An exciting hobby.... for everyone

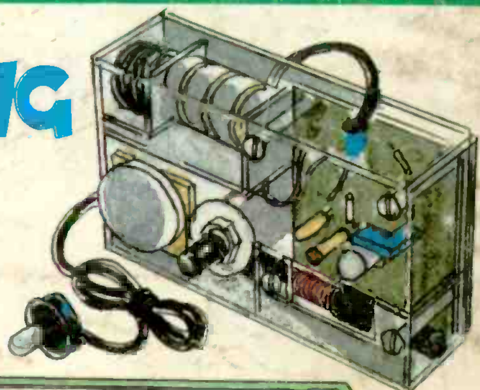
everyday electronics

SEPT. 73

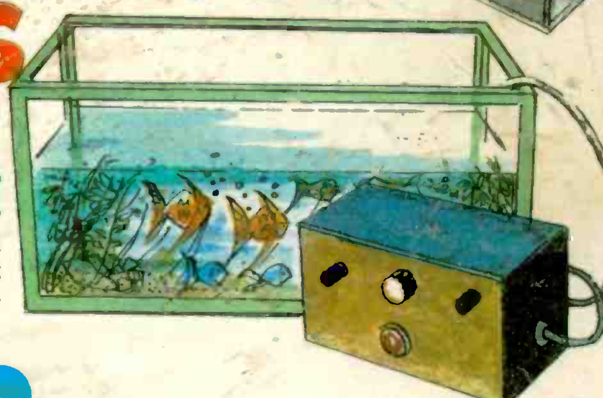
15p

HE'S MAKING THIS Receiver

An integrated circuit ensures excellent results and simplifies construction.



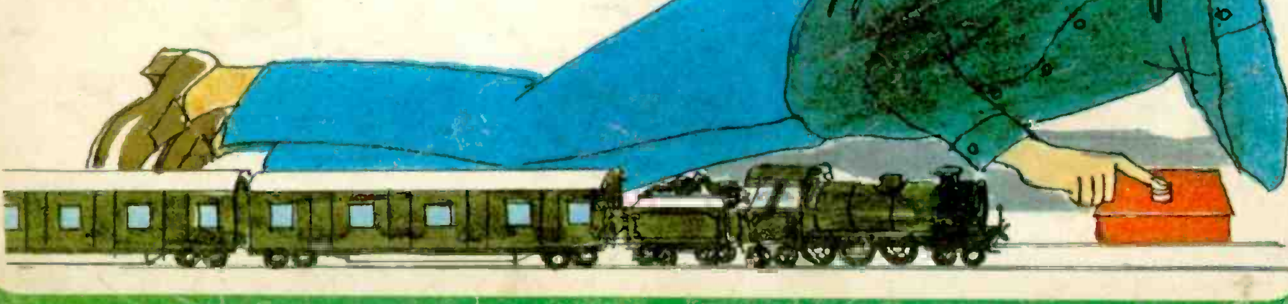
THIS Aquarium Thermostat



A simple unit that will maintain a set temperature accurately.

...AND THIS Train Controller !!!

Provides automatic, gradual speed change for stopping or starting, together with a manual facility to provide realistic speed control.



Build yourself a TRANSISTOR RADIO

WITH AFTER SALES SERVICE

ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS ALSO AIRCRAFT BAND

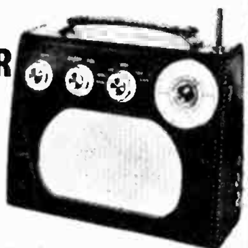
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Fine tone moving coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

Total building cost £9·35

P. P. & Ins. 52p

(Overseas P. & P. £1·05)

ROAMER EIGHT Mk I



NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

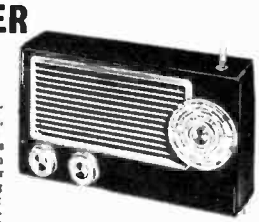
Total building cost £7·68 P. P. & Ins. 47p.
(Overseas P. & P. £1·05)

ROAMER SEVEN MK IV

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

Total building costs £6·58 P. P. & Ins. 47p.
(Overseas P. & P. £1·05)

ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler, band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Plans and parts price list 25p (FREE with parts).

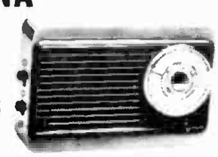
Total building costs £4·38 P. P. & Ins. 31p
(Overseas P. & P. £1·05)

POCKET FIVE

3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1¼ × 3½in. Plans and parts price list 15p (FREE with parts).

Total building costs £2·50 P. P. & Ins. 24p
(Overseas P. & P. 65p)

TRANSONA FIVE

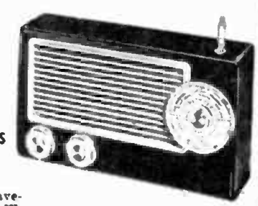


5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ × 4½ × 1½in. Plans and parts price list 15p (FREE with parts).

Total building costs £2·75 P. P. & Ins. 25p
(Overseas P. & P. 65p)

TRANS EIGHT



8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 25p (FREE with parts).

Total building costs £4·95 P. P. & Ins. 33p
(Overseas P. & P. £1·05)

"EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT.

COMPONENTS INCLUDE: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: 2 Plugs and Sockets: Battery Clips: 4 Tag Boards: Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¾" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.
Parts price list and plans 25p (FREE with parts).

(Overseas P. & P. £1·05)

All parts including Case and Plans £6·05 P. P. & Ins. 33p

FULL AFTER SALES SERVICE
- Callers side entrance "Lavells" Shop
- Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.

PLEASE NOTE: ALL PRICES INCLUDE VAT

RADIO EXCHANGE CO

61a HIGH ST., BEDFORD, MK40 1SA. Tel. 0234 52367
Reg. no. 788372

I enclose £.................. please send items marked.

ROAMER TEN	☐	ROAMER SEVEN	☐
ROAMER EIGHT	☐	TRANS EIGHT	☐
TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

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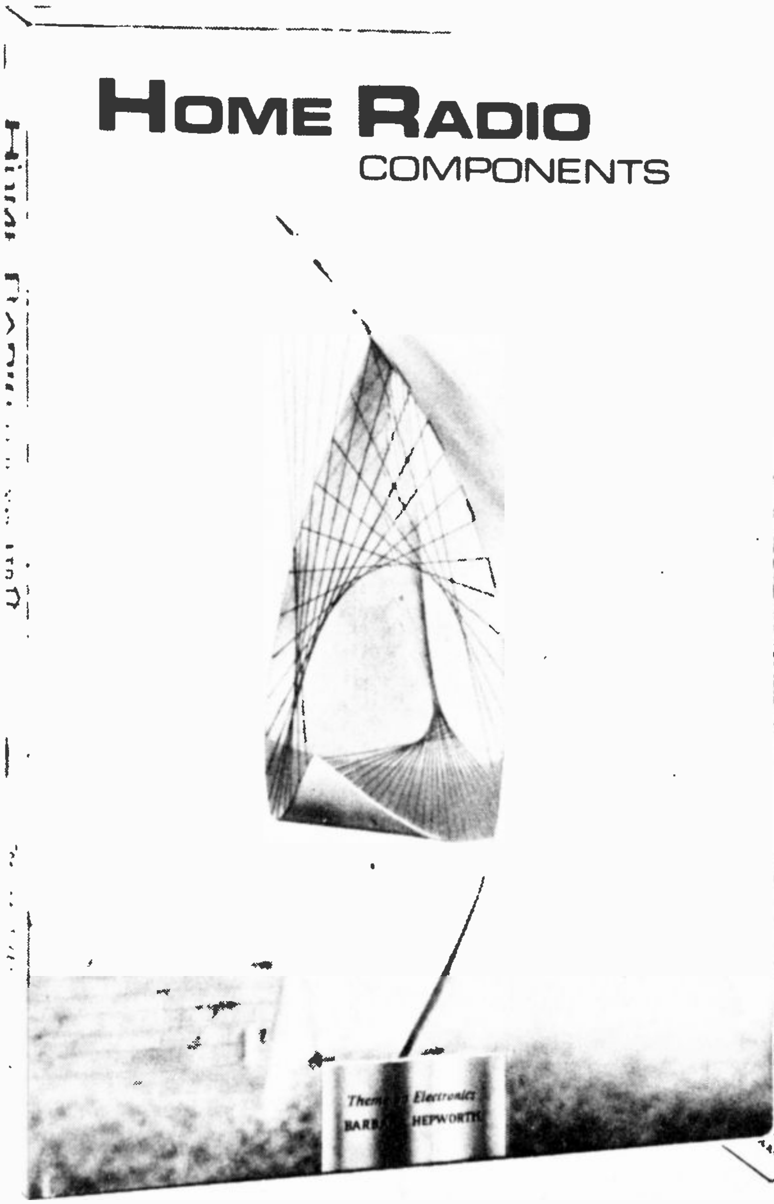
HOME RADIO (Components) LTD, Dept. EE, 234-240 London Road, Mitcham, CR4 3HD. Phone 01-648 8422

The Catalogue you MUST have!



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10 IN ONE MINI LAB
10 Instruments in one. Including AC & OC Voltmeter, Ohm Meter, etc.

£11·95 including VAT & P.P.

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Powerful trouble shooting signal injector. Model SE260.

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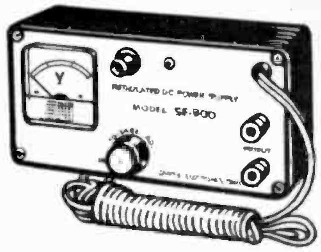

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Regulated power supply variable up to 15V 0·5A. Model SE800 . . . ideal for development work.

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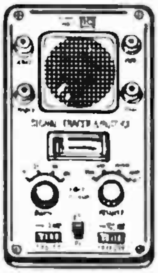

SIGNAL TRACER/ INJECTOR
Designed to receive audio frequency, built in amplifier with high gain of 60dB.

£11·55 including VAT & P.P.

NEW HIGHLY SENSITIVE MULTITESTERS
Model M650 with mirror scale.

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LIGHTING CONTROL

The DEXTER DIMMASWITCH is an attractive Dimma unit which simply replaces the normal light switch. It is available as a complete "ready to install" unit or "simple to assemble" kit. Two models are available controlling up to 300W or 600W of all lights, except fluorescents, at mains 200-250V 50Hz. All DEXTER DIMMASWITCH models have built-in radio interference suppression.

600 watt £3.52 Kit form £2.97
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All plus 12p post and packing
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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.

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

EX COMPUTER PC PANELS
2 x 4 in. packed with semiconductors and top quality resistors, capacitors, diodes, etc. Guaranteed min. 35 transistors plus data. 10 boards 50p (9p).

SPECIAL BARGAIN PACK
25 boards £1 (25p).
Panels with 4 power transistors sim. OC28 50p (9p)

ELECTROLYTICS
68,000µ 16v, 4½ x 2 in. dia., 25,000µ 25v, 20,000µ 30v, 5,000µ 90v, 35,000µ 15v, 8,000µ 55v, 4½ x 3 in. dia., 50p (12p). 15,000µ 15v, 10,000µ 35v, 5,000µ 75v, 4½ x 2 in. dia., 30p (10p). 2,000µ 25v wire ends 15p (5p), 12 for £1·50 (15p).

20A DIODES	4 for £1 (7p)
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8 BLACK TOGGLES dpst	50p (8p)
250 MIXED CAPACITORS	60p (8p)
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MIN. GLASS NEONS	12 for 50p (5p)
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QH BULBS 12V 55W	50p (5p)
PAPST EXTRACTOR BLOWER FANS 100 cfm 4½ x 4½ x 2in.	£3·50 (28p)

Postage and packing shown in brackets.
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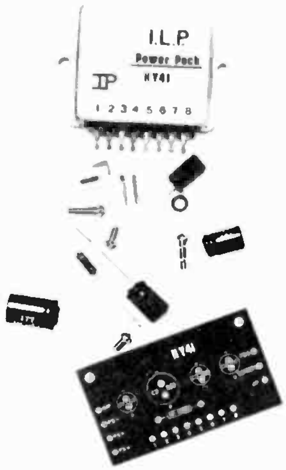


THE HY41

The HY41 supersedes the popular HY40 introduced by ILP last year. This highly improved module achieves true High Fidelity with a dramatic reduction in distortion (typically 0.05% at 1KHz into 8 ohms!) and is electronically and mechanically compatible with the HY40.

With this important improvement the HY41 retains all of the quality characteristics found in the earlier version and P.C. board, Resistor, Capacitors, Hardware Mountings and comprehensive manual are included in the basic kit. No further components are required to construct a complete power amplifier of extremely high performance sufficiently versatile to provide power not merely for Hi-Fi but also for public address systems and industry.

The free manual gives a full circuit diagram of the HY41 and its various applications including a complete stereo amplifier.

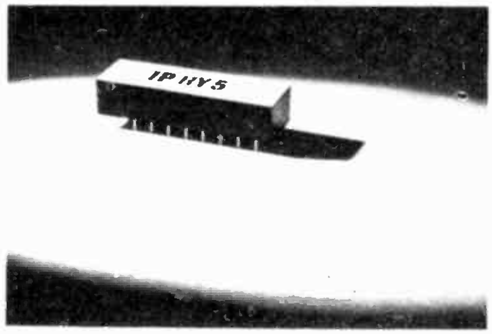
Like its predecessor the HY41 is based on conventional and proven circuit techniques developed over recent years.

OUTPUT POWER: British Rating 40 WATTS PEAK, 20 watts R.M.S. continuous.
LOAD IMPEDANCE: 4–16 ohms.
INPUT IMPEDANCE: 30K ohms at 1KHz.
VOLTAGE GAIN: 30db at 1KHz

TOTAL HARMONIC DISTORTION: less than 0.15% (typical 0.05%) at 1KHz.
FREQUENCY RESPONSE: 5Hz–50KHz ± 1db.
SUPPLY VOLTAGE: ± 22.5volts D.C.
SUPPLY CURRENT: 0.8 amps maximum.

PRICE: inc. comprehensive manual, P.C. board, five extra components and P. & P.:—
MONO: £4.90 STEREO: £9.80

UNIQUE HYBRID PRE-AMPLIFIER



The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an Integrated pre-amplifier circuit.

Supplied with the HY5 are two stabilizing capacitors and by the addition of volume, treble and bass potentiometers it is ready for use.

Internally the HY5 provides equalization for almost every conceivable input, the desired function is achieved by use of a multi-way switch or by direct interconnection.

Two distinctive features of the HY5 are its inbuilt stabilization circuit, allowing it to be run off any unregulated power supply from 16–25 Volts and a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo pre-amplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY41 and PSU45 forms a completely intergrated system.

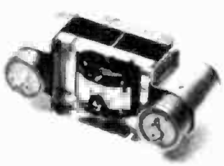
INPUTS
Magnetic Pick-up (within ±1db RIAA curve) 2mV. 47K Ω
Tape Replay (external components to suit head). 4mV. 47KΩ
Microphone (flat) 10mV. 47K Ω
Ceramic Pick-up (equalized and compensatable) 20–2000mV. variable.
Tuner (flat) 250mV. 100K Ω
Auxiliary 1 250mV. 47K Ω
Auxiliary 2 2–20mV. 100K Ω

OUTPUTS
Main Pre-amp output 500mV.
Direct tape output 120mV.

ACTIVE TONE CONTROLS (Baxendall)
Treble ± 12db.
Bass ± 12db.
INTERNAL STABILIZATION
Enables the HY5 to share an unregulated supply with the Power Amplifier.
SUPPLY VOLTAGE
16–25 volts

SUPPLY CURRENT
6mA approx.
OVERLOAD CAPABILITY
better than 26db on most sensitive Input infinite on tuner and auxl.
OUTPUT NOISE VOLTAGE: 0.5mV.

PRICE MONO: £3.60 STEREO: £7.20



POWER SUPPLY PSU45

The versatile P.S.U.45 is designed to supply your HY41's +HY5's in stereo or mono format.

Specification

Input: 200–240 Volts.
Output: ± 22.5 Volts at 2 amps.
Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

PRICE: £4.50 inc. P. & P.

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT

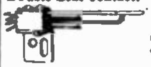
CANTERBURY 63218

Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2¼ × 2 × 2in. £1·65 each.

NEED A SPECIAL SWITCH



Double Leaf Contact. Very slight pressure closes both contacts. 8p each 10 for 60p. Plastic pushrod suitable for operating. 6p each. 10 for 54p.

AUTO—ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £6·35 plus 25p post and insurance.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1·10, plus 20p postage.

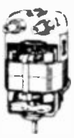
MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole .4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 22p each.

DRY FILM LUBRICANT

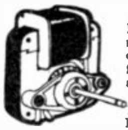
Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil can cannot reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator and are able to offer them to you for about half of the original list price. 88p per (8 oz.) can or 12 cans for £8 post paid. The lubricant is I.C.I. fluon L169.

MULTI-SPEED MOTOR



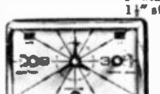
Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000, 12,000 & 15,500 r.p.m. Shaft is ⅛ in. diameter and approximately 1 in. long. 230/240v. Its speed may be further controlled with the use of our Thryrister controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long. Price 97p plus 23p postage and insurance.

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 65p. Postage 20p for first one then 10p for each one ordered.
1" stackmotor 94p.
1½" stackmotor £1·10.

15A ELECTRICAL PROGRAMMER



Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2·15 + 20p p & p or with glass front chrome bezel 83p extra.

I CHIP RADIO

Ferranti's latest device ZN414—gives results better than superhet. Supplied complete with technical notes and circuits. £1·35 each. 10 for £12.

Hi-Q TUNER COMPONENTS

For experimenting with the ZN414.
KIT NO. 1. Plessey Miniature Tuning Condenser with built in LW switch and 3" ferrit slab and litz wound MW coil and wave change switch. 72p
KIT NO. 2. Air spaced tuning condenser 6" ferrite rod litz wound MW and LW coils and wave change switch, 94p.
KIT NO. 3. Air spaced TC with slow motion drive 8" ferrit rod, with litz wound LW and MW coils and wave change switch, £1·10.
KIT NO. 4. Permeability tuner with fast and slow motion drive and LW loading coils and wave change switch. 50p.

HOUR MINUTE TIMER

Made by Smiths. Complete with control knob and calibrated dial. Useful in kitchen, office, dark-room, etc. Bargain at 55p.

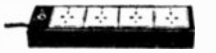
HONEYWELL PROGRAMMER

This is a drum type timing device, the drum being callibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price £6·33 plus 25p post and nsurance. Don't miss this terrific bargain.

MIGHTY MIDGET

Probably the tiniest possible radio, as described in Practical Wireless January 73. All electronics parts £2·20 post paid.

DISTRIBUTION PANELS



Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2·50 plus 23p P. & I

HORSTMANN "TIME & SET" SWITCH

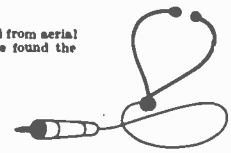
(A30 Amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc. up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5· Special snip price £1·65 Post and ins. 23p.

MULLARD UNILEX

This D.I.Y. Stereo Amplifier is still available complete at £7·06 for the four Mullard Modules, or Modules can be bought separately as follows: —4 watt amplifier module (2 required) Mullard Ref. No. E.P.9000—£1·60 each.
Pre amp module Mullard Ref. No. E.P.9001—£1·98 each.
Power module—Mullard Ref. No. E.P.9002—£2·53 each.
In addition and made to Mullard Specification we offer:—
Standard Control Unit with escutcheon and knobs—£3·30
Knobs—Set of 4—50p

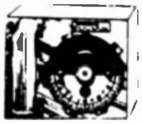
SPECIAL OFFER the complete Unilex with control panel at PRE VAT PRICE. £10 post paid.

RADIO STETHOSCOPE



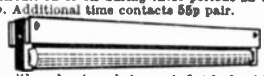
Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2·20—twin stethoset instead of earpiece 83p extra—post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

24hr. REPEATING TIME SWITCH



Made by Smiths these are A.C. mains operated. NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours. 5 amp change-over contacts will switch circuit on or off during these periods £2·75 post and ins. 23p. Additional time contacts 55p pair.

TWENTYLITE



Fluorescent lighting units with polyester choke and finished white enamel. 40 ins model, ideal kitchen, bedroom, hallway, porch, loft etc. With tube assembled ready to install, £2·20. post 40p.

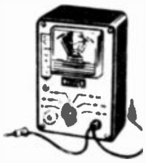
HONEYWELL THERMOSTAT

Made by Honeywell for normal air temperatures 40°-80°F (5-25°C). This is a precision instrument with a differential which can be adjusted to better than 1·5°F. A mercury switch breaks on temp. rise—the switch is operated by a coiled bi-metal element and adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows thermometer above and switch setting scale below-size approx. 3·8" x 3·2" x 1·4" deep—can be mounted on conduit box or directly on wall. Price £1·37 each or ten for £12·52.

KETTLE ELEMENTS

Made by the famous A.E.I. Co. Complete with washers and combined fixing ring and plug shroud. Normal 2 round pin and flat pin earth connection and overload reset push button. 2 Models—1⅛in (approx.) suitable for Swan and other similar models—1⅝in (approx.) suitable for G.E.C., Hotpoint, etc. All quick boil 2¼kW elements at 240V. Price £1·38.

BATTERY CONDITION TESTER



Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3½" x 6½" 2" x with leads and prods. Price £2·50 plus 20p postage.

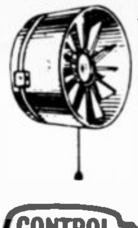
12 WAY SUB-MINIATURE MULTI-CORE CABLE

7·0076 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 22p per yard.

SNAP ACTION SLIDE SWITCH

Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 5p each. 10 for 54p.

EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5½" casing with 5½" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets. £2·75 + 20p P. & P.

DRILL CONTROLLER

NEW IKW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1·65 plus 13p post and insurance. Made up model also available. £2·50 plus 13p post & p.

TELEPHONES

Complete as illustrated. Save your legs, time and temper, simply by putting in some telephones. Ex. G.P.O. not new— but guaranteed in good condition and serviceable. Supplied with diagram and instructions showing how to connect. 3 types available as illustrated less internal bell £1 each. Ditto with bell but less dial £1·25 each. As illustrated with dial and bell £1·50 each. Post etc. 50p each.

BAKELITE INSTRUMENT CASE

Size approx. 6½" × 3½" × 2" deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price 54p each.
pax lid 11p extra.

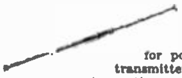
SPIT MOTOR

200-250V induction motor, driving a Carter gearbox with a 1½" output drive shaft running at 5 revs p.m. Intended for roasting chickens, also for driving models—windmills, coloured disc lighting effects, etc. £2·05 plus 20p post and ins.

SOLDER GUN

A must for every busy man, gives almost instant heat also illuminated job. 100 watt £3·47 plus post and ins. 20p.

TELESCOPIC AERIAL



for portable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw. 42p. KNUCKLED MODEL FOR F.M. 55p

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless, August issue. £3·30 plus 20p post and insurance.

IMMERSION HEATERS BY REMPLOY

Standard fitting for domestic water tanks, made by the famous Remploy Company. Complete with sealing washers suitable for 200–240 volts A.C. Depth into tank 11". 2kw or 3kw £1·65 plus 20p each post and insurance.

MAINS OPERATED SOLENOIDS

Model TT2—small but powerful 1" pull—approx. size 1¼" x 1½" x 1¾". 66p.
Model 400/1 ¼" pull. Size 2¼" x 2" x 1¾". 83p.
Model TT10 1½" pull. Size 3" x 2½" x 2½". £1·98 plus 20p post and insurance.

RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1·10 each or £12 per dozen, specify 5, 10 or 15 amp—*simply fit in place of switch.*

RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are:—
2 track record playback heads 50p each.
4 track record playback heads 72p each.
Erase heads are also available separately—2 track 33p—4 track 55p
Mu-metal mounting shields 39p each.
2 track record, playback and erase heads already fixed on heavy mounting plate with shield £1·28

1 R.P.H. MOTOR

Made by the famous Smiths Company. 240v 50 cycle mains working. Ideal motor to drive clock mechanisms. Price £1·10 each or 10 for £10.

ROCKER SWITCH

13 amp self-fixing into an oblong hole. Size approximately 1" × ½" 9p each 10 for 82p.

SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in × ½in rated 250V lamp. 6p each. 10 for 54p. 100 for £5·10. 500 for £24. Ditto as above but for printed circuit 5p each, 10 for 45p, 100 for £4·25. Sub Miniature Slide Switch. DPDT 19mm (¾in approx.) between fixing centres. 18p each or 10 for £1·08. SP Change over spring return 250v 1 amp. 10p.

HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack £6·10.

RELAYS BY KEYSWITCH

Makers Ref.KMK3 Our number Rel. A3. Open type mains operated coil—3 pairs change-over contacts rated at 6 amps each. Mounted by 1 screw. Solder tag connections. Price 60p each. Ditto but 12V. Our Ref. Rel A4. Price 55p each.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 55p post free.

AMPLIFIER IN CASE WITH SPEAKER

Marketed by British Relay under the name Luxistor. This is in a very neat looking cabinet and is ideal around the home or in the workshop for trouble shooting or for testing out a quick lash up. Size approx. 9½" x 6½" x 3½" deep. Input is via a matching transformer and volume control and amplifier may be powered by an internal 9v battery or an external 110v source. Speaker is an R–A elliptical 6" x 3½" 10,000 gauss. The amplifier proper is a Newmarket model ref. P.C.4. Price £3·85 each, 10 for £31·50. Post and insurance 20p.

EDUCATIONAL KITS—all with pictorial instructions

THIS BALANCE KIT FREE
Eagle educational kits. Japanese made these are excellent value for money. We do not expect to be able to repeat this offer once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give FREE an accurate 11 piece balance kit. Price of kits 44p each post paid. Special price for all 7 kits £3·00 with free balance kit.

KA2 Lens Kit. Eleven parts, including candle one concave lens, one convex lens, stage and slit frame, etc. Watch light rays bend as they pass through different lenses.

KA3 Water Pump Kit. Thirteen parts. Top of pump is transparent so that operating parts may be observed. Small parts are brightly coloured to be seen easily while working. Three types of pump may be made: Lift pump, Force Pump and Force Pump with reservoir and nozzle.

KA4 Buzzer Kit. Eleven parts. Transparent covers allow the operation of buzzer to be seen. Illustrates and teaches how electromagnetism with an automatic switch results in an operating buzzer.

KA7 Electro-Magnet Kit. Fifteen parts, includes compass. Makes two electro-magnets, one with one layer of wire and one with several layers of wire. Picks up tacks, nails and any small parts showing how magnetism works.

KA8 Current and Resistance Kit. Twenty-nine parts, including bench and light bulb. Conduct interesting and educational projects to learn the application of "OHMS LAW" and see the difference in current and resistance with different types and lengths of wire.

KA9 Bell Kit. Eight parts, including bell and push button switch. Build a complete electric bell and see how the hammer is triggered to make the bell ring.

KA10 Morse Key buzzer and bell kit. 25 part kit easy to construct, simple to operate.

TAPE PLAYBACK UNITS

Mains operated. Made by Reditune the famous "music in, background people". These are complete units ready to work. Have a superior motor driven flywheel to control the tape through the capstan and also an even equally useful valve amplifier with EL84 output. In a steel case with carrying handle. Two models offered, good as new £6·50 and somewhat used at £3·50, 75p carriage up to 200 miles then 50p per 100 miles extra. 90 minutes cassettes plain 77p recorded £1.

THYRISTOR LIGHT DIMMER

Domestic model for any lamp up to 250 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price £2·95. Industrial model 5 amp module with control knob £3·30.

PSYCHEDELIC LIGHTING can be yours with our mains motor driven cam switch. 8 cams drive 8 switches slots in cams make and break 10 amp contacts as they rotate. Hundreds of combinations possible to give all sorts of effects. Switches can handle more than 10kW of lighting. £3·85 each plus 20p post and insurance.

I.C. RADIO AQUARIUM THERMOSTAT CONTROLLER

To receive parts for these and other projects featured in this issue send quoted approximate amount any cash adjustment can be made later.

WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts and instructions to make. £2·48.

HORSTMANN 24-HOUR TIME SWITCH

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

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

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact there is no limit to the versatility of this Programmer. Mains operated. Size 3in. × 3in. × 2in. deep. Price £3·85 as illustrated but less case.

STANDARD WAFER SWITCHES

Standard size 1¼" wafer—silver-plated 5-amp contact, standard ¼" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10way	12way
1 pole	44p	44p	44p	44p	44p	44p	44p	44p	44p
2 poles	44p	44p	44p	44p	44p	44p	44p	77p	77p
3 poles	44p	44p	44p	44p	77p	77p	77p	£1·04	£1·04
4 poles	44p	44p	44p	77p	77p	77p	77p	£1·32	£1·32
5 poles	44p	44p	77p	77p	£1·04	£1·04	£1·04	£1·60	£1·60
6 poles	44p	77p	77p	77p	£1·04	£1·04	£1·04	£1·87	£1·87
7 poles	77p	77p	77p	£1·04	£1·32	£1·32	£1·32	£2·15	£2·15
8 poles	77p	77p	77p	£1·04	£1·32	£1·32	£1·32	£2·42	£2·42
9 poles	77p	77p	£1·04	£1·04	£1·60	£1·60	£1·60	£2·70	£2·70
10 poles	77p	77p	£1·04	£1·32	£1·60	£1·60	£1·60	£3·00	£3·00
11 poles	77p	£1·04	£1·04	£1·32	£1·87	£1·87	£1·87	£3·25	£3·25
12 poles	77p	£1·04	£1·04	£1·32	£1·87	£1·87	£1·87	£3·52	£3·52

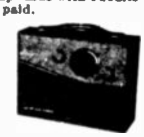
BURGLAR ALARM KIT

Protect your home & family by frightening away the intruder. With our circuit, a mains door bell rings directly the door or window is opened. Kit comprises 10 reed switches, 10 magnets, relay, mains transformer and bell with circuit. Price £7·65.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over £5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only £1 post paid.
DON'T MISS THIS TERRIFIC BARGAIN.

GOOD COMPANION

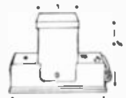


We can now offer these again in i.c. version using Ferranti ZN414 and Mullard AF Modules 1172. Excellent tone wood cabinet. Cabinet size approx. 11in wide × 8in. high × 3in. deep. Complete assembly instructions £5·75 plus 25p post and ins.

MINIATURE SEALED RELAY

American made. Our Ref. No. REL A1. Measures only ½" wide × ½" thick and ½" high and it's a double change over, we don't know the contact rating but estimate this at 3/5 amps. The coil resistance is 600 ohms and 9–12 volt will close it. Ideal for models and miniaturised equipment. It's a plug in relay but we supply complete with base. Price 28p including base.

METAL CHASSIS



14 gauge sheet steel—size approx. 7" × 3½" × 1 3/8" deep. Cadmium plated punched in the centre to take 3 P.O. 3000 type relays. There is also a removeable cover over this section measuring 4½" long × 3½" × 2½". The chassis also has a few holes and could take a small transformer and/or valve holders also some 3/8" holes for controls, pots etc. This is an ideal chassis for making up a relay unit or similar. These are ex-equipment but in excellent condition and may have a few resistors etc. still attached. Price 40p each.

CLOCKWORK TIME SWITCH

For delaying the switching on for up to 12 hours. Being clockwork this is independent of the mains and is therefore useful for remote operation or for battery appliance. The front dial which is calibrated in hours is turned through the required revolution then after pre-set time double pole 15A switch operates. Made by Smiths. Price £1·65.

MAINS TRANSFORMER

Our Ref. MTJ1. Drop through chassis—open construction. 240v Primary—9v 1A Secondary. Price 77p each.

MAINS TRANSFORMER

Our Ref. MTJ2. Parmeko Neptune series. This is a totally enclosed 'C' core construction, upright mounting and black enamelled. For 230/240v Sec. 25–0–25v at 50mA. Ideal for mounting on metal chassis mentioned above. Ex-equipment but unused. 77p each.

3 POST OFFICE TYPE 3000 RELAYS

Ex-equipment but guaranteed perfect—any not so would be changed.
1.—Ref. REL J1. Has 6 sets of change-over contacts and 2000 ohm coil. 55p each.
2.—Ref. REL J2. 2 pairs that close when relay energized and 2000+1000 ohm coil. Price 44p.
3.—Ref. REL J3. 2 pairs contacts that close and 6.4. K ohm coil. 44p.

1 REV. PER MINUTE MOTOR WITH GEAR-BOX

Made by the famous Chamberlain & Hookham Ltd. These could be made to drive clock or similar. Really robust reliable unit. Price 99p each

110 REV. PER MINUTE MOTOR WITH GEAR BOX

Good American make. Operates from mains and will drive switch mechanism or other medium device. Size approx. 4" × 3" × 2¼" with 4" diameter drive shaft. Price £2·20.

12V CAR BLOWERS

Units made by Delco. 6 bladed 5" dia. fan inside heavy duty cylinder. These have really powerful series wound motors giving a terrific air flow suitable for ventilating or heating a car, boat, caravan etc. Price £2·20 plus 40p post and insurance. (Note these are intended for 12V D.C. but can be run from A.C. up to 30V. The higher the voltage the more the air flow.)

13 AMP SWITCHED SOCKETS

By G.E.C. Standard type for fused plugs. Brown bakelite. 17p each or £1·50 for 10.

SPECIAL SUMMER OFFER

Mullard Unilex at Pre V.A.T. price. You want a good stereo system—well here's an offer you should not miss! The four Mullard modules all in original manufacturer's cartons and with original maker's guarantee. £7 the lot. Control unit with name plate and 4 spun aluminium faced control knobs £3. Total £10 post and VAT paid. 2 Goodman's Speakers £3·00.

V.H.F. AMPLIFIERS

With built in mains power pack, these are valve amplifiers, are metal cased and co-ax inputs and outputs. Optimum amplification at T.V. frequency. Useful also for re-building into another unit which needs a mains power pack. Price £2·75.

3 CORE MAROON COTTON COVERED FLEX

Very best makers but old coloured code. 6 amp—23/36 × 100 yd. coil £2 plus 50p. 15 amp—70/36 × 50 yd. coil £3·95 plus 50p post.
Kits of parts available for most previous EE projects send SAE for list.

TERMS:—10% discount if ten of an item ordered, send postage where quoted—other items, post free if order for these over £6·00 otherwise add 20p.

J. BULL (ELECTRICAL) LTD.

(Dept. E.E.), 7 Park Street, Croydon CRO 1YD
Callers to: 102/3 Tamworth Road, CROYDON.

DISCOUNTS UP TO 60%

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WE GUARANTEE THAT WITHIN 7 DAYS OF PURCHASE IF ANY ITEM OF GOODS IS FOUND TO BE GENUINELY DEFECTIVE WE WILL REPLACE THE SAID GOODS WITHOUT QUESTION. AFTER 7 DAYS GOODS ARE COVERED BY MANUFACTURERS 12 MONTHS GUARANTEE

ALL PRICES ARE INCLUSIVE OF V.A.T.

FANTASTIC OFFER
GARRARD SP25 Mk III
Goldring G800. Teak finish, plinth and tinted cover with mains lead and DIN plug and screened lead. All fully wired.
Please add £1·75 for P. & P. & Ins. **£14·75**

TURNTABLES

Please add 95p P. & P. & Ins.

BSR MP60	£9·15
Garrard SP25 Mk III	£9·95
Garrard SL65B	£12·75
Garrard AP76	£16·75
Garrard 401	£22·75
Garrard Zero 100 sgle.	£32·95
Garrard Zero 100 auto.	£36·45
Goldring G185/P&C	£59·35
Goldring G101P P&C	£19·40
Goldring GL72	£21·95
Goldring GL72/P	£28·55
Goldring GL75	£27·40
Goldring GL75P	£33·90
Goldring GL75 Lid	£3·85
Leak Delta	£44·20
Pioneer PL12D	£35·10
Thorens TD125	£58·75
Thorens TD125 AB	£88·95
Thorens TD160 AB&C	£49·30
Wharfedale Linton with cart.	£25·00

TUNERS

Please add 93p P. & P. & Ins.

Alpha Highgate FT 150	£33·30
Amstrad Multiplex 3000	£24·90
Leak Delta FM (Cased)	£47·95
Leak Delta AM/FM	£55·90
Metrosound FMS 20 Mk II	£33·35
Rogers R/brook FET4 (Cha.)	£32·95
Rogers R/brook FET4 (Cased)	£36·50
Rogers R/bourne FET4 (Cased)	£44·95
Sinclair PRO60 Mod.	£14·90
Sinclair cased tuner	£26·15

TUNER/AMPLIFIERS

Please add £1·10 P. & P. & Ins.

Alpha FR 3000	£61·35
Goodmans Module 80	£59·90
Goodmans Mod 80 Com	£107·75
Goodmans Mod 90	£74·65
Goodmans One-Ten	£86·65
Leak Delta 75	£107·75
Rogers R/brook cha.	£62·30
Rotel 150A	£45·90
Rotel 200A	£58·95

AMPLIFIERS

Please add 95p P. & P. & Ins.

