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## ADCOLA 64

for Factory Bench Line Assembly

A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit\*.

Standard temp. 360°C at 23 watts.

Special temps. from 250°C—410°C.

\*Additional Stock Bits (illustrated) available

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- B 38**  $\frac{1}{8}$ " — 3.2 mm CHISEL FACE
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- B 12**  $\frac{3}{16}$ " — 4.75 mm EYELET BIT
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Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service... reliability... from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.



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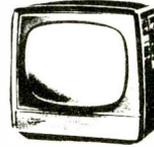
\* Write for price list and catalogue

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19" SLIMLINE 405/625 BBC 2 39 gns.



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Cloth covered. Size 16 1/2" x 14 1/2" x 7 1/2". Takes any modern autochanger. P. & P. 7/6.

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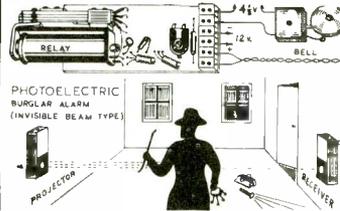
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TRANSISTORS 2 6 EACH. OC44, OC45, OC71, OC81, OC81D, AF114, AF117, AC128.

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CONTENTS: 2 P.C. Chassis Boards, Chemicals, Etching Manual, Infra-Red Photo-transistor, Latching Relay, 2 Transistors, Condensers, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation.



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### INVISIBLE BEAM OPTICAL KIT

Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.

CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks, Infra-red filter, projector lamp holder, building plans, performance data, etc. Price 19/8. Postage and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/-; Air Mail 8/-.

### LONG RANGE INVISIBLE BEAM OPTICAL KIT

CONTENTS: As above. Twice the range of standard kit. Larger Lenses, Filter, etc. Price 29/8. Postage and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/6. Air Mail 10/-.

### JUNIOR PHOTOELECTRIC KIT

Versatile Invisible-beam, Relay-less, Steady-light Photo-Switch, Burglar Alarm, Door Opener, Counter, etc., for the Experimenter.

CONTENTS: Infra-Red Sensitive Phototransistor, 3 Transistors, Chassis, Plastic Case, Resistors, Screws, etc. Full Size Plans, Instructions, Data Sheet "10 Advanced Photoelectric Designs". Price 19/8. Postage and Pack. 1/6 (U.K.). Commonwealth 2/-; Air Mail 4/-.

### JUNIOR OPTICAL KIT

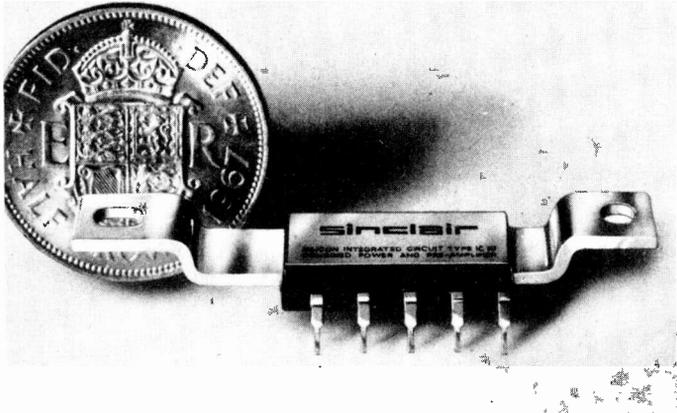
CONTENTS: 2 Lenses, Infra-red Filter, Lampholder, Bracket, Plans, etc. Everything (except plywood) to build 1 miniature invisible beam projector and photocell receiver for use with Junior Photoelectric Kit. Price 10/8. Post and Pack. 1/6 (U.K.). Commonwealth: Surface Mail 2/-; Air Mail 4/-.

## YORK ELECTRICS

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Send a S.A.E. for full details, a brief description and Photographs of all Kits and all 52 Radio, Electronic and Photoelectric Projects Assembled.

# MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER AND PRE-AMP



## the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output 5 watts R.M.S. (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 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. The photographic masks required as part of the process of producing monolithic I.C.s are expensive but once made, the circuits can be produced with complete uniformity and at very low cost. This enables us to cover every IC-10 with the Sinclair guarantee of reliability.

### ■ SPECIFICATIONS

Output	10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response	5 Hz to 100 KHz $\pm$ 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 $\times$ 0.4 $\times$ 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

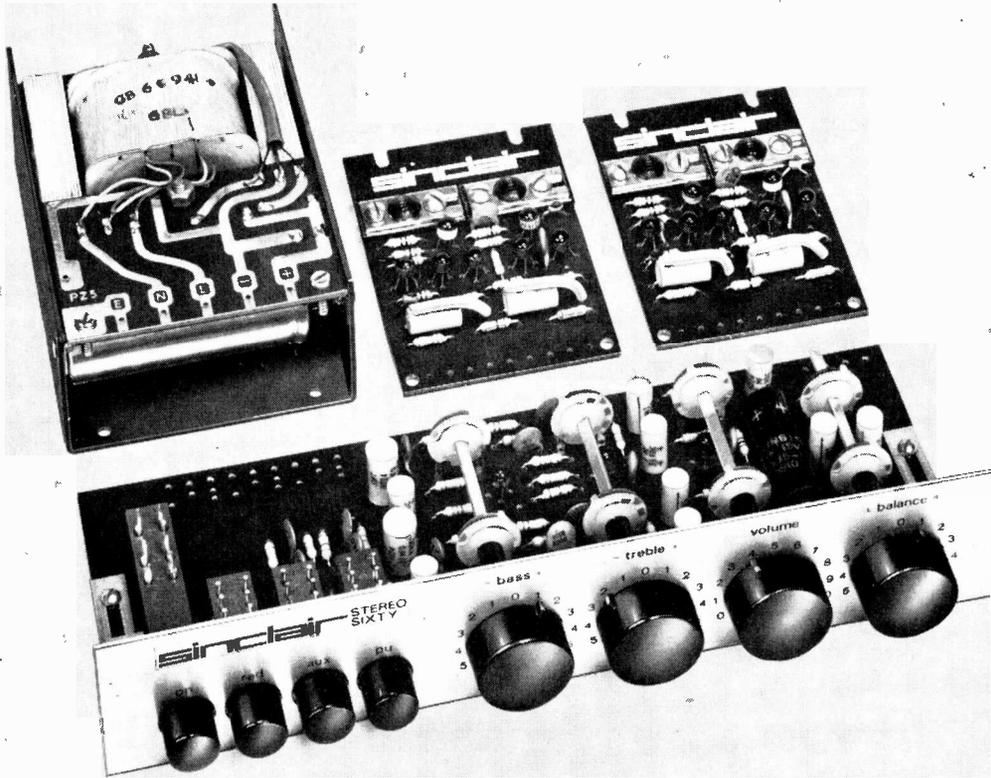
Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

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

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22 NEWMARKET ROAD · CAMBRIDGE  
Tel. 0223 52731



## Project 60 an exciting alternative

The buyer of an amplifier today has a remarkably wide variety to choose from. It is unlikely that a purchaser would have real difficulty in finding a unit that met all his requirements, although the price might not be as low as could be wished. The only snags are that one's needs can change and that the technically correct amplifier may be physically inconvenient. If you are confident that there is an amplifier available, of the right size and price, which will meet all your needs for the foreseeable future, then that is your best buy. If not, however, we can offer you another possibility which we believe to be an exciting alternative approach. That alternative is **Project 60**.

Project 60 is a range of modules which connect together simply to form a complete stereo amplifier with really excellent performance. So good, in fact, that only 2 or 3 amplifiers in the world can compare with it in overall performance.

The modules are: 1. The Z-30 high gain power amplifier, which is an immensely flexible unit in its own right. 2. The Stereo 60 preamplifier and control unit. 3. The PZ.5 and PZ.6 power supplies. A complete system comprises two Z-30's, one Stereo-60 and a PZ-5 or PZ-6. The power supplies differ in that the PZ-6 is stabilised whilst the PZ-5 is not. This means that the former should be used where the highest possible continuous sine wave rating is required. In a normal domestic application there will not be a significant difference between using either power unit unless loudspeakers of very low

efficiency are being used.

In view of the very high performance of an amplifier system built with Project 60 modules, the cost may seem surprisingly low. There are two reasons for this: Firstly, we are the largest producers of this type of module in Europe and we are able therefore to use highly efficient production methods. Secondly, you are not paying for a cabinet which you may not require anyway.

All you need to assemble your system is a screwdriver and a soldering iron. No technical skill or knowledge whatsoever is required and, in the unlikely event of you hitting a problem, our customer service and advice department will put the matter right promptly and willingly.

Project 60 modules have been carefully designed to fit easily into virtually every type of plinth or cabinet to provide a complete unit of great compactness. Only holes have to be drilled into the wood of the plinth and any slight slips here will be covered completely by the aluminium front panel of the Stereo 60. The Project 60 manual gives all the instructions you can possibly want clearly and concisely.

Perhaps the greatest beauty of the system is that it is not only flexible now but will remain so in the future. We shall shortly be introducing additional modules which will include a comprehensive filter unit, a stereo F.M. tuner and an even more powerful amplifier for very large systems. These and all other modules we introduce will be compatible with those shown here and may be added to your system at any time.

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SINCLAIR RADIONICS LTD · 22 NEWMARKET ROAD · CAMBRIDGE  
Telephone: 0223 52731

# Z.30 TWENTY WATT R.M.S. (40 WATT PEAK) HIGH FIDELITY POWER AMPLIFIER

The Z.30 is a complete power amplifier of very advanced design employing 9 silicon epitaxial planar transistors. Total harmonic distortion is incredibly low being only 0.02% at full output and all lower outputs. As far as we know, no other high fidelity amplifier made can match this specification, no matter what the price. Thus you can be utterly certain that your Project 60 system will do full justice to your other equipment however good it may be. The Z.30 is unique in that it will operate perfectly, without adjustment, from any power supply from 8 to 35 volts. It also has sufficient gain to operate directly from a crystal pickup. So in addition to its use in a high fidelity system you can use a Z.30 to advantage in your car or a battery operated gramophone for your children, for example. These, and many other applications of the Z.30 are covered in the manual of circuits and instructions supplied with every Z.30 high fidelity power amplifier.

## SPECIFICATIONS

**Power output**—15 watts R.M.S. into 8 ohms using a 35 volt supply; 20 watts R.M.S. into 3 ohms using a 30 volt supply.

**Output**—Class AB.

**Frequency response:** 30 to 300,000 Hz  $\pm$  1dB.

**Distortion:** 0.02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

**Signal-to-noise ratio:** better than 70dB unweighted.

**Input sensitivity:** 250mV into 100Kohms.

**Damping factor:** >500.

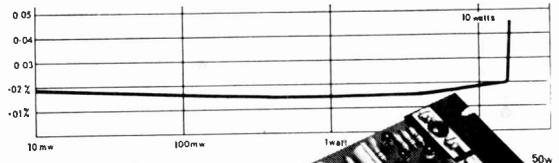
**Loudspeaker impedances:** 3 to 15 ohms.

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

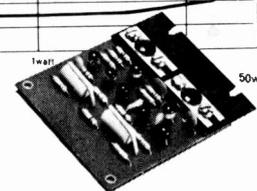
**Size:**  $3\frac{1}{2} \times 2\frac{1}{4} \times \frac{1}{2}$  inches.

## APPLICATIONS

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



Power versus distortion curve of Sinclair Z.30 amplifier.



Z.30  
Built, tested and guaranteed, with circuits and instructions manual

# 89/6

# STEREO SIXTY PREAMPLIFIER AND CONTROL UNIT

The Stereo 60 is a stereo preamplifier and 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 and great attention has been paid to achieving a really high signal-to-noise ratio and excellent tracking between the two channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

## SPECIFICATIONS

• Input sensitivities—Radio—up to 3mV  
Magnetic Pickup—3mV; correct to R.I.A.A. curve  $\pm$  1dB; 20 to 25,000 Hz.  
Ceramic Pickup—up to 3mV; Auxiliary—up to 3mV.

• Output—250mV

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

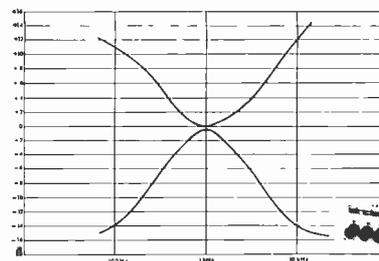
• Channel matching—within 1dB.

• Tone Controls—TREBLE +15 to -15dB at 10 KHz; BASS +15 to -15dB at 100 Hz.

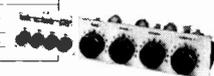
• Power consumption 5mA.

• Front panel—brushed aluminium with black knobs and controls.

• Size  $8\frac{1}{2} \times 1\frac{1}{2} \times 4$  ins.



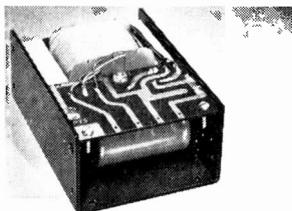
Treble and bass cut and boost curves of Sinclair Stereo Sixty



Ready for immediate installation

£9. 19s. 6d.

# SINCLAIR POWER SUPPLIES



PZ-5

30 volts un stabilised—sufficient to drive two Z 30's and a Stereo 60 for the majority of domestic applications.

Price: £4. 19s. 6d.

PZ-6

35 volts stabilised—ideal for driving two Z.30's and a Stereo 60 when very low efficiency speakers are employed.

Price: £7. 19s. 6d.

## GUARANTEE

If at any time within 3 months of purchasing Project 60 modules 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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22 NEWMARKET ROAD, CAMBRIDGE  
Telephone 0223 52731

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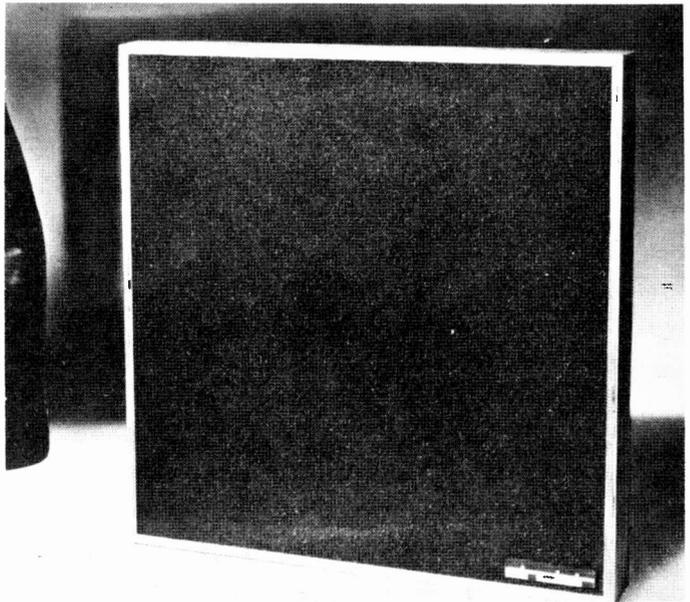
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# Q.16

new elegance in an outstanding loudspeaker



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

The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000 Hz. with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good transient response at all frequencies. Size: 9½" square × 4¾" deep from front to back.

**£8.19.6**  
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## SINCLAIR MICROMATIC The world's most successful miniature radio



**Specifications**

**Size:** 1 1/4" x 1 1/4" x 1/2" (46 x 33 x 13mm).

**Weight incl. batteries:** 1 oz. (28.35gm) approx.

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

**Earpiece.**

Magnetic type.

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

Complete kit incl. earpiece, case, solder and instructions in fitted pack.

**49/6**

*Inc. P/Tax*

Ready built, tested and guaranteed, with earpiece.

**59/6**

*Inc. P/Tax*

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

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P.E.5/70

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

**SINCLAIR GENERAL GUARANTEE**

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

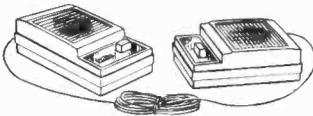
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# CRESCENT RADIO LTD.

11 & 40 MAYES RD. N.22 888-3206

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### TWO WAY INTER-PHONE

Suitable for: Room-to-room, office-to-office and an excellent baby alarm. Is complete with ample connecting wire and battery.

**65/-** Plus 3/6 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

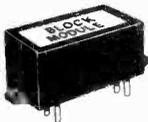
**59/6** Plus 4/- P. & P.



### STEREO JUNCTION BOX

For stereo amplifiers without stereo jack socket.

**22/6** Plus 1/6 P. & P.



### SOLID STATE BLOCK MODULES

Phono pre-amp E1311: input, 100K; gain, 28db; max. out, 3-volt; 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, 9-volt d.c.  
Electronic organ, tonb 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 160M/A.

We also stock the morse code practice modules in this range.

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

### I.C. MODULE TYPE BP1010

3 watts 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.



### TELETON TYPE NM.33 MAGNETIC CARTRIDGE

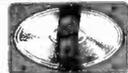
Stereo with diamond styli. This ever popular cartridge now at economy price: Diamond Stylus, 7 mil; Frequency, 20-20kHz; Separation, 20db at 10kHz.

**89/6** Plus 1/6 P. & P.

### SONOTONE 9TAHC

Ceramic cartridge diamond styli.

