An exciting hobby.... for everyone

everyday electronics

JULY 74

20p

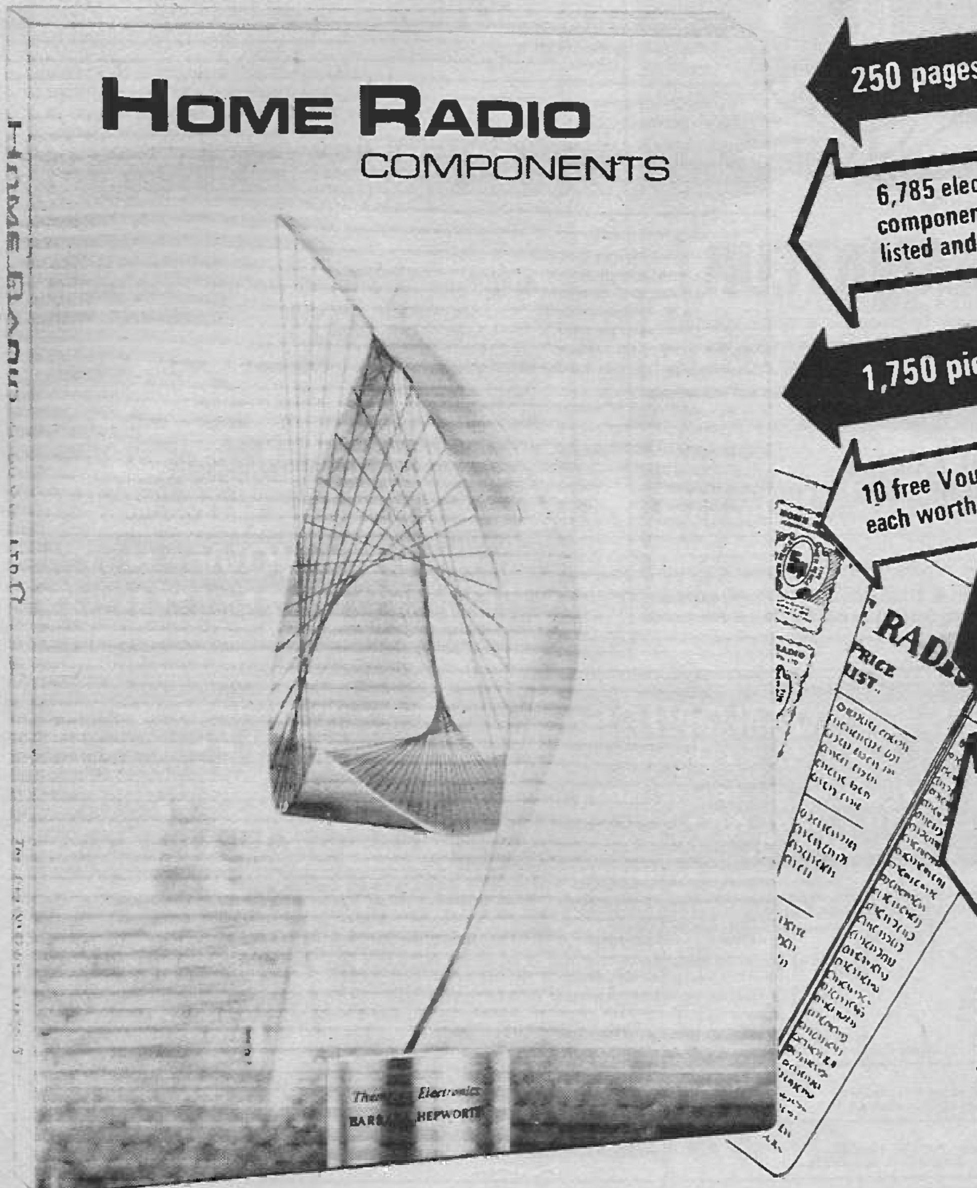
FREE ENTRY COMPETITION

Your last chance to win a . . .

Multimeter

HOME RADIO (Components) LTD. Dept. EE, 234-240 London Road, Mitcham, CR4 3HD. Phone 01-648 8422

The Catalogue you MUST have!



250 pages 11¾" x 8¼"

6,785 electronic components clearly listed and indexed

1,750 pictures

10 free Vouchers each worth 5p.

Price list regularly updated

Bookmark with useful list of technical abbreviations

Details of our popular Credit Account Service and our Easy Ordering System are included in the catalogue.

Only 55p. plus 22p POST AND PACKING

POST THIS COUPON
with cheque or P.O. for 77p.

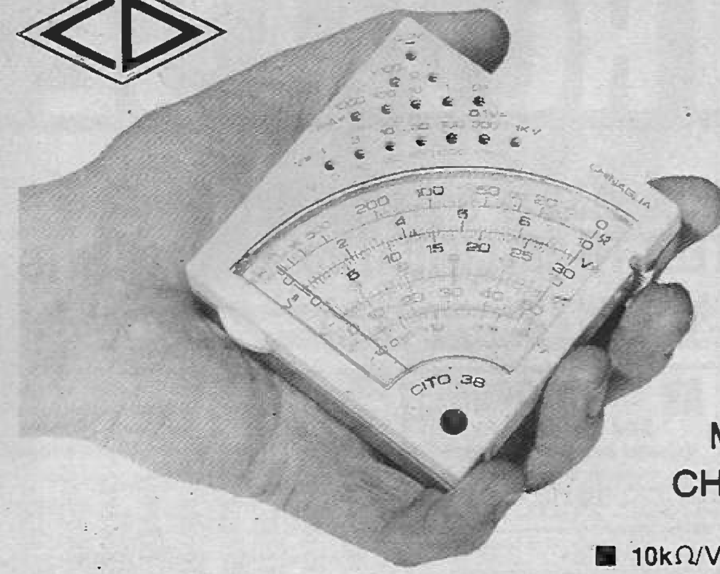
The price of 77p applies only to customers in the U.K. and to BFPO addresses

Name ____________________

Address ____________________

____

HOME RADIO (Components) LTD. (Regn. No. London 912966)
Dept. EE, 234-240 London Road, Mitcham CR4 3HD



A CITO IN THE HAND IS WORTH £10·10

INC. V.A.T.

THE TRULY POCKET MULTIMETER FROM CHINAGLIA OF ITALY

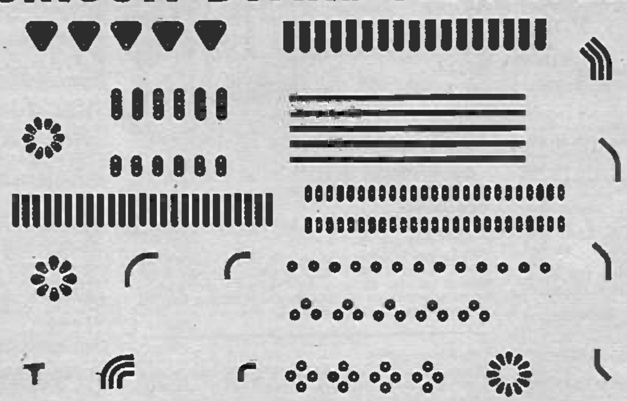
- 0·1V to 1kV f.s.d. d.c.; 5V to 1·5kV f.s.d. a.c.
- 100μA to 1A f.s.d. d.c.; 5mA to 0·5A f.s.d. a.c.
- 10kΩ/V d.c. sensitivity with 2·5% accuracy.
- Resistance 0–10kΩ and 0–1MΩ.
- Power −10 to +65dB in 6 ranges.

For further information on the "CITO" or other instruments from the exciting Chinaglia range write or telephone:

CHINAGLIA (U.K.) LTD. 19 Mulberry Walk, London S.W.3 Tel. 01-352 1897

Trade enquiries welcomed

PRINTED CIRCUIT BOARD TRANSFER SYSTEMS



Acid resistant transfers for direct application to P.C. Board. This is a new approach to printed circuit board manufacture, giving a professional finish with all details that an electronics engineer would require, including all drilling positions automatically marked.

Ideal for single unit boards or small quantities. All at a very low cost—for example an average 6" x 4" layout would cost less than 30p, and the time taken under one hour, including etching to complete.

The system is simple, briefly it consists of 10 sheets of self adhesive acid resistant transfers made in required shapes—i.e. edge connectors, lines, pads, dual in line I.C.'s, 8-10-12. T.O.5 Cans, 3-4 lead transistors, etc., etc., which only require pressing into the required positions on the printed circuit board before etching.

The printed circuit transfer system is a genuine offer to the public and industry. A full money back guarantee is sent with each order, trade prices on application.

List of Prices

Complete system including post and VAT	£2·00
Individual sheets	22p
Sample sheet	22p
Copper laminate (boards) size 6" x 4½" 6 sheets (with six months guarantee)	50p

Printed circuit board PCB transfer systems patent applied for.

E. R. NICHOLLS, 46 LOWFIELD ROAD, STOCKPORT, CHESHIRE

TELEPHONE NUMBER: 061-480-2179


ASK LASKYS
and make no mistake
People ask Laskys because of their keenly competitive pricing policy. People ask Laskys because of their staggering range of choice. People ask Laskys because every item they sell is fully guaranteed for a year with no sneaked in charges for labour or parts. People ask Laskys because they give advice that can be trusted.
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 £3.50 P&P 15p
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 15p
HIOKI Model 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 20p
MODEL PL436
20,000 opv DC. 8000 opv AC. Mirror scale. 6/3/12/30/120/600V DC. 3/30/120/600V DC. 50/600μA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. –20 to 46dB.
OUR PRICE £6.97 P&P 15p.
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 £7.00 P&P 20p
MODEL 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 15p.
MODEL TE300
30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/30uA/6mA/60mA/300mA/600mA. 0/8k/80k/800k/8 Meg ohms. –20 to +63dB.
OUR PRICE £7.50 P&P 15p
U4324 MULTIMETER
High sensitivity, overload protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: –10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
OUR PRICE £8.00 P&P 20p
U435 MULTIMETER
20,000opv. Overload protected. 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 20p
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 £10.50 P&P 20p
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. Resistance: 10k/100k/1 Meg/10 Meg ohms. –20 to +81.5dB.
OUR PRICE £12.50 P&P 17p
U4312 MULTIMETER
extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £9.75 P&P 25p
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/1.5/3/15/30/150/300mA/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
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&P20p
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 resistance: 0–20/200k/2/20 Meg. ohms. DC current:– 10/250uA/2.5/25/250 mA/10A. AC current:–0–10A. –20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
OUR PRICE £17.50 P&P 40p
MODEL AS.100D VOM
100,000 opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12 Amp. 0/2K/200K/2M/200 Meg Ohm. – 20 to +17dB.
OUR PRICE £17.50 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/10/10/100/500mA/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 25p
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/1/10/100mA/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 25p
KAMODEN 72.200 Multitester
High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges:–0/.06/.3/3/30/120/600/1200V DC. 0/3/12/60/300/1200V 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. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000V 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 £15.00 P&P 20p
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 £49.00 P&P 50p
TE65 VALVE VOLTMETER
28 ranges. DC volts 1.5–1500V. AC volts 1.5–1500V. Resistance up to 1000 Megohms. 200/240V AC operation. Complete with probe and instructions.
OUR PRICE £17.50 P&P 30p
Additional probes available: RF £2.12, HV £2.50
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 20p.
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 20p
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
KAMODEN HMG500 insulation resistance tester
Range 0–1,000 Megohms. 500V. Battery operated. Wide range clear meter 4"x4". Complete with deluxe carrying case, batteries and instructions.
OUR PRICE £19.95 P&P 30p
CI5 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 £39.00 Carr. paid
RUSSIAN CI16 Double Beam OSCILLOSCOPE
5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base. 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.
OUR PRICE £87.00 Carr. paid
MODEL TE15 GRID DIP METER
Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.
OUR PRICE £19.95 P&P 20p
Also see following pages
ALL PRICES EXCLUDE VAT

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 25p

AT201 Decade ATTENUATOR
Frequency range 0–200kHz. Attenuato. 0–111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 65mm.
OUR PRICE £12.50 P&P 37p

TRANSISTORISED L.C.R. A.C. BR/8 MEASURING BRIDGE
A new portable bridge offering excellent range and accuracy at low cost. Resistance: 6 ranges: 0.1 ohm-11.1 megohm ± 1% Inductance: 6 ranges: 1 microhenry-111 henries ± 2% Capacity: 6 ranges: 10pf-1110 mfd ± 2% Turns Ratio: 6 ranges: 1:1/1000-1:11100 ± 1% Bridge Voltage at 1,000cps. Operated from 9-volt battery. 100 microamp meter indication. Size 7½" x 5" x 2"
OUR PRICE £25.00 P&P 25p

TE16A TRANSISTORISED SIGNAL GENERATOR
5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 140 x 149 x 92mm. Complete with instructions and leads.
OUR PRICE £8.97 P&P 25p

MODEL TE20 RF SIGNAL GENERATOR
Six bands. 120kHz–260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105–125V, 220–240V AC. Size:183 x 265 x 150mm. Complete with test leads etc.
OUR PRICE £17.50 P&P 40p

TE-20D RF SIGNAL GENERATOR
Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xtal socket for calibration. 220/240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm.
OUR PRICE £17.50 P&P 30p

TE22 SINE SQUARE WAVE AUDIO GENERATOR
Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.
OUR PRICE £24.95 P&P 37p

ARF 300 AF/RF SIGNAL GENERATOR
All transistorised compact fully portable. AF sinewave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P-P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.
OUR PRICE £37.50 P&P 50p

Also see previous page

MODEL MG100 SINE SQUARE WAVE AUDIO GENERATOR
Range 19–220,000Hz Sine Wave 19–100,000 Hz Square Wave. Output Sine or Square wave 10v. P. to P. Size 180 x 90 x 90mm. Operation 220/240v. A.C.
OUR PRICE £19.95 P&P 37p

PS200 Regulated POWER SUPPLY UNIT
Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.
OUR PRICE £19.95 P&P25p

POWER RHEOSTATS
High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/50/100/250/500/1000 Ohms £1.15 P&P 10p

50 WATT 10/25/50/250/500/1000/2500/5000 Ohms £1.62 P&P 10p

100 WATT 1/10/25/50/100/250/500/1000/2500 Ohms £2.34 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	30p
2.5A	£12.00	35p
5A	£17.50	37p
8A	£30.35	50p
10A	£33.75	75p
12A	£29.50	75p
20A	£85.00	125p
25A	£95.00	130p
40A	£120.00	150p

MODEL S260B PANEL MOUNTING

1A	£10.00	30p
2.5A	£12.00	35p

BV05 Vernier TUNING DIAL
App. 7:1 ratio planetary drive vernier dial. Log scale 0–180 degrees. Blank scales 1–5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. ¼" diam. shaft
OUR PRICE £1.62 P&P 15p

240° Wide Angle 1mA METERS
MW 1–6 60x60mm
£6.50 P&P 15p
MW 1–8 80x80mm
£6.90 P&P 15p

CP110 CHASSIS PUNCH SET
Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1 1/8" punches complete with gripper and accessories.
OUR PRICE £3.00 P&P 40p

HITACHI FLUORESCENT LANTERN L1901
A portable battery operated lantern ideal for home, motoring, camping etc. Approx. 10" tall. Provides brilliant light from 9 1.5v batteries (not supplied).
OUR PRICE £7.19 P&P 25p.

KE630 3 Station INTERCOM
Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries
OUR PRICE £5.25 P&P 50p

WALKIE TALKIES
LIMITED STOCKS
SKYFON 100mW
OUR PRICE £24.95 per pair
P302 Two Channel 300mW
OUR PRICE £52.50 per pair
P1003 Three Channel 1 Watt
OUR PRICE £71.25 per pair
P&P 50p per pair
N.B. Unlicenceable in U.K.

OT55G DIGITAL CLOCK MECHANISM
Features 24 hour alarm setting, on/off and auto alarm 'sleep' switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V–3 Amp.
OUR PRICE £5.95 P&P 30p

SINCLAIR IC12 INTEGRATED CIRCUIT AMPLIFIER
complete with printed circuit mounting board.
OUR PRICE £2.35 P & P15p

LH02S STEREO HEADPHONES
Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.
OUR PRICE £1.97 P&P 30p

TE1018 Deluxe Mono High Impedence Headset.
Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms (600 ohms DC). Frequency response: 200–4,000Hz.
OUR PRICE £2.25 P&P 30p

TE1035 Stereo HEADPHONES
Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz–18kHz. Complete with cable and stereo jack plug.
OUR PRICE £2.60 P&P 30p

SH8DV MONO/STEREO HEADPHONES
Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz–18kHz. Complete with 10ft. coiled lead and jack plug.
OUR PRICE £4.97 P&P 30p

8H001 HEADSET and Boom Microphone
Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms.
OUR PRICE £5.95 P&P 30p

EMI LOUDSPEAKERS
Model 350 13 x 8" with single tweeter/crossover. 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.
OUR PRICE £7.50 each P&P 37p
Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms
OUR PRICE £3.62 each P&P 25p

SPECIAL PURCHASE LIMITED QUANTITY!
Tannoy 12" DR/8 Bass Speakers
8 ohms 30 watt. Heavy duty, ideal for Hi-Fi P.A. Group.
OUR PRICE £12.60.
P&P 60p.

SPECIAL BARGAIN! FERGUSON 3406 HI-FI SPEAKERS
High quality 2 way speaker systems. 25 Watts. 4–8 ohms. 40Hz–18kHz. Size: 560 x 340 x 255mm. approx. Wood grain finish with black fronts.
OUR PRICE £26.95 PR. P&P £1

SPECIAL BARGAIN !! STEREOSOUND SPEAKERS
Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm. 8 ohms. 8 watts RMS. 16 watts peak. Complete with Din lead.
OUR PRICE £12.95 P&P 50p

FM TUNER CHASSIS
6 transistor high quality tuner. Size only 153 x 101 x 63mm 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.
OUR PRICE £8.95 P&P 20p
Stereo Multiplex Adaptor £5.95 extra

Model A1018 FM TUNER
6 transistor high quality unit–3 IF stages and double tuned discriminator. For use with most amplifiers. Covers 88–108MHz. Powered by 9V battery.
OUR PRICE £13.50 P&P 30p
Stereo multiplex adapter £5.95 extra.

SINCLAIR "SCIENTIFIC" CALCULATOR
8 digit display. Four functions plus logarithms to base 10, antilog, sine, cosine, tangent, arcSine, arcCosine and arcTangent. Complete with instructions, case and batteries. Rec. Price £49.00
OUR PRICE £44.50
P & P 26p plus VAT

SINCLAIR SYSTEM 2000 STEREO AMPLIFIER AND TUNER
AMPLIFIER
Amplifier output 8 watts per channel RMS. Distortion less than 0.08%. Silicon transistors. Two pick-up plus radio and tape inputs, tape output and scratch filter. Excellent Value.
OUR PRICE £28.50 P & P 60p.

FM TUNER
Excellent selectivity and sensitivity. Twin dual-varicap tuning. 4 pole ceramic filter. 19 transistor stereo demodulator giving 40 dB separation. Distortion 0.2% output. Fantastic Value.
OUR PRICE £28.50 P & P 60p.

SINCLAIR Project 80 Modules

Z40 Power Amplifier	£5.45
Z60 Power Amplifier	£6.95
Stereo 80 Pre-Amplifier	£11.95
Active Filter Unit	£6.95
Project 805	£26.95
PZ5 Power Supply	£4.98
PZ6 Power Supply	£7.98
PZ8 Power Supply	£7.98
Transformer for PZ8	£4.05

SINCLAIR Project 80 Packages

2 x Z40/Stereo 80/PZ5	£25.00
2 x Z40/Stereo 80/PZ6	£27.75
2 x Z60/Stereo 80/PZ8	£30.45

POST & PACKING 35p each.

MP7 MIXER-PREAMPLIFIER
5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.
OUR PRICE £8.97 P&P 20p

HIGH QUALITY CONSTRUCTION KITS
JOSTY KIT
WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.
Post and Packing 15p per kit.

AF20 Mono amplifier	£4.80
AF25 Mixer	£3.60
AF30 Mono pre-amplifier	£2.61
AF35 Emitter amplifier	£2.27
AF80 0.5W mic. amplifier	£4.22
AF305 Intercom	£9.52
AF310 Mono amplifier	£5.91
AT5 Automatic light control	£2.58
AT25 Window wiper robot	£5.82
AT30 Photo cell switch unit	£5.70
AT50 400W triac light dimmer/speed control	£4.80
AT56 2,200W triac light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control	£14.55
GP304 Circuit board	£4.94
GP310 Stereo pre-amplifier for use with 2 x AF310	£21.27
GP312 Circuit board	£11.45
GU330 Tremolo unit	£7.50
HF61 Diode detector	£3.32
HF65 FM transmitter	£2.70
HF75 FM receiver	£2.87
HF310 FM tuner	£15.81
HF325 Deluxe FM tuner	£24.12
HF330 Decoder (HF310/325)	£9.98
HF380 lw/vhf aerial amplifier	£4.94
HF395 broadband aerial amp.	£1.77
LF380 Quadraphonic device	£11.36
M160 Multi-vibrator	£1.71
M191 VU Meter	£4.55
M192 Stereo balance meter	£4.97
M1302 Transistor tester	£8.45
NT10 Stabilised power supply 100mA, 9V	£6.15
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
NT315 Power supply 240V AC to 4,5/15V DC. 500mA	£9.57

Amateur Electronics by Josty-Kit, the professional book for the amateur—covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10 listed below.
OUR PRICE £3.30 (No VAT)
P&P 25p plus VAT.

AE1 100mW output stage	£1.50
AE2 Pre-amplifier	£1.15
AE3 Diode receiver	£1.82
AE4 Flasher	99p
AE5 Astable multi-vibrator	95p
AE6 Monostable multi-vibrator	93p
AE7 RC generator	97p
AE8 Bass filter	90p
AE9 Treble filter	90p
AE10 CCIR filter	90p

1021 Stereo Listening Station
For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on–off slide switch, stereo headphone socket.
OUR PRICE £2.25 P&P 15p

AUDIOTRONIC LOW NOISE CASSETTES

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

AUDIOTRONIC CrO2 CASSETTES

TYPE	5	10	25
CR60	£3.92	£7.72	£19.12
CR90	£5.32	£10.46	£25.22

AUDIOTRONIC 8 TRACK CARTRIDGES

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

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

AUDIOTRONIC AHA101 Stereo Headphone Amplifier
All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.
OUR PRICE £8.50 P&P 20p

EA41 REVERBERATION AMPLIFIER
Self contained, transistorised, battery operated. Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverberation control. Beautiful walnut cabinet. 184 x 77 x 108mm.
OUR PRICE £7.50 P&P 20p

ALL PRICES EXCLUDE VAT

SEW CLEAR PLASTIC PANEL METERS

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.

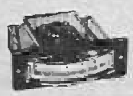
CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm

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

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4.60		
100uA	£4.50		
500uA	£4.30		
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	150V AC	£4.45
50V DC	£4.30	300V AC	£4.45
300V DC	£4.30	VU Meter	£4.90

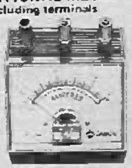
EDGWISE MODEL PE70
Size: 90 x 34mm



50uA	£4.15
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

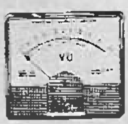
MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

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

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



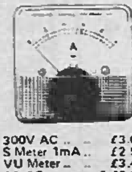
50uA	£5.45		
100uA	£5.40		
200uA	£5.35		
500uA	£5.25		
50-0-50uA	£5.40		
100-0-100uA	£5.35		
500-0-500uA	£5.20		
1mA	£5.20		
1-0-1mA	£5.20		
5mA	£5.20		
10mA	£5.20		
50mA	£5.20		
100mA	£5.20	300V DC	£5.20
500mA	£5.20	15V AC	£5.30
1A DC	£5.20	300V AC	£5.30
5A DC	£5.20	S Meter 1mA	£5.20
15A DC	£5.20	VU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

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

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

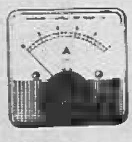
50uA	£4.30		
100uA	£4.25		
200uA	£4.20		
500uA	£4.15		
50-0-50uA	£4.25		
100-0-100uA	£4.20		
1mA	£4.10		
5mA	£4.10		
10mA	£4.10		
50mA	£4.10	10V DC	£4.10
100mA	£4.10	20V DC	£4.10
500mA	£4.10	50V DC	£4.10
1A DC	£4.10	300V DC	£4.10
5A DC	£4.10	15V AC	£4.20
10A DC	£4.10	300V AC	£4.20
5V DC	£4.10	VU Meter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

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



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

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



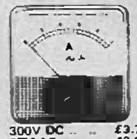
50uA	£3.10		
100uA	£3.05		
200uA	£3.00		
500uA	£2.85		
50-0-50uA	£3.05		
100-0-100uA	£3.00		
500-0-500uA	£2.80		
1mA	£2.80		
1-0-1mA	£2.80		
2mA	£2.80		
5mA	£2.80		
10mA	£2.80		
20mA	£2.80		
50mA	£2.80	20V DC	£2.80
100mA	£2.80	50V DC	£2.80
150mA	£2.80	100V DC	£2.80
200mA	£2.80	150V DC	£2.80
300mA	£2.80	300V DC	£2.85
500mA	£2.80	500V DC	£2.85
750mA	£.280	750V DC	£2.90
1A DC	£2.80	15V AC	£2.90
2A DC	£2.80	50V AC	£2.90
5A DC	£2.80	150V AC	£2.90
10A DC	£2.80	300V AC	£2.90
3V DC	£2.80	500V AC	£3.00
10V DC	£2.80	S Meter 1mA	£2.80
15V DC	£2.80	VU Meter	£3.20

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

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

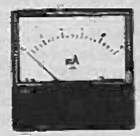
POSTAGE & PACKING 15p

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



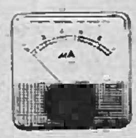
50uA	£3.95		
100uA	£3.85		
200uA	£3.80		
500uA	£3.75		
50-0-50uA	£3.85		
100-0-100uA	£3.80		
500-0-500uA	£3.70		
1mA	£3.70		
1-0-1mA	£3.70		
5mA	£3.70		
10mA	£3.70	300V DC	£3.70
50mA	£3.70	15V AC	£3.80
100mA	£3.70	50V AC	£3.80
500mA	£3.70	150V AC	£3.80
1A DC	£3.70	300V AC	£3.90
5A DC	£3.70	500V AC	£3.80
10A DC	£3.70	S Meter 1mA	£4.10
15A DC	£3.70	VU Meter	£3.70
20A DC	£3.80	1A AC	*£3.70
30A DC	£3.85	5A AC	*£3.70
50A DC	£4.05	10A AC	*£3.70
5V DC	£3.70	20A AC	*£3.70
10V DC	£3.70	30A AC	*£3.70
15V DC	£3.70	50mA AC	*£3.70
20V DC	£3.70	100mA AC	*£3.70
50V DC	£3.70	200mA AC	*£3.70
150V DC	£3.70	500mA AC	*£3.70

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm



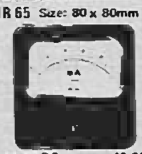
50uA	£4.50
100uA	£4.45
500uA	£4.20
50-0-50uA	£4.45
100-0-100uA	£4.40
1mA	£4.20
1A DC	£4.20
5A DC	£4.20
20V DC	£4.20
50V DC	£4.20
300V DC	£4.20
300V AC	£4.30
VU Meter	£4.70

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



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

BAKELITE MODEL MR 65 Size: 80 x 80mm



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

CALL INTO YOUR NEAREST LASKYS BRANCH OR ORDER WITH CONFIDENCE BY MAIL ORDER

CENTRAL LONDON

481 OXFORD ST.	01-493 8641
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
87 TOTTENHAM CT. RD.	01-580 3739
257/8 TOTTENHAM CT. RD.	01-580 0670
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

ESSEX

86 SOUTH ST. ROMFORD 70-20218

KENT

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

LEICESTERSHIRE

45 MARKET PLACE, LEICESTER 0533-537678

SURREY

1046 WHITGIFT CENTRE, CROYDON 01-681 3027
27 EDEN ST. KINGSTON 01-546 7845
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.

BARCLAYCARD & ACCESS

Holders welcome call into any branch or telephone your order to head office.

CREDIT TERMS available for Personal Shoppers

EXPORT Personal exports arranged for overseas visitors at all our branches. Goods despatched to all parts of the world through our Export Mail Order Department. Immediate attention given to orders.

CHEQUES ACCEPTED FROM PERSONAL SHOPPERS ONLY WITH BANKERS CARD.

All prices correct at 13-5-74 but subject to change

ALL PRICES EXCLUDE VAT

ASK LASKYS and make no mistake

A member of the Audiotronic Group of Companies

ASK LASKYS FOR MAIL ORDER

We offer a speedy and efficient service by mail order. Remember to add 10% VAT to total value of goods including post and packing.

TO LASKYS HEAD OFFICE AND MAIL ORDER DEPARTMENT
Audiotronic House, The Hyde, London NW9 6JJ. Tel: 01-205 5651/3735

Please send me the following items

TOTAL PURCHASE PRICE (inc P&P and VAT)

I enclose ☐ cheque ☐ postal order ☐ money order

NAME

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

ADDRESS

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

Signature

EE7

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

STABILISED POWER MODULES
Complete with circuit diagrams, etc. 99p 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 90p each

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

REPANCO CHOKES & COILS
RF Chokes
CH1. 2·5mH 25p CH2. 5·0mH 25p
CH3. 7·5mH 25p CH4. 10mH 25p
CH5. 1·5mH 25p

COILS
DRX1 Crystal set 31p DRR2 Dual range 45p

COIL FORMERS & CORES
NORMAN ¼" Cores & Formers 7p
⅜" Cores & Formers 8p

SWITCHES
DP/DT Toggle 25p SP/ST Toggle 18p

FUSES
1¼" and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A
QUICK-BLOW 4p ea. ANTI-SURGE 5p ea.

EARPHONES
Crystal 2·5mm plug 33p
Crystal 3·5mm plug 33p
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 £1·60

3-WAY STEREO HEADPHONE JUNCTION BOX
H1012 £1·87

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

CAR STEREO SPEAKERS
(Angled) £3·85 per pair.