Amstrad 8000 Mk II	£16·45
Amstrad IC2000	£28·15
Amstrad Integra 4000	£23·45
Alpha Highgate FA400	£39·05
Global 10+10	£19·75
Global 20+20	£25·20

Leak Delta 30	£49·40
Leak Delta 70	£63·10
Metrosound ST20E Mk II	£32·50
Metrosound ST60	£55·50
Rogers R/brook Ch.	£41·15
Rogers R/brook Ca.	£42·25
Rogers R/bourne Ch.	£54·25
Rogers R/bourne Ca.	£54·95
Sinclair 2000	£24·00
Sinclair 3000	£30·50
Sinclair 605	£21·45
Sinclair PRO 60 2 x Z30/PZ5	£16·40
Sinclair PRO 60 2 x Z30/PZ6	£19·45
Sinclair PRO 60 2 x Z50/PZ8 Trans.	£25·25
Sinclair AFU (Filter Unit)	£4·95
Sinclair Stereo 60 Pre-amp	£7·35
Sinclair IC 12 (Int. Circ.)	£2·20
Sinclair Z30 Amp.	£3·85
Sinclair Z50 Amp.	£4·50
Sinclair PZ5 Power Supp.	£4·20
Sinclair PZ6 Power Supp.	£6·15
Sinclair PZ8 Mains Trans.	£4·95
Sinclair PZ8 Power Supp.	£6·15

SPEAKERS

£1·65 for P. & P. (per pair)

Amstrad Acoustra 1500	£27·95
Amstrad Acoustra 2500	£31·95
Apollo 138	£14·05
B&W DM.S	£41·65
Celestion Ditton 15	£46·05
Celestion Ditton 44	£74·90
Goodmans D/Maxim	£39·70
Goodmans Mezzo 3	£49·70
Goodmans Havant	£34·45
Keletron LS 100	£18·95
Leak 150	£32·75
Sinclair Q16	£10·95
Sinclair Q30	£30·60
Wharfedale Denton II	£27·45

SPEAKER UNITS

Wharfedale Unit 3	£16·30
Wharfedale Unit 4	£28·70
Goodmans Din 20 Kit	£14·75

PLINTH & COVERS

£3·02*

For Garrard SP 25, 2025 TC, 3000, BSR McDonald MP60 £3·08, P. & P. 71p.
For AP76, SL72B, SL95B, etc. £4·51, + 71p P. & P.

CARTRIDGES

Please add 11p P. & P. & Ins.

Goldring G850	£2·85
Goldring G800	£3·70
Goldring G800E	£6·45
Goldring G800SE	£12·15
Shure M3D	£3·10
Shure M44E	£4·40
Shure M55E	£5·00
Shure 75ED Type 2	£9·35
Shure V15	£25·95
Shure M75EJ Type 2	£8·10

All prices correct at time of press E. & O. E. and are subject to alterations.

GLOBAL AUDIO DISCOUNT WAREHOUSES

Dept. (EE9), 174 Pentonville Road, London N.1. Tel. 01-278 1769
Or 4 High View Parade, Redbridge Lane East, Woodford Avenue Ilford, Essex. Tel. 01-550 1086

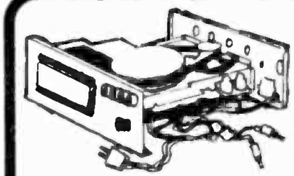
Open Monday to Saturday 9.30 a.m. to 6 p.m. LATE NIGHT FRIDAY 7 p.m.

MAIL ORDERS: Order with confidence. Send Postal Order, Cheque, Money Order, Bank Draft, Giro or Cash by Registered Mail. **CALLERS:** Please note that cheques can only be accepted together with cheque cards (not Barclay Card).

2 minutes from KING'S CROSS, EUSTON & ST PANCRAS on main road leading to the East and West Country

BI-PRE-PAK

AUDIO BARGAINS



8 TRACK ONLY £11

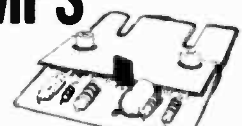
incl. P. & P. and VAT

The latest **B.S.R. 8 Track cartridge Replay Deck. Ready to install in your Hi-Fi Stereo System.**
This unit comes complete with Hi Gain Stereo Pre-Amplifier, 4-Programme Indicator Lamps, Track Selector Switch, all leads and plugs, etc. for 230 volt A.C. mains operation.

5W & 10W AMPS

5W ONLY £1.98
10W ONLY £2.49

incl. P. & P. and V.A.T.

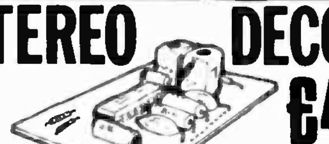


Specification:—	5 Watt	10 Watt
Nominal Volts	12–14V	25–30V
Into 3 Ohms	5W	10W
Into 8 Ohms	2W	10W
Into 15 Ohms	1W	5W
Typical Distortion	·5%	·5%
Freq. response at 3dB	10Hz to 30KHz	10Hz to 30KHz
Sensitivity (Typically)	20mV	20mV
Full power consumption (30 Ohms)	650mA	580mA
Size	2¼" x 1¾"	2¼" x 1¾"

The 5W matchbox sized amplifier will run satisfactorily from a 12V car battery. Can also be used for portable voice reinforcement such as public functions where mains supply is not accessible. A small mains unit kit is available.
Two amplifiers are ideal for Stereo. Complete connection details and treble, bass, volume and balance control circuit diagrams are supplied with each unit.
Discounts are available for quantity orders.

Cheapest in the U.K. Built and tested

STEREO DECODER £4.95



Incl. P. & P. and VAT

A ready built unit, ready for connection to the I.F. stages of your existing FM Radio or Tuner. A tell tale light can be connected to show the presence of a Stereo transmission and correct operation.
The Unit is in the form of a small printed circuit, and no further alignment is necessary, as all preset adjustments have already been carried out at the factory.
It is recommended that a L.E.D. is used as the indicating light and a suitable device is available from us at 36½p.
Supplied with all necessary instructions.

I enclose £.......... for .... 8 Tracks/.......... 5W Amps./..........10W Amps./.......... Decoders (Please insert quantities and delete those not applicable.)

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2N3055 npn silicon power 60p
AC153K pnp germanium low power 32p
AC176K npn germanium low power 32p
AD161 npn germanium medium power 42p
AD162 pnp germanium medium power 40p
AF139 pnp germanium UHF 49p
BC 107 13p; BC108 12p; BC109 13p; BC167 11p; BC168 10p; BC169 11p } npn
BC177 21p; BC178 19p; BC179 21p; BC257 12p; BC258 11p; BC259 13p } pnp
Standard groupings available.
BD135 npn med power 37p
BD136 pnp med power 38p

DIODES
OA90, OA91, OA95 each 6p
OA200 9p; OA202 10p

Other semiconductors
AC128 17p; AF117 32p
BFY51 19p

Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

SIEMENS THYRISTORS

0·8A 400V 56p, 600V 70p
3A 400V 60p, 600V 88p

ZENER DIODES full range E24 values: 400mW: 2·7V to 36V, 14p each; 1W: 6·8V to 82V, 21p each; 1·5W: 4·7V to 75V, 48p each. Clip to increase 1·5W rating to 3 watts (type 266F) 4p.

DIN PLUGS & SOCKETS

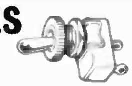
by Hirshmann, 4A rating

2 way L8—socket 10p; plug 12p. 3 way scr. socket 10p; plug 12p. 5 way scr. socket 12p; plug 15p.

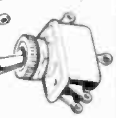
TRANSISTOR ACCESSORIES

To3 cover 7p
Heat sinks 1°C/w, type 6W1, undrilled 60p Drilled 78p.

SWITCHES



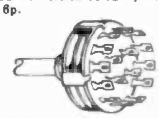
1011C SPST toggle 20p;
409 DPDT toggle 29p. (These are chrome plated 2·5A rating)
7201 Sub-miniature DPDT 250V a.c/2A 48p



ROTARY SWITCHES

Radiospares Miniature Maka-switch (in assembly kit form) Shaft 48p.
Wafers, MBB-2P5W, 1P11W; BBM-1P12W, 2P6W, 3P4W, 4P3W, 6P2W, each, 6p.

WAVECHANGE SWITCHES



1P12W, 2P6W, 3P4W, 4P3W, each 24p

TOGGLE SWITCHES

Chrome plated, 2·5A 1011C SPST 19p; 409 DPDT 28p. Sub-miniature DPDT 250V a.c./2A 48p.

ELECTROLYTIC CAPACITORS

AXIAL LEAD Prices subject to amendment by the manufacturer.

Rated voltage: Capacity µF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47							10p	7p
1·0						10p		7p
2·2					10p		7p	8p
4·7				10p		7p	8p	7p
10					7p	8p	7p	8p
22			7p	7p		7p	7p	9p
47	7p		8p	7p	8p	7p	9p	12p
100	8p	7p	7p	7p	7p	9p	11p	19p
220	7p	8p	8p	8p	9p	10p	17p	27p
470	8p	9p	9p	10p	12p	17p	24p	43p
1000	10p	12p	12p	17p	20p	24p	40p	
2200	14p	17p	22p	25p	36p	40p		
4700	25p	28p	37p	41p	54p			
10,000	40p	43p						

Polycarbonate —5% Tolerance

250V up to 0·1µF: 100V/0·1µF and above.
0·01; 0·012; 0·015; 0·018; 0·022; 0·027; 0·033; 0·047; 0·056; each 4p.
0·068; 0·082; 0·1; 0·12; 0·15 each 4p.
0·18; 0·22; each 5p.
0·27; 0·33; 6p. 0·39 7p. 0·47 8p. 0·56 10p. 0·68 11p. 1µF 13p.
Prices subject to amendment by the manufacturer.

SILVERED MICA non-polarised capacitors in 34 values from 2·2 pF to 680 pF, each 6p

RESISTORS 10%, 5%, 2%

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82 Ω-220K Ω	E12	9	8	7·5
C	1/8W	5%	4·7 Ω-470K Ω	E24	1	0·9	0·75 nett
C	1/4W	5%	4·7 Ω-10M Ω	E12	1	0·9	0·75 nett
C	1/2W	5%	4·7 Ω-10M Ω	E24	1·2	1	0·9 nett
C	1W	5%	4·7 Ω-10M Ω	E12	2·5	2	1·6 nett
MO	1/2W	2%	10 Ω-1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0·22 Ω-3·9 Ω	E12	7	7	6
WW	3W	5%	1 Ω-10K Ω	E12	7	7	6
WW	7W	5%	1 Ω-10K Ω	E12	9	9	8

Codes: C—carbon film, high stability, low noise.
MO—metal oxide, Electrosil TR5, ultra low noise.
WW—wire wound, Plessey.

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

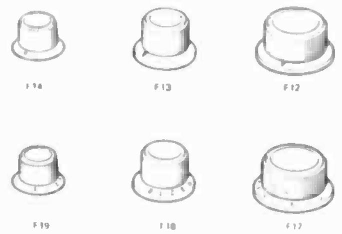
Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order).

★ Please remember to add V.A.T. to your order.

If you have already got your No. 6 catalogue and want to know latest additional items and price amendments, send S.A.E. for special supplementary list.

KNOBS

All grub screw fitting for ¼" shafts. Black. For other types—see Catalogue No. 6, P.54

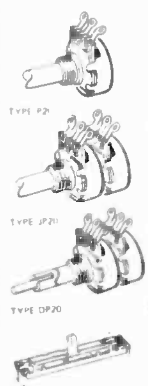


F.14 (20mm) pack of 2 32p
F.13 (26mm) pack of 2 38p
F.12 (33mm) pack of 2 40p
F.19 (20mm) pack of 2 32p
F.18 (26mm) pack of 2 38p
F.17 (38mm) pack of 2 40p
KB.4 (20mm) pack of 4 40p
K.30/3 (17mm) aluminium, each 24p

BAXANDALL SPEAKER KIT

Designed by P. J. Baxandall, of tone control circuit fame, and as described originally in *Wireless World*, this brilliantly designed economy speaker is simple to assemble and provides genuine hi-fi reproduction Handles 10 watt RMS. 15 ohms input. Complete kit including pack-flat cabinet 18" × 12" × 10" £14·90, plus 60p part cost of carr. Equaliser assembly £2·00. Loudspeaker Unit 59RM109 £2·45. Cabinet (to Baxandall design) £10·45

POTENTIOMETERS



Rotary carbon track, double wiper
SINGLE P20 lin 100 Ω to 2·2M Ω 12p, P20 log 4·7K Ω to 2·2 meg. 12p
JP20 Log. 4·7K Ω to 2·2M Ω 12p. Dual gang lin 4·7K Ω to 2·2m Ω, 42p; Dual log. 4·7K Ω to 2·2m Ω 42p; Log/antilog, 10K, 22K, 47K, 1M Ω only 42p; Dual antilog, 10K only, 42p. Any of above types with 2A D.P. mains switch, 12p extra.
Only decades of 10, 22 & 47 available in ranges quoted.

DUAL CONCENTRIC DP20 in any combination of P20 values, 60p; with switch, 72p.

SLIDER
Lin or log. 10K to 1meg. in all popular values, each 26p.
Escutcheons—White, grey, black, 10p each.
Control knobs: blk/white/red/yel/gr./blue/dk. grey/lt. grey, each 5p.

CARBON SKELETON PRE-SETS
Small high quality, PR lin: 100 Ω 220 Ω, 470 Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10M Ω. Vertical or horizontal mounting, 5p each.

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PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0·63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
600	0·59	0·63	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·06	0·06	0·08	0·16	0·23	0·66
100	0·04	0·07	0·06	0·15	0·18	0·26	0·83
200	0·06	0·10	0·07	0·16	0·22	0·27	1·10
400	0·07	0·15	0·08	0·22	0·30	0·41	1·38
600	0·08	0·18	0·11	0·26	0·38	0·50	2·05
800	0·11	0·19	0·12	0·28	0·41	0·61	2·20
1000	0·12	0·28	0·16	0·33	0·51	0·70	2·75
1200	—	0·37	—	0·42	0·63	0·83	—

TRIACS

VBOM	2A TO-5	6A TO-66	10A TO-48
	£p	£p	£p
100	33	55	83
200	55	66	99
400	77	82½	1·21

DIACS

FOR USE WITH TRIACS
BR100 (D32) 41p each

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BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed

Pak No.		EQVT
T1	8 2G3713	OC71
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T6	8 2G344B	OC44
T7	8 2G345B	OC45
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T9	8 2G399A	2N1302
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All 55p each pak

D1699 NPN SILICON DUAL TRANSISTOR

(Similar to 2N2060)

1	25	100+
0·28	0·26	0·23

ND 120 NIXIE DRIVER TRANSISTOR.

Suitable replacement for BSX 21, C 407, 2N 1893 120veb.

1	25	100+
0·19	0·17	0·16

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5½p each. Any Qty.

GP 100 TO3 METAL CASE GERMANIUM

Vebo = 80V. Vceo = 50V. I.C. = 10 amps. Ptot = 30W. hfe = 30–170. Replaces the majority of Germanium power transistors in the OC, AD and NKT range.

1	25	100+
0·48	0·44	0·40

GP 300 TO3 METAL CASE SILICON

Vebo = 100V. Vceo = 60V I.C. = 15 amps. Ptot = 115W. hfe = 20. 100fT. = 1MHz. Suitable replacement for 2N 3055, BDY 11 or BDY 20.

1	25	100+
0·55	0·53	0·51

FULL RANGE OF ZENER DIODES VOLTAGE RANGE

2-33V. 400mV (DO-7 Case) 15p ea. 1½W (Top-Hat) 20p ea. 10W (SO-10 Stud) 33p ea.

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 99p each

2 Amp. BRIDGE RECTS.

50 v	RMS	35p each
100 v	RMS	41p ..
400 v	RMS	51p ..

Size 16 mm × 16 mm.

UT 46 UNIJUNCTION TRANSISTORS

Direct replacement for T18 43rand BEN 3000 also electrically equivalent to 2N2646

1	25	100+
0·30	0·28	0·22

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ORP12 48p
ORP60, ORP61 44p each

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8. BSY-27/28/95A.

All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p
20	For	0·55
50	For	1·10
100	For	1·92
500	For	8·25
1000	For	14·30

SIL. G.P. DIODES £p

300mW	30	0·55
40PIV(Min.)	100	1·65
Sub-Min.	500	5·50
Full Tested	1,000	9·90

Ideal for Organ Builders.

R 2400 TO3 NPN SILICON HIGH VOLTAGE

Vebo = 250V. Vceo = 100V. I.C. = 6 amps. Ptot = 30W. hfe = typ.20 fT = 5MHz.

1	25	100+
0·55	0·50	0·44

2N3055

115 WATT SIL POWER NPN 55p EACH

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U14	150	Mixed Silicon and Germanium Diodes	0·55
U15	25	NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·55
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·55
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·55
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·55
U19	25	Silicon NPN Transistors like BC108	0·55
U20	12	1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·55
U21	30	AF. Germanium Alloy Transistors 2G300 Series & OC71	0·55
U23	30	MADT's like MHz Series PNP Transistors	0·55
U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·55
U25	25	300 MHz NPN Silicon Transistors 2N708, BSY27	0·55
U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·55
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·55
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·10
U30	15	Plastic Silicon Planar Trans. NPN 2N2926	0·55
U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·55
U32	25	Zener Diodes 400mW DO-7 case 3-18 volts mixed	0·55
U33	15	Plastic Case 1 Amp Silicon Rectifiers 1N4000 Series	0·55
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	0·55
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·55
U36	25	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·55
U37	30	Silicon Alloy Transistors SO-2 PNP OC200, 2S322	0·55
U38	20	Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·55
U39	30	RF. Germ. PNP Transistors 2N1303/5 TO-5	0·55
U40	10	Dual Transistors 6 lead TO-5 2N2060	0·55
U41	25	RF Germanium Transistors TO-1, OC45, NKT72	0·55
U42	10	VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·55
U43	25	Sil. Trans. Plastic TO-18 A.F. BC113/114	0·55
U44	20	Sil. Trans. Plastic TO-5 BC115/116	0·55
U45	7	3A SCR. TO66 up to 600PIV	1·10

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

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TO-18 Lens end NPN Sim. to BP×25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100 up
Price each	49p	44p	38p

F.E.T.'S

2N3819	31p	2N5458	35p
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2N3823	31p	MPF105	41p

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Q7	4	AC 128 transistors PNP high gain	0·55
Q8	4	AC 126 transistors PNP	0·55
Q9	7	OC 81 type transistors	0·55
Q10	7	OC 71 type transistors	0·55
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·55
Q12	3	AF 116 type transistors	0·55
Q13	3	AF 117 type transistors	0·55
Q14	3	OC 171 H.F. type transistors	0·55
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Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·55
Q20	4	OC 44 Germanium transistors A.F.	0·55
Q21	4	AC 127 NPN Germanium transistors	0·55
Q22	20	NKT transistors A.F. R.F. coded	0·55
Q23	10	OA 202 Silicon diodes sub-min.	0·55
Q24	8	OA 81 diodes	0·55
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·55
Q26	8	OA95 Germanium diodes sub-min 1N69	0·55
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Q28	2	Silicon power rectifiers BYZ 13	0·55
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·55
Q30	7	Silicon switch transistors 2N706 NPN	0·55
Q31	6	Silicon switch transistors 2N708 NPN	0·55
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·55
Q33	3	Silicon NPN transistors 2N1711	0·55
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·55
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·55
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·55
Q37	3	2N3053 NPN Silicon transistors	0·55
Q38	7	NPN transistors 4 × 2N3703, 3 × 2N3702	0·55

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The MK Slide Rule, designed to simplify Electronic calculations features the following scales:— Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and 'e' Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 22 cm × 4cm. Complete with case and instructions. Price each: £3·69

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

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00	12 × 7400	0·55	UIC46	5 × 7446	0·55	UIC86	5 × 7486	0·55
UIC01	12 × 7401	0·55	UIC47	5 × 7447	0·55	UIC90	5 × 7490	0·55
UIC02	12 × 7402	0·55	UIC48	5 × 7448	0·55	UIC91	5 × 7491	0·55
UIC03	12 × 7403	0·55	UIC50	12 × 7450	0·55	UIC92	5 × 7492	0·55
UIC04	12 × 7404	0·55	UIC51	12 × 7451	0·55	UIC93	5 × 7493	0·55
UIC05	12 × 7405	0·55	UIC53	12 × 7453	0·55	UIC94	5 × 7494	0·55
UIC06	8 × 7406	0·55	UIC54	12 × 7454	0·55	UIC95	5 × 7495	0·55
UIC07	8 × 7407	0·55	UIC60	12 × 7460	0·55	UIC96	5 × 7496	0·55
UIC10	12 × 7410	0·55	UIC70	8 × 7470	0·55	UIC100	5 × 74100	0·55
UIC13	8 × 7413	0·55	UIC72	8 × 7472	0·55	UIC121	5 × 74121	0·55
UIC20	12 × 7420	0·55	UIC73	8 × 7473	0·55	UIC141	5 × 74141	0·55
UIC30	12 × 7430	0·55	UIC74	8 × 7474	0·55	UIC151	5 × 74151	0·55
UIC40	12 × 7440	0·55	UIC75	8 × 7475	0·55	UIC154	5 × 74154	0·55
UIC41	5 × 7441	0·55	UIC76	8 × 7476	0·55	UIC193	5 × 74193	0·55
UIC42	5 × 7442	0·55	UIC80	5 × 7480	0·55	UIC199	5 × 74199	0·55
UIC43	5 × 7443	0·55	UIC81	5 × 7481	0·55			
UIC44	5 × 7444	0·55	UIC82	5 × 7482	0·55	UICX1	25 Assorted 74's	1·65
UIC45	5 × 7445	0·55	UIC83	5 × 7483	0·55			

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

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	1	25	100+		1	25	100+		1	25	100+
SN7400	0·17	0·16	0·13	SN7450	0·17	0·16	0·13	SN74141	0·74	0·71	0·64
SN7401	0·17	0·16	0·13	SN7451	0·17	0·16	0·13	SN74145	£1·65	£1·54	£1·43
SN7402	0·17	0·16	0·13	SN7453	0·17	0·16	0·13	SN74150	£3·30	£2·97	£2·75
SN7403	0·17	0·16	0·13	SN7454	0·17	0·16	0·13	SN74151	£1·10	£1·05	0·99
SN7404	0·17	0·16	0·13	SN7460	0·17	0·16	0·13	SN74153	£1·32	£1·21	£1·05
SN7405	0·17	0·16	0·13	SN7470	0·32	0·29	0·27	SN74154	£1·98	£1·87	£1·76
SN7406	0·39	0·34	0·31	SN7472	0·32	0·29	0·27	SN74155	£1·54	£1·43	£1·32
SN7407	0·39	0·34	0·31	SN7473	0·41	0·39	0·35	SN74156	£1·54	£1·43	£1·32
SN7408	0·20	0·19	0·18	SN7474	0·41	0·39	0·35	SN74157	£2·09	£1·98	£1·87
SN7409	0·20	0·19	0·18	SN7475	0·50	0·48	0·46	SN74160	£1·98	£1·87	£1·76
SN7410	0·17	0·16	0·18	SN7476	0·44	0·43	0·42	SN74161	£1·98	£1·87	£1·76
SN7411	0·28	0·27	0·26	SN7480	0·74	0·71	0·64	SN74162	£4·40	£4·13	£3·85
SN7412	0·39	0·34	0·31	SN7481	£1·32	£1·27	£1·21	SN74163	£4·40	£4·13	£3·85
SN7413	0·32	0·29	0·27	SN7482	0·96	0·95	0·94	SN74164	£2·43	£2·37	£2·31
SN7416	0·48	0·44	0·42	SN7483	£1·21	£1·16	£1·05	SN74165	£2·48	£2·42	£2·37
SN7417	0·48	0·44	0·42	SN7484	£1·10	£1·05	0·99	SN74166	£3·85	£3·58	£3·30
SN7420	0·17	0·16	0·13	SN7485	£3·96	£3·85	£3·74	SN74174	£2·53	£2·42	£2·31
SN7422	0·55	0·53	0·50	SN7486	0·35	0·34	0·33	SN74175	£1·76	£1·65	£1·54
SN7423	0·55	0·53	0·50	SN7489	£6·05	£5·78	£5·50	SN74176	£2·75	£2·64	£2·53
SN7425	0·55	0·53	0·50	SN7490	0·74	0·71	0·64	SN74177	£2·75	£2·64	£2·53
SN7426	0·50	0·46	0·44	SN7491	£1·10	£1·05	0·99	SN74180	£2·20	£1·76	£1·54
SN7427	0·50	0·46	0·44	SN7492	0·74	0·71	0·64	SN74181	£6·05	£5·50	£5·23
SN7428	0·77	0·72	0·66	SN7493	0·74	0·71	0·64	SN74182	£2·20	£1·98	£1·76
SN7430	0·17	0·16	0·13	SN7494	0·85	0·82	0·75	SN74184	£3·85	£3·58	£3·30
SN7432	0·50	0·46	0·44	SN7495	0·85	0·82	0·75	SN74190	£2·15	£2·09	£2·04
SN7433	0·88	0·83	0·77	SN7496	0·96	0·93	0·86	SN74191	£2·09	£2·04	£1·98
SN7437	0·71	0·68	0·66	SN74100	£1·82	£1·76	£1·71	SN74192	£2·15	£2·09	£2·04
SN7438	0·71	0·68	0·66	SN74104	£1·07	£1·04	0·97	SN74193	£2·20	£1·98	£1·93
SN7440	0·17	0·16	0·13	SN74105	£1·07	£1·04	0·97	SN74194	£2·97	£2·86	£2·75
SN7441	0·74	0·71	0·64	SN74107	0·44	0·42	0·40	SN74195	£2·20	£2·09	£1·98
SN7442	0·74	0·71	0·64	SN74110	0·61	0·59	0·55	SN74196	£1·98	£1·87	£1·76
SN7443	£1·43	£1·38	£1·32	SN74111	£1·38	£1·27	£1·21	SN74197	£1·98	£1·87	£1·76
SN7444	£1·43	£1·38	£1·32	SN74118	£1·10	£1·05	0·99	SN74198	£6·05	£5·50	£4·95
SN7445	£1·98	£1·95	£1·93	SN74119	£1·49	£1·38	£1·21	SN74199	£6·05	£5·50	£4·95
SN7446	£1·07	£1·04	0·97	SN74121	0·44	0·41	0·38	3 Terminal Pos Volt Reg. TO.3			
SN7447	£1·10	£1·07	£1·05	SN74122	£1·64	£1·43	£1·21	Plastic O/P 1.5 Amps. μA7805			
SN7448	£1·10	£1·07	£1·05	SN74123	£3·08	£2·97	£2·86	5V. & μA7812 12V. £1·76 each			

LINEAR I.C's—FULL SPEC.

Type No.	Price 1–24	25–99	100 up
BP 201C—SL201C	70p	59p	50p
BP701C—SL701C	70p	55p	50p
BP 702C—SL702C	70p	55p	50p
BP 702—72702	59p	50p	44p
BP709—72709	40p	38p	33p
BP 709P—μA709C	40p	38p	33p
BP 710—72710	50p	46p	44p
BP 711—μA711	50p	48p	44p
BP 741—72741	55p	50p	45p
μA703C	31p	29p	27p
TAA 263	77p	66p	61p
TAA 293	99p	83p	77p
TAA 350	£1·87p	£1·74p	£1·65p

S.G.S. EA1000 £2·90p

ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C's

Type No.	Price 1	25	100+
BP930	13p	12p	11p
BP932	14p	13p	12p
BP933	14p	13p	12p
BP935	14p	13p	12p
BP936	14p	13p	12p
BP944	14p	13p	12p
BP945	28p	27p	24p
BP946	13p	12p	11p
BP948	28p	27p	24p
BP951	72p	66p	61p
BP962	13p	12p	11p
BP9093	44p	42p	39p
BP9094	44p	42p	39p
BP9097	44p	42p	39p
BP9099	44p	42p	39p

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

NUMERICAL INDICATOR TUBES

MODEL	CD66	OR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1·87	£1·70	£1·50

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

RTL MICROLOGIC CIRCUITS

Epoxy TO·5 case	Price each 1–24	25–99	100 up
uL900 Buffer	38p	36p	29p
uL914 Dual 2I/p gate	38p	36p	29p
uL923 J-K flip-flop	55p	51p	49p

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

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	33p	30p	28p
TSO 16 „ „	39p	35p	33p
LOW COST No.			
BPS 14	17p	15p	12p
BPS 16	18p	16p	13p

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50W pk 25w (RMS)

0·1% DISTORTION!
HI-FI AUDIO AMPLIFIER

THE AL50

★ Frequency Response 15Hz to 100,000—1dB.

★ Load—3, 4, 8 or 16 ohms.

★ Distortion—better than ·1% at 1KHz.

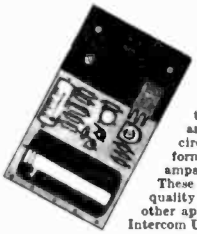
★ Signal to noise ratio 80dB.

ONLY **£3.58p each**

★ Supply voltage 10–35 Volts.

★ Overall size 63mm × 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.F. amplification needs.
FULLY BUILT — TESTED — GUARANTEED.



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	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
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.

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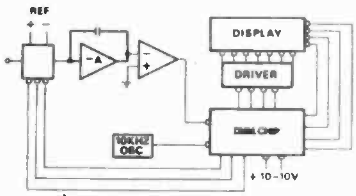
device of the month D.V.M. chip



3½ DECADE DIGITAL METER

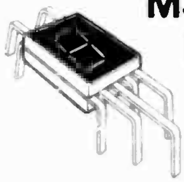
Now you can construct your own D.V.M. with this new G.I. Microelectronics chip – a single MOS LSI chip containing all the logic necessary for a 3½ Decade Digital Voltmeter utilising Dual Ramp integration. Just look at some of these features:

- 3½ Decade Display (± 1999 max. reading)
- Automatic Polarity Detection
- Overrange Indication
- Chopper Output Provided
- Up to 50 readings per second
- 16 lead DIL package
- Full G.I. Microelectronics warranty

complete D.V.M. logic for just £7·90 + VAT

including application notes

Compatible device 'M3' 7 segment LED display



Also from Monsanto this display is ideal for use with D.V.M. chip.

- 0.125" characters
- Displays all numbers plus nine letters
- Full specification included
- Application notes for this unit are included in the specification on the D.V.M. chip – they are available separately, however, price: 25p.

a superb 7 segment LED display for just £2·70 + VAT

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Pack 107 5 pin Din	22p
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Pack 100 Phono Plug	7p
Pack 230 3 pin Socket	25p
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READY MADE LEADS

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Speaker lead Din to spade 12ft.	40p
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All leads approx. 6ft. in length.

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(Send SAE for complete list) 8TA; 9TA; 9TAHC; GP91; ST4; ST9; EV26; GC8
All at 80p each.
Double Diamond £1·25.
Diamond suitable for Orbit NM22; G800; M3D £2·25 each.

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Prices inc VAT and Post.

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Audio-Magnetics C60

3	6	10	20
£1·00	£1·90	£3·20	£6·30

Cassette Caddy £1·20
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5" Standard 600ft	25p
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Sennheisser MD413N	£27·00
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E.M.I. 450 Kit 8 ohms	£4·50

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Goldring G800	£6·00
Orbit NM22	£4·00
Shure 75/6	£6·00
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New Versions using 3A 'Plastic Power' Driver Transistors Now Available. To meet demand, we have included a more powerful module in our well-established and proven range. These power amplifiers are carefully assembled, tested and guaranteed. They offer superb value for reliability and versatility.

SA35 35 watts RMS. Uses 7 transistors and 7 diodes Carr. paid. **£4·45**

A NEW ADDITION IS THE

SA50 at £5·65

Carr. paid. A rugged, well built unit, capable of 50 watts R.M.S. out, with all the advantages of Saxon Amplifier design and quality. Ready now.

SA100 makes an ideal unit in disco assemblies. A real glutton for work. **£10·90**
Reliable, tough and compact. 11 transistors, 6 diodes. Carr. paid.

BRIEF SPEC. FOR ALL THREE MODULES

All modules incorporate OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in the SA.100.

Freq. response	15–40,000 Hz ± 1dB
Distortion	0·2% at 1 kHz
Loads	4 to 16 ohms
Quiescent current	15 mA
Noise	Better than −75 dB
Supply voltage	SA35 25-45 volts SA50/SA100 40-70 volts
Size	4½" x 4" x 1" (SA100) 4" x 3" x 1" (SA35/SA50)

Circuits, connecting instruction and application data are supplied free with all modules.

POWER SUPPLIES FOR THE SA25/35 & SA100 AUDIO MODULES

PU45	Unstabilized supply for 2 SA25/35	£4·90
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MT30	Transformer for unstabilized supply complete with rectifier diodes mounted	£3·50 carr. 20p
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ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD AND SUPPLIED FULLY TESTED

TWO NEW PA/MIXER CONTROL UNITS

Using grouped pairs of inputs and outputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master control. These low-noise units will feed all makes of amplifiers, making them ideal for clubs, discos etc. Standard jack sockets. Compact design. In strong metal cases. All units guaranteed for 3 years.

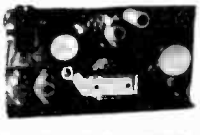
- **M.4H** 4 high Z, 4 low Z inputs, 4 sets of controls. Case 14" x 8" x 2½" Carr. pd. **£18·50** + V.A.T.
- **M.6HL** Case 18" x 8" x 2½" 12 inputs (6 high Z, 6 low Z). Carr. pd. **£27·50** + V.A.T.
- Channel section modules, for building your own mixer. Gain—16 x (24dB). Tone controls—18dB swing. Carr. pd. £3·50 + V.A.T.

SAXON CONTROL UNITS

Mono (as shown) Carr. 20p. **£6·50**
Stereo. Carr. 30p. **£15·80**

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½" x 3" x 4" deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass, treble, mains on/off.
COMPARABLE TO UNITS AT OVER TWICE THE PRICE. (N.B.—Stereo only has mic input.)

120 WATT HEAVY DUTY MODULE



Rugged class A driver stage, this module will run from all our mixers, etc., and most other makes. Delivers 120 watts into an eight ohm load and employs 4 T03 can (115 watt) output transistors. These are the modules where extra power is demanded.

Power output	120 watts into 8 ohms
Freq. response	20-20,000 HZ ± 2dB
Input sensitivity	200 mV into 10K
Construction	Fibreglass board
Size	8" x 4" x 4" (5" with supply)

Low distortion parallel push-pull output stage.

Module only (Carr. 20p) **£13·90**
Module & power supply (Carr. 40p) **£18·95**
160 watt version with power supply (Carr. 50p) ~~£27·90~~ **£27·50**

SOUND AND LIGHT UNITS

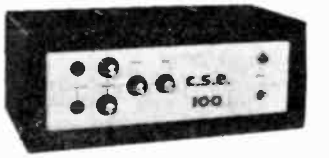
Our popular 3 channel model handles up to 3KW (3000 watts) of lighting and incorporates versatile sound control arrangement to enable professional standards to be achieved. Both units are excellent examples of Saxon quality and value.

3 CHANNEL UNIT
Includes bass, middle and treble as well as master controls. 2 amplifier sockets eliminate need for split leads. Up to 3KW lighting load. Smartly finished steel case. Carr. 30p. **£19·75**

SINGLE CHANNEL UNIT
Operates from 5 to 100 watt amplifiers. Supplied for bass note operation. Is easily adapted for treble or mid-range at a cost of about 5p. Carr. pd. **£8·90**

COMPLETE AMPLIFIERS

CSE 100. £34·90 carr. free
This versatile unit is now available in a black vynide case and so represents even better value than ever delivering speech and music powers of up to 100 watts RMS and continuous signal outputs of 70 watts. Two individually controlled inputs with wide range bass and treble controls.



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The Sinclair Cambridge... no other calculator is so powerful and so compact.

Complete kit-£29·95! (INC.VAT)

The Cambridge – new from Sinclair
The Cambridge is a new electronic calculator from Sinclair, Europe's largest calculator manufacturer. It offers the power to handle the most complex calculations, in a compact, reliable package. No other calculator can approach the specification below at anything like the price – and by building it yourself you can save a further £14!

Truly pocket-sized
With all its calculating capability, the Cambridge still measures just $4\frac{1}{2}'' \times 2'' \times \frac{11}{16}''$. That means you can carry the Cambridge wherever you go without inconvenience – it fits in your pocket with barely a bulge. It runs on ordinary U16 batteries which give weeks of life before replacement.

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

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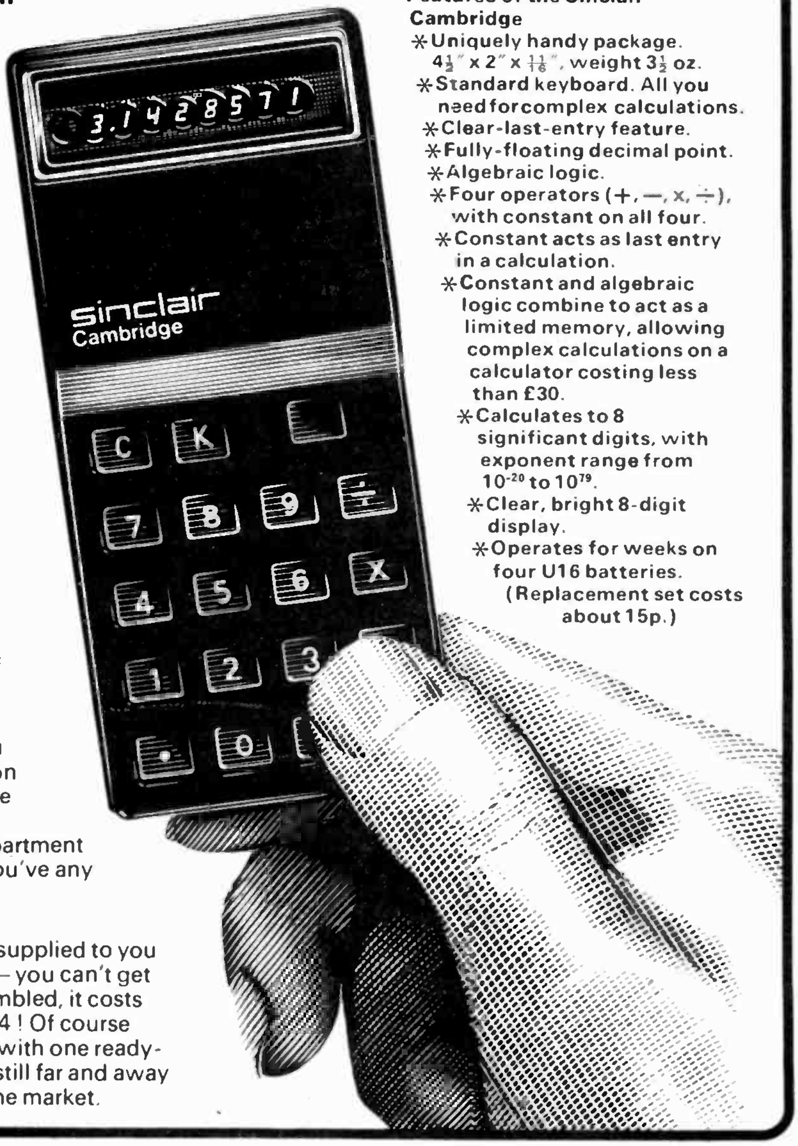
The Sinclair Cambridge kit is supplied to you direct from the manufacturer – you can't get it anywhere else. Ready assembled, it costs £43·95 – so you're saving £14! Of course we'll be happy to supply you with one ready-assembled if you prefer – it's still far and away the best calculator value on the market.