**47/6** Plus 2/6 P. & P.



### EMI LOUDSPEAKER 450

10 watts. 1 1/2in x 8in + two 2 1/2in tweeters and crossover. All wired and ready for use. This ever-popular 450. In 3-8-15 ohm imp.

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

### EMI Loudspeaker Set 350

20 watts. 20-20 k/c. 8 and 15 ohms.

**£6-19-6** Plus 7/6 P. & P.

### SHELF UNIT

Two teak finish shelves on a black frame (overall size: 28in x 25in x 12in). Ideal for hi fi equipment: amplifiers, speaker cabinets etc. The perfect answer for housing unit audio and equipment. This unit is wall mounting.

**50/-** Plus 8/6 P. & P.



### CRESCENT CASSETTES

Top quality cassettes at unbeatable prices (complete with standard storage case): C60, 9/-; C90, 14/-; C120, 19/- Please note the P. & P. on the cassettes is FREE.



### CASSETTE HEAD CLEANER

Designed to clean the heads on all cassette machines.

**11/6** Plus 1/- P. & P.

### INTERNATIONAL TAPE

A now famous brand of tape. 7in 2,400ft, 25/-; 7in 1,800ft, 21/-; 7in 1,200ft, 13/6; 5 1/2in 1,200ft, 15/-; 5 1/2in 1,800ft, 22/6; 5in 600ft 9/9; 5in 900ft, 12/6; 5in 1,200ft, 16/- Please note the postage and packing is FREE.



### A TAPE BARGAIN

Enitape 3in 175ft in EMI case **5/-** EACH

### EMI SET 850

A complete speaker system IN KIT FORM. We supply a modern styled teak finish cabinet with black front. Overall dimensions: 14in x 9in x 9in. Made to a very high standard. A 6in EMI woofer. A 3in tweeter. A crossover network. Acoustic wadding. Output terminals, wire and fixing hardware. Specification: Max. power, 10 watts; frequency, 65-20kHz; imp 3-8-15 ohms.

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

### COMPONENTS CORNER (Please inc. postage with order)

8in x 6in. One sided printed circuit board	2/- each
BY100 type rectifiers 800 p.i.v. 750 M/A	3/3 each
4 pin transistor holders	6d each
2 1/2in 80 ohm loudspeakers	6/8 each
2 1/2in 8 ohm loudspeakers	6/8 each

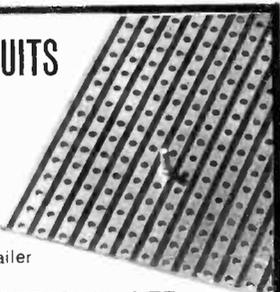
Send 3/- for our Component Catalogue and Flog Lists

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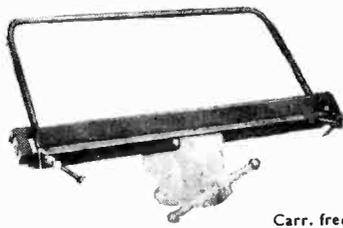
—the Universal Wiring Board— obtainable from your local Retailer

Trade enquiries to:  
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Technical enquiries to:  
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With Bevelled Former Bars

No. 1. Capacity 18 gauge mild steel x 36in. wide	£14.0.0
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No. 3. Capacity 16 gauge mild steel x 18in. wide	£8.0.0

Also new bench models. Capacities 48in. x 18 gauge £40. 36in. x 18 gauge £27.10.0. 24in. x 16 gauge £26.10.0. Carriage free.

End folding attachments for radio chassis. Tray and Box making for 36in. model, 5/6 per ft. Other models 3/6. The two smaller models will form flanges. As supplied to Government Departments, Universities, Hospitals, One year's guarantee. Money refunded if not satisfied. Send for details.

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## for fast, easy, reliable soldering

Contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required.

### SAVBIT ALLOY ALSO REDUCES COPPER BIT WEAR.

Economically packed for general electrical and electronic soldering. 75 ft. 18 gauge on plastic reel. Recommended retail price 15/-



### THIN GAUGE SOLDER, ESSENTIAL FOR

soldering small components and thin wires. High tin content, low melting point, 60/40 alloy, 170 ft. 22 gauge on plastic reel. Recommended retail price 15/-



### A RANGE OF SOLDERS IN HANDY DISPENSERS.

REF.	ALLOY	SWG	Length	Price
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Size 5 (illustrated)	Savbit	18	3'-6"	3/-
15	60/40	22	4'-6"	4/-

\*Recommended Price



### INVALUABLE FOR STRIPPING FLEX, THE NEW AUTOMATIC OPENING BIB WIRE STRIPPER AND CUTTER.

easily adjustable for all standard diameters. Plastic covered handles can also be used as wire cutter. Recommended retail price 8/6



From Electrical and Hardware shops. If unobtainable, write to: Multicore Solders Ltd., Hemel Hempstead, Herts.

# Laskys

## SCOOP Garrard 3000

**CUSTOM UNIT** BY FAMOUS BRITISH MANUFACTURER

A deluxe custom styled and built record player unit made by world famous British manufacturer. The unit incorporates the renowned Garrard 3000 four speed autochanger with lightweight tubular pick-up arm FITTED WITH SONOTONE ITA STEREO CARTRIDGE with diamond stylus. The beautifully made plinth is finished in richly figured teak veneer with tinted perspex panels in the lid and with attractive charcoal grey "mirror" insert panel on front. All metal trim parts are satin chrome. Black leather grain underplate. The lid allows the player to operate fully automatically when closed and has snap action "stay" when raised. Mains socket and 5 pin DIN audio output socket are at rear. Overall size 15 1/2 x 7 1/2 x 14in.

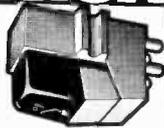
**LASKY'S SPECIAL PRICE £16.15.0** Post 15/-



## AUDIO-TECHNICA Garrard

### SPECIAL OFFER

**AT-35X** Stereo magnetic cartridge with elliptical diamond stylus. Frequency response 20-25 kHz  $\pm 2$  dB Channel separation 30 dB. List Price £24.4.9.



**LASKY'S PRICE £17.10.0** Post Free

Also available AT-35 stereo magnetic cartridges with either 0.5 or 0.7 mil diamond stylus assemblies. List Price £18.10.0.

**Lasky's Price £13.10.0.** Post Free.

**AT-33** Stereo magnetic cart.—frequency response 20-20 kHz with 0.7 mil diamond stylus. List £10.14.3.

**LASKY'S PRICE £7.19.6**

### SP.25 Mk II

THE U.K.'s MOST POPULAR

#### HI-FI TURNTABLE

4-speed single record playing deck features include heavy precision-built turntable pick-up arm bias compensation, calibrated stylus-force adjustment, cueing device. After play, the arm automatically rises, returns to rest and switches off motor. Finish: dark green polychromatic and silver.



**LASKY'S PRICE £11.19.6**

SP25 Mk. II with A.D.76K Stereo Magnetic Cartridge £15.10.0.

**OTHER GARRARD UNITS FROM STOCK AT LASKY'S EXCLUSIVE PRICES**

AUTDCHANGERS	3000 complete with 9TANC stereo cartridge	£9 19 6
SL72B	SL65B	£15 19 6
SL72B with stereo cartridge	1025 with stereo cartridge	£6 0 0
2025TC with stereo cartridge	SL95B	£40 0 0
	SL75B	£32 0 0

SINGLE PLAYERS	AP75, £18.10.0.	AP75 with AD76K mag. cart., £21.10.0.	401 Transcription Unit, £28.0.0
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**BASES AND COVERS FOR GARRARD UNITS**  
Type WB1 and WB5 for models, 2025TC, 3000, SL65B, 1025, SP25 Mk. II. Price WB1 £3.16.6. WB5 £3.12.6. Type WB4 for models SL72B, SL75B, SL95B. Price £5.12.6. Perspex covers: SPC1 for WB1, £3.14.1. SPC4 for WB4 and WB5 (allows unit to be played with the cover in place)—price £4.8.0.

### PACKAGE DEALS

AP75 complete with AD76K Stereo magnetic cartridge, teak plinth and perspex cover	<b>£30.0.0</b>	Post 10/-
SP25 Mk II complete with AD76K cartridge, teak plinth and perspex cover	<b>£19.0.0</b>	Post 7/6
1025 complete with J2105 stereo ceramic cart., teak plinth and perspex cover	<b>£11.19.6</b>	Post 7/6

Post on Garrard units: £/- extra—except AP75, SL75B, SL95B and 401 7/8 extra. Post on bases and covers 5/- extra.

## ADC 40 PRECISION PICK-UP ARM

The ADC 40 Mk II is a complete low inertia arm with side thrust compensator and anti-drag lead out arrangement. Single-thrust ball bearings used at four points. Accurately machined walnut non-resonant arm. Adjustable counter-weight. Plug-in head shell accommodates nearly all cartridges. Easy installations. Built-in arm rest. Arm length 10 1/2 in. overall. Pivot to stylus tip 9 in. Rear overhang 1 1/2 in.



List Price  
**£19.1.6**

**LASKY'S PRICE**  
**£8.19.6** Post 3/6

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**MAGNETIC RECORDING TAPE FROM THE U.S.A. AT LASKY'S RECORD LOW PRICES**

3in. Message tape, 150ft.	2 8	5 1/2 in. Long play, 1200ft. Mylar	15 0
3in. Message tape, 225ft.	3 9	5 1/2 in. Triple play, 2400ft.	35 0
3in. Message tape, 300ft.	7 8	7in. Standard play, 1200ft.	12 4
3 1/4 in. Triple play, 600ft. Mylar	10 0	7in. Standard play, 1200ft. Mylar	12 8
5in. Double play, 1200ft.	15 0	7in. Long play, 1800ft. Mylar	18 8
5in. Long play, 900ft. Acetate	10 0	7in. Double play, 2400ft. Mylar	25 0
5in. Standard play 600ft.	8 6	7in. Long play 1800ft. Acetate	15 0
5 1/2 in. Double play, 1800ft. Mylar	22 8	7in. Triple play 3600ft. Mylar	50 0
5 1/2 in. Long play 1200ft. Acetate	15 0		
5 1/2 in. Standard play 900ft. PVC	12 8		

P. & P. 1/- extra per reel, 4 reels end over Post Free. Special quotes for quantities.

## USA MADE CASSETTES

**AT LASKY'S BUDGET PRICES**

C80 7/8 each post 1/-	5	35/- post 2/-	65/- post 3/-
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C120 17/8 each post 1/-	5	85/- post 2/-	165/- post 3/-

## metrosound

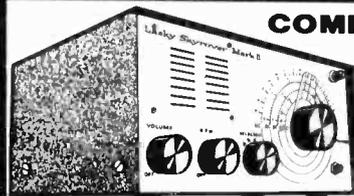
**CASSETTE HEAD CLEANER**

This ingenious device enables the delicate recording heads and drive system of your Cassette Recorder to be cleared without damage. Just slip in the cassette like any other cassette and run through once. Only takes moments and removes all dirt and oxide deposits in seconds.

**LASKY'S PRICE 10/8** POST 1/- EACH

## SKYROVER Mk II

### COMMUNICATION RECEIVER



A short wave receiver, exclusive to Lasky's, at a real economy price. Four valve line up using one each 6BE6, 6BA6, 6AV6 and 6AR5 valves, gives highly sensitive reception and powerful gain. Switch selected SW frequency range cover: 1.5 to 30MHz in three separate band-spread ranges and full AM medium waveband

cover in one range 550-1,600KHz. Reduction drive tuning with hair line cursor. Controls include volume on/off BFO, Band selector. Power-on indicator lamp. External antenna connections and mains fuse at rear. Internal speaker plus standard 5mm jack socket for phones on front. For 220/240V a.c. mains operation. Strong metal cabinet finished in grey crackle with anodised silver front panel. Size 9 1/2 x 5 1/2 x 5 1/2 in. Complete with mains lead and full instructions.

**THE IDEAL BEGINNERS' RECEIVER**  
**LASKY'S PRICE £13.13.0** Post 5/-

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The 1970 edition of Lasky's famous Audio-Tronics catalogue is now available—FREE on request. The 28 tabloid pages—many in full colour are packed with 1000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast, Electronics Hobbyist, Servicemen and Communications Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories plus Lasky's amazing money saving vouchers worth over £25.

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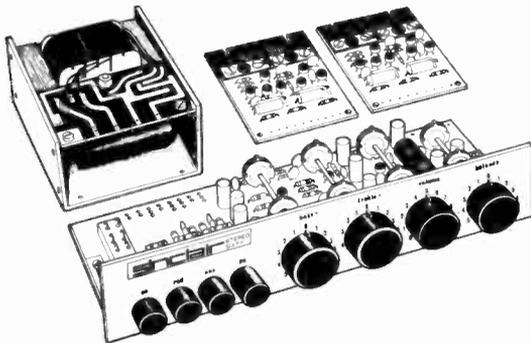
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THIS MONTH'S

## VOUCHERS WORTH 40/-!



# sinclair Project 60



Project 60 is a range of modules which connect together to form a complete stereo amplifier. The modules are: 1. Z-30 high gain power amp. 2. Stereo 60 pre-amp control unit. 3. The PZ-5 unbalanced and PZ-6 stabilised power supplies. A complete system comprises two Z-30's, one Stereo 60 and a PZ-5 or PZ-6.

### STEREO 60 SPECIFICATION

Input sensitivities: Radio up to 3mV, Magnetic Pick-up 3mV correct to R.I.A.A. curve = 1dB 20 to 25,000Hz. Ceramic Pick-up up to 3mV. Auxiliary up to 3mV. Output: 1 volt. Signal to noise better than 70dB. Front panel brushed aluminium with black knobs and controls. Size 8 1/4 x 1 1/2 x 4in. **£9.19.6** post 3/6

### Z-30 SPECIFICATION

Power output: 15 w. R.M.S. into 8 ohms using a 35 volt supply. Frequency response: 30 to 300,000Hz = 1dB. Distortion 0.02%. Signal to noise better than 70dB. Input sensitivity 250mV into 100 K ohms. Loudspeaker imp. 3 to 15 ohms. Power requirements from 8 to 35V DC (The Z30 will operate from batteries if required) - Size: 3 1/2 x 2 1/4 x 1 1/2in. **89/6** post 3/6

### PZ5

30V unbalanced - sufficient to drive two Z-30's and a Stereo 60 for domestic applications. **99/6** Post 2/6

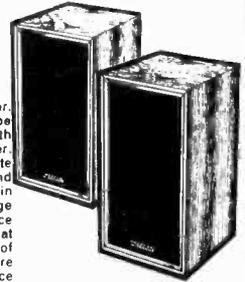
### PZ6

35V stabilised - ideal for driving two Z-30's and a Stereo 60 for low efficiency speakers. **£7.19.6** Post 2/6

**PACKAGE PRICE** For Stereo 60, two Z-30 and one PZ-5 **£21.10.0** Post 10/-

# EXCLUSIVE

## FOSTER "Criterion" MkII HIGH FIDELITY 2 SPEAKER TWO WAY BOOKSHELF SPEAKER SYSTEM



Another high quality bookshelf system from Foster. The "Criterion" Mk. II is a sealed infinite baffle type enclosure using 5 1/2in. bass/mid-range woofer with rolled cloth edge and a 2 1/2in. HF cone type tweeter. The compact cabinet is constructed of 1/2in. laminate with handsome oiled walnut veneer finish and black woven acoustic gauze—front panel with satin chrome edge insert. SPEC: Frequency range 90-20,000Hz. Power Handling 10 watts. Impedance 8 ohms. HF crossover. Screw Tag connections at rear. Size 12 1/2 x 7 1/2 x 6 1/2in. The performance of the "Criterion" is superior to many larger and more expensive units and at Lasky's exclusive price offers absolutely unbeatable value.

LASKY'S PRICE **£9.10.0** or **£17.10.0** Post 1-7/6 2-10/-

# SONICS AS-57

## ELEGANT BUDGET PRICED BOOKSHELF SPEAKER SYSTEMS

The AS-57 is a real space saver. This fine bookshelf high-fidelity speaker system will provide good quality sound anywhere in your home at remarkably low cost. Designed for use where space is at a premium, the AS-57 system is ideal for the small apartment or isolated listening area. The special high efficiency 5 x 7in. full range speaker has a frequency range of 70-18,000Hz with a peak handling capacity of 10 watts. Imp. 8 ohms. Finish: oiled walnut. Size: 5 1/2 x 15 1/2 x 8 1/2in. May be used upright or longways.

LASKY'S PRICE **£15 per PAIR** Post 10/-

# SPECIAL OFFER

## THIS MONTH ONLY THE SUPERB WHARFEDALE DENTON



A compact system sold in matched pairs for a perfectly balanced stereo system. Each Denton contains an 8in. bass unit with 3in. H.F. pressure unit, coupled by a Wharfedale cross-over network. Rated input 15 watts maximum. Frequency response 65-17,000Hz. Impedance 4/8 ohms. Cabinet 9 1/4 x 14 x 8 1/4in. In these most attractive units are available in either oiled teak or polished walnut and are small enough to blend in with most surroundings.

LIST PRICE NORMALLY £36 PAIR

**OUR PRICE £33 PAIR** Post 15/-

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**LASKY'S PRICE 72/6** Post 2/6

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AC128	ACY29	NKT212	OC44	2G302	
AC130	ACY30	NKT133	OC45	2G303	
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All Brand New and Coded.

