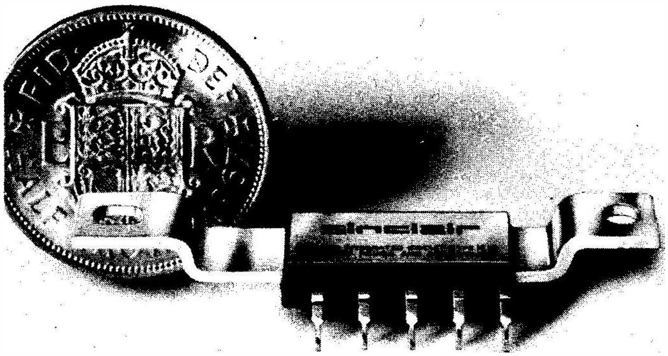
PRACTICAL
ELECTRONICS
DECEMBER 1969
THREE SHILLINGS

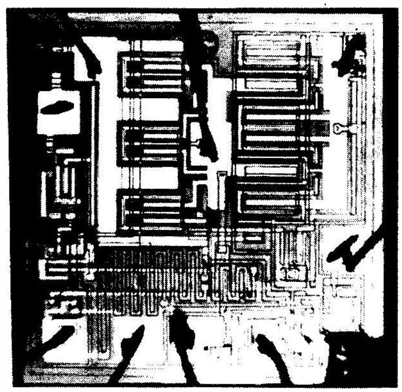
DOUBLE-SIX
electronic domino player

A New Outlook in Audio Design

HI FI STEREO AMPLIFIER

10 WATT MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER AND PRE-AMP





the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output 5 watts R.M.S. (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 zenor diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of the usual tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs servo amplifiers (it is d.c. coupled throughout) etc. The photographic masks required for producing monolithic I.Cs are expensive but once made, the circuits can be produced with complete uniformity and at very low cost. It also enables us to give a 5 year guarantee on each IC-10 knowing that every unit will work as perfectly as the original and do so for a lifetime.

■ SPECIFICATIONS

Output	10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response	5 Hz to 100 KHz±1dB.
Total harmonic distortion	Less than 1% at full output.
Load impedance	3 to 15 ohms.
Power gain	110dB (100,000,000,000 times) total.
Supply voltage	8 to 18 volts.
Size	1 × 0.4 × 0.2 inches.
Sensitivity	5mV.
Input impedance	Adjustable externally up to 2.5 M ohms.

■ CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feed-back is used round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

■ APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

SINCLAIR

IC.10 *with IC.10 manual and 5 year guarantee* **59/6**

POST FREE

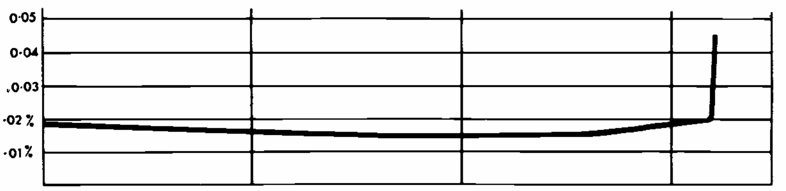
SINCLAIR RADIONICS LIMITED
22 NEWMARKET ROAD · CAMBRIDGE
Tel. 0233-52731

Z.30

THE WORLD'S LOWEST DISTORTION HIGH FIDELITY AMPLIFIER.

For four years, the Sinclair Z.12 dominated the constructor world, being the best selling unit of its kind this side of the Atlantic. Excellent as it was, the new Sinclair Z.30 is still better. Half the size of the Z.12, it has more than twice the power, very much greater gain and a level of distortion 50 times lower. This incredible figure results from using over 60dB of negative feed back with a constant current load to the driver stage obtained by incorporating a two transistor circuit in place of the more usual boot-strapping. 9 silicon epitaxial planar transistors are used to provide enormous power; up to 20 watts RMS sine wave (40 watts peak). The circuitry of this marvellous amplifier allows it to be operated from any voltage from 8 to 35 to perfection. At all output levels, distortion is only 0.02%. This puts true laboratory standards into the hands of every user of a Z.30. Two Z.30s and a new Stereo Sixty will make a stereo assembly of such perfection that it could not be bettered in its class no matter how much you spent. But the Z.30 has an enormous variety of applications, particularly where quality, precision and reliability are essential. It can also be used entirely on its own as an amplifier for an efficient economy record player.

APPLICATIONS
Hi-fi amplifier; car radio amplifier; record player amplifier fed directly from pick-up; inter-com; electronic music and instruments; P.A.; laboratory work, etc. Full details for these and many other applications are given in the manual supplied with the Z.30.



SPECIFICATIONS

Power output—15 watts R.M.S. into 8 ohms using a 35V supply: 20 watts R.M.S. into 3 ohms using a 30V supply.

Output—Class AB.
Frequency response—30 to 300,000 Hz ± 1dB.

Distortion—0·02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

Signal-to-noise ratio—better than 70dB unweighted.

Input sensitivity—250mV into 100kΩ.

Damping factor—>500.

Loudspeaker impedances—3 to 15 ohms.

Power requirements—From 8 to 35V d.c. (The Z.30 will operate ideally from batteries if required.)

Size—$3\frac{1}{2} \times 2\frac{1}{4} \times \frac{1}{2}$ inches.

Built, tested and guaranteed, with circuits and instructions manual

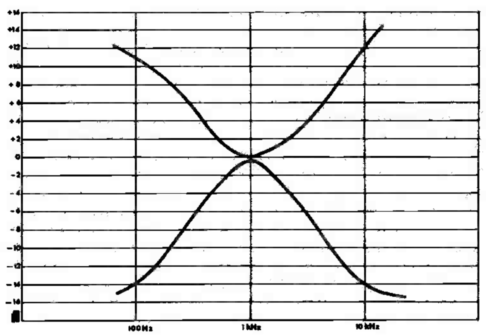
89/6

sinclair

SINCLAIR RADIONICS LIMITED
22 NEWMARKET RD., CAMBRIDGE Tel: 0223 52731

This attractive and completely new unit is intended for use with two new Z.30 amplifiers to provide the finest possible standards of stereo reproduction. Four press buttons and four rotary controls are used to provide on-off, three input selectors and Volume, Bass cut/boost, Treble cut/boost and Stereo balance. The on-off button also switches the power amplifiers. The front panel in brushed aluminium is flush mounted to the cabinet front, it being necessary only to drill holes to accommodate the controls. Rear adjustable brackets hold the chassis tight to the cabinet. The very latest ganged rotary controls are used to afford compactness and extra long working life free from noise.

The Stereo-60 may also be used with 2 IC-10's or any other high performance amplifiers.



Curves to show bass and treble cut and boost

SPECIFICATIONS

- ●Input sensitivities—Radio—up to 3mV Magnetic Pickup—3mV: correct to R.I.A.A. curve ± 1dB; 20 to 25,000 Hz. Ceramic Pickup—up to 3mV: Auxiliary—up to 3mV.
- ●Output—1 volt.
- ●Signal-to-noise ratio—better than 70dB.
- ●Channel matching—within 1dB.
- ●Tone Controls—TREBLE +15 to —15dB at 10 KHz: BASS +15 to —15dB at 100 Hz.
- ●Power consumption 5mA.
- ●Front panel—brushed aluminium with black knobs and controls.
- ●Size 8¼×1¼×4 inches.

Ready built, tested and guaranteed with instructions **£9.19.6**

PZ.5 POWER SUPPLY UNIT

A new heavy duty mains power supply unit designed specially to drive two Z.30s and a Stereo Sixty. New compact design.
For AC Mains, 200-240V/50Hz. **£4.19.6**

USE THIS COUPON FOR Z.30, STEREO 60 AND P.Z.5.

Q.16 LOUDSPEAKER AND MICROMATIC ON NEXT PAGE

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET RD., CAMBRIDGE

Please send

....

....

....

....

For which I enclose cash/cheque money order

NAME...

ADDRESS...

....

....

.... PE.1269

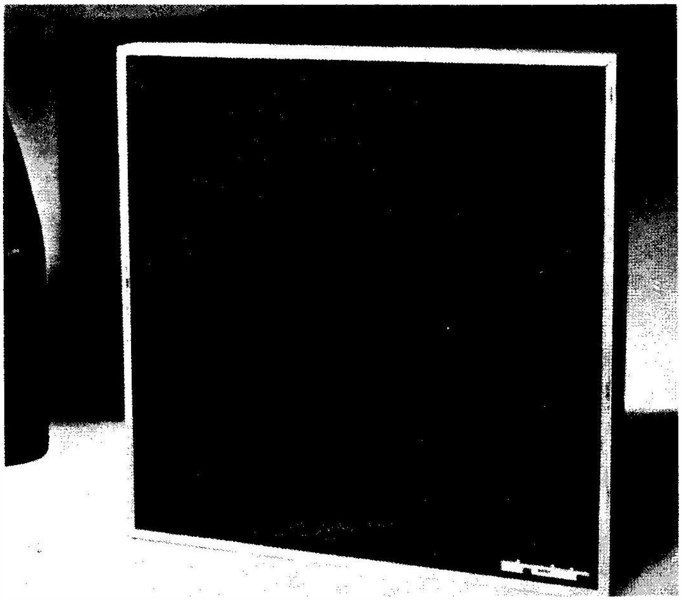
sinclair

SINCLAIR

Q.16

new elegance in an outstanding loudspeaker

All the superb features which went to make the Sinclair Q.14 have been incorporated in the new Q.16 which gives an exciting new opportunity for you to match your Sinclair equipment with modern decor. Employing the same well proven acoustic system in which materials, processing and styling are used in such a radical and successful departure from conventional design, the new Q.16 presents an entirely new appearance with its attractive teak surround and all-over special cellular foam front chosen as much for its appearance as for its ability to pass all audio frequencies without loss. The Q.16 is compact and slim. Its new styling makes it eminently suitable for shelf mounting, but it is no less versatile than its famous predecessor. Listen to a pair of Q.16s in stereo and marvel at the standards of quality and clarity they give.



The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000 Hz. with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good transient response at all frequencies. Size: $9\frac{3}{4}''$ square $\times$ $4\frac{3}{4}''$ deep from front to back.

£8.19.6

POST FREE

SINCLAIR MICROMATIC

The world's most successful miniature radio

Specifications

Size:
$1\frac{13}{16}'' \times 1\frac{7}{16}'' \times \frac{1}{2}''$ (46 x 33 x 13mm).

Weight incl. batteries:
1 oz. (28·35gm) approx.

Tuning:
Medium wave band with bandspread at higher frequency end.

Earpiece.
Magnetic type.

Case:
Black plastic with anodized aluminium front panel, spun aluminium dial.

Complete kit incl. earpiece, case, solder and instructions in fitted pack. **49/6**

Plus 11d. P.T. surcharge

Ready buit, tested and guaranteed, with earpiece. **59/6**

Plus 1/1d. P.T. surcharge

Mallory Mercury Cell RM675 (2 required) each 2/9d.

Considerably smaller than an ordinary box of matches, this is a multi-stage A.M. receiver meticulously designed to provide remarkable standards of selectivity, power and quality. Powerful A.G.C. is incorporated to counteract fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy at all times. Vernier type tuning plus the directional properties of the self-contained special ferrite rod aerial makes station separation much easier than with many larger sets. The plug-in magnetic earpiece which matches exactly with the output provides wonderful standards of reproduction. Everything including the batteries is contained within the attractively designed case. Whether you build your Micromatic or buy it ready built and tested, you will find it as easy to take with you as your wristwatch, and dependable under the severest listening conditions.

USE THIS COUPON FOR MICROMATIC AND Q.16 ORDERS

To: SINCLAIR RADIONICS LIMITED, 22 NEWMARKET ROAD, CAMBRIDGE

Please send ....

....

....

For which I enclose cash/cheque/money order.

NAME ....

ADDRESS ....

....

....

PE 1269

SINCLAIR GENERAL GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

sinclair

SINCLAIR RADIONICS LIMITED

22 NEWMARKET ROAD

CAMBRIDGE Tel. 0223 52731

Complete stereo system – 28 gns.

The new Duo general-purpose 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:-
Impedance 10 ohms. It incorporates Goodmans high flux 6″ × 4″ speaker and 2¼″ tweeter. Teak finish 12″ × 6¾″ × 5¾″. **4 guineas** each. 7/6d. p. & p.
Type 2 as type 1. Size 17½″ × 10¾″ × 6¾″. Incorporating 10½″ × 6¼″ bass unit and 2¼″ tweeter. 3 ohms impedance **5½ guineas** plus 7/6 p. & p. 7/6d. p. & p.
Garrard Changers from £7.19.6d. p. & p. 7/6d.
Cover and Teak finish Plinth £4.15.0d. 7/6d. p. & p.

These 5 items can be purchased together for 28 gns. + £1.10 P.&P.

Duetto Integrated Transistor Stereo Amplifier **9 GNS.** plus 7/6d. p. & p.

The Duetto is a good quality amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.
SPECIFICATION:
R.M.S. power output: 3 watts per channel into 10 ohms speakers
INPUT SENSITIVITY: Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1 Kc/s
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.
TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.

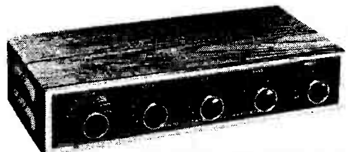
The Classic

Teak finished case

8½ GNS.
Plus P. & P. 7/6

SPECIFICATION: Sensitivities for 10 watt output at 1KHz into 3 ohms. Tape Head: 3mV (at 3¾ i.p.s.) Mag. P.U.: 2 mV. Cer.P.U.: 80mV. Tuner: 100mV. Aux. 100mV. Tape/Rec. Output. Equalisation for each input is correct to within +2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone Control Range: Bass*: 13dB at 60Hz. *Treble*: ±14dB at 15KHz. *Total Distortion*: (for 10 watt output) < 1·5%. Signal Noise: < −60dB. A.C. Mains 200–250V. Size 12½in long, 4¼in deep, 2¾in high. **Built and tested.**

The Viscount

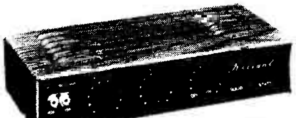


INTEGRATED HIGH FIDELITY TRANSISTOR STEREO AMPLIFER

13½ GNS.
Plus P. & P. 7/6

SPECIFICATION: *Output*: 10 watts per channel into 3 to 4 ohms speakers (20 watts monoral). *Input*: 6-position rotary selector switch (3 pos. mono and 3 pos. stereo). P.U., Tuner, Tape and Tape Rec. out. Sensitivities: All inputs 100mV into 1·8M ohm. *Frequency Response*: 40Hz–20KHz ±2dB. *Tone Controls*: Separate bass and treble controls. *Treble* 13dB lift and cut [at 15KHz]. *Bass*: 15dB lift and 25dB cut [at 60Hz]. *Volume Controls*: Separate for each channel. A.C. *Mains Input*: 200–240V, 50–60Hz. *Size*: 12½ × 6in × 2¾in teak-finished case. Built and tested. P. & P. 7/6.
Viscount Mark II for use with magnetic pick ups specification as above. Fully equalised for magnetic pick ups. Suitable for cartridges with minimum outputs of 4mV/cm/sec. at 1kc. Input Impedance 47k. **15 gns.** plus 7/6 P. & P.

THE RELIANT Mk. II



SOLID STATE GENERAL PURPOSE AMPLIFIER

6½ GNS. Plus P. & P. 7/6
In teak finished case

SPECIFICATION: *Output*: 10 watts into a 3 ohms speaker. *Inputs*: (1) for mike (10mV). Input (2) for gram. radio (250mV) individual bass and treble control. *Transistors*: 4 silicon and three germanium. *Mains input*: 220/250 volts. *Size*: 10½ × 4¾ × 2½in. *Mike to suit (crystal)*: 12/6 plus 1/6 P. & P. 8 × 5in speaker 14/6 plus 3/– P. & P. Mk. I 5½ gns. plus 7/6 P. & P. Less teak finished case.

SPECIAL OFFER

Complete stereo systems comprising BALFOUR 4 speed auto player with stereo head, 2 DUO speaker systems size 12 × 6¾ × 5¾in. Plinth (less cover) and the DUETTO stereo amplifier. All above items

19 GNS. Plus P. & P. 20/–

B.S.R. TD2 TAPE DECK

This tape deck takes 5¾in spools complete with two-track heads. Size 13¼ in long by 8¾in wide.

Price £8.19.6 Plus P. & P. 7/6

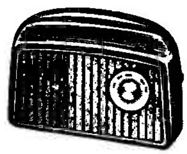
THE ELEGANT SEVEN Mk. III (350mW Output)

7-transistor fully tunable M.W.-L.W. Superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction. **MAINS POWER PACK KIT: 9/6 extra.**

Price £4.9.6 Plus P. & P. 7/6.

Circuit 2/6. Free with parts.

THE DORSET (600mW Output)



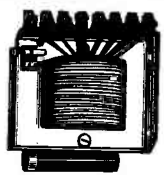
7 transistor fully tunable M.W.-L.W. superhet portaset—with baby alarm facility. Set of parts. The latest modulated and pre-alignment techniques makes this simple to build. Sizes: 12 × 8 × 3in.
MAINS POWER PACK KIT: 9/6 extra.

Price £5.5.0 Plus P. & P. 7/6.

Circuit 2/6. Free with parts.

RADIO & TV COMPONENTS
R.TV
(ACTON) LIMITED

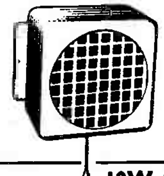
QUALITY MAINS TRANSFORMER



Input 250V OUTPUT (All RMS values) 4 windings of 11·5V connected in series total 46V at 4·5 amps (conservatively rated). The following combinations may be used. 1. 23—0—23V; 2. 46V. Both of these above voltages are commonly used in medium to high powered transistor amplifiers, power supplies, etc.

Price 35/- Plus P. & P. 7/6

Also see opposite page

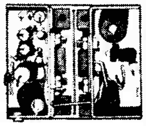


EXTRACTOR FAN

AC mains 230/250V. complete with pull switch. Size 6 × 6 × 4 in.

Price 27/6 Plus 7/6 P. & P.

X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Specifications: *Power Output* (into 3 ohms speaker) 10 watts. *Sensitivity* (for rated output): 1mV into 3K ohms (0·33 microamp). *Total Distortion at* 1KHz. at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *Speaker:* 3–4 ohms (3–15 ohms may be used). *Supply voltage:* 24V d.c. at 880mA (6–24V may be used).

Price 69/6 Plus 2/6 P. & P.

Control assembly: including resistors and capacitors.
1. Volume: PRICE 5/–.
2. Treble: PRICE 5/–.
3. Comprehensive bass and treble: PRICE 10/–.

The above 3 items can be purchased for use with the X101.

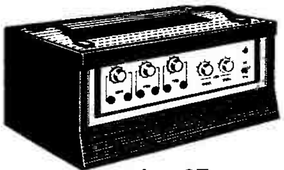
Power Supplies for the X101: P101 M (for mono) 35/– plus 4/6 P. & P. P101 S (for stereo) 42/6 plus 4/6 P. & P.

CAR TRANSISTOR IGNITION SYSTEM
(by famous manufacturer)

For 6V or 12V positive earth systems. Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardware (screws, washers etc.).

Price £4.19.6 (Post and Packing 5/- extra)

50 WATT AMPLIFIER A.C. Mains 200-250V



Price 27 gns. Plus 20/- P. & P.

An extremely reliable general purpose valve amplifier. Its rugged construction yet spage age styling and design makes it by far the best value for money. **TECHNICAL SPECIFICATIONS** 3 electronically mixed channels, with 2 inputs per channel, enables the use of 6 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES.** Channels 1 & 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars. Channels 3 & 4 300 mV at 1m. Suitable for most high output instruments (gram, tuner, organ etc.). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS. Bass Boost** +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s. **Treble Boost** +11dB at 15 KHz/s. **Treble Cut** −12dB at 15KHz/s. With bass and treble controls central −3dB points are 30Hz/s and 20 KHz/s. **POWER OUTPUT.** For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sinc wave 38·5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3·2% at 1KHz/s. Total distortion at 20 watts 0·15% at 1KHz/s. Output to match into 8 or 15 ohms speaker system. **NEGATIVE FEED BACK** 20dB at 1KHz/s. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES.** Adjustable from 200–250V. A.C. 50–60Hz/s. A protective fuse is located at the rear of unit. Output impedance 3, 8 and 15 ohms.

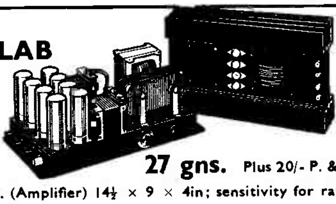
THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20kc/s. Size 13½ × 8⅞ × 4½ inches. By famous manufacturer.

List Price £7. **Our Price 74/6** Plus 5/- P. & P.

Similar speaker to the above without tweeters in 3 and 15 ohms 44/6 plus 5/– P. & P.

LIVINGSTONE LAB



50 watt RMS Base Transistor Amplifier. This amplifier is designed and manufactured by L.L. using the best quality components, thus making it extremely reliable and almost indestructible. Size (Power supply) 16 × 9½ × 6¼in. (Amplifier) 14½ × 9 × 4in; sensitivity for rated output 1V.

27 gns. Plus 20/- P. & P.

RECORD PLAYER SNIP A.C. MAINS 240V

The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7in to 10in or 12in. Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play.

Only £5.19.6 Post and insurance 7/6 extra

STEREO PRE-AMPLIFIER

Inputs—6 position rotary switch (3 position mono, 3 position stereo). Tuner 150 mV into 680k. Magnetic pick-up fully equalised and suitable for magnetic cartridges with minimising output of 4mV/cm/sec. Load 47k. Ceramic pick-up 150 mV into 680k. Sensitivities taken for 200mV output. Controls—separate volume controls for each channel. Twin ganged bass, 12dB lift and 15dB cut at 60c/s. Twin ganged treble, 10dB lift and 15dB cut at 10kc/s. Voltage required 23-30v D.C. at 5mA. Size 12½″ × 3¼″ × 2¾″. In teak finished case, complete with front panel and knobs. Built and tested.

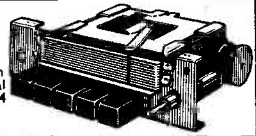
Price £7.7.0 Plus 5/- P. & P.

CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.

Price £2.10.0 Plus 1/- P. & P.

PYE CAR-RADIO
PUSH BUTTON TUNING HEART



This PRESTOLOCK 5 station Push-Button Tuner Heart with Manual Over-ride is an ideal basis for a quality AM car radio. Size 6¼ × 4 × 2in. **25/-** Plus 3/- P. & P.

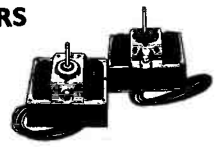
POCKET MULTI-METER

Size 3¾ × 2½ × 1⅜in. Meter size 2¼ × 1⅜in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1000 D.C. current 0–150mA. Resistance 0–100kΩ. Complete with test prods. battery and full instructions.

Price 42/6 Plus 3/6 P. & P.

FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/– to every purchaser of the Pocket Multi-Meter.

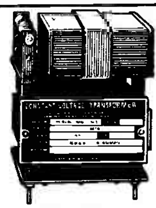
GARRARD TAPE MOTORS



Fast forward and fast re-wind motors, as used by famous manufacturer. Size 3 × 2½ × 2¾in. Spindle $\frac{5}{32}$in. A.C. Mains 250V.

39/6 per pair Plus 7/6 P. & P.

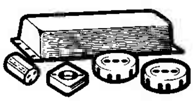
ADVANCE CONSTANT VOLTAGE TRANSFORMER



Output 7·5V at 1 amp and 30V at 100MA. Mains input 125V (2 can be used in series for 250V).

Price 22/6 Plus 7/6 P. & P.

40W FLUORESCENT LIGHT KIT



Incorporating **GEC** Choke size 8½ × 1¾ × 1¾in. 2 bi-pin holders. starter and starter-holder. P. & P. 5/6. **11/6**

Similar to above: 80W. Fluorescent Light Kit incorporating **GEC** choke size 11¾ × 1¾ × 1¾in. 2 bi-pin holders, start and starter holder. P. & P. 6/6. **17/6**

RADIO & TV COMPONENTS R TV (ACTON) LIMITED

TERMS C.W.O.
All enquiries S.A.E.

Goods not despatched outside U.K.

RADIO & TV COMPONENTS (ACTON) LTD.

21d High Street, Acton, London, W.3

Also at 323 Edgware Road, London, W.2

ALL ORDERS BY POST TO OUR ACTON ADDRESS

INTEGRATED CIRCUIT F.M. TUNER KIT

Dart Electronics has been appointed by General Avionics Limited as their U.K. distributor for their FM Tuner kit, the first to use integrated circuits with pulse counting techniques developed by Marconi-Elliott Microelectronics.

The circuit has built-in automatic frequency control, and with the inherent stability of the integrated circuits, a reliable and easily set up circuit is offered to the home constructor in kit form. A resistively tuned version is in widespread use as an industrial radio system and is noted for its extreme reliability under continuous, unattended operation. The circuit employed effectively contains 44 transistors and, although the quantity of discrete components is fairly high, the entire unit is built on a double-sided board measuring 133 × 98·5mm (3·875 × 5·25in). The Tuner can be run off a 12V d.c. power supply or a combination of 6 and 12V batteries.

All components are available BY POST ONLY from Dart Electronics at a special kit price of **£9 19s 6d** plus 5/- post and packaging (U.K. & N. Ireland) which includes selector switch and double-sided p.c. board ready drilled and tinned. The kit is complete with all necessary circuits and instructions.

Full assembly details, circuit diagram and parts list are also available separately from Dart Electronics at **2/6** per copy and an article appeared in the June issue of the WIRELESS WORLD magazine.

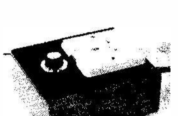
DART ELECTRONICS P.O. BOX No. 47, WITHAM, ESSEX

AUDIO EFFECTS

5 SHAW LANE HALIFAX YORKS.

Buy with confidence and obtain the right results. Refunds without question if any of our products fail to give 100% satisfaction.

REVERBERATION AMPLIFIER. Self-contained transistorised battery operated. An entirely different approach to sound reproduction. Normally sound reproduction from a single source has a flat, one-dimensional effect. With this unit proper sound delay through reverberation, tones are created with a truly third dimension for concert hall originality. Two controls adjust volume and reverberation. Simply plug microphone, guitar, etc. in and the output into your amplifier. Supplied in a beautiful walnut cabinet. 7¼ × 3 × 4¼in. **£10.4.0.** P.P. & Ins. 6/-.



POWER CONTROLLER. Power at your finger tips. Not merely half wave control but full wave. A single variable control gives zero to full power. Uses latest 15amp 3kW triac and special triggering device. Ideal for all types of lighting, fires, motors, drills, etc. Complete with box, power socket, cables, etc. In kit form with easy to follow instructions **£6.9.6.** Ready built **£9.4.6** plus 5/6 P.P. & Ins.

VOX SWITCH. This sound operated switch is ideal for mobile TX work, tape recorder switching, etc. You speak, it switches. High and medium imp. inputs. AF take off point. Drives your 12 volt relay. In kit form with full instructions, **42/6.** Ready built, tested and guaranteed, **62/6** plus 2/6 P.P.

METRONOME UNIT. Variable beat. Listen while you play and keep in time. Easily built, pocket size with personal mini earphone. In kit form **27/6** post paid. Ready built in an attractive black and white polythene case **37/6** post paid.

MORSE OSCILLATOR. PC board, transistors, high stab. components, battery carrier, ear piece. Adjustable tone. Just attach your key. Drives phones or speakers. In kit form **17/6** post paid. Ready built in similar case as above, **25/-** post paid.

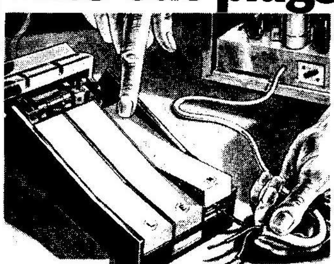
JUST ARRIVED IN STOCK. Texas transistors. Complementary symmetry. Driver, NPN, PNP output. The set of three ONLY **6/6** post paid.

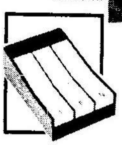
Free lists with every order. For lists only send 1/6 (*deductable from first order*).

MAINS Keynector

A REVOLUTIONARY NEW PRODUCT

cuts out plugs





SAFEST & QUICKEST WAY TO CONNECT ELECTRICAL EQUIPMENT TO THE MAINS

No plugs—no sockets—no risk of bare wires. To connect anything electrical, from an oscilloscope to an electric drill, simply open the fuse housing, depress the keys, insert the wires and close the housing. A neon light on the front of the Keynector glows to indicate proper connection. Multi-parallel connections can be made up to 13 amps. Keys are colour coded and lettered LEN for quick identification. The Keynector casing is in two-tone plastic and measures 5 x 3 x 1¼in. Please send for further information.

E.B. INSTRUMENTS
DIVISION OF ELECTRONIC BROKERS LTD.
49-53 PANCRAS ROAD, LONDON, N.W.1
Telephone 01-837 7781

DIMMASWITCH

This is an attractive dimmer unit which fits in place of the normal wall light switch. The mounting plate is ivory to match modern fittings and the control knob is in bright chrome. An ON/OFF switch is incorporated to control up to 500 watts at mains voltages from 200-250 volts, 50 Hz.

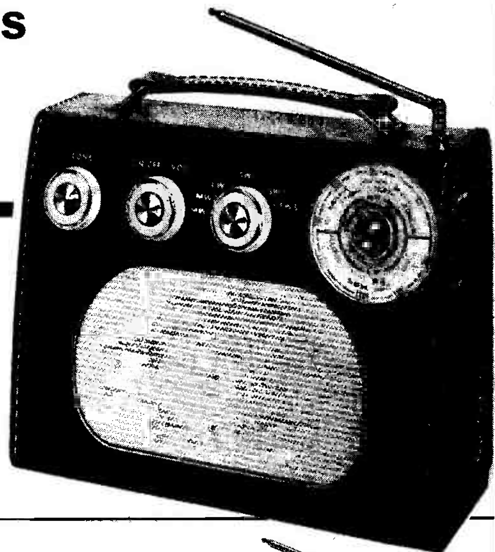
These are normally sold at £4 19s. 6d.—our price is £3 5s. We also offer at £2 15s. a complete kit of parts with simple instructions enabling you to build this dimmer yourself.

The circuit uses the latest miniature RCA triac and new diac triggering device to give complete reliability. Radio interference suppression is included.

DEXTER & COMPANY
ULVER HOUSE, 19 KING STREET
CHESTER CH1 2AH
Chester 25883

Quality Transistor Radios to build yourself

backed by our after sales service



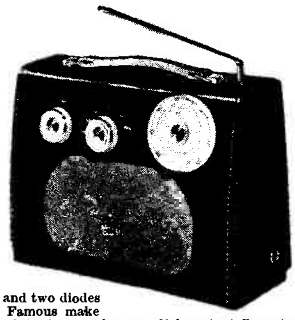
NEW! roamer eight mk 1

WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, S.W.1, S.W.2, S.W.3, and Trawler Band. Built in ferrite rod aerial for Medium and Long Waves. 5 section 22in chrome plated telescopic aerial for Short Waves can be angled and rotated for maximum performance. Push-pull output using 600Mw type transistors. Socket for car aerial. Tape record socket. Selectivity switch. Switched earpiece socket complete with earpiece for private listening. 8 transistors plus 3 diodes. Famous make 7 × 4in speaker. Air spaced ganged tuning condenser. On/off switch volume control. Wave change switch and tuning control. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in approx. First grade components. Easy to follow instructions and diagrams make the Roamer Eight a pleasure to build. Parts price list and easy build plans 5/- (FREE with parts).

Total building costs £6.19.6 P. & P. 7/6

roamer seven mk IV

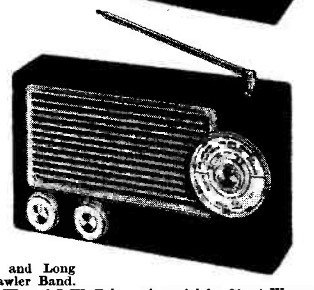


7 FULLY TUNABLE WAVE BANDS—M.W.1, M.W.2, L.W., S.W.1, S.W.2, S.W.3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. 5 Section 22in chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push-pull output. 7 transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in approx. First grade components. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build. Parts price list and easy build plans 3/- (FREE with parts).

Total building costs £5.19.6 P. & P. 7/6

Personal Earpiece with switched socket for private listening, 5/- extra.

NEW! transeight



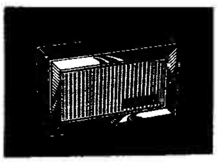
SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 × 5½ × 2¾in. approx. Tunable on Medium and Long Waves, 3 Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 8 improved type transistors plus 3 diodes. All top grade components. Push-pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/- (FREE with parts).

Total building costs 89/6 P. & P. 5/6

Earpiece with switched socket for private listening 5/- extra.

pocket five

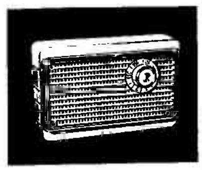


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive black and gold case. Size 5½ × 1½ × 5¼in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker, also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs 44/6 P. & P. 3/6

transona five

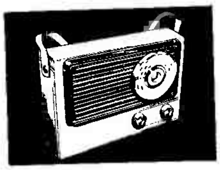


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6½ × 4½in × 1½in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. All first grade components. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs 47/6 P. & P. 3/9

roamer six



SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings. Size 7½ × 5¼ × 1¾in. Tunable on Medium and Long Waves, two Short Waves, Trawler Band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. All top grade components. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/- (FREE with parts).

Total building costs 79/6 P. & P. 4/6

** Callers side entrance Stylo Shoe Shop*

** Open 10-1, 2.30-4.30 Mon.-Fri. 9-12 Sat.*

RADIO EXCHANGE LTD

61a, HIGH STREET, BEDFORD. Tel. 0234 52367

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

ROAMER EIGHT ☐ ROAMER SEVEN ☐

TRANSEIGHT ☐ POCKET FIVE ☐

TRANSONA FIVE ☐ ROAMER SIX ☐

Parts price list and plans for..

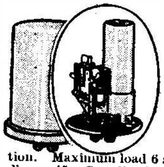
Name..

Address..

....

.... PE 12

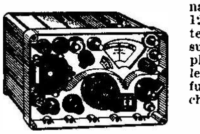
CAR LIGHT FLASHERS



Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset.) Housed in strong plastic case. Flashing rate between 60-120 per minute. 12 volt DC operation. Maximum load 6 amps. Size 2 11/16" dia. x 4". Supplied brand new at a fraction of original cost. **6/6** each. P. & P. 2/6. (3 for **17/6**. P. & P. 4/6.)

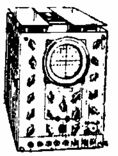
R209 MK II COMMUNICATION RECEIVER

11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, BFO. Aerial trimmer, internal speaker and 12 V d.c. internal power supply. Supplied in excellent condition, fully tested and checked.



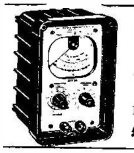
£15
Carr. 20/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope. T.B. 2 c/s-750 kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33 mV/CM. Operating voltage 0/110/200/250 V. a.c. Supplied in excellent working condition. **£22.10.0** or complete with all accessories, probe, leads, lid, etc. **£25.** Carriage 30/-.

MARCONI CT44/TF956 AF ABSORPTION WATTMETER

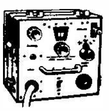


1 μ/watt to 6 watts. **£20.** Carr. 20/-.

SOLARTRON CD. 1016 OSCILLOSCOPE

Double beam. d.c. To 5 Mc/s. Excellent condition. **£55** each. Carr. 20/-.

CLASS D WAVEMETERS

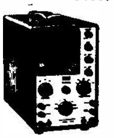


A crystal controlled heterodyne frequency meter covering 1·7-8 Mc/s. Operation on 6V d.c. Ideal for amateur use. Available in good used condition. **£5.19.6.** Carr. 7/6, or brand new with accessories. **£7.19.6.** Carr. 7/6.

CLASS D WAVEMETERS No. 2

Crystal controlled. 1·2-19 Mc/s. Mains or 12V d.c. operation. Complete with calibration charts. Excellent condition. **£12.10.0.** Carr. 30/-.

TO-3 PORTABLE OSCILLOSCOPE

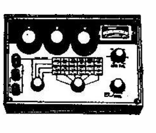


3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps-1·5 MHZ. Input imp. 2 meg Ω 25 PF. X amp. sensitivity 0·9v p-p/CM. Bandwidth 1·5 cps-800 KHZ. Input imp. 2 meg Ω 20 PF. Time base. 5 ranges 10 cps-300 KHZ. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 MM Weight 15½lb. 220/240 V. A.C. Supplied brand new with handbook. **£35.0.0.** Carr. 10/-.

SOLARTRON CD: 711S.2 OSCILLOSCOPES

Double beam. D.C. to 9 Mc/s. Perfect order. **£65.** Carr. 50/-.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



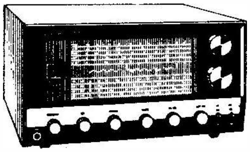
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω-11·1 meg Ω 6 Ranges ±1%. L.1 μH - 111 HENRYS 6 Ranges -2%. C. 10pF ±1110 mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000-1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7½ × 5 × 2in. **£20.** P. & P. 5/-.

UNR-30 4-BAND COMMUNICATION RECEIVER

Covering 550 Kc/s-30 Mc/s. Incorporates BFO. Built-in speaker and phone jack. Metal cabinet. Operation 220/240V. a.c. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

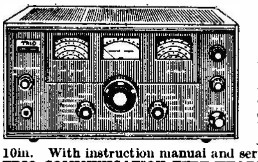
TRIO JR-310 NEW AMATEUR BAND 10-80 METRE RECEIVER. In stock. **£77.10.0.**

LAFAYETTE SOLID STATE HA600 RECEIVER



5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 kc/s-400 kc/s and 550 kc/s-30 Mc/s FET front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V a.c./12V d.c. neg. earth operation ● RF gain control. Size 15in × 9½in × 8½in. Weight 18lb. EXCEPTIONAL VALUE. £45. Carr. 10/-. S.A.E. for full details.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

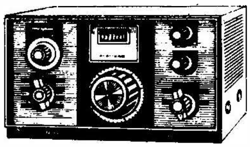


4 band receiver covering 550Kc/s to 30Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 445Kc/s ● Audio output 1·5W. ● Variable RF and AF gain controls. 115/250V A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. **£42** Carriage paid.
TRIO COMMUNICATION TYPE HEADPHONES Normally **£5.19.6.**
OUR PRICE **£3.15.0** if purchased with above receiver.

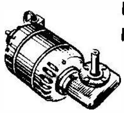
TRIO JR-500SE 10-80 Metre AMATEUR RECEIVER

Covers all the amateur bands in 7 separate ranges between 3·5 and 29·7Mc/s, 7 valves, 2 transistors and 5 diodes plus 8 crystals: output 8 and 500 ohm and 5,000 ohm phone jack, Crystal controlled oscillator. Variable BFO, VFO. AVC, ANL. S meter. SSB-CW. Stand-by switch. Special double gear dial drive with direct reading down to 1kHz. Remote control socket for connection to a transmitter. Audio output 1W 115/250V a.c. mains. Superb modern styling. Size 7 × 13 × 10in. with instruction manual and service data. **£69.10.0.** Carr. paid.

TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £212. IN STOCK!

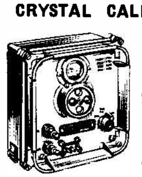


GEARED MAINS MOTORS



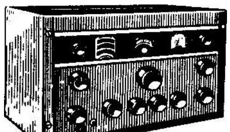
Paralux type SD19 230/250V a.c. Reversible 30 RPM. 40 lb in. Complete with capacitor. Excellent condition. **99/6.** Carr. 10/-.

CRYSTAL CALIBRATORS No. 10



Small portable crystal controlled wavemeter. Size 7" × 7½" × 4". Frequency range 500 Kc/s. 10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300 V.D.C. 15mA and 12 V.D.C. 0.3A. Excellent condition. **89/6.** Carr. 7/6.

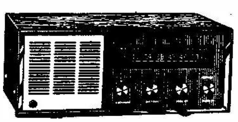
RCA COMMUNICATION RECEIVER AR88D



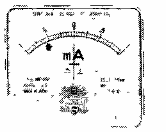
Latest release by ministry BRAND NEW in original cases. 110-250V a.c. operation. Frequency in 6 Bands. 535Kc/s-32Mc/s continuous. Output impedance 2·5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price **£87.10.0.** Carr. £2.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

A completely new transistorised receiver covering 152-174 Mc/s. Fully tuneable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. **£37.10.0.** Carr. 10/-.



CLEAR PLASTIC PANEL METERS



First grade quality Moving Coil panel meters.
Type MR 38P. $1^{21}/_{32}$in square fronts.

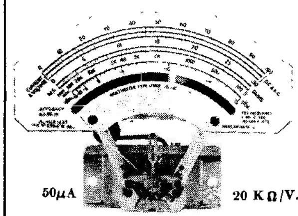
50μA	**40/-**	500-0-500μA	**27/6**	50mA	**27/6**	150V. D.C.	**27/6**
50-0-50μA	**37/6**	1mA	**27/6**	100mA	**27/6**	300V. D.C.	**27/6**
100μA	**37/6**	1-0-1mA	**27/6**	150mA	**27/6**	500V. D.C.	**27/6**
100-0-100μA	**35/-**	2mA	**27/6**	200mA	**27/6**	750V. D.C.	**27/6**
200μA	**35/-**	5mA	**27/6**	300mA	**27/6**	15V. A.C.	**27/6**
500μA	**40/-**	10mA	**27/6**	500mA	**27/6**	50V. A.C.	**27/6**
		750mA	**27/6**	3V. D.C.	**27/6**	150V. A.C.	**27/6**
		1 amp	**27/6**	10V. D.C.	**27/6**	300V. A.C.	**27/6**
		2 amp	**27/6**	20V. D.C.	**27/6**	500V. A.C.	**27/6**
		5 amp	**27/6**	100V. D.C.	**27/6**	S meter 1mA.	**32/-**
		20mA	**27/6**			VU meter	**42/-**

Full range of other sizes in stock. Send s.a.e. for leaflet.

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock Single hole fixing, ¼in. dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1,000/1,500/2,500 or 5,000 ohms, **14/6.** P. & P. 1/6.
50 WATT. 10/25/50/100/250/500/1,000/2,500 or 5,000 ohms, **21/-.** P. & P. 1/6.
100 WATT. 1/5/10/25/50/100/250/500/1,000 or 2,500 ohms, **27/6.** P. & P. 1/6.

AVOMETER MOVEMENTS



50μA 20 KΩ/V.

Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multimeter. Brand New and Boxed **69/6** P. & P. 3/6.

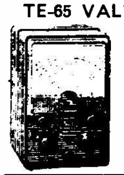
T.E.40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01 / ·003 / ·1 / ·3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. 4c/s.-1·2Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V a.c. **£17.10.0.** Carr. 5/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0·20 Kc/s on 2 ranges. Output 500 Ω or 5k Ω. Operation 200/250V. A.C. Supplied in perfect order. **£12.10.0.** Carr. 10/-.

TE-65 VALVE VOLTMETER

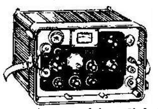


High quality instrument with 28 ranges. D.c. volts 1·5-1,500V. A.c. volts 1·5-1,500V. Resistance up to 1,000 megohms. 220/240V a.c. operation. Complete with probe and instructions. **£17.10.0.** P. & P. 6/-. Additional Probes available: R.F. **35/-.** H.V. **42/6.**

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

D.c. coupled. Band width 1kc/s. Perfect order. **£25.** Carr. 30/-.

AM/FM SIGNAL GENERATORS



Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80Mc/s. AM C.W./FM. Incorporates precision dial, level meter, precision attenuator 1μV-100mV. Operation from 12V d.c. or 0/110/200/250V a.c. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. **£45.** Carr. 20/-.

HAMMARLUND SP600J COMMUNICATION RECEIVER. 540 Kc/s-54 Mc/s in 6 bands. FEW ONLY! **£100.**

EDDYSTONE VHF RECEIVERS MODEL 770R. 19-165 Mc/s. Excellent condition. **£150.**

TE-16A Transistorised Signal Generator. 5 ranges 400 kHz-30 mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide, easy to read scale. 800 kHz modulation. 5¼ × 5¾ × 3½. Complete with instructions and leads. **£7.19.6.** P.&P. 4/-.

FIELD TELEPHONES TYPE L
Generator ringing, metal cases. Operates from two 1·5v. batteries (not supplied). Excellent condition. **£4.10.0** per pair. Carr. 10/-.

AUTO TRANSFORMERS

0/115/230v. Step up or step down. Fully shrouded.

150 W.	**£2.2.6,**	P. & P. 3/6
300 W.	**£2.19.6,**	P. & P. 4/6
500 W.	**£4.10.0,**	P. & P. 6/6
1,000 W.	**£6.10.0,**	P. & P. 7/6
1,500 W.	**£7.19.6,**	P. & P. 8/6
7,500 W.	**£15.10.0,**	P. & P. 20/-

G. W. SMITH & CO (RADIO) LTD.
Also see oppos. page

L.S.T. ELECTRONIC COMPONENTS LTD.

AA119	2/-	BC142	15/-	BYY25	31/9	NKT217	13/-	OC24	10/-	2G302	3/9	2N2369	5/6
AAY11	2/1	BC143	15/-	BYY142	3/9	NKT218	5/3	OC25	6/9	2G339A	5/-	2N2369A	6/-
AAZ12	17/6	BC147	4/7	BYZ10	9/-	NKT221	5/6	OC26	12/-	2G374	5/-	2N2432	58/4
AC107	14/6	BC148	3/3	BYZ12	6/-	NKT222	4/-	OC28	12/-	2G381	5/-	2N2477	18/-
AC126	6/6	BC149	4/7	BYZ13	5/-	NKT223	6/-	OC29	15/-	2G371	4/-	2N2484	14/-
AC127	6/-	BC154	12/-	C106F1	9/-	NKT223A	3/6	OC35	9/6	2G371B	3/-	2N2613	8/3
AC127Z	8/6	BCY10	7/6	C111	18/-	NKT224	4/6	OC36	13/-	2N174	24/-	2N2614	7/6
AC128	4/-	BCY12	7/6	C111E	12/-	NKT225	3/6	OC41	3/6	2N301	8/-	2N2646	10/-
AC151	8/8	BCY30	7/2	C400	9/-	NKT226	10/-	OC42	4/-	2N109	13/6	2N2894	13/9
AC176	7/6	BCY31	9/2	C426	8/3	NKT227	5/6	OC43	4/-	2N217	7/6	2N2904A	15/6
AC187	12/-	BCY32	20/5	CG6E	4/-	NKT228	6/-	OC44	3/-	2N352	15/-	2N2924	5/-
AC188	12/-	BCY33	4/11	CG63	2/-	NKT261	4/3	OC45	3/-	2N386	12/-	2N2925	5/6
ACY17	5/9	BCY34	6/6	D13T1	10/-	NKT270	3/6	OC70	3/-	2N384	17/-	2N3036	39/2
ACY18	3/6	BCY38	8/-	EA403	3/6	NKT271	5/-	OC71	3/-	2N385A	15/-	2N3053	8/-
ACY19	4/5	BCY39	28/-	EC401	5/-	NKT272	5/-	OC72	4/6	2N388A	15/-	2N3054	15/-
ACY20	3/7	BCY40	16/-	EC402	4/8	NKT273	4/-	OC73	3/-	2N370	15/-	2N3055	15/-
ACY21	4/-	BCY42	4/-	EB383	3/6	NKT274	5/-	OC75	5/-	2N404	4/2	2N3394	6/-
ACY22	2/11	BCY43	4/-	GET102	6/-	NKT275	5/-	OC76	2/6	2N410	6/-	2N3702	3/6
ACY30	9/-	BCY54	17/4	GET103	4/6	NKT276	3/6	OC77	9/3	2N456A	20/-	2N3703	3/3
AD140	15/-	BCY70	4/4	GET104	5/-	NKT279A	2/6	OC81D	3/-	2N458A	33/-	2N3704	3/9
AD149	11/8	BCY71	8/8	GET105	8/-	NKT281	5/-	OC81	4/6	2N511A	50/3	2N3705	3/4
AD161	6/-	BCY72	4/8	GET114	5/-	NKT301	16/-	OC82	4/6	2N513A	110/5	2N3706	3/10
AD162	6/-	BCY87	86/9	GET875	6/-	NKT302	11/2	OC82D	3/-	2N514B	192/-	2N3707	4/-
ADT140	12/6	BCZ11	10/8	GET573	7/6	NKT303	10/2	OC83	4/-	2N599	12/-	2N3708	2/5
AF102	18/-	BD119	15/-	GMO290	13/5	NKT304	9/8	OC84	4/-	2N601	5/-	2N3709	3/9
AF114	4/4	BD121	18/6	GMO378	11/-	NKT351	8/-	OC123	7/-	2N657	13/4	2N3710	3/10
AF115	4/4	BD123	23/6	GEX45/1	4/-	NKT352	7/6	OC139	8/-	2N696	5/3	2N3711	3/3
AF116	4/4	BD124	15/-	K8/15	4/-	NKT402	24/-	OC140	12/-	2N697	5/3	2N3819	8/-
AF117	4/4	BF152	13/6	K8/30	9/-	NKT403	16/-	OC169	6/-	2N698	4/6	2N3820	18/9
AF118	16/6	BF154	9/-	K3/50	8/3	NKT404	13/8	OC170	4/-	2N706	3/-	2N3826	6/-
AF124	6/-	BF159	15/-	MAT100	5/-	NKT405	15/-	OC171	6/-	2N706A	3/-	2N3906	7/6
AF126	3/9	BF163	9/-	MAT101	5/6	NKT451	13/8	OC200	6/3	2N708	4/-	2N4058	7/9
AF127	4/-	BF167	6/6	MAT120	5/-	NKT452	13/4	OC201	10/-	2N711	7/6	2N4284	3/-
AF139	8/-	BF173	6/2	MAT121	5/6	NKT453	12/-	OC202	18/10	2N711A	7/6	2N4285	3/-

PRICES FOR QUANTITIES IN EXCESS OF 100 PIECES ON APPLICATION

FIRST GRADE + FAST SERVICE

When enquiring for types not listed please enclose a STAMPED ADDRESSED ENVELOPE

AF181	12/-	BF178	14/-	ME4103	6/-	NKT674	6/-	OC203	8/3	2N715	7/6	2N4286	3/-
AF186	11/-	BF179	12/-	MJE520	15/-	NKT675	5/-	OC204	8/-	2N716	7/6	2N4287	3/-
AF239	12/-	BF180	6/-	MPF102	9/-	NKT676	5/-	OC205	9/-	2N718	7/2	2N4288	3/-
AFZ11	14/-	BF181	7/-	MPF103	9/-	NKT677	5/-	OC206	10/6	2N743	5/-	2N4289	3/-
AFZ12	11/9	BF184	7/6	MPF104	9/-	NKT703	8/-	OC207	7/6	2N744	5/6	2N4290	3/-
ASY26	4/5	BFX13	4/10	MPF105	9/-	NKT713	7/6	ORP12	9/6	2N753	5/-	2N4291	3/-
ASY27	6/-	BFX29	8/-	MPS3638	6/-	NKT773	6/-	ORP60	8/-	2N863	12/-	2N4292	3/-
ASY28	4/5	BFX44	6/5	MJ480	21/-	NKT774	5/4	ORP61	8/-	2N911	7/6	2N4303	15/-
ASY29	6/-	BFX87	6/-	MJ481	27/-	NKT0013	12/6	ORP63	9/-	2N914	4/3	2N4871	6/9
ASZ21	11/-	BFY50	4/6	MJ491	30/3	NKT10419	13/-	ORP93	24/-	2N918	15/-	2S002	15/-
ATZ10	40/-	BFY51	3/9	NKT121	10/11	NKT10519	12/6	OC309	12/-	2N929	5/6	2S004	23/-
AUY10	39/6	BFY52	4/6	NKT122	7/9	NKT10339	10/3	P346A	6/-	2N930	6/8	2S017	15/-
AFY19	16/10	BFY53	3/2	NKT123	6/2	NKT10429	11/3	RAS310AF	6/-	2N1131	9/6	2S018	12/6
BA110	6/-	BSX20	3/4	NKT124	9/8	NKT20329	12/6	RAS508AF	15/-	2N1132	7/6	2S020	15/-
BA111	6/-	BSX21	8/-	NKT125	6/2	NKT16229	11/-	ST2	9/9	2N1143	26/2	2S024	25/-
BA112	10/-	BSY27	4/-	NKT127	5/8	OA5	3/8	ST140	3/-	2N1177	14/-	2S034	12/6
BA115	2/8	BSY95A	3/4	NKT128	6/-	OA10	6/-	ST141	5/-	2N1302	4/6	2S102	10/-
BA130	3/-	BTX39/		NKT129	5/10	OA47	1/6	TIS44	1/7	2N1303	4/6	2S104	12/6
BAY31	2/6	600R	120/-	NKT141	6/11	OA70	1/6	TIS43	6/9	2N1304	5/-	2S301	7/7
BAY38	3/-	BTX40/		NKT142	5/10	OA73	1/6	U23AAA	5/-	2N1305	5/-	2S302	6/-
BC107	2/9	600R	120/-	NKT143	5/4	OA79	1/6	V405A	9/3	2N1306	6/6	2S304	15/-
BC108	2/9	BTY87/		NKT144	8/-	OA81	1/6	XA102	6/-	2N1307	6/6	2S320	12/6
BC109	2/9	150R	31/-	NKT152	3/4	OA85	1/6	XA702	15/-	2N1308	8/-	2S322	8/-
BC113	5/-	BTY91/		NKT161	5/8	OA90	1/6	ZT22	19/-	2N1309	8/-	2S701	18/-
BC114	7/5	300R	47/-	NKT162	5/8	OA91	1/6	ZT86	27/6	2N1507	4/8	2S702	12/-
BC115	7/11	BY100	5/-	NKT163	5/4	OA95	1/6	ZT2270	19/6	2N1613	6/6	2S711	23/3
BC116	9/-	BY125	3/6	NKT164	5/4	OA200	2/-	1N23A	20/-	2N1496	34/6	2S712	30/3
BC118	5/-	BYX10	3/-	NKT165	5/8	OA202	2/-	1N34A	4/-	2N1711	7/6	2S733	9/9
BC125	12/-	BYX36/150	2/6	NKT211	6/-	OA210	6/4	1N60	4/-	2N2147	17/-	40361	13/3
BC126	12/-	BYX36/300	2/10	NKT212	6/-	OA211	9/-	1N64	4/-	2N2148	12/6	40362	16/3
BC134	5/-	BYX36/600	3/8	NKT213	6/-	OC19	5/-	1N82A	9/6	2N2160	14/9	ZT22	19/-
BC136	7/11	BYY21	25/-	KNT214	4/-	OC20	33/-	1N87A	4/6	2N2218	12/-	ZT86	27/6
BC137	8/6			NKT215	4/-	OC22	13/-	1N191	5/-	2N2243	23/7		
BC138	12/-	BYY23	26/3	NKT216	10/5	OC23	15/-	1S44	1/6	2N2368	6/6	ZT2270	19/6

COMPONENTS

SKELETON PRESET POTS. 20% Tol. Linear. Low noise. Available in sub-miniature or standard size, horizontal or vertical. 100, 250, 500, 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1 Meg, 2.5 Meg, 5 Meg. NEW PRICE! 1/- each or any selection of 12 pieces **10/-**.