Features of the Sinclair Cambridge
- Uniquely handy package. $4\frac{1}{2}'' \times 2'' \times \frac{11}{16}''$, weight $3\frac{1}{2}$ oz.
- Standard keyboard. All you need for complex calculations.
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- Fully-floating decimal point.
- Algebraic logic.
- Four operators (+, −, x, ÷), with constant on all four.
- Constant acts as last entry in a calculation.
- Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £30.
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Assembly time is about 3 hours.

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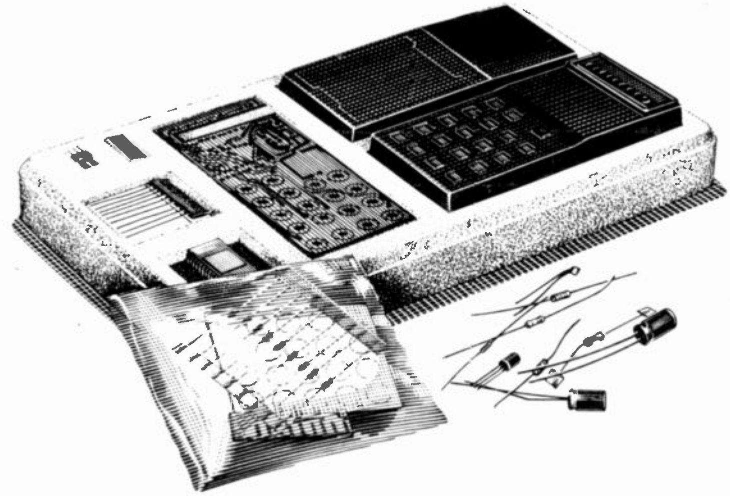
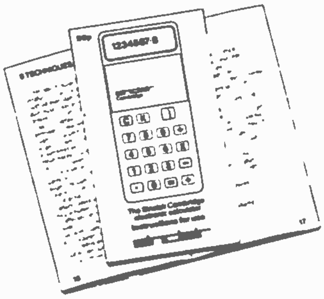
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



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 like:

Logs	Sines	Cosines
Tangents	Reciprocals	nth roots
Currency conversion	Compound interest	

and many others...

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St Ives, Huntingdonshire
Reg. no: 699483 England
VAT Reg. no. 213 8170 88

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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.

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everyday electronics

PROJECTS...
THEORY......

INTEGRATED CIRCUITS

There is a remarkable and noteworthy contradiction in present day electronics. While circuit designs are tending to increase in complexity and in variety of functions offered, in terms of actual hardware electronic equipments are tending to become less complicated and consequently simpler to build.

The explanation to this apparent paradox is to be found in the integrated circuit. This is a small component hardly larger than a conventional transistor, but containing a complete circuit arrangement incorporating a number of semiconductor devices as well as other circuit elements. As constructors, we don't really have to concern ourselves with the internal details of these remarkable devices. It is sufficient for many purposes to consider the integrated circuit (i.c.) as just another component, or as a "black box".

Integrated circuits have been around for many years, but EVERYDAY ELECTRONICS has so far concentrated upon discrete semiconductor devices. This makes sense, because it is our belief that a true understanding of electronics can only stem from an awareness of the discrete transistor and familiarity with its function as gained through practical constructional and experimental work.

But to ensure that our readers reap all possible advantages from modern developments, we shall make increasing use of integrated circuits in future designs. For a start, this month we include two quite dissimilar projects that are based upon different examples of these miniature marvels of current technology.

DON'T MISS THE BUS!

Great news for all those wishing to learn the basics of electronics from scratch. Here is their BIG OPPORTUNITY. An entirely new series *Teach-In '74* will be launched next month in EVERYDAY ELECTRONICS. This series has been carefully and expertly planned to meet the need of the ordinary person, man or woman, boy or girl, who wishes to acquire an understanding of electronic circuit principles without delving deeply into mathematics.

No previous experience or knowledge is required! Easy to follow text will be accompanied by easy to perform practical exercises requiring the very minimum of tools and components.

Regrettably it is our duty once again to advise readers that the supply of back numbers of EVERYDAY ELECTRONICS is not possible. So all budding enthusiasts *please* do take heed of this advance notice and friendly word of advice. Opportunities for the layman to learn the fundamentals in such an enjoyable and painless way in his own home as we have planned are all too rare, and of necessity come at infrequent intervals.

Fred Bennett.

Our October issue will be published on Friday, September 21

EDITOR F. E. Bennett • ASSISTANT EDITOR M. Kenward • B. W. Terrell B.Sc.
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..SIMPLY EXPLAINED

VOL. 2 NO. 9 SEPTEMBER 1973

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

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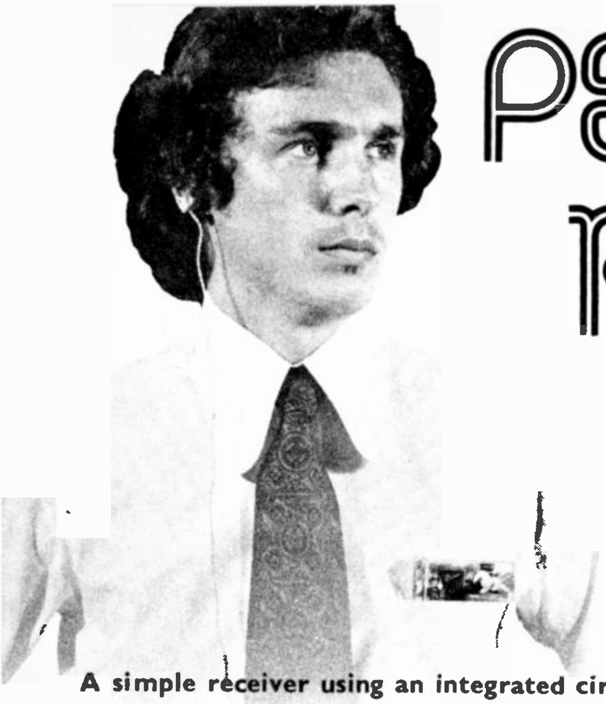


PERSONAL RECEIVER

BY F. R. HEATH

Approximate cost of components including V.A.T.
£3.10 plus batteries and case

A simple receiver using an integrated circuit and providing excellent reception.

ALTHOUGH it is very difficult to define what fascinates so many people about a miniature radio receiver, the fact remains that a great many people enjoy "messing about" with radio on this scale, and derive many hours of enjoyment (and learn a great deal of physics) from constructing these devices.

CRYSTAL SETS

The crystal set is the most basic receiver possible, Fig. 1 shows a typical simple crystal set using a tuned circuit, and a diode to detect the modulation—the audio part of the waveform which drives the earpiece. A long aerial wire and an earth are essential if any volume is to be expected, and unless very high impedance headphones are used the programmes will all merge into one. This is because a low impedance across the tuned circuit will damp it and increase the bandwidth or range of frequencies received.

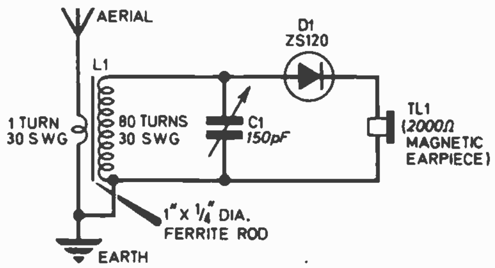
If one perseveres with the crystal set shown, one will notice that it possesses one or two fine qualities. These are:

1. The sound quality is very good (if a good ear piece is used).
2. The background noise is very low.

These are the basic requirements for a quality radio receiver. Unfortunately, the receiver has some bad qualities too. These are:

1. The volume is very low.
2. The large aerial necessary is somewhat cumbersome for a portable receiver.

Fig. 1. A typical, simple crystal set.



THE I.C.

Now, if we could add between the tuned circuit and the earpiece a circuit which possessed r.f. gain, low distortion and high input impedance, we would maintain the good qualities above and eliminate the bad qualities.

Using modern semiconductor processes it is now possible to achieve just this and the Ferranti ZN414 offers us complete radio tuner in a 3 pin "transistor" package. If the circuit of Fig. 1 is re-drawn using ZN414 we have an earpiece radio which has real advantages over existing types (Fig. 2). The very high input resistance (greater than 4 megohms) of the ZN414 ensures that the tuned circuit is virtually undamped by the device. Thus very high selectivity, low bandwidth operation is possible. The output of the ZN414 can now drive a lower impedance earphone.

If this circuit is built remember that although layout is not too important leads should be kept as short as possible. When the unit is operating the effects of varying L1 (unwinding turns) and C1 can be noted. Also, if one deliberately damps the tuned circuit by adding a resistor (say 10

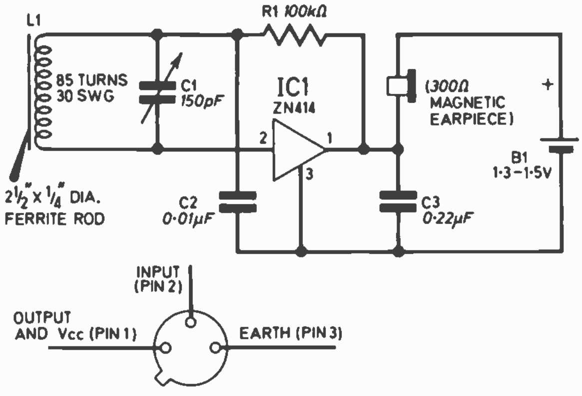


Fig. 2. The basic set using the ZN414.

kilohms) across it, it can be shown that the selectivity is reduced.

It does not need much imagination to realise that the radio shown in Fig. 2 could fit into a very small case. In practise, the size is limited by the ferrite rod which should not be reduced below about one inch in length.

A diagram of the connections to the ZN414 is shown in Fig. 2. Fig. 3 shows the internal circuitry of the ZN414 and is included for reference.

The basic receiver shown in Fig. 2, whilst capable of good results, lacks certain refinements which are desirable if optimum performance is to be achieved under all conditions. For this reason a further receiver circuit has been developed. This can have the refinement of volume control (or preset) volume control and a sensitivity control if wanted, and can be used to drive an amplifier (of input impedance greater than 20 kilohms) if necessary.

The circuit is shown in Fig. 4, the layout for printed circuit board in Fig. 5 and the wiring for the p.c. board in Fig. 6. One advantage of the crystal earpiece used is that two can be "paralleled" up to make a headphone. It is a lot less tiring to listen with both ears than one, and crystal earpieces are much cheaper than other

Components....

SEE SHOP TALK

Resistors
- R1 100kΩ
- R2 3·3kΩ
- R3 250Ω
- R4 560Ω
- R5 100Ω
- All ⅛W ±10% carbon

Capacitors
- C1 100pF to 200pF miniature variable
- C2 0·01μF miniature ceramic
- C3 0·1 or 0·22μF miniature ceramic
- C4 0·05μF miniature ceramic

Semiconductors
- IC1 ZN414 integrated circuit
- TR1 ZTX300 silicon *npn*
- D1 ZS120 } or any small signal silicon diode
- D2 ZS120 }

Miscellaneous
- L1 Ferrite rod 2½ x ¼inch diameter and length of 30 s.w.g. enamelled copper wire
- TL1 Crystal earpiece
- B1 3-6V battery (comprised of four RM 675's)
- Jack socket to suit TL1 incorporating an on/off switch (S1), 6BA fixings and stand-off pillars, plastic case approx. 3 x 1¾ x ¾ inches.

types. The quality of reproduction from two crystal earpieces using this circuit is astonishingly good.

The circuit now includes certain desirable features such as much higher volume (with optional control) and sensitivity control if required. This latter feature is vital for an experimenter, as it enables a much wider range of ferrite rod sizes and/or earphones to be used without making the receiver difficult to operate.

The prototype receiver used miniature "button" batteries which, although expensive, give extensive life and enable a fairly small receiver to be constructed. The voltage is not critical, the higher ranges will give higher volume without distortion.

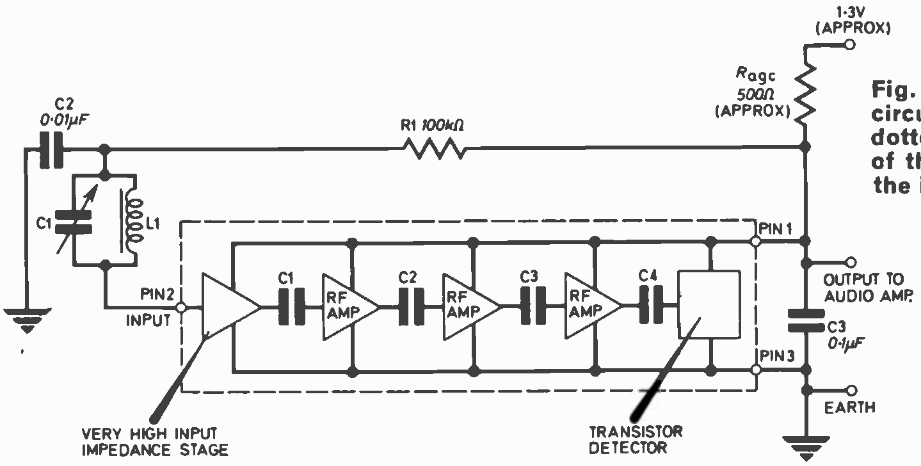


Fig. 3. The ZN414 in a basic circuit. The area inside the dotted line shows the basis of the internal circuitry of the i.c.

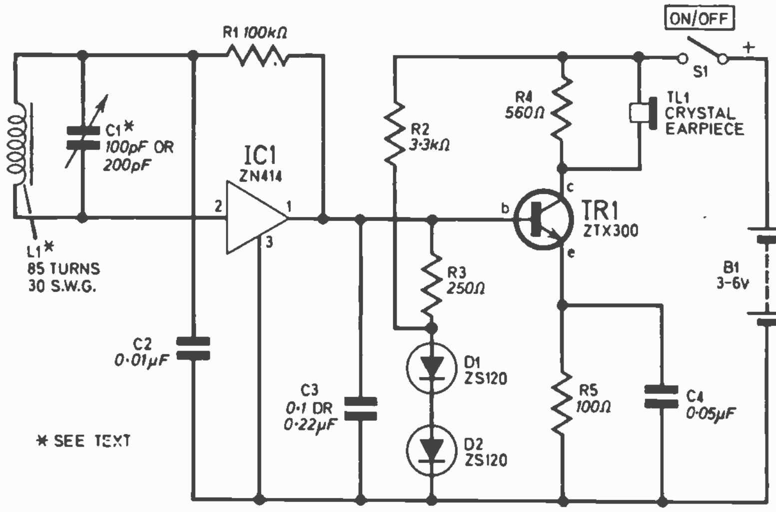
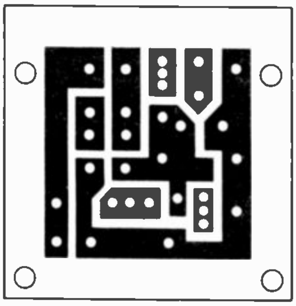


Fig. 4 (left). The complete circuit diagram of the Personal Receiver.

Fig. 5 (below). The printed circuit layout for the receiver shown full size.



A magnetic earpiece may be used in place of the crystal one, by substituting it for the 560 ohm resistor R4 soldered between the collector of TR1 and the positive supply rail; its impedance should be similar (about 500Ω).

If during experimentation one finds earpiece listening tiring (continual removal and replacement of an earphone can be very irritating) the earphone can be replaced by a connecting lead to an amplifier, which has a high input impedance. Most transistor amplifiers are suitable, and no damage will be incurred if the circuit in Fig. 7 is used.

CASE CONSTRUCTION

The constructional details given are not for a micro-miniature set. They are intended for an easily built receiver. The set is small and yet avoids very "fiddly" working. The complete unit is housed in a transparent Perspex box size 3 inches x $1\frac{3}{4}$ inches x $\frac{3}{4}$ inches shown in Fig. 8. Perspex is glued internally with polystyrene cement to provide a battery compartment, and a clamp for the ferrite rod.

The bottom of the box slides out for battery replacement. The batteries are held together by a small spring, laterally they are held by a piece of neoprene tubing slit across to allow the batteries to be inserted easily. The earpiece is connected by means of a jack socket and this also carries an on/off switch. Thus the set is turned on when the earpiece is plugged in.

Care is needed in drilling Perspex; if too much pressure is put on the drill it will crack the Perspex. Slow steady drilling is best.

VARIATIONS

A volume control can be added by inserting a 250 ohm potentiometer (a preset type could be used) in series with the emitter of TR1 e.g. between the junction of R5/C4 and the emitter. This control will only reduce the output power from the circuit as shown and was not found to be essential in the prototype. Resistor R5 should not be omitted or have its value reduced.

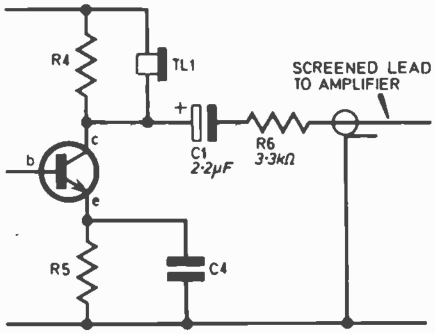
Diodes D1 and D2 are used to form a voltage stabiliser for the supply to the ZN414. These diodes can be any small signal silicon types, for these the forward voltage drop is about 600mV to 700mV each, giving a supply of about 1·4V.

The sensitivity control, if required, can be obtained by adding a 1 kilohm preset in place of D1.

The aerial coil should be wound using 30 s.w.g. enamelled copper wire. Start winding at about $\frac{3}{8}$ inch from one end of the rod and wind on 85 turns. The turns should be touching each other and not crossed or overlapping, insulation tape can be used to secure each end.

Any small (physically) tuning capacitor of value 100pF to 200pF may be used. A few more turns will be needed on the coil if lower values (less than 100pF) of capacitance are used. The internal layout of the prototype receiver is shown in Fig. 8. ▣

Fig. 7. Additional components and connections for use with an external amplifier.



PERSONAL RECEIVER

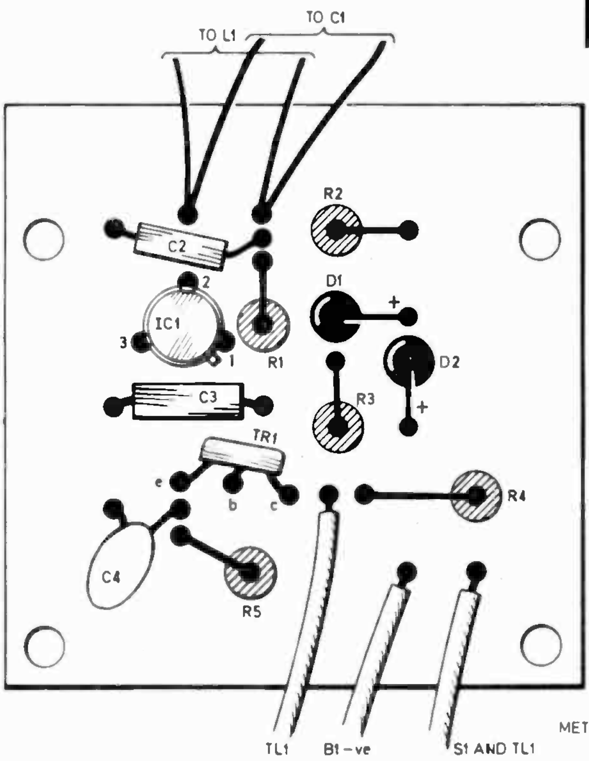
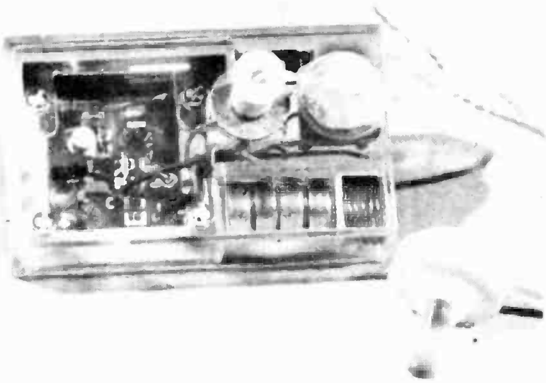


Fig. 6. Wiring of the printed circuit board.



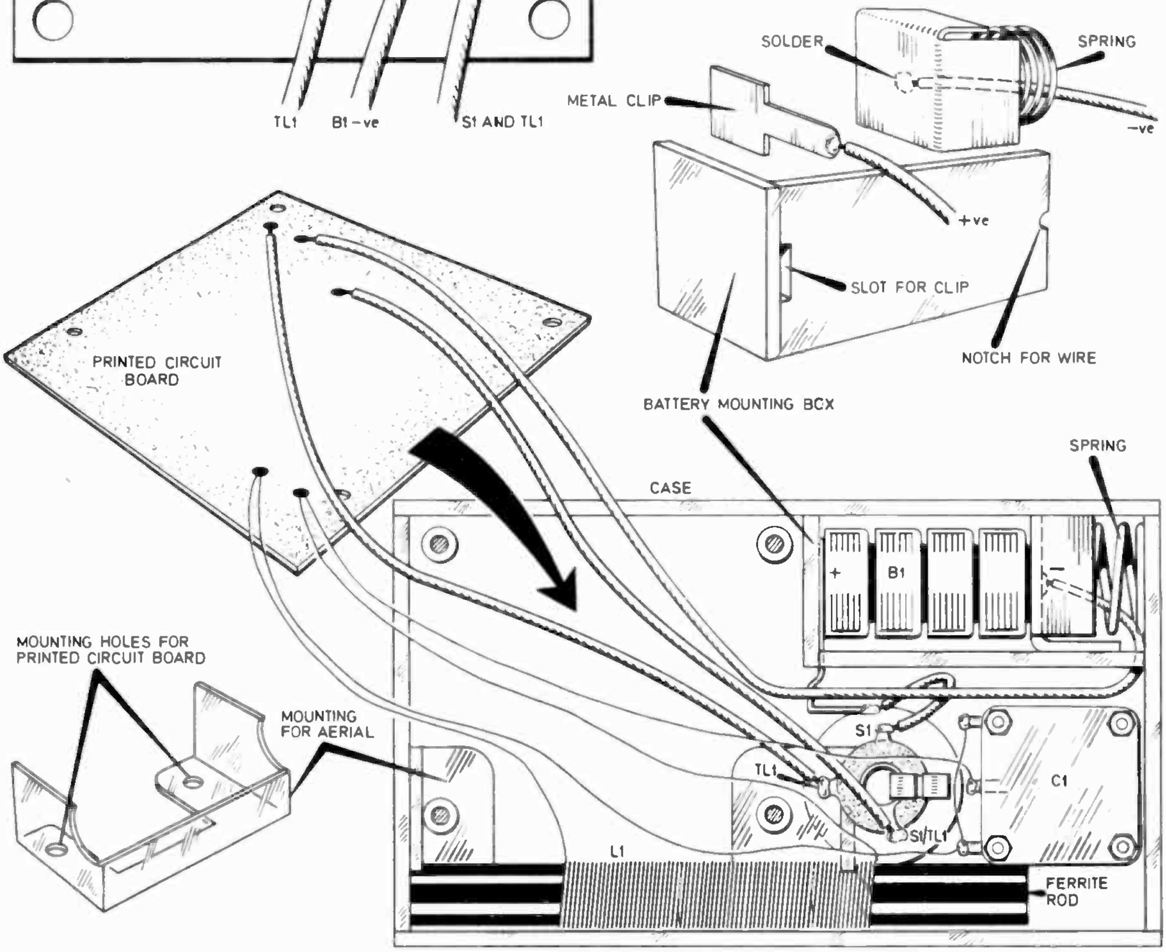


Fig. 8. Layout and General construction of the Personal Receiver.

Radar for Small Boats

By G.A.G. Brooke

Up to the last two or three years many keen yachtsmen and small workboat owners such as inshore fishermen with 40 foot boats were heard to complain of the lack of a suitable "mini" radar. After all, big ship radar had been with us since the early days of the last war, the world's leading manufacturer was about to clock up his 40,000th order, and radar for small craft, as opposed to "very" small boats, had been available since 1963 (in one case a small boat radar had first appeared in 1966, but the smallest boat which could use this is about 40 feet).

Suddenly there was a proliferation of sets suitable for "very" small craft but this was followed immediately by the failure, or at least lack of obvious success, of some of them. What is there to mini radars generally and why do the manufacturers appear to find this particular market so difficult? In answering these questions, it is hoped that old radar hands will forgive a description of basic principles.

BASIC OPERATION

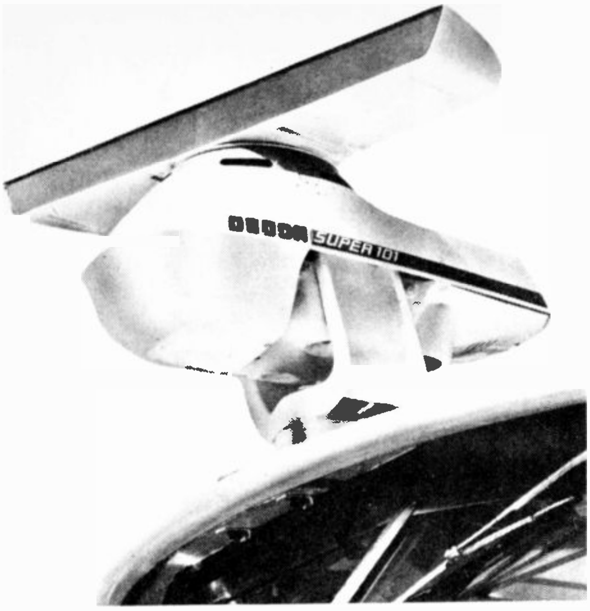
Radar is easily understood, once comparisons are made with sound waves, and the echoes which return from them. We know that sound travels through the air at the rate of about 1100 feet per second. Until radar was developed skippers of boats working near cliffs or up rivers used sound waves to determine distance away from bluffs, buildings and so on. A short blast on the whistle would be sounded, and the seconds counted until the echo was heard. If it took five seconds for the echo to return it meant that the sound waves had travelled a total distance out and back of approximately 5,500 feet; therefore the target was a little over half a mile away.

Now it happens that if you send out radio waves at a suitable frequency (the standard "X" band is 9380 to 9440 MHz) with sufficient energy, they actually bounce back to you from hard objects in exactly the same way. As the speed of both the emission and the returning echo is similarly constant, all you have to do to measure the distance of the hard object is to record the time taken for the entire operation. A marine radar incorporates many refinements to this principle but basically that is all there is to it.

Taking things a stage further: a radar set consists essentially of the following elements; the transmitter to generate short bursts of radio-frequency energy; a rotating scanner to radiate the radio waves in a narrow beam around the horizon and pick up the returning echoes; a receiver to detect and amplify these echoes; and a display tube to visually present them, with facilities for measuring range and bearing. The transmitter and the receiver are combined in one unit, which for convenience is called the transceiver, and there is an extra unit —making a total of four—for the power supply (all radars work off standard voltages from 12V upwards, but this has to be changed into a form acceptable to the radar, usually by a static inverter).

BASIC SYSTEM

Coming from the general to the particular, these four elements still exist but in recent years have been telescoped into three units, and lately into only two. This naturally simplifies and cheapens installation and there is a useful saving in wheelhouse space, particularly important in workboats which may already have much other instrumentation. The compression from four to three units came about by installing the transceiver immediately under the scanner in a form of a streamlined pod. With the transceiver below—where it still has to be in the case



The "exposed" scanner of the Decca 101 radar.

of larger big ship sets—it is joined to the scanner by an expensive and energy losing waveguide of rectangular copper tubing. The obviation of this, not only simplifies installation but allows a smaller power output for the same radar performance. This again results in a smaller power requirement from the boat's supply, usually a matter of great significance.

Further miniaturisation through the adoption of solid-state techniques (an ill-defined phrase but here taken to mean the latest micro-circuit and other solid-state devices) has enabled the power supply to be incorporated in either the scanner/transceiver assembly or in the display, or shared between the two. This results in a total of only two units, and is standard with mini-radars. With so much of the electronics of the system built into a scanner assembly which may be several feet up in the air, it is important that the different elements are designed on a modular plug-in principle as far as possible, for easy removal below.

TRANSCEIVER

The transmitter and receiver are in appearance almost a unity as the name transceiver implies, but in reality have, of course, very distinct functions. The transmitter and receiver circuits are provided with a means of isolating one from the other, so that when transmitting, none of the energy goes into the receiver; and only when the transmitter has stopped its emission is the receiver **on** and enabled to receive the reflected echoes. To measure the time lag between emission of a radio wave and its reflected echo obviously requires electronic switching **on** and **off** of the transmitted radio waves at a rate so rapid that it nearly defies comprehension.

The bursts of power, or pulses, are timed in two ways. First, the lengths of time measured in fractions of a microsecond that the transmitter is **on**. This is termed pulse length. Second, the number of times per second that the pulses are repeated. This is termed pulse repetition frequency.

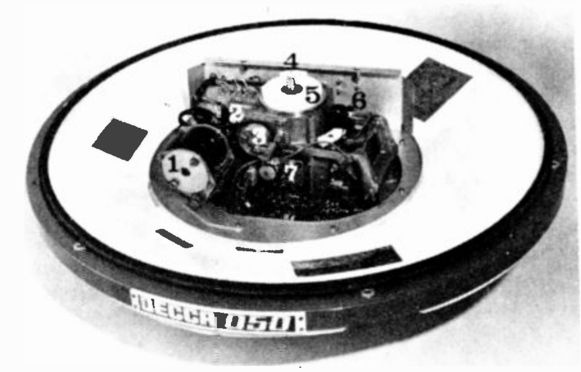
There are short and long pulse lengths automatically controlled by the range to which the radar is set. Usually shorter pulse lengths are used on short ranges for optimum range discrimination between objects; longer pulse lengths for longer ranges because of the need for a greater amount of power to create an echo. These pulse lengths typically vary between 0·05 and 1·5 microseconds.

SCANNER

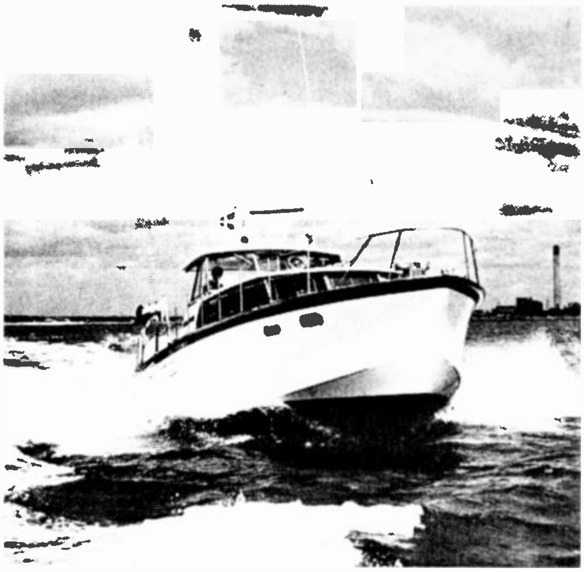
It is logical to consider the scanner next. As many readers may have noticed, in a large vessel, it consists of a horizontal bar from 4 feet to 9 feet long and about 6 inches deep. This is mounted on a pillar or other support and made to revolve at about 30 r.p.m. by a small motor mounted beneath. In mini-radars this assembly is invariably cased in a glass-fibre "radome", resulting in a mushroom appearance. The predominant reason is reduction in cost. The radome itself is not expensive and permits the scanner inside to be lighter, easier to rotate—since wind resistance is removed—not weatherproofed, and so cheaper and requiring less electrical power. As we have seen the radome houses the transceiver, and in one design the power supply as well.

Design of the scanner itself is always important but particularly in very small boats. Obviously, the smaller it can be the lighter and cheaper, but there is a limit below which performance in the form of discrimination (the ability to separate adjacent echoes) and freedom from side lobes, suffers unduly (it is impossible to direct all the energy into the desired beam and a small amount will be radiated to

Scanner unit of the Decca 050 radar showing the transmitter and turning assembly.



The two points of the Electronic Laboratories Seascan small boat radar.



The Decca Super 101, this is a three unit system suitable for boats down to about 40 feet.

either side, this is known as sidelobes and, if excessive, will create highly undesirable false echoes on the display).

The minimum size of scanner would appear to be 30 inches. The actual design of the aerial itself is another important point. Up to the late fifties the cheese type aerial was standard, where the end of the waveguide is positioned at the focal point of a parabolic reflector; the width of the latter has to be large in comparison with the wavelength so that transmission can be made in the form of a narrow beam. It is bulkier and not so efficient as the slotted waveguide scanner now universal in commercial and most other radars.

In the slotted waveguide type a bar aerial has slots cut in the vertical face through which pulses can be transmitted and echoes received. The disadvantage is that the slots have to be cut extremely accurately according to a mathematical formula and a slotted waveguide aerial is considerably more expensive than a cheese type.

DISPLAY

The echoes are handled in the receiver portion of the transceiver. Obviously they vary greatly in strength; a nearby ship produces an extremely strong echo, while a buoy some distance away produces only a faint one. All are very greatly amplified to bring the weak ones to a level that can be seen on the display. The echoes are then levelled to a common value, so that the echo created by a nearby ship will bear a reasonable relationship in size to that created by a buoy. All this is done electronically and may answer some queries as to why radars are not as cheap as washing machines!

To understand the working of the display, simple comparison with a searchlight may be made. Imagine yourself directly above the boat's searchlight which is being rotated 360 degrees. As it revolves the beam of light crosses boats close by and you see each of these objects momentarily. Consider now the radar's cathode ray tube, the circular extremity of which forms your radar display. As with the searchlight, your position is in the centre of the circle and the display shows all "radar conspicuous" objects within the range set at the time.

There is a difference, however, in that the inside of the tube is treated with a special material that continues to glow for a considerable period after the echo has been passed; in addition, each time the scanner directs the radio waves to cross a target (which it does about every two seconds) the echo is re-illuminated. In this way the entire radar scene is permanently visible, though the targets currently being swept show up more brightly than the remainder.

By courtesy of certain elements in both the receiver and the display any one boat mentioned above will be shown on the display as a bright spot at a range and bearing from the centre (which represents own ship) exactly corresponding to its true position. Radars have several range scales whereby, at the turn of a knob, the radius of the display can be taken to represent different distances from, say, half a mile to 18 miles. Concentric illuminated rings on the display represent increasing distances from the centre; as the range scale is changed the previous rings disappear, to be replaced by new rings in different positions, and it is always easy to gauge the range of an echo by its position relative to the nearest ring.

The display unit of the Decca 050 radar mounted in front of the "helmsman".

The relative bearing of an echo is read off the circumference of the display, with the aid of a revolving transparent disc. Modern big ship sets have more sophisticated facilities whereby, as controls manipulate a variable ring for range, and a radial line for bearing, the two readings come up simultaneously on digital readouts.

QUALITY, PERFORMANCE, PRICE

So much for the general principle of marine radar. At the outset of this article—which concentrates on mini-radars as being of interest to the widest circle of boat-owners—it was stated that, judging by results, many manufacturers find this is a very difficult market; not so much in selling the finished product but in getting its original design right. Why is this?

The basic reason is that the three-sided equation between quality, performance and price is a very awkward one. The price ceiling simply must be low, bearing in mind the likely pocket of the prospective owner and the danger of being undercut by a competitor. The manufacturer's outlets, usually agents in the case of pleasure craft and his own depots in the case of work-boats will have no chance (particularly with cost-conscious fishermen who form a very large section of the market) if the price is too high.

Performance in the form of maximum range, minimum range, definition (sharp, clear-looking echoes) discrimination, power required and so on must be adequate in view of competition. Last, but by no means least, there is quality; quality of electronic design, mechanical design and materials used; these are the basis of reliability. Contrary to general belief, the smaller the radar, the more hostile an environment it will be in. For example, a 30 foot family cruiser which is shipping a lot of water and spray and vibrating from the action of its engine is probably providing rougher treatment than that experienced by the radar of a large merchant ship on a sturdy bridge high above the waves and which is being operated by professional mariners.

The manufacturer has an agonising balancing act to perform between performance, extra ruggedness plus highly reliable material leading to high cost on the one hand and the necessity to keep the price down on the other. Some have failed to solve this equation first time, one large company having to dispose of its mini-radar altogether, and at least one other bringing out a second mark with major modifications.

CHOOSING

When choosing a radar it cannot be stressed too highly that reliability is the first thing to look for. As this is not assessable for any particular set in advance the best thing to do is enquire of existing owners. Performance is naturally important—but is of no account if the set won't work—and in the context of a very small boat it should be realised that theoretically long range may be unattainable in practice. This is because radar sees almost directly like the human eye (the radar horizon exceeds the optical horizon by 6 per cent).

There is little point in buying a 20 mile range radar if you are only going to mount it 18 feet above the water, because its "horizon" at that height will be only five miles. To be fair it will pick up high land at a greater range, but somewhat disappointing since the distance at which a feature will be on the horizon of a radar is found by adding the aerial's horizon to that of the feature. The following aerial heights (in feet) are followed by the corresponding radar horizon (in nautical miles) in brackets: 10 (4), 15 ($4\frac{1}{2}$), 18 (5), 24 (6), 32 (7), so that land at 32 feet will begin to appear above the horizon of an aerial at 10 feet, at $7+4=11$ miles.

