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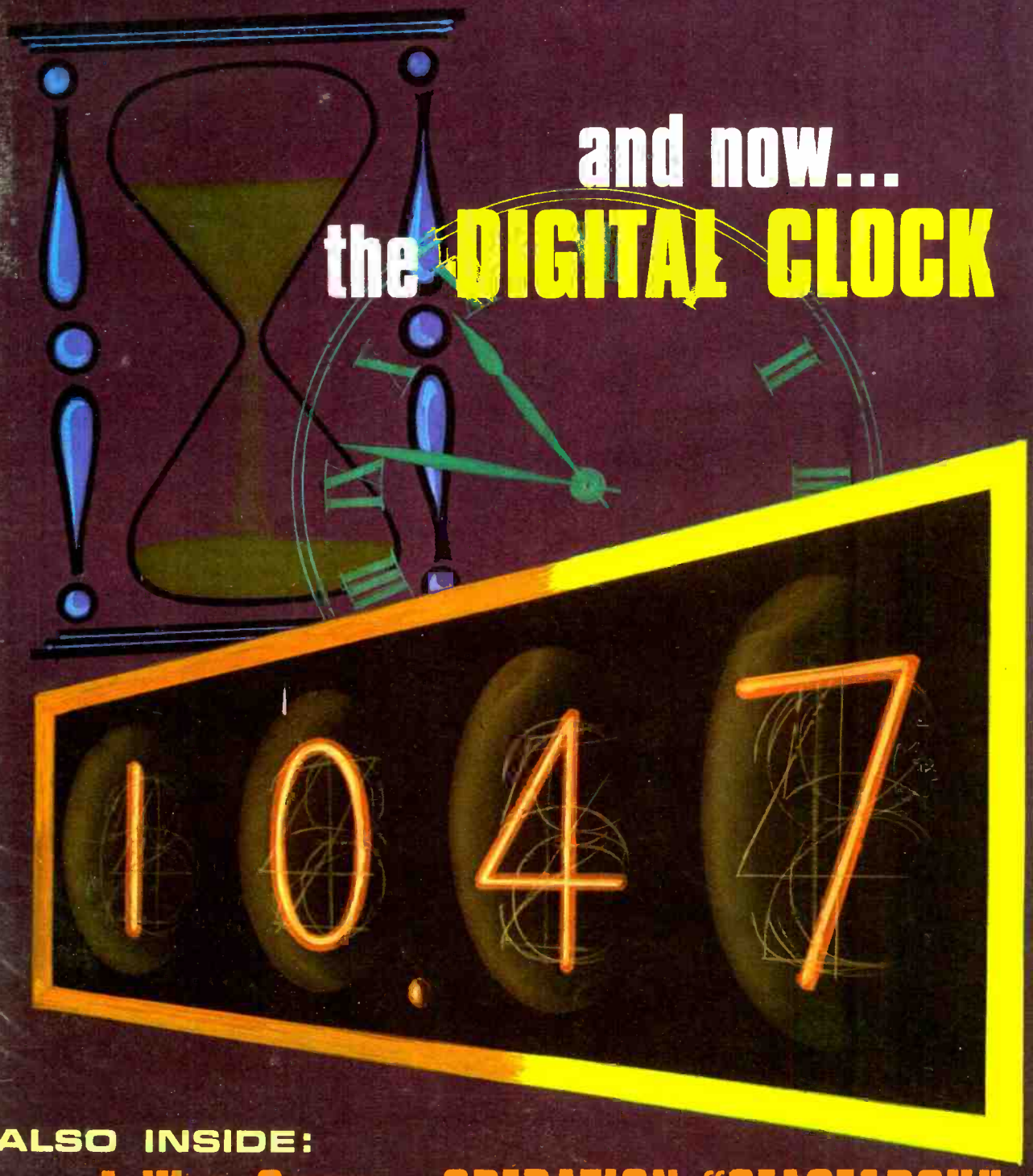

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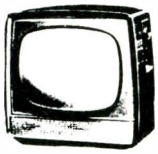

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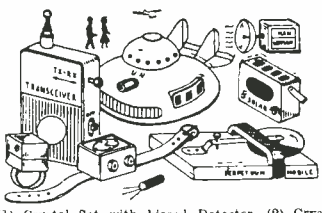

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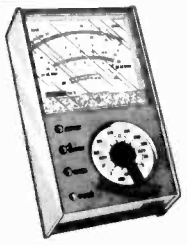

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- DC Current 0–300μA, 0–300mA.
- Resistance: 0–10kΩ, 0–1MΩ.
- Decibels: −10dB to +16dB.
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1 K ohms/volt

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Size Only 3½in. × 2¾in. × 1¼in

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- DC CURRENT: 0–1mA, 100mA.
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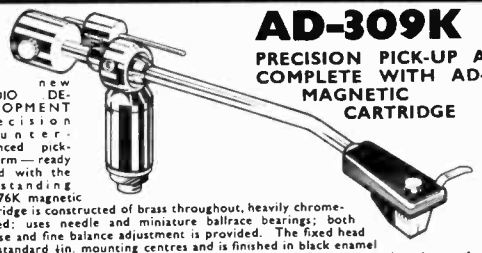
AUDIO DEVELOPMENT

AD-309K

PRECISION PICK-UP ARM COMPLETE WITH AD-76K MAGNETIC CARTRIDGE



The new AUDIO DEVELOPMENT precision counter-balanced pick-up arm—ready fitted with the outstanding AD-76K magnetic cartridge is constructed of brass throughout, heavily chrome-plated; uses needle and miniature ballrace bearings; both coarse and fine balance adjustment is provided. The fixed head has standard ½in. mounting centres and is finished in black enamel with chrome lifting spur. Completely wired, with all fixing nuts and washers. Arm rest also supplied. Tech. details: Overall length 285mm; needle to pivot length 223mm; offset angle 24°; overhang 10mm. Requires single 7/16in. dia. mounting hole.

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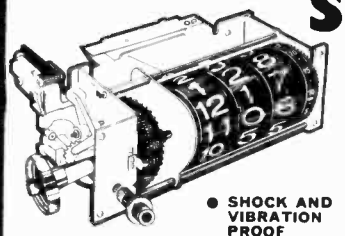

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Garrard

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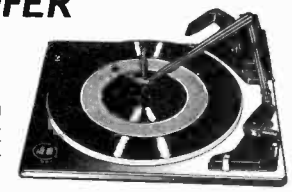

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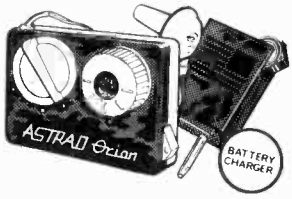

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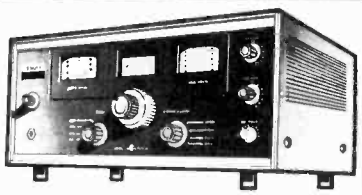

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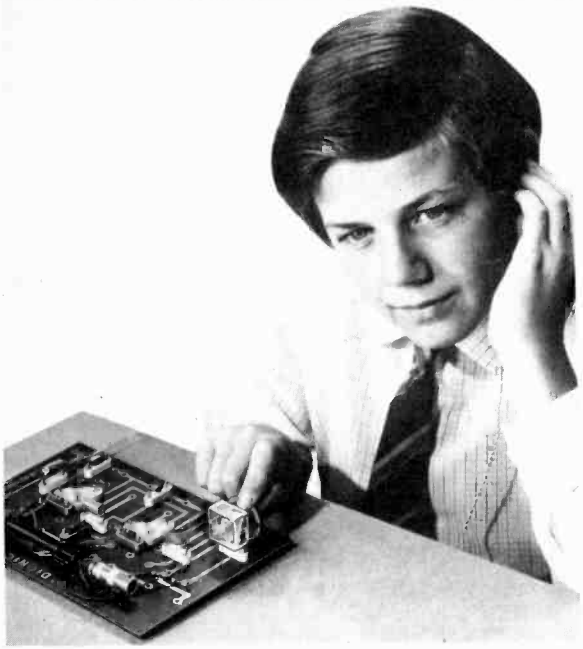

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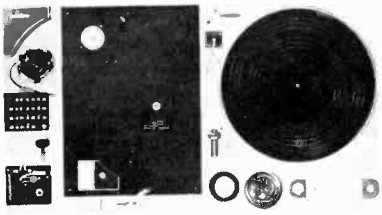

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SELECTIVE AMPLIFIER MODULE. The basis of the Wah-Wah pedal. Kit contains all the components to build a 2-transistor circuit module, also the sockets, control, etc., required for the constructor to assemble his own design, **35/-.**
Assembled and tested module **42/6.**

FOOT VOLUME CONTROL PEDAL. Foot pedal unit in very strong fawn plastic. Fitted with output lead and plug for connection to guitar amplifier. May be used for volume control or converted to Wah-Wah by adding the module.
Pedal unit now only **£5.2.6.**
Complete kit for Wah-Wah pedal now only **£6.10.0.**
All post free.

Send 2/6 for our catalogue of components, testmeters, musical electronics and more details of the above items.
Callers welcome.

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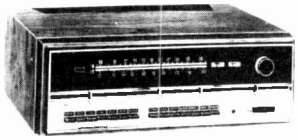
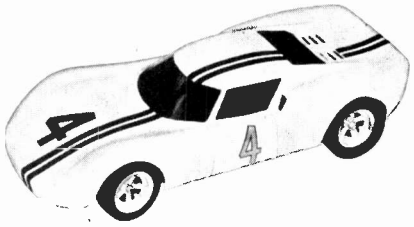
Many New Models! in the FREE HEATHKIT 1971 Catalogue . . .

CONSUMER



HI-FI & AUDIO



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Here's the bumper Heathkit catalogue for you. Read about the wonder and fascination of kit building . . . see in full colour the world's best values in Hi-Fi Radio, and even model radio control. Get up to date with what's new in scientific instrumentation . . . instruments for test and service . . . in fact there is a Heathkit for almost every purpose, in every walk of life. A wealth of information is all yours for the price of a postage stamp, in the Free Heathkit Catalogue.

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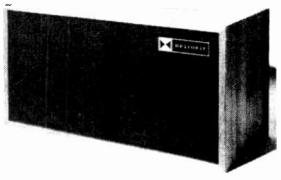

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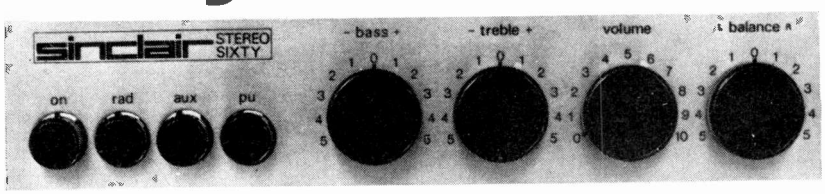
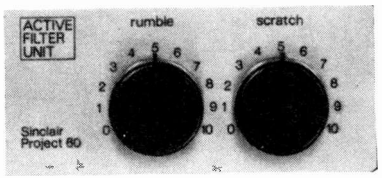
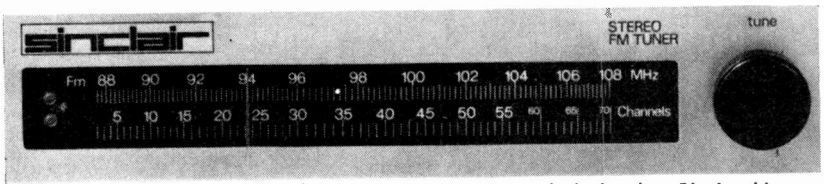
Project 60







the world's most advanced high fidelity modules

With the introduction of an entirely new and original high fidelity stereo F.M. tuner, the Project 60 range can be said at this stage to be complete. It offers the constructor a most attractive choice of modular arrangements whereby a high fidelity system can be selected to suit the user's personal requirements. Equally, it is possible to use any Project 60 modules separately or partially grouped and so benefit greatly from the flexibility in use these modules afford. The chart below shows some of the most popular applications for constructors to assemble. The Project 60 manual (free with the modules) suggests others as well and its 48 pages are packed with valuable information. The new tuner, for example can be used with any good high fidelity system as well as Project 60.

Project 60 now falls into four interdependent groups : – 1. The Z.30 and Z.50 amplifiers which have only 0.02% distortion at all output levels and are useful in a wide variety of other applications. 2. The control units comprising the Stereo 60 preamp and control unit and the Active Filter Unit (A.F.U.) with which both high pass and low pass filtering can be introduced between control unit and power amplifiers. 3. The Stereo F.M. tuner as described opposite ; and 4. The power supply units PZ.5, PZ.6 and PZ.8. For most requirements when using Z.30 power amplifiers, the PZ.5 will be perfectly adequate ; if low efficiency (high quality) loud speakers are used, the PZ.6 stabilised power supply unit will be used. The PZ.8 will be needed with Z.50s which can be used for any Project 60 system.

Project 60 modules incorporate some of the most advanced circuitry in the world to achieve unsurpassed standards of high fidelity and modern manufacturing techniques enable these modules to be sold at exceptionally attractive prices. Assembling the modules requires no skill or previous experience since the manual supplied with the modules explains clearly how everything can be done with nothing more than the simplest of domestic tools.

Project 60 manuals

How to assemble and use Project 60 modules to best advantage in the above and other applications will be found in the fully descriptive Project 60 manual included with Project 60 systems. This 48 page manual is available separately, price 2/6d including postage.

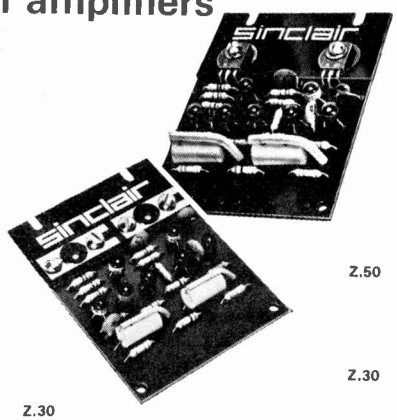
	System	The Units to use	In conjunction with	Cost of Units	+ Project 60 tuner
A	Car Radio	**Z.30**	Existing car radio, Sinclair Micromatic	**89/6**	
B	Simple battery powered record player	**Z.30**	Crystal pick-up, 12V or more battery supply and volume control	**89/6**	
C	Mains powered record player	**Z.30 and PZ.5**	Crystal or ceramic P.U. Volume control etc.	**£9.9.0**	**£34.9.0**
D	20+20 watts R.M.S. stereo amplifier for most needs	**Two Z.30s, Stereo 60 and PZ.5**	Crystal, ceramic or magnetic P.U., most dynamic speakers, F.M. tuner etc.	**£23.18.0**	**£48.18.0**
E	20+20 watts R.M.S. stereo amplifier for use with low efficiency (high performance) speakers	**Two Z.30s, Stereo 60 and PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc All dynamic speakers	**£26.18.0**	**£51.18.9**
F	40+40 watts R.M.S. de-luxe stereo amplifier	**Two Z.50s, Stereo 60 PZ.8 and mains transformer**	As for E	**£32.17.6**	**£57.17.6**
G	Outdoor public address system	**Z.50**	Microphone, up to 4 P.A. speakers, 12V car battery with converter, or 45V d.c., controls	**£5.9.6**	
H	Indoor P.A.	**One Z.50, PZ.8 and mains transformer**	Microphone, guitar, heavy duty speakers etc., controls	**£17.8.6.**	
J	High pass and low pass filters	**A.F.U.**	D, E or F as above	**£5.19.6**	

sinclair

Sinclair Radionics Limited, 22 Newmarket Road, Cambridge
Telephone (0223) 52731

Z.30 & Z.50 power amplifiers

The Z.30 together with the Z.50 are both of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use the Z.30 or Z.50 power amplifiers in your Project 60 system will depend on personal preference, but they are the same physical size and may be used with other units in the Project 60 range equally well. For operating from mains, for the Z.30 use PZ.5 for most domestic requirements, or PZ.6 if you have very low efficiency loudspeakers. For Z.50, use the PZ 8 described below.



SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).***
Power Outputs
Z.30 15 watts R.M.S. into 8 ohms, using 35V: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms from 40 volts: 30 watts R.M.S. into 8 ohms, using 50 volts.
Frequency response 30 to 300,000 Hz ± 1dB
Distortion 0.02% into 8 ohms
Signal to noise ratio better than 70 dB unweighted
Input sensitivity 250mV into 100 Kohms.
For speakers from 3 to 15 ohms impedance.
Size 3½ x 2¼ x ½ ins.

Z.30
Built, tested and guaranteed with circuits and instructions manual **89/6**

Z.50
Built, tested and guaranteed with circuits and instructions manual **109/6**

Stereo 60 pre amp/control unit

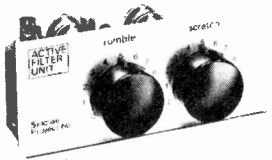
Designed for the Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS
- Input sensitivities – Radio – up to 3mV. Mag. p.u. – 3mV: correct to R.I.A.A. curve ± 1dB: 20 to 25,000Hz. Ceramic p.u. – up to 3mV: Aux. – up to 3mV.
- Output – 250mV.
- Signal-to-noise ratio – better than 70dB.
- Channel matching – within 1dB.
- Tone controls – TREBLE +15 to —15dB at 10kHz: BASS +15 to —15dB at 100Hz.
- Front panel – brushed aluminium with black knobs and controls.
- Size 8¼ x 1½ x 4 ins.

Built, tested and guaranteed **£9.19.6**

Active Filter Unit

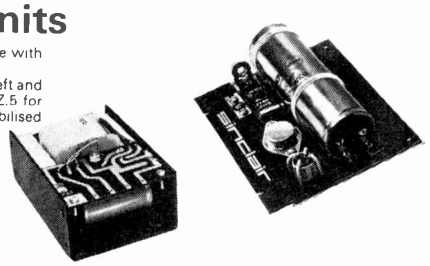
For use between Stereo 60 unit and two Z.30s or Z.50s, the Active Filter Unit matches the Stereo 60 in styling and is as easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The Sinclair A.F.U. is suitable also for use with any other amplifier system.
Two stages of filtering are incorporated – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F cut-off (–3dB) variable from 28kHz to 5kHz. L.F cut-off (–3dB) variable from 25Hz to 100Hz. Filter slope, both sections 12dB per octave. Distortion at 1kHz (35V supply) 0.02% at rated output.



Built, tested and guaranteed **£5.19.6**

Power Supply Units

The units below are designed specially for use with the Project 60 system of your choice.
Illustration shows PZ.5 power supply unit to left and PZ.8 (for use with Z.50s) to the right. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.



PZ-5 *30 volts unstabilised* **£4.19.6**
PZ-6 *35 volts stabilised* **£7.19.6**
PZ-8 *45 volts stabilised (less mains transformers)* **£5.19.6**
PZ-8 *mains transformer* **£5.19.6**

GUARANTEE *If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.*

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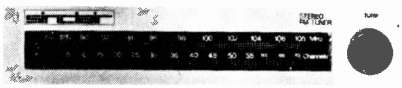
Stereo FM tuner

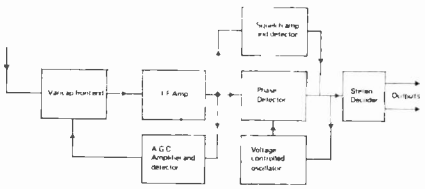


first in the world to use the phase lock loop principle

Before production of this tuner, the phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio over other systems. Now, for the first time the principle has been applied to an FM tuner with fantastically good results. By the inclusion of other original features such as varicap diode tuning, printed circuit coils and an I.C. in the specially designed stereo decoder, the tuner has an unsurpassed specification, which also incorporates a squelch circuit for silent tuning between stations, A.F.C. and A.G.C. Sensitivity is such that good reception becomes possible in difficult areas, foreign stations can be tuned in suitable conditions and often a few inches of wire are enough for an aerial. In terms of high fidelity, this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. Although the tuner is intended primarily for use with a Project 60 system, it can be used to advantage with any other high fidelity system. It is easily mounted into any cabinet as shown in the manual supplied with it.

Specifications

Number of transistors 16 plus 20 in I.C.
Tuning range 87.5 to 108 MHz
Capture ratio 1.5dB
Sensitivity 2μV for 30dB quieting
7μV for full limiting
Squelch level 20μV
A.F.C. range ± 200 KHz
Signal to noise ratio >65dB
Audio frequency response 10Hz—15kHz(±1dB)
Total harmonic distortion 0.15% for 30% modulation
Stereo decoder operating level 2μV
Pilot tone suppression 30dB
Cross talk 40dB
I.F. frequency 10.7 MHz
Output voltage 2 x 150mV R.M.S.
Aerial Impedance 75 Ohms
Indicators Mains on; Stereo on; tuning indicator
Operating voltage 25-30 VDC
Size 3.6 x 1.6 x 8.15 inches; 91.5 x 40 x 207 mm



Price: £25 built and tested. Post free.

To: Sinclair Radionics Ltd., 22 Newmarket Road, Cambridge

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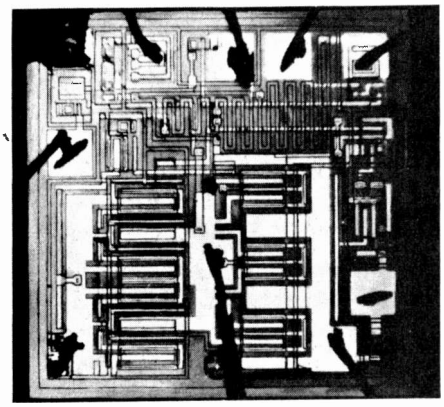
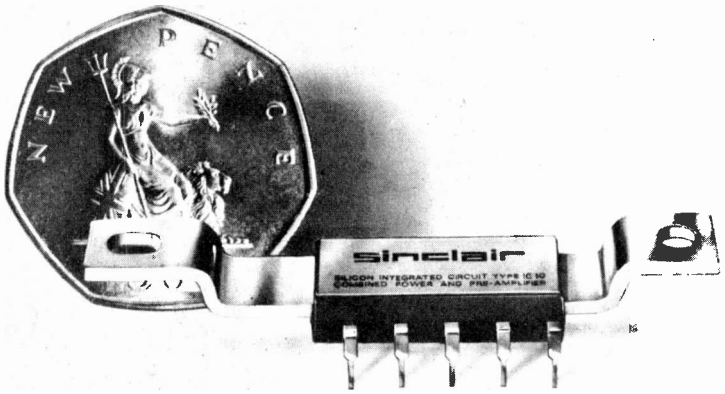
PE/12A

Sinclair IC-10





the world's most advanced high fidelity amplifier

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 x 0.4 x 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 feedback 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.

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 one hundredth of an inch thick, has 5 watts R.M.S. output (10w. peak). It contains 13 transistors (including two power types), 2 diodes, 1 zener 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 such components as 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. Once proven, the circuits can be produced with complete uniformity which enables us to give a full guarantee on every IC-10, knowing that every unit will work as perfectly as the original and do so for a lifetime.

SINCLAIR IC-10 *with IC-10 manual Post free.* **59/6**

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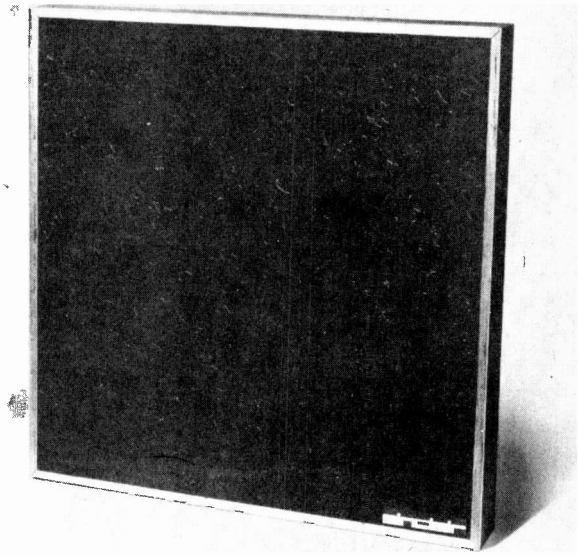
Q.16 High fidelity loudspeaker

Developed out of the revolutionary and much praised design of the original Sinclair Q.14 comes this more advanced version to meet the requirements of even greater numbers of high fidelity enthusiasts. The Q.16 employs the same well proven acoustic principles in which a special driver assembly is meticulously matched to the physical characteristics of the uniquely designed housing. In reviewing this exclusive Sinclair design, technical journals have been loud in their praise for it and it comfortably stands comparison with very much more expensive loudspeakers. The shape of the Q.16 enables it to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures, and with its improved styling, the Q.16 presents an entirely new and attractive appearance. A solid teak surround is used with a special all-over cellular black foam front chosen as much for its appearance as for its ability to pass all audio frequencies unimpaired.
The Q.16 is compact and slim and is the ideal shelf-mounted speaker, and brings genuine high fidelity within reach of every music lover.



Specifications

Construction:	A sealed seamless sound or pressure chamber is used with internal baffle, all of materials carefully chosen to ensure freedom from spurious tone coloration.
Loading:	Up to 14 watts R.M.S.
Input impedance:	8 ohms.
Frequency response:	From 60 to 16,000Hz, as confirmed by independently plotted B & K curve.
Driver unit:	Specially designed high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension. Excellent transient response is achieved.
Size and styling:	9¾″ square on face × 4¾″ deep with neat pedestal base. Black all-over cellular foam front with natural solid teak surround.
Price:	£8 19 6.

Micromatic Britain's smallest radio

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 very much easier than with many larger sets. The plug-in high fidelity type magnetic earpiece which matches exactly with the output of the Micromatic provides wonderful standards of reproduction both for speech and for music. 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.

Specifications

Size:	1 1/32″ × 1 7/16″ × ½″ (46 × 33 × 13mm).
Weight including batteries:	1 oz. (28.35gm) approx.
Tuning:	Medium wave band with bandspread at higher frequency end.
Earpiece:	High-fidelity magnetic type.
Battery requirements:	Two Mallory Mercury Cells, type R.M. 675, for long working life.
Case:	Black plastic with anodised aluminium front panel, spun aluminium dial.
Controls	Tuning dial, and on/off switching by means of earpiece plug.
Price:	Available in kit form complete with earpiece, case, instructions and supply of solder in fitted pack. 49/6. Ready built, tested and guaranteed. 59/6.

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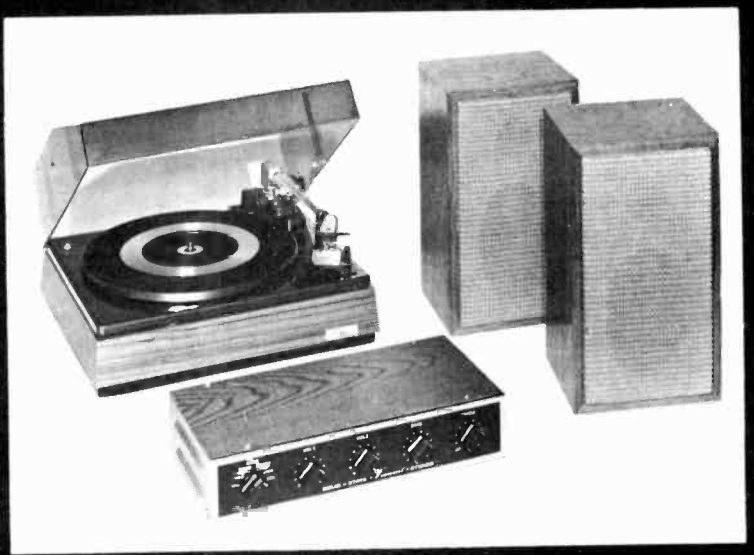
Complete Stereo System £41

WITH VISCOUNT F.E.T. FIELD EFFECT TRANSISTORS AMPLIFIER



This superb stereo system is a real price breakthrough. It comprises the VISCOUNT F.E.T. Mk. I amplifier on which full details are given below, the famous Garrard SP25 (including teak veneer base and transparent cover) with diamond cartridge or 2025 TC and the very successful DUO type 2 speakers.

Measuring 17½in × 10¾in × 6¾in, the Duo type 2 speakers are beautifully finished in simulated teak veneer with matching vynair grills. They incorporate a 10½in × 6¾in drive unit and high frequency speaker, both of which are of 3 ohms. impedance. The Duo speaker system is also available separately at **£6.6.0** each plus 15/- P. & P.

Complete stereo system £41 plus £2.10.0 P. & P.

With Mk. II Amplifier and Magnetic Cartridge £45 plus £2.10.0 P. & P.

The Classic

Simulated teak case

£9.10

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, 4½in deep, 2¾in high. **Built and tested.**

THE RELIANT Mk. II

SOLID STATE GENERAL PURPOSE AMPLIFIER

£7.5.0 Plus P. & P. 7/6

Simulated teak 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 × 4½ × 2½in.

ELEGANT SEVEN Mk. III (350mW Output)

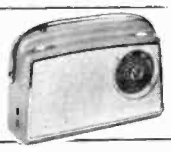
7-transistor fully tunable M.W.-L.W. Superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board —back printed for foolproof construction. **MAINS POWER PACK KIT: 9/6 extra.**

£5.5.0 Plus P. & P. 7/6. Circuit 2/6. Free with parts.

THE DORSET (600mW Output)

7-transistor fully tunable M.W.-L.W. Superhet portable 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.

£5.5.0 Plus P. & P. 7/6. Circuit 2/6. Free with parts.



The Viscount F.E.T. Mk. I £14.5.0 Plus 7/6 P. & P.

High fidelity transistor stereo amplifier employing field effect transistors. With this feature and accompanying guaranteed specifications below, the Viscount F.E.T. vastly surpasses amplifiers costing far more.

SPECIFICATION

Output per channel—10W rms.
Frequency bandwidth 20Hz to 20kHz ±1dB @ 1W.
Total distortion @ 1kHz @ 9W 0·5%.
Input sensitivities—CER. P.U. 100mV into 3 MΩ; Tuner 100mV into 100KΩ; Tape 100mV into 100kΩ.
Overload Factor—Better than 26dB.
Signal to noise ratio—70dB on all inputs (with vol. max).
Controls—6 position selector switch (3 pos. stereo and 3 pos. mono), separate vol. controls for left and right channels. Bass ±14dB @ 60Hz; Treble (with D.P.S. on/off) ±12dB @ 10kHz.
Tape recording output sockets on each channel.
Size 12½in × 6in × 2¾in in simulated teak case. Built and tested.

Mk. II (MAG. P.U.) £15.15.0 Post & packing 10/- extra.

Specification same as Mk. 1, but with the following inputs: Mag, P.U. CER. P.U. Tuner. Spec. on Mag. P.U. 3mV @ 1kHz input impedance 47kΩ. Fully equalised to within ±1dB RIAA. Signal to noise ratio—65dB (vol. max.).

LIQUIDATED STOCK

DANSETTE TOURISTE MK3 CAR RADIO

ALL TRANSISTOR

Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1 MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7" × 2" × 4½" deep.

Originally sold completely built for £15.4.6

SET OF PARTS

£6.6.0 plus 7.6 P. & P.

Circuit diagram 2/6, free with parts
Speaker, baffle and fixing kit 25/- extra plus 4/- P. & P.
Speaker postage free when ordered with parts

SOUND 50

SOUND 50 AMPLIFIER AND SPEAKER SYSTEM

The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

Output Power 45 watts R.M.S. (Sine wave drive). **Frequency response**—3db points 30 Hz at 18 KHz. **Total distortion** less than 2% at rated output. **Signal to noise ratio:** better than 60db. **Speaker Impedance** 3, 8 or 15 ohms. **Bass Control Range** ±13db at 60 Hz. **Treble Control Range** ±12db at 10 KHz. **Inputs** 4 inputs at 5 mV into 470 K. Each pair of inputs controlled by separate volume control. 2 inputs at 200 mV into 470 K.

To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.

SPEAKERS! Size 20" 20" 10" incorporating Baker's 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM £45

plus 60/- P. & P.

Amplifier £28.10.0 plus 20/- P. & P. **Speakers each £12.10.0** plus 30/- P. & P.

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WE HOLD THE LARGEST STOCK OF RETAIL COMPONENTS IN LONDON — SEND 3/- FOR CATALOGUE AND LISTS

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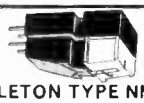
Plug your Transistor Radio, Amplifier, Cassette, etc., into the a.c. mains through this compact eliminator. 2¼in × 2in × 3inapprox. 4½V **29/6**, 6V **29/6**, 9V **29/6**, 7½V complete with cable and plug for Philips Cassette. **39/6** Plus 2/- P. & P. each.

TELETON TYPE NM.33 MAGNETIC CARTRIDGE



Stereo with diamond styli. This ever popular cartridge now at economy price: Diamond Stylus, ½ mil: Frequency, 20-20kHz: Separation, 20db at 10kHz.

79/6 Plus 1/6 P. & P.

I.C. MODULE TYPE BP1010

3W r.m.s. power amplifier and pre-amp. Complete with data sheet. Fully guaranteed. **25/-** P. & P. 1/6 each.

All Sinclair products are in stock. Please include postage with orders.

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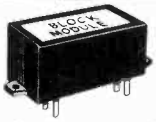
of the finest quality (all guaranteed). 5in 600ft, **8/6** each, 3 for **24/-**. 5½in 900ft, **10/-** each, 3 for **28/6**. 7in 1,200ft, **11/6** each, 3 for **33/-**. Please include 1/6 on each order for P. & P.

SOLID STATE BLOCK MODULES



Phono pre-amp E1311: input, 100K: gain, 28db: max. out, 3V: max. in, 50M/V: power, 9V.
Tape pre-amp E1312, as above.
Mic. pre-amp E1313, as above.
Power amplifier E1314: input, 1,000 ohms: gain, 20db, 300M/W: power, 9V d.c.
Electronic organ, tone osc. E1315: tone freq., 200–1kHz: output, 80M/W: power, 9V: current, 15M/A.
Dual flasher E1318: flasher time, 1/4 secs: power, 6V: current, 150M/A: lamp, 6V 150M/A.
We also stock the morse code practice modules in this range.

ALL AT 25/- Plus 2/- P. & P.

EMI SET 850

A complete speaker system **IN KIT FORM**. We supply a modern styled teak finish cabinet with black front. Overall dimensions: 14in × 9in × 9in. Made to a very high standard. A 6½in EMI woofer. A 3in tweeter. A crossover network. Acoustic wadding. Output terminals, wire and fixing hardware. Specification: Max. power, 10W: frequency, 65-20kHz: imp 8–15 ohms.

Kit price **9 Gns.** Plus 7/6 p. & P.

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Fused Primary 240V. at 50M/A, Secondary 220V 6·3V at 1A. This transformer is made to a very high standard and is a small size: 2in × 2½in × 2½in. **12/6** Plus 3/- P. & P.

IMPORTED PANEL METERS

KA-38C 1¾in 1¾in. 50μA, 100μA, 500μA, 1/MA, 5M/A. 8 meter 1M/A, 300V. All at **29/6** Plus 1/- P. & P.

KA-65C 3¼in 3¼in. 300V. 8 meter 500μA, 1M/A. All at **39/6** Plus 1/6 P. & P.

EMI LOUDSPEAKER 450

10W 13in × 8in × two 2-2½in tweeters and cross-over. All wired and ready for use. This ever-popular **450**. In 3-8-15 ohm imp.

65/- Plus 7/6 P. & P.

PSYCHEDELIC LIGHT CONTROL UNIT

Three Channel: Bass—Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 500W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed) **£18.10.0.** Plus 7/6 P. & P.
If you require more information please send S.A.E.

LOW VOLTAGE AMPLIFIER

5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output. With high IMP input this amplifier will work as a record player, baby alarm, etc., amplifier.
Few only at **35/-** plus 2/6 P. & P.

CRESCENT CASSETTES

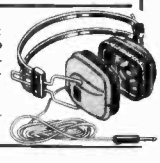
Top quality cassettes at unbeatable prices (complete with standard storage case): C60 **7/6**, C90 **12/6**, C120 **17/6**. Plus 1/- P. & P.

STEREO HEADSET

8 ohm impedance, complete with plug and 5ft lead. A very comfortable phone set. Listen to stereo without noise interrupting the pleasure. Wonderful value **5 9/6** Plus 4/- P. & P.

STEREO JUNCTION BOX

For stereo amplifiers without stereo jack socket. **2 5/-** Plus 1/9 P. & P.

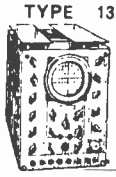


HIGH QUALITY IMPORTED HEADPHONES

1,000Ω per phone **15/11**
2,000Ω per phone **17/6**
Plus 2/- P. & P. per pair.

TTC G1105

TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope, T.B. 2 c/s-750KHz. Bandwidth 5·5 MHz. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V a.c. Supplied in excellent working condition. **£22.10.0.** Carriage 30/-.

AVO CT471A MULTIMETER

Battery operated, fully transistorised. Sensitivity 100mΩ/v. Measures AC/DC Voltages 12mV to 1,200v. AC/DC Current 12uA to 1.2 Amp. Resistance 12 ohm to 120 mΩ HF, VHF, UHF. Voltage with multiplier 4v to 400v up to 50 Mc/s, 40mV to 4V up to 1,000 Mc/s. Offered in perfect condition. **£55** each. 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.

TAPE CASSETTES

Top quality in plastic library boxes.

C60 60 min **8/6** 3 for **24/6**
C90 90 min **12/6** 3 for **36/-**
C120 120 min **15/-** 3 for **43/6**

Cassette Head Cleaner **11/3.** All Post Extra.

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.

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latest release 125kHz to 20MHz. Excellent condition. Fully tested and checked and complete with calibrator charts. **£27.10.0.** each, Carr. 10/-.

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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/-.

AVO CT.38 ELECTRONIC MULTIMETERS

High quality 97 range instrument which measures a.c. and d.c. Voltage, Current, Resistance and Power Output Ranges d.c. volts 250mV-10,000V (10 megΩ-110 megΩ input). D.c. current 10μA-25A. Ohms. 0-1,000 megΩ a.c. volt 100mV-250V (with R.F. measuring head up to 250MHz) a.c. current 10μA-25A. Power output 50 microwatts-5 watts. Operation 0/110/200/250V a.c. Supplied in perfect condition complete with circuit lead and R.F. probe. **£25.** Carr. 15/-.

ADMIRALTY B.40 RECEIVERS

High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 KHz-30 MHz. I.F. 500/KHz. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O. calibrator I.F. output, etc. Built-in speaker, output for phones. Operation 150/230V a.c. Size 19½ × 13½ × 16in. Weight 114lb. Offered in good working condition. **£22.10.0.** Carr. 30/-. With circuit diagrams. Also available B41 L.F. version of above. 15KHz-700KHz. **£17.10.0.** Carr. 30/-.

TO-2 PORTABLE OSCILLOSCOPE

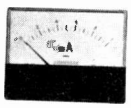
A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS-1 MHZ. Input imp. 2 megΩ 25 P.F. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240 V a.c. Supplied brand new with handbook. **£22.10.0.** Carr. 10/-.

SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC. ● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS



TYPE SW. 100
100 x 80 mm

1mA	59/6	50μA	69/6
20V d.c.	59/6	100μA	67/6
50V d.c.	59/6	500μA	62/6
1A d.c.	59/6		
5A d.c.	59/6		
300V a.c.	59/6		
VU Meter	75/-		

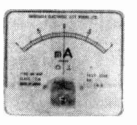
BAKELITE PANEL METERS

TYPE S-80
80 mm
square fronts

50μA	62/6	5A d.c.	49/6
100μA	59/6	300V a.c.	52/6
500μA	52/6	VU Meter	67/6
1mA	49/6		
20V d.c.	49/6		
50V d.c.	49/6		
1A d.c.	49/6		

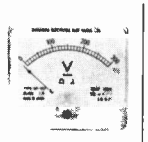
"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in 4¼in fronts.



50μA	72/-	10mA	52/-
50-0-50μA	62/-	50mA	52/-
100μA	62/-	100mA	52/-
100-0-100μA	62/-	500mA	52/-
200μA	57/6	1A	52/-
500μA	55/-	5A	52/-
500-0-500μA	52/-	15A	52/-
1mA	52/-	30A	52/-
1-0-1mA	52/-	20V d.c.	52/-
5mA	52/-	50V d.c.	52/-
		150V d.c.	52/-
		300V d.c.	52/-
		15V a.c.	52/-
		300V a.c.	52/-
		8 Meter 1mA	57/6
		VU meter	72/-
		1A a.c.*	52/-
		5A a.c.*	52/-
		10A a.c.*	52/-
		20A a.c.*	52/-
		30A a.c.*	52/-

Type MR.38P. 1 21/32in square fronts.



50μA	40/-	150mA	27/6
50-0-50μA	37/6	200mA	27/6
100μA	37/6	300mA	27/6
100-0-100μA	35/-	500mA	27/6
200μA	35/-	750mA	27/6
500μA	30/-	1A	27/6
500-0-500μA	27/6	2A	27/6
1mA	27/6	5A	27/6
1-0-1mA	27/6	10A	27/6
2mA	27/6	3V d.c.	27/6
5mA	27/6	10V d.c.	27/6
10mA	27/6	15V d.c.	27/6
20mA	27/6	20V d.c.	27/6
50mA	27/6	100V d.c.	27/6
100mA	27/6	150V d.c.	27/6
		300V d.c.	27/6
		500V d.c.	27/6
		750V d.c.	27/6
		15V a.c.	27/6
		50V a.c.	27/6
		150V a.c.	27/6
		300V a.c.	27/6
		500V a.c.	27/6
		8 meter 1mA	32/-
		VU meter	42/-

Type MR.52P. 2¼in square fronts.

50μA	62/-	10V d.c.	40/-
50-0-50μA	52/-	20V d.c.	40/-
100μA	52/-	50V d.c.	40/-
100-0-100μA	47/6	300V d.c.	40/-
500μA	45/-	15V a.c.	40/-
1mA	40/-	300V a.c.	40/-
5mA	40/-	8 Meter 1mA	42/-
10mA	40/-	VU Meter	62/-
50mA	40/-	1A a.c.*	40/-
100mA	40/-	5A a.c.*	40/-
500mA	40/-	10A a.c.*	40/-
1A	40/-	20A a.c.*	40/-
5A	40/-	30A a.c.*	40/-

Type MR.45P. 2in square fronts.

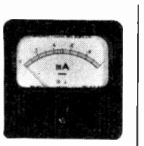
50μA	45/-	5A	30/-
50-0-50μA	42/-	10V d.c.	30/-
100μA	42/-	20V d.c.	30/-
100-0-100μA	37/6	50V d.c.	30/-
200μA	37/6	300V d.c.	30/-
500μA	32/-	15V a.c.	30/-
500-0-500μA	30/-	300V a.c.	30/-
1mA	30/-	8 meter 1mA	37/6
5mA	30/-	VU meter	45/-
10mA	30/-	1A a.c.*	30/-
50mA	30/-	5A a.c.*	30/-
100mA	30/-	10A a.c.*	30/-
500mA	30/-	20A a.c.*	30/-
1A	30/-	30A a.c.*	30/-

Type MR.65P. 3¼in x 3¼in fronts.

50μA	67/6	20V d.c.	42/-
50-0-50μA	55/-	50V d.c.	42/-
100μA	55/-	150V d.c.	42/-
100-0-100μA	52/-	300V d.c.	42/-
500μA	47/6	15V a.c.	42/-
500-0-500μA	42/-	50V a.c.	42/-
1mA	42/-	150V a.c.	42/-
5mA	42/-	300V a.c.	42/-
10mA	42/-	500V a.c.	42/-
50mA	42/-	8 meter 1mA	47/6
100mA	42/-	VU meter	67/6
500mA	42/-	50mA a.c.*	42/-
1A	42/-	100mA a.c.*	42/-
5A	42/-	200mA a.c.*	42/-
10A	42/-	500mA a.c.*	42/-
15A	42/-	1A a.c.*	42/-
20A	42/-	5A a.c.*	42/-
30A	42/-	10A a.c.*	42/-
50A	47/6	20A a.c.*	42/-
10V d.c.	42/-	30A a.c.*	42/-

"SEW" BAKELITE PANEL METERS

Type MR 65. 3¼in square fronts.



25μA	70/-	500mA	35/-
50μA	47/6	1A	35/-
50-0-50μA	45/-	5A	35/-
100μA	45/-	15A	35/-
100-0-100μA	45/-	30A	35/-
500μA	42/-	50A	35/-
1mA	35/-	5V d.c.	35/-
1-0-1mA	35/-	10V d.c.	35/-
5mA	35/-	20V d.c.	35/-
10mA	35/-	50V d.c.	35/-
50mA	35/-	150V d.c.	35/-
100mA	35/-	300V d.c.	35/-
		30V a.c.*	35/-
		50V a.c.*	35/-
		150V a.c.*	35/-
		300V a.c.*	35/-
		500mA a.c.*	35/-
		1A a.c.*	35/-
		5A a.c.*	35/-
		10A a.c.*	35/-
		20A a.c.*	35/-
		30A a.c.*	35/-
		50A a.c.*	35/-
		VU meter	62/-

*** MOVING IRON — ALL OTHERS MOVING COIL**

Please add postage

EDGWISE METERS

Type PE.70. 3 17/32in 1 15/32in 2¼in deep.

50μA	60/-	500μA	52/-
50-0-50μA	57/6	1mA	47/6
100μA	57/6	300V a.c.	47/6
100-0-100μA	55/-	VU meter	65/-
200μA	55/-		

Send for illustrated brochure — Discounts for Quantities

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.

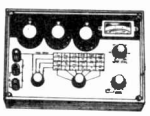
25 WATT. 10/25/50/100/250/500/1,000/1,500/2,500 or 5,000 ohms, **14/6.** P. & P. 1/6.
50 WATT. 10/25/50/100/250/500/1,000/2,500 or 5,000 ohms, **21/-.** P. & P. 1/6.
100 WATT. 1/5/10/25/50/100/250/500/1,000 or 2,500 ohms, **27/6.** P. & P. 1/6.

FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and ICO, *npn* or *pnp*. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. **£6.19.6.** P. & P. 3/-.

MARCONI TF142E DISTORTION FACTOR METERS. Excellent condition. Fully tested. **£20.** Carr. 15/-.

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 megΩ 6 Ranges ±1% L.1 μH - 1 1 1 HENRYS 6 Ranges -2%. C. 10pF ±1110mFd. 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/-.

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

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

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V a.c. Brand new with instructions. **£15.0.0.** P. & P. 7/6. S.A.E. for details.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

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

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 kc/s on 4 bands. Square: 20c/s to 30 kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads. **£16.10.0.** Carr. 7/6.

MARCONI TF885 VIDEO OSCILLATORS

0-5MHz. Sine Square Wave. **£45.** Carr. 20/-.

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

2pF-2,000 mfd 2 ohms-200 megohms. Also checks impedance, turns ratio, insulation, 200/250V a.c. **Brand New £17.10.0.** Carr. 7/6.

MARCONI TF195M BEAT FREQUENCY OSCILLATORS

0-40KHz. **£20.** Carr. 30/-.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons.

J1B. AUDIO SIGNAL GENERATOR. 15 c/s to 50 Kc/s. Sine wave. Output 600 ohms or 5 ohms. **£30.0.0.**

VM79. UHF MILLIVOLT METER. 100 Kc/s to 1,000 Mc/s. a.c. 10 mV to 3V. D.c. 10 mV to 3V. Current 0·01 μA to 0·3 mA. Resistance 1 ohm to 10 megohm. **£125.0.0.**

TT1S. TRANSISTOR TESTER. Full range of facilities for testing PNP or NPN transistors in or out of circuit. **£37.10.0.** Carriage 10/- per item.

G. W. SMITH & CO (RADIO) LTD.

Also see next two pages

SEMI-CONDUCTORS/VALVES

BRAND NEW & FULLY GUARANTEED

TRANSISTORS

1N914	1/6	AC128	4/-	BSY38	4/6
1N4001	2/-	AC154	4/6	BSY39	4/6
1N4002	2/3	AC176	5/-	BSY51	6/6
1N4003	2/6	AC187	12/6	BSY56	18/-
1N4004	3/-	AC188	7/8	BSY95A	2/6
1N4005	3/6	ACY17	5/8	BY100	3/6
1N4006	4/-	ACY18	5/-	BY124	3/-
1N4007	4/6	ACY19	5/-	BY126	4/-
1N4148	1/9	ACY20	5/-	BY127	4/6
1N5054	4/6	ACY21	5/-	BYZ10	7/-
2G301	4/-	ACY22	4/-	BYZ11	6/6
2G302	4/-	ACY28	4/-	BYZ12	6/-
2G303	4/-	ACY40	4/-	BYZ13	5/-
2G306	7/6	AD140	8/-	MJ480	19/6
2G308	6/-	AD149	11/6	MJ481	25/-
2G309	6/-	AD161	7/6	MPF102	8/6
2G371	3/-	AD162	7/6	MPF103	7/6
2G374	4/-	AF114	5/-	MPF104	7/6
2G381	4/6	AF115	6/-	MPF105	7/6
2N696	4/-	AF116	5/-	NKT213	6/-
2N697	4/-	AF117	5/-	NKT214	4/6
2N698	5/-	AF118	12/6	NKT216	7/6
2N706	2/6	AF119	4/-	NKT217	8/6
2N706A	2/6	AF124	4/6	NKT224	5/-
2N708	3/-	AF126	4/-	NKT241	5/6
2N914	3/6	AF127	4/-	NKT261	4/-
2N916	3/6	AF139	6/-	NKT271	4/-
2N918	6/-	AF178	11/-	NKT272	4/-
2N929	4/6	AF180	10/6	NKT274	4/-
2N930	5/6	AF181	8/6	NKT275	4/-
2N1131	5/6	AF186	9/-	NKT278	3/6
2N1132	6/8	AF239	8/6	NKT281	5/6
2N1302	3/6	A8Y26	5/-	NKT403	15/-
2N1303	3/6	A8Y27	7/6	NKT404	12/6
2N1304	4/6	A8Y28	5/6	NKT405	15/-
2N1305	4/6	A8Z17	8/6	NKT773	5/-
2N1306	5/-	ACY10	30/-	NKT10439	7/6
2N1307	5/-	BAY31	1/8	OA5	2/6
2N1308	6/-	BC107	3/-	OA10	2/6
2N1309	6/-	BC108	3/-	OA47	1/6
2N1613	5/-	BC109	3/-	OA70	1/6
2N1711	5/-	BC113	5/6	OA79	1/9
2N1889	6/6	BC116	12/6	OA81	1/6
2N1893	8/6	BC125	11/-	OA85	1/6
2N2147	14/6	BC126	11/-	OA90	1/6
2N2160	11/6	BC147	3/6	OA91	1/6
2N2193	9/6	BC148	3/-	OA95	1/6
2N2217	5/6	BC149	3/6	OA200	2/-
2N2218	6/6	BC167	3/-	OA202	1/-
2N2219	6/6	BC172	3/6	OA210	3/6
2N2369	3/6	BC177	7/6	OC19	8/6
2N2369	3/6	BC186	7/8	OC20	15/-
2N2369A	4/-	BC182L	4/-	OC22	10/-
2N2484	6/8	BC184L	4/-	OC23	10/-
2N2613	7/-	BC212L	4/6	OC24	11/6
2N2646	11/8	BCY30	5/6	OC25	10/-
2N2904	7/-	BCY31	5/6	OC26	6/6
2N2923	3/6	BCY32	7/6	OC28	10/-
2N2924	3/6	BCY33	4/-	OC29	12/6
2N2925	3/6	BCY34	4/6	OC35	8/-
2N2926G	2/9	BCY38	4/6	OC36	12/6
2N2926O	2/6	BCY42	3/-	OC41	4/6
2N2926Y	2/6	BCY43	3/-	OC42	5/-
2N3053	5/-	BCY71	8/6	OC44	4/-
2N3054	11/-	BCY72	3/6	OC45	2/6
2N3055	15/-	BCZ11	7/6	OC46	3/-
2N3391A	6/-	BD121	13/-	OC70	3/-
2N3416	7/6	BD123	16/6	OC71	2/6
2N3570	17/6	BD124	12/-	OC72	2/6
2N3702	3/6	BF115	5/-	OC73	5/-
2N3703	4/6	BF117	9/6	OC74	6/-
2N3704	4/6	BF167	5/-	OC75	4/6
2N3705	4/-	BF173	6/6	OC76	4/6
2N3706	4/6	BF180	7/-	OC77	6/-
2N3707	4/-	BF181	6/6	OC78	4/6
2N3708	3/6	BF182	6/6	OC81	4/-
2N3709	3/6	BF184	6/6	OC81D	4/-
2N3710	4/-	BF185	8/6	OC83	5/-
2N3711	4/-	BF194	4/8	OC84	5/-
2N3819	7/-	BF195	5/6	OC139	6/6
2N3903	7/-	BF200	10/6	OC140	6/6
2N3904	7/-	BF224	6/-	OC169	4/6
2N3905	7/6	BF225	6/-	OC170	6/-
2N3906	7/8	BF244	9/6	OC171	6/-
2N4058	5/6	BFX12	4/6	OC200	6/6
2N4059	5/-	BFX13	4/6	OC201	9/6
2N4061	4/6	BFX29	7/-	OC202	12/6
2N4062	4/6	BFX30	9/-	OC203	8/6
2N4286	3/6	BFX44	7/6	OC204	8/6
2N4287	3/6	BFX85	7/-	OC205	8/6
2N4288	3/6	BFX86	6/-	OC207	12/6
2N4289	3/6	BFX87	6/-	OCP71	8/6
2N4290	3/6	BFX88	5/-	ORP12	10/-
2N4291	3/6	BFY18	6/6	ORP60	10/-
2N4292	2/6	BFY20	12/6	P346A	4/6
2N5354	5/6	BFY50	4/6	PL4001	2/9
2N5355	5/6	BFY51	4/6	PL4002	3/-
28102	6/6	BFY52	4/6	PL4003	3/3
28103	6/6	BFY90	13/6	PL4004	3/6
28104	6/6	B8X19	3/6	PL4005	3/9
40250	10/-	B8X20	3/6	PL4006	4/-
40361	12/6	B8X21	7/6	PL4007	4/9
40362	13/6	B8X76	4/6	TIS43	8/-
AC107	6/-	B8Y26	3/6	TIS44	2/6
AC126	4/-	B8Y27	3/6	TIS45	3/6
AC127	5/-	B8Y28	3/6	TIS46	3/6

VALVES

1L4	2/6	25L6	7/6	EL91	5/-
1R5	7/-	25Z4	6/-	EL95	7/-
1S5	5/-	25Z5	8/6	EM80	8/-
1T4	4/6	25Z6	11/6	EM81	8/6
1U4	6/-	30C15	15/-	EM84	7/6
1U5	9/6	30C17	16/-	EM85	11/-
OA2	6/6	30C18	15/-	EM87	11/-
OB2	6/6	30F5	17/-	EY51	8/-
OZ4	6/-	30FL1	15/-	EY86	8/-
OL4	2/6	30FL12	18/6	EY87	8/6
2D21	6/6	30FL14	15/6	EZ40	7/6
3Q4	8/-	30L15	17/-	EZ41	9/-
3S4	7/-	30L17	17/-	EZ80	5/6
3V4	8/-	30P12	16/-	EZ81	5/6
5R4	11/-	30P19	15/-	GZ32	9/6
5U4	6/-	30PL1	15/6	GZ34	11/-
5V4	8/-	30PL13	18/-	K166	27/6
5Y3	6/-	30PL14	17/-	KT88	33/6
5Z4G	7/6	35L6	9/6	MU14	8/-
6/30L2	15/-	35W4	5/-	PABC80	8/-
6AC7	4/-	35Z4	5/-	PC86	11/6
6AG7	7/6	35Z5	7/-	PC88	13/-
6AK5	6/-	50B5	7/-	PC97	8/6
6AK6	11/6	50C5	7/-	PC900	9/6
6AL5	3/3	80	9/-	PCC84	7/-
6AM6	4/6	85A2	7/6	PCC85	8/-
6AQ5	6/6	807	9/6	PCC88	12/-
6AS6	6/-	1625	6/-	PCC89	10/6
6AT6	5/-	5763	13/-	PCC189	11/-
6AU6	5/-	6146	30/-	PCF80	6/6
6AV6	6/6	AZ31	10/-	PCF82	6/9
6BA6	4/6	CY31	7/-	PCF84	9/-
6BE6	5/-	DAF91	5/6	PCF86	11/-
6BH6	8/6	DAF96	7/9	PCF8000	15/-
6BJ6	8/6	DF91	4/6	PCF801	10/-
6BQ7A	7/6	DF96	7/9	PCF802	10/-
6BR7	17/-	DK91	7/-	PCF805	15/-
6BR8	13/-	DK92	9/-	PCF806	13/-
6BW6	16/-	DK96	8/-	PCF808	15/6
6BW7	13/6	DL92	7/-	PCL82	7/9
6BZ6	6/6	DL94	8/-	PCL83	13/-
6C4	6/-	DL96	7/6	PCL84	8/9
6CD6	23/-	DM70	6/6	PCL85	9/6
6CL6	10/-	DY86	6/6	PCL86	9/6
6CW4	12/6	DY87	7/-	PFL200	11/-
6F1	12/6	E88CC	12/6	PL36	11/-
6F6G	5/-	E180F	15/-	PL81	9/6
6F13	7/-	EABC80	6/6	PL82	9/-
6F14	12/-	EAF42	10/-	PL83	8/-
6F15	11/-	EB91	3/3	PL84	7/-
6F18	8/-	EBC41	10/6	PL500	15/-
6F23	15/6	EBC81	6/6	PL504	16/-
6H6	3/-	EBF80	8/-	PY32	11/-
6J4	9/6	EBF83	8/6	PY33	12/6
6J5	4/-	EBF89	6/6	PY80	6/6
6J5GT	6/-	EBL21	12/-	PY81	6/-
6J6	3/6	EC86	12/-	PY82	6/-
6J7	8/6	EC88	12/-	PY83	7/6
6K8G	6/-	ECC40	11/-	PY88	8/-
6L6GT	9/-	ECC84	6/-	PY800	10/-
6LD20	6/6	ECC85	5/6	PY801	10/-
6Q7	7/6	ECC88	8/-	U25	15/-
6SA7	7/-	ECF80	7/-	U26	15/-
6SG7	6/-	ECF82	7/-	U50	6/-
6SJ7	7/-	ECF86	12/6	U52	6/-
6SK7	6/-	ECH21	11/6	U191	14/-
6SL7	6/-	ECH35	12/-	U281	8/-
6SN7	5/6	ECH42	13/-	U282	8/-
6SQ7	8/-	ECH81	5/6	U301	11/6
6U4	12/6	ECH83	8/6	U801	20/-
6V6G	5/-	ECL80	9/-	UABC80	6/9
6V6GT	6/6	ECL82	6/6	UAF42	10/6
6X4	5/-	ECL83	12/6	UBC41	9/6
6X5G	5/6	ECL86	8/6	UBC81	8/-
6X5GT	5/6	EF37A	8/-	UBF80	7/3
10C2	10/-	EF39	8/-	UBF89	7/-
10F1	18/-	EF40	10/-	UCC84	9/9
10P13	11/-	EF41	12/6	UCC85	8/-
10P14	20/-	EF42	14/-	UCF80	10/6
12AT6	5/-	EF80	5/-	UCH21	11/-
12AT7	4/-	EF85	7/-	UCH42	13/-
12AU7	5/-	EF86	6/6	UCH81	6/6
12AX7	6/-	EF89	5/6	UCL82	7/-
12AV6	6/-	EF91	4/8	UCL83	12/-
12BA6	6/6	EF92	7/6	UF41	10/-
12BE6	6/6	EF183	6/6	UF80	7/6
12BH7	6/6	EF184	7/-	UF85	8/-
19AQ5	6/6	EH90	8/-	UF89	7/-
20D1	9/-	EL34	10/6	UL41	12/-
20F2	15/-	EL33	17/6	UL84	6/6
20L1	20/-	EL41	11/-	UY41	8/-
20P1	10/-	EL42	11/6	UY85	6/-
20P3	12/-	EL81	10/-	VR105/30	5/6
20P4	20/-	EL84	5/-	VR150/30	5/-
20P5	20/-	EL85	8/3	VR150/30	5/-

ZENER DIODES

400mw. (3·3 to 33V) 3/-
1·5 watt (2·4 to 200V) 4/-
10 watt (3·9 to 100V) 5/-

THYRISTORS

1A: 50PIV, 5/-; 100PIV, 5/6; 200PIV, 7/6; 300PIV, 8/-; 400PIV, 9/6. 3A: 50PIV, 6/-; 100PIV, 7/6; 200PIV, 8/-; 300PIV, 9/-; 400PIV, 10/-. 5A: 100PIV, 11/-; 200PIV, 13/-; 400PIV, 15/-. 7A: 100PIV, 11/-; 200PIV, 13/-; 300PIV, 14/-; 400PIV, 19/6. 100A: 350PIV, 50/-; 400PIV, 55/-.

TRIACS

8C41A 100PIV 6A, 19/6; 8C41B 6A 200PIV, 22/-; 8C41D 400PIV 6A, 27/6.

SEND SAE FOR FULL LISTS DISCOUNTS:

10% on 12 + any one type.
15% on 25 + any one type.
Large quantity discounts on application.
Postage: Semi-Conductors 1/6. Valves 3/-.

HI-FI EQUIPMENT

SAVE UP TO 33⅓% OR MORE

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GARRARD

FULL CURRENT RANGE OFFERED, BRAND NEW AT FANTASTIC SAVINGS

1025 stereo	£7.19.6	SL72B	£24.19.6
2025T/C stereo	£8.17.6	AP75	£16.19.6
40 MKII stereo	£8.8.0	SL75	£25.19.6
3000 stereo	£9.19.6	SL75B	£27.19.6
SP25 MKII	£10.19.6	SL95B	£37.10.0
SL55	£11.12.6	A70/11	£11.19.6
SL65B	£14.19.6	401	£25. 0.0

Carriage 7/6 extra each item.

TEAK PLINTHS AND PERSPEX COVERS
1. For SP25, SL65, SL55, 3000, 2025T/C, 2025, 1000. £4.10.0
2. For AP75, SL75, SL95. £5.19.6
3. For SP25 etc. to operate with lid in place £5.19.6

Carriage 7/6 extra each type. Full range of Garrard accessories available.

HALF PRICE OFFER! SINCLAIR STEREO 25

Hi-Fi solid state pre-amplifier and control unit incorporating treble, bass, volume and balance controls. Switched input for p.u. (magnetic and ceramic), mike and radio. Will also accept tape head. Operates from 9V-12V battery (20V max. 7·5mA). Frequency response 25Hz-30kHz ± 1dB. Noise level better than −50dB on all inputs. Principally designed for use with Z12 Amplifier but full instructions are supplied to enable it to be used with any amplifier. Size 6½" × 2½" × 2½" overall plus knobs. Brushed and polished aluminium front panel with matching knobs. Supplied brand new and guaranteed, with full instructions.

Original price £9.19.6
OUR PRICE 99/6. P. & P. 3/-

TELETON SAQ203E STEREO AMPLIFIER

Solid state, 10W per channel music power. 6W r.m.s. Inputs for mag, ceramic, tuner, aux.

SPECIAL PRICE £20. Carr. 7/6.

ECHO HS-606 STEREO HEADPHONES

Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25-17,000 cps. 8 ohm imp. 67/6. P. & P. 2/6.

HOSIDEN DH04S 2-WAY STEREO HEADSETS

Each headphone contains a 2½in woofer and a 1in tweeter. Built in individual level controls. 8Ω imp. 25-18,000c/s. with cable and stereo plug. £5.19.6. P. & P. 2/6.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discount on quantities.

3in. 225ft. L.P. acetate	3/6
3½in. 600ft. T.P. mylar	10/-
5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/-
5in. 1,200ft. D.P. mylar	15/-
5½in. 1,200ft. L.P. acetate	12/6
5½in. 1,200ft. L.P. mylar	16/-
5½in. 1,800ft. D.P. mylar	22/6
5½in. 2,400ft. L.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/-
7in. 1,800ft. L.P. mylar	20/-
7in. 2,400ft. D.P. mylar	25/-
7in. 3,600ft. T.P. mylar	45/-

Postage 2/-. Over £3 post paid.

SPECIAL OFFERS!

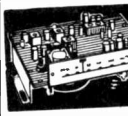
Garrard SP25/11 fitted Goldring G800 cartridge and wooden plinth and plastic cover. Total list price £35.
OUR PRICE £20.19.6. Carr. 10/-.
GOLDRING GL69/2 fitted Goldring G800 cartridge complete with de luxe base and cover. Total list price £50.16.0.
OUR PRICE £39. Carr. 20/-.

SINCLAIR EQUIPMENT

Project 60. Package offers. 2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply, £19.0.0. Carr. 7/6. Or with PZ6 power supply, £21. Carr. 7/6. 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply, £21.10.0. Carr. 7/6. Transformer for PZ8, 59/6 extra. Add to any of the above £4.17.6. for active filter unit and £16 for a pair of Q16 speakers.

All other Sinclair products in stock. 2,000 amplifier, £23. Carr. 7/6. Neoteric amplifier, £46. Carr. 7/6.

★ TRANSITORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6·4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108 MHz. Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiplex adaptors 99/6.

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RUSSIAN C1-16 DOUBLE BEAM OSCILLOSCOPES

5MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated triggered sweep from 0·2μsec to 100msec/cm.
Supplied complete with all accessories and instructions, **£87**, Carr. paid.

MARCONI CT44/TF956 AF ABSORPTION WATTMETER

1 μ/watt to 6 watts.
£20. Carr. 20/-.

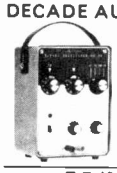
TE111. DECADE RESISTANCE ATTENUATOR
Variable range 0-111dB. Connections. Unbalanced T and Bridge T. Impedance 600Ω range (0·1dB .. 10) + (1dB .. 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (−3dB). Accuracy: 0·05dB. +indication dB < 0·01. Maximum input less than 4W (50V). Built in 600Ω load resistance with internal/external switch. Brand new **£27.10.0**. P. & P. 5/-.

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

Sine 18-200,000Hz: Square 18-50,000Hz. Output max +10dB (10kΩ). Operation internal batteries.
Attractive two-tone case 7¼in × 5in 2in. Price **£17.10.0** Carr. 3/6.

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 × 5¼ × 3¼. Complete with instructions and leads. **£7.19.6**. P.&P. 4/-.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



New high quality portable instrument. Sine 1Hz to 100kHz. Square 20Hz to 20kHz. Output max. +10dB (10kΩ). Operation 220/240V a.c. Size 215mm × 150mm × 120mm.
Price **£27.10.0**. Carr. 5/-.

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

10 meg. input 10 ranges: ·01 / ·03 / ·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/-.

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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 **42/6**. H.V. **50/-**.

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

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500 W.	**£4.10.0**. P. & P. 6/6
1,000 W.	**£6.10.0**. P. & P. 7/6
1,500 W.	**£8.19.6**. P. & P. 8/6
7,500 W.	**£15.10.0**. P. & P. 20/-

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Compact and panel mounting. Ideal for control of lamps, drills, electrical appliances, etc. Input 230/240V a.c. Output continuously variable from 20V to 230V.
Model MR2305 5A 68 × 46 × 43mm, **£8.7.6**. Model MR2310 10A 90 68 60mm, **£11.19.6** Postage 2/6.

MULTIMETERS *for EVERY purpose!*

TECH PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000V a.c. and d.c. 0/1/100/500mA. d.c.-0/100K. **39/6**. P. & P. 2/6.

MODEL TE-200. 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V d.c. 0/10/50/250/1,000V a.c. 0/50μA/250MA. 0/60K/6 meg. −20 to ●62dB. P. & P. 3/-.

MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 meg. **£5.10.0**. P. & P. 3/-.

TMK MODEL TW-50K. 46 ranges, mirror scale. 50K/Volt d.c. 5K/Volt a.c. D.c. volts: 0·125, 0·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 10K, 100K, 1 meg., 10 meg. Decibels: −20 to +81·5dB. **£8.17.6**. P. & P. 3/6.

TE-900 20,000Ω/VOLT GIANT MULTIMETER. Mirror scale and overload protection. 6in full view meter. 2 colour scale. 0/2·5 / 10 / 250 / 1,000 / 5,000V a.c. 0/25/12·5/10/50/250/1,000/5,000V d.c. 0/50μA/110/100/500mA/10A d.c. 02K/200K/20 meg. ohm. **£15.0.0**. P. & P. 5/-.

MODEL 5025. 57 ranges, giant 5¼in meter, polarity reverse switch. Sensitivity: 50K/Volt d.c. 5K/Volt a.c. D.c. Volts: 0·125, 0·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 2K, 10K, 100K, 1 meg, 10 meg. Decibels: −20 to +85dB. **£12.10.0**. P. & P. 3/6.

HONOR TE.10A. 20kΩ/Volt 5/25/50/250/500/2,500V d.c. 10/50/100/500/1,000V a.c. 0/50μA/2·5mA/250mA d.c. 0/6K/6 meg. ohm. −20 to +22dB. 10-0, 100 mfd. 0·100-0·1 mfd. **69/6**. P. & P. 3/-.

MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/0·6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA / 6mA / 60mA / 300mA/600mA. 0/8K/80K/800K/8 meg. −20 to +63dB. **£5.19.6**. P. & P. 3/-.

MODEL TE-90. 50,000 O.P.V. Mirror scale, overload protection. 003/13/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V a.c. 0·03/6/60/600mA. d.c. 16K/160K/1·6/16 meg. −20 to +63dB. **£7.10.0**. P. & P. 3/-.

TMK MODEL TW-20CB. Features Resettable Overload Button. Sensitivity: 20KΩ/Volt d.c. 5KΩ/Volt a.c. D.c. volts: 0-0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 0-2·5, 10, 50, 250, 1,000V. D.c. currents: 0-0·05, 0·5, 5, 50, 500mA, 10A. Resistance: 0-5K, 50K, 0-500K, 5 meg. Decibels: −20 to +52dB. **£11.10.0**. P. & P. 3/6.

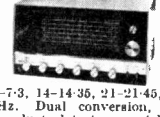
MODEL AS-100D. 100KΩ/Volt. 5in, mirror scale. Built-in meter protection 0/3/12/60/120/300/600/1,200V d.c. 0/6/30/120/300/600V a.c. 0/10μA/6/60/300mA/12A. 0/2K/200K/2M/200M. −20 to +17dB. **£12.10.0**. P. & P. 3/6.

TMK LAB TESTER. 100,000 O.P.V. 6½in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 500, 1,000V. D.c. current: 10, 100μA, 10, 100, 500mA, 2·5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: −10 to +49dB. Plastic case with carrying handle, size 7¼in × 6¾in × 3¼in. **£18.18.0**. P. & P. 5/-.

LAFAYETTE HA-600 SOLID STATE RECEIVER

General coverage 150-400KHz, 550KHz-30MHz. FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter, Bandspread. RF Gain. 15in × 9¼in × 8¼in. 18lb. 220/240V a.c. or 12V d.c. Brand new with instructions. **£45**. Carr. 10/-.

LAFAYETTE HA-800 SOLID STATE AMATEUR COMMUNICATION RECEIVER

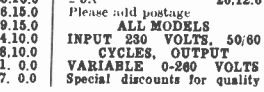


3·5-4, 7-7·3, 14-14·35, 21-21·45, 28-29·7, 50-54MHz. Dual conversion, 2 mech. filters, product detector, variable BFO, S Meter, 100KHz calibrator. 220/240V a.c. or 12V d.c. 15in × 9¼in × 8¼in. 18lb. Brand new with instructions. **£57.10.0**. Carr. paid (100KHz Crystal **39/6** extra).

TO-3 PORTABLE OSCILLOSCOPE

3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps-1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5 cps -800 KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. **£37.10.0**. Carr. 10/-

LAFAYETTE PF60 VHF FM RECEIVER



Solid State. 152-174MHz. Fully tuneable or crystal controlled (not supplied). Built in Speaker, Squelch and Volume Controls. 220/240V a.c. or 12V d.c. Brand new with instructions. **£37.10.0**. Carr. 10/-.

"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality . Low price . Immediate delivery

MODEL S-260 General Purpose Bench Mounting		MODEL S-260 B Panel Mounting	
1A	**£5.10.0**	1A	**£5.10.0**
2·5A	**£6.15.0**	2·5A	**£6.12.6**
5A	**£9.15.0**	Please add postage	
8A	**£14.10.0**	ALL MODELS	
10A	**£18.10.0**	INPUT 230 VOLTS, 50/60 CYCLES, OUTPUT VARIABLE 0-260 VOLTS	
12A	**£21. 0.0**		
20A	**£37. 0.0**	Special discounts for quality	

UNR-30 RECEIVER

4 Bands covering 550KHz-30MHz. B.F.O. Built in Speaker 220/240V a.c. Brand new with instructions. **£13.13.0**. Carr. 7/6.

WS62 TRANSCEIVERS

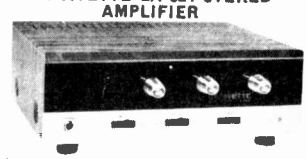
Large quantity available for EXPORT! Excellent condition. Enquiries invited.

UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 55KHz-30MHz. FET, S Meter, Variable BFO for SSB. Built in Speaker, Telescopic Aerial, Bandspread, Sensitivity Control. 220/240V a.c. or 12V d.c. 12¼in × 4¼in × 7in. Brand new with instructions. **£24**. Carr. 7/6.

FULL RANGE OF CODAR AMATEUR EQUIPMENT IN STOCK

LAFAYETTE LA-324 STERED AMPLIFIER



Solid State. 12·5W r.m.s. per channel. 20-20,000Hz ± 1dB. Inputs Mag/Cer/Tuner/Aux. Output 4-16. Headphone socket, tape output. Black and brushed aluminium front panel. 10¼in × 3¼in × 8¼in. **£24**. Carr. 7/6.

FULL RANGE OF PARTRIDGE JOYSTICK AERIALS IN STOCK

TRIO 9R59DE COMMUNICATION RECEIVER

4 bands 500KHz-30MHz. S Meter, Variable B.F.O., Bandspread, 7in × 15in × 10in. 115/250V a.c. Brand new with instructions. **£42**. Carr. Paid. Full Range of other Trio Products in stock.

JR.500SE	Amateur Receiver	**£65. 0.0**
JR.310	Amateur Receiver	**£77.10.0**
TS.510	Amateur Transceiver	**£130. 0.0**
SP5D	Matching Speaker	**£4. 7.6**
HS4	Headphones	**£5.19.6**

VOLTAGE STABILISER TRANSFORMERS

180-260V input. Output 230V. Available 150W or 225W. **£12.10.0**. Carr. 5/-.

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

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets.
£6.19.6. P. & P. 3/6.

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BARGAINS IN NEW SEMICONDUCTORS

Many items at new reduced prices. All power types supplied with free insulating sets

1N914	1/3	2N3706	2/6	40512	39/-	BC147	3/-	BFY51	4/-
1N3754	4/-	2N3707	2/6	40602	9/6	BC148	3/-	BSX20	3/9
1N4148	1/9	2N3708	2/6	AC107	14/6	BC149	3/-	BY164	10/-
1N5054	4/-	2N3709	2/6	AC126	4/-	BC153	7/-	BY238	3/6
1S940	1/-	2N3710	2/6	AC127	4/-	BC154	7/6	C106B1	14/6
2N696	3/6	2N3711	2/6	AC128	4/-	BC157	3/9	MC140	5/-
2N697	3/6	2N3731	24/-	AC176	6/-	BC158	3/6	MJ480	21/-
2N706	2/9	2N3794	3/-	ACY22	4/6	BC159	3/9	MJ481	27/-
2N1131	6/3	2N3819	7/-	ACY40	4/-	BC167	2/6	MJ491	30/-
2N1132	6/6	2N3820	12/-	ACY41	5/-	BC168	2/3	MPF102	7/6
2N1302	4/-	2N3904	7/6	AD142	14/3	BC169	2/6	NKT403	15/6
2N1303	4/-	2N3906	7/6	AD149	12/-	BC177	6/3	NKT405	15/-
2N1304	4/6	2N4058	4/-	AD161/AD162		BC178	5/8	OA47	1/9
2N1305	4/6	2N4059	4/-	(matched)	14/- pr.	BC179	6/-	OA90	1/3
2N1613	6/-	2N4060	4/-	AF114	7/-	BC182L	2/6	OA91	1/3
2N1711	7/-	2N4061	4/-	AF115	7/-	BC183L	2/3	OA95	1/3
2N2147	19/-	2N4062	4/-	AF116	6/6	BC184L	2/6	OA99	3/-
2N2218	9/3	2N4284	3/3	AF117	6/6	BC186	8/6	OA200	1/11
2N2270	12/9	2N4286	3/3	AF124	7/6	BC212L	5/-	OA202	2/-
2N2483	6/3	2N4289	3/3	AF127	7/-	BC213L	5/-	OC71	7/6
2N2484	9/6	2N4291	3/3	AF139	9/6	BC214L	5/3	TIP31A	16/-
2N2646	10/9	2N4292	3/3	AF180	18/6	BCY70	4/-	TIP32A	20/-
2N2904	11/-	2N4410	4/9	AF239	9/9	BD121	21/-	TIP33A	20/-
2N2924	4/-	2N5062	12/3	A8Y26	6/6	BD123	21/-	TIP34A	10/6
2N2925	4/6	2N5163	5/-	A8Y27	8/3	BD124	20/-	ZTX300	3/6
2N2926	2/3	2N5192	25/-	A8Y28	6/6	BF167	8/6	ZTX301	3/6
2N3053	5/6	2N5195	28/3	B5041	15/-	BF178	10/6	ZTX302	4/6
2N3054	14/3	2N5457	9/9	BA102	6/-	BF180	12/-	ZTX303	4/6
2N3055	15/-	2N5458	9/9	BA156	4/-	BF194	7/-	ZTX304	6/9
2N3325	10/9	2N5459	9/9	BA130	4/6	BF195	7/6	ZTX500	5/-
2N3663	11/6	40250	14/3	BM156	4/-	BFX29	6/3	ZTX501	5/-
2N3702	2/6	40361	12/6	BC107	2/9	BFX84	5/9	ZTX502	6/-
2N3703	2/6	40362	16/-	BC108	2/6	BFX85	7/-	ZTX503	5/-
2N3704	2/6	40406	16/3	BC109	2/9	BFX87	5/9	ZTX504	12/-
2N3705	2/6	40408	14/6	BC125	11/-	BFX88	5/3	ZTX530	5/5
		40430	37/-	BC126	11/-	BFY50	4/6	ZTX531	6/9

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82Ω–220kΩ	E12	18d	16d	15d
C	¼W	5%	4·7Ω–330kΩ	E24	2·5d	2d	1·75d
C	¼W	10%	4·7Ω–10MΩ	E12	2·5d	2d	1·75d
C	½W	5%	4·7Ω–10MΩ	E24	3d	2·5d	2·25d
C	1W	10%	4·7Ω–10MΩ	E12	6d	5d	4·5d
MO	½W	2%	10Ω–1MΩ	E24	9d	8d	7d
WW	1W	10% ± 1/20Ω	0·22Ω–3·9Ω	E12	1/6d all quantities		
WW	3W	5%	12Ω–10kΩ	E12	1/6d all quantities		
WW	7W	5%	12Ω–10kΩ	E12	1/9d all quantities		

CODES: C = carbon film high stability low noise. MO = metal oxide Electrosil TR5 ultra low noise. WW = wire wound Plessey.

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

Prices are in pence each for same ohmic value and power rating. NOT mixed values. (Ignore fractions of **1d** *on total resistor order.)*

INTEGRATED CIRCUIT AMPLIFIERS

SINCLAIR IC.10 complete with instruction book giving amplifier circuit details and range of applications. **59/6** nett. Components pack for stereo inc. mains transformer, controls, etc., **£4.15.0** nett.

PLESSEY SL403A. Only **42/6** each nett. 3W into 7·5Ω for 18V supply. Application data **2/-**; free with two or more.

WAVECHANGE SWITCHES LONG SPINDLES

1P 12W; 2P 6W; 3P 4W; 4P 3W ... ... **4/9** each

SLIDER SWITCHES D.P.D.T. ... ... 3/- each

NEON INDICATOR LAMPS all 200/250V

Square bezel, red only **3/9**

Round chrome bezel red, amber, clear ... ... **4/9** each

Toggle switches, 250V a.c. 1·5A. Chrome dolly and chrome milled nut S.P.S.T. **3/9**; S.P.D.T. **4/6**; D.P.D.T. **5/9**; S.P.D.T. centre off **5/-**.

S-DeC's put an end to "birdsnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC (70 points) only **20/-**. Compact T-DeC, increased capacity, may be temperature-cycled. T-DeC (208 points) only **50/-**. Full range stocked.

MULLARD POLYESTER C280 series

250V 20%: 0·01, 0·022, 0·033, 0·047, **8d** ea.; 0·068, 0·1, **9d** ea.; 0·15, **11d**; 0·22, **1/-**. 10%: 0·33, **1/5**; 0·47, **1/8**; 0·68, **2/3**; 1μF, **2/9**; 1·5μF, **4/2**; 2·2μF, **4/9**.

MULLARD SUB-MIN ELECTROLYTIC

C426 range axial lead **1/3** each

Values (μF/V): 0·64/64, 1/40, 1·6/25, 2·5/16, 2·5/64, 4/10, 4/40, 5/64, 6·4/6·4, 6·4/25, 8/4, 8/40, 10/2·5, 10/16, 10/64, 12·5/25, 16/40, 20/16, 20/16, 20/64, 25/6·4, 25/25, 32/4, 32/10, 32/40, 32/64, 40/16, 40/2·5, 50/6·4, 50/25, 50/40, 64/4, 64/10, 80/2·5, 80/16, 80/25, 100/6·4, 125/4, 125/10, 125/16, 160/2·5, 200/6·4, 200/10, 250/4, 320/2·5, 320/6·4, 400/4, 500/2·5.

LARGE CAPACITORS

High ripple current types: 1000/25 **5/6**; 1000/50 **8/2**; 1000/100 **16/3**; 2000/25 **7/4**; 2000/50 **11/4**; 2000/100 **28/9**; 2500/64 **15/5**; 2500/70 **19/6**; 5000/25 **12/6**; 5000/50 **21/11**; 5000/100 **58/3**; 10000/15 **17/-**; 10000/25 **24/6**; 10000/50 **44/-**; 10000/70 **61/-**.

MEDIUM RANGE ELECTROLYTICS

Axial leads: 50/50 **1/9**; 100/25 **1/9**; 100/50 **2/6**; 250/25 **2/6**; 330/25 **2/6**; 250/50 **3/9**; 500/25 **3/9**; 500/50 **4/6**; 1000/25 **4/-**; 1000/50 **6/-**; 2000/25 **6/-**.

SMALL ELECTROLYTICS

Axial leads: 4·7/10, 4·7/25, 5/50, 1/- ea. 10/10, 10/25, 10/50, 33/10, 50/10, 1/- ea. 25/25, 25/50, 47/25, 100/10, 220/10, **1/3** ea.

ENAMELLED COPPER WIRE even No. 8WG.

only: 2 oz. reels: 16–22 8WG **4/3**; 24–30 8WG **5/-**; 32, 34 8WG, **5/6**; 36, 38 8WG, **6/3**. 4 oz. reels: 16–22 8WG only **7/6**.

PEAK SOUND PRODUCTS ENGLEFIELD AMPLIFIER

Build it 12 + 12 watts

Stereo amplifier in modular kit form (including cabinet) 12 watts per channel **£38.9.0.** Cabinet kit only **£6.** These prices nett. As recently reviewed in Hi Fi Sound.

BAXANDALL SPEAKER SYSTEM

Designed by Peter Baxandall. Superb reproduction for its size. Handles 10 watts with ease. Uses **ELAC** 15Ω 59RM109 speaker unit. Kit **£13.12.0** nett.; built **£19.8.6** nett.

MAINLINE AMPLIFIER KITS

RCA/8G8 designed main amplifier kits. Input sensitivity 500–700mV for full output into 8Ω.

Power	Kit price including components	Suitable unreg. power supply kit
12W	**168/-** nett	**92/-**
25W	**190/-** nett	N/A
40W	**210/-** nett	**115/1**
70W	**252/-** nett	**138/10**

30 WATT BAILEY AMPLIFIER KIT

Sensitivity 1·2V for full output into 8Ω. Transistors and PCB for one channel **£7.5.6.** Transistors and PCBs for two channels **£14.11.0.** Capacitors and resistors (metal oxide) **40/-** per channel.

Complete unregulated power supply kit **£4.15.0.**

ZENER DIODES

5% full range E24 values: 400mW: 2·7V to 30V **3/9** ea. 1W: 6·8V to 82V **9/-** ea. 1·5W: 4·7V to 75V **12/-** ea. Clip to increase 1·5W rating to 3 watts (type 266F) **9d.**

CARBON TRACK POTENTIOMETERS, long spindles.

Double wiper ensures minimum noise level.

Single gang linear	220Ω to 2·2MΩ	**2/6**
Single gang log	4·7kΩ to 2·2MΩ	**2/6**
Dual gang linear	4·7kΩ to 2·2MΩ	**8/6**
Dual gang log	4·7kΩ to 2·2MΩ	**8/6**
Log/antilog	10K, 47K, 1MΩ only	**8/6**
Dual antilog	10K only	**8/6**

Any type with 2A D.P. mains switch, extra **2/3.** Please note: only decades of 10, 22 and 47 are available within ranges quoted.

CARBON SKELETON PRE-SETS

Small high quality, type PR, linear only 100Ω, 220Ω, 470Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10MΩ. Vertical or horizontal mounting 1/- each.

COMPONENT DISCOUNTS

10% on orders for components for £5 or more. 15% on orders for components for £15 or more (No discount on nett items).

POSTAGE AND PACKING

Free on orders over **£2.** Please add 1/6 if under. Overseas orders welcome: carriage charged at cost.

THE NEW ELECTROVALUE CATALOGUE

48 pages—thousands of items—packed with information, generously illustrated with product pictures and technical diagrams—**2/-** post free. Add 4/- if sent overseas by air mail.

ELECTROVALUE **Dept. PE12, 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY**

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AKAI 4000 STEREO TAPE RECORDER

SAVE OVER £20

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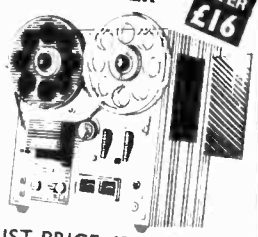
LIND AIR PRICE 99 GNS

Carr. & Ins. 35/-

A complete stereo tape recorder. 2 speeds 3¾ & 7½ i.p.s. and offering full stereo recording and play back facilities.

AKAI 1710 L STEREO TAPE RECORDER

SAVE OVER £16



LIST PRICE £89

LIND AIR PRICE 69 GNS

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Excellent value for money stereo recorder 3 speeds. Output power 4 watts per channel and every required facility for stereo recording and play back.

AKAI 4000 D STEREO TAPE DECK

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The ideal stereo tape desk for use with existing hi-fi stereo systems to give you the full enjoyment of stereo tape recording and play back.

LA 20 STEREO SYSTEM

SAVE OVER £11

Only takes a few minutes to set up ready for use.

Lind-Air LA20 Amplifier	£23.2.0
Garrard 5-200 Changer with Sonotone Cartridge	£11.7.6
Pair of Lind-Air General Purpose Speakers	£19.0.0
Recommended Retail Price	£53.9.6

LIND-AIR PRICE

39½ gns.

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(Also available with Garrard 3000 changer 4 gns. extra)

SAVE £3-15-6

SCOOP PURCHASE ! !

FAMOUS "SANYO" COLORANO TRANSISTOR PORTABLE RADIO

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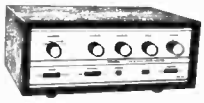

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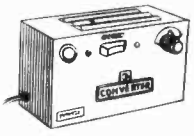

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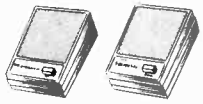

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PRACTICAL ELECTRONICS

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VIDEO UNLIMITED

AFTER years of behind the scenes activity, two different commercial systems for playback of video recordings on standard television receivers have recently been unveiled. The EVR Partnership have launched their video and sound on film system. Rival contenders for this new and important market are Sony of Japan and Phillips of Holland, who are collaborating to produce a video tape system to suit European television standards.

To add yet further complication to the present scene, there is a third system in production, Teldec. This is significantly different from the other two in that it employs a plastic foil disc revolving at 1,500 r.p.m. The promoters are Decca and Telefunken of West Germany.

The outcome of the ensuing battle is anyone's guess at the moment. But it seems unlikely that, in the long run, more than two systems can co-exist on any worthwhile scale. Probably, in the end, a single system will be adopted for world-wide use. The need for interchangeability of video recordings makes this almost imperative.

Major problems in visual recording (as indeed in sound recording), concern scanning and tracking. These problems are mainly of a mechanical nature, and the three companies mentioned above have tackled them in quite different ways. Successfully too, it appears. But the reproducing equipments have yet to be subjected to prolonged use under domestic conditions. Turntables or magnetic heads revolving at the very high speeds demanded suggest some hazards arising.

If one tries to envisage the ultimate in perfection, one is drawn inevitably towards an all electronic concept where complicated high speed mechanisms are unnecessary. And in this connection there is encouraging news from RCA. The Selectavision system under development by this company may prove to be the answer to most—but not all—needs in visual recording and playback in the home. It has the virtue of being almost entirely electronic; and, incidentally, will assuredly gain fame as the first consumer product to employ a laser. But the inability to make home recordings is a handicap of Selectavision, as indeed it is of the other systems mentioned, with the exception of the video-tape system.

The making of visual recordings by private individuals, both "off the air" and with a video camera, is going to be a commonplace and popular activity in due course. Therefore, we may have to become reconciled to two separate approaches, according to the functional requirements. There is a parallel in the audio field, i.e. the record reproducer, and the tape recorder/player.

It looks as though the fate of the home cine projector may be in the balance; but the television receiver will remain even more firmly ensconced in the corner when it has its new associate, the video player.

F.E.B.

THIS MONTH

CONSTRUCTIONAL PROJECTS

SPECIAL SERIES

GENERAL FEATURES

BEGINNERS

NEWS AND COMMENT

Our January issue will be published on Monday, December 14

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

TIME

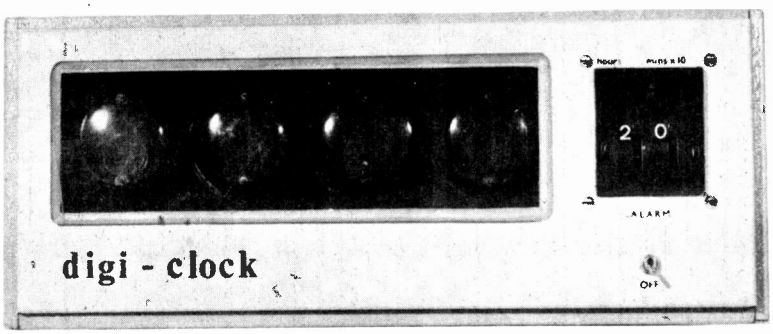
★ Medium scale integration

★ TTL logic i.c.s

★ Synchronous alarm

★ Reset facility

★ Nixie number tubes



THE prices of all integrated circuits have fallen considerably in the last year, and the most dramatic drop of all has been in the price of digital devices. The new low prices have brought even the complex "medium scale integration" TTL circuits into the ever widening sphere of amateur projects. The digital clock described here makes full use of this newly available technology.