ELECTROLYTIC CAPACITORS (Mullard). −10% to +50% tol. Subminiature (all values in μF).

4V	8	32	64	125	250	400
6.4V	6.4	25	50	100	200	320
10V	4	16	32	64	125	200
16V	2.5	10	20	40	80	125
25V	1.6	6.4	12.5	25	50	80
40V	1	4	8	16	32	50
64V	0.64	2.5	5	10	20	32
Price	1/6	1/3	1/2	1/-	1/1	1/2

MIN. POLYESTER CAPACITORS. Printed circuit type 250 Vdc working. 0.01, 0.015, 0.022, **7d** each; 0.033, 0.047, **8d** each; 0.068, 0.10, **9d** each.

VEROBOARD 0.15" Matrix FLUX COATED 2½ × 3¾", 3/3. 2½ × 5", 3¾ × 3¾", 3/11. 3¾ × 5", 5/6. 3¾ × 18", 18/-. BARGAIN PACK of 36 square inches all good size pieces only **10/-** pack.

VEROBOARD 0.1" Matrix, 3¾ × 2½", **3/9.**

VEROPINS for 0.15", 36 pieces **3/-**.

VER CUTTER 9/- (including free sample pieces).

S-DeCs Single "DeC" with accessories and project manual .. **29/6**
"2-DeC" kit contains two "DeCs" component tray accessories, instruction book, all packed in attractive plastic box **69/6**
"4-DeC" kit contains four "DeCs", accessories, manual, etc. **117/6**

BOOKS FROM STOCK
New RCA Hobby Circuits Manual — dozens of interesting projects. Order HM90 .. .. 24/-
NEW!! "110 Semiconductor Projects" by R. M. Marston 25/-
General Electric Transistor Manual, 660 pages of data and circuits 29/6
RCA Transistor Manual, 554 pages, includes SCR circuits 28/-
Designers' Guide to British Transistors. Excellent data book lists over 1,000 common types plus Computer-selected substitution chart 25/-
(ADD 2/6 POST & PACKING FOR ALL BOOKS)

NEONS
Signal neons for many types of circuit, type "N"
Price 1/6 each or 16/- dozen.

HEATSINKS. Suitable for 2 × OC35, etc. As used in commercial equipment. Type 10D 6/-

ALUMINIUM CHASSIS
6 × 4 × 2½" with reinforced corners **6/9** each (P & P 1/6). Ally panel to fit **1/6.** Paxolin panel to fit **2/-**. Many other sizes in stock up to 12 × 8 × 2½" (see catalogue).

ZENER DIODES. 400mW 10% Tolerance. Complete range preferred values 3 volt to 30 volt, each .. **3/6**

SOLAR CELLS
B2M 0.2–0.4 volts @ 2mA Selenium type **12/6**
B3M 0.2–0.4 volts @ 1½–2½mA Selenium type .. **15/-**
S1M 0.3–0.4 volts @ 10–16mA Silicon **19/-**
S4M 0.3–0.4 volts @ 25–40mA Silicon **33/6**

2N3819 Texas FET **8/-**
25 + 6/9 100 + 5/9

2N4871 MOTOROLA Unijunction **6/9**
25 + 5/9 100 + 4/9

2N3055 115 WATT POWER **15/-**
25 + 13/- 100 + 11/-

56CAY Gallium Arsenide Infra-Red emitter
29/6 each. (Incl. data)

BC107/8/9 Planars 2/9

TAA263 MULLARD LINEAR **17/6**

SC41D GE Triac
400piv 6amp **37/6**

μ LOGIC

	1-6	7-11	12+
uL900	9/9	9/-	8/-
uL914	9/9	9/-	8/-
uL923	13/-	12/-	11/-

Five Page Data article 2/6
Larger quantity prices (100+ and 1,000+) on application.

BF180 MULLARD UHF AMPLIFIER **6/-**
25 + 4/11 100 + 4/3

2N2614 RCA LOW NOISE AUDIO **4/9**
25 + 4/- 100 + 3/-

CRS3/40AF STC/ITT Thyristor 12/6
400piv 3Amp
25 + 11/- 100 + 10/3

2N2926 LOW COST NPN PLANAR **2/-**
25 + 1/8 100 + 1/6

SILICON RECTIFIERS

PIV	200mA	750mA	2 Amp	10 Amp
50	6d	1/-	2/3	—
100	9d	1/6	2/3	4/6
200	1/3	2/-	2/9	5/-
400	—	2/6	4/-	8/-
600	—	3/-	4/6	9/6
800	—	3/9	5/-	11/3
1000	—	6/-	6/6	14/-

THYRISTORS-SCRs

PIV	1A	3A	10A	30A	100A
50	7/6	9/-	7/6	25/-	20/-
100	—	10/-	10/-	30/-	22/-
200	8/6	—	12/6	42/-	35/-
300	—	11/-	—	51/-	—
400	9/6	12/6	15/-	60/-	45/-
600	—	—	20/-	84/-	120/-
800	—	—	—	—	—

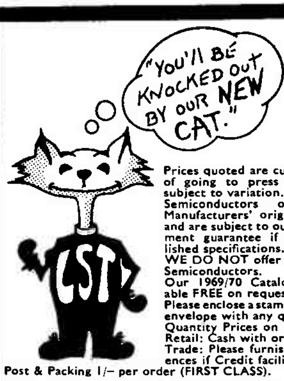
NEW SPECIAL ITEMS !!

40602— Dual Gate MOS-FET **9/- each**
L14B— Photo-Darlington Amplifier **26/6**
MGA100—Gallium Arsenide Infra Red Light Source **35/-**
31F2— Infra Red Detector Diode **28/6**
3N84— Silicon Controlled Switch **29/6**
TAA320—Monolithic IC with MOS-FET input followed by Bi-Polar transistor **13/6**
Data sheets 1/- on request—**free** with above items.

ULTRASONIC TRANSDUCERS

Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 trans-ducers can transmit and receive.

FREE: With each pair our complete transmitter and receiver circuit.
PRICE
£5.18.0 Pair
(Sold only in pairs)



Prices quoted are current at time of going to press and may be subject to variation.
Semiconductors offered bear Manufacturers' original markings and are subject to our full replacement guarantee if not to published specifications.
WE DO NOT offer "Re-marked" Semiconductors.
Our 1969/70 Catalogue is available FREE on request.
Please enclose a stamped addressed envelope with any queries.
Quantity Prices on application.
Retail: Cash with order, please.
Trade: Please furnish usual references if Credit facilities required.
Post & Packing 1/- per order (FIRST CLASS).

MAIL ORDER DEPT. & RETAIL SHOP:—
LST, 7 Coptfold Road, Brentwood, Essex
Telephone: 226470/1 (Sales Department)
EXPORT ENQUIRIES PARTICULARLY WELCOME
GIRO No. 388-3159

VOL. 5 No. 12
December 1969

PRACTICAL ELECTRONICS

THE NON-REGISTERED ENGINEER

THE news that a national register of qualified engineers and technicians is planned will certainly provoke argument amongst the professional engineering community. The idea will no doubt appeal to those eligible for inclusion in the register, that is those who have attained membership of one of the engineering institutions. On the other hand, practising engineers and technicians who do not possess the appropriate qualifications may fear their professional prospects could be harmed by the existence of such a register. Indeed, they may suspect this to be the first step towards the total exclusion of non-registered persons from the more rewarding and responsible posts in industry, government departments, and other establishments.

It is understandable that members of the engineering institutions should endeavour to enhance their status and terms of employment, just as members of other professional bodies do. But concern must be expressed about the possible harm this could also cause. With regard to electronics specifically, if this scheme is carried out to the detriment of non-member engineers and technicians, the loss will not be the latter's alone, but the electronic industry as a whole would suffer.

Much normal commercial development and application work does not necessarily demand the higher academic qualifications. Given a sound basic knowledge of electronic principles and circuit practice, the most important and desirable asset, in many instances, would seem to be an imaginative mind. Some engineers and technicians have an innate ability to invent and develop ways and means for exploiting electronic devices and circuits. Surely these are the kind of people industry should be looking for, without too much concern about qualification status.

The expansion of electronics is not entirely a self-generating process, as may be innocently believed by some. New ideas must, constantly, be found to widen further the infiltration of this branch of technology into everyday activities. Microcircuits provide a topical illustration. These devices are a key factor in future expansion of the industry; however, their economic viability depends upon large scale production and this can only be maintained if a large user demand exists.

The national register sounds fine in its way, but it is impossible to detect a potential inventor or innovator by examination alone. Somehow we must guard against any academic barrier denying us the fruits of ingenious minds, just because they have not been formally examined and attested.

F. E. Bennett—*Editor*

THIS MONTH

CONSTRUCTIONAL PROJECTS

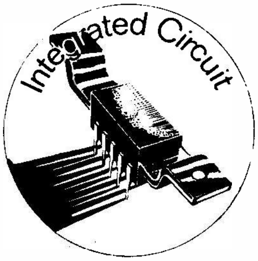
SPECIAL SERIES

GENERAL FEATURES

NEWS AND COMMENT

Our January issue will be published on Monday, December 15

Subscription Rates including postage for one year, to any part of the world, 42s.
All correspondence intended for the Editor should be addressed to Tower House, Southampton St., London, W.C.2. Phone: 01-836 4363.
Address correspondence regarding advertisements to Advertisement Manager, Fleetway House, Farringdon St., London, E.C.4. Phone 01-236 8080.



hifi stereo

By M. J. Gay Chief Circuit Engineer (Linear), Plessey Microelectronics

THIS, the last article in the series describing the use of the Plessey SL402 and SL403 integrated circuit audio amplifiers, will describe a high fidelity stereo system using SL403's and a pre-amplifier suitable for feeding the system from magnetic, crystal, tape or radio inputs.

BASIC SYSTEM

The essential feature of the system is that a three speaker set-up (bass, middle, treble) with one SL403 feeding each speaker is used (Fig. 1). The part of the frequency spectrum fed to each speaker is selected by an active filter formed around the pre-amplifier section of the corresponding SL403. Potentiometers between the pre-amplifiers and main amplifiers allow differences in the sensitivities of the speakers to be corrected for.

This system has a number of advantages over the conventional arrangement in which the speakers are fed from a single amplifier via passive cross-over filters and attenuators. These are:

(a) All speakers are always voltage fed.
(b) The frequency spectrum is split before passing through the power amplifiers, so intermodulation distortion is reduced.
(c) The cross-over frequencies and filter characteristics may be freely and independently chosen; the system is free from spurious electrical resonances.
(d) No inductors are required.

ACTIVE FILTER DESIGN

The part of the frequency spectrum to be handled by each amplifier is selected by its pre-amplifier section connected as an active filter. Thus we have one pre-amplifier acting as a low-pass filter for the bass range amplifier, one acting as a band-pass filter for the mid-range amplifier and one acting as a high-pass filter for the treble range amplifier. The active filter design is of the basic two integrator type, the particular arrangement being commonly attributed to Rauch. It generates a second order filter characteristic giving a cut-off rate of 12dB per octave.

The low-pass design is shown in Fig. 2a and Fig. 2b shows the high-pass design. The responses are characterised by the equations given. By suitable choice of the passive components we may produce responses corresponding to any of the standard forms, e.g. Butterworth, Bessel, Chebyshev, Gaussian. Of these Cheby-

SPECIFICATION...

Output power: 3 watts r.m.s. per channel into 15 ohm loads.

Frequency response: 13Hz to 100kHz ± 3dB.

Total harmonic distortion—at full output: 0·3% at 1kHz.

Integrated noise level: 90dB below full output.

Tone control characteristics
Treble: ± 15dB at 15kHz.
Bass: ± 18dB at 20Hz.

Sensitivity
Radio: 35mV r.m.s.
Ceramic p.u.: 400mV r.m.s.
Magnetic p.u. and tape: 2·5mV r.m.s. at 1kHz.

Crosstalk: —40dB at 1kHz

Speaker system: two three-channel speakers having individual 15 ohm impedance low, middle and high frequency units.

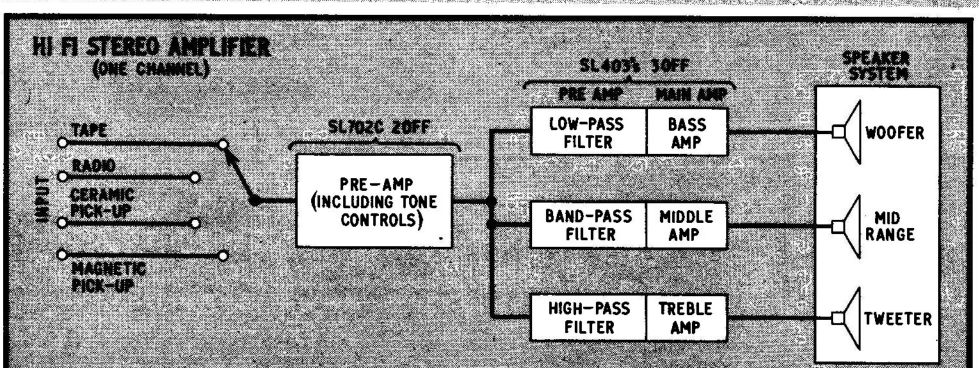
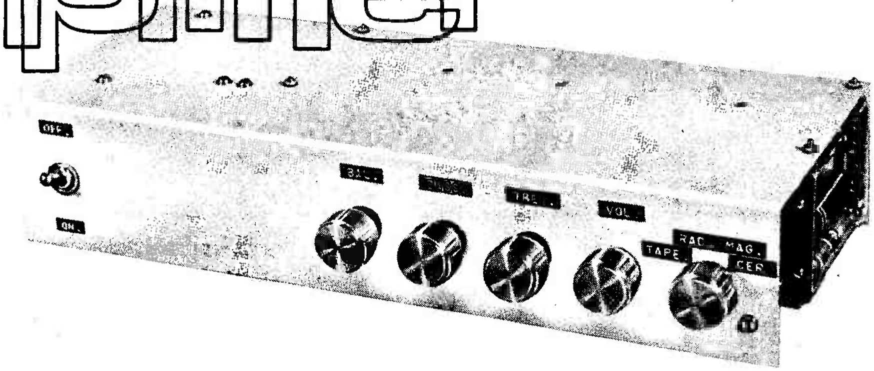
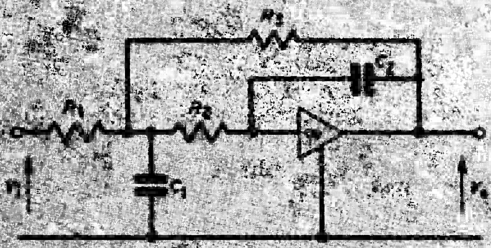


Fig. 1. Block diagram

amplifier



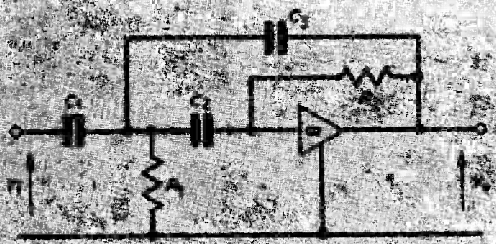
ACTIVE FILTER CIRCUITS



(a)

Bessel Response
$R_1 = R_2 = R_3$
$C_1 = 3C_2$
Cut off frequency $= \dfrac{1 \cdot 4}{2\pi C_1 R_1}$

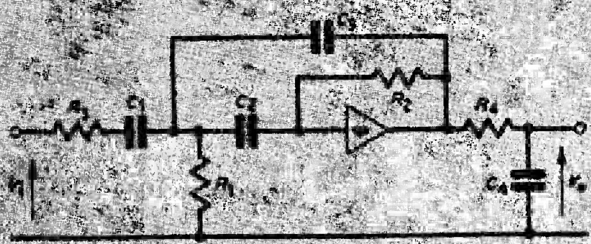
$$\frac{V_o}{V_i} = \frac{-R_3}{R_1}\left[\frac{1}{1 + j\omega\left(\dfrac{R_1R_2 + R_2R_3 + R_1R_3}{R_1}\right)C_2 - \omega^2 R_2R_3C_1C_2}\right]$$



(b)

Bessel Response
$C_1 = C_2 = C_3$
$R_2 = 3R_1$
Cut off frequency $= \dfrac{0 \cdot 7}{2\pi C_1 R_1}$

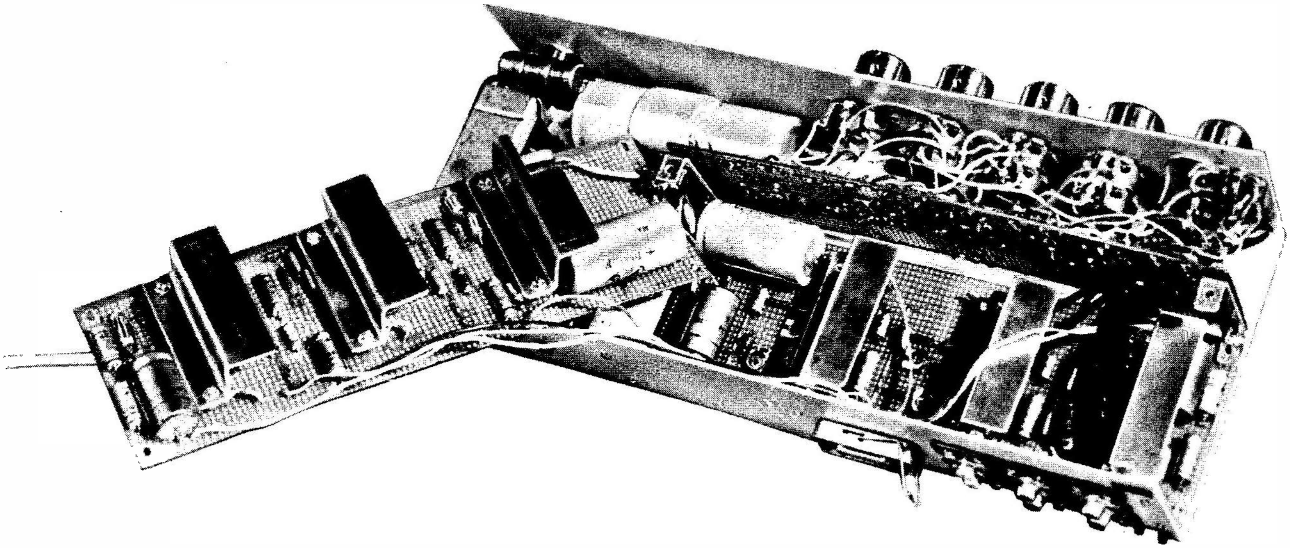
$$\frac{V_o}{V_i} = \frac{-C_1}{C_3}\left[\frac{1}{1 + j\omega\left(\dfrac{C_1 + C_2 + C_3}{C_2C_3R_2}\right) - \dfrac{1}{\omega^2}\left(\dfrac{1}{C_1C_2R_1R_2}\right)}\right]$$



(c)

Bessel High-pass	Gaussian Low-pass
$C_1 = C_2 = C_3$	$C_3R_3 = C_4R_4$
$R_2 = 3R_1$	
Cut off frequency $= \dfrac{0 \cdot 7}{2\pi C_1 R_1}$	Cut off frequency $= \dfrac{0 \cdot 64}{2\pi C_4 R_4}$

Fig. 1. Active filter circuits: (a) low-pass filter; (b) high-pass filter; (c) band-pass filter



General view of the hi fi stereo amplifier with one board removed to show layout and construction

shev gives the sharpest cut-off but will ring badly on transients; Gaussian will not ring or overshoot on transients but gives a rather slow initial roll-off; Butterworth and Bessel are in between.

Bessel response was in fact selected as about the best compromise giving reasonably sharp cut-off with negligible overshoot on transients. The second order Bessel polynomials are of the form

$1\Big/\left(1 + \sqrt{3}\mathrm{j}\omega t - \omega t^2\right)$, low pass with cut-off at $\omega t = 0{\cdot}8$

$1\Big/\left(1 + \dfrac{\sqrt{3}}{\mathrm{j}\omega t} - \dfrac{1}{\omega^2 t^2}\right)$, high pass with cut-off at $\omega t = 1{\cdot}25$

and these forms are produced with the component ratios tabulated in Fig. 2. The component values are not too critical; it suffices to use low tolerance resistors (preferably $\pm$ 2 per cent, but $\pm$ 5 per cent will suffice) and $\pm$ 10 per cent capacitors.

The mid-range filter being band-pass has a rather more difficult task to perform. It is shown in Fig. 2c and consists of a second order Bessel high-pass section as in Fig. 2b, followed by a simple *RC* low-pass section giving 6dB per octave roll-off at the top end of the pass band and preceded by a series resistor R3, which generates a further 6dB per octave roll-off at the top end by virtue of the input impedance of the basic high-pass section being reduced to C1 at high frequencies. The addition of R3 necessitates slight modifications to the other resistor values to maintain the desired high-pass characteristic.

A set of response curves of the three filter sections and the resultant overall response are shown in Fig. 3. It will be seen that the high frequency cut-off rate of the mid-range filter is initially less sharp than the other cut-off rates. This is because it is generated differently as outlined above; in fact this particular characteristic is second order Gaussian. The slower cut-off rate is acceptable here as it is not too important to remove the treble from the mid-range speaker.

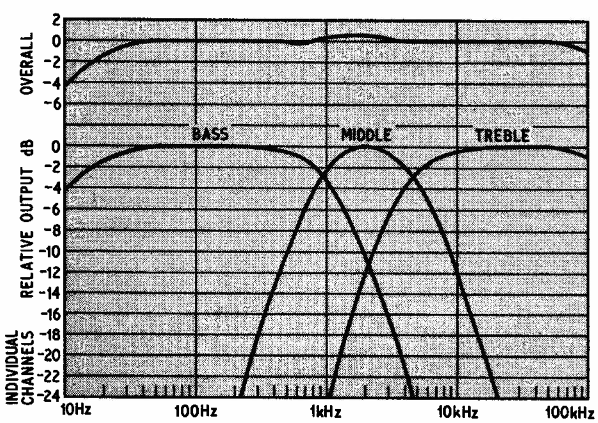


Fig. 3. Frequency responses of the hi fi stereo amplifier—individual and overall

Table 1. ACTIVE FILTER COMPONENT VALUES FOR VARIOUS CROSS-OVER FREQUENCIES

Lower cross-over	Bass channel		Middle channel	
	R1	C1	R1	C1
250Hz	82kΩ	10nF	39k$\frac{1}{3}$	10nF
400Hz	56kΩ	10nF	27kΩ	10nF
600Hz	33kΩ	10nF	18kΩ*	10nF
950Hz	22kΩ	10nF	10kΩ*	10nF

Upper cross-over	Middle channel			Treble channel	
	R3	R4	C4	R1	C1
3kHz	3·3kΩ	82kΩ	330pF	27kΩ	1·5nF
5kHz	2·2kΩ	47kΩ	330pF	15kΩ	1·5nF

NOTE: where resistor and capacitor ratios of 3 : 1 are required take nearest standard values.
* Reduced to correct for presence of R3.

CROSS-OVER FREQUENCIES

The cross-over frequencies shown in Fig. 3, 950Hz and 5kHz, are those recommended for a Goodman's three speaker system consisting of Audiom 61, Midax and Trebax. The frequencies can readily be set virtually anywhere in the audio range by scaling the resistor and/or capacitor values in the filters. The cut-off frequencies (−3dB) are given in Fig. 2 and Table 1 gives a list of component values for some typical choices. Note that for smooth cross-over the cut-off frequency of the bass filter must coincide with the lower cut-off frequency of the mid-range filter and the upper cut-off frequency of the mid-range filter must coincide with the cut-off frequency of the treble filter.

COMPLETE DESIGN—POWER AMPLIFIER

The complete circuit for the three amplifiers of a single channel is shown in Fig. 4; this has the cross-over characteristics shown in Fig. 3. As always the pre-amplifier must provide the main amplifier bias. The filter arrangement provides 100 per cent d.c. shunt feedback around the pre-amplifier in all cases, so that its output and input quiescent voltages are equal and provide the correct temperature compensated bias voltage as detailed in the first article (October issue).

The bias voltage is applied to the main amplifier via the pre-set potentiometers VR6, VR8 and VR10 (Fig. 4) which allow the gain of each amplifier to be adjusted to balance out differences in the sensitivities of the loudspeakers. Bias adjustment is by means of pre-set potentiometers VR5, VR7 and VR9 which are set so that the quiescent output voltages of the main amplifier are at half supply potential.

The main amplifier sections are connected in the usual manner except that the values of speaker coupling capacitors, bootstrap capacitors and compensation components have been altered where appropriate, in accordance with the frequency range to be handled

POWER AMPLIFIER (one channel only)

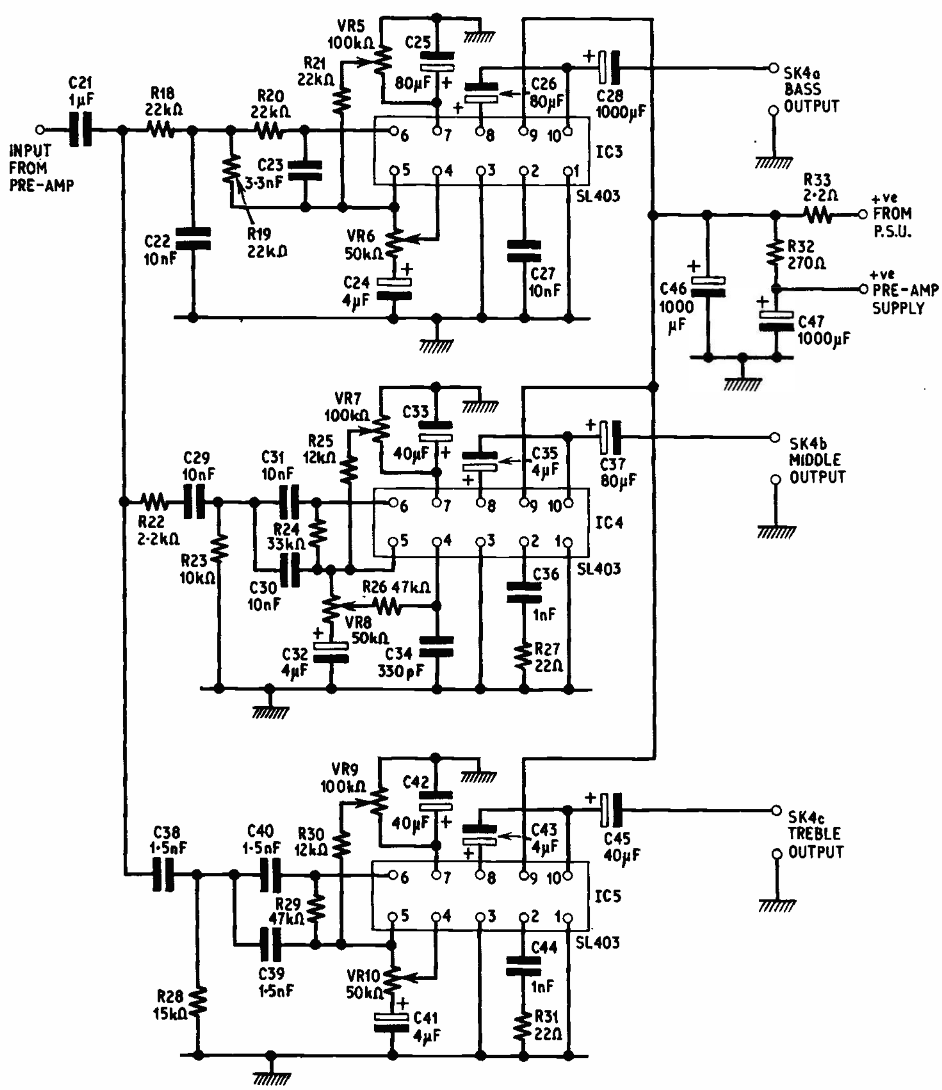


Fig. 4. Circuit diagram of one channel of the hi fi stereo power amplifier; not including the pre-amplifier

(one should not use a 1,000μF coupling capacitor to the treble speaker for example).

Note that although all amplifiers have been provided with level and bias adjustment potentiometers, some of these are not really necessary in practice. Commonly, middle and treble speakers are more efficient than bass units so that the bass amplifier level adjustment potentiometer VR6 and the blocking capacitor C24 could be dispensed with. The treble range output is much smaller than the bass and middle range outputs, so the treble range amplifier need not be provided with bias adjustment to obtain maximum possible output. Thus VR9 and R30 could be dispensed with.

CONSTRUCTION OF POWER AMPLIFIER

A Veroboard layout for a single channel power amplifier is shown in Fig. 5. In this design 0·1in matrix Veroboard was used to allow a more compact layout. A number of copper strips were tinned and connected in parallel to provide a low impedance earth line.

When using 0·1in matrix Veroboard, great care must be taken to avoid short circuiting adjacent conductors. Finished boards should be very carefully inspected; it is a good idea to run a small screwdriver blade along the spaces between conductors to ensure that no bridges are present.

POWER AMPLIFIER WIRING (one channel only)

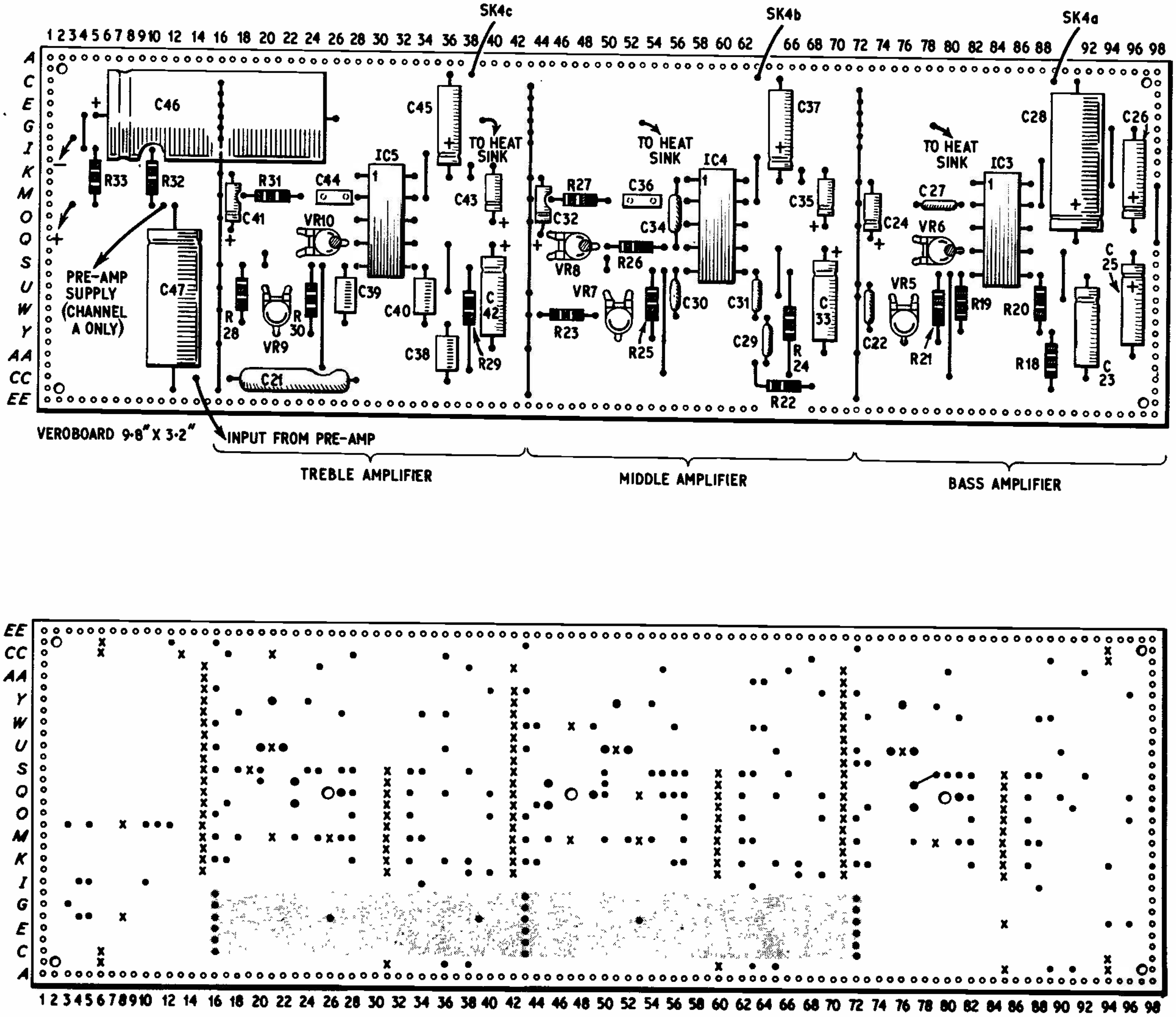
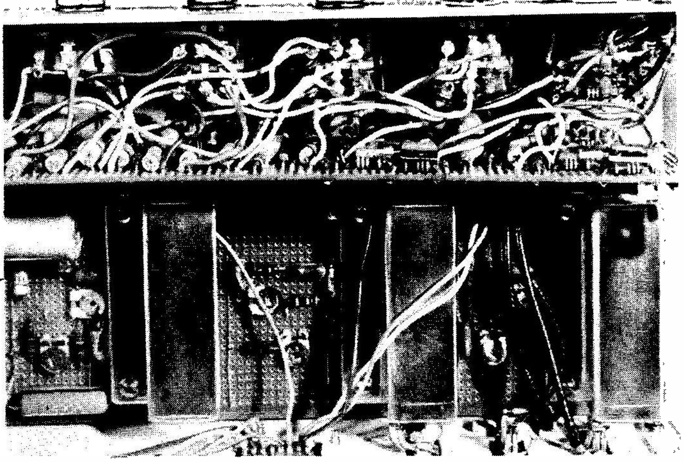


Fig. 5. Component layout and wiring diagram of one channel of the power amplifier. Conductors within the tinted area to be tinned for earth line



Part of one complete main amplifier board, with heat sinks attached, mounted in the chassis

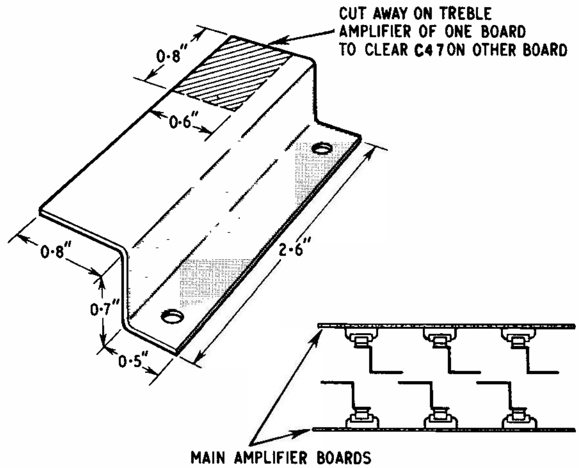


***Fig. 6.** Showing constructional details of the heat sinks for the six SL403's used in the main amplifiers and the arrangement of the amplifier boards*

POWER AMPLIFIER PERFORMANCE

Because most multiple speaker systems are based on 15 ohm units, the amplifier performance is specified into that impedance. The amplifier can of course be operated quite satisfactorily into 7·5 ohm speakers (though the speaker coupling and bootstrap capacitors on the bass channel should be doubled to maintain the same l.f. response). The only performance difference with 7·5 ohm speakers will be a rise in maximum output power to 3 watts maximum into each speaker and a

COMPONENTS...

MAIN AMPLIFIER

All components except R32 and C47 must be duplicated for channel B

Resistors

R18	22kΩ	± 5% h.s.
R19	22kΩ	± 5% h.s.
R20	22kΩ	± 5% h.s.
R21	22kΩ	±10%
R22	2·2kΩ	± 5% h.s.
R23	10kΩ	± 5% h.s.
R24	33kΩ	± 5% h.s.
R25	12kΩ	±10%
R26	47kΩ	± 5% h.s.
R27	22Ω	±10%
R28	15kΩ	± 5% h.s.
R29	47kΩ	± 5% h.s.
R30	12kΩ	±10%
R31	22Ω	±10%
R32	270Ω	±10%
R33	2·2Ω	±10%

Capacitors

C21	1μF polyester
C22	10nF polyester
C23	3·3nF polystyrene
C24	4μF elect. 16V
C25	80μF elect. 16V
C26	80μF elect. 16V
C27	10nF polyester
C28	1,000μF elect. 16V
C29	10nF polyester
C30	10nF polyester
C31	10nF polyester
C32	4μF elect. 16V
C33	40μF elect. 16V
C34	330pF polystyrene
C35	4μF elect. 16V
C36	1nF ceramic
C37	80μF elect. 16V
C38	1·5nF polystyrene
C39	1·5nF polystyrene
C40	1·5nF polystyrene
C41	4μF elect. 16V
C42	40μF elect. 16V
C43	4μF elect. 16V
C44	1nF ceramic
C45	40μF elect. 16V
C46	1,000μF elect. 25V
C47	1,000μF elect. 16V

Potentiometers

VR5	100kΩ skeleton preset
VR6	50kΩ skeleton preset
VR7	100kΩ skeleton preset
VR8	50kΩ skeleton preset
VR9	100kΩ skeleton preset
VR10	50kΩ skeleton preset

Integrated circuits

IC3, 4 and 5 SL403 Plessey (3 off)

Miscellaneous

SK4 12 pole sub miniature plug and socket (Radiospares)
Veroboard 0·1in matrix 9·8in × 3·2in
16 s.w.g. aluminium 2·6in × 2in (3 off for heat sinks)
6B.A. fixings

slight rise in distortion (to around 0·5 per cent).

The frequency response of the three amplifiers and the overall frequency response is shown in Fig. 3, while Fig. 7 shows distortion at the onset of clipping over the audio frequency range. The rise at l.f. is due to thermal feedback in the integrated circuit. Distortion is once again predominantly second harmonic and falls as power is reduced in a similar manner to the curves given in previous articles; since the amplifier is biased in class AB, cross-over distortion does not occur. Fig. 8 shows the output noise voltage ($\mu V/\sqrt{Hz}$) as a function of frequency over the audio band. This is measured with short circuit input and at the output of the appropriate amplifier for each frequency. The integrated noise level over the band is 90dB below full output; the perceived noise level will be about 5dB lower since the l.f. components which are significant in the integrated figure are much less audible.

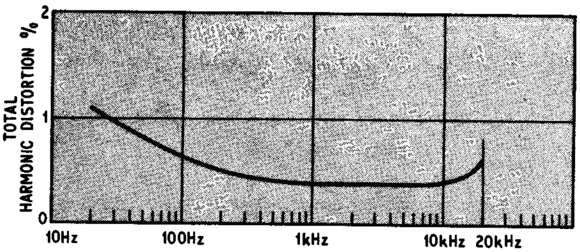


Fig. 7. Distortion curve for the stereo amplifier at full output

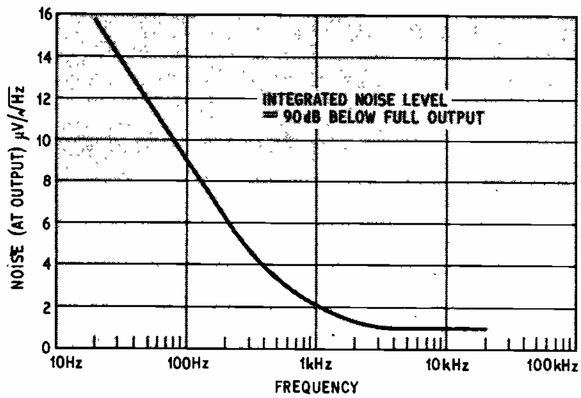


Fig. 8. Noise output curve for the stereo amplifier

POWER SUPPLY

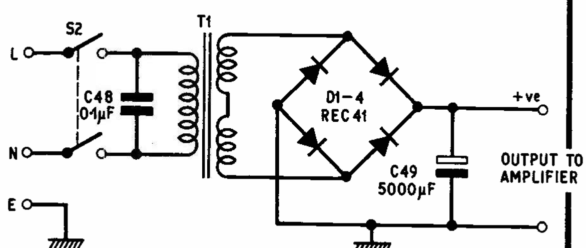


Fig. 9. Power supply circuit

COMPONENTS ...

T1 LVT/1 mains transformer, secondary 2×6·3V (Electroniques)
S2 D.P.S.T. toggle
C48 0·1μF paper 300V
C49 5,000μF elect. 25V
D1–4 REC 41 bridge rectifier (Radiospares)

OUTPUT POWER

The output power available is 2 watts r.m.s. (continuous sine wave) from each amplifier into a 15 ohm load on an 18 volt supply or 3W into a 7·5 ohm load. The effective r.m.s. output power on music depends on how the music frequency spectrum, during fortissimo passages, splits between the ranges covered by each amplifier. Some simple tests indicate that with the cross-over frequencies at 950Hz and 5kHz the effective power rating for music is around 1·5 times the individual amplifier rating. Thus the effective music power rating is 3W r.m.s. into 15 ohm speakers and 4·5W r.m.s. into 7·5 ohm speakers. With a 400Hz cross-over frequency the effective power rating would be about twice the individual amplifier rating.

These powers may seem rather low by the standards of hi fi amplifiers but it must be remembered that 30W sounds only twice as loud as 3W. Using the types of speakers envisaged for this system, 3W r.m.s. music power per (frequency) channel is more than adequate.

POWER SUPPLY ARRANGEMENTS

The main amplifiers are fed from a transformer and bridge rectifier with a 5,000μF reservoir capacitor, see Fig. 9. This produces a hum level of −70dB which is normally considered adequate. With a simple power supply such as this, however, the supply ripple is a sawtooth wave-form containing significant components at 300Hz, 500Hz, etc. which are much more audible than the fundamental 100Hz ripple. For this reason additional smoothing is incorporated by including the 1,000μF capacitors and 2·2 ohm supply line resistors on each power amplifier. This gives 12dB attenuation of the 300Hz component, 17dB attenuation of 500Hz, etc.

PRE-AMPLIFIER SUPPLY

The pre-amplifier supply is taken via an additional decoupling network (R32 and C47 in Fig. 4) from one of the power amplifiers. If power supply for external equipment is required, it can be taken from the other power amplifier via a similar decoupling network.

The amplifier described offers a novel approach to high fidelity reproduction. The emphasis of the design is on establishing ideal feed conditions for all speakers and on ensuring that they are fed with a properly selected section of the frequency spectrum. Incidental advantages of the system are reduction in intermodulation distortion and improved transient performance, due to the fact that low and high frequency components are not handled by the same power amplifier. Particular attention has been paid to obtaining low hum and noise levels.

Next month: Pre-amplifier and final construction details

Note. In Fig. 3 page 813 (last month) VR1 should have been 2MΩ and C11, 2,200pF. The distortion curves on pages 812 and 816 must be transposed.

★ A FEW EXAMPLES!
★ QUANTITY DISCOUNTS!
★ GUARANTEED GOODS!

MODULES with instructions
ADASTRA Electric E1315 organ, 22/6; E1316 Code oscillator, 22/6; E1317 Wireless code oscillator, 22/6; E1318 Dual lamp flasher, 22/6.

JASON KITS

FANTASTICALLY POPULAR

★ **TAPE** ★

We offer you fully tensillised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports. TRY ONE AND PROVE IT YOURSELF.

Standard Play				Long Play		
3in.	150ft.	2/3	... 3in.	225ft.	2/9
4in.	300ft.	4/6	... 4in.	450ft.	5/6
5in.	600ft.	7/6	... 5in.	900ft.	10/6
5¾in.	900ft.	10/6	... 5¾in.	1,200ft.	13/-
7in.	1,200ft.	12/6	... 7in.	1,800ft.	18/6
Double Play				Triple Play	
3in.	300ft.	4/-	... 4in.	900ft.	13/-
4in.	600ft.	8/-	... 5in.	1,800ft.	25/-
5in.	1,200ft.	15/-	... 5¾in.	2,400ft.	34/-
5¾in.	1,800ft.	19/6	... 7in.	3,600ft.	44/-
7in.	2,400ft.	27/-	...	Quadruple Play	
Postage 1/- reel.			3in.	600ft.	8/6

Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE: *Large tape stocks at all branches.*

V.H.F. F.M. TUNER HEADS
GORLA. The famous complete continental F.M. tuning heart in dye cast case complete with ECC85 valve (I.F.10·7 Mc/s) and tuning cord 19/-
FERGUSON. Ditto size 2 × 2 × 3in, screened case with ECC85 valve 17/6
EHRCORDER. Tape recorder, 4 transistor complete with tape mike, terrific value £5.19.0
HONEYTONE. As above, but superior finish.... £6.19.0
EAGLE. TE188 Signal Generator all wave, large size, super accuracy, big saving .... 17 gns.

AMPLIFIERS
SINCLAIR PACKAGE DEAL. 2 × Z12 amps., PZ4 power supply, Stereo 25 pre-amp. £21
MINET. 3–4W AC amplifier chassis—sacrificed price £3.10.0
VALVE RECORD PLAYER AMPLIFIERS. 4W output with 2 valves UY85, UL84 .... 39/-
DITTO high gain UCL82 valve 45/-

RECEIVERS
AIWA. AR813 4-band large radio L/M/S1/S2, super snip .... 12 gns.
WIEN PILOT II. Aircraft/MW receiver .... 11 gns.
ERRES. 4-band L/M/S/FM large type wooden cases, 5in. heavy speaker, car socket—bargain offer .... 12 gns. (normal value approx. 25 gns.!!)
FMT640 F.M. TUNER. High sensitivity, 2uV, high fidelity, response 20-20000 cps. tuning meter, AFC built-in power pack, attractive plinth, provisioned for multi-plex (RRP over £30) Super snip ...... 23 gns.

BARGAIN PARCELS
OUR SELECTION—
100 MIXED RESISTORS. 1-3W wide selection, standard carbon types, good quality 6/-
100 MIXED CONDENSERS. 5pf. to 25 mfd. ceramic silver mica, paper, listed at £ £ £'s 9/6
100 MIXED HI-STAB. RESISTORS. Wellyn 1% to 5% 10 ohms to 2 Megohms, range ½–1W, ideal quality amps., meters, etc. 9/6
25 MIXED TAG STRIPS. 2-way to 13-way, with feet 3/9
25 MIXED ELECTROLYTICS. H.T., bias and transistor types 7/6
CONNECTING WIRE. Coloured, PVC insulated, 5 coils of 25ft. each 5/-
TRANSISTOR KITS. (Standard superhet sets)
NEWMARKET. 6 transistors and 1 diode complete, consisting: mixer, 2 i.f.'s, detector, 1 a.m. and 2 P/P outputs in maker's pack, only 12/6
EAGLE. TRK, 6 as above but with addition of a thermistor. Greatly reduced 15/-

MIXED BARGAIN PARCELS ★★★
Selected from variable condensers, I.F. coils, loudspeakers plugs, sockets, knobs, potentiometers, condensers, resistors, nuts, bolts, cabinet fittings, switches, valves, transformers, lamps, complete p.c. boards, chokes, rectifiers, transistors, etc., etc. OFFERED at a small fraction of list value. DUE TO HEAVY DEMAND, we now pack them in several sizes—BE AMAZED!!—TRY ONE NOW: 3lb. parcel (post 3/-) 9/-; 7lb. parcel (post 5/-), 17/6; 14lb. parcel (post 6/6), 29/-.

FANTASTIC BARGAIN OFFER
PARCELS OF POTENTIOMETERS
Twenty Five mixed types, our selection, from ganged, presets, switched, un-switched, tandems, log. and lin., at approx. 4½d. each! . . .9/6.

CABINETS, CHASSIS
AUTOCHANGE RECORD PLAYER CABINETS (carriage 6/-).
SEAFIRLE. Size 17½ × 15½ × 7½in. standard lift-up lid type, cut out for 7 × 4in. speaker and BSR VA25 Super Slim, and standard 2-knob amp. Colours: grey, green, mustard, tangerine. Snip 50/-
PERDIO. Starmaker de luxe, size 16 × 15½ × 7 × in. as above, but base, treble, vol., chrome trim 59/-
Two-tone blue, as above, but deeper, will take Garrard record player or BSR (please specify) 69/-

POST 1/- NOW FOR "FLOG LIST"
To TECHNICAL TRADING CO., Park Crescent Place, Brighton
Please send free "Flog List", without obligation, to
NAME..............................
BLOCK CAPITALS PLEASE
ADDRESS..............................
....
.... P.E.12/69

TECHNICAL TRADING

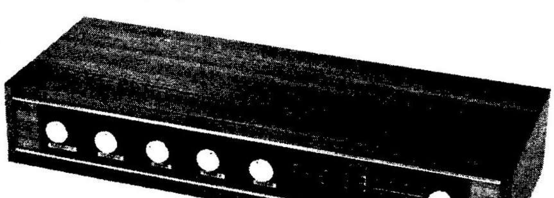
★ LONDON 10 Tottenham Court Rd., W1 Tel MUSeum 2639
★ BRIGHTON 6 Queens Road Tel. 23975
★ PORTSMOUTH 350-342 Fratton Rd. Tel. 22034
★ SOUTHAMPTON 72 East Street Tel. 25851
★ MAIL ORDER
Devonian Court, Park Crescent Place, Brighton (Tel. 680722) 24 hour Telephone C.O.D. Order Recording Service
Widest range of audio equipment and electronic components in all branches at keenest prices
Complete installation quotations a speciality

POSTAGE: Add ¼lb., 1/-; 1½lb., 2/6; 6 lb., 4/6; 10 lb., 6/-; 14lb., 7/6; 22lb., 10/6.

---

stereosound TA 160
TRADEMARK

AM-FM 16 watt TUNER AMPLIFIER Surpassing the performance of many higher priced equipments



£56...

★ 8 watts per channel music power ★ 3 wave-bands: L, M, VHF ★ Multiplex optional (£6 extra) ★ A.F.C. ★ Push button selection ★ Magnetic and Ceramic inputs ★ Mono/Stereo tape input or output ★ 4 ohms speaker impedance ★ Range 30 Hz to 18 kHz ★ Cabinet in Teak veneers. Size: Length 24", Height Overall 4½". Depth 8¾".

Full specification on request. Available through most Audio retailers and Stores.

Designed and Manufactured by
STEREOSOUND PRODUCTIONS LTD
Capital Works, Brighouse, Yorks. Tel: Brighouse 4355/6

NEW COMPONENTS
BY RETURN OF POST

RESISTORS
High stability carbon film. Very low noise. 0·5 watt 5% 4·7 ohms to 2·2MΩ 2d each. 0·5 watt 10% 4·7 ohms to 10MΩ 2d each.

DEVELOPMENT PACK
0·5 watt 5% resistors 50/-. 325 resistors 5 off each value, 4·7 ohms to 1MΩ (E12 series).

4 WATT WIRE WOUND RESISTORS 1/6 each.
10% 1·0, 1·8, 2·7, 3·3, 3·9, 4·7, 5·6, 6·0, 6·8, 8·2 ohms.
5% 10, 15, 20, 25, 50, 100 ohms.

MULLARD POLYESTER CAPACITORS ±10%
400V: 0·001µF, 0·0015µF, 0·0022µF, 0·0033µF, 0·0047µF, 0·0068µF, 0·01µF, 0·015µF, 0·022µF, 0·033µF, 6d. 0·047µF, 0·068µF, 0·1µF, 8d.
160V: 0·01µF, 0·015µF, 0·022µF, 0·033µF, 0·047µF, 0·068µF, 6d.. 0·1µF, 0·15µF 0·22µF, 8d. 0·33µF, 1/-. 0·47µF, 1/4. 0·68µF, 2/-. 1·0µF, 2/6.
250V: P.C. mounting miniature ±20%: 0·01µF, 0·015µF, 0·022µF, 0·033µF, 0·047µF, 0·068µF, 6d. 0·1µF, 0·15µF, 0·22µF, 7d.

MINIATURE ELECTROLYTIC CAPACITORS (−10% +50%)

50µF	6·4V	10µF	10V	125µF	10V	40µF	16V	8µF	40V
100µF	6·4V	16µF	10V	200µF	10V	6·4µF	25V	16µF	40V
200µF	6·4V	20µF	10V	10µF	15V	10µF	25V	50µF	40V
320µF	6·4V	25µF	10V	16µF	15V	16µF	25V	10µF	64V
6·4µF	10V	64µF	10V	25µF	15V	25µF	25V	20µF	64V

1/- each, 10/6 doz.
250µF 16V 1/6. 100µF 40V 1/3.

CERAMIC DISC CAPACITORS
100pF, 270pF, 470pF, 680pF, 1,000pF, 5d each.
0·02µF, 800V, 8d each.

SKELETON PRE-SET POTENTIOMETERS
Miniature linear 100, 250, 500 ohms and decades to 1MΩ.
0·3 watt ±20% ⩽ 250 kΩ ±30% > 250kΩ.
Horizontal or vertical P.C. mounting (0·1 matrix) 1/- each.