Another aspect that prospective owners should look into most carefully is the service organisation of the manufacturer. In spite of what the brochures claim (so often "a new concept in radar reliability") radars do break down, and the proximity of a manufacturer's service depot or trained agent—there are few about—can make or mar a sailing holiday in certain circumstances. This is actually a factor in the price of the radar, since widespread service organisations are not maintained for nothing, and charges must be realistic.

USE

A brief look at what radar will do for you. Collision avoidance was its original object and still holds pride of place in the minds of most people. On a dark night or in fog, the possession of radar confers peace of mind, in that it should be impossible for anything bigger than a football, providing it is projecting far enough, to come dangerously close undetected. And if you want to see whether another vessel will hit you if both stand on, it is only necessary to take successive bearings of her when your own boat is dead on course. If they do not alter considerably she will at least pass close. This check is more easily performed than with a compass.

However, study of an article that appeared some time ago in the yachting press on the uses for which radar was put throughout a seven port cruise, showed that collision avoidance came up only once in half a dozen times. Why do virtually all Scottish motor fishing vessels fit a radar when the instance of fog on the North East coast of Scotland is in fact slight? They use it for a multitude of small tasks from locating the small dan buoy which marks the end of their net, to fixing their position. Most radars are efficient, in calm conditions, down to about 20 yards and this can be a great help in locating your moorings or picking your way into harbour among lines of moored yachts.

Coastal navigation is a subject in itself, but basically, everything that the navigator does to fix his craft by cross bearings can be emulated and more quickly, with radar. In addition, a range facility is added, enabling 'range and bearing' fixes to be obtained as well. Is important of course that the point you are taking on the display is exactly identifiable on the chart; this is not difficult with experience but it is advisable to practice in good conditions when checking is easy.

CONCLUSION

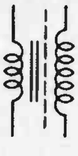
In conclusion, a quote from an american enthusiast, which is being proved by more and more British owners: "Since the fitting of radar we have cruised thousands of miles more safely and without the anxiety that is ever present when compelled to operate in thick weather, or to enter a strange harbour at night."

What do you know?

1 You want a transformer to supply 24 volts at 1 amp. You have a 24 volt 500mA, a 12-0-12V 2A and 30V 1A which one would you use, and how would you connect it.

2 A coil and a capacitor are used to form a tuned circuit in a project you are building. The coil you have is slightly higher in inductance than that required, you cannot alter its value so what could you do to get the correct resonant frequency.

3 What does the following circuit symbol represent:



T

4 The impedance of a coil is stated as being 400 ohm, when you measure its resistance on a multimeter it is only 100 ohm. Say if you think this is correct and why.

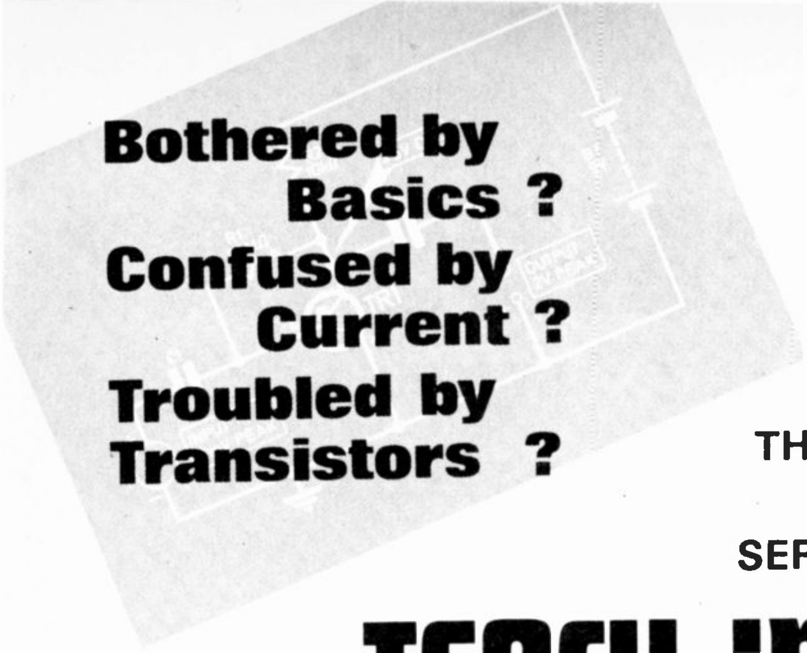
ANSWERS

1 Use the 12-0-12V 2A, connect across the two tags marked 12V (this gives a 24V winding) ignoring the 0V tag. The 2A is a maximum rating and the transformer can supply the 1A required without trouble (although the voltage may be slightly high).

2 Reduce the capacitor value slightly. The resonant frequency $f = \frac{1}{2\pi\sqrt{LC}}$ thus if L (the inductance) is increased, reduce C for the same f.

3 A transformer with two windings, a laminated core and a screen between the windings.

4 This could well be correct, the impedance is measured at a particular frequency and will always be higher than the d.c. resistance.



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Confused by Current ?
Troubled by Transistors ?

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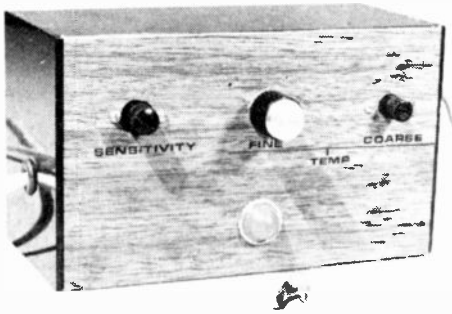
October issue on sale Friday, September 21

Aquarium THERMOSTAT

BY MIKE KENWARD



A unit for accurate temperature control of liquids.

PROPRIETARY thermostats for fish tanks and other heat control and monitoring applications are available and many of them are simple and cheap. However it has long been the requirement of many tropical fish keepers and others to have a more reliable, more accurate thermostat that can be set to the required temperature and that will maintain the temperature of a liquid to within ½ degree centigrade.

The thermostat to be described in this article was designed for this purpose and was found in practice to be extremely accurate, once set, and able to keep the temperature to within less than ½ degree should this be required.

Approximate cost of components including V.A.T.

£2·85 plus case

CIRCUIT

The circuit diagram of the thermostat is shown in Fig. 1. Transistor TR1 is operating in the emitter follower mode, the output of which is determined by the setting of VR1 and VR2, and by the resistance of thermistor RTH1 which is determined by its temperature. The output from TR1 emitter is fed, via a current limiting resistor R2, to a Schmitt trigger formed by TR2 and TR3. The use of TR1 prevents undue loading of the Schmitt by the thermistor.

The thermistor RTH1 is located in the liquid, the temperature of which is to be controlled. With a fall in temperature the resistance value of RTH1 rises and causes TR1 to pass less current through its collector emitter junction. Thus the voltage at TR2 base falls and TR2 begins to turn off, at a certain level (set by R3, R4 and R6, TR3 turns on and forces TR2 to turn completely off (Schmitt action). This switching of states happens very quickly and TR3 switches from off to fully on with only a slight change in the value of RTH1.

Transistor TR3 operates a relay which is used to switch the mains supply to a tank heater. Thus when TR3 turns on the heater is turned on and the liquid begins to warm up. When the required temperature is reached the fall in the resistance of RTH1 causes TR1 current to rise and the Schmitt to revert to its original state (TR2 on TR3 off) thus turning off the heater via RLA1.

HYSTERESIS

Although the above action is straightforward one problem is encountered—the hysteresis present in the Schmitt trigger circuit. This means that the unit would only switch with a

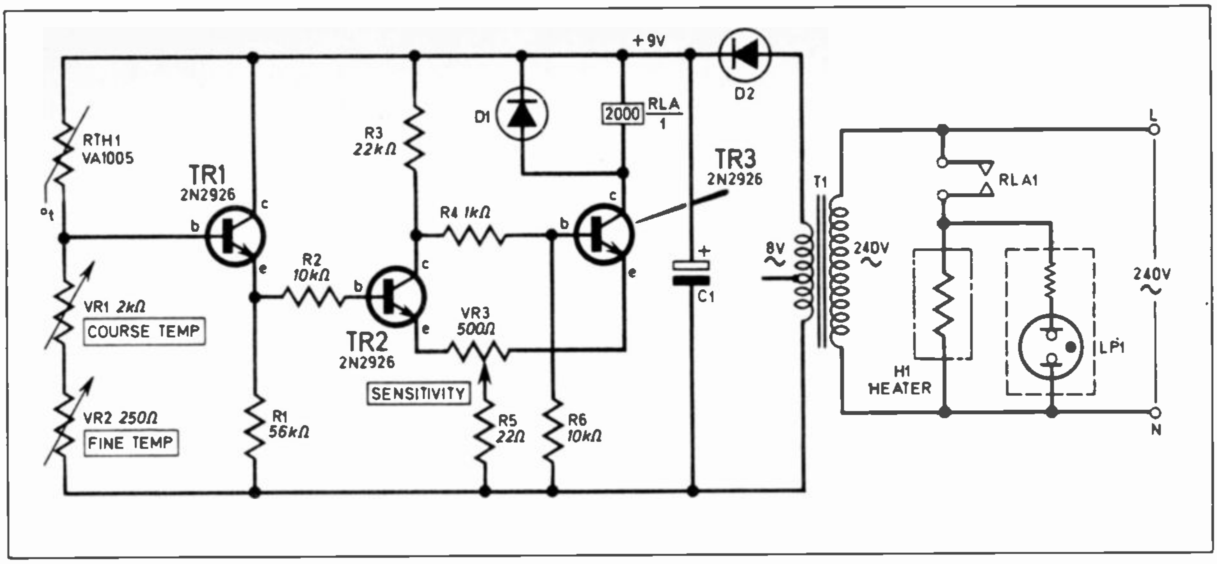


Fig. 1. The complete diagram of the Aquarium Thermostat.

rise and fall in temperature of about 3 degrees centigrade which is greater than the required temperature control.

To overcome this VR3 has been incorporated in the Schmitt circuit and this resistor is used to "balance" the two transistors and thus reduce the amount of hysteresis. Thus this potentiometer can be used to vary the sensitivity of the thermostat and can be set to keep the temperature to within about plus or minus 5 degrees centigrade down to less than plus or minus ½ degree centigrade. In actual fact the prototype was able to maintain the temperature to a very high degree of accuracy—higher than is practically useful in an aquarium and higher than we were able to measure by conventional means.

SUPPLY

Power for the circuit is derived from the mains via the bell transformer T1, the rectifier D2 and smoothing capacitor C1. This very basic half wave supply was found to be quite adequate in practice. Diode D1 is incorporated to prevent the back e.m.f., caused by RLA1 switching off, from damaging TR3.

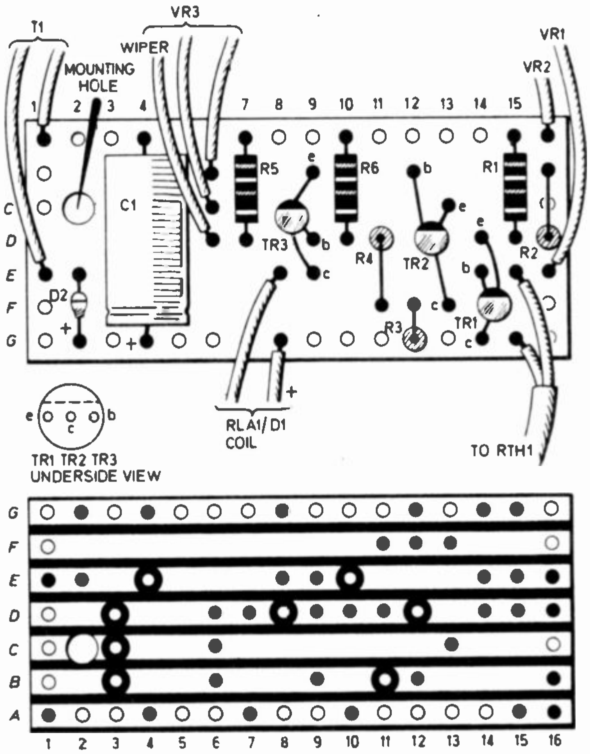
CONSTRUCTION

Commence construction by cutting and drilling the circuit board as shown in Fig. 2. Mount all the components—soldering in the transistors and diodes after the other components and flying leads.

Next mount all the components in a suitable metal or plastic case as shown in Fig. 3 and wire up the complete unit. Note that if a metal case is used a three core mains lead should be provided and the box should be earthed by means of a tag bolted to the inside.

The themistor must be isolated from the water and can be mounted in any convenient way. The prototype used a thermistor mounted on the end of a short length of plastic tube (ball pen case) and covered in Araldite to insulate and protect it. Take care not to use too much Araldite on the thermistor as this may prevent it from reacting quickly to temperature changes.

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



Aquarium THERMOSTAT

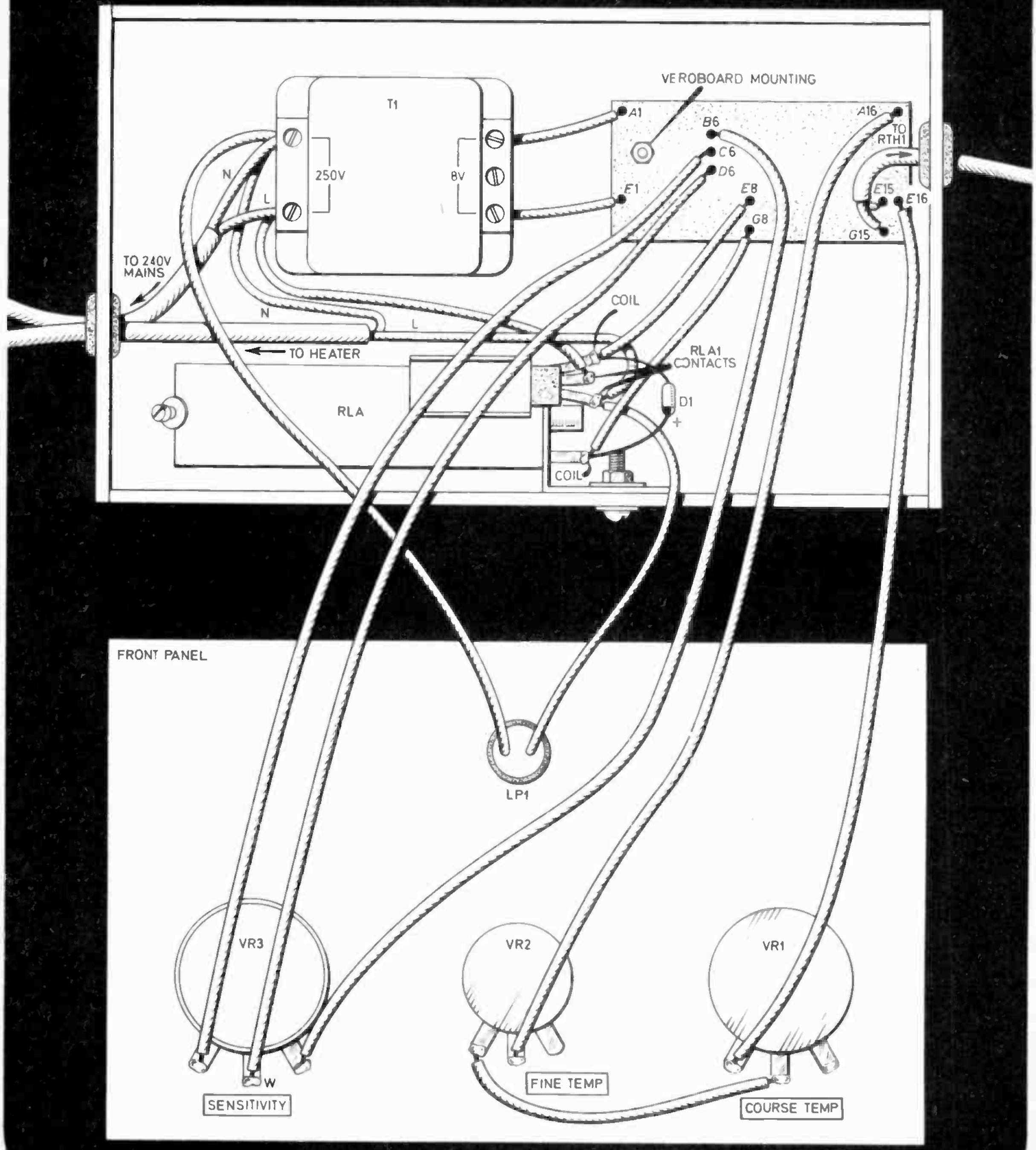


Fig. 3. Layout and wiring of the components mounted in the case.

Components....

Resistors
R1 56kΩ
R2 10kΩ
R3 22kΩ
R4 1kΩ
R5 22Ω
R6 10kΩ

SEE SHOP TALK

Capacitor
C1 100μF elect. 15V

Variable Resistors
VR1 2kΩ carbon linear
VR3 250Ω carbon linear
VR3 500Ω carbon linear

Semiconductors
D1 Any small signal silicon diode
D2 IN4148 or any 50V 200mA silicon diode
TR1 2N2926 (any colour) silicon *npn*
TR2 2N2926 (green) silicon *npn*
TR3 2N2926 (green) silicon *npn*

Miscellaneous
RTH1 VA 1005 thermistor
RLA 2000Ω P.O. type 3000 relay with one set of normally open contacts
T1 Friedland bell transformer (200–250V primary, 8V secondary)
LP1 Neon indicator lamp with built in resistor
Veroboard 2½ x 1⅛ x 0·15 inch matrix, small aluminium bracket for RLA, mains lead, materials for mounting RTH1 (see text), plastic case approx. 7 x 4 x 3 inches, 4BA fixings, mains plug, knobs as required.

TESTING

Connect the unit to the heater and mains and with RTH1 in free air and VR3 fully clockwise switch on. Turn VR1 (coarse temperature) through the range and check that RLA1 clicks in and out as you do this, LP1 is incorporated to show when the relay is operating (ie. heater on). Next set VR2 (fine temperature) fully clockwise and VR1 so that RLA1 has just operated—switched on the heater—now turn down VR2 and check that as it nears its minimum value RLA1 drops out—turn up VR2 until RLA1 just operates.

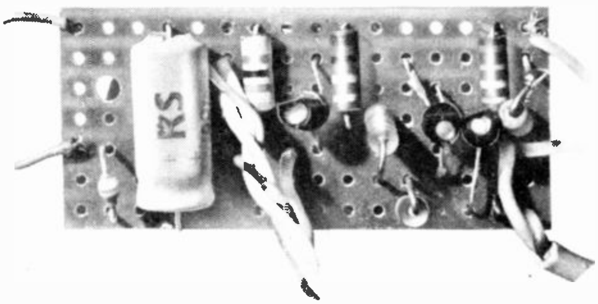
By breathing on the thermistor it should now be possible to cause RLA1 to drop out and switch off the heater. Now test the function of VR5 (sensitivity) by turning it fully anticlockwise and resetting the unit as above. It should now take a greater rise in temperature to make RLA1 operate.

If all is well place RTH1 in the tank and turn VR1 up, when the required temperature of the liquid is reached back off VR1 and adjust both VR1 and VR2 until RLA1 just drops out. Leave the unit set and observe the rise and fall in the temperature.

By adjustment of VR3 and the two temperature controls the correct temperature and controlled level (rise and fall) can be set. This may take a little time but once set will remain constant. Any latter alteration of VR3 (sensitivity) may also mean slight adjustment of VR2 and possibly VR1 to maintain the correct temperature.

The thermostat can be used to maintain the temperature of other liquids—such as used in colour photographic work—but for accurate control the thermistor should be mounted away from the heater and some means of "stirring" the liquid introduced. ▣

Photograph of the completed Veroboard with the components mounted on it.



PLEASE TAKE NOTE

The connections to VR1 and B1 positive on the *Waa Waa* Veroboard layout (page 439, August '73) should each be moved one place to the left to position A9 and A8 respectively. The wiring diagram of Fig. 6 with reference to these connections is correct. The connection from A2 to SK1 should be omitted and the screen from C2 should be connected to SK1 auxiliary tag.

In the *Electronic Doorbell* article (August '73) transistor TR5 was incorrectly shown as an AC 126. This should have been an AC 176.

Under *What Do You Know* it was stated that the AC 127 could not be used in place of the BC 109 because it is a *pnp* device. It is an *npn* device but it would not be as likely to work as the 2N2926 because it has a much lower gain.

We apologise for any confusion caused by these mistakes.

SEMICONDUCTORS

FOUR — THE TRANSISTOR

J.B. DANCE M.Sc.

We continue this month with further properties and theory of the transistor and introduce some transistor types which will be completed in Part 5.

COMMON EMITTER CURRENT GAIN

The a.c. current gain of a transistor in the common emitter circuit is usually designated β, γ', h_{21} or h_{fe}. It is given by the equation:

$$\beta = \frac{\text{change in collector current}}{\text{change in base current}}$$

The current gain of typical transistors in the common emitter circuit varies from about 5 to 1,000. It varies from one type of transistor to another, but even amongst transistors of the same code number there are variations in the current gain of between about two times to five times (depending on type). The current gain is temperature dependent.

The common emitter current gain usually rises at first with increasing collector current until it reaches a maximum, after which it falls again (see Fig. 4.1).

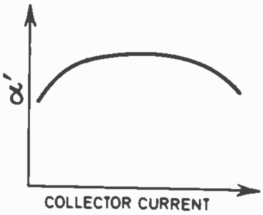


Fig. 4.1. Variation of current gain with collector current in a typical transistor.

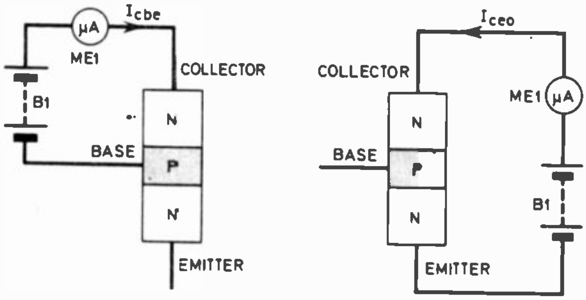
Some transistors (such as the 2N2484) are designed so that they provide a high current gain even at very low collector currents (perhaps 0·01mA), whilst other transistors provide a high gain in the medium current range (typically 1mA to 100mA) and yet others in the high current range (perhaps 5A to 10A).

The common emitter circuit not only provides a current gain of over unity, but it also provides a voltage and a power gain when used in a suitable circuit. The power gain provided is normally greater than that obtainable using the same type of transistor in either of the other basic circuits.

LEAKAGE CURRENT

In Fig. 4.2a, a transistor is biased in the normal way with the collector positive with respect to the base, but the emitter is left unconnected so that the emitter current is zero.

Although the collector/base junction is reverse biased, a small current will pass, since both of the materials contain limited numbers of minority carriers which are attracted across the junction (as in the reverse biased diode). This small current is known as the **leakage current**.



(a) (b)

Fig. 4.2. Measurement of leakage current.

The leakage current in the common base connection is designated I_{cbo} (or sometimes I_{co}). The subscrip "cb" indicates that the current flows between the collector and base, whilst the third subscript, "o", shows that the current passing to the third electrode is zero.

The leakage current in Fig. 4.2a is that of the collector/base diode and is therefore much smaller in the case of silicon transistors than in germanium devices.

The common emitter leakage current is measured with the base open circuited as shown in Fig. 4.2b. It is normally given the symbol I_{ceo}, but is sometimes designated I_{co}.

The value of the common emitter leakage current is much larger than that of the common base leakage current. The leakage current of the collector/base diode acts as the base current and is therefore amplified by the current gain of the transistor concerned.

In a germanium transistor I_{ceo} may be some hundreds of microamperes, increasing slightly with applied voltage over the working range of the transistor.

The leakage current of any transistor increases rapidly with temperature for the same reason that the leakage current of a diode increases with temperature.

PNP TRANSISTORS

The principles of operation of *pnp* transistors are exactly similar to those of *npn* transistors, but the polarities of the applied voltages are reversed and the charge carriers are of the opposite polarity.

As shown in Fig. 4.3, the base is forward biased with respect to the emitter, so in this type of transistor the base must receive a negative bias (as opposed to the positive base bias of the *npn* type). Similarly, a negative voltage is applied to the collector so that the collector/base junction is reverse biased.

The *n*-type base is lightly doped, so the emitter/base current consists mainly of holes moving from the emitter to the base with only a few electrons moving in the opposite direction.

Most of the holes passing from the emitter into the base reach the depletion region of the collector/base junction and they are then swept into the collector to form the collector current in the external circuit.

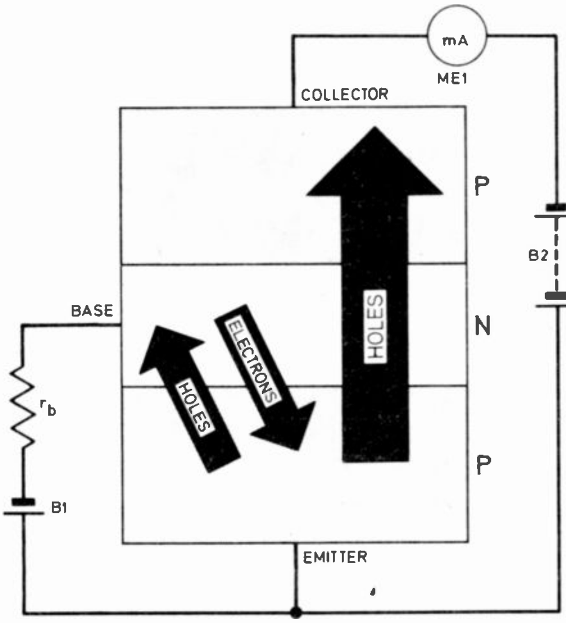


Fig. 4.3. Flow of charge carriers in the *pnp* transistor.

SYMBOLS

The normal symbol for an *npn* transistor is shown in Fig. 4.4a. Sometimes the circle is omitted for simplicity, since it is only used to indicate that the device is sealed in a suitable encapsulation.

The direction of the arrow shows the direction in which conventional current flows in the emitter circuit. (Conventional current flows from the positive to the negative terminal of a battery in the opposite direction to the flow of electrons.)

Fig. 4.4b shows the symbol used for a *pnp* transistor. It is similar to that of the *npn* transistor, except that the direction of the arrow is changed.

Alternative symbols for the *npn* and *pnp* transistors are shown in Figs. 4.4c and 4.4d respectively.

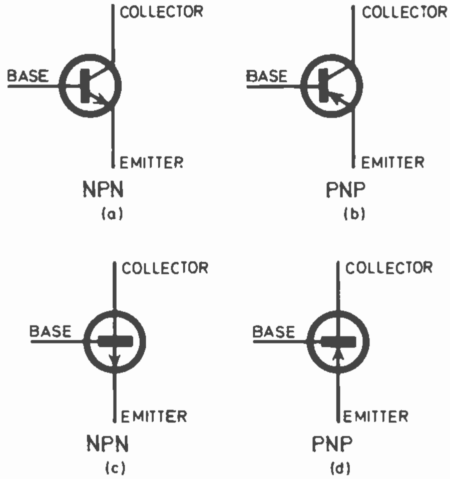


Fig. 4.4. Symbols for *npn* and *pnp* transistors.

BASE VOLTAGES

The forward bias applied to the base of a silicon *npn* transistor results in this electrode being about 0·5 to 0·6V positive with respect to the emitter.

This follows from the fact that a forward biased silicon diode does not pass very much current until this forward voltage is reached, but the current then increases very rapidly with forward voltage (refer to Fig. 2.8 in Semiconductors Part 2).

Similarly, the base of a germanium *npn* transistor operates at about 0·15V positive with respect to the emitter.

The base operating voltages of silicon and germanium *pnp* transistors are about −0·5 to −0·6V and about −0·15V respectively relative to the emitter.

COLLECTOR VOLTAGES

If the collector of a transistor is operated from too low a supply voltage, the maximum output voltage swing will be limited and the gain may be reduced. Generally, supply voltages below about 3V are seldom used. The upper limit depends on the type of transistor used for the reasons discussed below.

Some silicon transistors are designed to operate with collector voltages well above 100 volts, but most types are only capable of satisfactory operation at lower voltages.

Germanium *pnp* transistors are seldom

designed to operate with their collector voltages more than 80V negative with respect to their emitter voltage.

If the collector/base voltage is made greater than the maximum permissible value quoted in the manufacturer's data sheet, **avalanche breakdown** of the collector/base junction may occur. (The doping level in transistors is usually greater than that at which true Zener breakdown takes place.)

A maximum permissible value of the collector/base reverse voltage, V_{cbo} (or, sometimes, V_{cb}), is therefore quoted in the data sheet. This is the collector/base maximum voltage when the emitter current is zero.

The maximum permissible collector/emitter voltage with the base open circuited (that is, with zero base current) is designated V_{ceo} and is often lower than V_{cbo}, since the collector/base leakage current is multiplied by the current gain of the transistor.

In addition to normal avalanche breakdown, an effect known as **second breakdown** can occur in which some parts of the junction become hotter than others. If any part tends to become hot, conduction in that part may become more like conduction in a metal, so that the current concentrates there and makes it hotter still.

A voltage applied between the collector and emitter (but not between the collector and base) can lead to an effect known as **punch-through**. In this case the collector/base depletion region becomes so deep that it encompasses the whole of the base region and enters the emitter. When this occurs, a large current can flow between the collector and emitter.

The punch-through voltage depends mainly on the base width and resistivity; in many transistors the punch-through voltage is arranged to be of the same order as the avalanche breakdown voltage of the collector/base junction.

Although avalanche breakdown and punch through do not *in themselves* destroy the transistor, in most circuits they would cause such a high current to flow that the power dissipation in the device would be great enough to destroy it. The manufacturer's limiting values of V_{cbo} and V_{cbo} should therefore be strictly observed.

FREQUENCY LIMITS

The amplification given by a transistor falls off at high frequencies, the symbol f_T is used as a meaure of this fall in modern transistors; it is the **gain-bandwidth product** or, more precisely, the common emitter current gain multiplied by the bandwidth measured in the frequency region where the gain is falling fairly rapidly.

It must be stressed, however, that the high frequency performance is dependent on the circuit in which the transistor is used as well as on the properties of the transistor itself.

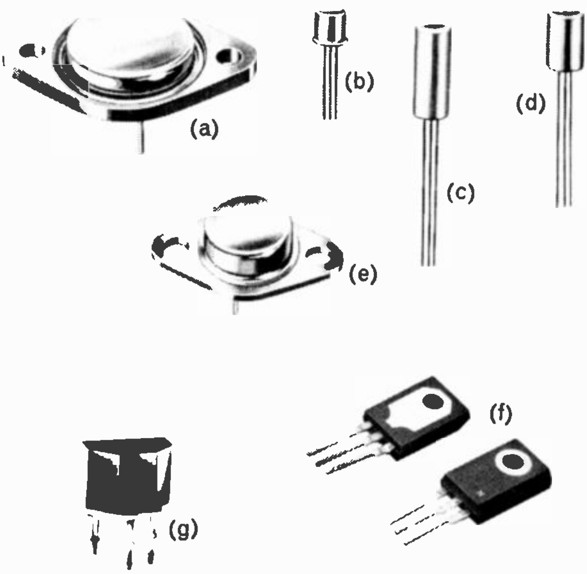
It is not always wise to use a transistor with a good high frequency performance in a circuit where this property is not really needed, since oscillation at a very high frequency may occur. The latter may not be easy to detect.

It should be remembered that the value of f_T quoted by most manufacturers is the minimum value and many specimens of their transistors of a specified type number may have a far higher value of f_T.

TRANSISTOR TYPES

The number of transistor types on the market is extremely large. It is obviously necessary to have many different types available for various purposes but the profusion of type numbers now available tends to confuse not only the beginner, but also the somewhat more experienced designer.

This series will give some information on the ways in which some types of transistor provide the characteristics required by the circuit designer, but it is obvious that this account cannot be a comprehensive review or even cover the majority of the types in normal use. In general only the more common types will be considered and no attempt will be made to include details of transistors suitable for operation at GHz (1,000 million Hz) frequencies or of any radio frequency power transistors.



Photograph showing some of the various transistors available:
(a) AD149 (b) BC107 (c) OC72 (d) AC128 (e) AD161 (f) BD201 (g) BC147—Lockfit. *(Mullard)*

TOLERANCES

Manufacturers can produce cheap transistors only if they can sell huge quantities of each type and if they do not have to carry out long testing procedures or guarantee that their products have very close tolerances.

The most expensive devices have tended to be used in the military and space research fields where human lives may depend on the satisfactory operation of a large number of devices over a long period.

Somewhat cheaper transistors have been used for general industrial purposes and in instrument manufacture, whilst the cheapest devices are used in the domestic entertainment field where wide tolerances are of no great disadvantage if one allows for them in the circuit design.

REPLACEMENT TYPES

Although this article may help readers to choose a suitable replacement type for a defective transistor, it cannot be stressed too strongly that *the manufacturer's data sheet should always be examined in detail* before any transistor is used to replace another type or is used in a new circuit.

In many cases modern epoxy encapsulated silicon transistors can be used as a cheap (but perfectly satisfactory) replacement for some of the types supplied in metal cans. Epoxy encapsulation is a kind of plastic material and can be used for silicon (but not normally germanium) device manufacture.

Germanium devices were developed before the more modern silicon types and will therefore be covered first.

PNP ALLOY JUNCTION GERMANIUM TYPES

Some of the earliest transistors were produced by the alloy junction process. If a *pnp* germanium transistor is to be made, pellets of the *p*-type additive are placed on each side of a wafer of lightly doped *n*-type material.

In the case of the OC71 transistor, for example, the size of the *n*-type wafer is 4 x 2 x 0·12mm.

After suitable heat treatment, the *p*-type additive diffuses into the wafer to form a *pnp* device with a lightly doped base. The cross section of such a transistor is shown in Fig. 4.5.

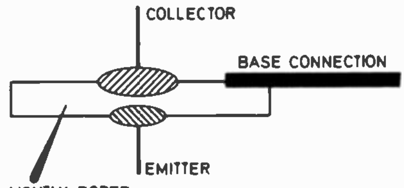


Fig. 4.5. The structure of an alloy junction transistor.

Transistors manufactured by this technique are suitable for use only at audio and low radio frequencies. For example, the *pnp* audio frequency transistor type OC71 has a typical common emitter cut off frequency of 11kHz (minimum 5kHz) and a common base cut off frequency of 600kHz.

The *pnp* OC45 has a thinner base and can be used as a 475kHz intermediate frequency amplifier in radio receivers, since the thinner base raises its common base cut off frequency to about 6MHz.

The *pnp* OC44 has about the optimum high frequency performance possible with transistors manufactured by the alloy junction technique; it has a common base cut off frequency of typically 15MHz (minimum 7·5MHz) and is often used as a self oscillating mixer in radio receivers for the medium and long wavebands. Various other types, such as the OC42, are similar to the OC44.

Table 4.1: Germanium Alloy Junction Transistors

Device	V_{cbo} (V)	V_{ceo} (V)	$I_{c\ max}$ (mA)	$P_{t\ max}$ (MW)	h_{fe}	f_T (MHz)	Application
pnp							
OC71	−30	−20	10	75	50	0·6	Medium gain general purpose
OC75	−20	−20	10	75	90	0·6	High gain general purpose
OC45	−10	−10	5·0	43	50	6·0	I.F. amplifier in medium frequency receivers
OC44	−10	−10	5·0	43	100	15	Mixer/oscillator in medium frequency receivers
OC72	−16	−16	125	75	70	>0·35	Low power output transistor
OC77	−60	−60	125	75	>45	>0·35	High voltage low power switch
2N1309	−30	−15	200	150	60–120	15	General purpose
npn							
OC139	20	15	250	145	20–84	3·5	Medium current transistors
OC140	20	15	400	145	20–150	4·5	Medium current transistors
OC141	20	15	400	145	80–200	9·0	Medium current transistors
2N1308	25	15	200	150	80–300	15	General purpose

Returning to audio transistors, the OC71 has a common emitter current gain of 30 to 75 at a collector current of 3mA. The OC75 is a high gain version with a current gain h_{fe} or β of 60 to 130 at a collector current of 3mA.

The OC71 has a collector voltage rating of 20V, but the thinner base of the OC44 and OC45 involves a reduction of the collector rating to 10V.

All of the above types except the OC42 are encapsulated in a small, black painted, glass tube with the three leads emerging from the one end, as shown in Fig. 4.6.

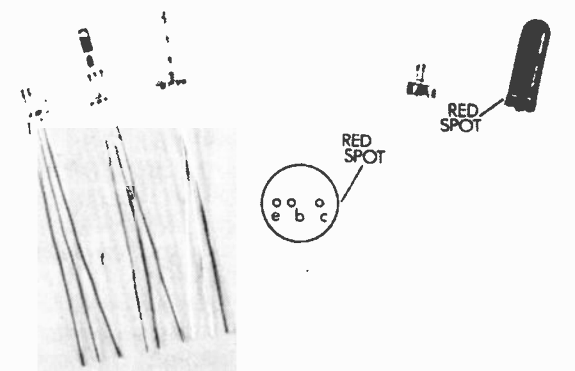


Fig. 4.6. The OC71 type transistor showing stages of production. *(Mullard)*

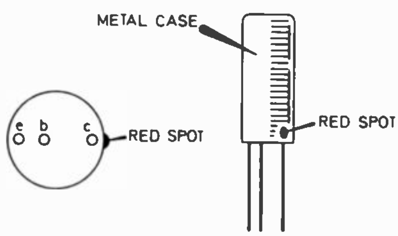


Fig. 4.7. The OC72 type transistor.

The OC71 is rated at a maximum average collector current of 10mA. The OC72 has a maximum average collector current rating of 125mA and has been much used in the past in the output stages of small radio receivers. It is encapsulated in a metal tube, as shown in Fig. 4.7, so that the heat will be conducted away if it is placed in a small heat sink.

The OC77 is essentially a high voltage version of the OC72.

Low noise types, such as the AC107, are available, but one can obtain a better low noise performance with a modern silicon planar type.