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

INSTRUMENT CASES

(Black Vinyl covered)

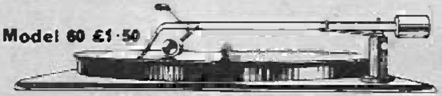
No.	Length		Width		Height	Price
BV1	8"	×	5½"	×	2"	90p
BV2	11"	×	6"	×	3"	£1·20

ALUMINIUM BOXES

BA1	5¼"	×	2¼"	×	1½"	42p
BA2	4"	×	4"	×	1½"	41p
BA3	4"	×	2½"	×	1½"	41p
BA4	5¼"	×	4"	×	1½"	47p
BA5	4"	×	2½"	×	2"	41p
BA6	3"	×	2"	×	1"	34p
BA7	7"	×	5"	×	2½"	66p
BA8	8"	×	6"	×	3"	84p
BA9	6"	×	4"	×	2"	54p

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen
Model 42 £1·84
Chrome Finish Model 60 £1·50



Ref. 36A. Record/Stylus Cleaning Kit 28p
Ref. 43. Record Care Kit £2·35
Ref. 31. Cassette Head Cleaner 54p
Ref. 32. Tape editing Kit £1·54
Model 9. Wire Stripper/Cutter 83p
Ref. P. Hi-Fi Cleaner 31p
Ref. 32A. Stylus Balance £1·36
Ref. J. Tape Head Cleaning Kit 51p
Ref. 34. Cassette Case £1·27
Ref. 56. Hi-Fi Stereo Hints & Tips 32p

ANTEX SOLDERING IRONS
X25. 25 watt £1·93
CCN 240. 15 watt £2·15
Model G. 18 watt £2·15
SK2. Soldering Kit £2·86
STANDS: ST1 £1·21. ST2 77p
SOLDER: 18SWG Multicore 7oz 82p
22SWG 7oz 82p. 18SWG 22ft 28p
22SWG Tube 22p

ANTEX BITS and ELEMENTS

Bits No.		
102	For model CN240 3/32"	38p
104	For model CN240 3/16"	38p
1100	For model CCN240 3/32"	38p
1101	For model CCN240 3/8"	38p
1102	For model CCN240 ¼"	38p
1020	For model G240 3/32"	38p
1021	For model G240 1/8"	38p
1022	For model G240 3/16"	38p
50	For model X25 3/32"	38p
51	For model X25 1/8"	38p
52	For model X25 3/16"	38p

ELEMENTS
ECN 240 £1·16 ECCN 240 £1·32
EG 240 £1·16 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	250	Resistors mixed values approx. count by weight	0·55
C2	200	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
C 8	10	Reed Switches	0·55
C 9	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	40	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	4	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	3	Relays 6—24V Operating	0·55
C20	4	Sheets Copper Laminate approx. 10" × 7"	0·55

PLUGS AND SOCKETS
SOCKETS

PS 35 DIN	2 Pin (Speaker)	0·08
PS 36 DIN	3 Pin	0·10
PS 37 DIN	5 Pin 180°	0·10
PS 38 DIN	5 Pin 240°	0·10
PS 39	Jack 2·5mm Switched	0·09
PS 40	Jack 3·5mm Switched	0·10
PS 41	Jack ¼" Switched	0·17
PS 42	Jack Stereo Switched	0·26
PS 43	Phono Single	0·06
PS 44	Phono Double	0·10
PS 45	Car Aerial	0·09
PS 46	Co-Axial Surface	0·09
PS 47	Co-Axial Flush	0·14

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0·13
PS 22	D.I.N. 3 Pin	0·17
PS 23	D.I.N. 5 Pin 180°	0·17
PS 24	D.I.N. 5 Pin 240°	0·17
PS 25	Jack 2·5mm Plastic	0·10
PS 26	Jack 3·5mm Plastic	0·12
PS 27	Jack ¼" Plastic	0·24
PS 28	Jack ¼" Screened	0·28
PS 29	Jack Stereo Plastic	0·28
PS 30	Jack Stereo Screened	0·32
PS 31	Phono Screened	0·14
PS 32	Car Aerial	0·15
PS 33	Co-Axial	0·17

PLUGS

PS 1	D.I.N. 2 Pin (Speaker)	0·11
PS 2	D.I.N. 3 Pin	0·12
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·14
PS 5	D.I.N. 5 Pin 240°	0·15
PS 6	D.I.N. 6 Pin	0·15
PS 7	S.I.N. 7 Pin	0·15
PS 8	Jack 2·5mm Screened	0·10
PS 9	Jack 3·5mm Plastic	0·09
PS 10	Jack 3·5mm Screened	0·12
PS 11	Jack ¼" Plastic	0·13
PS 12	Jack ¼" Screened	0·18
PS 13	Jack Stereo Screened	0·29
PS 14	Phono	0·06
PS 15	Car Aerial	0·15
PS 16	Co-Axial	0·10

CABLES

CP 1	Single Lapped Screen	0·06
CP 2	Twin Common Screen	0·08
CP 3	Stereo Screened	0·08
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	0·07
CP 8	Twin Oval Mains Cable	0·06
CP 9	Speaker Cable	0·04
CP 10	Low Loss Co-Axial	0·10

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

VC 1	Single less Switch	0·14
VC 2	Single D.P. Switch	0·26
VC 3	Tandem Less Switch	0·44
VC 4	1K Lin Less Switch	0·14
VC 5	100K Log anti-Log	0·44

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

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

EX-COMPUTER BOARDS
BY THE BOXFULL!!

20 Boards packed with Semiconductors and other Electronic Components. Each board approx. size 8" x 7". All known type no's and easily recognisable.

FANTASTIC VALUE AT £2.20 per BOX p. & p. 52p

SPECIAL PURCHASE
2N3055. Silicon Power Transistors NPN. Famous manufacturers out-of-spec devices free from open and short defects—every one able! 115w. T03. Metal Case.

OUR SPECIAL PRICE 8 for £1

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

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

8-TRACK CARTRIDGE CASES
Holds 14. 13" x 5" x 6". Lock & Handle £1·95
Holds 24. 13½" x 8" x 5½". Lock & Handle £2·70
COLOURS: Red, Black and Tan—Please state preference.

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	£1·93	30p
MT50/1	1	£2·42	35p
MT50/2	2	£3·30	40p

CARTRIDGES
ACOS GP91-1SC. 200mV at 1·2cms/sec £1·16
ACOS GP93-1. 280mV at 1cm/sec £1·65
ACOS GP96-1. 100mV at 1cm/sec £2·65
TTC J-2005. Crystal/Hi Output 95p
TTC J-20 10C Crystal/Hi Output Compatible £1·10
TTC J-200 CS Stereo/Hi Output £1·60
TTC J-2105 Ceramic/Med. Output £1·64

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	40p
R2	50 Mixed 1K ohms–8·2K ohms	40p
R3	50 Mixed 10K ohms–82K ohms	40p
R4	50 Mixed 100K ohms–1 Meg. ohms	40p

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

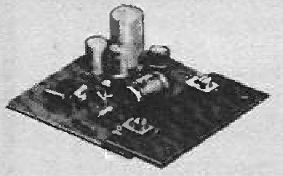
BI-PAK SUPERIOR QUALITY LOW-NOISE CASSETTES
C60, 32p C90, 41p C120, 52p

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

-the lowest prices!

BI-PAK *QUALITY* COMES TO AUDIO!

AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



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

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

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

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

AUDIO AMPLIFIER MODULES

AL 10.	3 watts	RMS	£2·19
AL 20.	5 watts	RMS	£2·59
AL 30.	10 watts	RMS	£3·01

POWER SUPPLIES

PS 12. (Use with AL10 & AL20) 88p
SPM 80. (Use with also AL30 & AL50) £3·25
FRONT PANELS SP 12 with Knobs £1·10

PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20) £4·35
PA 100. (Use with AL30 & AL50) £13·15

TRANSFORMERS

T461 (Use with AL10) £1·38 P & P 15p
T538 (Use with AL20) £1·93 P & P 15p
BMT80 (Use with AL30 & AL50) £2·15 P & P 25p

PA 12. PRE-AMPLIFIER SPECIFICATION

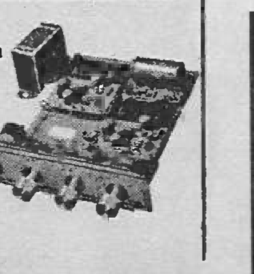
The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges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

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

Look for our
SEMICONDUCTOR ADVERTISEMENTS in
Practical Wireless
Wireless World
Radio Constructor

ALL PRICES INCLUDE V.A.T.

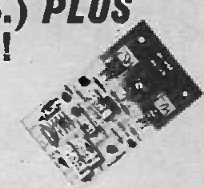
The STEREO 20



The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ±12dB at 60Hz typically 0·25% at 1 watt. Treble con. ±14dB at 14kHz.

£14·45

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



- Max Heat Sink temp. 90°c.
- Frequency Response 20Hz to 100KHz
- 0·1% Distortion
- Distortion better than 1% at 1KHz
- Supply voltage 10-35 volts
- Thermal Feedback
- Latest Design Improvements
- Load—3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

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

STABILISED POWER MODULE SPM80

AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address Intercom Units, etc. Handbook available 10p **PRICE £3·25**

TRANSFORMER BMT80 £2·15 p. & p. 28p

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz − 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

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

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

ONLY £13·15

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £25·30 FREE p. & p.

Giro No. 388-7005
Please send all orders direct to warehouse and despatch department

BI-PAK

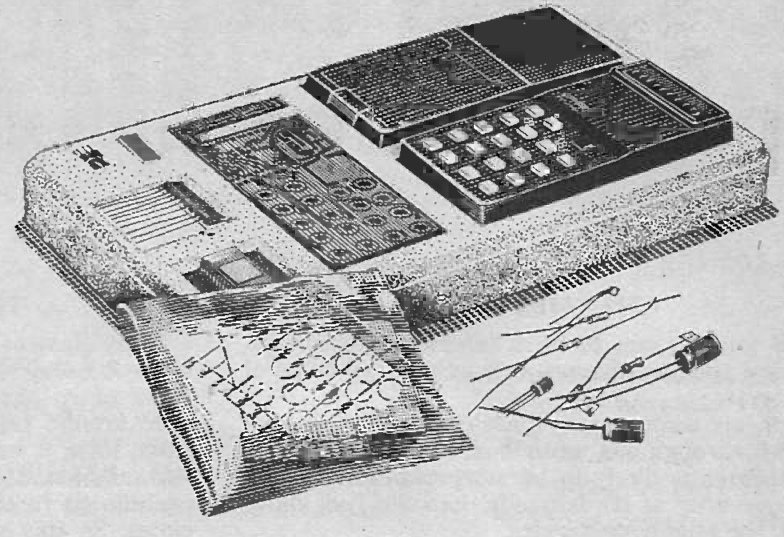
P.O. BOX 6, WARE · HERTS
Postage and packing add 11p. Overseas add extra for airmail.
Minimum order 55p. Cash with order please.
Guaranteed Satisfaction or Money Back

A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge.
Assembly time is about 3 hours.

Contents:

1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.

How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations.

sinclair

Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire
Reg. no: 699483 England
VAT Reg. no: 213 8170 88

Why only Sinclair can make you this offer
The reason's simple: only Sinclair – Europe's largest electronic calculator manufacturer – have the necessary combination of skills and scale.

Sinclair Radionics are the makers of the Executive – the smallest electronic calculator in the world. In spite of being one of the more expensive of the small calculators, it was a runaway best-seller. The experience gained on the Executive has enabled us to design and produce the Cambridge at this remarkably low price.

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 80 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
And *you* benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £14·95 + £1·50 VAT. (Total: £16·45)
Price fully built: £24·95 + £2·50 VAT. (Total: £27·45)

EE 7 74

To: Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire, PE17 4HJ

Please send me

☐ a Sinclair Cambridge Calculator kit at £14·95 + £1·50 VAT (Total: £16·45)

☐ a Sinclair Cambridge calculator ready built at £24·95 + £2·50 VAT (Total: £27·45)

*I enclose cheque for £________, made out to Sinclair Radionics Ltd, and crossed.

*Please debit my *Barclaycard/Access account. Account number__________

*Delete as required.

Name __________

Address __________

PLEASE PRINT

everyday electronics

PROJECTS..
THEORY.....

ON THE PHONE

If you happen to be a telephone subscriber, one of this month's projects cannot fail to be of interest.

Of all those many unwelcome missiles that shoot through the letter box at quarterly intervals none is likely to be more unpredictable in the severity of its demands than the Post Office bill for telephone service.

"Surely we can't have made all those calls?" are the first words to be gasped by the unbelieving recipient following examination of the account. The customary dire warnings to all members of the household to moderate their conversations in future are then made—but have little lasting effect, as the next bill will undoubtedly show.

Strange how those minutes tick away. And at today's rates the charges rapidly mount up. What is required is some means to monitor the total call charge ticking up as one speaks. This, we are happy to say, is now possible with the *Telephone Call Charge Calculator* described in this issue.

A useful aid to have beside the 'phone, an ever-present reminder of the accumulated call charges and (let's hope) a deterrent or moderating influence for the more loquacious members of the family.

TRY IT AND SEE

Many devices essential in electronics as we know it today were not in existence a mere 20 years or so ago. The magnet, in contrast, has been around rather longer: in its natural lodestone form it was in use about 4,000 years ago. An understanding of magnetism is an essential prelude to further study into electronics principles. So this venerable yet humble and commonplace device receives top billing in the opening articles of our new series *Physics Is Fun!*

These articles, specially prepared for beginners, are intended to amuse *and* instruct by means of simple experiments anyone can carry out at home. The expense involved will be nil, or very nearly so. For this is one special and exceptional occasion when we advocate the seeking out an use of "junk" material.

Just try the experiments and you'll quickly discover that the title of this series is perfectly true.

Fred Bennett.

Our August issue will be published on Friday, July 19

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. 7 JULY 1974

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Publisher's Annual Subscription Rate, including postage to any part of the world, £2·95. 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 11p 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.

Telephone call charge calculator

By BRIAN W. TERRELL B.Sc.

Sorry – can't afford another second....

Enables you to keep a watchful eye on the mounting telephone bill.

With the ever-increasing cost of living, it is the wise person who keeps a controlling eye on his (or her) bills as they are mounting up and puts funds aside regularly to meet the bills, so that when they do arrive he is adequately prepared for the amount demanded.

As far as electricity and gas bills are concerned, these can be easily estimated since there are dials and meters that the consumer can read and note. With the telephone bill it is not so easy since there are no dials to be read by the user and the cost of a telephone call depends on three factors:

1. Time spent on the telephone
2. Time of day the call is made
3. The distance of the call

With all these factors to take into consideration, the calculation of the costing of calls becomes complex and tedious.

The Telephone Call Charge Calculator does all the calculating for you electronically, and automatically gives you a running total of all calls placed, thus enabling the cost of all self-dialled calls over any period to be noted and allowed for.

CHARGES

The relation between the three factors mentioned above and the cost of a call is summarised in Table 1 which is reproduced from the latest Post Office leaflet entitled "New Charges for Telecommunications Services".

It is seen from Table 1 that times for all calls are normalised to a unit of one penny (1p)—see later; that is to say, depending on the call made, one penny buys a fixed amount of time and this is charged whether the whole time is used or not. For example, if a "*c*" call is made during the "peak" period, and the call lasts for 18 seconds, the cost is three pence.

Table 1: Time bought for 1p for trunk and local dialled telephone calls from STD exchanges.

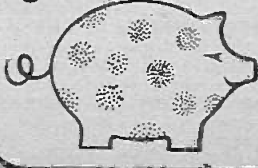
Peak Mon–Fri 9am–noon	**Standard** Mon–Fri 8am–9am noon–6pm	**Cheap** Every night 6pm–8am and all day Sat and Sun	**Code**
24	40	90	*a*
8	10	40	*c*
		(seconds)	
Local calls	Mon–Fri 8am–6pm	3min	*1*
	All other times	12min	*2*

THEORY

The block diagram of the unit is shown in Fig. 1. It consists of a pulse generator whose

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

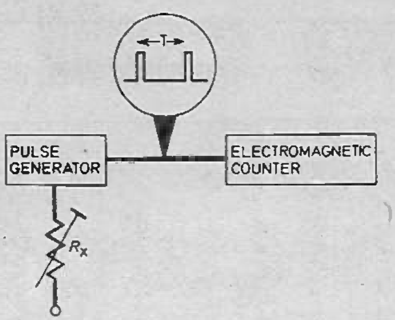


Fig. 1. Block diagram of the unit.

periodic time (T) can be controlled by selecting value of R_x these values being trimmed so that the periodic times of the pulses are made equal to the fixed times depicted in Table 1.

The pulses are then fed to an electromagnetic counter which causes its readout to advance by one unit for each pulse received.

INTEGRATED CIRCUIT

The heart of the unit is the versatile timer i.c. known as the "555". It is used in the astable multivibrator mode, see Fig. 2, and thus forms the pulse generator.

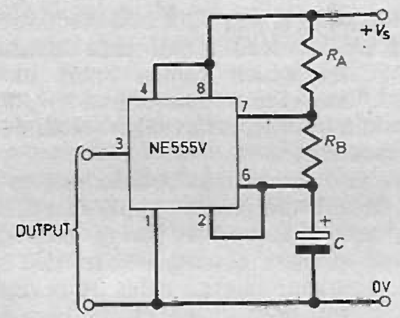


Fig. 2. The 555 timer i.c. wired as an astable multivibrator.

On connecting the positive supply voltage, the capacitor begins to charge up through the series combination R_A+R_B. When the potential at pin 6 reaches two-thirds the supply voltage, the internal circuitry of the i.c. switches and the capacitor begins to discharge through resistor R_B. When the potential at pin 6 drops to one-third the supply voltage, the internal circuitry resets and re-charging starts immediately. This action is repeated for as long as the supply is connected.

The output is at pin 3 and the voltage here can have only two values, these being either equal to the positive supply voltage or zero. While the capacitor is charging the output is equal to the supply voltage, when the capacitor is discharging the output is zero. This action is shown graphically in Fig. 3.

The reasons for using the 555 i.c. are two-fold; firstly construction is made very simple and secondly the most important, the frequency (1/T) of the multivibrator is virtually independant of the supply voltage which can range from 5 to 15V. Also, the frequency is virtually unaffected by temperature over its range of 0 to 70 degrees centigrade. The choice of operating voltage depends on the type of electromagnetic counter used; the type used in the prototype had a coil impedance of 500 ohms and operates from a voltage in the range 12 to 24 volts. With the transformer specified, an output of 15V is available which satisfies both counter and i.c.

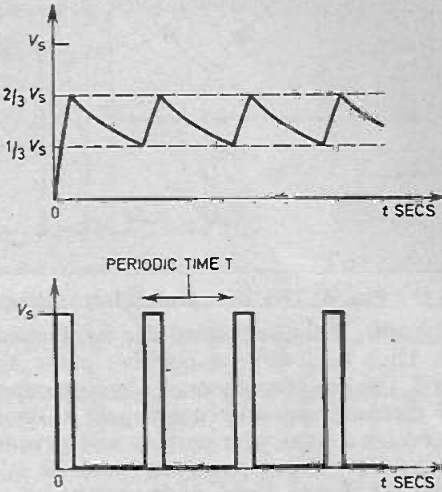


Fig. 3. (top) Charging and discharging of the timing capacitor as a function of time and (bottom) the corresponding output at pin 3.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Telephone Call Charge Calculator is shown in Fig. 4. It can be either mains or battery operated depending on the choice of the constructor. If battery operated, components T1, D1-D4, C1 and LP1 should be omitted. A suitable battery supply is three bell batteries type 126 wired in series.

The power supply consists of a readily available Friedland bell transformer and uses the 8V tappings. On full wave rectification by the diode bridge D1-D4 and smoothing by capacitor C1, a 15V d.c. supply is available.

The pulse generator has been described earlier (Fig. 2); the basic difference between the two circuits is the addition of the steering diodes D6 and D7. With these diodes, the charging time of the capacitor C2 is proportional to R10 and the discharge time proportional to the series combination of (R1+VR1), (R2+VR2) etc, depending on the position of S2.

This arrangement is necessary so that the charging time can be made rapid (in the order of 120 milliseconds) and the first pulse must be produced and operate the counter at the instant of switch on.

The electromagnetic counter is connected directly across pin 3 and ground, and D5 prevents the back e.m.f. produced when the counter

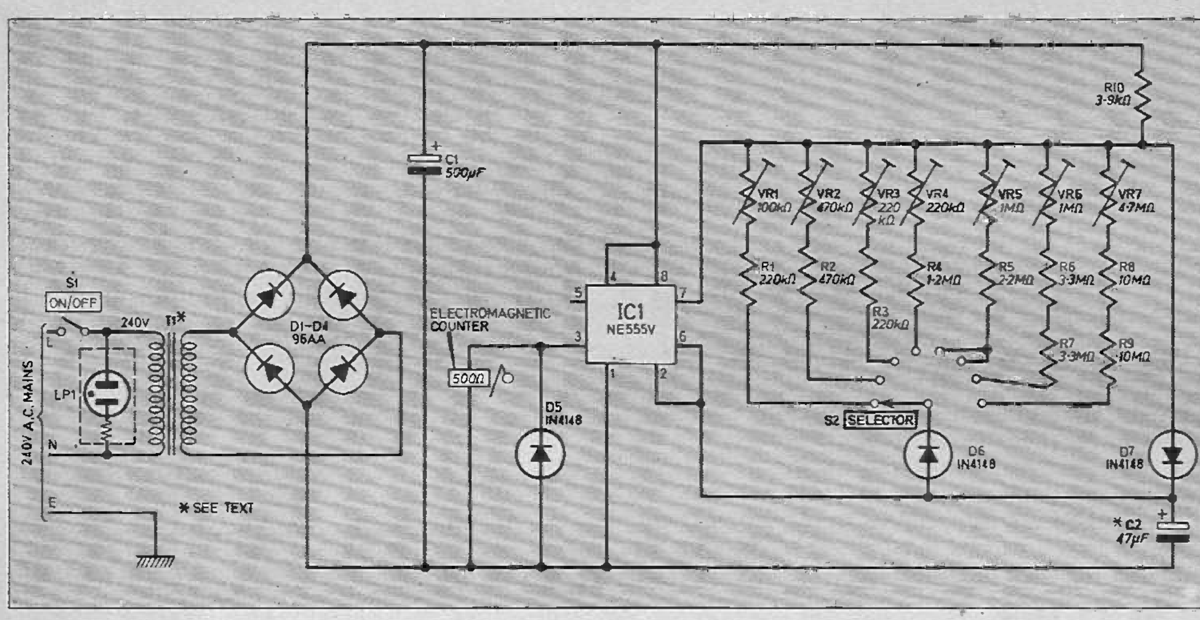


Fig. 4. The complete circuit diagram of the Telephone Call Charge Calculator.

switches off, from damaging the i.c. output transistor. Thus each time a positive pulse appears at pin 3, the counter advances by one count.

The discharge resistor (previously R_B) has been replaced by a bank of resistors and presets, R1-R9 and VR1-VR7 respectively, and S2 is incorporated so that a fixed discharge time can be readily selected. The seven discharge paths are calculated so that the discharge times are in accordance with Table 1.

The charge (t_c) and discharge (t_d) times can be calculated from the following formulae:

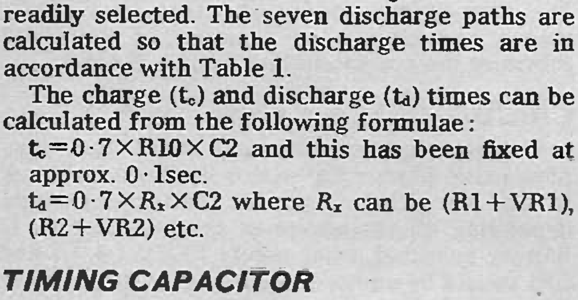
$t_c = 0{\cdot}7 \times R10 \times C2$ and this has been fixed at approx. 0·1sec.

$t_d = 0{\cdot}7 \times R_x \times C2$ where R_x can be (R1+VR1), (R2+VR2) etc.

TIMING CAPACITOR

For accurate long time delays, capacitor C2 ideally needs to be a low leakage type with low tolerance such as 20 per cent or better. Values for the discharge resistors were calculated based on a 20 per cent capacitor. Normal electrolytic capacitors may be used but may need a higher value preset than that detailed, depending on the leakage factor.

The capacitor used in the prototype was obtained from a surplus computer panel and was a tantalum type.



A 25V working electrolytic chosen at random functioned satisfactorily.

CONSTRUCTION DETAILS

The prototype unit was built in a commercially available p.v.c. covered metal case measuring 150×130×75mm which comes apart as two "U-sections". This case size should be considered as the minimum to comfortably accommodate all the components.

There are two component boards, one to take the timing circuit and power supply components (board A), and a second to carry the timing resistors and presets (board B). In this way, should the telephone charge rates be revised in the future, it will only be necessary to remove board B to update the device.

Begin construction by drilling the fixing holes in the boards and then making the breaks along the copper tracks as detailed in Figs. 5 and 6. Now assemble and solder the components in positions indicated paying attention to diode and capacitor polarities. Veropins are used on board B.

An 8 pin d.i.l. socket should be used for IC1 as this facilitates easy removal and replacement should this be necessary. Also, using a socket eliminates possible damage from the heat of the soldering iron. When complete, recheck for possible errors and insert the i.c. in its holder, paying attention to polarity indicated by a notch at one end. Do not attach the flying leads.

Next, with reference to Fig. 7 the case should be prepared to accept the counter, S2, S1 and LP1, all of which are mounted on the front face. The case should then be drilled to accept all the other component fixings, and a hole made in the rear face to suit a grommet through which the mains cable is passed.

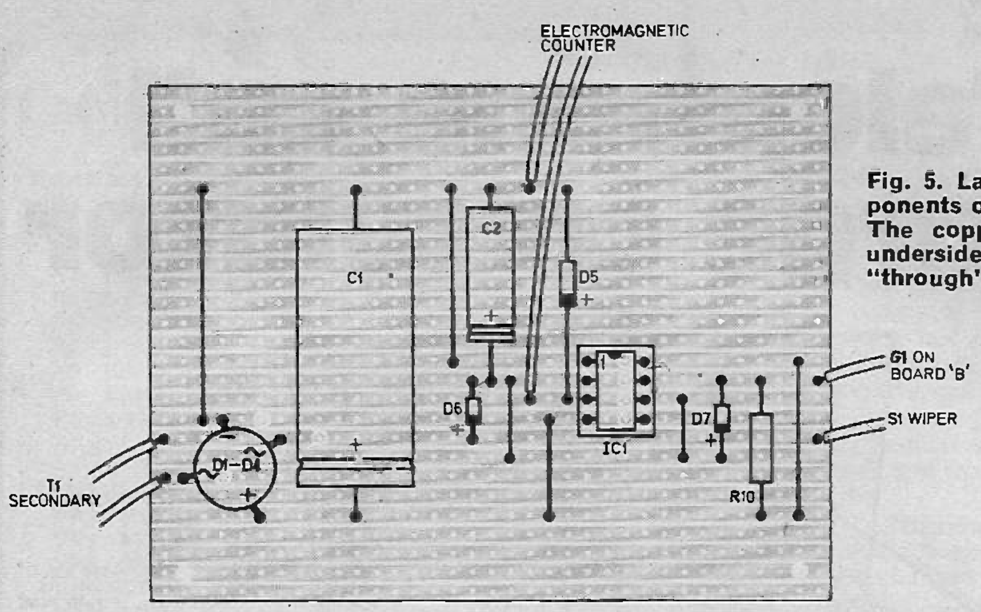
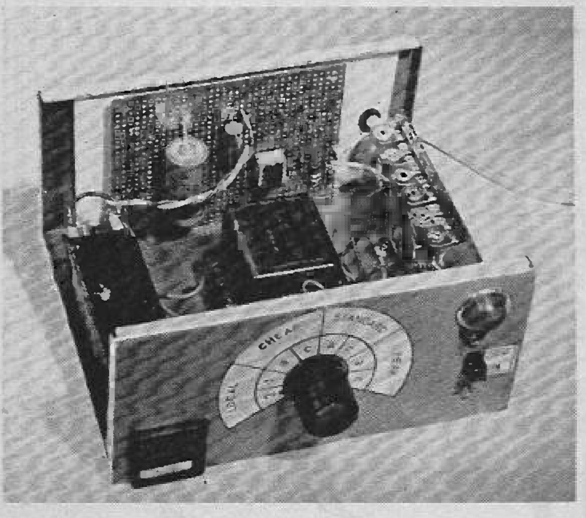


Fig. 5. Layout of the components on the main board. The copper strips on the underside are shown tinted "through" the board.

Two small aluminium brackets are required, one to hold board B in position and the other to secure the counter to the case.

With the exception of board A, secure all the components and board B in place as indicated in the photograph and wire up as shown in Fig. 7. Thoroughly check all the wiring and when fully satisfied, secure board A in place using 4BA nuts, bolts and spacers. A piece of stiff cardboard interposed between the case and each board will eliminate possible shorting against the case.

Three-core mains cable should be used and led out at the rear of the case via a rubber grommet. The mains lead should be fitted with a fused plug. A suitable earthing point is board B fixing bracket via a solder tag.



Photograph of the finished unit with lid removed.

CALIBRATION

A dial should now be drawn up and glued around S2 as shown in photograph and a pointer knob fitted. The pointer should be made to read "peak c" with S2 set so that (R1+VR1) are in circuit. Set all the potentiometers at their midway positions and plug into the mains.

Switch on at S1; the neon should illuminate and the counter should click and its readout advance by one. If this does not happen switch off immediately and check the circuit wiring etc.

Assuming all is well, switch off; obtain a timing device such as a stop watch or clock with

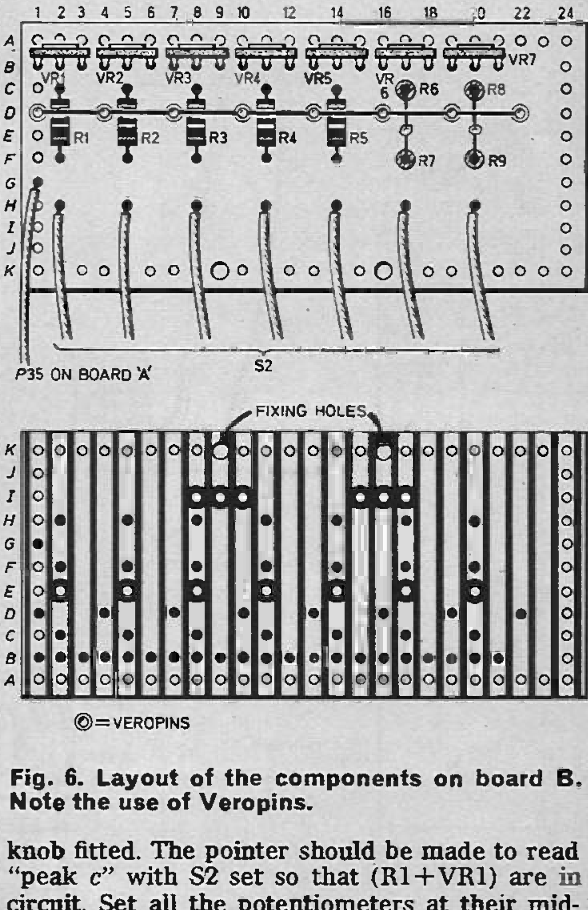


Fig. 6. Layout of the components on board B. Note the use of Veropins.