DIODES—OA85, OA91, 1/6 each.

SILICON RECTIFIERS
BY236 800V 0·8 amp 3/- each.
BY237 1250V 0·8 amp 3/6 each.

VEROBOARD
0·1 matrix: 2½ × 3¾ 3/6, 3¾ × 3¾ 4/3, 5 × 2½ 4/3, 5 × 3¾ 5/3.
0·15 matrix: 2½ × 3¾ 3/3, 3¾ × 3¾ 3/9, 5 × 2½ 3/9, 5 × 3¾ 5/3.
Spot Face Cutter 7/6. Terminal Pins 36 for 3/-.

C.W.O. please. 1/- post and packing on orders under £1.
Export Enquiries welcome

YATES ELECTRONICS (FLITWICK) LTD.
29 LYALL CLOSE, FLITWICK, BEDS.

MARKET PLACE

Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned.

EQUIPMENT CASE

Finding a means of obtaining an attractively finished case for a piece of equipment can become a problem to the amateur constructor, since there are several proprietary cases now on the market.

The Contil Mod-2 case from **West Hyde Developments** is available in varying sizes each with a p.v.c. coating. It comes in kit form and is easily assembled with a special cross-head screwdriver, included with each case kit.

The finish makes the case look equally attractive in the living room or laboratory. It is quite easy to add your own lettering to the front panel.

The cases would seem to be suitable for housing any of the P.E. i.c. amplifiers described last month and in this issue.

The prices of the Contil Mod-2 cases vary from 29s 6d to 129s 6d, postage extra.

Sizes and prices of the cases are contained in a short form catalogue available from West Hyde Developments Ltd., 30 High Street, Northwood, Middlesex.

TEST EQUIPMENT

A regulated d.c. power supply, designed for operating or testing transistor receivers, amplifiers and other low voltage equipment is the latest product from **Nombrex (1969) Ltd.,** Exmouth, Devon.

Known as the Model-22 Mk11 it provides a variable voltage from zero to 15V at currents of up to 500mA. Any short circuit or overload condition (approximately >600mA) is indicated instantly by a red warning light on the front panel.

The required output voltage is selected by a control on the front panel and both voltage and current can be monitored on separate scales of the output meter. The maximum loading for the power supply unit is 12 watts. Regulation accuracy from zero to full load is claimed at better than 2 per cent, and ripple is less than 5mV at maximum current.

The Model-22 d.c. power supply is mains operated and is priced at £14 18s 6d.

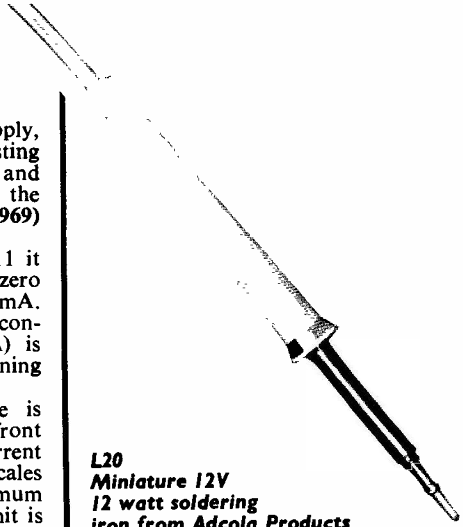
Another item of importance for the test bench is the oscilloscope and although this is a rather expensive item it should be considered a must for any amateur experimenter.

A fairly inexpensive oscilloscope is the EA 0699-1 from **Mitre Electronic Products,** 22 Powis Terrace, London, W.11. Intended for use in schools, as a monitor, or for use in the service repair laboratory, it costs £24 10s.

It features a $2\frac{3}{4}$in diameter tube and has a *Y* bandwidth from d.c. to 100kHz. The *Y* sensitivity at maximum gain with full *Y* shift is claimed to be less than 100mV/cm. The timebase covers a range of approximately 10μs/cm to 100ms/cm.

SOLDERING IRON

A new miniature 12V 12W soldering iron, type L20, has just been



L20 Miniature 12V 12 watt soldering iron from Adcola Products

introduced by **Adcola Products Ltd.,** price 28s 6d. The iron is ideal for printed circuit work and being 12V operated is a useful addition to the car tool box for carrying out small or temporary electrical repairs on printed circuits.

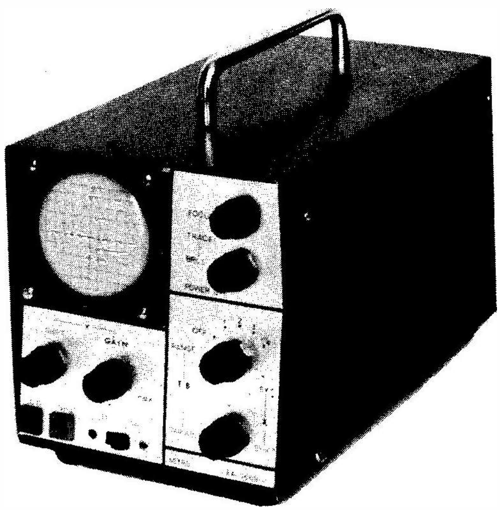
The iron can also be powered from the mains using a transformer which will become available as an extra.

SMALLEST RADIO

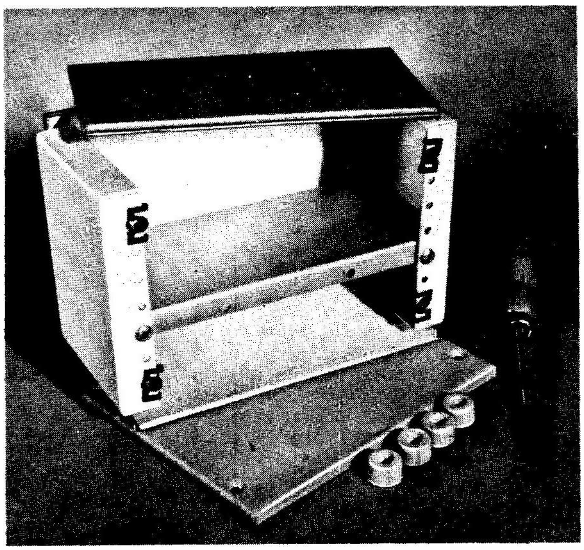
The introduction of the world's smallest radio in production is now claimed by **Lasky's Radio Ltd.** Called the Astrad Orion it is made in Russia and is a six transistor two-waveband receiver measuring only $1\frac{11}{16}$in × $1\frac{3}{16}$in × $\frac{5}{16}$in.

The set has a built-in ferrite rod aerial and is fully tunable over the medium and long waves. The signal output is heard through a miniature earphone and the set is powered by either a rechargeable nickel cadmium cell or a hearing aid mercury cell.

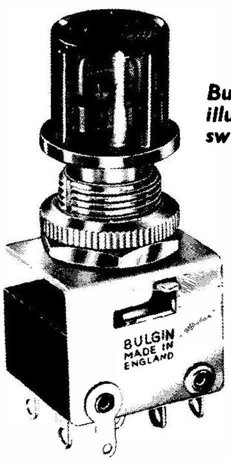
Complete with earpiece and battery the Astrad Orion costs 39s 6d.



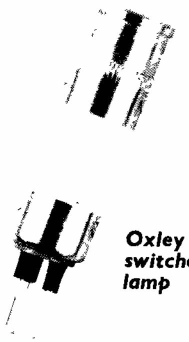
EA 0699-1 Oscilloscope manufactured by Mitre Electronic Products



West Hyde Developments Contil Mod-2 case kit



Bulgin illuminating switch



Oxley transistor switched indicator lamp

SWITCHES AND LAMPS

The practice of illuminating controls seems to be on the increase each month, whether this is due to an increase in general short-sightedness, or the ever increasing sophistication and greater demand expected of the electronics industry, is a matter of conjecture.

But following this trend is the latest range of illuminated switches from **A. F. Bulgin & Co. Ltd.,** Bye-Pass Road, Barking, Essex. The switch unit has a normally biased push action which can be locked in the depressed position by twisting the lens cap.

Two versions are available with either single-pole changeover or twin single-pole changeover switches. The maximum switch contact ratings are 8A 250V a.c.

The lampholder accepts l.e.s. lamps up to 28V and the lens caps are available in five different colours. The lamp contacts are isolated from the switch.

A new product from **Oxley** is a range of transistor switched indicator lamps. The lamp contains its own driver stage enabling the bulb to be controlled from a low-current signal and is available in two versions, normally on and normally off.

The lamp holders have been specifically designed to indicate the state of logic or counting circuitry, but no doubt many ingenious readers will find other applications when they finally appear on the retail market.

CINE/TAPE SYNC

Many of our photographically minded readers may be interested in the new Carol Model CS/2 pulse system of tape/film synchronisation. This new version is very similar to the original one and incorporates all of the more proven facilities of the previous model, as well as some new features.

The tape/film synchroniser is housed in a two-tone metal case with controls and a frames per second meter all mounted on the front panel. The recommended selling price, including tax, is £46 13s 6d and is designed so that most projectors can stand on top of the case, making a neat compact set-up.

The main feature of the CS/2 model is the inclusion of a motor speed control circuit, which eliminates the need for heavy ballast resistors and gives more precise sync control.

The Carol Cinesound Model CS/2 is obtainable at most photographic shops or direct from **Contronics Ltd.,** Deepcut, Camberley, Surrey.

LITERATURE

Some 5,800 semiconductor devices, including integrated circuits, f.e.t.'s and thyristors are given in the new semiconductor price list now being issued by **W.E.L. Components Ltd.,** 5 Loverock Road, Reading, Berks.

Items listed cover devices manufactured by Texas, A.E.I. Semiconductors, Ferranti and Sprague; a large number of CV types are also listed. The semiconductor price list is available free of charge, but all applications for copies must be made on company letterhead paper.

Also recommended is the added service of **Mainline Electronics** who now provide a catalogue of semiconductor devices which they can supply from S.G.S., R.C.A., International Rectifier, Emihus, Semitron, and Plessey. Additions to their components of all kinds are the i.c. amplifiers 12A, 25A, and 70A at £7, £8 5s, and £10 10s respectively. These are R.C.A. designs that are available in kit form. Details are given in 4s catalogue by post from Mainline Electronics Ltd., Thames Avenue, Windsor, Berkshire.

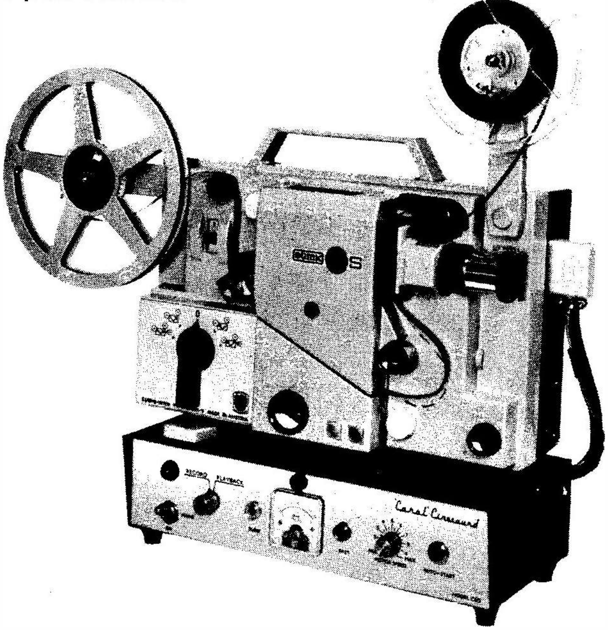
Two new editions of component catalogues are now available from **LST Electronic Components Ltd.,** 7 Coptfold Road, Brentwood, Essex, and **Adcola Products Ltd.,** Adcola House, Garden Road, London, S.W.4.

The LST catalogue lists many new semiconductor devices, including a special *pnpn* unijunction, type D13T, which is claimed to be programmable. Also listed in the catalogue are complete power supply and audio amplifier kits.

The Adcola catalogue contains details of their complete range of soldering instruments from replacement bits to de-soldering irons. The new de-soldering instrument styled on the lines of their soldering irons is also shown.

Both of the above mentioned catalogues are available free of charge.

Carol Model CS/2 tape/film synchroniser from Contronics

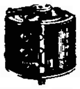


VARIABLE VOLTAGE TRANSFORMERS

◄ 50 AMPS

INPUT 230/240v. A.C. 50/60— OUTPUT VARIABLE 0-260v.
BRAND NEW
Keenest prices in the country. All Types (and Spares) from ½ to 50 amp. from stock.

SHROUDED TYPE
1 amp, £5. 10. 0. 2.5 amps, £6. 15. 0. 4 amps, £9. 0. 0. 5 amps, £9. 15. 0. 8 amps, £14. 10. 0. 10 amps, £18. 10. 0. 12 amps, £21. 0. 0. 15 amps, £25. 0. 0. 20 amps, £37. 0. 0. 37.5 amps, £72. 0. 0. 50 amps, £92. 0. 0.



½ AMP ► £3.10.0

OPEN TYPE (Panel Mounting)
½ amp, £3.10.0. 1 amp, £5.10.0. 2½ amps, £6.12.6.

LIGHT SENSITIVE SWITCH

Kit of parts, including ORP12 Cadmium Sulphide Photocell, Relay, Transistor and Circuit, etc., 6-12 volt D.C. op. price 25/- plus 2/6 P. & P. ORP 12 including circuit, 10/6 each, plus 1/- P. & P.

A.C. MAINS MODEL. Incorporates Mains Transformer, Rectifier and special relay with 2 5 amp mains c/o contacts. Price inc. circuit 47/6 plus 2/6 P. & P.

LIGHT SOURCE AND PHOTO CELL MOUNTING

Precision engineered light source with focusible lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP. 12 or similar cell. Both units are single hole fixing. Price per pair £2.15.0. P. & P. 3/6.

STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250v. A.C. operation.

EXPERIMENTERS' ECONOMY KIT
1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions £5.5.0 plus 5/- P. & P.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor 1-80 f.p.s. Price 9 gns. 7/6 P. & P.

HY-LYGHT STROBE
This strobe has been designed and produced in response to wide public demand, for use in large rooms, halls and the photographic field. It has four times the light output at 30 f.p.s. and utilizes a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Light output approx. 4 joules. Price £10.17.6. P. & P. 7/6.

7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price 10/6. P. & P. 2/6 or Post Paid with kits.
Several types of Flash Tubes available from stock.

RELAYS

New SIEMENS, PLESSEY, etc. miniature relays at highly COMPETITIVE PRICES

Coil Ω	Working d.c. Volts	Contacts		Price
170	9-12	4 c/o H.D.		14/6
170	9-12	3 c/o + 1 H.D. c/o		12/6
280	6-12	2 c/o	I.B	14/6
700	12-24	2 c/o	I.B	12/6
700	16-24	4 c/o	I.B	15/6
700	16-24	4M 2B	I.B	12/6
1250	20-40	2 c/o H.D.	I.B	12/6
2500	30-50	2 c/o H.D.	I.B	12/6
9000	40-70	2 c/o	I.B	10/-

H.D. Heavy Duty. POST PAID
I.B. = Including Base

MINIATURE RELAYS

9–12 volt d.c. 2 c/o 500 M.A. contacts. Size 1 × ⅞ × ½in. Price 11/6 post paid.
30-36 v d.c. 2 c/o 500 M.A. contacts. 3,200 ohm coil. Size 1 × 7/16 × 13/16in. 8/6. Post paid.

100 WATT POWER RHEOSTATS (NEW)

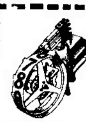
AVAILABLE IN THE FOLLOWING VALUES:
1 ohm, 10 a.; **5 ohm**, 4.7 a.; **10 ohm**, 3 a.; **25 ohm**, 2 a.; **50 ohm**, 1.4 a; **100 ohm**, 1 a.; **250 ohm**, .7 a.; **500 ohm**, .45 a.; **1,000 ohm**, 280 mA; **1,500 ohm**, 230 mA; **2,500 ohm**, .2 a. Diameter 3¼in. Shaft length ⅝in., dia. ¼in. All at 27/6 each. P. & P. 1/6.

50 WATT. 1/5/10/25/50/100/250/500/1,000/1,500/2,500 ohm. **All at 21/- each.** P. & P. 1/6.

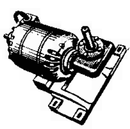
25 WATT. 10/25/50/100/250/500/1,000/1,500/2,500 ohm. **All at 14/6 each.** P. & P. 1/6.

VEEDER ROOT, 230V a.c. 50 cycle, 5-figure counter (non-resettable). 18/6, P. & P. 1/6. **AW**

Large Digit 12-18 V D.C. MAGNETIC COUNTER. 4in drum calibrated 0-9. Figures 1⅛in high, ⅝in wide. Set of 1m, 1b; 1c/o contacts operated by drum cam. The units which can be used in multiples are ideally suited for batch or lap recording or for the many purposes where large easily read numerals are required. Price 18/6, P. & P. 2/6.



PARVALUX TYPE SD19 230/250 VOLTS A.C. REVERSIBLE GEARED MOTOR.
30 r.p.m. 40lb. ins. Position of drive spindle adjustable to 3 different angles. Mounted on substantial cast aluminium base. Ex-equipment. Tested and in first class running order. A really powerful motor offered at a fraction of makers' price. **6 GNS.** P. & P. 10/-.



NICKEL CADMIUM BATTERY. 1.2 volt 35 AH. Size 8½ in. high × 3 × 1¼ in. 30/- each plus 4/- P. & P. Sintered Cadmium Type 1·2 v. 7AH. Size: height 3½ in., width 2⅜ × 1 3/16 in. Weight: approx. 13 oz. Ex-R.A.F. Tested. 12/6. P. & P. 2/6.

UNISELECTOR SWITCHES ***NEW***

4 BANK 25 WAY FULL WIPER
25 ohm coil, 24v. D.C. operation. £5.17.6, plus 2/6 P. & P.
6 BANK 25 WAY FULL WIPER
25 ohm coil, 24 v. D.C. operation. £6.10.0, plus 2/6 P. & P.
8 BANK 25 WAY FULL WIPER
24 v. D.C. operation, £7.12.6, plus 4/- P. & P.

230 VOLT AC RELAYS

230 volt AC Coil. Three c/o 5 amp. contacts. 17/6 post paid. (Illustrated).
LONDEX 4 c/o 3 amp contacts. 18/6 inc. base, post paid.

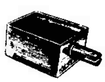
RING TRANSFORMER

Functional Versatile Educational

This multi-purpose Auto Transformer, with large centre aperture, can be used as a Double wound current Transformer, Auto Transformer, H.T. or L.T. Transformer, by simply hand winding the required number of turns through the centre opening. E.g. Using the RT. 100 V.A. Model the output could be wound to give 8V. @ 12½a., 4V. @ 25a., 2V. @ 50a., etc.
Price: RT.100VA 3.18 turns per volt, £2.5.0 + 3/6 p. and p. RT.300VA 2.27 turns per volt, £4.4.0 + 5/6 p. and p. RT. 1KVA 1.82 turns per volt, £6.10.0 + 6/6 p. and p.

SANWA MULTI RANGE METERS

New Model U50D Multi tester, 20,000 OPV, mirror scaled with overload protection. Ranges—d.c. volts: 100mV, 0·5V, 5V, 250V, 1,000V; a.c. volts: 2·5V, 10V, 50V, 250V, 1,000V; d.c. current: 5μA, 0·5MA, 5MA, 50MA, 250MA. Complete with battery and test probe. £7.5.0 post paid.



230V A.C. SOLENOID. Heavy duty type. Approx. 2lb pull. 17/6, P. & P. 2/6.
12V D.C. SOLENOID. Approx. 1lb pull. 10/6, P. & P. 1/6.
50V D.C. SOLENOID. Approx. 1lb pull. 10/6, P. & P. 1/6.
50V D.C. SOLENOID. Approx. 2lb pull. 12/6, P. & P. 1/6.

SERVICE TRADING CO

All Mail Orders—Also Callers—Ample Parking Space
57 BRIDGMAN ROAD, LONDON, W.4 Phone 995 1560
SHOWROOM NOW OPEN CLOSED SATURDAY

Personal callers only
9 LITTLE NEWPORT ST. LONDON, W.C.2. Tel. GER 0576

NEW BOOKS

OCTOBER 1969

TRANSISTOR SUBSTITUTION HANDBOOK — 9th Edition 18/- net

47 EASY ENTERTAINMENT AND SCIENCE PROJECTS VOL. 1
by Robert M. Brown and Tom Kneitel 24/- net

NOVEMBER 1969

TRANSISTOR COLOUR TV SERVICING GUIDE
by Robert G. Middleton 35/- net

CLOSED CIRCUIT TV FOR ENGINEERS AND TECHNICIANS
by Leonard E. Showalter 50/- net

JANUARY 1970

UNDERSTANDING AND USING UNIJUNCTION TRANSISTORS
by S. Hoberman 24/- net

ELECTRONIC CIRCUIT DESIGN
by Farl J. Waters 30/- net

FEBRUARY 1970

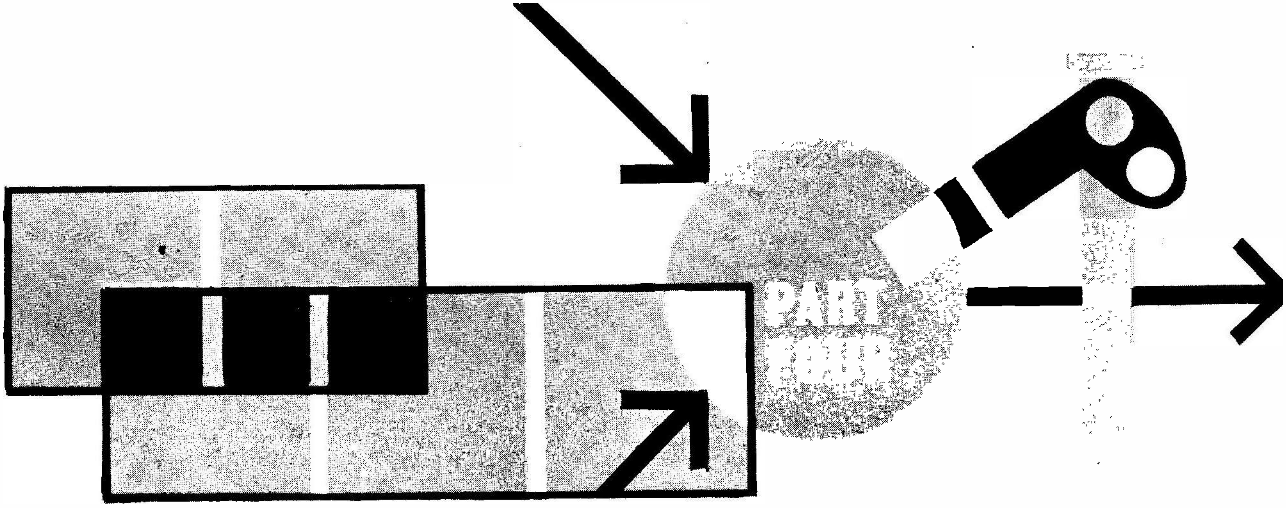
LEARN ELECTRONICS THROUGH TROUBLESHOOTING
by Wayne Lemons 75/- net

FM FROM ANTENNA TO AUDIO
by Leonard Feldman 30/- net

The above are obtainable from most good bookshops or direct from the Publishers (see below) on remittance of the price plus 2/6 p. & p.

FOULSHAM–SAMS TECHNICAL BOOKS

(W. FOULSHAM & CO. LTD.)
YEOVIL RD., SLOUGH, BUCKS, ENGLAND



MODEL RAILWAY LOGIC SYSTEMS

By P. GOODES

AUTOMATIC MARSHALLING YARD AND TURNTABLE

LAST month's article gave some suggestions, based on the author's layout, for automatic control of a marshalling yard. The gates used on the master control panel (G3, G4, G5, G6, G7) and those on the store (G2, G4, G6, G8, G10) require buffer amplifiers on the output. The gate and buffer are shown in Fig. 4.1.

For added security, gates G1 to G5 on the track switch decoder should each have an input from bistable BS2B on the master control.

A greater degree of flexibility can be provided if a loco unit can be made to turn round or change track. This is where an automatic turntable can come in useful. The remainder of this last part of the series will describe the author's home-made unit.

TURNTABLE

The turntable to be described was built entirely from scratch, since those obtainable commercially were unable to give the required facilities. The requirements were as follows:

To allow a train on to the turntable at any one outlet and to enable it to be removed either forwards or backwards from any preselected one of five outlets.

BISTABLE CONTROL

Obviously a bistable is required to do this, giving a sharp control so that it is either stationary or rotating. Rotation is started by a push button on the control panel. This sets the bistable BS1 in Fig. 4.2 with a 1 at its B output and a 0 at its A output. Since the control amplifier is an inverting device, the A output 0 is fed to it, starting the turntable rotating.

To stop the turntable at the required outlet, a negative voltage "1" is taken from the output of monostable MS1 and is applied to a control wiping contact mounted on the underside of the turntable. On the fixed base, five contacts are mounted and as the turntable rotates a 1 pulse is fed through each of these five contacts in turn. A rotary switch S3, mounted on the control panel, is used to select the particular outlet and when the 1 pulse reaches the corresponding fixed contact, it is fed through to switch off the bistable.

Monostable MS1 is used to overcome such conditions as follows: if, for example, the turntable starts at position 2, it is impossible to bring the engine out in reverse at, say, outlet 5 without the turntable stopping at outlet 5 and then needing to be restarted to take it through another 180 degrees.

When switch S1 is closed the 1 pulse from BS1B output triggers the monostable which has a time constant of approximately the time taken for the turntable to complete a quarter of a revolution. Thus the output becomes 0 for this period of time and the bistable cannot be triggered off until the monostable reverts to its quiescent state.

The speed of the turntable was made adjustable, but optimum speed was found to be about 1½ rev/minute.

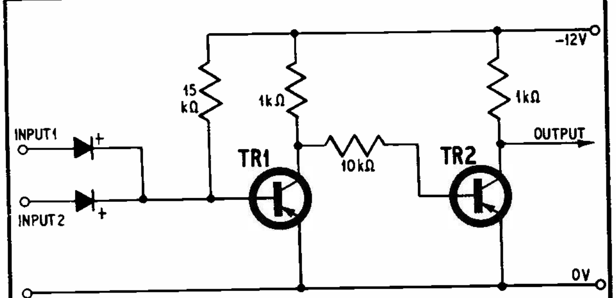


Fig. 4.1. Gate and buffer for the master control and store

TRIP SWITCH

As an alternative to the start button a trip switch may be mounted on the turntable so that the engine starts the turntable rotating. In this case a relay buffer and relay should be used instead of the control amplifier and should be operated from the B output of BS1. One pair of contacts is used to switch the turntable motor on and another two pairs to cut off the supply to the engine.

The circuitry is mounted on a printed circuit board, the layout for which is shown in Fig. 4.3. The board shown caters only for the bistable and monostable and it is left to the reader to build up a relay buffer or control amplifier according to which ever he requires.

WIPER SWITCH MECHANISM

The moving part of the turntable consists of a circle of hardboard 12in in diameter. On to the underside of this is fixed a circle of ordinary railway track (Fig. 4.3). The central wiping contacts are also fitted to the underside of this piece of hardboard and may be made

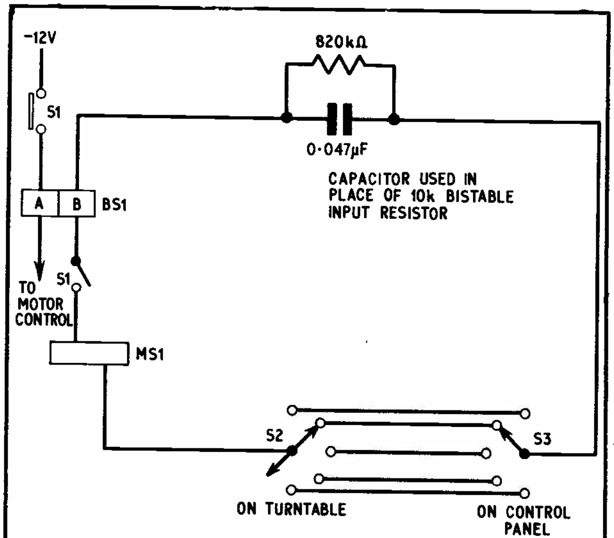


Fig. 4.2. Circuit diagram for the semi-automatic turntable

from old relay contacts or similar springy material and bent to shape. This contact is connected electrically to a Meccano wheel which is screwed on to the board and acts as a bush.

The base carries four cradles set at 90 degree intervals. Slots are cut in the tops of these cradles to carry truck axles and wheels and the whole so set that the rails of the rotating part run on these wheels. At the centre of the base another Meccano wheel is fitted and a short piece of rod is secured through this wheel. Using this as the axis of rotation, the rotating table should now run smoothly on the base. At this stage the piece of straight railway track, which carried the engine to be turned, may be fitted and this should be a little over 12in in length.

The five fixed contacts should now be fitted to the base so that contact is made between the wiper and each fixed contact as the track on the table is opposite the associated incoming track.

The motor may be fitted now (Fig. 4.4). The motor used was a "Mighty Midget" motor with gears.

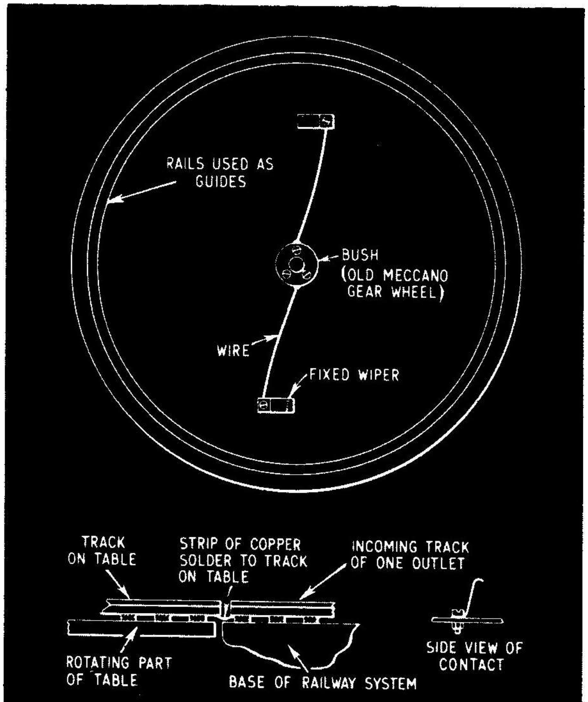


Fig. 4.3. Underside view of the rotating table

This is screwed to an aluminium base which in turn is hinged to the base. A rubber band connected between the motor and the base ensures that the drive shaft is tensioned against the edge of the rotating table. The electronics may now be incorporated and a dummy run attempted. When the turntable stops at each point the incoming tracks should be aligned to the track on the rotating table and secured.

Finally, a piece of spring strip should be soldered to each rail of the turntable track so that connection is made to the track at the outlets selected, thereby ensuring that the train supply gets through to the turntable track. ★

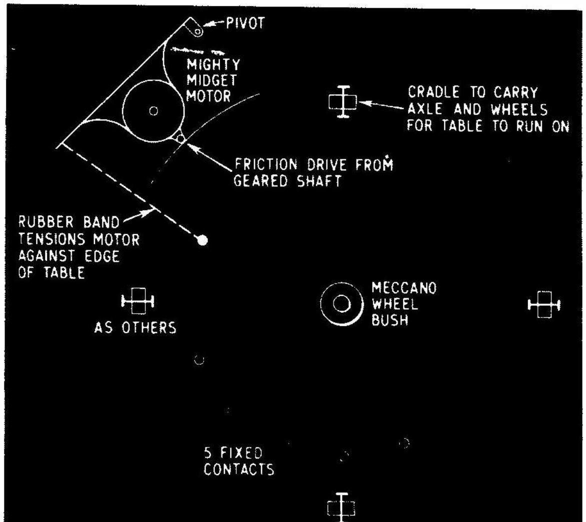


Fig. 4.4. Top view of the turntable bed on which the table runs

4/- brings you a mountain of components at manufacturers' prices

The serious amateur should never be without this comprehensive price list and guide to semiconductors and electronic components from RCA, IR, SGS, Emihus, Semitron, Keyswitch, Plessey, Morganite, Litesold and others (together with manufacturers' application data) which you can buy direct from us at *manufacturers' prices* e.g. IN914 ***1/3d.*** □ IN916 ***1/11d.*** □ 2N697 ***4/5d.*** □ 2N706 ***2/3d.*** □ 2N706A ***2/9d.*** □ 2N929 ***5/8d.*** □ 2N1613 ***4/8d.*** □ 2N3011 ***9/1d.*** □ 2N3053 ***6/2d.*** □ 2N3055 ***15/9d.*** □ 3N140 ***15/3d.*** □ BFY50 ***4/8d.*** □ BFY51 ***3/9d.*** □ BSY27 ***18/-*** □ BSY95A ***3/3d.*** □ C407 ***4/6d.*** □ CA3012 ***18/3d.*** □ CA3014 ***25/6d.*** □ CA3020 ***25/9d.*** □ OA200 ***1/9d.*** □ OA202 ***1/11d.***

Build the NEW Mainline Audio Amplifier kits – UP TO 70 WATTS

The result of the combined resources of SGS and RCA, these quasi circuits set new standards in quality and performance. Each kit is complete with circuit diagram, all semiconductors, resistors, capacitors and printed circuit board.

12A	**£7. 0. 0.**
25A	**£8. 5. 0.**
40A	**£9. 0. 0.**
70A	**£10.10. 0.**

Any two will make an outstanding stereo equipment.

To: Mainline Electronics Limited, Thames Avenue, Windsor, Berkshire

I enclose 4/-. Please send me your price list and guide □

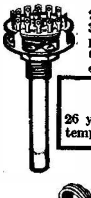
I am interested in .... Amp Mainline Audio Amplifier Kits. Please send me full data □

I am interested in receiving data on preamplifier & power supply kits □

NAME ________________ ADDRESS ________________

____

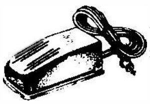
(A member of the ECS Group of Companies) PE 1269



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 3/6 each. 36/- dozen, your assortment.

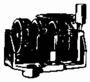
WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 10/- post free.



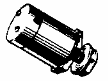
15 Amp FOOT SWITCH

Suitable for sewing machine motor, drilling machine or in fact to switch any job where both hands are to be left free. Rated at 13A, 250V. Price 22/6.

3 DIGIT COUNTER



For tape recorder or other application, re-settable by depressing button. Price 8/6.



TRANSDUCER

Made by ACOS, reference No. I.D.1001. For measuring vibration, etc., to be used in conjunction with "G" Meter. Regular price £5. Our price 49/6. Brand new and unused.

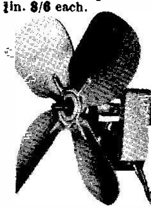
ISOLATION SWITCH

20A D.P. 250V. Ideal to control water heater or any other appliance. Neon indicator shows when current is on, 4/6. 48/- per dozen.

12 VOLT SOLENOID

For energizing Reed Switches, etc., size approx. 1¾in. long by 1½in. diameter. Hole through solenoid approx. ⅜in. 8/6 each.

AC FAN



Small but very powerful mains motor with 5½" blades. Ideal for cooling equipment or as extractor. Silent but very efficient. 17/6, post 4/6. Mounts from back or front with 4BA screws.

M.W. SIGNAL GENERATOR

Complete kit as described in last month's issue 12/6 each.

80 OHM BALANCED ARMATURE EAR PIECE

Usable as microphone or loudspeaker 4/6 each.

ELECTRIC CLOCK WITH 25 AMP SWITCH

Made by Smith's, these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only 39/6, less than the value of the clock alone—post and insurance 2/9.

BECKASTAT

This is an instant thermostat, simply plug your appliance into it and its lead into wall plug. Adjustable setting for normal air temperatures. 13A loading. Will save its cost in a season 19/6, post and insurance 2/9.

SOLDER GUN

A must for every busy man. Gives almost instant heat; also illuminates job. 100 watt 220/240V, 39/6 (saves you over 30/-) post and ins. 4/6. BIG JOB 250 watt model, 99/6 (saves you over £3.10), post and ins. 6/6.

FLEX BARGAINS

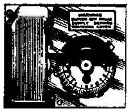
Screened 3 Core Flex. Each core 14/0076 copper P.V.C. insulated and coloured, the 3 cores laid together and metal braided overall. Price £3.15 per 100yd coil.

15 amp 3 Core Non-Kink Flex. 70/0076 insulated coloured cores, protected by tough rubber sheath, then black cotton braided with white tracer. A normal domestic flex as fitted to 3kW fires. Regular price 3/6 per yd. 50yd coil, £4.10 or cut to your length 2/6 per yd.

10 amp 3 Core Non-Kink Flex. As above but cores are 28/0076 copper. Normal price 2/6 per yd. 100yd coil £7.10 or cut to your length 1/9 per yd.

6 amp 2 Core Flex. As above but 2 cores each 23/0076 as used for vacuum cleaners, electric blankets, etc., 39/6 100yd coil.

23/0076 Triple Core P.V.C. covered, circular, normally sold at 1/6 yd. Our price 100 yd. coil £3.19.6. Post and Insurance 6/6.



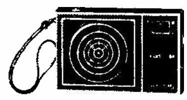
ELECTRIC TIME SWITCH

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 changeover contacts will switch circuit on or off during these periods. 59/6, post and ins. 4/6. Additional time contacts 10/- pair.

STEREO CABINET

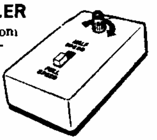
Size 25in. × 14in. × 9½in. deep—speaker compartment each end. Centre portion with hinged lid and removable bottom has platform for autochanger and room for amplifier. Two tone (red and grey) rexine covered but loud speaker ends need metal grilles. With handle and clips, 22/6. Carriage and packing 15/-.

'GLADIATOR' 2 WAVE BAND TRANSISTOR RADIO



7 transistor, 2 wave band (medium and long) pocket radio with carrying handle and ear-plug. These radios use a ferrite slab aerial and a conventional superhet circuit with built in moving coil speaker. Completely built up, ready to play. Offered at less than importers price due to bankrupt purchase. A remarkable bargain. 39/6 plus 3/6 post and insurance.

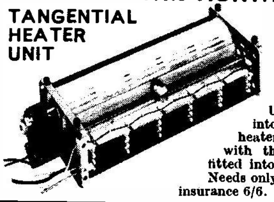
DRILL CONTROLLER



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, 19/6 plus 2/6 post and insurance. Made up model available at 37/6 plus 2/6 p. & p.

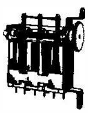
THIS MONTH'S SNIP

TANGENTIAL HEATER UNIT



Winter is coming but act today and you won't dismay. This heater unit is the very latest type, most efficient and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Units complete, wired ready to fit into cases, i.e. motor impeller, 3kW, heater switching 1, 2 and 3kW, and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Needs only on/off switch, 79/6; postage and insurance 6/6. Don't miss this.

3 STAGE PERMEABILITY TUNER

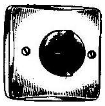


This Tuner is a precision instrument made by the famous "Cyldon" Company for the equally famous Radiomobile Car Radio. It is a medium wave tuner (but set of longwave coils available as an extra if required) with a frequency coverage 1620 kc/s–525 kc/s and intended to operate with an I.F. value of 470 kc/s. Extremely compact (size only 2¼ × 2 × ½in thick) with reduction gear for fine tuning. Snip price this month 12/6, with circuit of front end suitable for car radio or as a general purpose tuner for use with Amplifier. Post Free.

DISTRIBUTION PANELS

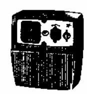
Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar advertised at £5. Our price 39/6, post and ins. 4/6.

VARYLITE



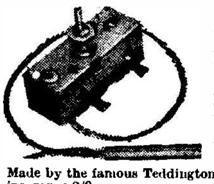
Will dim incandescent lighting up to 600 watts from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this, or mount on surface. Price complete in heavy plastic box with control knob £3.19.6.

BUY TIME SLOT METERS



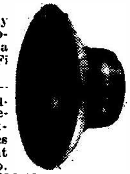
If you hire out equipment such as T.V. sets by the hour then these slot meters are what you require. We have 3 types, 8d an hour, 1/- an hour and 1/6 an hour. Brand new. Made by the famous Weston Company. Price £3.19.6, postage and insurance 6/6.

THERMOSTAT WITH PROBE



This has a sensor attached to a 15A switch by a 14in length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at 12/6 each. Postage and insurance 2/9.

HI-FI BARGAIN



FULL FI 12-INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.
Flux Density 11,000 gauss. Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre. Freq. response 30–10,000 c.p.s.—specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis diam. 12in—12¼in over mounting lugs—Baffle hole 11in diam.—Mounting holes 4, holes —¼in diam. on pitch circle 11⅛in diam.—Overall height 5¼in. A £6 speaker offered for only £3.9.6 plus 7/6 p. & p.
Don't miss this offer, 15in 30 watt £7.19.6, 18 in 100 watt £24.10.

REED SWITCHES

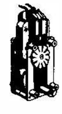
Glass encased switches operated by external magnet—gold welded contacts. We can now offer 3 types:—

Miniature. 1in long × approximately ⅛in diameter. Will make and break up to ½ amp tip to 300 volts. Price 2/6 each, 24/- dozen.

Standard. 2in long × ³⁄₁₆in diameter. This will break currents of up to 1 amp, voltages up to 250 volts. Price 2/- each, 18/- per dozen.

Flat. 2in long, just over ⅛ in thick, approximately ⅜in wide. The Standard type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp. 200 volts. Price 6/- each, £3 per dozen.

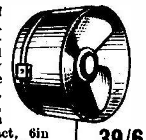
Small ceramic magnets to operate these reed switches 1/3 each, 12/- per dozen.



MOTOR WITH GEARBOX

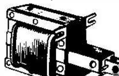
Very powerful 7 r.p.m., operates from standard A.C. mains. 29/6 plus 3/6 P. & P.

EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic feet per hour. At the pull of a cord it extracts grease, grime and cooking smells before they dirty decorations. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 6in casing with 5¼in fan blades. Suitable wherever it is necessary to move air fast. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector and fixing brackets.

39/6 + 6/6 post and ins.



230 VOLT SOLENOID

⅜in stroke. Size 2¼in × 2in × 1¾in. 14/6, postage 2/9.

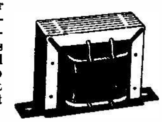
FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. 19/6. Kit B—30-40 w. 19/6. Kit C—80 w. 19/6. Kit E—65 w. 19/6. Kit MF1 is for 6in, 9in and 12in miniature tubes, 19/6. Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

DEAC RECHARGEABLE BATTERY

1·2V–2000mA/hr type (2000DKZ). Size 2in dia. × ⅜in thick approx. Tremendously powerful, will deliver 4 amp for ½ hour. Regular price over £2 each. Snip price 19/6 each. NEW AND UNUSED.

MAINS TRANSFORMER SNIP

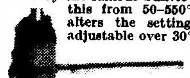


Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/240v.) and isolated secondaries two types (1) 12v. 500mA at 8/6; (2) 15v. 500mA at 8/6.

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F. 9/6 plus 1/- post. Suitable box for wall mounting, 5/-. P. & P. 1/-.

Type "B" 15 amp. This is a 17in long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven kiln immersion heater or to make flame-stat or fire alarm. 8/6 plus 2/6 post and insurance.



Type "D". We call this the Ice-stat as it cuts in and out at around freezing point, 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing, if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. 7/6. P. & P. 1/-.

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. 7/6, plus 1/- post.

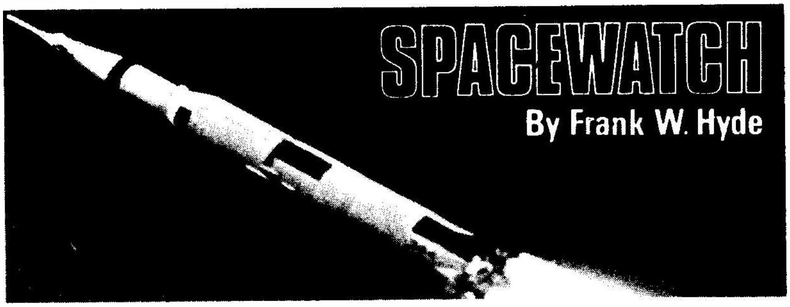
Type "F". Glass encased for controlling the temp. of liquid, particularly those in glass tanks, vats or sinks, thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 18/-, plus 2/- post and insurance.

Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semiconductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

ELECTRONICS (CROYDON) LTD

Dept. PE, 266 London Road, Croydon CRO 2TH

Also 102/3 Tamworth Road, Croydon



JUPITER PROBE

The fly-by probes scheduled for launching to study the Jupiter environment in 1973 and 1974, are making demands on the time of astronomers for planning the trajectories. Accurate observations are required of the positions of the Galilian satellites *Io, Europa, Ganymede* and *Callisto*.

There are a number of difficulties here, the principal one being the uncertainty of predicting the orbits of these bodies. The errors at present are high and amount to some thousands of kilometres. Amateur observers have been able to establish this with their much less sophisticated apparatus than that of the professional observatories.

The general studies to be made of the Jovian environment includes the study of particles, magnetic and electric fields, gravitational fields, effect of the solar wind and the atmospheric constituents of the planet!

One of the instruments used will be an imaging photo-electric polarimeter which will observe the Galilean satellites and Jupiter itself. Unfortunately, the error noted above is certainly larger than the field of view of the imaging instrument.

Locking on to the satellites could be impossible unless the astrometric data is improved and NASA is therefore urgently seeking positional data of the four Galilean satellites, and if possible also the position of *Amalthea* (satellite V).

If the position is not improved, particularly for the next two apparitions, NASA made be forced to set up conventional observatories to deal with this problem.

HONEYSUCKLE DISH

The rapid growth of Australia's contribution to the U.S.A. space programmes may have a spectacular reward. As a result of the successful *Apollo 11* mission NASA have indicated that Honeysuckle Creek tracking centre near Canberra will be up-graded by the addition of a 200ft dish aerial.

The existing 85ft aerial was able to receive the telemetry quite satisfactorily but its ability to deal with the television signals was marginal. It was as a result of this situation that the Commonwealth Scientific and Industrial Research Organisation made the Parkes 210ft dish available during the critical moon transmissions.

The geographical position of Australia in relation to Cape Kennedy has been the reason for the close co-operation between the personnel and their contact with advanced space techniques. These facilities in the southern hemisphere are essential to the future projects of space exploration and the moon based stations of the future.

WATCHING THE BIRTH OF STARS

The dark clouds in the Orion Nebula look like "protostars" condensing and the Green Bank radio astronomers have found some very compact clouds in regions of star formation.

These clouds of ionised hydrogen emit radio waves at 2cm. The emission at 18cm of the hydroxyl radical (OH) is believed to come from protostars and there is also the possibility that the OH radical also emits at 2cm. Some nebulae also show that they contain concentrations of ionised hydrogen.

In 1947 Bok, working with the Mount Palomar telescope, noticed the dark patches against bright emission nebulae and suggested that they were clouds of matter. Since then Dr M. Penston has studied several of the Bok globules which are seen against the bright Orion nebula, three of these are like spheres of gas, and they appear to have cooled down well below the usual temperature in interstellar space. Their mass is of the order of one solar mass and this supports the idea that they are stars in formation.

SATELLITE AERIAL WITHOUT A DOME

On October 1 this year *Raistang 2*, a new large radio aerial for satellite communications, went into operation. *Raistang 1* went into service in 1964 and was 25 metres in diameter, housed in a radome of plastic kept inflated by internal excess pressure.

The theory was that by housing it in a protective cover the construction could be both lighter to erect and easier to maintain. Also working conditions for staff would be more amiable.

In practice however, a number of grave disadvantages appeared. When wet the radome causes a higher level in the noise component of the system and this leads to considerable damping of the signal in passing through the wet shell. Also the wet shell reflects earth radiation back to the aerial. With a rainfall of 1mm/h there is a rise of noise temperature of 3·5db and when the rainfall rises to 10mm/h the increase is as much as 7 Bels.

The second aerial, which was built without the radome, has a far more robust structure and provision is also made for differing weather conditions according to location.

Some five thousand 150 watt radiators (infra red) are arranged in groups behind the reflector to take care of snow and ice. The rear of the dish aerial is totally enclosed so that the supporting struts of the aerial are shaded from the heat of the sun in order to reduce distortion.

An axially mounted horn feed enables both transmitter and receiver electronics to remain in position wherever the aerial is moved. The diameter of this dish is 28 metres.

There are plans for two more aerials in this complex which is the measure of what is expected from the increase in communications traffic when *Intelstat III* programme gets under way.

The next major event to be handled by the present aerials will be the 1972 Munich Olympics.

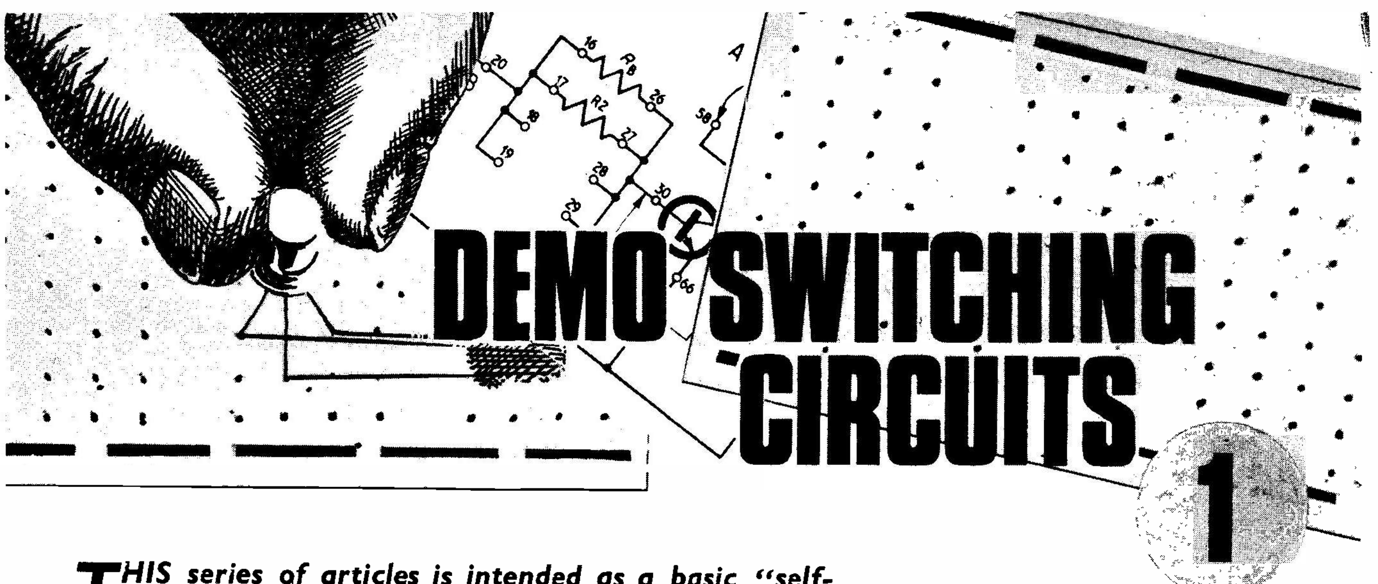
METEORS ON TAPE

A machine which will increase man's knowledge of the origin of meteors has been developed by Sheffield University and the Projects Division of Dunford Hadfields. The University team under Prof. Kaiser have installed an automatic digital recording system to process and analyse meteor echoes at the radio astronomy observatory at High Bradfield.

For some 12 years meteors have been observed at Bradfield using the technique of reflected pulses from ionised meteor trails. The new technique being developed by Prof. Kaiser's team will help to remove the laborious analysis work involved in the old method.

THE MOON AIDS THE MOTORIST

A new synthetic rubber which man used to make his first footprints on the moon may help the motorist. The material, a fluoro-elastomer can be used for seals, disc brake systems and other places where very high temperatures occur. Full return after deformation is possible up to 200 degrees centigrade.



DEMO SWITCHING CIRCUITS 1

THIS series of articles is intended as a basic "self-teaching" course for the home-constructor who wishes to design his own transistor switching circuits. Component values may be calculated from the simple theory given and it will be shown how the circuits may be assembled and tested.

Expensive test gear will not be required; neither will elaborate power supplies. Battery operation will be utilised throughout so that circuits may be tested without the need for setting up elaborate equipment.

By B. Pounder

ANYONE with a knowledge of little more than Ohm's law can easily acquire the facility of arriving at first-approximation circuit designs from which improvements can be made as experience develops. The designs given start with basic transistor operation and lead on to practical circuits.

BREADBOARD ASSEMBLY

One of the easiest methods of construction is the "breadboard" assembly technique based upon the use of component push-in boards such as S-Dec, μ-Dec and T-Dec. These are available from component suppliers and from M.L.I. for members of the teaching profession.

The use of these Decs enables a limited kit of components to be used many times over, and makes the task of changing components in an already assembled circuit simplicity itself. Because of this easy form of component assembly, a number of circuits can be built and tested very quickly. If a mistake is made in the connections, correction is straightforward without using a soldering iron.

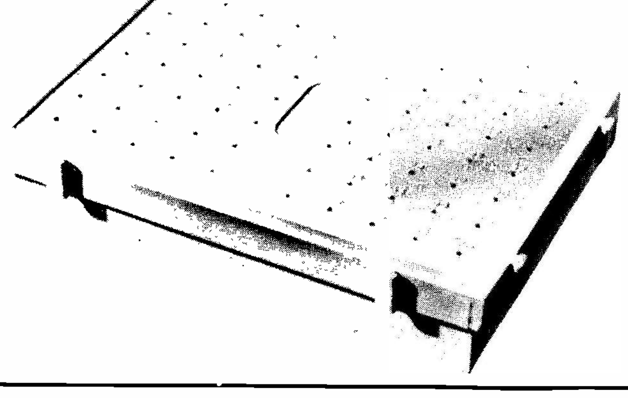
There are three basic types of "Dec", S, μ, and T. Each contains rows of phosphor bronze contact strips mounted in a small box beneath a plastics panel. The panel contains rows of numbered holes above the contact strips through which component leads may be inserted into the contact strips. Contacts are electrically and mechanically sound. Once a lead has been set in a particular position and attitude, so it will remain unless pushed or bent into another.