The use of both discrete component logic circuitry and RTL i.c.s in attempts to realise a practical clock design proved to have their attendant disadvantages in such a complex system. TTL provides the noise immunity necessary to give reliable time keeping and opens up the possibility of simplifying wiring further by using it in the medium scale integration (MSI) form. (Detailed articles on the functioning of TTL and MSI appear in the current Logic ICs series.)

DESIGN FEATURES

As can be seen from the photographs in these pages, the clock forms an attractive and useful item of equipment for the home or office.

A Contil MOD–2 case is used to house the design, and the display is provided by four gas-filled number indicating "Nixie" tubes.

An alarm circuit is incorporated, the alarm time being entered by means of thumb-wheel switches which conveniently give an output directly in binary coded decimal form.

The 50Hz from the mains supply is used to drive the clock as this proves to be surprisingly constant in practice, and quite capable of providing the accuracy required. A crystal oscillator could be employed, but it would require extra divider stages, and probably temperature control to gain a significant increase in accuracy.

The circuit employs a total of twenty dual-in-line i.c. packages, fourteen MSI/TTL types, four SSI/TTL types, and two integrated transistor arrays used in the analogue circuitry. Only three discrete transistors and a few diodes are used apart from the i.c.s in the counting and timing circuits.

The logic circuitry is built entirely on two "Dualine" i.c. cards, providing a neat layout and a considerable simplification of the wiring up compared with the perforated s.r.b.p. boards commonly used for such projects. These i.c. cards have provision for either nine or fifteen d.i.l. 14/16 pin packages with ground and V_{CC} rails provided to each package position. Each i.c. pin is provided with a two hole copper pad for wiring up, and blank holes are available for the use of terminal pins.

Either a single sided 0·1in 22-way edge connector or a 44-way double-sided edge connector is provided on each board, although in this design, to save the considerable expense of sockets, solder terminations are made to these edge contacts.

The circuit boards are mounted flat against the chassis, spaced from it by about ¼in. The chassis is earthed to act as a ground plane and also to provide screening from the power supply components mounted above.

The power requirements are +5V at up to 1 amp, well regulated and filtered for the i.c.s, and 180V to power the "Nixie" tubes.

A novel voltage regulator circuit, employing fold-back current limiting, and built with an integrated transistor array is used to supply the 5V required by the logic circuitry. A simple Zener diode/emitter follower combination provides the 180V supply for the "Nixies" and decimal point indicator neon. A switch is provided to allow the clock to be run at two fast speeds for initial time setting.

SYSTEM OPERATION

A block diagram of the clock circuit is given in Fig. 1. The low voltage power supply provides 10V to the low voltage regulator which also uses the 200V supply for biasing. The 5V output from this regulator is used to power all the logic i.c.s, and is decoupled on each board by both tantalum electrolytics and small r.f. capacitors.

The transformer which provides the 200V supply to the "Nixie" regulator also gives a 6·3V 50Hz output which is squared and used as the timing waveform for the clock. This 50Hz is frequency divided by a factor of 3,000 by a series string of four MSI counter i.c.s to provide the one pulse per minute rate required by the clock counters.

These minute pulses are further divided by ten in a decade counter package, the four outputs of which being decoded to ten line decimal and used to drive the 0 to 9 minutes "Nixie". The pulses from the ÷10 package occur once every ten minutes and are used to drive the ÷6 tens-of-minutes counter. The outputs from this are also decoded (three lines to six lines) to drive the tens-of-minutes display.

DIGI-CLOCK

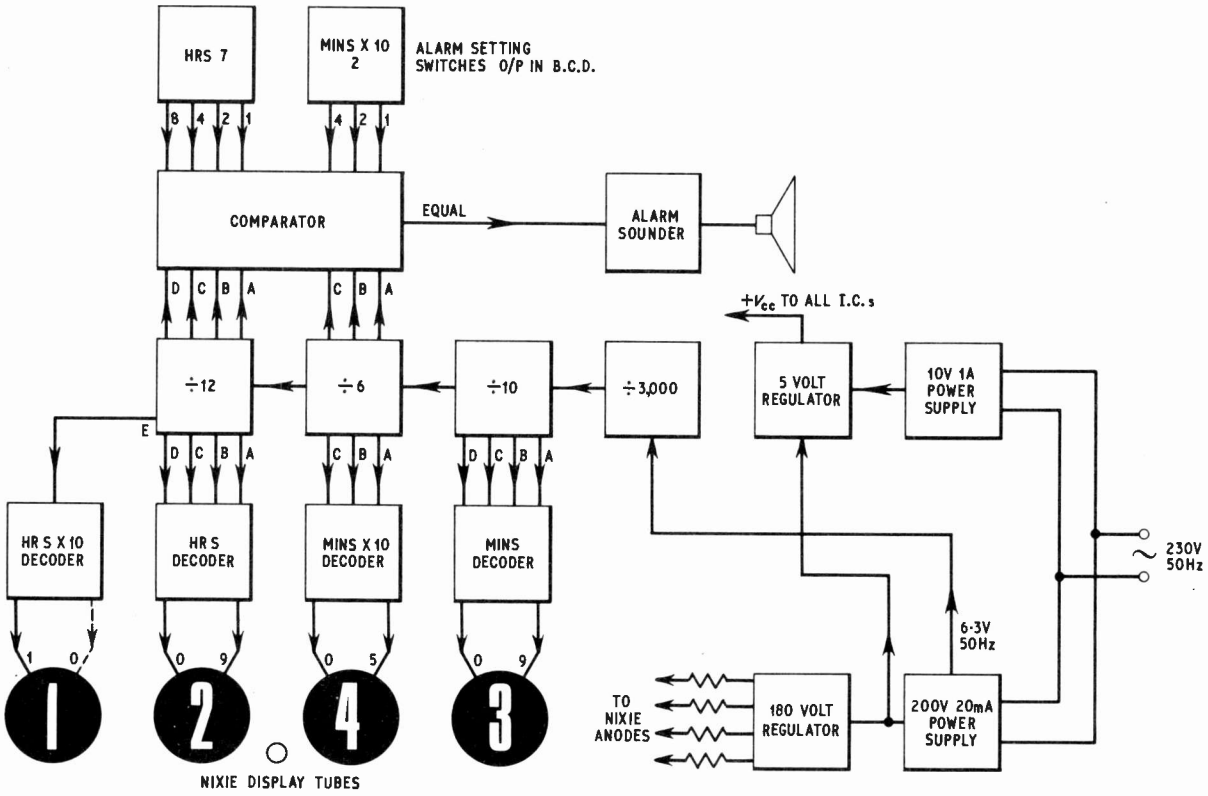
By R. W. Coles

The pulses from the ÷6 package occur once every hour and are used to drive a ÷12 counter which provides the binary coded decimal inputs to the hours and tens-of-hours display decoder/drivers. Note here that the twelve hour clock system was used for this design to make the clock acceptable for domestic use.

The binary coded decimal outputs of the tens-of-minutes and hours counters are also fed to the alarm circuit, where the digital code is constantly compared with a similar (but negated) binary pattern from the alarm-time switches. When the alarm time and the display time are exactly equal, the comparator registers this equality, and sets a bistable latch which in turn initiates the alarm sounder.

The oscillator for the alarm sounder can best be described as a "tristable, astable multivibrator" which oscillates alternately at two different audio frequencies producing a rapidly varying bleep tone. When the alarm circuit is active this tone is gated to a speaker to provide an output which is difficult to ignore.

The alarm circuit may be reset by means of a



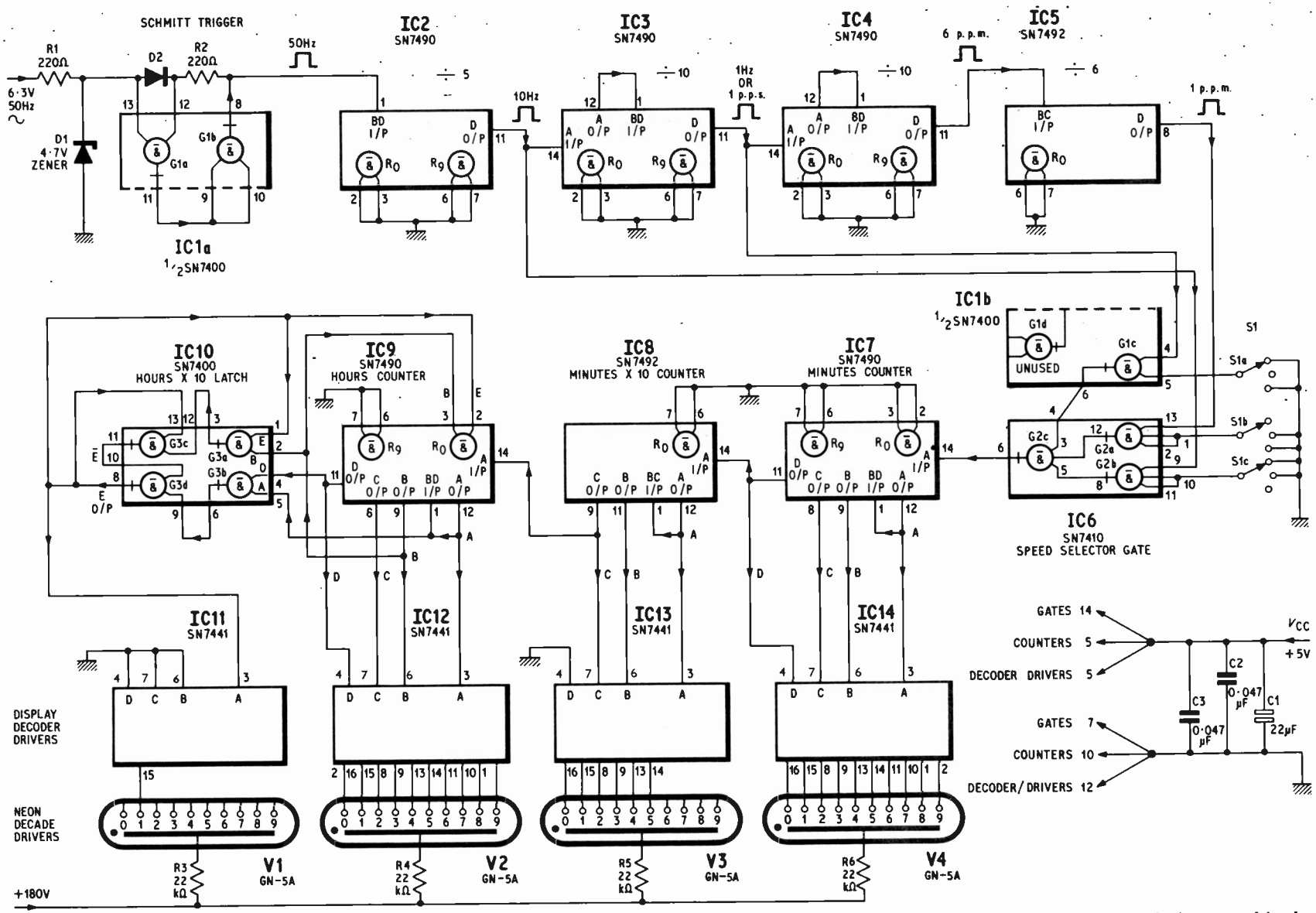


Fig. 2. Circuit diagram of the main clock board only incorporating the dividers, counters and decoder/drivers. All pin connections of the i.c.s which are used in the clock circuit are labelled and numbered. The decoupling capacitors and power supply connections are shown on the right

miniature toggle switch on the front panel, which will also deactivate this circuit altogether when required.

Now that we have a general grasp of the clock operation we can pass on to considering each section in detail, beginning this month with the main clock board. The other sections will follow later together with the appropriate diagrams and components lists.

MAIN CLOCK CIRCUIT BOARD

All the logic i.c.s for the main clock counting section are mounted on a Dualine i.c. printed circuit card type DL110/44. This particular board has positions for fifteen digital integrated logic (DIL) i.c.s; only fourteen are used in this application.

The board also has copper strips for connecting wires and $+V_{cc}$ and "ground" runs. At one end is a double-sided 44-way edge connection which is used to carry all the inputs and outputs required.

From the simplified circuit diagram in Fig. 2, it can be seen that the gates are shown individually; the MSI circuits incorporating several flip-flops are given in block form, to emphasise the treatment of these devices as complete building blocks. The internal logic and pin connections of these devices are given separately in Fig. 3, along with the gate package diagrams.

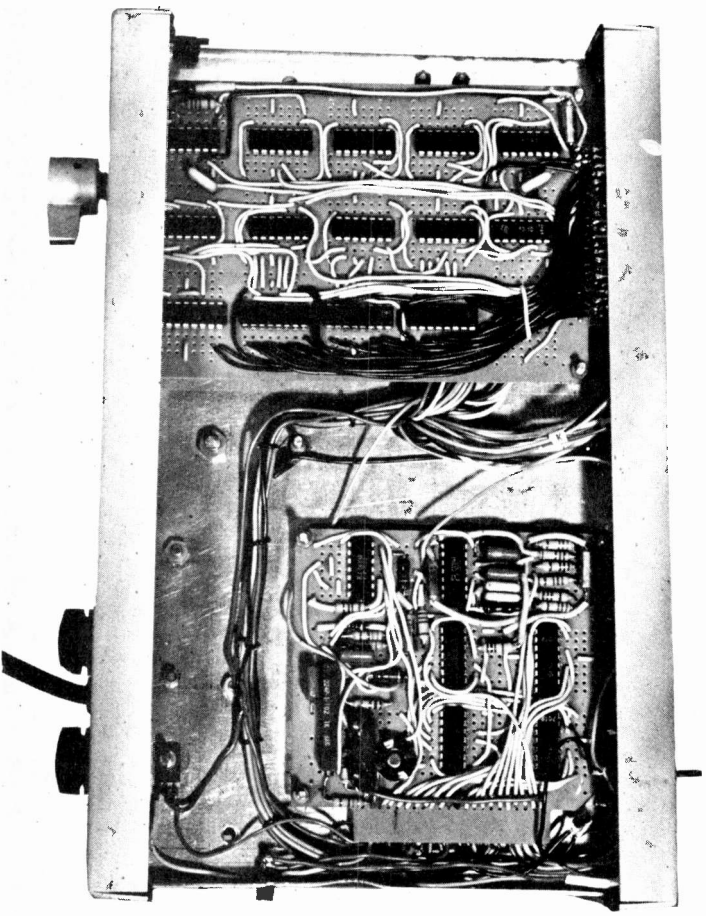
The SN7490N counter contains four flip-flops grouped to form a divide-by-five counter (BCD), and a separate divide-by-two stage (A). These counters may be used separately or in series to form a decade counter, only one external link wire being required in this mode.

This device also contains two gated reset lines, one of which sets all the flip-flops to the zero state (R_0), and the other setting the flip-flops to the 1001 condition (R_9). The reset facility is only used in the hours counter of this clock, so all other reset inputs are grounded to de-activate them.

The SN7492N counter also contains four flip-flops, but in this device they are grouped to form a divide-by-six and divide-by-two stage, which may be used independently or in series to form a divide-by-twelve counter.

One important reservation should be noted here: the BCD stage may be used as a divide-by-six stage in the divider, but its outputs do not follow the binary code in this mode. Where this is necessary, as in the "tens-of-minutes" counter, a divide-by-six stage is formed by cascading the two internal counters, and using the C flip-flop as an output. The binary outputs to be decoded are taken from the ABC outputs in this case.

The SN7441AN decoder/driver package is used, as the name implies, to decode the binary outputs from the clock counters and convert to decimal outputs suitable for driving a high voltage "Nixie" tube. These outputs are taken from the "free" collectors of ten transistors with high collector-breakdown voltage characteristics, provided in the device. The decoding is carried out by an internal gating array, and to provide the same logic and drive capability using small scale integrated (SSI) circuits it would be necessary to use at least five DIL gate packages, and ten discrete transistors, so the advantages offered by the 7441 are obvious.



Underside view of the clock chassis showing the main Clock Board 'A' at the top and the Alarm Board 'B' at the bottom

DETAILED CIRCUIT OPERATION

The 6·3V r.m.s. 50Hz sine wave input from the power supply, needs to be converted into a square d.c. pulse train before it can be used to drive the divider chain IC2 to IC5.

Zener diode D1 is used to achieve this. D1 is reverse biased until the sine wave input reaches 4·7V positive with respect to ground. At this point it breaks down and limits the positive excursion to this voltage level, in effect giving a square top to the waveform. As the sine wave input swings negative, the same diode conducts in the forward direction, limiting the negative excursion to −600mV.

The d.c. pulses formed in this manner are square topped, but their rise and fall times are much too slow to be used to drive TTL gates directly, as there is a danger of parasitic oscillations during the transition through the gate's active, or threshold, region.

This oscillation, which would cause false triggering in the following counters, is avoided by using a Schmitt trigger with positive feedback to speed up the transition. In this circuit two gates from a 7400 package are used to form the Schmitt with d.c. positive feedback via a resistor R2.

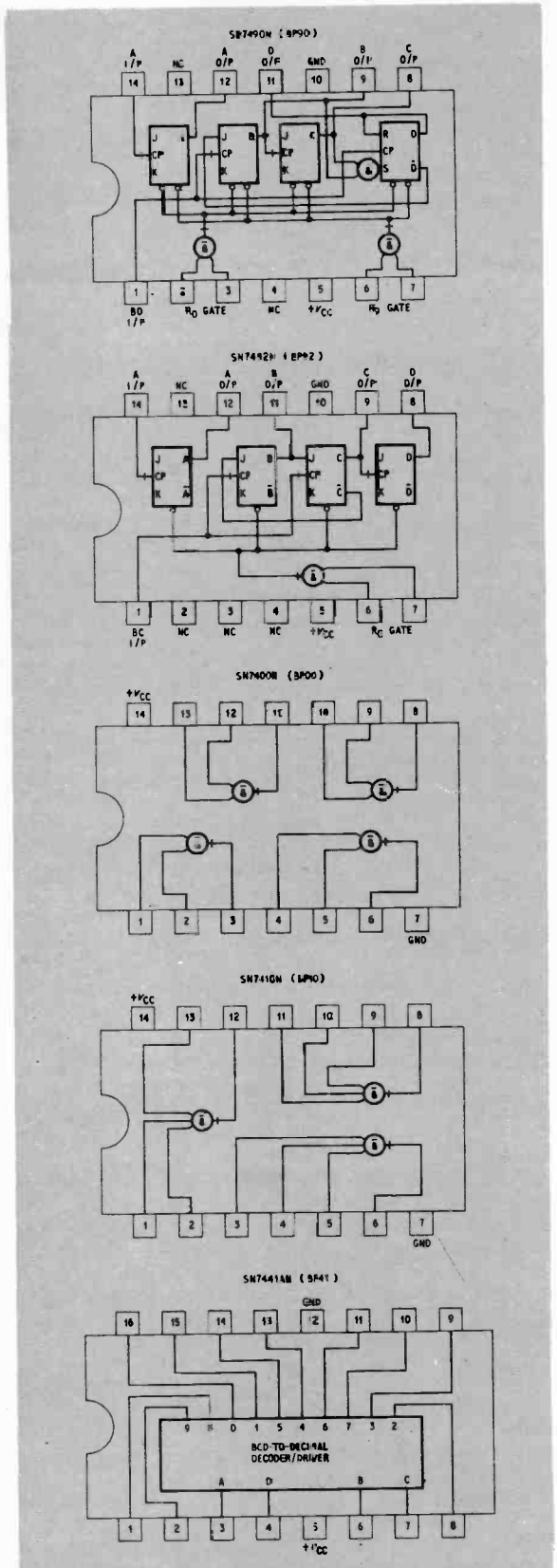


Fig. 3. Arrangement of logic in each i.c. package type with pin connections

The silicon diode D2 is necessary when triggering this kind of circuit from low impedance sources, as in this case. The output produced is a d.c. square wave with very fast positive and negative edges, ideally suited to form the input to the divider flip-flops.

DIVIDERS

The first divider stage, IC2 is a 7490 used in the divide-by-five mode, giving an output pulse train at 10Hz. The wiring of this stage is very simple, the BD input and the D output being the only connections necessary apart from grounding the resets and wiring up the power lines.

The second divider stage, IC3, is also a 7490, being used this time in the divide-by-ten mode, and giving an output of 1Hz. In this case the A input and the D output are used, and an external link from the A output to the BD input is necessary.

The next two stages divide by sixty to produce minute pulses to drive the clock counter proper. These are arranged so that if necessary they could be decoded in the same fashion as the hours and minutes counters to provide a two-digit "seconds" display.

This type of display was not considered necessary in the prototype, but if the clock is to be used to time, for example, sports events, some constructors may consider the extra expense worthwhile. Of course, if this course is followed, an extra pair of 7441 packages will be required, and there is only room for one of these on the board as it stands.

TIME CORRECTION

The pulses supplied by IC5 are ready to operate the counting circuits for each display tube. IC6 is a triple 3-input gate package used with one of the spare gates in IC1 to form a speed selector gate. It is used when setting the clock to the correct time initially, and is controlled by S1.

The three gates G1c, G2a and G2b each have one of their inputs connected to one of three timebase speeds, 10Hz, 1Hz, and the normal speed 1 pulse per minute. A three-pole, three-way switch is used to control the other input or inputs in such a way that only one gate is enabled with a "1" input, the others having "0" connected, so that their particular input pulses are not allowed through.

The three gates have active level low outputs (due to the inversion inherent in the NAND gate), and may therefore be fed to a fourth gate, G2c, which is used as a NOR, giving a single output to drive the counters. The control switch is connected as in the diagram; an open circuit represents a 1 input, and a ground connection for a "0".

In retrospect it may be a very good idea to wire the three "1" tags to V_{cc} through a 1 kilohm resistor, rather than use an open circuit which could lead to noise pick-up. No trouble has been experienced in the prototype from this source, but the fastidious will no doubt wish to incorporate this simple modification, to be absolutely sure.

Some readers may have realised that a one-pole three-way switch could be used to replace the gate/switch system used here. Although this simplification seems worthwhile on a circuit diagram, in practice it would necessitate taking the signal path off the board in a long loop to the switch and back, a distance of well over the maximum of ten inches recommended for single wire driving with TTL circuits.

When the switch is set to the fast position, a complete 12 hour cycle is completed in 72 seconds, making it

easy to set the clock to the correct hour, and when set to the slow position a minute is clocked up every second, facilitating the final setting. In the normal position of course, the clock operates at the speed of real time.

MINUTES COUNTERS

The 7490 and 7492 packages which form the "minutes" and "tens-of-minutes" counters operate in exactly the same fashion as they did in the divider stages considered previously, except that here the outputs are fed to the 7441 decoder/drivers, to operate the display.

The 7492 is wired in a slightly different way from its division counterpart to facilitate decoding as explained earlier. Only three inputs to the "tens-of-minutes" decoder are needed to provide the necessary six decimal outputs, and the D input from each 7441 is taken to ground to simulate a "0" level.

HOURS COUNTER

A consideration of the display sequence for the "hours" Nixies reveals that in the 12 hour clock system, no simple count/decode system is possible. Of the several solutions considered, the one used here satisfies the conditions best, and gives a count sequence sufficiently close to the binary coded decimal inputs required by the alarm comparator, that it could be easily altered merely by adding a "1" in an adder circuit.

The "truth-table" for the hours counter and display is given in Fig. 4. A quick glance at the "Hours" column shows that zero hours never occurs (unlike in the 24 hour system) and the start of the sequence can best be taken as 1 o'clock.

Considering the hours Nixie first, it is seen that it starts with a 1, counts normally to 9, then goes to 0 and counts up to 2 before being reset to the start condition.

An immediate snag occurs here because the binary count equivalent to 1 o'clock is 0000, which, when decoded, drives the 0 output of the 7441. Similarly, at 10 o'clock the equivalent binary count is 1001, which will activate the 9 output of the 7441. Fortunately this problem is easily overcome by wiring the 1 cathode of the Nixie to the 0 output of the 7441, and so on, so that the 0 Nixie cathode ends up wired to the 9 decoder output.

After 10 o'clock the 7490 recycles normally to 0000, and again displays a 1, just as we require. Two counts later it is necessary for the 7490 to be reset forcibly back to one again, as the 12 hour sequence has been completed. This is performed by detecting the "13 o'clock" state with the R_0 reset gate, and immediately resetting. The 7490 thus carries out one full count and one partial count in each 12 hour period.

TENS OF HOURS COUNTER

Having grasped the principles of the hours sequence, the tens of hours display should follow quite easily, as another glance at the table shows that this Nixie must go to a 1 at 10 o'clock and be reset to 0 at 1 o'clock.

The tens-of-hours count is registered on a simple set/reset bistable formed from two cross-coupled gates in the usual fashion. This latch is set by a further gate at 10 o'clock, when it is opened by the hours count of 1001. The latch is reset by the fourth gate at "13 o'clock", and of course this reset is coincidental with the 7490 reset, and is detected in the same way.

The truth table shows that the logic required to set the latch is $\overline{A}$ AND $\overline{D}$; the logic to reset both it and the 7490 is $\overline{B}$ AND $\overline{E}$. It follows that 2-input NAND gates are ideal for the job, and in the case of the reset condition the $\overline{B}$ AND $\overline{E}$ state is detected simultaneously by gate G3a and the R_0 gate of the 7490.

Decoding of the tens-of-hours latch is not required to drive the Nixie, because when the E output is up a 1 is displayed, and when the E output is up, a 0 is displayed. For the sake of simplicity however, a 7441 is still used to drive this display, using only the A input.

			HOURS COUNT O/P'S				TENS HOURS LATCH O/P
HOUR	TEN HOURS NIXIE	HOURS NIXIE	A	B	C	D	E
1 O'CLOCK	0	1	0	0	0	0	0
2 "	0	2	1	0	0	0	0
3 "	0	3	0	1	0	0	0
4 "	0	4	1	1	0	0	0
5 "	0	5	0	0	0	0	0
6 "	0	6	1	0	1	0	0
7 "	0	7	0	1	1	0	0
8 "	0	8	1	1	1	0	0
9 "	0	9	0	0	1	0	0
10 "	1	0	1	0	0	1	1
11 "	1	1	0	0	0	0	1
12 "	1	2	1	0	0	0	1
			0	1	0	0	1

THIS TRANSIENT STATE DETECTED & COUNTER & LATCH RESET

7490 RECYCLES

TENS HOURS LATCH SET

Fig. 4. Truth table for the hours counter and display

COMPONENTS . . .

MAIN CLOCK BOARD

Resistors

R1, R2 220 Ω 2% ½W metal oxide (2 off)

Capacitors

C1 22μF 15V tantalum bead type or elect.

C2, C3 0·047μF 250V met. foil.

Diodes

D1 4·7V 400mW Zener (e.g. IS2047 Texas)

D2 1N914 silicon diode for switching

Integrated Circuits

IC1, 10 SN7400N (BP00) quad 2-input gates (2 off)

IC2, 3, 4, 7, 9 SN7490N (BP90) decade counters (5 off)

IC5, 8 SN7492N (BP91) ÷12 counters (2 off)

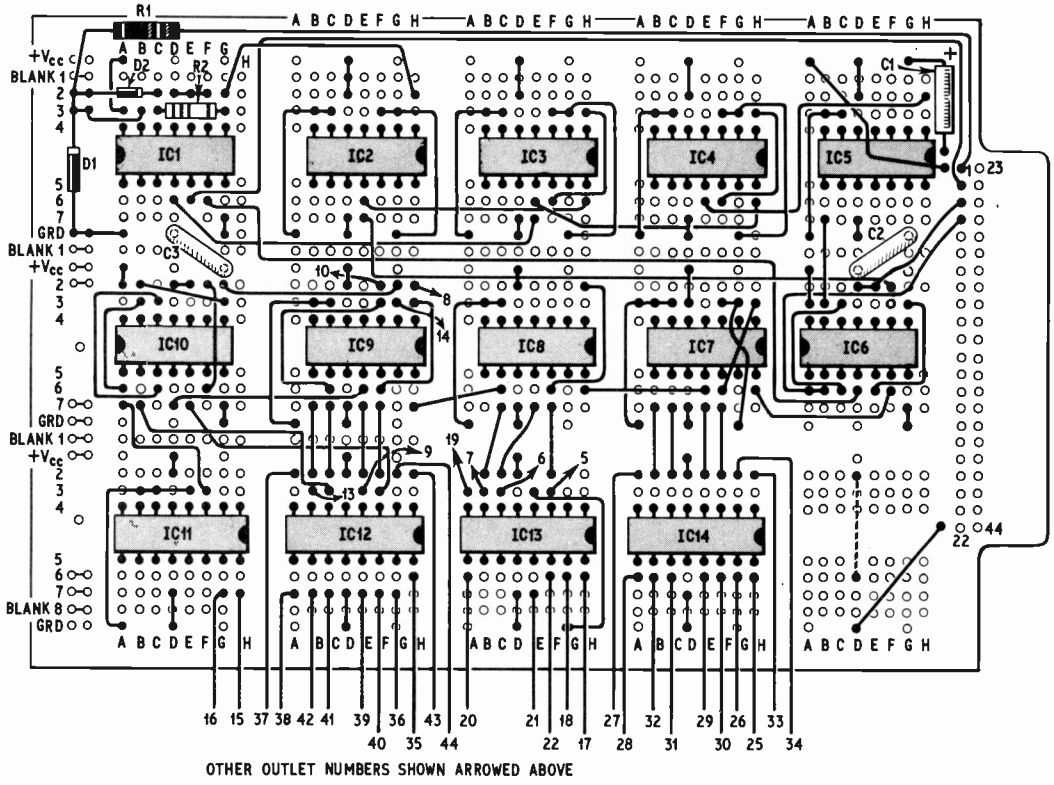
IC6 SN7410N (BP10) triple 3-input gate

IC11, 12, 13, 14 SN7441AN (BP41) BCD to decimal decoder/drivers (4 off)

Further notes on purchasing i.c.s given in the article "Making the Most of Logic ICs"

Miscellaneous

Dualine type DL110/44 printed circuit card (Shirehall Electronics Ltd., Station Yard, Borough Green, Sevenoaks, Kent.)



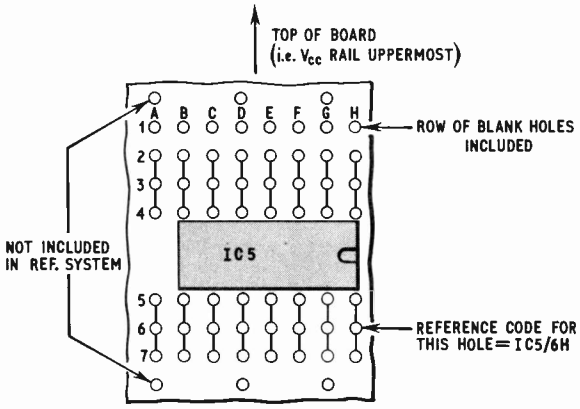


Fig. 6. Interconnection coding of the main clock board outlets for each i.c. position matrix

If desired a couple of discrete transistors could be used instead, driven directly from the complementary E outputs.

This completes the description of the main clock board circuit, except perhaps to mention that the $+V_{CC}$ rail is decoupled near its edge contact with a 22μF tantalum electrolytic capacitor. Two 0·047μF capacitors, spaced out on the board, effectively remove h.f. noise on this supply line generated by the logic itself. This is normal practice and should be adopted in any i.c. logic application.

WIRING UP

The board wiring is shown in Fig. 5, and should be carried out with thin flexible p.v.c. covered connecting wire. Interconnections must be kept as short as possible commensurate with a neat layout. Where adjacent printed copper pads are connected (such as on IC6) this may be simply carried out on the underside of the board with a solder run, to save the tedium of producing tiny wire links. Discrete components C1, C2, C3, D1, D2, R1 and R2 are best added after the rest of the wiring.

Wiring to the edge connector is facilitated by using the coding adopted in Figs. 5 and 6.

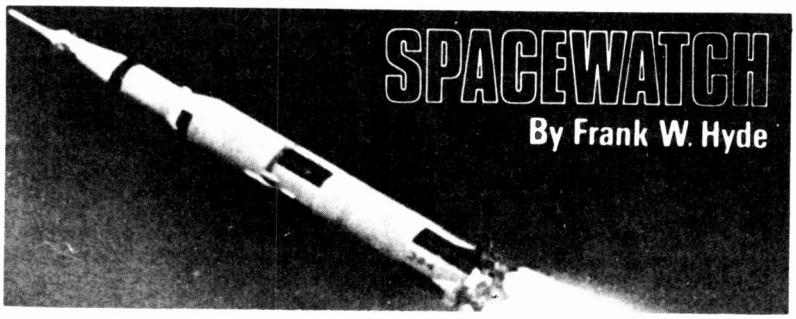
The wiring is carried out on the top of the board, even that which connects to the upper edge connector pads. The outputs are numbered with their respective circuit references for interconnection at a later stage.

It is recommended that at each stage of wiring up, a circuit is drawn up from the wiring actually carried out so that this may be checked against the circuit given. A mistake could be very difficult to rectify when the faulty link is buried under several other layers of wire.

It is also a good idea to connect the board to a 5V supply and, using a 6·3V heater transformer as a timing input source, check the counter operation before adding the edge connector wiring. Nixie outputs can be checked by connecting a voltmeter across them to ground, and using a 4·7 kilohm resistor to V_{CC} to simulate a load.

To be continued

Fig. 5. Wiring of the main clock Dualine printed circuit Board 'A' with edge connector outlet coding on lead-out wires. Plain side terminations on top to outlets 1 to 22, copper side terminations to outlets 23 to 44. The ground rail is connected to outlet 11, the $+V_{CC}$ rail to outlet 12



SPACEWATCH

By Frank W. Hyde

ITALY TO LAUNCH U.S. SATELLITE

Later this month or early December Italy will have the distinction of being the first foreign country to launch a U.S. satellite. It is part of an agreement signed by the two powers in which the United States will be able to use the Italian built San Marco launch platform.

The use of this facility on the equator will enable smaller launch vehicles to be used. For example, the four stage *Scout* rocket can be used instead of the larger vehicles which would be required at Cape Kennedy to attain equatorial orbit.

The San Marco platform is situated in the Indian Ocean off the coast of Kenya and it is expected that under the present programme NASA will require three launches by the Aerospace Research Centre of the Daglia Studi di Roma (Rome University). These will consist of two astronomy satellites and one scientific satellite.

The Italian launch team have been trained by NASA at the Wallops station in Virginia. They have already made a successful launch from Wallops in 1964, and in 1967 they made an equally successful launch from the San Marco platform.

The actual contract provides for the supply of the satellites and the launch vehicles by NASA. The Italian team will assemble, check out, and launch the satellite. They will also provide some tracking and data acquisition facilities.

The first satellite will be an astronomy unit designated *SAS-A*. The *SAS* spacecraft are unique in their construction and the first one will weigh approximately 320lb. Each group of instruments is in a separate section and connected to a common section containing the power supply, communications, attitude control and any other equipment required to support the mission.

Facilities are available for the mission to take a quick look at the entire sky over a period of six weeks, and then a detailed study of the sky will be made during the remainder of the expected life of the satellite which is about six months.

The *SAS-A* will have about 140lb of the available instrument space for instrumentation dealing with X-ray sources and the resulting catalogue will be used as a basis for detailed observations from another craft in 1971.

The *SAS-B* spacecraft scheduled for launch in late 1971 will carry a sky mapping system. It will also look for gamma ray sources, an important mission in view of the discovery of high energy gamma rays in the "milky-way".

SPACE PHENOMENA STUDY

The scientific satellite (*SSS*), which will be called *SSS-A* will undertake the investigation of space phenomena. This will include the study of aurora magnetic storms, the acceleration of charged particles in the inner magnetosphere and electrical currents circulating in the magnetosphere. It will have an apogee of 16,000 miles, an ideal orbit for such investigations.

The *SSS* satellite has had a difficult beginning because it was partly damaged by fire in December 1969. This was due to an outbreak of fire at the Goddard Space Flight Centre, Green Belt. This damage was rectified and the satellite brought back to operational condition and will be ready for launch in the Spring of 1971.

MOON WATER DIVINING

When the *Apollo 14* is launched on January 31, 1971, the astronauts on landing on the moon will carry out a unique experiment to discover if water does in fact exist on the moon. Some scientists believe that concentrations of ice may be buried near the lunar surface.

Astronaut Edgar Mitchell will be responsible for the equipment and will use a technique similar to that used for oil prospecting. Small explosions are set off on the surface and the shock waves from these explosions penetrate deep into the ground and are bounced back to be detected on the surface. The character, or signature of the trace that is recorded provides a clue to the presence of oil or water bearing layers.

The experiment will be carried out in one of the five hour excursions on the surface in the Fra Mauro region. The astronaut will lay out some 310 feet of cable which will be connected to three vibration detecting geophones. He will then walk beside the cable and at intervals of fifteen feet fire a device called a "thumper". The "thumper" consists of a short tube with a firing mechanism at the upper end and hollow cylinder at the lower end. In the cylinder there is a plate which will be pressed down on the surface of the moon.

During his walk Mitchell will fire 21 cartridges in this manner, each with the force of a pistol shot and the resulting seismic waves and reverberations will be picked up by the geophones.

This experiment is a bonus arising from the need to get information on the shape of the moon and the structure and thickness of the moon's outer crust.

In addition to the shot firing Mitchell will set up and arm a mortar containing four grenades. The grenades will be set off by radio, from the earth, after the spacecraft has left the moon on its return journey. The grenades will be fired away from the area in which the astronauts have collected samples and will be timed to explode at 500, 1,000, 3,000 and 5,000 feet from their launch point. The vibrations will be detected by the geophones and automatically radioed back to earth for analysis.

The characteristics of these signals which will come from as deep as 1,500 feet will be examined to see whether the moon is layered like the earth or whether it is homogeneous. The results of this analysis will give some idea of the early history of the moon.

The questions that may be answered are whether the moon had a hot molten core like the earth from the beginning of its existence, or whether it cooled off quickly after its formation.

NEW COLOUR FILM

To study the solar eclipse of March 1970 a new colour film called XRC (Extended Response Colour) was tried out. It has a near human eye response and has a brightness range greater than 10,000 to 1.

The film has a very marked fidelity of colour response and was developed for the use of astronauts on the moon landings where the extreme range of response is very necessary.

The results obtained from the last eclipse by astronomers confirmed a prediction made by Professor C. W. Allen of the London University Observatories. In the Monthly Notices of 1946 he suggested that the corona would become redder as the distance from the photosphere increased. This effect could be quite clearly seen in the recorded photographs using this new film.

Amateur astronomers who have an interest in astrophotography might well try this film for the need for monochromatic filters does not arise.

THE PROFESSIONAL FINISH

BY M.K.TITMAN B.Sc. (ENG.)

THE second and final part of this article describing technique and working methods used in obtaining a professional finish on home constructed equipment

WHEN plastics coated materials are being formed, the plastics should be protected by cardboard stuck on with sticky tape and all markings should be on the internal face. When working in wood the important considerations, especially where furniture finishes are required, are that the edges be perfectly square and straight and the measurements precise, such that square joints and thin, mating gaps result. Work is enhanced by using the saw attachment to an electric drill, since with this attachment a square edge can be achieved and a perfectly straight edge can be formed.

It is important that tools be of the correct type and particularly that saws and chisels be sharp. A material suitable for furniture finishes is Contiboard which is chipboard, veneered on both sides by the same wood sheet; this is particularly important for such things as lids of stereo cabinets. Contiboard has a disadvantage in that some edges are not veneered, but veneering is very simple using Contistrip, which is affixed, using a hot iron, directly onto the sawn edges and results in a very professional and robust finish.

POLISHING

When working with wood it should also be remembered that apart from good joints and edges, the final polish is of utmost importance. After the wood has been sanded, it must be filled with a grain filler and stained prior to the application of the final polish. A simple and very effective final polish which gives a professional finish in a gloss or matt, can be obtained by the use of polyurethane varnish, which can be applied by French polishing or more easily by direct brush application. When polyurethane varnish is used, the surface should be smoothed with fine glass paper prior to the next coat and the final coat should be burnished with a burnishing powder to give the best results.

WORKING PERSPEX

Working with Perspex is difficult, especially to maintain a non-scratched finish, but Perspex is usually supplied with a stiff paper covering on both sides and this should be retained, and all the marking carried out on the stiff paper. Care must be taken in cutting Perspex since it is very brittle and sawing should not be carried out unless the sheet is adequately supported very close to the cutting point; this results in continual movement of the sheet in the vice in order to maintain the supported edges near to the cutting point. After cutting to the desired contours, a file can be used to smooth the edges, but again it should be remembered that the edges must be adequately supported during this operation. Once cut to shape the sheet can be polished using Perspex polish to remove any file marks from the edges or scratches from the surface.

SURFACE FINISH

The overall surface finish is important since this enhances the artistic impression. Although p.v.c. and fabric covers are sometimes employed, paint is widely used, with grey hammer or black crackle being the past standard for non-commercial units. Manufacturers, however, are drifting increasingly away from this uniformity of colour and using such striking finishes as dark green with red panels or blue hammer with white. Suffice it to say that instrument casing manufacturers never illustrate their catalogues with grey hammer but use bright contrasting colours.

Good paint finishes are not always easy to obtain and care should be taken particularly when plain colours with gloss finish have been chosen. Aerosols should be used as far as possible and the surface cleaned and scratches removed before application of the undercoat. All painting should be carried out in a dust free atmosphere and left undisturbed until completely dry. Hammer and crackle paints should be used for cases with poor surface qualities since they disguise surface irregularities.

FRONT PANELS

Front panel finishes are usually the weak point of home constructed equipment. Often they are poorly labelled or not labelled at all, whilst the control knobs and indicators are ill matched and of ancient design.

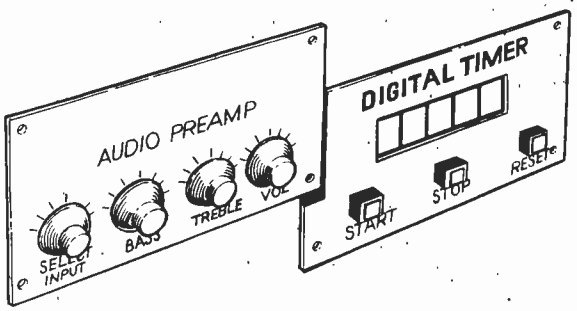


Fig. 5. Typical front panel layouts

Whilst it is true that such units function adequately, the overall impression is poor and such equipment is often difficult to use.

Now contrary to popular opinion, a professional finish can be achieved with little additional effort or cost with the use of modern techniques. The essential feature of the panel layout is that the information should be clear and the controls accessible. Knobs should match each other and either contrast or match the panel colour, whilst their size should enable simple operation and allow room for labelling. Lettering should be clear and in proportion, whilst the general layout should be symmetrical to aid clarity and please the eye. Fig. 5 illustrates some typical layouts that can be utilised to achieve a neat professional appearance.

FRONT PANEL FINISH

An audio pre-amplifier is shown in Fig. 5; the knobs can been chosen to contrast the panel, whilst lettering is black on white. Adhesive lettering has been used to designate the functions of the controls and sprayed with clear lacquer to reduce wear. The panel finish can be either spray paint or matt finish aluminium—achieved by rubbing the surface with emery until a satin appearance is obtained. This finish is cheap and very effective, but suffers from the disadvantage that constant use of the controls inevitably wears away the lacquer and adhesive lettering. Therefore it is best employed on equipment where the controls are not used excessively.

Where equipment is required for constant use as in the case of test instruments, receivers and transmitters, then the front panel can be covered by a sheet of clear Perspex. This enables constant use without wear and gives an added depth to the gloss finish.

A second style of finish is illustrated by the digital timer shown in Fig. 5. Here the front panel proper is completely covered by a Perspex escutcheon on which the colouring and lettering is on the reverse face. Apart from freedom from wear this system has the considerable advantage that it conceals the metal front panel which can thus be used as a chassis with components mounted directly, using countersunk screws. Other advantages are that illuminated legends can be used and mechanical pointers, level indicators, numerical indicator tubes, etc. are protected by the Perspex. The reverse marking system is used extensively by manufacturers, particularly since it can be mass produced at low cost when the markings are produced by a photographic dye-etching system.

REVERSE LETTERING

Since the home constructor cannot utilise the photographic-dye system, let us examine alternative methods of producing the same basic finish. Fig. 6 illustrates the steps by which the amateur can fabricate a Perspex escutcheon of this type. First, the basic metal front panel is measured and a sketch produced of the required holes and markings; such a panel is shown in Fig. 6a. The Perspex escutcheon is then cut to size and the holes and cut-outs drilled and formed, as illustrated in Fig. 6b. Fig. 6c shows the marking of the Perspex sheet with legends and designs on the reverse face. Since the lettering is reversed, normal adhesive letters cannot be used, but special purpose reverse lettering is available.

For the photographic enthusiast the reverse lettering can be achieved by photographing white lettering on a black background and glueing the resultant negative to the reverse side of the Perspex sheet. However, since the outline of the negative is always visible, this method is not entirely satisfactory.