PNP ALLOY DIFFUSED GERMANIUM

The *pnp* alloy diffused germanium transistors have been widely used in the radio and intermediate frequency sections of radio receivers.

A cross section of such a transistor is shown in Fig. 4.8.

The manufacturing technique employed enables a base width of a few thousandths of a millimetre to be obtained. A drift field is developed by adding both *n*- and *p*-type impurities to the emitter pellet and allowing the *n*-type material to penetrate more deeply into the crystal than the *p*-type at a high temperature so that a graded base layer is formed.

Such transistors have a high gain at a low collector current and a low collector base feedback capacitance.

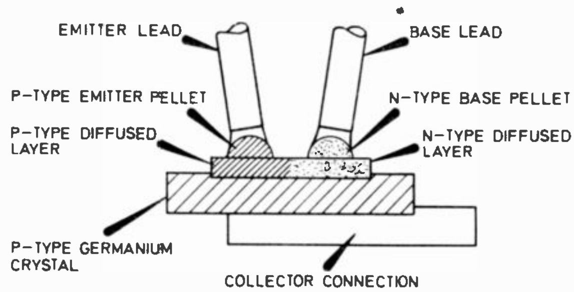


Fig. 4.8. The structure of an alloy diffused germanium transistor.

The OC170 and OC171 are two well known types manufactured by this technique. They have an h_{fe} value of about 100 (minimum 20) and a cut off frequency of around 70MHz.

In current radio receivers these transistors have been replaced by the AF114 to AF117 series. The AF114 is a v.h.f. amplifier for f.m. receivers, the AF115 a mixer/oscillator for a.m./f.m. and short wave receivers, the AF116 an i.f. amplifier for f.m. receivers and the AF117 a mixer/oscillator and i.f. amplifier for the long, medium and short wave bands.

Another use for alloy diffused transistors is as video amplifiers in television receivers and the AF118 has been designed especially for this purpose.

All of the alloy diffused transistors mentioned above have the type of construction shown in Fig. 4.9. The shield electrode is connected to the metal case and should be earthed.

Alloy diffused *npn* germanium transistors do not appear to be available.

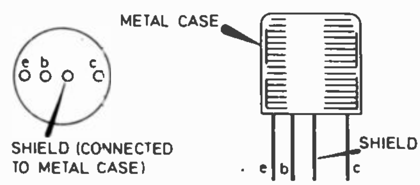
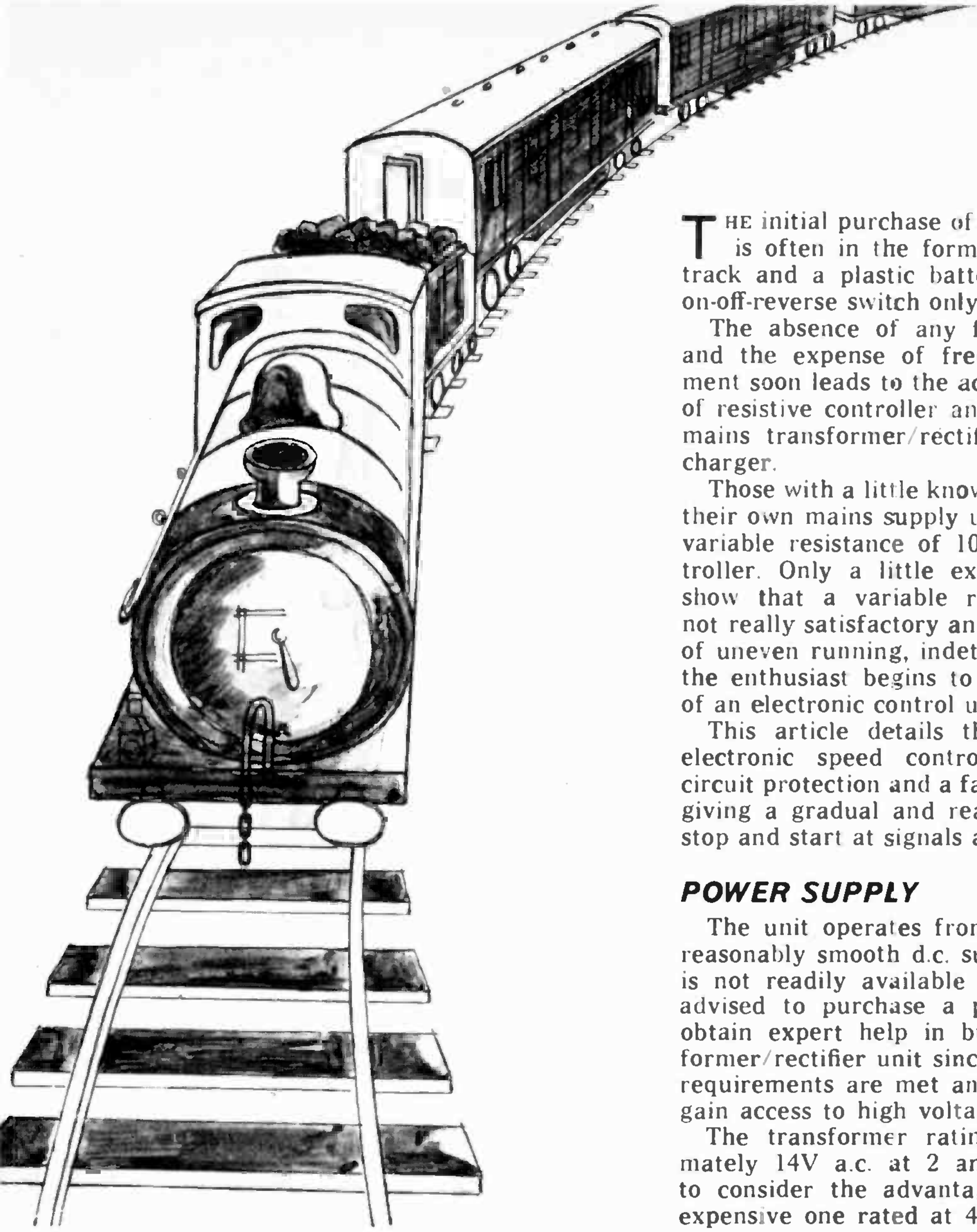


Fig. 4.9. The OC170 and OC171 types of transistor.

Next month: More types, manufacture of planar devices and testing.



THE initial purchase of model train equipment is often in the form of a "set" with train, track and a plastic battery box fitted with an on-off-reverse switch only.

The absence of any form of speed control and the expense of frequent battery replacement soon leads to the acquisition of some form of resistive controller and, either a proprietary mains transformer/rectifier unit, or a battery charger.

Those with a little know-how elect to construct their own mains supply unit using a heavy duty variable resistance of 100-200 ohm as the controller. Only a little experience is needed to show that a variable resistance controller is not really satisfactory and to counter the effects of uneven running, indeterminate starting, etc., the enthusiast begins to consider the purchase of an electronic control unit.

This article details the construction of an electronic speed control incorporating short circuit protection and a facility for automatically giving a gradual and realistic speed change to stop and start at signals and stations.

POWER SUPPLY

The unit operates from an approximate 12V reasonably smooth d.c. supply. If such a supply is not readily available the novice is strongly advised to purchase a proprietary unit or to obtain expert help in building a mains transformer/rectifier unit since it is vital that safety requirements are met and that children cannot gain access to high voltages.

The transformer rating should be approximately 14V a.c. at 2 amps, though it is well to consider the advantage of a slightly more expensive one rated at 4 amps preferably with two sets of windings to provide two independent

TRAIN CONTROLLER

BY A. J. DUNN

Gives realistic performance to your electric model train

Approximate cost of components including V.A.I.

£3.15 plus case

d.c. supplies and ample unrectified a.c. for electric point operation, lamps, etc.

A *smoothed* supply is essential.

Many proprietary units have no smoothing since the action of the train's motor is to average out the waveform. If such a supply unit is available it may be used if an electrolytic capacitor of approximately 2000μF is connected across its terminals.

The working voltage of such a capacitor should be at least 20V since it will charge up to the peak value when not connected to a load; when on load the voltage will fall to a lower voltage with a waveform as in Fig. 1.

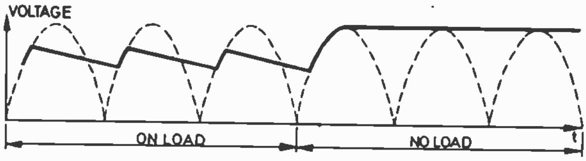


Fig. 1. Shows the voltage increase for no load condition.

Such a smoothing capacitor will take a momentary large charging current, possibly in excess of a fitted current trip. In such a case the trip should be wired *after* the supply has been smoothed. Should it be intended to use an unprotected d.c. supply other than for the short circuit protected circuit to be described, it would be necessary to provide a means of short time constant overload protection such as a quick acting magnetic cut out. Similarly, any a.c. output could be protected by a thermal cut out.

DESIGN REQUIREMENT

The starting performance of a loco is a common source of dissatisfaction; unless the resistive controller is well advanced it is often found that the loco will not move at all and then it suddenly speeds up, requiring immediate controller adjustment to avoid excess speed at points, curves, etc.

This effect is comparable to attempting to start off and drive a car in top gear; obviously the equivalent of a gear box is required, or a means to change the torque/speed characteristic.

In this design, this effect is achieved by switching the supply on and off at a fast rate; the ratio of the time it is switched on to the time it is switched off (the mark-space ratio) is varied by a control so that the extreme ends of the control range corresponds to the supply being virtually fully on or off.

In the condition of starting from rest, the supply is switched on for brief periods only (Fig. 2a), each period being long enough to develop the maximum torque from the motor but not long enough to allow for much movement so the loco moves in a series of almost undetectable jerks, slowly increasing speed.

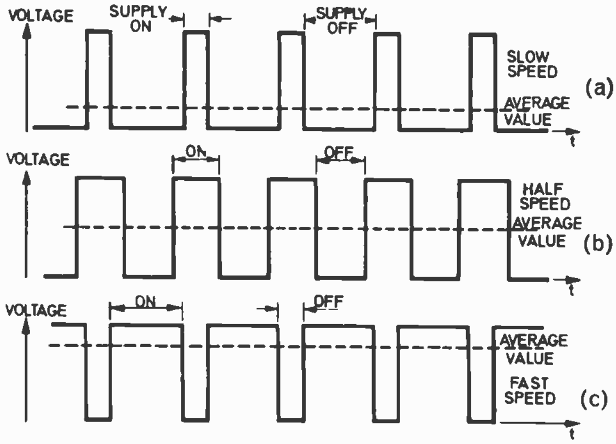


Fig. 2. Shows that the average value is proportional to the mark-space ratio.

In the half-way position, the controller creates an equal mark-space ratio or on for half the time (Fig. 2b) and the inertia of the motor integrates this and runs as if powered by half the supply volts.

In the fast position the controller switches the supply on for most of the time (see Fig. 2c) and the loco rail voltage is therefore the supply voltage (12-14V d.c.) less a 0·7V drop across TR1 and less the small voltage drop across R6 dependent upon the current taken.

TRAIN MOTOR

Consider the loco motor as shown in Fig. 3 here the resistance of the motor windings is shown as R_m in series with a generator—this being the back e.m.f. generator with an output proportional to speed.

At rest, when the supply is connected, the current that flows is the supply voltage V_s divided by R_m plus the control resistance R_c (including the supply resistances). The torque caused by the current causes the motor to revolve and overcome initial or static friction whereupon the motor runs faster and the back e.m.f. increases..

The current taken is now

$$\frac{V_s - V_g}{R_c + R_m}$$

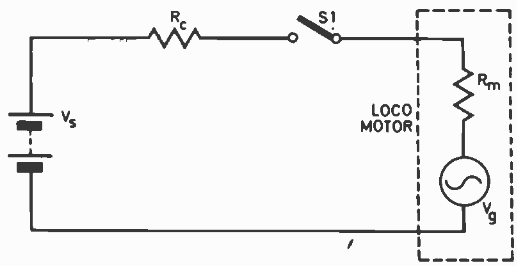


Fig. 3. The equivalent circuit of the loco motor in circuit.

and the torque is reduced accordingly. It is obvious that if V_s and R_c are both made very large and constant (normal constant current circuit) the motor speed will vary as a function of the load and, in cases of indeterminate frictional effects, will vary wildly.

From this consideration, the series resistance should be reduced as far as possible and the motor speed controlled by either a variable voltage low impedance source or by a fixed voltage and switched time division.

CIRCUIT

The complete circuit diagram of the train controller is shown in Fig. 4. Transistors TRA and TRB (inside the integrated circuit) form a multivibrator whose period is determined by the values of the capacitors C1, C2, R1 and (R2+VR1). The mark-space ratio is approximately 1:1 with the wiper of VR1 in the central position, and the collector of TRB (pin 5) is alternately at the supply voltage or approximately +0·2V when TRB is turned on hard or saturated. This square wave signal is applied via R4 to TRC which is switched on or off.

For the moment leaving aside transistor TRD, the collector of TRC is connected to the base of TRE which forms, with TR1, a compound emitter follower giving a large current low impedance square wave output.

Diode D2 is wired in the circuit, reverse biased, to protect TR1 from transient reverse voltage produced by the inductance of the motor winding and commutator switching.

SHORT CIRCUIT PROTECTION

Short circuit protection is provided by the use of R6 (approximately 0·5 ohm), the connections to TRD being so arranged that if a current in excess of 1·5 amps flows through R6, the voltage across it will turn on TRD.

The base current of TRD is limited by R7, but it will saturate and the collector of TRD will fall to approximately +0·2V pulling down the base of TRE and virtually turning off TR1.

Accidental short circuits are thereby limited to approximately 1·5 amps though this figure may be readily changed by changing R6 such that,

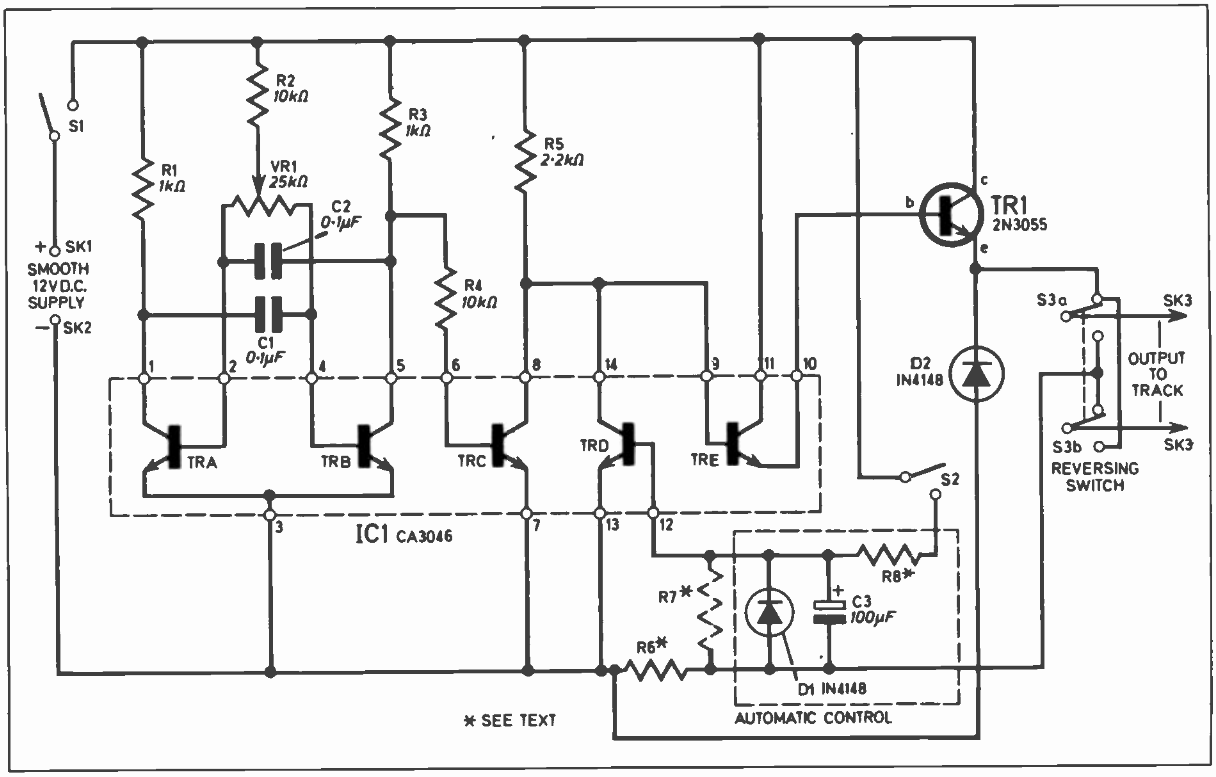
$$(\text{short circuit current in amps}) \times (\text{R6 in ohms}) \simeq 0{\cdot}7\text{V}.$$

AUTOMATIC CONTROL

Automatic control is achieved by replacing R7 with D1, C3 and R8 as shown in Fig. 4.

Consider first that S2 is open: if a short circuit is applied to the output, the voltage across R6 will be applied via D1 to the base of TRD. The voltage that must be produced across R6 to saturate TRD is now approximately 1·4V made up of 0·7V to turn on D1, and 0·7V the voltage dropped across the base/emitter junction of TR1.

Fig. 4. The complete circuit diagram of the Train Controller.



TRAIN CONTROLLER

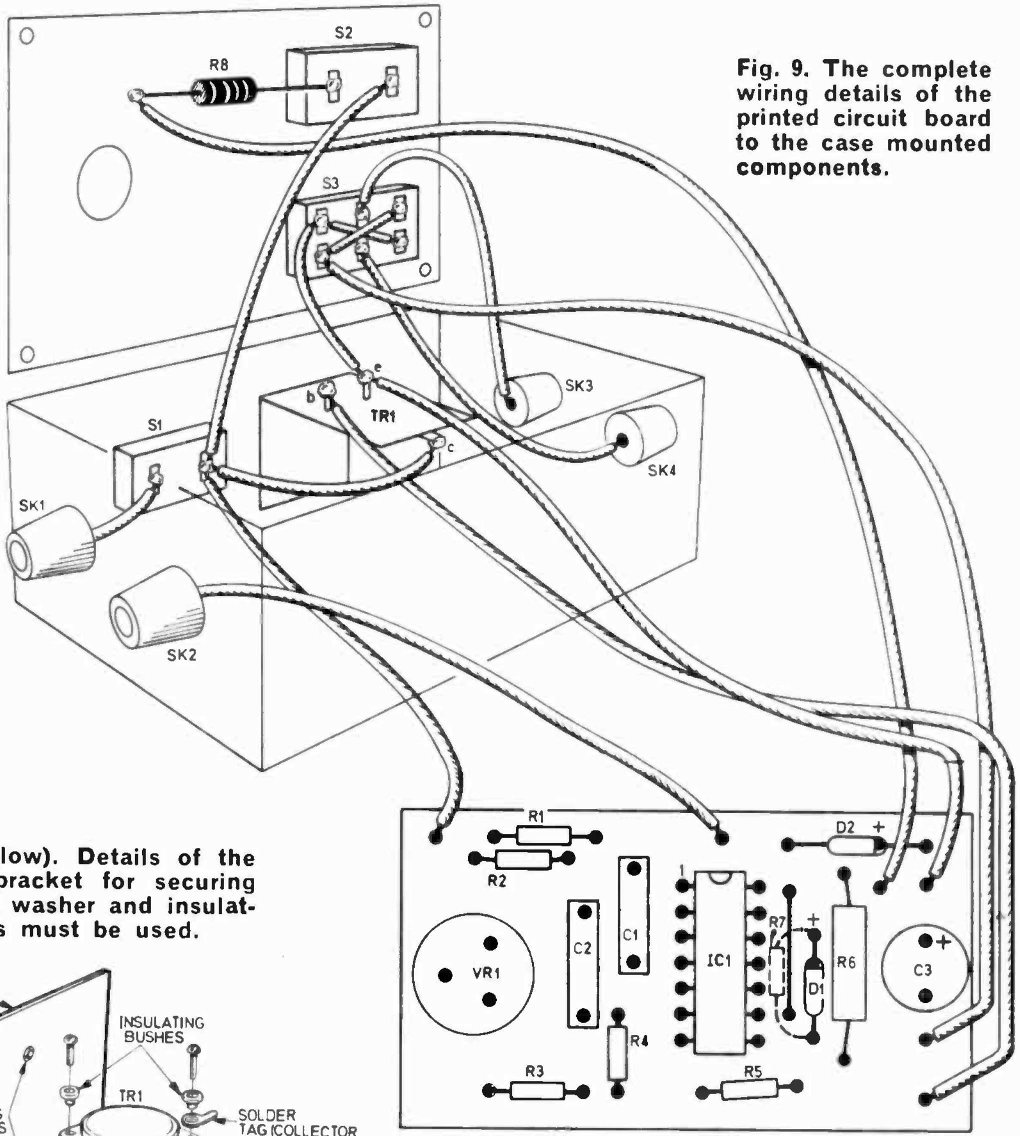
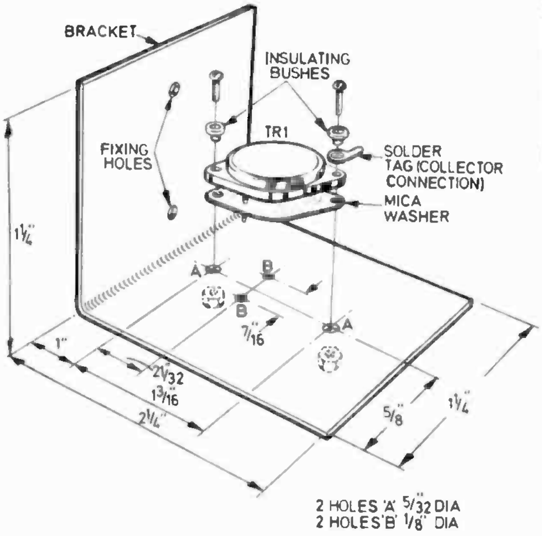


Fig. 9. The complete wiring details of the printed circuit board to the case mounted components.

Fig. 7 (above). The layout of the components on the top side of the printed circuit board. Note the polarity of the diodes and the integrated circuit.

Fig. 8 (below). Details of the heatsink bracket for securing TR1. Mica washer and insulating bushes must be used.



The value of R6 should be selected accordingly.

Assume that the control VR1 is adjusted centrally to give a 1:1 mark-space ratio and that a train is running to a signal set at stop.

If S2 is closed, C3 will charge slowly via R8. The time constant of C3, R8 is given by

$$t(\text{secs}) = (\text{R8 in ohms}) \times (\text{C3 in farads})$$

With R8 at 100 kilohm this gives t = 10secs.

However, this corresponds to approximately 60 per cent of the charge voltage, or 7V from a 12V supply and only approimately 1V is necessary to operate TRD. The relationship between time and charge is approximately linear so 1V will be obtained in one-seventh of the time for 7V or 10/7secs $\simeq 1\frac{1}{2}$ secs.

As C3 charges, TRD will gradually pass more current, limiting the pulses from TR1 and after $1\frac{1}{2}$ seconds TR1 will be cut off and the train stopped.

Consider now that the signal aspect is changed and that by the use of a parallel switch or a relay, S2 is opened. The charge on C3 cannot pass via D1 (reverse biased) and so must dissipate by providing the base current to TRD. As the charge on C3 falls, so the current taken by TRD falls and output pulses from TR1 increase and start the train. After a short period C3 is virtually discharged and the train runs as in the original condition.

PRINTED CIRCUIT BOARD

The unit is to be constructed on a piece of printed circuit board the full-size drawing of which is shown in Fig. 5. The component layout on the top side of the board is shown in Fig. 6, the only critical positioning being the holes for VR1 and the integrated circuit, ICI via its holder.

Note that R7 is shown (dotted) for initial testing; automatic control is obtained (if desired) by replacing R7 after testing with D1 and C3 wired as shown.

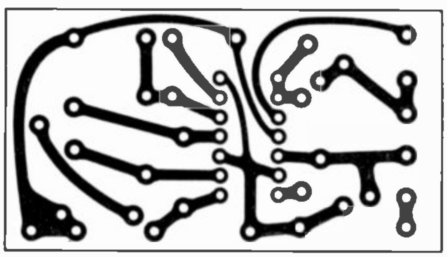


Fig. 5. The full-size master of the printed circuit.

CONSTRUCTION

The printed circuit board should be produced as described in the article *Making Printed Circuit Boards*, E.E. June 1973.

When the board is ready, drill all the holes with a No. 62-68 drill bit and then enlarge the holes to take the potentiometer VR1 with a larger drill or small file so that a snug fit is obtained.

Next solder VR1, the i.c. holder, the resistors and capacitors in position as indicated in Fig. 6. If the automatic control is to be installed leave the leads of R7 long for easy removal later. When this has been done plug in IC1 ensuring that it is the correct way round; this is done with reference to the notch at one end of the integrated circuit.

Next make the aluminium heatsink bracket as shown in Fig. 8 for the power transistor TR1 and fix the latter to the bracket via a mica washer and insulating bushes.

Secure the solder tag to the case of TR1 via one of its fixing bolts; this is the connection to the collector of TR1 since the casing is internally connected to the collector.

Put some heatsink compound on the bracket where it is to be in contact with the diecast case and tightly bolt the bracket in position.

Fix the other components to the case and wire up as shown in Fig. 9.

Components....

SEE **SHOP TALK**

Resistors

R1 1kΩ
R2 10kΩ
R3 1kΩ
R4 10kΩ
R5 2·2kΩ
R6 0·5Ω 1W wirewound }
R7 100Ω } See text
R8 100kΩ }
All $\frac{1}{8}$ watt carbon ± 10% unless otherwise stated.

Potentiometer

VR1 25kΩ carbon linear, printed circuit type

Capacitors

C1 0·1μF
C2 0·1μF
C3 100μF 12V elect.

Semiconductors

TR1 2N3055 silicon *npn*
IC1 CA3046 integrated circuit
D1, D2 IN4148

Miscellaneous

SK1-4 Screw terminals (4 off)
S1, S2 On/off toggle or slide (2 off)
S3 D.P.D.T. break-before-make
Printed circuit board, size 58 x 32 mm; etchant—ferric chloride; diecast aluminium case or similar metal case; knob; 16 s.w.g. aluminium; mica washer and bushes for TR1; 14 pin dual-in-line socket.

TESTING

The board should be carefully examined to ensure that the components have been wired up correctly paying particular attention to the polarity of D2 and the wiring to TR1.

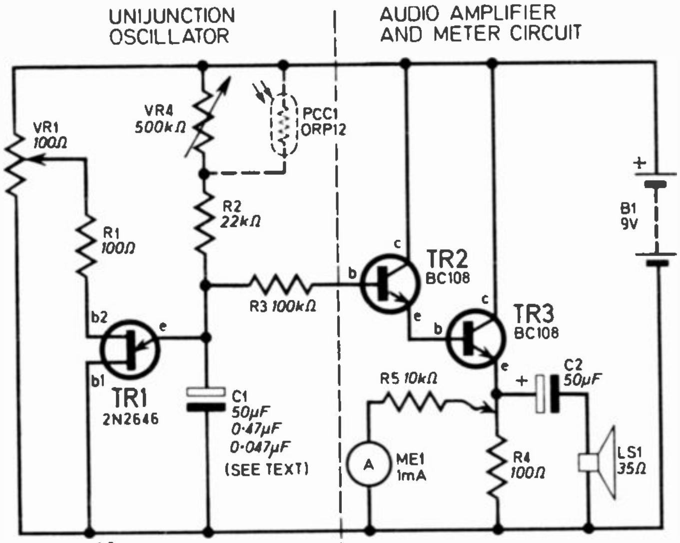
Check for short circuits, solder bridges, etc., and that the polarity of the supply is correct.

falls towards zero—and this encourages more current to flow in from the emitter which again makes R_{b1} reduce in value. We have, in effect, a sort of positive feedback reaction. The current flowing into the emitter flows out of C1 and the potential at *B* falls rapidly towards zero. When it reaches almost zero the inflow of current reduces and the resistance of R_{b1} rises back to its original level; the diode again becomes reverse biased and C1 is free to charge up again.

OUTPUTS

The nice thing about a unijunction oscillator is that we have two possible waveforms at our disposal; one approaching a sawtooth at point *B* which rises—as the capacitor charges—along an exponential curve and then falls very rapidly to zero. While the feedback reaction is taking place extra current flows through R1 (because the internal resistance of the unijunction falls) and we will get very short duration negative going pulses at point *A*.

Resistor R2 should always be greater than a certain value otherwise sufficient emitter/base current could flow through it to maintain the unijunction in conduction. On the other hand it can be as high a value as you like—provided it does not approach the leakage resistance of the emitter base junction. Capacitor C1 can be of almost any value hence it is possible to get a tremendous range of frequencies with this very simple circuit by changing the value of C1 and making R2 variable—above a certain value.



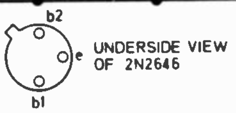


Fig. 10.3. Practical circuit used to demonstrate the operation of the unijunction oscillator. Alteration of C1 varies the frequency, as does VR4 or PCC1, whichever is in circuit. Potentiometer VR1 will also alter the frequency but this will affect the amplitude of the output.

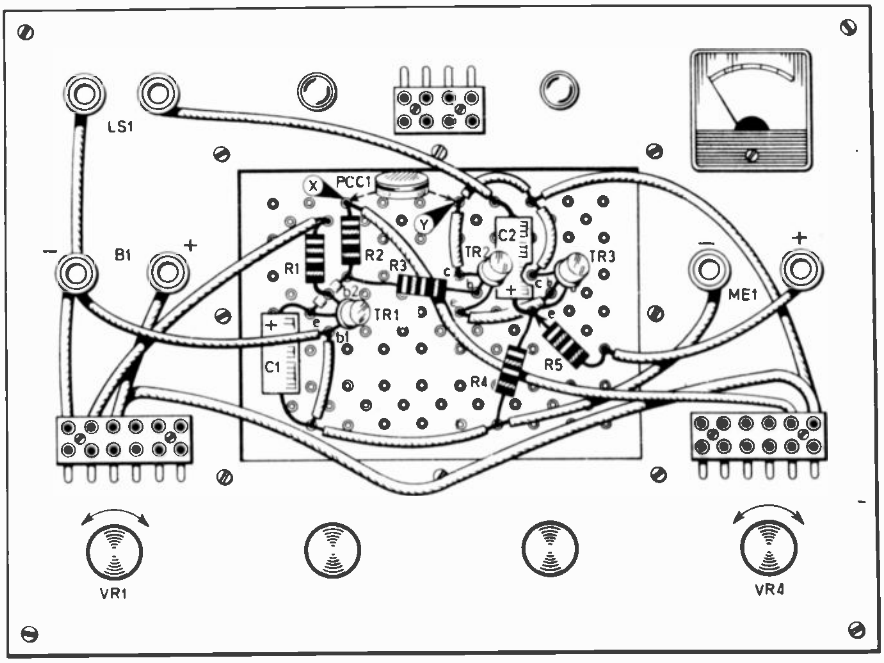


Fig. 10.4. The circuit of Fig. 10.3 wired up on the Demo Deck.

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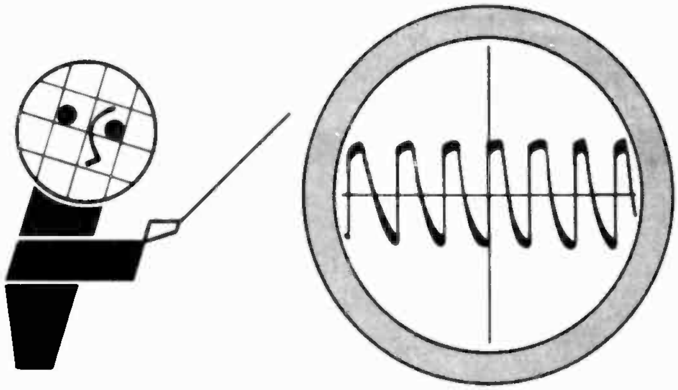

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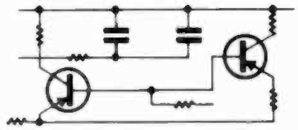

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A15B	75p	GL23	£1·00	VA1005	15p
CZ1	15p	R53	£1·32	VA1026	13p
CZ4	13p	R54	£1·46	VA1033	13p
CZ13A	13p			VA1040	10p
E298 ED/A258	10p			VA1053	10p
E298 ZZ/06	10p			VA1055S	10p
GL16	£1			VA1034	10p

Potentiometers

5KΩ	50KΩ	500KΩ
10KΩ	100KΩ	1MΩ
25KΩ	250KΩ	2MΩ

log or lin less switch (& 1KΩ lin)	12p
log or lin with switch	24p
dual less switch	40p
dual with switch 10K, 100K & 1M log only	52p
10K log 10K antilog less switch	40p

Capacitors

disc ceramic		low voltage		
·01μF 18v	5p	0·1μF	30v	5p
·022μF 18v	5p	0·22μF	6v	5p
·047μF 12v	5p	0·47μF	3v	5p

ceramic plate		30V	
1000pf	10p	4700pf	10p
2200pf	10p	10,000pf	10p

Ceramic – plate		63V (C333)	
1·8pf	8·2pf	33pf	120pf
2·2pf	10pf	39pf	150pf
3·3pf	12pf	47pf	180pf
3·9pf	15pf	56pf	220pf
4·7pf	18pf	68pf	270pf
5·6pf	22pf	82pf	330pf
6·8pf	27pf	100pf	

all 5p. each

mylar film		100V			
1000pf 2p	·01μF	3p	·068μF	4p
2000pf 2p	·02μF	3p	·1μF	4p
5000pf 2p	·04μF	3p	·2μF	5p
	·05μF	3p		

polystyrene 160V
10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68. 3p each

metallised polyester		250V (C280)			
·01μF	3p	·068μF 3½p	·47μF	8p
·015μF	3p	·1μF 4p	·68μF	11p
·022μF	3p	·15μF 4p	1μF	13p
·033μF	3p	·22μF 5p	1·5μF	20p
·047μF	3p	·33μF 6½p	2·2μF	24p

metallised polyester		400V (C281)			
·01μF	4½p	·047μF 6p	·22μF	10p
·015μF	4½p	·068μF 6p	·33μF	14p
·022μF	4½p	·1μF 7p	·47μF	15p
·033μF	5½p	·15μF 8p		

silvered mica 1% (>50pf) 500V

2·2pf—820pf	7p	4·7nF—5600pf	19p
1nF—2·2nf	9p	6800pf—·01μF	29p
2·7nF—3·6nF	16p		

mixed dielectric		600V			
·01μF	7p	·047μF 7p	·22μF	16p
·022μF	7p	·068μF 8p	·47μF	24p
·033μF	7p	·1μF 8p	1μF	33p

Slider Pots

Single	Dual	log
10K	10 + 10K	or
25K	25 + 25K	lin
50K	50 + 50K	
100K	100 + 100K	Knobs
30p	50p	10p.

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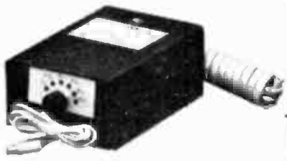
1 W	10% Carbon Composition	3p each
2 W	10% Carbon Composition	6p each
2½ W	5% Wire wound	9p each
5 W	Wire wound	9p each
10 W	Wire wound	10p each

plus p. & p. 7p for up to 25 resistors plus 1p for each additional 25.

