTE CASES
Holds 12. 10" x 3½" x 5". Lock & Handle. £1·30

SPECIAL PURCHASE
2N3055. Silicon Power Transistors NPN. Famous manufacturers out-of-spec devices free from open and short defects—every one able! 115w. TO3. Metal Case.

OUR SPECIAL PRICE 8 for £1

LOW COST CAPACITORS
·01UF 400v. 3p. each
500UF 50v. Elect. 10p each

REPANCO TRANSFORMERS
240v. Primary. Secondary voltages available from selected tappings 4v, 7v, 8v, 10v, 14v, 15v, 17v, 19v, 21v, 25v, 31v, 33v, 40, 50 and 25v-0-25v.

Type	Amps.	Price	P & P
MT50/½	½	£1·98	30p
MT50/1	1	£2·42	35p
MT50/2	2	£3·30	40p

CARTRIDGES

ACOS	
GP91-1SC 200mV at 1·2cm/sec	£1·35
GP93-1 280mV at 1cm/sec	£1·85
GP96-1 100mV at 1cm/sec	£2·80
TTC	
J-2005 Crystal/Hi Output	£1·05
J-2010C „ „ „ Compatible	£1·29
J-2006S Stereo/Hi Output	£1·75
J-2105 Ceramic/Med Output	£1·95
J-2203 Magnetic 5mV/5cm/sec, including stylus	£4·95
J-2203S Replacement stylus for above	£3·00
AT-55 Audio-technica magnetic cartridge 4mV/5cm/sec	£3·30

CARBON FILM RESISTORS
The E12 Range of Carbon Film Resistors, 1/8th watt available in PAKS of 50 pieces, assorted into the following groups:—

R1	50 Mixed 100 ohms–820 ohms	50p
R2	50 Mixed 1K ohms–8·2K ohms	50p
R3	50 Mixed 10K ohms–82K ohms	50p
R4	50 Mixed 100K ohms–1 Meg. ohms	50p

THESE ARE UNBEATABLE PRICES—JUST 1p EACH INCL. V.A.T.

BI-PAK SUPERIOR QUALITY LOW - NOISE CASSETTES
C60, 36p C90, 48p C120, 60p

VISIT OUR COMPONENT SHOP
18 BALDOCK ST., WARE, Herts. (A10)
Open Mon.–Sat. 9–5.30 p.m. Tel. 61593

Everyday Electronics Classified Advertisements

RATES: 11p per word (minimum 12 words). Box No. 30p. extra. Semi-display—£7·50 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Department, "EVERYDAY ELECTRONICS," I.P.C. Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD.

EDUCATIONAL

C AND G EXAM

Make sure you succeed with an ICS home study course for C and E Electrical Installation Work & Technicians Radio/TV/Electronics Technicians. Telecommus Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers.

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering. Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self-build radio kits. Get the qualifications you need to succeed.

Free details from:

INTERNATIONAL CORRESPONDENCE SCHOOLS.
Dept 731A, Intertext House, London SW8 4UJ.
Or Phone 01-622 9911

FOR SALE

MICROPHONES: AKG D109, £12·65; AKG D202E1, £43·45; AKG D190C, £18·70; AKG D190E, £20; AKG D224, £55; Sennheiser MD211N, £49·50; Sennheiser MD413N, £29·70. All brand new and boxed. Send CWO to J. J. Francis (Wood Green) Ltd., Manwood House, Matching Green, Harlow, Essex. Tel: Matching 476.

RECEIVERS and COMPONENTS

RADIO, TV and other valves. Large stocks 1930 to 1974. Many obsolete types. SAE for quotation. Price List 15p. Also available a large range of Transistor and Stili. Cox Radio, The Parade, East Wittering, Sussex. West Wittering 2023.

LOWEST COST IC SOCKETS. Use Soldercon IC socket pins for 8 to 40 pin DIL's. In strips of 100 pins: 100+ pins 70p, 300+ 50p, 1000+ 40p. Instructions supplied. 10p p&p for orders under £2. Add 8% VAT. SINTEL, 53e Aston Street, Oxford.