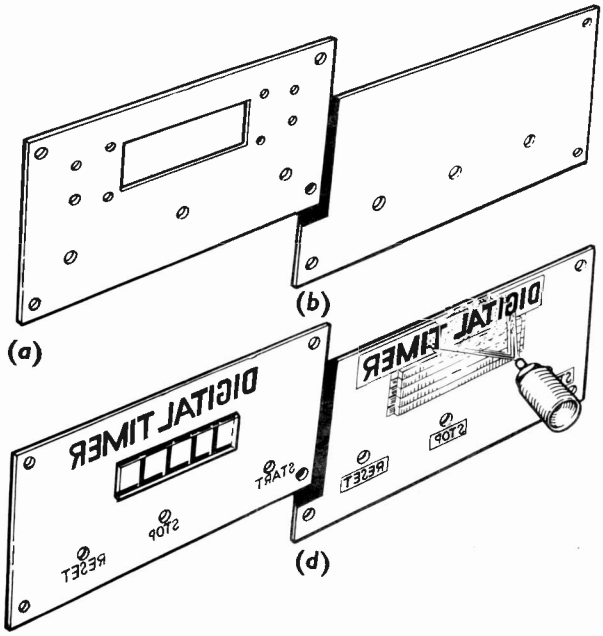
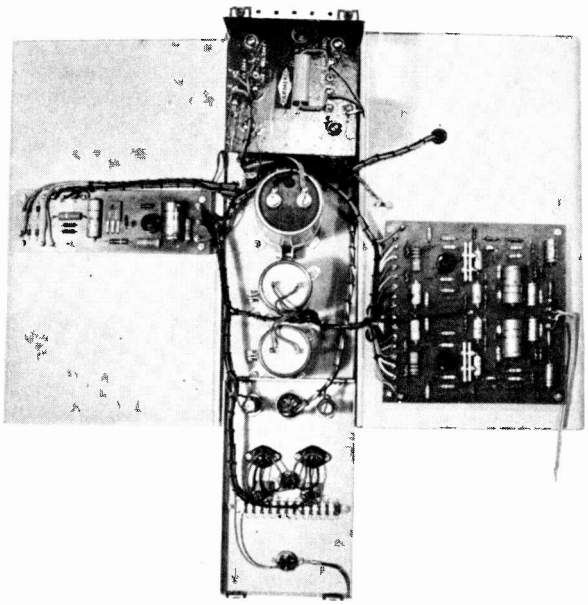


Fig. 6. Escutcheon manufacture and finishing



The professional touch to internal layout and finish of the P.E. Gemini stereo amplifier

Generally, the reverse lettering can be achieved with the use of stencils and quick drying paint. This has the advantage of choice of colour but requires the purchase of a set of stencils. Some practise is advisable to achieve spacing and uniformity when reverse stencilling.

When the marking is complete the clear areas for legends and windows are masked and the reverse face sprayed with aerosol paint of the desired colour, as illustrated in Fig. 6d. The result is an escutcheon of professional appearance which will wear well and give a smart and finished appearance to the equipment.

INTERNAL FINISH

Whilst the internal layout and finish contribute nothing to the artistic effect of an equipment, it is worth mentioning that neat layouts with proper cableforms are also a feature of professional equipment. A neat layout contributes to the ease of servicing and reliability, in addition to the more obvious mass production requirements. Layout naturally is governed by technical considerations and it is preferable that the layout follows the circuit diagram as far as is practicable. Thus the input should be physically removed from the output to aid servicing and eliminate unwanted feedback.

Printed circuits should always be adequately supported to prevent damage and never used to support heavy components. After soldering, the boards should be cleaned and defluxed using carbon tetrachloride and a stiff brush, which results in a better appearance and often highlights bad joints, thus contributing to reliability.

Cableforming aids servicing and repair and allows a neater component density to be achieved. Three methods of cableforming are illustrated in Fig. 7. The most common method, using binding cord, is illustrated in Fig. 7a. This system is time-consuming and presents difficulties should subsequent cable modifications be required, but is very cheap. Fig. 7b illustrates the use of rubber sleeves and, like the binding cord system, gives a neat finish. However, a special tool is used to expand the sleeving and consequently it is not practical for the home constructor.

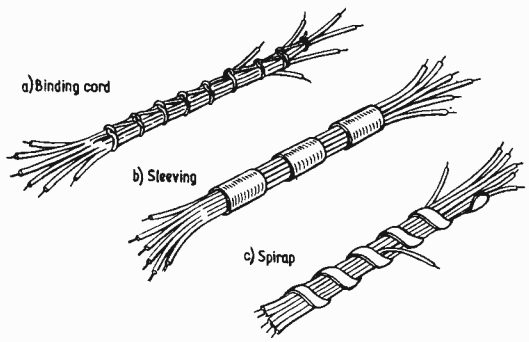
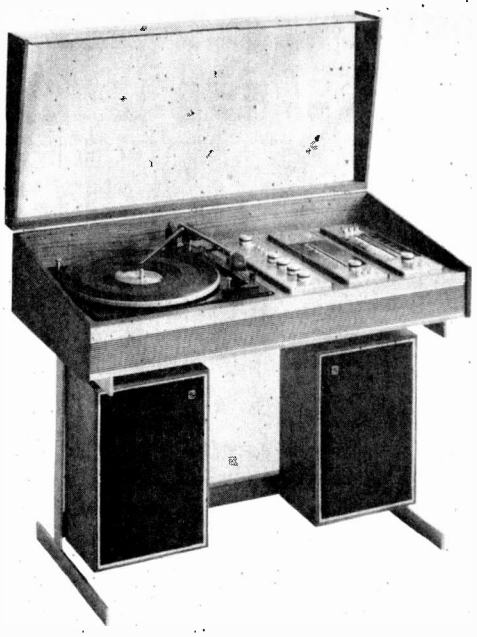


Fig. 7. Methods of cableforming

The third system shown in Fig. 7c illustrates the use of a spirally cut plastics tube available for cableforming. This product, known as Spirap, is easy to use and can be removed and re-used if subsequent modifications are necessary. The disadvantage is that it is more expensive than binding cord and is not always easy to procure.

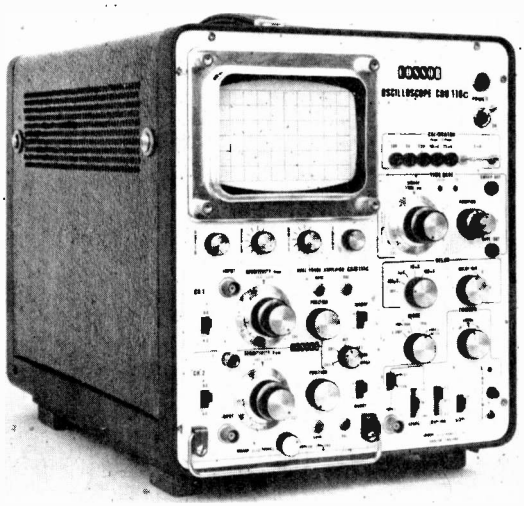


The professonial finish illustrated by the Decca Compact 3

CONCLUSION

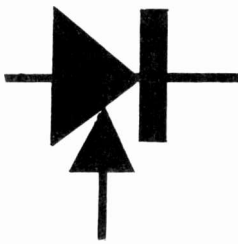
A neat attractive finish is not vital to the performance of electronic equipment and consequently should never deter the home constructor from attempting to build any unit. However, for self satisfaction a good finish is desirable and using the techniques discussed, even a tobacco tin and secondhand components can be fabricated in such a way as to give an acceptable finish.

The first essential is that a professional finish becomes a prime objective of the constructor. Subsequently, using the principles of symmetry, colour and labelling a professional artistic finish will result. ★



Front panel finish of a professional oscilloscope

THYRISTOR RELAY UNIT



By A.G. Wood

THIS article describes a sensitive electronic relay, the action of which is governed by a sensor or transducer. The applications are dependent on the type of input control devices used; these can include tape recorder auto-stops, burglar or fire alarms, moisture detectors and pump controls.

External control switching is done by means of a relay which is controlled by a thyristor. The circuit is simple and makes use of an electronic method of latching, a facility which is of special use where the unit is to be used as a burglar alarm.

CIRCUIT ACTION

The circuit of the relay unit is given in Fig. 1. With S1 closed an alternating voltage is induced in the secondary winding of the filament transformer T1. This is rectified by D1 and C1 to provide d.c. for the other circuit elements.

With no conducting path provided between SK1 and SK2 no bias current will pass to TR1 so that this transistor is off. For the thyristor SCR1 to turn on a gate current must be provided and since this current would be the collector output from TR1 the relay is not energised.

With the circuit completed between SK1 and SK2 bias current flows by way of VR1 and R2 to switch on TR1 which in turn makes the thyristor conduct and the relay to operate.

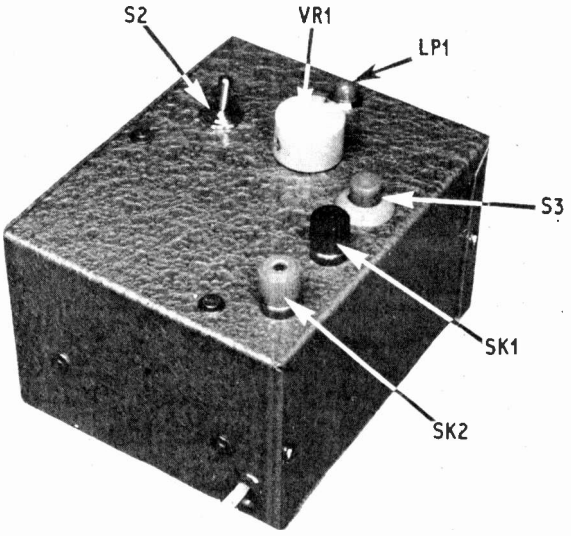
SENSITIVITY CONTROL

Since the devices that can be connected across the sensor input socket are manifold and will vary in impedance in individual cases, a potentiometer, VR1, is included to provide variable voltage inputs. It therefore acts as a sensitivity control.

Typical devices that can be used with success here are cadmium sulphide photocells, high resistance thermistors, reed switches or Veroboard if this is intended as a moisture sensor.

LATCH FACILITY

With S2 in the "latch" position, the thyristor SCR1 will maintain its conducting state if the sensor input circuit is broken as with the gate current reduced to



Layout of control items on prototype unit

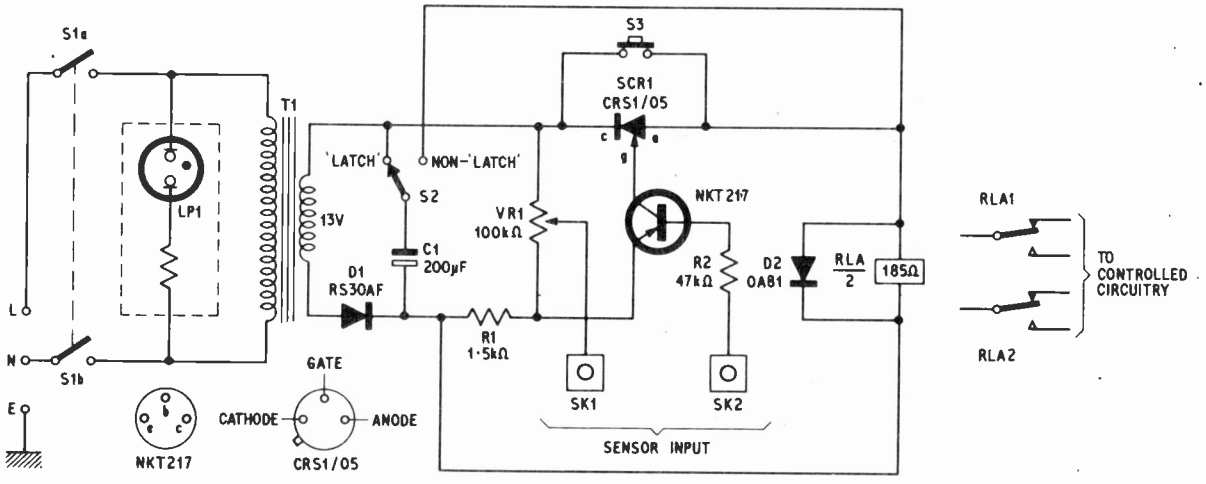


Fig. 1. Circuit diagram of thyristor relay unit

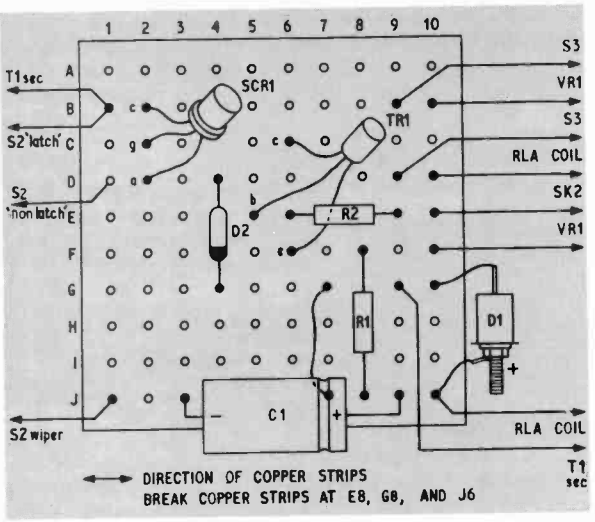


Fig. 2. Component and wiring layout of Veroboard sub-assembly

zero, a thyristor will still remain switched on until the anode current is reduced below its minimum holding value.

In order to release the relay, S3 must be depressed; this short circuits the thyristor so that the relay is completely de-energised when the switch is released.

When S2 is in the "non-latch" position, C1 is removed from the power supply and the voltage applied to the circuit consists of halfwave pulses at the mains frequency.

In this case, the thyristor cannot remain in the conducting state; it must be turned on again when the next pulse arrives if the relay is to remain closed. This means that the sensor input circuit conducting the relay will operate and will de-energise when this circuit is open.

In the "non-latch" position, C1 is connected across the relay to prevent chatter.

CONSTRUCTION

The majority of the circuit components can be mounted on a piece of Veroboard 1½in × 1½in. A layout for the board assembly is given in Fig. 2.

As component placement and wiring is not critical the smaller items could equally well be soldered to tag strips.

The prototype housing was a 3in × 4in × 5in aluminium box. This easily accommodated the filament transformer T1.

Since the Veroboard sub-assembly occupies such a small volume of the box, it is a simple matter to arrange the other components around this, so that interwiring is most conveniently managed. Some idea of this can be gained from the photograph.

Make sure to check the wiring thoroughly before plugging in the mains, as a short circuit could destroy the rectifier diode or thyristor. ★

COMPONENTS . . .

Resistors
R1 1·5kΩ
R2 47kΩ
½W 10% carbon

Capacitors
C1 200μF elect. 25V

Transistors
TR1 NKT217

Thyristor
SCR1 CRS1/05

Diodes
D1 RS30AF
D2 OA81

Switches
S1 Double-pole mains on/off
S2 Single-pole changeover
S3 Single-pole push-to-make

Potentiometer
VR1 100kΩ carbon linear

Relay
RLA 9V 185Ω 2-pole changeover
Contact rating 2A, Omron Type MH2

Transformer
T1 Primary 0–230/240V
secondary 13V, 0·5A

Miscellaneous
LP1—Mains neon, diecast box 3in × 4in × 5in
SK1–SK2 Insulated terminals (2 off)

POINTS ARISING

TRIAC LAMP REGULATOR *(October 1970)*

The meter in the components list should read 0 to 1mA f.s.d.

"TRANSTAB" POWER SUPPLY UNIT *(November 1970)*

Page 890, under side heading D.C. AMPLIFIER fifth line should read ". . . by means of range switch S2b and S2c with VR1."
Fig. 1, Numbering on switch S2b and S2c should be reversed to comply with numbering on S2a, i.e. for S2b, R5 to position 4, R6 to position 3, R7 to position 2, R8 to position 1. For S2c, R9 to position 4, R10 to position 3, R11 to position 2, R12 to position 1.

INSTALLING AUDIO (Supplement) *(November 1970)*

Page 15, Fig. 9 caption should read "Phono plug and socket".

VARIABLE VOLTAGE TRANSFORMERS

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.


8 AMP

SHROUDED TYPE
1 amp, £5. 10. 0. **2.5 amps,** £6. 15. 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

OPEN TYPE (Panel Mounting) ½ amp, **£3.18.6.** 1 amp, **£5.10.0.** 2½ amps, **£6.12.6.** Carr. extra on open types.

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. **12/6** each, Post Paid.

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 adjustable 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.

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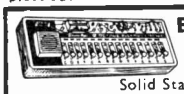
Coil Ω	Working d.c. Volts	Contacts		Price
52	6-9	6M	I.B.	12/6
230	6-12	2 c/o	I.B.	12/6
280	6-12	2 c/o	I.B.	14/6
700	16-24	4 c o	I.B.	15/6
700	12-24	2 c o	I.B.	12/6
2500	36-45	6M	I.B.	12/6
5800	80-85	4 c/o	I.B.	12/6
9000	40-70	2 c/o	I.B.	10/-

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

'AVO' MODEL 48A

Ex-Admiralty in good condition with instructions, leads, plus D.C. Shunts for 120 Amp. and 480 Amp. A.C. Transformer for 60 Amp. and 240 Amp. Multiplier for 3600 volt. Complete outfit in fitted case. **£15.0.0.** P. & P. 10/-.



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EXPERIMENTERS' ECONOMY KIT
Speed adjustable 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.

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This strobe has been designed and produced for use in large rooms, halls and the photographic field, and utilizes a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0-30 f.p.s. 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.

100 WATT POWER RHEOSTATS (NEW)

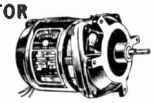
AVAILABLE IN THE FOLLOWING VALUES:
1 ohm, 10 a.; **5 ohm,** 4.7 a.; **10 ohm,** 3 a.; **25 ohm,** 2 a.; **50 ohm,** 1.4 a; **100 ohm,** 1 a.; **250 ohm,** .7 a.; **500 ohm,** .45 a.; **1 Kohm,** 280 mA; **1·5 Kohm,** 230 mA; **2·5 Kohm,** .2 a.; **5 Kohm,** 140 mA. Diameter 3¼in. Shaft length ⅞in., dia. ¼in. All at **27/6** each. P. & P. 1/6.

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

25 WATT. 10/25/50/100/250/500/1/1·5/2·5 Kohm. **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.

BODINE TYPE N.C.I. GEARED MOTOR



(Type 1) 71 r.p.m. Torque 10lb. inch. **Reversible.** 1/70th h.p., 50 cycle, ·38 amp. **(Type 2) 28 r.p.m.** Torque 20lb. inch. **Reversible.** 1/80th h.p., 50 cycle, ·28 amp. The above two precision made U.S.A. motors are offered in "as new" condition. Input voltage of motor 115V a.c. Supplied complete with transformer for **230/240V a.c. input.** Price, either type **£3.3.0** plus 6/6 P. & P. or less transformer **£2.2.6** plus 4/6 P. & P.

SOLID STATE INTERVAL TIMER

24-30V D.C. operation. Stabilised unijunction Timer and S.C.R. (30V 1 amp.), encapsulated in metal core. Timing interval adjustable from a fraction of a second to several minutes by means of external resistor or pot. By adding a 24V Relay many other complex timing Functions are possible. Price: **16,6** incl. circuit. P. & P. 2/6. Suitable relay **10/-** post paid.

MOTOROLA MAC11/6 PLASTIC TRIAC 400 PIV. 8 AMP

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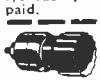
2 1·2V, 250 MA/HR Nickel Cad. Cells, connected to give 2·4V @ 25 milliamp. 10 hour rate, complete with 200/250V A.C. charger. Fully tested and unused. Price **9,6** each plus 1 6 P. & P. or 2 units for **£1** post paid.



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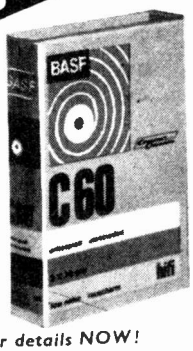

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MARKET PLACE

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.

DOUBLE-BEAM OSCILLOSCOPE

Over the last few years a very tight rein on any grants to schools and colleges for purchasing laboratory equipment has been closely scrutinised by educational boards and committees before any purchasing has been given the all clear.

Due to the above conditions it is very difficult to recommend any piece of equipment to schools and colleges unless it will pass the closest scrutiny of cost plus performance appraisal. Available from **Z. & I. Aero Services,** the C1-16 double beam oscilloscope is value for money at £87, and to be recommended to educational establishments.

This double-beam oscilloscope is a laboratory instrument designed for investigation and measurement of pulsed and periodic waveforms. The timebase is common to both beams and the timebase generator provides triggered and free running sweep.

Both vertical channels are fitted with attenuators which allow signals as large as 100V peak to be fed in. For signals up to 400V peak an external attenuator is used, supplied with the standard equipment. Duration of pulses and time intervals are measured by comparison with preset triggered sweep periods. The accuracy of this is checked with the aid of a quartz crystal calibrator.

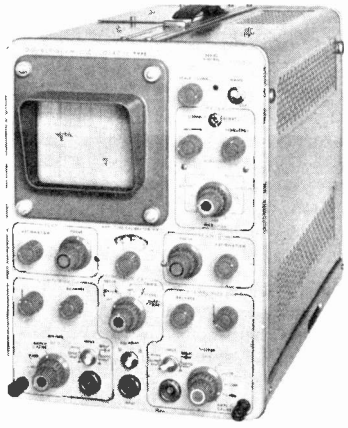
A brief technical specification of the C1-16 oscilloscope is: repetition rates of investigated waveforms 50Hz to 10MHz; range of pulse length is 0·35μs to 1sec; range of amplitudes 0·04 to 100V, increasing to 400V with external attenuator.

Characteristics of vertical amplifiers are 0 to 1MHz, amplifier passband at 1dB, and 0 to 5MHz, amplifier passband at 3dB. The sensitivity at medium frequencies at broad passband is 500mm/V. Input impedance is 0·5 megohms $\pm$0·015 megohms shunted by 45pF; with external attenuator 5 megohms shunted by 13pF.

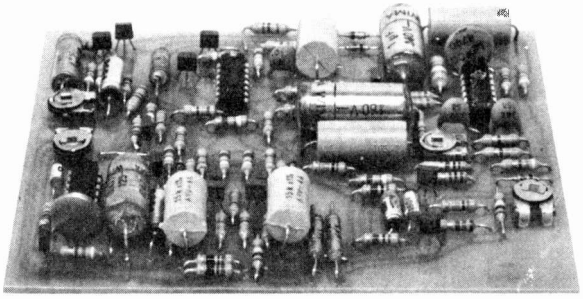
Timebase preset calibrated sweep durations are 0·2, 0·5, 1, 2, 5, 10, 20, 50 and 100 microseconds per centimetre; and 0·2, 0·5, 1, 2, 5, 10, 20, 50 and 100 milliseconds per centimetre. The free running timebase frequency range is 50Hz to 1MHz. Sweep sync voltage and trigger voltage is 0·5V and maximum trigger pulse repetition is 10kHz.

The frequency of the quartz crystal calibrator is 100kHz.

Full particulars of the C1-16 oscilloscope is obtainable from Z & I Aero Services Ltd., 44a Westbourne Grove, London, W.2.



C1-16 Oscilloscope from Z. & I. Aero



Phase-locked Stereo Decoder Circuit Board Manufactured by Integrex

STEREO DECODER UNIT

A phase-locked stereo decoder kit is the latest product from **Integrex Ltd.,** P.O. Box 45, Derby, DE1 1TW, to appear on the market.

This unique design avoids the use of inductors and tuned circuits but achieves a high separation.

Based on a phase-locked loop the decoder uses integrated circuits and transistors and is ideally suited for the constructor as it may be "set-up" by using a d.c. voltmeter.

Typical performance figures are: separation 45dB at 1kHz, 40dB at 10kHz; distortion is 0·3 per cent at full modulation. The decoder will accept signals within the range of 130mV r.m.s. to 1·3V r.m.s. A simple change of a resistor will extend the sensitivity to 70mV if required.

In order to match the majority of f.m. tuners a variable gain preamplifier is incorporated in the circuit. The decoder requires $\pm$6V at 50mA, or a voltage not less than $\pm$15V (using Zener diodes).

The kit contains 3 i.c's, 15 silicon planar transistors, 8 silicon diodes, 62 low noise resistors, 23 capacitors and 4 miniature preset potentiometers, together with a fibreglass board drilled, roller tinned and screen printed with component positions. Input, output, power supply connections, left and right channel outputs are also marked.

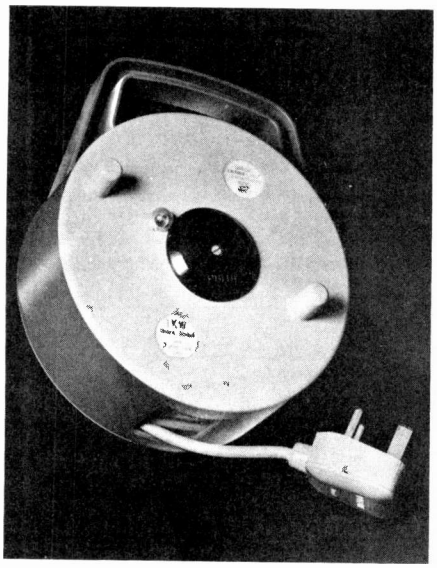
The decoder kit costs £8 19s 6d plus 2s 6d postage and packing. Included with the kit is full constructional details. A power supply kit is available at £2 19s plus 3s 6d postage and packing.

EXTENSION CABLE

A useful product suitable for the workshop is a cable reel, complete with neon indicator, 13A plug and socket with fuse, and spare, available with either 5A or 13A cable, from **West Hyde Developments Ltd.**

There are two types of reel available: the 5 amp reel with 50ft of cable and a 13 amp reel with 30ft of cable. The price of the extension unit is 99s 6d and is finished in two-tone moulded plastics with a carrying handle and a rewind handle.

Further details are available from West Hyde Developments Ltd., Ryefield Crescent, Northwood Hill, Northwood, Middlesex.



Extension Cable from West Hyde Developments

LIGHT OPERATED SWITCH

The Transelectric light operated switch has many applications which, it is claimed, are only limited by individuals' own ingenuity.

Triggered by an ordinary light bulb, street lamp, reflected light from bright surfaces or mirrors, infra-red or ultra violet light, it is also claimed to be different from similar devices on the market because it uses a principle they term "wide beam" technique.

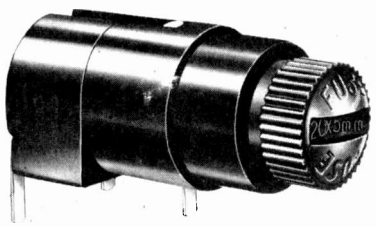
Some of the features of the detector unit are: two separate circuit response controls and one light beam sensitivity control; digital counter; and a built-in claxon horn. The unit is powered by batteries, making it portable, or from a special mains unit. The output socket enables a range of accessories to be plugged in, extending the range of applications even further.

In the home the unit can be used as an automatic light switch, porch light switch, intruder and fire alarm, automatic tape control or to switch on the radio, etc.

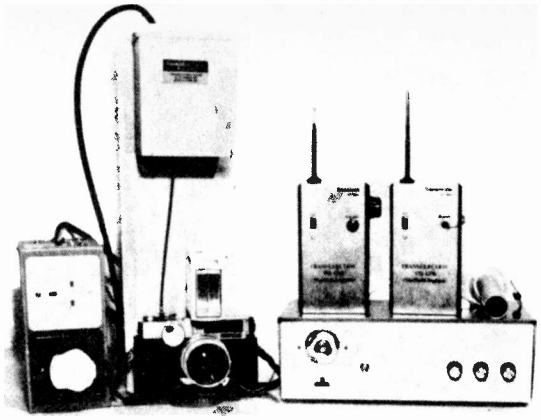
For shops and offices it can be used as an automatic window advertising display lights switch, counter anti-theft device, customer entrance and exit counter, etc.

For seacraft it is an ideal sentry, protecting gear or monitoring the gangway. With the use of an adapted transmitter and receiver, the owner can be ashore in strange ports and still know the instant a stranger boards his craft. The transmitter and receiver operate on the 27MHz band and no notice is given by the manufacturers that a licence is required to operate the units—perhaps because the operator will be the criminal.

Prowl Alarm produced by Computer Devices



Printed Circuit Board Fuseholder marketed by A. F. Bulgin



Transelectric Light Operated Switch and Accessories

Another useful accessory is a camera trigger unit. Full details and price of the Transelectric detector and accessories can be obtained from **Transelectric Co. Ltd.,** 46, Townend Street, Sheffield, S10 1NN.

A more simple and cheap alarm, although less versatile, is the Prowl Alarm from **Computer Devices Ltd.** This device looks very similar to an ordinary hand torch and is triggered when knocked on its side.

The device is placed on a flat surface, behind doors or windows, inside drawers and cupboards, or a trip cord can be attached to the device and any likely place of entry. Being top heavy it is easily toppled by any intruder and sounds the built-in audible siren. Only a predetermined sequence of switching will silence the alarm.

No price was given but details can be obtained from Computer Devices Ltd., 8, North Street, Guildford, Surrey.

CIRCUIT BOARD FUSEHOLDERS

The widespread use of printed circuits and more compact units has necessitated the re-design of many components to allow them to be mounted directly on the circuit board. Until recently fuseholders were either mounted on cabinet panels, in a convenient position, or held on circuit boards by wire loops. Now **Bulgin's** have introduced a new range of fuseholders, type No. F330, designed specially for printed circuit boards.

These holders are moulded from black phenolic with a "D" shaped rear section, the flat part rests on the circuit board to give stability. There are three mounting pins, two common to the rear fuse contact and one for the front contact, arranged in a triangular formation to give a secure fixing against the torque from fuse replacement and renewal. The front of the fuseholder is circular and will protrude through a pre-drilled or punched hole in equipment. The screw-in cap grips the fuse which is withdrawn when the cap is removed.

Addresses of local stockists can be obtained from A. F. Bulgin and Co. Ltd., Bye-Pass Road, Barking, Essex.

I.C.'s FOR ORGANS

Of particular interest to organ constructors are two MOS Arrays being distributed by **WEL Components Ltd.**

Designed specifically for electronic organs, type MA70 is a 12 $\sqrt{2}$ divider giving a true semi-tone relationship. Array type MA60 is a six stage binary divider giving six outputs, each 1 octave apart. Thus, the total organ divider functions can be simulated with four MA70 circuits and 12 MA60's.

Designed free of colouration, the organ designer can experiment to find the final colouration system of his own choice. Designers requiring a free phase system could use 30 MA70's.

Further particulars of stockists and cost can be obtained from WEL Components Ltd., 5 Loverock Road, Reading, Berks.

LITERATURE

During the last few years **LST Electronic Components** has sold many hundreds of copies of the RCA Hobbies Circuit Manual, reference HM.90. But many customers have complained that they have been unable to obtain the special transistors specified for the many useful and varied circuits described in this book.

After some months of effort, LST have finally managed to publish a short list of direct equivalents and now wish to contact their many customers who have bought this book and inform them that the equivalents chart is available, free of charge.

NEMATIC CRYSTALS

The mention of nematic crystals and their possible future applications in technology aroused considerable interest when the article on *Conductive Glass* was published in November 1969. The Aldrich Chemical Co. Inc. of Milwaukee, Wisconsin now advise us that a special Liquid Crystal Edition of their journal *Aldrichimica Data* has been issued. It includes an article on the applications of liquid crystals to science.

Copies are available to readers, free of charge, from their British Associates, **R. N. Emmanuel Ltd.,** 264 Water Road, Alperton, Middx.

LOW COST ELECTRONIC & SCIENTIFIC EQUIPMENT & COMPONENTS

MOTORS

HIGH PRECISION MAINS MOTOR

230V 50Hz ¼ h.p. continuously rated. 3,000 r.p.m. Made by Croydon Engineering Model KA 60 JFB. Suitable for capstan motor. Size 8in long, 4¼in diameter with 6in diameter flange and 4 fixing holes. These motors are Capacitor Start, Capacitor Run, supplied less Capacitor. Also available 3 Phase. **£4.10.0.** each. £1.5.0. P. & P.

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200/250V 50Hz self-starting. Model 87 1 r.p.h., **30/-**; Model 87 1 r.p.m., **30/-**, Clock Motor 2 r.p.h., **20/-**. Type MA23 Low Torque Hysteresis Motors. 1/60 r.p.m., 1/20 r.p.m., 1/12 r.p.m., ½ r.p.m., 1½ r.p.m. **25/-** each. Fitted one-way clutch, 1/12 r.p.m., ½ r.p.m., 1 r.p.m., 2 r.p.m., **30/-** each. P. & P. on any of above 5/- each.

BRAND NEW MOVING COIL DC TEST METERS

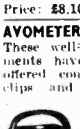
Compact and portable. Width 2¼in, height 1¼in, depth 3in. In black plastic case. Available as follows: 3–0–3V. Prod on Base. 0–15V and 0–300V Dual Range Voltmeter. 0–3V and 0–300V Dual Range Voltmeter. 0–7·5A Ammeter. Our Price **£1.10.0** each. P. & P. 5/-.

BATTERY OPERATED NEW L TRANSISTOR TESTERS

Type R2285 for checking leakage current and gain current of pnp transistors. Audio and Meter for calibration purposes. Our Price: **£8.10.0.**

AVOMETERS

These well-known portable test instruments have been overhauled and are offered complete with leads, crocodile clips and prods. Model HR2/HRM



20,000ohm/V d.c., 1,000ohm/V a.c., **£16.10.0.** Model 7, **£15.10.0.** Model 48A, **£12.** Model 47A, **£12.** Model 40, **£11.** P. & P. on any of above **£1.** Model 47A or 48A (dependent upon availability) complete with voltage multiplier for 480V and 3,600V. Current Shunts for 120A and 480A. Current Transformer for 20A and 60A. In special wooden box, **£15.10.0.** Carriage £1. (N.B. Model 47A and 48A are similar instruments.)

AVO Cases, Leather, **£1.** P. & P. 5/-. Wooden box to take meter only, **£1.** P. & P. 7/6.

EX-AIRCRAFT

Moving Coil Ratiometers in "AS NEW" Condition by Sangamo Weston, 24V. Mainly calibrated °C. 2¼in 2¼in 3in. This precision instrument has many applications. **£3.** P. & P. 5/-.

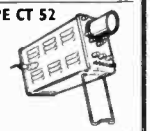
BLOWER MOTORS

"AS NEW". 240V, 16W, 50Hz, 3,000 r.p.m. Shaded pole motor; 2¼in dia. cast aluminium fan, **£2.10.0.** P. & P. 5/-.

SELECTRO BOARDS

"X" "Y" Matrix for programming. 29 37, **£9.10.0.** P. & P. 7/6. 59 24, **£12.10.0.** P. & P. 10/-. Diode Pins to suit, 1/3 each.

OSCILLOSCOPE TYPE CT 52



A very handy miniature portable instrument for general purpose applications. 2¼in diam. tube. Wave form investigation from 10Hz–20MHz. Pulse monitoring duration 50 microseconds to 0·1 microsecond. Time base free running 10Hz–40kHz. Also single sweep facility from 50 microseconds to 3 microseconds. "Y" Amplifier. Delay Line Calibration Voltage. Power supply 110–250V 40/60Hz. 50W. Supplied with metal carrying case. L. 13in. H. 8in. W. 5¼in. Weight 14½lb. Price **£22.** P. & P. **30/-.**

PRECISION MULTI-TURN POTENTIOMETERS IN STOCK

PANEL LAMPS

Robust superior design, ¼in dia. to fit ⅜in hole, 1in O/A length. Available Red or Green, 15 for **30/-**. P. & P. 5/-. With Press to Test facility, ¼in dia. to fit ½in hole, 1¼in O/A length. Available White or Red, 12 for **30/-**. P. & P. 5/-. Both types take 6mm Midget Flange Bulbs.

STOCK CLEARANCE

In order to give clearance in our new stores the following scientific equipment is being sold at realistic prices. All items are offered in "As is condition".

(1) R.F. Oscillator Advance P1, 6 ranges, 100kHz to 100MHz. Attenuator 1V to 100mV. Audio frequency O/P. Mains I/P. Carriage £1 . . . **£8**

(2) Low Frequency Oscillator Dawe 400C, 0·1Hz to 1kHz. Fitted C.R.T. Frequency Comparator. Mains I/P. Carriage 30/- . . . **£12**

(3) Fluxmeter TS 15C/AP Ex-USA Battery Powered. P. & P. 10/- . . . **£4**

(4) A.F. Analyser by Dawes. 7 Ranges 2·5Hz to 8kHz. Carriage 30/- . . . **£25**

(5) Pulse Analyser. Dynatron Radio Ltd. N/101. Carriage 30/- . . . **£8**

(6) Directional Coupler Io 52ohm line. P. & P. 10/- . . . **£7.10.0**

(7) Time Interval Meter. Carriage £1 **£4**

(8) Standard Resistance Box. Decade steps 0–9999. 4 dials by Evershed & Vignoles. P. & P. 10/- . . . **£5**

(9) Valve Tester "Windsor" Taylor. Model 45B. Damaged Meter. P. & P. £1 . . . **£3**

(10) Valve Voltmeter. Marconi TF428. Mains I/P, Range 1·5–150V a.c./d.c. Carriage £1 . . . **£5**

(11) Electro Static Voltmeter, 0–6kV, 3½in dia. P. & P. 10/- . . . **£5.10.0**

(12) Valve Voltmeter, CT54. Battery Powered by Electronic Instruments. Carriage £1 . . . **£8**

(13) Phase Sensitive Voltmeter. 2 meters Ex Equipment. Carriage £2 . . . **£5**

(14) Stabilised d.c. Power Supply. Mains I/P. d.c. O/P. 2·5–10V at 50mA, H. 9in, W. 9in. Carr. £1 **£7.10.0**

(15) Variable d.c. Power Supply. Mains I/P. d.c. O/P 0–300V at 150mA, 6·3V a.c., height 9in, width 9in, depth 5in. Carriage £1 . . . **£7**

(16) D.C. Stabilised Power Supply Electronic Instruments. Mains I/P, d.c. O/P 0–300V at 100mA, a.c. 6·3V at 3A, width 11in, height 9in, depth 9in. Carriage 30/- . . . **£9.10.0**

(17) TV Waveform Generator "CHANNEL" Bands, I and III. Carr. £1. **£5**

(18) Noise Generator. CT410. V.G. Condition. Mains I/P. Carr. £1 **£25**

MINIATURE UNISELECTORS

3 bank, 12 way, 250 ohm, 24V. Type 2200A. Supplied complete with plug-in base. Size 3in 1in 2in. A very neat precision component. Price **£4.19.6.** P. & P. 5/-.

STANDARD CELL, MUIRHEAD D550A

1·01859V at 20°C, **£1.10.0.** P. & P. 5/-.

TRANSISTORISED MULTILINE COMPARATOR.

Vesner Type TS39, **£5** P. & P. 5/-

TELEPHONE DIALS

Clear perspex. No markings, **£1.** P. & P. 5/-

OSCILLOSCOPES

Caller collects. Sold "AS IS" Condition.

Cossor 1035 Mk. 1	**£12.10.0**
Furzehill 0110	**£10.10.0**
Airmec 723	**£7.10.0**
Airmec 830	**£7.10.0**
Solartron D300	**£10.0.0**
Dumont 241	**£8.0.0**

COUNTERS

HIGH SPEED IMPULSE COUNTERS

by Davis, Wynn & Andrews. 4in dial and pointer registers up to 100 and 4-digit counter, both manually resettable. The drive to the counter is by air inverse escapement so that there is no loading of the pointer mechanism when digits are changed and adjustable pawls are unnecessary. Coil resistance 100 ohms for nominal volt operation, but the device works reliably from 20V at rates up to 10 impulses/sec. In circuit with a thyratron, or neostron counting rates up to 100 impulses/sec are possible provided pulse width is restricted to keep mean current to 100mA. New. **£6.0.0.** P. & P. 7/6.

New, 24V 5 Digit. Non-resettable. 500 ohm coil. 1in 1in 4in. **£1.15.0.** P. & P. 5/-. Similar to above but next size larger. Displaying 5in digits only 0–9. In "AS NEW" Condition. **£2.15.0.** P. & P. 5/-.

BRAND NEW 4 Digit Resettable Counter

by Stonebridge. Type ATC & F4E. Operating voltage 12V d.c. 120mA. Reset 12V d.c. 10 impulses/second. W 1¼in, H 2¼in, D 4in. Panel mounting. Price **£5.0.0.** P. & P. 5/-.

4 DIGIT NON-RESETTABLE COUNTER

Totalising 10 impulses per second. Length 3¼in 1¾in 1¾in. 24V d.c., 300 ohm. Price **6/6.** P. & P. 5/-.

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 **59/6.** P. & P. 5/-.

VEEDER ROOT 6 DIGIT COUNTER

Suitable for counting all kinds of production runs, business machine operation. Mechanically driven. Reset type KA 1337, manual knob. Ex-equipt. but new condition. Special price **25/-** plus 5/- P. & P.

3 DIGIT RESETTABLE COUNTER

Totalising 48V d.c. at 48mA; 10 impulses sec. Length 4in ¾in 1in. Price **£3.15.0.** P. & P. 5/-.

6 DIGIT RESETTABLE COUNTER

Totalising 240V 50Hz. Viewing window 2in ¼in. Ex-equipment. Price **55/-**, P. & P. 5/-.

6 DIGIT TOTALISING NON-RESETTABLE COUNTER

Mechanical operation. Chromium finish. Length 1¼in ¾in ¾in with viewing window ¾in ⅜in. Ex-equipment. Price **9/6.** P. & P. 2/6.

BERKELEY DECIMAL COUNTING UNIT 0-9

4 valves double triode type 5965 special quality Unit plugs into standard octal base. Modular construction with 10 miniature neon lamps on display panel. Power supplies 6·3V, a.c., 150V d.c. Cut-on or Cut-off 15V. Size 5¼in 5¼in ¾in. Price **65/-**, P. & P. 5/-.

MINIATURE DIGITAL DISPLAY

Operates on a rear projection 6·3V, pilot lamp. Character size ¼" high. 0–9 digits with 1-degree symbol, i.e. (4°). Dimensions 1" wide, 3¼" deep, 1 3/16" high. List price 6 gns. Our price **49/6.** P. & P. 5/-.

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Uses a sensitive moving coil movement to project digits 0–9 on to a viewing screen via an optical lens system. Image height 1⅝". Lamp 6·3V. Sensitivity 250 micro-amp. Dimensions L. 4¾" W. 2½" H. 1⅝". Price **£3.10.0.** P. & P. 5/-.

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High quality solidly constructed solenoids. Actuated by 42V 45 Ω coil. Overall length 3" 1" square with a ¼" travel of the ¼" dia. shaft. **8/6.** P. & P. 3/-.

24V. 70 ohm. Armature ¼" movement. Lug type fitting. L. 1½" ⅝" ⅝". Price **4/6.** P. & P. 2/6.

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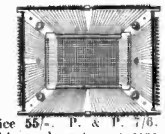

42 52 2K bit ferrite core store complete with 84 OA10 load diodes. Ideal for building computer store or holding information in binary form. Price **55/-**. P. & P. 7/6. Handbook available on how to use core stores. 2/6.

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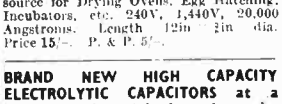

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25,000	50	65	**30/-**
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35,000	15	20	**10/-**
37,000	15	20	**20/-**
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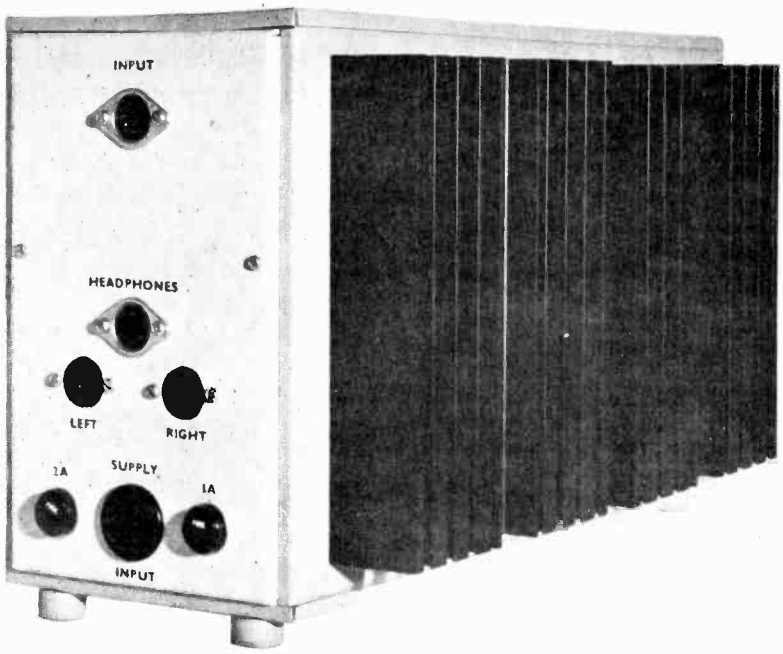
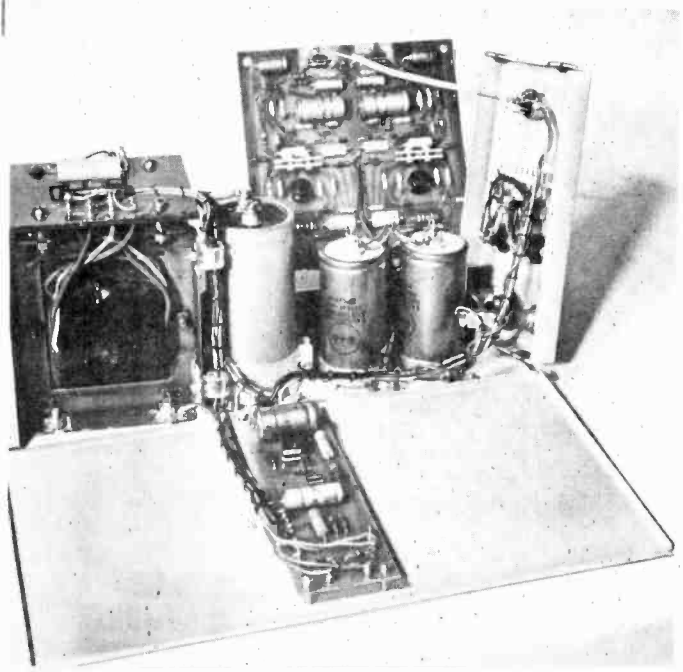


PE GEMINI DUAL PURPOSE STEREO AMPLIFIER PART TWO

THIS month we complete construction details of the main amplifier unit. Setting up instructions are also given; components lists appeared last month.