Eliminators



6 volt 50mA	£1.50
9 volt 50mA	£1.50
6 + 6 volt, 50mA	£2.50
9 + 9 volt, 50mA	£2.50
7½ volt for cassette recorders	£2.00
6, 7½ or 9 volt	£3.00
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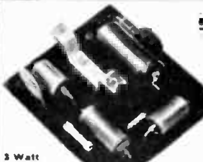
AA120	9p	BA243	56p	BY182	£1·50
AA129	9p	OA47	10p	BY250	23p
BA102	25p	OA79	9p	IN4001	6p
BA115	17p	OA90	7p	IN4002	7p
BA130	10p	OA91	7p	IN4003	8p
BA145	20p	OA200	10p	IN4004	8p
BA148	20p	BY100	16p	IN4005	10p
BA154	13p	BY126	15p	IN4006	12p
BA155	14p	BY127	15p	IN4007	15p

SGS



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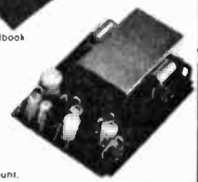
25 + less 25%
100 + less 33⅓%



5 Watt Audio Amplifier

Our Price £3·99
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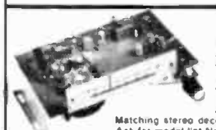

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250	2·5KΩ	25KΩ	250KΩ	2·5MΩ
500	5KΩ	50KΩ	500KΩ	5MΩ

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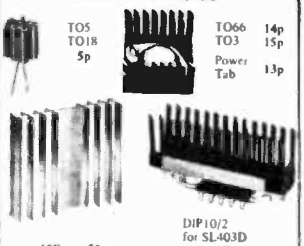
Telephone 01-883 3705

mixed dielectric		1000V			
1000pf	6p	6800pf	9p	·1μF	12p
2200pf	6p	·01μF	9p	·22μF	22p
3300pf	6p	·022μF	9p	·47μF	30p
4700pf	6p	·047μF	12p		

Ceramic

12KV.d.c.		8KV.d.c.		HI-K 750V	
10pf	9p	200pf	9p	1000pf	5p
15pf	9p	220pf	9p		
22pf	9p	250pf	9p	2000pf	5p
68pf	9p	270pf	9p	3000pf	5p
82pf	9p	300pf	9p	5000pf	5p
100pf	9p	750V DISC		10,000pf	5p
120pf	9p	470pf	5p	feed-	
140pf	9p	1000pf	5p	through	
150pf	9p	5000pf	5p		
180pf	9p	10,000pf	5p	1000pf	5p

Heat Sinks



TO5 TO18	5p
TO66	14p
TO3	15p
Power Tab	13p
10D	50p
DIP10/2 for SL403D	15p

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AC107	25p	BC147	10p	BF196	15p	OC81	19p	2N1304	22p	2N5172	15p
AC126	17p	BC148	10p	BF197	15p	OC140	20p	2N1711	25p	BZY88 ZENERS SERIES	10p ea.
AC127	15p	BC149	10p	BF272	53p	OC170	23p	2N1893	30p		
AC128	15p	BC157	12p	BFY50	24p	OC171	30p	2N2926 all	10p		
AC176	15p	BC158	10p	BFY51	21p	ZTX107	15p	2N3053	23p	LO05TI	£1.50
AC187	25p	BC159	12p	BRY39	36p	ZTX108	12p	2N3054	50p	LO36TI	£1.50
AC187K	25p	BC169	15p	BSX21	26p	ZTX109	15p	2N3055	49p	LO37TI	£1.50
AC188	25p	BC268	15p	BSY95A	14p	ZTX300	12p	2N3702	12p	MC1303L	£1.75
AC188K	25p	BD115	67p	BU105/02	£1.75	ZTX301	15p	2N3703	12p	MC1330	80p
ACY20	20p	BD131	70p	MJE340	67p	ZTX302	20p	2N3704	10p	MC1350	75p
AD140	40p	BD132	70p	MPF102	40p	ZTX303	20p	2N3705	10p	MC1351	£1.00
AD149	40p	BD131/2M P.	149p	MPF103	37p	ZTX304	25p	2N3706	10p	MC1352	£1.00
AD161 AD162	60p			MPF104	37p	ZTX341	20p	2N3707	15p	MFC4000B	49p
		BF160	21p	MPF105	40p	ZTX500	15p	2N3708	12p	MFC4010A	55p
AF114	18p	BF167	20p	MPF106	45p	ZTX501	15p	2N3709	12p	LM380	£1.45
AF115	18p	BF173	20p	OC28	40p	ZTX502	20p	2N3710	12p	SL403D	£1.50
AF116	18p	BF180	25p	OC35	40p	ZTX503	17p	2N3711	12p	TAD100	£1.50
AF117	18p	BF181	30p	OC44	15p	ZTX504	50p	2N3819	35p	FILTER UP1175	£1.50
AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3903	15p	μA709C	45p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3904	17p	μA710	45p
BC108	10p	BF194	15p	OC72	17p	2N706	12p	2N3905	21p	μA723C	£1.05
BC109	10p	BF195	15p	OC76	15p	2N708	15p	2N3906	12p	μA741C	58p

Mullard & Siemens Electrolytics

CAP μF	4	6.3	10	16	25	40	63
1	—	—	—	—	—	—	6p
1·5	—	—	—	—	—	—	6p
2·2	—	—	—	—	—	—	6p
3·3	—	—	—	—	—	—	6p
4·7	—	—	—	—	—	—	6p
6·8	—	—	—	—	—	6p	6p
10	—	—	—	—	6p	—	6p
15	—	—	—	6p	—	6p	6p
22	—	—	6p	—	6p	—	6p
33	—	6p	—	6p	—	6p	—
47	6p	—	6p	—	6p	6p	6p
68	—	6p	—	6p	—	—	10p
100	6p	—	6p	—	6p	6p	12p
150	—	6p	—	6p	6p	10p	12p
220	6p	—	6p	6p	10p	12p	18p
330	6p	—	6p	10p	—	—	21p
470	—	6p	10p	—	12p	18p	40p
680	—	10p	—	12p	18p	21p	—
1000	10p	—	12p	18p	21p	40p	60p
1500	—	12p	18p	21p	—	—	—
2200	—	18p	21p	40p	45p	55p	93p
3300	—	21p	—	—	—	—	—
4700	21p	—	—	60p	75p	93p	—

CAP μF	16	25	40	64
500			33p	40p
1250			50p	—
1600			—	75p
2000	40p	50p	—	—
2500	—	—	75p	93p
3200	50p	—	—	—
4000		75p	93p	—
6400	75p	93p	—	—

Quantity Prices on application

Veroboard

	Copperclad 0.1"	Copperclad 0.15"	Plain 0.15"
2½" x 1"	6p	6p	—
2½" x 3¾"	20p	16p (9)	10p
2½" x 5"	24p	21p (7)	12p
3¾" x 3¾"	24p	21p (8)	—
3¾" x 5"	27p	27p (10)	17p
17" x 2½"	67p	50p	37p
17" x 3¾"	90p	70p	52p
17" x 5"	—	—	75p

Spot-face Cutter	36p
Pin Insertion Tool	47p
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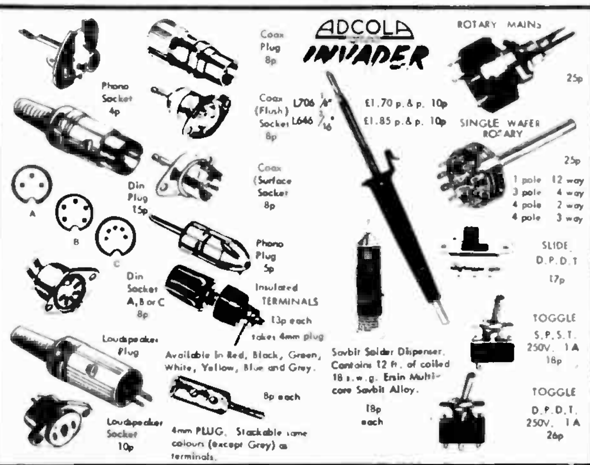
(10)	4" x 5¼" x 1½"	40p	8p
11	4" x 2½" x 2"	35p	8p
12	3" x 2" x 1"	32p	9p
13	6" x 4" x 2"	50p	10p
14	7" x 5" x 2½"	58p	12p
15	8" x 6" x 3"	75p	18p
16	10" x 7" x 3"	85p	20p



Hi-Volt Electrolytics

1; 2; 4; 8μF	450V	14p	32μF	450V	20p
16μF	450V	15p	50μF	350V	20p
8 + 8μF; 450 V.W		18p	32 + 32μF; 350 V.W		25p
8 + 16μF; 450 V.W		20p	32 + 32μF; 450 V.W		43p
16 + 16μF; 450 V.W		25p	50 + 50μF; 350 V.W		35p

EXPERIMENTAL CIRCUIT

The experiment—shown in Fig. 10.3 will operate very slowly (several seconds per cycle) if C1 is made to be 50μF and thus it is possible to monitor the exponential waveform at the emitter on the 1mA meter movement of the Demo Deck. Alternatively insert a lower value capacitor (two alternative values are suggested) and listen to the sound on Demo Deck's loudspeaker. Fig. 10.4 shows the experimental circuit with audible and visual monitoring wired up on the Demo Deck.

Potentiometer VR1 is included to alter the quiescent potential at the point originally called *A*. Start with VR1 set with the wiper nearest the positive supply rail and then reduce this voltage by turning the potentiometer down; the frequency of the oscillator will increase because the level to which the capacitor has to charge is being reduced—the amplitude of the signal will, however, reduce. Adjustment of VR4 will modify the frequency over a very wide range without altering the amplitude.

Substitute PCC1 for VR4 and it is possible to make a light controlled oscillator—the basis for an interesting musical instrument if you shade the cell with your hands! An interesting feature of the unijunction is that b1 can be interchanged for b2 and the device will still work, but this will be turning the intrinsic stand off ratio on its head and the amplitude of signal will be nothing like as great—try it and see!

Next part: The Hartley Oscillator

SHOP TALK

By Mike Kenward

BECAUSE the electronic component industry is booming private constructors are having difficulty in obtaining some components. It sounds stupid but it's true, the manufacturers have trouble in keeping up with the demands of industry and very often cannot supply the smaller customer. At the present time a number of capacitors are difficult to get and we know some firms have been quoted delivery times months away.

Unfortunately there is nothing that either we or the retailer can do about this situation other than be aware of it and try to help you overcome the problems by finding alternative components. So don't always blame the shopkeeper—remember that in this business he is at the bottom of a very long list when it comes to supply deliveries from the big companies.

Personal Receiver

The *Personal Receiver* is likely to fall foul of the problems mentioned above—two of the capacitors may be difficult to get (C3 0·1μF and C4 0·05μF, miniature) to overcome these problems we have given an alternative for C3 (0·22μF) and we suggest that you use the receiver without C4 until this can be purchased. This will result in some loss of volume as the audio signal will have to pass through R5 instead of being decoupled by C4 but the receiver will work quite well like this.

A marked and drilled printed circuit board for the receiver is available from Valance Electronics, 2A Canel St., Droglesden, Manchester. We believe this firm may also be able to supply the plastic case used.

Finally, remember that this project is fairly small and all the components used should be miniature or very small types as listed in the components box.

Train Controller

It seems strange that this issue contains two projects which use integrated circuits, perhaps it's a sign of the times—no doubt these devices will be featured more and more in our projects as the months go by. We suggest that you use a socket for mounting the i c. in the *Train Controller* so that this can be soldered in without fear of damage to the i.c.

The electrolytic capacitor used should be a printed circuit type and the right size component is available from Electrovalue, 28 St. Judes Road, Englefield Green, Egham, Surrey.

It is mentioned in the text that a metal case should be used as this forms a heat sink for the power transistor. Diecast boxes of the appropriate size are available and should make excellent cases for this project. If you paint the case remember that darker colours dissipate the heat better.

Aquarium Thermostat

We had better not praise the *Aquarium Thermostat* too much, someone might notice who wrote the article! In fact, it is difficult to say much about it since most of the components are generally available. The transformer should be available from most electrical shops or Woolworths. The thermistor can be obtained from most of the larger suppliers, while the relay is available from G. W. Smith should other sources fail.

The heater used with the prototype was a standard one sold for aquarium use. Incidentally, too large a heater (wattage size that is) will result in a poor constant temperature.

Bulb Resistance

I measured the resistance of a 6V, 0·04A bulb and was surprised to see it was much lower than expected. To pass 40mA with 6V applied, it should have a resistance of $\frac{6}{0{\cdot}04}=150$ ohm but mine was round about 80 ohm. Is this a "rogue" lamp?

No. The tungsten filament in the bulb has what is called a "positive temperature coefficient of resistance". This means that when it is cold it has a lower resistance than when hot. The current stated for the bulb is that which it draws when it has got up to its working temperature—well over 1,000 degrees Centigrade.

Screening

Could you explain—in simple terms—how a screened lead prevents hum pick up?

Hum pick up is often caused by capacitive coupling between a wire and mains wiring in the same area. If you surround the wire in question with a shield (the screen) capacitive coupling will be between the mains lead and this screen. If the latter is connected to ground the potential of the screen remains constant and the capacitively induced current runs straight to ground. According to Faraday (his ice pail experiment) no charge can be induced on a totally enclosed body and as the conductor wire is now totally enclosed by the screen it will pick up no hum.

Output Stage

In the days of valves we had to drive loudspeakers with transformers but it seems as though this is not necessary with transistors. Why is this so?

Valves operated by controlling quite high voltages at small currents while loudspeakers — because of their low coil resistances need high current at quite low voltages. If you assume that there is conservation of power between input and output of a transformer it is an excellent device for converting from high voltage swings at low current to low voltage swings at high current. This is why they are used in valve circuits.

On the other hand transistors are basically current controllers and consequently are able to handle low voltages at reasonable currents directly and there is no need to use transformers in most cases. It is, of course, highly desirable to remove transformers from circuits because they are bulky and are never perfectly efficient: they also introduce a degree of distortion that had to be overcome with quite complicated circuitry in the old valve days.

Smoothing

In the old days I used to use chokes for smoothing but never see these in modern equipment. Are they not as good as the modern approach—which seems to use a resistor?

The resistor between the two capacitors in a smoothing circuit is not as good as the "old fashioned" choke because it is inefficient (wastes power) and the smoothing effect is not so good.

However, these days when we use transistors in most equipment the current that is drawn from the power supply tends to be very high (compared with that taken by equivalent valve circuitry) and to prevent the core of the choke becoming "saturated" it would be necessary to have a large amount of iron. Not only this but the windings would have to be of stouter wire to carry the higher current. Consequently chokes would be very expensive and far too cumbersome in modern systems. One of the sacrifices in quality we have to make for the convenience of modern living?

Wiring Layout

Why is it that some of your articles say "layout" is important? Surely a wire is a wire and provided it goes to the right place—irrespective of position—then all is correct.

Layout is not always important but in some cases it is. More particularly when the circuit is dealing with high frequencies. All connecting wire—even if it is straight—has a small amount of inductance. This can modify the tuning of radios and introduce reactance where it is not wanted.

There is always a degree of capacitance between a wire and neighbouring components—it may only be small but at very high frequencies this small capacitance can transmit small a.c. currents. These currents might cause positive feedback—making the circuit oscillate—or negative feedback which reduces the gain of the system. You can also get inductive coupling.

In a.c. circuits it is good practice to keep wire lengths as short as possible and to separate input circuits from output circuits. Sometimes neat "loomed" wiring makes matters worse because the bundling together of the wires makes the inter-wire capacitive coupling greater. Generally speaking there are no problems with simple d.c. and logic circuits unless they are operating at very high speeds.

"But dad, the article in here says it's so simple to strip down that even a child could do it."

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B86	100	Sil. Diodes sub. min. IN914 and IN916 types	55p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc	55p
B1	50	Germanium Transistors PNP, AF and RF	55p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	55p
H17	20	3 amp. Silicon Stud Rectifiers, mixed volts	55p
H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	55p
H16	15	Experimenters' Pak of Integrated Circuits. Data supplied	55p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	55p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	55p

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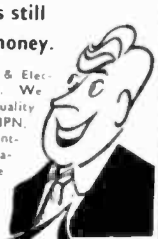

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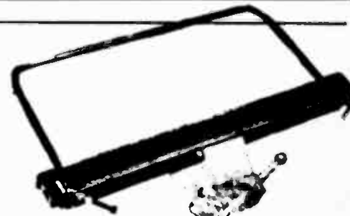

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DOWN TO EARTH

By GEORGE HYLTON

> "In published circuits a volume control is sometimes connected as in Fig. 1a, with the input to the slider, and sometimes as in Fig. 1b, with the output from the slider. Which method of connection is correct?"

The short answer is: when the output from the volume control is connected to a low impedance load, use Fig. 1a. For high impedance load, use Fig. 1b.

The essential point is that a volume control doesn't exist in isolation. The way it works in a practical circuit depends on what comes before it and what goes after it. Disregard this simple fact and you may end up with a control which has no effect as it is turned until the slider is very nearly at the end of the track, whereupon the volume suddenly changes from minimum to maximum. What's known to the trade as a "fierce" control.

ENDS AND MEANS

The circuit of Fig. 2a is a case in point. With the slider at the start (*s*) of the track, the signal (here 1 volt from a source of 100 ohms) is shorted, so the output is zero—the output in this case being the voltage which appears across the 1 megohm load resistance. With the slider at the finish (*f*) of the track, the signal source is connected to the total resistance of the track (100 kilohms) in parallel with the load (1< megohm), i.e. about 90 kilohms.

When current flows, only a small amount of the 1 volt signal is lost in the signal-source's own internal impedance of 100 ohms (it might be a 100 ohm microphone, for instance) and practically the whole 1 volt appears across the load R_L. In a word, volume is maximum.

So the volume is zero with the slider at *s* and maximum with the slider at *f*. This is alright if you only want to operate your equipment at maximum volume, but not for intermediate settings.

CALCULATE

First, calculate, or at any rate get a rough idea of the current through the load when the slider is at *f*. As we saw, the voltage across the load is almost 1 volt, so 1 micramp flows. Now move the slider back to the bottom (*s*) of the track and then adjust it so that there's just 1 kilohm between slider and earth. What current flows?

Well, obviously the current from the source divides at the slider, part flowing up and through the load and part down to earth. But since there's nearly 1100 kilohm in the upper path (1 megohm plus 100 kilohm) and only 1K in the lower, we can safely say that the lower path has the controlling effect and forget about the upper.

For practical purposes, the signal "sees" a load of its own 100 ohms plus the 1 kilohm between slider and earth: in other words, the total resistance is 1100 ohms, which with 1 volt gives a current of 0·9 milliamps (using ohm's law $I=V/R$). This 0·9 milliamps flows through the 1 kilohm, setting up a voltage drop of 0·9 volt between slider and earth.

LOAD VOLTAGE

Now we come to the important point of the voltage across the load. The 0·9 volt at the slider drives a small current up through the track and then on through the 1 megohm load and back to earth. The resistance in this loop is 1·1 megohm, near enough, so the current is 0·9/1100000=0·8 microamps approx. Now, 0·8 microamp in 1 megohm produces a voltage of 0·8 volt, so, with the slider at the 1 kilohm point, the output is 0·8 volt. This, you'll note, is only 20 per cent less than the maximum output of 1 volt, and in terms of audibility is just perceptible.

So in moving the slider up to the 1 kilohm position we've changed the volume from zero to just below maximum. With a logarithmic law 100 kilohm volume control the 1 kilohm change calls for a rotation of about 10 per cent. The other 90 per cent produces hardly any further increase in volume.

The correct arrangement is as in Fig. 2b. But it's not universally correct. If you have a high impedance signal source Fig. 2c feeding a low impedance load, then this will now give a fierce control and the correct arrangement is as shown in Fig. 2d. These second two circuits are a complete reversal, in terms of fierceness or gentleness, of the first two, even though the volume control is 100 kilohm in every case.

A final tip. If, as sometimes happens, you are stuck with a particular value of volume control, then the best compromise is to use whichever of the two connections produces the least variation in the input signal current drawn as the control is turned from minimum to maximum volume.

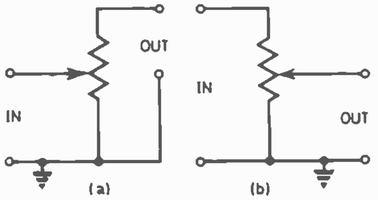


Fig. 1. Two common ways of connecting a volume control.

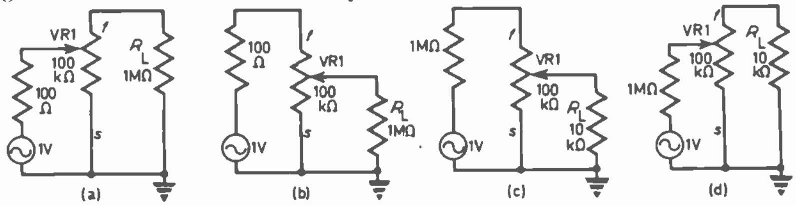
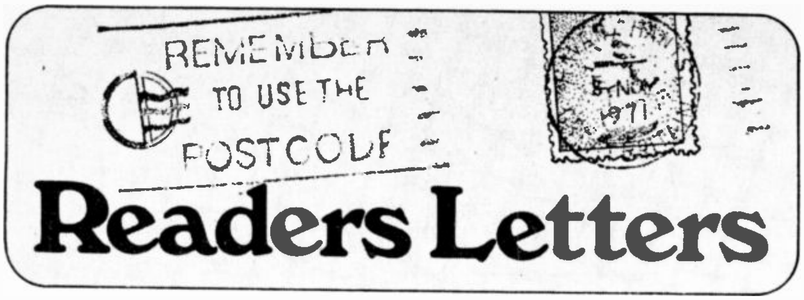


Fig. 2. Fierce (a and c) and gentle (b and d) volume controls.



Readers Letters

Simplified

Would it be possible to give me a brief description of the Demo Deck as I unfortunately missed that particular issue. I am now taking EE regularly, and I find it more suitable at my age (I am 75 yrs old), having started back in the old cat whisker days. I find the other publications a bit too complicated but interesting, what with all this hifi etc., which is a vast improvement on the old methods of valves and corner wall baffles etc. The explanations in EE are also much plainer, this must suit the younger people also, making it easier to grasp. The gadgets for the home are a great attraction for experimenting with, and your simple circuits require less time to make. Hoping you will carry on providing even more simplified versions.

E. Skidmore
Birmingham.

The Demo Deck will no longer feature in our pages. It has been used since December '71 and can still be used by readers for experimenting. The new beginners series Teach-In '74 will not be based on the Demo Deck.

Radio Amateurs

I write to ask that a brief item be inserted in EVERYDAY ELECTRONICS re. the amateur radio course run by the Northumberland County Education Dept., at Gosforth, very near to Newcastle upon Tyne.

The course to prepare students for the R.A.E. (Radio Amateurs Examination) in May/June 1974 will be run at the Grammar School, Gosforth, Northumberland, commencing in September 1973.

Held on Tuesday/Wednesday of each week from 7 pm to 9 pm. candidates may sit the R.A.E. at the School.

Enquiries should be addressed to the Principle, Gosforth Grammar School, Northumberland, who will forward a prospectus. Or further information can be had by telephoning Gosforth 851000.

I take the class and your co-operation in this matter would be appreciated.

D. R. Loveday.
Newcastle upon Tyne.

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

I find etching p.c. (printed circuit) boards takes a long time, to speed up the process all that is needed are two match sticks. Make up the etchant in the usual way, but before putting the p.c. board in the etchant dish, put the two match sticks in, parallel but some distance apart. The board rests on the match sticks keeping it away from the bottom of the dish.

The dish can now and again be rocked gently to and fro, all the dissolved particles of copper fall to the bottom of the dish and fresh etchent can start to dissolve the rest of the copper away.

J. Majchrowski.
Ayr.

Having made numerous projects I always find that the front panel or fascia presents a problem with respect to labelling. Engraving and "silk screen printing" being very expensive for the home builder and Dymo labels not giving a suitable appearance. I think the method I have adopted might be of interest to many other readers.

The process is as follows:

1. Drill all holes and slots in the required positions.
2. Spray the panel the desired colour using an aerosol spray.
3. Add the lettering using Letraset or Magic Letters, these need no more than placing on the panel and rubbing with a ball point pen to transfer each letter to the panel. A sheet of graph paper suitably placed and tacked in position lightly with sellotape, helps in keeping letters in alignment.
4. When satisfied that all is correct, a sheet of clear self adhesive film (available at W. H. Smiths) is rolled onto the panel starting at one end and making sure no air bubbles are left. If, accidentally an air pocket is made do not attempt to pull the film off but carefully pierce the bubble with a pin and roll again from the edges of the bubble towards the pin hole. The edges of the film should be left large enough so that they can be turned over and stuck to the reverse side of the panel so that with use the edges will not curl.

The finished panel viewed from a foot or so cannot easily be distinguished from a panel which has been silk screen printed. The surface is easily cleaned with a damp cloth and gives projects the professional finish.

A. Evans,
Portsmouth.

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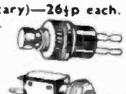
SW4—1 pole, 12 way.
SW5—2 pole, 6 way.
SW6—3 pole, 4 way.
SW7—4 pole, 2 way.
SW8—4 pole, 3 way.



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MAINS ISOLATING TRANSFORMERS
Is your bench safe?
Brand new, Hinchley, 200W, fully shrouded. Pri. 240V; Sec. tapped 210–240V. At a fraction of the maker's price. £3·50 plus 72p p. & p.

LAMP FLASHERS 240V
Connect in series with lamp supply to flash approx. once per second.

Type B: 100W, 44p.
Type C: 500W, £1·36.

EA 1000 BARGAIN
This popular 3W amplifier complete with comprehensive data book showing circuits for mono., stereo, tone controls, power supply, etc. **Our price only £2·35**, plus 13p P. & P.

PANEL NEON INDICATORS 240V
N1—Round, 9mm diameter, 33p.
N2—Round, 18mm diameter, 28½p.
N3—Oblong, 31 × 7mm, 32p.

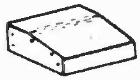
CASSETTE ACCESSORIES
Head cleaning tape, in library case, 54p.
Cassette rack with teak ends, holds 10 cassettes in library cases. 72p, plus 12p P. & P.

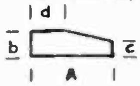
CONNECTING WIRE PACK
Contains 30 feet of stranded wire, 5 colours per pack. 11p.

RESISTORS
Carbon film
All 5%, high-stability, E12 values. ⅛W, 1p; ¼W, 1½p; 1W, 4½p; 2W, 6½p.
Wire-wound
5W, 11p; 10W, 13p.

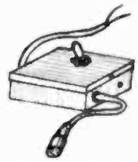
CONSOLE CASES
In plain aluminium, ideal for mixers, instruments, etc.

Type	W. in	A in	B in	C in	D in	Price	P.P.
GB20	8	9	3½	2	3	£1·56	33p
GB21	10	9	3½	2	3	£1·74	33p
GB22	12	9	3½	2	3	£1·89	33p





CAR-CASSETTE VOLTAGE STABILISERS
PU12 for Philips and similar cassette recorders. Gives 7½V stabilised output when connected to 12V + or − E car circuit. Fitted with 5 pin, 240° plug, **£3·55** plus 16p P. & P.
PU126, as above, but for 6V recorders. Fitted with coaxial power connector, **£3·55**, plus 16p P. & P.

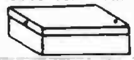


MAINS POWER SUPPLY
PP75 for Philips and similar cassette recorders. Input 240V a.c.; output 7½V d.c. Fitted with 5 pin, 240° plug, **£2·15**, plus 16p P. & P.

ALUMINIUM BOXES
with lids and screws

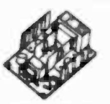
Type	L.	W.	D.	Price	P. & P.
GB7*	5¼in	2¼in	1½in	42p	16p
GB8*	4in	4in	1½in	42p	16p
GB9*	4in	2¼in	1½in	42p	14p
GB10*	5¼in	4in	1½in	49p	19p
GB11	4in	2¼in	2in	42p	14p
GB12	3in	2in	1in	36p	15p
GB13	6in	4in	2in	57p	20p
GB14	7in	5in	2½in	69p	21p
GB15	8in	6in	3in	89p	29p
GB16	10in	7in	3in	£1·00	29p

* These sizes fit standard veroboards



CRYSTAL MICROPHONE


A very neat, sensitive microphone for hand or table use. Complete with lead and 3·5 mm plug. £1·00.

10 WATT AMPLIFIER module


Input: 30mV into 10k Ω for 10W, 40 – 16,000 Hz. Output: 3·8–16 Ω Power Supply 12V **£4·70** plus 24p P. & P.

DYNAMIC MICROPHONE UD 130HL
This sensitive, quality microphone is uni-directional and is complete with mute switch and 20 feet of cable and plug. 100–12,000Hz. Dual impedance 600 Ω and 50k Ω.

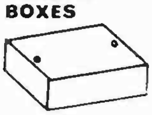
£6·60, plus 24p P. & P.

MINIATURE SPEAKERS
2½in. 8 Ω
2½in. 8 Ω
2½in. 80 Ω
All 71p each.

TAPE ERASER


erases a whole reel of tape in seconds. 240V a.c. Full instructions. £2·20, plus 22p P. & P.

SCREENED CABLES
Single for mics, audio leads, etc. 5½p yd.
Twin, as above, common screen 10p yd.
Stereo, two cores, individually screened 11p yd.
Four core with common screen 23p yd.
Four core, individually screened 30p yd.
Coiled screened leads, 20 feet long £1·05 each.

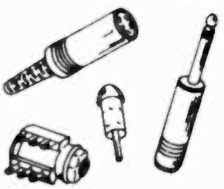
PLASTIC BOXES


for constructional projects. White, with lid and screws. **BP1** 4½ins × 3ins × 1½ins—37p. **BP2** 6ins × 4ins × 2½ins—37p.

CATALOGUE
15p
POST FREE

PLUGS

Car aerial	15½p
Co-axial	10p
D.I.N. 2 pin (speaker)	11p
D.I.N. 3 pin	15p
D.I.N. 4 pin	15½p
D.I.N. 5 pin, 180°	14½p
D.I.N. 5 pin, 240°	16½p
D.I.N. 6 pin	16½p
Jack, 2½mm unscreened	10p
Jack, 2½mm screened	11p
Jack, 3½mm unscreened	9p
Jack, 3½mm screened	13p
Jack, ¼in unscreened	13p
Jack, ¼in screened	22p
Jack, stereo, unscreened	22p
Jack, stereo, screened	38p
Phono, plastic top	5½p
Phono, plated metal	13p
Wander, red or black	3½p
Banana 4mm, red or black	6½p



SOCKETS

Car aerial	9p
Co-axial, surface	9p
Co-axial, flush	10p
D.I.N. 2 pin (speaker)	11p
D.I.N. 3 pin	10p
D.I.N. 5 pin, 180°	10p
D.I.N. 5 pin, 240°	10p
Jack, 2½mm	11p
Jack, 3½mm	11p
Jack, ¼in unswitched	16½p
Jack, ¼in switched	18½p
Jack, stereo, switched	26p
Phono, single	5½p
Phono, 2 on a strip	7½p
Phono, 3 on a strip	10p
Phono, 4 on a strip	11p
Wander, single, red or black	5½p
Wander, twin strip	7½p
Banana 4mm red, or black	6½p

LINE SOCKETS

Car aerial	15½p
Co-axial	19p
D.I.N. 2 pin (speaker)	16½p
D.I.N. 3 pin	17½p
D.I.N. 5 pin, 180°	17½p
D.I.N. 5 pin, 240°	17½p
Jack, 3½mm	16½p
Jack, ¼in screened	54p
Jack, stereo, screened	37p
Phono, plated metal	15½p

TRANSFORMERS
all with 0-250 Volt primaries.
Miniature
MM6 6V, 500mA + 6V, 500mA.
MM12 12V, 250mA + 12V, 250mA.
MM20 20V, 150mA + 20V, 150mA.
£1·42, plus 14p P. & P.
L.T.
LT1 6·3V, 1·5V—82p, plus 20p P. & P.
LT2 6·3V, 3A—96p, plus 28p P. & P.
LT3 12V, 1·5A—96p, plus 28p P. & P.
LT4 12V, 3A—£1·45, plus 33p P. & P.
LT5 9-0-9V, 0·5A—83p, plus 23p P. & P.
LT6 12-0-12V, 1A—£1·04, plus 29p P. & P.
Multi-tapped
MT30/2 0-12-15-20-24-30V, 2A—£2·15, plus 33p P. & P.
MT60/1 0-5-20-30-40-60V, 1A—£2·31, plus 33p P. & P.
MT60/2 0-5-20-30-40-60V, 2A—£3·25, plus 37p P. & P.
Charger
CT/01 1A—£1·16, plus 28p P. & P.
CT/02 2A—£1·43, plus 33p P. & P.
CT/03 4A—£1·76, plus 33p P. & P.
Secondaries 0-5-11-17V.
Speaker Matching 3-8-16 Ω
Example: 16 Ω speaker to 8 Ω amplifier, 8 Ω amplifier to 3 Ω speaker, etc. £1·15, plus 22p P. & P.

MINIATURE ELECTROLYTICS

1·0µF	63V	7p	150µF	25V	8p
1·5µF	63V	7p	150µF	40V	13p
2·2µF	63V	7p	150µF	63V	15p
3·3µF	63V	7p	220µF	4V	7p
4·7µF	63V	7p	220µF	10V	7p
6·8µF	40V	7p	220µF	16V	8p
6·8µF	63V	7p	220µF	25V	13p
10µF	25V	7p	220µF	40V	15p
10µF	63V	7p	220µF	63V	22p
15µF	16V	7p	330µF	4V	7p
15µF	40V	7p	330µF	10V	8p
15µF	63V	7p	330µF	16V	13p
22µF	10V	7p	330µF	63V	26p
22µF	25V	7p	470µF	6·3V	8p
22µF	63V	7p	470µF	10V	13p
33µF	6·3V	7p	470µF	25V	15p
33µF	16V	7p	470µF	40V	22p
33µF	40V	7p	680µF	6·3V	13p
47µF	4V	7p	680µF	16V	15p
47µF	10V	7p	680µF	25V	22p
47µF	25V	7p	680µF	40V	26p
47µF	40V	7p	1000µF	4V	13p
47µF	63V	8p	1000µF	10V	15p
68µF	6·3V	7p	1000µF	16V	22p
68µF	16V	7p	1000µF	25V	26p
68µF	63V	13p	1500µF	6·3V	15p
100µF	4V	7p	1500µF	10V	22p
100µF	10V	7p	1500µF	16V	26p
100µF	25V	7p	2200µF	6·3V	22p
100µF	40V	8p	2200µF	10V	26p
100µF	63V	15p	3300µF	6·3V	26p
150µF	6·3V	7p	4700µF	4V	26p
150µF	16V	7p			

VEROBOARD

Size	0·1 Matrix	0·15 Matrix
2½in × 3¾in	25½p	18½p
2½in × 5in	28½p	28½p
3¾in × 3¾in	28½p	28½p
3¾in × 5in	32p	35p
17in × 2½in	87p	66p
17in × 3¾in	£1·18	94p

Spot face cutter—44p
Pins, either size, pack of 36—21p
Edge connectors:
24 way, 0·1—37½p   36 way, 0·1—48½p
24 way, 0·15—37½p   16 way, 0·15—25p

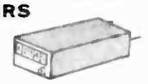
BONDED ACRYLIC FIBRE
B.A.F. wadding, 18in wide, 1in thick. The ideal lining for speaker enclosures, 33p per yard. P. & P. 1yd 14p; each extra yard 4p.

CONTROLS
Log. or Lin.
Single, less switch, 15p
Single, D.P. switch, 26p
Tandem, less switch, 44p
5k Ω, 10k Ω, 25k Ω, 50k Ω, 100k Ω, 250k Ω, 500k Ω, 1M Ω, 2M Ω.

BATTERY ELIMINATORS
suitable for transistor radios and similar light current equipment. Input 240V a.c.
Output: PP6—6V d.c.; PP9—9V d.c.
Price £1·65, plus 15p P. & P.

RESISTOR BARGAIN PACK
of 100 ½W resistors. Tolerance 5% or better, E24 values. Good assortment; our selection, only 50p.

MAGNETIC COUNTERS
Brand new, neat, 48 volt, 5 digit counters. 66p.



CASSETTE MICROPHONE
Low impedance dynamic with remote control switch. Fitted 2½mm and 3½mm plugs. £2·34, plus 15p P. & P.