Telephone call charge calculator

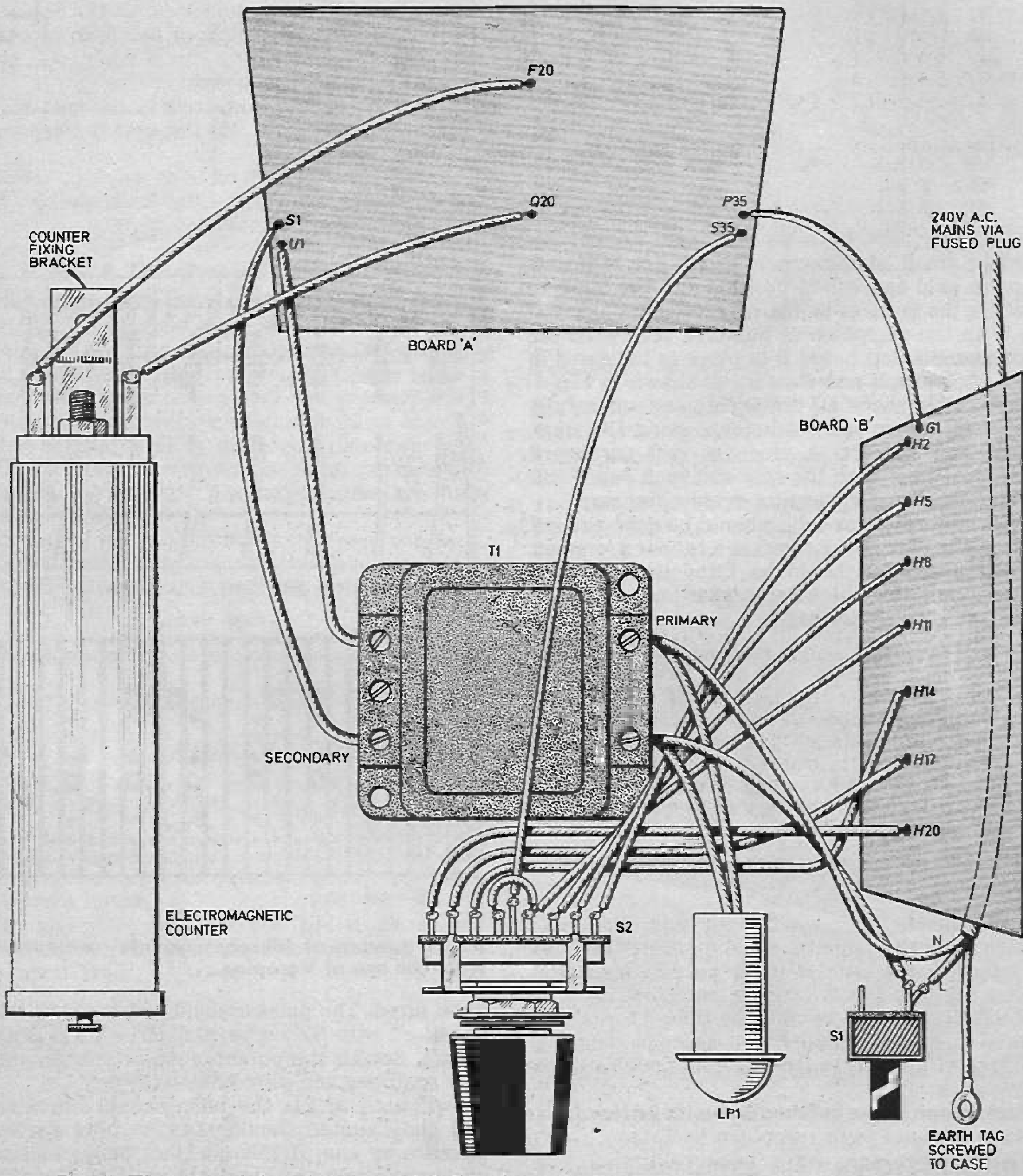


Fig. 7. The complete wiring up details of the unit.

Components....

Resistors
R1 220kΩ
R2 470kΩ
R3 220kΩ
R4 1·2MΩ
R5 2·2MΩ
R6 3·3MΩ
R7 3·3MΩ
R8 10MΩ
R9 10MΩ
R10 3·9kΩ
All ¼W carbon ± 5% tolerance

SEE
SHOP TALK

Potentiometers
VR1 100kΩ
VR2 470kΩ
VR3 220kΩ
VR4 220kΩ
VR5 1MΩ
VR6 1MΩ
VR7 4·7MΩ
All miniature carbon vertical skeleton types

Capacitors
C1 500μF 16V elect.
C2 47μF 10V elect.—see text

Semiconductors
D1-D4 96AA ½A 50 p.i.v. bridge rectifier or similar
D5, 6, 7 IN4148 (3 off)
ICI NE555V timer i.c. 8-pin d.i.l.

Miscellaneous
S1 mains on/off slide or toggle
S2 1-pole 8-way wafer
LP1 mains neon with built-in resistor
T1 Friedland mains bell transformer—see text
Electromagnetic counter type 14A or similar having a minimum coil resistance of 200 ohms that will operate at 15V; 8-pin d.i.l. socket; Veroboard: 0·1in. matrix 35 holes by 27 strips, 0·15in matrix 11 holes by 24 strips; Veropins; solder tag; length of three-core mains cable; 4BA fixings; knob; case.

second hand, and switch both unit and stop watch on at the same time and measure the time it takes for the counter to advance by a further count after its initial turn on count. Preset VR1 should be adjusted so that the time interval between successive counts is 8 seconds. Turning the preset in a clockwise direction decreases the timing period.

All other settings should be adjusted in a similar manner with reference to Table 1.

When all ranges have been calibrated and checked, a dab of glue or nail varnish should be applied to each preset to prevent the latter being disturbed from their set positions.

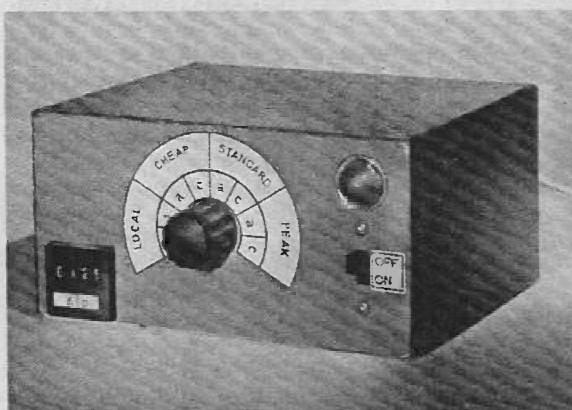
USING THE UNIT

The unit should be situated within easy reach of the telephone when in use. When wishing to cost a call, the call code should first be determined from the Dialling Instructions booklet as an "*a*", "*c*" or local call; switch S2 is then set to this code according to rate for the time of day i.e. cheap, standard, peak, *1* or *2* (see Table 1).

The call should then be dialled and the unit switched on at the instant of "getting through"; the unit should be switched off as the receiver is replaced. The difference in the counter readings before and after the call is made, will give the cost of the call in pence.

Alternatively, the counter can be read regularly, say once a week and the weekly telephone bill determined.

In the Dialling Instructions booklet (issued pre-Oct 1973) there are some calls coded "b", these should now be changed to "c".



Photograph of completed unit.

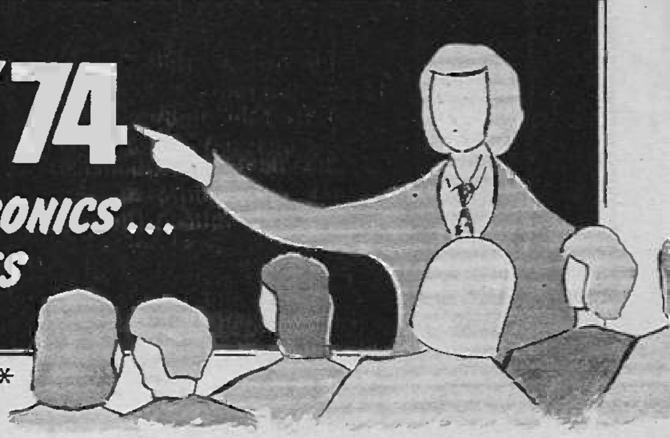
REVISION OF CHARGES

Since the charges at present are normalised to a 1p unit, the counter display can be read directly in pounds and pence. If in the future the basic unit changes from 1p the readout will give the number of units used.

Also, if the rates are later revised, the timing resistors will need replacing, values being calculated using the formula given above. ■

TEACH-IN '74

FOR BEGINNERS IN ELECTRONICS... THEORY AND EXPERIMENTS



TUTOR: PHIL ALLCOCK*

LESSON 10 Transformer, Reed Relay, Loudspeaker and Unijunction

THE ratio of the numbers of turns on the coils is an important quantity since it can be used to measure the amount by which the input voltage or current is transformed (i.e. stepped up or down).

RATIO

The Friedland transformer, which is used later in the Tutor Board experiments, is designed to be connected to the normal mains supply on the primary side and to supply 3, 5 or 8 volts from the secondary side.

The mains supply provides the current to magnetise the core and since the supply is a.c. the resulting magnetic flux is continuously varying. The varying flux links equally with the primary and secondary coils and each coil will have a voltage induced in it, just as in the case of the alternator coil.

Since the changing flux is common to all coils the rate of change of flux linkage will only depend on the number of turns on each coil. The situation is illustrated in Fig. 10.1 and if we assume that $N_1 = 3000$ and $N_2 = 100$ the primary flux linkage will be 3000Φ whereas the secondary flux linkage will be 100Φ. (Φ represents the rate of change of magnetic flux.)

We know that voltage is proportional to the rate of change of flux linkage so we can write:—

(primary current)×(primary turns)=
(secondary current)×(secondary turns)

The first equation tells us that $\Phi = \frac{240}{3000}$ and substituting this in the second equation we get—

$$\text{Secondary voltage} = \left(\frac{100}{3000}\right)240 = 8 \text{ volts.}$$

The ratio 100:3000 is the "step down" turns ratio going from the primary coil to the secondary coil. Note that the coil with least turns also has the least voltage. The turns ratio thus determines the output voltage for a given mains supply voltage at the primary (input) coil. If this same transformer was connected to a mains supply of say 210 volts the output voltage would be reduced:

$$\text{Output voltage} = \left(\frac{100}{3000}\right)210 = 7 \text{ volts.}$$

TRANSFORMER ON LOAD

If a resistor or some other form of load is connected to the secondary a secondary current must flow due to the existing secondary voltage.

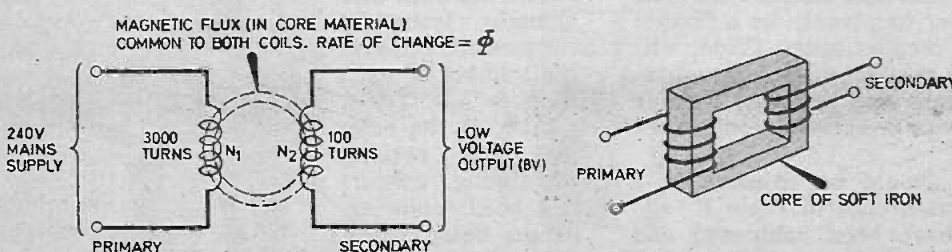


Fig. 10.1. Flux linkage in a simple transformer, and illustration of a simple transformer system.

* North Staffordshire Polytechnic (*Any communications arising from the Teach-In '74 series must be addressed to Everyday Electronics, Fleetway House, Farringdon Street, London E.C.4*).

To keep the magnetisation of the core at its correct level, so that the primary induced voltage is equal to the mains supply voltage, extra current must be taken from the mains supply to compensate for the flow of secondary current.

Since the magnetic effect of each current depends on the product of the current magnitude and the number of turns through which it flows, the transformer flux "constancy" requires that:

(primary current)×(primary turns)=(secondary current)×(secondary turns).

Thus the current ratio also depends on the turns ratio but this time the least turns is associated with the greatest current. If our load is 100 ohms an 8 volt output would give a secondary current of $\left(\frac{8}{100}\right)A=80mA$. The corresponding primary current would be $\left(\frac{100}{3000}\right)80mA=2\frac{2}{3}mA$. If these are the r.m.s. values, the power dissipation in the load will be 0·64 watts and a similar power is taken at the primary side since

$240V\times\frac{8}{3}mA=640mW$.

Our transformer is 100 per cent efficient simply because we have not allowed for any of the losses that occur in practice due to coil resistances, core heating and magnetisation. For our purposes we can neglect these losses and use the following simple relationship for all our calculations:

$$\left(\frac{\text{primary turns}}{\text{secondary turns}}\right)=\left(\frac{\text{primary voltage}}{\text{secondary voltage}}\right)=\left(\frac{\text{secondary current}}{\text{primary current}}\right)$$

REED RELAY

Another component that uses the magnetic effect of a current is the reed relay. The reed switch is usually encapsulated in a thin glass tube and consists of two (or sometimes three) blades made of magnetic material. The tips of the blades are usually gold plated to form a low resistance contact.

If the reed switch is exposed to a suitable magnetic field from a current-carrying coil or a permanent magnet the blades become magnetised and the contacts attract each other. If the magnetic field is sufficiently strong the contacts will close whilst the field is present. The reed switch with outer coil is known as a reed relay, and a wide variety of different types are now available.

Some switches have three blades to form a "change-over" contact. One of the characteristics of these switches is that the contacts can "bounce" when the relay is operated. This means that the contacts do not settle down to their operated positions immediately but undergo a series of momentary closures before final closure. The effect is due to the bouncing of contacts and can depend on the strength of the magnetic field used.

In some systems this "bounce" cannot be tolerated and precautions must then be taken to minimise its effects. In the experiments this month a simple "make" contact switch is used to demonstrate the action of the reed relay using an easily wound relay coil.

RELAY TRANSIENTS

If an inductor, reed relay coil or transformer winding carries a steady current (d.c.) the resulting magnetic field will be constant. When the current is switched off the magnetic flux must fall to zero and must therefore generate an induced voltage in the coil due to the changing flux linkage. Since the rate of change can be very high, large induced voltages can be produced which might cause damage to semiconductor devices if not protected.

A typical situation in which a reed relay coil is connected in the collector circuit of a transistor is shown in Fig. 10.2. If the transistor is saturated when on, the collector current will be limited by the resistance of the reed relay coil which in this case is one kilohm. When the transistor is switched off the collapsing magnetic flux, linked with the coil turns, produces an induced voltage that makes the collector end of the coil positive with respect to the other end.

By connecting a suitable diode D1 across the coil, as shown dotted, this voltage spike can be limited so that excessive voltage does not appear at the transistor collector. The diode provides a current path whilst the field collapses and the energy previously stored in the magnetic field is lost by power dissipation in the coil.

In some circuits, resistance is included in series with the diode to limit the current flow. The waveforms in Fig. 10.2 show the effect of the diode. Note that the induced voltage is established in a direction that tries to maintain the relay current in its original direction.

By using similar reasoning it can be seen that if we switch a current on and off and the current flow is via, say, a transformer winding, then a large voltage can be produced at a second winding if a suitable turns ratio is employed. This is of course the same principle as that used in the well established method of generating the high voltage pulses for the spark plugs of a car-engine.

LOUDSPEAKER

One further component using magnetic effects is the moving coil loudspeaker. Just as the coil of a moving coil meter is made to turn by the interaction of a permanent magnet field and the field of the current-carrying coil, so the cone of

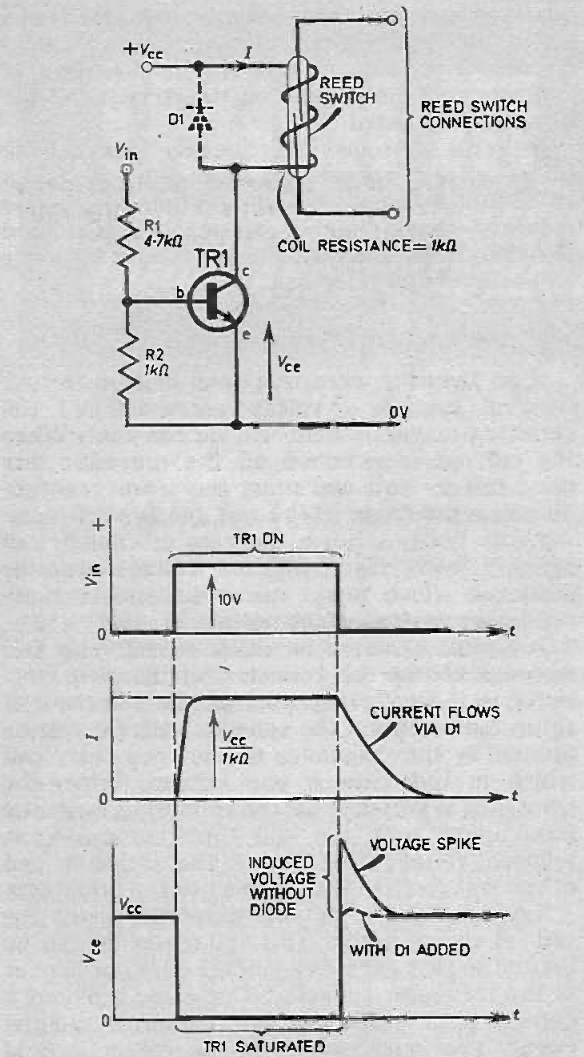


Fig. 10.2. Transistor operated reed relay with associated waveforms.

a loudspeaker is displaced by a similar interaction. In this case the moving coil is attached to the base of the cone and the cone movement generates variations in air pressure which we observe as sound, see Fig. 10.3.

It is apparent from what we have said so far that devices employing magnetic effects are very common in electrical and electronic engineering. Some of these devices are specialised and need not concern us now. However the main features of the electromagnetic effects have been illustrated and it is usually a straightforward matter to apply the basic ideas to other devices such as buzzers, horns and motors.

OTHER SEMICONDUCTOR DEVICES

In addition to the diode and bipolar transistor, covered in earlier lessons, a wide variety of semiconductor devices exist and some of these will be used in the experimental circuits that have been planned for the remaining parts of the Teach-In series. The first of these devices is the so called unijunction transistor which was originally known as a double-base diode.

Like the bipolar transistor it has three connections but there the resemblance ends. The device we have selected is the TIS43 and we shall deal specifically with this type, but other types of similar ratings are available and may be tried if these are available.

UNIJUNCTION OPERATION

The unijunction behaves in some respects like a voltage-sensitive switch. The device connections are known as emitter (e), base No. 1 (b1) and base No. 2 (b2) and these are illustrated together with the circuit symbol in Fig. 10.4. Notice that the arrow head on the emitter symbol points towards the connection known as base No. 1 (b1).

As far as the b1, b2 connections are concerned the device behaves just like a resistor made of lightly doped *n*-type silicon material. The use of light doping means that the resistance of the device between the points b1 and b2 is relatively high, typically 10 kilohms, due to the restricted number of free electrons available.

The connections to the silicon at b1 and b2 are "non rectifying" i.e. they do not behave like a diode, but the emitter connection which is formed part way along the silicon material is in

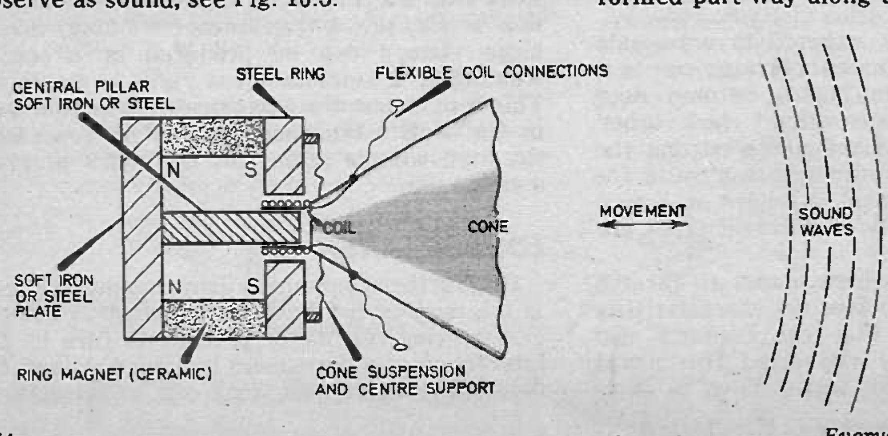


Fig. 10.3. Construction of a loudspeaker using the moving coil principle.

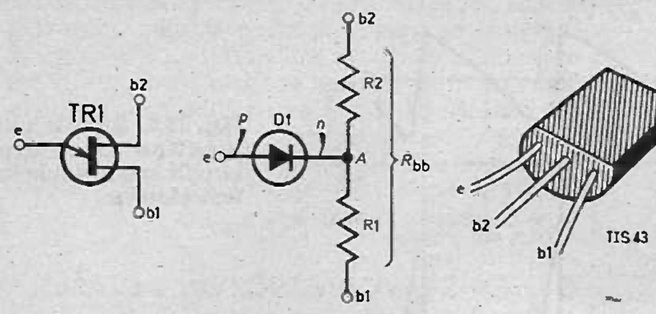


Fig. 10.4. Detail of the unijunction transistor, circuit symbol, equivalent circuit and mechanical details.

fact a normal *pn* junction and so the equivalent circuit for the unijunction is as shown in Fig. 10.4.

Point *A* represents the region at which the emitter junction is formed and R1, R2 represent the resistance of the material between this point and the base connections b1, b2. In use, a voltage V_{bb} is developed across the effective potential divider formed by R1 and R2 as shown in Fig. 10.5 and this makes point *A* positive with respect to b1. If the total resistance is $R_{bb}=(R1+R2)$ then we can define our first useful parameter as

$$\eta(\text{eta})=\frac{R1}{R_{bb}}=\text{intrinsic stand-off ratio.}$$

This rather fancy title need not frighten anyone—it is simply the ratio of the resistance R1 to the total resistance R_{bb} and is particularly useful since the voltage at *A* is given by ηV_{bb}. Since the voltage level at *A* is important to the subsequent mode of operation it is useful to realise that η must always be less than unity and is typically about 0·6 for the TIS43 transistor.

Thus if V_{bb} was set to +10 volts the voltage at point *A* would be +6 volts (measured with respect to the b1 terminal). Let us now consider the test circuit of Fig. 10.5 in which the emitter is connected to a variable voltage supply via a current limiting resistor R_e.

If we had suitable instruments available we could measure the current I_e and the voltage V_{eb1} for various settings of the variable voltage supply V_{ee}. With V_{bb} connected and V_{ee} set at zero a small leakage current would flow via the diode because of the positive voltage at point *A*. As we increase V_{ee} this leakage current would reduce until at point *Z*, on the characteristic shown in Fig. 10.5, the current would be zero.

For this zero current condition the emitter-base voltage V_{eb1} must be equal to the voltage at point *A* so that the voltage across the diode is zero. Thus the voltage at point *Z* is

$$V_{eb1}=\eta V_{bb}=\text{voltage across R1,}$$

and $I_e=0$. If we increase V_{ee} further the voltage V_{eb1} will continue to rise until the diode starts to conduct. This is a critical point on the characteristic (*X*) and is known as the **peak point**.

As the diode starts to conduct the number of current carriers in the R1 section of the device increases and this has the effect of increasing the conductivity of the silicon in this region. The resistance R1 thus tends to fall and this causes a further increase in diode current.

The resulting characteristic is shown by the curve between *X* and point *Y*, and this latter point is usually known as the **valley point**. Once the peak point is reached the transition from *X* to *Y* is very rapid and does not require any change in V_{ee}. The increased emitter current is limited by the external emitter resistor R_e and if the transistor reaches the region to the right of the valley point the circuit will remain in this new condition until the V_{ee} supply is disconnected or reduced to a much lower value.

If R_e is made sufficiently large the current I_e will not reach the valley current and the circuit can then be made to oscillate by adding a single capacitor to the emitter circuit.

OSCILLATOR

The complete oscillator is shown in Fig. 10.6 where it can be seen that the same battery is used for the two supply voltages i.e. $V_{bb}=V_{ee}$. The resistance in the emitter is made variable, by VR3, and has a minimum value determined by R1. A second variable resistor VR1 is used as a potentiometer in the b1 lead to derive an output voltage waveform.

The capacitor C1 charges via the resistances and VR3 and the capacitor voltage (V_c) rises exponentially as described in earlier lesson material. When the critical peak voltage (V_p) is

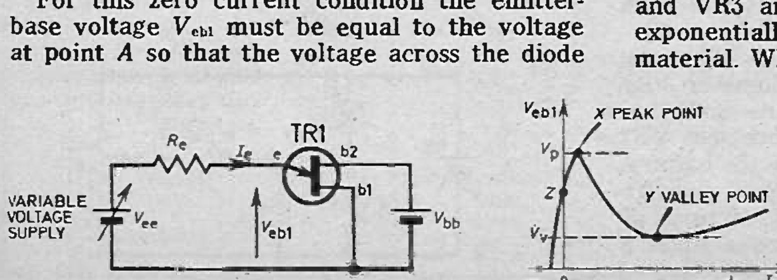


Fig. 10.5. Unijunction operating characteristics.

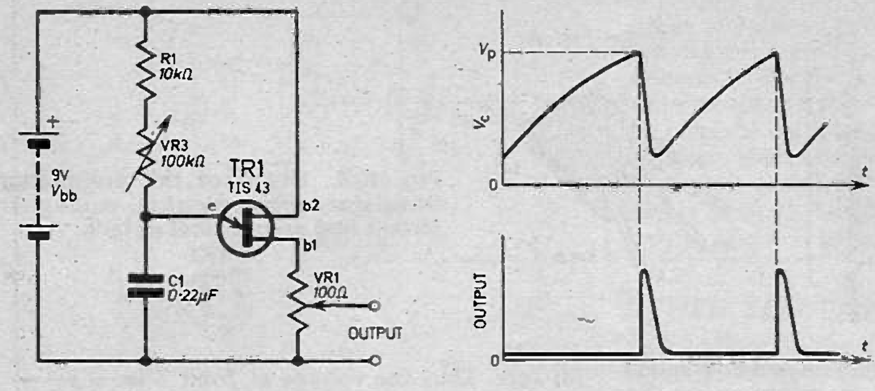


Fig. 10.6. Simple unijunction oscillator circuit and associated waveforms.

reached the transistor switching action is initiated and V_c falls rapidly. If the total emitter resistance is large enough the final emitter current will be limited to less than the valley point current and the capacitor will start to recharge again.

Every time the capacitor discharge occurs a pulse of current flows via VR1 and this produces a series of voltage pulses at the output. Since the charging of C1 depends on the time constant C1 (R1+VR3) the frequency of the pulses can be controlled by VR3. The waveforms shown in Fig. 10.6 illustrate the circuit behaviour. Note that the voltage V_p is given by

$$V_p \simeq 0\cdot5+\eta V_{bb}$$

where the forward voltage of the emitter diode has been taken as 0·5 volts. Since V_p depends on both η and V_{bb} the frequency will also depend on these two quantities.

Next month we shall investigate some of the features of field effect transistors.

TUTOR BOARD EXPERIMENTS

Test No. 20

Remove the cotton from the plastic spool (as listed in the May 1974 issue) by winding it onto a piece of cardboard so that it is not wasted. Carefully wind the enamelled wire onto the spool until it is full. The start end can be fixed with sticky tape, to stop it slipping, and it will help if someone can support the bobbin of wire on a knitting needle whilst the coil winding is in progress. Fasten the end of the wire with tape to complete your relay coil.

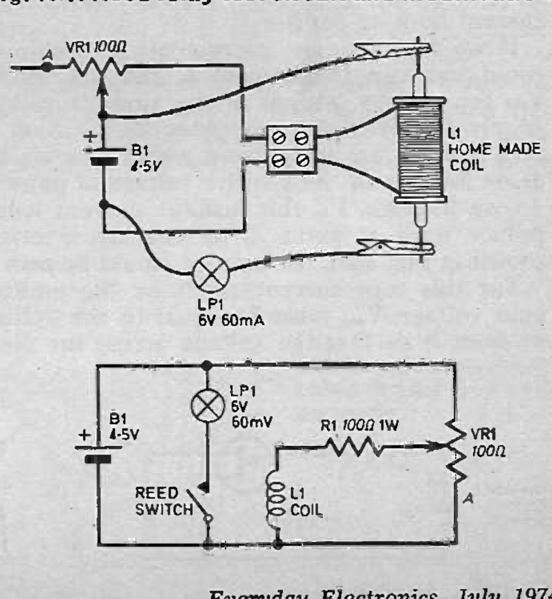
Use the circuit of Fig. 10.7 to check that your reed switch operates. The potentiometer VR1 can be used to vary the coil current—note that your coil will have a low resistance and VR1 helps to limit the current taken from the battery. The prototype coil used a plastic spool approximately 1½ inches long and a coil of 400 turns of 30 s.w.g. wire. The coil resistance was about 3 ohms.

The 6-RSR-A reed switch requires 20 to 40 ampere-turns to give reliable operation and with 400 turns this means a current of 50 to 100mA. By noting the position of the potentiometer VR1 at which the relay operates it may be possible to estimate the operating current for your coil. Once operated the current must be reduced to about half the operating value to ensure that the relay contact opens again.

If the range of adjustment is insufficient using the 100 ohm potentiometer an additional resistor of 100 ohms, 1W, can be used to reduce the coil current using the circuit modification shown in Fig. 10.7. With this arrangement the maximum current is limited to about 45mA but the current can be reduced to zero.

If a larger number of turns is used the operating and release currents will be correspondingly reduced. A coil of at least 400 turns is recommended. An accurate measurement of operating and release current can be made by measuring the voltage drop across the 100 ohm fixed resistor but because of the limited maximum current not all coils can be tested this way.

Fig. 10.7. Reed relay test circuit and modification.



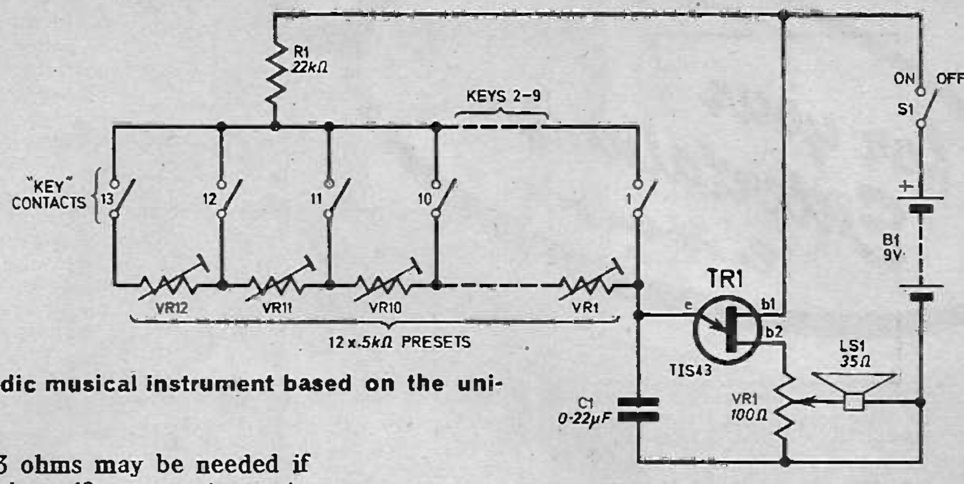


Fig. 10.9. Simple melodic musical instrument based on the unijunction oscillator.

A resistor of say 33 ohms may be needed if the reed switch requires 40 ampere-turns to operate and a coil of 400 turns is used. (Note: A resistor of 33 ohms is not available in the existing component collection. Three 100 ohm resistors can be connected in parallel as an alternative if these are available, or a higher voltage (9V) could be used. Do not try to operate the lamp circuit from the full 9 volts as this will probably ruin the lamp! If your relay coil does not work, try winding a coil with more turns. Remember, patience is a virtue!)