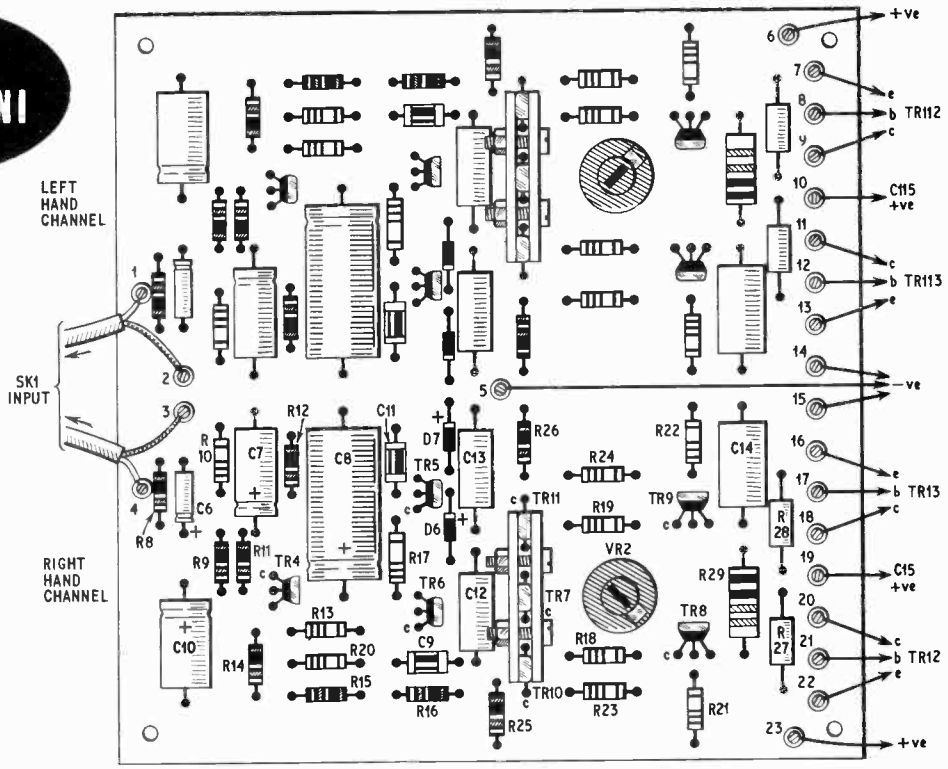
CONSTRUCTION—CIRCUIT BOARDS

Most of the small components for the main amplifier and the power supply are mounted on two fibreglass printed circuit boards. Scale drawings of these boards are given in Figs. 13 and 14. Turret tags are inserted at all the points where wire connections are made to the board. Whilst not essential it does lead to a neater finished article, but as a second best the connecting wires can be inserted through the turret tag holes and soldered onto the copper directly. The following instructions apply to the turret tag version only.

Twenty-three tags are needed for the main amplifiers and 12 for the power supply. The component layouts are given in Figs. 13 and 14 and no explanations are necessary for this stage of the operation. Flying leads should be soldered to all the turret tags using p.v.c. insulated wire of a suitable size such as 14/0076 except those to the output transistors TR12, TR13, TR112, TR113 and transistor TR3, which should be left unconnected. The input turret tags to the main amplifier should also be left unconnected.

It will be seen from the photograph of the main amplifier board that transistors TR7, TR10 and TR11 are thermally connected. Drawings of these clips are given in Fig. 17, of which two are required per channel. They are connected together by 6B.A. bolts and care must be taken to see that when in situ they do not touch any of the other components or transistor wires. Transistor lead connections are given in Fig. 16.

MAIN AMPLIFIER



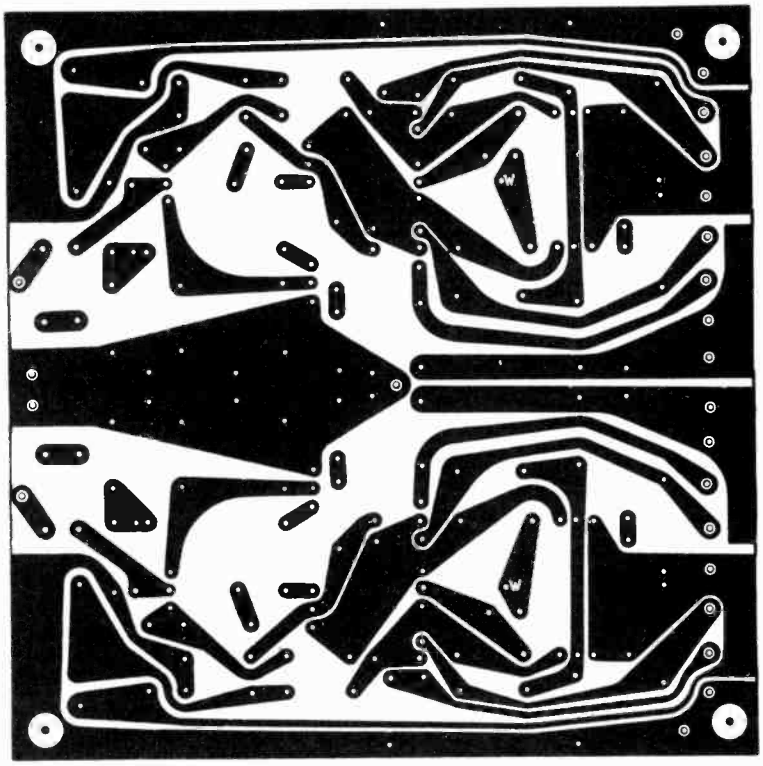


Fig. 13. Layout and wiring diagram of both channels of the main amplifier printed circuit board. Finished size of this board is 5⅝in square

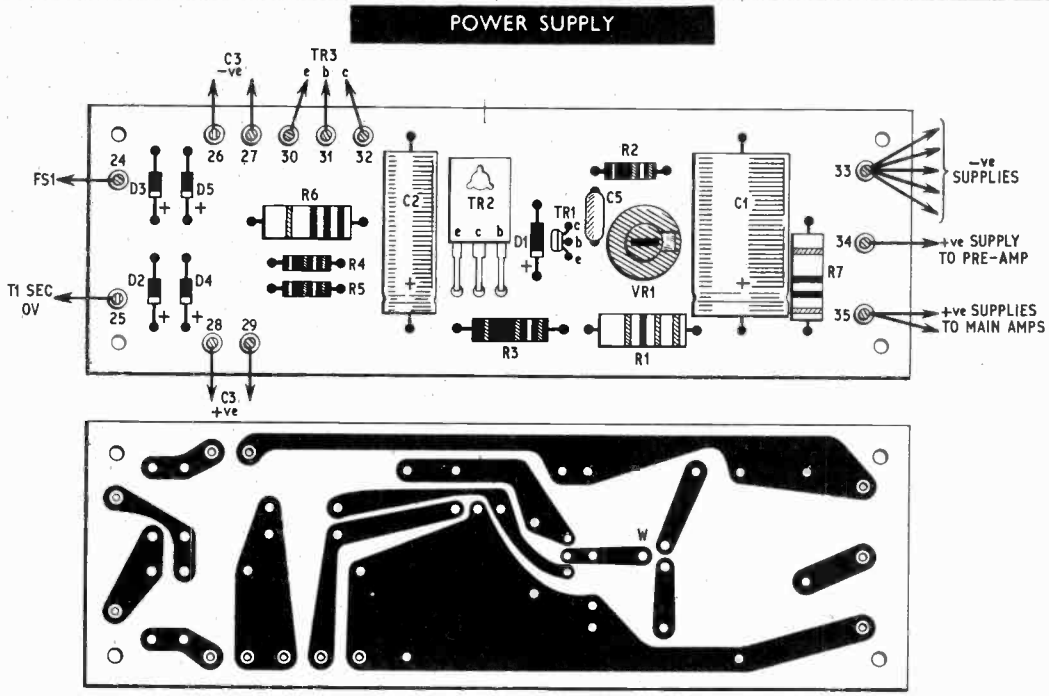
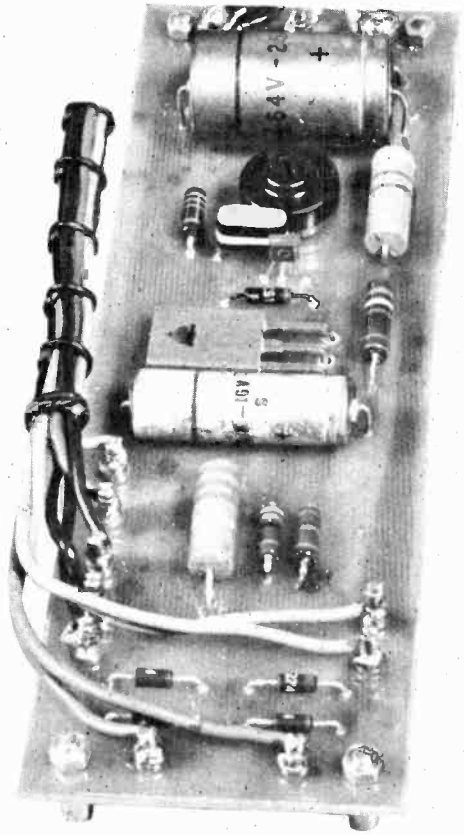
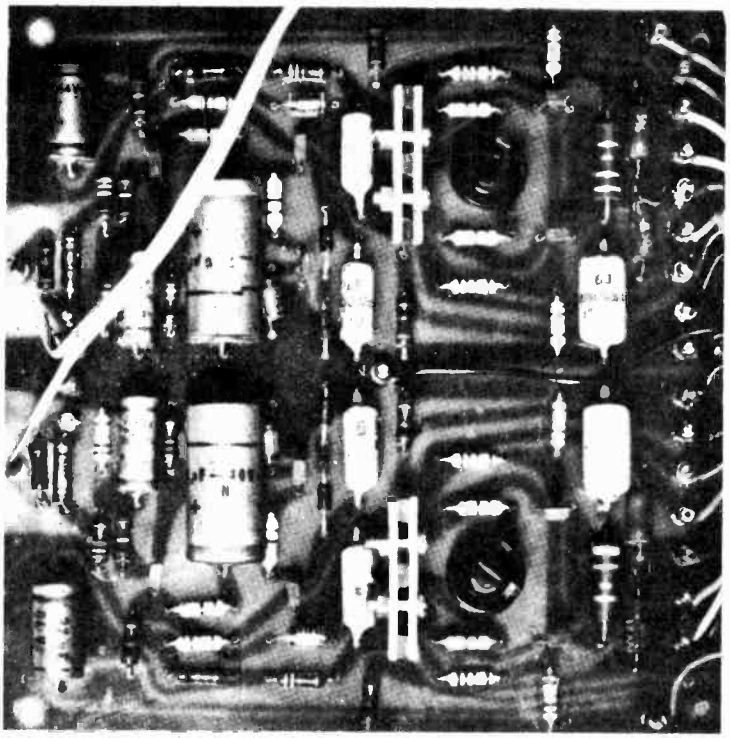


Fig. 14. Layout and wiring diagram of the stabilised power supply printed circuit board. Finished size of this board is $6\frac{3}{8}$in by 2in





DRILLING

Both the main amplifier and pre-amplifier are housed in Contil Mod-2 cases of the types given in the components list. The panels and heatsinks should be drilled as indicated in Figs. 18 to 22, and all burrs removed with a file or large drill. Please note that if different components are used such as a different mains transformer or tagstrip then the hole positions must be modified to suit.

LABELLING

The main amplifier front panel should be given a light coat of Letracote Gloss and then the sockets and fuses labelled with black Letraset as in the photographs. Two more coats of Letracote Gloss should then be applied, allowing suitable drying times.

HEATSINKS

Transistors TR12, TR13, TR112, TR113 are mounted on heatsink A and transistor TR3 on heatsink B. All these devices are supplied with a mica washer and a shakeproof washer, and they should be mounted as shown in Fig. 15, preferably with a smear of silicon grease on each side of the mica washer. When the heatsinks are fastened to the case the transistors will be inaccessible, therefore the wires must be connected at this stage, suitably colour coded. All holes must be deburred and transistors fitted with 4B.A. nylon screws.

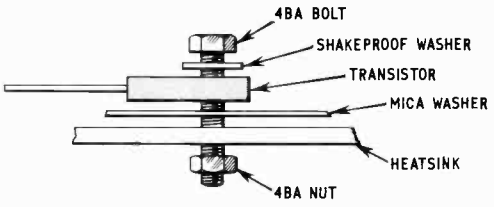


Fig. 15. Mounting details for transistors mounted on heat sinks

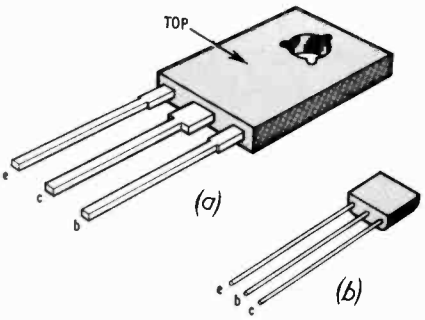


Fig. 16. Transistor connections (a) Motorola transistors as used for TR2, 3, 12, 13, 112 and 113, (b) Ferranti transistors as used for TR1, 4 to 11 and 104 to 111

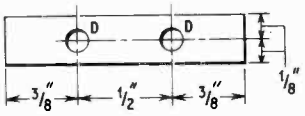


Fig. 17. Thermal clips for the driver transistors; manufacturing details—two required per channel—$\frac{1}{16}$ in Dural

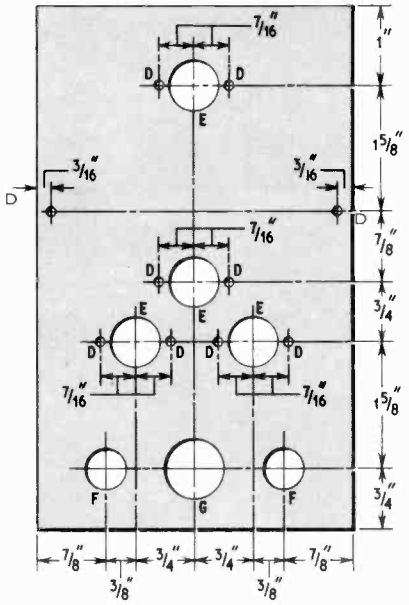
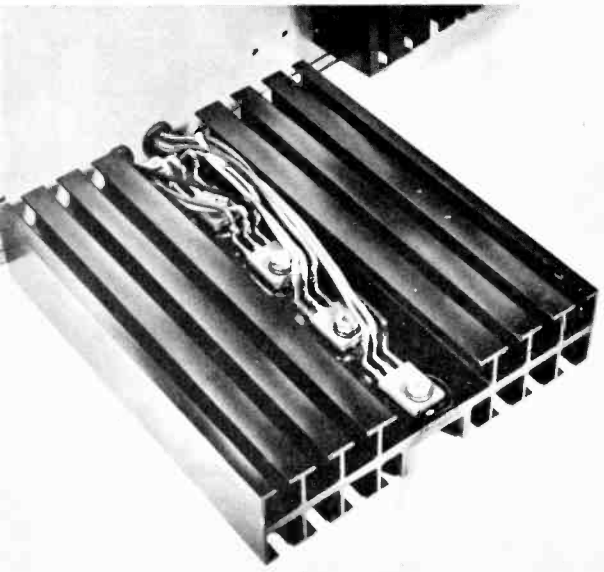


Fig. 18. Drilling details of the main amplifier front panel—no holes are necessary in the back panel or lid of the case



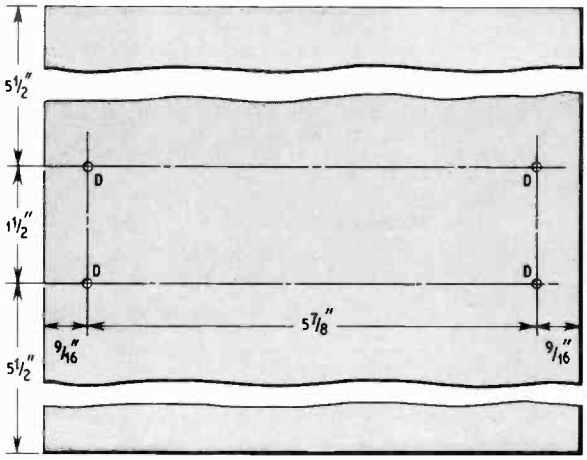


Fig. 19. Drilling details of the power supply board side of the case

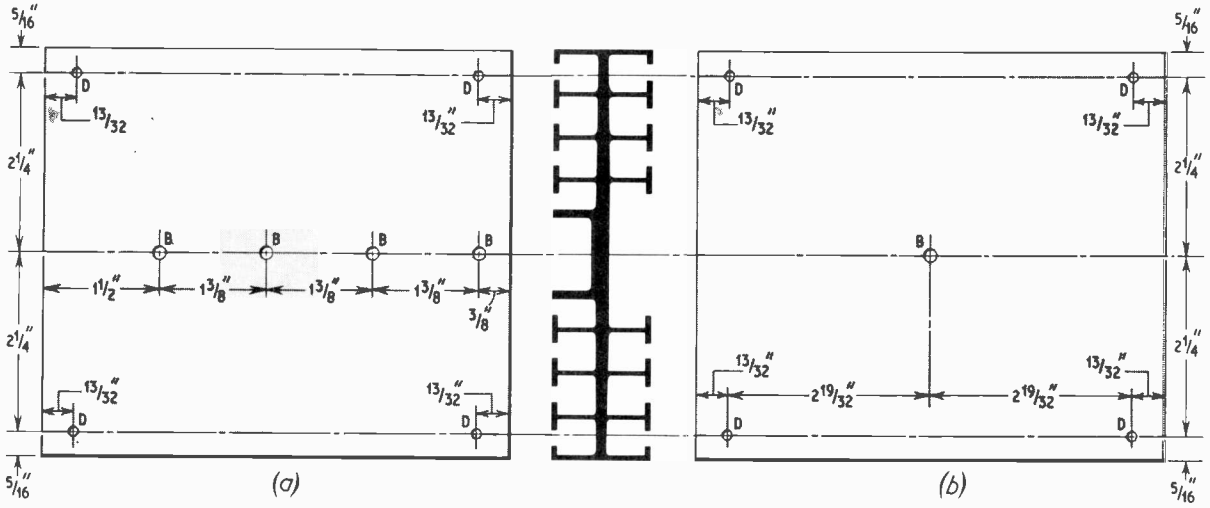
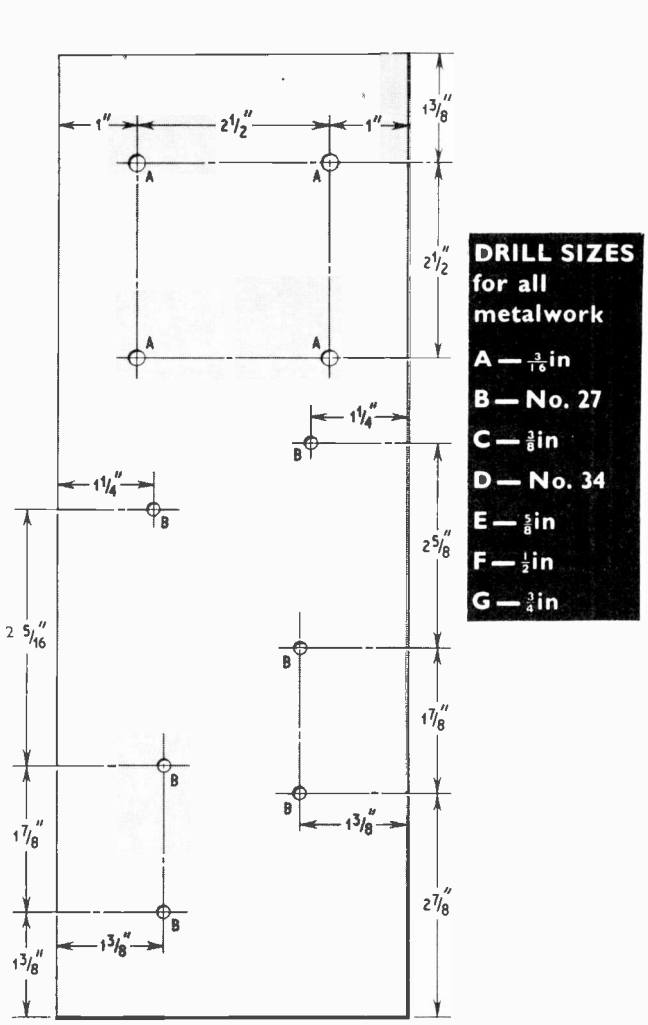


Fig. 20. Heat sink drilling details, (a) heatsink A for transistors TR12, 13, 112 and 113, (b) heat sink B for transistor TR3



DRILL SIZES for all metalwork

- A — 3/16 in
- B — No. 27
- C — 3/8 in
- D — No. 34
- E — 5/8 in
- F — 1/2 in
- G — 3/4 in

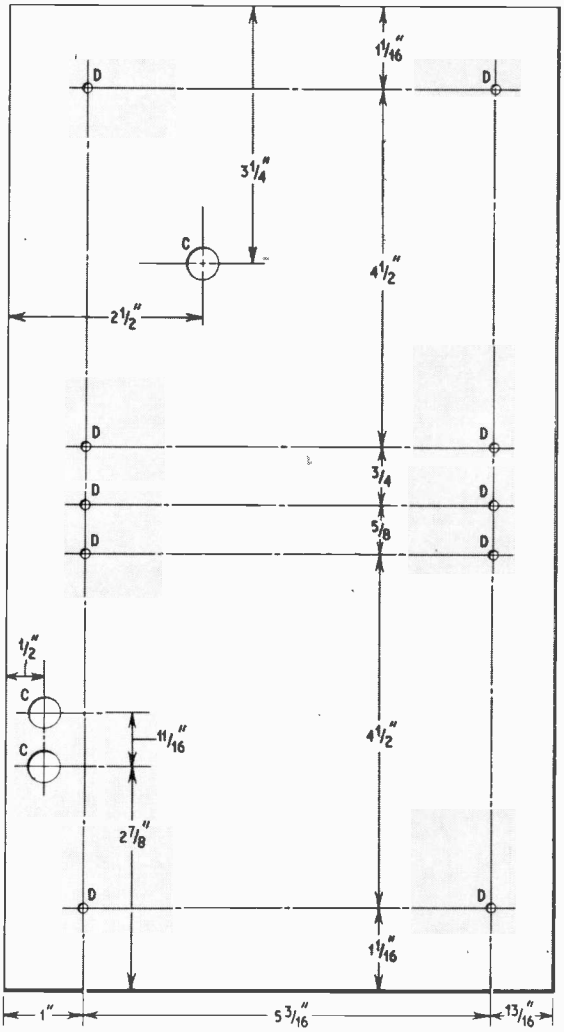


Fig. 21. Drilling details of the base of the main amplifier case

Fig. 22. Drilling details of the heatsink side of the main amplifier case

ASSEMBLY

The front panel should now be assembled with the tag-strip, sockets and fuses using Fig. 23 as a guide. The main transformer, C3, C15, and C115 are bolted to the base plate. The printed circuit boards must be mounted as indicated in Fig. 23 on ½in spacers noting that the two central screws of heatsink A must be fitted before the main amplifier printed circuit board, since the board will mask the holes for the heat-sink when fitted. The other two fixing holes for the heatsink are common to the printed circuit board. The wires from the power transistors pass through the three ⅜in holes fitted with grommets.

WIRING

The 12 wires from the transistors on heatsink A are wired to the appropriate tags on the main amplifier board. Components R30, R31 and L1 and their counterparts in the other channel should be connected as in Fig. 23 and all the rest of the interconnections made between the panels as in Fig. 23. The twin screened lead must still not be connected and the wire from the centre of the main amplifier printed circuit board to the negative output of the power supply printed circuit board, must not be taken along the same route as the two other negative return wires between these boards.

If this warning is not heeded and these cables run parallel, even for a few inches, the increase in distortion due to induction will be quite alarming. Also four leads, two positive and two negative, must be taken from the power supply board to capacitor C3 to reduce the ripple voltage before stabilisation. *Two wires, with the appropriate tags linked are not sufficient due to the high ripple currents involved.*

The mains connections from the socket are simply wired directly to the appropriate tap on the mains transformer via the mains fuse FS1. The earth wire must be connected only to the electrostatic screen on the mains transformer and not to the case, since this will be earthed via the pre-amplifier.

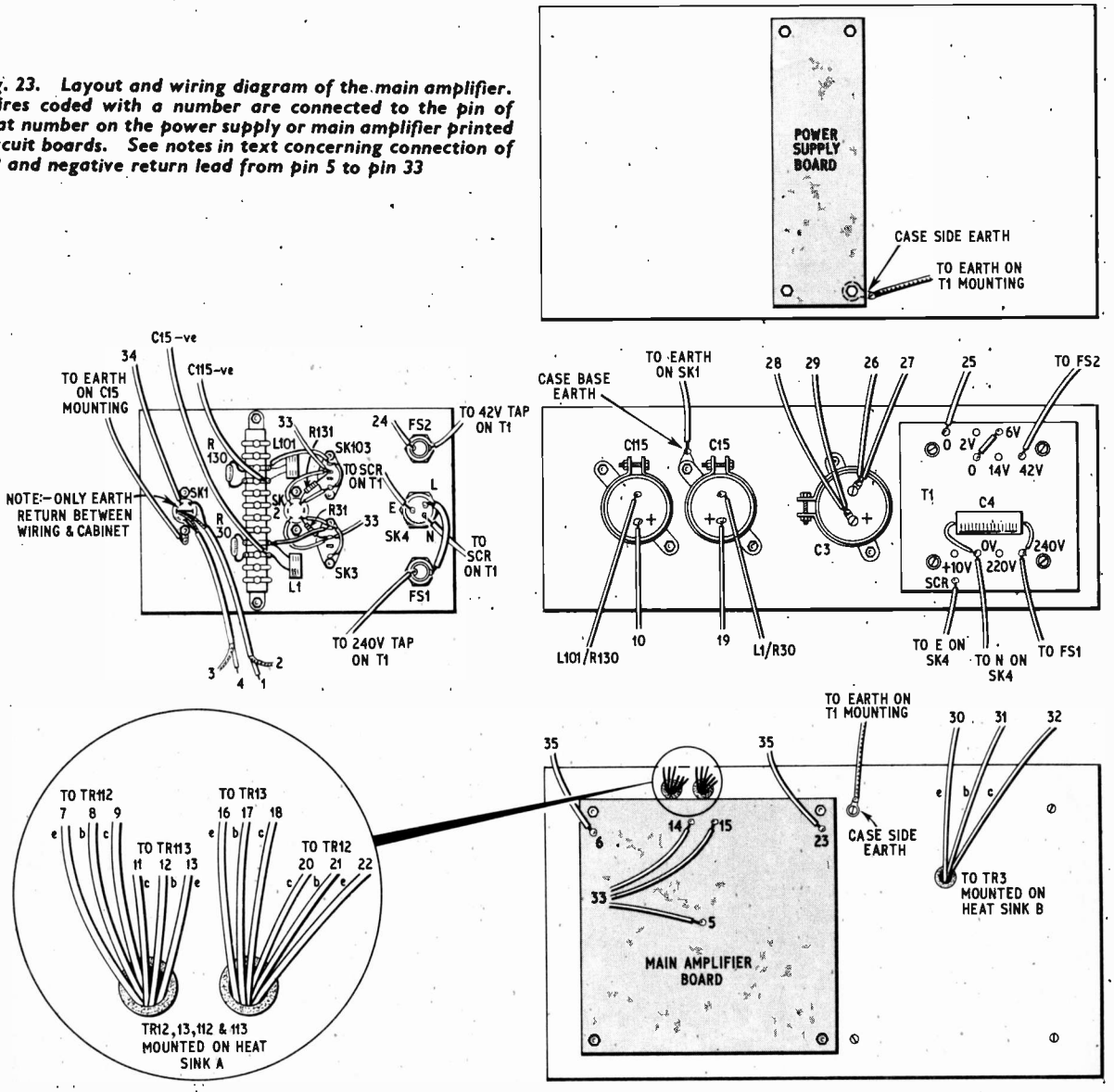


Fig. 23. Layout and wiring diagram of the main amplifier. Wires coded with a number are connected to the pin of that number on the power supply or main amplifier printed circuit boards. See notes in text concerning connection of C3 and negative return lead from pin 5 to pin 33

Capacitor C4 should be connected across the mains winding of the mains transformer with its leads suitably sleeved. It must be ensured that the panels are electrically connected by removing paint at the touching points, if necessary, in order to have a completely screened amplifier and power supply.

The leads to the power supply positive output from the main amplifier board are left disconnected to facilitate the setting up procedure. After all the wiring has been completed it must be thoroughly checked for "expensive" mistakes before switching on.

SETTING UP

With a 100V f.s.d. d.c. meter across the main output of the power supply the mains power should be applied, The output voltage should rise to approximately 55V. This should be adjusted to 55V by VR1 and the amplifier allowed to warm up for 5 minutes; the voltage can then be readjusted. Potentiometers VR2 and VR102 are set to maximum resistance, i.e. clockwise and counter clockwise respectively and a 100mA f.s.d. d.c. meter connected between the power supply main positive output and the right-hand channel supply input wire. Potentiometer VR2 should be adjusted to give 42mA, the amplifier allowed to warm up for a few minutes and then readjusted. The left-hand channel amplifier must be similarly adjusted using VR102.

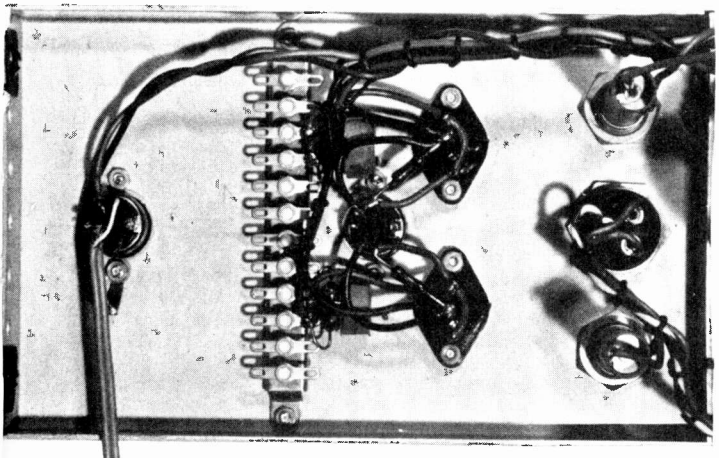
ASSEMBLY

The front and rear panels are fastened loosely by the bottom screws and the heatsink side supported in the correct position. The screened cable from the input of the main amplifier can now be connected to the input socket, taking care to distinguish left from right (see Figs. 13 and 23). The other side panel is placed in position and fastened with the top in place.

Note: It is regretted that the following errors occurred in the first part of P.E. Gemini:

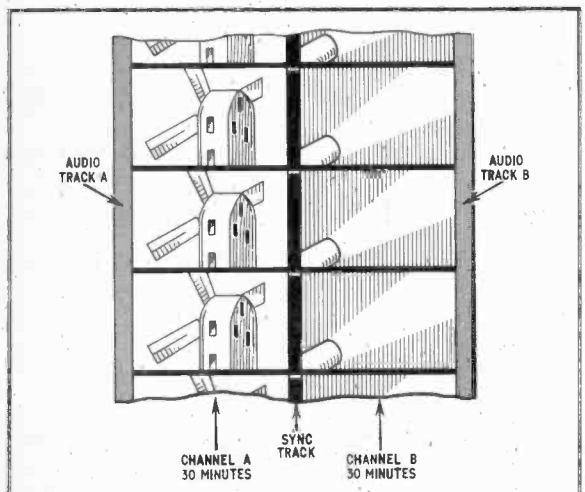
1. Specification—pre-amplifier signal to noise ratio, weighted figures are referred to the 30-phon curve.
2. Page 862, last paragraph—the word linear should be Lin —the person's name.
3. Page 863, second paragraph of Circuit Description—Transistor TR11 should be included in the first line.
4. Caption to Fig. 4 should read "cascode output" not "cascade".
5. Page 864, second paragraph—TR6 should be TR8.
6. Components, power supply—C5 should be 0·1μF polyester Mullard.
7. Fig. 11a—the oscillogram was taken at 10kHz into 8 ohms.
8. Fig. 11c should be rotated through 180 degrees.

Next month: pre-amplifier details



The EVR teleplayer can be connected directly to a domestic television set to provide pictures and sound from the telecartridge microfilm

General view of the Electron Beam Recorder in use at the EVR processing plant. The special clothing worn by the operators together with the filtered air supplied maintains the high degree of cleanliness required in the manufacturing process



Layout of monochrome EVR film. Each channel on this has its own sound track so that two separate half-hour programmes can be accommodated on one telecartridge film strip

ELECTRONIC video recording (EVR) has just been launched in this country by the internationally owned EVR Partnership. This entirely new system of recording sound and vision on microfilm enables reproduction of professionally recorded programmes simply by plugging into the aerial socket of a 625 line television receiver.

A reproducer, or teleplayer, is needed to process the film information. Here an electronic scanner converts the film recording into electrical signals that a television set can use.

Programmes come in the form of cartridge films. With a monochrome cartridge there can be two half hour programmes with appropriate sound and with colour cartridges one half hour programme is accommodated.

ELECT

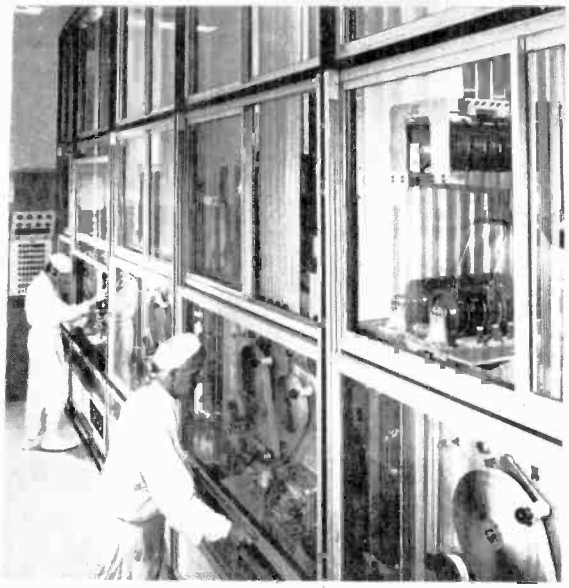
The Videocassette player connected to a colour television receiver. The tape can be stopped at any point in the programme, removed without rewinding and replaced with another cassette

AS A STRONG contender in this potential world market the Sony Corporation of Japan unveiled in London recently their colour videocassette system using the magnetic tape method. At present the system is only suitable for use with any NTSC colour (the system adopted by the U.S. and Japan) or black and white television receivers.

The outstanding feature of the Sony system is that it uses a Videocassette not unlike the standard audio tape cassette. The playing time of the videocassette is approximately 10 minutes, is capable of 200 playings and is easily loaded or removed from the playback unit.

The tape takes 2½ minutes to rewind and a taped programme can be erased easily and as frequently as on audio tape. The tape can be returned to the programme's supplier for re-recording another programme. An adaptor for recording direct from the television will also be available.

The tape has two sound tracks and can be used for dual track stereo or monaural sound. In the case of a foreign movie or the teaching of a



The high speed photographic printer in use. Here the special 35 mm EVR print stock can be seen on the feed and take-up reels in each of the four print sections

Incoming visual material supplied by programme owners being monitored by engineers

At first, production of telecartridges is being confined to the educational and instructional field. Subsequently, EVR will move into the entertainment market.

To provide cartridges for the United Kingdom and overseas markets, a multi-million pound processing plant has been built at Basildon in Essex.

In the manufacturing process conversion to the EVR telecartridge format first requires that the incoming film or videotape programme to be copied, is reproduced as a 40mm master film.

This is made using an Electron Beam Recorder. In this system, an electron beam, modulated by the programme information, is made to bombard the special master film. Two visual tracks are laid on it with a centre synchronising track.

Print copies of the master are made in a high speed multiple copying machine. Here the two sound tracks are also laid. Finally, the film stock from the printer is developed, spliced into individual 8·75mm strips and then spooled into the EVR cartidges.

The capacity of the plant is several thousand cartridges a day.

Production will concentrate initially on monochrome film cartridges; full scale colour cartridge manufacture is planned for early 1972.

Under license, Rank·Bush Murphy Ltd., will begin production of the Teleplayer next January. Selling will be direct to users at a price of £360.

Telecartridge selling prices, rental charges and distribution will be decided by the programme owners. As an example, prices of telecartridges being produced are in the range £20 to £40 for purchase and 30s. to 50s. for hiring.

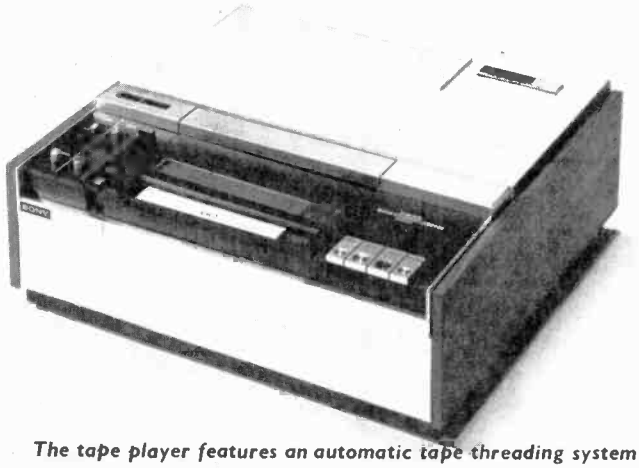
RONORAMA LOOKS AT VIDEO RECORDING

foreign language, the programme can have narration in two different languages so that it can be heard in either one or both languages simultaneously.

The playback machine (right) operates just like any other tape playback machine but is plugged directly into the television aerial input socket. The television will not require any modification and being fully compatible the set can be colour (NTSC) or black and white.

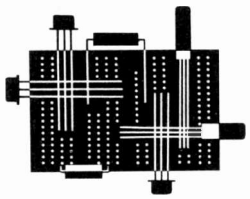
The Sony Colour Videocassette system will be available in the U.K. late 1971 and will cost approximately £260. It is estimated that the player will cost £200, the 10 minute tape £10 and the adaptor for recording direct from the television £50.

In order to create a tape library Sony intends to make its facilities available to the motion picture and television industries, music and record companies, publishers and educational institutions. Sony believes this will create, for these industries, a new medium for educating and selling to the public.—Video taped P.E. each month?



The tape player features an automatic tape threading system

F.E.T. TIME SWITCH



THE circuit to be described consists of an accurate timing circuit, an electronic switch and a lamp driver which provides a visual indication when a set time interval has elapsed. A relay can be substituted for the lamp if other external circuitry needs to be switched.

Intervals of from 5 to 65 seconds can be set and this upper limit can be extended to 10 minutes with suitable resistor substitution.

FIELD EFFECT TRANSISTOR

If a resistor and a capacitor are connected to a battery of E volts as shown in Fig. 1a, then the voltage that will appear across the capacitor will take the form given in Fig. 1b. A capacitor and resistor so arranged have a time constant which is the time in seconds for the voltage V_c to reach approximately two thirds of the applied voltage and is given as CR seconds.

In the circuit of Fig. 2 the resistance/capacitance timing network combines VR1, R1 and C1. To make use of the voltage that appears across the capacitor a special type of transistor, TR1, is used. This has the full title of an n-channel field effect transistor and its most important quality is that of having a very high input impedance when its gate and source are reverse biased.

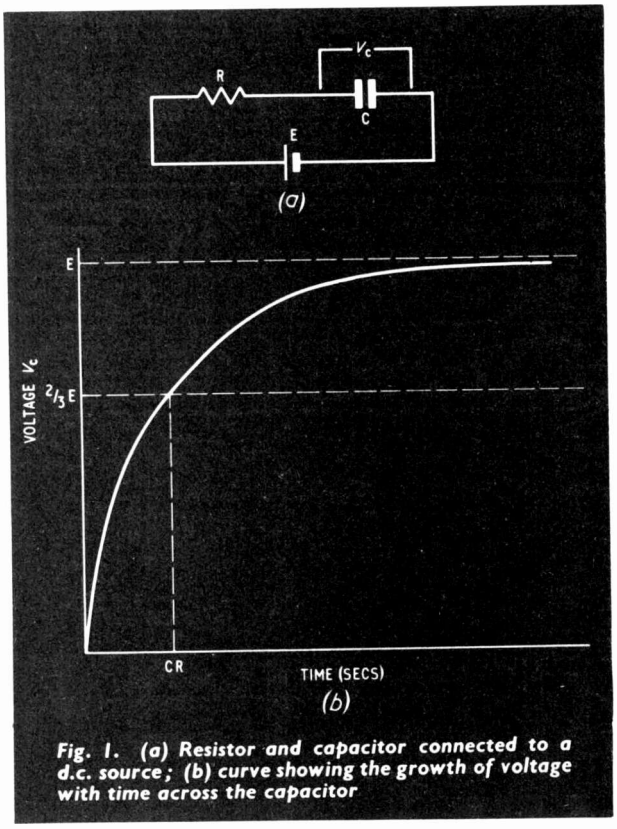


Fig. 1. (a) Resistor and capacitor connected to a d.c. source; (b) curve showing the growth of voltage with time across the capacitor

A high impedance device is very important in this position as it prevents current leaking from the capacitor and so upsetting extended charging intervals.

TRIGGER LEVEL

At the moment when S2 is closed the capacitor C1 is discharged and the voltage at the gate of the field effect transistor is 0V. Some current, known as drain current, does flow through the device effectively reverse biasing the gate and source. This voltage is about 1V in practice.

With the switch S2 closed, C1 commences to charge at a rate which depends on the value of resistance in series with it.

In Fig. 3 is given the growth curves of capacitor voltage for three different values of resistance. It can be seen from the graphs that the CR time constants, or time taken to reach approximately 6 volts varies considerably with each resistance/capacitance combination. Also, the lower part of each curve is essentially linear.

If we can arrange to switch, or trigger the indicator lamp with a low voltage on C1 then any later calibration of VR1 will be found to be linear, that is, the movement of the slider will vary directly with the interval required.

COMPONENTS . . .

Resistors

R1 100kΩ	R4 1·5kΩ	R7 4·7k
R2 120Ω	R5 5·6kΩ	R8 22ΩΩ
R3 6·8kΩ	R6 1kΩ	

All ½ watt 10% carbon

Capacitors

C1 100μF tantalum elect. 12V

Diodes

D1 Z3·9 3·9V 250mW Zener
D2* OA81

Potentiometer

VR1 1MΩ carbon linear

Transistors

TR1 2N3819
TR2–TR4 ZTX300 (3 off)

Switches

S1 Single pole, push-to-make
S2 On/off toggle

Relay

RLA* Two pole two way 6 volt operated 185 ohm coil (Omron Type MH2)

Lamp

LP1 6V 0·06A

Miscellaneous

T-Dec, connecting wire

** Diode D2 and Relay RLA are alternatives to R8 add LP1 (see Fig. 2).*

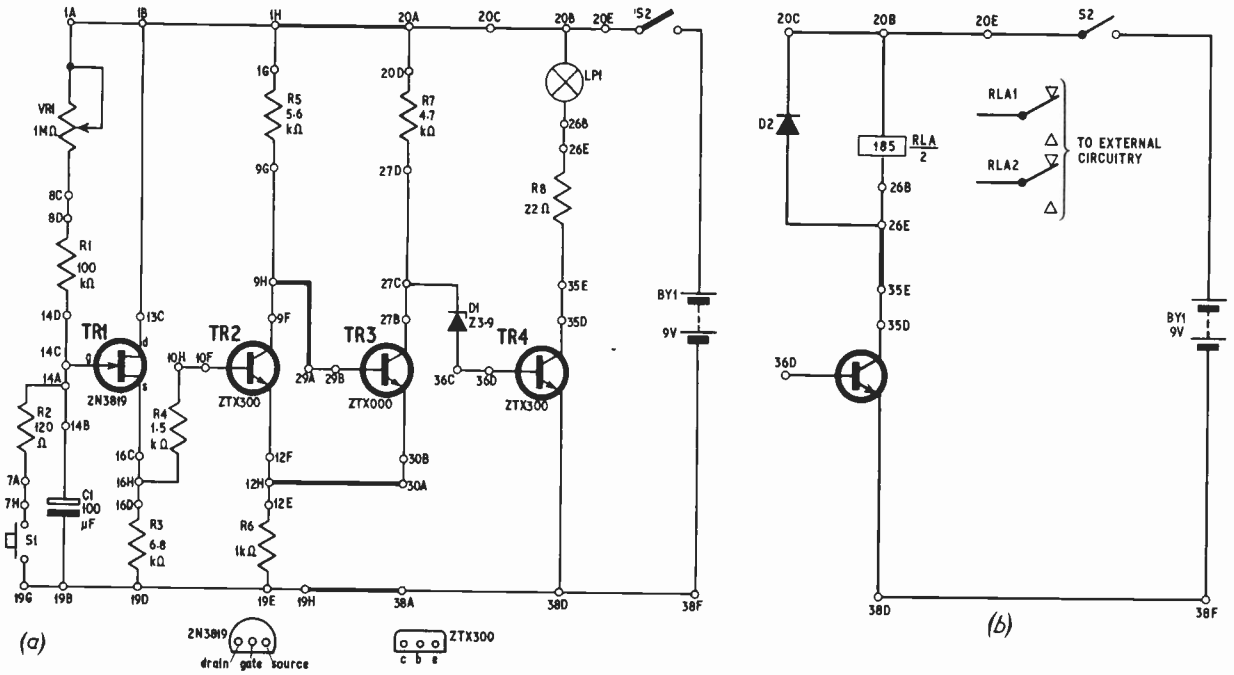


Fig. 2. (a) Circuit diagram of time switch. The thick lines indicate link wires on the T-Dec assembly; (b) substitution of a relay at the collector of TR4. Items needed for this modification are marked with an asterisk in the components list

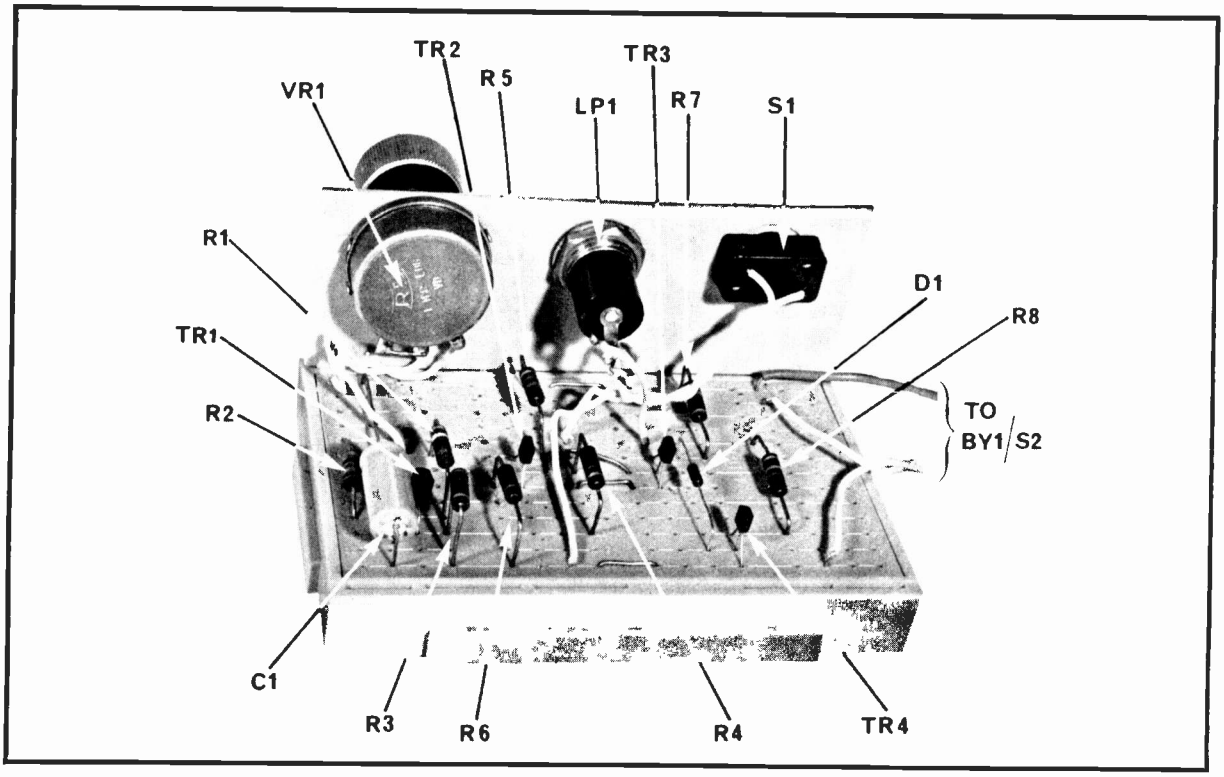
The switching voltage, or trigger level, is arranged for approximately 3V at which point TR2 will turn on.