The arrangement of sockets on the three types of Dec is shown in the photographs. Circuit layouts are similar to those used with Veroboard, except that no solder is required.

Of the three types of Dec, the S-Dec is the least expensive and the easiest to get components into and out of on account of the relatively wide pitch between socket rows. It is designed for long-lead transistors in TO1 or TO5 encapsulations and will only accept short-lead TO18 or plastics devices if these are used in conjunction with transistor sockets to which leads about 1·5in long have been pre-soldered.

The other two types are more expensive but much more versatile. They will accept both long- and short-lead transistors directly as well as the standard integrated circuit packages provided that they are purchased with the appropriate i.c. carriers. The small socket spacings on the μ- and T-Decs enables circuits of considerable complexity to be assembled as will be shown as this series develops.

S-Dec



If required, two or more of these "breadboards" can be fitted together by their dovetail slots and panel mounted components can be fitted to the associated metal brackets.

COMPONENTS

Before getting down to the actual circuits, a word or two about the components to be used is appropriate here.

Apart from the breadboard and some single stranded connecting wire, a stock of transistors, resistors and capacitors will be required for all the circuits to be discussed. In addition, one or two extras will be required for some circuits, for example, diodes, bulbs, a relay, and so on. Some of these may need wires attached to facilitate insertion in the breadboard holes.

The transistor stock need only consist of a few general purpose types, *npn* or *pnp*, silicon or germanium; few circuits will require both *npn* and *pnp* devices. If the transistors will stand currents of up to one ampere, they will be capable of working in all the circuits, but smaller types can be substituted in low current applications up to about 100mA.

The circuit layouts to be given will be based on the assumption that the transistors used have an e-b-c lead sequence. It should be noted that some readily available plastics devices have an e-c-b sequence. It will be a simple matter to modify the suggested layouts to accommodate devices of this type. Some specimen lead arrangements are shown in Fig. 1.1.

For resistors, it is advisable to have a few of all the 10 per cent values. This may not be as expensive as it seems and has the advantage that a component of approximately the same value as that calculated will always be available for use in a circuit.

Capacitor requirements will be modest. If a few components of about 100pF, 0·1μF, 10μF are available, most needs should be met.

TRANSISTOR CHARACTERISTICS

Fig. 1.2 shows the basic diagram of a one transistor operational test circuit with S-Dec hole numbers given at the appropriate junctions. This is converted to a practical layout in Fig. 1.3. This circuit is used to illustrate the function of a transistor under linear d.c. conditions.

Before using transistors as switches, it will be useful to have a look at those characteristics which illustrate the behaviour of a typical device under d.c. conditions and see how a set of these characteristics may be plotted

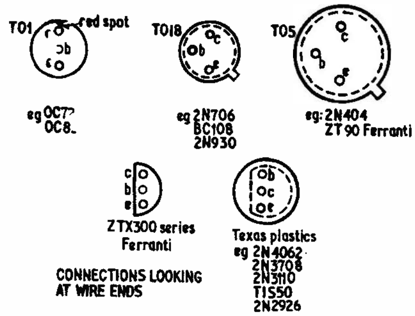


Fig. 1.1. Lead arrangements for some commonly used types of transistors

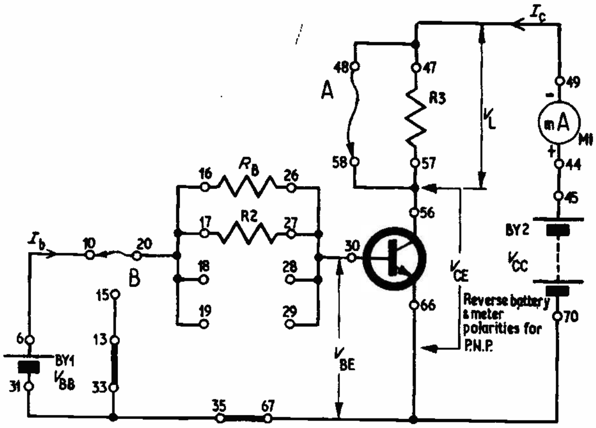


Fig. 1.2. A test circuit used to demonstrate the function of a transistor. S-Dec hole numbers are given at the component junctions

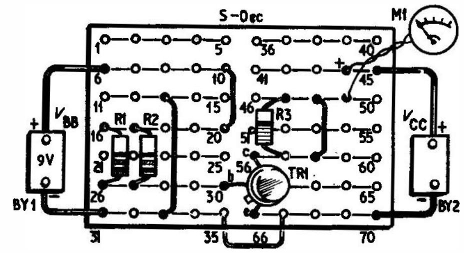
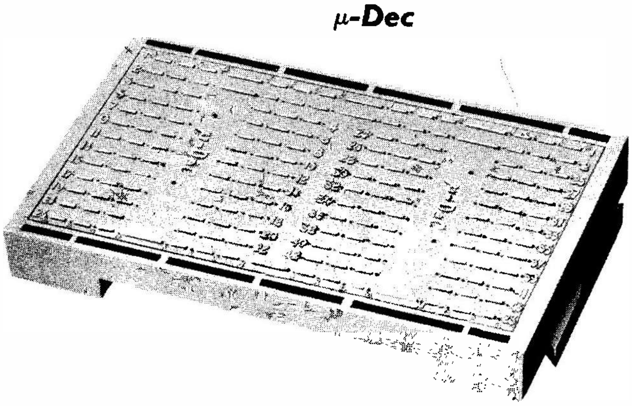
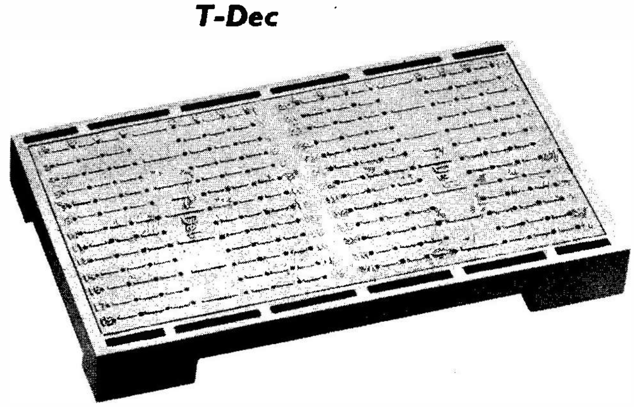


Fig. 1.3. Practical arrangement of circuit given in Fig. 1.2

μ-Dec



T-Dec



quickly to a degree of accuracy sufficient for many practical purposes.

Fig. 1.4 shows a set of output characteristics, that is, curves of collector current I_C against collector-emitter voltage V_{CE}, each plotted for a constant base current I_B.

A point P is shown on one of the curves, and for the particular transistor to which these curves refer, the

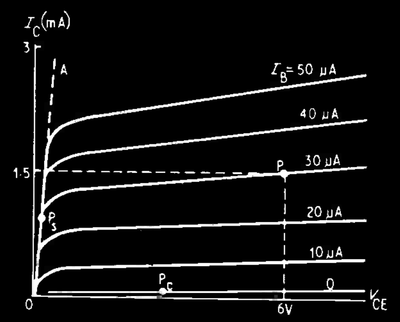


Fig. 1.4. A set of transistor output characteristics

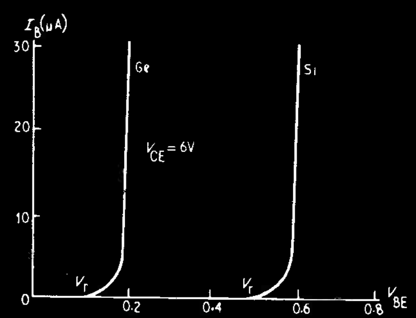


Fig. 1.5. Transistor input characteristics

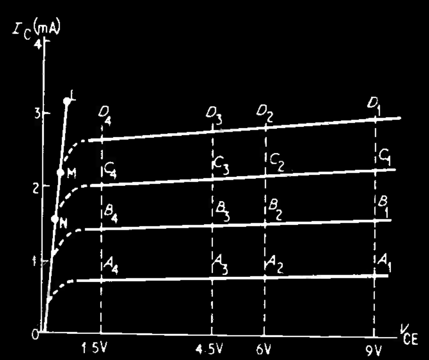


Fig. 1.6. Plotting the output characteristics

collector current and collector-emitter voltage are 1·5mA and 6V respectively. Also, the base current is 30μA. The ratio of the collector current to the base current at this point is the d.c. current gain for a grounded emitter configuration, usually given one of the symbols β or h_{FE}.

$$\text{Thus } \beta = h_{FE} = \frac{I_C}{I_B} = \frac{1{,}500}{30} = 50$$

Roughly the same value would be obtained at other points on the other curves, except at values of I_C very much greater or very much less than that chosen.

Note that all the curves merge into a line OA. If the transistor is operated at a point such as P_S on this line, the transistor is said to be saturated; I_C and V_{CE} for this point could correspond to any one of the base current values of all the curves which pass through this point, i.e. to all base currents greater than 30μA in the example shown. Conversely, if the transistor is operated at a point such as P_C on the zero base current curve, it is said to be cut-off.

Two input characteristics are shown in Fig. 1.5. These are curves of base current I_B against forward bias base-emitter voltage V_{BE}, drawn for a particular value of V_{CE}. Curves drawn for other values of V_{CE} differ only slightly from one another.

The curves shown are typical for germanium and silicon transistors, and show an important difference between the two types, namely that the base current is approximately zero for forward bias voltages of less than about 0·1V for germanium and 0·4V for silicon. Further, the curves rise rapidly with increase in V_{BE} beyond about 0·2V for germanium and 0·6V for silicon.

When saturated, V_{BE} values are approximately 0·3V and 0·8V for germanium and silicon transistors respectively. These figures are worth remembering.

PLOTTING THE CHARACTERISTICS

A quick method of plotting a set of output characteristics is as follows.

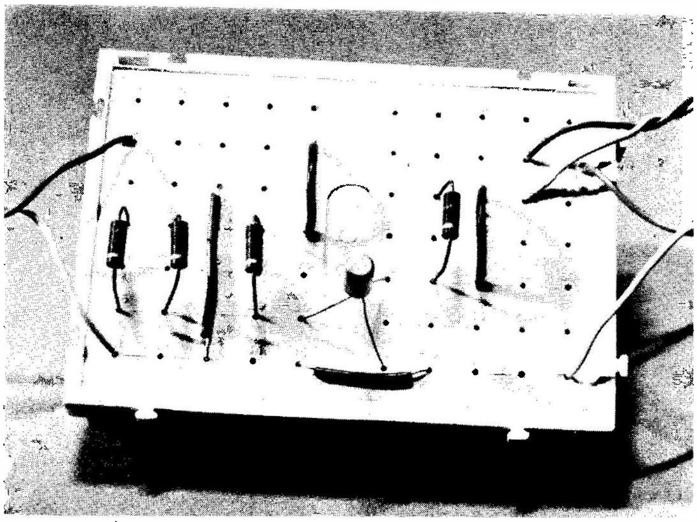
Connect up the circuit shown in Fig. 1.2 with R3 shorted by means of the link A. Use a 9V battery for V_{CC}. Insert a 2 megohm resistor for R_B and connect the link B to contact 15. The collector current should be small, much less than 0·1mA for a germanium transistor and negligibly small for a silicon device.

Now connect link B to contact 10 and note I_C. This will probably be less than 1mA. Whatever the value of I_C, replace R_B by a resistor of value such that I_C = 1mA (as near as possible). The base current corresponding to this collector current is calculated as follows.

From Fig. 1.2, it can be seen that the battery voltage V_{BB} is divided by the potential difference across R_B and that between the base and emitter terminals of the transistor. Thus the potential difference across $R_B = V_{BB} - V_{BE}$. But since V_{BE} is much less than V_{BB}, even if a silicon transistor is used, it can be neglected by comparison; the whole of the base circuit supply voltage V_{BB} can be considered to exist across R_B.

Ohm's Law now tells us that the base current $I_B \simeq V_{BB}/R_B$. Having calculated this current, and knowing I_C and V_{CE}, mark in a point such as A_1 shown in Fig. 1.6.

Next shunt R_B with a resistor of the same value in order to double I_B. Read the new value of I_C and mark in point B_1 on Fig. 1.6. Next shunt R_B with two further resistors of the same value so that I_B is three times and then four times its initial value. Note the corresponding values of I_C and mark in points C_1 and D_1.



Photograph of the arrangement shown in Fig. 1.3

The whole procedure is then repeated using batteries, for V_{CC} of 6V, 4·5V and 1·5V, and points A_2, B_2, C_2, D_2 etc. marked in on Fig. 1.6. The small-slope sections of the characteristics can be drawn in as shown. The saturation part of the characteristic can now be found.

Replace the supply battery V_{CC} by one of 9V and remove the link A in order to place the collector load resistance R3 in circuit. A suitable value is 3·3 kilohms. Insert resistance R_B of gradually decreasing value until the collector current no longer rises. This occurs when the transistor saturates.

Calculate the voltage dropped along R_C at saturation using Ohm's Law, i.e. $V_L = I_C R_3$, where I_C is the saturation collector current $I_{C(sat)}$. The collector-emitter voltage at saturation is therefore $V_{CE(sat)} = V_{CC} - V_L$. Mark in the point L corresponding to these values of $I_{C(sat)}$ and $V_{CE(sat)}$ on Fig. 1.6.

Repeat the whole procedure with $R_3 = 4{\cdot}7$ and 5·6 kilohms, and obtain points such as M and N. Join points L, M and N by a smooth curve to complete the characteristics.

The whole procedure described above need take no longer than it does to read the instructions, once a little practice is obtained.

For the home experimenter who is interested in a quick check of a particular transistor, rather than a more complete knowledge of the characteristics as a set, all that is usually required is to check that I_C is approximately zero at $I_B = 0$, and then find a value of R_B for which I_C is about 1mA. The current gain is then obtained by dividing the indicated I_C by the calculated value of I_B.

TRANSISTOR OPERATED AS A SWITCH

The circuit shown in Fig. 1.7 depicts a transistor amplifier with collector load resistance R_L. Part of the supply voltage V_{CC} is dropped across R_L, the remainder between the collector and emitter terminals Thus

$$V_{CC} = V_L + V_{CE}$$
$$\text{But } V_L = I_C R_2$$
$$\text{so } V_{CC} = I_C R_L + V_{CE}$$
$$\text{or } V_{CE} = V_{CC} - I_C R_L.$$

This last equation is the load-line equation for the load R_L. It shows that

(a) if $I_C = 0$, $V_{CE} = V_{CC} - 0 = V_{CC}$,
(b) if $V_{CE} = 0$, $I_C R_L = V_{CC}$, so $I_C = V_{CC}/R_L$,
(c) if $V_{CE} = V_{CC}/2$, $I_C = V_{CC}/2R_L$.

These points are plotted at the extremities and centre of a load line in Fig. 1.8 (p, q, r).

A transistor can be used to switch the current through R_L on and off if it is operated between cut-off (i.e. point P_C almost at the lower end of the load line) and a point higher up the load line corresponding to the required current. The higher point is frequently the saturation point P_S for the following reason. At P_S, $V_{CE} = V_{CE(sat)}$ and is very small, so although I_C may be large, the power dissipated in the transistor, $V_{CE}I_C$, is small. The power is also small at cut-off, since I_C is very small even though V_{CE} may be large.

At a point about half way up the load line however, the power dissipated in the transistor is a maximum, and equal to $(V_{CC}/2) \times (I_{C(sat)}/2)$. For example, suppose we have the following numerical values,

$$I_C \simeq 0{\cdot}1\text{mA},\ V_{CE} = 6\text{V at cut-off},$$
$$I_C \simeq 100\text{mA},\ V_{CE} = 0{\cdot}1\text{V at saturation},$$

then $I_C = 50$mA, $V_{CE} = 3$V at the mid-point of the load line. The power dissipations are therefore:

At cut-off, 0·1mA × 6V = 0·6mW,
At saturation, 100mA × 0·1V = 10mW,
At mid-point, 50mA × 3V = 150mW.

It can be seen from these results that a transistor with a maximum rated dissipation of only 100mW could be used for switching between saturation and cut-off,

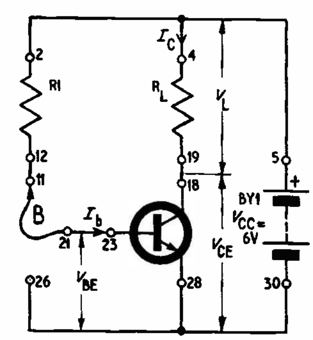


Fig. 1.7. A transistor amplifier circuit

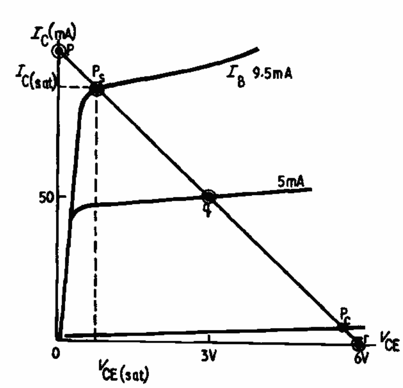


Fig. 1.8. Plotting the load line for the circuit given in Fig. 1.7

provided first that it can carry a steady current of 100mA, and second that it is made to spend most of its time at cut-off or in saturation. The transitions between cut-off and saturation would have to be fast.

It is for this reason that in first-approximation designs using small low power transistors as switches, it is important to be certain that sufficient base current can be supplied in order to ensure saturation.

LAMP DRIVER

When TR1 in Fig. 1.7 is cut-off, $I_C = 0$ so $V_L = 0$. When it is saturated, $V_{CE} = V_{CE(sat)} \simeq 0$, so $V_L = 6V$. Also, if $R_L = 60$ ohms, $I_{C(sat)}$ will be $6/60 = 100mA$. Hence if R_L is a 6V, 100mA lamp, it will be off when the transistor is cut-off, and on when the transistor is saturated.

Connect up the circuit and check that the bulb is switched on and off when the link B is changed from socket 11 to socket 26. If the transistor used happens to have an h_{FE} value greater than 20, the base current being supplied will be more than sufficient to ensure saturation. Check this by changing R_B in small steps, keeping a careful watch on the bulb.

As soon as the bulb glows with less than its maximum brightness, the transistor is not being operated under saturation conditions. The power which is not now being dissipated by the bulb is being dissipated as heat from the transistor.

Some high-gain TO18 or plastics transistors may be harmed in this circuit, e.g. 2N930 or BC108. TO5 size devices, or TO1 metal-canned devices such as the OC72 will operate satisfactorily.

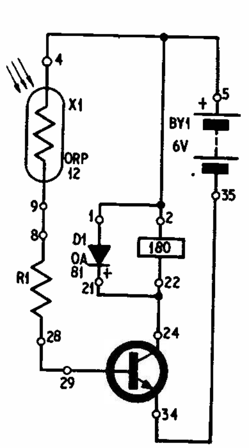


Fig. 1.9. Circuit for a light operated relay

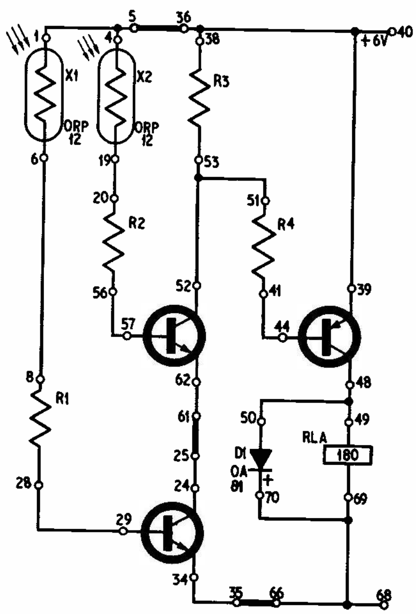


Fig. 1.10(a). A multi-transistor "AND" circuit developed from Fig. 1.9

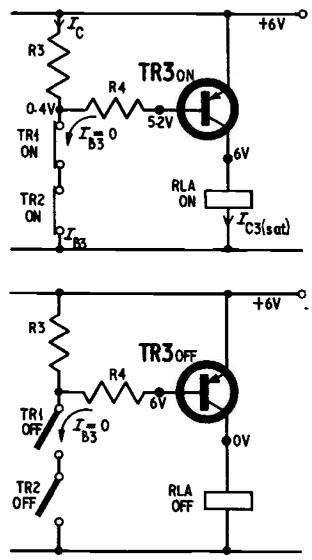


Fig. 1.10(b) and (c). These are simple equivalent circuits which demonstrate the action of the light operated circuit

In order to avoid excess power dissipation in the transistor, the base current supply must be sufficient to ensure saturation. At 100mA collector current, the average general purpose or switching transistor might have a d.c. current gain of only 20. Thus the base current must be $100/20 = 5mA$ to meet this "worst case" possibility.

If a surplus transistor is used, it might be desirable to double this current to allow for a minimum possible h_{FE} of 10. The base current flows through R_B which drops a voltage $V_{CC} - V_{BE(sat)}$ under saturation conditions. Hence using the value of 20 for the minimum h_{FE},

$R_B = (6-0{\cdot}8)V/5 \simeq 1{,}000$ ohms for a silicon device, or $R_B = (6-0{\cdot}3)V/5 \simeq 1{,}200$ ohms for a germanium device.

LIGHT OPERATED RELAY

The ORP12 photo-conductive cell shown in Fig. 1.9 has a low resistance when brightly illuminated and a high resistance when in darkness (megohms). The cell is used to pass base current under conditions of bright illumination and in sufficient quantity to saturate the transistor. When the transistor saturates, the collector current, which also flows through the relay coil, actuates the relay. The relay used is a 6V, 180 ohm type. Calculation of component values is as follows.

$$I_{C(sat)} = 6/180 = 30mA$$
$$\text{If } h_{FE(min)} = 20$$
$$I_{B(sat)} = 30/20 = 1{\cdot}5mA.$$

Let the combined resistance of the ORP12 and R1 be equal to R_B

Then $R_B = (6 - 0{\cdot}8)/1{\cdot}5$ kilohms for silicon,
or $R_B = (6 - 0{\cdot}3)/1{\cdot}5$ kilohms for germanium.
Thus try $R_B = 3{\cdot}3\text{k}\Omega$ (Si)
or $3{\cdot}9\text{k}\Omega$ (Ge)

The extra base resistor R1 is included to protect the transistor from too high a base current under conditions of extremely bright illumination when the resistance of the ORP12 may be very small. Any transistor should be able to withstand a base current of 5mA without harm.

Thus we arrange for R1 to limit the base current to this value even under the lower possible resistance of the ORP12, namely zero. Hence $R_1 = 6\text{V}/5 = 1{,}200$ ohms (we have ignored V_{BE} here).

The diode shown shunting the relay coil can be almost any type to absorb the stored energy (back e.m.f.) from the relay coil when the magnetic field collapses during the switch-off period. If the diode is not included, the back e.m.f. set up by the relay coil might be sufficiently large to exceed the collector-emitter breakdown voltage and possibly damage the transistor. Such diodes are always included across inductive loads in switching circuits.

LIGHT OPERATED AND CIRCUIT

The circuit shown in Fig. 1.10 is included to show how to calculate the component values in a multi-transistor circuit. TR1 and TR2 are *npn* transistors while TR3 is *pnp*. There is no reason why TR1 and TR2 should not be *pnp* and TR3 *npn*, provided that the battery and diode polarities in the current are reversed.

Collector current cannot flow through TR1 if TR2 is cut off and vice-versa, because the two transistors are connected in series. Therefore, these transistors can only saturate when both photo-conductive cells are illuminated simultaneously.

If both TR1 and TR2 are cut off, the base current flow path for TR3 is blocked as shown, so TR3 is also cut off. If both TR1 and TR2 are saturated, they act as low resistances and allow a path along which current can flow from the base of TR3. TR3 can therefore saturate if R_4 has a low enough value.

Typical voltage values are shown in Fig. 10 for a circuit employing silicon transistors. Component values are calculated starting from the output end of the circuit as follows.

If the relay is a 6V, 180Ω type,

$$I_{C3(sat)} = 6/180 = 33\text{mA}$$

Assuming $h_{FE3(min)} = 20$, $I_{B3(sat)} = 33/20 = 1{\cdot}6\text{mA}$.
Hence $R_{4(min)} = (5{\cdot}2 - 0{\cdot}4)/1{\cdot}6 \simeq 3{,}300$ ohms.

Let $I_{C1(sat)} = I_{C2(sat)} = 5\text{mA}$ (a current at which the average small switching transistor will have plenty of current gain) and assume a minimum current gain of 20.
Then $R_C = (6 - 0{\cdot}4)/5 = 1{,}100$ ohms.
and $I_{B1} = I_{B2} = 5/20 = 0{\cdot}25\text{mA}$.

The resistance in each base lead of the series transistors must therefore be $(6 - 0{\cdot}9)/0{\cdot}25 \simeq 2{,}200$ ohms. (The 0·9V is the average base voltage on TR1 and TR2). The limiting resistors R1 and R2 can be about 4·7 kilohms each in order to limit the base currents to about 1mA.

If these calculations are repeated with base-emitter voltages assumed to be zero, it will be seen that few errors of importance will be made. If germanium transistors are to be used, the above component values will therefore suffice. If need be, the values can easily be recalculated using the base-emitter voltage of 0·3V under saturation conditions, instead of the 0·6V used above.

To be continued

RSGB EXHIBITION

"CRITICS of annual exhibitions are often heard to complain that they become in time the mixture as before. To some extent this is true of our International Radio Engineering and Communications Exhibition, but I venture to suggest that this sameness is one of its salient features . . . Yet from another point of view we must try never to be accused of sameness." Thus wrote, Mr John Swinnerton, President of the R.S.G.B., in his "Foreword" for the show catalogue.

As one of the participants of this exhibition, held at the New Horticultural Hall, London, from October 1 to 4, *Practical Electronics* is well aware of this "sameness."

If ever an exhibition, albeit for amateur interests, needs progressive thought in its design, this one does to update the image of modern communications to its rightful position in modern society.

HOME CONSTRUCTION

Practical Electronics had a communication receiver on show of revolutionary design (now being published). *Practical Wireless* exhibited a panoramic receiver of simple construction and suitable for visual display of signals on the 80 and 160 metre bands.

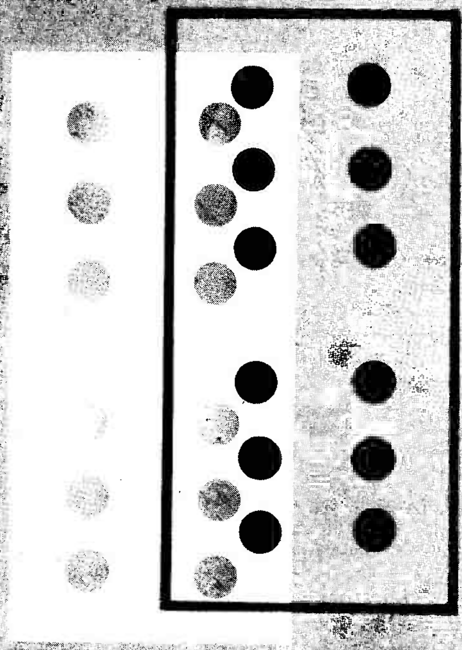
Although not strictly communications, P.E. were fully justified in showing advanced techniques in the "50 plus 50" fully stabilised power transistor amplifier, which can deliver up to 120 watts r.m.s. power from each channel of a stereo outfit. This design will no doubt find many homes in ham shacks for transmitter modulation when published in the near future.

Probably the most interesting feature of an otherwise clerical R.S.G.B. stand is the section devoted to the display of home constructed equipment, including transmitters, receivers and even a discotheque control panel. The standard achieved by the worthy award winners is often on a par with professional work, and one tends to think that many of these undertake similar work as a full time occupation.

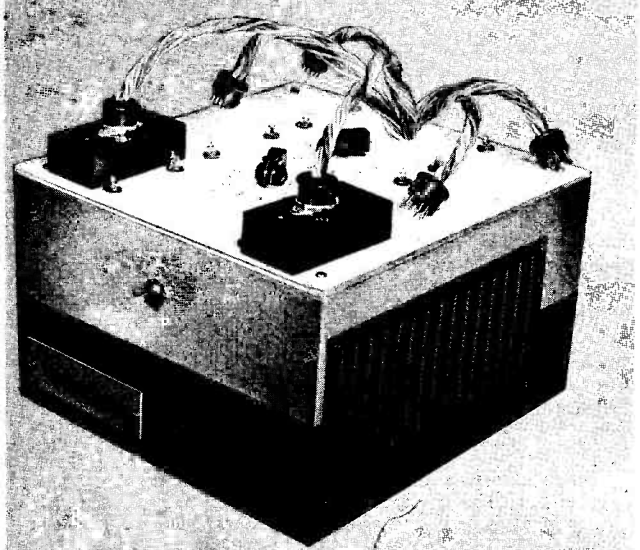
WORKING DEMONSTRATIONS

It was apparent that working demonstrations attracted some of the best crowds. These included those put on by the British Amateur Television Club, Cable and Wireless with their teleprinters and facsimile transmitters and receivers, British Amateur Teleprinter Group, and the Royal Navy Amateur Radio Society who conducted morse code proficiency tests. The Post Office celebrated their change to the Ministry of Posts and Telecommunications by demonstrating their latest type of television detector vehicle for the u.h.f. as well as v.h.f. bands.

Several visitors come to the exhibition every year, and it was obvious that this is a good way of meeting those faceless radio contacts over a sandwich downstairs. But behind the very conspicuous R.A.F. *Skynet* satellite world communications demonstration, there was an equally large and conspicuous empty space. If only some seats could have filled this space many a QSO could have taken place face to face in comfort.



DOUBLE SIX



By S. J. KEARLEY

DOUBLE SIX is a machine which plays dominoes. In operation Double Six is given six dominoes, face down, and plugged into them. When it is Double Six's turn to play, the machine causes a light to appear opposite the most favourable domino, at the same time emitting a "cackling" noise. If unable to play, Double Six makes a dismal moaning noise. Full playing instructions and the rules by which Double Six plays will be given later in this article.

STRATEGY

Double Six's strategy has been kept fairly simple so as to keep down the complexity and price of the machine. If allowed to play first against good opposition, Double Six should win just over half the time.

The strategy is as follows:

1. To play a domino matching one of those on the end of the chain.
2. When there is a choice between two dominoes, to play the domino with the most spots on. This gives the machine a useful chance of winning if nobody is able to play, and the total number of spots are counted. This rule is broken for "doubles" which are played in preference to any other dominoes—even those with more spots on. This is for three reasons:
   - (a) One has two chances of disposing of most dominoes, as they have two different numbers on. However, "doubles" have the same number on both ends, and so there is a correspondingly smaller chance of disposing of them, especially towards the end of the game. So it is advisable to play "doubles" while one has the chance.
   - (b) If the opponent plays onto the opposite end from the "double", Double Six will certainly be able to play on its next turn.
   - (c) If the opponent cannot play and the machine plays a "double", the opponent will still be unable to play, and so he will miss yet another turn.
3. When unable to play, the machine must acknowledge this fact. In the prototype this was achieved by making the machine "moan", and this has proved one of Double Six's most popular features. The machine may easily be modified to make a "knocking" sound if a more conventional response is desired.

DOUBLE SIX CIRCUIT

The main circuit diagram is shown in Fig. 1. TR1 and TR2 form a multivibrator, the output of which is fed to TR6 via the emitter follower TR3. The emitter follower prevents TR6 from loading the multivibrator and so stopping it oscillating. When TR6 is being driven the primary of T1—the winding that was originally the 6·3 volt secondary—has an a.c. voltage of approximately 9V across it and an output of approximately 350V is obtained at D2 causing a high voltage to build up across C3.

If any indicating neons (V2 to V13) strike current flows through R6 and R7 making the base of TR5 negative and hence turning on TR4 and TR5. This virtually shorts the base of TR6 to the positive line and prevents it being driven by TR3; it also turns off TR10, reverse biasing D4. Transistor TR9 will now oscillate in bursts, unaffected by TR8 which is turned off via D3. The bursts of oscillation form the "cackle", heard when Double Six can play, and this can be adjusted by VR2; the pitch can also be varied by altering C5.

Once the oscillation at TR6 collector has stopped, the voltage across C3 will fall until the neon which has fired extinguishes, returning the circuit to its original condition. The voltage across C3 then begins to build up again. This process causes the neon to flash and prevents the voltage across C3 from rising above the striking voltage of the neon in the lowest resistance path.

If the machine cannot play a domino, V1 eventually strikes, this turns on TR7, reverse biasing D3 and allowing TR8 to oscillate, producing the "moan". By increasing R12 in value the oscillator can be made to block and so produce a "knocking" sound.

While Double Six is on, a rising voltage is applied to the pins of plugs PL1 to PL6 (Fig. 3), for this reason a biased off switch has been used for S1.

CONSTRUCTIONAL DETAILS

Most of the circuitry was constructed on a piece of plain Veroboard using pins for transistor and fly lead connection and the component wires for wiring up where possible, see Fig. 2. The transistors should be added when the rest of the circuit has been completed and the whole unit can then be housed in a suitable wooden case similar to that shown in the photographs. The case must be large enough to house the circuit board, batteries, transformer and loudspeaker, and there should be plenty of room under the top panel to allow for wiring to switches S2 and S3; the suggested case size is 10in × 9in × 6in deep.

FRONT PANEL CONSTRUCTION

The front panel is made of paxolin, ¼in diameter holes are drilled for the neons (see Fig. 6), rubber grommets are inserted, and the neons pushed into the grommets. (If the glass envelopes of the neons are moistened slightly, this job is made much easier.) Switches S2 and S3 are single pole, 10- or 12-way wafer switches; only seven positions are used.

Wiring to the switches and neons on the top panel is shown in Fig. 5. Two small tag strips were used for the wires from pins 1 and 9 on the B9A plugs but these are not essential if longer wires are fitted. The wiring connections to the B9A plugs are shown in Figs. 3 and 4; each wire is thin p.v.c. covered, preferably colour coded to make wiring easier. The wires to each plug are twisted together. As seven wires are to be connected to each tag of S2, each individual wire should be carefully inserted into its tag, and bent over to keep it in place. Solder is not applied until all the wires are in place.

It is wise to check the wiring to each plug with a continuity tester or an ohmmeter before soldering, in case wiring errors have been made. Such errors would be extremely difficult to track down at a later stage. The length of the wires to each B9A plug should be adjusted so that each plug matches its own position on the top panel.

DOMINO DETAILS

The dominoes are made from solid blocks of wood, a ¾in diameter hole being drilled in each to accept a B9A valveholder, see Fig. 7. It is advisable to obtain the valveholders either off old TV chassis, or from a "surplus" supplier, as otherwise the cost of these components may be rather high. The inside of each hole should be varnished to prevent leakage through the wood. The dominoes are painted matt black, and

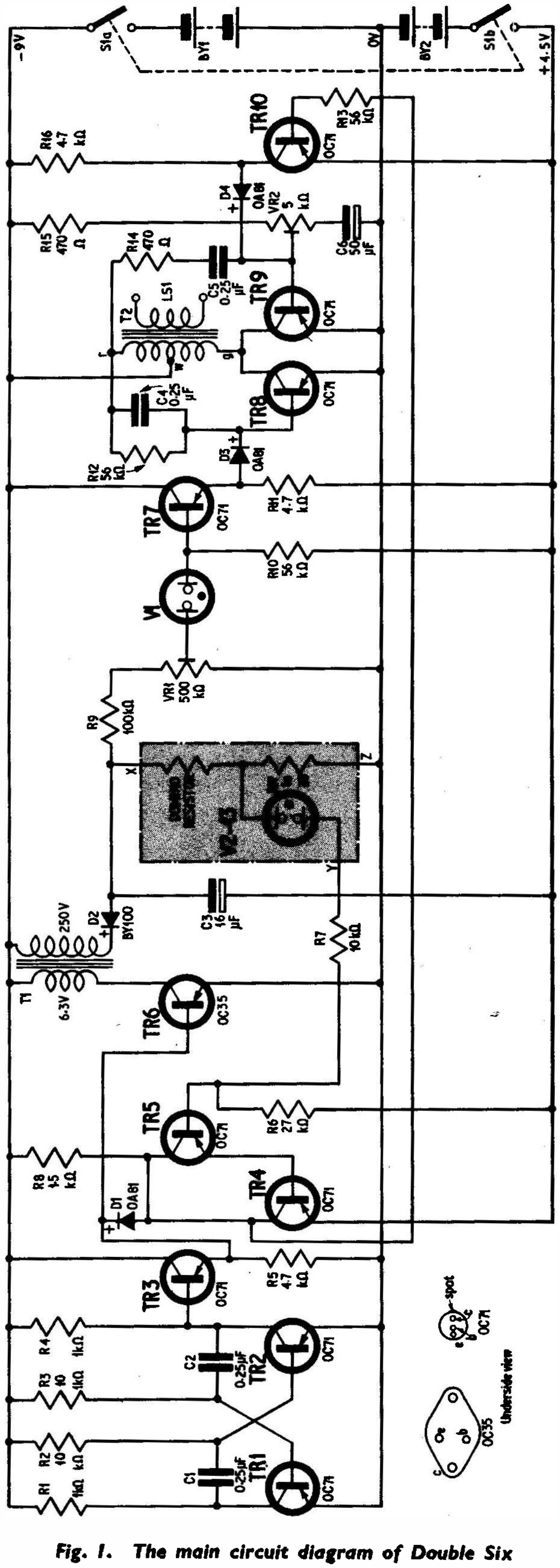


Fig. 1. The main circuit diagram of Double Six

Table 1. DOMINO WIRING DATA

Domino	Resistor	Pins	Resistor	Pins	Dominio	Resistor	Pins	Resistor	Pins
6–6	0	1–8	0	9–8	4–3	150kΩ	1–6	100kΩ	9–5
6–5	56kΩ	1–8	22kΩ	9–7	4–2	220kΩ	1–6	100kΩ	9–4
6–4	100kΩ	1–8	22kΩ	9–6	4–1	330kΩ	1–6	100kΩ	9–3
6–3	150kΩ	1–8	22kΩ	9–5	4–0	470kΩ	1–6	100kΩ	9–2
6–2	220kΩ	1–8	22kΩ	9–4	3–3	0	1–5	0	9–5
6–1	330kΩ	1–8	22kΩ	9–3	3–2	220kΩ	1–5	150kΩ	9–4
6–0	470kΩ	1–8	22kΩ	9–2	3–1	330kΩ	1–5	150kΩ	9–3
5–5	0	1–7	0	9–7	3–0	470kΩ	1–5	150kΩ	9–2
5–4	100kΩ	1–7	56kΩ	9–6	2–2	0	1–4	0	9–4
5–3	150kΩ	1–7	56kΩ	9–5	2–1	330kΩ	1–4	220kΩ	9–3
5–2	220kΩ	1–7	56kΩ	9–4	2–0	470kΩ	1–4	220kΩ	9–2
5–1	330kΩ	1–7	56kΩ	9–3	1–1	0	1–3	0	9–3
5–0	470kΩ	1–7	56kΩ	9–2	1–0	470kΩ	1–3	330kΩ	9–2
4–4	0	1–6	0	9–6	0–0	0	1–2	0	9–2

Note: Resistors shown as 0 must be wire links between the pins indicated

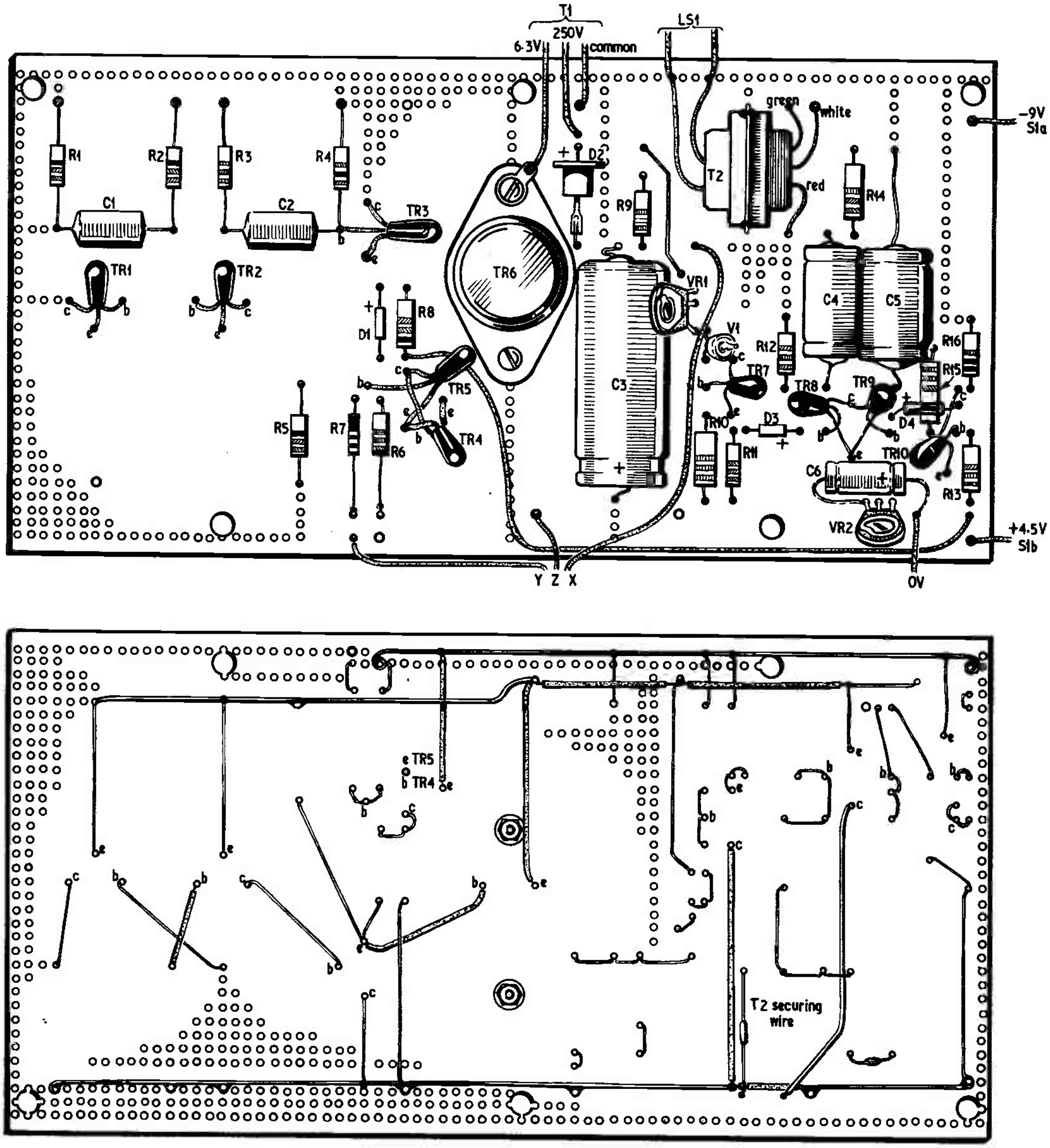


Fig. 2. *Component layout and wiring of the circuit board*

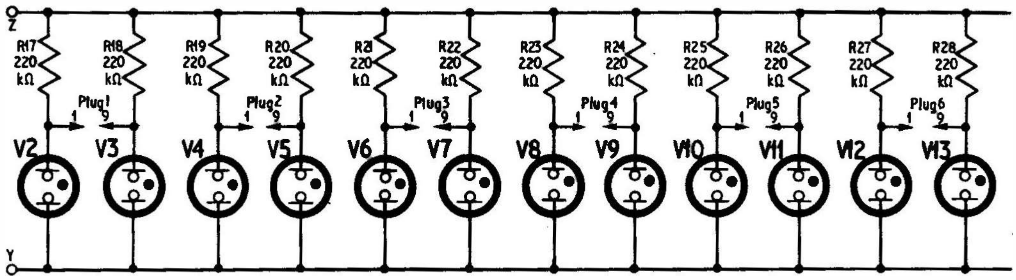


Fig. 3. Circuit diagram of the components mounted on the front panel

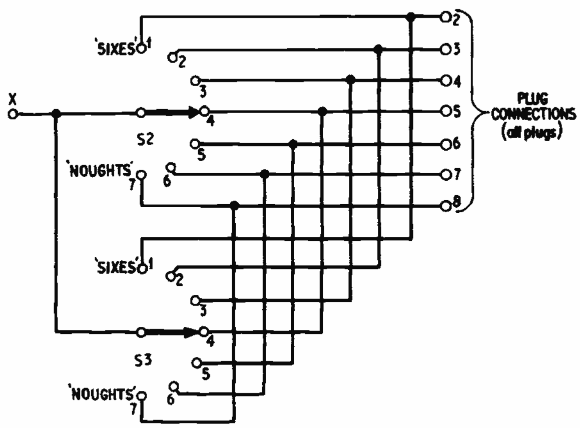


Fig. 4. Circuit details of the selector switches

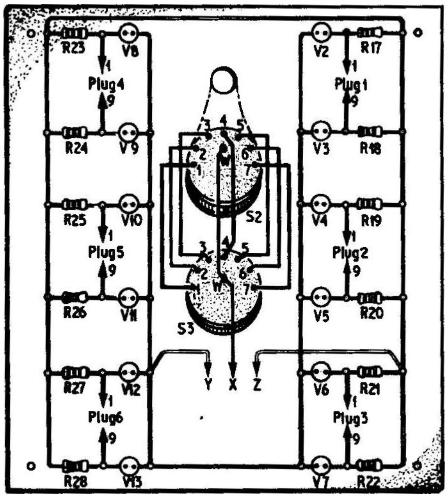


Fig. 5. Top panel wiring details

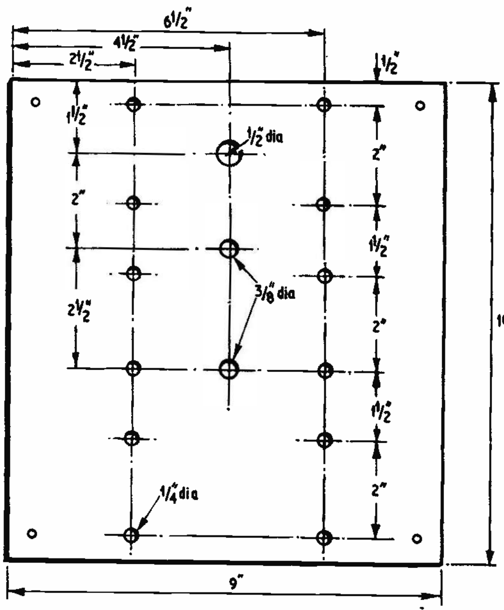


Fig. 6. Top panel drilling measurements

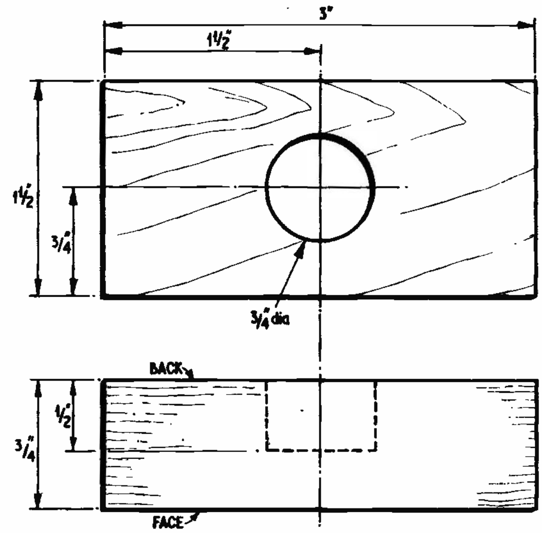


Fig. 7. Details of a domino. The 28 dominoes can be made from one 7ft 6in length of 1½in × ¾in wood

COMPONENTS . . .

Resistors
R1 1kΩ
R2 10kΩ
R3 10kΩ
R4 1kΩ
R5 4·7kΩ
R6 27kΩ
R7 10kΩ
R8 1·5kΩ
R9 100kΩ
R10 56kΩ
R11 4·7kΩ
R12 56kΩ
R13 56kΩ
R14 470Ω
R15 56kΩ
R16 4·7kΩ
R17–R28 220kΩ±5%
All ±10%, $\frac{1}{4}$ watt carbon
except where stated

Resistors for dominoes (6 of each)
22kΩ ±10%
56kΩ ±10%
100kΩ ±10%
150kΩ ±5%
220kΩ ±5%
330kΩ ±5%
470kΩ ±5%
All $\frac{1}{8}$ watt carbon

Capacitors
C1 0·25μF
C2 0·25μF
C3 16μF elect. 450V
C4 0·25μF
C5 0·25μF
C6 50μF elect. 12V

Potentiometers
VR1 500kΩ skeleton preset
VR2 5kΩ skeleton preset

Semiconductors
TR1–TR5 OC71 (5 off)
TR6 OC35
TR7–TR10 OC71 (4 off)
D1 OA81
D2 BY100
D3 OA81
D4 OA81

Switches
S1 D.P.D.T. biased off
S2 Single pole 10- or 12-way wafer (only 7 ways used)
S3 Single pole 10- or 12-way wafer (only 7 ways used)

Miscellaneous
V1–V13 miniature (wire ended) neons
T1 Mains transformer. Secondary 0–6·3V (used in oscillator)
T2 LT700 transistor push/pull output type, 19·4 : 1
LS1 Small 3Ω loudspeaker
BY1 3V type 800 (3 off)
BY2 4·5V type 1289
PL1–PL6 B9A plugs (6 off)
B9A valveholders (28 off)
Veroboard
Grommets small (12 off)
Wood for case and dominoes (see text)

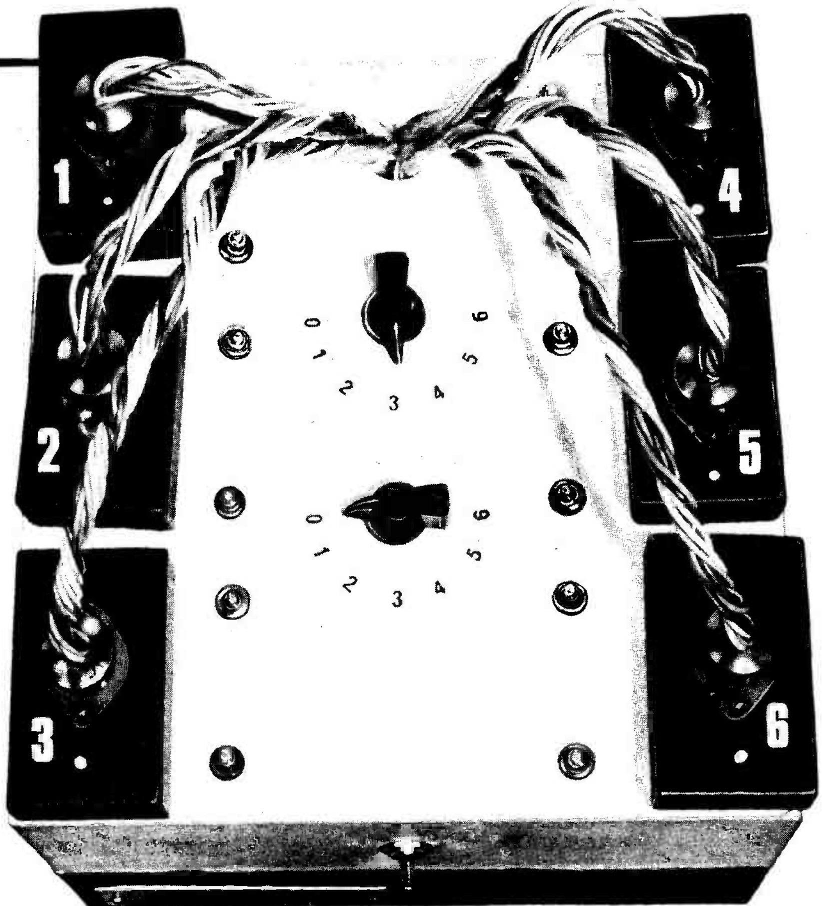


Fig. 8. View of the top panel of Double Six showing the dominoes in their positions and the indicating marks on the dominoes

drawing pins with white plastic covered heads inserted as the spots on the dominoes.

It is necessary to place a small dab of glue under the head of each drawing pin, or the plastic covering the heads may fall off. The connections of the resistors inside each domino are given in Table 1.

BASIS OF OPERATION

The pins of the socket in the dominoes to which resistors are connected define the number of spots on either face of the domino; the value of the resistor defines how many spots are on the other face. To give an example of Double Six in action, let us assume that the 6-0 domino is in position 1 (Fig. 8) and that the 6-4 is in position 2.

When S2 or S3 is switched to "sixes", a steadily rising voltage is applied to pin 2 on each B9A plug. So the neon indicating position 1 is connected to h.t. via a 470 kilohm resistor, whilst the neon indicating position 2 is connected via a 100 kilohm resistor. Therefore there is a greater fraction of the h.t. voltage across the neon indicating position 2 than across the neon indicating position 1, therefore it will strike first. This is arranged to cause the h.t. voltage to fall and therefore the neon will switch off allowing the voltage to rise again.

This results in the neon indicating position 2 to flash and the "cackling" to be heard, while the neon indicating position 1 will not attain its striking voltage. The machine thus indicates that the 6-4 domino is to be played, in accordance with its strategy.

DOMINO MARKING

It is desirable to make the machine light the neon opposite the end of the domino which matches, e.g. when set to play "sixes" (tag 1 on S2 and S3 connected) and playing a 6-4 domino, to light the neon opposite the "six" end rather than the "four" end.

For this reason the dominoes are marked with a locating spot as in Fig. 8. This is done by the following method:

(a) Fit the valveholder such that pins 1 and 9 are on the same side as the locating mark.
(b) For each domino, ensure that the higher number of spots is on the same side as the locating mark.
(c) When plugging dominoes onto the machine, orient them so that the locating mark always faces the front, i.e., S1 end of Double Six.

SETTING UP

When the wiring has been completed, the following setting up operations are required. Disconnect the wire from h.t. to S2, and turn VR1 clockwise (no voltage across V1). Check that the voltage across C3 exceeds 310 volts. It will possibly be well in excess of this and if it is over 350V a resistor should be placed in series with TR6 collector and T1. The value of this resistor can be determined by trial and error to obtain an output of around 350 volts.