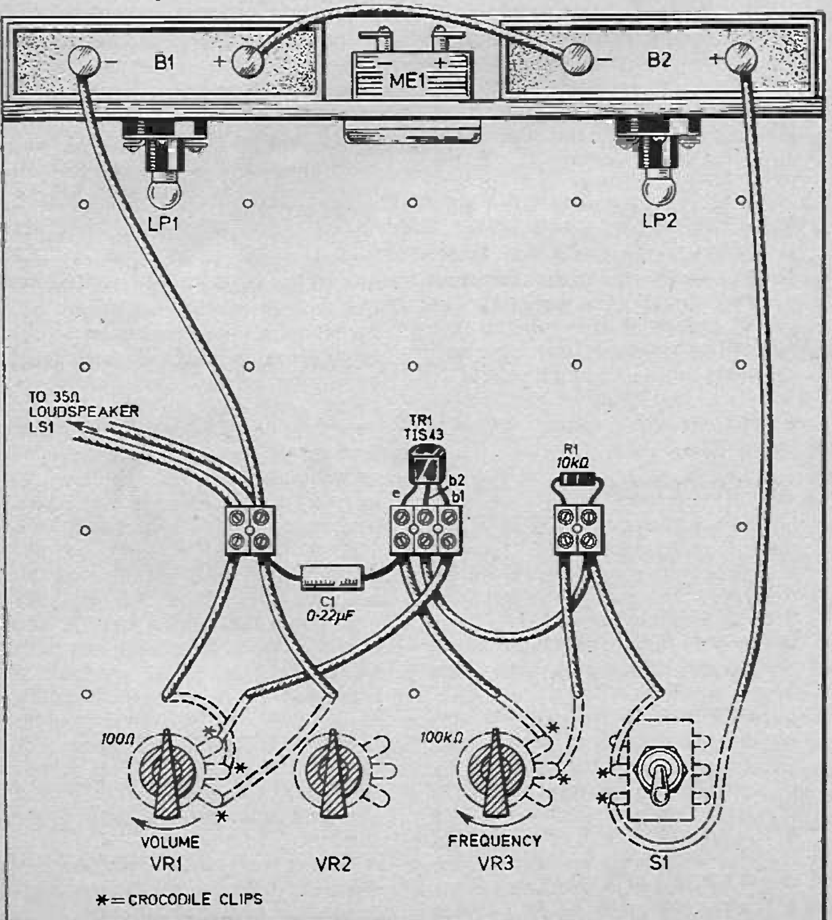


Fig. 10.8 Layout and wiring of Fig. 10.6 on the Tutor Board.

Test No. 21

Build the unijunction oscillator (Fig. 10.6) on the Tutor Board using the layout shown in Fig. 10.8. Connect the loudspeaker (35 ohms) to the output terminals and listen to the sound produced as VR3 is varied. Adjust the 100 ohm potentiometer (VR1) to give a suitable volume level from the loudspeaker. Note that the lowest frequency occurs when VR3 is set to its maximum value of 100 kilohms. If you have a piano or other musical instrument in the home try to estimate the frequency range covered as VR3 is varied.

It is possible to build a simple musical instrument using this oscillator. All that is required is to switch in different resistors by means of "contacts" as shown in Fig. 10·9. The mechanical arrangement for such an instrument is left to the ingenuity of the reader. The overall "pitch range" can be changed by using a different value for capacitor C1. Doubling C1 halves the frequency of all notes.

The output at the 100 ohm potentiometer can be fed to an amplifier, if required, via a 0·22μF series capacitor.

for your Entertainment...

By Adrian Hope

ONLY a few years ago the only electronics used for entertainment in most homes was a radio set, a simple black and white TV set running on an indoor aerial, and a mono record player. Now many people are almost literally ankle deep in exotic electronic gear. And daily they are subjected to the temptation of buying yet more.

Matching one piece of new equipment with another so that both work properly is no mean feat and I'll bet that all over the country, or the world for that matter, there are expensive electronic arrangements producing such bad results that the owner would have been far better off with what he had before.

Some times the fault is witb the equipment, some times with the setting up and some times local conditions are responsible for poor results. Whatever the cause tbe effect is little or no entertainment for anyone. The idea of this column is to offer a few practical suggestions on buying and using equipment which really is primarily *For Your Entertainment*.

CONTINENTAL ENTERTAINMENT

Cheap holidays in Spain and the Balearic Islands beckon all the year round. So a few thoughts on the electrical facts in Spanish life should not come amiss. Also many people, myself included, like the idea of a little music or world news being available on tap in the privacy of our hotel room.

Palma, Majorca has a local f.m. studio which broadcasts in the English language every evening and into the night on 96·6MHz. The programming is mostly good popular music, for instance in the Sinatra bracket, and reception is fine in the coastal area around Palma. But because the station is low strength (1 kilowatt transmitter power) and the island very mountainous, you will be hard pressed to receive it in any other part of Majorca.

This radio station is, incidentally commercial and one of the few in the world that you can visit any time you like. This is because the "studio" is a Palma bar called "My Own Place" run by American expatriate Riki Lazaar. Buy the local English language newspaper (The Majorca Bulletin) for further information.

Elsewhere in Spain there is little, if any, English language f.m. radio so you will need to rely on the medium and long wave bands for your listening. And this is where the plot starts to thicken. Although Radio Algeria should come in loud and clear on the long wave band with some light music every night, it is in many concrete hotels likely to be a weak signal and drowned out by local interference. The prime source of this interference is hard to tie down but may well be thyristor-controlled circuitry for dimming lights or controlling heaters or drive motors for lifts and airfans.

INTERFERENCE

The interference problem is bad enough in England, but in Spain it is even worse and reception of m.w. and l.w. may be impossible. This is probably because even new modern hotels being built there are electrically wired with little or no earthing. This is not only potentially dangerous, but it also means that any interference which is created for instance by a motor, a thermostat or a thyristor control will have the best-possible chance of pervading the hotel wiring system, which then acts as one glorious aerial.

I have stripped down several hotel wall sockets and switches in Spain and never yet found any earthing, even in stone-floored bathrooms where unshielded two-pin sockets are provided with astonishing lack of common safety sense. Shocks received from lift switch panels also suggest that their high-power drive motors may be unearthed. And even the toilets in some new Spanish hotels are flushed by heavy duty electric solenoids. Small wonder that a.m. radio reception is so poor!

Of course f.m. radio is largly immune to interference of this type, but as we have already seen, there is relatively little f.m. to be received. So anyone going on holiday to Spain and wanting to be sure of some music in their hotel room, will need to take not only an f.m./a.m. radio, but also a cassette player with some prerecorded cassettes. That way if there is no local f.m. station and local interference blots out everything on the a.m. bands, taped music can come to the rescue.

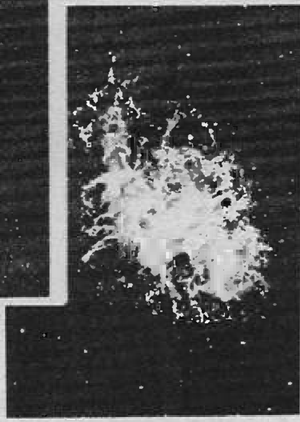
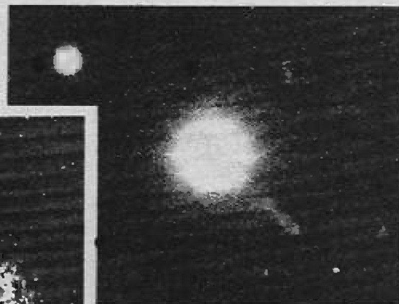
VOLTAGE

Incidentally, the mains supply voltage in Spain is now a nominal 220 volts a.c., with the plug sockets of standard continental two-pin type. The pins of the plugs to fit these sockets are smaller than those on British two-pin plugs and are spaced apart by 2cm.

Although adapters to convert British plugs to continental size are cheap in most Spanish shops, the hotels often charge an exhorbitant price so it may be worth buying one in England. And don't be too bothered if you run equipment such as a shaver, hair dryer or radio off the mains and find its performance erratic.

Although mains voltage is *nominally* 220 volts it fluctuates like mad, often down to around 190 volts. In this country a 6 per cent change only is allowed by law i.e. 15 volts either way. All over Spain there is a roaring trade in voltage stabilisers for use with television sets. So if you see a television in a bar and it has a mysterious white boxed gadget standing on top, the chances are that it's a stabiliser. This keeps the voltage to the set steady and prevents the picture size from shrinking.

In fact a few days with Spanish electrics makes the British system a joy to live with.

The Andromeda Galaxy
The Crab Nebula
The Quasar 3c 273

(United States Information Service)

RADIO ASTRONOMY AT JODRELL BANK

BY S. McCLELLAND

EVERY second of the day and night, many types of electromagnetic radiation impinge on the earth from outer space. Although we can see some of this—the starlight—most is invisible and it was totally unknown until the advent of radio astronomy.

This fascinating science probes every secret of our amazing universe through this newly-discovered "window". To do this, it uses highly-complex instruments such as the radio telescopes at Jodrell Bank, Cheshire where Manchester University's Nuffield Radio Astronomy Laboratories are based. This article will briefly look at these telescopes and the purpose for which they were built.

A NEW WINDOW ON THE SKY

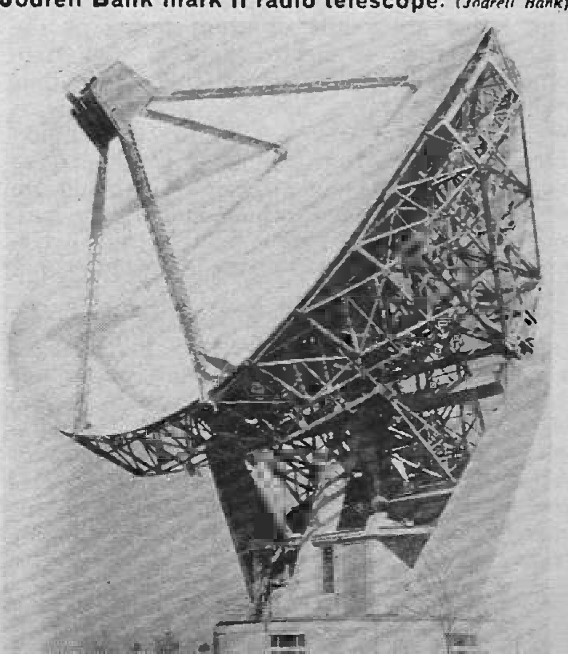
The science of radio astronomy is young even compared to the relatively brief life of radio communication. Indeed, it was not until 1931 that Karl G. Jansky, an American engineer working on the problems of radio interference, discovered a background static in his equipment and deduced from its nature that it must originate in space. Although he published the results of his important work little notice was taken of it.

In fact, only an American radio amateur named Grote Reber followed up Jansky's discoveries by building a small parabolic dish aerial in his garden. He used it to discover that areas of our galaxy were strong radio sources. However it became apparent that, contrary to expectations, only our sun, among all the normal stars in the sky, had a definite radio output associated with it. This is because of its proximity.

The second world war provided an impetus to radio astronomy and the subject was re-examined. Among the post-war researchers in England was a physics lecturer at Manchester University named Bernard Lovell.

Interested in the detection of the cosmic rays and meteors which continually bombard our planet, he was allowed to set up his equipment on a site free from man-made electrical interference at the botanical department of the University—a place called Jodrell Bank.

Jodrell Bank mark II radio telescope. *(Jodrell Bank)*



THE GROWTH OF JODRELL BANK

The work of Bernard Lovell with fairly elementary equipment was so successful that he was allowed to build larger and more efficient radio telescopes. Eventually he realised that to make further progress a giant, fully-steerable radio telescope with a parabolic dish 250 feet in diameter, was required.

The magnificent design of, and supervision work on, the telescope was carried out by H. C. Husband and Co., of Sheffield.

Construction of the telescope commenced in 1952, and it was finished in the International Geophysical Year of 1957. About half of the £700,000 cost was borne by the Department of Scientific and Industrial Research (now the Science Research Council), the bulk of the remainder being very generously met by Lord Nuffield and the Nuffield Foundation.

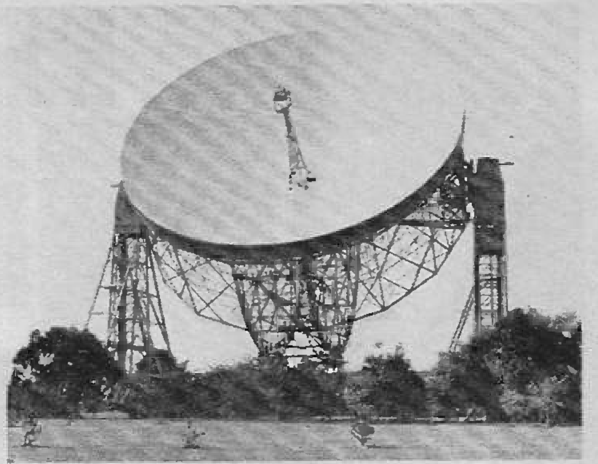
Any existing doubts about the value of the telescope were disposed of in an immediate and spectacular way, when the instrument showed its great versatility by being the first Western device to detect and track the carrier rocket of the first space satellite—the Russian Sputnik I. Great successes, also in the field of tracking, continued to be achieved at Jodrell Bank, notably with the American Pioneer space probes, and the first man-made object to hit the moon—the Russian Lunik II.

Today, Jodrell Bank has become world famous through these events, but it still remains primarily a radio astronomical station with a very small percentage of its research time being devoted to tracking. In the past decade, it has been greatly involved with the discoveries of the so-called "new" astronomy—especially the fantastic quasars and pulsars.

THE RADIO TELESCOPE

The light and radio waves which originate from space are really different forms of the same radiation — electromagnetic radiation. Some methods of receiving them are thus similar. Radio waves, however, are very much longer than light waves—typically ten million times, and those from about one centimetre to many metres in wavelength can easily penetrate the earth's atmosphere which hinders the passage of light waves. This means that radio astronomical observations can be made through cloud and mist, etc.

However, because of the dissimilarity in wavelengths, radio telescopes have to be much larger in order to achieve the resolving power—or distinguishing power—of a comparable optical telescope. Hence the collecting area, the parabolic dish, of the big telescope (called the mark IA) at Jodrell Bank is 250 ft. in diameter. This steel bowl weighs over 1,000 tons, and the giant mass of steel which supports it weighs roughly twice as much.



This photograph gives some idea of the size of the Jodrell Bank Mark IA telescope. *(Jodrell Bank)*

Modifications recently carried out on the telescope have resulted in a lower working wavelength, namely 11 centimetres. The instrument has a large working range and is thus very versatile in operation. Indeed, it is this versatility which has contributed to the great success of the telescope. It is also fully steerable, still one of the largest of this kind in the world, and it can be pointed to any area of the sky.

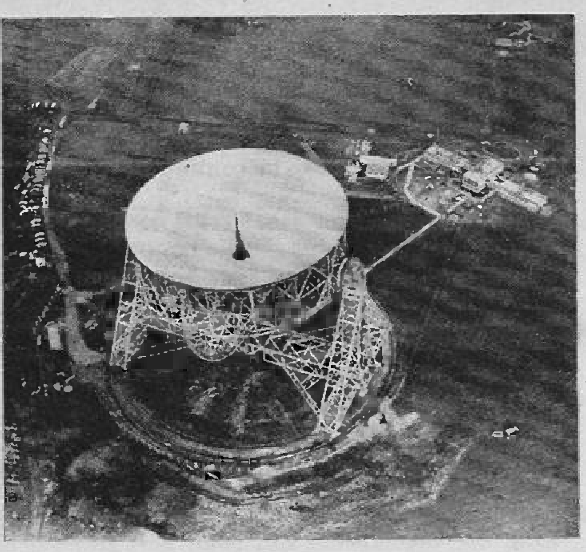
This is achieved by using computer-controlled electric motors to drive the complete telescope in azimuth (i.e. to the various points of the compass) and the bowl alone in elevation (i.e. tilt) through two huge racks that were salvaged from the gunnery equipment of the *Royal Sovereign* battleship. These are housed at the top of the two bowl support towers, 180 feet above the ground.

Radio waves which are collected by the bowl are focused on to the aerial at the dish's centre. Here, a very sensitive receiver amplifies the weak signals and they are passed to the control building and converted to binary form for analysis by a computer. This can print out its results on punched tape for further reference or make pen-recordings of signal intensity in the area of sky studied.

This is the nearest the radio astronomer can get to having a "picture" of the source, but his observations are usually combined with those made by an optical telescope in the same area to build up a complete knowledge about it.

OTHER TELESCOPES

Besides the mark IA, Jodrell Bank also has a mark II instrument. This is a smaller and more recent instrument with an unusual dish shape (see photograph) and it is used for lower wavelength work.



Aerial view of the Jodrell Bank telescope.

A similar telescope, the mark III, has a mesh dish and is stationed near Nantwich.

These instruments, besides being independent, can be used together, the output from each telescope being combined in a special way to effectively produce a very large radio telescope. The complete arrangement is known as an interferometer. Interferometers have been constructed between a Jodrell Bank telescope and instruments at places as far ranging as Malvern in Worcester, to Onsala, Sweden and Arecibo, Puerto Rico.

The remaining instruments at Jodrell Bank include a 50 foot telescope for lunar radar and miscellaneous work and another 50 foot "az-el" telescope for tracking space probes.

THE NEW TELESCOPE

In December 1972, it was announced that the University of Manchester is to build another radio telescope on a site near Welshpool, in Wales. The diameter of its dish will be 375 feet, making it the largest of its type in the world. It also means that the telescope's resolving power will be considerably greater than that of the present mark IA.

THE RADIO SKY

There are several varieties of radio sources in the sky, and Jodrell Bank has been concerned with almost every type, ranging from the radio "noise" areas of the sun and the planet Jupiter to the incredibly distant objects in the farthest reaches of the universe.

A great feat of radio astronomy has been the mapping of our galaxy. This is because the internal structure of the atoms of hydrogen gas of which the galaxy is largely composed can undergo a slight energy change. This change gives rise to a radio signal on a unique wavelength of 21cm, which can be detected by radio telescopes such as those at Jodrell Bank, so the distribution of hydrogen in our galaxy can be mapped. Also, the fact that the hydrogen line, as it is called, is sometimes slightly shifted in frequency due to the Doppler effect, means that the hydrogen gas and, therefore the galaxy, is in motion.

Such investigations have helped to build up a picture of our galaxy as being a gigantic, slowly rotating disc with spiral arms. It is indeed huge—about 100,000 light years across (a light year is the distance light travels in one year: it is about six million million miles)—and probably contains in the region of 100,000,000,000 stars.

Our sun, one of that number, is insignificantly placed away from the centre. The whole galaxy is probably quite similar to the Andromeda galaxy—also a nearby radio source, but still over two million light years away.

Other very interesting and mysterious radio sources exist in the sky which emit radio signals by different methods. These include the radio galaxies and the intriguing quasars and pulsars.

Quasi-stellar objects or quasars for short are certain, very small, star-like objects which emit incedible amounts of radio and optical energy. Evidence from the latter tends to suggest that they are enormously distant, but until the true distance is actually ascertained, quasars will continue to be a central problem in astronomy. The radio telescope at Jodrell Bank has played an important part in the discovery of the quasars.

Another of the amazing phenomena that have been discovered by the science of radio astronomy in the past ten years are the pulsating radio sources or pulsars. As their name suggests they emit bursts of radio and sometimes, light-energy. Perhaps the most famous example of a pulsar is that in the Crab Nebula.

This is a glowing cloud of gas which is thought to contain an incredibly dense neutron star. The latter could give rise to the radio pulses as a consequence of its spin. Although its origination is unclear, astrophysicists believe that the Nebula and the neutron star are remnants of a star which just blew itself up in a gigantic explosion or supernova which was observed by Chinese astronomers in 1004 A.D.

In this field, too, Jodrell Bank has made a very significant contribution by discovering many new pulsars.

RADIO ASTRONOMY AND OUR UNIVERSE

The aim of radio astronomy is to discover by its singular techniques more about the universe —its formation, evolution and end, if any, and its true nature. These are some of the most important questions of all. A great advantage with observational astronomy in general is that not only vast gulfs of space but also of time, can be surpassed.

This is because even light and radio waves, the messengers of the events which we observe in the sky, can take an enormous time to cross the distances involved. Thus, the father we can probe into space, the farther we also probe back in time, perhaps even towards the possible creation of the universe. This is why the nature of distant galaxies and quasars is of great importance to the astronomer.

Radio astronomy is helping scientists to decide between the various theories of the creation of the universe. These include the widely held "big bang theory" that suggests that at one time in the distant past all the matter in the universe was concentrated at one point before being scattered by a colossal explosion. Another theory, that of the "steady state" considers the matter in the universe to be continuously created as the universe expands.

In radio astronomy's brief life of 40 years almost paralleled by the development of Jodrell Bank, many questions have been answered, but many more have been unearthed. However, in the future, as in the past, we can be sure that Jodrell Bank will number among those prominent establishments providing the knowledge so necessary to mankind's understanding of the universe. ▣

Circuit Supply

Please would you tell me how it is possible to vary the current of a circuit whilst keeping the supply voltage constant?

For a fixed supply voltage circuit current is set by the total circuit resistance. In the simplest case this would comprise a set of resistors in series. The only way of altering the current is to alter the value of one or more of the resistors. In a more complicated case the current in question might be the collector or emitter current of a transistor and in this instance the circuit current can be controlled via the transistor's base current.

Loudspeaker Connection

Could you tell me how to connect two 60 watt loudspeakers together to give a total power rating that will handle 100 watts.

This is simply done by putting the two loudspeakers either in series or parallel but remember that you must match the output impedance of your amplifier. If your loudspeakers are *twice* the impedance of your amplifier then connect them in parallel; if they are each *half* its impedance put them in series. If each of your loudspeakers has the same impedance as your amplifier then you cannot use this simple technique because it is impossible to produce a good match without the use of a transformer.

Remember to keep the phasing correct; when connecting the speakers in parallel connect like terminals together. For series connection, unlike terminals should be linked.

Preferred Values

Some of your advertisers show resistors categorised as E12 and E24 series. I would be pleased if you could explain what this means.

As you must be aware, resistors are supplied with preferred values. There are 12 different values within a decade of ±10 per cent tolerance resistors. These are 1·0, 1·2, 1·5, 1·8, 2·2, 2·7, 3·3, 3·9, 4·7, 5·6, 6·8, 8·2 and multiples of ten on these values. The values have been carefully selected so that the upper 10 per cent tolerance of the lower value approximately equals the lower 10 per cent tolerance of the next higher value—this is how the rather strange selection of values comes about. This is called the E12 series of values.

There is a similar series for ±5 per cent tolerance devices—called E24—and there are twenty-four different values within a decade as follows: 1·0, 1·1, 1·2, 1·3, 1·5, 1·6, 1·8, 2·0, 2·2, 2·4, 2·7, 3·0, 3·3, 3·6, 3·9, 4·3, 4·7, 5·1, 5·6, 6·2, 6·8, 7·5, 8·2, 9·1. Note that the same tolerance law applies except that now it is ±5 per cent.

SEMICONDUCTOR PRIMER

By A. P. STEPHENSON

16 ■ TESTING TRANSISTORS

The instruments available for testing transistors, and how an AVO can be used both for testing and sorting out *pnp* from *npn* types.

Various transistor-test sets are manufactured, some quite simple, others bristling with knobs, dials and switches and capable of measurements on almost any transistor.

For transistor manufacturers they are no doubt very useful for testing h_{fe}, h_{oe}, h_{re}, h_{ie}, noise, f_T etc. For the small workshop, the capital investment in one of these spectacular instruments is seldom justified.

By the time the voluminous instruction manuals are studied, the various knobs twiddled, the dial readings laboriously checked, the poor technician is mentally exhausted and too weak to insert the transistor.

In most cases, it is only required to find out if a suspect transistor is working at all, or definitely unserviceable. An AVO meter (on resistance range) is quite adequate. Three tests are required.

(a) Resistance between base and emitter should be *LOW* with leads one way round but *HIGH* the other way. The difference should be at *least* 10:1.

(b) As (a) above but between base and collector.

(c) A test across emitter and collector should be *HIGH* either way round. The actual reading in ohms will vary widely between serviceable transistors even of the same type and there is little point in attempting figures—it is only the *ratio* which is important. (**Note: it is unwise to use the very high ohms range in case the highest battery voltage causes damage**).

Unknown transistors can be sorted into *pnp* or *npn* by this method.

Put RED lead of AVO to base and BLACK lead to emitter. If reading is low ohms, the transistor is *pnp*. (This appears to contradict normal *pn* junction theory until it is remembered that an AVO on ohms range is delivering a small *negative* voltage from its RED lead and a *positive* voltage from its BLACK lead).

17 ■ VARIOUS BIASING METHODS

The simple diagrams of Fig. 17.1 (a-e) illustrate the various methods of setting the d.c. bias conditions in a class A amplifier operating in the common-emitter mode.

(a) Simple, economical on current, but gain sensitive to h_{FE} productions spreads, temperature and supply voltage, seldom used.

(b) The inclusion of the emitter resistor R_E helps to reduce the sensitivity of the stage to temperature, supply voltage and h_{FE} spreads. Also, the input impedence is higher due to the series negative feedback across R_E. Unfortunately, the gain is lowered as well as the output swing.

(c) Instead of an emitter resistor a direct voltage negative feedback action is provided by R_F. Has a similar effect on reducing sensitivity but lowers the input impedence as well as the gain. Also the amount of feedback is fixed by the bias required on base. Output swing not affected.

(d) Has all the advantages of (b) but the potential divider *R1*, *R2* provides a much steadier base bias. Unfortunately the extra resistor *R2* provides an additional load across the signal. However, this circuit is the most widely used in general amplifier design.

(e) Similar to (d) but the emitter as well as the base, is fed by a potential divider. The extra stability of this circuit must be paid for in extra current drain through *R3*, *R4*.

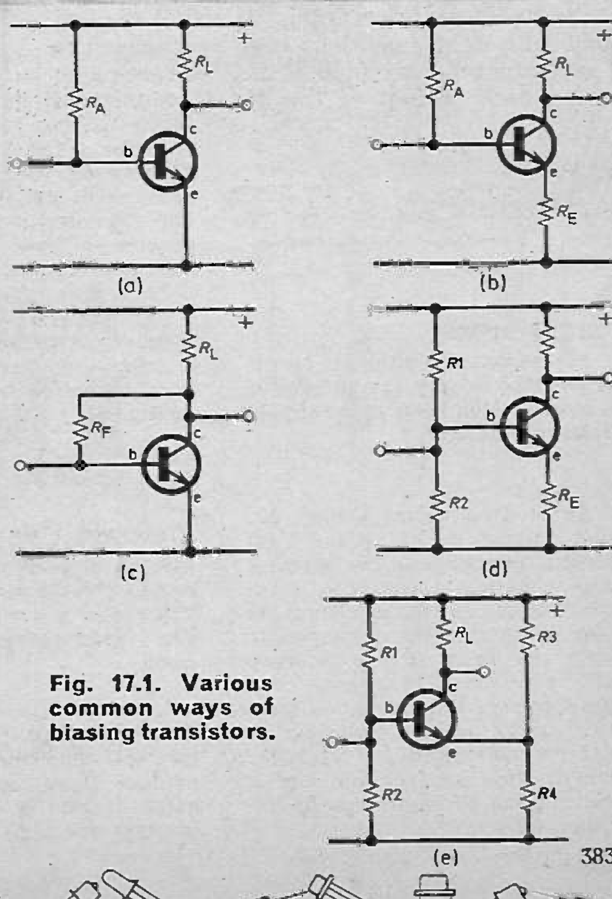


Fig. 17.1. Various common ways of biasing transistors.

Automatic Light Level Controller

By M. DVORAK

A dimmer unit with the ability to automatically keep a pre-set light level.

FOR GUIDANCE ONLY

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

£4.00 excluding case

*Based on prices prevailing at time of going to press

THANKS to the selection of semiconductors, such as relatively cheap triacs and high-tension transistors which are at present on the market, it is possible to design a simple device to automatically control light level in household or similar uses.

With regard to the fact that there are a large number of non-fluorescent light sources in use, this light controlled device was designed to control a luminous intensity over a very wide range and at the same time automatically hold a pre-set light level.

DESIGN CONSIDERATIONS

As the only practical solution, without visible flickering effect, a phase shift system was chosen although this system is known to have some disadvantages, such as the necessity for interference suppression circuitry and the deformation of the supply waveform. These disadvantages are caused by the fast triac switching.

The circuit described is not expected to be connected to the mains in large quantities where consumption exceeds 200 watts. Due to the large number of light dimmer units using the same principle and working satisfactorily it was not necessary to develop a new control principle.

Light dimmers at present on the market are characterized by manual adjustment of required light level only. These dimmers are without any automatic readjustment of luminous intensity of the light source according to actual requirement (the light conditions may be changed in a very short period such as in the evening or during dark periods of the day in connection with weather changes). In such cases normal circuits require readjustment of light level or the user must be satisfied with an unsuitable light level.

In some cases it would be desirable to switch some of the lights in the house on whilst the house is unoccupied. To fulfil this condition the light must be switched on when leaving the house. In the case of the controller to be described a constant level of light will be automatically kept.

ADJUSTMENT

In manually controlled dimmers the adjustment of a very low light level becomes critical and from a certain point practically impossible due to instability of the mains voltage and the inaccuracy of triac switching circuits.

Another disadvantage of manually controlled dimmers is the use of potentiometers for control of the phase-switching triac circuit. These potentiometers, which are in some designs loaded with high currents, are the reason for many faults and instability after a certain time of use.

To avoid the disadvantages of presently manufactured dimmers the described device was designed, this unit solves these problems for an

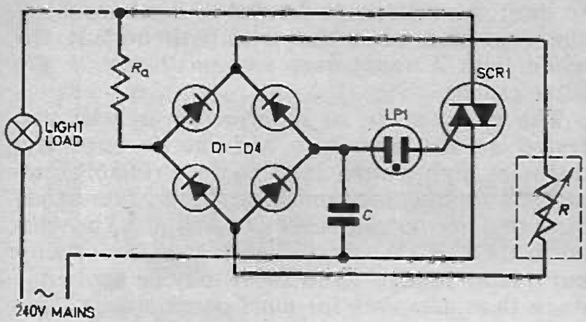


Fig. 1. Basic dimmer circuit with the inclusion of a bridge rectifier.

acceptable price. The design incorporates the following points. (1) A photoresistor in the dimmer unit to enable automatic control of luminous intensity. (2) The use of an iris instead of potentiometer to control the light passing to the photoresistor. (3) Increase of stability at low light levels by the introduction of negative optical feedback.

BASIC CIRCUIT

It is necessary to avoid oscillation of the light source, caused by positive feedback, of about 8Hz between the dimmer unit and the controlled light source. The oscillation can be avoided by moving the oscillation frequency to a higher level so that it is not noticeable, however, this is practically impossible due to the necessity of the use of standard incandescent lamps connected to the mains.

Another possibility is to use an electronic filter designed to suppress the frequency band of about 8Hz in the light controlled circuit. This filter appears to be very effective and oscillation can be eliminated by a relatively simple circuit. One of the disadvantages is the necessity to filter the low frequency by means of a large (25μF) electrolytic capacitor connected to a d.c. transistorised circuit.