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59/6

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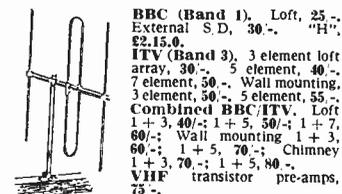
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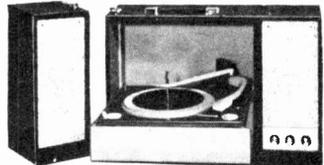
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Why not prove how easy it is the HEATHKIT way.  
Build one of these beginner kits.



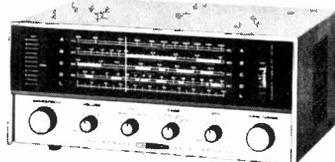
**Stereo Record Player**  
Exciting Sound — Budget Price  
Kit: K/SRP-1 - - £27.6.0  
Carr. 11/-



**Automobile Tune-up Meter**  
For D.I.Y. Car Mechanics  
Kit: K/ID-29 - - £17.8.0  
Carr. 5/-



108-136 MHz  
Portable  
**Aircraft Monitor Receiver**  
Kit: K/GR-98 - - £27.12.0  
Carr. 5 -



**Economy SW Receiver**  
World-wide Reception  
1 to 30 MHz plus 550-1620 KHz  
Kit: K/GR-64 - - £24.16.0  
Carr. 9/-

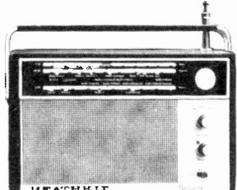


**Deluxe Car Radio**  
Heathkit Value—Powerful Output  
Kit: K/CR-1 (Less Speakers) £12.12.0  
Carr. 5/-



**Technician's Versatile 'VVM'**  
7AC, 7DC,  
7 ohm ranges  
Kit: K/IM-18U - - £16.14.0  
Carr. 5-

**'SEVERN' AM/FM Radio**  
Beautiful Looks — Luxury Sound



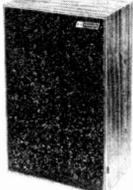
Kit: K/SEVERN - - £18.18.0  
Carr. 5/-

**Portable 'VVM'**  
For Hobbyists — Householders



Kit: K/IM-17 - - £14.8.0  
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**'Ambassador' Speaker**



Luxury Looks  
Hi-Fi Sound  
Kit: K/(AMB) - - £29.16.0  
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A Schlumberger Company

**DAYSTROM LTD.**  
**GLOUCESTER GL2 6EE**

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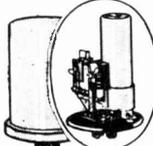
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### CAR LIGHT FLASHERS



Heavy duty light flasher employs a condenser discharge principle operating on electro-mechanical relay. (As inset.) Housed in strong plastic case. Flashing rate between 60-120 per minute. 12 volt DC operation. Maximum load 6 amps. Size 2 1/16" dia. 4". Supplied brand new at a fraction of original cost. 6/8 Carr. P. & P. 2/6. (3 for 17/6. P. & P. 4/6.)

### 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. £12.10. Carr. 7/6, or brand new with accessories. £7.10.6. Carr. 7/6.

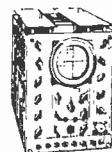
### CLASS D WAVEMETERS No. 2

Crystal controlled. 1.2-19 Mc/s. Mains or 12V d.c. operation. Complete with calibration charts. Excellent condition. £12.10.0. Carr. 30/-.

### R209 MK II COMMUNICATION RECEIVER

11 valve high grade communication receiver suitable for tropical use. 120 Mc/s on 4 bands. AM, CW, FM operation. Incorporates precision vernier driver, BFO. Aerial trimmer, internal speaker and 12 V d.c. internal power supply. Supplied in excellent condition, fully tested and checked. £15 Carr. 20/-.

### TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose 10" oscilloscope. T.B. 2 c/s-750 kc/s. Bandwidth 5.5 Mc/s. Sensitivity 33 mV/CM. Operating voltage 0/110/200/250 V. a.c. Supplied in excellent working condition. £22.10.0 or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.



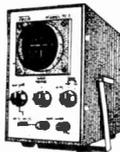
MARCONI CT44/TF956 AF ABSORPTION WATTMETER  
1 μ watt to 6 watts.  
£20. Carr. 20/-.

### BOLABTRON CD. 71182 DOUBLE BEAM OSCILLOSCOPES.

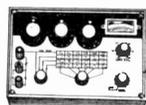
D.C. to 9 Mc/s. Perfect order. £85. Carr. 50/- . Few available less C.R.T. £25. Carr. 50/-.

### TO-2 PORTABLE OSCILLOSCOPE

A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CFS-1 MHz. Input imp. 2 meg Ω. 25 P.F. Illuminated scale. Sin. tube. 115 x 180 230mm. Weight 8lb. 220/240 V a.c. Supplied brand new with handbook. £22.10.0. Carr. 10/-.



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



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω-111 meg Ω. 6 Ranges ±1%. L.I.F. = 1-11 HENRYS 6 Ranges -2%. C. 10pF ±1110 MFD. 6 Ranges -2%. TURNS RATIO 1:1/1000-1:1100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100mA. Meter indication. Attractive 2 tone metal case. Size 7 1/2 x 5 1/2 in. £20. P. & P. 5/-.

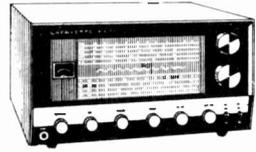
### UNR-30 4-BAND COMMUNICATION RECEIVER

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



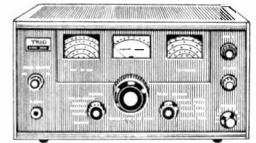
### TRIO JR-310 NEW AMATEUR BAND 10-30 METRE RECEIVER.

In stock. £77.10.0.



### LAFAYETTE SOLID STATE HAGOO RECEIVER

5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 kc/s-400 kc/s and 550 kc/s-30 Mc/s FET front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● 8 meter ● 24in Bandsread ● 230V a.c./12V d.c. neg. earth operation ● RF gain control. Size 16in x 9in 8in. Weight 18lb. EXCEPTIONAL VALUE. £45. Carr. 10/- . S.A.E. for full details.



### TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 550Kc/s to 30Mc/s continuous and electrical bandsread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● 8 meter ● Sep. bandsread dial ● IF 445Kc/s ● Audio output 1.5W. ● Variable RF and AF gain controls. 115/250V A.C. Mains. Beautifully designed. Size: 7 1/2 x 16in. With instruction manual and service data. £42. Carriage paid.

### TRIO COMMUNICATION TYPE HEADPHONES

Normally £5.19.6. OUR PRICE £3.15.0 if purchased with above receiver.

### TRIO TS 510 AMATEUR TRANSCEIVER

with speaker and mains P.S.U. £180

### UR-1A SOLID STATE COMMUNICATION RECEIVER

4 bands covering 550 Kc/s-30 mc/s continuous. Special features are use of FET transistors, 8 meter, built in speaker and telescopic aerial, variable BFO for SSB reception, noise limiter, bandsread control, sensitivity control. Output for low impedance headphones. Operation 220/240 volt A.C. or 12 volt D.C. Size 12 1/2 x 4 1/2 x 7 1/2. Excellent value. ONLY £24. Carr. 7/6.



### LAFAYETTE HA.900 6-BAND AMATEUR RECEIVER.

£57.10.0. Carr. Paid.



### RCA COMMUNICATION RECEIVER AR88D

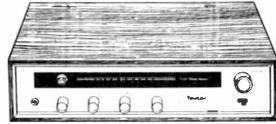
Latest release by ministry BRAND NEW in original cases. 110-250V a.c. operation. Frequency in 6 Bands. 535Kc/s-32Mc/s continuous. Output impedance 2.5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price £87.10.0. Carr. £2.

### LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

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



### TELETON MODEL CR 10T AM/FM STEREO TUNER AMPLIFIER



A new model from Teleton. 31 solid state devices. 4+4 watt output. Inputs for ceramic/crystal cartridge. Frequency range AM 540-1590 KHz FM 88-108 MHz. Automatic FM stereo reception. Stereo indicator. Controls: Tuning, function selector, Tone and R & L volume controls. AFC switch. Stereo headphone socket. Size: 13 1/2" x 3 1/2" x 9 1/2" approx. Price £34. Carr. 7/6.

### CLEAR PLASTIC PANEL METERS

First grade quality Moving Coil panel meters. Type MR 38P. 1 1/2" in square fronts.

500-0-500μA	27/6	50mA	27/6	150V. D.C.	27/6
1mA	27/6	100mA	27/6	300V. D.C.	27/6
1-0-1mA	27/6	150mA	27/6	500V. D.C.	27/6
2mA	27/6	200mA	27/6	750V. D.C.	27/6
5mA	27/6	300mA	27/6	15V. A.C.	27/6
10mA	27/6	500mA	27/6	50V. A.C.	27/6
750mA	27/6	3V. D.C.	27/6	150V. A.C.	27/6
1 amp	27/6	10V. D.C.	27/6	300V. A.C.	27/6
100μA	37/6	2 amp	27/6	500V. A.C.	27/6
100-0-100μA	35/-	5 amp	27/6	20V. D.C.	27/6
200μA	35/-	25mA	27/6	100V. D.C.	27/6
500μA	40/-			8 meter IMA	32/6
				VC meter	42/-

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

### POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock. Single hole fixing, jin. 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.	1/6/10/25/50/100/250/500/1,000 or 2,500 ohms, 27/6. P. & P. 1/6.

### CRYSTAL CALIBRATORS No. 10



Small portable crystal controlled wavemeter. Size 7" x 7 1/4" x 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.

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

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



### LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

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

### TE-65 VALVE VOLTMETER

High quality instrument with 28 ranges. D.c. volts 1.5-1,500V. A.c. volts 1.5-1,500V. Resistance up to 1,000 megohms. 220/240V a.c. operation. Complete with probe and instructions. £17.10.0. P. & P. 6/- . Additional Probes available: R.F 35/- . H.V. 42/6.



### COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

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

### AM/FM SIGNAL GENERATORS

Oscillator Test No. 1. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80Mc/s. AM C.W./F.M. Incorporates precision dial, level meter, precision attenuator 1μA-100mV. Operation from 12V d.c. or 0/110/200/250V a.c. Size 12 x 8 1/2 in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. 20/-.



### PLESSEY SL 403A

3 watt Integrated Amplifier Circuit 49/6 POST PAID

### EDDYSTONE VHF RECEIVERS MODEL 770R.

19-163 Mc/s. Excellent condition. £150



TE-16A Transistorised Signal Generator. 5 ranges 400 KHz-30 MHz. An inexpensive instrument for the handyman. Operates on 9V battery. Wide, easy to read scale. 800 kHz modulation. 57 1/2 x 3 1/2. Complete with instructions and leads. £7.19.6. P.P. 4/-.

### HOSIDEN DH-025 STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable headband. 8 ohm impedance. 20-12,000 cps. Complete with lead and stereo jack plug. ONLY 47/6. P.P. 2/6.



### AUTO TRANSFORMERS

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

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

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

### ARF-100 COMBINED AF-RF SIGNAL GENERATOR



**A.F. SINE WAVE**  
20-200,000 c/s.  
Square wave 20-30,000 c/s. O.P.  
**HIGH IMP. 21V.**  
P/P600  $\Omega$  3.8 V. P/P.  
TF 100 kc/s-300 Mc/s. Variable R.F. attenuator Int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240 V a.c. **£32.10.0.** Carr. 7/6.

### 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 instruction. **£5.15.0.** P. & P. 7/6. S.A.E. for details.

### TE22 SINE SQUARE WAVE AUDIO GENERATORS



Size: 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 TF142E DISTORTION FACTOR METERS. Excellent condition. Fully tested. £20. Carr. 15/-.

### LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

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



### 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.**

#### V.M.75 UHF MILLIVOLT METER.

100 Kc/s to 1,000 Mc/s. 10 mV to 3V. D.c. 10 mV to 3V. Current 0.01  $\mu$ A to 0.3 mA. Resistance 1 ohm to 10 megohm. **£125.0.0.**

#### T15 TRANSISTOR TESTER.

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

#### MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Icc. Equally adaptable for checking diodes, etc. Spec.: A: 0.7-0.9967. B: 5-200. Icc: 0-50 microamps 0-5 mA. Resistance for diode 200  $\Omega$ -1 M $\Omega$ . Supplied complete with instructions, battery and lead. **£5.19.8.** P. & P. 2/6.

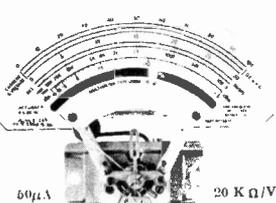


#### TE111 DECADE RESISTANCE ATTENUATOR

Variable range 0-111dB. Connections. Unbalanced T and Bridge T. Impedance 600  $\Omega$  range (0 1dB  $\times$  10) + (1dB  $\times$  10) +10 + 20 + 30 + 40dB. Frequency: 0.5c to 200kHz (-3dB). Accuracy: 0.05dB. +indication dB  $\pm$  0.1. Maximum input less than 4W (50V). Built in 600  $\Omega$  load resistance with internal/external switch. Brand new **£27.10.0.** P. & P. 5/-.



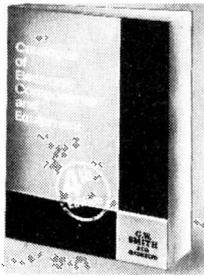
### AVOMETER MOVEMENTS



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

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SL65B	£14.19.6	SL55 with Sonotone	
SL72B	£25.0.0	9TAHCD	£12.10.0.
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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.



### LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

19 transistors, 8 diodes, 1HF music power, 30W at 8  $\Omega$ . Response 30-20,000  $\pm$  2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3-16  $\Omega$ . Separate L and R volume controls. Treble and bass control. Stereo phono jack. Brushed aluminium, gold-anodised extruded front panel with complementary metal case. Size 10 1/2 x 9 1/16 x 7 13/16in. Operation 115/230V. A.C. **£24.** Carriage 7/6.



## MULTIMETERS for EVERY purpose!

**TE-51. NEW 20,000  $\Omega$  / VOLT MULTIMETER** with overload protection and mirror scale. 0/6/30/120/300V a.c. 0/3/30/120/300/600/3,000V d.c. 0/60 $\mu$ A/1/300mA d.c. 0/60K/6 meg. ohm. **£2.6.** P. & P. 2/6.

**MODEL AS-100D. 100K  $\Omega$  / 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. 0/10 $\mu$ A/6/60/300MA/12 Amp. 0/2K/200K/2M/200M  $\Omega$ . -20 to +17dB. **£12.10.0.** P. & P. 3/6.

**MODEL TE-90 50,000 O.P.V. MIRROR SCALE OVERLOAD PROTECTION** 0/3/12/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V a.c. 0/6/60/600/600MA d.c. 16K/160K  $\Omega$  / 1/6/16M  $\Omega$ . -20 to +23dB. **£7.10.0.** P. & P. 3/6.

**MODEL TE-70. 30,000 O.P.V.** 0/3/15/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V a.c. 0/30 $\mu$ A/1/3/30/300mA. 0/16K/160K/1.6M/16megohm **£5.10.0.** P. & P. 3/-.

**MODEL PT-34. 1,000 O.P.V.** 0/10/50/250/500/1,000V a.c. and d.c. 0/1/100/500 mA d.c. 0/100 K  $\Omega$  39/8. P. & P. 1/6.

**TE-900 20,000  $\Omega$  / VOLT GIANT MULTIMETER.** 5in full view meter. 2 colour scale, overload protection. 0/2/5/10/250/1,000/5,000V a.c. 0/25/12.5/10/50/250/1,000/5,000V d.c. 0/50 $\mu$ A/2.5/100/500mA 10A d.c. 20K/200K/20M  $\Omega$ . **£15. P. & P. 5/-.**

**MODEL TE-10A. 20K  $\Omega$  / Volt.** 5/25/50/250/500/2,500 V. d.c. 10/50/100/500/1,000V. a.c. 0/50 $\mu$ A/2.5/100/500mA. 20 to +22dB. 10-0, 100 mfd. 0 0-100-0-1 mfd. 69/8. P. & P. 2/6.

**MODEL TE 80. 20,000 O.P.V.** 0/10/50/100/500/1,000V. a.c. 0/3/25/50/250/500/1,000V d.c. 0/50 $\mu$ A. 5/50/500MA/0/6K/60K/600K/6 Meg **£4.17.6.** P. & P. 3/6.

**MODEL TE12. 20,000 O.P.V.** 0/6/30/120/600/1,200/3,000/6,000V d.c. 1/6/30/120/600/1,200V a.c. 0/10 $\mu$ A/6/6/60/600MA. 0/1K/60K/6meg/650. Megohm 50PP. 2 MFD **£5.19.6.** P. & P. 3/6.

**LAFAYETTE 57 Range Super 50,000 O.P.V.** Multimeter. D.c. Volts 125V-1,000V A.c. Volts 1.5V-1,000V D.c. Current 25 $\mu$ A-10 Amp. Ohms. 0-15 Meg  $\Omega$  dB. -20 to +23dB. Overload Protection. **£12.10.0.** Carr. 3/6.