ELECTROLYTICS

1µF	450V	21p	1000µF	50V	46p
2µF	450V	22p	2000µF	25V	43p
4µF	350V	15½p	2000µF	50V	58p
8µF	450V	18½p	2500µF	25V	50p
16µF	450V	20p	2500µF	50V	66p
25µF	25V	7½p	3000µF	25V	53p
25µF	50V	11p	5000µF	25V	66p
32µF	450V	30p	5000µF	50V	£1·21
50µF	50V	11p	8–8µF	450V	20p
100µF	50V	12p	8–16µF	450V	22p
250µF	25V	15½p	16–16µF	450V	30p
250µF	50V	19p	16–32µF	450V	69p
500µF	25V	20p	32–32µF	450V	54p
500µF	50V	27½p	50–50µF	350V	42p
1000µF	25V	30p			

BRAND NEW SEMICONDUCTORS AND COMPONENTS GUARANTEED

WE SUPPLY NEARLY ALL THE COMPONENTS FOR PROJECTS ADVERTISED IN THIS MAGAZINE

TRANSISTORS

2G301	0·15
2G302	0·15
2G303	0·25
2G306	0·30
2G309	0·30
2G345B	0·25
2G371	0·15
2G374	0·15
2N174	1·40
2N404	0·43
2N456	0·75
2N456A	0·75
2N457A	0·80
2N491	3·25
2N696	0·15
2N697	0·15
2N698	0·25
2N699	0·29
2N706	0·10
2N706A	0·12
2N708	0·18
2N709	0·38
2N711	0·30
2N718	0·21
2N718A	0·30
2N720	0·50
2N721	0·55
2N914	0·23
2N916	0·17
2N918	0·30
2N929	0·14
2N930	0·14
2N1090	0·23
2N1091	0·24
2N1131	0·20
2N1132	0·20
2N1302	0·16
2N1303	0·16
2N1304	0·20
2N1305	0·20
2N1306	0·22
2N1307	0·22
2N1308	0·25
2N1309	0·25
2N1483	0·90
2N1507	0·24
2N1613	0·20
2N1631	0·35
2N1637	0·36
2N1638	0·32
2N1701	1·10
2N1702	2·15
2N1711	0·22
2N1893	0·34
2N2102	0·30
2N2147	0·70
2N2148	0·94
2N2192	0·40
2N2192A	0·40
2N2193	0·40
2N2193A	0·61
2N2194	0·27
2N2194A	0·30
2N2195	0·37
2N2195A	0·18
2N2218A	0·30
2N2219	0·37
2N2219A	0·51
2N2220	0·20
2N2221	0·20
2N2221A	0·33
2N2222	0·31
2N2222A	0·41
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2N2646	0·50
2N2647	1·30
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2N2713	0·17
2N2714	0·17
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2N2905A	0·35
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2N2906A	0·30
2N2907	0·33
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2N2924	0·12
2N2925	0·15
2N2926	
Green	0·12
Yellow	0·10
Orange	0·10
2N3053	0·31
2N3054	0·60
2N3054	0·60
2N3055	0·50
2N3390	0·20
2N3391	0·20
2N3391A	0·23
2N3392	0·13
2N3393	0·12
2N3394	0·17
2N3402	0·12
2N3403	0·19
2N3404	0·24

2N3405	0·27
2N3414	0·10
2N3415	0·10
2N3416	0·15
2N3417	0·21
2N3570	1·25
2N3571	1·12
2N3572	0·97
2N3702	0·11
2N3703	0·10
2N3704	0·14
2N3705	0·10
2N3706	0·09
2N3707	0·13
2N3708	0·07
2N3709	0·09
2N3710	0·12
2N3711	0·09
2N3712	0·95
2N3713	1·08
2N3714	1·15
2N3715	1·23
2N3716	1·30
2N3773	3·00
2N3779	3·15
2N3790	2·20
2N3794	2·06
2N3791	2·06
2N3792	2·20
2N3794	0·10
2N3819	0·32
2N3820	0·47
2N3823	0·97
2N3824	0·75
2N3826	0·23
2N3854	0·16
2N3854A	0·16
2N3855	0·16
2N3855A	0·16
2N3856	0·16
2N3856A	0·16
2N3858	0·16
2N3858A	0·16
2N3859	0·16
2N3859A	0·16
2N3860	0·16
2N3866	0·70
2N3877	0·25
2N3877A	0·26
2N3900	0·20
2N3900A	0·21
2N3901	0·32
2N3903	0·32
2N3904	0·17
2N3905	0·21
2N3906	0·22
2N4036	0·46
2N4037	0·40
2N4058	0·16
2N4059	0·09
2N4060	0·11
2N4061	0·11
2N4062	0·11
2N4302	0·25
2N4303	0·47
2N4916	0·20
2N4917	0·17
2N4918	0·50
2N4919	0·63
2N4920	0·71
2N4921	0·50
2N4922	0·55
2N4923	0·60
2N5172	0·08
2N5174	0·22
2N5175	0·26
2N5176	0·32
2N5245	0·43
2N5190	0·92
2N5191	0·96
2N5192	1·24
2N5193	1·01
2N5194	1·10
2N5195	1·46
2N5245	0·36
2N5457	0·36
2N5458	0·33
2N5459	0·33
3N128	0·63
3N138	1·65
3N139	1·42
3N140	0·92
3N141	0·81
3N142	0·58
3N143	0·75
3N152	0·92
3N153	0·81
3N154	0·84
3N158	1·17
3N187	1·55
3N200	2·49
3N201	1·05
40050	0·78
40251	0·81
40309	0·30
40310	0·50
40313	0·92
40316	0·50
40318	0·92
40360	0·46

40361	0·43
40362	0·45
40363	0·61
40389	0·46
40394	0·56
40395	0·65
40406	0·44
40407	0·33
40408	0·50
40409	0·52
40410	0·53
40411	2·00
40414	3·55
40467A	0·69
40468A	0·44
40600	0·69
40601	0·67
40602	0·46
40603	0·58
40604	0·56
40636	1·10
40673	0·50
AC107	0·35
AC113	0·16
AC115	0·16
AC117	0·20
AC121	0·13
AC126	0·25
AC127	0·20
AC128	0·20
AC141K	0·30
AC142K	0·25
AC151V	0·14
AC152V	0·17
AC153	0·22
AC153K	0·25
AC154	0·20
AC176	0·18
AC187K	0·30
AC188K	0·26
ACY17	0·35
ACY18	0·24
ACY19	0·27
ACY20	0·22
ACY21	0·26
ACY22	0·16
ACY28	0·20
ACY30	0·42
ACY39	0·65
ACY40	0·17
ACY41	0·17
ACY44	0·31
AD136V	0·96
AD140	0·55
AD142	0·50
AD143	0·45
AD149V	0·66
AD150	0·63
AD161	0·45
AD162	0·45
AD161 }	PR
AD162 }	1·05
AF109R	0·40
AF114	0·25
AF115	0·24
AF116	0·25
AF117	0·20
AF118	0·50
AF121	0·22
AF124	0·24
AF125	0·20
AF126	0·19
AF127	0·20
AF139	0·33
AF170	0·25
AF172	0·25
AF178	0·55
AF179	0·65
AF180	0·50
AF186	0·40
AF200	0·35
AF239	0·41
AF240	0·72
AF279	0·54
AF280	0·54
AFY42	0·74
AF211	0·55
AL102	0·75
AL103	0·70
ASY26	0·30
ASY27	0·36
ASY28	0·28
ASY29	0·36
ASY50	0·20
ASY55	0·35
AU103	1·25
BC107	0·10
BC108	0·10
BC109	0·10
BC113	0·10
BC114	0·12
BC115	0·15
BC116	0·15
BC116A	0·18
BC117	0·21
BC118	0·11
BC119	0·27
BC121	0·23
BC125	0·15
BC126	0·20
BC132	0·30
BC134	0·11

BC135	0·11
BC136	0·15
BC137	0·15
BC138	0·24
BC140	0·34
BC141	0·39
BC142	0·24
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BC144	0·24
BC145	0·21
BC147	0·12
BC148	0·12
BC149	0·12
BC153	0·18
BC154	0·18
BC157	0·14
BC158	0·13
BC159	0·14
BC160	0·37
BC167B	0·11
BC168B	0·13
BC168C	0·11
BC169B	0·11
BC169C	0·13
BC170	0·11
BC171	0·18
BC172	0·11
BC182	0·10
BC182L	0·12
BC183	0·09
BC183L	0·09
BC184	0·11
BC184L	0·11
BC186	0·25
BC187	0·25
BC207	0·12
BC208	0·11
BC212K	0·10
BC212L	0·18
BC214L	0·23
BC237	0·09
BC238	0·09
BC239	0·09
BC251	0·20
BC253	0·23
BC257	0·09
BC258	0·09
BC259	0·13
BC261	0·20
BC262	0·18
BC263	0·26
BC300	0·42
BC301	0·34
BC302	0·27
BC303	0·54
BC307	0·10
BC307A	0·10
BC308	0·09
BC308A	0·09
BC308B	0·09
BC309	0·10
BC309A	0·10
BC309B	0·10
BC327	0·24
BC328	0·22
BC337	0·19
BC338	0·19
BCY30	0·43
BCY31	0·40
BCY32	1·15
BCY33	0·34
BCY34	0·35
BCY38	0·53
BCY39	1·05
BCY40	0·81
BCY42	0·15
BCY43	0·15
BCY58	0·21
BCY59	0·22
BCY70	0·17
BCY71	0·22
BCY72	0·13
BCY87	3·47
BCY88	2·40
BCY89	0·97
BCZ10	0·35
BCZ11	0·50
BD115	0·75
BD116	0·50
BD121	0·75
BD123	0·82
BD124	0·67
BD130	0·57
BD131	0·40
BD132	0·50
BD135	0·43
BD136	0·49
BD137	0·55
BD138	0·68
BD139	0·71
BD140	0·83
BDY10	1·25
BDY11	1·50
BDY17	1·50
BDY18	1·75
BDY19	1·97
BDY20	1·05
BDY38	0·65
BDY60	0·90
BDY61	1·25
BDY62	1·00
BF115	0·23

BF117	0·43
BF119	0·58
BF121	0·25
BF123	0·27
BF125	0·25
BF152	0·20
BF153	0·29
BF154	0·16
BF158	0·23
BF159	0·27
BF160	0·23
BF161	0·42
BF163	0·30
BF166	0·35
BF167	0·21
BF173	0·24
BF177	0·29
BF178	0·35
BF179	0·43
BF180	0·35
BF181	0·32
BF182	0·40
BF183	0·40
BF184	0·17
BF185	0·17
BF194	0·14
BF195	0·17
BF196	0·15
BF197	0·15
BF198	0·16
BF199	0·18
BF200	0·40
BF224J	0·14
BF225J	0·19
BF237	0·22
BF238	0·22
BF244	0·16
BF245	0·33
BF246	0·43
BF247	0·49
BF254	0·16
BF255	0·17
BF257	0·47
BF258	0·53
BF259	0·45
BF270	0·25
BF272	0·53
BF273	0·25
BF274	0·23
BF457	0·53
BF458	0·65
BF821A	2·30
BF828	0·92
BF861	0·27
BF898	0·28
BFW10	0·61
BFW11	0·61
BFX13	0·23
BFX29	0·30
BFX30	0·25
BFX37	0·30
BFX44	0·33
BFX63	2·48
BFX68	0·68
BFX84	0·24
BFX85	0·29
BFX86	0·24
BFX87	0·28
BFX88	0·25
BFX89	0·45
BFY10	0·35
BFY11	0·45
BFY17	0·90
BFY18	0·35
BFY19	0·35
BFY20	0·50
BFY29	0·40
BFY37	0·20
BFY41	0·43
BFY43	0·65
BFY50	0·22
BFY51	0·15
BFY52	0·20
BFY53	0·15
BFY56	0·34
BFY64	0·41
BFY76	0·32
BFY77	0·24
BFY78	0·36
BFY90	0·60
BRY39	0·38
BSX19	0·13
BSX20	0·14
BSX21	0·20
BSX26	0·49
BSX27	0·34
BSX28	0·25
BSX29	0·47
BSX60	0·54
BSX61	0·42
BSX76	0·15
BSX77	0·20
BSX78	0·25
BSW70	0·28
BSY24	0·20
BSY25	0·15
BSY26	0·20
BSY27	0·15
BSY28	0·15
BSY38	0·20
BSY39	0·20
BSY51	0·25

BSY52	0·25
BSY53	0·25
BSY54	0·30
BSY56	0·79
BSY65	0·15
BSY78	0·40
BSY79	0·40
BSY95A	0·09
C111	0·53
D40N3	0·55
GET111	0·45
GET114	0·20
GET115	0·50
GET119	0·35
GET535	0·30
GET536	0·20
GET880	0·30
GET883	0·20
GET887	0·20
TIP29A	0·49
TIP30A	0·58
TIP31A	0·62
TIP32A	0·74
TIP33A	1·01
TIP34A	1·51
TIP35A	2·90
TIP36A	3·70
TIP41A	0·79
TIP42A	0·90
TIP2955	0·98
TIP3055	0·80
ME0401	0·18
ME0402	0·20
ME0404	0·13
ME0411	0·17
ME0412	0·18
ME0413	0·14
ME1120	0·25
ME4001	0·09
ME4002	0·11
ME4003	0·14
ME4101	0·10
ME4102	0·11
ME4103	0·10
ME4104	0·11
ME6101	0·14
ME6102	0·16
ME8002	0·17
ME8003	0·16
MJ400	0·78
MJ420	0·96
MJ421	0·88
MJ430	0·75
MJ440	0·71
MJ480	0·75
MJ481	0·85
MJ490	0·94
MJ491	1·10
MJ802	4·12
MJ901	2·65
MJ1001	2·34
MJ1800	1·88
MJ2500	2·92
MJ2501	3·25
MJ2955	1·00
MJ3000	2·47
MJ3001	2·79
MJ3701	0·93
MJ4502	4·44
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MJE370	0·73
MJE371	0·80
MJE520	0·59
MJE521	0·73
MJE1092	1·98
MJE1102	1·57
MJE2801	1·19
MJE2901	1·56
MJE2955	1·65
MJE3055	0·83
MM1613	0·43
MM1711	0·49
MM1712	0·64
MM2712	0·64
MPF102	0·25
MPS111	0·32
MPS112	0·40
MPS113	0·47
MPSA05	0·25
MPSA06	0·20
MPSA12	0·40
MPSA14	0·24
MPSA55	0·30
MPSA56	0·28
MPSA65	0·25
MPSA66	0·28
MPSU01	0·44
MPSU05	0·48
MPSU55	0·60
MPSU06	0·55
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We stock the full range of the low number SN7400 series—some examples:

SN7400	0·20	SN7401	0·20	SN7402	0·20
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We also stock the unusual numbers as follows:

SN74100	2·50	SN74153	1·53	SN74176	1·50
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SN74118	1·00	SN74155	1·55	SN74181	7·00
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SN74121	0·60	SN74160	2·60	SN74191	1·95
SN74122	1·35	SN74161	2·60	SN74192	1·90
SN74123	1·35	SN74164	2·28	SN74193	1·90
SN74141	0·90	SN74165	4·00	SN74196	1·60
SN74145	1·50	SN74167	6·25	SN74198	4·60
SN74150	3·25	SN74174	2·00	SN74199	4·00
SN74151	1·10	SN74175	1·35		

FM multiplex stereo demodulator	MC1304	£3·60
Dual monolithic stereo preamplifier	MC1303	£2·70

Motorola MC Series, RCA CA 3000 Series and Cosmos, Plessey SL Series. Try us first for Linear and Digital Integrated Circuits.

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10A	30p	35p	40p	47p	58p	66p	75p	—
15A	36p	45p	48p	55p	65p	75p	87p	—
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1 amp and 3 amp are plastic encapsulation.

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IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY161	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	23p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
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10 watt 5% (up to 26k Ω only), 10p.

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Carbon:
Log. or Lin., less switch, 17½p
Log. or Lin., with switch, 28p
Wire-wound Pots (3W), 38p
Twin Ganged Stereo Pots, Log. or Lin., 47p.

PRESETS (CARBON)

0·1 Watt 6p
0·2 Watt 6p
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VERTICAL OR HORIZONTAL

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58mm TRACK
SINGLE GANGED, LOG or LIN 1k to 1M. 40p each.
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Sinclair Project 60

New performance standards ...new safety margins

Z.50 Mk 2

Such are the results of using a PZ8 Mk.3 to drive two Z.50 Mk.2 power amplifiers. Developed from the original Z 50, the Mk 2 has improved thermal stability, better regulated D.C. limiting to ensure more symmetrical output voltage swing with still less distortion at lower outputs and automatic transient overload protection. The PZ.8 Mk.3 is the most advanced power supply unit ever to be made at a reasonable price. It cannot be damaged by direct shorting, nor will it fail through overloading, because of an ingenious re-entrant current limiting principle used usually only in expensive laboratory equipment. Because output voltage is variable, the PZ8 Mk.3 makes a worthwhile alternative where PZ 5 and PZ.6 are recommended for Project 60 applications, particularly since this most powerful of all Sinclair supply units can be operated from a smaller mains transformer. Together, the Z 50 Mk 2 and PZ8 Mk 3 provide new standards of performance and reliability and these modules are compatible with earlier types in the Project 60 range.

Z.50 Mk.2 SPECIFICATIONS

Input impedance 100 KΩ
Input (for 30w into 8Ω) 400mV
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better
Distortion 0.02% up to 20W at 8Ω. See published curve
Frequency response 10Hz to more than 200 KHz ± 1dB
Max. supply voltage 45v (4Ω to 8Ω speakers) (50v 15Ω speakers only)
Min. supply voltage 9v
Load impedance – minimum: 4Ω at 45v HT
Load impedance – maximum: safe on open circuit

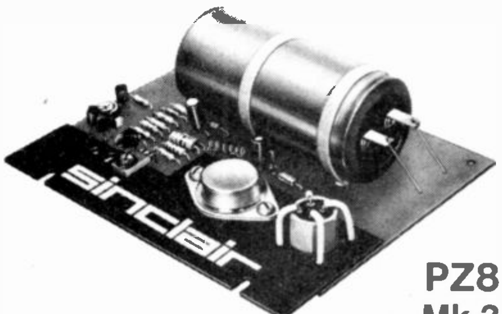
£5.48 + V.A.T 54p

PZ.8 Mk.3 SPECIFICATIONS

Nominal working output 45V.
Adjustable between 20 & 50V

£7.98 + V.A.T. 79p

Mains Transformer £5.98 + V.A.T. 59p



PZ8 Mk 3

Other power supplies

In addition to the remarkable Sinclair PZ.8 Mk.III as described, there are two other power units available, which should be chosen according to their types in order to buy to best advantage. All are for operation from A C. mains 240V.

PZ.5 30 volt, unstabilised **£4.98** + V A T 49p

PZ.6 35 volt, stabilised (Not suitable for Super IC.12). **£7.98** + V A T 79p

Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.
Each Project 60 module is tested before leaving our factory and guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you. A small charge may be made in those cases where damage arises through miss-use. No charge is made for postage by surface mail. Air Mail charged at cost.

Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.50**	Crystal P.U., 12V battery volume control, etc.	**£5.48** + V.A.T. 54p
Mains powered record player	**Z.50, PZ.5**	Crystal or ceramic P.U. volume control, etc.	**£10.46** + V.A.T. £1.04
12W. RMS continuous sine wave stereo amp. for average needs	**2 x Z.50, Stereo 60; PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£25.92** + V.A.T. £2.59
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.50, Stereo 60; PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£28.92** + V.A.T. £2.89
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50 Mk.2, Stereo 60; PZ.8 Mk.3 transformer**	As above	**£34.90** + V.A.T. £3.49
Indoor P.A.	**Z.50 Mk.2, PZ.8 Mk.3 transformer**	Mic., guitar, speakers, etc., controls	**£19.44** + V.A.T. £1.94

A.F.U. (**£5.98** + V.A.T. 59p) may be added as required.

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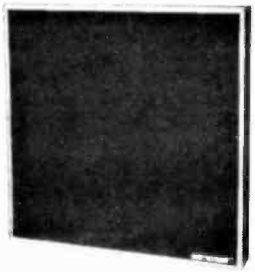
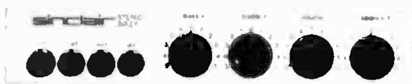


The Q 16 employs original and by now well proven acoustic principles in which a special driver assembly is meticulously matched to a uniquely designed cabinet. In performance it comfortably stands comparison with very much more expensive loudspeakers. A solid teak surround is used with a special all-over cellular black foam front chosen both for its appearance and ability to pass all audio frequencies without masking.

Specifications
Construction: A sealed seamless sound or pressure chamber is used with internal baffle, and special high flux driver
Loading: Up to 14 watts RMS, into 8 ohms
Frequency response: From 60 to 16,000 Hz
Size and styling: 248 mm square x 120 mm deep (9¾" x 4¾") with neat pedestal base.

£7.70 +V.A.T. 77p



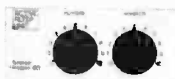
Stereo 60 pre-amp/control unit

Designed specifically for Project 60 systems, the Stereo 60 is equally suitable with any high quality power amplifier. Silicon epitaxial planar transistors used throughout ensure high signal-to-noise ratio and excellent tracking between channels. Input selection is by press buttons, with accurate equalisation on all input channels. The unit is easy to mount.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A. curve ±1dB: 20 to 25,000Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE +12 to —12dB at 10KHz: BASS +12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

Built, tested and guaranteed. **£9.98** +V.A.T. 99p

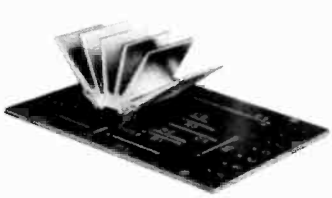
AFU filter unit



For use between Stereo 60 and two Z 30's or Z 50's in stereo formation. Cut off frequencies are continuously variable, with 12dB/octave cut in the rejection band. Two stages of filtering – rumble (high pass) and scratch (low pass). Amplitude and phase distortion are negligible. Supply voltage needed – 15–35V. H.F. cut-off (–3dB) 28KHz to 5KHz L.F. (–3dB) 25Hz to 100Hz. For Project 60 or any good stereo system. Built, tested and guaranteed

£5.98 +V.A.T. 59p

Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC.10, which was the first time an IC had ever been made available for such purposes, we followed it with an even more efficient version, the Super IC.12. This needs very few external resistors and capacitors to make an exceedingly efficient high fidelity amplifier for pick-up, F.M. radio or small P.A. set up etc. The free 40 page manual supplied details many other applications which this remarkable IC make possible. The Super IC.12 is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all likely requirements. The Super IC.12 is also compatible with those Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

SPECIFICATIONS
Output power: 6 watts RMS continuous (12 watts peak) into 6–8 Ω. **Frequency Response:** 5Hz to 100KHz ±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0.1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 x 45 x 28mm including pins and heat sink.

Manual available separately 15p post free

With FREE printed circuit board and 40 page manual.

£2.98 +V.A.T. 29p Post free

Project 605

the simple way to build a Project 60 system without soldering

For the many audio enthusiasts anxious to build to high standards without too many involvements, there could be nothing better or simpler than Project 605. It offers the advantages of Project 60 and is absolutely complete down to the last piece of wire cut to length. Whilst not as powerful as assemblies using Z.50 power amplifiers, we know from experience that there are many for whom the specifications of Project 605 are ideal, particularly in relation to the environment in which it is required to be used. In Project 605 you have everything necessary to build a versatile Project 60 thirty watt high fidelity amplifier system suitable for all domestic requirements. The convenient pack includes two Z.30 power amplifiers, a Stereo 60 pre-amp control unit and the special Masterlink unit to and from which all input and output connections are made. For power a PZ.5 is provided. Building is particularly easy since all necessary leads are supplied colour coded, cut to length and terminated by contact clips which connect firmly to the modules. There is absolutely no soldering to be done. Complete with comprehensive, easy to follow instructions manual.

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A top quality speaker ideal where small size is important. Manufactured by E.M.I. for a well-known hi-fi set maker. Size: 7in. × 4in. Impedance: 8 ohms. Flux: 38,000. Max. Free range: 90Hz to 12kHz. Power handling: 5W. Unbeatable. Price: £1·60. Free postage on this item.

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5 Section
Extended Length 100cm
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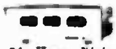
Cable Length 120cm
complete with Fixing Bracket and Control Switch **£6·75** plus 25p P. & P.

"CRESCENT" DIGITAL CLOCK KIT



24 Hour Nixie Digital Clock Kit We Supply:

- ★ A complete set of components
- ★ A complete set of easy to follow instructions
- ★ Printed circuits made to make construction as simple as possible
- ★ A cabinet and front panel to give a professional finish.

All for the price of the components. £22·50. + 50p. P. & P. Please send S.A.E. for more information.

MINIATURE RELAY

6 volt 70 ohm.
Single Pole Changeover.
Approx. size = 1¼" × 1" × ⅞".

40p plus 5p P. & P.

TRI-VOLT BATTERY ELIMINATOR

Enables you to work your transistor radio, amplifier, or cassette, etc. from A.C. mains through this compact eliminator. Just by moving a plug you can select the voltage you require — 6v, 7½v or 9 volts. This means all your transistor power pack applications can be handled by this one unit. Approx. size: 2¾" x 2¼" x 3¼". OUR PRICE — £2·75p + 10p. P. & P. Same model suitably wired for the Philips Cassette — £3·00 + 10p. P. & P.

TRI-VOLT CAR CONVERTER

Enables you to work your Transistor Radio, Amplifier or Cassette etc. from the 12 volt car supply positive or neg. earth.
This converter supplies 6, 7½ or 9 volts and is transistor regulated. Approx. size 2½" × 3½" × 2" Very easy to fit and a real money saving device for £2·50 + 10p. P. & P.

WAFER SWITCHES

1 pole 12 way
2 pole 2 way
2 pole 3 way
2 pole 4 way
3 pole 6 way
3 pole 4 way
4 pole 3 way
18p each. Please inc. 5p P. & P. Up to 3 switches.

"CRESCENT" BUBBLE LIGHT SHOW

PROJECTOR
150 watt.
Convection Cooled.
At 30ft the projected image—16ft.
MOTOR
One Rev per Two Min.
LIQUID WHEEL
6" Diameter Multicolour
The motor is fitted to the projector and can only be purchased as a single unit. The Liquid Wheel however is our standard very popular model and may be purchased separately.

A BARGAIN AT—

Projector with Motor, ready for instant use	£15·00
6" Liquid Wheel	£5·00
	£20·00

plus 30p P. & P.

V.A.T.

From 1st April, 1973, will you please include on your Total (Goods plus Postage and Packing) Value Added Tax at the Standard Stated Rate.

"CRESCENT BEAT BRITE" SINGLE CHANNEL SOUND TO LIGHT UNIT

This fantastic little box approx. 4" × 3" × 2½" when connected to the output of a sound source from 1 to 100 watts produces a psychedelic light display of up to 1000 watts. Complete with a sensitive level control the unit is fused and can not harm your amplifier.
A Bargain at £7·50 plus 10p P. & P.

POTENTIOMETERS

All types 1 and less diameter.

SINGLES		DUAL	
5K	Log or	5K	
10K	Lin Less	10K	
25K	Switch	25K	Less
50K	12p ea.	50K	Switch
100K		100K	40p.
250K	Double	250K	each
500K	Pole	500K	
1M	Switch	1M	
2M	24p ea.	2M	

Up to 3 Pots. Please add 5p. P. & P.

MINIATURE RELAYS

Brand new range of British made Relays.
Size—1¼" × 1" × ⅞"
All two changeovers with 250V. 1·5A contacts and suitable for fitting on ·1m Veroboard.

Type	Volts	Current	Ohms.
27/A	12v	17M/A	700 Ω
21/A	12v	28M/A	430 Ω
12/A	6v	33M/A	185 Ω

80p each.
Please include 5p P & P up to 3 Relays.

STEREO / MONO HEADPHONE VOLUME CONTROL BOX

Plug Stereo phones into this control box and you then incorporate a right and left hand volume control and a stereo/mono switch. Complete with stereo jack plug and 2 m cable.
A Bargain at £1. Plus 10p P. & P.

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Stereo jack plug to two stereo line sockets complete with 110 mm of cable. For plugging two stereo inputs into one. A Bargain at 65p plus 5p P & P.

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Few only at **£1·75** plus 13p P. & P.

5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output.
With high IMP input this amplifier will work as a record player, baby alarm, etc., amplifier.

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E.M.I. 450 set 3, 8, 15 ohm
£3·75 plus 38p. P. & P.
E.M.I. 350 set 8 ohm.
£7·00 plus 38p. P. & P.

MINI LOUDSPEAKERS

2¼" (57mm) 40ohm — 50p each
2¼" (57mm) 80ohm — 50p each
Please include 5p. P. & P. up to 3 Mini-Loudspeakers

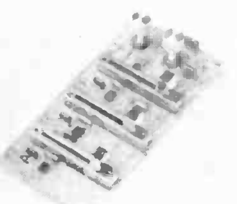
200/250V MAINS RELAY

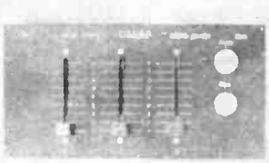
Heavy duty contacts. 2,500 Ω coil. All new and unused D.P.D.T. mains relays 50p + V.A.T. Carr. Free. Special quantity price: £40 per 100 relays.

MAINS TRANSFORMER

Fused Primary 240V. Secondary 220V @ 50mA. 6·3V @ 1A. This transformer is made to a very high standard and is a small size: 2in × 2¼in × 2¼in. 63p plus 15p P. & P.

DABAR MN3 MIXER KIT





INTRODUCING THE NEW DABAR MINI THREE CHANNEL MIXER KIT WITH THE FOLLOWING FEATURES:

- ★ Three inputs easily adjustable to suit users input requirements, e.g., Mic., Tape, Disc., etc.
- ★ Uses advanced design with five integrated circuits.
- ★ Slider fader volume controls mount directly on P.C. board.
- ★ Full range bass and treble controls.
- ★ Guaranteed top grade components with fibreglass printed circuit board, ready-drilled and tinned.
- ★ Battery operated (2 x PP3) not supplied with kit.
- ★ Easy to follow assembly instructions (available separately 25p).
- ★ Attractive ready punched facia plate, available at extra cost, gives that professional finish to the unit.
- ★ Size: 9·5" x 4·8" x 2".

PRICE: KIT ONLY £11·00
FACIA PLATE £1·50
MANUAL AND ASSEMBLY INSTRUCTIONS 25p
AVAILABLE READY BUILT WITH FACIA £15·00

ALL PRICES INCLUDE V.A.T. & POSTAGE IN U.K.

S.A.E. ALL ENQUIRIES.

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B.H. COMPONENT FACTORS LIMITED

SPECIAL RESISTOR KITS (¼W 5% or ½W 5% CARBON FILM)
10E12 Kit: 10 of each E12 value, 10 ohms—1M, a total of 610, £3·10 net
25E12 Kit: 25 of each E12 value, 10 ohms—1M, a total of 1,525, £7·20 net

POLYESTER CAPACITORS MULLARD C280 250V
μF: 0·01, 0·015, 0·022, 0·033, 0·047, 3½p each; 0·068, 0·1, 0·15, 4½p each; 0·22, 5½p; 0·33, 8p; 0·47, 9p; 0·68, 11p; 1·0, 15p; 1·5, 22p; 2·2, 25p.

MULLARD POLYESTER CAPACITORS C296 SERIES
160V: (μF) 0·01, 0·015, 0·022, 2½p; 0·047, 0·068, 3½p; 0·1, 0·15, 4½p; 0·22, 5p; 0·33, 6p; 0·47, 7½p; 0·68, 11p; 1·0, 12½p.
400V: (μF) 0·001, 0·0015, 0·0022, 0·0033, 0·01, 2½p; 0·015, 0·033, 3½p; 0·068, 4½p.

MINIATURE ELECTROLYTIC MULLARD C426 SERIES (6p each)
(μF/V) 1/63, 4/40, 8/40, 10/40, 10/64, 16/40, 20/64, 25/25, 32/10, 40/16, 64/10, 80/16, 80/25, 100/6·4, 125/16, 200/6·4, 200/10, 320/6·4, 125·10.
MULLARD C437: (μF/V) 64/64, 10p; 160/25, 10p; 160/40, 12p; 640/6·4, 10p; 1600/6·4, 16p.

ELECTROLYTIC CAPACITORS, Tubular and large can
(μF/V) 2·5/50, 3p; 4/10, 10/25, 16/15, 20/25, 25/15, 25/25, 40/6, 64/10, 200/6, 250/10, 5p; 10/6, 10/50, 25/50, 32/50, 50/10, 64/25, 100/25, 6p; 50/50, 64/40, 250/15, 1,000/3, 7p; 100/50, 250/25, 400/10, 500/10, 500/12, 640/10, 1,000/6, 9p 500/25, 11p; 500/50, 14p; 1,000/12, 11p; 1,000/25, 2,000/12, 2,500/12, 17p; 1,000/50, 39p; 2,000/25, 27p; 2,500/25, 33p; 2,500/50, 62p; 3,000/50, 72p 5,000/50, 94p; 1,000/100, 66p; 8/350, 14p; 16/350, 19p; 32/350, 25p.

MINIATURE CERAMIC PLATE CAPACITORS
50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8. (μF) 0·01, 0·015, 0·022, 0·033, 0·047, 2½p; 0·1, 30V, 4½p; 0·1, 100V, 5½p.

CARBON FILM RESISTORS ¼W 5% 10 ohms—2·2M, ½ W 5% 10 ohms—1M, 1p each or 100 for 62p; 1,000 for £4·50.
METAL FILM RESISTORS 1W 5% 10 ohms—10M, 1½p each or 100 for £1·10. 15E12 KIT (15 each value 10 ohms—10M) £8.

Veroboard	0·1	0·15
2½ x 5in	28p	28p
2½ x 3¾in	26p	19p
3¾ x 5in	32p	33p
3¾ x 3¾in	28p	28p
2½ x 1in	7p	7p
2½ x 5in (plain)	—	14p
2½ x 3¾in (plain)	—	12p
5 x 3¾in (plain)	—	22p
Insertion tool	59p	59p
Track cutter	44p	44p
Pins, pkt. 25	10p	10p

2 pin DIN Plug, 12p; Skt., 10p. 3 pin DIN Plug, 13p; Skt., 10p. 5 pin DIN Plug, 180°, 15p; Skt., 12p. Transistor Equiv. Book, 40p. Carbon pots 5K–2M log. & lin. single 16½p, single with switch 26p, dual 46p.

1N4001	6½p
1N4002	7½p
1N4003	9p
1N4004	9½p
1N914	7p
μL914	35p
OC71	13p
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50V	1A	29p	3A	33p
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400V	1A	50p	3A	60p

Screened wire, m. 5½p
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Stereo s.c. wire, m. 10p
Connecting Wire, all colours, m. 2½p
Neon bulb 90V wire ended..........5 for 24p
Preset skeleton pots 1K–1M.......... 6p

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SN7402	0·20	0·18	0·16	SN7453	0·20	0·18	0·16	SN74151	1·10	0·95	0·90
SN7403	0·20	0·18	0·16	SN7454	0·20	0·18	0·16	SN74153	1·35	1·27	1·20
SN7404	0·20	0·18	0·16	SN7460	0·20	0·18	0·16	SN74154	2·00	1·75	1·55
SN7405	0·20	0·18	0·16	SN7470	0·30	0·27	0·25	SN74155	1·55	1·47	1·35
SN7406	0·30	0·27	0·25	SN7472	0·30	0·27	0·25	SN74156	1·55	1·47	1·35
SN7407	0·30	0·27	0·25	SN7473	0·40	0·37	0·35	SN74157	1·80	1·70	1·50
SN7408	0·20	0·19	0·18	SN7474	0·40	0·37	0·35	SN74160	2·60	2·40	2·25
SN7409	0·45	0·42	0·35	SN7475	0·55	0·52	0·50	SN74161	2·60	2·40	2·25
SN7410	0·20	0·18	0·16	SN7476	0·45	0·42	0·39	SN74162	3·40	3·25	2·70
SN7411	0·23	0·22	0·20	SN7480	0·80	0·75	0·67	SN74163	3·40	3·25	2·70
SN7412	0·42	0·40	0·35	SN7481	1·25	1·15	1·10	SN74164	2·75	2·30	2·10
SN7413	0·30	0·27	0·25	SN7482	0·87	0·80	0·70	SN74165	4·00	3·50	3·00
SN7416	0·30	0·27	0·25	SN7483	1·00	0·90	0·85	SN74166	4·00	3·50	3·00
SN7417	0·30	0·27	0·25	SN7484	0·90	0·85	0·80	SN74167	6·25	5·60	5·10
SN7420	0·20	0·18	0·16	SN7486	0·45	0·41	0·38	SN74170	4·10	3·55	3·05
SN7422	0·48	0·44	0·40	SN7490	0·75	0·70	0·65	SN74174	2·00	1·75	1·30
SN7423	0·48	0·44	0·40	SN7491AN	1·00	0·95	0·90	SN74175	1·35	1·27	1·15
SN7425	0·48	0·40	0·35	SN7492	0·75	0·70	0·65	SN74176	1·60	1·35	1·20
SN7427	0·42	0·39	0·35	SN7493	0·75	0·70	0·65	SN74177	1·60	1·35	1·20
SN7428	0·50	0·45	0·42	SN7494	0·80	0·75	0·70	SN74180	1·55	1·30	1·20
SN7430	0·20	0·18	0·16	SN7495	0·80	0·75	0·70	SN74181	7·00	6·00	5·50
SN7432	0·42	0·39	0·35	SN7496	1·00	0·97	0·95	SN74182	2·00	1·80	1·60
SN7433	0·70	0·61	0·44	SN7497	6·25	5·50	5·00	SN74184	2·40	2·00	1·80
SN7437	0·65	0·60	0·50	SN74100	2·50	2·30	2·00	SN74185A	2·40	2·00	1·80
SN7438	0·65	0·60	0·50	SN74104	1·45	1·35	1·20	SN74190	1·95	1·85	1·75
SN7440	0·20	0·18	0·16	SN74105	1·45	1·35	1·20	SN74191	1·95	1·85	1·75
SN7441AN	0·75	0·72	0·70	SN74107	0·50	0·45	0·40	SN74192	2·00	1·90	1·80
SN7442	0·75	0·72	0·70	SN74110	0·80	0·70	0·60	SN74193	2·00	1·90	1·80
SN7443	1·00	0·95	0·90	SN74118	1·00	0·95	0·90	SN74194	2·50	2·25	1·90
SN7445	2·00	1·75	1·60	SN74119	1·90	1·78	1·65	SN74195	1·85	1·70	1·60
SN7446	2·00	1·75	1·60	SN74121	0·60	0·55	0·50	SN74196	1·50	1·40	1·30
				SN74122	1·35	1·25	1·10	SN74197	1·50	1·40	1·30
SN7447	1·75	1·60	1·45	SN74123	2·70	2·55	2·47	SN74198	4·60	3·70	3·35
SN7448	1·75	1·60	1·45	SN74141	1·00	0·95	0·90	SN74199	4·60	3·70	3·35

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AC107	35p	BC214	15p	BY127	15p	OC71	15p	ZTX300	12p	2N3525	75p
AC126	25p	BCY32	75p	BYZ13	35p	OC72	25p	ZTX301	15p	2N3614	59p
AC127	25p	BCY34	35p	C106D	65p	OC77	45p	ZTX302	18p	2N3615	75p
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AC176	25p	BCY42	30p	GET115	55p	OC83	25p	ZTX500	15p	2N3704	10p
AC187	25p	BCY43	25p	GET880	45p	OC140	55p	ZTX503	17p	2N3705	10p
AC188	25p	BCY55	2·50	LM309K (T03)	1·87	OC170	25p	2G301	30p	2N3714	1·80
ACY17	30p	BCY70	15p	MAT121	25p	OC171	30p	2N404	20p	2N3771	1·75
ACY20	20p	BCY71	20p	MJE340	50p	OC200	45p	2N527	35p	2N3773	2·00
ACY21	20p	BCY72	15p	MJE370	70p	OC201	75p	2N696	15p	2N3790	2·25
ACY39	55p	BCY87	2·99	MJE520	75p	OC202	80p	2N697	15p	2N3819	35p
AD140	50p	BCZ11	50p	MJE2955	1·10	OC203	50p	2N706	10p	2N3820	50p
AD149	50p	BD124	80p	MJE3055	75p	OCP71	1·25	2N930	20p	2N3866	85p
AD161	35p	BD131	75p	MPF105	40p	ORP12	50p	2N987	45p	2N3903	15p
AD162	35p	BD132	80p	NKT214	20p	ORP60	40p	2N1131	25p	2N3906	12p
AF117	20p	BF115	25p	NKT216	40p	P346A	20p	2N1132	25p	2N4061	12p
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AF124	25p	BF173	25p	NKT403	70p	RAS508AF	55p	2N1304	22p	2N4126	15p
AF139	30p	BF179	30p	NKT404	50p	TAA263	75p	2N1305	22p	2N4871	35p
AF186	40p	BF180	30p	OA5	50p	TIL209	39p	2N1307	25p	2N5457	30p
AF239	40p	BF194	15p	OA10	35p	TIP29A	50p	2N1308	25p	2N5777	55p
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BA102	30p	BF898	25p	OA200	7p	TIP32A	70p	2N2147	75p	2S018	6·25
BA115	7p	BFX13	25p	OA202	10p	TIP33A	1·00	2N2160	59p	2S026	8·90
BA145	15p	BFX34	75p	OC16	75p	TIP34A	1·50	2N2217	25p	2S301	50p
BAX13	5p	BFX37	30p	OC20	95p	TIP35A	2·50	2N2221	20p	2S303	65p
BAX16	7p	BFX88	20p	OC23	85p	TIP36A	3·00	2N2222A	25p	2S324	95p
BC107	10p	BFY50	20p	OC25	40p	TIP41A	75p	2N2369A	15p	40250	50p
BC108	10p	BFY51	20p	OC28	65p	TIP42A	85p	2N2906	20p	40360	40p
BC109	10p	BFY52	20p	OC35	50p			2N2926 (all cols)	10p	40361	40p
BC109C	12p	BFY64	50p	OC36	65p			2N3053	20p	40362	50p
BC113	15p	BFY90	59p	OC42	40p			2N3054	50p	40408	50p
BC117	20p	BLY36	8·00							40486	75p
BC143	35p	BSX20	15p							40636	1·10
		BSY27	15p							40430	1·00

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10% 12+ ; 15% 25+ ANY ONE
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500 + 12p

2N3819 Texas 35p
25 + 30p
100 + 25p
500 + 20p
1000 + 15p

OC170 Mullard 25p
25 + 20p
100 + 18p
500 + 15p
1000 + 13p

BC107, BC108, BC109 10p each
All Makes
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

BY127 Mullard 15p
25 + 12p
100 + 10p
500 + 9p
1000 + 8p

AD161, AD162 35p each
25 + 32p
100 + 28p
500 + 25p
1000 + 22p

OA202 10p
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

2N3053 20p
25 + 18p
100 + 15p
500 + 12p
1000 + 10p

OC35 Mullard 50p
25 + 45p
100 + 40p
500 + 35p
1000 + 30p

2N3055 55p
25 + 50p
100 + 45p
500 + 38p
1000 + 33p

ZENER DIODES

400 M/W 5%
Miniature
BZY 88 Range

All voltages
3·3 – 33 Volt
10p each.