The use of transistors is additionally suitable to match the high resistance of the chosen photoresistor in darkness and thus to increase the light sensitivity of the complete unit. To fully control the light source the triac should be switched by transistors, thus the internal conversion from a.c. to d.c. was designed.

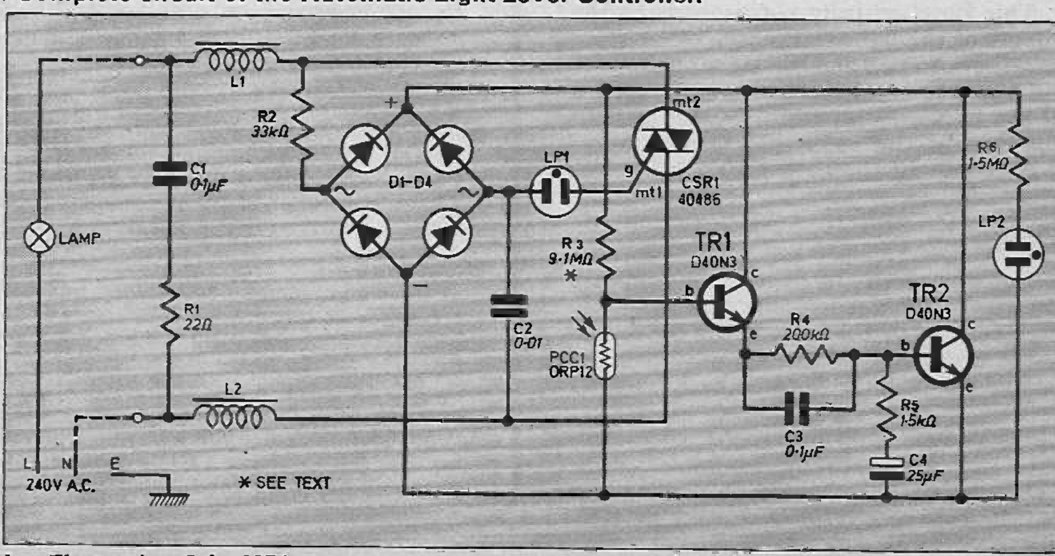
The solution, which is simple, consists of a bridge-rectifier, connected with the circuit of the controller as shown on Fig. 1. This circuit is connected on the principle of currently designed dimmer units, the neon lamp is fired by the *RC* phase control circuit. The current passing through resistor *R* is d.c. and it is therefore possible to replace resistor *R* by a transistor circuit. Resistor R_a limits the maximum current when the resistance in circuit (*R*) is reduced to a low value.

CIRCUIT OPERATION

The readily available photoresistor type ORP 12 has a high "dark resistance" and in order to match this high resistance transistor TR1 (Fig. 2) is connected as an emitter follower to maintain high sensitivity. The frequency filter formed by C3 and C4 is connected to the base of TR2 which works as a variable resistor. Overall frequency response characteristic of this stage is shown in Fig. 3.

The frequency and phase response around 8Hz is not excessively critical but it is not recommended to alter substantially any value in the filter circuit. The entire filter was designed to match the expected range for different types of light sources.

Fig. 2. Complete circuit of the Automatic Light Level Controller.



In some cases after a sudden change of light level a sort of damped oscillation can be observed on the luminous intensity of the controlled light source. This effect is caused by the imperfection of the low frequency filter and lasts about one second. It does not visibly affect normal conditions of the dimmer unit in use.

The 25μF capacitor C4 is across a low voltage and a 12V type is quite sufficient for this purpose. Resistor R2 (9·1 megohm) is not always available and it may be necessary to use two resistors of 4·7 megohms connected in series. The transistors TR1 and TR2 should be 300V types of low collector dissipation, the most suitable transistor is the D40N3 designed for power line connection. If this is not available a BF259 can be used.

REFERENCE LIGHT SOURCE

The light level is controlled by an iris in front of the photocell a substitute light source (neon LP2) in front of the photoresistor is necessary because with the iris fully open it would not be possible to set a completely dark level. The internal light source serves as a commanding light during the period in which the main light is turned fully off.

Without the use of this arrangement it is not possible to set up an extremely low light level which could be dependent on the sensitivity of the unit and its distance from the light. So that this arrangement cannot reduce the light sensitivity of the unit, by adding a constant light level, the signal lamp must be placed in such a way that it will not effect the photoresistor until the iris is almost fully opened and the controlled light is dimmed.

This neon is connected across the d.c. side of the bridge-rectifier; if the lamp is fully dimmed the voltage across the neon is high and the neon lights to its maximum. If the lamp is half on the neon lamp is automatically turned off in consequence of a high voltage drop across the dimmer. This function fully corresponds to the requirements of the light reference.

It is necessary to position the signal neon with regard to the photoresistor and iris in such a way that the unit suits all requirements of light regulation and at the same time would allow the unit to switch off the light source by means of the iris.

R.F. FILTER

Interference caused by the unit appears mostly on wireless frequencies because of switching of high current by the triac in the controlled light circuit. To suppress this interference the unit employs an r.f. filter, formed by L1, L2, C1 and R1.

In the prototype unit the suppression coils used (L1, L2) were readily available ready-wound TV type chokes capable of passing two amperes. The capacitor C1, 0·1μF must be 400V a.c. working and resistor R1 (22 ohms) is used to limit the voltage peaks due to discharging of the capacitor when the triac switches, at the same time it suppresses any oscillation in the filter circuit.

The filter, made as described was used and tested on the prototype and interference frequencies higher than 100kHz were reliably suppressed. On medium and short wave radio bands virtually no interference appeared. The disadvantage of this filter is a low load capacity but a lamp load of up to 200W may be applied—more than adequate for most situations.

CONSTRUCTION

The complete unit can be housed inside any suitable case—it is a good idea to use a plastic case to provide good insulation but a metal case can be used provided the case is **connected to the mains earth via three-core lead and plug fused at one amp.**

Commence construction by cutting a length of tagboard to size and wiring up the components as shown in Fig. 4. The wires to LP2 should be about 150mm long so that LP2 can be positioned correctly as described earlier, LP2 is glued to the lid of the unit when finally positioned.

When mounting PCC1 it must be positioned slightly above all the other components on the board with its front on the same plane as the tagboard.

The wiring to the mains should be normal twin flex or—if a metal case is used—three-core wire.

Components....

SEE **SHOP TALK**

Resistors

R1	22Ω	R4	200kΩ
R2	33kΩ	R5	1·5kΩ
R3	9·1MΩ	R6	1·5MΩ

All ± 5% ¼W carbon

Capacitors

C1 0·1μF 400V a.c. metalized paper
C2 0·01μF 250V metalized paper
C3 0·01μF 250V metalized paper
C4 25μF elect. 12V

Semiconductors

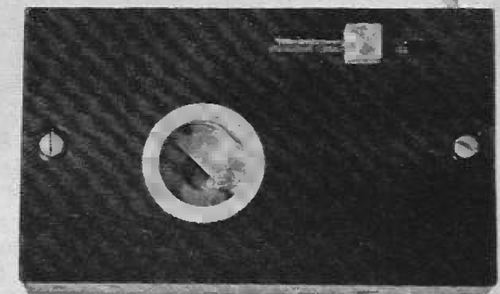
D1–D4 400V 0·5A bridge rectifier
CSRI 40486 triac or any 400V 2A triac
TR1 D40N3 or BF259 silicon *npn*
TR2 D40N3 or BF259 silicon *npn*

Miscellaneous

LP1,2 neon lamps 80V type—no series resistor (2 off)
L1,2 2 amp chokes type TV2 (2 off)
PCC1 ORP12 light dependent resistor.
11 way double sided tagboard, stand off spacers, 4BA fixings, wide based insulated knob, 6mm diameter bolt with nut, aluminium for iris, felt to shade PCC1, case (size depends on tagboard used), wire.

Automatic **Light Level** Controller

By M. DVORAK



Photograph of the completed unit, the iris and part of LP2 can be seen through the aperture.

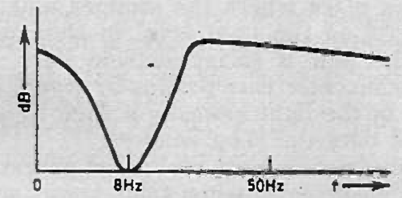
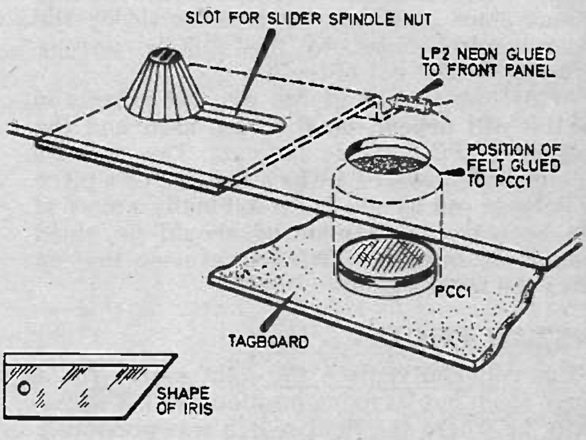


Fig. 3. Overall frequency response characteristic of the transistor stage.



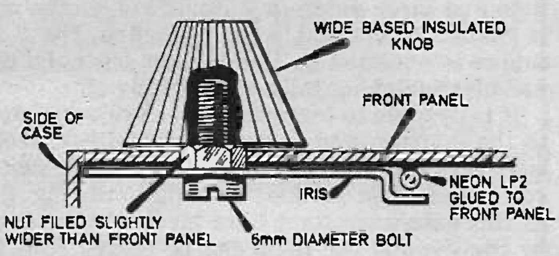


Fig. 5. (above and above right). Construction and fixing of the iris and LP2.

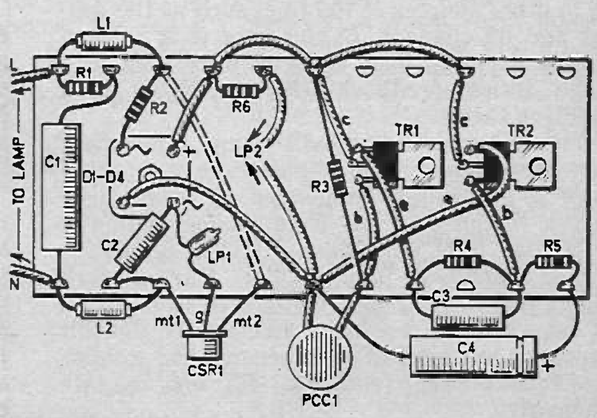


Fig. 4. (right) Construction of the Automatic Light Level Controller on a single tagboard. PCCI must be mounted as described in the text.

Having completed the tagboard it should be placed in the case and mounted so that it is insulated, using stand off spacers and nylon bolts. With the board mounted the position of PCC1 should be marked on the lid and a hole cut as shown in Fig. 5.

IRIS

The iris is constructed from 22 s.w.g. aluminium with two bends, as shown in Fig. 5, so that the neon LP1 is covered by one side of it. **It is important that the leads to the neon are completely insulated so that they cannot touch the iris or case (if metal) and also that the control knob used is an insulated type with a sunken grub screw attachment.**

The iris must be made the correct width so that it covers the whole of the aperture plus LP2 and also touches the side of the case nearest PCC1. This prevents the iris from twisting around since it is only fixed to the lid by the slider control, fixed to the spindle passing through the slot cut in the lid.

Actual dimensions of the iris and cutouts in the lid will depend on the case used and the position of PCC1 inside the case. The aperture hole must be covered with cellophane or a piece of Perspex can be glued into it. Finally a piece of felt or other thick material should be glued around the outside of PCC1 to provide shading when the iris is closed.

INSTALLATION

The unit can replace the light switch for a single room but its fixing position will not necessarily be where the light switch was previously situated. It is essential to take into account some principles which result from the function of devices of this sort. The following analysis shows which principles are to be dealt with.

(1) Placing the dimmer unit very close to the light source a very strong negative feedback will come into effect, the iris will be usually fully closed and the whole device will become insensitive to other sources of lighting, such as the daylight and its changes. In this case it is easy to adjust a very low level of light, in consequence of the optical feedback which operates as a stabilizing factor.

(2) Another extreme will come into effect when the dimmer unit is placed in a position where it is strongly influenced by other light sources. In this case any insignificant change of the outside light will cause a strong alteration in the controlled light source. During dark periods the dimmer unit will try to work to its full capacity and it will be much more difficult to adjust a low level of light because the stabilizing effect of the feedback will not operate sufficiently.

It is not practical to install the dimmer unit in a place where the photoresistor could be shaded

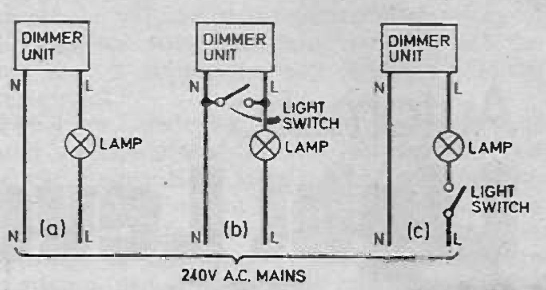


Fig. 6. Methods of connecting the unit to the supply and load (a) no mains switch (b) in parallel with switch (c) in series with switch.

by any movement in the room. Because PCC1 is very sensitive it would be affected by such changes and the intensity of operated light source would change as a result. A similar effect will take place where the dimmer unit is used for operating the light level in shop windows, when the unit is facing outside light. In this case for instance cars passing-by would cause a change of the light intensity if their lights were directed onto the shop window.

The dimmer is very useful for operating the light intensity level when table lamps are used. In this case the unit automatically levels the light during dark periods of the day. It is not suitable for use with fluorescent lights.

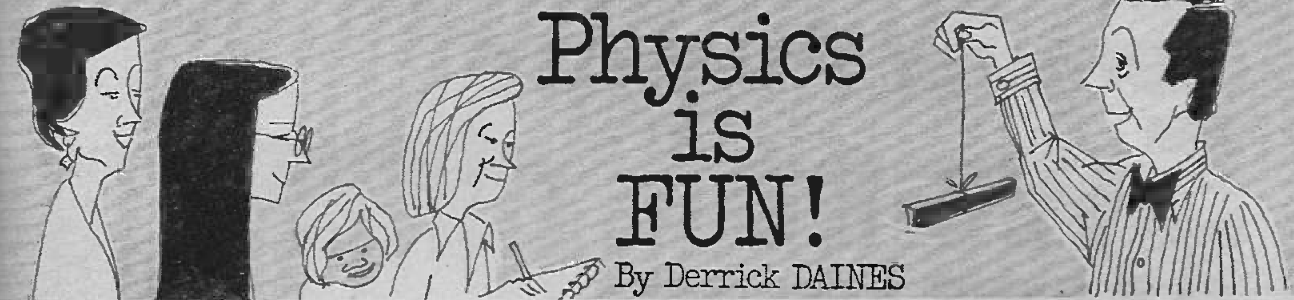
CONNECTION

The unit can be connected to the light source in one of three different ways, in Fig. 6a the unit is connected without a mains switch, the light source is operated by the dimmer iris only, this includes switching fully on and fully off.

It is possible to leave the automatic regulation to the dimmer, and in case of immediate necessity to switch the light fully on the light switch can be wired in parallel with the unit (Fig. 6b). In this case a constant light level can be set up by the iris and the lamp can be turned fully on if required by the switch.

In Fig. 6c the dimmer unit is connected in series with the mains switch this results in complete disconnecting of the light source by the switch with automatic regulation of the light level being controlled by the dimmer unit. It is also possible to achieve a complete switching off by means of adjusting the iris to its end position.

The functional model was tested in various conditions for 7 months without any faults whatsoever and no interference of radio reception was noticed. As no potentiometer is used in the dimmer unit, a longer life is expected in comparison with the dimmers which are at present on the market. The neon LP2 can provide a small amount of external light, so that the knob can easily be found in the dark (this will not be the case if the circuit of Fig. 6c is used and the switch used to turn off the lamp). ■



Physics is FUN!

By Derrick DAINES

THIS is the series for you—and you—and YOU. No matter if you are the most complete beginner or if you already know quite a lot, you will get something out of this series.

*We are going to describe simple and practical experiments in a language that **all** can understand. These experiments will enable you to discover for yourself the fundamental laws of physics that govern our hobby and give rise to the often bewildering tricks that we get up to in designing circuits. This is in fact the BASIC basic series!*

If we are ever to get a start in electronics, we must accept, various laws, but later we run into difficulties because we do not fully understand the reason for those laws. However, here we present you with a series of experiments designed especially to give you the most basic understanding possible; an understanding that will stand you in good stead in future years.

Please do carry out the experiments. Seeing and doing will fix facts in your mind far more effectively than just reading. Besides, it is more fun, and these experiments should give you plenty of that.

Finally, keep a little notebook. It doesn't matter what sort, nor how you keep it—what IS important is that after you have finished experimenting and just before you turn to something else, you jot down in your own words what the experiment has taught you. Again, this will help to fix it in your mind and later, when you browse through your notebook, the experiments will come alive again.

THE MAGNETIC FIELD

Take a magnet—any magnet; bar, horseshoe, pot, anything. (Many fine magnets are to be had for the asking from car-breakers' yards or out of old TV sets). Sprinkle a few pins on the table and slowly lower the magnet towards them. Notice that the magnet does not have to actually touch the pins, but that when the magnet is some distance away, the pins leap up to cling to the magnet. "So what?" you say. So this—we are so familiar with this extraordinary event that we don't stop to think about it.

Magnetism stretches out into space

Silently, invisibly, magnetism reaches out to grab the pins. Isn't it odd that little old ladies who are uneasy at the very idea of silent, invisible electricity, will use a magnet to pick up pins?

If magnetism stretches out into space, there ought to be a way in which we can map it—find out what shape it is and how far it goes. Well, there is a way. Put your magnet firmly on the table and place a sheet of cartridge paper over the top. Now you need some iron-filings. You can buy these, but its cheaper to drag your magnet round underneath a bench. Or why not actually file a piece of iron?!!

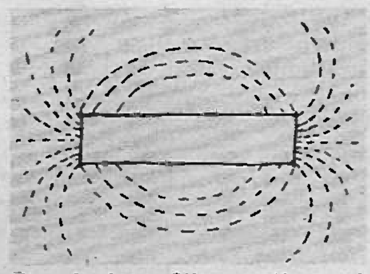


Fig. 1: Iron filing pattern obtained with a bar magnet.

Sprinkle the filings evenly over the paper and tap the paper very gently. The filings will arrange themselves into a pattern conforming to the shape of the magnet field. The actual shape of this pattern will depend upon what sort of a magnet you have. If it is a bar magnet, the shape will be as in Fig. 1. If a horseshoe, as in Fig. 2. (Pot magnets and ring magnets are not really suitable for this experiment.) If you tap too hard or too long, the filings will travel across the paper to cluster over two areas of the magnet—but only two.

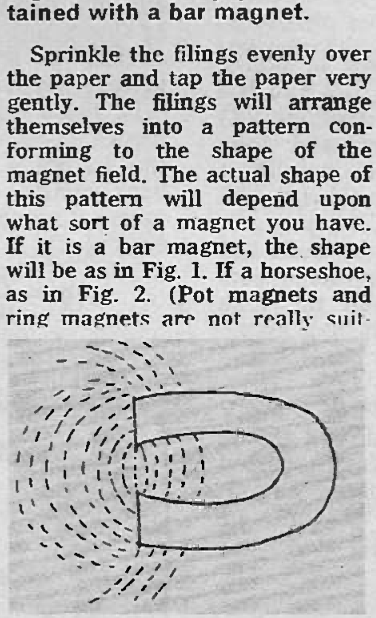


Fig. 2. A Horseshoe magnet will produce this filing arrangement.

The centre of the magnet does not attract the filings

We say that the magnetic field (and the magnet) is polarised—that is, they have a North pole and a South pole. Strictly speaking, we should call them North-seeking and South-seeking, as the next experiment shows.

If you have a bar-magnet, hang it up by a fine thread. After swinging about for some time, the magnet will eventually settle down in a North/South orientation. Mark one end with a piece of chalk and swing the magnet again. However many times you do it, the marked end will always finish up pointing in the same direction. This of course is what a compass does. Again—so what?

Well, ask yourself this question—you know that the compass points North/South, but is this because the Earth is attracting the compass, or because the compass is attracting the Earth? In other words, in the compass/Earth relationship, is one of the pair active and the other passive? If so, which?

Answer next month.

General Purpose 5 Watt AMPLIFIER

By Tom Mason

For use with electric musical instruments, record player, radio and tape deck.

An amplifier is probably one of the most popular projects for the amateur electronics constructor for it can find many applications both in the home and as a test amplifier on the work bench.

The General Purpose 5 Watt Amplifier described here can be used to amplify the signals from record players fitted with ceramic or crystal cartridges, radio tuners, tape decks, musical instruments such as electric guitar and organ, microphones, and in the workshop for testing prototypes requiring an amplification stage.

The quality is not claimed to be up to hi fi standard, but nevertheless is good enough to be acceptable to most listeners; maximum available output power is 5W r.m.s.

SEPARATE UNITS

The complete amplifier as shown in Fig. 2 uses three integrated circuits, IC1, IC2 and IC3 and can be split into two distinct sections: (1) the battery powered preamplifier and tone controls, consisting of operational amplifiers IC1, IC2 and local components, and (2) the mains powered power amplifier IC3.

If desired, the two sections can be built and used independently of each other; some constructors may not wish to include the tone control and preamplifier stages into their amplifier in which case these should be omitted and input fed directly to capacitor C5.

The sensitivity of the main amplifier is 80mV for full output into a 16 ohm load, and this is suitable for most of the audio devices listed above, but for those with a lower signal output, down to 5mV, *maximum* output will only be obtained with a suitable preamplifier stage.

OPERATIONAL AMPLIFIERS

The preamplifier and tone control stages each use differential operational amplifiers type 741; these are two-input devices, one inverting (−) and one non-inverting (+) and are symbolised as shown in Fig. 1a. The output voltage of these devices is proportional to the difference in voltage between the two inputs.

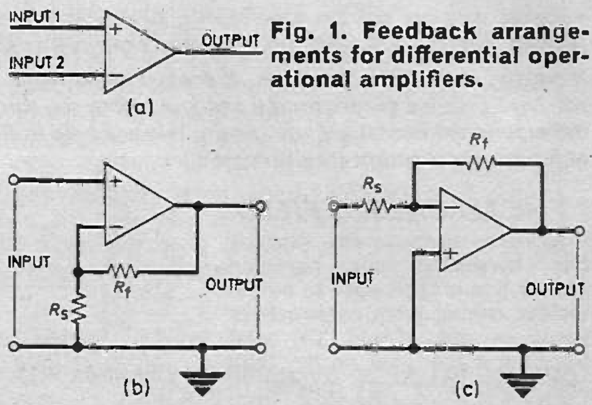


Fig. 1. Feedback arrangements for differential operational amplifiers.

In audio work they can be used in two basic modes as shown in Figs. 1b and c. The gain of the system is controlled by the choice of feedback resistor R_f and source resistor R_s, both external components, and it can be shown that for Fig. 1b.

$$\text{gain} = \frac{\text{output voltage}}{\text{input voltage}} = \frac{R_f + R_s}{R_s}$$

and Fig. 1c, $\text{gain} = \dfrac{R_f}{R_s}$

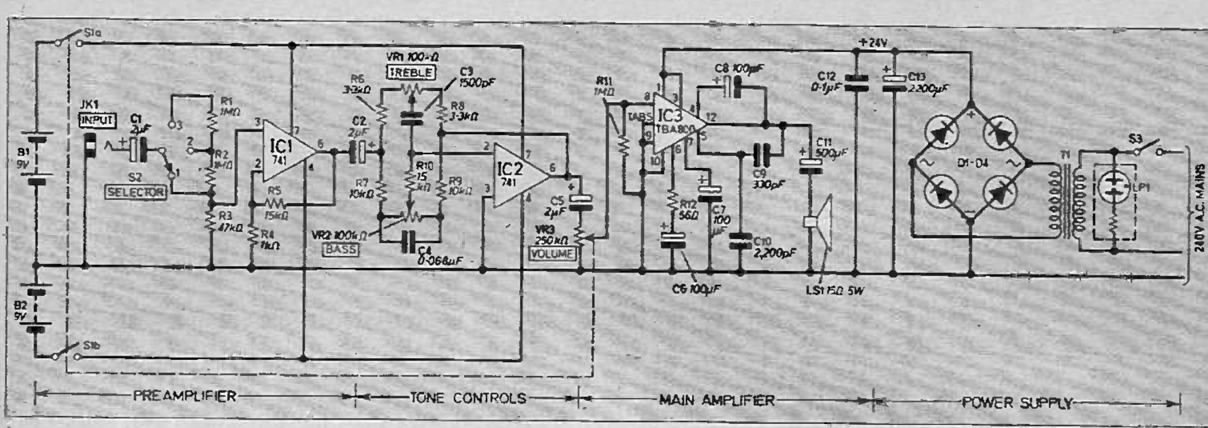


Fig. 2. The complete circuit diagram of the General Purpose 5W Amplifier.

CIRCUIT DESCRIPTION

The complete circuit diagram of the General Purpose 5 Watt Amplifier is shown in Fig. 2. The main amplifier i.c. TBA800 can be powered by a supply in the range 5 to 30 volts (depending on load) and can be terminated in an 8 to 16 ohm loudspeaker to give output powers up to 5W r.m.s. (with suitable heatsink).

It was decided to use a 15 ohm loudspeaker (since this is more readily available than a 16 ohm one) to obtain 5 watts. This necessitates a 24 volt supply, which in the prototype is mains derived via T1 which steps down the mains voltage to approximately 17V; diode bridge D1-D4 gives full-wave rectification and the output from the bridge is smoothed by capacitor C13 to give a 24V (approx.) supply to pins 1 and 3 of IC3.

The prototype used a mains transformer with a secondary rated at 16V 1A. Any similarly rated transformer will do; current consumption at maximum output is about 600mA.

Input to IC3 is at pin 8 from the wiper of potentiometer VR3 (volume control) which is connected across the output of IC2. The output is a.c. coupled to the loudspeaker by capacitor C11.

Other circuit components around IC3 should be evident to readers from the pin identification drawing of Fig. 3.

PREAMPLIFIER

Input to the preamplifier is via d.c. blocking capacitior C1 and selector switch S2, the position of the latter being chosen to suit the amplitude of the input signal.

The resistor chain, R1, R2 and R3 form an attenuator network, the voltage appearing across R3 being applied to IC1 input (pin 3). The value of these resistors has been calculated such that (1) 5mV at position 1 (2) 100mV at position 2 (3) 200mV at position 3 causes 5mV to be present at the input to IC1 which is connected in the mode of Fig. 1b. Thus the gain of the first stage is approximately 16.

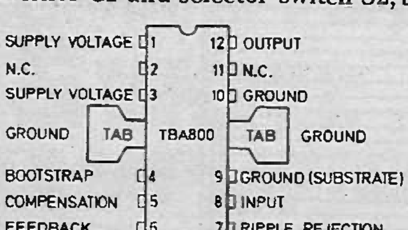


Fig. 3. Pin identification for the TBA800.

TONE CONTROLS

Output from IC1 is fed to the tone control circuitry, IC2 and local components, via C2.

The tone control employed is a Baxandall-type network that gives both boost and cut of treble and bass. Inspection of Fig. 2 will show that IC2 is connected in the mode of Fig. 1c, but since capacitors are now in circuit, the "resistances" equivalent to R_f and R_s are now frequency

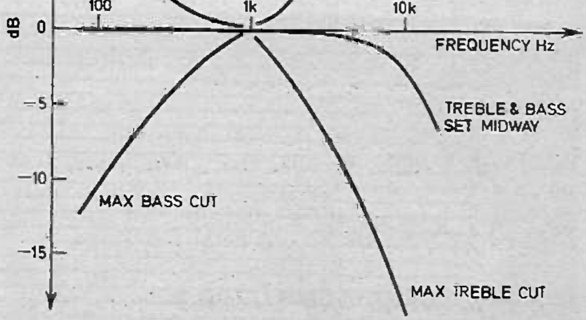


Fig. 4. Performance graphs for the tone control stage.

dependent ie. they are impedances.

When VR1 and VR2 are set to their midway positions, the gain of this stage is unity for all frequencies; also, the gain for a frequency of 1kHz is unity for all settings of the tone controls (within component tolerances). All other frequencies are boosted or cut as the controls are rotated. This is standard practice. The performance of the tone controls is shown graphically in Fig. 4.

MAIN AMPLIFIER BOARD

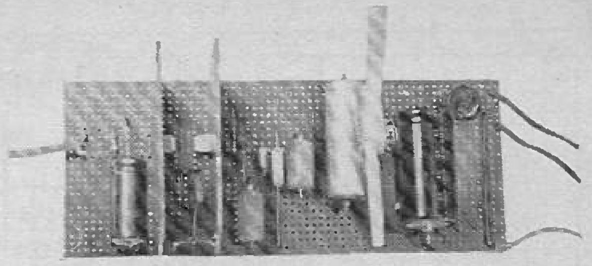
The main amplifier is constructed on a piece of 0·1in. matrix Veroboard size 58 holes by 24 strips. The layout of the components on the top side of the board and the breaks along the copper strips on the underside are shown in Fig. 5.

Begin by making all the cut-outs and drilling the fixing holes and then with the exception of IC3, position and solder the components and link wires to the board as shown in Fig. 5.

The heatsinks for IC3 are made from two pieces of copper clad board size 65mm x 50mm which are soldered to the heatsink tabs on the i.c. These tabs should be very carefully straightened using a pair of pliers and then about 4mm of each end bent up vertically.

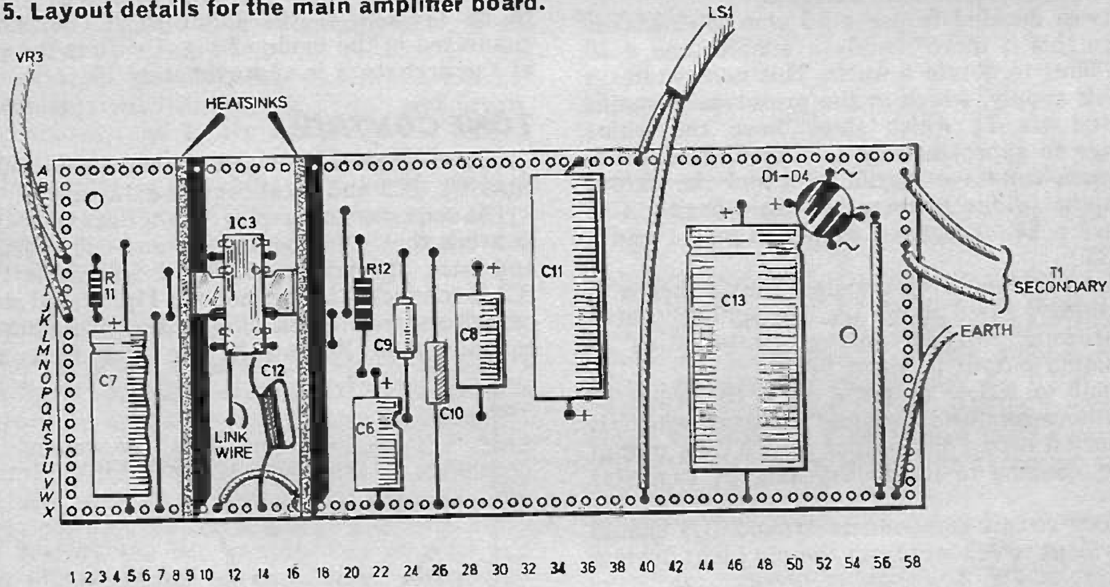
The i.c. should then be positioned and soldered to the board paying attention to polarity (pin 1 is marked on the body of the i.c.). The two heatsink boards should now be soldered to the tabs so that they rest on the component board and stand vertical. Now connect the link wire between ground and heatsink.