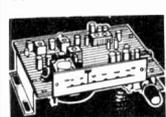
**MODEL TE12. 20,000 O.P.V.** 0/6/30/120/600/1,200/3,000/6,000V d.c. 1/6/30/120/600/1,200V a.c. 0/10 $\mu$ A/6/6/60/600MA. 0/1K/60K/6meg/650. Megohm 50PP. 2 MFD **£5.19.6.** P. & P. 3/6.

**MODEL TE 80. 20,000 O.P.V.** 0/10/50/100/500/1,000V. a.c. 0/3/25/50/250/500/1,000V d.c. 0/50 $\mu$ A. 5/50/500MA/0/6K/60K/600K/6 Meg **£4.17.6.** P. & P. 3/6.

**MODEL TE12. 20,000 O.P.V.** 0/6/30/120/600/1,200/3,000/6,000V d.c. 1/6/30/120/600/1,200V a.c. 0/10 $\mu$ A/6/6/60/600MA. 0/1K/60K/6meg/650. Megohm 50PP. 2 MFD **£5.19.6.** P. & P. 3/6.

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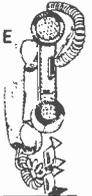
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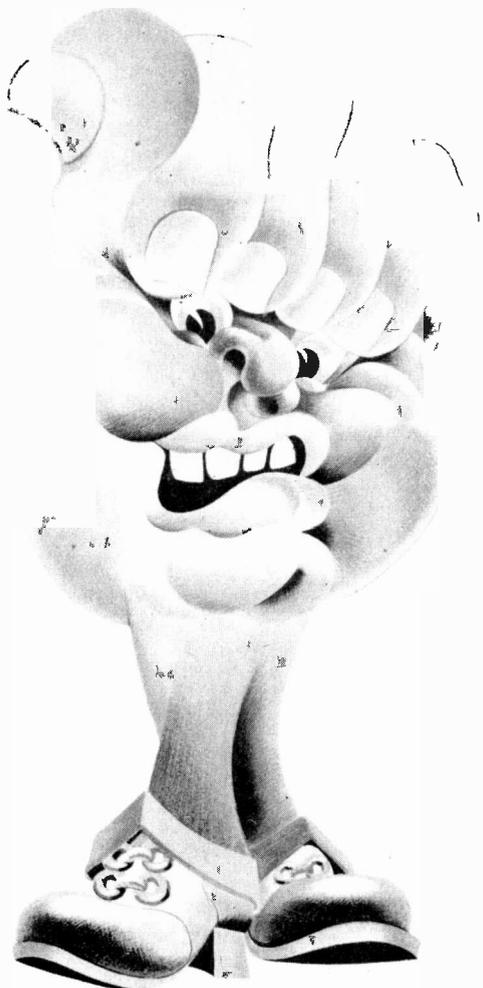
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Type 3TI

Ideal for intercoms, baby alarms, record-players, etc. 9-12V operation.

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#### ORGAN MODULE 17/6

Type 3TN

Will make the ideal basis for either monophonic or polyphonic organs. Can be used as a divider, locking in to the correct frequency. Will drive a loudspeaker or can be fed into tone circuits, amplifiers, etc.

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Type 3TO

For use with the 3TI, or as an impedance matcher, high gain pre-amp., headphone amplifier, etc. It may be used as an oscillator or high fidelity preamplifier using the requisite feedback loops.

Input impedance and gain fully variable up to 500 kilohms and 40dB. Output impedance 300 ohms. Will deliver 30mW into 15 ohms. Frequency response 20-35,000Hz  $\pm$  2dB. Supply voltage 6-24V. Noise level -60dB.

#### DUAL-VOLTAGE PRE-AMPLIFIER 17/6

Type 1TO

For increasing the input sensitivity of low gain valve or transistor amplifiers. A high smoothing factor makes operation direct from H.T. lines possible.

Gain 20-26dB. Input impedance 50 kilohms. Frequency response 30-45,000Hz  $\pm$  2dB. Supply voltages 9-24 and 200-500.

#### TACHOMETER MODULE 18/9

Type 2TN

For 4 or 6 cylinder, 6 or 12V positive or negative earth vehicles. Will operate 200 microamp to 1mA meters on 12V and 200-500 microamp meters on 6V. Suitable meters from 57/6. This module will provide linear readings up to 10,000 r.p.m. if your car can provide the signal!

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Integral pre-amp—SAE details. 86/- + 2/- p. & p.

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## RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99	100 up
CC	½W	5%	100Ω-220kΩ	E12	18d	16d	15d
CC	½W	5%	4.7Ω-330kΩ	E24	2.5d	2d	1.75d
CC	½W	10%	4.7Ω-10MΩ	E12	2.5d	2d	1.75d
CC	½W	5%	4.7Ω-10MΩ	E24	3d	2.5d	2.25d
MO	½W	2%	18Ω-1MΩ	E24	9d	8d	7d
C	1W	10%	4.7Ω-10MΩ	E12	6d	5d	4d
WW	1W	10%	0.22Ω-3.3Ω	E12	15d all quantities		
WW	3W	5%	12Ω-10kΩ	E12	15d all quantities		
WW	7W	5%	12Ω-10kΩ	E12	15d all quantities		

**CODES:** C = carbon film, high stability, low noise. MO = metal oxide, Electrofil TR5, ultra low noise. WW = wire wound, Plessey.  
**VALUES:** E12 denotes series: 1, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2 and their decades. E24 denotes series: 1.1, 1.2, 1.3, 1.6, 2, 2.4, 3, 3.6, 4.3, 5.1, 6.2, 7.5, 9.1 and their decades.  
 Prices are in pence each for quantities of same ohmic value and power rating, not mixed values. (Ignore fractions of one penny on total resistor order.)

**COLVERN 3 watt wire-wound potentiometers:** 10Ω, 15Ω, 25Ω, 50Ω, 100Ω, 150Ω, 250Ω, 500Ω, 1kΩ, 1.5kΩ, 2.5kΩ, 5kΩ, 10kΩ, 15kΩ, 25kΩ, 50kΩ. Price only 5/6 each.

**CARBON TRACK POTENTIOMETERS:** Double wiper ensures minimum noise level. Long plastic spindles.

Single gang linear: 220Ω, 470Ω, 1kΩ, etc. to 2.2MΩ	each	Dual gang linear: 4kΩ, 10kΩ, 22kΩ, etc. to 1MΩ	each
2/6		8/6	
Single gang log: 4kΩ, 10kΩ, 22kΩ, etc. to 2.2MΩ	2/6	Dual gang log: 4kΩ, 10kΩ, 22kΩ, etc. to 2MΩ	8/6
Any type with ½ amp double pole mains switch: extra	2/3	Log/Anti-log: 10kΩ, 47kΩ, 1MΩ only	8/6
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**FETS n-channel.** Low cost general purpose 2N5163, 25V, only 5/- each. Audio/r.f., Texas 2N3819 8/6, Motorola 2N5459 (MPF105) 9/9 each.

**NEW PLESSEY INTEGRATED CIRCUIT POWER AMPLIFIER,** Type 5L403A. Only 48/- net. Operates with 18V power supply. Sensitivity 20mV into 20MΩ, 3W into 7.5Ω Application data with two or more. P.E., Nov. 69, Stereo Amplifier kit less metalwork £11.18.2 net complete.

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Transistors for one channel £7.5.6. list, with 10% discount only £6.11.0. Transistors for two channels £14.17.6. list, with 15% discount: £12.7.5. Capacitors and resistors for one channel list £2. Printed circuit board free with each transistor set. Complete unregulated power supply kit £4.17.6. mono or stereo, subject to discount. Complete regulated power supply kit £9.5. subject to discount. Further details on application.

**SINCLAIR IC10** Integrated Circuit Amplifier and Pre-amplifier. This remarkable monolithic integrated circuit amplifier and pre-amp is now available from stock. The equivalent of 13 transistor/18 resistor circuit plus 3 diodes and the first of its kind ever. It is d.c. coupled and applicable to an unusually wide range of uses as detailed in the manual provided with it. As advertised, post free 59/6 net.

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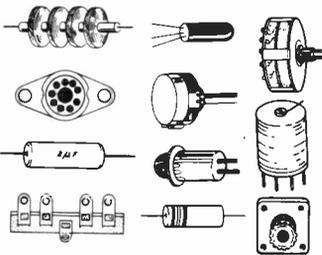
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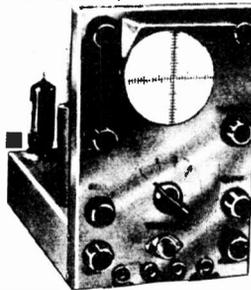
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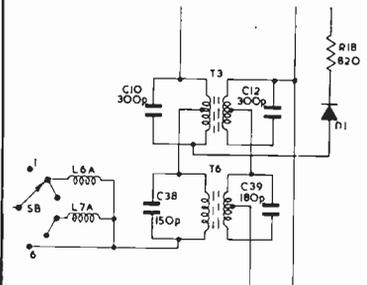


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**INDUSTRY'S BEST INVESTMENT**

**D**ESPITE all those interesting developments in computerised design, the electronics industry is far from the stage of being able fully to automate itself in all processes, from conceptual design, through development, to final production and testing of its products. If that day ever comes, it certainly will not be in this decade.

According to the report just published by the Economic Development Committee for the Electronics Industry, on the Economic Assessment to 1972, the U.K. electronics industry will be facing a serious shortage of skilled labour after that year. Any further expansion of the industry will then depend almost solely upon the availability of the right kind of trained and qualified manpower.

Having identified the major problem of the future, the Report makes a number of suggestions relating to education. The most perceptive and important point it makes in this connection is that *the industry can do much more to help itself*. The Report states that the industry should make greater efforts to improve its image with school leavers; and that more practical assistance is required by schools in order for them to undertake building projects.

Regarding this last point, presumably the EDC is referring to the supply of components, since there is no shortage of design information for projects to suit a wide range of students of various age groups and levels of intelligence. The Schools Council, for example, disseminates information amongst educational establishments, notably in their publication "Project Technology" which lists abstracts of suitable scientific and technological projects selected from a hundred or more different sources, including PRACTICAL ELECTRONICS. But many schools, especially those at the lower end of the education spectrum, have a limited budget for expenditure on technical pursuits. The electronics industry could afford to act as Mr. Bountiful to a greater degree than at present.

We suspect another obstacle is one frequently encountered by the private constructor—the non-availability through normal distributive channels of some of the more important recently developed circuit devices.

What better recruitment pool can industry wish for than one composed of thousands of youngsters and teenagers who have acquired familiarity with electronic components and have built projects which demonstrate the truth of their text book theory. If the electronics industry is blind to this latent enthusiasm and interest among the younger generation, or refuses to make the special effort required to allow its products to reach these eager hands, it will have no right to complain five or ten years hence of a shortage of skilled manpower. Its future is in its own hands, right now.

F.E.B.

**THIS MONTH****CONSTRUCTIONAL PROJECTS**

MUSICAL STAVE	370
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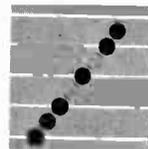
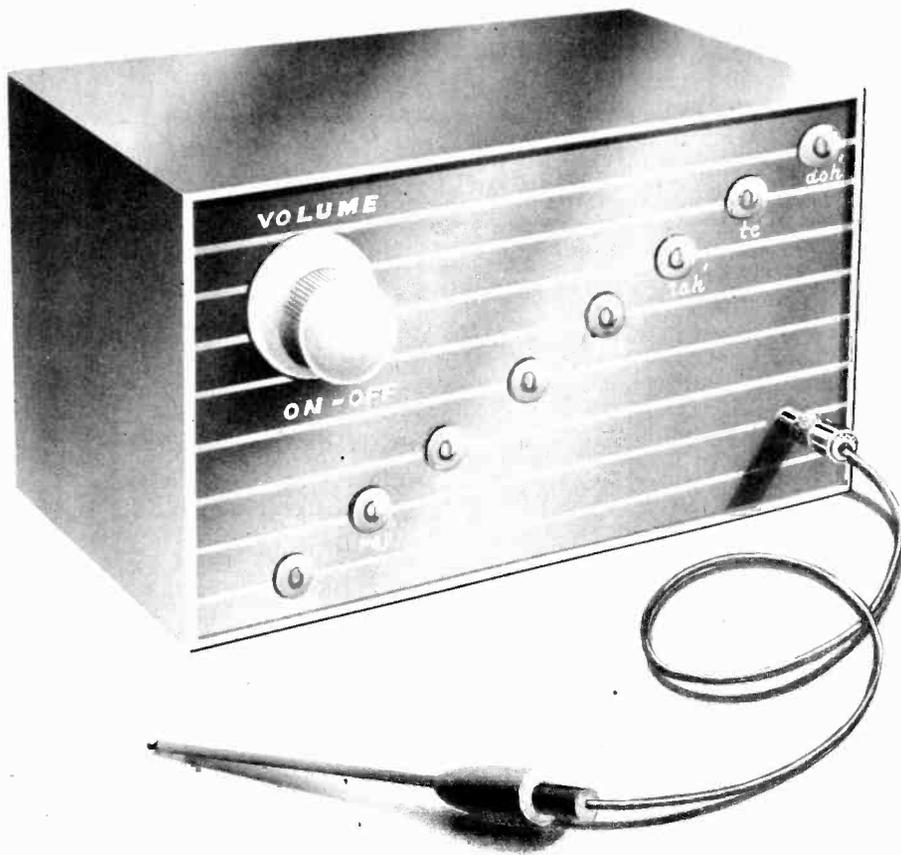
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*Our June issue will be published on  
Friday, May 15*

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# musical staff

By C. Cartlidge

THE simple instrument to be described was devised to provide children with an elementary teaching aid for an awareness of musical intervals in the treble staff.

Eight notes, with an appealing harmonic content, are available to the user by simply touching electric contacts with a baton. This eight note, diatonic scale, has syllable, or sol-fa identification so that melodies picked out can be easily sung.

With an overall frequency coverage from 200Hz to 2kHz, this instrument can be tuned within the piano range from middle C to nearly three octaves above.

Of course, only eight notes of a diatonic scale can be selected in this range but they can be chosen to suit a voice which means that a key note or commencing note *doh*, can be any one contained in the first two octaves from middle C.

## CIRCUIT DESCRIPTION

The tone generator circuit is given in Fig. 1. It is a simple astable multivibrator where frequency variation is made possible by linking different resistance values at the points x-x.

The chain of pre-set resistors which make up this arm, is given in Fig. 2. Note selection consists of shorting out resistances by applying a probe or baton, at the

appropriate sol-fa annotated contacts. The frequency of the note so selected can be approximately calculated by the equation:—

$$f = \frac{1}{0.7(C_1.R_T + C_2.R_3)} \text{ Hz}$$

where  $R_T$  is the total resistance between the base of TR2 and the negative line.

The output is taken from the emitter of TR2 to reduce the effect of loading by the following amplifier which would cause frequency changes.

A suitable amplifier for the output square waves is given in Fig. 3. Here the driver transformer has two secondaries, working in antiphase, two single-ended class B amplifiers. The bias resistor chain R12-R15 are chosen to offset crossover distortion of the output signal, an effect which would be apparent if ideal class B operation is worked.

## POWER OUTPUT

The maximum power produced can easily be estimated in an output stage of this kind, for the output transistors can be considered as causing point A in the Fig. 3 to swing between plus and minus 9 volts. This swing is sinusoidal so that the r.m.s. output voltage is

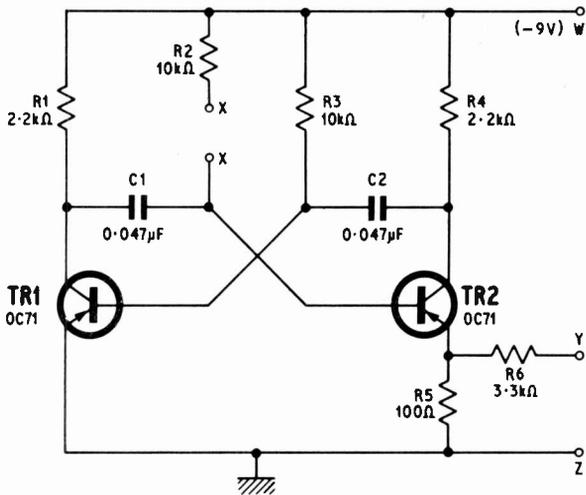


Fig. 1. Circuit of tone generator

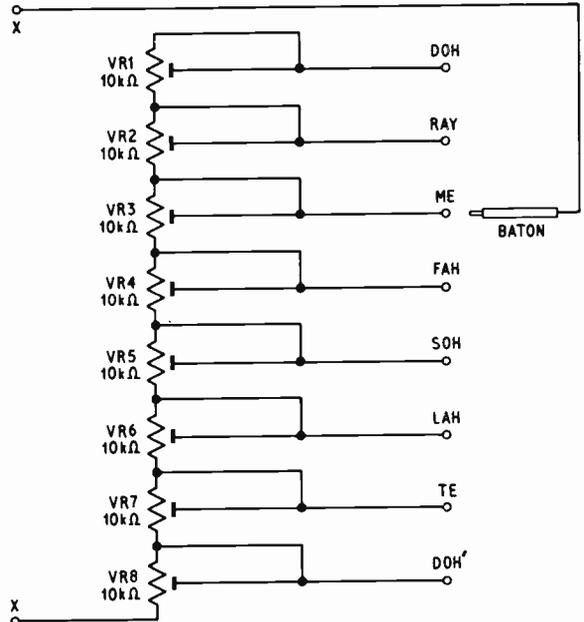


Fig. 2. Resistor chain used for varying frequency of tone generator

$9/\sqrt{2}$ . With a 35 ohm speaker load this means that the power available is approximately 1 watt which in practice is more than adequate.