SCHMITT TRIGGER

With the rise of voltage on C1 towards the trigger level, the reverse bias on TR1 falls and the drain current increases so that the source voltage follows the gate.

The transistor pair comprising TR2 and TR3 constitute, in effect, an electronic toggle switch with a very rapid action. In the quiescent state with the lamp switched off, TR2 is off and TR3 on.

The voltage at the collector of TR3 is not sufficient to turn TR4 on, it being less than the 3·9V of the Zener diode D1. As TR3 is conducting, its collector current



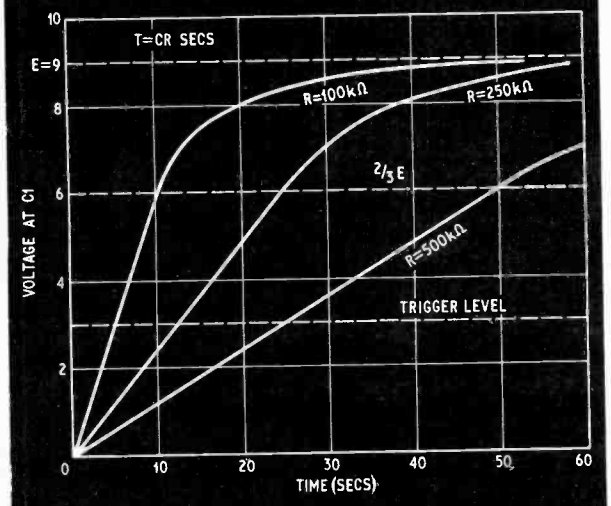


Fig. 3. Three graphs showing how variations of resistance at VR1 produce different charging rates at the timing capacitor C1. A trigger level that falls on the linear parts of the curves makes for time calibration linearity

passes through R6 and produces a volt drop which reverse biases the base and emitter of TR2.

The trigger voltage at the base must exceed this voltage to turn on the transistor and when it does the voltage at its collector and emitter so arrange as to turn off TR3.

LAMP DRIVER

As TR3 switches off, the collector voltage rises. When it exceeds the 3·9V of the Zener diode D1, this conducts and switches on the lamp driver TR4 so that nearly all of the line volts appear across R8 and LP1.

The resistor R8 is included to reduce the cold filament current of the lamp as the initial resistance of this is very low.

If the lamp driver TR4 was in any way directly coupled to the slowly rising voltage at R3 the lamp turn on would be gradual. The inclusion of the Schmitt trigger circuit ensures an instantaneous switching action.

TURN OFF

To turn off the lamp, the voltage at R3 must be reduced by about a volt below the trigger voltage of the Schmitt circuit.

With S1 depressed C1 discharges through R2 on a short time constant. As the gate of TR1 moves towards 0V the gate-to-source junction becomes reverse biased. This means a reduction in drain current so that the voltage at R3 falls below the trigger voltage and turns off TR2 and consequently the lamp.

RELAY SUBSTITUTION

If external circuitry, requiring larger power, is to be switched then a 6V relay can be substituted provided that the coil resistance is above 120 ohms. In this application R8 can be deleted.

A diode should be connected in parallel with the coil as in Fig. 1b, to suppress transient voltage spikes which could damage TR4.

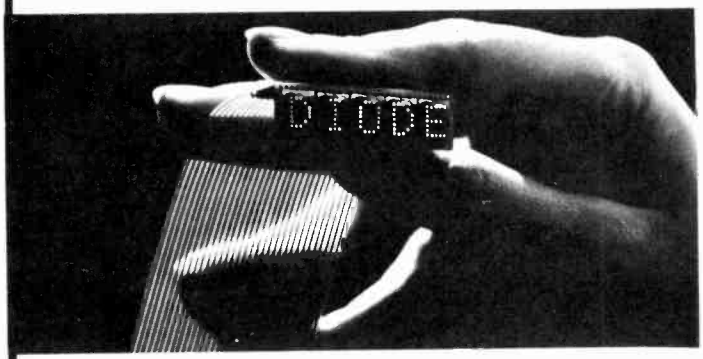
To extend the timing range from 1–10 minutes a 10MΩ potentiometer should be substituted for VR1. ★

NEWS BRIEFS

Diode Display

SIGNIFICANT new work on small size, solid-state data displays is being carried out at the Research Laboratories of The Marconi Company, on behalf of Marconi Radar Systems. Tiny slices of glass ceramic, no larger than a finger tip, each carry a matrix of Gallium Arsenide Phosphide, light-emitting diodes, which can be switched on to provide a pattern of brightly lit red dots, making up high contrast letters, numbers or symbols, as shown below.

The major features of this development are in the production of a display format in which the total area of each character display module is completely utilised as a display, and in the development of a matrix addressing system.



Printed Circuit Developments

PALMABOARD, a series of partly processed standard printed circuit boards, which can be tailor-made to individual designs, particularly suited to the needs of the small processor, captive laboratory and consumer, has been introduced by the Printed Circuits division of Palmer Aero Products Limited at Camberley, Surrey.

Individual designs are applied to the partly finished board to coincide with in-built contacts and a hole matrix system. Boards can be brought to completion in the minimum of time making a very attractive proposition in terms of reduced delivery times, and effect a substantial reduction in cost due to standardisation and the instant readiness from stock.

The case of printed circuits has recently been extended to car instrument panels, the photographs below show Pressac printed circuits incorporated in Ford Cortina and Rover 2000 TC panels. The panel used on the Ford motor car is a flexible circuit that folds around the instruments to provide the connections.

The 'KIT IDEA' by HEATHKIT

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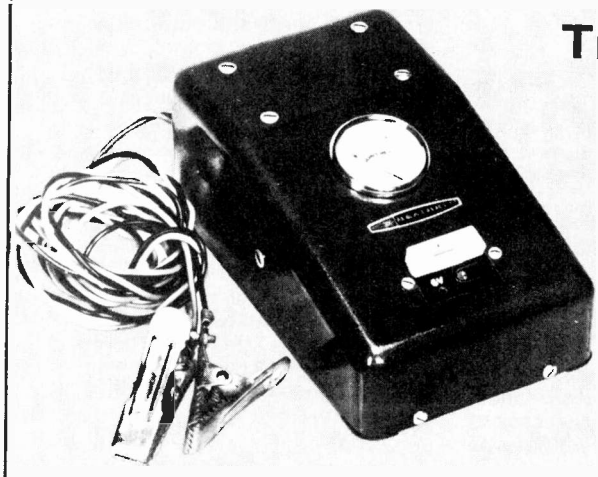

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Subject: OPERATION 'SEASEARCH'

AN ELECTRONIC WAR GAME BY D. R. DAINES

THE sea is a big place. One of the problems facing the Royal Navy in the last war was that of patrolling extended shipping lanes with depleted forces. This in turn put a premium on the ability of commanders to anticipate where the enemy was likely to strike next. Operation Seasearch does just that.

DESCRIPTION

The unit houses two games—the present one and another to be described later. Since both games utilise much common wiring, housing the two games within the same case affects a considerable saving. The game to be played is selected by turning a three-pole two-way switch.

Everyone is familiar with the lettered system of co-ordinates to describe the position on a map of any feature (see Fig. 1). Two twelve-way rotary switches are used in this game to denote the position of each ship. One switch determines the North/South position and the other the East/West position. Each player has two ships under his control, hence a total of eight switches and knobs are needed. The knobs are placed in such a position that each player may easily conceal his switch settings yet also be able to manipulate them readily.

Between the players is a map representing the North Atlantic, marked off in squares to correspond with the positions of the switches. There are also three push-buttons, only two of which are used in this game. Depressing one will cause a lamp number 1 to be projected onto the map if contact has been made with the raider. Depressing the other will cause a number 2 to be projected if contact has been made with the raider's supply ship. The lamps are concealed underneath the map and when lit project an appropriate number onto it.

METHOD OF PLAY

The "Redland" player has a surface raider and a supply ship. The "Blueland" player has a destroyer and a cruiser. The raider is positioned west of the Azores, position Gh (Fig. 1); the supply ship to Cayenne, position Ca; the Cruiser to Scapa Flow, position L1; and the destroyer to Gibraltar, position Lh; play now begins. The "Red" player "moves" his raider one square in any direction—representing one day's sailing—and for the simplest possible game ignores the supply ship completely. The "Blue" player now moves both of his ships, attempting to catch the raider with either. At the completion of his move he presses the "raider" pushbutton. If he has succeeded in getting either of his ships in the same square as the (unseen) raider the lamp will glow and the game ends.

The raider scores automatically whenever he positions his ships on a shipping lane. This causes a lamp to light, projecting a "3" onto the map. The raider scores one merchant ship sunk for each move that he is on a shipping lane, and the fact that the lamp lights is an indication to the "Blue" player that his opponent is somewhere on one of the lanes, thus helping to narrow the search. Further play details will be given at the end of this article.

CIRCUIT

In Fig. 2, switches S1a and S2a are each one wafer of two twelve-way two-pole switches. They control the position of the raider. Switches S3 and 4 are also twelve-way (see components list) and control the position of the supply ship. At the other end of the unit, switches 5 and 6 control the destroyer and 7 and 8 the cruiser. All East/West co-ordinate switches are wired in parallel as shown, as are all the North/South co-ordinates. Jumper wires connect the centre of switches 5 and 6 and the centre of switches 7 and 8. The outputs are from the centre tags of S2 and S4, through pushbuttons to their respective lamps.

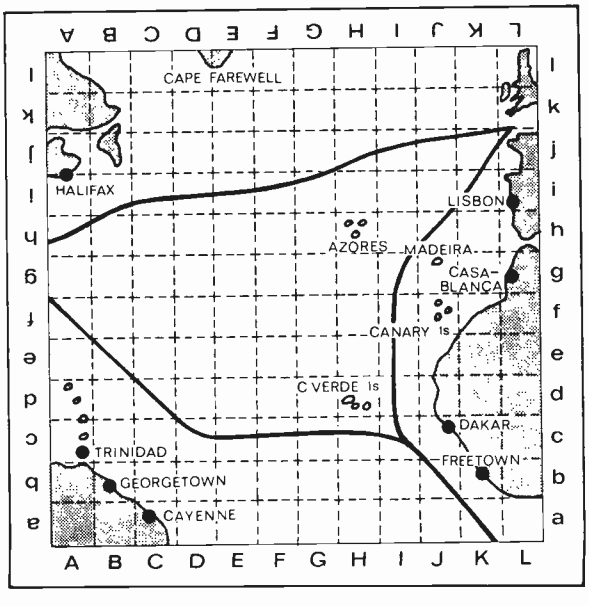
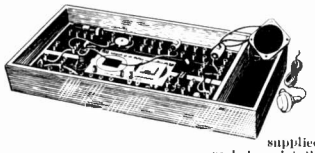


Fig. 1. Map (7in × 7in) of the North Atlantic, showing shipping lanes, used for the basis of Operation Seasearch

ROC ELECTRONICS

50 PROJECT ELECTRONIC KIT Model R.130



King of the Roc Electronic Kits is the Giant R.130 which makes up into no less than 50 separate projects including Radio Receivers, Transmitters, Tachometer, Rain Alarm, Testers, Electronic Switches, Amplifiers and even an Electronic Target Game. As well as earphone, speaker, meter, relay, transformer, solar cell, buzzer, etc., etc., the R.130 is supplied complete with a fitted hardwood case and clear detailed instructions for all 50 projects.

PRICE £7.19.0

20 PROJECT SOLAR ELECTRONIC KIT Mod. R.128

This ultra modern Project Kit is shaped for the space age. Carried inside a transparent domed 4½in capsule the R.128 comes complete with a self-contained solar cell to power any one of 20 projects ranging from a one transistor radio to a morse set complete with key and morse training code. Supplied complete with easy to follow instructions and even the cement to assemble this unique electronic space capsule.

PRICE £4.10.0

2 OCTAVE ELECTRONIC ORGAN KIT Mod. R.129

Complete with a music book containing 10 easy to play songs the R.129 solid state organ kit covers 2 full octaves. Slotting into a fitted hardwood case the top panel carries the key assemblies and all the components including the loudspeaker. Like all Roc Electronic Kits every item is included down to the last nut and bolt so that the constructor can start assembly within minutes of opening the package.

PRICE £4.10.0

10 PROJECT INTEGRATED CIRCUIT KIT Model R.127

Using a robust Solid State Integrated circuit the R.127 kits will build any one of these projects: (1) Germanium Radio. (2) Test Oscillator. (3) Morse Telegraph Training Set. (4) I.C.1. Transistor Radio. (5) Germanium 1 Transistor Radio. (6) Record Player Amp. (7) Continuity Tester. (8) AF Signal Tracer. (9) Radio Transmitter. (10) Water Purity Tester.

PRICE £3.10.0

2 TRANSISTOR SOLAR RADIO KIT Model R.126

Like all Roc Electronic Kits the R.126 uses reliable no-solder connections to produce a complete 2 transistor radio in under 2 hours. As well as battery operation the kit is supplied complete with a solar cell to provide power from the Sun or any strong light source.

PRICE £2.10.0

CRYSTAL RADIO KIT Model R.125

This easy to build Radio is based on the same circuit developed by Marconi for the very first radio transmission but uses a modern ferrite aerial for maximum efficiency. A perfect introduction to Radio Theory.

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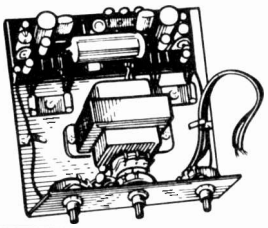
5 WATT STEREO INTEGRATED AMPLIFIER CHASSIS Model R.123



Mounted on a heavy gauge chassis the fully transistorised R.123 stereo amplifier is completely self-contained even down to ganged volume and separate tone controls. For a simple stereo amplifier of excellent quality all you have to provide is the cabinet and control knobs.

SPECIFICATION:
Output: 5W total. 2·5W per channel.
Input sensitivity: 600mV at 2·2Mohms.
AC 240V operation.

PRICE £4.19.0

5 WATT 8 TRACK CARTRIDGE STEREO AMPLIFIER Model R.133

Just slot in one of the many 8 track cartridge tapes available for a continuous programme of your favourite music. A manual programme override switch enables you to switch from one track to the next at the push of a button at the same time a numbered indicator lights up to show which track is playing. Beautifully finished in an oiled walnut cabinet the R.133 is mechanically engineered to provide long and reliable service. SPECIFICATION- Tape speed: 9·5 cm/sec (3¾ i.p.s.). Wow & flutter: better than 0·3%. Frequency range: 40–12,000Hz. Cross talk: better than 45dB at 1,000Hz. Output: 5W total. 2·5W per channel. Amplifier outputs: 200mV.

PRICE £36.0.0

STEREO HEADPHONES Model R.328

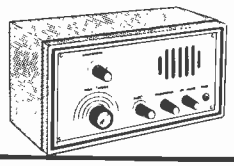
Built up to a standard not down to a price, the R.328 stereo headphones represent a breakthrough in value for money.

A valuable addition to any stereo installation they will provide many hours of listening pleasure.

SPECIFICATION:
Matching impedance: 8–16 ohms.
Frequency range: 30–15,000Hz.

PRICE £2.8.0

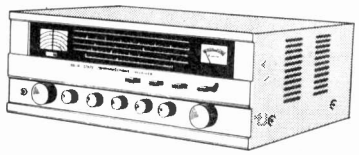
FOUR BAND SHORT WAVE RECEIVER KIT Model R.140



This excellent transistorised battery operated kit will not only provide hours of entertainment when made up but also in its construction.
It receives the normal broadcast band 550kHz to 1·6MHz and on short wave 1·5–30MHz in three bands.
The 32-page manual not only shows step by step instructions on how to assemble the kit but also includes a guide on broadcasting stations throughout the world.

PRICE £9.8.0

PROFESSIONAL SOLID STATE FOUR BAND COMMUNICATION RECEIVER Model R.135



This is the communication receiver that you have long been waiting for. Fully transistorised and continuous coverage from 555kHz to 3MHz in four bands including illuminated electronic bandspread for 160–10 metres. Also incorporated is an internal speaker, automatic noise limiter, SSB/AM/CW Switch, AVC Switch, S Meter, Receive and Standby Switch, external socket for headphone or speaker, bandspread control, BFO control, on/off/AF gain, band selector, antenna trimmer and RF gain. The R.135 will run off of 240V a.c. dry batteries or any 12V d.c. negative ground source.

PRICE £45.0.0

10 WATT BUDGET STEREO ALL TRANSISTOR AMPLIFIER Model R.136

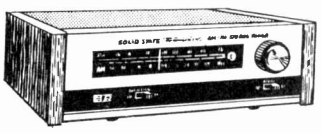
Ideal as a second stereo system or for the newcomer to Hi-Fi who wishes to upgrade existing equipment the R.136 sounds every bit as good as it looks. As well as inputs for crystal or ceramic cartridge the R.136 has a Stereo Tuner input which accepts the matching R.134 Stereo AM/FM Tuner.

The Satin Finish front panel carries a stereo headphone socket as well as volume, balance, tone, (all ganged) speaker, mode and selector controls. Supplied complete with oiled walnut enclosure.

SPECIFICATION: Output: 10 watts total. 5 watts per channel. Frequency Range: 35–18,000Hz. Inputs: Phono and Tuner.

PRICE £13.0.0

AM/FM/MPX STEREO TUNER Model R.134



Perfect Matching Unit to the R.136 Amplifier. The R.134 Stereo Tuner is designed to give years of reliable performance. The Tuning Band covers AM & FM with a separate stereo beacon to indicate when stereo broadcasts are being received.

SPECIFICATION:
FM: frequency range: 88–108mHz. Usable sensitivity: 18μV. Stereo separation: 26dB at 1kHz. Image rejection: 55dB. AM: frequency range: 535–1,605kHz. Usable sensitivity: 280μA.

PRICE £21.0.0

4 WATT STEREO FM/AM/MPX TUNER AMPLIFIER Model R.124

Another Roc Exclusive offering top value for money performance the R.124 is a Stereo Tuner/Amp with facilities only usually found in much more expensive units. Features like separate bass and treble controls, automatic frequency control switch and stereo headphone socket give the R.124 a price to specification ratio second to none.

Housed in a handsome walnut cabinet the classical low line styling of the R.124 will grace any home.

SPECIFICATION: FM: Frequency Range: 88–108MHz. Usable sensitivity: 20μV. Stereo Separation: 26dB at 1kHz, 20dB minimum. Image Rejection: 55dB. AM: Frequency Range: 535–1605kHz. Usable Sensitivity: 300μV. Audio Section: Total Output Power: 4W. Phono Input: 200mV at 1MΩ. Tape Input: 100mV at 100KΩ.

PRICE £29.19.0

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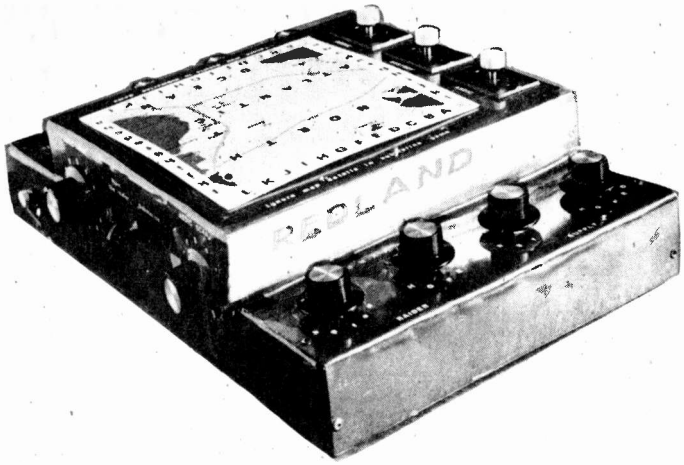

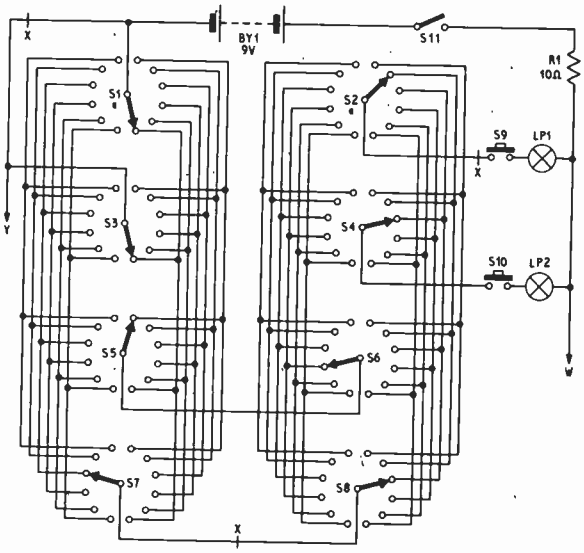

Fig. 2. Wiring diagram of the switches controlling the positions of the four ships, also showing contact indicator circuits

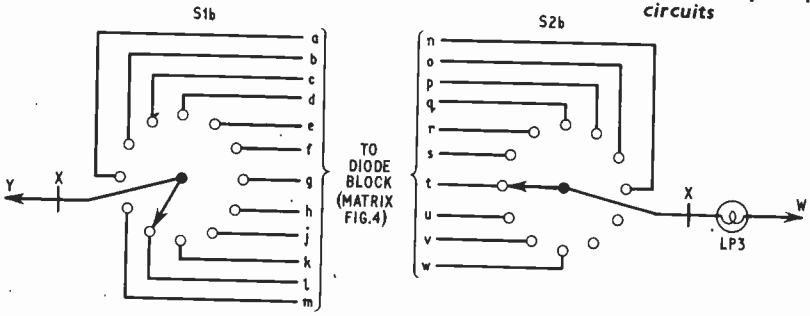

Fig. 3. Wiring of raider automatic score switching

COMPONENTS . . .

Switches

	For Operation Seasearch	If both games to be built (Where different)
S1	2p 12w	
S2	2p 12w	
S3	1p 12w	2p 12w
S4	1p 12w	
S5	1p 12w	
S6	1p 12w	
S7	1p 12w	2p 12w
S8	1p 12w	
S9	1p make, push button	2p make (or two separate 1p)
S10	1p make, push button	2p change over (or DPDT)
S11	S.P.S.T. toggle	

(All rotary Maka switches except where stated)

Miscellaneous

LP1—3 6·3V 0·06A (MES bulbs clip-on holders—3 off)
8 skirted knobs with pointers
Veroboard 3in × 3in (2 off)
D1—29 small glass point-contact diodes (29 off)
R1 10 ohm ¼ watt resistor
BY1 9V battery, type PP6
Aluminium, pop rivets, 4B.A. nuts, screws and washers.
Letraset card, cellophane, etc.

It will be seen that when S5 coincides with the position of either S1a or S3, current will pass to S6. Then if S2a or S4 coincide with S6, one of the lamps will glow; this illustrates a serious snag. If together the positions of the four ships form a rectangle, both lamps will glow but neither ship will have been detected! Hence the use of the pushbuttons. Pressing the detection pushbuttons S9 and S10 one at a time prevents the malfunction when the ships are at opposite corners of a rectangle.

There is another important reason for the use of push buttons. If a searching ship wishes to move one square diagonally—say from Af to Bg (Fig. 1)—he would have to turn both of his control switches. Since he is unlikely to turn them together, he would in fact search an extra square—say from Af to Ag and then to Bg. With pushbuttons he must complete his move before determining whether or not he is successful.

DIODE MATRIX

The raider's automatic score indication is illustrated in Figs. 3 and 4. The second pole of switch S1a is used to feed current to a diode matrix which will pass on to switch S2a only when S1a coincides with the North/South of a shipping lane. Similarly, the second pole of S2a will pick off current from the matrix only when it coincides with the East–West of the shipping lane. Together, the diodes and the switches will therefore only conduct current when switches S1a and S2a exactly coincide with a particular shipping lane square.

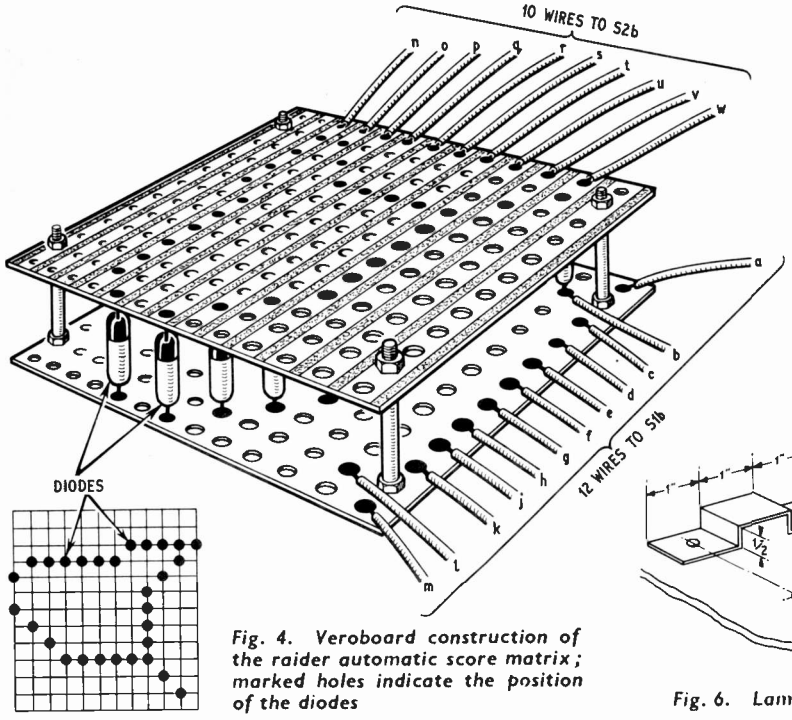

Fig. 4. Veroboard construction of the raider automatic score matrix; marked holes indicate the position of the diodes

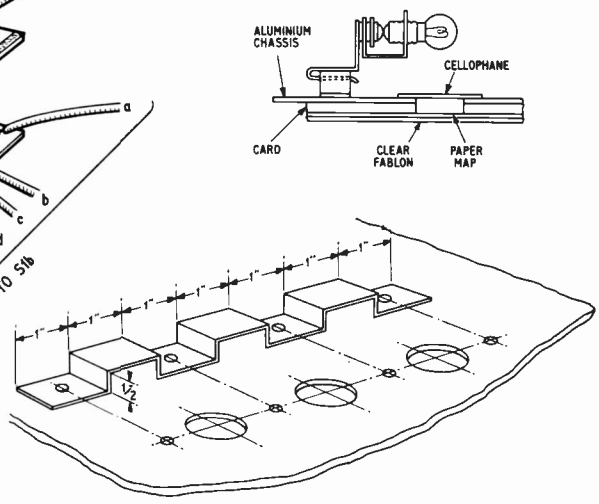

Fig. 6. Lamp mounting and number projection details

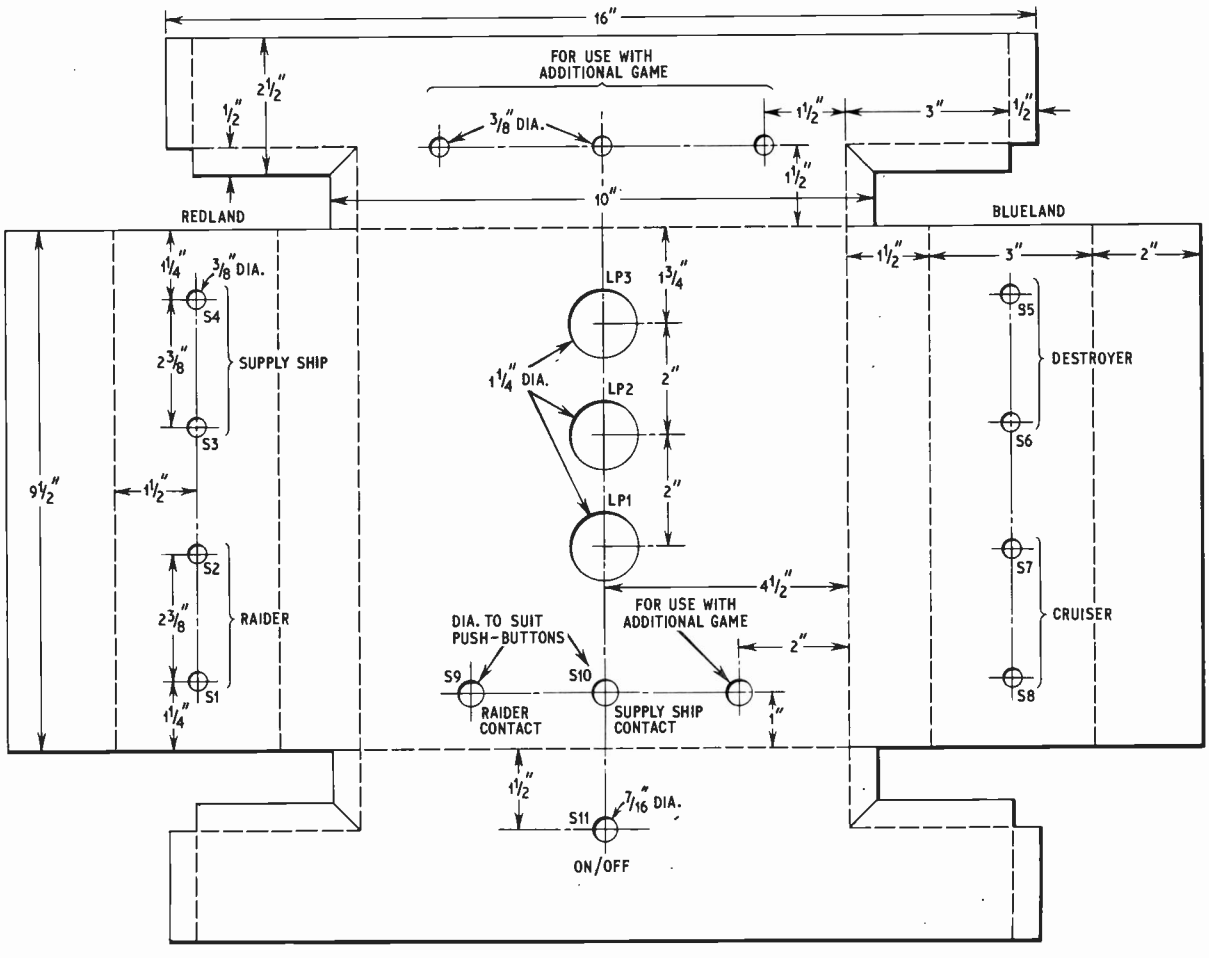

Fig. 5. Chassis cutting and drilling diagram for Operation Seasearch. Drilling for the additional game is also included

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RCS DE-LUXE 3 WATT AMPLIFIER. Ready made tested, 2-stage with triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer. Knobs, loudspeaker, valves ECL82, EZ80. Response 50-12,000 cps. Sensitivity 200mV. Post 5/-. **£4**

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1¼" dia. 6/6. ACOS 1¼" dia. 12/6. BM3, 1" dia. 9/6

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Portable mini p.a. system. Many uses — ideal for Parties, or as a Baby Alarm, Intercom, Telephone or Record Player Amplifier, etc. Attractive rexine covered cabinet, size 12 9 4in., with powerful 7 4in. speaker and four transistor one watt power amplifier. Uses PP9 battery. Brand new with famous makers' guarantee. Post 5/-. **75/-**

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Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/- STEREO L/S 11/-. D.P. 15/- Edge 5K. S.P. Transistor, 5/-.

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2½ 5in. 3/8. 2½ 3½in. 3/2. 3½ 3½in. 3/8. 3½ 5in. 5/2.

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Complete: a die, a punch, an Allen screw and key ⅛in. 16/6 ¼in. 17/6 1¼in. 19/6 1½in. 24/- 2⅜in. 44/3 ⅛in. 16/6 1in. 19/6 1¼in. 20/6 1½in. 29/- 2⅜in. 57/3 ¼in. 16/9 1¼in. 19/6 1½in. 21/6 2in. 39/9 1in. sq. 36/6

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With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. Post 2/6 each **45/-**

Also with twin tweeters. With crossover. 10 watt. State 3 or 8 or 15 ohm. Post 2/6 each **£4**

Recommended Teak Cabinet Size 16 10 9in. Post 2/6 **£5**

MINI-MODULE LOUDSPEAKER KIT

10 WATT **65/-** CARRIAGE 5/-

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 8 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16 10 9 in. Modern Scandinavian fluted front design for Mini-Module. **£5** Post 5/-

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in MAJOR £9

30-14,500 c.p.s., 12in double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. State 3 or 8 or 15 ohm. Post Free.

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12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**

TEAK HI-FI SPEAKER CABINETS. Fluted wood front.
For 10 or 12in round Loudspeaker ..... £9.0.0.
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With variable tweeter attenuator giving accurate high/low frequency balance. Mounted on panel 5½in. 4in. with control knob, tweeter and woofer leads and input terminals. Suitable for 3 to 8 ohm impedance. Post 2/-. **38/-**

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TWO-WAY 3000 c.p.s. CROSSOVERS 3 or 8 or 15 ohm 19/-.
SPECIAL OFFER: 80 ohm. 2½in, 2½in. dia.; 35 ohm, 3 in. 25 ohm, 3in. dia.; 6 4in; 8 5in. **17/6** EACH TYPE 15 ohm, 3½in. dia.; 7 4in; 8 5in.
8 ohm 6 4in; 3 ohm, 2½in, 3in, 5in. 5 3in, 7 4in.
LOUDSPEAKERS P.M. 3 OHMS. 6½in 22/6; 8 5in, 25/-; 8 2½in 18/-; 8in 35/-; 10 6in 38/-.
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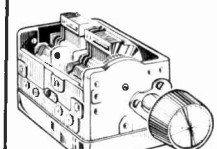
VHF-FM TUNER FRONT END 88-108 Mc/s



Transistor FM tuner oscillator and frequency changer printed circuit. Slow motion tuning gang condenser. Ready wired and tested including two transistors AF124 and AF125. A total of 29 components. Size 2½ 2 2in. Requires I.F. and Detector stages 10.7 M/cs. 9 Volt. Connection details supplied but we have no further information available.

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BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3.10**

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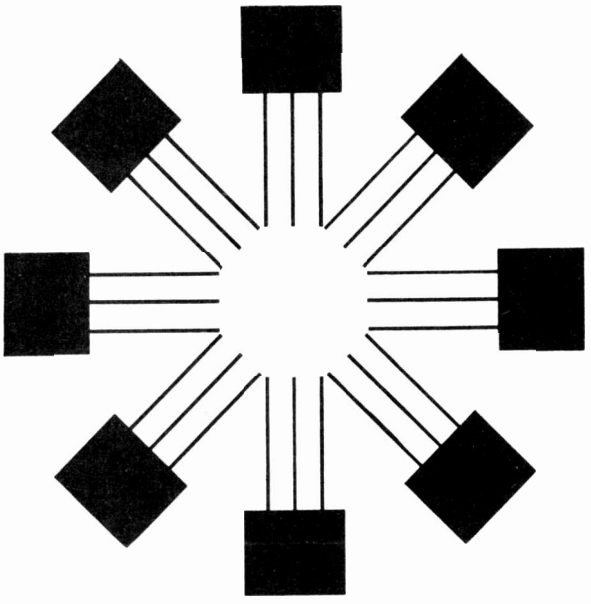

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2N706	3/-	AD140	8/-	BFX68A	13/6	NKT210	6/-	OC77	8/-
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2N709	12/6	AD161	7/6	BFX87	9/6	NKT213	6/4	OC79	5/-
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Construction of the matrix is given in Fig. 4. Two pieces of Veroboard are mounted back to back with the strips running in opposite directions. Suitable 1½ inch bolts provide rigidity and correct spacing. The diodes are then mounted between the boards with their positive ends all the same way up. Twelve wires are taken off to switch S1a and ten to switch S2b. If the circuit does not work correctly, simply reverse the wires to the wipers. Points Y and W in Figs. 2 and 3 are connected to their respective letter. Points X in Figs. 2 and 3 are points at which it is necessary to affect a change when changing over from this game to the later addition. They are best left as they are for the time being, but reference will be made to them later.

CONSTRUCTION

In the prototype, aluminium sheet was cut and bent-up as per Fig. 5 to form the chassis but as nothing is critical in this layout, the constructor may adopt any layout or method of construction that he fancies.

Holes for controls and lamp apertures were cut with a chassis punch before the chassis was bent and pop rivetted. Details of the lamp mountings are given in Fig. 6, which also shows how the numbers—black Letraset on cellophane—were projected up onto the map. Fig. 7 gives details of a simple battery holder bent up out of aluminium and screwed to the chassis.

When complete, the aluminium was given a coat of navy-blue paint and the Letraset co-ordinates added to match the knob positions on all eight knobs.

THE MAP

Map details are given in Fig. 1; a square of good quality card 7in × 7in is the base. Three holes were cut with the chassis punch to match the lamp holes in the aluminium, and then the map marked out on paper, was stuck on leaving a ½ inch margin all round. In the prototype a pleasing effect was gained by using sticky coloured paper—blue for the sea and green for the land—but it might just as well be drawn on cartridge paper. The squares are hatched in with a mapping pen. Note that the lettering round the edge is designed to be read from both sides.

When the map is complete it can be covered over with clear Fablon an inch oversize all round, the excess being carefully wrapped underneath. A strip of cellophane is stuck over the holes in the aluminium, and large Letraset numerals applied to it in the centre of each hole—number 1 for LP1, 2 for LP2 and 3 for LP3. Finally the map was mounted on top, using small self-tapping screws. It will thus be seen that over each lamp is a hole in the aluminium and card, a strip of cellophane with a black numeral, and the thin map protected by clear Fablon. When the lamp glows, a circle of light appears through the map with a number in it.

WIRING UP

When the case is complete and the controls mounted, wiring may begin. Complete the wiring in Fig. 2 first. Provided that care is taken correctly to identify the wiper and the first tag of each switch, no trouble should be encountered, but the work is greatly facilitated by the use of colour-coded twelve-core cable, if any is available.

Test the wiring before proceeding to Figs. 3 and 4. When the diode matrix is first assembled, four holes may be made under the map. Short bolts through

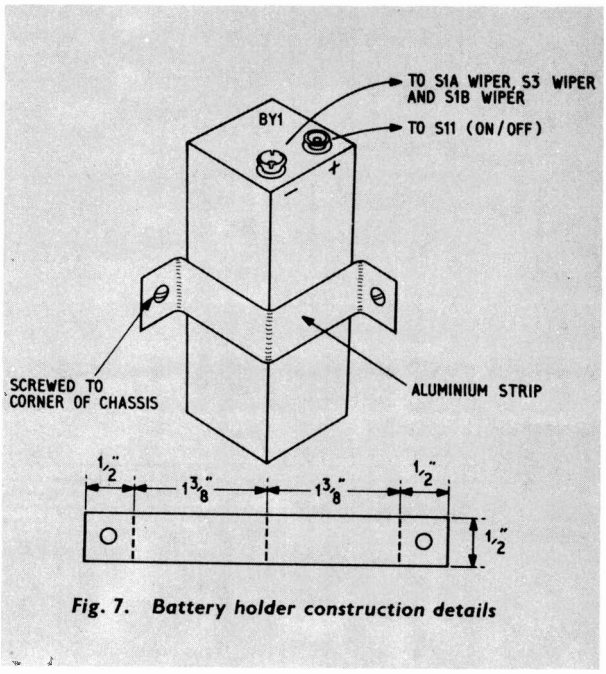

Fig. 7. Battery holder construction details

these, with stand-off spacers will securely hold the matrix block in position. An on/off switch S11 may be placed at one side of the game.

VARIATIONS

When the above-described very simple (and infuriating!) game has been mastered, any or all of the following variations may be tried.

1. Each player is "Red" in turn. He keeps a score for the opponent to beat.
2. For every move that the raider scores, he rolls a dice. The result indicates the number or tonnage of shipping sunk that day.
3. If a 5 or 6 is rolled, one of the stricken merchant ships manages to radio her position before she goes down. The raider must reveal his whereabouts.
4. The raider must make contact with the supply ship every ten moves or less. Failure to do so means that she runs out of supplies and scuttles herself.
5. Between contacts, the supply ship must call at any neutral port, where her presence is revealed by "Blue" agents.
6. Any ship entering a square which is crossed by a section of coast is spotted by enemy agents and must announce her position.
7. When contact between enemy ships is made, a dice is rolled. The result indicates the number of daylight hours left and also the number of attempts the "Blue" player has of rolling a six. If he fails, the "Red" may slip away in the gathering dusk.
8. An arbitrary points value is awarded to each ship, say 5 to the supply ship, 10 to the raider, 15 to the destroyer and 25 to the cruiser. This is the accumulative score to be made against it before it is sunk. When contact is made, a dice is rolled for hours of daylight. Each player rolls that number of dice to score against the other. If the "Red" is still afloat he may slip away to continue his depradations elsewhere.

★

Another game entitled "Submarine Chaser" which can be added to the above unit, will be described in a future issue.

MAKING THE MOST OF LOGIC IC's

PART SIX—By R. W. COLES

TTL BINARY ADDER

FROM the details given in Part 5 on TTL gates it should be possible to use them to practical advantage. This article describes a simple binary adder as a forerunner to their use in other designs.

As an example, let us investigate the logic required to produce a circuit which will add together two binary numbers, and any carry figure which may have been generated in previous addition, with the result that a sum and a carry output is produced.

BOOLEAN ALGEBRA

In has been the policy in this series to assume that the reader has a knowledge of the binary number system, but not necessarily a wide knowledge of logic simplification, or Boolean algebra.

Boolean algebra is not the same as ordinary algebra, but it is easy to understand if denary counting is temporarily ignored. It is based on the processing of information in two-digit code, 0 and 1. In the counting sequence of denary calculation the next figure after 9 is 0. So in binary code, the next figure after 1 is 0 with a carry 1 passed to the next column on the left. Bearing in mind that the solution to be presented could be reduced in its complexity by the proper application of Boolean Algebra, let us see just how simple it is to work out gate arrangements for any desired result.

The first thing to do is draw up a table of all the possible combinations of inputs which will be presented to the adder. As the inputs consist of three separate digits, A, B, and the "carry" from a previous addition, C, there can be a total of eight combinations. Following the simple rules for binary addition we can then add to the table the outputs which each of these combinations will be required to produce.

Remembering that 0 plus 0 gives a sum output of 0, 0 plus 1 gives a sum output of 1, and 1 plus 1 gives a 0 output and a carry 1 output, the table so derived will be as shown in Fig. 6.1. To produce a logic 1 output when a particular input combination exists, it is simply necessary to connect the true inputs to a 3-input gate, in this case a TTL NAND gate which will then produce an output only for this combination.

Notice that the gate produces a logic 1 output when its input conditions are satisfied, but this is a negative logic 1, because of the inverting action of a NAND gate. Several of these combinations give a sum output, several give a carry output, and one of them gives both.

It is not necessary however, for all of the sum or carry combinations to be present at the same time (this is impossible anyway) so we can write that for a sum output, combinations 2 or 3 or 5 or 8 must be present, otherwise there will be no sum output. The same principle applies to the carry output, and the conditions are 4 or 6 or 7 or 8.