3 ASS. M.C. METERS £1·15 (35p). LARGE COMPUTER PANELS. 35-50 Transistors, Long Leads 85p (30p).
COPPER CLAD PAX PANELS 5½" × 5½". 6—50p c.p. 7½" × 9". 6—£1·30 c.p.
SILICON DIODES 650V 1½A. 10 on Tagboard 50p c.p.
T.V. CONVERGEANCE PANELS 2 × AC128 3 Slugged Coils, 3 Slide Switches, 11 W.W. Pots, 3 Carbon Presets, 2 Ferritte Chokes etc. £1·10 c.p.
VALUPAKS. P9 100 S/Mica Caps 67p c.p. send 10p for Lists of others plus Panels etc. Refund on purchase.
7 LBS ASSORTED COMPONENTS £1·75 c.p.
J.W.B. RADIO
2 Barnfield Crescent, Sale, Cheshire M33 1NL
Postage in brackets — Mail Order only

LED's. Red Green Yellow. Sizes, ·1", ·125", ·16", ·2". Mixed bags all sizes and colours. 50—£5, 100—£9 including postage, VAT. C.W.O. Individual types and larger quantities by negotiation. Industrial Electronic Supplies (Stockport) Ltd., 181a Bramhall Lane, Davenport, Stockport, Cheshire.

TUNBRIDGE WELLS. Components from Ballard's, 108, Camden Road, Tunbrdge Wells. Tel: Tunbridge Wells 31803. S.a.e. for all enquiries.

COMPONENTS GALORE. Pack of 500 mixed components manufacturers surplus plus once used. Pack includes Resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers etc. Send £1+10p p. and p. c.w.o. to CALEDONIAN COMPONENTS, Strathore Road, Thornton, Fife.

SERVICE SHEETS

SERVICE SHEETS for over 6,000 models of Television, Radios, Transistors, Stereo, Tape Recorders, Record Players, etc., at only 30p plus S.A.E. with free Fault-Finding Guide. Over 50,000 sheets in stock for 10,000 models. S.A.E. enquiries. Catalogue 20p plus S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

WANTED

WANTED E. E. Volumes 1 & 2. Mint condition with all Blueprints etc. State Price. Box No. 5.

MISCELLANEOUS

LOUD 6v SIRENS for burglar alarms etc. (new and boxed) £1·20p, add 10p pp. List No. 9 6p. Grimsby Electronics, 64 Tennyson Rd., Cleethorpes, Lincs.

WRIGHT'S AERIALS

Multibeams: MBM46 £5·90; MBM70 £12·10; Multibeam stacking kit £4·00
Antiierence New Extra gain: XG8 £7·75; XG14 £13·55. Please state channel group or transmitter.
Coax: semi-airspaced low-loss 12p per yard.
Comprehensive instructions/suggestions if requested.
Prices include VAT and mainland postage. Large SAE for full list.
Dept. 2, 3 Cheltenham Rise, Scawsby, Doncaster, Yorks. Don. 69743/3000

CONSTRUCTION AIDS. Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards-masters, negatives and boards, one-off or small numbers. Send 6p for list. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warks.

AERIAL BOOSTERS—£3·30

We make three types of aerial boosters B45-UHF-TV, B12-VHF-TV, B11-VHF-Radio.

VALVES BARGAINS

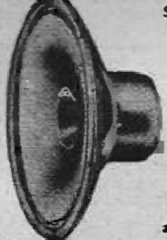
ANY 5-50p, 10-75p, 100-£3·30.
ECC82, EF80, EF183, EF184, PCC189, PCF80, PCF802, PCL82, PCL84, PCL85/805, PFL200, PL36, PL504, PY800, PY88.
COLOUR TV VALVES—PL508, PL509, PY500—25p each.
Prices includes VAT, P&P 10p, SAE—leaflet
Electronic Mail Order Ltd, 62 Bridge Street, Ramsbottom, Bury, Lancs. Tel RAMS 3036.