### CONSTRUCTION

The tone generator, with the exception of the trimmers, and the amplifiers are mounted on a single perforated s.r.b.p. board. Wiring pins are used to fix these components and serve as wiring junctions. Fig. 4 shows the component and wiring layout which is entirely on one side of the board.

The exploded view of Fig. 5 shows how the board and associated components are mounted on a 10in by 5in by 6in plywood box. As can be seen, the back panel accommodates the eight note preset controls VR1-VR8; the front panel carries the touch plates for the baton, the amplifier volume control, and combined on/off switch.

### TOUCH PLATES

The eight touch plates are made up from 0B.A. nuts, bolts and washers with solder tags to make the connections to the wipers of the preset controls.

The bolts and washers face the panel arranged in a symmetrically spaced diagonal line with the nuts and solder tags completing the assemblies on the opposite face.

For the baton wire a  $\frac{1}{4}$ in hole should be drilled and a  $\frac{1}{4}$ in by  $\frac{1}{8}$ in rubber grommet fitted.

### LOUDSPEAKER

Before fitting the 35 ohm,  $3\frac{1}{2}$ in round loudspeaker, a 3in hole should be drilled in the end panel and this covered with a piece of plastics grille or fabric.

The s.r.b.p. board should now be mounted, using stand-off bushes and screws, and all flying leads connected.

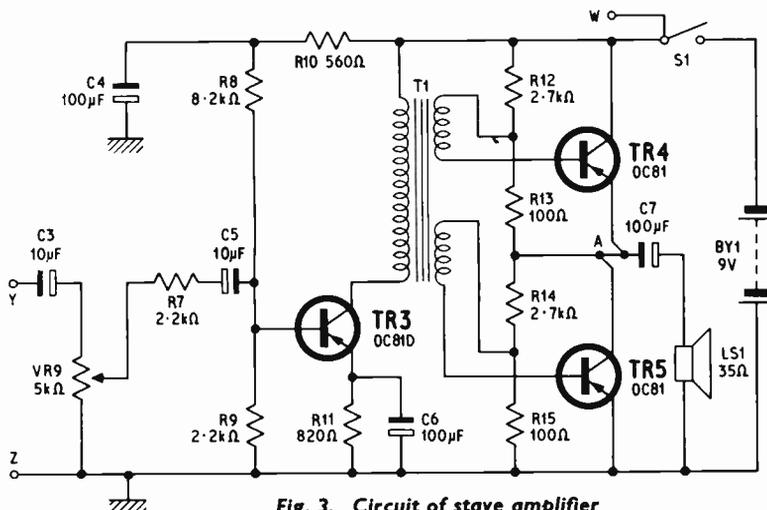
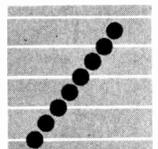


Fig. 3. Circuit of stage amplifier



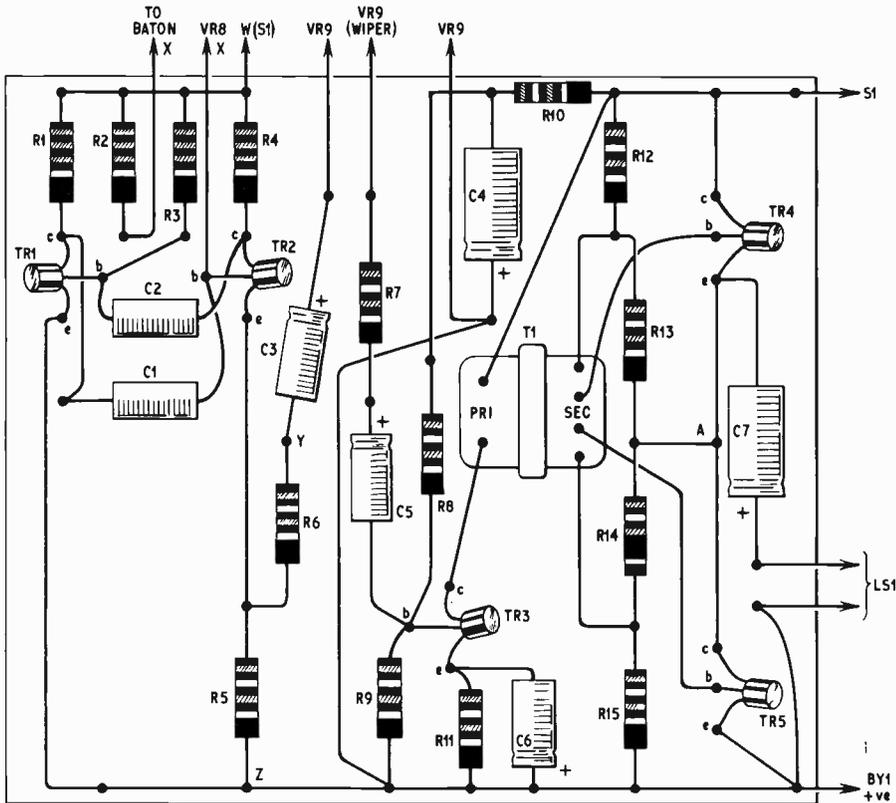


Fig. 4. Component layout and wiring of the s.r.b.p. board

## COMPONENTS . . .

### Resistors

R1 2.2k $\Omega$	R9 2.2k $\Omega$
R2 10k $\Omega$	R10 560 $\Omega$
R3 10k $\Omega$	R11 820 $\Omega$
R4 2.2k $\Omega$	R12 2.7k $\Omega$
R5 100 $\Omega$	R13 100 $\Omega$
All $\frac{1}{2}$ watt, 10% carbon	

### Capacitors

C1 0.047 $\mu$ F polyester	C6 100 $\mu$ F elect. 16V
C2 0.047 $\mu$ F polyester	C7 100 $\mu$ F elect. 16V
C3 10 $\mu$ F elect. 16V	
C4 100 $\mu$ F elect. 16V	

### Transistors

TR1 OC71	TR3 OC81D	TR5 OC81
TR2 OC71	TR4 OC81	

### Loudspeaker

LS1 35 $\Omega$  3in loudspeaker

### Potentiometers

VR1-VR8 10k $\Omega$  presets  
VR9 5k $\Omega$  log

### Transformer

T1 Transformer T/T5 (Radiospares)

### Miscellaneous

0B.A. bolt, nut, washers and solder tags, plywood, wire, s.r.b.p. board (Lektrokit LK-141), push fit solder pins (Lektrokit LK-3011), 6B.A. brass rod, knob

## BATON

The common contact, or baton, may be made up from a 6in length of 6B.A. brass rod and a 2ft length of stranded insulated wire connected and soldered to its end. A piece of sleeving is then pushed over the rod so as to cover the connection and leave about  $\frac{1}{4}$ in of the rod tip exposed. The free end of the wire should now be connected to the main chassis board.

In the prototype a proprietary test probe terminating on a coaxial plug and socket were used. Whilst this is more expensive it does facilitate easy removal when transporting.

The case panels can now be glued together using triangular wooden fillets at the corners for strength.

## TUNING

Initial tuning is as follows. The stove is switched on and the volume control turned up. The baton is applied to the lowest touch plate (low *doh* in fact) when a note should be heard. This note should fall within the compass of the first three octaves from middle C.

Any tonic, or first note, of the chosen scale should now be sounded on a piano within the first two octaves from middle C. When this keynote is decided upon,

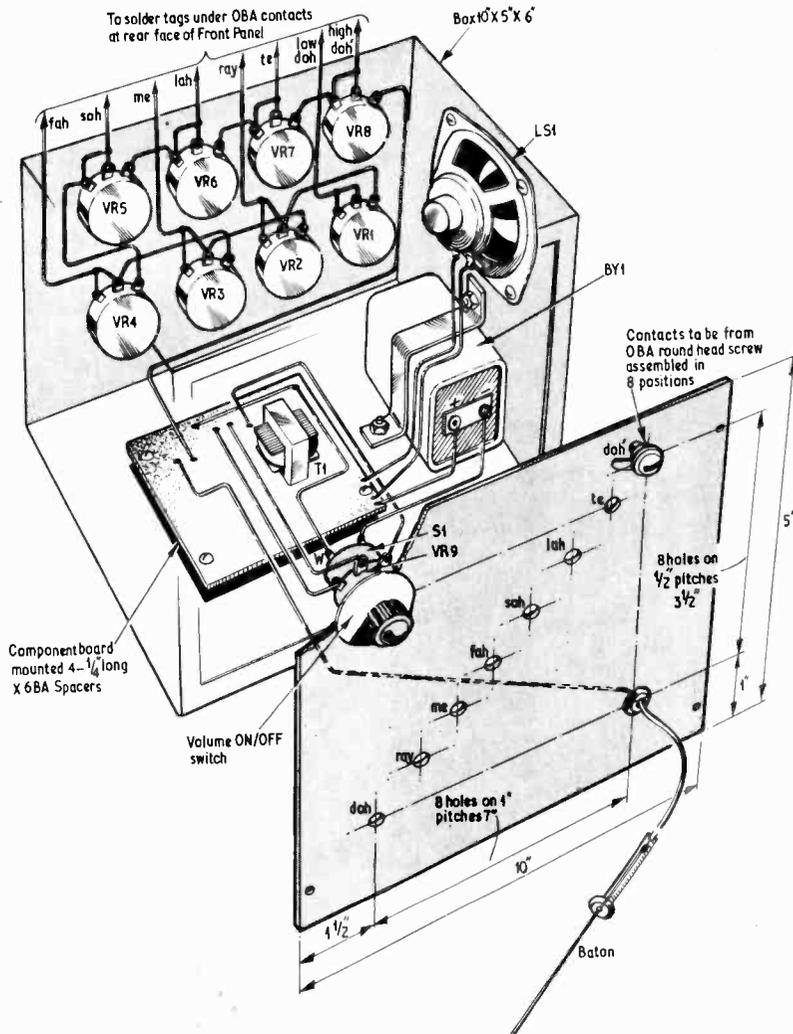


Fig. 5. Exploded view of the completed musical stave

potentiometer VR1 is carefully adjusted to provide an identical note with the one on the piano.

When this first note has been tuned the baton is held to the touch plate (*ray*), the second one up, and tuning to the second note of the chosen key on the piano continued.

This procedure is continued for the remaining six notes of the stave.

It should be mentioned here that skeleton presets should not be substituted for the potentiometers VR1-VR8 as the reduced track diameter makes accurate tuning difficult.

Whilst battery deterioration will change the frequency of the tonic, or commencing note of the scale, the drift from original tuning is not important as the intervals between notes will remain the same.

### USING THE STAVE

Anyone who wishes to develop skill in singing from staff notation will find the sol-fa syllables the best mnemonics to the related sounds.

To use this instrument, the simple written melody to be sung should be placed in front of the pupil. Suppose the tune was "Three Blind Mice" in the key of "C Major". Here the tonic is low *doh*.

With the instrument tuned to this key the baton is applied to the touch plate at low *doh*. The pupil should sing this tonic C which establishes the key.

The sol-fa pattern is now as follows:

Me, ray, *doh*;  
 Soh, fah, me, soh: soh fah, fah, me  
 Soh, *doh'*, *doh'*, te, lah, te, *doh*, soh, soh  
 Soh, *doh'*, *doh'*, *doh'*, te, lah, te, *doh'*, soh, soh  
 Soh, *doh'*, *doh'*, *doh*, te, lah, te, *doh'*, soh, soh, soh  
 Fah, me, ray, *doh*.

After practice in this key with other simple nursery rhymes, the pupil will have established the link between "sol-fa-ing", which gives the sounds, and the tune's staff notation, which gives the musical symbols.

Other keys can be tried if the stave is retuned. Here, of course, low *doh* will be the tonic of the new scale.



# MARINE TACHOMETER

By C. M. Dance and D. W. Nelson

Boating is an increasingly popular pastime and is now within the financial reach of almost everyone. The tachometer described in this article is designed to aid the small boat owner particularly when using an outboard motor.

This tachometer can also be used with almost any engine, including motorcycle and car engines

**A**PART from the normal safety precautions one takes while "riding the waves" it is worth sparing a thought for the boat's engine; after all a motor car engine is well monitored by instruments so why not a marine engine. To monitor the engine revs is a very useful thing when dealing with a high revving outboard motor, not only for the obvious reasons as regards fuel economy and engine life but also with respect to "cavitation". This is the phenomenon whereby air gets trapped in and around the propeller blades giving rise to very poor engine performance. By employing a tachometer, cavitation may be easily spotted and corrected—a sharp increase in engine revs would indicate that cavitation is taking place.

The unit described is ideal for a one or two cylinder two-stroke outboard engine of either the magneto or battery type.

## TACHOMETER CIRCUIT

The tachometer circuit is shown in Fig. 1. A simple monostable multivibrator is used (TR1 and TR2); TR1 is normally non-conducting (this being the stable state), its base being held at three volts positive by the bias battery. C2 and R3 form a differentiating network giving one positive and one negative pulse for each input square wave from the contact breakers. Diode D1 is employed to eliminate the positive going spike and ensures reliable triggering. The average current in the collector of TR1 is monitored by a 500 microamp moving coil meter which acts as a simple pulse integrator. Since the collector current will be directly proportional to the triggering frequency, determined by

the engine revolutions, the meter may be directly calibrated in terms of revs per minute. The accuracy of the reading is determined essentially by the accuracy of the meter used. The meter used was the edgewise type and could be either a Sew or a Taylor type. Of course the larger the meter used the better, but any 0-500 microammeter may be used with reasonable accuracy.

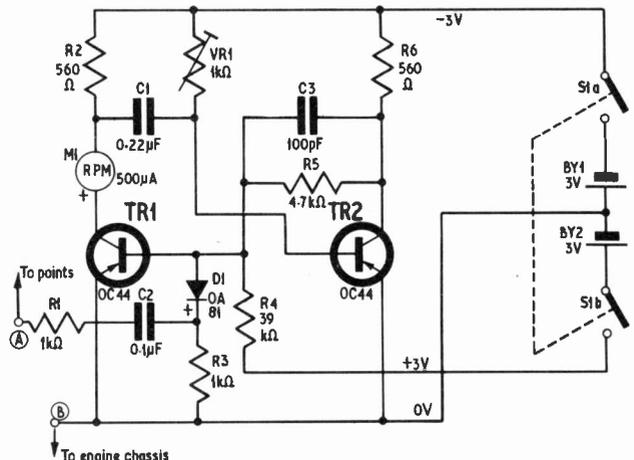


Fig. 1. Circuit diagram of the marine tachometer

The meter scale can be altered to read directly in engine revs per minute, the relevant maximum revs as quoted by the engine manufacturer being marked directly on the new scale.

Practically any transistors may be used in the circuit without affecting performance. Good quality silicon transistors will decrease the effect of temperature on circuit operating conditions.

### TACHOMETER CONSTRUCTION

Tag board may be used to accommodate the components if desired although in the original unit a printed circuit board was employed to give greater reliability. The circuit board is shown actual size in Fig. 2 together with component layout and wiring details. When making the board it is best to trace around the diagram shown and use this as a pattern.

## COMPONENTS . . .

#### Resistors

- R1 1k $\Omega$
  - R2 560 $\Omega$
  - R3 1k $\Omega$
  - R4 39k $\Omega$
  - R5 4.7k $\Omega$
  - R6 560 $\Omega$
- All  $\pm 10\%$ ,  $\frac{1}{4}$  watt carbon

#### Capacitors

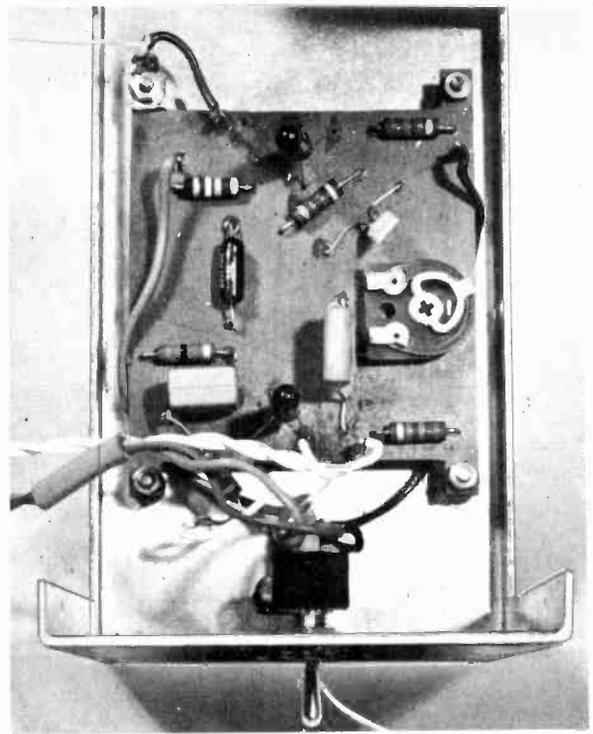
- C1 0.22 $\mu$ F 200V
- C2 0.1 $\mu$ F 200V
- C3 100pF

#### Semiconductors

- TR1, 2 OC44 or equivalent (2 off)
- D1 OA81

#### Miscellaneous

- M1 500 $\mu$ A moving coil meter (edgewise type)
- VR1 1k $\Omega$  skeleton preset potentiometer
- S1 D.P.S.T. toggle switch
- BY1, 2 3V battery (2 off)
- Copper laminate board  $2\frac{3}{8}$ in  $\times$   $2\frac{1}{2}$ in
- Case (see text)
- Clips and 6B.A. fixings



After etching away the excess copper the respective holes are drilled using a 0.8mm drill. It is advisable to use a heat sink such as a pair of long nosed pliers when soldering the transistors and diodes into place. To fix the variable resistor VR1 in place it will be necessary to enlarge the two drilled holes slightly. I cut off one of the connecting pins. To facilitate mounting the board, three holes are provided, the copper being etched away around the hole in the -3V segment. Screws and spacers are used to mount the panel.