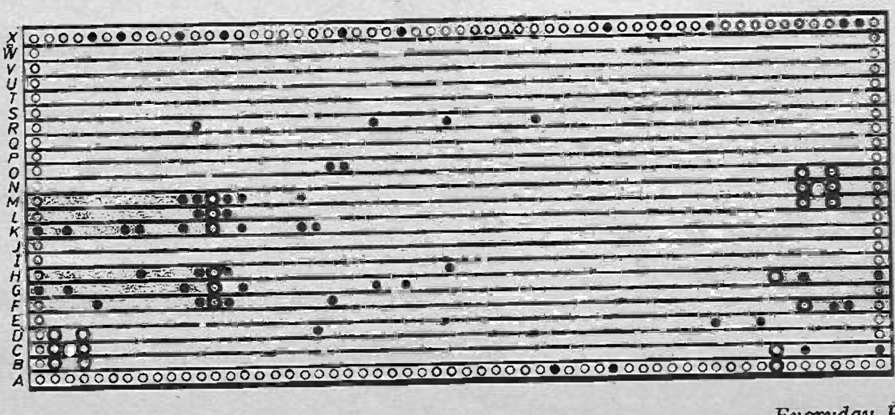
The flying leads to the loudspeaker should now be soldered in position. In the prototype, 200mm of twin-cored mains cable was used.



Completed main amplifier board.

Fig. 5. Layout details for the main amplifier board.





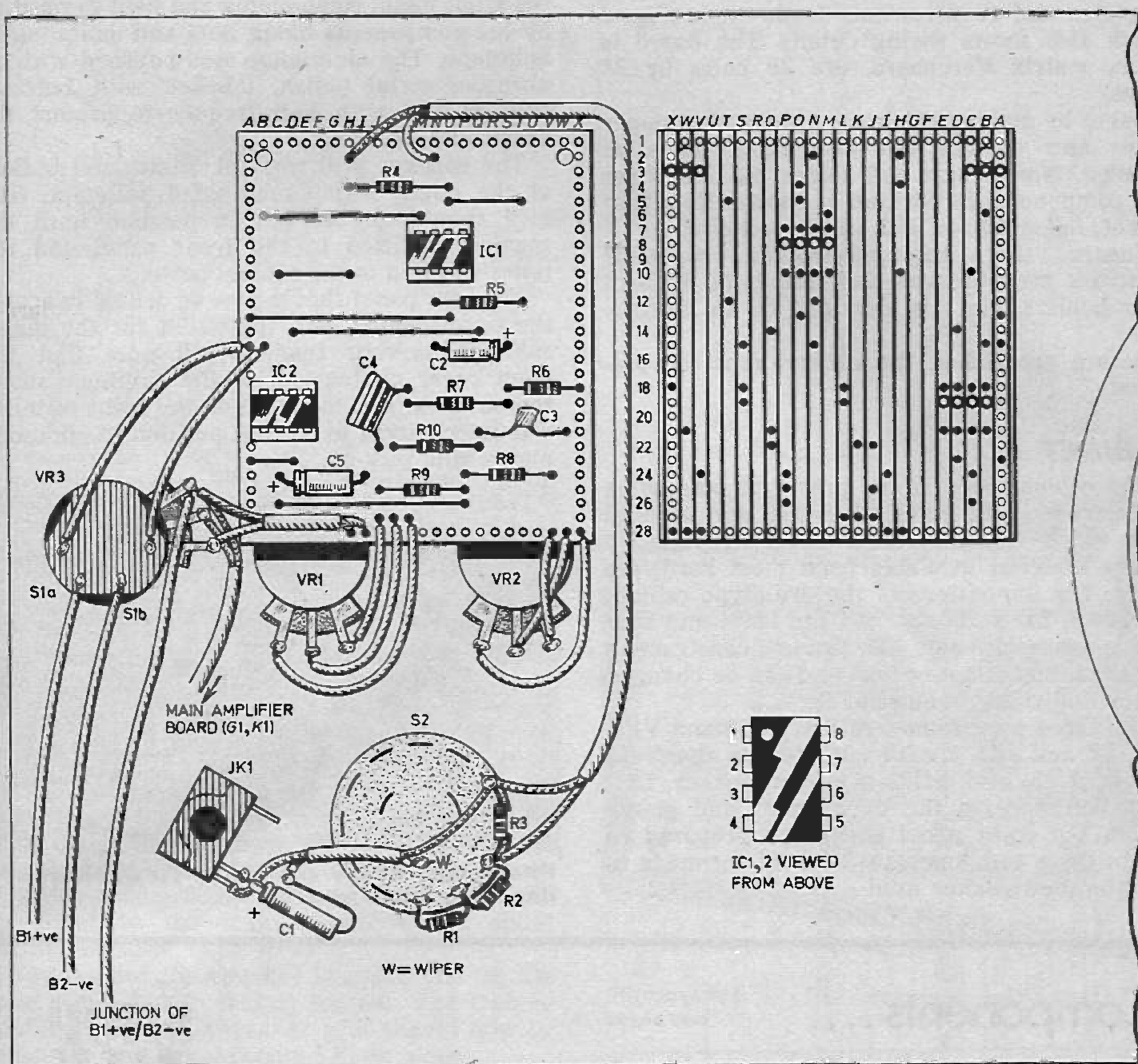
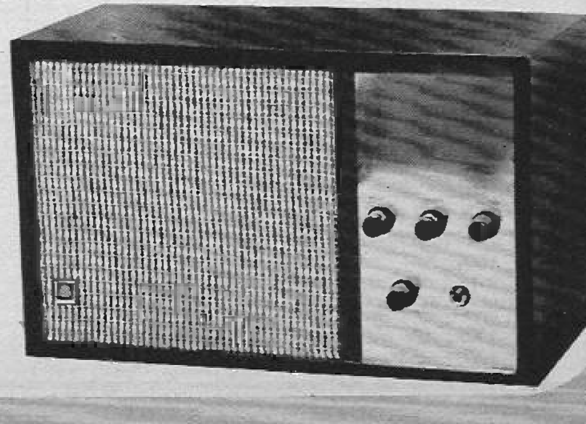


Fig. 6. The layout of the components on the preamplifier board and wiring up details.

Below: photograph of completed unit showing new position of mains neon indicator.

General Purpose 5Watt AMPLIFIER



PREAMPLIFIER BOARD

The layout of the components for the preamplifier and tone controls is shown in Fig. 6 which also shows wiring details. The board is 0·1in, matrix Veroboard size 28 holes by 24 strips.

Begin by making the breaks along the copper strips and drilling the two fixing holes as detailed. Next insert and solder all link wires and components in position as shown. Note that sockets are used for both integrated circuits.

Ensure that the electrolytic capacitor polarities are observed and insert the i.c.'s in their holders, pin 1 is identified by an indentation.

Before proceeding the cabinet must be prepared.

CABINET

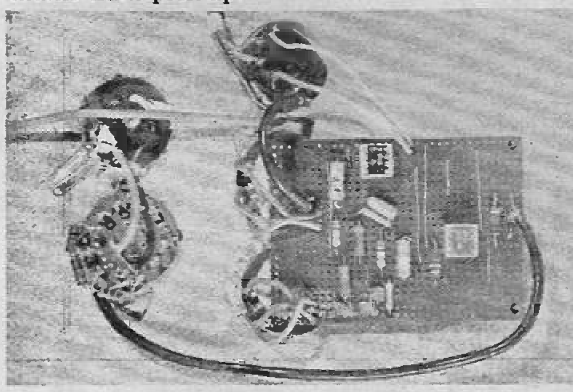
The cabinet used in the prototype was home made from 12mm thick chipboard and covered with black Contact which is a self-adhesive plastic material available from most hardware shops. The dimensions of the prototype cabinet are 380 x 230 x 200mm and the front and rear panels are removeable. The size and construction of the cabinet is not critical and can be changed to suit individual requirements.

The three potentiometers VR1, VR2 and VR3, LP1, S2 and JK1 are all mounted on the front panel which also holds the loudspeaker LS1. With reference to the illustrations and photograph, the front panel should be prepared to accept these components with a cut-out made to suit the loudspeaker used.

In the prototype a facia was made from a thin sheet of aluminium which is drilled to suit the front panel components and held in position by the components fixing nuts and double-sided Sellotape. The aluminium was polished with an abrasive metal polish, labelled with Letraset and sprayed with hair lacquer to protect the sheen and lettering.

The speaker grill was cut to size and backed at the edges with double-sided Sellotape. The grill should not be put in position until the speaker is fitted to the front panel and the latter screwed to the cabinet battens.

The rear panel should now be drilled to accept the on/off switch and the outlet for the mains cable. Observant readers will note that the front cover photograph of the amplifier shows the on/off switch mounted on the front panel. It was later moved to its new position to eliminate mains hum pick-up.



Photograph of the completed preamplifier section mounted in position.

Components....

SEE SHOP TALK

Resistors

R1	1MΩ	R5	15kΩ	R9	10kΩ
R2	1MΩ	R6	3·3kΩ	R10	15kΩ
R3	47kΩ	R7	10kΩ	R11	1MΩ
R4	1kΩ	R8	3·3kΩ	R12	56Ω

All ¼W ± 10% carbon

Potentiometers

VR1 100kΩ lin. carbon
VR2 100kΩ lin. carbon
VR3 250kΩ log. carbon with ganged d.p.d.t. switch

Capacitors

C1	2μF 10V elect.	C8	100μF 15V elect.
C2	2μF 10V elect.	C9	330pF
C3	1500pF	C10	2200pF
C4	0·068μF	C11	500μF 15V elect.
C5	2μF 10V elect.	C12	0·1μF
C6	100μF 6V elect.	C13	2200μF 25V elect.
C7	100μF 25V elect.		

Integrated Circuits

IC1, 2 741 differential operational amplifier, 8-pin d.i.l. (2 off)
IC3 TBA800 5W audio amplifier

Miscellaneous

D1–D4 ½A 50 p.i.v. type 96AA or similar
S1 d.p.d.t.—see VR3
S2 1-pole 3-way wafer
S3 mains on/off toggle
LP1 mains neon with built-in resistor
JK1 standard jack socket
T1 mains/17V 1A secondary—see text
LS1 15Ω 5 watts
B1, B2 9V PP3 (2 off)
0·1in. matrix Veroboard: 58 x 24 strips (main amplifier), 28 holes x 24 strips (preamplifier); 8-pin d.i.l. sockets (2 off); copper clad board —p.c.b.—for heatsinks; screened lead; knobs (4 off); small wood screws for fixing boards; length of three-core mains lead; materials for cabinet.

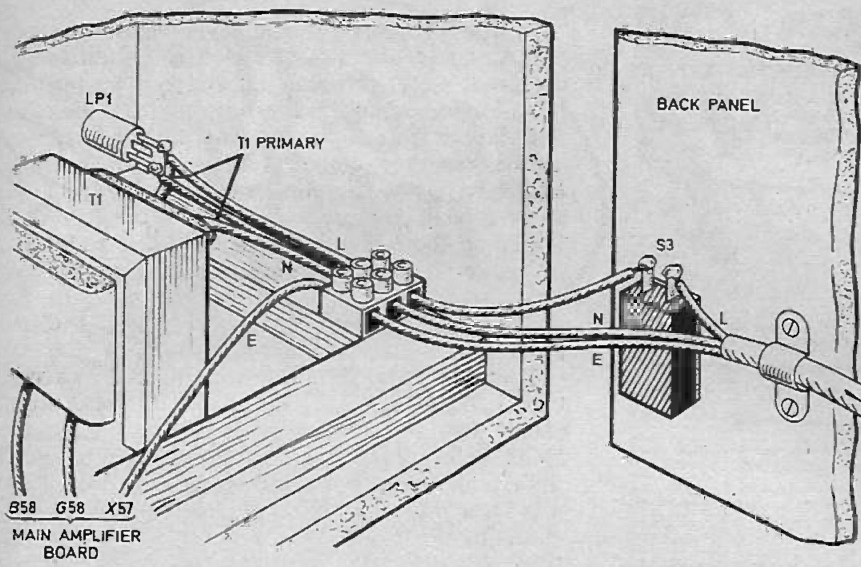


Fig. 7. Wiring up details around the mains transformer.

ASSEMBLY

Place all the front panel components in position and wire up to the preamplifier board as shown in Fig. 6; using small wood screws secure the board to a short length of batten on the front panel. Ensure that the board does not touch VR1 and VR2. Screened lead must be used where shown.

Two PP3 9V batteries were found suitable to power the preamplifier and these should be wired up to the switch on VR3 and fixed to the side of the cabinet with a suitable bracket.

Solder about 200mm of screened lead to VR3 for input to the main amplifier and about 150mm of mains cable to LP1.

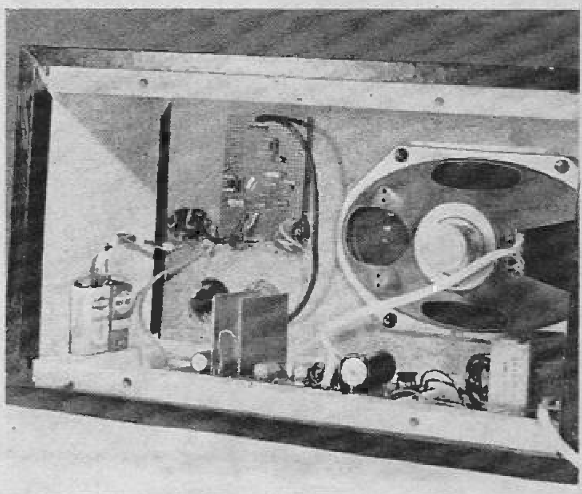
Now secure the speaker in place and fix the front panel to the cabinet battens. The treated labelled fascia and speaker grill should now be attached. Insert and secure LP1 in place.

Use two woodscrews to hold T1 firmly to the cabinet base and then wire up the primary to S3, LP1 and terminal block as shown in Fig. 7. Connect T1 secondary, the earth lead and screened input lead to the main amplifier board. All that remains is to solder the lead to the speaker and secure the board to the base. Screw on the back cover and the unit is complete.

Connection to the mains should be via a fused plug containing a 500mA fuse.

IN USE

The main amplifier is switched on at S3 located on the rear panel (indicated by the illumination of LP1) and the preamplifier at S1 ganged to VR3 (volume). Input is via a jack socket—which may be changed to suit existing plugs—and should be via screened lead for best results.

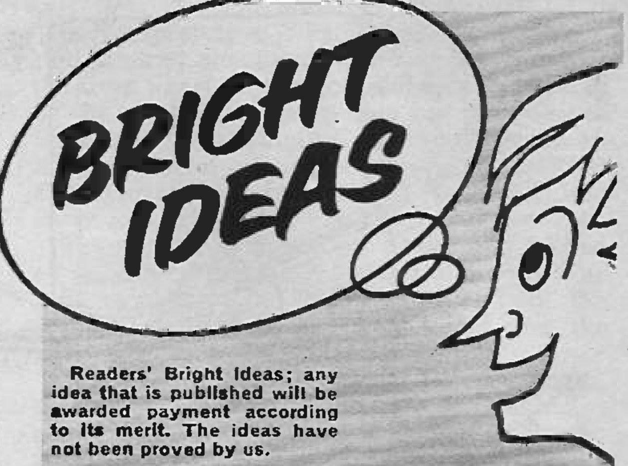


Photograph of the prototype with rear panel removed.

SPECIFICATION

OUTPUT	5 watts r.m.s. into 15 ohms			
SENSITIVITY	1. 5mV r.m.s. into 47 kilohms 2. 100mV r.m.s. into 1 megohm 3. 200mV r.m.s. into 2 megohms			
TONE		Boost	Cut	
	Bass	+9dB	−11dB	at 100Hz
	Treble	+12dB	−20dB	at 10kHz
FREQUENCY RESPONSE	Within ±3dB from 20Hz to 13kHz			

If in doubt as to the amplitude of the input signal set S2 to least sensitive position, (3), and adjust so that volume control gives widest range. For input signals greater than 200mV, the attenuator should be modified to suit. ▣



Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

Since cabinets for loudspeakers on the infinite baffle system must have two main features, i.e. they must be perfectly air tight and they must be made of something which prevents the passage of sound, then I suggest that when cabinets have been made from wood, a coat of rubberised underseal for cars would be a good idea as it would seal any small holes and even the pores of the wood and, as it says on the container, it is a very good sound insulator.

J. Beever,
Chippenham, Wilts.

I wish to submit, for possible publication in the Bright Ideas column, a design for a simple and inexpensive cordless electric soldering iron.

A miniature insulated three-pin mains plug is fitted to the soldering iron lead, the lead is cut about 2cm away from the point where it leaves the iron, it is then fitted into the plug which is Araldited to the iron, a matching socket is fitted to the bench and connected to the mains. This system relies on the fact that when the iron is hot it will remain hot for a long enough time for one or more joints to be completed.

M. Renshaw,
Sheffield, Yorks.

An idea which may be of interest to readers concerns the use of nails when trying small circuits: Instead of drilling elaborate boards or using turret board, both of which due to the time and trouble in their making, not to mention the cost, have to be cleaned afterwards for re-use, simply mark the circuit diagram on to a piece of scrap wood, and then tap 10mm long brass brads in at all the junctions and solder the components and wires on to these. I make less mistakes this way, when I'm in a hurry. With the parts removed the board can become firewood once again, or in the case of rough projects for the garage etc. can be made into the back of the box quite easily.

P. Stokes,
Lowestoft, Suffolk.

NEXT MONTH...

EXPERIMENT IN HEADPHONE STEREO

When listening to stereo material through headphones one tends not to get the impression of a continuous sound stage in front of you. This simple experimental circuit sets out to try and overcome this problem, it also provides alternation to give a comparable speaker to phones level, and a balance control.

RADIATION MONITOR

Consisting of a very simple circuit powered by a small battery, this monitor is portable and can be used for field work or demonstration purposes. Despite the simple circuit the unit is as
commercial units using si
tubes.

HEADS OR TAILS

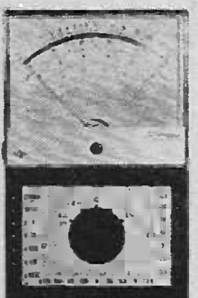
An electronic version of "heads and tails". The unit is inexpensive and employs an integrated circuit for ease of con-

eve
elec

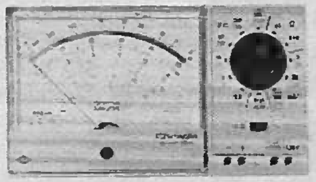
FREE ENTRY COMPETITION

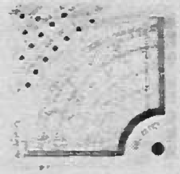
...WIN A CHINAGLIA MULTIMETER!

Here is your second and last chance to try for one of these high quality multimeters. Thirteen meters are being presented as prizes in this exciting free competition, open only to Everyday Electronics readers.



First prize, a Chinaglia Dino electronic multimeter which utilises f.e.t.s. to provide a d.c. input impedance of 200kΩ/V and an a.c. impedance of 20kΩ/V. This instrument has 33 ranges, all with high accuracy and costs over £28.





Second and third prize, a Chinaglia Minor multimeter with a sensitivity of 20kΩ/V on d.c. and 4kΩ/V on a.c. ranges. This instrument is a versatile pocket-sized instrument, having 25 ranges all with high accuracy. It sells for over £13.

Ten runner-up prizes, a Chinaglia Cito pocket multimeter designed specifically to provide a low cost instrument for everyday use. Sensitivity 20kΩ/V on d.c. ranges and 2kΩ/V on a.c. ranges. With 24 high accuracy ranges the Cito sells for over £10.

HOW TO ENTER

Place the eight multimeter features, given below, in what you consider to be their order of importance to the average reader working on typical Everyday Electronics constructional projects.

For example, if you consider that "A.C. current ranges" is the most important of them all, write "C" in the box marked 1st on your entry coupon; the key letter of your choice goes into the second box and so on for all eight.

IMPORTANT

All entries must be with us by Monday 22nd July 1974—the closing date. Regular readers submitting last month's entry coupon as well, may send both in the same envelope.

A Anti-parallax mirrored scale.
B Degree of accuracy.
C A.C. current ranges.
D Resistance ranges beyond 1MΩ.
E Clearly marked, well arranged controls.
J High sensitivity (ohms/volt).
K Large, easy to read scale.
L Overload Protection.

COMPETITION RULES

There is no entry fee, but each attempt must be fully completed in ink on the proper printed coupon cut from Everyday Electronics, and bear the entrant's own full name and address.

Every accepted entry will be examined and the first prize, as described, will be awarded to the entrant who, in the opinion of an expert panel of judges, and in any one attempt, has shown the most skill and judgement in listing the eight features in order of importance. The other prizes will be awarded to the senders of the 12 next best attempts in order of merit. No entrant may win more than one prize.

In the event of a tie or ties for any of the prizes, a further eliminating contest will be conducted by post between the tying competitors to determine such winner/s or winning order.

Any entry which does not comply with the printed instructions or is received after the closing date will be disqualified, as will any received mutilated or illegible, incomplete, bearing alterations, or with more than one key letter in each space. No responsibility will be accepted for entries lost or delayed in the post or otherwise.

The judges' decision, and that of the Editor of Everyday Electronics in all other matters affecting the competition, is final and legally binding. No correspondence can be entered into.

The competition is open to all readers in Great Britain, Northern Ireland, and the Channel Isles except employees (and their families) of IPC Magazines, the printers of Everyday Electronics or of Chinaglia (U.K.) Ltd.

The winners will be notified, and the result announced in the earliest possible issue of this magazine.

Mulberry Walk, London, S.W.3

New products and component buying for constructional projects

SHOP TALK

By Mike Kenward

We often get letters from readers asking how to get started in constructional electronics and we usually reply by saying buy a kit for one of our more simple projects—some of the advertisers sell them—and build it to the details shown, this way we know the unit works and that the reader will be starting at a fairly elementary level. However there is another way of constructing items—a way which requires very little skill and no soldering, you can build things and learn something with no fears of damaging components and when you are profficient you can gradually change to normal construction methods. The new way—with an Electroni-Kit.

Some time ago we were supplied with a SR4A kit which we tried out (the electronic machine-gun is good but fortunately failed to injure anyone!) and eventually passed on to the son of a staff member for further "trials". The unit has proved to be quite good and has provided hours of fun and entertainment as well as education.

The biggest advantage is that youngsters can build many projects without help and without the need for tools, cases or soldering irons. The kits are not cheap but are worthwhile and cost from £8·80 to £33·95 including V.A.T. They provide many designs to build and the components can be used over and over again. There is no reason why almost any design should not be constructed and tested once the user became able to lay out the design.

Details from Electroni-Kit Ltd., 408 St. John's St., London EC1.

The Electroni-Kit ST100 kit–good value for value for money.

General Purpose Amplifier

The parts for the *General Purpose 5 Watt Amplifier* should all be readily available, only the speaker is likely to provide any difficulty and this is an R. S. Components type which can be ordered from them by almost any dealer. The speaker unit must be a 15 or 16 ohm type.

Some notes on one or two other parts will not be amiss, the 741 integrated circuit should be obtained in the eight-pin dual-in-line (d.i.l.) case—most of them are this type nowadays. The transformer used can be any type with a mains primary and secondary rated at about 17V at 1A, various types are available from suppliers and prices vary considerably.

In the prototype one of the tags on the input selector switch has been used for component mounting (earth), if your switch is a single pole three way type it will not have this extra tag and the connection will have to be self supporting—this will be quite satisfactory in this application.

Telephone Call Charge Calculator

The most important part in the *Telephone Call Charge Calculator* is probably the counter—the bit that actually shows what your wife has spent, provided you can convince her to use the unit! As far as we know this counter is only available from Henry's Radio. If you find one anywhere else make sure that it is a 12V to 24V type (the 24V only types will not work on the 15V supply) and the coil resistance is in excess of 200 ohms.

The 555 timer integrated circuit should be obtained in the eight pin d.i.l. case, once again most of them are these days anyway. We always advise readers to use sockets with integrated circuits since they can be damaged by soldering and are difficult to remove without special tools once they are soldered in.

Light Level Controller

We recommend the use of a plastic case for the *Light Level Controller* and advise readers to take note of the points concerning insulation as mentioned in the text.

The triac listed is a 6A 400V device but is reasonably priced at about 90p and is more than adequate for the maximum permissable lamp load imposed by the suppression coils. Other types of triac can be used provided they are rated at least 400V at 2A (to avoid overheating—no heatsink is fitted), remember other types may have different cases and wire configurations.

The transistors are high voltage types and have few direct equivalents. A. Marshall (London) Ltd., 42 Cricklewood Broadway, London NW2 3ET can supply two BF259s for £1·35 including V.A.T and postage.

Transistor Assisted Ignition

We have been informed by Marshall's that due to the very large number of orders they have received for the semiconductors for the Transistor Assisted Ignition they have run out of stock of the TIP49 transistor.

Unfortunately their suppliers have already put back the quoted delivery date (in April) by approximately three months and it could be quite a few weeks before Marshalls can supply the outstanding orders. Readers' money will be refunded on request or the orders will be held until a supply is available.

Blow for Bagpipes

Just a few comments about the *Electronic Bagpipes* article of the May issue of EVERYDAY ELECTRONICS.

Firstly there appears to be an error in the second full paragraph of column 2 page 254 in that the references to positions 1 and 3 of the switch are interchanged. Position 1 gives vibrato, whilst position 3 gives "bagpipes", or so it seems to me from Fig. 1. Incidentally I do not think that the Scottish folk will like it one bit to read the part that says that "in position 3 it becomes a pleasing sound not unlike an organ".

I suspect that the author is Tom Richardson of North Shields former fellow of the Electronic Organ Constructors Society, and next time I see him, I must pull his leg about this, should we say, "praising with feint damns", or left handed compliments.

However I do think that the article would have been improved by the inclusion of a few dimensions, and perhaps an extra elevation, in Fig 3. Also by the inclusion of a musical stave showing the exact compass to be aimed at (because the "spread" of unijunctions can alter the tuning), together with much more precise instructions for the tuning of the drones than is given in the closing paragraph.

James W. Robson
Newcastle upon Tyne.

We thank you for pointing out the error in our text namely that in the above mentioned paragraph, positions 1 and 3 should be transposed. We apologise to any Scottish readers who may have been offended.

As far as "more information" is concerned we think sufficient has been given to successfully construct the unit. We would be interested in readers' comments on this point.

Suppression

I feel that I must make a few comments on the reply given in your *Help* column of the May issue of EVERYDAY ELECTRONICS, concerning automobile interference.

If carbon leads are fitted (as the practice seems to be these days) the standard way of suppressing these leads is to replace the carbon h.t. lead between the coil and distributor with a length of copper h.t. lead, and insert a "cut-lead suppressor" $1\frac{1}{2}$ inches from the coil end of the lead.

The h.t. coil is suppressed with a $1\mu F$ not $0{\cdot}1\mu F$ capacitor as stated, and is fitted to the *ignition*, or *SW* side of the coil. The same value $1\mu F$ is fitted to the alternator, or dynamo. In either case it is advisable to disconnect the battery.

Hoping you will correct these errors made in a future issue of your otherwise excellent magazine.

A. N. Choat
Medway Sound Service
Rainham.

Amateur Exhibition

I was very interested to see in the May issue of EVERYDAY ELECTRONICS the discussion by Mr. Paul Young on page 270 in *Counter Intelligence*. I am pleased to say that I can answer Mr. Young's plea as the British Amateur Electronics Club is holding a B.A.E.C. Amateur Electronics Exhibition at the Shelter, The Esplanade, Penarth, from July 20 to July 27 next.

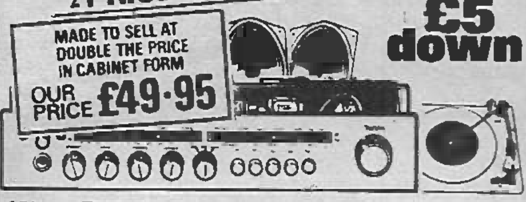
I am expecting many exhibits from members in all parts of the country, so that there should be a very good cross-section of both original exhibits and designs taken from your excellent magazine. All readers are welcome.

Cyril Bogod
B.A.E.C.

QUALITY* STEREO SOUND

SOLENT AUDIO SYSTEM

ALMOST ½ PRICE OFFER!



£5 down

*Stereo Tuner Amplifier chassis with AM/FM radio covering long medium short and Stereo FM wavebands. Separate Base and Treble controls. Power output 7 watts R.M.S. per channel (frequency response 25-20,00 Hz) Tape record and playback facilities. Dimensions 18" x 8½" x 3½". The very latest BSR automatic record deck with cue and pause control. Two matching elliptical speaker units.

Order early limited stocks available cash price £49·95. Credit Sale £5·00 deposit 9 monthly payments of £5·75 (Total Credit price £56·75). P. & P. £2·50. Send £7·50 today.

Chassis only available for cash at £35·00.

Full 12 months Guarantee.

CALLERS WELCOME.

FREE Stereo headphones supplied with every order.

LEWIS radio E.E. 7/74, 100 CHASE SIDE SOUTHGATE LONDON N14 5PL Telephones: 01-886 9666/3733

ENGINEERS FREE YOURSELF FOR A BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New Opportunities" shows you how to get them through a low-cost B.I.E.T. home study course. There are no books to buy and you can pay-as-you-learn.

The B.I.E.T. guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

CUT OUT THIS COUPON

POST NOW

CHOOSE A BRAND NEW FUTURE HERE!

Tick or state subject of interest. Post to the address below.

- Practical Radio & Electronics (Technatron) ☐
- Electronic Engineering ☐
- Television Maintenance & Servicing ☐
- General Radio & TV Engineering ☐
- Radio Servicing, Maintenance and Repairs ☐
- City & Guilds Radio, TV Electronics Mechanics ☐
- Radio Amateurs ☐
- Practical TV ☐
- Colour Television ☐
- Computer Electronics ☐
- C & G LI Radio TV Servicing Cert. ☐
- Post Master General 1st & 2nd class Certs. ☐
- C & G Electrical Engineering Practise ☐
- C & G LI Installations and Wiring ☐
- General Electrical Engineering ☐
- Society of Engineers (Electrical Eng.) ☐
- Electrical Installations and Wiring ☐
- C & G Electrical Technicians (Primary) ☐
- C & G Telecommunications ☐

To B.I.E.T. BEE 05 Aldermaston Court, Reading RG7 4PF QK BEE 05

NAME (Block Capitals Please) ....