NEGATIVE LOGIC NAND

To give this result, we need two 4-input OR gates, one for sum and one for carry. Now a TTL NAND gate fed with negative logic inputs behaves as a NOR gate (this principle was explained in the article on RTL). If the shift register used provides complementary outputs, these gates will not be necessary.

The operation in this configuration is quite simple. Before the first clock pulse arrives, the first set of digits are already present at the inputs of the adder, which will therefore have produced sum and carry outputs. These will be waiting to be clocked into their respective stores.

Assume that the sum output is connected to a third shift register, which will store the answer to the sum of the two words, and is consequently connected to the common clock line.

At this stage the carry store will be empty (i.e. it will contain a logic 0) as there have been no previous additions. When the clock pulse arrives, several things will happen at once:

1. The sum output will be stored in the third register.

	INPUTS			OUTPUTS	
	A	B	CARRY IN C	SUM	CARRY OUT
1	0	0	0	0	0
2	1	0	0	1	0
3	0	1	0	1	0
4	1	1	0	0	1
5	0	0	1	1	0
6	1	0	1	0	1
7	0	1	1	0	1
8	1	1	1	1	1

Fig. 6.1. Truth table requirement for a binary full adder. Sum output should be produced when inputs are (A. $\bar{B}$. $\bar{C}$) or ($\bar{A}$. B. $\bar{C}$) or ($\bar{A}$. $\bar{B}$. C) or (A. B. C). Carry output should be produced when inputs are (A. B. $\bar{C}$) or (A. $\bar{B}$. C) or ($\bar{A}$. B. C) or (A. B. C)

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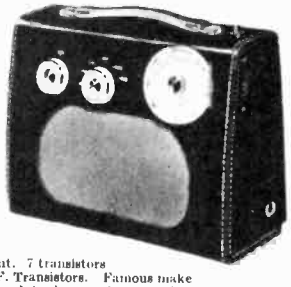

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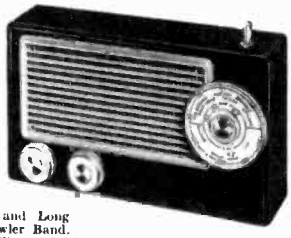

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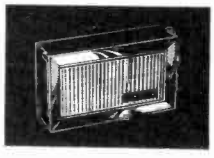

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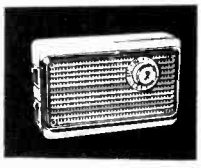

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2. The carry output will be stored in the carry store.
3. The word in both register A and B will be shifted one place to the right, therefore a new pair of digits will be supplied to the adder.
4. As a consequence of operation 2, a new carry input will also be presented to the adder inputs.

The word "new" used in the previous list does not imply that the digits supplied to the adder after the clock pulse are necessarily different from those preceding them; this depends on the contents of the shift registers of course.

The above operations will be repeated for every clock pulse; the total number of clock pulses depending on the word length stored in the shift registers. At the end of the series of clock pulses the sum of the two words will be stored in the third register, and registers A and B will be empty. As the outputs from the gates which detect the eight possible combinations are in the negative logic convention, we can use a NAND gate to provide the required NOR functions.

If the use of the dual polarity logic system is a little confusing, just try the logic diagram shown in Fig. 6.2 with voltage levels, imagining the gate circuitry inserted instead of the logic symbols. Positive levels will represent a 1 at the inputs to the three input gates, zero levels will represent a 1 at their outputs. Zero voltages represent 1 at the inputs of the 4-input gates, and positive voltages will represent 1 at their outputs.

SERIAL ADDITION

The dual polarity logic system is just a way of describing the action, the electrical circuit action is always the same.

The logic diagram shows the full adder connected to perform "serial addition". The digits to be summed are fed to the adder one pair at a time from two shift registers, A and B, which could contain any number of separate digits, the total number in each register being described as the "word-length".

The carry input is fed into the adder from a carry store, which is simply a clocked bistable used to provide a delay of one clock period. The input to the carry store is provided by the carry output of the adder, and as the bistable used in this position may be any one of the various TTL flip-flops, the precise input terminal has not been named.

The adder requires seven 3-input gates which are available three in a package. Two spare gates are left in the three packages necessary, but these can be put to good use as inverters of the shift register outputs as shown. Remember that both true and inverted inputs to the adder are needed, so these spare gates serve the purpose admirably.

There are a number of disadvantages in the method of serial addition, when used in a high speed computer, because it is quite a slow process, requiring N shift pulse periods to complete the process.

Using the adder we have designed, it is possible to build a system which will add two words together in only one clock period, but to achieve this it is necessary to use a separate adder circuit for each bit of the word. The basic principle of this sort of addition is shown in Fig. 6.3.

The four adders each have an exclusive pair of digits supplied to them, one from each register, the carry output from the first adder is connected directly to the carry input of the next and so on, no carry store being necessary. Remember that a TTL gate has a specified propagation delay, so it will take a finite time for the final sum outputs to become established.

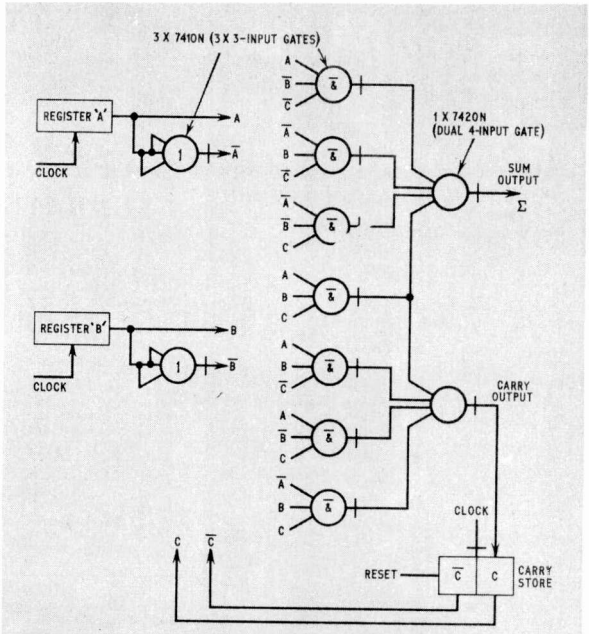

Fig. 6.2. Logic diagram showing the 0 and 1 pulses from the registers to be fed into the adder inputs. The carry output is fed into a flip-flop store prior to supplying the C inputs on the gates

The limiting factor here is the fact that the carry output from the first adder can affect the sum output of the final adder. The time taken for the carry to propagate through the four adders can be many times (eight to be exact) the delay of a single gate. With a longer word length the delay will of course be correspondingly longer.

It is obvious that this method is much faster than serial addition. Not surprisingly, the name used for this system is "parallel addition".

Having now gained some confidence in the use of TTL gates, it is now time to proceed to the perhaps more interesting subject of flip-flops, and all their diverse uses.

DEVICE IDENTIFICATION

Logic integrated circuits are coded differently by the various manufacturers, even though many of them are electrically identical. The TTL family is probably the worst in this respect, because so many manufacturers,

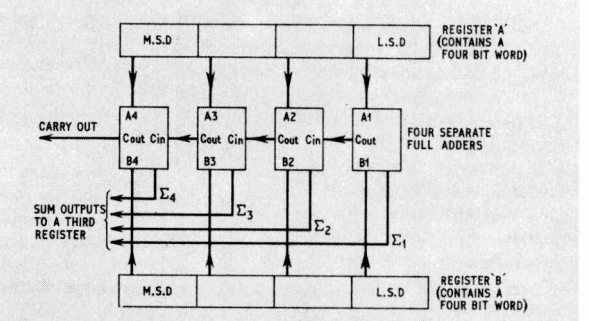

Fig. 6.3. System for adding two words together, each supplied from a 4-bit (binary digit) register. A full adder is used for each bit. L.S.D. is the least significant digit and M.S.D. is the most significant digit

Table 6.1. TTL PACKAGES

Texas Instruments	Mullard	A.E.I.
7400	FJH131	880
7401	FJH231	
7402	FJH221	
7410	FJH121	870
7420	FJH111	816
7430	FJH101	808
7440	FJH141	855
7441	FJL101	
7450	FJH151	
7451	FJH161	840
7453	FJH171	
7454	FJH181	
7460	FJY101	806
7470	FJJ101	
7472	FJJ111	825
7473	FJJ121	
7474	FJJ131	These A.E.I. devices are shown as nearest equivalents, there may be some pin differences between the Texas 74 and Mullard FJ ranges.
7475	FJJ181	
7476	FJJ191	
7490	FJJ141	
7492	FJJ251	
7493	FJJ211	

Table 6.2. LOGIC IC AVAILABILITY

SUPPLIER	RTL	DTL	TTL
Bi-Pak Ltd.	Fairchild TO-5 epoxy resin range ML914 to ML923 15 to 55°C	Motorola DIL plastic range MC844P to MC862P 0 to 70°C	Full range of 74 series devices including MSI in plastic DIL SN7400N to SN7496 0 to 70°C and fall-outs
A. Marshall Ltd.	Motorola DIL plastic range MC724P to MC799P Fairchild ML900 Series 15 to 55°C	Mullard FC series	Full range of Mullard FJ and Texas 74 series in plastic DIL 0 to 70°C
Bi-Pre-Pak Ltd.		A.E.I. DIL plastic range SP616A to ST680A. Mixed temperature ranges	A.E.I. DIL and Flat Pack. SP806A to NE880J. Mixed temperature ranges
L.S.T. Electronic Components Ltd.	Fairchild TO-5 epoxy range ML914 to ML923 15 to 55°C	Also R.C.A., Mullard, General Electric, and Texas types available	

Logic ICs are available from other sources and readers are recommended to study the advertisements for more details.

both in Europe and the U.S.A., have their own range of these devices, in some cases using an individual coding system, even though their circuits are produced under licensing agreements with the two or three design originating companies who hold the patents.

Fortunately, however, even in the most complex type number, there is generally a central group of two or three figures which tells us all we need to know to identify a particular logic circuit, all the other letter and figure prefixes and suffixes giving ancillary information about operating temperature range, package outline, and package material. It is usually only this ancillary coding which varies depending on the manufacturer.

To take a notorious example, the DTL flip-flop, used in the slide projector timer described in the October issue, could have been specified as either U6A994559X (Fairchild), or MC845P (Motorola), or 9945 (S.G.S.), or MIC 945 (S.T.C.). These devices are electrically identical, the only difference being in the type of package material used, for example, ceramic or plastic.

The important figure group in this example is 845/945, which not only tells us that the devices are interchangeable, but also that they are in different package materials, the other information being irrelevant for our purposes. Even TTL devices can be identified in this-simple way, though in this case there are three or four basic systems to which the search can be narrowed, after which a reference table is necessary.

Such a cross reference guide is given in Table 6.1; although by no means complete, it does list the TTL devices currently advertised.

REJECT DEVICES

Identifying reject i.c.s which are not marked in any way is well nigh impossible and without identification the devices are useless. All is not lost, however, because manufacturers usually stamp the underside of the package with the basic code group referred to above before they test them, making the task quite simple.

An SN7474N fallout from the Bi-Pak range, for instance, is marked "74", and an SN7490N from the same range is marked "90", thus conveying all the information necessary, and enabling the experimenter to re-test them to discover their usefulness.

It is surprising, in fact, just how many of these reject circuits appear to be fully serviceable when tested. Of course, even those which have faults often contain other logic functions which are still useable, and are ideal for experimenters on a low budget, if he can identify the useful part of the package. One example is where one gate of a four gate package may be faulty, the other three may still be useable.

Many advertisers in this magazine now supply logic i.c.s originating from a variety of manufacturers, in either fully tested or fall-out form, and Table 6.2 will enable prospective constructors to decide just which devices, of those available, will suit their needs best.

One last word of advice, learn to recognise by the number codes which types are manufacturer's fall-outs. Remember also that these packages do not quite come up to the rigid industrial specifications laid down, although they may be put to some use by the experimenter, and may be fair value for money.

Next month's article will look into TTL flip-flops in more detail and describe their use in counting circuits and as shift registers and stores. This part will be particularly useful to readers interested in the Digital Clock, as will the following article on medium scale integration.

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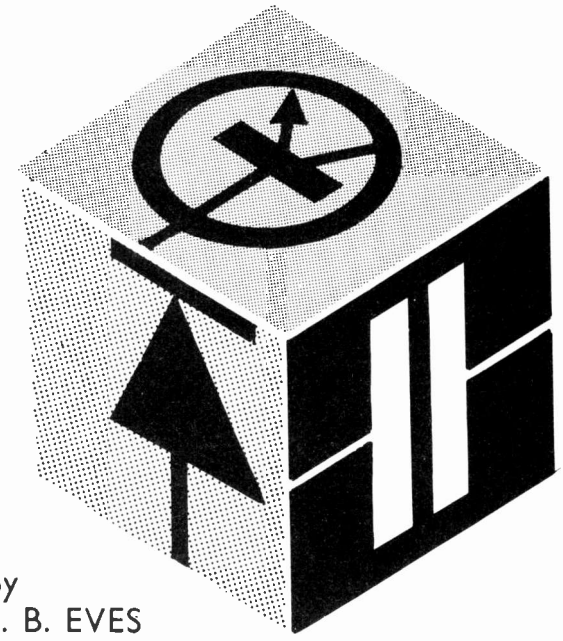


By
E. B. EVES

ELECTRONIC DICE

IN the construction of an electronic random number generator, such as an electronic dice or die there must be no bias towards any of the possible results. Bias might occur in two ways; firstly due to electronic unbalance and secondly due to human bias. Both can be eliminated by allowing the circuit to rest in each of the possible states for a very short time, say, less than $\frac{1}{100}$ second. The time in each state must of course, be equal.

CIRCUIT

By using a miltivibrator (Fig. 1a) running at about 150–200 Hz to drive a "divide-by-six" ring circuit (Fig. 1b)—that is one which returns to its original state after six pulses have been applied to its input—bias towards one result is eliminated. If the multivibrator is connected to the ring circuit by means of a push button (S1) being depressed, the ring circuit cycles until the button is released. The state of the ring circuit will, therefore, depend on the length of time the button is depressed.

If the cycle time of the multivibrator was slow enough it would be possible to "guess" the state of the ring circuit and, therefore, bias the result. Because the switching from one state to the next occurs 150 to 200 times a second this form of bias is eliminated. As the ring circuit switches once every full cycle of the multivibrator and the period of this is constant, over short times, the time spent in each state is constant, thus eliminating electronic bias.

CONSTRUCTION

The design of the layout may be done on printed circuit board or on copper clad Veroboard. The suggested layout for components and copper connections are shown in Figs. 2 and 3.

Board 1 is the driving multivibrator, board 2 is the basic module of the ring counter, three such boards being required. Capacitor C4 is not required on bistables 1 and 2.

DICE BOX

The design of the dice box may be varied to suit individual requirements, and materials available. The box in the suggested design (see Fig. 5) is made from opal perspex. The "3" face has the lamps mounted behind the "spots" which are holes drilled through with inserts of clear Perspex rod with Letraset numbers on them. The "one" face has a small on/off switch mounted at its spot. The other faces have the spots drilled part way through and painted black.

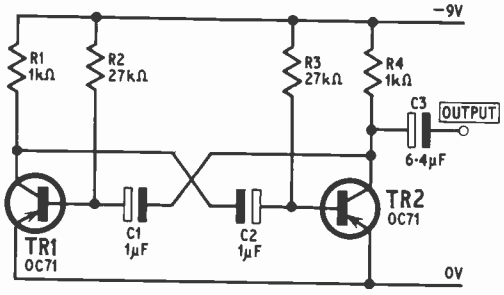


Fig. 1a. Multivibrator pulse generator for the electronic dice

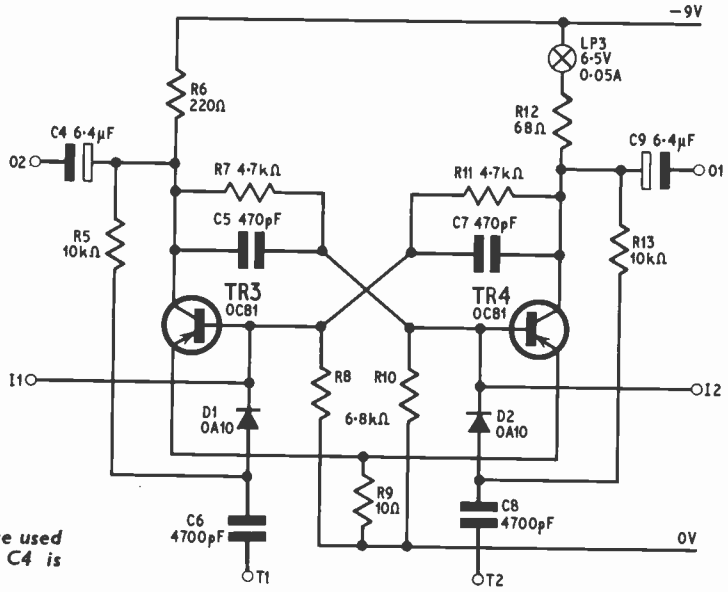


Fig. 1b. Basic bistable circuit, three such circuits are used to form the divide-by-six ring circuit. Capacitor C4 is not required in bistables 1 and 2

COMPONENTS . . .

Resistors

R1	1kΩ	
R2	27kΩ	
R3	27kΩ	
R4	1kΩ	
R5	10kΩ	3 off each
R6	220Ω	
R7	4·7kΩ	
R8	6·8kΩ	
R9	10Ω	
R10	6·8kΩ	
R11	4·7kΩ	
R12	68Ω	
R13	10kΩ	

All ±10%, ¼W carbon

Capacitors

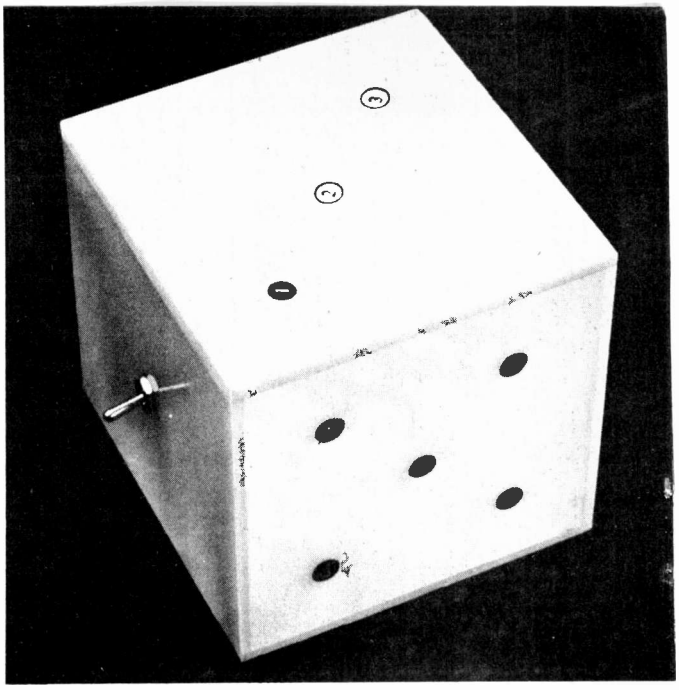
C1	1μF elect. 16V	C5	470pF	3 off each
C2	1μF elect. 16V	C6	4,700pF	
C3	6·4μF elect. 16V	C7	470pF	
C4	6·4μF elect. 16V	C8	4,700pF	
		C9	6·4μF elect. 16V	

Semiconductors

TR1, 2 OC71 (2 off) D1, 2, OA10 (3 pairs)
TR3, 4 OC81 (3 pairs) D3 OA81

Miscellaneous

LP1–3 6·5V, 0·05A MES bulb and holder (3 off)
S1 push to make microswitch
BY1, 2 × 4·5V batteries
Veroboard 2¼in × 1⅜in (4 off)
Plain s.r.b.p. 2¼in × 1⅜in (2 off)
Opal perspex ⅛in × 3¾ × 3¾in (6 off)
Perspex rod ⅜in diam × ¾in (3 off)



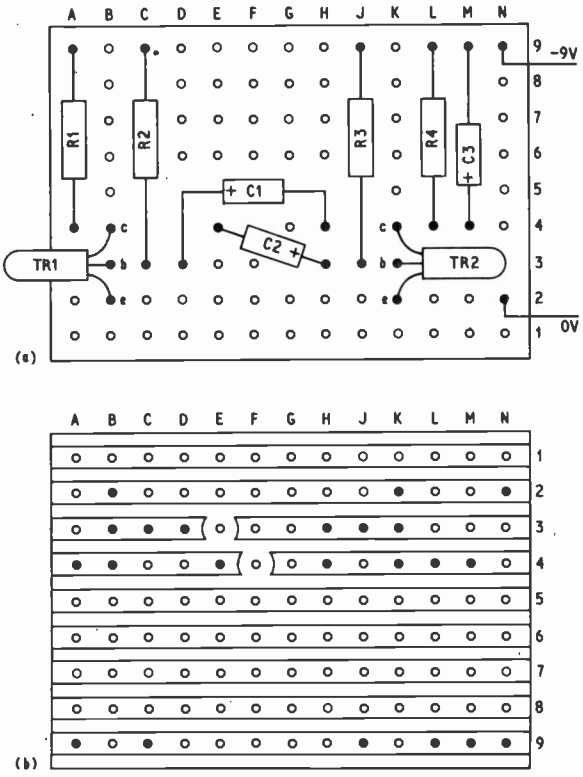


Fig. 2. Layout and wiring of the multivibrator

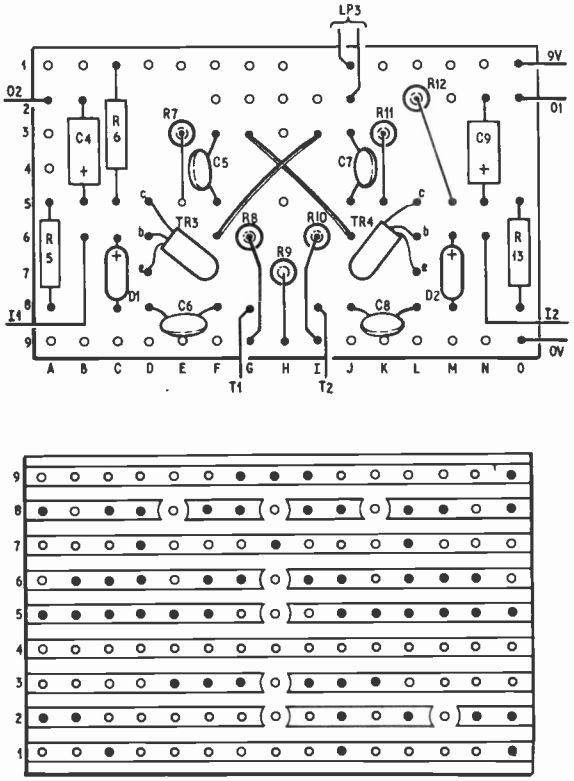


Fig. 3. Layout and wiring of one bistable

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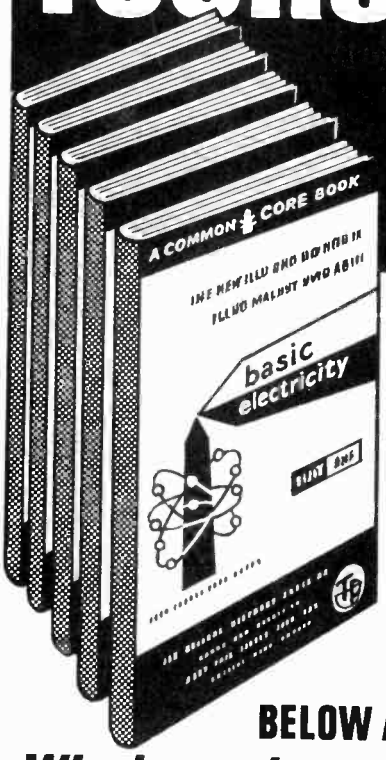

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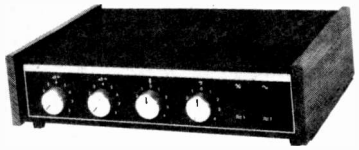
STEREO 8 + 8 MK. II HI-FI AMPLIFIER KIT



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A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, attractive front panel, knobs, wire, solder, nuts, bolts— no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output 8·5W r.m.s. per channel into 5 ohms. Frequency response: ±3dB 15–30,000Hz. Sensitivity: 50mV into 1MΩ. Full power bandwidth: ±3dB 20–14,000Hz. (Readings taken at 8·5W into 5 ohms.) Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 25V at 0·6 amp. PRICES: AMPLIFIER KIT, **£10.10.0**. P. & P. 3/-. POWER PACK KIT, **£3.0.0**. P. & P. 5/-. CABINET, **£3.0.0**. P. & P. 5/-. (Post Free if all units purchased at same time.) Also available STEREO 10+10. As above but 10W per channel. PRICES: AMPLIFIER KIT, **£12.0.0**. P. & P. 3/-. POWER PACK KIT, **£3.10.0**. P. &P. 5/-.

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3in 4 ohm **10/-**, P. & P. 1/6. 5in 3 ohm **16/-**, P. & P. 3/-. 7 × 4in 3 ohm **21/-**, P. & P. 4/-. 10 × 6in 3 or 15 ohm **35/-**, P. & P. 6/-. E.M.I. 8 × 5in 3 ohm with high flux magnet **26/-**, P. & P. 4/-. E.M.I. 13½ × 8in 3 ohm with high flux ceramic magnet **42/-**, (15 ohm **45/-**), P. & P. 6/-. E.M.I. 13 × 8in, 3 or 15 ohm with two inbuilt tweeters and crossover network **4 gns**, P. & P. 6/-.

BRAND NEW. 12in 15w HI/D Speakers, 3 or 15 ohm. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£5.10.0**, P. & P. 7/6. Guitar models: 25w **£8.10.0**. 35w **£8.10.0**.

E.M.I. 3½in HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3, 8 or 15 ohm **18/6** each. P. & P. 2/6.

12in "RA" TWIN CONE LOUDSPEAKER
10 watts peak handling. 3 or 15 ohm, **37/6**, P. & P. 6/-.

35 OHM SPEAKERS. 3½in **14/-**, P. & P. 2/6.

MAGNAVOX DESK TYPE MOVING COIL MICROPHONE. Medium impedance. Brand New—Special Price **42/-**. P. & P. 2/-.

SINGLE HEADPHONE. With aluminium headband. Approx. 200 ohm. **5/-**. P. & P. 1/6.

CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity, **18/6**. P. & P. 1/6.

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **21/-**. P. & P. 1/6.

HIGH IMPEDANCE DYNAMIC STICK MIKES. High sensitivity. **39/6**. P. & P. 2/6.

SPECIAL OFFER! PLESSEY TYPE 29 TWIN TUNING GANG. 400pF + 146pF. Fitted with trimmers and 5:1 integral slow motion. Suitable for nominal 470 kc/s I.F. Size approx. 2 × 1 × 1½ in. Only **8/6**. P. & P. 2/6.

HONEYWELL MICROSWITCHES S/P. C/O. Push-button action. Rating 250v. AC at 15 amps. Size approx. 1½" × ½" × ½". **5/-** each. P. & P. 1/- (6 or more post free).

TELESCOPIC AERIALS WITH SWIVEL JOINT. Can be angled and rotated in any direction. 6 section Lacquered Brass. Extends from 6" to approx. 22½". Maximum diameter ½". **5/-** each. P. & P. 1/-.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 0-5-10-15-20-25-30-35-40-60V half wave at 1 amp or 10-0-10, 20-0-20, 30-0-30V. at 2 amps full wave. Size 3inL × 3½inW × 3inD. Price **35/-**. P. & P. 6/-.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240V. Sec. 9–0–9 at 500mA. **14/-**. P. & P. 2/6. Pri. 200/240V. Sec. 12–0–12 at 1 amp. **17/6**. P. & P. 2/6. Pri. 200/240V. Sec. 10–0–10 at 2 amp. **27/6**. P. & P. 3/6. Tapped Primary 200–220–240V. Sec. 21·5V at 500mA. **12/6**. P. & P. 2/6.

BATTERY CHARGER TRANSFORMERS. 200/240V. input. Nominal output for 6 or 12V. batteries 3 amps. Size approx. 3 × 2½ × 2½in. Brand New. Price **21/-**. P. & P. 5/-.

HIGH GRADE COPPER LAMINATE BOARDS
8 × 6 × ⅛in. FIVE for **10/-**. P. & P. 2/-.

SPECIAL OFFER!!

HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½in high × 10½in wide × 6in deep. Fitted with E.M.I. Ceramic Magnet 13in × 8in bass unit, two H.F. tweeter units and crossover. Power handling 10W. Available 3 or 15 ohm impedance.

Our Price £8.8.0 Carr. 10/-.

Also available in 8 ohm with EMI 13in × 8in bass speaker with parasitic tweeter, **£6.10.0**. Carr. 10/-.

STOCKISTS OF SINCLAIR EQUIPMENT
Z.30 Amplifier **89/6** p. & p. 2/6.
Stereo 60 Pre. Amplifier **£9.19.6** p. & p. 5/-.
PZ5 Power Supply **£4.19.6** p. & p. 3/6.
PZ6 Power Supply **£7.19.6** p. & p. 3/6.
IC.10 Integrated Circuit **59/6** p. & p. 2/-.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15,000Hz. Matching impedance 8–16 ohms. PRICE **59/-**. P. & P. 3/-.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER. For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9–18V. Battery or from H.T. line 200/300V. Frequency response 15Hz–25KHz. Gain 26dB. Solid encapsulation size 1¾ × 1¾ × ¾in. Brand new — complete with instructions. Price **17/6**. P. & P. 2/6.

SPECIAL PURCHASE ! E.M.I. 4-SPEED PLAYER

Heavy 8¾in. metal turntable. Low flutter performance 200/250 V shaded motor (90 V tap). Complete with latest type lightweight pick-up arm and mono cartridge with t/o stylii for LP/78. ONLY **63/-**. P. & P. 6/6.

BRAND NEW E.M.I. LIGHTWEIGHT PICK-UP ARM WITH ARM REST (as above). Fitted mono t/o stylus and cartridge for LP/78. ONLY **20/-**. P. & P. 1/6.

QUALITY RECORD PLAYER AMPLIFIER MK II
A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. × 3d. × 6 h. Ready built and tested. PRICE **75/-**. P. & P. 6/-. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE **97/6**. P. & P. 7/6.

DE LUXE QUALITY PORTABLE R/P CABINET MK II
Uncut motor board size 14½ × 12in., clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **79/6**. P. & P. 9/6.

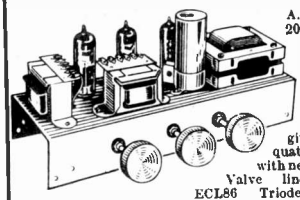
10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **2/6** (Free with parts). **All parts soldseparately. ONLY £7.19.6.** P. & P. 8/6. Also available ready built and tested complete with std. input sockets, **£9.19.6**. P. & P. 8/6.

BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched Pair) **15/-**; V15/10p, **10/-**; OC71 **5/-**; OC76 **6/-**; AF117 **3/6**; 2G339 (NPN) **3/-**.
Set of Mullard 6 transistors OC44, 2—OC45, AC128D, matched pair AC128 **25/-**; ORP12 Cadmium Sulphide Cell **10/6**. All post free.

VERY POWERFUL COMPACT MOTOR
For 12v. D.C. operation. Off load consumption approx. 100mA. Totally enclosed. Quiet in operation with high starting torque. Overall size approx. 1¾"L × 1¼" dia. Free shaft ¼" dia. × ½"L. Ideal for Model Makers, etc. ONLY **7/6** each P. & P. 1/-.
3 or more post free (A few 6v. versions also available).

DE LUXE STEREO AMPLIFIER



A.c. mains 200–240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 EZ80 as full wave rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. **Price £8.18.6.** P. & P. 8/-.

4-SPEED RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.

LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6.19.6.** Carr. 6/6. With stereo cartridge **£7.19.6.** Carr. 6/6.

LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000, AT60, etc. S.A.E. for Latest Prices!

PLINTH UNITS cut out for Garrard Models 1025, 2025, 2000, 3000, 3500, etc. With rigid transparent plastic cover. Special design enables above models to be used with cover in position. Also suitable for housing AT60 and SP25. OUR PRICE **£5.15.0** complete. P. & P. 8/6.

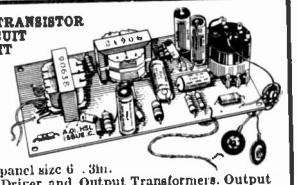
LATEST ACOS GP91/18C Mono Compatible Cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **30/-**. P. & P. 1/6.

SONOTONE 9TAHC compatible Stereo Cartridge with diamond stylus **50/-**. P. & P. 2/-.

LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **32/6.** P. & P. 2/-.

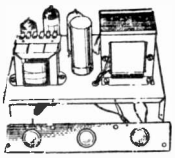
LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono or stereo records on mono equipment. **30/-**. P. & P. 2/-.

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



Peak output in excess of 1½ watts. All standard British components. Built on printed circuit panel size 6 × 3in. Generous size Driver and Output Transformers. Output transformer tapped for 3 ohm and 15 ohm speakers. Transistors (GET114 or S1 Mullard AC 128D and matched pair of AC128 o/p). 9 volt operation. Everything supplied, wire, battery clips, solder, etc. Comprehensive easy to follow instructions and circuit diagram **2/6** (Free with Kit). All parts sold separately. **SPECIAL PRICE 49/6.** P. & P. 3/-. Also ready built and tested, **55/-**. P. & P. 3/-.

3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves etc., wired and tested for only **£4.15.0.** P. & P. 6/-.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **79/6.** P. & P. 6/-.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240V. Supplied absolutely Brand New, completely wired and tested with good quality output transformer. FEW ONLY.

OUR ROCK BOTTOM BARGAIN PRICE **55/-** P. & P. 6/-

Open 9-5.30 Monday to Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, LONDON, S.W.19 Tel. 01-540 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

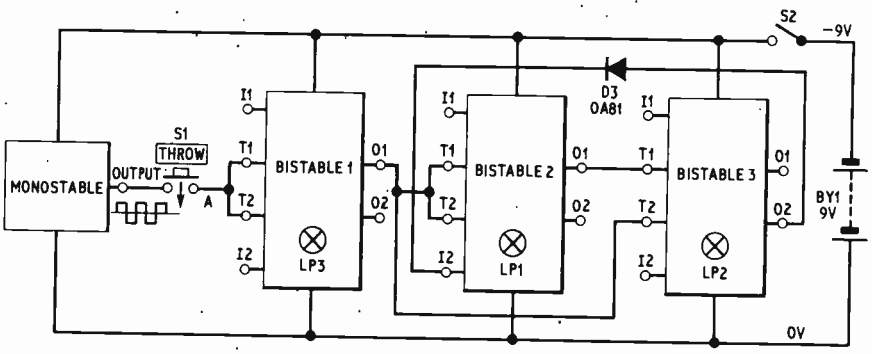


Fig. 4. Interboard wiring diagram switch S1 is a micro-switch

The face opposite to the "3" has no spots but has a microswitch button mounted through a hole in it. This is adjusted so that when the dice is lifted the switch is activated and is depressed when the box is put down. The sides and top of the box may be glued together, the base being fixed by means of four countersunk screws. If two 4·5 volt batteries are used they may be fixed to the base by means of Terry clips and electrical contact made to brass strips, mounted on the "one" spot side of the box, by the spring contacts on the battery.

The circuit boards are mounted on four lengths of studding, suitably spaced apart and screwed into the top surface of the box. The lamps are mounted above these boards on a plain piece of laminate and positioned so that they coincide with the Perspex rods. They should be shielded with aluminium foil to prevent light leaking to the wrong rod. The microswitch is mounted on a fifth board below the circuit boards which is adjustable on the studding by means of nuts and springs. The studding may be used as the power supply rails to the boards if required.

TESTING THE CIRCUIT

Before wiring the boards together they should be checked individually. Check the multivibrator board connections then apply the battery, observing correct polarity. The output should be fed to an oscilloscope, if possible, or via a suitable attenuator to an audio amplifier; A note should be heard in the second case.

The inputs T1 and T2 should be coupled together on the bistable boards for the test and the lamps wired in.

When the voltage is applied and a pulse of about 6V put onto the trigger inputs T1 and T2 the lamp should switch.

If all boards are working they should now be wired together as shown in Fig. 4. Note that diode D7 is part of the interboard wiring and not included on any board.

When the three "ring" boards have been connected and checked, the power rail should be connected. One, two or all three lamps should light. A 6 to 9V pulse may now be fed into the input at A (Fig. 4); the lamps should change state. Apply a total of six pulses and note the state of the lamps. Apply six more pulses and the lamps should be in the same state again without having repeated any combination, if this is not the case the interboard wiring should be checked. If working properly the multivibrator may be brought into use to supply the pulses. When contact is made at A by the microswitch all the lamps should glow until the switch is released when one, two or all should

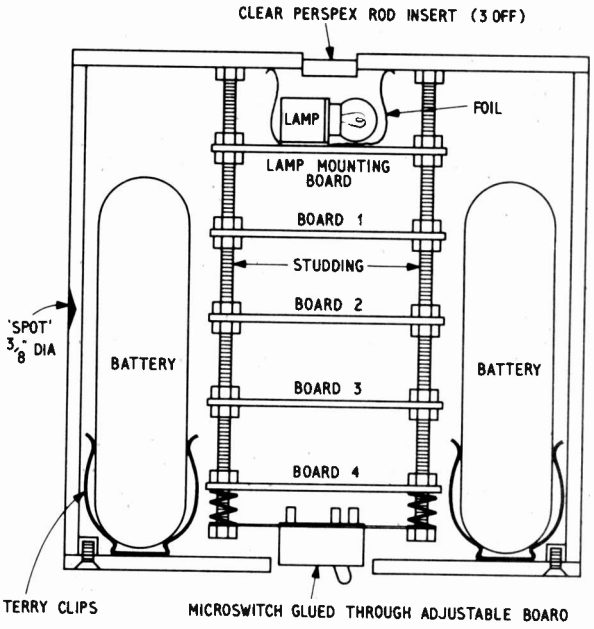


Fig. 5. Suggested design and construction of the electronic dice

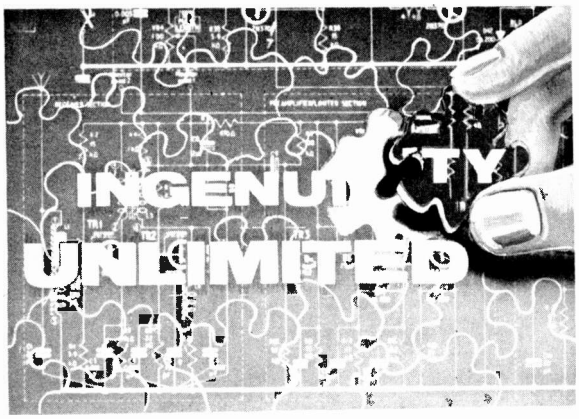
turn fully on and the remaining lamps, if any, should switch off. Pressing and releasing the microswitch should give a random selection of lights.

The circuit may now be inserted into the box. The numbers applied to the Perspex "spots" should be carefully placed over the correct lamp, i.e., 1 over LP1, 2 over LP2, and 3 over LP3.

When installed, the microswitch should make and break as the box is lifted and put down.

TO PLAY

Switch on the power switch. The first player lifts the "die" and puts it down. The sum of the illuminated numbers on the top face is the score for that throw. The next player then lifts and replaces the box again scoring the total shown. ★



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.

FUZZ CIRCUIT

THE CIRCUIT diagram in Fig. 1 is my design for a simple "Fuzz Box", which readers may be interested to experiment with.

The circuit is basically a two transistor pre-amplifier followed by a Schmitt trigger. The pre-amplifier section was designed with variable gain, so that background noise and internal feedback would not operate the trigger.

Since the signal from a guitar contains many harmonics, it is likely that "double-triggering" could occur if certain precautions were not taken. To cure double triggering the values of R5, R7 and C3 were determined by experiment. Capacitor C3 also determines the tone of the fuzz effect. If triggering still occurs then a 10 kilohm resistor inserted between TR2 collector and TR3 base may cure it.

The square-wave output signal is fed via C4 to the attenuating network made up of C5 and VR2. The values of the latter components set the maximum gain of the circuit at slightly more than unity.

Some readers may consider this to be a "waste" of the amplifying powers of TR1 and TR2 and might choose to use the pre-amplifier section for other purposes. A treble booster could be made by switching in the primary windings of an inter-valve transformer across the input.

S. Sharpes,
Brough, Yorks.

METAL LOCATOR

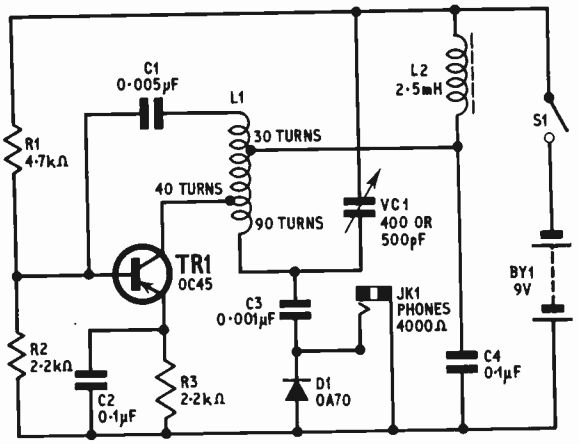


Fig. 1. Single transistor metal locator

ONE of my more unusual circuits is a simple transistor metal detector shown in Fig. 1. It has a current drain of only 1·5mA from the battery.

The OC45 transistor oscillates in the common emitter configuration at a frequency of about 200Hz, using a Hartley type circuit. The frequency of oscillation can be altered by means of the timing capacitor VC1. The output from the oscillator has a low frequency component, which, after detection by the diode D1, is heard in the headphones.

All the components may be mounted on Veroboard and housed in a plastics case, except the search coil. The coil was wound on a table tennis bat, but any 5in diameter former will suffice. The coil is made by pile winding 160 turns of 28 s.w.g. enamelled wire on the former and tapping off at 30 and 70 turns.

Transistors other than OC45 will work, but they must have an alpha cut-off frequency of at least 6MHz. Headphones of 2 kilohm or 4 kilohm impedance can be used.

The detector may be used to a depth of 1 ft. When the search coil is brought near a non-ferrous metal object, the inductance is reduced which increases the frequency of oscillation. Ferrous objects cause a rise in inductance and a fall in frequency of oscillation. With certain settings of the tuning capacitor, the note in the headphones stops completely, giving a very positive indication.

K. A. Coward,
Durban, S. Africa.

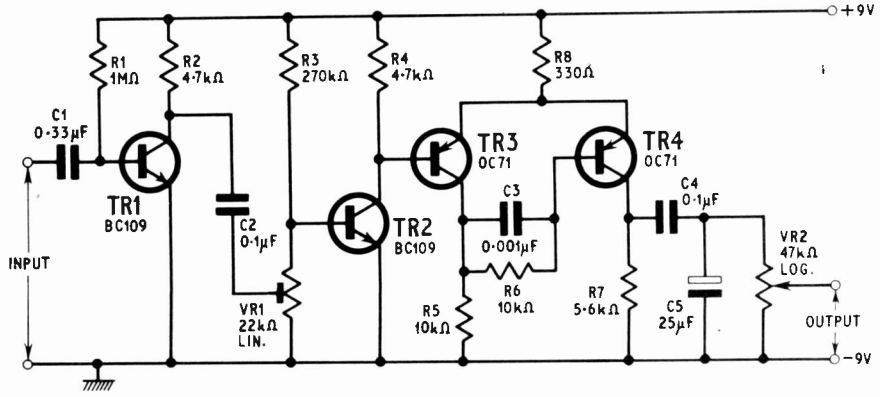


Fig. 1. A simple four transistor "fuzz" circuit for use with all types of electronic and electric musical instruments

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.

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—15–20W **19/6**. Kit B—30–40W **19/6**. Kit C—80W **23/6**. Kit E—65W **23/6**. Kit F for 8ft. 125W tube **35/-**. Kit MF1 is for 6in, 9in and 12in miniature tubes. **19/6**. Kit MF2 for 21in 13W miniature tube, **20/-**. 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 F 6/6 then 4/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

BLANKET SWITCH

Double pole with neon let into side so luminous in dark. Ideal for dark room light or for use with waterproof element—new plastic case. **5/6** each. 3 heat model **7/6**.

BLANKET SIMMERSTAT

Although looking like, and fitted as an ordinary blanket switch, this is in fact a device for switching on for varying time periods, thus giving a complete control from off to full heat. Although suitable for controlling the temperature of any other appliances using up to 1A. Listed at **27/6** each we offer these while our stocks last at only **12/6** each.

REED SWITCHES

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

Miniature. 1in long . approximately ¼in diameter. Will make and break up to ½A up to 300 volts. Price **2/6** each, **24/-** dozen.

Standard. 2in long " ⅜in diameter. This will break currents of up to 1A, voltages up to 250 volts. Price **2/-** each, **18/-** per dozen.

Flat. Flat type, 2in long, just over ⅛in thick, 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 **1/9** each. **18/-** dozen.

HIGH CAPACITY ELECTROLYTICS

Brand new, not ex-equipment.

100 mfd. 25V, **1/3** each **12/-** doz.
200 mfd. 25V, **1/6** each **15/-** doz.
250 mfd. 50V, **3/3** each **33/-** doz.
400 mfd. 40V, **4/4** each **46/-** doz.
500 mfd. 12V, **2/-** each **£1.1.0** doz.
500 mfd. 25V, **3/6** each **36/-** doz.
500 mfd. 50V, **4/6** each **48/-** doz.
500 mfd. 350V, **8/6** each **£4.10.0** doz.
1000 mfd. 12V, **3/-** each **£1.10.0** doz.
1000 mfd. 18V, **3/4** each **34/-** doz.
1000 mfd. 64V, **7/4** each **80/-** doz.
2000 mfd. 25V, **6/8** each **70/-** doz.
5000 mfd. 12V, **4/8** each **£2.8.0** doz.
10,000 mfd. 6V, **5/9** each **£3.0.0** doz.
10,000 mfd. 15V, **8/6** each **£4.10.0** doz.
15,000 mfd. 10V, **10/6** each **£5.0.0** doz.
60,000 mfd. 8V, **22/-** each **£10.0.0** doz.
70,000 mfd. 13V, **40/-** each **£20.0.0** doz.