The entire unit plus batteries is best housed in a plastic or Duraloy box to minimise temperature effects and protect the unit against the elements. In the prototype a 4in  $\times$  3in  $\times$  4in case was used to house the meter, batteries and circuit board, the batteries being firmly located in the case using spring clips which are insulated from the case with fibre washers and nylon screws.

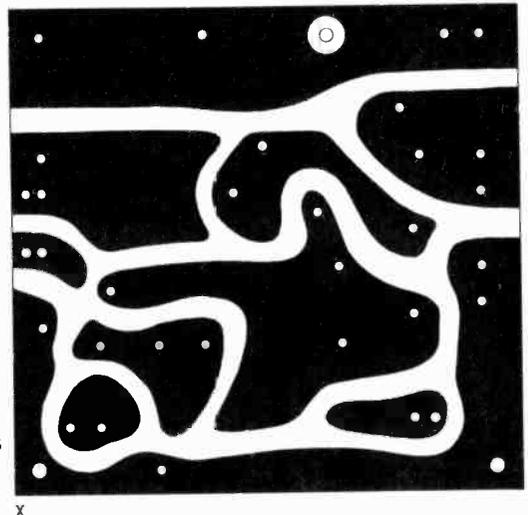
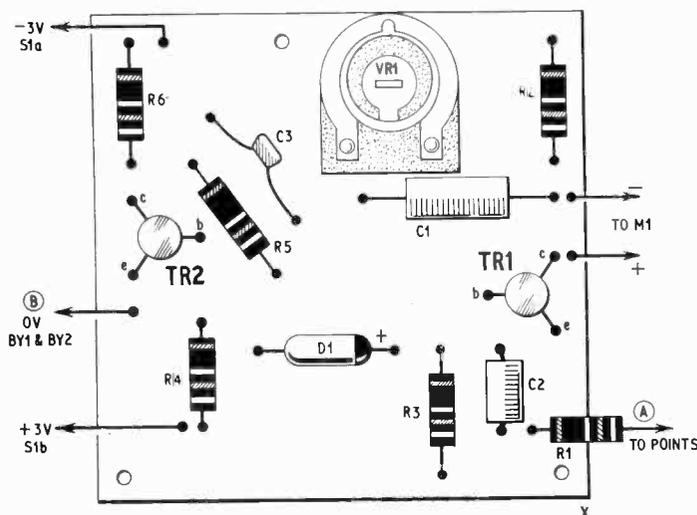
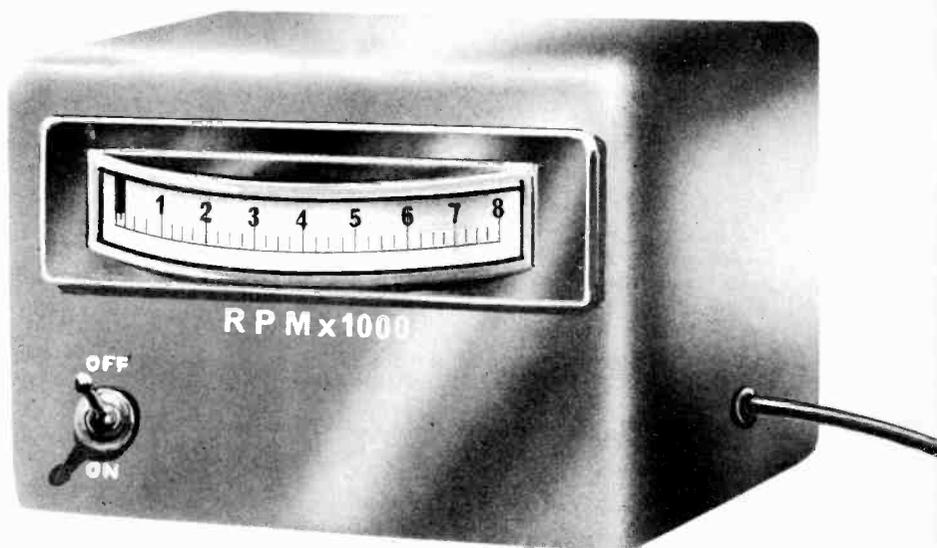


Fig. 2. Circuit board layout and wiring diagram

Completed tachometer housed in a water resistant case, showing the linear meter scale for a maximum r.p.m. reading of 8,000



**Table 1. TACHOMETER CALIBRATION FREQUENCY CORRESPONDING TO 1,000 r.p.m.**

No. of cylinders	Frequency	
	2 stroke	4 stroke
1	16.7Hz	8.4Hz
2	33.4Hz	16.7Hz
3	50Hz	—
4	—	33.4Hz
6	—	50Hz
8	—	67Hz

The connection marked OV(B) in Fig. 2 is taken to the centre connection of BY1 and BY2, to earth on the tachometer case and to earth on the engine.

In the case of multi-cylinder engines, triggering pulses may be obtained by connecting the zero rail (B) to the engine chassis, and one end of R1 (A) to the contact breakers. For a single cylinder engine, pulses may be obtained either as above or by using a ten turn pick up coil of 24 s.w.g. enamelled copper wire wound around the spark plug h.t. lead and connected to (A).

#### CALIBRATION

Once the device has been completed, it is ready for calibration. Before the actual calibration is carried out the full scale reading of M1 must be decided upon, this will depend on the engine with which the tachometer is to be used but will probably be in the region of 6,000 to 8,000 r.p.m. Once the full scale reading has been decided the meter scale can be divided up into equal 1,000 r.p.m. segments. The meter can then be adjusted for zero using the set screw on the meter case.

Calibration is best carried out using a low frequency square wave generator giving an output of between 6 and 10 volts. The frequency settings to give a reading corresponding to 1,000 r.p.m. are shown in Table 1.

These frequencies are given for both two stroke and four stroke engines, enabling the tachometer to be used with almost any engine.

To calibrate the tachometer the required frequency is selected and VR1 adjusted so that the meter indicates 1,000 r.p.m.

The device may also be calibrated by direct comparison with another tachometer if desired. By this method both tachometers are placed in parallel, the engine throttled up to a suitable speed and VR1 adjusted so that both tachometer readings are the same.

Once calibration has been carried out the resistance of VR1 may be determined and a high quality wire wound resistor used in its place if desired, thus minimising temperature effects.

One last point is worth mentioning; unless the unit is to be fitted inside a car it should be waterproofed to protect the components from the elements. ★

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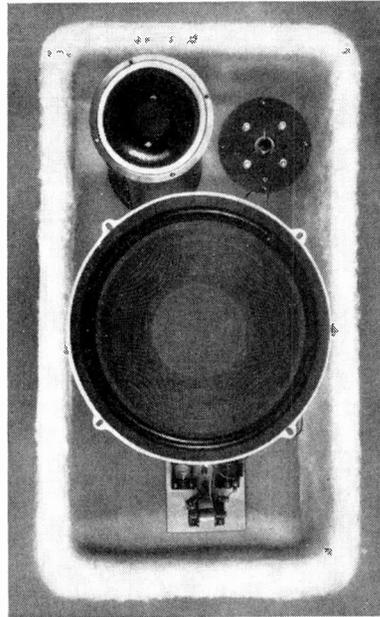
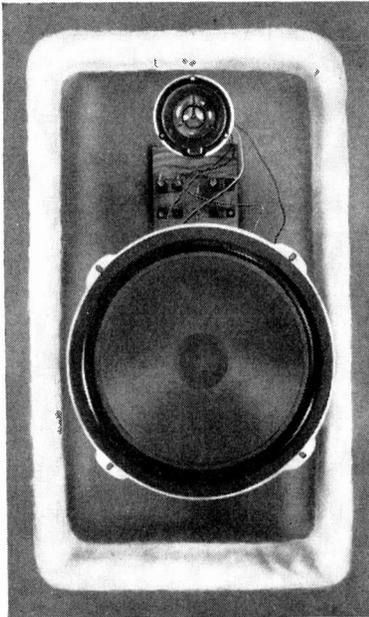
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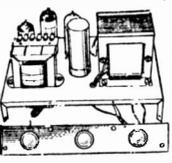
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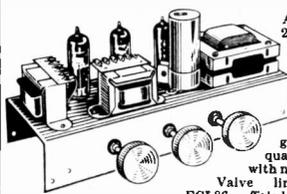
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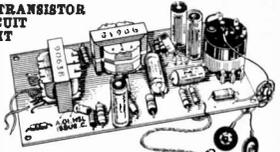
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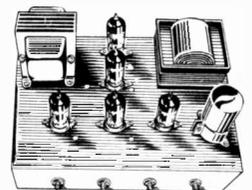
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# DEMO SWITCHING CIRCUITS

6

## BINARY DIVIDER

By B. Pounder

THE bistable multivibrator described last month can be extended to provide some useful switching functions. A gated alarm system described below uses a bistable, whereby trigger pulses set the circuit to switch on an oscillator.

Further modification to the basic bistable circuit can convert it to perform binary division, as described later.

### GATED ALARM

The  $\mu$ -Dec circuit shown in Fig. 6.1 illustrates the 5mA bistable, considered previously, coupled to an audio frequency relaxation oscillator. Except for TR3, the oscillator is exactly the same as that described in last month's article. The circuit is set initially so that TR2 is on. This can be done by momentarily shorting the base and emitter leads of TR1.

When TR2 is on, its collector voltage is approximately zero, so there will be no base current path for TR3. This transistor is therefore off, so TR4 is also off, for TR3 and TR4 are connected in series.

If the trigger link of C1 is in socket 2C, C1 will be charged to the supply voltage. On swinging the trigger link to socket 1C, C1 will discharge, then on swinging

back to 2C, the circuit will trigger. TR2 turns off on triggering, and its collector voltage rises to that of the supply. R7 is now able to pass base current into TR3 which switches on; this in turn allows the relaxation oscillator to operate and produce an audible alarm note. The alarm is reset by a similar operation of the trigger link of capacitor C2. The base current resistor R7 is easily calculated.

The on collector current of TR4 is chosen as 2mA, so assuming a minimum  $h_{FE}$  of 20, the maximum base current which must be supplied will be 0.1mA. Thus  $R_7 = 6/0.1 = 60$  kilohms (68k $\Omega$  can be used). The circuit can be assembled on a pair of S-Decs or one  $\mu$ -Dec as shown in the photograph.

### SPEED-UP OR COMMUTATING CAPACITORS

The presence of stray base-emitter capacitances has been ignored in the paragraphs above. Although these strays are small, they are not necessarily unimportant, for it must be noted that they must be charged by the applied trigger voltage before the base voltages reach their triggering values.

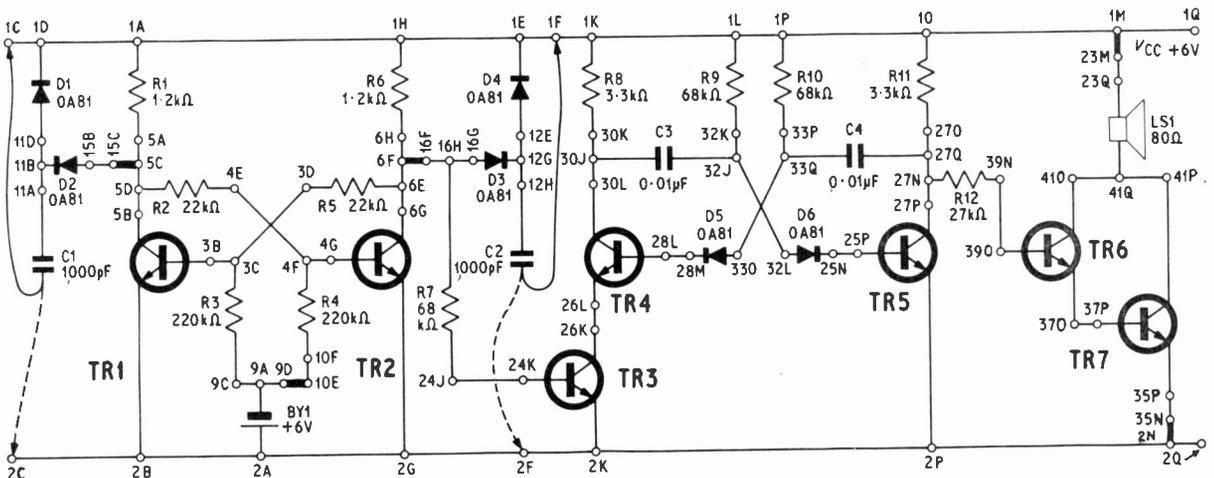
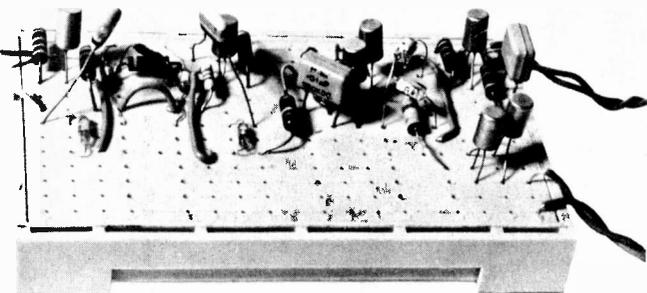


Fig. 6.1. Gated alarm circuit with  $\mu$ -Dec connections. The bistable TR1 and TR2 triggers a relaxation oscillator TR4 and TR5 via TR3. The sound is amplified by TR6 and TR7 and fed to an 80 ohm loudspeaker. Positive and negative trigger pulses are supplied by the connection of C1 or C2 to either supply rail



Gated alarm circuit made up on  $\mu$ -Dec

The strays reduce the rates at which the base voltages change, and if the rates are so slow that the trigger pulse has been removed before any appreciable change can take place in a base voltage, triggering may not occur. This possibility can be eliminated by connecting speed-up or commutating capacitors between the collector of each transistor and the base of the other as shown in Fig. 6.2a.

With the speed-up capacitor in the circuit, any change in voltage at the collector of, say, TR2 will be coupled rapidly to the base of TR1 provided that the speed-up capacitor is large enough to swamp the effect of the stray at the base of TR1. We are in effect, converting an integrating circuit comprising the coupling resistor R2, in series with the input impedance of the transistor, into a differentiating circuit, comprising C and the

input impedance of the transistor. The effects are illustrated in Fig. 6.2b.

The calculation of suitable values for speed-up capacitors is difficult, the equations requiring a knowledge of the physical processes which take place within a transistor when it is switched from a state of saturation to cut-off. The usual procedure is to find by trial and error a value which ensures reliable switching at the highest operational trigger frequency.

## BINARY DIVIDER

We saw in the previous article how the bistable multivibrator could be switched by the application of SET and RESET trigger pulses. The circuit acted as a "gate", being "opened" by the SET pulse and "closed" by the RESET pulse. A useful modification is achieved by connecting both the input terminals together in such a way that triggering takes place on receipt of any of a train of input pulses.

A bistable multi operated in this way is called a "binary divider". A circuit is shown in Fig. 6.3a. Note that this circuit is the same as that shown in Fig. 5.5 of the previous article except that the SET and RESET terminals have been strapped together as a single trigger input.

The important voltage waveforms of the circuit are shown in Fig. 6.3b. Note that since we are assuming that *n*p*n* transistors are used, triggering occurs on the negative-going edges of the input pulses (see last month's article).