ADDRESS ....

Other subjects .... Age ....

Accredited by C.A.C.C. Member of A.B.C.C.

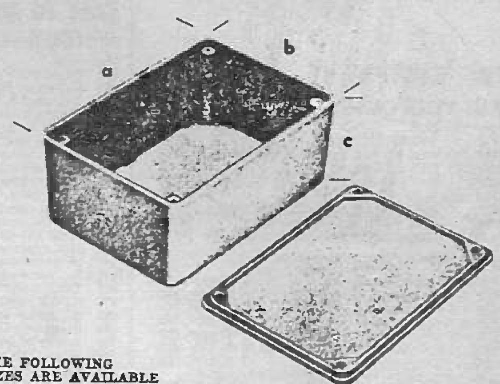
BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

CRESCENT RADIO LTD.

11-15 & 17 MAYES ROAD, LONDON N22 6TL
(also) 13 SOUTH MALL, EDMONTON, N.9

MAIL ORDER DEPT.
11 MAYES ROAD, LONDON N22 6TL
Phone 888 3206 & (EDM). 803 1685

PLASTIC BOXES



THE FOLLOWING SIZES ARE AVAILABLE

		a	b	c	
1005	—	10·5 cm ×	7·3 cm ×	4·7 cm	= 51p
1006	—	14·9 cm ×	7·3 cm ×	4·8 cm	= 66p
1007	—	18·2 cm ×	12·2 cm ×	6·4 cm	= 96p
:- 1021	—	10·6 cm ×	7·4 cm ×	4·5 cm	= 50p

Post and Packing 10p
:- SLOPING FRONT 60DEG (Approx.)

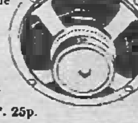
stabilised

POWER PACK/CONVERTER

Switched 3, 6, 7½ or 9 volts
Up to 400mA Output

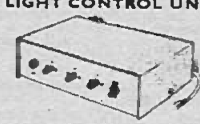
£5·25 + VAT. 16p P. & P.

ELAC HI-FI
10" Twin Cone
Speaker.
7 Watts
Free Air
40 Hz 12000 Hz



£3·75 P. & P. 25p.

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT



Three Channel: Bass—Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed.)

£18·50 plus 38p P. & P.

"CRESCENT" 100 WATT R.M.S. ALL PURPOSE AMPLIFIER U . BUILD . IT

We supply the three modules for you to build this Disco-Group-P.A. amplifier into the cabinet of your choice.

★ THE POWER AMP MODULE

170W. r.m.s. sq. wave 300W instantaneous peak into 8 ohm (60W into 16 ohm). £14·28, carr. 45p.

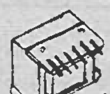
★ THE PRE-AMP MODULE

Four control pre-amp, Vol. Bass. Treble. Middle controls. Designed to drive most amplifiers using F.E.T. first stage. £3·96 carr. 25p.

★ THE POWER SUPPLY

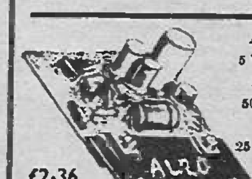
Is supplied complete with the mains transformer. £9·66, carr. 50p. Complete fixing instructions are supplied and no technical knowledge is required to connect the three ready wired modules. A fantastic bargain. If you purchase all three modules. £25, carr. 75p. Send S.A.E. for further details on this or our ready built amplifiers.

MAINS TRANSFORMER



200-240 PRI
180v. 50MA SEC.
6·3v. 1 Amp Sec.

£1·00 + 10p P. & P. EACH



AL20
5 Watt
RMS
50 Hz
to
25 kHz

£2·36
P. & P. 10p.

CRESCENT CATALOGUE

If you construct you should own one. Send 20p inc. carriage.

★

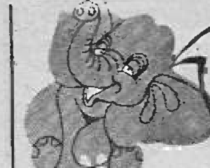
VAT

Please include 10% VAT on goods plus carriage.

Henry's

DON'T RELY ON YOUR MEMORY BUY NOW AT BARGAIN PRICES
Hi Fi and Transistors – Up to date Brochures on request

HENRY'S CATALOGUE
Due to rapid price changes, shortages of paper and raw materials, all prices in the existing catalogues no longer apply. Call or phone for latest prices. A new catalogue will be available for Aug/Sept. 1974.



TEST EQUIPMENT

MULTIMETERS

(carr. etc. 30p)

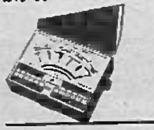
ITI-2	20K/Volt Slimline	5·95
M210 (Case £1·25)	20K/Volt Slimline de-luxe	6·75
TLH33D	2K/Volt Robust	7·50
U4323	(+IF&AF Osc)	7·00
AF105 (Case £2·25)	50K/Volt	12·50
U4313	20K/Volt AC current. Steel case	10·50
U4341	Plus Built in transistor tester	10·50
Model 500 (Case £2·25),	30K/Volt	11·75

OTHER EQUIPMENT

SE250B Pocket Signal Injector	2·25 carr. 15p
TE15 Grid Dip meter 440kHz–280mHz	16·50 carr. 30p
TE40 AC Millivoltmeter 1·2mHz	19·75 carr. 35p
TE65 28 Range valve voltmeter	22·50 carr. 40p
TE20D 120kHz-500mHz RF Generator	18·95 carr. 40p
TE22D 20Hz-200kHz Audio Generator	19·95 carr. 40p
SE350A Deluxe Signal Tracer	12·95 carr. 20p
SE400 Volts/ohms/R-C sub./RF field/RF gen.	15·50 carr. 20p

New Revolutionary Supertester 680R

680R Multi-tester £18·50



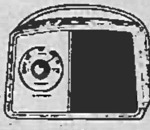
Accessories	
Transistor tester	11·00
Electronic voltmeter	18·00
Ampclamp	11·95
Temperature probe	11·95
Guass meter	11·95
Signal Injector	5·95
Phase Sequence	5·95
EHT Probe	5·95
Shunts 25/50/100A	4·50

A SELECTION OF INTERESTING ITEMS

C3025	Compact transistor tester	6·95 p & p 15p
Q4002	Photoelectric System	£13·70
E1310	Stereo mag. cart. preamp.	4·80 p & p 25p
Easlphone D1201 telephone amplifier		7·50 p & p 25p
D1203	Teleamp. with PU coil	4·95 p & p 20p
LL1	Door Intercomm. and chime	8·40 p & p 25p
9" Twin spring unit	For	3·30 p & p 15p
16" Twin spring unit	Reverbs	6·65 p & p 25p
US50 Ultrasonic Switch Transmitter/Receiver		£12·75
C3041 1-250 MHz		£4·25
C3043 5CH 1-300 MHz		£5·75
VHF 105 Aircraft Band Convertor		4·50 p & p 15p
B2005 4 Ch. mic. mixer		4·20 p & p 15p
B2004 2 ch. Stereo mixer		6·75 p & p 15p
PK3 Kit. Etch your own ptd. circuits		£1·95 p & p 20p

BUILD THIS RADIO

Portable MW/LW radio kit using Mullard RF/IF module. Features MW—bandspread for extra selectivity. Slow motion tunning. Fibre glass PVC cabinet. 600MW output. All parts £7·98 (battery 22p), carr. etc. 32p.



EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO + or – Earth with speaker and fixings. £8·50 c./p. 30p.

8 TRACK CAR STEREO (– Earth) with speakers in Pds & fixgs. £12·50 c./p. 40p.

Portable Battery Cassette Tape Player £7·25.

Car Lighter Plug and adaptor for all cassette and radio 6/7½/9 volt output (state width) £1·95 each

Rotel Stereophones
RH630 £6·80
RH700 £10·25
RH430 £4·14

Wein W500 Battery/Mains Cassette Recorder £12·75

PORTABLE CASSETTE TAPE PLAYER—for car or carry around. £7·25 c./p. 20p.

HANIMAX BC808 POCKET CALCULATOR WITH % KEY. £28·95

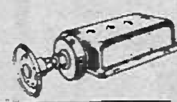
HANIMAX BC811M MEMORY VERSION £33·75

- BC807 % Key £22·95
- BCM850 % Key + Memory £33·95
- Mains unit £3·25 extra

HANIMAX H101 STEREO COMPACT RECORD PLAYER 2 x 7 watts. Complete with Speakers (List £54·50) Price £39·95. Plus free pair of stereo phones.

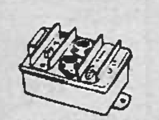
SPECIAL PURCHASES

UHF TV TUNERS CHANNELS 21 TO 64
Brand new transistorised geared tuners for 625 Line Receiver IF output. £2·50, Post 20p.



EASY TO BUILD KITS BY AMTRON—EVERYTHING SUPPLIED

Model No.		
310	Radio control receiver	3·29
300	4-channel R/C transmitter	6·61
345	Superhet R/C receiver	6·61
65	Simple transistor tester	1·66
115	8 watt Amplifier	4·50
120	12 watt amplifier	4·73
125	Stereo control unit	6·61
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. preamplifier	6·98
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
760	Acoustic switch	12·57
780	Metal Detector (electronics only)	10·91
790	Capacitive Burglar alarm	7·92
835	Guitar preamp.	4·99
840	Delay car alarm	6·99
875	CAP. Discharge ignition for car engine (-Ve Earth)	13·99
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	2·30
390	VOX	15·50
432	Testakit	19·30
670	Buffer Battery Charger	6·55
850	Electronic Keyer	18·75
820	Electronic Digital Clock	58·50



ALL KITS OFFERED SUBJECT TO STOCK AVAILABILITY

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

BUILD THIS TUNER ML3

MW/LW Radio Turner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built in battery. Excellent results. Size 7" x 2¾" x 3¾". All parts £5·25, carr. 15p.

Mullard FM Modules
LP1186 Tuning Heart Module.
LP1185 IF Module complete with data. Price £9·00 pair.

FM Tuner Module
FM5231 12v FM Tuner £7·95.
SD4912 Stereo Decoder £7·95.
SF82H 6v Stereo FM Tuner £14·95.

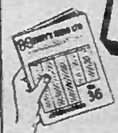
Sinclair Special Offer
Stereo 60 Pre-amplifier—for use with most small amplifiers. Exclusive offer £6·75.

PP9 Eliminator Kit
Complete module kit 9v 100mA output £1·95, p & p 25p.

TBA800 5 WATT I.C.
Suitable alternative to SL403D.
5/30 volt operated. 8/16 ohm
5 watt output.
With circuits and data £1·50.
Kit with printed circuit panel £2·70. All kits available from stock.

STROBE TUBE
ZFT4A. Suitable for December '73 Pract. Electronics £3·50.
ST2 (D32) DIAC 25p
CRS1/40 SCR 45p.

ZFT4 £3·50
ZFT8 £4·00



UK'S LARGEST RANGE OF TRANSISTORS AND DEVICES

JUST A SELECTION

*TBA800 5 Watt IC	£1·50
*Sinclair IC12 6 Watt IC	£2·00
*ZN414IC Radio	£1·20
*Ultrasonic Transducers	£5·90 pr.
*3015F 7SEG Indicator	£1·70
TIL 209 LED	24p each. 22p each per 10

* With circuits/data sheet

OVER 1500 DIFFERENT SEMI - CONDUCTOR DEVICES IN STOCK
Free stock list—latest edition (Ref. 36) on request. Includes radio valves, I.C.'s Rectifiers, Triacs, SCR's, LED's, etc. More types—better prices—discounts for quantity small or large.

GARRARD BATTERY TAPE DECK

GARRARD 2 speed 9 volt tape decks. Fitted record / play and oscillator/Erase heads. Wind and rewind controls. Takes up to 4" spools. Brand new complete with head circuits. £9·50 carr. 30p.

TOP QUALITY SLIDER CONTROLS
60mm stroke high quality controls complete with knobs (post, etc. 15p any quantity).

Singles Log and Lin 5K, 10K, 22K, 50K, 100K, 250K, 500K, 1 Meg. 45p each.

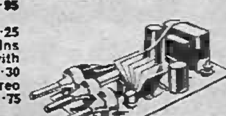
Ganged Log and Lin 10K, 22K, 50K, 100K, 250K, 65p each.
Quantity discounts available)
Complete with knobs.

MARRIOT TAPE HEADS
4 TRACK MONO or 2 TRACK STEREO
'17' High Impedance £2·50
'18' Med. Impedance £3·50
'36' Med. Impedance £5·00
R730/E73 2 track mono Record/Erase low Imp. 75p pair.
Erase Heads for '17', '18' and '36' £1·00
'63' 2 track mono, Hi Imp. £1·75
'43' Erase Head for '63' 75p
(Post, etc. 15p any qty).

SINCLAIR, MINIATURE AMPLIFIERS & TUNER/DECODER

AMPLIFIERS (carr., etc. 20p)

4-300, 0·3 watt 9 volt	1·75
104, 1 watt 9 volt	3·10
304, 3 watt 9 volt	3·95
555, 3 watt 12 volt	4·10
E1208, 5 watt 12 volt	5·10
608, 10 watt 24 volt	4·95
410, 10 watt 28 volt	4·95
E1206, 30 watt 45 volt	9·95
E1210, 2½ + 2½ watts 12 volt	8·25
RE300, 5 watt IC mains operated Amplifier with controls	6·30
SAC14, 7 + 7 watt Stereo with controls	11·75
SAC13, 15 + 15 watt Stereo with controls	14·95
SP40-5 2240/stereo 80/PZ5	25·00
SP40-6 2Z40/stereo 80/PZ6	27·75
SP60 2Z60/stereo 80/PZ8	30·45
Transformer PZ8	3·95



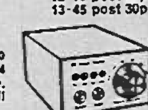
POWER SUPPLIES FOR EVERY PURPOSE

(All cased unless stated chassis)

470C 6/7½/9 volt 300 mA (includes Multi-Adaptor for Tape Recorders, etc.)	2·25 post 20p
Car Lighter Voltage Adaptors 300mA (State voltage 6v, 7½v, 9v)	1·95 ea. post 25p
SC202 3/6/7½/9 volt 400mA	4·25 carr. 30p
HC244R Stabilised version	5·50 carr. 30p
P500 9 volt 500mA	3·20 post 20p
P11 24 volt 500mA (chassis)	2·90 post 20p
P15 26/28 volt 1 amp (chassis)	2·90 post 20p
P1080 12v 1 amp (chassis)	4·70 post 20p
P1081 45v 0·9 amp (chassis)	7·80 post 20p
P12 4½–12 volt 0·4-1 amp	7·15 post 30p
SE101A 3/6/9/12 volt 1 amp (Stab.)	12·75 post 25p
RP164 6/7½/9/12 1 amp (Stab.)	13·45 post 30p

FIBRE OPTICS

0·01 Diam. Mono Filament £5·50 per 100 metre reel 0·13 Diam. 64 Fibres Sheathed. £1·00 per metre. SPRAYS 15mm Diam. (Mares Tail Spray £10·50)



All types offered subject to availability. Prices correct at time of press E & OE. 10% VAT TO BE ADDED TO ALL ORDERS. UK post etc. 15p per order unless stated.

Henry's RADIO LIMITED

EDGWARE ROAD, LONDON W2

404-406 Electronic Components and Equipment 01-402 8381
309 PA – Disco – Lighting High Power Sound 01-723 6963
303 Bargains Store (Callers only)
Home and Car Entertainment Centres London and branches now open.
120 Shaftesbury Avenue, London W1 01-437 9692
144 Burnt Oak Broadway, Burnt Oak, Edgware 01-952 7402
190-194 Station Road, Harrow, Middlesex 01-663 7788/9
354-356 Edgware Road, London W2 01-402 5854/4736

All mail to
303 Edgware Road,
London W2 1BW

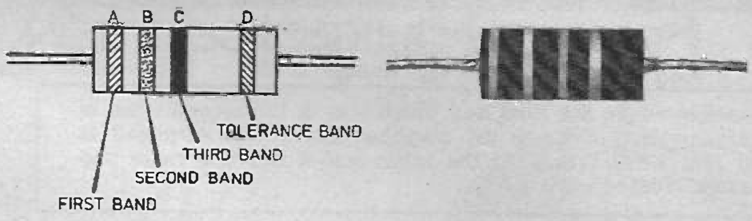
All stores open 9 am to 6 pm six days a week
Hi-Fi – Tape Equipment
Discount Stock List
Free at all stores

KNOW YOUR COMPONENTS...

Hints & Tips for the Novice Constuctor

By Ron Adams

THE beginner in electronics often has difficulty in identifying components, component values (sometimes coded), polarities, etc. This "information page" has been formulated to help in this area and begins this month with the most common component—the resistor.



The Resistor

The obviously important thing to watch on this device is the ohmic value, depicted by a colour code. At least all resistors—excepting some high stability types, which have the value printed on the body—have a colour coding of bands or dots, see Table 1.

If you don't know your colour code, then keep it written on a card next to you when constructing your projects. You will save yourself a lot of headaches and time by putting the right resistors in circuit. Not to mention the damage to components that can result.

The other thing to watch carefully is the current rating. Remember that you can put a half watt resistor in place of an eighth watt resistor, but not vice versa.

The wattage of the resistors can usually only be found from the size and type of resistor and various types and sizes with wattage ratings are also shown in full-sized silhouettes below.

Table 1: Resistor Colour Code

Colour	1st digit (A)	2nd digit (B)	Multiplier (C)	Tolerance ± per cent (D)
Black	–	0	1	–
Brown	1	1	10	1
Red	2	2	100	2
Orange	3	3	1,000	3
Yellow	4	4	10,000	4
Green	5	5	100,000	—
Blue	6	6	1,000,000	—
Violet	7	7	10,000,000	—
Grey	8	8	100,000,000	—
White	9	9	1,000,000,000	—
Gold	–	–	0·1	5
Silver	–	–	0·01	10

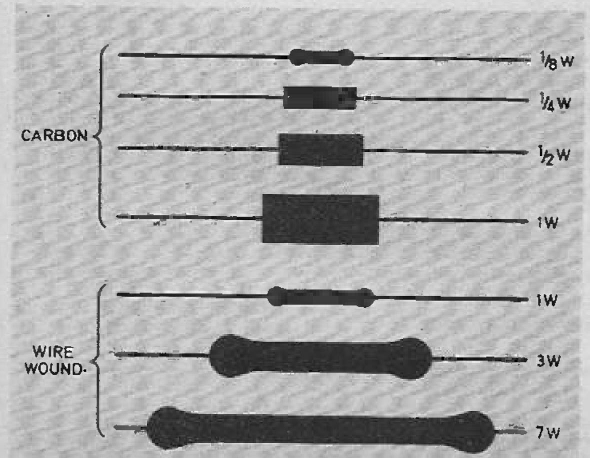
No fourth band indicates a ± 20 per cent tolerance.
A fifth band is sometimes used, colour salmon pink, to indicate high stability (hi-stab) resistors.

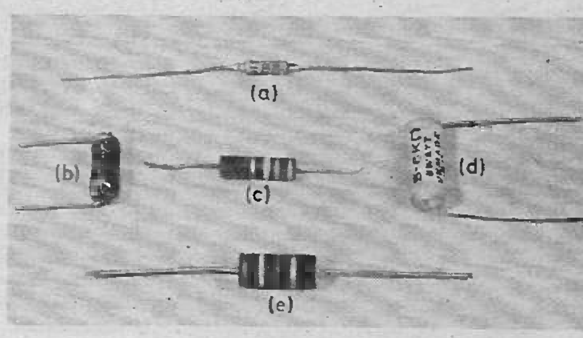
Also, it is surprising how many people think that a resistor is polarised and has to be put in circuit one way only—it isn't and can be put in either way round.

Colour Code Example

A resistor coded as A—red, B—violet, C—yellow, D—gold indicates a value of 470 kilohm ±5 per cent.

Next part: capacitors.





Above. A selection of resistors. (A) high stability (B) enamelled wirewound (C) and (E) carbon composition (D) high voltage wire wound. Left. Size and wattage of common types.

DOWN TO EARTH

By GEORGE HYLTON

"I connected up the *Fuzz Box* which was in the second issue of *Everyday Electronics* to my amplifier and I was surprised to find that when I touched the input lead I heard a radio programme. Please explain."

This kind of experience isn't at all uncommon. It explains why audio pre-amplifiers have "unnecessary" capacitors in them which have no appreciable effect on their audio performance. They are there to prevent "breakthrough" of unwanted r.f. signals picked up by the input leads.

HUMAN AERIAL

In the dear old days when even medium wave receivers had to have an aerial wire plugged in at the back, many of us found out that a finger touched on the aerial terminal was a useful temporary substitute. Not that anybody spent his evenings standing by a set with a finger poked into it, but it was a handy trick for testing purposes.

The human body may not be a very efficient aerial, but it does pick up strong radio signals. That explains how the radio-freqeuncy signals got into the *Fuzz Box*. What it doesn't explain is how they were converted to audio, in other words how they were "detected."

RECTIFICATION

Detection is rectification—the conversion of the r.f. carrier into d.c. Fluctuations in the r.f. strength appear as fluctuations in the d.c. output. The fluctuations are caused deliberately at the transmitter, by "modulating" the r.f. carrier with the audio programme, and rectification recovers the audio.

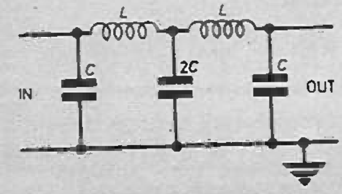


Fig. 1. A low-pass LC filter.

Now, rectification is normally carried out by diodes, and there are no diodes in the *Fuzz Box*. So how does it rectify?

DISTORTION

Well, rectification is a form of *distortion*, in which the positive half-cycles, say, are allowed to pass and the negative ones are suppressed. Even if the process is incomplete, and the unwanted half-cycles are only partially suppressed some degree of rectification still takes place. In the *Fuzz Box* this kind of distortion is deliberately introduced to provide the "fuzz" effect, so it's not surprising that r.f. signals are detected by it.

The question is, how to eliminate the r.f. breakthrough, if it is bad, without at the same time eliminating the "fuzz" effect.

LOW-PASS FILTER

The obvious method is to put a low-pass filter in the input circuit, so as to allow audio signals to pass but attenuate radio-frequency signals. In theory, an *LC* filter (Fig. 1) is most effective, but the chokes are apt to be bulky and expensive.

If the lowest radio frequency is far above the highest audio frequency the less efficient but cheaper *RC* filter is adequate.

In the U.K., the 200kHz long wave transmitter (Radio 2) is likley to be the lowest dangerous radio frequency (unless you live near one of the v.l.f. navigational aid transmitters). The highest audio frequency of interest is 10kHz, since "fuzz" in the form of harmonics of higher frequencies is beyond the limit of human hearing, and anyway most of the "fuzz" tends to be at much lower frequencies than even 10kHz. So a filter which attenuates 10kHz slightly is the best bet, since it will attenuate 200kHz at least 20 times more.

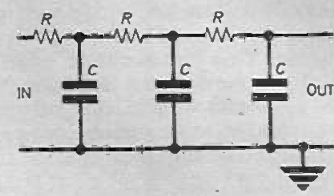


Fig. 2. A three-section low-pass RC filter.

The values of *R* and *C* and the number of filter sections needed are a matter for experiment, but a three-section filter as shown in Fig. 2, with $R = 10$ kilohms and $C = 1{,}500$picofarads should function satisfactorily. Neither value is critical, but ceramic or mica capacitors are better than paper or plastic types. The rated capacitor working voltage is not important here.

SCREENING

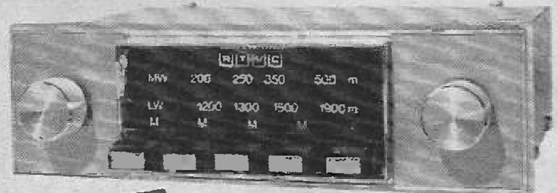
The filter should, along with the rest of the *Fuzz Box* components, be enclosed in an earthed metal box for screening, and connected to the amplifier with a screened lead. Quite short lengths of unscreened lead can pick up enough r.f. to cause interference, particularly if the source is a short-wave one such as the local television transmitter.

"I wish you wouldn't make so many labour-saving gadgets—I get tired of going round switching them all on."

R T V C FOR AUDIO ON A BUDGET

PUSH BUTTON(*) CAR RADIO KIT

The first time **Motor *magazine have nominated a push button car radio for their Top Ten Accessory Awards***



NOW BUILD YOUR OWN AWARD WINNING PUSH BUTTON CAR RADIO

Technical specification:

1.) **Output** 2.5 watts R.M.S. into 8 ohms. For 12 volt operation on negative or positive earth.
2.) **Integrated circuit output stage**, pre built three stage IF **Module**.

Controls Volume, manual tuning and five push buttons for station selection, illuminated tuning scale covering full medium and long wave bands.

Size Chassis 7 ins. wide, 2 ins. high and 4 $\frac{5}{16}$ ins. deep approx.

NOTE: The ability to solder on a printed circuitboard is necessary to complete this kit successfully. Circuit diagram and comprehensive instructions 55p free with kit.

Car Radio Kit
£6.60 + 55p. postage & packing.

Speaker including baffle and fixing strips
£1.65 + 23p. postage & packing.

Recommended Car Aerial – fully retractable and locking.
£1.35 post paid.

STEREO 21

QUALITY SOUND(*) FOR LESS THAN £19·00

Stereo 21 easy to assemble audio system kit. – no soldering required. Includes:—

BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge.

Two speakers with cabinets.

Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded:—

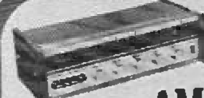
Specifications:

Input sensitivity 600mV; Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs. **Overall Dimensions**. Speakers approx. 15½" × 8" × 4". Complete deck and cover in closed position approx. 15½" × 12" × 6". Complete only **£18.95** +£1.60 p & p.

Extras if required.
Optional Diamond Styli **£1.37**

Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£3.85.**

DISCO AMPLIFIER



Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.

Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).

Inputs *5 Electrically Mixed Inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.

INPUT SENSITIVITIES

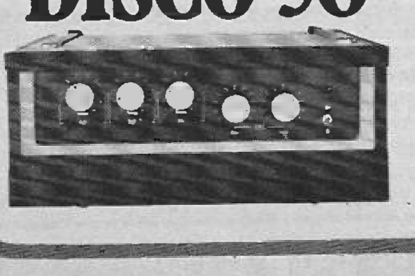
1) Crystal Mic or Guitar 9mV. 2) Moving coil Mic or Guitar 8mV. 3), 4), 5) Medium output equipment (Gram, Tuner, Monitor, Organ, etc.) – all 250mV sensitivity.

AC Mains 240V. operation.

Size approx. 12½ ins × 6 ins × 3½ ins

£15.00 + 60p. postage & packing

DISCO 50

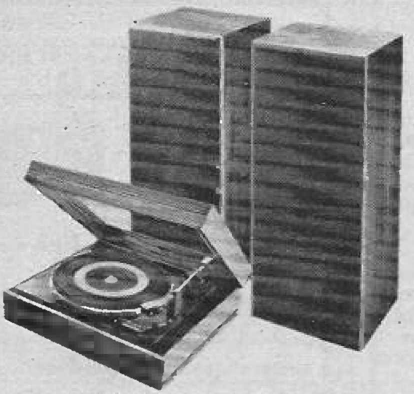


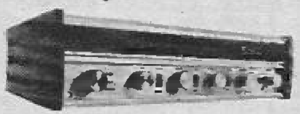
45 WATT R.M.S. MONO DISCOTHEQUE AMPLIFIER

Ideal for Disco Work. Output Power: 45 watts R.M.S. Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K. Size: 19¼ × 10½ × 8ins. approx. Amplifier **£27.50 + £1.50 p. & p**

Special Offer: Disco 50 plus two 15" E.M.I. speakers type 14A/780 (as illustrated on opposite page). **Complete £57.00 + £4.00 p&p.**

COMPLETE(*) STEREO SYSTEM





£51·00

40 Watt Amplifier.
Viscount III – R102 now 20 watts per channel.
System I includes.
Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.

Specification
20 watts per channel into 8 ohms.
Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within — 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics*. Bass: – 12dB to –17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble – 12dB to –12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio*: (all controls at max.) –58dB.
Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾" × 9" × 3¼".

Garrard SP25 deck, with magnetic cartridge, de luxe plinth and hinged cover.

Two Duo Type II matched speakers – Enclosure size approx. 17½" × 10¾" × 6" in simulated teak. Drive unit 13" × 8" with parasitic tweeter (10 watt handling)

Complete System £51.00

£69·00

System II
Viscount III amplifier (As System I)
Garrard SP. 25 (As System I)
Two Duo Type IIIA matched speakers— Enclosure size approx. 31" × 13" × 11½". Finished in teak veneer. Drive units approx. 13½" × 8½" with 3½" HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

Complete System £69.00

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£14·00 + £2·20 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p.
total	£59.20

Available complete for only **£51.00** + £3·50 p. & p.

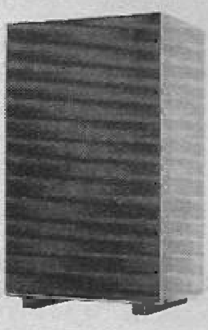
PRICES: SYSTEM 2

Viscount R102 amplifier	£24·20 + £1·00 p. & p.
2 Duo Type IIIA speakers	£39·00 + £4·00 p. & p.
Garrard SP25 with MAG cartridge de luxe plinth and hinged cover	£21·00 + £1·75 p. & p.
total	£84·20

Available complete for only **£69.00** + £4 p & p.

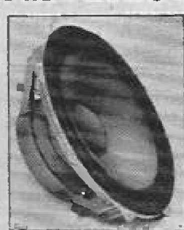
EMI SPEAKERS AT FANTASTIC REDUCTIONS

THE ULTIMATE COMPLETE SPEAKER SYSTEM EMI LE 315 listed price £86·00



A professional standard five way speaker system with enclosure giving top quality performance.
Enclosure Dimensions
approx. (3ft. × 2ft. × 1ft.).
Drive Units
Hand built – 15" diameter bass with 3" voice coil. – two 5" diameter Mid Range units. – two 3½" HF. units. plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.
Power Handling
Continuous rating 35 W rms., Peak power rating 70 W.
Frequency Response
20 Hz 20,000 Hz. Imp. 8 ohms.

Our price £45·00 — £3·50 p. & p. Recommended retail price £86·00



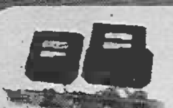
15" 14A/780 BASS UNIT

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

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

950 KIT

Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19" × 14" (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each 3½" dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2", others 0·5". Recommended list price £44·00. **OUR PRICE £19.50 + £1·50 p & p Special Offer.**



BUILD YOUR OWN STEREO AMPLIFIER(*)

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

£7·64 + 55p. p & p

8 TRACK CARTRIDGE PLAYER(*)

Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21.
Technical specification   Mains input, 240V. Output sensitivity 125mV
Comparable unit sold elsewhere at £24·00 approx.

Yours for only £10.95 + 90p. p & p

BARCLAYCARD

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

● Mail orders to Acton. Terms C.W.O.
All enquires Stamped Addressed Envelope.
Goods not despatched outside U.K.

● Leaflets available for all items listed thus(*)
Send stamped addressed envelope.