The current drawn by TR6 when oscillating is approximately 350mA, so large capacity batteries must be used. Turn VR1 anticlockwise until V1 strikes; this should be accompanied by the "moan" from the speaker. If all is well, connect point X to S1 wiper, and plug in a domino, setting up its value on S2 and S3. Soon after switching on S1 the "cackling" sound should be heard and a neon should flash alongside the domino. If not, check the connections to first the domino, then the plug. If the neon comes on but does not flash, check the circuitry around TR4 and TR5.

When Double Six is functioning satisfactorily, it is ready for its "test" game. Put six dominoes face down in positions 1 to 6, with the locating marks facing the front of the machine and plug them in. Choose six dominoes for yourself, and play one of them. Set S2 and S3 to inform the machine as to what you have played and switch on S1. A cackle will probably be heard, accompanied by a neon flashing alongside a domino. Switch off S1, remove the domino, and play it next to your own. The correct end to play is that alongside which the neon was flashing (for this reason it is necessary to put the dominoes in the right way round). Continue in this way until the game is finished.

This design has no provision for starting the game—the procedure adopted is to set S2 and S3 to "sixes or fives" and if Double Six has none of these (very unlikely) to try fours. If preferred, a seven pole two-way switch could be wired between h.t. and S2, in order to connect tags 1 to 7 to h.t. when S1 is in the "on" position. The machine would then play a "double" or a six or five if it had no "double".

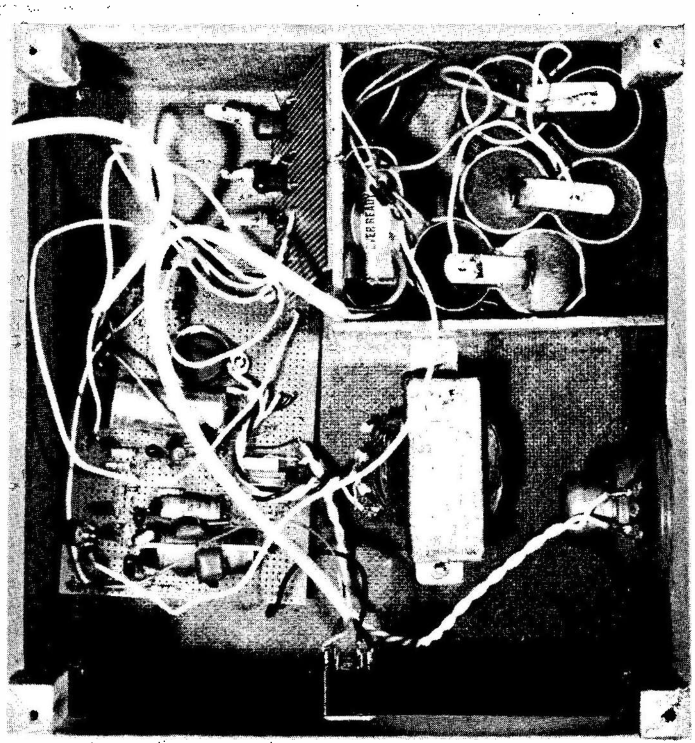
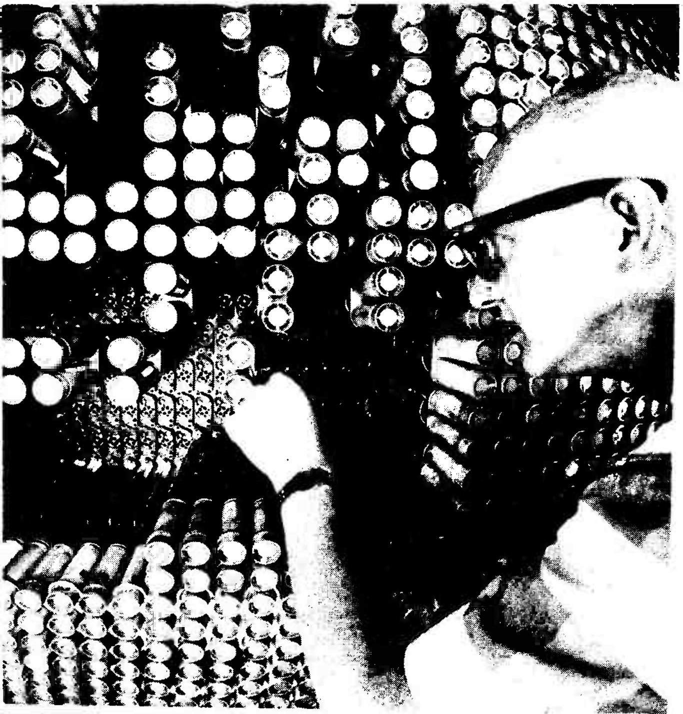


Fig. 9. Prototype wiring; the main circuitry has now been included on a single board. This shows the positioning of the major components in the case

RULES OF THE GAME

Since there are many variations of the game of dominoes, it would be as well to state the rules of the game which Double Six plays. (By modifying the circuit slightly, it should be possible to programme the machine to play other variations.) Each player is given six dominoes face-down, which he does not show to his opponents. The first player may put down any domino he chooses to start with. If a player has no domino matching the ones on the table, he admits this, usually by knocking on the table, and misses his turn.

The first player to dispose of all his dominoes is the winner. If no player has a domino which matches, the player with the lowest total number of spots on his remaining dominoes is the winner. It should be noted that, as no player knows which dominoes his opponents have, and the selection of dominoes which each player gets depends on chance alone, the outcome of the game is not strictly determined, and no strategy can guarantee a win. This is in contrast to games like Noughts and Crosses, or Nim, where correct play always arrives at a predetermined result. ★



Advanced Radar System

SYSTEM tests on a new advanced radar prototype—forerunner of what could be the world's most powerful radar for defence against missile attack in the 1970's and beyond—have begun at Hughes Aircraft Company in California.

The tests include radar range exercises and actual detection and tracking of air traffic. The prototype, a scale version of a proposed long-range system called ADAR (Advanced Design Array Radar), will be the most powerful radar yet built by Hughes.

An engineer is shown making adjustments to energy feeds on a scale prototype of the new phased-array radar. The energy feeds are devices that channel radio-frequency energy between points in the system.

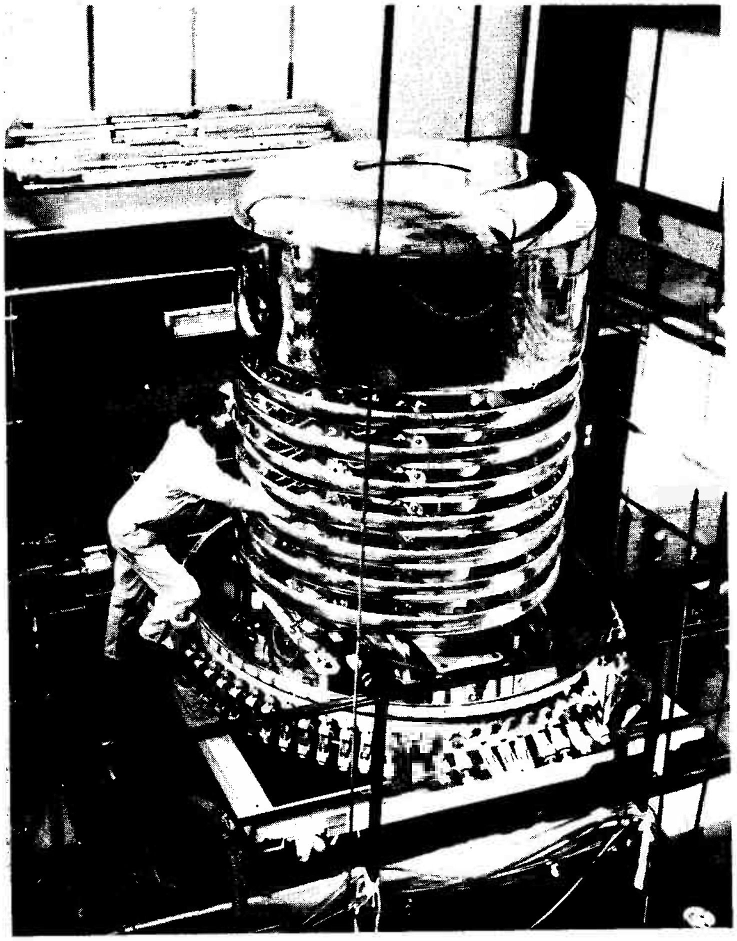
ELECTRONORAMA

Laser Television Tape Player

A LABORATORY model of a revolutionary, low-cost colour television tape player built around lasers and holography and destined for home use in the early 1970's was unveiled recently by RCA. In commercial form the tape player, named "Selectavision", is expected to be the first consumer product to employ lasers, and will be designed to attach to any standard colour or black and white television set. It will play full-colour programmes recorded on tapes made of the same clear, inexpensive plastic material used in supermarkets to wrap and display meats. The material for the tapes will cost only about one-tenth as much as conventional type films.

The clear plastic Selectavision programme tapes will be scratch-proof, dust-proof, and virtually indestructible under conditions of normal use. They will have countless replay capabilities, be able to run in slow motion, or be able to be stopped and started at will so that a single frame can be studied at length, if desired. The player itself will be compact, and as easy to operate as a modern cartridge player.

The television tape player is shown in use on the left—tape cartridges can be changed easily as can be seen from the photograph



Giant Microscope

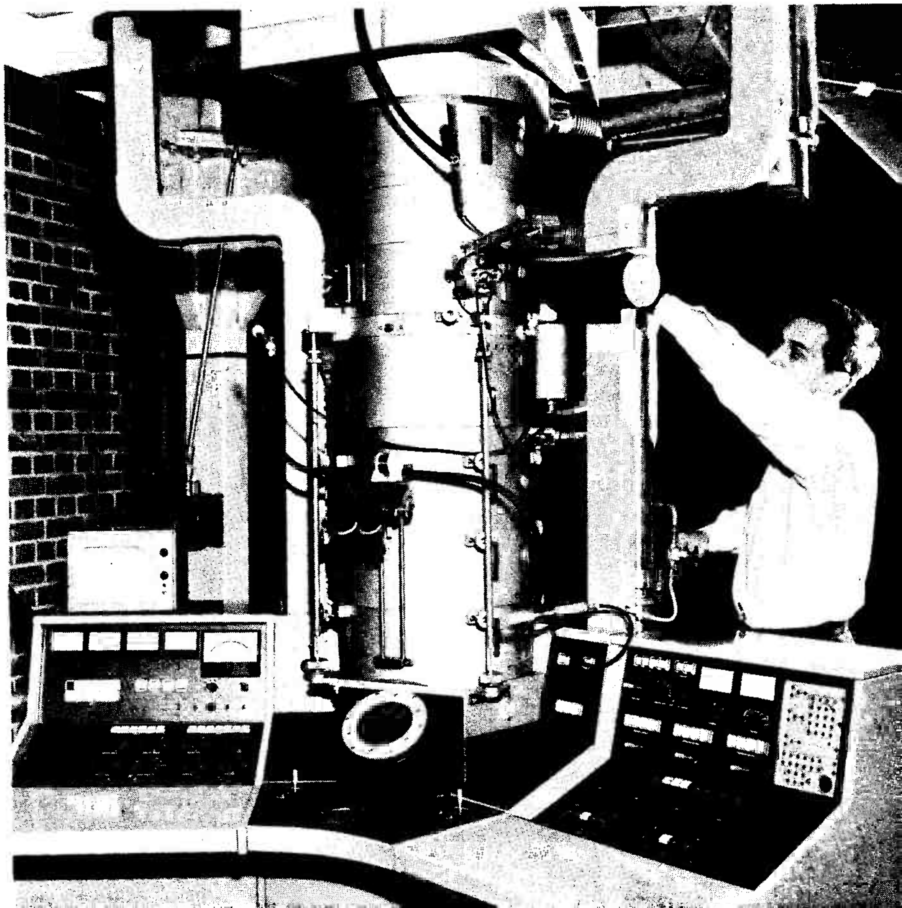
THE first of five giant electron microscopes is nearing completion at the AEI Scientific Apparatus Limited; it has already been operating successfully at one million volts during tests.

In November the UKAEA, Harwell, will take delivery of this advanced instrument, the first commercial million-volt electron microscope to be built in Europe. It will be used to investigate thicker sections of metals and materials than hitherto possible using an electron beam accelerated by ten times the voltage used in a conventional high resolution electron microscope. The beam will probe the samples in an effort to discover new information about the structure and behaviour of metals both in common use and those with special properties needed for new technological developments.

Biologists will also use these electron microscopes to study the structure of cells. There is also the exciting possibility that the great penetrating power of these new instruments may permit observation of living material in special protective surroundings in the microscope.

The accelerator and voltage generator (above) of the AEI million-volt electron microscope during manufacture. Five of these instruments are on order from AEI

The massive microscope column (right), over 8ft high and 18in diameter, and the control desks



E ORGAN PART 8

By Alan Douglas, Sen. Mem. I.E.E.E.

In the last two parts we have presented all of the tone forming circuitry as Veroboard modules.

Since the solo accompaniment and pedal sub-assemblies are contained in a metal box, details of the shelf needed for mounting this are presented first. In addition to the screening box this shelf also serves as a platform for the 23 stop tab units used variously for voice selection.

VOICE BOX SHELF

The shelf supporting the voice box and stop tab assemblies measures 4ft 3¼in by 8in by ½in and is of plywood. Reference to the console rear view given in Part Two shows that the shelf just clears the upper manual assembly.

To fix this position, measure off 6in from the lower keyframe and make pencil marks on the console sides "A" shown in Fig. 1.4. Angle brackets or lengths of 1in batten can be affixed at these marks and the shelf attached.

STOP PANEL ASSEMBLY

In Fig. 8.1 is given details of the stop panel (A) and keyboard flanking panels (B).

Whilst the latter need not be made up at this stage, it is rather important that the stop panel is, as the four rectangular apertures will fix the final placement of the stop tab units. With the panel completed this can be temporarily screwed to the top panel B of Fig. 1.4. If the keyboard flanking panels have been made up it should be possible to press fit this without a screw.

STOP TAB UNITS

The stop tab units used are made by Kimber-Allen Ltd. These are manually operated switches which are used to activate or de-activate the individual voice nets of the tone forming circuitry.

Each switch has a smooth positive toggle action and there is screw adjustment with felt stops for correct positioning of the tab.

In the tone networks of Fig. 6.5 the stop switches, S1–S10, are shown open; here the voices are active as square waves from the pre-amplifier are not short circuited to ground.

For this condition to prevail, the switch tabs would normally be depressed hence the stop tab unit required is of the depress-to-break variety.

However, for the 8ft Dolce in the accompaniment and the 16ft Sub-Bass of the pedals a depress-to-make type of switch is required as additional filtration is being included to soften the voice it complements.

Of the 23 stop units called for, two are spares—for additional functions as required—and one used for switching the tremulant motor.

Details of a stop unit is given in Fig. 8.2. The accompanying photograph shows the order of the stop voices as viewed at the stop panel.

TAB ENGRAVING

The tabs used are standard K-A types, again available from Kimber-Allen Ltd. These are tapered and radiused at the nose. Made from cellulose sheet, they can be obtained in a choice of three colours: grained ivorine, red, and black. On the prototype organ the choice was ivorine for the solo tabs, red for the accompaniment, and black for the pedals.

When ordering the stop units and tabs, engraving details should be included as follows:

Table 8.1.

Solo		Accompaniment		Pedals	
Contra Viole	16	Dolce	8	Major Bass	16
Contra Tibia	16	Flute	8	Sub Bass	16
Viole	8	Viole Acute	8	Bass Flute	8
Tibia	8	Flute	4		
Tibia	4	Violina	4	Tremulant	
Violina	4	Clarinet	8	Leslie Trem	
Piccolo	2	Trumpet	8		
Double Horn	16				
Echo Horn	8				
Oboe	2				

SCREENING BOX ASSEMBLIES

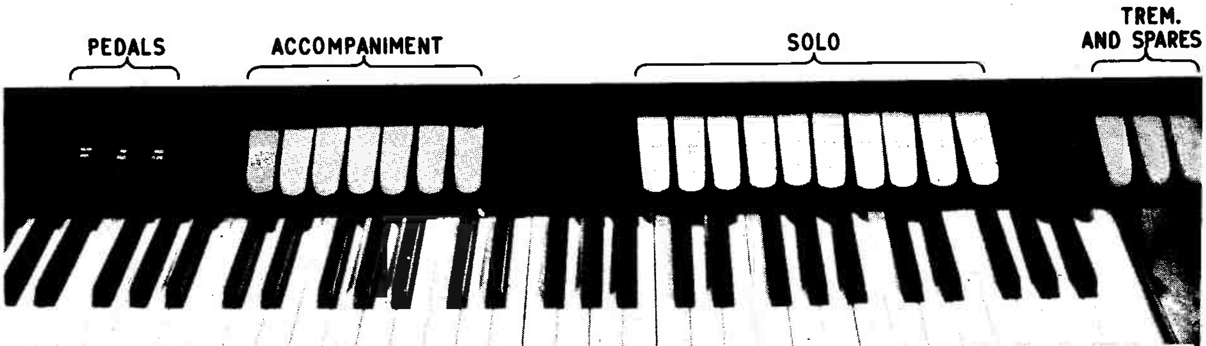
When the stop tab units have been shelf mounted, we can proceed with the mounting of the voicing sub-assemblies in a metal screening box.

The screening box, which measures 24in by 5½in by 2in is shown in the photograph with the sub-assemblies mounted inside. The chokes, boards and relevant cables are shown annotated. The box drilling requirements are for busbar, filter and stop unit leads; the placement of these is not critical. This 16 s.w.g. aluminium box must have a lid to be effective. It can be obtained undrilled from H. L. Smith and Co., Ltd., 287/289 Edgware Road, London, W.2.

To insulate the Veroboard modules, two lengths of 5in by 8in s.r.b.p. board are used, one for each pair of sub-assemblies. Reference to the photograph shows the coils centrally placed between these assemblies. These coils are in fact the first items to be mounted, this being achieved by Aralditing.

With this completed, the two tag strips can be mounted. These serve merely as junctions between the fragile choke wires and Veroboard assemblies.

FINAL CONSOLE DETAILS



Stop units in position with tabs shown projecting at stop panel aperatures. Table 8.1. gives the order of the stop engravings reading from left to right

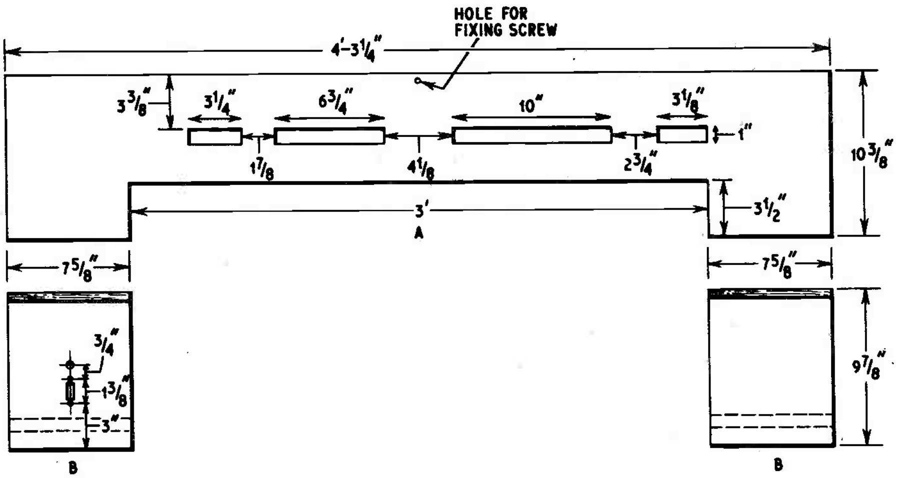


Fig. 8.1. Details of stop panel (A) and keyboard side panels. With the stop aperatures cut these should be lined with green felt

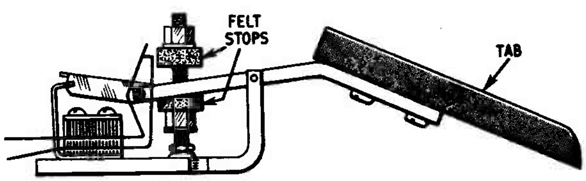


Fig. 8.2. Details of a stop tab unit

The wires should be carefully cleaned with a fine gauge sandpaper before soldering. The first unit to be wired up and mounted is the solo pre-amplifier board. Details of this are given in Fig. 6.3 where it can be seen that there are four busbar connections and two positive and negative supply connections.

We have previously connected coaxial cables at the busbars so it only means routing these as shown in the photograph and connecting at the points shown in Fig. 6.3.

As these cables travel the length of the box, cable clip fixing is necessary. Small polythene press-fixing straps were used here.

The supply lines can be conveniently picked off from the oscillators and taken through a hole drilled in the shelf. This supply, of course, will feed all of the pre-amplifiers in the box, it only being necessary to parallel the connections.

WIRING THE SOLO FILTERS

The next board to wire is that of the solo filters. Wiring between this and the adjacent pre-amplifier board is fully detailed in Fig. 6.6 so this can be undertaken.

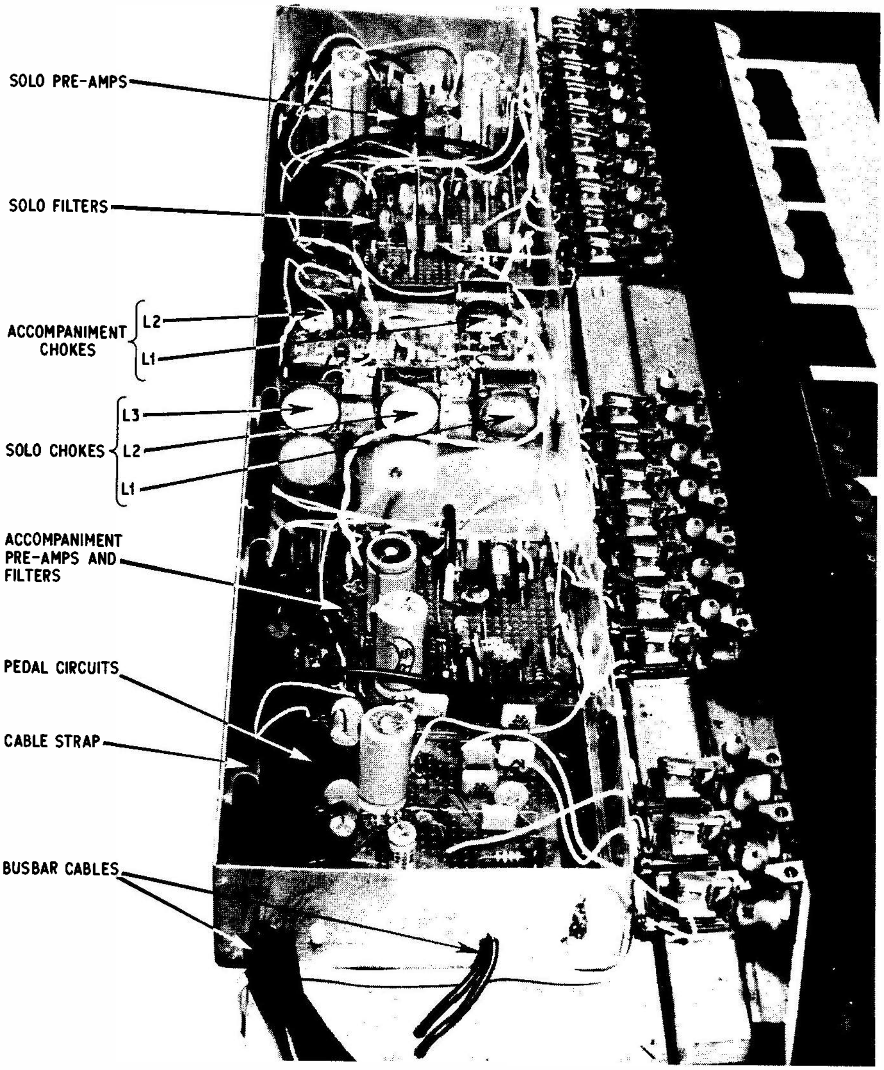
Lengths of sleeved wires are connected at the stop units shown as S1–S10 in Fig. 6.5 and then run through the holes drilled as shown in Fig. 8.3.

Connections to the chokes at the tag strips are by twisted wire pairs.

ACCOMPANIMENT AND PEDAL BOARDS

The wiring of the accompaniment and pedal boards follow the same general procedure as has gone before.

The 8ft and 4ft pitch coaxial cables are routed from the accompaniment busbars through the box and connected as in Fig. 7.2; then the stop switches are con-



View of voice box interior and adjacent stop units nected. At this stage connection from the solo and accompaniment filter outputs can be made with 2ft lengths of miniature coaxial cable.

As was described in Part Four, the pedal inputs are taken from pins 31 and 32 of one of the pedal sockets, so lengths of coaxial cable can be taken from the pedal socket chosen. The accompanying photograph to Fig. 4.1 shows these cables clearly.

With these terminated at the pedal pre-amplifiers it remains to earth their screens. This is done at the pedal sockets by baring the coaxial braid and soldering a common wire connection to a simple aluminium surround seen in the photograph of the pedal resistor boards in Part Four. This screens the pedal plugs and resistor boards from extraneous field influences.

With the stop switches wired, it only remains to loop in the supply lines from the pre-amplifier board. Now, since the negative supply line is finally grounded, this should be connected to the aluminium of the voice box; suitable connection will be found at the screwed terminals of the choke tag strips.

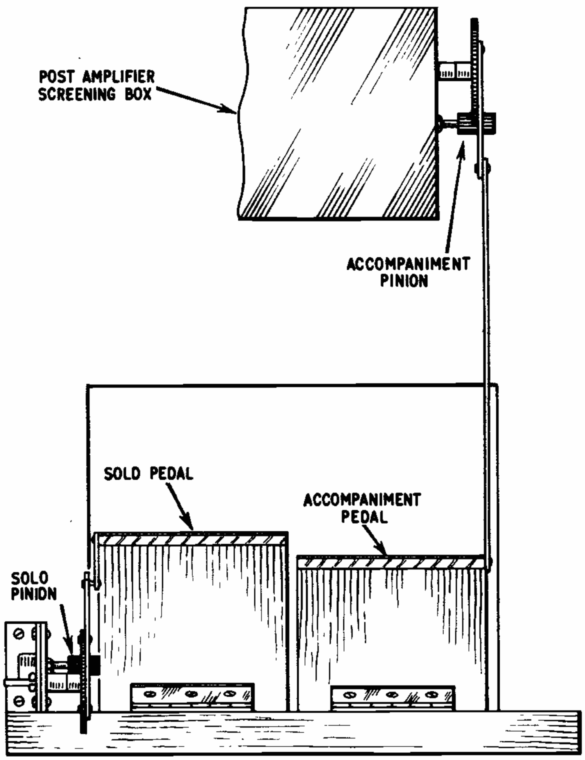
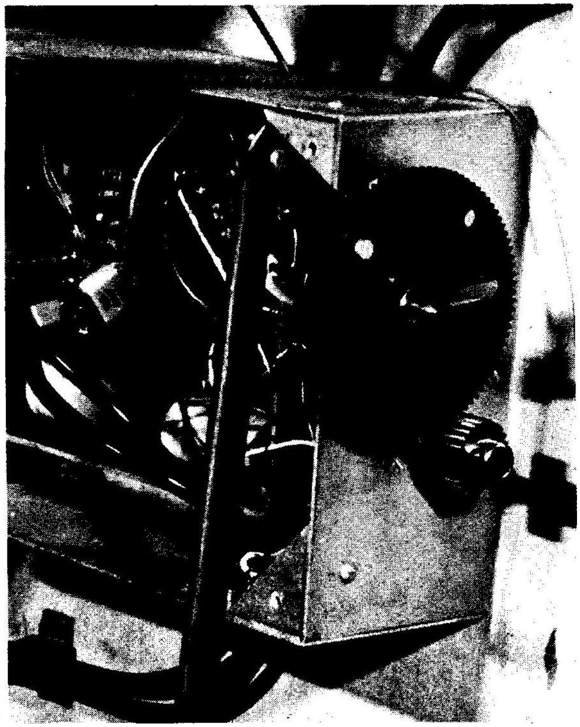


Fig. 8.3. Solo and accompaniment swell pedals shown hinge mounted

To complete the earth line of the voicing circuits, a length of 22 s.w.g. tinned copper wire is strung along the unattached connectors of the stop tab units and soldered. The free wire end is soldered to a tag at the screening box.

POST AMPLIFIER SCREENING

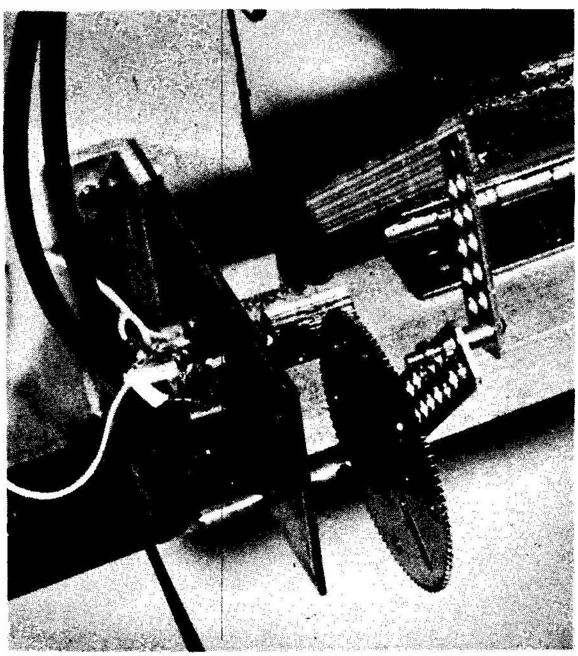
The outputs from the manual filters terminate at the post amplifiers "A" and "B" as described in Part Seven. The two cables used are again miniature coaxial. Before any flying connections are made to these Veroboard assemblies a 7in by 5in by $2\frac{1}{2}$in screening box should be fixed to the kneeboard with two binder screws, positioning being indicated in the



Details of accompaniment swell linkage at post amplifier screening box

rear console view given in Part Two. This box is lidded an can also be obtained from H. L. Smith Ltd. In this is mounted the post amplifiers "A" and "B" using s.r.b.p. insulating boards. Sufficient space should be left for mounting the swell potentiometer and gear wheel as seen in Fig. 8.3 and the photograph.

Details of solo swell linkage. The bush for mounting the large wheel spindle is soldered to the brass plate



Now we can go on to wiring these amplifiers. First, 15V supply leads are taken again from the oscillator shelf and connected as shown in Fig. 7.10. Then the filter coaxial cables are connected, making sure that the copper braid is grounded at the box.

EXPRESSION PEDALS

The next thing to tackle is the expression pedals. Two have to be made from 9½in by 5in by ¾in plywood and faced one side with ribbed rubber or linoleum. In the usual type of construction, these pedals are carried on substantial metal rods and pivots, but we are not making them do much work so plain 3in steel hinges will suffice as shown in Fig. 8.3 and Fig. 8.4.

First of all a piece of 2in by 1in hardwood is screwed across the swell aperture of the kneeboard at the bottom. This is reinforced at the end with metal strips which are screwed to the lower frame member. This can be seen in the photograph.

Two lengths of pierced s.r.b.p. or metal strip are used to transmit the pedal movement. To fix the strip at the pedal end a 1in round head wood screw with washer is used. The shorter strip is bolted to the large gearwheel to give about 25 degrees of movement to the pedal for a full rotation of the potentiometer.

The small pinions will need to be drilled out slightly to fit the ¼in spindle of the potentiometer. Standard Meccano spindles support the 60 tooth wheels.

The potentiometer for the accompaniment swell is situated near to the bottom of the post amplifier screening box as seen in the photograph. The fitting of this component is not critical, the main object being to ensure a straight pull being exerted on the connecting strip by the pedal. Full details of the gear assembly are given in Fig. 8.3.

If 4B.A. screws with nylon locknuts are used to assemble the moving parts, a good degree of stiffness can be imparted to the movement.

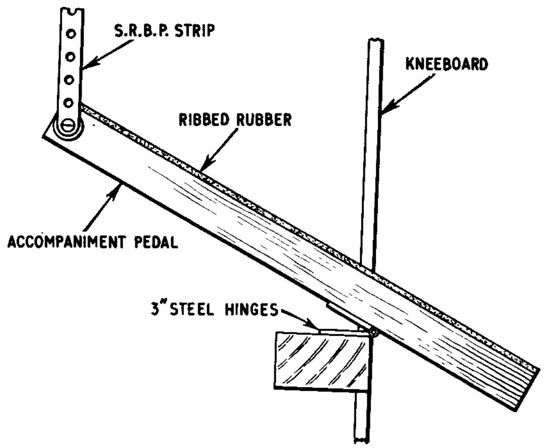


Fig. 8.4. Side view of accompaniment pedal

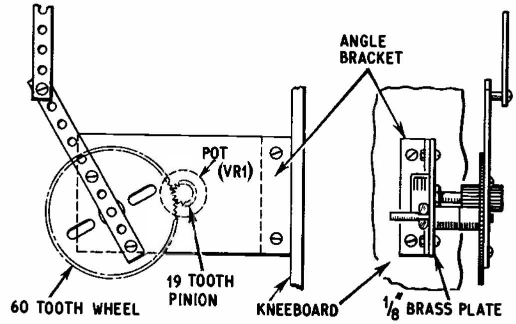


Fig. 8.5. Detail of solo swell linkage which is identical to the accompaniment assembly on the post amplifier screening box. To stiffen the pedal action nylon, lock nuts should be used at the junction of the s.r.b.p. strips

The hinges are then attached to the wood block and pedals; plain wood side of course.

SWELL MECHANICS

We could control the volume by several means, including photocells, but to keep the circuits as simple as possible we use logarithmic 4·7 kilohm potentiometers as the emitter resistors of the post amplifier emitter follower outputs as shown in Fig. 7.8.

The potentiometer for the solo post amplifier "A" is mounted below the divider boards. The potentiometer for the accompaniment post amplifier "B" is on the post amplifier screening box. For the gear assembly we need two No. 26A 19 tooth pinions and two No. 27D 60 tooth gear wheels. These items should be obtainable from any Meccano parts stockist.

Fig. 8.5 gives details of the solo swell linkage. Here the potentiometer and gear train are mounted on ⅛in brass plate which is fixed to the kneeboard by way of an angle bracket.

With the potentiometers connected, these can be wired to the post amplifier outlets, making sure that all earth return lines terminate at the post amplifier screening box.

MAINS WIRING

The mains wiring layout is given in Fig. 8.6. A three-pin 5A socket is fitted to a wooden bracket as shown in the photograph of the console rear given in Part Two. Two terminal strips serve to route the supply to the master switch S1 and neon indicator to the left keyboard flanking panel shown in Fig. 8.1.

The switch is an on/off rocker switch type RS200 available from Henry's Radio Ltd. S2 is the tremulant stop unit, the capacitor across it being used for spark suppression as without it unpleasant thumps feed through to the speakers when the tremulant motor is switched in.

SUPER BARGAIN STOCKTAKING SALE!!!

Use the form below for your order. **CONDENSERS MUST BE ORDERED BY STOCK NUMBER ONLY.** If any sale item is "sold-out" when order received we shall substitute items of equal value.

ELECTROLYTIC CAPACITORS

Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.
1	1μF	6	4d		
2	4μF	25	4d		
3	4μF	4	4d		
4	6μF	6	4d		
5	3μF	25	4d		
6	64μF	9	4d		
7	20μF	6	4d		
8	20μF	50	6d		
9	30μF	15	6d		
10	8μF	12	4d		
11	8μF	6	4d		
12	1μF	350	6d		
13	8/8/8	350	1/-		
14	50μF	6	4d		
15	100/200	275	6/-		
16	32	150	9d		
17	64	2·5	3d		
18	100/200/200/50	275	7/6		
19	50/80	300	3/-		
20	150/200	275	6/-		
21	24	275	1/-		
22	10	25	3d		
23	125	2·5	3d		
24	2	150	3d		
25	16/32	350	2/6		
26	32	275	1/6		
27	350	12	6d		
28	75/75/75/75	150	2/6		
29	1	20	3d		
30	12·5	40	9d		
31	640	2·5	3d		
32	3,000	35	7/6		
33	3,000	15	3/-		
34	3,000	30	7/-		
35	250	70	2/-		
36	2,500	9	2/-		
37	32	50	9d		
38	750	12	1/9		

Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.
39	100μF	275	2/6		
40	30μF	10	3d		
41	2,000/2,000	25	7/6		
42	16μF	50REV	2/-		
43	16/16	275	2/-		
44	16	275	1/-		
45	350	12	9d		
46	20/4	275	1/-		
47	250	50	2/-		
48	500	25	1/6		
49	400	15	1/-		
50	400	2·5	3d		
51	64	275	1/9		
52	32/32	350	2/6		
53	8/8/8	275	1/9		
54	500	6	6d		
55	64	275	1/3		
56	25	6	3d		
57	100	9	6d		
58	400	50	2/-		
59	400	30	1/6		
60	500	4	3d		
61	150	30	1/6		
62	64/32/8	275	2/6		
63	200	275	2/6		
64	40	6·4	3d		
65	50	25	6d		
66	250	50	1/9		
67	30	6	3d		
68	100/100/50	275	5/-		
69	50/50/50	350	4/-		
70	40/40/20	275	2/-		
71	400	6·4	3d		
72	320	10	3d		
73	32/32	275			
	25	25	2/6		

Total:—

RESISTORS. 5% EXCELLENT QUALITY. 7/6 per 100 or **2/-** per doz.
Tick the values required.

13 ohms	220 ohms	1·5k Ω	3·6k Ω	7·5k Ω	22k Ω	39k Ω	62k Ω	130k Ω	560k Ω	1·8M Ω	7·5M Ω
22 ohms	470 ohms	1·8k Ω	4·3k Ω	10k Ω	24k Ω	43k Ω	75k Ω	360k Ω	620k Ω	3·6M Ω	8·2M Ω
36 ohms	560 ohms	2·2k Ω	4·7k Ω	16k Ω	27k Ω	47k Ω	82k Ω	430k Ω	1·2M Ω	5·1M Ω	9·1M Ω
47 ohms	750 ohms	2·4k Ω	5·6k Ω	18k Ω	30k Ω	51k Ω	91k Ω	470k Ω	1·5M Ω	6·2M Ω	10M Ω
91 ohms	1k Ω	3·3k Ω	6·8k Ω								

or our selection (mixed) **6/6** per 100

Total:

SILVER MICA/CERAMIC/POLYSTYRENE CONDENSERS 10/- per 100, **3/-** per doz.
Available in following values. Tick those required.

2pF	5pF	12pF	25pF	50pF	80pF	135pF	180pF	250pF	680pF	1,000pF	2,500pF
3·9pF	6pF	15pF	27pF	58pF	82pF	140pF	190pF	330pF	800pF	1,100pF	2,700pF
4pF	8pF	18pF	30pF	62pF	100pF	158pF	200pF	420pF	820pF	1,500pF	3,000pF
4·7pF	10pF	22pF	39pF	72pF	125pF	170pF	240pF	600pF	900pF	2,200pF	6,200pF

Total:

COMPARE THESE PRICES

MULLARD POLYESTER CONDENSERS

	No.	Price
1,000 pF **3d** ea. 400V		
1,500 pF **3d** ea.		
1,800 pF **3d** ea.		
2,200 pF **3d** ea.		
0·15 μF **6d** ea. 160V		
0·22 μF **6d** ea. 160V		
0·27 μF **6d** ea. 160V		
1 μF **1/-** ea. 125V		

Total:

25% discount lots of 100 per type.
50% discount lots of 1,000 per type.

GANGED STEREO POTS. 250K Ω, **2/6** ea.

SKELETON PRESETS. Mixed. **6/-** doz.

VOLUME CONTROLS. ½ MΩ, 1 MΩ, with D.P. switch, **2/-** ea.

TELEVISION REMOTE CONTROLS. Philips, contain 11 7-way cable, 1 double pot., 5 resistors, two condensers, **10/-** ea. (cost £3/3/-).

THIN CONNECTING WIRE
10yd **1/-** 100yd **7/6.** 1,000yd **50/-**

CO-AXIAL CABLE. Black. **6d** yd, **£1** 50 yd.

CRYSTAL MIKES. 10/- ea.

TRANSISTOR BARGAIN! THEY CAN'T GET ANY CHEAPER!!!
P.N.P. Audio, Untested, unmarked. MAINLY O.K., **10/-** per 100.
N.P.N. Silicon. R.F. types, unmarked. ALL USABLE, **10/-** per 50.
POWER OUTPUT (Similar OC35) ALL TESTED, **4/-** ea; **£2** doz.
SILICON PLANAR TRANSISTORS. ALL TESTED. NO LEAKS OR SHORTS
Gain of 20/50, **6d** ea.; 50/100, **9d** ea.; 100/200, **1/-** ea.
Transistors similar to OCP71 (Light sensitive) **2/-** ea.

THYRISTORS 400V BTY79, **7/6** ea. SCR51 (10A), **£1** ea.

RECTIFIERS Latest type. All marked. **800V** peak, 1A mean current type IN4006
2/6 ea., **24/-** doz, **£7/10/-** 100.
S.T.C. 3/4 (400V), **2/6** ea., **24/-** doz, **£7/10/-** 100.
BYZ 13 or 19 (6A), **2/6** ea., **24/-** doz, **£7/10/-** 100.

RECORDING TAPE GIVE-AWAY!!!
ALL BRITISH MADE, BEST QUALITY. 5in, 600ft, **7/3**; 5¾in, 900ft, **9/-**; 7in, 1,200ft, **12/-**.
3in "odd-ends"—may be standard, long or double play—but minimum 150ft, **2/3.**
MAINS DROPPER TYPE RESISTORS. Hundreds of types from 0·7 ohm upwards. 1W to 50W. A large percentage of these are Multi-tapped droppers for radio/television. Owing to the huge variety these can only be offered "assorted", **10/-** per doz.
GIANT SELENIUM SOLAR CELLS. Last few to clear at half price!
Circular, 67mm diameter, **5/-** ea.; 50 × 37mm, 3 for **10/-.**

RECORD PLAYER CARTRIDGES
ACOS GP67/2, **15/-** (Mono)
GP91/3, **20/-** (Compatible)
GP93/1, **25/-** (Stereo)
GP94/1, **30/-** (Stereo, ceramic)
GP93/1 with diamond needle, **32/6**
GP94/1 with diamond needle, **37/6**
TRANSISTORISED FLUORESCENT LIGHTS. 12V.
8W 12in tube, Reflector type, **59/6**
15W 18 in tube, Batten type, **79/6**
Complete with tube. Postage **3/-**
TRANSISTORISED SIGNAL INJECTOR KIT 10/-

TRANSISTORISED SIGNAL TRACER KIT 10/-
TRANSISTORISED REV. COUNTER (CAR) 10/-
VERO-BOARD

2½ × 1 × 0·15in, **1/3**	17 × 3¾ × 0·15in, **14/8**
3¾ × 2½ × 15 in, **3/3**	3¾ × 2½ × 0·1in, **4/2**
3¾ × 3¾ × 0·15in, **3/11**	3¾ × 3¾ × 0·1in, **4/9**
5 × 2½ × 0·15in, **3/11**	5 × 2½ × 0·1in, **4/7**
5 × 3¾ × 0·15in, **5/6**	5 × 3¾ × 0·1in, **5/6**
17 × 2½ × 0·15in, **11/-**	

Spot Face Cutter **7/-.** Pin Insert Tool, **9/6.**
Terminal Pins, **3/6** for 36.
Spot Face Cutter and 5 2½ × 1in boards, **9/9.**

These prices cannot be repeated. Order now. Don't forget to add your name and address! Please include suitable amount to cover post and packing. Minimum 2/-.

G. F. MILWARD - DRAYTON BASSETT - Nr. TAMWORTH, STAFFS - Phone TAMWORTH 2321

NEWS BRIEFS

Airborne Equipment

A CONTRACT worth £73,000 to supply the European Space Technology Centre with airborne telemetry equipment has been awarded to Dynatel Ltd. This is the first time a contract of this kind has been awarded to a British company.

The telemetry equipment will be installed in sounding rockets and used in a number of research projects to transmit data picked up by the sensors in the vehicle to a receiving station.

Memory Drum

SPERRY HAVE introduced a new magnetic storage drum (the J101) which has been designed as an economical memory storage unit for a wide range of digital data applications, including use as a back-up store for computers and invoicing machines.

Read/write heads which float on a minute air cushion, are used to record the information as binary digits (bits) on the ferric oxide covered drum surface. The average access time to retrieve stored information is 10 milliseconds.

Telephone Messenger

PUBLICLY demonstrated for the first time at the Business Efficiency Exhibition at Olympia was a new business communication machine (shown below) that can send and receive documents and drawings over any distance by telephone.

Sendox, as the new system is named, will provide the much-needed breakthrough in inter-office and inter-city document communication by overcoming current problems of availability of messengers, transport and skilled operators.

Sendox has been developed by Muirhead Ltd. of Beckenham—suppliers of facsimile systems to newspaper publishers, police forces and meteorological services. It can operate over private or public telephone lines or radio circuits, to an office in the same building or a customer or supplier miles away.

FUNCTIONAL CHECKS

With the mains wiring completed we can start making functional checks on the manuals.

First switch off P.S.U.2, the pedal power unit.

Now adjust all of the potentiometer wipers in the voice box to mid-travel.

With a WB HF.1214 loudspeaker connected at the terminal block of P.A.2 the mains supply can be switched on.

Checking the solo and accompaniment stops merely means depressing each tab individually, noting the voice and balancing the output level with the filter attenuators.

As we have not, as yet, tuned the oscillators it is necessary for these checks to add capacitors to one oscillator, at least.

Roughly tune one oscillator to B flat by adding one 500pF and one 10pF capacitor connected in parallel

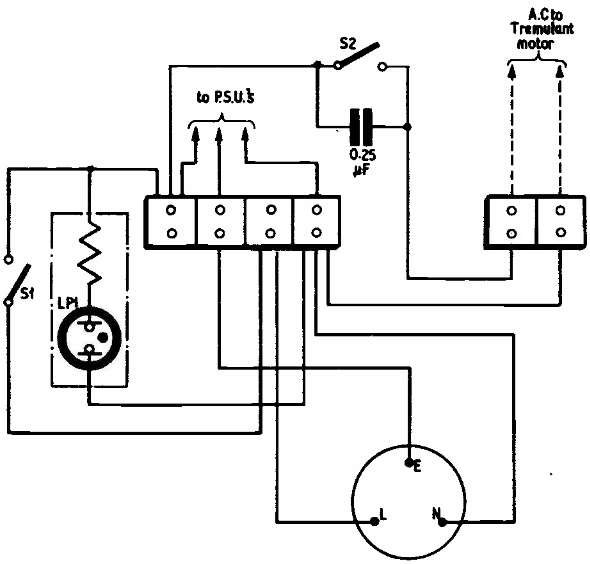


Fig. 8.6. Mains wiring layout for organ console. For plug mounting details refer to rear view photograph of organ given in Part Two

across the coil. These components should be close tolerance silver mica types.

The related divider will be indicated as shown in Fig. 3.5 if the method of annotating the retaining bars has been followed.

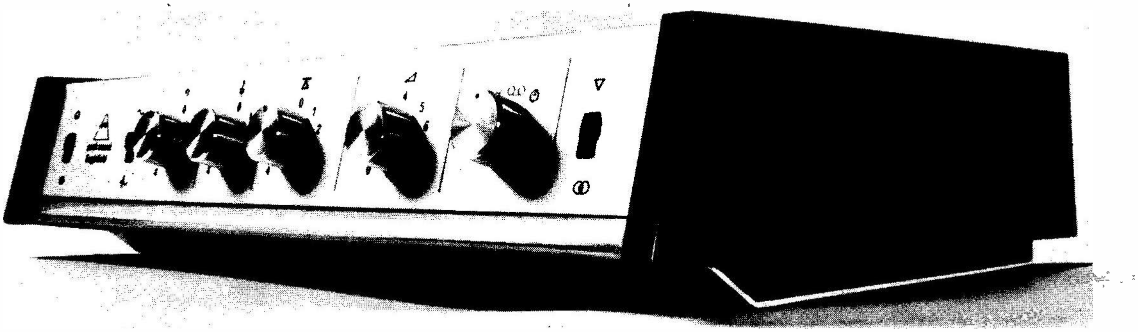
If the supply is now switched on and the middle keyboard B flat depressed and held, it should be possible to check the stops and output levels. This method should be followed for both keyboards and at the same time the action of the swell pedals can be examined.

If all is well, the solo and accompaniment tone box assemblies can be fixed with binder screws. It is important that no screw should come in contact with active circuitry and in this connection reference should be made to the relative underboard wiring diagram given in Parts Six and Seven.

Next month we will start on the pedalboard assembly.

To be continued

peak sound englefield



think of hi-fi this way

Think of a stereo amplifier delivering 12 watts R.M.S. into 15 ohms per channel and having a total harmonic distortion of 0·1% at full output at 1 kHz. Think what an overload factor of 29dB means on all inputs. Think what it means, too, to have a top-flight amplifier housed in a cabinet of elegantly original design that is both beautiful and completely practical back and front. Think what such an amplifier with its many desirable features might cost—then remember that by assembling the Peak Sound " Englefield " yourself from the pre-built lab. tested modules we design and make, you can own one of the best designed amplifiers you have ever heard for about £38. The ease with which you can do this will delight you. So will the performance and appearance of the complete equipment. The Englefield system enables you to use the exclusive design cabinet for either a 12 + 12 watt assembly complete with built-in power supply, or 25 + 25 watt assembly, the pre-amp and tone control unit is common to either.

SPECIFICATION

Using two Peak Sound PA 12-15's. SCU400 and PS45K.

Power output per channel	13 watts into 15Ω. 18w. into 8Ω, 24w, into 3Ω all R.M.S.

Frequency bandwidth—10Hz to 45kHz for 1dB at 1 watt. Total Harmonic Distortion at 1kHz at 11 5w. into 15Ω—0·1%.

Input sensitivities—	Mag. P.U. RIAA—3 5mV. RIAA equalized ceramic P.U. 35mV low imp. Tape—100mV linear: Radio 100mV linear.
Overload factor—	29dB on all input channels.
Signal/noise ratio—	—65dB on mag. P.U.
Controls—	Volume; Treble (+ to −12dB at 10kHz); Bass (+12dB at 100Hz); Filter 9kHz at 12dB per Octave. Mono/Stereo: On/off.

Using two PA 25-15 amplifiers and PS/68S power supply output is then 28 watts into 15Ω per channel at 1kHz or 35w. into 8Ω.

THE MODULES

Englefield Amplifier Cabinet with front panel, knobs, sockets, cut wire, fuses, edge connectors, etc.	£6 0 0
Two PA.12-15 power amp. built modules (£5/19/6 each)	£11 19 0
SCU/400 Pre-amp./Control module, built	£15 15 0
PS/4S Power Supply kit	£4 10 0
	£38 4 0
Using two PA25-15 power amplifier modules at £11/15/0 each and PS/68S Stabilized Power Supply Unit at £13/10/0, total price for complete system comes to	£58 15 0

Go to your Stockist. The products of Peak Sound are available from dealers in all parts. If, however, your own local stockist is not yet ready with the Peak Sound items you require, please send direct together with your supplier's name and address and your requirements will be dealt with without delay. **TRADE ENQUIRIES INVITED.**

PEAK SOUND (HARROW) LTD.
32 ST. JUDE'S ROAD
ENGLEFIELD GREEN, EGHAM
SURREY Telephone : Egham 5316

To PEAK SOUND, 32 ST. JUDE'S ROAD, ENGLEFIELD GREEN, EGHAM, SURREY. Please send details of

Englefield and .... **to**

NAME ....

ADDRESS ....

....

PE12

DIOTRAN SALES

P.O. BOX 5
WARE, HERTS
TEL.: WARE 3442

SIL. G.P. DIODES

300mW	30	10/–
40PIV (Min.)	100	30/–
Sub-Min.	500	£5
Fully Tested	1,000	£9

Ideal for Organ Builders.

Post and Packing costs are continually rising. Please add 1/- towards same. **CASH WITH ORDER PLEASE. GIRO No. 30-102**

OVERSEAS QUOTATIONS BY RETURN SHIPMENTS TO ANYWHERE IN THE WORLD

OVER 3 MILLION SILICON ALLOY & GERM. TRANSISTORS AVAILABLE FOR IMMEDIATE DELIVERY

TRANSISTORS Type and Construction		Qty. Price 100	Qty. Price 500	Qty. Price 1,000	Qty. Price 10,000
A 1 Germ. A.F. NPN T0-1	=AC127, NKT773, AC157, ASY86	£3.10	£15	£25	£200
A 2 Germ. A.F. PNP T0-5	=ACY17-21, NKT237-245	£1	£3	£5	£40
A 3 Germ. A.F. PNP T0-1	=AC128, NKT271, 2G381	£1	£3	£5	£40
A 4 Germ. R.F. PNP T0-1	=OC44-45, NKT72/12S, ASY54	£1.10	£4.10	£7.10	£60
A 5 Germ. R.F. PNP T0-5	=2N1303, NKT164-7, 2G301-3	£1.10	£4.10	£7.10	£60
A 6 Germ. V.H.F. PNP T0-1	=AF116-7, KNT667, 2G417	£3.10	£15	£25	£200
A 7 Assorted Germ. A.F.-R.F. PNP mixed cans, general purpose		15s.	£2.10	£4	£32
A 8 Germ. A.F. S0-2 PNP	=2G371-89, ACY27-31, OC71-75	£2	£7.10	£12.10	£100
A 9 Sil. Alloy PNP T0-S	=2S301-5, BCY17-29, BCY30-34	£2	£7.10	£12.10	£100
A10 Sil. Alloy PNP S0-2	=2S321-325, OC200-205	£2	£7.10	£12.10	£100

A1 to A7 Guaranteed 80% Good usable Transistors ideal for low cost production work and experimental use. A8 to A10 are all perfect devices, factory tested, no open or short circuit Transistors in these lots.