25+ 9p
100+ 8p
500+ 6·5p
1000+ 5p

Any one type.

1½ Watt 5%
Wire Ends
Metal Case
All voltages
6·8 – 100 Volts
20p each

25+ 18p
100+ 16p
500+ 12p
1000+ 10p

Any one type.

3 Watt Plastic
Wire Ends 5%
SEZ Range

All voltages
6·8 – 100 Volts
30p each.

LINEAR (O/P AMPS)

702C	TO5	75p
709C	TO99	35p
709C	D.I.L.	35p
723C	TO99	£1·00
723C	D.I.L.	95p
725C	TO99	£4·50
741C	TO99	55p
741C	D.I.L.	55p
747C	TO99	£1·10
747C	D.I.L.	£1·10
72741P	D.I.L.	60p
72748P	D.I.L.	60p

SINCLAIR
IC12 £1·80
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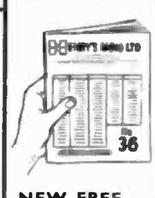
TH9013P
20 WATT AMP
£4·47 POST PAID
TH9014P Pre Amp £1·50

DATA AND CIRCUITS REF. 42 10p
FREE WITH PURCHASES

SILICON RECTIFIERS WIRE ENDED PLASTIC

Type	P.I.V.	1-11
1 amp miniature		
IN4001	50	6
IN4002	100	7
IN4003	200	8
IN4004	400	8
IN4005	600	10
IN4006	800	12
IN4007	1000	15
1·5 amp miniature		
PL4001	50	8
PL4002	100	9
PL4003	200	10
PL4004	400	10
PL4005	600	12
PL4006	800	15
PL4007	1000	18

TRANSISTORS, IC's, TRIACS, BRIDGES, SCR's, LDR's



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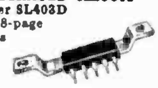
3 Watt Amplifier SL403D
Complete with 8-page booklet, circuits and data
£1.50 each



TRIACS

STUD WITH ACCESSORIES

Type	Volts P.I.V.	Price 1-11
3 AMP RANGE		
SC35A	100	75p
SC35B	200	79p
SC35D	400	85p
6 AMP RANGE (TO48)		
SC40A	100	85p
SC40B	200	90p
SC40D	400	£1·00
SC40E	500	£1·20
10 AMP RANGE (TO48)		
SC45A	100	95p
SC45B	200	£1·00
SC45D	400	£1·25
SC45E	500	£1·45
15 AMP RANGE (TO48)		
SC50A	100	£1·25
SC50B	200	£1·35
SC50D	400	£1·65
SC50E	500	£1·85
DIAC D32 25p		
TRIACS— Additional Types		
40430	(TO66)	85p
40669	(Plastic)	£1·00
40486	(TO5)	80p

3 Amp
T048

15 Amp
T048

NEW BRIDGE RECTIFIERS

SMALL SIZE AND LOW COST

Type	Volts P.I.V.	Price 1-11
HALF AMP		
BO5/05	50	20p
BO5/10	100	25p
ONE AMP ¼ × ¼ H TUBULAR		
B1/05	50	25p
B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
ONE AMP (G.I.) TUBULAR		
W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
TWO AMPS ½ H × ½ L × ⅛		
B2/05	50	35p
B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
B2/1000	1000	60p
FOUR AMPS ½H × ½L × ⅛		
B4/100	100	60p
B4/200	200	65p
B4/400	400	70p
B4/600	600	75p
B4/800	800	£1·00
SIX AMPS ½H × ½L × ⅛		
B6/100	100	70p
B6/200	200	75p
B6/400	400	90p
B6/600	600	£1·00

SILICON CONTROLLED RECTIFIERS

Type	Volts P.I.V.	Price 1-11
ONE AMP		
CRS 1/05	50	25p
CRS 1/10	100	30p
CRS 1/20	200	30p
CRS 1/40	400	35p
CRS 1/60	600	45p
THREE AMP (TO48)		
CRS 3/05	50	30p
CRS 3/10	100	30p
CRS 3/20	200	35p
CRS 3/40	400	45p
CRS 3/60	600	55p
FIVE AMP (TO66)		
CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
SIXTEEN AMP		
SCR 16/100	100	65p
SCR 16/200	200	70p
SCR 16/400	400	80p
SCR 16/600	600	£1·00

1 Amp
T05

3 Amp
T048

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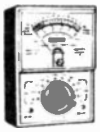
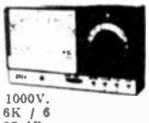
AUDIOTRONIC MODEL ATM.1



Top value 1000 o.p.v. pocket multimeter. Ranges: 0/10/50/250/1000v. AC and DC DC Current 0-1mA/100mA. Resistance 0/150k ohms. Decibels −10 to +22dB. Size 90 × 60 × 28mm. Complete with test leads. £2·50. Post 15p.

LT601 MULTIMETER



New style 20,000 o.p.v. pocket multimeter 5/25/50/250/500 / 2500 V. D.C. 10 / 50 / 100 / 500 / 1000V. A.C. 50µA / 250mA. 6K / 6 meg ohms. −20 to + 22 dB. £3 75. Post 20p.

MODEL TH-12

20,000 o.p.v. Overload protection. Slide switch selector 0 / ·25 / 2 5 / 10 / 50 / 250 / 1000V. D.C. 0 / 10 / 50 / 250 / 1000V. A.C. 0 / 50µA / 25 / 250mA. D.C. 0 / 3K / 30K / 300K / 3 meg −20 to + 50dB £4 97. Post 15p.

RUSSIAN 22 RANGE MULTIMETER

Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100µA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5 97. P. & P. 25p

MODEL PL436

20k Ω/Volt D.C. 8k Ω/Volt AC. Mirror scale. 6/3/12/30/120/600 V D.C. 3/30/120/600 V A.C. 50/600µA/60/600 mA. 10/100K/1 Meg/10 Meg Ω −20 to +46db. £6·97. P. & P. 12p.

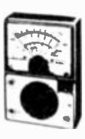
MODEL 500

30,000 O.P.V. with overload protection mirror scale 0/ 5/2 5/10/25/100/250/500/1,000v. D.C. 0/2 5/10/25/100/250/500/1,000V. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω £9 95. Post paid. Leather Case £1·75

U4312 MULTIMETER

Extremely sturdy instrument for general electrical use. 667 o.p.v. 0/ 3/1·5/7 5/30/60/150/300/600/900 VDC and 75mV. 0/ 3/1 5/7 5/30/60/150/300 600/900 VAC. 0/300µA/1 5/6/15/60/150 600MA/1·5/6 AMP. D.C. 0/1 5/6/15/60/150/600MA/1·5/6 AMP. AC. 0/200 Ω/3K/30K Ω. Accuracy DC 1%. AC 1 5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. £9 50. P. & P. 25p.

HIOKI MODEL 700X



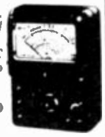
100,000 O.P.V. Overload protection Mirror scale. ·3/ 6/1 2/1 5/3/6/12/30/60/120/300/600/1200V DC 1·5/3/6/12/30/60/150/300/600 1200 V. A.C. 15/30µA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm −20 to +63dB. £13 50. P. & P. 20p

MODEL C-7080 EN

Giant 6" mirror scale. 20,000 o.p.v. 0 / ·25 / 1 / 2 5 / 10 / 50 / 250 / 1000 / 5000V. D.C. 0 / 2 5 / 10 / 50 / 250 / 1000 / 5000V. A.C. 0 / 50µA / 1 / 10 / 100 / 500mA / 10 amp. D.C. 0 / 2K / 200K / 20 meg − 20 to + 50 dB. £13 95. Post 35p.

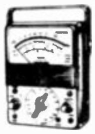
All prices are subject to 10% VAT

370 WTR MULTI-METER



Features A.C. current ranges. 20,000 o.p.v. 0/·5/2·5/10/50/250/500 1000 V. D.C. 0/2·5/10/50/250/500/1000V AC 0/50uA/1/10/100mA/1/10 Amp D.C. 0/100mA/1/10 Amp AC 0/5K/50K/500K/5 MEG/ 50 MEG. −20 +62db. £15. P. & P. 25p.

KAMODEN 72.200 MULTITESTER



High sensitivity tester. 200,000 o.p.v. Overload protection. Mirror scale. Ranges: 0 / ·06 / ·3 / 3 / 30 / 120 / 600 / 1200V. D.C. 0 / 3 / 12 / 60 / 300 / 11,200V. A.C. 0 / 6µA / 1·2mA / 120mA / 600mA / 12A. D.C. 0 / 12A. A.C. −20 to +63dB. 0 / 2K / 200K / 2 meg / 200 meg ohms. £16·95. Post 30p.

TMK LAB TESTER.

100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: ·5, 2 5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 25, 50, 250, 500, 1,000V. D.C. Current: 10, 100µA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size: 7½in. × 6½in. × 3¼in. £18·95. P. & P. 25p.

Model S-100TR MULTIMETER/TRANSISTOR TESTER

100,000 o.p.v. mirror scale/overload protection. 0/·12/·6/3/12/30/120/600 V DC. 0/6/30/120/600. V AC. 0/12/600µA/ 12/300mA/12 AMP DC. 0/10 K/1 MEG/100MEG. −20 to +50db. 0·01−2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. £13·50. P/P 25p.

KAMODEN HM.350 TRANSISTOR TESTER

High quality instrument to test Reverse Leak current and DC current. Amplification factor of NPN, PNP, transistors, diodes, SCR's etc. 4" × 4¾" clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. £12·50. Post 30p.

MODEL 449A IN CIRCUIT TRANSISTOR TESTER

Checks true A.C. beta in / out. Checks Icbo. Checks diodes in / out. Checks SCR, etc. Beta H1 10 - 500, LO 2 - 50. Icbo 0–5000µA. 220/240 V A.C. operation £17·50. Post 25p.

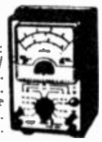
LB3 TRANSISTOR TESTER

Tests ICO and B. PNP / NPN. Operates from 9v battery. Complete with all instructions, etc. £3 95. P. & P. 20p.

LB4 TRANSISTOR TESTER

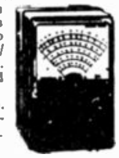
Tests PNP or NPN transistors. Audio indication. Operates on two 1·5v batteries. Complete with all instructions, etc. £4·50. P. & P. 20p.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER



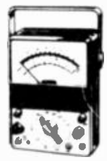
10 meg. input 10 ranges: 01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4cps.-1·2 Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17·50. Carr. 25p.

TE-65 VALVE VOLTMETER



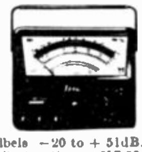
28 ranges. D.C. volts 1·5–1,500v. A.C. volts 1·5–1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions. £17·50. P. & P. 30p. Additional probes available: R.F. £2·12½; H.V. £2·50.

KAMODEN HM. 720B F.E.T. V.O.M.



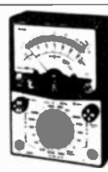
Input impedance 10 meg ohms. Ranges: 0 / ·25 / 1 / 2·5 / 10 / 50/ 250 / 1000V. D.C. 0 / 2·5 / 10 / 50 / 250 1000V. A.C. 0 / 25µA / 2·5 / 25 / 250 MA D.C. − 20 to + 62dB 0 / 5K / 50K / 500K / 5meg 500meg ohms. £14·95. Post 30p

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



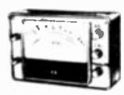
Battery operated, 11 meg input, 26 ranges. Large 4½" mirror scale. Size 5¼" × 4¾" × 2¾". DC VOLTS 0·3–1200V AC VOLTS 3–300V RMS. 8·0–800V P-P. DC CURRENT ·12–12MA. Resistance up to 2000M ohm. Decibels −20 to + 51dB. Complete with leads/instructions. £17·50. P. & P. 20p.

MODEL L-55 FET V.O.M.



Input impedance 10 meg ohms. 0 / ·3 / 1·2 / 6 / 30 / 120 / 600V. D.C. 0 / 3 / 12 / 60 / 120 / 600V. A.C. 0 / 120µA / 120mA D.C. 0 / 1K / 100K / 10 meg /100 meg ohms £15·97. Post 15p.

KAMODEN HMG-500 INSULATION RESISTANCE TESTER



Range 0–1000 Megohms, 500 Volt. Battery operated. Wide range clear meter 4¾" × 4". Complete with deluxe carrying case, batteries, instructions. £19·95. Post 30p

MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER

Sensitivity 330 ohms/Volt AC and DC. Accuracy 5% D.C. 1% AC. Scale length 165mm. 0/300/750µA/1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750mA / 1·5 / 3 / 7·5AMP DC 0 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750mA / 1·5 / 3 / 7·5 AMP 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. Supplied complete with test leads, manual and test certificate. £49 00. Post 50p.

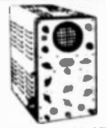
BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Sine 18 × 200,000 Hz; Square 18 × 50,000 Hz Output max. + 10 dB. (10 K ohms) Operation internal batteries Attractive 2-tone case 7¼" × 5" × 2". Price £17·50. Carr. 17½p.

TO-3 PORTABLE OSCILLOSCOPE

3in. tube, Y amp. Sensitivity 0 1v p-p/CM. Bandwidth 1·5 cps 1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5cps–800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. £47·50. Carr. 50p.

CI-5 PULSE OSCILLOSCOPE



For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100KHz VRMS/mm. ·1-25; HOR. AMP. Bandwidth 500KHz. Sensitivity at 100KHz, V RMS/mm. ·3-25; Preset triggered sweep 1-3,000usec.; free running 20-200,000Hz in nine ranges. Calibrator pips. 220 × 360 × 430mm. 115-230V. AC operation. £39·00. Carr. paid.

RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

5 mc/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. × 4in. C.R.T. Calibrated triggered sweep from ·2 u/sec. to 100 milli-sec. per cm. Free running time base 50 c/s-1 mc/s. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual £87. Carr. Paid.

MODEL AT201 DECADE ATTENUATOR

Frequency range 0–200KHz. Attenuator 0–111db, 0·1db step. Impedance 600 ohms. Max. input power 30dbm. Size 180 × 90 × 55mm. £12·50. Post 37p.

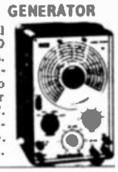
ARF-300 AF/RF SIGNAL GENERATOR

All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine / square 10v. P-P. RF 100 KHz to 200 MHz. Output 1v maximum. Operation 220/240v. AC. Complete with instructions and leads. £29·95. Post 50p.

MODEL TE.15 GRID DIP METER

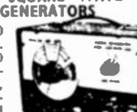
Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440Kc/s–280Mc/s in 6 coils. 500µA Meter. 9V battery operation. Size 180 × 80 × 40mm. £15·00. Post 20p.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s 500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions £17·50. Carr. 37p. Size 140 × 215 × 170 mm.

TE22 SINE SQUARE WAVE AUDIO GENERATORS



Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms. 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. £17 50. Carr. 37½p.

AUTO TRANSFORMERS

0/115/250V. Step up or step down. Fully shrouded.

80 W	£2·10	P. & P. 18p
150 W	£2·70	P. & P. 18p
300 W	£3 60	P. & P. 23p
500 W	£5·25	P. & P. 33p
1000 W	£7·50	P. & P. 38p
1500 W	£10·20	P. & P. 43p
2250 W	£17·25	P. & P. 50p
5000 W	£35·00	P. & P. £1

MCA. 220 AUTOMATIC VOLTAGE STABILISER

Input 88 125 VAC or 176, 250VAC. Output 120VAC or 240VAC. 200VA rating. £11·97. Carr. 50p.

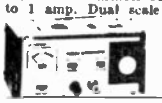
JOSTY KIT

HIGH QUALITY CONSTRUCTION KITS
Appointed stockists at all branches
Complete with comprehensive easy to follow instructions and covered by full guarantee
Post and packing 15p per kit

AF20	Mono transistor amplifier	£4·80
AF30	Mono transistor pre-amplifier	£2·61
AF310	Mono amplifier [illegible]	£5·91
AT5	Automatic light control	£2·58
AT30	Photo cell switching unit	£5·70
AT50	400W Triac light dimmer, speed [illegible]	£4·80
AT56	1 300W Triac light dimmer, speed [illegible]	£5·70
AT56	2 200W Triac light dimmer [illegible]	£6·90
AT60	Psychedelic light control [illegible]	£7·60
AT65	Psychedelic light [illegible]	£14·55
HF61	Medium wave transistor [illegible]	£3·33
HF65	FM transistor transmitter	£2·70
HF75	FM transistor receiver	£2·88
HF310	FM tuner unit	£15·81
HF325	De luxe FM tuner unit	£24·12
HF330	Stereo decoder for HF310 HF325	£9·96
HF395	Aerial amplifier for AM FM bands	£1·77
GP310	Stereo pre amp for use with 2x AF310	£1·77
GU330	Tremolo unit for guitars etc	£7·50
NT10	Power supply 100 mA 9V [illegible]	£6·15
NT300	Professional stabilized power supply 2-30V 2·2 Amp	£12·51
NT305	Transformer [illegible] 7·5V 9V DC	£4·50
NT310	Power supply 4·5V [illegible] 18V [illegible]	£4·80
NT315	Power [illegible] V AC [illegible]	£9·57

RP214 REGULATED POWER SUPPLY

Solid state. Variable output 0–24V DC up to 1 amp. Dual scale meter to monitor voltage and current. Input 220/240V AC. Size 185 × 85 × 105mm. £8·97 P. & P. 25p.



PS.200 REGULATED P.S.U.

Solid state. Variable output 5-20 volt D.C. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240 V. A.C. Size 7½" × 5½" × 3½". £19·95. P. & P. 25p.

PS.1000B REGULATED POWER SUPPLY

Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240v AC. Size 4" × 3½" × 6½". £11·97. P. & P. 25p.

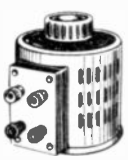
"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. All models—Input 230V. 50/60 c/s. Variable output 0–260V.

MODEL S-260 GENERAL PURPOSE BENCH MOUNTING

1 Amp ..	£7·00
2·5 Amp ..	£8·05
5 Amp ..	£11·75
8 Amp ..	£15·90
10 Amp ..	£22·50
12 Amp ..	£23·60
20 Amp ..	£49·00
25 Amp ..	£58·00
40 Amp ..	£82·50

MODEL S-260B



Panel Mounting.

1 Amp ..	£7·00
2·5 Amp ..	£8·05

Carriage and Packing Extra

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. ¼in. dia. shafts. Bulk quantities available.

25 WATT. 10/25/50/100/250/500/1000 ohms. 95p. P. & P. 10p.

50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms. £1·35. P. & P. 10p.

100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms. £1·95. P. & P. 15p.

230V/240V SMITHS SYNCHRONOUS GEARED MOTORS

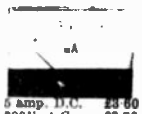
Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 2 RPH ACW; 30 RRH CW;
50p each Post 12p.

SEW CLEAR PLASTIC PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVT. DEPTS., EDUCATIONAL AUTHORITIES, ETC.

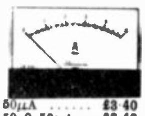
Over 200 ranges in stock—other ranges to order. Quantity discounts available.
Send for fully illustrated brochure.

Type SW.100 100 x 80 mm.



50μA	£4·15	5 amp. D.C.	£3·60
50–0–50μA	£3·95	300V. A.C. ..	£3·70
100μA	£3·95	VU Meter ..	£4·30
100–0–100μA	£3·90		
500μA	£3·70		
1mA	£3·50		
20V. D.C. ..	£3·50		
50V. D.C. ..	£3·60		
300V. D.C.	£3·60		
1 amp. D.C.	£3·60		

Type SD.830 82.5mm x 110mm Fronts



50μA	£3·40	10mA	£3·10
50–0–50μA	£3·40	50mA	£3·10
100μA	£3·35	100mA	£3·10
100–0–100μA	£3·35	500mA	£3·10
200μA	£3·30	1 amp.......	£3·10
500μA	£3·15	5 amp.......	£3·10
1mA	£3·10	10 amp.	£3·10
5mA	£3·10	5V. D.C. ..	£3·10
		10V. D.C. ..	£3·15
		20V. D.C. ..	£3·10
		50V. D.C. ..	£3·10
		300V. D.C.	£3·10
		15V. A.C. ..	£3·30
		300V. A.C. ..	£3·30
		VU Meter ..	£3·50

Type SD.640 63.5mm x 85mm Fronts

50uA	£3·05	500mA	£2·90
50–0–50μA	£3·05	1 amp... ...	£2·90
100μA	£3·00	5 amp... ...	£2·90
100–0–100μA	£3·00	10 amp	£2·90
200μA	£3·00	5V. D.C. ..	£2·90
500μA	£2·95	20V. D.C. ..	£2·90
1mA	£2·90	50V. D.C. ..	£2·90
5mA	£2·90	300V. D.C.	£2·90
10mA	£2·90	15V. A.C. ..	£3·00
50mA	£2·90	300V. A.C. ..	£3·00
100mA	£2·90	VU Meter	£3·15

Type SD.460 46mm x 59.5mm Fronts

50μA	£2·80	1 amp.......	£2·60
50–0–50μA	£2·80	5 amp.......	£2·60
100μA ...	£2·75	10 amp.	£2·60
100–0–100μA	£2·75	5V. D.C. ..	£2·60
200μA	£2·70	10V. D.C.	£2·60
500μA	£2·55	20V. D.C. ..	£2·60
1mA	£2·60	50V. D.C. ..	£2·60
5mA	£2·60	300V. D.C.	£2·60
10mA	£2·60	15V. A.C. ..	£2·70
50mA	£2·60	300V. A.C. ..	£2·70
100mA	£2·60	VU Meter ..	£2·90
500mA ...	£2·60		

"SEW" EDGWISE METERS

Type PE.70. 3 17/32in. x 1 15/32in. x 2⅞in. deep

50μA	£3·15	500μA	£3·20
50–0–50μA	£3·60	1mA	£3·20
100μA	£3·60	300V. A.C. ..	£3·25
100–0–100μA	£3·50	VU Meter ..	£3·35
200μA	£3·40		

*MOVING IRON—
ALL OTHERS MOVING COIL
Please add postage

Type MR.85P. 4½in. x 4¼in. fronts

50μA	£4·40	50mA	£3·90
50–0–50μA	£4·25	100mA	£3·90
100μA	£4·25	500mA	£3·90
100–0–100μA	£4·05	1 amp.......	£3·90
200μA	£4·05	5 amp.......	£3·90
500μA	£3·90	15 amp.	£3·90
500–0–500μA	£3·90	30 amp	£3.95
1mA	£3·90	20V. D.C.	£3·90
1–0–1mA ..	£3·90	50V. D.C.	£3·90
5mA	£3·90	150V. D.C.	£3·90
10mA	£3·90	300V. D.C.	£3·90
		15V. A.C. ..	£3·95
		300V. A.C. ..	£3·95
		8 Meter 1mA	£3·90
		VU Meter ..	£4·65
		1 amp. A.C.*	£3·90
		5 amp A.C.*	£3·90
		10 amp. A.C.*	£3·90
		20 amp. A.C.*	£3·90
		30 amp. A.C.*	£3·90

Type MR.52P. 2½in. square fronts

50μA	£3·50	10V. D.C. ..	£2·50
50–0–50μA	£3·05	20V. D.C. ..	£2·50
100μA	£3·00	50V. D.C. ..	£2·50
100–0–100μA	£2·95	300V. D.C.	£2·50
500μA	£2·65	15V. A.C. ..	£2·60
1mA	£2·50	300V. A.C. ..	£2·60
5mA	£2·50	8 Meter 1mA	£2·60
10mA	£2·50	VU Meter ..	£3·60
50mA	£2·50	1 amp. A.C. *	£2·50
100mA	£2·50	5 amp. A.C. *	£2·50
500mA	£2·50	10 amp. A.C. *	£2·50
1 amp	£2·50	20 amp. A.C. *	£2·50
5 amp	£2·50	30 amp. A.C. *	£2·50

Type MR.65P. 3½in. x 3¼in. fronts

50μA	£3·70	10V. D.C. ..	£2·60
50–0–50μA	£3·15	20V. D.C. ..	£2·60
100μA	£3·15	50V. D.C. ..	£2·60
100–0–100μA	£3·10	150V. D.C.	£2·60
200μA	£3·05	300V. D.C.	£2·60
500μA	£2·75	15V. A.C. ..	£2·80
500–0–500μA	£2·60	50V. A.C. ..	£2·80
1mA	£2·60	150V. A.C. ..	£2·80
5mA	£2·60	300V. A.C. ..	£2·80
10mA	£2·60	500V. A.C.	£2·90
50mA	£2·60	8 Meter 1mA	£3·25
100mA	£2·60	VU Meter ..	£3·70
500mA	£2·60	50mA A.C. *	£2·60
1 amp.......	£2·60	100mA A.C. *	£2·60
5 amp.......	£2·60	200mA A.C. *	£2·60
10 amp.	£2·60	500mA A.C. *	£2·60
15 amp.	£2·60	1 amp. A.C. *	£2·60
20 amp.	£2·60	5 amp. A.C. *	£2·60
30 amp.	£2·80	10 amp. A.C. *	£2·60
50 amp.	£2·90	20 amp. A.C. *	£2·60
5V. D.C. ..	£2·60	30 amp. A.C. *	£2·60

"SEW" EDUCATIONAL METERS

Type ED.107. Size overall 100mm x 90mm x 108mm

A new 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. Available in the following ranges:

50μA	£6·90	20V. d.c. ..	£5·95
100μA	£6·40	50V. d.c. ..	£5·95
1mA	£5·95	300V. d.c. ..	£5·95
50–0–50μA	£6·40		
1–0–1mA	£5·95	Dual range	
1A d.c.	£5·95	500mA/5A d.c	£7·00
5A d.c.	£5·95	5V/50V d.c.	£7·00
10V d.c.	£5·95		

Type MR.38P. 1 21/32in. square fronts

50μA	£2·55	200mA	£2·25
50–0–50μA	£2·50	300mA	£2·25
100μA	£2·45	500mA	£2·25
100–0–100μA	£2·40	750mA	£2·25
200μA	£2·25	1 amp.......	£2·25
500μA	£2·25	2 amp.......	£2·25
500–0–500μA	£2·25	5 amp.......	£2·25
1mA	£2·25	10 amp.	£2·25
1–0–1mA ..	£2·25	3V. D.C. ..	£2·25
2mA	£2·25	10V. D.C. ..	£2·25
5mA	£2·25	15V. D.C. ..	£2·25
10mA	£2·25	20V. D.C. ..	£2·25
20mA	£2·25	50V. D.C. ..	£2·25
50mA	£2·25	100V. D.C.	£2·25
100mA	£2·25	150V. D.C.	£2·25
150mA	£2·25	300V. D.C.	£2·25
		500V. D.C.	£2·25
		750V. D.C.	£2·25
		15V. A.C. ..	£2·30
		50V. A.C. ..	£2·30
		150V. A.C. ..	£2·30
		300V. A.C. ..	£2·30
		500V. A.C. ..	£2·30
		8 Meter 1mA	£2·30
		VU Meter ..	£2·65

Type MR.45P. 2in. square fronts

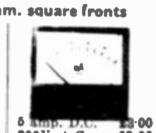
50μA	£2·70	5 amp.......	£2·40
50–0–50μA	£2·65	10V. D.C. ..	£2·40
100μA	£2·60	20V. D.C. ..	£2·40
100–0–100μA	£2·50	50V. D.C. ..	£2·40
200μA	£2·50	300V. D.C.	£2·40
500μA	£2·45	15V. A.C. ..	£2·40
500–0–500μA	£2·40	300V. A.C. ..	£2·40
1mA	£2·40	8 Meter 1mA	£2·50
5mA	£2·40	VU Meter ..	£2·70
10mA	£2·40	1 amp. A.C. *	£2·40
50mA	£2·40	5 amp. A.C. *	£2·40
100mA	£2·40	10 amp. A.C. *	£2·40
500mA	£2·40	20 amp. A.C. *	£2·40
1 amp.......	£2·40	30 amp. A.C. *	£2·40

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts

25μA	£4·60	1 amp.......	£2·60
50μA	£3·55	5 amp.......	£2·60
50–0–50μA	£3·05	15 amp.	£2·60
100μA	£3·00	30 amp.	£2·60
100–0–100μA	£3·00	50 amp.	£2·60
500μA	£2·70	5V. D.C. ..	£2·60
500–0–500μA	£2·70	10V. D.C. ..	£2·60
1mA	£2·60	20V. D.C. ..	£2·60
1–0–1mA ..	£2·60	50V. D.C. ..	£2·60
5mA	£2·60	150V. D.C.	£2·60
10mA	£2·80	300V. D.C.	£2·60
50mA	£2·60	50mV. D.C.	£2·90
100mA	£2·60	100mV. D.C.	£2·90
500mA	£2·60	30V. A.C. *..	£2·65
		50V. A.C. *..	£2·65
		150V. A.C. *	£2·65
		300V. A.C. *	£2·65
		500mA A.C. *	£2·60
		1 amp. A.C. *	£2·60
		5 amp. A.C. *	£2·60
		10 amp. A.C. *	£2·60
		20 amp. A.C. *	£2·60
		30 amp. A.C. *	£2·60
		50 amp. A.C. *	£2·60
		VU Meter ..	£2·65

Type S-80 80 mm. square fronts



50μA	£3·50	5 amp. D.C.	£3·00
50–0–50μA	£3·40	300V. A.C. ..	£3·00
100μA	£3·40	VU Meter ..	£3·70
100–0–100μA	£3·30		
500μA	£3·05		
1mA	£3·00		
20V. D.C. .	£3·00		
50V. D.C. ..	£3·00		
300V. D.C.	£3·00		
1 amp. D.C.	£3·00		

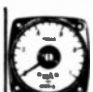
HAND HELD 2-WAY WALKIE TALKIES

Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic aerial. Complete carrying cases.

100mW	£24·95	Pair. Post 50p.
2 channel 300mW	£52·50	Pair. Post 50p.
3 channel 2 watt	£71·25	Pair. Post 50p.

Licence required for operation in U.K.

240° Wide Angle 1mA Meters



MW 1-6 60mm square	£3·97
MW 1-8 80mm square	£4·97

P. & P. extra

230 VOLT A.C. 50 CYCLES RELAYS

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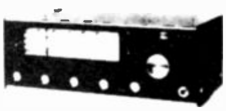
UNR 30 RECEIVER

4 Bands covering 550 kc/s-30 mc/s B.F.O. Built-in Speaker 220/240 v. A.C. Brand new with instructions.

Our Price **£15·75** Carr. 37p

UR-1A RECEIVER



4 Bands covering 550 kc/s-30 mc/s. FET, S Meter. Variable BFO for SSB. Built-in Speaker, Bandspread, Sensitivity Control. 220/240 v. A.C. or 12 v. D.C. 12½in. × 4½in. × 7in. Brand new with instructions.

Our Price **£25·00** Carr. 37p

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Solid state, 5 bands covering 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning. BFO, AVC, ANL. "S" meter. AM/CW/SS B. Integrated speaker and phone socket. 220/240 v. A.C. or 12 v. D.C. Size 325 × 266 × 150 mm. Complete with instructions and circuit.

Our Price **£32·50** Carr. 50p

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General coverage 150-400 kc/s, 550 kc/s-30 mc/s, FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter Bandspread. RF Gain. 15in. × 9½in. × 8½in. 18 lb. 220/240 v. A.C. or 12 v. D.C. Brand new with instructions.

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TRIO 9R59DS RECEIVER

4 bands covering 550 kc/s to 30 mc/s continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW, ANL, Variable BFO. S meter. Sep. bandspread dial. IF frequency 455 kc/s, audio output 1·5w. Variable RF and AF gain controls 115/250 v. A.C. Size: 7in. × 13in. × 10in. with instruction manual.

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FULL RANGE OF TRIO STOCKED

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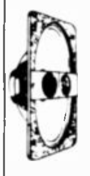
EMI LOUDSPEAKERS



Model 350. 13" × 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. £7·25 each. P. & P. 37p.

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Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14½" × 9" × 7¼". 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead.

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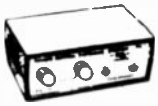
HA-10 STEREO HEADPHONE AMPLIFIER

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 5MU/100MU. Output 50MW.

Our Price **£6·97** P. & P. 15p

1021 STEREO LISTENING STATION



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6" × 4" × 2¼".

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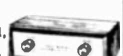
MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½" × 5" × 3". Inputs Mics: 3 × 3mV 50K; 2 × 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.

Our Price **£8·97** P. & P. 20p

EA.41 REVERBERATION AMPLIFIER



Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7½ × 3 × 4½in.

Our Price **£7·50** P. & P. 15p

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ACD.660 Stereo Cassette Deck

A beautifully styled 4 track stereo deck with an outstanding specification offered at a remarkably low price. Incorporates a host of features including switchable noise filter normal/chrome tape selector, twin VU meter, slider record/playback level controls, front panel headphone socket, recording indicator lamp, phono/Din line input sockets, 3.5mm mike input sockets etc. etc. Frequency response 100-8KHz (100-12KHz Cr02) S/N-45dB. Crosstalk 45dB. Separation-35dB. Noise limiter-6dB at 10KHz. Complete with phono connecting leads.

OUR PRICE **£39·50** Carr. & Ins.50p

AHP-8D 8 Track Stereo Tape Deck

Can be used with most hi fi amplifiers. Push button track selector and illuminated track indicators. Attractive cabinet with black and silver trim. Output level 750mV. AC 220/240v.

OUR PRICE **£11·95** P. & P. 50p.

AHP-8A 8 Track Stereo Tape Player

Incorporates built in amplifiers giving 2½ + 2½ watts rms output. Push button track selector, illuminated track indicators, slider controls for volume, balance and tone. Attractive cabinet with black and silver trim. Output impedance 8 ohms. AC 220/240v.

OUR PRICE **£17·25** P. & P. 50p.

Stereo Headphones

LSH.20 Individual volume controls Stereo mono switch. 8 ohms. 40-19,000 Hz. £3·50 P & P 30p

LSH.30 Open back type. Individual tone and volume controls. 8 ohms. 30-20,000 Hz. £5·50 P & P 30p

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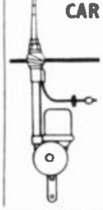

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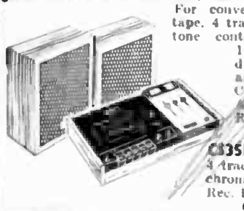

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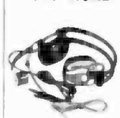

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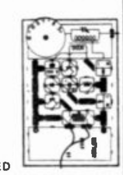

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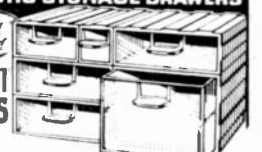

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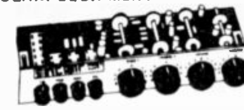

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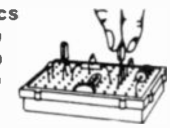

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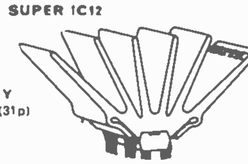

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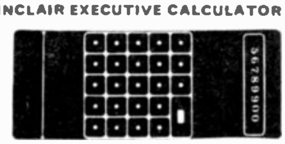

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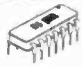

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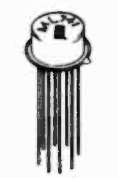

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1500µF	20p
2200µF	24p

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2N3405	44p
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Heat Sinks
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TO18 6p

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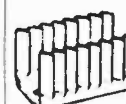

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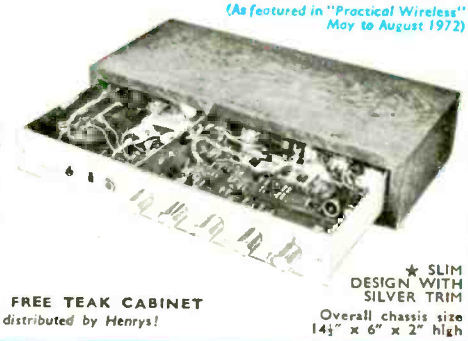
(As featured in "Practical Wireless" May to August 1972)



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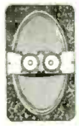

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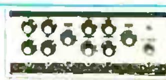

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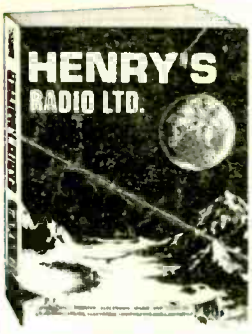

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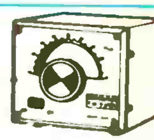

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