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**. Knuckled model for FM., **10/-**.

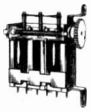
TOGGLE SWITCH

3 amp. 250V with fixing ring. **1/6** each, **15/-** doz.

80 OHM BALANCED ARMATURE EAR PIECE

Usable as microphone or loudspeaker, **4/6** each.

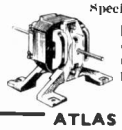
3 STAGE PERMEABILITY TUNER



This Tuner is a precision instrument made by the famous "Cyldon" Company for the equally famous Radionobile 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 ¼in 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.

HORSTMANN "TIME AND SET" SWITCH

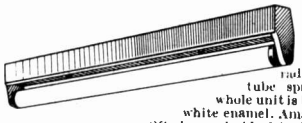
(A 15 amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch-on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost period of up to 3 hours. Equally suitable to control processing. Regular price probably around **£5**. Special snip price **29/6**, p. & ins. 4/6.



DOUBLE ENDED MAINS MOTOR

On feet with holes for screw-down fixing. To drive models, oven, blower heater, etc. **8/6** each, plus 3/6 post and insurance, 6 or more post free.

ATLAS SLIMLINE FLUORESCENTS



Fluorescent lighting units 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. 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**, post & ins 6/6. 5ft. twin with diffuser, regular price £21, our price **£10**, carr £1. Postage and insurance 6/6 extra.

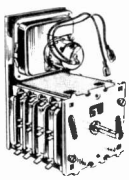
230 VOLT MAINS OPERATED KLAXON HORN

This is small (about 10in long) but has a very piercing and effective note hence it would make good Fire Alarm or Works stop and start Siren. Also useful for instance to scare birds off crops. Made for the G.P.O. so obviously best quality. Slightly used but OK. **39/6** plus 1/6 p. & p.

THIS MONTH'S SNIP

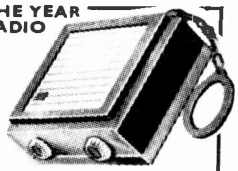
40 WATT 12in HI-FI SPEAKER. Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 40W R.M.S.—Cone moulded fibre—Freq. response 30–10,000 c.p.s.—specify 3 or 15 ohms. Chassis diam. 12in—12⅝in over mounting lugs. Overall height 5¼in. A £10 speaker offered this month for **£5.19.6** plus 7/6 post and ins.

MOTORISED CAM SWITCH



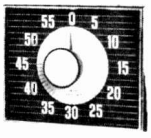
Made by the famous meter company Chamberlain and Hookham, these have a normal mains 200–240V motor which drives a ratchet mechanism so geared to give one ratchet action per minute on a wheel with 60 teeth thus a complete revolution of the cam takes place in one hour. The cam operates 8 switches (6 changeover and 2 on/off thus 480 circuit changes per hour are possible). Contacts, rated at 15A have been set for certain switch combinations but can, no doubt, be altered to suit a special job. Also other switch wafers or devices can be attached to the shaft which extends approximately one inch. **47/6**, p. & ins. 4/6.

BARGAIN OF THE YEAR
MICROSONIC KEYCHAIN RADIO



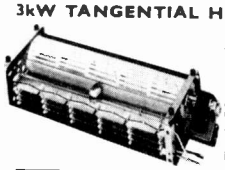
7 transistor Key chain Radio in very pretty case, size 2¾ " 2¼ " 1¼in—complete with soft leather zipped bag. Specification: Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1,600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465Kc/s or 455Kc/s. Power output: 40mW. Antenna: ferrite rod. Loudspeaker: Permanent magnet type. In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new. Price only **24/6** plus 2/6 post and insurance, less batteries. 6 for **£7**, post free. Rechargeable batteries **8/6** pair.

1 HOUR MINUTE TIMER



Made by famous Smiths company, these have a large clear dial, size 4¾ 3¾, which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch **22/6**.

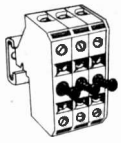
3kW TANGENTIAL HEATER UNIT



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. Comprises motor, impeller, and two elements allowing 3 heat switching and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. 2¼kW model **59/6**; 2kW model **39/6**. Postage and insurance 6/6. Control switch **5/6**.

Where postage is not stated then orders over £5 are post free. Below £5 add 2/9. Semiconductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

Mains Connector. A quick way to connect equipment to the mains safely and firmly; disconnection by plugs prevents accidental switching on; has sockets which allow insertion of meter without disconnection; cable inlets firmly hold one hair wire on up to four 7.029 cables. **12/6** each.



CONTROL DRILL SPEEDS

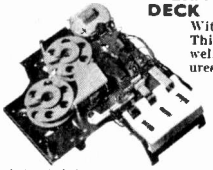
DRILL CONTROLLER

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 also available **37/6** plus 2/6 p. & p.

BALANCED ARMATURE UNIT

500 ohm, operates speaker or micro phone, so useful in intercom or similar circuits, **6/6** each, **£3.10.0** doz. 80 ohm model **5/6**.

BATTERY OPERATED TAPE DECK



With Capstan control. This unit is extremely well made and measures aprox. 6" 5 2in deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4/5V. Supplied complete with 2 spools ready to install. Record, Replayhead is a sensitive M4 type intended for use with transistor amplifier. Unused, ex-equipment. Price **79/6**. Post and insurance 4/6.

PROTECT VALUABLE DEVICES FROM THERMAL RUNAWAY OR OVERHEATING:

Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90deg. to 190deg.F. or with the dial removed range setting is between 80 to 800deg.F. Price **10/-**.

THYRISTOR LIGHT DIMMERS

Will dim incandescent lighting up to 600W from full brilliance to out. Assembled and wired ready to install. **59/6**.

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.

0·005mFd TUNING CONDENSER

Proved design, ideal for straight or reflex circuits **2/6** each, **24/-** dozen

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6V, 9V, 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **16/6** plus 3/6 postage.

MICRO SWITCH

5 amp. changeover contacts, **1/9** each, **18/-** doz. 15 amp Model **2/-** each or **21/-** doz.

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FIND BURIED TREASURE!

TREASURE LOCATOR—

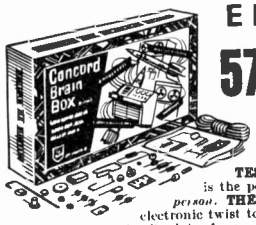
NOW IT'S HERE AT LAST.

after experimenting for four and a half months with a multitude of different circuits and carrying out actual field tests with prototypes, our design team have come up with this real winner. This fully portable transistorised metal locator detects and tracks down buried metal objects it signals exact location (no phones used). **FINDS GOLD, SILVER, LOST COINS, JEWELLERY, KEYS, WAR SOUVENIRS, ARCHAEOLOGICAL PIECES, METALLIC ORE, NUGGETS, ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground! Can be built with ease in one short evening* with the wonderfully clear, easy to follow, step-by-step, fully illustrated instructions. Fully transistorised — no valves. Uses standard PP3 battery. No soldering necessary. Size of detector head 13¾in 10in 2¼in. **Great demand expected at this remarkably low price**—All parts including detector head case, nuts, screws, wire, simple instructions, etc. Send now **47/6** plus 6/6 P. & P. (Telescopic handle as illustrated 25/- extra.) Parts available separately. Made up looks worth £15.

ONLY 47/6

READ PEOPLE'S MINDS—TEST THEIR NERVES—BEAT THEM AT CARDS—TEST THEIR MENTAL ABILITY, ETC. ASTONISHING

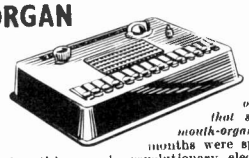
ELECTRONIC BRAINBOX



57/6

Make this an exciting Christmas. If you've seen a giant computer on show at an electronics exhibition, you will have seen people of all ages queueing to pit their abilities against the giant electronic brain. There is tremendous fascination that attracts ordinary people and professional engineers alike to electronic games of skill, chance and mystery. With this "Brainbox" you will be able to *perform mind-boggling feats.* **THE MIND READING DEVICE** will make *people swear you have telepathic powers.* **THE AMAZING CARD TRICK UNIT** completely mystifies and baffles from one to six people. *You correctly "guess" the two cards each person has selected at random from a pack they themselves shuffled.* **THE ELECTRONIC NERVES TESTER** puts your friends to a very lively test. It gives out fall and finish signals (the winner is the person with lowest number of fall signals.) *Can be adjusted from the weakest to strongest person.* **THE ELECTRONIC MAZE** *tests the mental ability of the player* because it uses psychology with electronic twist to it. You can change the maze pathways in seconds to prevent the maze becoming too stale after lots of use. Completely safe and foolproof, uses standard battery. Size 18in × 12in × 6in (Max.) You can play all these games and more beside. **WE GUARANTEE THAT ANYONE CAN EASILY ASSEMBLE THESE PROJECTS IN UNDER ONE HOUR!** No soldering, pictorial, step-by-step illustrated instructions. **ONLY 57/6** plus 6/6 P. & P. for all parts including chassis, switches, stylus, signalling lights, wire, nuts, screws, etc. etc. (PARTS AVAILABLE SEPARATELY). **FULL OPERATING DIRECTIONS WITH EACH OF THE PROJECTS.**

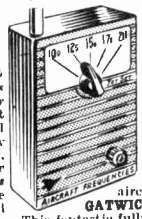
REAL WORKING ELECTRONIC ORGAN



ONLY 55/-

Don't confuse with ordinary electric organs that simply blow air over mouth-organ type reeds, etc. Eight months were spent in creating and testing this superb, revolutionary electronic organ. Fully transistorised, no valves. **Proper self-contained loudspeaker.** *Fifteen separate keys span two full octaves*—play the *"Yellow Rose of Texas", "Silent Night", "Auld Lang Syne", and lots of similar tunes* on this real working electronic organ. Size 13¾in × 10in × 2¼in. Uses standard battery. Have the thrill and excitement of building it together with the pleasure of playing a real electronic organ. *Play it anywhere.* No soldering necessary. Easy as A.B.C. to make following the fully illustrated, step-by-step instructions. **BIG DEMAND ANTICIPATED FOR THIS UNIQUE INSTRUMENT** at our low price. **ONLY 55/-+4/6** P. & P. for all parts, including case, loudspeaker, transistors, condensers, resistors, knobs, transformers, volume control, wire, nuts, screws, instructions, etc. (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

LISTEN TO AIRCRAFT COMMUNICATIONS JUST OUT V.H.F. AIRCRAFT BAND CONVERTER



ONLY 47/6

Listen in to **AIRLINES, PRIVATE PLANES, JET PLANES.** *Eavesdrop on exciting crosstalk between pilots, ground approach, ground control, airport tower. Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—tune in to the international distress frequency. Covers aircraft frequency bands including **HEATHROW, GATWICK, LUTON, KINGSWAY, PRESTWICK, ETC.** This fantastic fully transistorised instrument **can be built by anyone nine to ninety in under two hours.** (Our design team built four—everyone worked first time). No soldering necessary. Fully illustrated simply worked instructions take you step-by-step. Uses standard PP3 battery. Size only 4¼in × 3in by 1¾in. All you do is extend rod aerial, place close to any ordinary medium-wave radio (even tiny pocket radios). **NO CONNECTIONS WHATEVER NEEDED.** Use indoors or outdoors. **SEND NOW. ONLY 47/6** for all parts, including case, nuts, screws, wire, etc. etc. (parts available separately).

Your money refunded in full if not 100% delighted.

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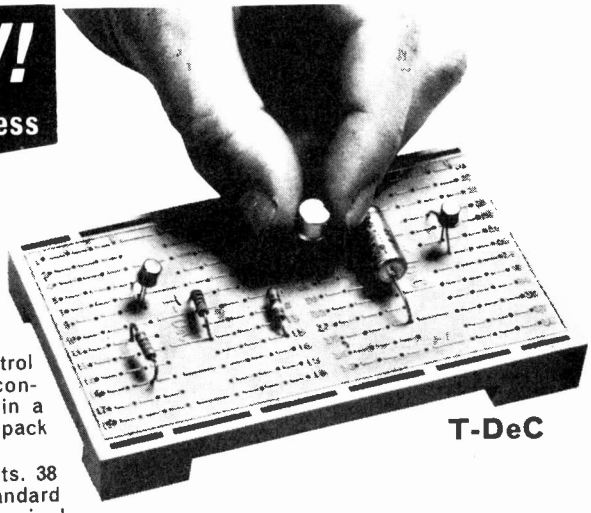

T-DeC

We are pleased to announce that greatly increased demand has enabled us to slash the prices of our **S-DeC** range. In addition we offer Practical Electronics readers a special reduction in the price of **T-DeC** for one month only.

S-DeC Available as single packs with accessories and control panel **NOW AT 20/-** or the DeCSTOR double pack containing 2 S-DeCs, accessories, control panel, all in a plastic storage container. **NOW ONLY 50/-.** A 4 DeC pack is available, **NOW ONLY 78/-.**

T-DeC Now available to the amateur. 208 connection points. 38 independent junctions. Accommodates I.Cs using standard carriers. Three times the capability for only twice the price! Unit pack with control panel 50/-.

μ-DeC Primarily for use with integrated circuits; further details on request.

SPECIAL OFFER — 7/6 OFF T-DeC

Normal recommended retail price of 50/-

Take this coupon to your local stockist who will supply one T-DeC for . . . **42/6d**

Offer closes 15th December 1970

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2N696	4/-	2N3605	5/6	40312	9/6	BC172	3/-	BPX25	37/-	NKT10439	7/6
2N697	4/-	2N3606	5/6	40314	7/6	BC175	4/6	BPX29	36/-		
2N698	5/-	2N3607	4/6	40320	7/6	BC182	2/6	BPY10	29/-	NKT10519	7/6
2N706	2/6	2N3662	7/6	40323	6/6	BC182L	2/-	BRY39	9/6		
2N706A	2/6	2N3663	7/6	40324	9/6	BC183	2/6	BSW41	8/6	NKT20329	6/6
2N708	3/-	2N3702	2/6	40326	7/6	BC184	3/-	BSW70	5/6		
2N709	12/6	2N3703	2/6	40329	6/-	BC212L	2/6	BSX19	3/6	NKT20339	9/6
2N718	5/-	2N3704	3/6	40344	5/6	BCY30	5/6	BSX20	3/6		
2N726	6/-	2N3705	3/-	40347	7/6	BCY31	5/6	BSX21	7/6	NKT80111	7/6
2N727	6/-	2N3706	2/6	40348	10/6	BCY32	7/6	BSX26	9/-		15/6
2N914	3/6	2N3707	3/-	40360	8/6	BCY33	4/-	BSX27	9/6	NKT80112	
2N916	3/6	2N3708	2/-	40361	9/6	BCY34*	4/6	BSX28	6/6		19/6
2N918	6/-	2N3709	2/-	40362	11/6	BCY38	4/6	BSX60	16/6	NKT80113	
2N929	4/6	2N3710	2/6	40370	6/6	BCY39	10/6	BSX61	12/6		22/6
2N930	5/6	2N3711	2/6	40406	11/6	BCY40	7/6			NKT80211	
2N1090	4/6	2N3715	44/6	40407	8/-	BCY42	3/-	BSX76	4/6		18/6
2N1091	4/6	2N3716	58/-	40408	10/6	BCY43	3/-	BSX77	5/6	NKT80212	
2N1131	5/-	2N3791	85/	40410	12/6	BCY54	6/6	BSX78	5/6		18/6
2N1132	5/-	2N3819	7/-	40467A	11/6	BCY58	4/6	BSY24	3/-	NKT80213	
2N1302	3/6	2N3823	19/6	40468A	7/-	BCY59	4/6	BSY25	3/-		18/6
2N1303	3/6	2N3854	5/6	40600	14/6	BCY60	19/6	BSY26	3/6	NKT80214	
2N1304	4/6	2N3854A	5/6	AC107	6/-	BCY70	4/-	BSY27	3/6		18/6
2N1305	4/6	2N3855	5/6	AC126	4/-	BCY71	8/6	BSY28	3/6	NKT80215	
2N1306	5/-	2N3855A	6/-	AC127	5/-	BCY72	3/6	BSY29	3/6		18/6
2N1307	5/-	2N3856	6/-	AC128	4/-	BCZ10	5/6	BSY32	5/-	NKT80216	
2N1308	6/-	2N3856A	7/-	AC154	4/6	BCZ11	8/6	BSY36	5/-		18/6
2N1309	6/-	2N3858	5/-	AC176	5/-	BD116	22/6	BSY37	5/-	OC20	15/-
2N1507	3/6	2N3858A	6/-	AC187	12/-	BD121	13/-	BSY38	4/6	OC22	10/-
2N1613	5/-	2N3859	5/6	AC188	7/6	BD123	16/6	BSY39	4/6	OC23	10/-
2N1631	7/	2N3859A	6/6	ACY17	5/6	BD124	12/-	BSY40	6/6	OC24	10/-
2N1632	6/-	2N3860	6/-	ACY18	5/-	BD131	19/6	BSY51	6/6	OC25	8/6
2N1637	6/-	2N3866	30/-	ACY19	5/-	BD132	19/6	BSY52	6/6	OC26	5/6
2N1638	5/6	2N3877	8/-	ACY20	5/-	BDY10	27/6	BSY53	7/6	OC28	12/6
2N1639	5/6	2N3877A	8/-	ACY21	5/-	BDY11	32/6	BSY54	8/-	OC29	12/6
2N1711	5/-	2N388A	12/6	ACY22	4/-	BDY17	30/-	BSY56	18/-	OC30	8/-
2N1889	6/6	2N3900	7/6	ACY28	4/-	BDY18	35/-	BSY79	9/-	OC35	10/-
2N1893	7/6	2N3900A	8/-	ACY40	4/-	BDY19	39/6	BSY82	10/6	OC36	12/6
2N2147	16/6	2N3901	19/6	ACY41	5/-	BDY20	22/6	BSY90	11/6	OC38	10/6
2N2148	11/6	2N3903	7/-	ACY44	8/-	BDY38	19/6	BSY95A	2/6	OC41	4/6
2N2160	11/6	2N3904	7/-	AD140	10/6	BDY60	25/-	D16P1	7/6	OC42	5/-
2N2193	8/-	2N3905	7/6	AD149	11/6	BDY61	25/-	D16P2	8/-	OC44	4/-
2N2193A	8/-	2N3906	7/6	AD150	12/6	BDY62	20/-	D16P3	7/6	OC45	2/6
2N2194A	6/-	2N4058	3/6	AD161	7/6	BFI15	5/-	D16P4	8/-	OC46	3/-
2N2217	5/6	2N4059	2/-	AD162	7/6	BFI17	9/6	GET102	6/-	OC70	3/-
2N2218	6/-	2N4060	2/6	AF106	8/6	BFI63	7/6	GET113	4/-	OC71	2/6
2N2219	6/-	2N4061	2/6	AF114	5/-	BFI67	5/-	GET114	4/-	OC72	2/6
2N2220	5/-	2N4062	2/6	AF115	6/-	BFI73	6/6	GET118	4/-	OC74	6/6
2N2221	6/-	2N4244	9/6	AF116	5/-	BFI77	6/6	GET119	4/-	OC75	4/6
2N2222	5/-	2N4285	3/6	AF117	5/-	BFI78	10/6	GET120	6/6	OC76	4/6
2N2287	21/6	2N4286	3/6	AF118	12/6	BFI79	14/6	GET873	3/-	OC77	6/-
2N2297	6/-	2N4287	3/6	AF119	4/-	BFI80	7/-	GET880	6/-	OC81	4/-
2N2303	5/-	2N4288	3/6	AF124	4/6	BFI81	6/6	GET887	4/-	OC81D	4/6
2N2368	5/-	2N4289	3/6	AF125	4/-	BFI84	5/-	GET889	4/6	OC83	5/-
2N2369	3/-	2N4290	3/6	AF126	4/-	BFI85	8/6	GET890	4/6	OC84	5/-
2N2369A	3/6	2N4291	3/6	AF127	3/6	BFI94	3/6	GET896	4/6	OC139	6/6
2N2410	8/6	2N4292	2/6	AF139	7/6	BFI95	4/-	GET897	4/6	OC140	6/6
2N2483	5/6	2N4303	9/6	AF178	8/6	BFI96	8/6	GET898	4/6	OC170	6/-
2N2484	6/6	2N5027	10/6	AF179	14/6	BFI97	8/6	MAT100	6/-	OC171	6/-
2N2539	4/6	2N5028	11/6	AF180	10/6	BFI98	8/6	MAT101	6/-	OC200	7/6
2N2540	4/6	2N5029	9/6	AF181	8/6	BF200	10/6	MAT120	6/-	OC201	9/6
2N2613	7/-	2N5030	8/6	AF239	8/6	BF224	4/-	MAT121	6/-	OC202	12/6
2N2614	5/-	2N5172	2/6	AF279	9/6	BF225	4/-	MC140	6/6	OC203	8/6
2N2646	11/6	2N5174	10/6	AF280	12/6	BF237	4/6	MJ400	21/6	OC204	8/6
2N2696	6/6	2N5175	10/6	AFZ11	6/6	BF238	4/6	MJ420	22/6	OC205	12/6
2N2711	5/-	2N5176	9/-			BF244	6/6	MJ421	22/6	OC207	15/-
2N2712	5/-	2N5232	5/6	ASY26	5/-	BFW58	5/6	MJ430	20/6	OCP71	8/6
2N2713	5/6	2N5232A	6/-	ASY27	7/6	BFW59	5/-	MJ440	19/6	ORP12	12/6
2N2714	6/-	2N5245	9/-	ASY28	5/6	BFW60	5/-	MJ480	19/6	ORP61	10/-
2N2865	12/6	2N5246	8/6	ASY29	5/6	BFW61	9/6	MJ481	25/-	P346A	4/6
2N2904	6/-	2N5249	13/6	ASY36	5/-	BFX12	4/6	MJ490	20/-	TIP31A	16/6
2N2904A	6/6	2N5249A	13/6	ASY50	5/-	BFX13	4/6	MJ491	27/6	TIP32A	19/6
2N2905	7/6	2N5265	65/-	ASY54	5/-	BFX29	6/-	MJ1800	43/6	TIS34	12/6
2N2905A	8/-	2N5266	55/-	ASY86	6/6	BFX30	6/-	MJE340	12/6	TIS43	8/-
2N2906	5/-	2N5267	52/6	ASZ20	7/6	BFX43	7/6	MJE520	17/6	TIS44	2/6
2N2906A	5/6	2N5305	7/6	ASZ21	8/6	BFX44	7/6	MJE521	17/6	TIS45	2/6
2N2907	6/-	2N5306	8/-	AUY10	30/-	BFX68	13/6	MPF102	8/6	TIS46	2/6
2N2923	3/-	2N5307	7/6	BC107	2/5	BFX68A	13/6	MPF103	7/6	TIS47	2/6
2N2924	3/-	2N5308	7/6	BC108	2/6	BFX84	5/-	MPF104	7/6	TIS48	2/6
2N2925	3/-	2N5309	12/6	BC109	2/6	BFX85	6/6	MPF105	7/6	TIS49	2/6
2N2926		2N5310	8/6	BC113	5/6	BFX86	5/-	MPS3638	6/6	TIS50	3/6
,, Green	2/9	2N5354	5/6	BC115	8/-	BFX87	5/6	NKT0013	9/6	TIS51	2/6
,, Yellow	2/6	2N5355	5/6	BC116A	7/6	BFX88	5/-	NKT124	8/6	TIS52	2/6
,, Orange	2/6	2N5356	6/6	BC118	6/6	BFX89	12/6	NKT125	5/6	TIS53	4/6
2N3011	6/-	2N5365	6/6	BC121	4/-	BFX92A	12/6	NKT126	5/6	TIS60	4/6
2N3014	6/6	2N5367	11/6	BC125	11/-	BFY10	6/6	NKT135	5/6	TIS61	5/-
2N3053	5/-	2N5457	7/6	BC126	11/-	BFY11	8/6	NKT137	6/6	TIS62	5/6
2N3054	10/-	2S005	15/-	BC134	6/6	BFY12	4/6	NKT210	6/-	ZTX107	3/6
2N3055	15/-	2S020	40/-	BC135	8/6	BFY13	4/6	NKT211	6/-	ZTX108	3/6
2N3133	6/-	2S102	10/-	BC136	7/6	BFY17	4/6	NKT212	6/-	ZTX109	3/6
2N3134	6/-	2S103	5/-	BC140	7/6	BFY18	6/6	NKT213	6/-	ZTX300	3/6
2N3135	5/-	2S104	5/-	BC147	3/6	BFY19	6/6	NKT214	4/6	ZTX301	3/6
2N3136	5/-	2S501	6/6	BC148	2/6	BFY20	12/6	NKT215	4/6	ZTX302	4/6
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2N3393	3/-	3N140	15/6	BC158	3/6	BFY41	10/-	NKT224	5/-	ZTX502	5/-
2N3394	3/-	3N141	14/6	BC159	4/-	BFY43	12/6	NKT225	4/6	ZTX503	5/-
										ZTX504	12/6

Post & Packing 2/- per order. Europe 5/-. Commonwealth (Air) 13/- Minimum. Send 6d. stamp for price list.

PANEL METERS

38 Series—FACE SIZE 42 × 42mm. All prices for 1-9 pieces. 50μA, 37/6; 100μA, 35/-; 200μA, 32/6; 500μA, 27/6; 50-0-50μA, 35/-; 100-0-100μA, 32/6; 500-0-500μA, 25/-; 1MA, 25/-; 5MA, 25/-; 10MA, 25/-; 50MA, 25/-; 100MA, 25/-; 500MA, 25/-; 1A, 25/-; 5A, 25/-; 10V, 25/-; 20V, 25/-; 50V, 25/-; 300V, 25/-; 500V, 25/-. ALL METERS ARE D.C.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	2/-	2/6	3/-	3/3	3/6	3/9	4/-	—
3A	3/-	—	—	4/6	—	6/-	—	—
6A	—	—	5/-	6/-	6/6	7/-	10/-*	—
10A	10/6	11/6	13/-	15/6	17/6	19/6	25/-	32/-
17A	11/6	12/6	15/6	18/-	19/6	24/-	31/6	37/6

*5A only 1A Types are plastic

DIODES & RECTIFIERS

IN461	4/6	IS131	2/6	BA144	2/6	BY164	11/6	OA73	1/9
IN914	1/6	IS132	3/-	BAX13	1/6	BYX10	4/6	OA79	1/6
IN916	1/6	IS940	1/6	BAX16	1/9	BYZ10	7/-	OA81	1/6
IN4007	4/6	AA119	2/6	BAY18	3/3	BYZ11	6/6	OA85	1/6
IS010	3/-	AA213	4/6	BAY31	1/6	BYZ12	6/-	OA90	1/6
IS021	4/-	AAZ13	4/-	BAY38	3/9	BYZ13	5/-	OA91	1/6
IS025	5/-	AAZ15	2/6	BY100	3/6	FST3/8	4/-	OA95	1/6
IS44	2/-	AAZ17	2/-	BY103	4/6	OAS	3/6	OA200	2/-
IS113	3/-	BA100	3/-	BY122	7/6	OA9	2/-	OA202	2/-
IS120	3/-	BA102	4/6	BY124	3/-	OA10	2/6		
IS121	3/6	BA110	7/-	BY126	3/6	OA47	1/6		
IS130	2/6	BA115	1/6	BY127	4/6	OA70	1/6		

MAINS TRANSFORMERS

1 amp Charger. Sec. 0-3·5-9-17V 19/6
2 amp Charger. Sec. 0-3·5-9-17V 25/6
1 amp (Douglas) MT103 Sec. tappings from 6V to 50V .. 32/6
2 amp (Douglas) MT104 Sec. tappings from 6V to 50V .. 42/6
Post and packing 4/6.
5 amp (Douglas) MT107 Sec. tappings from 6V to 50V .. 110/-
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Various other Douglas Transformers ranging from ½A to 5A in stock (details in catalogue).

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SC41B 6 amp 200V 22/-
SC41D 6 amp 400V 27/6
SC50D 15 amp 400V 60/-
40512 (RCA) TO-5 mod. 6 amp 400V 33/-
40430 (RCA) TO-66 6 amp 400V 27/6
40486 (RCA) TO-5 mod. 6 amp 400V 24/-

Economy Range Triacs

TC4/10 (Pressfit) 4 amp 100 PIV 15/-
TC4/20 (Pressfit) 4 amp 200PIV 17/-
TC4/40 (Pressfit) 4 amp 400 PIV 19/6
TC3/40 (TO-5) 3 amp 400 PIV 22/6
ST2 DIAC 9/6

INTEGRATED CIRCUITS
SEE OUR SEPARATE ADVERTISEMENT ON PAGE 996 SHOWING NEW I.C.s AT NEW LOW PRICES.

SCOTCH CASSETTES C-60
NORMAL PRICE 17/11. OUR PRICE 12/-
SCOTCH 3in TRIPLE PLAY 600ft
NORMAL PRICE 24/10. OUR PRICE 18/-

PLEASE NOTE: DUE TO BULK BUYING WE CAN NOW OFFER MOST TEXAS, RCA AND NEWMARKET SEMICONDUCTORS AT INDUSTRIAL DISTRIBUTOR PRICES. NEW QUANTITY PRICE LIST NOW AVAILABLE FOR INDUSTRIAL USERS UPON REQUEST.

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PIV	50	100	200	300	400
1A	5/-	5/6	7/6	8/-	9/6
3A	6/-	7/6	8/-	9/-	10/6
5A	—	11/-	13/-	—	15/-
7A	—	11/-	13/-	—	19/6
25A	27/6	30/-	33/-	—	—

Also 12A, 100 PIV, 15/-; 600 PIV, 35/6; 25A, 400 PIV 37/6

VEROBOARD 0·15 0·1

	Matrix	Matrix
2½ × 3¾in	3/6	4/-
2½ × 5in	4/3	4/9
3¾ × 3¾in	4/3	4/9
3¾ × 5in	5/6	5/6
3¾ × 17in	16/-	21/6
3¾ × 17in (plain)	—	11/6
5 × 17in (plain)	15/6	—
Vero Pins (bags of 50)	5/-	5/-
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4·8 × 4 × 1in Finned *or* Two TO-3 Trans., 9/6. 4·8 × 2 × 1in Finned, for One TO-3 Trans., 6/6. For SO-1, 6d. For TO-5, 1/- Finned. For TO-18, 1/- Finned. For TO-18, 1/- Finned.

RESISTORS

Carbon Film
¼ watt 5%, 3d.
½ watt 5%, 4d.
¾ watt 5%, 5d.
1 watt 10%, 6d.
2 watt 10%, 1/3

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A large and comprehensive range available: Electrolytic, Polyester, Ceramic, Polystyrene, Silver Mica, Tantalum, Trimmers, Tuners.
Examples:
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2,500mF 50V, 13/6
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5,000mF 50V, 19/6

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2·5 watt 5% (up to 270 ohms only), 1/6
5 watt 5% (upto 8·2k Ω only), 2/-
10 watt 5% (up to 25k Ω only), 2/6

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Carbon:
Log. and Lin., less switch, 3/-.
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Twin Ganged Stereo Pots, Log. and Lin., 7/6.

PRESETS (CARBON)

0·1 Watt 1/-
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0·3 Watt 1/6

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K151 (Ik) 2/6
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Know who is calling and speak to them without leaving bed, or chair. Outfit comprises microphone with call push button, connectors and master intercom. 8/mply plugs together. Originally sold at £10. Special snip price **49/6**, plus 3/6 postage.

Be first this year! SEED AND PLANT RAISING

Soil heating wire and transformer. Suitable for standard size garden frame. Post and ins. 3/6. **19/6**

12V EXTRACTOR FAN BY DELCO

Ideal to make heater for Caravan, Car or Boat. 6 Bladed 5in diameter fan inside heavy duty cylinder with 3 point fixing flange. 5¼in diameter fixing hole. Length approx. 8½in. Exceptional bargain **27/6** plus 5/6 post and insurance.

HAPPY FISH

and lively indoor Plants have "LUX GROWTH" lighting which gives U.V. and other rays essential to healthy flora & fauna—Special Trial Offer. 9in U.V. tube complete with choke, starter tube, connections and spring clips—all you need incl. wiring diagram. **39/6** plus 4/6 post & ins.

12V 1½amp POWER PACK

Comprises double wound mains transformer with full wave rectifier and 2000 mfd smoothing. **27/6** plus 4/6 p. & p.

2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (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.

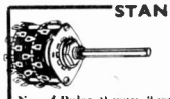
RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only **£1** each or **£11** per dozen, specify 10 or 15A—simply fit in place of switch.

VARIAC CONTROLLERS

With these you can vary the voltage applied to your circuit from zero to full mains without generating undue heat. One obvious application therefore is to dim lighting. We offer a range of these, ex-equipment but little used and in every way as good as new. Any not so, will be exchanged or cash refunded.
2A **£4.19.6**. 5A **£7.19.6**. 8A **£12.19.6**. 10A **£15.19.6**.

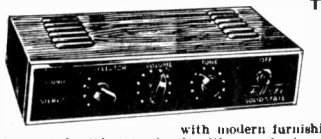
STANDARD WAFER SWITCHES



Standard size 1½ wafer—silver-plated 5-amp contact, standard ¼in spindle 2in long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6
2 poles	6/6	6/6	6/6	6/6	6/6	6/6	6/6	10/6	10/6
3 poles	6/6	6/6	6/6	6/6	10/6	10/6	10/6	14/6	14/6
4 poles	6/6	6/6	6/6	10/6	10/6	10/6	10/6	18/6	18/6
5 poles	6/6	6/6	10/6	10/6	14/6	14/6	14/6	22/6	22/6
6 poles	6/6	10/6	10/6	10/6	14/6	14/6	14/6	26/6	26/6
7 poles	10/6	10/6	10/6	14/6	18/6	18/6	18/6	30/6	30/6
8 poles	10/6	10/6	10/6	14/6	18/6	18/6	18/6	34/6	34/6
9 poles	10/6	10/6	14/6	14/6	22/6	22/6	22/6	38/6	38/6
10 poles	10/6	10/6	14/6	18/6	22/6	22/6	22/6	42/6	42/6
11 poles	10/6	14/6	14/6	18/6	26/6	26/6	26/6	46/6	46/6
12 poles	10/6	14/6	14/6	18/6	26/6	26/6	26/6	50/6	50/6

THE FULL-FI STEREO SIX



The amplifier sensation of the year

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled and teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. Price is **£8.19.6** plus 7/6 post and insurance.

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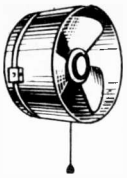

Cleans the air at the rate of 10,000 cu ft per hour. At the pull of a cord it extracts grease, grime and cooking smells before they dirty decorations. Suitable for kitchens, bathrooms, factories, changing rooms, etc. It's so quiet it can hardly be heard. Compact, 5¾in casing with 5¼ in fan blades. Suitable 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** plus 6/6 post and ins.

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Replacement in many well-known food mixers. Six speeds are available 500, 850 and 1,100 r.p.m. from either or both of the nylon sockets (where the beaters of the food mixers normally go) and 8,000, 12,000 and 15,500 r.p.m. (ideal polishing speeds) from the main drive shaft. This drive shaft is ¼in diameter and approximately 1in long. A further point about this motor is that being 230/240V a.c.–d.c. series wound its speed may be further controlled with the use of our Thyristor controller. This is a very powerful and useful motor size approx. 2in diameter × 3in long, mains 230/240V. Price **17/6** plus 4/6 p. & ins. 12 or more post free.

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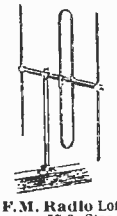

B.B.C. (Band 1). Loft, 25/-. Wall S.D. 32/6. "H" array, 60/-. **I.T.V. (Band 3).** 5 element loft array, 45/-. 7 element, 55/-. Wall mounting 5 element, 65/-. Combined BBC ITV loft 1 + 5, 55/-. 1 + 7, 67/6. Wall mounting 1 + 5, 77/6. Chimney mounting 1 + 5, 90/-. Pre-amps from 75/-.

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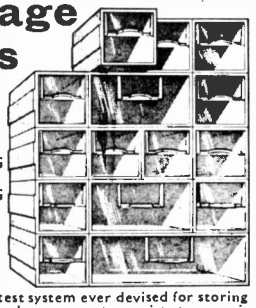

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59/6

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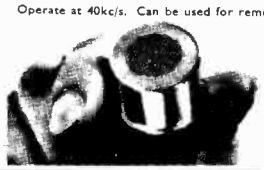

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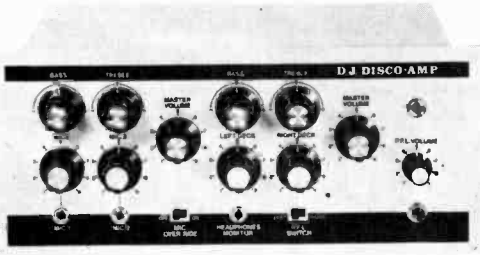

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Specification: Output power 70 watts R.M.S. ± 1 db at 8 ohms. Frequency response: 30-20,000 Hz ± 3db. Harmonic distortion: Less than 1% at full output. Signal/noise ratio: Better than −65db. Inputs: Mic 1 & 2 5 mV at 50 K ohms. Turntable 1 & 2 100 mV at 1 meg ohm.
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BP30	7430N Single 8-Input NAND GATE	6/6	5/6	4/6
BP40	7440N Dual 4-Input BUFFER GATE	6/6	5/6	4/6
BP41	7441N BCD to decimal decoder and NIT Driver	22/6	20/–	17/6
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BP95	7495N 4 Bit Up-Down Shift Register	22/6	20/–	17/6
BP96	7496N 5 Bit shift register	24/–	21/–	18/6

Data is available for the above Series of Integrated circuits in booklet form, price 2/6.

BRAND NEW. FULL TO MANUFACTURERS' SPECIFICATION

	Price each 1–24	25–99	100 up
BP709 Operational Amplifier, dual-in-line 14 pin package = SN72709 and similar to MIC709 and ZLD709C	10/6	9/–	8/–

This is a high performance operational amplifier with high impedance differential inputs and low impedance output.

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Manufacturers' "Fall outs"—out of spec. devices including functional units and part functional but classed as out of spec. from the manufacturers very rigid specifications. Ideal for learning about I.C's and experimental work, on testing, some will be found perfect.

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UIC02	5 × 7402N 10/–	UIC75	5 × 7475N 10/–
UIC03	5 × 7403N 10/–	UIC76	5 × 7476N 10/–
UIC04	5 × 7404N 10/–	UIC80	5 × 7480N 10/–
UIC05	5 × 7405N 10/–	UIC82	5 × 7482N 10/–
UIC10	5 × 7410N 10/–	UIC83	5 × 7483N 10/–
UIC20	5 × 7420N 10/–	UIC86	5 × 7486N 10/–
UIC40	5 × 7440N 10/–	UIC90	5 × 7490N 10/–
UIC41	5 × 7441AN 10/–	UIC92	5 × 7492N 10/–
UIC42	5 × 7442N 10/–	UIC93	5 × 7493N 10/–
UIC50	5 × 7450N 10/–	UIC94	5 × 7494N 10/–
UIC51	5 × 7451N 10/–	UIC95	5 × 7495N 10/–
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RTL Micrologic Circuits Epoxy case To-5 temp. range 15°C to 55°C	Qty. prices each 1–11	12–24	25–99	100 +
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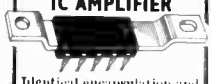

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TRIACS

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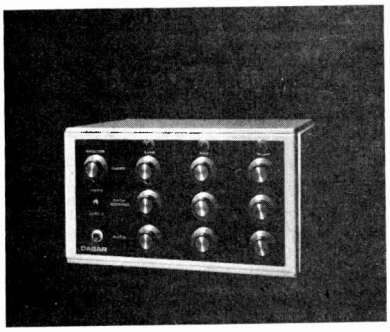

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1N5GT	7/9	30C15	13/–	DL96	7/3	EM80	8/3
1R5	5/9	30C17	16/–	DY86	5/9	EM81	8/3
1S5	4/3	30C18	13/6	DY87	5/9	EM84	6/9
1T4	3/–	30F5	15/6	EABC80	6/6	EM87	7/6
3S4	5/9	30FL1	12/9	EAF42	10/–	EY51	7/3
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6/30L2	11/9	30L15	13/–	EBF80	6/9	EZ80	4/6
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6AM6	2/9	30P4	13/–	ECC81	3/9	GZ32	8/9
6AQ5	5/3	30P12	13/9	ECC82	4/9	GZ34	9/9
6AT6	4/6	30P19	13/–	ECC83	7/–	KT41	15/6
6BA6	4/6	30PL1	12/9	ECC85	5/9	KT61	9/9
6BE6	4/9	30PL13	14/6	ECC804	12/–	KT66	16/9
6BJ6	8/6	30PL14	14/–	ECF80	6/–	LN329	14/6
6C5G	4/9	35L6GT	8/9	ECF82	6/–	N78	17/6
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6F23	13/9	150B2	13/6	ECH81	5/9	PC86	10/3
6F25	12/6	807	9/–	ECH83	8/3	PC88	10/3
6K7G	2/6	6063	12/6	ECH84	7/6	PC96	8/6
6K8G	3/6	AZ31	9/6	ECL82	6/9	PC97	8/–
6V6G	3/6	B349	13/–	ECL86	8/–	PC900	7/6
6V6GT	6/6	B729	12/6	EF37A	6/6	PCC84	6/6
6X4	4/9	CCH35	13/6	EF39	4/9	PCC85	6/–
6X5GT	5/9	CL33	18/6	EF41	11/9	PCC88	9/–
10F18	7/–	CY31	6/9	EF80	4/6	PCC89	9/6
10P13	12/–	DAC32	7/3	EF85	6/3	PCC189	9/9
12AH8	45/–	DAF91	4/3	EF86	6/3	PCC805	13/–
12AT7	3/9	DAF96	7/3	EF89	5/3	PCF80	6/6
12AU6	4/9	DF33	7/9	EF91	2/9	PCF86	9/6
12AU7	4/9	DF91	3/–	EF183	5/9	PCF800	13/6
12AX7	4/9	DF96	7/3	EF184	6/6	PCF801	8/9
12K8GT	7/3	DH77	4/6	EH90	8/6	PCF802	9/–
19BG6G	17/6	DK32	7/6	EL33	9/9	PCF805	13/6
20F2	13/6	DK91	5/9	EL34	9/6	PCF806	11/3
20P3	11/9	DK92	8/6	EL41	11/–	PCF808	14/–
20P4	18/6	DK96	7/3	EL84	4/9	PCL82	7/3
25L6GT	5/–	DL35	5/–	EL90	5,3	PCL83	12/–
						PCL84	7/6
						PCL85	9/–
						PCL86	8/3
						PCL88	14/6
						PCL805	15/6
						PENA4	8/6
						PEN36C	14/–
						PFL200	11/9
						PL36	9/9
						PL81	9/3
						PL81A	10/3
						PL82	6/–
						PL83	6/6
						PL84	6/6
						PL500	13/–
						PL504	13/6
						PL508	23/6
						PM84	7/6
						PX25	23/6
						PY32	10/–
						PY33	10/–
						PY81	5/3
						PY82	5/3
						PY83	5/9
						PY88	6/9
						PY800	7/6
						PY801	7/6
						R19	6/6
						R20	12/–
						SU2150A	12/6
						U25	13/–
						U26	12/–
						U47	13/6
						U49	12/–
						U78	4/9
						U191	12/6
						U193	8/6
						U251	14/6
						U301	10/6
						U329	14/6
						U801	19/6
						UABC80	6/6
						UAF42	10/3
						UBC41	10/6
						UBF80	5/9
						UBF89	6/9
						UCC84	7/–
						UCC85	7/3
						UCF80	7/3
						UCH42	12/6
						UCH81	6/6
						UCL82	7/–
						UCL83	11/–
						UF41	10/6
						UF85	6/9
						UF89	6/9
						UL41	12/–
						UL44	20/–
						UL84	7/–
						UM80	5/–
						UM84	4/6
						UY41	7/6
						UY85	5/9
						VP4B	15/6
						W119	7/–
						Z77	4/6
						AC107	3/6
						AC127	2/6
						AD140	7/6
						AF115	3/–
						AF116	3/–
						AF117	4/–
						AF125	3/6
						AF127	3/6
						OC26	5/–
						OC44	2/6
						OC45	2/6
						OC71	2/6
						OC72	2/6
						OC75	2/6
						OC81	2/6
						OC81D	2/6
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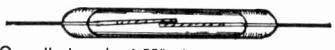

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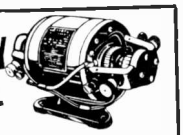

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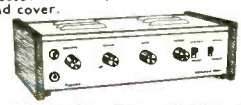

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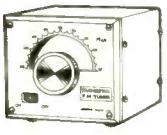

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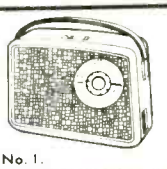

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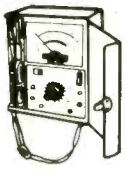

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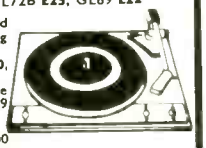

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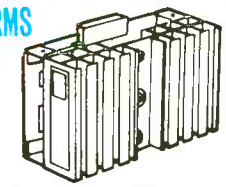

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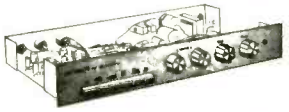

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