BRAND NEW FULLY TESTED EPOXY CASE UNIJUNCTION TRANSISTORS. Type TIS43 and BEN 3000 and replacement for 2N2646. Full data available. LOWEST PRICE AVAILABLE ANYWHERE. 100 off 4/- each = **£20**; 500 off **3/6** each = **£87.10**; 1,000 off **3/-** each = **£150.** Sample devices 7/- each on request.

HIGH QUALITY SILICON PLANAR DIODES. SUB-MINIATURE DO-7 Glass Type, suitable replacements for OA200, OA202, BAY38, 1S130, 1S940. 200,000 to clear at **£4** per 1,000 pieces. GUARANTEED 80% GOOD.

SILICON PLANAR PLASTIC TRANSISTORS. 2N3708A VcB30 Hfe 20-60. All marked fully tested and guaranteed. 1 off **1/6** each; 100 off **10d.** each; 500 off **9d.** each; 1,000 off **7½d.** each.

TO-5 METAL CAN SILICON PLANAR TRANSISTORS. VERY HIGH QUALITY 99% good type. 2N697, BFYS1, 2N1893, **£8** per 500 pieces. **£13/0/0** for 1,000 pieces.

FULLY TESTED DEVICES AND QUALITY GUARANTEED—SURPLUS TO REQUIREMENTS

OA202 Silicon Diode. Fully Coded.
150 PIV 250mA Qty. Price **£30** per 1,000 pieces.

02A00 Silicon Diode. Fully Coded.
50PIV 250mA. Qty. Price **£25** per 1,000.

BY100 SIL. RECT'S 800 PIV 550mA.
1-49 **2/6** each; 50-99 **2/3** each; 100-999 **2/-** each; 1,000 up **1/10** each. Fully Coded. 1st Qlty.

PLASTIC, PNP SILICON TRANSISTORS. Manufacturers' seconds from 2N3702–3 family. Ideal cheap trans. for manufacturing, etc. **£8.0.0.—500, £13.10.0—** 1,000 pieces.

PLASTIC NPN SILICON TRANSISTORS. Manufacturers' seconds from 2N3707–3711 family. Ideal cheap trans. for manufacturing, etc. **£7.10.0—500, £12.0.0** —1,000 pieces.

TO-18 METAL CAN SILICON PLANAR TRANS. Very high quality, 99% good. Type 2N706, BSY27, **£8** per 500 pieces. **£13** per 1,000 pieces.

TOP HAT RECTIFIERS. All good. No short or open circuit devices. Voltage range 25–400PIV, 750mA. **£3** per 100, **£12.10.0** per 500.

S.C.R.'s 16AMP (unplated)

	1–24	25–99	100 up
100PIV,	**9/6**	**7/6**	**6/–**
400PIV,	**14/–**	**12/–**	**10/–**

All tested perfect functional devices guaranteed.

1/- each TESTED TRANSISTORS 1/- each

ONE PRICE ONLY PNP. NPN. SILICON PLANAR 1/- EACH

BC108	2N696	2N1132	2N2220	2S733
BC109	2N697	2N1613	2N3707	2N3391
BFY50	2N706	2N1711	2N3711	TIS44
BFY51	2N708	2N2904	2S102	2N2906
BFX84	2N929	2N2905	2S103	2N2907
BFX86	2N930	2N2924	2S104	2N2696
BFX88	2N1131	2N2926	2S732	2N3702
				2N3703

From Manufacturers' Over-runs—Unmarked Plastic and Metal cases. Devices similar to above Nos.

GERM. PNP AND NPN TRANSISTORS FULLY TESTED, UNMARKED SIMILAR TO 1/6 EACH

AC125	ACY22	ACY36	NKT677	OC81	2G381
AC126	ACY27	NKT141	NKT713	OC82	2G382
AC127	ACY28	NKT142	NKT773	2G301	2G399A
AC128	ACY29	NKT212	OC44	2G302	
AC130	ACY30	NKT213	OC45	2G303	
ACY19	ACY31	NKT214	OC71	2G308	1/6
ACY20	ACY34	NKT215	OC72	2G371	each
ACY21	ACY35	NKT271	OC75	2G374	

POWER TRANSISTORS

OC25	OC35	NKT403	ASZ17	
OC26	AD130	NKT404	T13027	5/-
OC28	AD140	NKT405	T13028	each
OC29	AD149	NKT452	T13029	

Manufacturers' Surplus Germ. A.F. All similar to above.

TRANSISTOR EQVT. BOOK

2,500 cross references of transistors—British, European, American and Japanese. A must for every transistor user. Distributed by DIOTRAN SALES. 15/- EACH.

TEXAS 2G371 A/B Eqvt. OC71 Germ. Gen. Purpose Trans.

	Each
1-99	1/6
100-499	1/3
500-999	1/-
1000 up	9d.

All Brand New and Coded.

Vast mixed lot of subminiature glass diodes. Comprising of Silicon, Germ., Point Contact and Gold Bonded types plus some Zeners. 500,000 available at Lowest of Low Price. 1,000 pieces **£3.0.0.** 5,000 pieces **£13.10.0.** 10,000 pieces **£23.**

TRANSISTOR AUDIO AND RADIO CIRCUITS

for Radio Receivers, Radiograms, Record Players, Tape Recorders and Hi-Fi Equipment.

A Mullard Publication

30/- Postage **1/-**

TELEVISION ENGINEERS' POCKET BOOK, by J. P. Hawker & J. A. Reddihough. **21/-.** Postage 1/-.

RADIO SERVICING PROBLEMS, by W. A. L. Smith. **9/-.** Postage 6d.

SERVICING WITH THE OSCILLOSCOPE, by Gordon J. King. **28/-.** Postage 1/-.

THE HI-FI AND TAPE RECORDER HANDBOOK, by Gordon J. King. **40/-.** Postage 2/-.

PRACTICAL INTEGRATED CIRCUITS, by A. J. McEvoy & L. McNamara. **18/-.** Postage 1/-.

TRANSISTOR MANUAL, by General Electric Company. **21/-.** Postage 1/6.

TRANSISTOR ELECTRONIC ORGANS FOR THE AMATEUR, by Alan Douglas & S. Astley. **20/-.** Postage 1/-.

110 SEMICONDUCTOR PROJECTS FOR THE HOME CONSTRUCTOR, by R. M. Marston. **18/-.** Postage 1/-.

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books
19-21 PRAED STREET
LONDON, W.2
Phone: PADdington 4185
Closed Saturday 1 p.m.

CRESCENT RADIO LTD.

(electronic component specialists)

For all regular components try
40 Mayes Road, Wood Green, N.22

For surplus components and equipment try
11 Mayes Road, Wood Green, N.22

BARGAIN COMPUTER BOARDS

Assorted Components mounted on boards all with long tags. Ideal for breaking down and experimenting with. Take advantage of bulk purchase

1 Board	**2/–** each
20 Boards	**20/–**

PRINTED CIRCUIT BOARD

8 × 6 inch One Sided Board .. **2/–** each

TRANSISTOR RADIO PANEL

Incomplete Min. Radio Panel; I.F.T.s; Transistors; Resistors; Capacitors; All for **2/-** per panel.

COMPONENT BARGAINS

S.P. Flick Toggle Switch, 2in. Dolly	**3/6** each
250V 2 amp. Toggle Switch	**1/6** each
4 Pin Transistor Holders	**6d.** each
1in. Spun Aluminium Knobs, ¼in Spindle	**2/6** each
OC19 Power Transistor	**5/–** each
Low Impedance Transistor Earpiece	**1/6** each
2¼in 8ohm Loudspeaker	**5/6** each
Continental Razor Adaptor Kit	**7/6** each
100mF 6V d.c. Transistor Capacitor	**9d.** each
500mF 6V d.c. Transistor Capacitor	**1/–** each
6,800pF Mullard Capacitor 400V d.c.	**6d.** each

We have large stock of
Veroboard; Valves; Transistors; Loudspeakers; Auto-Changers; Recording Tape; Cable; Hi Fi

Send 1/6d for Our Catalogue

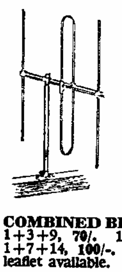
Postage with order please

NEW RANGE BBC 2 AERIALS

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.

Loft Mounting Arrays, 7 element, **37/6.** 11 element, **45/-.** 14 element, **52/6.** 18 element, **60/-.** **Wall Mounting with Cranked Arm,** 7 element, **60/-.** 11 element, **67/-.** 14 element, **75/-.** 18 element, **82/6.** **Mast Mounting** with 2in. clamp. 7 element, **42/6;** 11 element, **55/-;** 14 element, **62/-;** 18 element, **70/-.** **Chimney Mounting Arrays, Complete,** 7 element, **72/6;** 11 element, **80/-;** 14 element, **87/6;** 18 element, **95/-.** Complete assembly instructions with every unit. **Low Loss Cable, 1/6 yd. U.H.F. Pre-amps** from **75/-.** State clearly channel number required on all orders.

BBC · ITV AERIALS



BBC (Band 1). Telescopic loft, **25/-.** External S/D, **30/-.** "H", **£2.15.0.**

ITV (Band 3). 3 element loft array, **30/-.** 5 element, **40/-.** 7 element, **50/-.** Wall mounting, 3 element, **47/6.** 5 element, **52/6.**

Combined BBC/ITV. Loft 1+3, **40/-;** 1+5, **50/-;** 1+7, **60/-;** Wall mounting 1+3, **57/6;** 1+5, **67/6;** Chimney 1+3, **67/6;** 1+5, **75/-.**

VHF transistor pre-amps, **75/-.**

COMBINED BBC1—ITV—BBC2 AERIALS 1+3+9, **70/.** 1+5+9, **80-/.** 1+5+14, **90/-.** 1+7+14, **100/-.** Loft mounting only. Special leaflet available.

F.M. (Band 2). Loft S/D, **15/-,** "H", **32/6,** 3 element, **55/-.** External units available. Co-ax. cable, **8d.** yd. Co-ax. plugs, **1/4.** Outlet boxes, **5/-.** Diplexer Crossover Boxes, **13/6.** C.W.O. or C.O.D. P. & P. 6/-. Send 6d. stamps for illustrated lists.

CALLERS WELCOME

OPEN ALL DAY SATURDAY

K.V.A. ELECTRONICS (Dept. P.E.)
40-41 Monarch Parade
London Road, Mitcham, Surrey
01-648 4884

A SOLID state flashing indicator for a car can be constructed for relatively low cost and has several advantages over the standard electro-mechanical type. As transistor switching is employed there are no moving parts that can wear out; the flash or pulse repetition frequency (p.r.f.) can be set to within the legal limits of 90 ± 30 flashes/minute and does not vary with time or load; the on/off time ratio can be pre-set and does not alter if a lamp fails or additional lamps are flashed, for example, when towing a caravan.

Further improvements incorporated in this circuit are an internal warning of flasher lamp failure, without affecting the operation of the remaining lamps, and the inclusion of an audio bleeper as an alternative, or additional warning system if preferred. The design is illustrated for positive 12V car battery systems, but can be modified for negative earth systems (see later).

TRANSISTOR TIME SWITCH

A simple two wire flasher circuit for flashing any low power indicator lamp from 6 to 24V is shown in Fig. 1.

When the circuit is switched on, practically the full battery voltage appears across TR1 bias chain but the transistor is held off until the capacitor C1 charges up through R4 and the lamp causing TR1 to conduct. The resulting collector current of TR1 is then amplified by complementary transistor TR2, increasing the lamp voltage and decreasing the control circuit voltage.

As the emitter voltage of TR1 is held by the voltage across C1, the bias of TR1 is increased causing a further increase of collector current. This action is cumulative, producing a rapid switching action which saturates TR1 and TR2, holding the lamp on until C1 discharges through TR1, R3, and the base emitter junction of TR2. When the capacitor discharge current drops below the saturation current of TR1 and TR2, the switching action is reversed and the cycle is repeated.

The "off" time of the lamp depends on the charging time constant C_1R_4; the "on" time depends on the discharging time constant C_1R_3. Hence the p.r.f. is proportional to $1/(C_1R_3 + C_1R_4)$.

Resistor R4 limits TR2 overload current by pre-warming the lamp; switching on from cold can produce a peak of about five times the normal lamp current. A 10 ohm resistance in series with LP1 is preferable for switched lamp circuits as this extends the life of the lamp as well as the transistor but it requires a supply voltage higher than the normal lamp voltage.

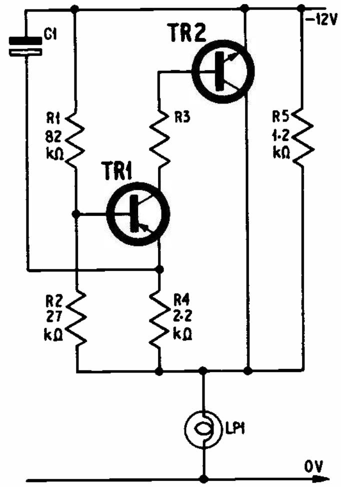


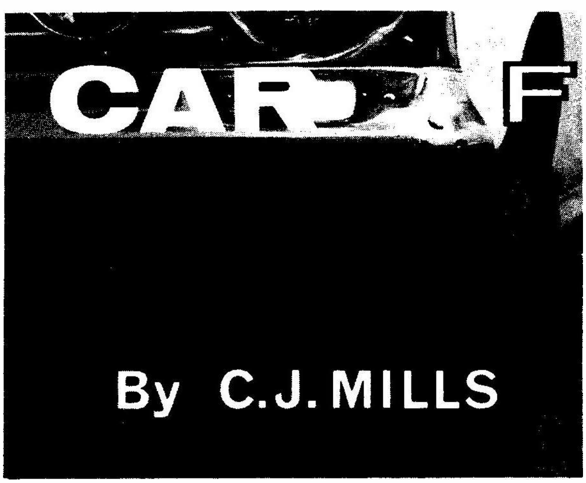
Fig. 1. Circuit diagram of a simple lamp flasher

COMPLETE BLEEPING FLASHER

The final circuit (Fig. 2) is developed from the above by adding a power transistor TR3 and an indicator switching transistor TR4. The 0·25W resistor in series with TR3 provides enough bias to switch the indicator lamp on via TR4 when two 20 watt flasher lamps are used. If only one or both flasher lamps fail, the indicator lamp will not light.

For the motorist who prefers an audio indicator, the circuit in Fig. 1 can be used as a "bleeper" by changing the value of C1 to 0·25μF (selected to suit preferred tone). This is an aid for forgetful drivers and produces some interesting comments from passengers who hear it for the first time. A limiting resistor R10 to control the amplitude from the loudspeaker completes the circuit.

The final circuit (Fig. 2) includes the bleeper and its components are re-numbered around TR5 and TR6.



CAR FLASHER

By C.J. MILLS

CAR FLASHER

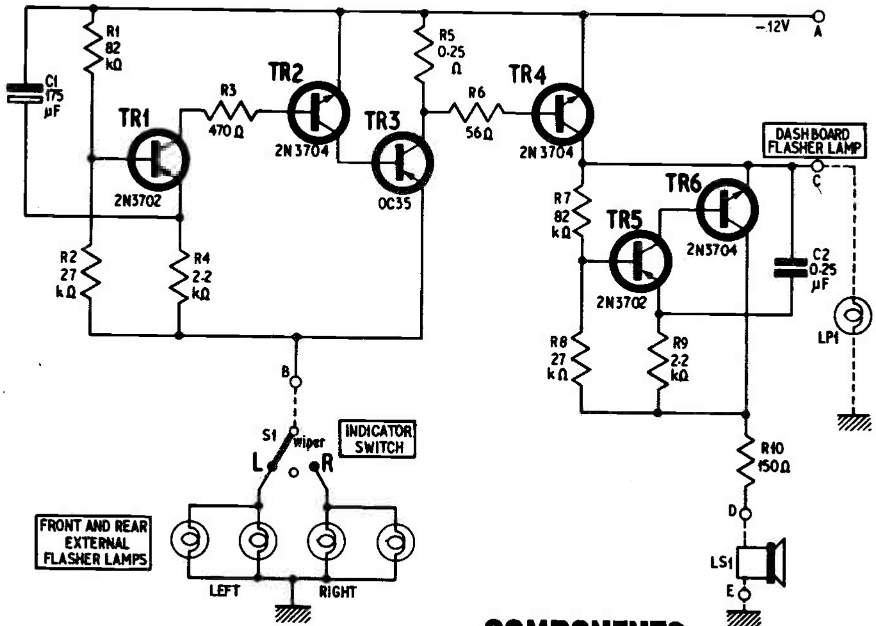


Fig. 2. Complete circuit diagram of car flasher unit. The circuit includes the audio bleeper section and is wired for positive earth systems. See Fig. 4 for negative earth circuit

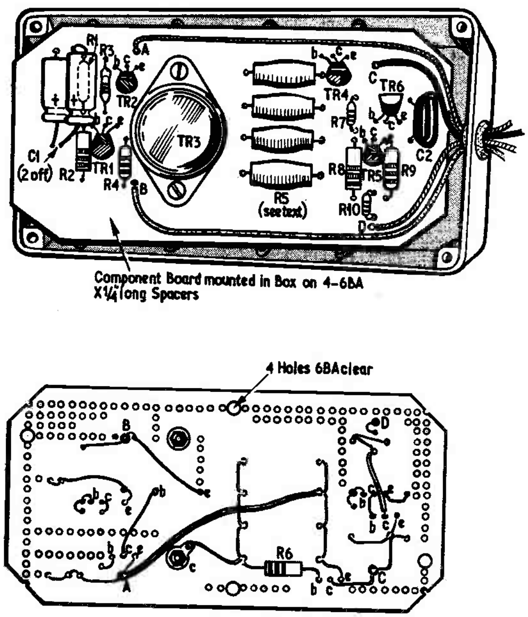


Fig. 3. Component layout and wiring of the flasher unit for positive earth systems

COMPONENTS...

Resistors

R1	82kΩ	R6	56Ω
R2	27kΩ	R7	82kΩ
R3	470Ω	R8	27kΩ
R4	2·2kΩ	R9	2·2kΩ
R5	0·25Ω (see text)	R10	150Ω

All ±10%, ¼ watt carbon except R5.

Capacitors

C1 175μF elect. 16V (120μF+50μF in parallel)
C2 0·25μF polyester

Transistors

TR1 2N3702 *or* OC202
TR2 2N3704 *or* BFY50
TR3 OC28, OC29, *or* OC35
TR4 2N3704 *or* BFY50 for positive earth
OC205 for negative earth systems
TR5 2N3702 *or* OC202
TR6 2N3704 *or* BFY50

Miscellaneous

Die cast box 4⅜in × 2⅜in × 1¼in
Perforated s.r.b.p. 4in × 2in
Wire, car connectors

INSTALLATION

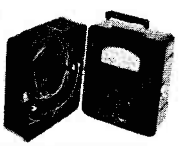
The following plan indicates connections to the car for both positive and negative earth systems.

Circuit Pin	
A	Ignition switch
B	Indicator switch wiper
C	Dashboard flasher lamp
D	Loudspeaker
E	Loudspeaker to chassis

Details are not given for 6V systems since this would need a complete redesign of the whole circuit.

ELECTRONIC BROKERS

NEW—TEST EQUIPMENT



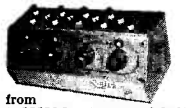
20,000 ohm/volt AC/DC MULTIRANGE METER
Eleven current ranges. Fourteen voltage ranges. Three resistance. Price £12.19.6. P. & P. 15/-.

PORTABLE WHEATSTONE BRIDGE
with five switched range from 0·05 Ω to 50,000 Ω. 2% accuracy. Price £9.19.6. P. & P. 10/-.

MUTUAL INDUCTANCE BOX

Ranges from 0 to 11·1mHz in 0·002 divisions. Price £26.10.0. P. & P. £1.0.0.

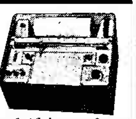
HIGH VALUE DECADE RESISTANCE BOX



Ranges from 0·01MΩ to 111MΩ. Accuracy 0·05%. Maximum Power Rating 0·1W per step. Price £22.10.0. P. & P. £1.0.0.

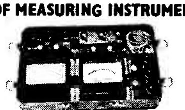
MUTUAL INDUCTANCE COIL
0·001 Hz. Accuracy 3%. Maximum current 3 amps. Price £2.10.0. P. & P. 7/6.
Full specification available on request.

NEW—5 in. CHART PEN RECORDER JY100A-2



High quality single pen recorder with 0–10mV deflection. Chart speed 1 in per min. and 16 in per hour. Adjustable zero location. Power supplies 230V 50Hz. Full specification available on request. £69.10.0. P. & P. 30/-.

SET OF MEASURING INSTRUMENTS



Specification Type: Moving Coil D.C. Ranges: 0–75mV, 0–3V, 3–15–150V, 3–150–450V, 0·3–0·75A, 1·5–7·5A, 15–30A. Scale Length: 82mm. Accuracy: 1·0%. Shunts: 1.0·3–0·75 amps. 2. 1·5–7·5 amps. 3. 15–30 amps. Case: Moulded plastic. Carrying Case: Stove enamelled metal. List price £30. Our price £8.19.6. P. & P. 30/-.

DECODER WITH 4 and 5 DIGIT READ-OUT
Can be used to construct frequency counter or Digital Voltmeter: Consists of NOR gates with amplifiers to drive digital display. 4 digit, £19.10.0.; 5 digit, £25.0.0. P. & P. £2.0.0.

MULLARD MATRIX CORE STORE STACKS

A.W. 510 5 planes 8 × 16 cores/per plane	£12. 10.0
A.W. 511 5 planes 18 × 32 cores/per plane	£25. 0.0
A.W. 534 20 planes 64 × 64 cores/per plane	£89. 10.0
A.W. 597 8 planes 32 × 32 cores/per plane	£55. 0.0
Single plane 40 × 25 × 4	£8. 10.0

LOW COST ELECTRONIC & SCIENTIFIC EQUIPMENT AND COMPONENTS

MOTORS

HYSTERESIS REVERSIBLE MOTOR
Incorporating two coils. Each coil when energised will produce opposite rotation of output shaft. 240V 50Hz. ½ r.p.m., ⅓ r.p.m., ¼ r.p.m., 6 r.p.m. 30/- each. P. & P. 3/-.

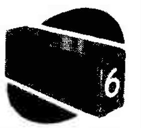
LOW TORQUE HYSTERESIS MOTOR MA23

Ideal for instrument chart drives. Extremely quiet, useful in areas where ambient noise levels are low. High starting torque enables relatively high inertia loads to be driven up to 60Z/in. Available in the following speeds and ranges: 240V 50Hz, 15 r.p.m., 4 r.p.m., 2 r.p.m., 1½ r.p.m., 1 r.p.m., ½ r.p.m., ¼ r.p.m., 1/3 r.p.m., 1/5 r.p.m., 1/6 r.p.m., 1/10 r.p.m., 1/12 r.p.m., 1/40 r.p.m., 1/60 r.p.m., 1/75 r.p.m., 1/120 r.p.m., 1/180 r.p.m., 1/360 r.p.m., 1/720 r.p.m., 1/14400 r.p.m., 1/2880 r.p.m.; 120V 50Hz, 1/6 r.p.m., 1/5 r.p.m., 1/15 r.p.m., 1/16 r.p.m., 1/20 r.p.m., 1/30 r.p.m., 1/60 r.p.m., 1/120 r.p.m., 1/240 r.p.m., 1/300 r.p.m. 25/- each.

HYSTERESIS CLUTCH MOTOR

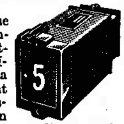
With integral clutch allowing the motor to drop out of engagement with the gear train, thereby facilitating easy resetting when used in timers or in conjunction with a light spring. 6 oz torque at 1 r.p.m. 240V, 50c/s. L = left, R = right. 15 r.p.m. L, 8 r.p.m R and L, 6 r.p.m. L. 4 r.p.m., ½, ¼, ⅛ r.p.m. L, 1/5 r.p.m., 1/6 r.p.m., R and L, 1/10 r.p.m., 1/12, 1/15 r.p.m. L. Also 120V 50c/s 2, 1/6, 1/12, 5/12, 4/11, 1/10 r.p.m. 25/-. P. 3/-.

MINIATURE DIGITAL DISPLAY



Operates on a rear projection 6·3 pilot lamp. The lamp projects the corresponding digit on the condensing lens through a projector lens, on to the viewing screen at the front of the unit. 1in width. 3$\frac{5}{16}$in deep. 1$\frac{5}{16}$in high. Weight 3½oz. Character size ⅝in high, 0·9 with 8 right hand decimal point and degree. List price 6 gns. Our price 49/6. P. & P. 5/-.

EAC DIGIVISOR Mk. II DIGITAL READ-OUT DISPLAY



Ideally suitable for use in conjunction with transistorised decade counting devices. The DIGIVISOR incorporates a moving coil movement which moves a translucent scale through an optical system and the resultant single plane image is projected on a screen. The translucent scale is made to represent digits 0–9. Specifications: 6·3V 250 microamp. Image height ⅝in. Size 4 9/16 × 2 39/64 × 1⅛in. Our price 3½ gns. List price 8½ gns.

MINIATURE MOVING COIL RELAY S115

By Sangamo Weston, suitable for D.C. circuit. A high sensitivity relay more sensitive than the electromagnetic type. Single Coil Resistance 310 micro amps. 315Ω. List price £4.10. Our price 20/-.

ELECTRO MAGNETIC COUNTER

Slow impulse counter of 10 impulses per second. 6/6. P. & P. 3/-.

6 DIGIT ELECTRICAL IMPULSE COUNTER with electrical and mechanical reset counter driven by 110 V DC 4400 ohms coil. Reset 110 V DC 800 ohms coil. Housed in plastic-alloy case. The units can be interlocked with each other to give vertical or horizontal displays. Price 79/6. P. & P. 5/-.

REPEAT CYCLE TIMERS

These timers repeat a set cycle of switching operations via a cam and micro switch, for as long as the motor is energised. Single Cam RB 21in 2 min, 3 min, 4 min, 5 min, 6 min, cycles at 45/-. Twin Cam RD 22 in 1 min, 2 min, 3 min, 4 min, 5 min cycles at 55/-. 4 Cam RD 24 in 4 min, and 5 min cycles at 75/-. 3 Cam RD 26 in 1 min, 2 min, 3 min, 4 min, 5 min cycles at 95/-. 8 Cam RD 28in 1 min, 2 min, 3 min, 4 min, 5 min, cycles at 115/-. All plus P. & P. 5/-.

AVO SIGNAL GENERATOR
Frequency Range 50kc/s–80Mc/s. Output 0·5V. Price £15. Carriage £1.10.

Low ohm safety meter 12mA 5 ohms. Suitable for testing circuits where currents must be limited. W/N and P/E. £12.10.0. P. and P. 17/6.

ADVANCE TRANSISTORISED DC POWER UNITS

	Input Volts	Output Volts	Amps	Price
DC 4	200–245 ± 15%	12	4	£17.10

LEDEX ROTARY SWITCHES (New)
N.S.F. wafer switches driven by 24V or 48V d.c. motor. Ideal where switching is to be controlled by a signal pulse. Following sizes available: 2E—3 wafers, 1 pole, 12 position per wafer. 3E—1 wafer, 1 pole, 12 pole per wafer. 35/- each. P. & P. 3/6.
3E—Tandem Drive 12 wafers—70/-. P. & P. 5/-.
2E—twin mounted 4 wafer Ex Equip. 60/-. P. & P. 5/-.

DC TACHO GENERATOR
11 Miscl. Size 11. 400 cycles, 115v. input, 0.5v/1000 r.p.m. £15. P. & P. 5/-.

SERVO MOTORS
11M. 10EZ. Size11. 400 cycles. Ref/Control: 115/40v. Torque 20 oz per inch. Speed 5,600 £12.10.0. P. & P. 5/-.
Size 18. 400 cycles, 115/115v. 2.35 oz per inch. 4,800 r.p.m. £12.10.0. P. & P. 5/-.

SYNCHRO TORQUE TX.
11 TX. 4B. Synchro Torque Transmitter. 400 cycles. Ref/Control: 115/90v. £9.10.0. P. & P. 5/-.

SYNCHRO CONTROL TX/TRANSFORMER
15 CX/CT 4 SL. 400 cycles. Ref/Control: 115/15v. 1.4v. per degree. £15. P. & P. 5/-.

★ HIGH PRECISION ★ FULLY STABILISED TRANSISTORISED LOW VOLTAGE POWER SUPPLIES
incorporating
* S.C.R. Panel for overload projection.
* OVERLOAD & CIRCUIT BREAKER WITH MANUALS RESET button.
* RIPPLE belter, better than 3000: 1.
* CHOKE OF CAPACITOR transistorised 120/130V A.C. INPUT.

Available in the following types:

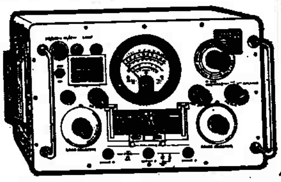
6V	12 amp	£17.10.0
6V	16 amp	£22.10.0
12V	8 amp	£22.10.0
12V	16 amp	£25. 0.0
12V	22 amp	£25. 0.0
20V	16 amp	£25. 0.0
24V	4 amp	£22.10.0
30V	8 amp	£18.10.0
56V	7 amp	£25. 0.0

Ex-equipment but fully tested in our laboratory. Carr. 30/-

POCKET CALCULATOR

Save time and solve all your multiplication, division, percentage, cube and square root problems. Easy to use pocket calculator with no errors. Invaluable daily aid, should last a lifetime, offered complete in black wallet with full instructions, 3½in diam. 12/6 each, P. & P. 1/6.

NEW—AVO ELECTRONIC METER



A quality instrument capable of measuring A.C. and D.C. voltage and current, resistance plus power output.
Ranges: D.C. voltage 250mV–10,000V. D.C. current 100uA–25A. A.C. voltage 100mV–250V, A.C. current 10u-A–25A, Resistance 0–100M Ω. Power output 50μW–5W. Supply voltage 110/200/25 50Hz.
Complete with lead and probe for RF measurement up to 250M Hz £25. P. & P. £1

METERS

Milliammeter. A.C./D C. 100MA and 200MA FSD Cambridge 47526/4 Electro-dynamic	£25
Precision Voltmeter. A.C./D.C. 0–75V: 0–150V: 0–300V Sangamo Weston S.92.1–6	£35
Precision Multimeter. V.I.R.W. E.I.L. Model 44	£15. 0.0
Watt Absorption Meter. Marconi CT44 200 UW–6W	£35. 0.0
A.F Micro Voltmeter. Dymar 703, as new	£45. 0.0
V.H.F. "Q" Meter—Marconi TF886B	£45. 0.0
Wide Band Millivoltmeter—Marconi TR1371	£35.10.0

POTENTIOMETERS

Precision—Tinsley 5205C	£55. 0.0
Precision Vernier Pot.—Cambridge	£65. 0.0
Wheatstone Bridge—Tinsley	£35. 0.0

OSCILLOSCOPES

Cossor 1035	£25. 0.0
Cossor 1035 Mk. III	£35. 0.0
Cossor 1049 Mk. III	£40. 0.0
Solartron CD513.2, CD523S.2—LF and Servos, Long Persistent tube	£49.10.0
Solartron AD557—Pulse and Radar Field	£55. 0.0
Solartron CD711S.2—Double Beam DC.7 Meg.	£65. 0.0
Mullard L101/3 Double Beam	£99.10.0
Furzehill 0·100	£25. 0.0
Airmec 723	£19.10.0
Airmec 249	£25. 0.0

PEN RECORDERS

Ammeter D.C. 0–2mA Single Pen—Elliott	£37.10.0
Portable Single Pen—Record Electrical New	£49. 0.0

OSCILLATORS

Automic L.F. Sweep Oscillator Dawe 444C New	£89.10.0
Wide Band Oscillator Dawe 400C	£35.10.0

CONTINUOUS TAPE CASSETTE

Suitable for sleeping, learning, teaching programmes. Programming machine tools, telephone answering, etc. Complete with replay/record head and separate erase head. ¼in. tape, twin track tape. Price £3.9.6. P. & P. 7/6.

SINGLE SPEED TAPE DECK
Driven by 240v 50 Hz power supply. Speed 3¾in. per sec. Remote control operation, 3 motors, record/replay heads with separate erase head. Fast erase facilities and counter. Price £2.19.6. P. & P. 10/-.

MEMORY CORE STORES
42 × 52 2K bit ferrite core store complete with 84 OA 10 load diodes. Ideal for building computer store or holding information in binary form. Price £4.10.0. P. & P. 6/-.

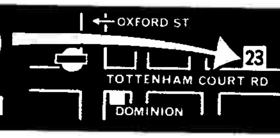
MINIATURE SQUARE COUNTER 6 DIGIT
by Veeder Root. Rotary ratchet type, adds 1 count for each 36° movement of shaft 9/6 + 2/6 P. & P.

ELECTRONIC BROKERS LTD., 49-53 PANCRAS RD., LONDON, N.W.1 Tel. 01-837 7781/2 Cables: SELELECTRO

CARRIAGE EXTRA

PREMIER RADIO

23, TOTTENHAM COURT ROAD, LONDON, W.1 Tel: 01-636 3451



SPECIAL STEREO CARTRIDGES

SHURE

M3D	List £8.10.6.	Premier Price £6.19.6
M44-5	List £14.9.1.	Premier Price £10.10.0
M44C	List £12.19.5.	Premier Price £9. 9.0
M44E	List £17.8.4.	Premier Price £13.19.6
M55E	List £20.15.1.	Premier Price £15.15.0
M75-6	List £17.8.4.	Premier Price £13.19.6
M75E	List £25.18.10.	Premier Price £21.0.0

AUDIO-TECHNICA

AT7S	Stereo	List £22.0.0	Our Price £15.0.0
AT7X	Elliptical	List £25.0.0	Our Price £18.0.0

Post and Packing 1/6 each

"NOVA" TRANSISTOR STEREO AMPLIFIER

A superb stereo amplifier offering every facility for the hi-fi enthusiast. Output 10 watts per channel. Frequency response 40–20,000Hz ± 3dB. Inputs for Radio, P.U. Ceramic, P.U. Magnetic Tape. Separate bass and treble controls, Volume and Balance Controls. Mono/Stereo Switch. Also features headphone socket and tape output. Teak case with attractive illuminated front panel. Size 14½ 9½ × 3½in., a.c. 200/250V.

WONDERFUL VALUE AT ONLY 25 gns. Carr. 10/-.

PICK-UP CARTRIDGES

AT MONEY SAVING PRICES!

GOLDRING G800 (Stereo)	£8.19.6
SONOTONE 9TAHC/D (Stereo)	£2.15.0
ACOS GP91/1SC (Mono compatible) .	£1.13.5
ACOS GP93-1 (Stereo)	£2. 8.7
ACOS GP94 (Stereo)	£2.14.8
B S R X3M (Mono compatible)	£1.16.5
B S R X3H (Mono compatible)	£1.16.5
RONETTE 105 (Stereo)	£1.15.0
RONETTE 106 (Stereo)	£1.15.0

All complete with mounting brackets and instructions. Post and Packing 1/6 each.

COMPLETE STEREO SYSTEM

FOR ONLY 39 GNS

CARRIAGE 35/-

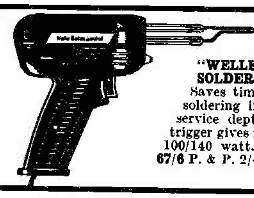
The Premier Stereo System consists of an all transistor stereo amplifier, Garrard Model 2025 auto/manual record player unit fitted stereo/mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor Amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on/off, stereo/mono switch. Brushed aluminium front panel. Black metal case with teakwood ends: Size 12″ × 5½″ × 3½″ high (Amplifier available separately if required **£14.19.6.** Carr. 7/6).

WIDE RANGE OF HI-FI STEREO EQUIPMENT ON DEMONSTRATION

All leading makes available including Rogers, Armstrong, Dulci, Wharfedale, Goodmans, Goldring, Shure, etc. etc.

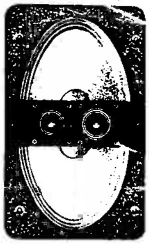
SAVE NEARLY £5!

Premier Stereo System with "Nova" 10 watt Stereo Amplifier as above. **45 Gns.** Carr. 35/-.



"WELLER EXPERT" SOLDER GUN.

Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat 100/140 watt. 240 volt A.C. 67/6 P. & P. 2/-.



E.M.I. 13 × 8in HI-FI SPEAKERS

Fitted two 2½in tweeters and crossover network. Impedance 3 & 15 ohms. Handling capacity 10W. Brand new. **99/6.** P. & P. 7/6. Also available without tweeters. **49/6.** P. & P. 7/6.

TEAK FINISHED CABINET Size 17½ × 10 × 7¼in. Ideal for above speakers. **£5.10.0.** P. & P. 7/6.

VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 2in. suitable for crystal microphone, low impedance microphone with transformer, radio, tape, etc. Max. input 1·5V, max. output 2·5V, gain 6dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

Mono Model 59/6 Stereo Model 69/6 P. & P. 2/6.

POCKET SIZE MULTI TESTER

With wide-angle, jewelled meter movement, ceramic long-life, low-loss switching, tough impact resisting case. Sensitivity 20,000 ohms/volt d.c. 10,000 ohms/volt a.c. **19 Ranges:** 0-5-25-50-250-500-2,500 volts d.c. 0-10-50-100-500-1,000 volts a.c. 0-50μA-2·5mA-250mA d.c. 0-6,000 ohms-6 megohms, 10μ μF-0·001 mF-1 mF. −20 to +22dB. Complete battery, test lead and instructions. **£4.19.6** P. & P. 3/6.

'VERITAS' V-313 TAPE HEAD DEFLUXER

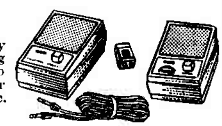
A must for all tape users! Tape heads become permanently magnetized with constant use; this leads to background noise that prevents perfect recordings. Simply applied to recording head the V313 leaves head free of magnetism. Cleans any tape head in seconds. **34/6** P. & P. 1/6

HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2½in speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft lead and stereo jack plug. **59/6** P. & P. 5/-.

MONO HEADPHONES 2,000 ohm **14/6** P. & P. 2/6.
STEREO STETHOSCOPE SET Low imp. **25/-** P. & P. 2/-.
MONO STETHOSCOPE SET Low imp. **10/6** P. & P. 2/-.

TWO STATION TRANSISTOR INTERCOMS.



Complete with battery and 50ft connecting wire. Compact size, two way call system. Ideal for home, office, factory, etc. **65/-** P. & P. 4/-.

FOUR STATION INTERCOM. Master unit and 3 slaves. Ideal for office and home. Complete with battery and connecting wire **£7.19.6.** P. & P. 5/6.

SPECIAL BARGAIN OFFER!

B.S.R. UA75 RECORD PLAYER UNIT COMPLETE WITH TEAK PLINTH, 4 speeds. Automatic or Manual operation. Low mass arm with cue and pause lever, bias compensator, stylus pressure adjuster, etc. Complete with Stereo/Mono Cartridge.

Original Price £25.18.8

OUR PRICE **14 gns.** Carr. 10/6

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED.

TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped—attractively boxed.

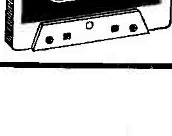
LP3	3″	250′	P.V.C.	5/6	LP6	5¾″	1200′	P.V.C.	12/6
TT3	3″	450′	POLYESTER	7/6	DT6	5¾″	1800′	POLYESTER	22/6
DT3	3¼″	600′	POLYESTER	11/6	TT6	5¾″	2400′	POLYESTER	37/6
SP5	5″	600′	P.V.C.	8/6	SP7	7″	1200′	P.V.C.	12/6
LP5	5″	900′	P.V.C.	10/-	DT7	7″	2400′	POLYESTER	25/-
DT5	5″	1200′	POLYESTER	15/-	TT7	7″	3600′	POLYESTER	50/-

TAPE SPOOLS 3″ 1/-, 5″, 5¾″, 7″ 1/9. TAPE CASES 5″, 7″ 2/6.
Post and Packing 3″ 1/-, 5″, 5¾″ 1/6, 7″ 2/-. (3 reels and over Post Free.)

"PREMIER" TAPE CASSETTES

C60	(60 min.)	7/6	3 for 21/-
C90	(90 min.)	12/6	3 for 36/-
C120	(120 min.)	17/6	3 for 51/-

P. & P. 1/-.



CASSETTE HEAD CLEANER

Removes unwanted deposits from delicate tape heads. Fits all cassette recorders. **11/6** P. & P. 1/-.

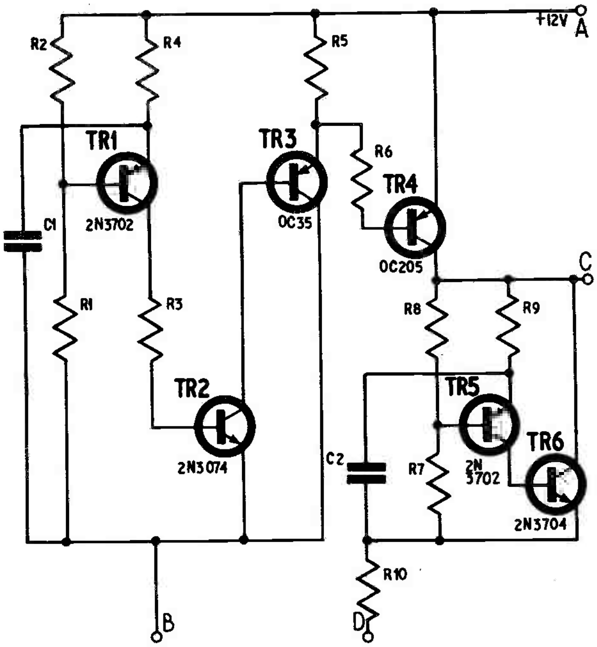


Fig. 4. Alternative arrangement for negative earth systems. Connections from A, B, C, and D to car components are the same as for the positive earth system. TR4 here is an OC205; all other components are as given in the components list

CONSTRUCTIONAL DETAILS

A piece of perforated s.r.b.p. board is trimmed to fit inside a 4in × 2in (internal size) diecast box and is drilled for mounting on four 6B.A. screws. The components are then mounted on the board and connected up as shown in Fig. 3 for positive earth systems, using the termination wires whenever possible. *If the circuit in Fig. 4 is used this layout must be modified to suit it.*

The 0·25 ohm resistor consists of four 1 ohm wire-wound resistors connected in parallel or alternatively a 9in length of 22 s.w.g. eureka wire can be used. It should be insulated with heat resistant sleeving and wound on a small bobbin or former.

Due to the on/off time ratio of about 1 : 3, the mean current through R5 and the power transistor is less than 1 amp and the power dissipated is less than ¼W and 1W respectively. Hence the heat generated is comparatively low and a heat sink should not be required.

The bleeper circuit is mounted at the opposite end of the board to the main flasher components and miniature components may be required to fit it into the space available. Three leads from pins A, B and C are brought out through grommeted holes to flat male "car connectors". A mounting bracket is screwed to the case to complete the unit—a direct replacement for an electro-mechanical flasher. When the bleeper circuit is used in positive earth systems, the third lead should be connected from pin D to the loudspeaker as shown in Fig. 2; another lead connects the loudspeaker to the positive earth terminal of the car battery.

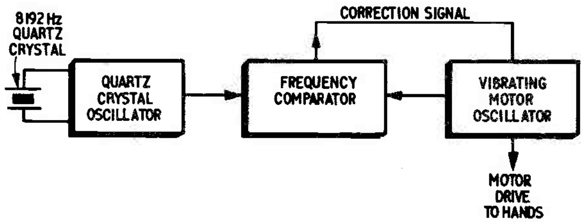
An alternative method of construction with the bleeper circuit is to use a slightly larger case with a small speaker mounted inside it. The unit is then completely self-contained. ★

NEWS BRIEFS

Quartz Oscillator Wristwatch

IN SPITE of improved timekeeping in modern wrist watches, the Longines company of Switzerland have developed an electronic watch, called the "Ultra Quartz", which is claimed to maintain an accuracy of one tenth of a second per day or less than one minute per year.

It uses a quartz crystal oscillator to control the speed of a vibrating motor by comparison with actual motor speed. The quartz resonator operates at a frequency of 8,192Hz while the vibrant motor oscillator runs at a much lower frequency, 170Hz. The difference signal detected by the comparator is used to stabilise the motor speed.



The electronics comprises 14 transistors, 19 resistors and 7 capacitors which, with the motor drive and 1·35V screw-in battery, is built into a case. Battery life is in excess of 18 months. The watch is not expected to become generally available until late 1970, when it will retail for about £150.

A Register of Engineers

THE organisation of a composite register covering the principal sections of the engineering community is proposed by The Council of Engineering Institutions. Those to be eligible for inclusion in this register are Chartered Engineers, Technician Engineers, and Engineering Technicians.

A Working Party has been set up to implement the intention and its first duty will be to prepare a submission to the Privy Council to get agreement to such modifications to the CEI Charter and By-laws as may be necessary, and then to determine which other interested parties should be invited to collaborate.

The Council of Engineering Institutions embraces all branches of engineering. Its constituent members include the I.E.E. and the I.E.R.E.

Instant Banking

NINE BANKS have commissioned NDPS (GPO National Data Processing Service) to set up and operate a computing system for handling nearly 20 million transactions a year.

Customers' records will be maintained on a large magnetic disc file and will be amended in real time by transactions received from bank branches. The terminals will automatically align the passbook and will print transaction details and new balances in the book while the customer waits, the entire process taking a claimed maximum of five seconds.

The system will cover other aspects of TSB work, including the automatic processing of standing orders and savings scheme transactions and the maintenance of customer records.

ELECTRONICS AT THE DUTCH

FIRATO-69

INTERNATIONAL EXHIBITION

THE 16th biennial Firato International Electronics Exhibition held at the R.A.I. Gebouw in Amsterdam attracts a very large audience. This year colour television was competing heavily with hi fi, electronic musical instruments and home video recording.

One of the highlights of the exhibition was a display of "50 years in sound recording and broadcasting" in which the original transmitter of the first Dutch broadcasting station PCGG was featured.

The Dutch Amateur Radio organisation V.E.R.O.N. were operational with s.s.b. transmitters on 80, 40, and 20 metres and the N.V.G. tape recording and colour slide society were showing the new Philips domestic video tape recorder in action.

An organisation called "Elektron", which is an information centre for students and others interested in electronics, were also displaying a vast range of equipment, books and literature. Elektron is sponsored by the joint efforts of various Government departments, professional institutions, major electronics companies and industrial and scientific organisations.

SMALLEST TELEVISION

The Firato is a very large exhibition covering even domestic electrical products and although most of the hi fi equipment, electronic musical instruments and other equipment on show were of either British, Dutch, German or Japanese manufacture, there were items being shown for the first time that have not yet appeared in the U.K.

Some of these may have arrived here by the time this report appears in print. For example, what is claimed to be the world's smallest complete television receiver was being shown by the National Company of Japan. This tiny receiver, called the National Panasonic, is operated entirely from an internal battery and has a screen only 25mm × 25mm.

VIDEO AND TAPE

The Japanese Akai company were showing for the first time a domestic video tape recorder that uses standard ¼in wide tape and converts to a conventional quarter-track stereo recorder. This can be supplied complete with a standard television receiver and video camera and it employs twin rotating heads for video recording and playback.

No details were available regarding video frequency response but recordings from the tape taken off camera were producing pictures as well defined as those from average television broadcast reception.

Philips also introduced their new domestic video tape recorder which employs ½in wide tape and a scanning head record/replay system. This too is available complete with camera and a standard television receiver on which video recordings can be reproduced.

Another unusual tape recorder was the Japanese made "Dokorder" which makes copies, hence the four spools as can be seen in the photograph. It has separate tape head sets for recording, replay and copying but employs a common tape drive for both normal recording and the copying facility. The tape drive is a centre capstan system and will run the tape in either direction.

Most of the hi fi equipment on show was the same as that available in the U.K., in fact quite a number of British manufacturers were exhibiting. One novel item however, was a stero headphone set with a built-in f.m. receiver and aerials. This was produced by the Japanese National Company and the receiver covers the normal 87 to 108MHz band. The outfit is battery operated, has a stereo balance control and can also be connected to a hi fi amplifier system.

ELECTRONIC ORGANS

Electronic organs were also attracting a good deal of attention. The Hammond Netherlands NV were demonstrating a completely new series of transistorised Hammond organs with the "tone wheel" sound, but which despite the vast range of voices and facilities, sells in Holland at only £500.

Another novel feature now being incorporated in electronic organs is a tape cassette recorder, which records directly from the organ pre-amplifier or replays via the main amplifier. The new Gawina organ (Dutch made) has this facility and they also supply pre-recorded cassette tapes for instructional and practice purposes.

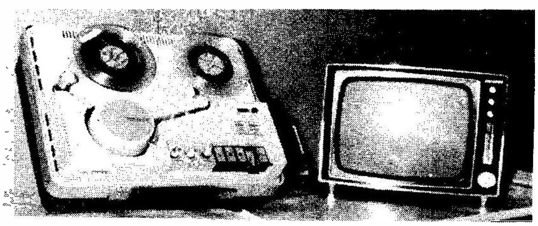
A large annual exhibition on the lines of the Firato might be a worthwhile proposition in this country instead of the many small and separate "trade only" and/or "open to the public" exhibitions now being run at odd intervals during the year.

F.C.J.

The new Akai video/audio tape recorder (left) records TV with a scanning head system on ¼in tape

This four spool "Dokorder" (right) is a new idea from Japan, that makes copies of tapes but employs a single tape drive system

The latest from Philips in Holland. A domestic video tape recorder (below) which uses ½in wide tape and a scanning head system for video recording and playback



LIND-AIR OPTRONICS LTD

See our vast range of
Electronic Components
and Accessories
at our enlarged
Component Centre
25 Tottenham Court Road

LIND-AIR COMPACT HI-FI STEREO SYSTEM

ONLY 39½ GNS.

Carr. & Ins. 25/-.

NEVER BEFORE SUCH VALUE!

Big sound at low cost! 6 watt r.m.s. per channel. Controls: Bass, Treble, Volume, Balance, Function selector. Mono/Stereo switch. Tape record outlet. Inputs for Tape replay/Tuner. Headphone facility. Beautiful teak case with matched loudspeakers. Garrard Autochanger unit fitted Stereo Cartridge.

LIMITED PERIOD ONLY! EXCLUSIVE TO LIND-AIR!

Visit our Brand New enlarged
Hi-Fi Demonstration Room,
Tape, Record Bar and
Scientific Show of
Microscopes, Binoculars,
Telescopes and Watches at
18/19 Tottenham Court Road

MAINS KEYNECTOR

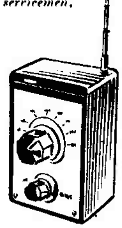
SAVES TIME—SAFELY!

One mains "Keynector" instantly and safely connects electrical appliances to mains supply without the use of a plug. A number of appliances may be used simultaneously up to the full 13 amp rating of this device. A red light glows when "live". The "Keynector" is fused and has its own robust switch which is interlocked to prevent connections when "live".

Invaluable to handymen, servicemen, demonstrators, etc.

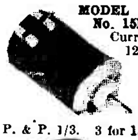
39/6 P. & P. 3/-.

VHF AIRCRAFT BAND CONVERTOR.



When placed within 1in. of a MW band radio full coverage of VHF Aircraft Band 108-135Mc/s. can be obtained. All transistor, 9V battery operation. Fully tunable 18½in. × 7-section telescopic aerial. Size 4 × 2¾ × 1⅜in. **79/6.** P. & P. 3/6.

MODEL MAKER'S MOTOR No. 15RN.

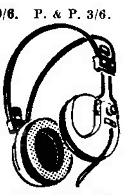


Voltage 11·5V. Current 400mA. Torque 12g.cm. Body size 1⅜" long × ⅞" dia. Shaft 5/16" long × 1/16" dia. Ideal for small models and toys. **5/6** each. P. & P. 1/3. 3 for **15/-**. P. & P. 2/6.

DE-LUXE STEREO HEADPHONES

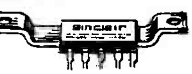
With soft rubber earpieces. Impedance 8-16 ohms. Frequency response 23-13,000cps. With lead and stereo plug. Only **59/6.** P. & P. 3/6.

NEW STEREO/MONO HEADPHONES.



SDH-7. Soft rubber earpieces with slide switch for mono/stereo listening and ind. vol. controls. Impedance 8–16 ohm Freq. response 25–15,000cps. With lead and stereo plug. **£6.6.0.** P. & P. 3/6.

SINCLAIR IC-10 INTEGRATED CIRCUIT



10 watt Amplifier. Size only 1 × 0·4 × 0·2in. A true hi-fi amplifier complete with manual giving details of a wide range of applications and instructions. Guaranteed 5 years. ONLY **59/6.** P. & P. 1/6.

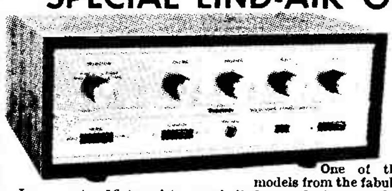
SPECIAL TRANSFORMER FOR OPERATING SINCLAIR IC-10 from A.C. mains 230/250V. Output 13V. at 0·5 amps. **12/6.** P. & P. 2/6.

HI-TONE RECORDING TAPE

BRITISH MADE TOP QUALITY

J1001	3"	Long Play PVC	225ft	**5/6**	P. & P. 1/2
J1002	3"	Triple Play Poly	600ft	**10/6**	P. & P. 1/2
J1003	5"	Long Play PVC	900ft	**10/-**	P. & P. 1/8
J1004	5"	Double Play Poly	1200ft	**15/-**	P. & P. 1/8
J1005	5¾"	Long Play PVC	1200ft	**12/6**	P. & P. 2/-
J1006	5¾"	Double Play Poly	1800ft	**22/6**	P. & P. 2/-
J1007	7"	Standard Play PVC	1200ft	**12/6**	P. & P. 2/6
J1008	7"	Long Play PVC	1800ft	**17/6**	P. & P. 2/6
J1009	7"	Double Play Poly	2400ft	**25/-**	P. & P. 2/6
J1010	7"	Triple Play Poly	3600ft	**50/-**	P. & P. 2/6

SPECIAL LIND-AIR OFFER!