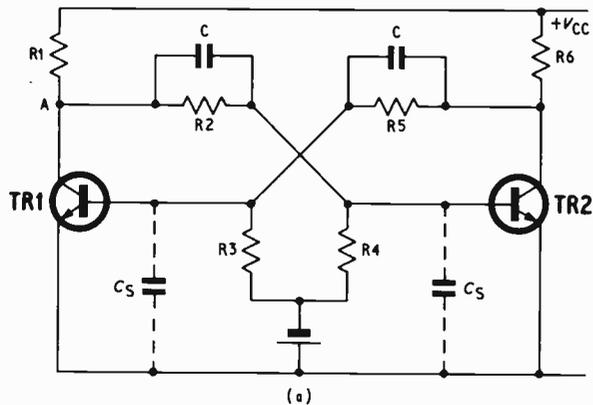


Fig. 6.2a. Speed-up capacitors marked C are connected across the coupling resistors to ensure triggering

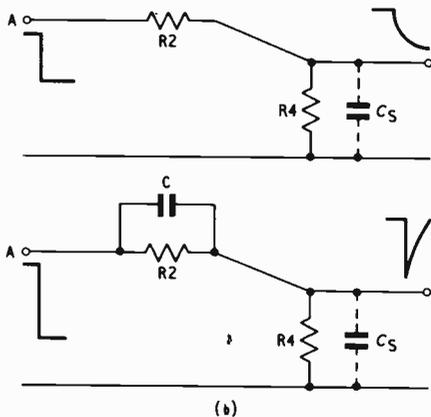


Fig. 6.2b. The effect of applying commutating capacitors to overcome the stray capacitors  $C_s$

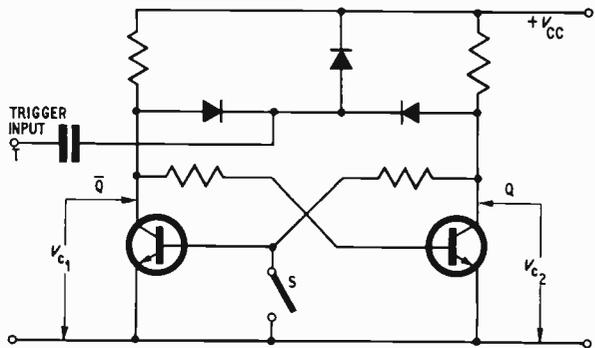


Fig. 6.3a. Bistable used as a binary divider

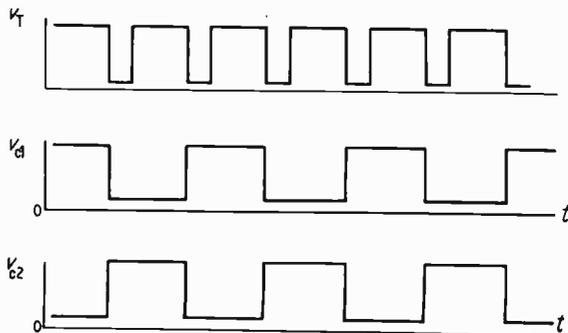
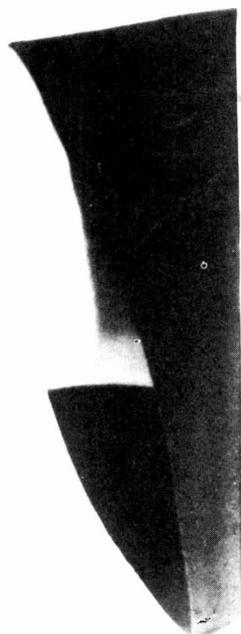


Fig. 6.3b. Waveforms for the binary divider

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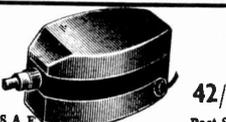
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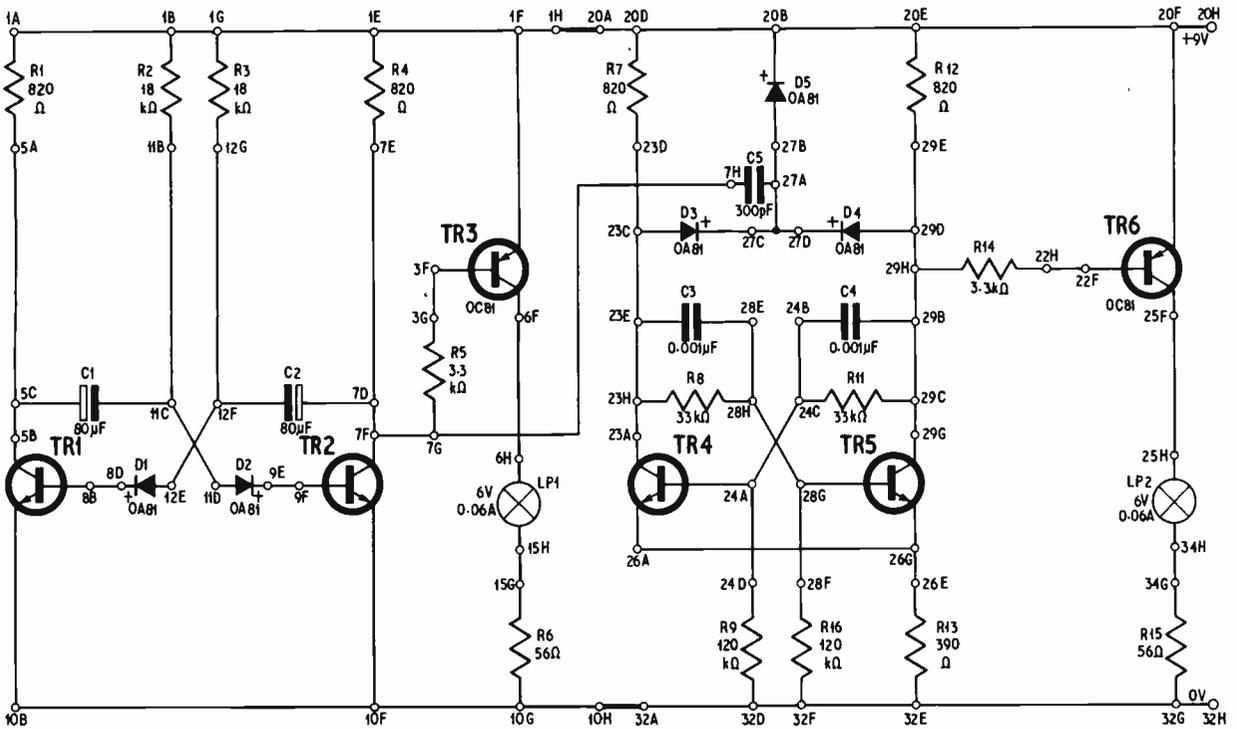


Fig. 6.4. Circuit of practical square wave generator and  $\div 2$  divider with T-Dec connections

## BINARY DIVISION

Suppose that the link S in Fig. 6.3a is momentarily closed to ensure that TR1 is off. The collector voltage  $V_{c1}$  of this transistor will therefore be at the supply voltage  $V_{cc}$ . The collector voltage of TR2 will be approximately zero. Now if a train of trigger pulses is applied to the trigger input T, the circuit will switch on receipt of each member of the train, and voltage changes, such as those illustrated in Fig. 6.3b, will occur. Examination of these waveforms immediately shows up an important property of the circuit: for every two input pulses, there will be one output pulse. The circuit acts as a "divide by two" or binary divider.

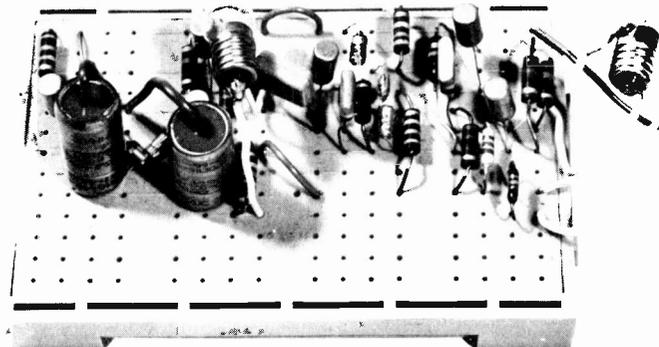
## CIRCUIT EXAMPLE

A demonstration circuit is shown in Fig. 6.4. It consists of a low frequency astable multivibrator (TR1 and TR2), a binary divider (TR3 and TR4), and lamp driver stages TR5 and TR6. The outputs from the astable multi and the binary are made visible simultaneously. Component values for the circuit are calculated according to the design procedures outlined in previous articles in this series.

An alternative demonstration circuit can be made up by increasing the frequency of the astable multi to about 2kHz and replacing the lamp driver stages by simple amplifiers each driving a small loudspeaker. The circuit shown earlier in connection with the gated alarm would be suitable.

## BINARY COUNTER

If a number of binaries are connected in cascade, division of a train of input pulses by 2, 4, 8, 16, and so on, occurs at each output. However, in addition to this property of frequency division, the circuit can also be used to count the number of trigger pulses applied.



Square wave generator and  $\div 2$  divider made up on T-Dec

To see how this is achieved, first let us label the collectors of TR1 and TR2 in Fig. 6.4 by  $\bar{Q}_1$  and  $Q_1$  respectively. Now suppose that four binaries are connected in cascade; the Q output of binary 1 is connected to the T input of binary 2; the Q2 output of binary 2 is connected to the T input of binary 3, and so on. This is illustrated in Fig. 6.5.

Further, suppose that each of the binaries is first set so that TR1 is off and TR2 is on. This could be done by means of a trigger link such as S shown in Fig. 6.3a.

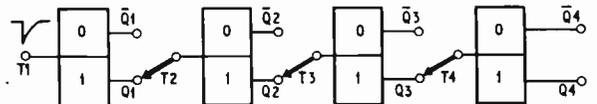


Fig. 6.5. Block diagram of a binary counter chain of dividers with trigger inputs T2, T3, T4 switchable to either preceding binary output

**Table 6.1. LOGIC OUTPUT FROM EACH STAGE**

Input	$\bar{Q}_1$	$\bar{Q}_2$	$\bar{Q}_3$	$\bar{Q}_4$	$Q_1$	$Q_2$	$Q_3$	$Q_4$
Initial condition	0	0	0	0	1	1	1	1
Just after pulse no.	1	1	0	0	0	1	1	1
" " " "	2	0	1	0	0	1	0	1
" " " "	3	1	1	0	0	0	0	1
" " " "	4	0	0	1	0	1	1	0
" " " "	5	1	0	1	0	0	1	0
" " " "	6	0	1	1	0	1	0	0
" " " "	7	1	1	1	0	0	0	0
" " " "	8	0	0	0	1	1	1	0
" " " "	9	1	0	0	1	0	1	1
" " " "	10	0	1	0	1	1	0	1
" " " "	11	1	1	0	1	0	0	1
" " " "	12	0	0	1	1	1	0	0

The collector voltage of each TR1 transistor is now equal to the supply voltage  $V_{CC}$ , while each TR2 collector voltage is almost zero.

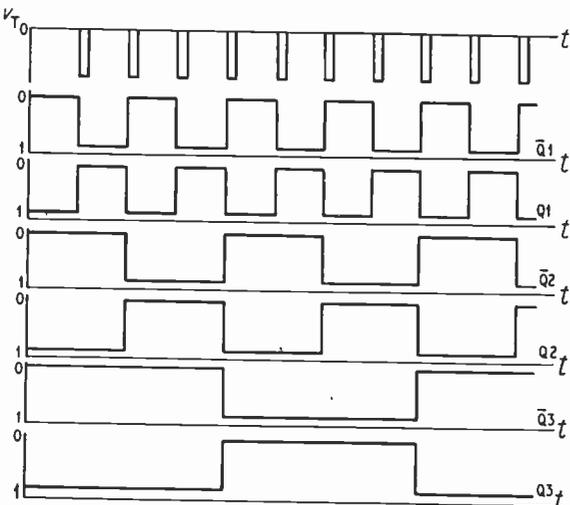
Label these collector voltages by means of a "0" or a "1". Let  $V_{CC}$  be denoted by "0", and zero voltage be denoted by "1". (This uses a system known as negative logic.) Thus at the start, all the  $\bar{Q}$  outputs are at "0" and all the Q outputs are at "1". This situation is shown in the first row of Table 6.1.

**LOGIC SWITCHING**

Now let a negative-going pulse be applied to the input T1. Because it is negative-going, it causes the first binary to switch so the collector of TR1 drops from  $V_{CC}$  to almost zero voltage while the collector of TR2 rises from almost zero voltage to  $V_{CC}$ . In other words,  $\bar{Q}_1$  changes from "0" to "1" while  $Q_1$  changes from "1" to "0".

The  $Q_1$  change is coupled to input T2 of the second binary, but because it is a rising voltage (i.e. positive-going) it has no effect on this second binary. Now apply a second trigger to the first binary.

It switches again, but this time  $\bar{Q}_1$  changes from "1" to "0" while  $Q_1$  changes from "0" to "1". This change in  $Q_1$  is negative-going, so it causes the second binary to switch. Thus  $\bar{Q}_2$  changes from "0" to "1" while  $Q_2$  changes from "1" to "0". The change in  $Q_2$  is positive-going so has no effect on binary 3.



**Fig. 6.6. Collector voltage waveforms of the binary counter**

If we allow more and more input pulses to trigger binary 1,  $Q_1$  causes binary 2 to trigger whenever it changes from "0" to "1";  $Q_3$  causes binary 3 to switch whenever it changes from "0" to "1", and so on. The successive states of the outputs are shown in Table 6.1 and also in Fig. 6.6 which shows the collector voltage waveforms.

**DECIMAL TO BINARY**

Now consider something quite different. Taking a decimal number such as 5, we can write this number as the sum of a succession of powers of 2 as follows:  $5 = 1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 0 \times 2^3$ . (Note that any number raised to the power zero equals 1.)

Similarly, the decimal number 6 can be written as:

$$6 = 0 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 0 \times 2^3$$

For each row of "0"s and "1"s in Table 6.1, the decimal number is given in the left-hand column. They are read in the same way as the "0"s and "1"s which precede the multiplication signs in the two examples above.

Thus the states of the output terminals  $\bar{Q}$  immediately tell us how many input trigger pulses have been applied, up to a maximum determined by the number of binaries in the cascade. The number appears however in binary notation rather than in decimal notation.

Part 7 next month is the final article in this series, in which the binary divider circuit is further expanded to make a decade divider.

**CORRECTION**

In the article on the "Monostable Multi" in the February issue, the following line should be inserted immediately after equation 1 (page 151): "which shows the change in voltage that takes place following triggering".

# NEWS BRIEFS

## Time Division Multiplex Slide Display

A TRI-PICTURE colour slide display, in which any combination of three adjacent screens can show one, two, or three pictures at once, is being used with an exhibition touring the designated area of new Milton Keynes city development in Buckinghamshire.

The fully automatic display, produced by Viscon Ltd., employs time division multiplex pulsed tape recordings, with sound track, and nine 35mm Kodak projectors. The electronic control equipment is being provided by Electro-sonic Ltd. A similar type of display for the Irish Government will be used at the Osaka World Fair in Japan.

## Post Office Progress

THE first few months of 1970 have seen more than one jump ahead, in technical methods, by the Post Office.

A fully automatic telephone service for every telephone customer in the United Kingdom came a step nearer recently when the Post Office's North-East Region became the first region in the country to have all its telephones working through automatic exchanges.

This milestone was reached with the opening of a new electronic telephone exchange at Corbridge, Northumberland. It was the last manually operated exchange in the region to be converted to automatic working.

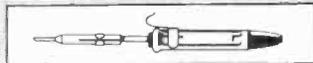
The Post Office-space aerial at Goonhilly in Cornwall recently handled the first television broadcasts between this country and the new Australian aerial at Ceduna in South Australia. This is the beginning of regularly available direct television service with Australia.