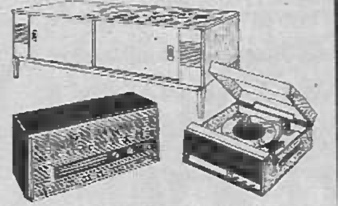
R T V C
Radio and TV Components (Acton) Ltd.

21 High Street, Acton, London W3 6NG /c
323 Edgware Road, London W2

Personal Shoppers — Edgware Road: 9a.m.–5.30p.m. Half day Thurs.
Acton: 9.30 a.m.–5 p.m. Closed all day Wed.

NO OVERSEAS ORDERS

The items below are from the March Supplement to our 1974 Catalogue. You can receive this Catalogue and the next 12 supplements by sending 66p.



Stereo Radiogram Cabinet. Long, Low and Modern. Teak veneered with sliding front and tapered legs. Speaker spaces each end. Size approx. 4ft. 2" × 15" × 15". Probably cost over £20 to make. Our Price £8·10 each. Carriage £2 per 200 miles.
Bush Record Player. Bush Ref. No. SRP 64. Separate bass and treble controls help give this unusually good sound quality. A suitable amplifier/speaker unit converts this to full stereo. Cabinet size 7½" × 16½" × 18" deep. Finished in charcoal grey leather cloth. Fully transistorised with 8" × 5" speaker. Controls bass, on/off, treble and volume. Socket stereo. Makers recommended price £27·73. Our Price £17·72. A saving of over £8. Post and insurance £2.
Erres Table Radio. Dutch made. Three wavebands (L.M. & S.) Nice size (16½" × 5½" × 5") wooden cabinet with high gloss finish. 6" × 4" speaker gives better than average tone—these radios are very well made from good quality components and should not be confused with Hong Kong makes. They recently retailed at £18 each and were well worth it. The ones we have are brand new and working but have failed final inspection because either they will work only on mains or only on batteries. It is unlikely that the fault is very much however and we are arranging for a circuit diagram. Price £8·64 plus £1 post and insurance.
Electric Welder. Big transformer in metal case with carrying handle and control switch, output through very heavy duty terminals. Output volts 1·9–4·25 volts max. 117 amps.—normal mains input socket for optional foot switch. £19·50 plus £2 carriage up to 200 miles. A further £1 for each 100 miles extra.
24v 3 amp Mains Transformer. Upright mounting with fixing clamps, standard primary 240/200/195/160—£3·60 plus 30p post and service.
Mains Transformer. (6·5v–0–6·5v at 500 mA and 1v at 1 amp). Normal tapped primary. Upright mounting with fixing lugs. £1·00.
Mains Transformer. (18v–37v–39v–41v at 2 amp or this would function at 18v–0–18v). Primary tapped 110, 115, 127, 200, 220 and 240v selected by labelled plug. Primary screen and multi-tapped. Upright mounting with fixing lugs £2·95.
Midget Two Gangs. Tuning condenser as fitted to many Japanese and Hong Kong radios—probably 300pf each section with ¼" spindle with terminals less trimmers. Price 38p. With trimmers 50p.
Ferrite Rods for aerials, etc. The following types are in stock Dia. ¼". 4" long 15p. 5" long 18p: Dia. 5/16". 5" long 20p. 6" long 25p. 8" long 30p: Dia. 3/8". 4" long 20p, 5" long 25p. 6" long 30p. 8" long 40p: Dia. ½", 6" long 35p: Ferrite Slab 6" long × ¾" × 1/8th"–20p.
Photo Resistor. Mullard type. This drops its resistance from approx. 250Kohms in dark to only approx. 200 ohms in bright light but it is only quite small, in fact less than ¼" square with leads coming out of corners on one side. Price 22p.
0-8 Ammeter. 2" square, full vision face for flush mounting—moving iron. Ideal for charger 75p each.
I.F. Transformers. Tuneable around 465 KC. Japanese manufacture as fitted to many Japanese-made portable radios. Three sizes available—Sub. miniature approx. ¼" x ¼" x ¾" high—Miniature approx. ¾" x ¾" x ½" high—Small approx. 9/16" x 9/16" x ¾" and Standard 9/10" x 9/10" x ¾". All at 11p each.
12v Power Pack. "Smooth flow" Double wound mains transformer, full wave rectifier and overload protection. Completely enclosed in plastic case with output terminals and flex lead—ideal to operate models, drive motors, charge small batteries etc. Price £2·25.
Time Switch. Mains driven 24 hours clock—driving 2 pairs of on/off switches this switch sequence will repeat until re-programmed. Complete in pressed steel case with glass window in front. Continental make. Price £3·50.
Relay. Clare Eliot. Sealed and wire ended. 675 ohm coil with two pairs change over contacts. Price £1·65

TERMS:—Add 10% V.A.T.

Send postage where quoted—other items, post free if order for these items is £6.00, otherwise add 20p.

J. BULL (ELECTRICAL) LTD.
(Dept. E.E.)
102/103 Tamworth Rd.,
Croydon. CRO IXX

INSTRUMENTAL AUDIO EFFECTS

SUPER "FUZZ" UNIT KIT. CONNECTS BETWEEN GUITAR & AMPLIFIER. OPERATES FROM 9v BATTERY (not supplied). ALL COMPONENTS AND PRINTED CIRCUIT BOARD WITH FULL INSTRUCTIONS. KIT PRICE: £2·86 post paid.

CREATE "PHASE" EFFECT ON YOUR RECORDS, TAPES ETC., UNIQUE CIRCUITRY ENABLES YOU TO CREATE PHASE EFFECT AT THE TURN OF A KNOB. OPERATES FROM 9v BATTERY (not supplied) COMPLETE KIT OF COMPONENTS WITH PRINTED CIRCUIT BOARD & FULL INSTRUCTIONS. KIT PRICE: £2·86 post paid.

MAIL ORDER ONLY.

S.A.E. ALL ENQUIRIES.

DABAR ELECTRONIC PRODUCTS

98a, LICHFIELD STREET, WALSALL, STAFFS. WS1 1UZ

ELECTRONI·KIT

Electronic fun for all ages

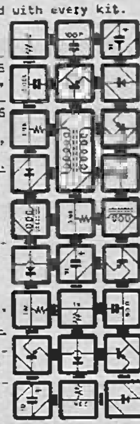
THE MOST VERSATILE ELECTRONICS KITS.

All components are beautifully encapsulated in unbreakable transparent plastic blocks. Perfect connections are made WITHOUT SOLDERING, SCREWING OR WIRING.

INCREDIBLE VALUE. Build, dismantle and rebuild projects any number of times and invent your own experiments too.

COMPLETELY SAFE. Instructive and FUN - all kits operate from 9v. battery only.

VALUABLE MANUALS included with every kit. No previous knowledge is required, even with the largest kits.



Kit 2A-30 projects £10.45
Radios, amplifiers, alarms, microphones, morse, etc.

Kit 3A-100 projects £20.45
As 2A plus electronic birds, cats, sirens, organs, metronome, guns, light and sound, burglar alarms, etc.

3ADX-105 projects £25.25
As 3A plus solar cell experiments and complete sophisticated control panel, etc.

4ADX-150 projects £33.95
As 3ADX plus Relay and Meter experiments: ion concentration-, volume-, output-, field intensity-, volt-, resistance meters, ammeter, illuminometer, etc. and many, many more.

ADD-ON parts and manuals available as required.

The three larger kits include Electrical experiments too.

All prices include Battery, VAT & p.& p.

Cheque/P.O. (or 6p. for literature) to:

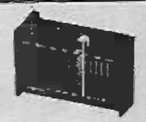
Satisfaction guaranteed

ELECTRONI-KIT LTD, 408 St. John's Street, London, EC1. [01-278 4579]

SINCLAIR CALCULATORS
Cambridge Kit £19·95 (£2·25)
Cambridge Assembled £21·95 (£2·50)
Executive £27·95 (£3·05)
Executive with Memory £34·95 (£3·75)
New Sinclair Scientific £39·95 (£4·25)

FERRANTI ZN414
IC radio chip with data £1·20 (23p). Also available kit of extra parts to complete a radio £2·39 (40p). Send sae for free leaflet

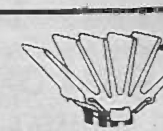
SINCLAIR PROJECT 80



AFU £6·95 (69p)
Z40 £5·45 (54p)
Z60 £6·95 (59p)
Q16 £7·70 (77p)
PZ5 £4·98 (49p)
PZ6 £7·98 (79p)
PZ8 £7·98 (79p)
Decoder £7·45 (74p), Trans. for PZ8 £3·35 (50p).
Tuner £11·95 (£1·19). Stereo 80 £11·95 (£1·19).
Project 805 £26·95 (£2·69)
2 x Z40/Stereo 80/PZ5 £25·00 (£2·50)
2 x Z40/Stereo 80/PZ6 £27·75 (£2·77)
2 x Z60/Stereo 80/PZ8/Transformer £33·11 (£3·31)
Write for our most competitive quotation.

SINCLAIR GOES QUADRAPHONIC!
Introducing the Napolex QA10 self-contained matrix quadraphonic synthesizer. Just feed the output of a Project 80 stereo system into it and hook on 4 speakers to obtain the latest experience in sound. Send for free leaflet. Only £9·95 (£1·30).

SINCLAIR SUPER IC12
6W rms power. With 44 page booklet and printed circuit £2·10 (43p)



SWANLEY IC TOMORROW £1·80 (40p)
The world's most powerful IC amplifier. Similar to IC12 but rated at 10W r.m.s. power. Supplied with data but no printed circuit. Write for leaflet

DELUXE KIT FOR THE IC12
Includes all parts for the printed circuit and volume, bass and treble controls needed to complete the mono version £1·60 (27p). Stereo model with balance control £3·60 (48p)

IC12 POWER KIT
Supplies 28V 0·5 Amps £2·67 (50p)

LOUDSPEAKERS FOR THE IC12
5" 8 ohm £1·10 (27p). 5" x 8" 8 ohm £1·55 (37p)

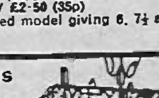
PREAMP KITS FOR THE IC12
Type 1 for magnetic pickups, mics and tuners) Mono model £1·35 (25p). Stereo model £2·40 (36p).
Type 2 for ceramic or crystal pickups. Mono 65p (18p). Stereo £1·30 (25p)

SEND SAE FOR FREE LEAFLET ON KITS

BATTERY ELIMINATOR BARGAIN
The most versatile battery eliminator ever offered. Switched output of 3, 4½, 6, 7½, 9 and 12V at 500 mA £4·15 (70p)

Other eliminators stocked:—
50mA:—6V £1·80 (30p). 9V £1·80 (30p). 7½V cassette type £2·25 (30p). Double 6V + 6V £2·50 (35p). 9V + 9V £2·50 (35p)
250mA:— 3-way switched model giving 6, 7½ and 9V £2·95 (60p).

S-DECS AND T-DECS



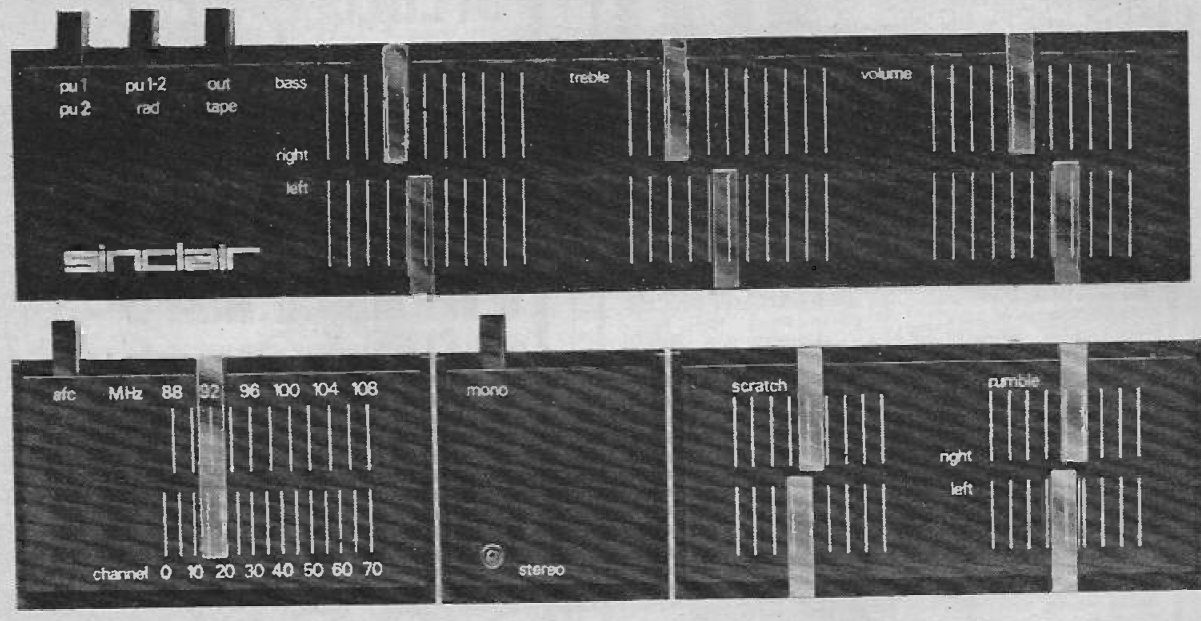
S-DEC £1·98 (31p)
T-DEC £3·63 (47p)
μ-DEC A £3·99 (51p)
μ-DEC B £6·99 (81p)
IC carriers:—
16 dil:—plain 81p (15p). With socket £1·77 (25p)
10 TO5:—plain 78p (15p). With socket £1·68 (24p)
Experiment guides:—A £1·50 (26p), B £1·77 (29p), C 90p (15p), D £2·40 (35p). E £4·20 (53p)

SWANLEY ELECTRONICS
P.O. Box 68, Swanley, Kent BR8 8TQ

Please add the sum shown in brackets after the price to cover the cost of post and VAT. Official credit orders from schools, etc. welcome. No VAT charged on overseas orders.

Sinclair Project 80

exciting



only $\frac{3}{4}$'' deep x 2'' high

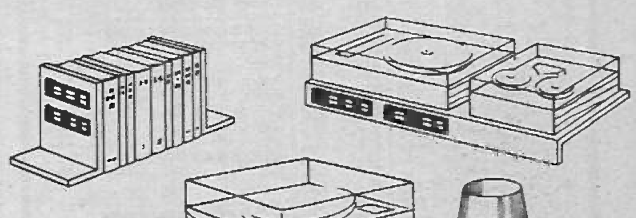
Living with hi-fi takes on new meaning with Sinclair Project 80. The electronics of these revolutionary new modules are all contained within elegantly designed matching cases no more than three-quarters of an inch deep. They are designed for mounting on any appropriate flat surface by means of 6BA bolts extending from the rear of each module and which pass through suitably drilled holes. Connections are taken away out of sight in a similar manner. The possibilities opened up by Project 80 are endless – superb hi-fi systems can be installed in ways hitherto only dreamed about and never before made practical. No more cutting out and shaping to put modules in position. A few holes drilled with the aid of templates supplied and the job is done. Now you need never again be faced with problems of keeping the hi-fi from clashing with carefully thought-out furnishing schemes. (That will surely please wives!) Slider controls have been introduced in place of knobs and all modules in the range incorporate new up-dated circuitry with emphasis on performance standards and built-in protection against overload and shorting. The aim was to re-think modular construction completely – to make it infinitely more versatile, even simpler and more reliable – the result – Project 80 – another triumph for Sinclair, and the most exciting construction modules ever.

the slimmest, most elegant hi-fi modules ever made

Typical Project 80 applications

System	The Units to use	Units cost
Simple battery record player	Z.40	£5·45 +54p V.A.T.
Mains powered record player	Z.40, PZ.5	£10·43 +£1.04 V.A.T.
30W. RMS continuous sine wave stereo amp.	2 × Z.40s, Stereo 80; PZ.6	£30·83 +£3.08 V.A.T.
50W (8 Ω) RMS continuous sine wave de luxe stereo amp.	2 × Z.60s, Stereo 80; PZ.8	£33·83 +£3.38 V.A.T.
Indoor P.A.	Z.60, PZ.8	£14·93 +£1.49 V.A.T.

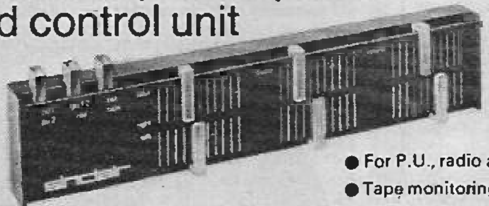
Project 80 FM tuner, decoder, and A.F.U. may be added as required



Mount Project 80 on a bookshelf, a loudspeaker, a lampshade base a false wall with two Q.16 loudspeakers . . . almost anywhere.

new thinking in modular hi-fi

Stereo 80 pre-amplifier and control unit



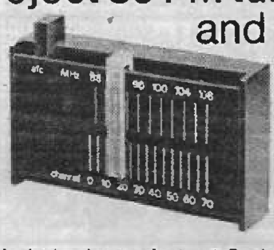
- For P.U., radio and tape
- Tape monitoring switch
- Simplest ever fixing

Each channel has its own separate tone and volume controls operated by sliders, enabling ideal environmental matching to be obtained. A virtual earth input stage forms part of the up-dated circuitry that ensures the finest possible quality from all signal sources. Generous overload margins are allowed on all inputs. Clear instructions with template are supplied.

TECHNICAL SPECIFICATIONS
Size – 260 × 50 × 20mm (10¼ × 2 × ¾ins)
Finish – Black with white indicators and transparent sliders
Inputs – Magnetic pick-up 3mV RIAA corrected; Ceramic pick-up 300mV
Radio 300mV; Tape 30mV
Signal/noise ratio – 60dB
Frequency range – 20Hz to 15KHz ± 1dB; 10Hz to 25KHz ± 3dB
Power requirements – 20 to 35 volts
Outputs – 100mV + AB monitoring for tape
Controls – Press button for tape radio and P.U. Sliders for volume, bass (+ 12dB to – 14dB at 100Hz) treble (+ 11dB to – 12dB at 10KHz)

R.R.P. £11.95 +£1·19 V.A.T.

Project 80 FM tuner and stereo decoder



- Twin dual varicap tuning: 4 pole ceramic filter: switchable A.F.C.
- On the decoder, solid state stereo indicating beacon.

Making the Project 80 F.M. tuner and decoder available separately gives a wider choice of systems and saves money where stereo reception may not be required. The tuner is a triumph of electronic design and assures excellent performance. The decoder gives a 40dB channel separation with 150mV output per channel. Both units may be used with other than Project 80 systems.

TECHNICAL SPECIFICATIONS OF TUNER
Size – 85 × 50 × 20mm (3½ × 2 × ¾ins)
Tuning range – 87·5 to 108 MHz
Detector – I.C. balanced coincidence for good A.M. rejection
One I.C. equal to 26 transistors
Distortion – 0·2% at 1KHz for 30% modulation
4 pole ceramic filter in I.F. section
Aerial impedance – 75 Ω or 240-300 Ω
Sensitivity – 4 microvolts for 30dB quieting
Output – 300 mV for 30% modulation
Power requirements – 23 to 33 volts

R.R.P. £11.95 +£1·19 V.A.T.

DECODER
Size – 47 × 50 × 20mm (1⅞ × 2 × ¾ins)
One 19 transistor I.C.

R.R.P. £7.45 +0·74 V.A.T.

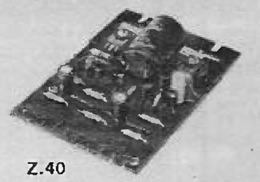
Guarantee

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, we will service it without charge.

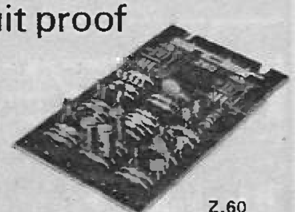
sinclair

Sinclair Radionics Ltd. London Road, St. Ives, Huntingdon PE17 4HJ
Telephone St. Ives (0480) 64646

Z.40 & Z.60 power amplifiers totally short-circuit proof



Z.40



Z.60

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 TECHNICAL SPECIFICATIONS
Size – 55 × 80 × 20mm (2¼ × 3⅛ × ¾ins) 9 transistors
Input sensitivity – 100mV
Output – 15 watts RMS continuous into 8 Ω (35v)
Frequency response – 10Hz – 100KHz ± 1dB
Signal/noise ratio – 64dB
Distortion – at 10 watts into 8 Ω less than 0·1%
Power requirements – 12 to 35 volts

Z.60 TECHNICAL SPECIFICATIONS
Size – 55 × 98 × 15mm (2¼ × 3⅞ × ¾ins) 12 transistors
Input sensitivity – 100-250mV
Output – 25 watts RMS continuous into 8 Ω (45V).
Distortion – typically 0·03%
Frequency response – 10Hz to more than 200KHz ± 1dB
Signal/noise ratio – better than 70dB
Built-in protection against transient overload and short circuiting
Load impedance – 4 Ω min; max. safe on open circuit

Z.40 R.R.P. £5.45 + 0·54 V.A.T.; Z.60 R.R.P. £6.95 + 0·69p V.A.T.

Project 80 active filter unit

Makes a highly desirable part of any worthwhile system where inputs may be from record, radio or tape. As with Stereo 80, separate controls applied to each channel make it easier to obtain ideal stereo balance.

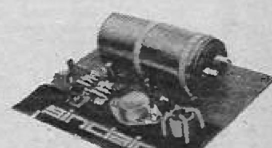
TECHNICAL SPECIFICATIONS
Size – 108 × 50 × 20mm (4¼ × 2 × ¾ins)
Voltage gain – minus 0·2dB
Frequency response – 36Hz to 22KHz controls minimum
Distortion – at 1KHz – 0·03% using 30V supply
HF cut off (scratch) – 22KHz to 5·5KHz, 12dB/oct. slope
L.F. cut off (rumble) – 28dB at 20Hz, 9dB/oct. slope

- For scratch and rumble control
- Transistorised active circuitry

R.R.P. £6.95 +0·69 V.A.T.

Power supply units

PZ.8



Stabilised. Re-entrant current limiting makes damage from overload or even direct shorting impossible. Normal working voltage (adjustable) 45V.

R.R.P. £7·98 + 0·79p V.A.T.
Without mains transformer

PZ.5 30V unstabilised
R.R.P. £4·98 + 0·49p V.A.T.

PZ.6 35V. stabilised
R.R.P. £7·98 + 0·79p V.A.T.

To SINCLAIR RADIONICS LTD. ST. IVES, HUNTINGDON PE17 4HJ

Please send post paid ______

______

______

for which I enclose Cash/Cheque for £ ______ including V.A.T.

Name ______

Address ______

7/74

Everyday Electronics Classified Advertisements

RATES: 9p per word (minimum 12 words). Box No. 20p. extra. Semi-display—£6·00 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 731P, Intertext House, London SW8 4UJ.
Or Phone 01-622 9911

FOR SALE

FOR SALE E.E. volume 1, Nos 1-14, Bound volume 2, Nos 1-12. Offers for complete set. Box No. 2.

EVERYDAY ELECTRONICS No. 1 to December 1973: £6 including postage. Apply with stamped addressed envelope.—T. Darby, 85 Lakedale Road, Plumstead, London SE18 1PR.

E.E. from first copy to date in binders, mint condition. Offers, Skilbeck, 12 South Cliff Avenue, Eastbourne (STD 0323) 33280.

MISCELLANEOUS

DON'T LOOK

unless you can resist the temptation to get these super 'attention-getters':

★ Pocket-sized **MAXI-VOLT** Big ½inch Spark Generator (instant 15,000 volts!). Ready-made, needs no batteries. Carry it around anywhere. Only weighs about 3 oz. (85g.) send £1·35 for your Maxi-Volt now!

★ Unique **TRANSMITTER/RECEIVER** Kit. No licence examinations or tests required to operate this translstorised equipment. Easy to build. Get transmitting. Send £6·40 for yours now!

★ Psychedelic **MINI-STROBE** Kit. Take a pocket-sized lightening storm to Disco's and parties. 'Brain-freeze' 'em with vari-speed stop-motion flashes. Includes super case too. Send £2·40 now!
(All prices include V.A.T., packing, and postage.)

Send remittance to:
BOFFIN PROJECTS,
4 CUNLIFFE ROAD,
STONELEIGH, EWELL, SURREY
(Mail order U.K. only)
Or for more details, send 20p for lists, plus free design project sheet.

LOUD 6v SIRENS for burglar alarms etc. (New and Boxed) £1·25p. Clockwork motors 16p, Reed switches 8p. Add 10p P.P. List 6p. Grimsby Electronics, 64, Tennyson Road, Cleethorpes, Lincs.

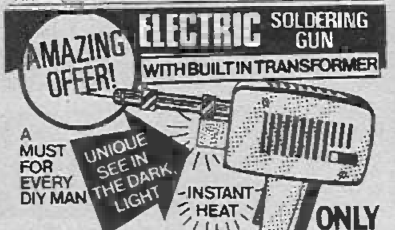
SUPERB INSTRUMENT cases by Bazelli, manufactured from heavy duty PVC faced steel, choice of 70 types, send for free list: Bazelli Instrument Cases, Dept 24, St. Wilfrid's, Foundry Lane, Halton LA2 6LT, near Lancaster.

**A BONANZA FOR CONSTRUCTORS—
B. B. SUPPLIES OFFER**

CURLIES, 5ft., 3-core, 15p ea. 4-core, 20p ea. STRAIGHT Cords, 25ft., 4-core, 25p ea. DIODES, Silicon, CV7040 (OA 202), 3" leads 4 for 25p DIALS, (GPO Type), plastic face, metal mech. 30p ea. TRANSISTOR panels, type M4, comprising: 5 BCY34, 4 ACY 17, diodes, resistors & capacitors (ex new equipment—rel. long leads) 50p ea. INTRODUCTORY OFFER: 1 of each above plus surprise item for £1-25p (offer ends 31-7-74) MONEY back guarantee—prices inc. VAT and pp. ORDERS or SAE for complete list to:-

38, HEATHWOOD GARDENS SWANLEY
KENT BR8 7HN

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.



This Soldering Gun is a MUST for D.I.Y. Men, Motorists, Mechanics, etc. A rugged, strong construction that will last a lifetime. Now you can do all those repairs that would normally cost you £'s at any electrical shop. Voltage 240 AC. 50c/s. LIMITED QUANTITY AVAILABLE. Similar product sells at £4·50. C.W.O. Immediate despatch. Refund if not delighted.

V.G.S. INTERNATIONAL (SGE10)
Pickworth, Sleaford, Lincolnshire.

BEGINNERS, we exist for you. Instruction, components, constructional kits. Send S.A.E. to Electrolern, Lyburn Lodge, Nomansland, Wiltshire.

FERRIC CHLORIDE

Anhydrous technical quality in sealed bags 1lb 55p (20p), 3lb £1·32 (30p), 10lb £3·85 (60p).

COMPUTER PANELS

3lbs asstd. panels £1·10 (30p), 7lb £2·20 (40p), 56lb £14 (£2). 12 high quality panels with trimpots, IC's, power transistors etc. £2·20 (30p), 100 panels £13 (£1). Pack of boards containing at least 500 components inc. at least 50 transistors 66p (20p).

DEKATRON UNITS

Contain 2xCV2271 dekatrons, 2 4-digit resettable counters, 2 sealed relays, R's, c's etc. Only £1·70 (30p).

3W TAPE AMPLIFIERS

2xECC83, EL84, EZ80 on 12 x 5 x 3" chassis with tone and volume controls. 3 watts output to 7 x 4" 3 Ω speaker (provided) £2·58 (50p). Or in case 14 x 13 x 9" with non-standard tape deck £3·58 (£1). Suitable cassette £1·10, tape 75p, head 30p.

"HOT WHEELS" MODEL GARAGE

Contains 1·7V @ 1A transformer (can be modified to give up to 10V output) lamp, switch, jack plug etc. ONLY £1·65 (30p).

7lb BARGAIN PARCELS

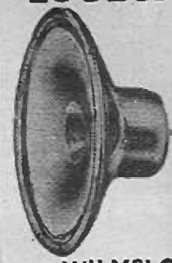
Hundreds of new resistors, capacitors, pots, switches, + PC boards with transistors and diodes and loads of odds and ends. Still only £1·82 (40p). New 6 x 4" 4 Ω speakers £1·10 pr (20p). 500 asstd. resistors £1·10 (20p). 150 mica, ceramic, poly caps 66p (14p).
All prices include VAT. SAE list, enquiries.

GREENWELD ELECTRONICS [EE4]

51 Shirley Park Rd. SOUTHAMPTON. TEL 0703 772501. Callers only at 38 Lower Addiscombe Road, Croydon.

RADIO & TELEVISION AERIAL BOOSTERS £2·95p, five television valves 45p. 50p bargain transistor packs, bargain £1 resistor and capacitor packs. UHF-VHF televisions £7·50, carr. £1·50p. S.A.E. for 3 leaflets. ELECTRONIC MAIL ORDER (BURY) LTD., Bridge Street, Ramsbottom, Bury, Lancs.

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

RECEIVERS and COMPONENTS

KITS FOR THE Everyday Electronics Buzzer £1. Balanced armature Earpieces 25p, MLK034CN/S Lever Keys £1·06. Chris Smith Components, 31 Priory, Neston, Wirral, Cheshire.

3 ASS. M.C. METERS 2-3" £1·15 (27p).
WIRE ENDED NEONS 10—50p (10p).
COPPER CLAD PAX. PANELS 5½" × 5½" 6—45p c.p. 7½" × 9" 6—£1·25 c.p.
T.V. CONVERGEANCE PANELS 2 × AC 128, 3 slugged coils, 3 slide switches, 11 w.w. pots, 3 carbon presets, 2 ferrite chokes etc. £1·10 c.p.
VALUPAKS P9 100 s/mica caps 65p c.p. Send 10p for lists of others plus panels etc. Refund on purchase.
7LB ASSORTED COMPONENTS £1·65 c.p.
2LB ASSORTED PANELS £1·65 c.p.

J. W. B. RADIO
2 Barnfield Crescent, Sale, Cheshire M33 1NL
Postage in brackets — Mail order only

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.

**ELECTRONIC COMPONENTS
WATFORD**

Visit our Warehouse for your requirements of Resistors, Capacitors, Transistors, SCR's, Speakers, Metal Boxes, Headphones, Intercoms, Meters, Audio Cables, Cartridges, Microphone, wide range of Plugs & Sockets etc., etc.

HILLS COMPONENTS LTD.
Unit 8, Mellnite Industrial Estate,
Brixton Road,
Watford, Herts.
Telephone: Watford 27711

SPECIAL PACK of components, 25 resistors, 10 diodes, 20 capacitors, all tested and guaranteed. Also contains 20 transistors, untested manufacturers rejects. Send 50p to Felectronics, 6 The Grassing, Carlisle.

SERVICE SHEETS

SERVICE SHEETS for Televisions, Radios, Transistors, Record Players, Tape Recorders, etc., from 5p with free Fault-Finding Guide. Over 10,000 models available. S.A.E. enquiries. Catalogue 20p and S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

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 & Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Publisher's Subscription Rate (including postage): For one year to any part of the world £2·95. 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 the cover, 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.