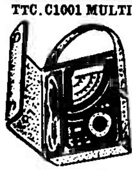


TELETON SAQ203 TRANSISTOR STEREO AMPLIFIER

One of the most popular models from the fabulous Teleton range. Incorporates 16 transistors and diodes producing superb quality hi-fi. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble. Stereo/Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price **£28.7.0**

OUR PRICE 22 GNS

TTC. C1001 MULTITESTER in leather case.

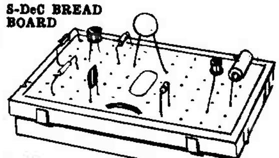


Overload protection. 20,000 opv. AC volts 10, 50, 250, 1,000V. DC, volts 5–25, 125, 500, 2,500V. DC Current 0–50μA, 0–250mA Resistance 0–60K, 0–6 Megohm. Decibels −20 to +22dB. Size of meter 4½ × 3¾ × 1 in. **85/-.** P. & P. 3/6.

SHIRA 62D MULTI-TESTER 20,000 o.p.v.

DC voltage: 5-25-50-250-500-2·5K (20,000 ohms per volt). AC Voltage: 10-50-100-500 1000 volts (10,000 ohms per volt). DC Current: 0-50μA, 0-2·5mA, 0-250mA. Resistance: 0-6K, 0-6Mg (300 ohm and 30K at centre scale). Capacitance: 10pf. to ·001 mfd, ·001μf to ·1μF. Decibels: −20 to +22dB. Size 4½ × 3½ × 1in. Complete with case **77/-.** P. & P. 3/6.

S-DeC BREAD BOARD



British made

Solderless breadboard panels, for fast reliable component connections.

Single DeCs. One S-DeC with Control Panel, Jig and Accessories for solderless connections to controls, etc., with booklet "Projects on S-DeC" giving construction details for a variety of circuits. **29/6.** P. & P. 2/6.

4-DeC KIT. Four S-DeCs wth two Control Panels, Jigs and Accessories and the booklet "Projects on S-DeC" all contained in a strong attractive plastic case. Ideal for the professional user. **£5.17.6.** P. & P. 3/6.

TRANSFORMERS

AUTO WOUND TRANSFORMERS

All winding voltage ratings and tappings 0–115–200–220–240V, except MT113 0–115–210–240V

		Size	Weight	Price	
MT113	20W	2⅝ × 1⅞ × 1⅝in	11oz	**12/6**	(P. & P. 2/6)
MT64	75W	2¾ × 2½ × 2⅞in	1lb 14oz	**21/9**	(P. & P. 4/6)
MT4	150W	3⅛ × 2¾ × 3in	3lb	**33/-**	(P. & P. 6/-)
MT65	200W	3½ × 4½ × 4in	4lb	**39/6**	(P. & P. 6/-)
MT66	300W	4 × 4 × 3¾in	6lb 7oz	**59/4**	(P. & P. 9/-)
MT110	400W	4¾ × 4½ × 4in	11lb	**85/-**	(P. & P. 10/-)
MT67	500W	5½ × 4 × 4½in	12lb 8oz	**89/-**	(P. & P. 10/6)
MT83	750W	4½ × 5½ × 5½in	13lb 4oz	**95/7**	(P. & P. 10/6)
MT84	1000W	4½ × 5½ × 5½in	16lb	**142/2**	(Carr. extra)
MT93	1500W	5 5/16 × 5⅞ × 6½in	28lb 9oz	**170/6**	(Carr. extra)
MT94	1750W	5 5/16 × 6⅝ × 6½in	31lb	**195/-**	(Carr. extra)
MT95	2000W	7 × 6½ × 8½in	40lb	**211/2**	(Carr. extra)
MT73	3000W	6⅞ × 7⅛ × 8⅝in	45lb 8oz	**300/-**	(Carr. extra)

LOW VOLTAGE 12V RANGE

Primary 200-250V; secondary 12V

MT111	0·5A	3 × 2½ × 1¾in	12oz	**15/3**	(P. & P. 2/6)
MT71	2A	2¾ × 2½ × 2½in	1lb	**19/-**	(P. & P. 3/9)
MT69	4A	3½ × 2¾ × 2¾in	2lb 4oz	**28/-**	(P. & P. 6/-)
MT70	6A	4 × 3 × 3⅝in	3lb 12oz	**39/-**	(P. & P. 6/-)
MT72	10A	3½ × 4½ × 4in	6lb 3oz	**51/-**	(P. & P. 9/-)
MT115	20A	4¾ × 4½ × 4in	11lb 13oz	**95/-**	(P. & P. 9/-)
MT187	30A	5½ × 4¾ × 4¾in	16lb 12oz	**180/-**	(P. & P. 13/6)

Other ranges available—Send for complete list.

GARRARD DECKS

SRP22 less cartridge	**£5. 9.6**
1025 Stereo/Mono with cart.	**£6.19.6**
2025 Stereo/Mono with cart.	**£7.19.6**
3000S Stereo/Mono with cart. ..	**£9.19.6**
3000D Stereo/Mono with cart. ..	**£10.19.6**
SP25 less cartridge	**£11.19.6**
SP25 with Decca Deram cart. ..	**£17. 4.6**
SL55 less cartridge	**£11.19.6**
SL55 with Decca Deram cart. ..	**£17. 4.6**
SL65 less cartridge	**£14. 9.6**
Covers for above	**£2.19.6**
Bases for above	**£2.10.0**
AP75 less cartridge...........	**£18.18.0**
SL75 less cartridge	**£28. 7.0**
SL95 less cartridge	**£38.19.6**
Bases for above	**£4.19.6**

SPECIAL OFFER!

SP25 less cart., with base **£13.10.0**

P. & P. Decks 12/6, Cover 4/6, Base 4/6.
P. & P. Deck/Cover/Base 17/-.

MINIATURE SOLDERING IRON

British made and designed for use with transistor circuitry but ideal for many other uses. A.C. 240V, 18W. Length 7⅛in, ¼in slide on bit. Price **32/6.** P. & P. 2/-.

LAO

LIND·AIR OPTRONICS LTD

18, 25 & 53 TOTTENHAM COURT ROAD, LONDON W.1.
Telephone: 01-580 2255/4532/7679
Shops open 9-6 pm. Monday to Saturday. Thursday until 7 pm.

ALL MAIL ORDERS To Dept. PE1269 54a Tottenham Court Road, London, W.1

P.E. WIDEBAND H.F. COMMUNICATIONS RECEIVER

By R. HIRST S.T.C. LTD.

PART THREE FIRST I.F. MODULE

THE circuit diagram of the first i.f. is given in Fig. 3.1. This unit was described in reasonable functional detail in the first article of this series. The following paragraphs should be studied in conjunction with the previously presented material and with the block diagram Fig. 1.4.

CONSTRUCTION

The complete circuit of the i.f. unit (Module 2) is shown in Fig. 3.1. As before the inductors L6, L7 and L8 should be wound first, to the information given in Fig. 3.2. The winding of L7 and L8 is carried out in the following manner: a 12in length of 20 strand 50 s.w.g. wire is doubled and wound onto the bobbin as if it were a single wire. The 11 turns of wire should make up slightly more than one complete layer. Once the wire is in place the bobbin is covered with varnish and allowed to set. The cores are then glued around the bobbin and fixed to the circuit board.

Once the inductors have been completed the circuit board should be constructed in a manner similar to that indicated last month for the r.f. unit. Layout and wiring details for the i.f. module are shown in Fig. 3.3. The construction of the module case was detailed last month.

SETTING UP INSTRUCTIONS

This particular section applies to the constructor who has sufficient equipment to make the necessary measurements listed below. The instruments required are as follows:

(a) **Power supply:** 12 volts, 50mA and 2·5V, 5mA.
(b) 34MHz **signal generator** capable of delivering 1mV into 50 ohms.
(c) 36MHz **signal generator** capable of delivering 1V into 50 ohms.
(d) **Valve voltmeter** capable of measuring 100μV to 1V at 2MHz to 36MHz.

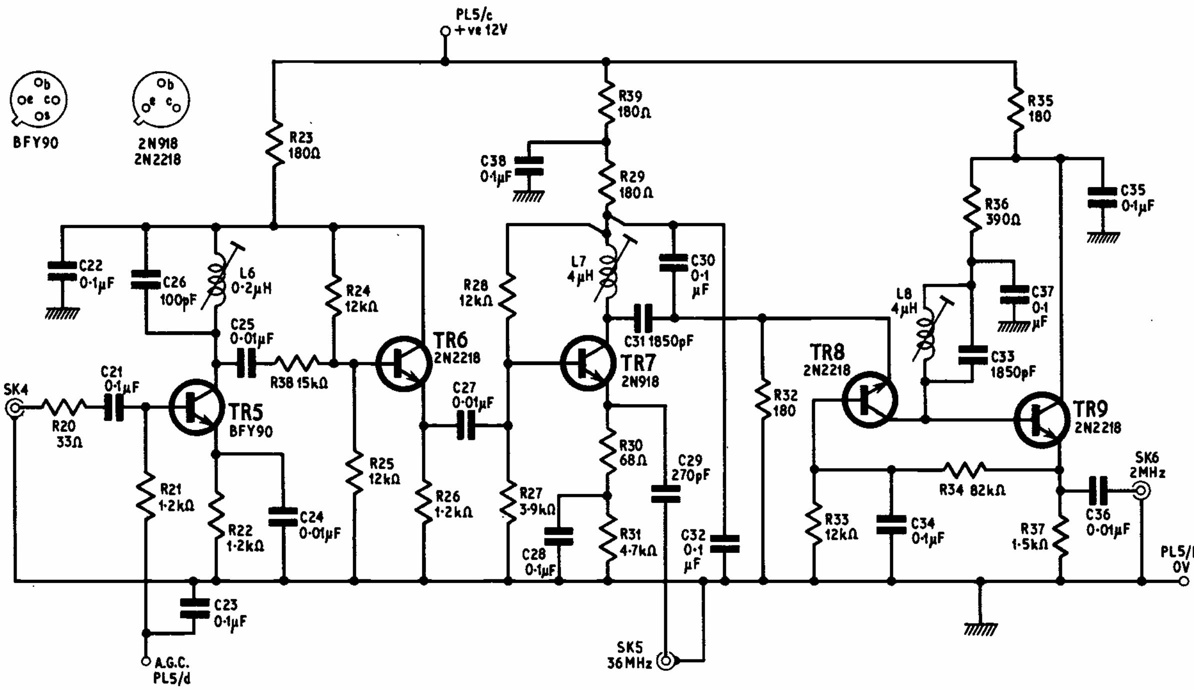
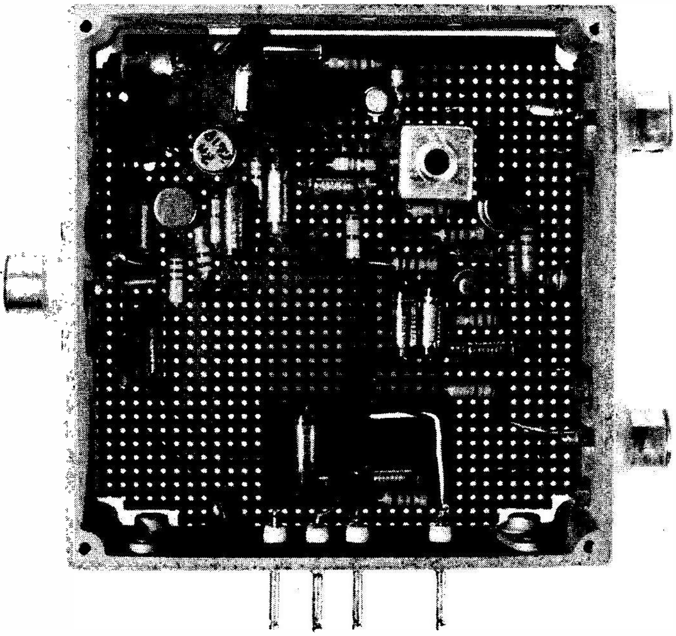


Fig. 3.1. The complete circuit diagram of the i.f. unit



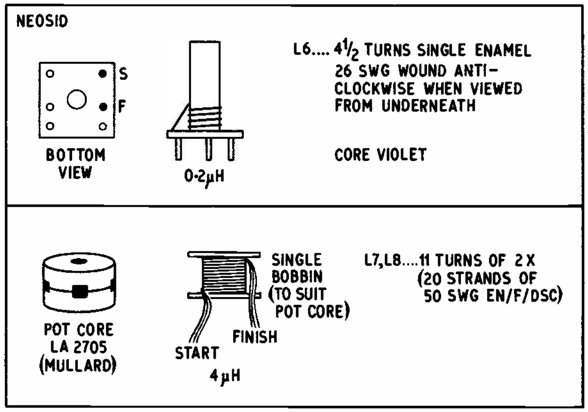
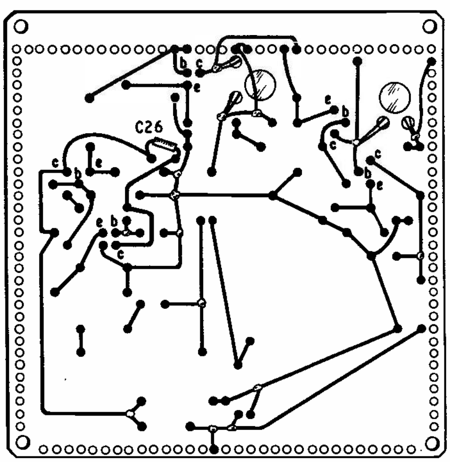


Fig. 3.2. Coil winding details for the i.f. unit

PROCEDURE

Apply the required h.t. potential, ensuring correct polarity, and set the a.g.c. voltage at the incoming terminal (PL5/d) to 2·5 volts. Check all potentials at the base, collector and emitter of each stage to ensure that they correspond with the levels indicated in Table 3.1. Resistor R34 may be adjusted in value if the voltage at the emitter of TR9 is less than eight volts or more than ten volts. Once R34 has been adjusted recheck all the potentials. If the circuit appears to be functioning correctly from a d.c. point of view the a.c. testing can be undertaken as follows.

Apply a 34MHz signal to SK4 and set the level of this signal to 1 millivolt. Connect the valve voltmeter across R27 and adjust L6 for maximum signal. Now apply a 36MHz signal at a level of 400 millivolts to SK5 (this level to be measured when connected to SK5) and transfer the millivoltmeter to SK6. Inductors L7 and L8 should now be adjusted so that a maximum reading is obtained on the meter. Having adjusted the two coils in this latter measurement it is advisable to reduce the input signal of 34MHz by 10dB and readjust coils L6, L7 and L8 for maximum output. If the 34MHz input signal is set so that the output at SK6 is 500 microvolts and the a.g.c. voltage adjusted for maximum output at SK6 by measuring the input signal



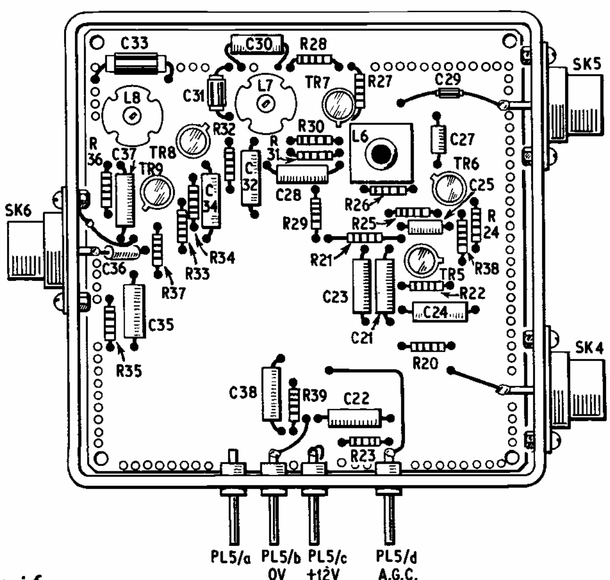


Fig. 3.3. Veroboard layout and wiring details of the i.f. module

COMPONENTS...

I.F. UNIT

Resistors

R20	33Ω	R27	3·9kΩ	R34	82kΩ
R21	1·2kΩ	R28	12kΩ	R35	180Ω
R22	1·2kΩ	R29	180Ω	R36	390Ω
R23	180Ω	R30	68Ω	R37	1·5kΩ
R24	12kΩ	R31	4·7kΩ	R38	15kΩ
R25	12kΩ	R32	180Ω	R39	180Ω
R26	1·2kΩ	R33	12kΩ		

All 5%, ¼W to ½W high stability carbon film

Capacitors

C21	0·1μF	Polyester or foil
C22	0·1μF	Polyester or foil
C23	0·1μF	Polyester or foil
C24	0·01μF	Ceramic
C25	0·01μF	Ceramic
C26*	100pF	Polystyrene
C27	0·01μF	Ceramic
C28	0·1μF	Polyester or foil
C29	270pF	Polystyrene
C30	0·1μF	Polyester or foil
C31*	1,850pF	Polystyrene
C32	0·1μF	Polyester or foil
C33*	1,850pF	Polystyrene
C34	0·1μF	Polyester or foil
C35	0·1μF	Polyester or foil
C36	0·01μF	Ceramic
C37	0·1μF	Polyester or foil
C38	0·1μF	Polyester or foil

* The exact value of these capacitors will depend on the coils; it may be necessary to adjust the capacity to suit

Transistors

TR5	BFY90	TR7	2N918	TR9	2N2218
TR6	2N2218	TR8	2N2218		

Inductors

L6 0·2μH
L7 4μH See Fig. 3.2
L8 4μH

Miscellaneous

Veroboard 3½ × 3½in, 0·1in grid
PL5/a, b, c, d insulated lead through connectors (4 off)
SK4, 5, 6 coaxial chassis mounted sockets (3 off)

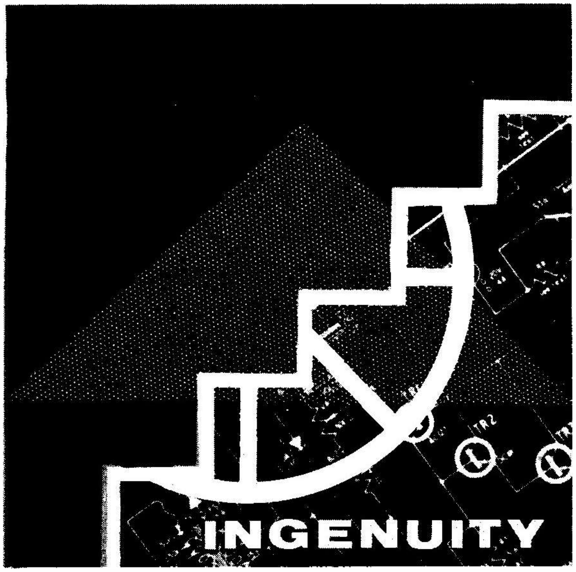
of 34MHz, the overall gain of the unit may be determined. This input level should be in the order of 25 microvolts. The i.f. unit is now complete.

Table 3.1. I.F. UNIT D.C. VOLTAGES

Stage			Voltage
TR5	V_c	=	11V
	V_b	=	2·3V
	V_e	=	1·8V
TR6	V_c	=	11V
	V_b	=	5·6V
	V_e	=	5V
TR7	V_c	=	11V
	V_b	=	2·8V
	V_e	=	2·1V
TR8	V_c	=	9·6V
	V_b	=	1V
	V_e	=	0·4V
TR9	V_c	=	10·5V
	V_b	=	9·6V
	V_e	=	9V

The measurements for TR5 were taken with the incoming a.g.c. voltage set for 2·5 volts at the input terminal. A 20 kilohm per volt voltmeter was used in all the measurements.

Next month: details of further modules



UNLIMITED!

A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.
This is YOUR page and any idea published will be awarded payment according to its merit.

TAPE STOP-FOIL DEVICE

SOME years ago, I decided to build a stop-foil device for my tape recorder, and not wanting the machine to draw any current, even the small amount needed to hold the relay down, I devised a latching relay using a small permanent magnet. The applied voltage is derived from the tape recorder 6·3V heater supply, and is rectified and smoothed by D1 and C1 before it is connected to the relay, Fig. 1.

The relay used is a Keyswitch subminiature, type 1051, having a 6V 120 ohm coil, and single-pole changeover contacts rated at 250V 5A continuous load. The diagram in Fig. 2 shows the positioning of the permanent magnet glued to the top of the armature. The foil contacts are arranged as shown in Fig. 3, and only about an inch of foil is actually required.

The pèrmanent magnet has to be mounted so that the polarity of the electromagnet on the relay is opposite to the bottom end of the magnet glued to the armature. Once the relay has been triggered the relay is then held on by the attraction of the permanent magnet, even though the supply voltage has been removed.

Any small type of magnet will suffice, and the beauty of the device is that it effectively turns the whole machine off. The relay is reset manually by pushing a lever connected to the armature as shown in Fig. 2, although an electrical reset is also possible.

T. Price,
Pencoed.

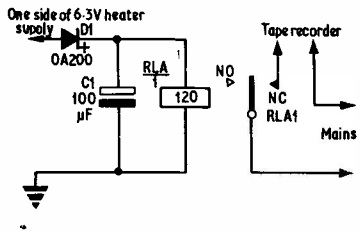


Fig. 1. Tape stop-foil circuit

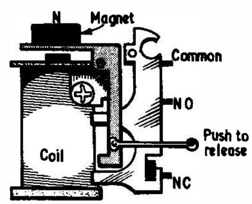


Fig. 2. Positioning of permanent magnet on relay

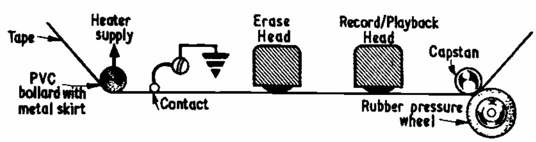


Fig. 3. Contact arrangement of tape stop-foil device

LOGICAL STATE INDICATOR

THE circuit diagram in Fig. 1 was designed to enable the logical state of i.c. flip-flops, such as the Motorola MC790P or the Fairchild μL923 to be determined.

The high input impedance avoids any possibility of the flip-flop outputs being loaded down, which would inhibit their operation.

When the input is at 0V (logical 0 in positive logic system) the lamp is off. When the input is at 3V or so (logical 1) the lamp is on.

L. F. Heller,
London, W.4.

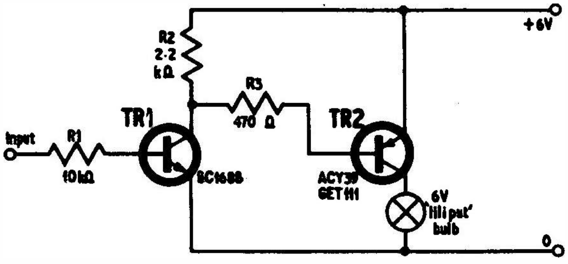


Fig. 1. Logical state indicator circuit diagram

VALUE ALL THE WAY

INTEGRATED CIRCUITS

BI-PAK MONOLITHIC DIGITAL CIRCUITS (10 lead TO-5)

BP305A, 6-Input AND gate, **9/6 each.**
BP314A, 7 Input NOR gate, **9/6 each.**
BP315A, Dual 3-Input NOR gate, **9/6 each.**
BP316A, Dual 2-Input NOR gate (expandable), **9/6 each.**
BP320A, J-K-Binary element, **11/6 each.**
BP332A, Dual 3-Input OR gate, **9/6 each.**

BI-PAK MONOLITHIC AMPLIFIERS (TO-5 8 lead)

BP709C, Operational amplifier, **15/- each.**
BP701C, Operational amplifier (with Zener output), **12/6 each.**
BP702C, Operational amplifier (with direct output), **12/6 each.**
BP501, Wide band amplifier, **18/- each.**
BP521, Logarithmic wide band amp., **14/- each.**
BP20/C, General purpose amplifier (TO-5 8 lead). (voltage or current amp.). **12/6 each.**
I.C. Operational Amplifier with Zener output. **Type 701C.** Ideal for P.E. Projects. 8 Lead TO-5 case. Full data.

Our price 12/6 each

5 off 11/- each. Large Qty. Prices quoted for.

OTHER MONOLITHIC DEVICES

BP424, Zero voltage switch, **8/6 each.**
This device is a monolithic I.C. that acts as combined threshold detector and trigger circuit for controlling a triac. It is designed to pulse the gate of a thyristor at the point of zero supply voltage, and therefore eliminate radio frequency interference when used with resistive loads.
D13D1 Silicon Unilateral switch **10/- each.**
A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

FAIRCHILD (U.S.A.) RTUL MICROLOGIC INTEGRATED CIRCUITS

Epoxy case T8-5 lead temp. range 15°C. to 55°C.
UL900, Buffer, **10/6 each.**
UL914, Dual two-input gate, **10/6 each.**
UL923 J-K-flip-flop, **14/- each.**
Complete data and circuits for the Fairchild I.C.'s available in booklet form priced **1/6.**

MULLARD I.C. AMPLIFIERS

TAA243, Operational amplifier, **70/- each.**
TAA263, Linear AF amplifier, **18/6 each.**
TAA293, General purpose amplifier, **21/- each.**

CA3020 RCA (U.S.A.) LINEAR INTEGRATED CIRCUITS

Audio Power Amplifier, **30/- each.**
Owing to the mass of I.C. printed matter often required by customers in connection with the I.C.'s themselves we ask you to help us in the cost of reproducing this literature by adding 2s. towards same. This is only necessary when a number of different sheets are required.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 1/- each. Any Qty.

AD161 *NPN*
AD162 *PNP*

MATCHED COMPLEMENTARY PAIRS OF GERM. POWER TRANSISTORS.
For mains driven output stages of Amplifiers and Radio receivers.
OUR LOWEST PRICE OF **12/6** *PER PAIR*

HIGH POWER SILICON PLANAR TRANSISTORS. TO-3.
TEXAS 2S034 NPN
VCB100 Ic 4A
fT. 15M/cs
VCE100 Ptot. 40W
VEB8 hFE(min.)
15/- each 60
2N3055 **12/6** each.

FREE

One 10/- Pack of your own choice free with orders valued £4 or over.

NPN DIFFUSED SILICON PHOTO-DUO-DIODE TYPE IS701 (2N2175) for Tape Readout, high switching and measurement indicators. 50V, 250mW. OUR PRICE **10/-** EACH, 50 OR OVER **8/6** EACH, FULL DETAILS.

LOW COST F.E.T.s

Fully Tested, Guaranteed Perameters equit. to 2N3819, MPF102, 2N-5459. 1-24 **7/6** each; 25-99 **6/3** each; 100 up **5/6** each. Coded FE19. Full data sent. TO-72 case.

TRIACS

2A, 400 PIV, TO-5 case, **20/-** each; 6A, 400 PIV, TO-66 case, **25/-** each; 10A, 400 PIV, TO-48 case, **35/-** each. New and fully tested.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		
U1	120 Glass Sub-min. General Purpose Germanium Diodes	10/-
U2	60 Mixed Germanium Transistors AF/RF	10/-
U3	75 Germanium Gold Bonded Diodes sim. OA5, OA47	10/-
U4	40 Germanium Transistors like OC81, AC128	10/-
U5	60 200mA Sub-min. Sil. Diodes	10/-
U6	40 Silicon Planar Transistors NPN sim. BSY95A, 2N706	10/-
U7	16 Silicon Rectifiers Top-Hat 750mA up to 1,000V	10/-
U8	50 Sil. Planar Diodes 250mA OA/200/202	10/-
U9	20 Mixed Volts 1 watt Zener Diodes	10/-
U11	30 PNP Silicon Planar Transistors TO-5 sim. 2N1132	10/-
U13	30 PNP-NPN Sil. Transistors OC200 & 2S104	10/-
U14	150 Mixed Silicon and Germanium Diodes	10/-
U15	30 NPN Silicon Planar Transistors TO-5 sim. 2N697	10/-
U16	10 3-Amp Silicon Rectifiers Stud Type up to 1000 PIV	10/-
U17	30 Germanium PNP AF Transistors TO-5 like ACY 17-22	10/-
U18	8 6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	10/-
U19	30 Silicon NPN Transistors like BC108	10/-
U20	12 1·5-amp Silicon Rectifiers Top-Hat up to 1,000 PIV	10/-
U21	30 A.F. Germanium alloy Transistors 2G300 Series & OC71	10/-
U23	30 Madt's like MAT Series PNP Transistors	10/-
U24	20 Germanium 1-amp Rectifiers GJM up to 300 PIV	10/-
U25	25 300Mc/s NPN Silicon Transistors 2N708, BSY27	10/-
U26	30 Fast Switching Silicon Diodes like IN914 Micro-min	10/-
U28	Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc., 8 Assorted Pieces	20/-
U29	10 1 amp SCR's T0-5 can up to 600 PIV CRS1/25-600	20/-
U30	15 Plastic Silicon Planar trans. NPN 2N2924-2N2926	10/-
U31	20 Sil. Planar NPN trans. low noise Amp 2N3707	10/-
U32	25 Zener diodes 400mW D07 case mixed Volts, 3–18	10/-
U33	15 Plastic case 1 amp Silicon rectifiers IN4000 series	10/-
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 2S302/4	10/-
U35	25 Sil. Planar trans. PNP TO-18 2N2906	10/-
U36	25 Sil. Planar NPN trans. TO-5 BFY50/51/52	10/-
U37	30 Sil. alloy trans. SO-2 PNP, OC200 2S322	10/-
U38	20 Fast Switching Sil. trans. NPN, 400Mc/s 2N3011	10/-
U39	30 RF Germ. PNP trans. 2N1303/5 TO-5	10/-
U40	10 Dual trans. 6 lead TO-5 2N2060	10/-
U41	30 RF Germ. trans. TO-1 OC45 NKT72	10/-
U42	10 VHF Germ. PNP trans. TO 1 NKT667 AF117	10/-

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked

QUALITY-TESTED PAKS

6	Matched Trans. OC44/45/81/81D	10/-
20	Red Spot AF Trans. PNP	10/-
16	White Spot RF Trans. PNP	10/-
5	Silicon Rects. 3 A 100-400 PIV	10/-
2	10 A Silicon Rects. 100 PIV	10/-
2	OC1 140 Trans. NPN Switching	10/-
1	12 A SCR 100 PIV	10/-
3	Sil. Trans. 2S303 PNP	10/-
4	Zener Diodes 240mW 3-12V	10/-
3	200 Mc/s Sil. Trans. NPN BSY26/27	10/-
3	Zener Diodes 1W 33V 5% Tol.	10/-
4	High Current Trans. OC42 Eqvt.	10/-
2	Power Transistors 1 OC26 1 OC35	10/-
5	Silicon Rects. 400 PIV 250mA	10/-
4	OC75 Transistors	10/-
1	Power Trans. OC20 100V	10/-
10	OA202 Sil. Diodes Sub-min.	10/-
2	Low Noise Trans. NPN 2N929/30	10/-
1	Sil. Trans. NPN VCB 100 ZT86	10/-
8	OA81 Diodes	10/-
4	OC72 Transistors	10/-
4	OC77 Transistors	10/-
4	Sil. Rects. 400 PIV 500mA	10/-
5	GET884 Trans. Eqvt. OC44	10/-
5	GET883 Trans. Eqvt. OC45	10/-
2	2N708 Sil. Trans. 300Mc/s NPN	10/-
3	GT31 LF Low Noise Germ Trans.	10/-
6	IN914 Sil. Diodes 75 PIV 75mA	10/-
8	OA95 Germ. Diodes Sub-min. IN69	10/-
3	NPN Germ. Trans. NKT773 Eqvt.	10/-
2	OC22 Power Trans. Germ.	10/-
2	OC25 Power Trans. Germ.	10/-
4	AC128 Trans. PNP High Gain	10/-
4	AC127/128 Comp. pair PNP/NPN	10/-
3	2N1307 PNP Switching Trans.	10/-
7	CG62H Germ. Diodes Eqvt. OA71	10/-
3	AF116 Type Trans.	10/-
12	Assorted Germ. Diodes Marked	10/-
4	AC126 Germ. PNP Trans.	10/-
4	Silicon Rects. 100 PIV 750mA	10/-
3	AF117 Trans.	10/-
7	OC81 Type Trans.	10/-
3	OC171 Trans.	10/-
5	2N2926 Sil. Epoxy Trans.	10/-
7	OC71 Type Trans.	10/-
2	2S701 Sil. Trans. Texas	10/-
3	12 Volt Zener 400mW	10/-
2	10 A 600 PIV Sil. Rects. 1S45R	10/-
3	BC108 Sil. NPN High Gain Trans.	10/-
1	2N910 NPN Sil. Trans. VCB 100	10/-
2	1000 PIV Sil. Rect. 1·5 A R53310 AF	10/-
3	BSY95A Sil. Trans. NPN 200Mc/s	10/-
3	OC200 Sil. Trans.	10/-
2	GET880 Low Noise Germ. Trans.	10/-
1	AF139 PNP High Freq. Trans.	10/-
3	NPN Trans. 1 ST141 & 2ST140	10/-
4	Madt's 2 MAT100 & 2MAT120	10/-
3	Madt's 2 MAT101 & 1 MAT121	10/-
4	OC44 Germ. Trans. AF	10/-
3	AC127 NPN Germ. Trans.	10/-
1	2N3906 Sil. PNP Trans. Motorola	10/-
2	Sil. Power Rects. BYZ13	15/-
1	Sil. Power Trans. NPN 100Mc/s. TK201A	15/-
6	Zener Diodes 3-15V Sub-min.	15/-
2	2N1132 PNP Epitaxial Planar Sil.	10/-
3	2N697 Epitaxial Planar Trans. Sil.	15/-
4	Germ. Power Trans. Eqvt. OC16	15/-
1	Unijunction Trans. 2N2646	15/-
2	Sil. Trans. 200Mc/s 60Vcb ZT83/84	15/-
1	Tunnel Diode AEY11 1050 Mc/s	15/-
2	2N2712 Sil. Epoxy Planar HFE225	15/-
8	BY100 Type Sil. Rects.	20/-
25	Sil. and Germ. Trans. Mixed, all marked, New	30/-

LUCAS 35A SIL. RECTS.

Branded. 400 PIV. Special Price, stud type, flying lead, **22/6** each.

SPECIAL OFFER S.C.R.s

3A, 400 PIV similar to CRS3/40AF—BYT97400R, 2N1777, **10/-** each; 25-99, **9/-** each; 100 up **8/6** each.

NPN SILICON PLANAR

BC107/8/9, **2/-** each; 50-99, **1/10**; 100 up, **1/8** each; 1,000 off, **1/6** each. Fully tested and coded TO-18 case.

PNP SIL. PLASTIC TRANS.

Similar to 2N3702, uncoded but fully tested, **1/6** each; 25-99, **1/3** each; 100 up, **1/-** each.

"TRANSISTOREN"

Transistor equit. book. New Dutch edition printed in English. Equit. to European, American and Japanese Trans. 190 pages, **15/-** each.

SPECIAL CLEARANCE OF GET120

PNP Med. Power Trans. complete with heatsink, Mica washers, etc. similar to NKT303, I.C. 2A, 5W, **2/6** each; 12 up, **2/-** each.

BRAND NEW TEXAS GERM. TRANS.

Coded and Guaranteed

Pak No.			EQVT.	
T1	8	2G371B	OC71	10/-
T2	8	2G374	OC75	10/-
T3	8	2G3744A	OC81D	10/-
T4	8	2G381A	OC81	10/-
T5	8	2G382T	OC82	10/-
T6	8	2G344A	OC44	10/-
T7	8	2G345B	OC45	10/-
T8	8	2G378	OC78	10/-
T9	8	2G399A	2N1302	10/-
T10	8	2G417	AF117	10/-

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-16V.

400mW (DO-7 Case) ..... **2/6** each
1·5W (Top-Hat) ...... **3/6** each
10W (SO-10 Stud) ...... **5/-** each
All fully tested 5% tol. and marked state voltage required.

SILICON HIGH VOLTAGE RECTIFIERS

10 Amp 3 kV (3000 PIV). Stud type with flying leads **16/-** each

2N2060 NPN SIL. DUAL TRANS.

CODE D1699 TEXAS. OUR PRICE **5/-** each.

120 VCB NIXIE DRIVER TRANSISTOR Sim. BSX21 & C407. 2N1893 FULLY TESTED AND CODED ND120. 1-24 **3/6** each. TO-5 NPN 25 up **3/-** each.

PLEASE NOTE. To avoid any further Increased Postal Charges to our Customers and enable us to keep our "By Return Postal service" which is second to none, we have re-organized and streamlined our Despatch Order Department and we now request you to send all your orders together with your remittance, direct to our Warehouse and Despatch Department, postal address: **BI-PAK SEMICONDUCTORS, Despatch Dept., P.O. BOX 6, WARE, HERTS.** Postage and packing still 1/- per order. Minimum order 10/-.

FET'S

2N 3819......... **10/-**
2N 3820......... **25/-**
MPF105......... **8/-**
OCP71 Type ... **8/6**

UNIJUNCTION

UT46, Eqvt. 2N2646, Eqvt. TIS43. BEN3000 **7/6** ea. 25–99 **5/-** 100 up **4/-**

CADMIUM CELLS

ORP60, ORP61 **8/-** each

TESTED SCR'S

PIV	1A	7A	16A	30A
25	—	7/6	—	30/-
50	7/6	8/6	10/6	35/-
100	8/6	10/-	15/-	45/-
200	12/6	15/-	20/-	55/-
300	15/-	20/-	25/-	—
400	17/6	25/-	35/-	80/-
500	30/-	40/-	45/-	95/-
600	—	40/-	50/-	—

SIL. RECTS. TESTED

PIV	750mA	3A	10A	30A
50	1/-	2/9	4/3	9/6
100	1/3	3/3	4/6	15/-
200	1/9	4/-	4/9	20/-
300	2/3	4/6	6/6	22/-
400	2/6	5/6	7/6	25/-
500	3/-	6/-	8/6	30/-
600	3/3	6/9	9/-	37/-
800	3/6	7/6	11/-	40/-
1000	5/-	9/3	12/6	50/-
1200	6/6	11/6	15/-	—

BI-PAK

Giro No. 388-7006

500 CHESHAM HOUSE
150 REGENT STREET
LONDON, W.1

KING OF THE PAKS BI-PAK GUARANTEE SATISFACTION OR MONEY BACK

0·0005 mFd TUNING CONDENSER

Proved design, ideal for straight or reflex circuits. **2/6** each. **24/-** doz.

ELLIOT SEALED CONTACT REED RELAY

Three circuits closed by 3V or 100 MA. **9/6** each.

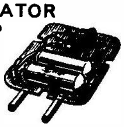
SLIM TUBULAR MICROPHONE

For hand holding or frontal suspension—lever switch—high impedance with lead and plugs for cassette tape recorder but suitable for most amplifiers. **19/6.**

500 MICRO AMP MOVING COIL METER

2in flush mounting round meter ex Government but unused and perfect. **17/6.**

PP3 BATTERY ELIMINATOR

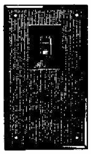


Run your small transistor radio from the mains—full wave circuit—made up ready to wire to your set and adjustable high or low current. **8/6** each.

5000 mFd 12V CONDENSER

Tubular size 3 × 1in dia., made by Plessey. **4/9** Each, **48/-** doz.

5A, 3 PIN SWITCH SOCKETS

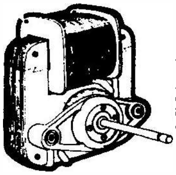


An excellent opportunity to make that bench dis board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered 5A switch sockets for only **10/-** plus 3/6 post and insurance. (20 boxes post free.)

5in x 5in PRINTED CIRCUIT BOARD

Ideal for dozens of projects. Heavy copper on $\frac{1}{32}$ sheet. **1/6** each or **15/-** per dozen.

MAINS MOTOR



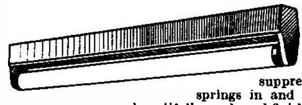
Precision made — as used in record decks and tape recorders—ideal also for extractor fans, blower, heater, etc. New and perfect. Snip at **9/6.** Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

Horstmann "Time and Set" Switch

(A 15 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 period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price **29/6**, p. & ins. 4/6.

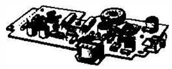
ATLAS SLIMLINE FLUORESCENTS

THE TWENTYLITE



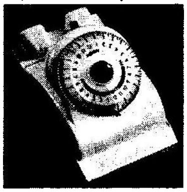
A Fluorescent lighting unit made by the famous Atlas company, with super silent polyester filled choke and radio suppressed starter. The tube springs in and out and the whole unit is beautifully made and finished white enamel. Amazingly economical. If left on all the time costs only one penny per day (uses ¼ unit). Measures 2ft long. Is ideal in Kitchen, Bedroom, Hallway, Porch, Loft, etc. Don't miss this amazing offer, **39/6** with tube. Assembled ready to install. **4ft. twin model 59/6.** Postage and insurance 6/6 extra.

1 WATT AMPLIFIER & PREAMP



5 transistors—highly efficient made for use with tapehead G4 but equally suitable for microphone or pick up—limited quantity **29/6.** Full circuit diag. also shows tape controls 5/-.

DREAMLAND CLOCK SWITCH



The wonderful DREAMLAND mains operated clock switch will automatically switch your blanket on and off each evening and you will always have a warm bed. It's luminous; you can always see the time and it's a really beautiful unit. An ideal gift. Can also control tape recorder, radio, lamp, etc., up to 500 watts. **39/6** plus 3/6 post and ins.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 kΩ in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ¼in. thick. Rated at 500MW, wire ended, **8/6** with circuit.

INSTRUMENT BUZZER

6-12 volts, adjustable tone, a very neat metal cased U.S.A. made unit, approx. 1¼in. × 1in. × ¾in. thick. **6/6** each.

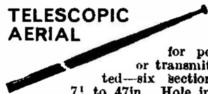
ELECTRIC BLANKET BARGAIN

Famous Norvic electric blanket claimed to be the most reliable in Britain. We offer at less than wholesale price "Corona de luxe" model, this has flame resistant super safe element and double thick fleecy cover attached by press studs—just undo the press studs to wash cover—double bed size 60 × 48in—with control switch giving choice of three heats—in presentation box showing regular price **£9.3.9**—we offer at **£5.19.6.**

THERMAL CUTOUT

A miniature device ⅜in dia. on one screw fixing mount—can be used for motor overload protection—fire alarm—soldering iron switch off, etc. etc. —15 amp contacts open with flame, radiant or conducted heat. **1/6** each, **15/-** doz., **£5** 100.

TELESCOPIC AERIAL



for portable, car radio or transmitter. Chrome plated—six sections, extends from 7¼ to 47in. Hole in bottom for 6BA screw. **7/6.**

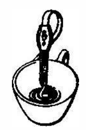
2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heat (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit **£3.15.0.** Post and ins., 7/6 or **made up model £4.15.0. Post & ins. 7/6.**

COPPER CLAD ELEMENT

1250 watts—4ft. long but bent to U shape, ideal for overhead heater—just mount reflector above, **12/6** each, plus 4/6 post. **£6** doz. post paid.

QUICK CUPPA



Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **19/6,** post and insurance 1/6. 12v. car model also available.

Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semiconductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

ELECTRONICS (CROYDON) LTD

Dept. PE, 266 London Road, Croydon CRO 2TH

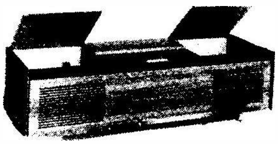
Also 102/3 Tamworth Road, Croydon

STEREOGRAM CABINET £19

An elegant Stereogram Cabinet in modern Veneered Mahogany and cloth covered Front Panel

BLACK LEATHERETTE SIDE PANELS

Dimensions: 52" × 17½" × 12". Speaker positions for Twin 10" × 5" Speakers



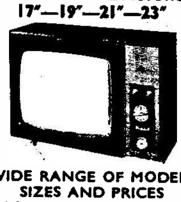
SPEAKERS 6/6
2"—75Ω. 2½"—35Ω. P. & P. 2/6.
ACOS MICS. 35/- STANDARD
STICK MIC. 2gns. P. & P. 3/6.
ASSORTED CONDENSERS
10/- for 50. P. & P. 7/6.
ASSORTED RESISTORS
10/- for 50. P. & P. 4/6.
ASSORTED CONTROLS
10/- for 25. P. & P. 7/6.
TRANSISTORS
MULLARD MATCHED OUTPUT KIT
9/- OC81D—2 OC81's.
P. & P. FREE.
FERRITE RODS 3/6
6", 8" × ⅜" complete with LW/MW COILS. P. & P. FREE.

17in.—£11.10.0 Carr. 30/-

19in. SLIM-LINE FERGUSON 24 gns.

TWO-YEAR GUARANTEE EX-RENTAL TELEVISIONS

FREE ILLUSTRATED LIST OF TELEVISIONS 17"—19"—21"—23"



WIDE RANGE OF MODELS SIZES AND PRICES
DEMONSTRATIONS DAILY

RECORD PLAYER CABINET 49/6.
Cloth covered. Size 16½" × 14¼" × 8". Takes any modern autochanger. P. & P. 7/6.

SINGLE PLAYER CABINETS 15/6. P. & P. 7/6.

TRANSISTOR CASES 19/6. Cloth covered, many colours. Size 9½" × 6¼" × 3¼". P. & P. 3/6. Similar cases in plastic 7/6.

TWO-YEAR GUARANTEED REGUNNED TUBES
70° & 90° 14in.—69/6. 17in.—89/6. 21in.—99/6. 110° 17in., 19in. & 21in.—99/6. 23° (not bonded)—119/6. Exchanged Bowls. Carr. 10/6.

DUKE & CO. (LONDON) LTD.
621/3 Romford Road, Manor Park, E.12
Phone 01-478 6001-2-3 Stamp for Free List.

ERSIN *Multicore* 5 CORE SOLDER

for fast, easy, reliable soldering

Contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required.

SAVBIT ALLOY ALSO REDUCES COPPER BIT WEAR.

Ecomically packed for general electrical and electronic soldering. 90 ft. 18 gauge on plastic reel. Recommended retail price **15/-**

THIN GAUGE SOLDER, ESSENTIAL FOR

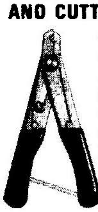
soldering small components and thin wires. High tin content, low melting point, 60/40 alloy, 202 ft. 22 gauge on plastic reel. Recommended retail price **15/-**

A RANGE OF SOLDERS IN HANDY DISPENSERS.

REF.	ALLOY	SWG	
4A	60/40	18	2/6*
Size 5 (Illustrated)	Savbit	18	2/6*
15	60/40	22	3/-*

*Recommended Price

INVALUABLE FOR STRIPPING FLEX, THE NEW AUTOMATIC OPENING BIB WIRE STRIPPER AND CUTTER,



easily adjustable for all standard diameters. Plastic covered handles can also be used as wire cutter. Recommended retail price **8/6**

From Electrical and Hardware shops. If unobtainable, write to: Multicore Solders Ltd., Hemel Hempstead, Herts.

Sonotone 9TA and 9TA/HC. Diamond Cartridge brand new, boxed in manufacturers' carton **49/6** plus 2/6 p/p. **Acos** GP 91-1 and GP 91-3 stero compatible cartridges, new in sealed manufacturers' cartons **22/6** plus 2/6 p/p.

BASF TAPE 25% OFF

5in	600ft. 14/-	900ft.	19/-	1200ft.	30/-
5¾in	900ft. 19/-	1200 ft.	24/-	1800ft.	39/-
7in	1200ft. 24/-	1800ft.	35/-	2400ft.	57/-

P/P 2/- per reel—over £5 FREE

SPECIAL PURCHASE

12in 15watt HI-FI LOUDSPEAKERS

Made by famous British manufacturer to very high standards, heavy duty cast chassis, twin cone construction, smooth extended range, with very low level of distortion.—Response 35–17,500Hz.—impedance 15 ohms—flux, 11,000 gauss.

WALDON PRICE 97/6 each plus 6/6 P. & P.

E.M.I. HI-FI SPEAKERS

SET 450: 13×8 with two built-in tweeters and cross-over unit. **Our Price 69/6.** 3 or 15 ohm, 10W, 40-13,000Hz.

SET 850: 6½in bass plus 3¾in tweeter and cross-over unit. 8 ohm, 10W, 65-20,000Hz. **79/6.**

SET 250: 5in heavy duty bass plus 3in tweeter and cross-over unit. 8 ohm, 6W, 80-20,000Hz. **65/-**

Add 5/6 p/p for each speaker set.

TRIO Stereo Moving Magnet Cartridge Model AD76K. Diamond Stereo LP Stylus. Frequency response 20-20,000c/s output. 7mV tracking pressure 2 grammes ± 0·5 grm. Fully guaranteed. Price **85/-** p/p free.

GARRARD UNITS

	£	s	d
SP25 Mk. II	11	9	6
AP75	17	19	6
SL65	14	9	6
***3500**	11	9	6

***Denotes** including Sonotone 9TA-Stereo/Diamond Cartridge. Elegantly styled plinth and cover to suit the above units. From **5 gns.** Please add 10/- p/p each on all above items.

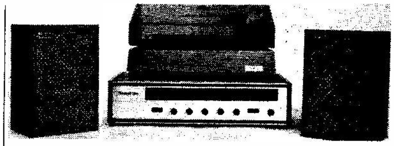
SPEAKER ENCLOSURES

Designed to accept the full range of E.M.I. loudspeakers. Beautifully styled in teak.

Prices from 89/6 each.

25 WATT GROUP SPEAKERS

Guitar group 25. 12in round, heavy duty cone, with solid aluminium chassis, 15 ohms imp. 12,000 gauss. Response 30-10,000c/s. OUR SPECIAL PRICE **£.5.9.6** plus 6/6 P. & P.



The greatest budget system available today—can't be beaten—price or quality anywhere—look at these great features—then compare:

	£	s	d
Teleton FZ000 Mk. II. Tuner amp. Latest version with all the new features. Tuning indicator—fused circuit protection, AM-FM fitted multiplex, A.F.C. 2×5 watts per channel. A truly outstanding unit.	43	1	8
Garrard 3500 (Auto/single). Latest in the great new Garrard range, provides facilities and controls that are usually found only on much more expensive units	13	11	0
Teleton SA1003 matching speaker systems	10	0	0
Sonotone 9TA stereo cartridge with diamond styli—a perfect match	4	2	0
Plinth/Cover elegantly styled	7	0	0
Plugs and Leads all supplied	1	5	0
Normal Retail Price	£78	19	8

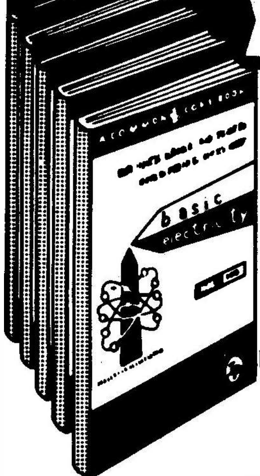
Exclusively offered by WALDON at the remarkably low price of 63 gns +25/- Carrg.

All items may be purchased separately.

WALDON ELECTRONICS, 707 Blackburn Road, Bolton, Lancs. Bolton 54280

PLEASE ENCLOSE 1/0 IN STAMPS WITH ENQUIRIES

YOURS FREE FOR 7 DAYS



The 'New Picture-Book' way of learning BASIC ELECTRICITY (5 VOLS.) ELECTRONICS (6 VOLS.)

You'll find it easy to learn with this outstandingly successful NEW PICTORIAL METHOD—the essential facts are explained in the simplest language, one at a time, and each is illustrated by an accurate, cartoon-type drawing. The books are based on the latest research into simplified learning techniques. This has proved that the PICTORIAL APPROACH to learning is the quickest and soundest way of gaining mastery over these subjects.

TO TRY IT, IS TO PROVE IT

The series will be of exceptional value in training mechanics and technicians in Electricity, Radio and Electronics.

WHAT READERS SAY

"I am more than pleased with these publications and I have learnt more in Part 1 than I have learnt in any other books."
S.S., Dagenham.

"I am highly delighted with the books: I didn't know a complicated subject could be so easily presented."
J.K., Earlsfield.

"I am pleased to say how understandable your books are. I have now quite a sound knowledge of Electronics."
P.S., Southgate.

A TECH-PRESS PUBLICATION

POST NOW FOR THIS OFFER!!

To The SELRAY BOOK CO., 60 HAYES HILL, HAYES, BROMLEY, KENT BR2 7HP

Please send me WITHOUT OBLIGATION TO PURCHASE, one of the above sets on 7 DAYS FREE TRIAL, I will either return set, carriage paid, in good condition within 7 days or send the following amounts. BASIC ELECTRICITY 75/-. Cash Price or Down Payment of 20/- followed by 3 fortnightly payments of 20- each. BASIC ELECTRONICS 90/-. Cash Price or Down Payment of 20/- followed by 4 fortnightly payments of 20/- each. This offer applies to UNITED KINGDOM ONLY. Overseas customers cash with order, prices as above.

Tick Set required (*Only one set allowed on free trial*)

BASIC ELECTRICITY ☐ **BASIC ELECTRONICS** ☐

Prices include Postage and Packing.

Signature ....

(*If under 21 signature required of parent or guardian*)

NAME ....
BLOCK LETTERS

FULL POSTAL
ADDRESS ....

....

Practical Electronics Classified Advertisements

MISCELLANEOUS

6 OR 12 VOLT FLUORESCENT LIGHTS
12 ins. 8 Watt tube ample light for caravan, tent, etc. Fully transistorised, low battery drain
Unbeatable at **£2.19.6** post paid.
or in kitform **50/-**

4 WATT GRAM AMPS.
Volume and tone controls, mains operation, 3Ω output, new and boxed **65/-** POST PAID
SALOP ELECTRONICS Callers welcome
23 Wyle Cop
Shrewsbury, Shropshire *S.A.E. for lists*

MORE ROBOTS
Synthetic Animals with "BRAINS" of their own. The LATEST range of projects include: an electronic 'animal' which "LEARNS", an Electro Chemical device capable of "REPRODUCING" itself! Other projects SURE TO INTRIGUE YOU are an audio transmitter/receiver which has quite an amazing range and requires NO LICENCE; also TEN new projects, one of which is an electronic dice machine. HOSTS OF EASY-TO-CONSTRUCT projects, for anyone with a basic knowledge of Electronics. DON'T WAIT.
SEND 3/- for your list—NOW!
To: 'BOFFIN PROJECTS'
incorporating
BIONIC DESIGNS, 4 CUNLIFFE RD.
STONELEIGH, EWELL, SURREY
Designed by GERRY BROWN and JOHN SALMON and presented on T.V.