GADGETS GALORE!!

Alarms — Test Gear — Musical Instruments
Timers — Audio — Disco — Sound Effects
★ READY BUILT & TESTED ★
Sample prices: Signal Injector £1 95
Signal Tracer £2 95
PRICES INCLUDE U.K. POSTAGE & BATTERIES
Mail Order Only—SAE list to
G. K. SERVICES, 83 Westdale Rd., London SE18 3BQ

SUPERB INSTRUMENT cases by Bazelli, manufactured from heavy duty PVC faced steel, choice of 212 types, send for free list: Bazelli Instrument Cases, Dept 24, St. Wilfrid's, Foundry Lane, Halton LA2 6LT, near Lancaster.

LOUDSPEAKERS



Speakers, kits and cabinets for D.I.Y., Hi Fi, P.A., Disco, etc. by EMI, Fane, Goodmans, Baker, Elac, Richard Allan, Wharfedale, etc. Send for free booklet "Choosing a speaker"

WILMSLOW AUDIO
Dept. H, Swan Works, Bank Square, Wilmslow, Cheshire SK9 1HF
Tel. Wilmslow 29599

BEGINNERS, a complete course in electronics for only £3·45, post free. Basic electricity, switching and amplifier circuits. Instructions and components provided, For details of this and other kits send S.A.E. to Electrolern, Lyburn Lodge, Nomansland, Wiltshire.

FERRIC CHLORIDE

Anhydrous technical quality in sealed 1lb packs 1lb 80p; 3lb £1·60; 10lb £4·40.

COMPUTER PANELS

3lbs asstd £1·40; 7lb £2·60; 56lb £16. 12 high quality panels with trimpots, IC's, power transistors etc £2·50. 100 panels £14. Pack of boards containing at least 500 components inc. at least 50transistors 90p.

3 WATT TAPE AMPLIFIERS

2xECC83, EL84, EZ80 on 12x5x3" chassis with tone & volume controls. 3 watts output to 7x4" 3Ω speaker (provided) £3·00. Also in case 14x13x9" with non-standard tape deck £4·50. Suitable cassettes £1·08, tape 74p, head 30p.

7lb BARGAIN PARCELS

Hundreds of resistors, capacitors, pots, switches + PC boards with transistors & diodes and loads of odds & ends. Still only £2·25.

PC ETCHING KIT

Contains Ferric chloride, DALO etch-resist pen, 100 sq. ins. copper laminate board, etching dish, abrasive powder and instructions £3·30.

VEROBOARD

Offcuts, 100 sq. ins (no tiny pieces) £1·10. 500 assorted resistors £1·40. 150 mica, ceramic, poly capacitors 80p. 250 1%, 2%, 5% Hi-stabs £1·30. LEO III COMPUTER, all parts available.

GREENWELD ELECTRONICS [EE7]

Mail order, retail & wholesale shop 51, Shirley Park Road, Southampton, Tel (0703) 772501. Also callers at 21 Deptford Broadway SE8, Tel 01-692 2009 & 38 Lower Addiscombe Rd, Croydon, Tel 01-688 2950.
ALL PRICES QUOTED INCLUDE 8% VAT AND POSTAGE. SAE LIST, ENQUIRIES.

PUBLISHER'S ANNOUNCEMENT

Due to production difficulties existing at the time this issue went to press, we strongly advise readers to check with advertisers the prices shown and availability of goods, before purchasing.

Published approximately the third Friday of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London E.C.4. 4AD. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Publisher's Subscription Rate including postage for one year, Inland £2·95, Overseas £3·00. International Giro facilities Account No. 5122007. Please state reason for payment, message to payee. Everyday Electronics is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, excluding Eire where the selling price is subject to V.A.T., and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.