PROFESSIONALLY MADE CONTROL PANELS from **4d.** sq. in. 16/18 gauge aluminium, cut, drilled, spray painted and legend. Send full size drawing for quotation. C. S. CONDUIT, 7 Millbrook, Salisbury, Wilts.

HI-FI loudspeaker systems for the home constructor, cabinet kits, the new range of Peerless speakers, speaker kit systems and cross-over networks. BAF wadding, speaker fabric (samples on request) and all other necessary components. Send 5d in stamps to: AUDIOSCAN, Dept. PE, 4 Princes Square, Harrogate, Yorks.

ONE OFF PRINTED CIRCUIT BOARDS. Cheaply made to customers' requirements. Send s.a.e. for details: D. R. MANN, 12 Randolph St., Nottm.

CLEARING LABORATORY, scopes, V.T.V.M's, V.O.M's, H.S. recorders, transcription turntables, electronic testmeters, calibration units, P.S.U.'s, pulse generators, D.C. null-potentiometers, bridges, spectrum analysers, voltage regulators, sig-gens, M/C relays, components, etc. Lower Beeding 236.

COMPUTER IN YOUR POCKET. Home, college, workshop. 5in pocket slide rules, **17/6**, 10in desk/bench slide rules, **25/-**. Full instructions. DEPT. PE, 19 Paynesfield Avenue, S.W.14.

Send 1/- for
STATE OF THE ARTISTS LIST OF
Comps and full data, applications on latest dc/uhf low noise N/FET. 2N5245, **10/-** ea. also Sprague 'UNICIRCUIT' ULN2111A, d.i.l. for FM/SSB det, 60db wdebnd amp/lim, etc. **£1.10.6** ea. C.W.O. 6d. p.p. per order to:
T. ADVISER
2 Crown Acre, Brockenhurst, Hants

RATES: 1/3 per word (minimum 12 words). Box No. 1/6 extra. Advertisements must be prepaida nd addressed to Advertisement Manager, "Practical Electronics" IPC MAGAZINES LTD., Fleetway House, Farringdon Street, London, E.C.4

MISCELLANEOUS *(continued)*

MUSICAL MIRACLES. Send S.A.E. for details of Rhythm Modules, Versatile Bass-pedal unit, self-contained with unique effects, kits for waa-waa pedals. Also new 50μA meters **25/-** post paid. HURRY! D.E.W. LTD. 254 Ringwood Road, Ferndown, Dorset.

UFO DETECTOR CIRCUITS, data. 10s. (refundable). Paraphysical Laboratory (UFO Observatory), Downton, Wilts.

ETCHED PRINTED CIRCUIT BOARD KITS. Full instructions. **19/6,** c.w.o. CIRCUITETCH, 12 Cambridge Rd., St. Albans, Herts.

A CORNUCOPIA OF COMPONENTS! Scarce valves, selected TV Components, Educational and Projects kits, Speakers and Cabinets, Transistors, Resistors and values, ¼ watt, **3d** each. State your requirements. S.A.E. for details. MAIL-MART, 6 Eastbourne Road, Pevensey Bay, Sussex.

YOUR KITS professionally assembled and tested, write: A. M. BAYNES, Capitol Buildings, Longford, Coventry.

NOTES ON USE OF TV for Aircraft or UFO Detection. Optical Detector Set and Instructions, **7/6** each. RADAR & ELECTRONICS PUBLICATIONS, 1 Stowmarket Road, Needham Market, Suffolk.

PSYCHODELIC LIGHTING UNIT. A brand new design that adds a new dimension to music. Ideal for use by pop groups and disco's. Used in conjunction with a record player it can turn a house party into a psychodelic freek out! It modulates up to 1·5kW of light and sensitivity is fully variable. Money back if not "turned on". They come complete with instructions either as a kit or ready built and tested. Kit form: **14 gns;** Built: **16 gns** (inc. P/T). Send now to: SOUND ELECTRONICS, 30 Second Avenue, Newcastle upon Tyne, NE6 5XS. For further details send S.A.E.

BUILD IT in a DEWBOX quality cabinet 2in × 2½in × any length. DEW LTD., Ringwood Road, Ferndown, Dorset. S.A.E. for leaflet. Write now—right now.

FOR SALE

MORSE MADE EASY **!!**
FACT NOT FICTION. If you start **RIGHT** you will be reading amateur and commercial Morse within a month (normal progress to be expected).
Using scientifically prepared 3-speed records you automatically learn to recognise the code **RHYTHM** without translating. You can't help it, it's as easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.
For details and course C.O.D. ring S.T.D. 01-660 2896 or send 8d. stamp for explanatory booklet to:
G3HSC (Box 19), 45 GREEN LANE, PURLEY, SURREY

FOR SALE *(continued)*

MINIATURE DYNAMIC MICROPHONES. High impedance, size ⅞ × ⅝ × $\frac{5}{16}$in. Also work as mini speakers, suit transistor circuits, **7/6** each, 3 for **20/-**. Tested, guaranteed. Ardente 10kΩ edgewise volume controls, **3/6** each, 3 for **10/-**. DREW, 77 The Crescent, Southwick, Sussex.

SEEN MY CAT? 5,000 items. Mechanical and Electrical Gear, and materials. S.A.E. K. R. WHISTON, Dept. PE, New Mills, Stockport.

BOOKS AND PUBLICATIONS

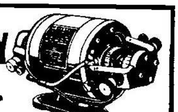
SURPLUS HANDBOOKS

19 set Circuit and Notes	**6/6** P.P. **6d**
1155 set Circuit and Notes	**6/6** P.P. **6d**
H.R.O. Technical Instructions ..	**5/6** P.P. **6d**
38 set Technical Instructions....	**5/6** P.P. **6d**
46 set Working Instructions....	**5/6** P.P. **6d**
88 set Technical Instructions....	**7/-** P.P. **6d**
BC. 221 Circuit and Notes	**5/6** P.P. **6d**
Wavemeter Class D Tech. Instr	**5/6** P.P. **6d**
18 set Circuit and Notes	**5/6** P.P. **6d**
BC.1000 (31 set) Circuit & Notes	**5/6** P.P. **6d**
CR.100/B.28 Circuit and Notes	**10/-** P.P. **9d**
R.107 Circuit and Notes........	**7/-** P.P. **6d**
A.R.88D. Instruction Manual....	**18/-** P.P. **6d**
62 set Circuit and Notes	**6/6** P.P **6d**

52 set Sender & Receiver Circuits **7/6.** post free
Circuit Diagrams 5/- each post free. R.1116/A, R.1224/A, R.1355, R.F. 24, 25, & 26. A.1134, T.1154, CR.300, BC.342, BC.312, BC.348.J.E.M.P. BC.624. 22 set.
Colour Code Indicator .... **2/6** P.P. **6d**
S.A.E. with all enquiries please.
Postage rates apply to U.K. only.
Mail order only to:
Instructional Handbook Supplies
Dept. P.E., Talbot House, 28 Talbot Gardens Leeds 8

ELECTRICAL

240 VOLT ELECTRICITY ANYWHERE



BEST EVER 200/240 VOLT "MAINS" SUPPLY FROM 12 VOLT CAR BATTERY
Exclusive World Scoop Purchase. The fabulous **Mk.2D American Heavy Duty Dynamotor Unit** with a **Massive 220** watt output and giving the most **Brilliant** 200/240 volt performance of all time. Marvellous for **Television, Drills, Power Tools, Mains Lighting, AC Fluorescent Lighting** and all 200/240 volt Universal AC/DC mains equipment. Made at tremendous cost for U.S.A. Govt. by Delco-Remy. This magnificent machine is unobtainable elsewhere. **Brand New and Fully Tested. Only £4.19.6** + 10/6 postage. C.O.D. with pleasure, refund guarantee. Please send S.A.E. for illustrated details.
Dept. PE, STANFORD ELECTRONICS
Rear Derby Road, North Promenade
BLACKPOOL, Lancashire

WANTED

WANTED: November 1968 copy of "Practical-Electronics". Any reasonable cash offers? Box No. 25.

CAN ANYONE SUPPLY a working circuit of a 1–5 Volt Sub Miniature F.M. Transmitter? Box No. 24.

SERVICE SHEETS

LARGE SUPPLIER OF SERVICE SHEETS

T.V., RADIO, TRANSISTORS, TAPES, CAR RADIOS

Only 5/- each, plus LARGE S.A.E.

(Uncrossed P.O.'s please, returned if service sheets not available.)

FREE TV FAULT TRACING CHART OR TV LIST ON REQUEST

C. CARANNA

71 BEAUFORT PARK, LONDON, N.W.11

MAIL ORDER ONLY

RADIO TELEVISION, over 8,000 Models. JOHN GILBERT TELEVISION, 1b Shepherds Bush Rd., London, W.6. SHE 8441.

SERVICE SHEETS (1925-69) for televisions, radios, transistors, tape recorders, record players, etc., by return post, with free fault-finding guide. Prices from 1/-. Over 8,000 models available. Please send S.A.E. with all orders/enquiries. HAMILTON RADIO, 54 London Road, Bexhill, Sussex.

SERVICE SHEETS, Radio, TV, 5,000 models. List 1/6. S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

EDUCATIONAL

GET INTO ELECTRONICS—big opportunities for trained men. Learn the practical way with low-cost Postal Training, complete with equipment. A.M.I.E.R.E., R.T.E.B., City & Guilds, Radio, T/V, Telecoms., etc. For FREE 100-page book, write Dept. 856K, CHAMBERS COLLEGE, 148 Holborn, London, E.C.1.

CITY & GUILDS AND R.T.E.B. EXAMS. Specialised ICS home-study course will ensure success. For details of wide range of exam. and diploma courses in Radio, T.V. and Electronics, also new practical courses with kits, write to ICS (Dept. 577), Intertext House, Stewarts Road, London, S.W.8.

TECHNICAL TRAINING in Radio, TV & Electronics thro' world-famous ICS. For details of proven home-study courses write: ICS, Dept. 561, Intertext House, Stewarts Road, London, S.W.8.

ENGINEERS. A technical certificate or qualification will bring you security and much better pay. Elem. and adv. private postal courses for C.Eng., A.M.I.E.R.E., A.M.S.E. (Mech. & Elec.), City & Guilds, A.M.I.M.I., A.I.O.B. and G.C.E. exams. Diploma courses in all branches of Engineering—Mech., Elec., Auto, Electronics, Radio, Computers, Draughts., Building, etc. For full details write for FREE 132-page guide. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 125K), Aldermaston Court, Aldermaston, Berks.

RADIO OFFICERS see the world. Sea going and shore appointments. Trainee vacancies during 1970. Grants available. Day and Boarding students. Stamp for prospectus. WIRELESS COLLEGE, Colwyn Bay, Wales.

SITUATIONS VACANT

A.M.I.E.R.E., A.M.S.E. (Elec.), City & Guilds, G.C.E., etc., on "Satisfaction or Refund of Fee" terms. Wide range of Home Study Courses in Electronics, Computers, Radio, T.V., etc. 132-page Guide—FREE. Please state subject of interest. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 124K), Aldermaston Court, Aldermaston, Berks.

TESTERS AND TEST TECHNICIANS

We require all grades of Test Engineers who are experienced in the testing and fault-finding of complex electronic equipment, including control systems.

We offer Staff positions to suitable applicants and four weeks' holiday after three years service. High rates of pay, good working conditions, canteen, social and sports club.

Please write or phone:

The Personnel Officer (Ref. 170)

ULTRA ELECTRONICS LTD.

Western Avenue, Acton, London, W.3

Tel. 01-992 3434

UEL

TECHNICAL TRAINING by ICS IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

First-class opportunities in Radio and Electronics await the **I C S trained man.** Let I C S train YOU for a well-paid post in this expanding field.

I C S courses offer the keen, ambitious man the opportunity to acquire, quickly and easily, the specialized training so essential to success. Diploma courses in Radio/TV Engineering and Servicing, Electronics, Computers, etc. Expert coaching for:

* **C. & G. TELECOMMUNICATION TECHNICIANS' CERTS.**
* **C. & G. ELECTRONIC SERVICING.**
* **R.T.E.B. RADIO AND TV SERVICING CERTIFICATE.**
* **RADIO AMATEURS' EXAMINATION.**
* **P.M.G. CERTIFICATES IN RADIOTELEGRAPHY.**

Examination Students Coached until Successful.

NEW SELF-BUILD RADIO AND ELECTRONIC COURSES

Build your own 5-valve receiver, transistor portable, signal generator, multimeter and valve volt meter—**all under expert guidance.**

POST THIS COUPON TODAY and find out how I C S can help YOU in your career. Full details of I C S courses in Radio, Television and Electronics will be sent to you by return mail.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES

INTERNATIONAL CORRESPONDENCE SCHOOLS

A WHOLE WORLD OF KNOWLEDGE AWAITS YOU!

International Correspondence Schools
(Dept. 152), Intertext House, Stewart Road,
London, S.W.8.

NAME ....
Block Capitals Please

ADDRESS ....

....

.... 12/69

GEC-Marconi Electronics

ELECTRONIC TECHNICIANS

are required to work on calibration, fault-finding and testing of telecommunications measuring instruments. The work is varied and will enable technicians with experience of r.f. circuits to broaden their knowledge of the latest techniques employed in the electronics and telecommunications industries by bringing them into contact with a wide range of the most advanced measuring instruments embracing all frequencies up to u.h.f.

Entrants may be graded as Testers, Test Technicians, Senior Test Technicians and Technician Engineers according to experience and qualifications. Our expanding production and servicing programme, geared to our recognised export achievement, provides security of employment combined with good prospects of advancement, not only within these grades, but into other technical and supervisory posts within the Company at St Albans and Luton.

Salaries are attractive and conditions excellent. A Pension Scheme includes substantial life assurance cover provided by the Company. Assistance with removal may also be given in appropriate cases. Please write or telephone for application forms to:

mi

Mr. P. Elsip,
Personnel Officer,
Marconi Instruments Ltd,
Longacres, St. Albans, Herts.
Tel: St. Albans 59292

THE QUEEN'S AWARD TO INDUSTRY

Member of GEC-Marconi Electronics

SEMICOMPS LIMITED *try harder*

Semiconductor enthusiast wanted living in Wembley region with interest in semiconductors and integrated circuits to train as inside sales engineer. Good starting salary and prospects. Apply to Managing Director, Semicomps Limited, Station Wharf, Alperton, Middlesex. 01-903 3161.

SERVICE ENGINEERS—we are an old established electronics company, but headed by a young management team, and we need you to help us. Age is no barrier to a high salary as you will find out when you join us. If you have experience in T.V., Radio or H-Fi Service and want a job that looks ahead, phone MICHAEL ADLER at 01-636 9606.

RECEIVERS AND COMPONENTS

INTEGRATED CIRCUITS at lowest price. GE Type PA234, 1 watt Audio Amplifier, **17/6** each inc. data. Newst GE Silicon *npn* planar transistor 2N5172, 25V, 200mW, hfe 100 min.; epoxy for economy; passivated for reliability, **1/9** each. C.W.O. P. & P. 1/- per order. JEF ELECTRONICS, 12 York Drive, Grappenhall, Warrington, Lancs. Mail Order Only.

RECEIVERS AND COMPONENTS *(continued)*

TAPE HEADS

BSR BRAD. 2-TRACK **39/6** pair

BSR MARR. 4-TRACK **39/6** pair

MICHIGAN REC./PLAY MED. IMP. 4-TRACK **35/-**

REUTER — COLLARO ERASE 4-TRACK **12/6**

BOGEN ERASE UL218/6 4-TRACK **25/-**

COSMOCORD ERASE T.E. 2/9 4-TRACK **12/6**

TRANSISTOR LW/MW/FM TUNER CHASSIS
The most compact three-band Tuner chassis ever engineered. Output 50mV, exceptional sensitivity and selectivity on all bands. Operates from single 9 volt battery. Complete with aerials, 3-band tuning dial, mounting bracket circuit and instructions. **£13**

TUNER DULCI FMT7S STEREO LIST £31 FEW ONLY AT **£23**
Sens. 14mV, O.P. 100mV, 88-108 m/c, dim. 13¾ × 2¾ × 7".

COMPACT TRANSISTOR FM TUNER
Oiled Walnut cabinet, brushed gold front panel, vertical styling, internal batteries. Sensitivity: Better than 10uV. Audio Output: More than 500 m/v (input level 25db). Signal to Noise Ratio: More than 35db (input level 25db). 6 Transistors, 3 diodes. **£8.19.6**

FM MULTIPLEX STEREO ADAPTOR
Printed circuit biscuit, 4 trans. 6 diodes 9V with full instructions **£4.19.6**

LOUDSPEAKERS

GUITAR, P.A., or HI-FI
12" 25 watt, 15 ohm, 25-13K, Ceramic **£5.7.0**

10" 10 watt, 15 ohm, CERAMIC — MAGNET **49/6**

2" 40 ohm, 2½" 80 ohm **6/6**

SPEAKER CABINET £8
Takes 12" or 10" Speaker and a 4" or 3" Tweeter. Ht. 21", W. 15", D. 7½". Polished Teak, matching vynair grille, list price £9.5.0.

CABINET Teak 23¾ × 13½ × 9½", contemp. 12" legs for Tape Recorder and Tuner or Amplifier, etc. **89/6**

RELAYS 4 pole changeover, ideal for models. 1¼ × 1¼ × ¾", 700 ohm 9-24v, 185 ohm 6-12v, 430 ohm 9-18v **10/-**

TWEETER Horn type Hi-Fi 3" 16 ohm, 10 watt crossover 3k Ω, 18,000 c/s **19/6**

CROSSOVER NETWORK **15/-**
3kc/s, 16 or 3 or 8 ohm.

CHARGER RECTIFIERS
F.W. 12 volt 1 Amp. **5/-**
F.W. 12 volt 4 Amp. **10/6**

CHARGER TRANSFORMER.
2/6/12 volt, 3/- P/P
1A **18/-**, 2A **16/6**
4 Amp **21/6**

SUPER SILICON RECT. T.V., etc., 1,200 PIV 800mA, **5/-**; or complete with instr. resistor, condenser, **6/6**; 400 PIV HW 6A, **6/-**. BY100 type, 6 for **10/-**.

MULTIMETERS from **32/-**

TRANSISTORS
2N3638A **5/-**, 2N3643 **5/6**, AC138 **5/-**, AC141 **5/-**, ACY20 **3/8**, ACY21 **4/-**, AF178 **11/8**, AF186 **10/-**, BC108 **2/6**, BC109 **2/6**, BCY33 **4/6**, BF181 **7/-**, NKT213 **5/6**, NKT226 **5/6**, OA91 **1/6**, OAZ270 **3/6**, OC35 **5/-**, OC45 **2/-**, OC81D **2/3**, OC82 **4/-**, OC200 **3/8**. GET103–113–118–119–887–889–890–896–7–8 **3/-**

SWITCH ROTARY RECIPROCATING 4 Position, 15amp. Single hole fixing, with instrnctions. List 14/7 **5/6**
C60 CASSETTE **10/3**. C90 **14/3**. 3 Post free

Stamped envelope for full selection and bargain offers in MULTIMETERS, RADIOS, BABY ALARMS, INTERCOMS, WALKIE-TALKIES, RECTIFIERS, SINCLAIR, DULCI.
UNDER £1—P. & P. 6d., £1 to £3—1/6, over £3—2/6. C.O.D. 3/6. MAIL ORDER ONLY. U.K. ONLY

DURHAM SUPPLIES
367 KENSINGTON STREET
BRADFORD 8, YORKSHIRE

5% RESISTORS 3d EACH

High stability, Carbon Film, ½ Watt, 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91Ω etc. to 1MΩ.

PRINTED CIRCUIT KITS ONLY 17/6

TRANSISTORS 2N3708A 1/6 EACH

Hfe 20-60, Vce30, 230mW, 200 Mc/s Silicon, Brand new, Fully guaranteed. P. & P. 1/-.

J. M. KING (A)
14 Acton Street, London, W.C.1

Single channel Radio Control at a price you can afford

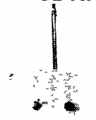
RADIO CONTROL PRODUCTS

EXCELLENT RANGE AND PERFORMANCE

TRANSMITTER—

- Crystal controlled tone Tx. 12v. operation. Silicon transistors. In smart case with micro-switch.

Tx only **£6 - 5 - 0**



RECEIVER—

- Sub-miniature Wt 40 grms. Size only 3·5 × 2·8 × 2 cms. Working voltage 4·5v.

Rx only **£4 - 5 - 0**

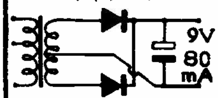
SUITABLE FOR MODELS OF ALL KINDS
ONLY £10 - 10 - 0 COMPLETE

DIRECT FROM **RADIO CONTROL PRODUCTS**
38 FRANCHE ROAD
KIDDERMINSTER, WORCS.

TERRIFIC TRANSISTORS!

New. No seconds. No re-marks
Orders over 10/– post free.

AD161/2 high-gain (80-250) complementary audio power pair. SPECIAL OFFER: AD161 and AD162 WITH TWO INSULATING KITS, ONLY **12/-**, UK post paid.
BC168B, high-gain (250-500), small-sized exact equivalent of BC148, only **2/3**.
BC169C, high-gain (450-900) equiv. BC149, **2/6**; **BC107, 3/-**; **BF167, 5/3**; **2N706, 2/7**; **40468A, 7/6**, etc., etc.



MINI MAINS PACK COMPS. 17/6

Mini Mains Trans.
MT9, 9-0-9V, 80mA 12/6
MT6, 6-0-6V, 100mA 13/6
MT12, 12-0-12V, 50mA 13/6
Submin. bridge rect., 30Vrms, 150mA, 3/6

AMATRONIX LTD. (Mail order only)
396 Selsdon Rd., South Croydon, Surrey
CR2 0DE

WE ARE BREAKING UP COMPUTERS

EX COMPUTER PRINTED CIRCUIT PANELS 2in × 4in packed with semi-conductors and top quality resistors, capacitors, diodes, etc. Our price, 10 boards **10/-**. P. & P. 2/-. With a guaranteed minimum of 35 transistors.

SPECIAL BARGAIN PACK. 25 boards for **£1**. P. & P. 3/6. With a guaranteed minimum of 85 transistors. 100 boards 55/-. P. & P. 7/6. With a guaranteed minimum of 350 transistors.

GIANT PANELS. 5½in × 4in, min. 20 transistors, 9 × 56 μH inductors, resistors, diodes, etc. 3 for **£1**. P. & P. 2/-.

As above, only 21 transistors, 70 diodes, 62 min. ⅛th.W resistors. 3 for **25/-**. P. & P. 2/-.

PANELS with 2 power transistors sim. to OC28 on each board +components. 2 boards (4 × OC28) **10/-**. P. & P. 2/-.

TRIM POTS. On 2in × 4in boards +Ta caps and other components. Ideal for organ key-board tuning, etc. 100Ω, 500Ω, 15K., 20K. State requirements. 5 boards **10/-**. P. & P. 2/-.

NPN GERMANIUM TO5 1 WATT POWER TRANSISTORS. On small heat sink, on 2in × 4in panel. 5 for **10/-**. P. & P. 2/-.

POWER TRANSISTORS. Sim. to 2N174 ex-eqt. On Finned Heat Sink (10D). 4 for **£1**. P. & P. 5/-.

DIODES. Ex eqpt., Silicon, 150 PIV, 10 amp' 4 for **10/-**. 150 PIV, 20 amp. 4 for **£1**. Post free.

OVERLOAD CUT OUTS. Panel mounting in the following values . . . **5/-** each. 3, 4 amp. P. & P. 1/-.

MINIATURE GLASS NEONS, 13/6 doz.

PAPST FANS. Powerful Extractor/Blower fans. 4½" × 4½" × 2", 230/250V. 100 c.f.m., 2,800 r.p.m. **50/-** post free.

MICRO SWITCHES. Miniature button type. **10/-** doz. P. & P. 1/6.

NEW SPRAGUE. 0·22μF 250V small capacitors. **5/-** doz. P. & P. 1/-.

NEW SPRAGUE ELECTROLYTICS. 4μF 150V. **5/-** doz. P. & P. 1/-.

NON-POLAR TANTALUM CAPS. 2.2μF 50V. **10/-** doz. P. & P. 1/-.

LARGE CAPACITY ELECTROLYTICS. 4½in, 2in diam. Screw terminals. **7/6** each post free.

4,000μF	72V d.c. wkg.
10,000μF	25V d.c. wkg.
25,000μF	12V d.c. wkg.

4½" × 1½". Plessey 5,000μF 55V d.c. wkg. **8/-** each. 3" × 1" Plessey 2,000μF 25V d.c. wkg. **6/-** each. 4½" × 1½" screw terminals 2,500μF 55V d.c. wkg. **6/-** each.

KEYTRONICS, 52 Earls Court Road
London, W.8. Mail order only
Tel. 01-478 8499

TRANSISTOR PANELS

INTEGRATED CCT'S TAKEN FROM PANELS

A — Quad 2 I/P Gate	5/-	With Pin
B — Dual 4 I/P Gate	5/-	Connections
C — Dual 2 Level Gate	5/-	
F — Single I/P Gate	5/-	Post Paid

EX GOVMT. RECEIVER R.209 covering 1—20 mc/s 12V D.C. Input **£12.10.0** Post Paid (Tested).

50 VARIOUS TRANSISTORS on Panels **15/-** Post Paid.

20—OC45	£1
20—OC76	£1
40—TK28c	£1

COMPUTER PANELS with 40 sil. pnp or npn transistors, Diodes and res., **22/6** Post Paid.

COMPUTER PANELS WITH SEMI-CONDUCTORS. Postage 6d per panel

8—OC43 or GET875 + 24—OA81	7/6
24—A1678 (V405A) 550 mc/s PNP + 24 Diodes	15/-
4—OC170 + 2—OC139 + 2—OC42	7/6
9—ASZ20 + 1—T2040 + 27 Diodes	7/6
4—OC42 + 6—GET875 + Diodes	7/6
2—OC170 + 1—2G306 + OC42	4/-
5—OC23 + 15—OA10	25/-
8—ASZ20 + 80 Diodes	7/6
6—ASZ21 + 15—OA91	6/-
9—SB240 + 18—OA47	10/-
12—2G106 + 24 Diodes	9/6
8—OC72 + 8—OA10	10/-
8—OC76 + 8—OA10	7/6
12—A1678 (V405A) 550 mc/s PNP + 22 Diodes	10/-
36—OA5	6/-
6—GET872 + 8—OA10	5/-
4—OC42	3/-
12—ASZ20 + 80 Diodes	9/6
4—GET872 + 8—OA10	3 for 12/-
4—2G106 + 1—2N2410	4/-
2—OC42 + 8—OA47	3/-
2—GET872 + 4—OA10 + RF Chokes	3 for 10/-
24—Sil. h.f. Transistors	15/-
3—GET872 + 3—GEXS41, ETC.	22/6
3—OC23 + 6—OA10 + 2—OA5	16/-

ELECTROLYTICS 25,000 @ 12V, 16,000 @ 12V, 15,000 @ 10V, 10,000 @ 30V, 4,000 @ 60V, 2,000 @ 50V, 1,200 @ 180V, **8/6** Post Paid.

ZENER DIODES—2·4, 2·7, 3·6, 4·75, 6·2, 6·8, 7·5, 13, 15, 16, 18, 20, 27, 30, 33 volts. **3/6** each, mostly 1 watt

POLYSTYRENE CAPACITORS. 125V, 18, 22, 120, 220, 270, 330, 390, 560, 820, 1,000, 1,200, 1,800, 2,200, 2,700, 3,300, 3,900, 5,600, 6,800, 8,200, 0·01, 0·012, 0·015, **2/6** doz. Post/Packing, 1/-.

BRAND NEW BOXED CHASSIS containing 2—OC35, 2—OC29 12 WW resistors **25/-**. Postage 1/6

NEW CROSS RADIO
6 OLDHAM ROAD, MANCHESTER 4

NEW VHF KIT

Receives Television Sound, Ambulances, Aircraft, Radio 2, 3 and 4 on VHF, etc.

This novel little set will give you endless hours of pleasure and can be built in one evening. The Kit comes with easy to follow instructions and circuit. Powered by 9v Battery. Complete with built in Jack Plug Socket for use with Earphones or Amplifier.

ONLY 57/-. P. & P. FREE U.K. ONLY

2 Watt general purpose Power Amplifier in very attractive Cabinet covered in black leatherette with polished alloy trim. Size 10" high × 4½" × 4". Very versatile, suitable for use with above kit or use as Baby Alarm, Intercom, Record Player Amplifier, etc. Uses PP6 Battery. **ONLY 90/-**. P. & P. included U.K. only.

Postal Orders, Cheques to
Dept. P.E.4
GALLEON TRADING CO.
298A Lodge Lane, Romford, Essex

R & R RADIO

51 Burnley Road, Rawtenstall
Rossendale, Lancs
Tel.: Rossendale 3152

VALVES BOXED, TESTED & GUARANTEED

BF80	3/-	PCC84	3/-	PY81	3/6
EBF89	3/6	PCF80	3/-	PY82	3/-
ECC82	3/-	PCF82	3/6	U191	4/6
ECL80	3/-	PCL82	4/-	6F23	5/-
EF80	1/6	PCL83	4/-	30F5	2/6
EF85	3/-	PL36	5/-	30L15	5/-
EY86	4/-	PL81	4/-	30P12	4/6
EZ40	4/6	PL83	4/-	30C15	5/-
EBC41	4/6	PY33	5/-	50CD6G	7/6

Transistor Audio Pack, 2G339A, 2G381A, 2G371B
10/- each post **6d.**

POST, ONE VALVE **9d.** TWO TO SIX **6d.**
OVER SIX POST PAID.

BRAND NEW ELECTROLYTICS, 15/16 volt 0·5, 1, 2, 5, 6, 8, 10, 15, 20, 30, 40, 50, 100, 200 mF, **8d.** Mullard 25 volt 6·4, 12·5, 25, 50, 80 mF, **10d.** 1·6, 160 mF, **1/-**. Minimum order **7/6**, postage 1/-. THE C.R. SUPPLY CO., 127 Chesterfield Rd., Sheffield S8 0RN.

Whether Buying or Selling a Classified Advertisement in PRACTICAL ELECTRONICS, could be the answer to your Problem.

For details write to:—

Classified Advertisement Dept.,
PRACTICAL ELECTRONICS
Fleetway House,
Farringdon Street, London, E.C.4

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 6v, 9v, 12v, 18v (single output) 39/6 each. P. & P. 2/9. 9v + 9v; 6v + 6v; or 4½v + 4½v (two separate outputs) 42/6 each. P. & P. 2/9. Please state output required. All the above units are completely isolated from mains by double wound transformer ensuring 100% safety.

R.C.S. PRODUCTS (RADIO) LTD.
(Dept. P.E.), 31 Oliver Road, London, E.17

ORGAN BUILDERS!

Use our bistable dividers for your tone sources and cut your costs by more than half.

A small printed board with four complete transistor dividers will cost you only 18/6 including postage so why pay more?

Removed from working equipment, each circuit is meticulously inspected and tested before dispatch.

Just send a S.A.E. for free details to:

Roger Allen
13 Millways
Great Totham, Essex

4-STATION INTERCOM

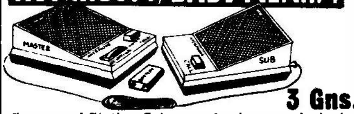
£7/15/0

Solve your communication problems with this **4-Station Transistor Intercom** system (1 **master** and **3 Subs**), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master to Subs** and **Subs to Master**. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 7/6.

MAINS INTERCOM

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control. Price **£10.19.6.** P. & P. 8/6 extra.

INTERCOM/BABY ALARM



3 Gns.

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 4/6.

Transistor TELEPHONE AMPLIFIER

59/6

Why not boost business efficiency with this incredible De-Luxe **Telephone Amplifier.** Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume control. Battery 2/6 extra. P. & P. 3/6. Full price refunded if not satisfied in 7 days.

WEST LONDON DIRECT SUPPLIES (PE/3)
169 KENSINGTON HIGH STREET, LONDON, W.8

WENTWORTH RADIO

SEND S.A.E. FOR NEW STOCK LIST

104 SALISBURY ROAD
HIGH BARNET

01-449 3087

Packing and Postage 1/-

AF114	4/3	BCY38	5/6	BF195	3/3	2N1304	5/-
AF115	3/9	BCY39	5/6	2N696	5/-	2N1305	5/-
AF116	3/6	BCY40	8/-	2N697	4/-	2N1306	5/6
AF117	3/6	BF115	6/6	2N706	3/-	2N1307	5/-
AF118	8/-					2N1308	6/6
AF124	5/-					OC44	2/9
AF125	5/-					OC45	2/6
AF126	5/-					OC70	3/-
AF127	5/-					OC71	2/6
BC107	3/-					OC72	2/6
BC108	3/-					OC170	2/6
BC109	3/6					OC171	3/3
BC113	6/6	BF117	11/6	2N706A	2/6	OC172	3/6
BC118	6/6	BF167	3/6	2N708	4/6	NKT274	5/-
BC147	5/-	BF173	4/2	2N709	11/6	NKT275	5/-
BC148	4/6	BF180	5/-	2N914	3/6	NKT674F	6/-
BCY31	5/-	BF181	3/3	2N916	4/-	NKT713	6/-
BCY32	5/6	BF184	3/6	2N918	6/6	NKT773	5/-
BCY33	6/-	BF194	3/3	2N919	4/6	NKT774	6/-
BCY34	5/6					NKT20329	11/6

SPECIAL OFFERS

2N2924	3/-	BY126	3/6
AC128	3/-	BY127	3/6

VALVES SAME DAY SERVICE

NEW! TESTED! GUARANTEED!

SETS 1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94. Set of 4 for 18/6. DAF96, DF96, DK96, DL96, 4 for 26/6

OZ4	4/6	12AX7	4/9	DK91	5/9	EH90	6/3	PCL83	9/-	UBC41	8/6
1A7GT	7/6	12K8GT	7/-	DK92	8/3	EL33	8/9	PCL84	7/6	UBF80	5/9
1H5GT	7/3	19BG6G	17/6	DK96	7/-	EL34	9/6	PCL85	9/-	UBF89	6/9
1N5GT	7/9	20F2	13/6	DL35	5/-	EL41	10/6	PCL86	8/3	UC92	5/-
1R5	5/9	20P3	11/9	DL92	5/9	EL84	4/9	PENA4	12/6	UCC84	7/-
1S5	4/3	20P4	18/6	DL94	6/-	EL90	4/6	PFL200	12/6	UCC85	6/9
1T4	2/9	25L6GT	5/-	DL96	7/-	EL500	12/6	PL36	9/9	UCF80	7/3
3S4	5/9	25U4GT	11/6	DY86	5/9	EM80	7/6	PL81	7/3	UCH42	11/6
3V4	6/-	30C1	6/6	DY87	5/9	EM81	7/6	PL82	6/6	UCH81	6/3
5U4G	4/6	30C15	13/-	EABC80	6/6	EM84	6/6	PL83	6/6	UCL82	6/9
5Y3GT	5/9	30C17	16/-	EAF42	8/9	EM87	7/6	PL84	6/6	UCL83	11/6
5Z4G	7/6	30C18	11/6	EB91	2/3	EY51	7/6	PL500	13/-	UF41	10/6
6/30L2	12/-	30F5	16/-	EBC33	8/-	EY86	6/6	PL504	13/6	UF80	7/-
6AL5	2/3	30FL1	13/9	EBC41	9/9	EZ40	7/6	PL508	23/6	UF85	6/9
6AM6	2/9	30FL12	14/6	EBF80	6/9	EZ41	7/6	PL802	14/6	UF89	6/9
6AQ5	4/6	30FL14	12/-	EBF89	6/3	EZ80	4/6	PM84	7/6	UL41	10/6
6AT6	4/-	30L1	6/6	ECC81	3/9	EZ81	4/9	PX25	10/6	UL44	20/-
6AU6	4/6	30L15	14/-	ECC82	4/9	GZ32	8/9	PY32	10/-	UL84	7/-
6BA6	4/6	30L17	15/6	ECC83	7/-	GZ34	9/9	PY33	10/-	UM84	6/6
6BE6	4/9	30P4	12/-	ECC85	5/-	KT61	8/9	PY81	5/3	UY41	8/3
6BJ6	8/6	30P12	13/9	ECC91	8/-	KT66	16/-	PY82	5/3	UY85	5/9
6BW6	13/-	30P19	12/-	ECC804	12/-	N78	17/6	PY83	5/9	VP4B	10/-
6F13	3/6	30PL1	13/9	ECF80	6/6	PABC80	7/-	PY88	6/9	W119	7/-
6F14	9/-	30PL13	15/6	ECF82	5/9	PC86	10/3	PY800	7/6	Z77	2/9
6F23	14/3	30PL14	15/6	ECH35	6/-	PC88	10/3	PY801	6/9	AC107	3/6
6F25	13/-	35L6GT	8/6	ECH42	11/-	PC96	8/6	R19	6/6	AC127	2/6
6J6	3/-	35W4	4/6	ECH81	5/3	PC97	8/6	R20	12/6	AD140	7/6
6K7G	2/6	35Z4GT	5/-	ECH84	7/6	PC900	7/6	U25	13/-	AF115	3/-
6K8G	2/9	6063	12/6	ECL80	6/9	PCC84	6/6	U26	12/-	AF116	3/-
6L18	6/-	AC/VP2	10/-	ECL82	6/9	PCC85	6/-	U47	13/6	AF117	3/3
6V6G	3/3	AZ31	9/6	ECL83	8/6	PCC88	9/-	U49	13/6	AF125	3/6
6V6GT	6/6	B729	12/6	ECL86	8/-	PCC89	10/6	U52	4/6	AF127	3/6
6X4	4/3	CCH35	10/-	EF37A	6/6	PCC189	11/6	U78	4/3	OC26	5/9
6X5GT	5/9	CL33	18/6	EF39	4/9	PCF80	6/6	U191	12/6	OC44	2/3
7B7	7/-	CY31	6/9	EF41	10/9	PCF82	6/6	U193	8/6	OC45	2/3
7C6	6/9	DAC32	7/3	EF80	4/6	PCF86	11/6	U251	14/6	OC71	2/6
10F1	14/-	DAF91	4/3	EF85	5/3	PCF200	13/6	U301	10/6	OC72	2/6
10F18	7/-	DAF96	6/6	EF86	6/3	PCF800	13/6	U329	14/6	OC75	2/6
10P13	15/6	DF33	7/9	EF89	5/3	PCF801	6/9	U801	19/6	OC81	2/3
12AH8	33/-	DF91	2/9	EF91	2/9	PCF802	9/-	UABC80	6/6	OC81D	2/3
12AT7	3/9	DF96	6/6	EF94	4/6	PCF805	11/6	UAF42	9/6	OC82	2/3
12AU6	4/9	DH77	4/-	EF183	5/9	PCF808	12/-	UB41	6/6	OC82D	2/6
12AU7	4/9	DK32	7/6	EF184	5/6	PCL82	7/-			OC170	2/6

READERS RADIO (P.E.)

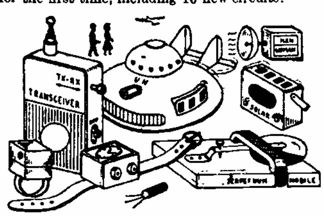
85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

PRINTED CIRCUIT KIT

BUILD 40 INTERESTING PROJECTS on a PRINTED CIRCUIT CHASSIS with PARTS and TRANSISTORS from your SPARES BOX

CONTENTS: (1) 2 Copper Laminate Boards 4½″ × 2½″. (2) 1 Board for Matchbox Radio. (3) 1 Board for Wristwatch Radio, etc. (4) Resist. (5) Resist Solvent. (6) Etchant. (7) Cleanser/Degreaser. (8) 16-page Booklet *Printed Circuits for Amateurs*. (9) 2 Miniature Radio Dials SW/MW/LW. Also free with each kit. (10) Essential Design Data, Circuits, Chassis Plans, etc. for 40 TRANSISTORISED PROJECTS. A very comprehensive selection of circuits to suit everyone's requirements and constructional ability. Many recently developed very efficient designs published for the first time, including 10 new circuits.



EXPERIMENTER'S PRINTED CIRCUIT KIT

8/6

Postage & Pack. 1/6 (UK)

Commonwealth:
SURFACE MAIL 2/-
AIR MAIL 8/-
Australia, New Zealand
South Africa, Canada.

(1) Crystal Set with biased Detector. (2) Crystal Set with voltage-quadrupler detector. (3) Crystal Set with Dynamic Loudspeaker. (4) Crystal Tuner with Audio Amplifier. (5) Carrier Power Conversion Receiver. (6) Split-Load Neutralised Double Reflex. (7) Matchbox or Photocell Radio. (8) "TRI-FLEXON" Triple Reflex with self-adjusting regeneration (Patent Pending). (9) Solar Battery Loudspeaker Radio. The smallest 3 designs yet offered to the Home Constructor anywhere in the World. 3 Subminiature Radio Receivers based on the "Triflexon" circuit. Let us know if you know of a smaller design published anywhere. (10) Postage Stamp Radio. Size only 1·62″ × ·95″ × ·25″. (11) Wristwatch Radio 1·15″ × ·80″ × ·55″. (12) Ring Radio ·70″ × ·70″ × ·55″. (13) Bacteria-powered Radio. Runs on sugar or bread. (14) Radio Control Tone Receiver. (15) Transistor P/P Amplifier. (16) Intercom. (17) 1-valve Amplifier. (18) Reliable Burglar Alarm. (19) Light-Seeking Animal, Guided Missile. (20) Perpetual Motion Machine. (21) Metal Detector. (22) Transistor Tester. (23) Human Body Radiation Detector. (24) Man/Woman Discriminator. (25) Signal Injector. (26) Pocket Transceiver (Licence required). (27) Constant Volume Intercom. (28) Remote Control of Models by Induction. (29) Inductive-Loop Transmitter. (30) Pocket Triple Reflex Radio. (31) Wristwatch Transmitter/Wire-less Microphone. (32) Wire-less Door Bell. (33) Ultrasonic Switch/Alarm. (34) Stereo Preamplifier. (35) Quality Stereo Push-Pull Amplifier. (36) Light-Beam Telephone "Photophone". (37) Light-Beam Transmitter. (38) Silent TV Sound Adaptor. (39) Ultrasonic Transmitter. (40) Thyristor Drill Speed Controller.

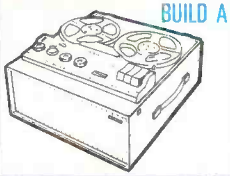
YORK ELECTRICS
333 YORK ROAD, LONDON, S.W.11

Send a S.A.E. for full details, a brief description and Photographs of all Kits and all 52 Radio, Electronic and Photoelectric Projects Assembled.

Published approximately on the 15th of each month by IPC Magazines Limited, Tower House, Southampton Street, London, W.C.2. Printed in England by The Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd.: South Africa—Central News Agency Ltd.: Rhodesia, Malawi and Zambia—Kingstons Ltd. East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage): For one year to any part of the world £2 2s. 0d.

HENRY'S RADIO LTD. ENGLAND'S LEADING COMPONENT AND EQUIPMENT CENTRES

BUILD A QUALITY 4 TRACK TAPE RECORDER



To get the best out of your MAGNAVOX DECK, you need a MARTIN RECORDAKIT. This comprises a special high quality 6 valve amplifier and pre-amplifier which comes to you assembled on it's printed circuit board — in fact everything for making a superb Tape Recorder. You need no experience or technical skill to bring this about.
THE INSTRUCTIONS MANUAL MAKES BUILDING EASY, AND SUCCESS IS ASSURED.
Kit comprises: Deck, Amplifier, Cabinet and speaker, with microphone, 7" 1200 ft. tape, and spare spool.
ASK FOR BROCHURE 6. TODAYS VALUE £60.
PRICE 39 gns. p.p. 22/6. NOTHING ELSE TO BUY

HENRY'S RADIO *Fully Illustrated* CATALOGUES

A
ALL TYPES OF ELECTRONIC COMPONENTS TEST EQUIPMENT KITS BUILT UNITS

B
HIGH FIDELITY & GENERAL AUDIO EQUIPMENT CATALOGUE

COMPREHENSIVE · CLEAR · CONCISE · CATALOGUES

A Over 300 pages fully detailed and illustrated with more than 6,000 stock items. Everything for amateur and professional use. Complete with 5 vouchers. 10/- value, for use with purchases.

ORDER AS CATALOGUE A PRICE 7/6. p.p. 2/-.

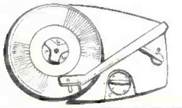
B New audio and high fidelity catalogue. 120 pages containing ideas and equipment for every application. Special low prices for all leading makes Plus 12/6 extra discount voucher.

ORDER AS CATALOGUE B PRICE 5/-. p.p. 1/-.

WHY NOT SEND AWAY TODAY!

SCOOP! STAAR RECORD PLAYER

Deck plays 33, 45, 78, R.P.M. records. 9 volt operated, with mono cartridge. BRAND NEW . . . as illustrated.

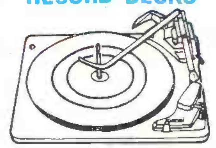


PRICE 59/6.
p.p. 3/6.
Send for leaflet No. 2.

MULLARD 1 WATT AMPLIFIER

Portable Transistor Unit-Ideal for Intercoms, Baby Alarms, Tele phone, Record Players or Guitar Practice.
9 Volt 5 transistors with volume control, output 3 ohms.
Ideal for use with STAAR RECORD DECK.
PRICE 45/-. p.p. 2/6.
OTHER ITEMS. Suitable 7 x 4 inch. 3 ohm speaker 17/6 p.p. 1/6.
Rexine covered cabinet 12 x 9 x 4 12/6 p.p. 2/6.
P.P.9 9 volt battery 3/9. Write for leaflet No. 2.

GARRARD RECORD DECKS

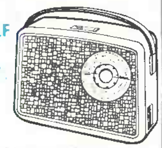


All the latest models BRAND NEW and guaranteed — TERRIFIC SAVINGS!

*2025 STEREO	£ 7.19.6.
*2025TC DIAMOND. 9TAH.C.	£ 9.19.6.
*3000 STEREO 9TAH.C.	£ 9.19.6.
*SP 25 Mk.II	£11.19.6.
*SL 55	£11.19.6.
A70 Mk.II.	£12.10.0.
*AT 60 K.II.	£13.10.0.
*SL 65	£14.14.0.
AP 75	£19. 0.0.
401	£28. 7.6.
SL 75	£29. 0.0.
SL 95	£35. 0.0.
GL 75 GOLDRING	£33. 0.0.
GL 75 P "	£46.15.0.

ALSO IN STOCK — THORENS — LENCO — B.S.R
Carriage/insurance 7/6 extra on any model.
WB4 BASES £3.19.6. PERSPEX COVERS £3.10.0.
*Special offer base and cover available for these models at £4.15.0. Carriage 5/-.
Complete range of Cartridges/Plinths/Covers.
SEND FOR 8 PAGE BROCHURE 16/17 TODAY.

BUILD YOURSELF A QUALITY RADIO



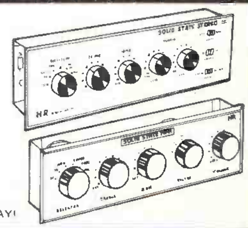
New printed circuit design with full power output. Fully tuneable on both mw/lw. bands. 7 Mullard transistors. Fitted 6" speaker, Room Filling Power. Easy to build with terrific results. All local and continental stations. Complete detailed instructions.
TOTAL COST £6.19.6. p.p. 4/6.
Ask for Leaflet No. 1.

TRANSISTORS DIODES RECTIFIERS

WE HAVE THE MOST COMPREHENSIVE STOCK IN GREAT BRITAIN.
NEW 1969 LIST OF 1000 TYPES.
SEND FOR FREE COPY TODAY (LIST 36)
Whether you require one or 1000, devices we can fulfil your order from stock!
For quantity quotations telephone: (01) 723 0401 Ex. 4. or (01) 402 6823.

AUDIO EQUIPMENT

Mono or Stereo Audio equipment developed from Dinsdale Mk.II — each unit or system will compare favourably with other professional equipment selling at much higher prices. COMPLETE SYSTEMS AND MIXERS from £11.12.6. to £38.17.6. (all units available separately)



THE FINEST VALUE IN LOW COST HIGH FIDELITY — CHOOSE A SYSTEM TO SUIT YOUR NEEDS AND SAVE YOURSELF POUNDS.
SEND FOR BROCHURES No. 12/14 and 21 TODAY!

HI-FI equipment to suit EVERY POCKET

HIGH FIDELITY AUDIO EQUIPMENT CATALOGUE 5/- p.p. 1/-

VISIT OUR NEW HI-FI CENTRE AT 309 EDGWARE ROAD, for all leading makes of — AMPLIFIERS, TUNERS, DECKS, SPEAKERS, MICROPHONES, TEST EQUIPMENT. ALL WITH DISCOUNTS — IT WILL PAY YOU TO PAY US A VISIT. AUDIO SYSTEMS £40 — £300 TO SUIT EVERY POCKET. DEFERRED TERMS AVAILABLE.
SEND FOR ILLUSTRATED BROCHURE 16/17.
TWO DEMONSTRATION ROOMS

HENELEC 5–5 STEREO AMPLIFIER

Excellent low priced British designed Stereo Amplifier for use with Record Decks, Mike, Tuners.
16 transistor mains operated. Output 5+5 watts for 8-15 ohm speakers. Black, silver and wood finish, size 13" x 3" x 6".

PRICE £13.10.0. p.p. 7/6. (Leaflet on request).
Complete Stereo System 5-5.
Garrard 2025 stereo, 5-5 Amplifier, Plinth/Cover, Two 10 watt speakers with tweeters in polished cabinets.
Usual price £47.0.0. OUR PRICE £39.10.0. p.p. 20/-. ASK FOR BROCHURE 13

SINCLAIR EQUIPMENT

The SINCLAIR IC-10 is the worlds first monolithic intergrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself has an output power of 10 watts, yet with an overall size of 1 x 0.4 x 0.2 in.

IC-10 Integrated Circuit Amplifier	59/6
Z30	89/6
Stereo 60	£9.19.6.
PZ5 Power Supply	£4.19.6.
Q16 Loud Speaker	£8.19.6.
Z12 Amplifier	89/6
PZ 4 Power unit	99/6
Stereo 25	£9.19.6.
Q14 Speaker system	£7.19.6.

All post paid, delivery from stock.

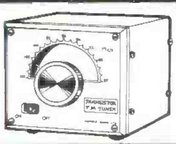
OTHER TYPES OF INTEGRATED CIRCUITS

RCA. CA3014	29/6
RCA. CA3018	22/6
RCA. CA3020	29/6
RCA. CA3036	18/6
Sinclair I.C.10	59/6
G.E. PA230*	22/6
G.E. PA234*	20/0
G.E. PA237*	37/6
G.E. PA246*	52/6
SL402 Plessey	45/0
SL403 Plessey	49/6
S.G.S. UL910	10/0
S.G.S. UL900	10/0
S.G.S. UL914	11/0
Mullard TAA263	15/0

*Data sheets 3/6 set for these, for others see catalogue.

BUILD THIS VHF FM TUNER

5 MULLARD TRANSISTORS. 300 kc/s BANDWIDTH. PRINTED CIRCUIT. HIGH FIDELITY REPRODUCTION MONO & STEREO. A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it — VHF FM gives the REAL sound.



PARTS TOTAL COST £6.19.6. DECODER £5.19.6.
ASK FOR LEAFLET No. 3. (FOR STEREO)

Electronic Musical Instruments

ELECTRONIC ORGANS

COMPLETE KITS FOR THE HOME CONSTRUCTOR

START BUILDING FOR AS LITTLE AS £10.
MODELS FROM £99 — £350.

STAR FEATURES:
*ALL TRANSISTOR PRINTED CIRCUIT DESIGNS.
*BRITISH DESIGN. *STEP BY STEP DETAILED INSTRUCTIONS. *SAVES UP TO 50% ON COMMERCIAL EQUIVALENT. *EVERYTHING SUPPLIED DOWN TO THE LAST ITEM. *FULL AFTER-SALES SERVICE & ADVICE. *CREDIT SALE & H.P. TERMS AVAILABLE

We are pleased to offer the choice of FOUR British designs from a single manual portable at £99 THE MAYFAIR for light or classical music — to a two manual five octave de-luxe model with OAK CONSOLE from £285 for the serious musician.

These kits are the result of years of research and design and offer the best that is essential to good organ designs, coupled with excellent value are within the reach of most pockets. No technical skill or knowledge is required in construction, with the aid of the STEP BY STEP illustrated manuals will produce an instrument that will be a delight to own and use and will give years of trouble free entertainment for the whole family.

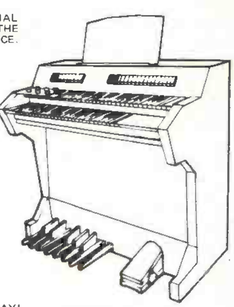


ILLUSTRATION of GROSVENOR ELECTRONIC ORGAN

SEND FOR ILLUSTRATED BROCHURES 9/10/11 TODAY!
When in LONDON. . . CALL IN SEE, HEAR, PLAY FOR YOURSELF.
Organ Demonstration Room 1st Floor.
PRACTICAL ELECTRONICS ORGAN — ORGAN COMPONENTS
We are able to supply all items for this series, details on request.
Built models available from £124.

HENRY'S RADIO LTD.

Mail Order Dept., Components, Organ Dept.
303 EDGWARE ROAD, LONDON W.2.
Telephone: 01-723 1008/9

High Fidelity and Equipment Centre
309 EDGWARE ROAD, LONDON W.2.
Telephone: 01-723 6963

OPEN MON-SAT 9am-6pm. THURS 9am-1pm.