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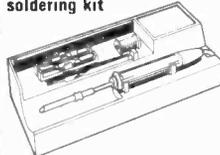


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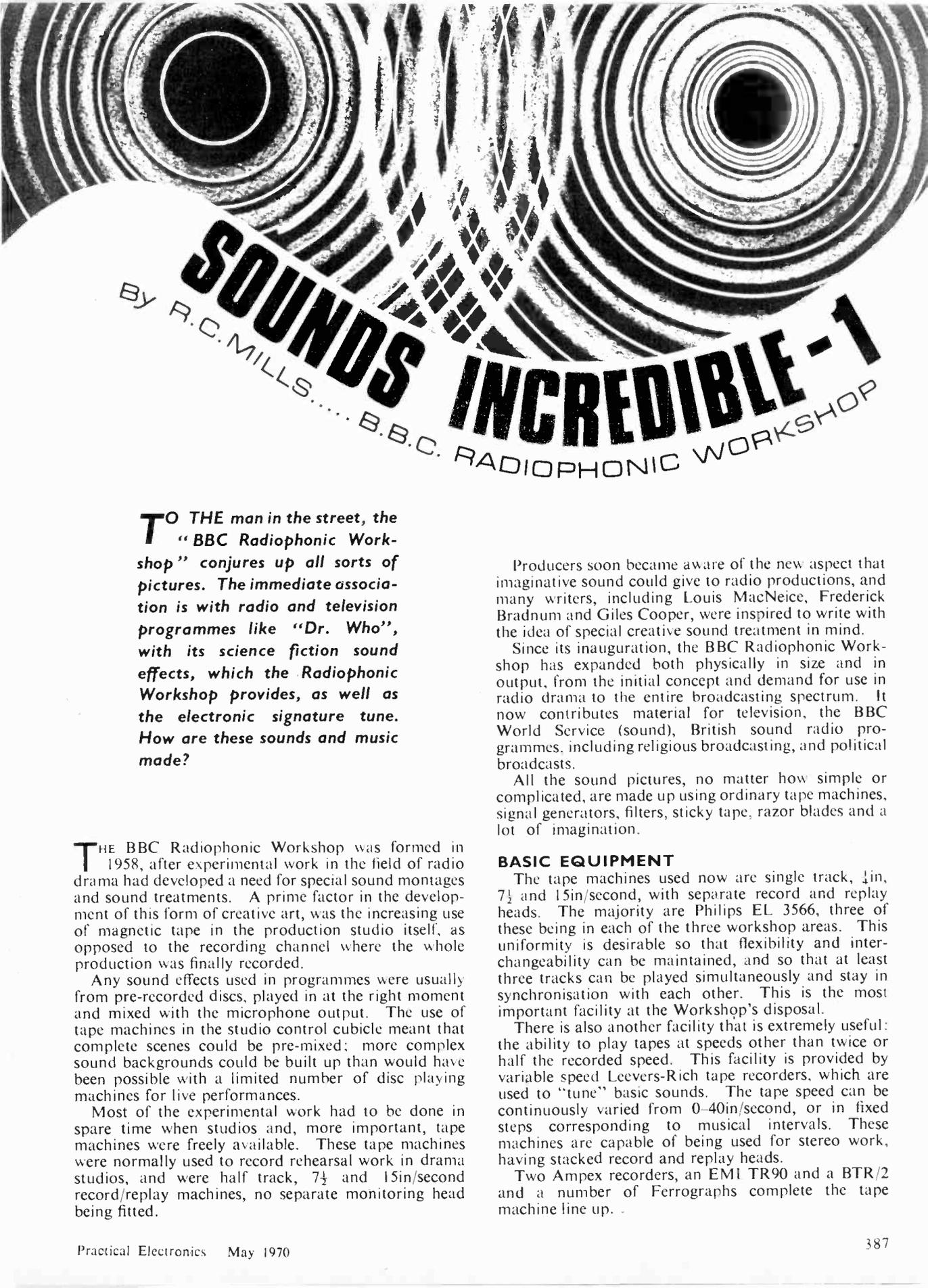
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BY R.C. MILLS..... B.B.C. RADIOPHONIC WORKSHOP

# INCREDIBLE - 1

**T**O THE man in the street, the "BBC Radiophonic Workshop" conjures up all sorts of pictures. The immediate association is with radio and television programmes like "Dr. Who", with its science fiction sound effects, which the Radiophonic Workshop provides, as well as the electronic signature tune. How are these sounds and music made?

**T**HE BBC Radiophonic Workshop was formed in 1958, after experimental work in the field of radio drama had developed a need for special sound montages and sound treatments. A prime factor in the development of this form of creative art, was the increasing use of magnetic tape in the production studio itself, as opposed to the recording channel where the whole production was finally recorded.

Any sound effects used in programmes were usually from pre-recorded discs, played in at the right moment and mixed with the microphone output. The use of tape machines in the studio control cubicle meant that complete scenes could be pre-mixed: more complex sound backgrounds could be built up than would have been possible with a limited number of disc playing machines for live performances.

Most of the experimental work had to be done in spare time when studios and, more important, tape machines were freely available. These tape machines were normally used to record rehearsal work in drama studios, and were half track,  $7\frac{1}{2}$  and 15in/second record/replay machines, no separate monitoring head being fitted.

Producers soon became aware of the new aspect that imaginative sound could give to radio productions, and many writers, including Louis MacNeice, Frederick Bradnum and Giles Cooper, were inspired to write with the idea of special creative sound treatment in mind.

Since its inauguration, the BBC Radiophonic Workshop has expanded both physically in size and in output, from the initial concept and demand for use in radio drama to the entire broadcasting spectrum. It now contributes material for television, the BBC World Service (sound), British sound radio programmes, including religious broadcasting, and political broadcasts.

All the sound pictures, no matter how simple or complicated, are made up using ordinary tape machines, signal generators, filters, sticky tape, razor blades and a lot of imagination.

## BASIC EQUIPMENT

The tape machines used now are single track,  $\frac{1}{2}$ in,  $7\frac{1}{2}$  and 15in/second, with separate record and replay heads. The majority are Philips EL 3566, three of these being in each of the three workshop areas. This uniformity is desirable so that flexibility and interchangeability can be maintained, and so that at least three tracks can be played simultaneously and stay in synchronisation with each other. This is the most important facility at the Workshop's disposal.

There is also another facility that is extremely useful: the ability to play tapes at speeds other than twice or half the recorded speed. This facility is provided by variable speed Leever-Rich tape recorders, which are used to "tune" basic sounds. The tape speed can be continuously varied from 0.40in/second, or in fixed steps corresponding to musical intervals. These machines are capable of being used for stereo work, having stacked record and replay heads.

Two Ampex recorders, an EMI TR90 and a BTR/2 and a number of Ferrographs complete the tape machine line up.

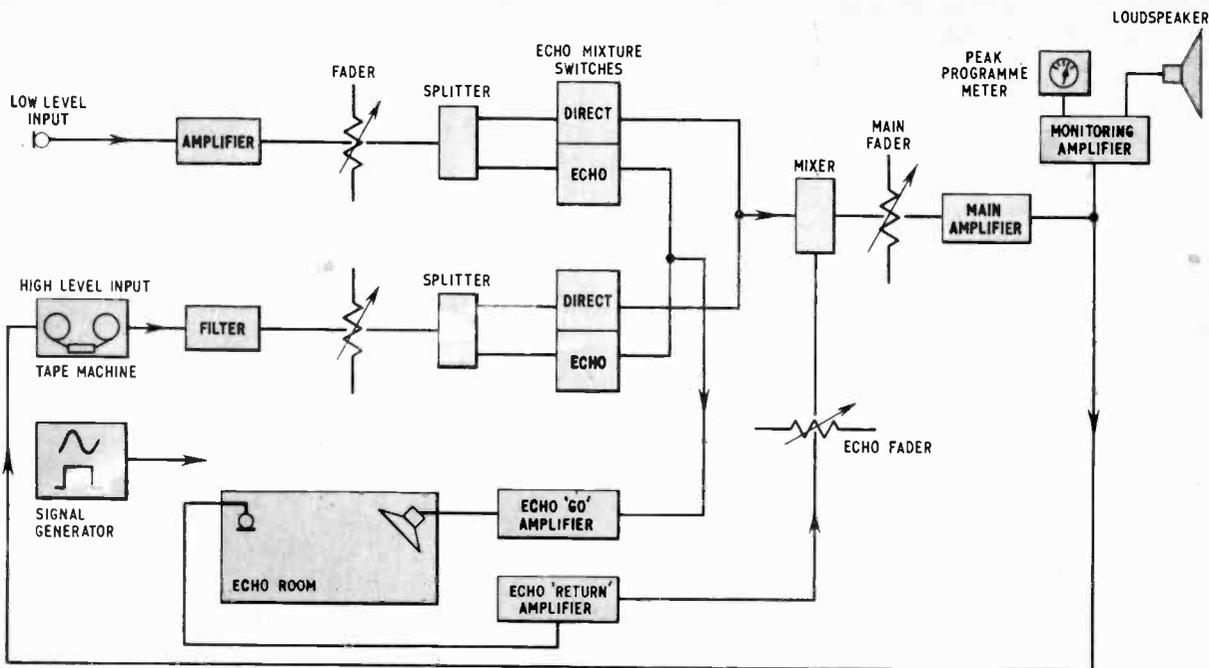


Fig. 1. Typical block diagram of a sound effects set-up for adding effects to a programme

## SOUND SOURCES

The signal generators produce both sine and square waveforms over a frequency range 10Hz to 100Hz. Two other signal generators produce sine waves only, but with continuous frequency sweep. Modulated output is also available. These are used in conjunction with an accurate master oscillator that is used as a reference when tuning.

The electronic sound sources are completed with a "white noise" generator, which produces a sound like escaping steam. This can be filtered to give different "shades" of sound, "pink noise", "brown noise", and so on.

All electronic signal generators produce no noise in themselves, and the "note" is only heard when converted into sound energy by the loudspeaker. One

virtue of this is that, as these sounds are recorded directly, they are not marred by extraneous noises, and can be treated "on the way" to the recording machine.

## FILTERS

The filters used are of two types, passive and active. In the first type, the sound is attenuated at certain frequencies, i.e. 3,200, 1,600, 800, 400, 200Hz top cut, and 220, 440, 880, and 1,760Hz bass cut. Being passive filters, there is no compensating amplification and the sound level or volume is decreased with increasing filtering.

The active filters consist mainly of BBC designed equipment which give top cut and boost, bass cut and boost, and a peak at certain selectable frequencies around 1-5kHz, to give "presence" effect.



General view of the BBC Radiophonic Workshop. In the background is a bank of signal generators, keying unit and oscilloscope. The EMI BTR/2 tape recorder is in the centre. Behind this are the jackfields associated with the mixing desk (behind TR90 recorder on left)

Both types of filters have bypass switches fitted, which progressively insert or remove the effect of the filter, so that certain prerecorded sounds can be filtered if necessary without affecting adjacent passages. A new sound quality can also be created gradually for dramatic effect, and equally gradually removed, without any sudden audible step which might disturb and break continuity of mood.

Other filters available are octave and one third octave filters for more specialist work.

These are the tools of the trade, and with one other important item, the microphone, the scene is set for work. Every sound that can be recorded is our basic material, and anything that gives the required sound is pressed into service, including the human voice.

## WORKSHOP LAYOUT

As each of the three "Workshop" areas is similarly equipped, a description of the basic pattern of equipment may not come amiss.

another for treatment such as "feedback", and the third for recording the final result.

It should be understood that in all references to sound treatment by means of tape machines, the machines are of the three head type, i.e. with separate record and replay heads.

A word about "feedback", a phenomenon quite common these days. If a tape machine is set to "record" and the machine's replay fader is left open on the desk, a "howl-round" or feedback path is established.

If this feedback is controlled, a repetitive echo is obtainable, the repetition rate of which is dependent upon the distance between the recording and replay heads and tape speed. Reference to Fig. 2 will clarify and also be useful in understanding an extension of this phenomenon.

If a second tape machine is used, and the tape laced up as shown, a longer delay will be obtained: this is

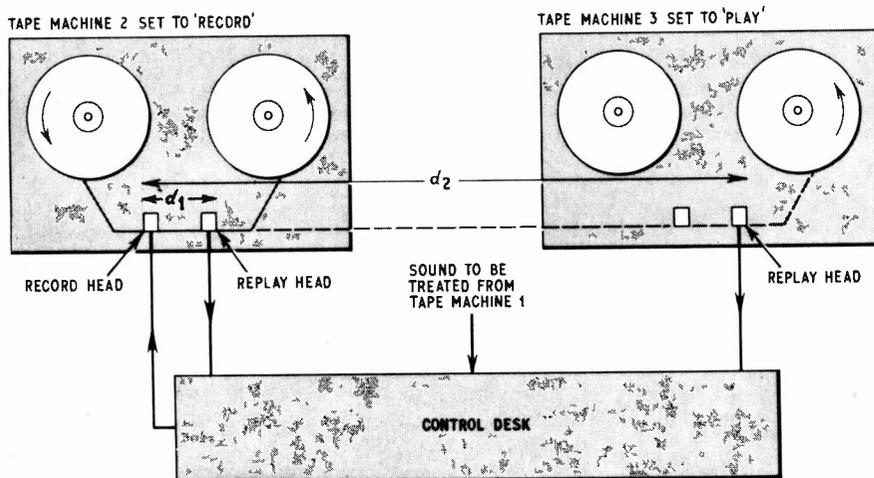


Fig. 2. Obtaining feedback effects with a sound repetition rate based on the distance between replay and record heads

Dominating the studio, is the control panel or mixing desk. This has a number of channels or faders (usually 12 or more); to each fader is connected a sound source which can be one of two types: high or low level. High level sources are tape machines, signal generators and disk players; low level sources, microphones and electronic pick-ups fitted to guitars and other instruments. See Fig. 1.

It is from the mixing panel that the recording chain is fed. This panel also houses the filters, echo mixture facilities and things like remote start circuits, cue lights, line-up reference tone and talkback circuits.

A minimum of three tape machines, a bank of signal generators, a disc playing desk, a jackfield (of terrifying appearance) and a loudspeaker complete the scene. Various other items of local development are available as "optional extras", but are not part of the basic equipment nor present in every studio.

## SOUND TREATMENT

For sound treatment or manipulation, a basis of three tape machines is needed; unless a sound is to be treated "live", one machine is used for playback,

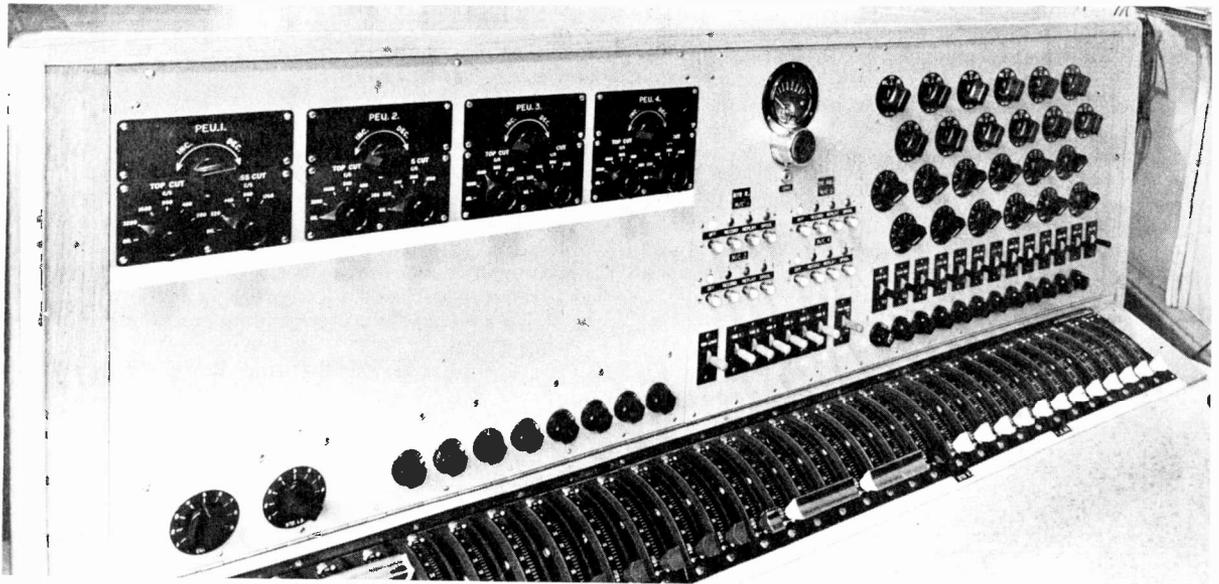
because the record head to replay head distance has increased to  $d_2$  instead of  $d_1$ . By moving the machines apart according to the time required, a pattern can be created in sympathy with the original sound pattern.

This technique, with a pre-recorded track played from another machine, makes use of three identical machines, but the final recording is safely recorded on machine 2 and wound up on machine 3.

Exponents of the art will be quick to see many possibilities in this. Two delayed echoes (why not use both machines' outputs?) can be filtered on their respective channels, and reverberation can be added. In fact, the original sound can be removed altogether, and a new sound formed which contains a flavour of the original. If a mistake is made and a restart is necessary, all faders are closed down to let the system clear itself, otherwise the piece of sound on the tape between the machines will start the montage off on a wrong note.

## ECHO

Echo, or reverberation, has been mentioned as a facility for treating sound. The Radiophonic Workshop has, over the past 12 years, used four types of



*This photograph shows the mixing desk with quadrant type faders. Immediately above those on the right are preset level controls, echo select, echo mixture and group switches. Above those on the left are four passive filters. The centre section contains remote start facilities, cue light, talkback and line-up tone keys, and a peak programme meter*

reverberation: the echo room, a magnetically coated revolving drum, a steel plate, and springs.

The echo room is a sound proof room, with bare walls to assist sound reflections. At one end is a loudspeaker fed from the echo mixture switches on the control panel, and at the other end a microphone picks up the reflected sounds.

The revolving drum system has a magnetic coating around the circumference, and erase, recording and up to eight replay heads are placed around the periphery. These heads are all set at about one "thou" away from the coating. The sound is fed to the record head, and picked off, by either a single replay head or all eight, to give "echo". This tends to be noisy and, because of the necessary gap between head and revolving drum, gives rather inferior quality compared with that of the input.

The plate system consists of a steel plate suspended on edge; a contact transducer feeds the sounds on to the plate while a contact microphone picks up the reflected sounds.

The echo spring technique is often found in electronic organs, and consists of a single or double row of springs fitted to a transducer, which converts the sounds fed to the device into mechanical vibrations. These are transmitted along the springs, re-converted into electrical energy by another transducer, and fed back to the control desk.

The reverberation times of the spring device and echo room are fixed, although variations can be achieved by moving the microphone nearer or further away from the loudspeaker in the echo room. The drum type echo time could be varied by choosing a replay head a different distance from the record head. The reverberation time of the plate is dependent upon the amount of damping applied.

Echo is derived from the sound source by splitting the sound into two separate paths, "direct" and "echo". The "direct" sound continues through the control desk to the output, where it is mixed with the

echoed sound from the echo device. A proportional switch is used to feed the echo signal to the echo device. Up to the halfway position more direct sound is audible; past this point more echo is obtained.

Whilst on the subject of echo, tape can be used to modify the reverberation times, if only a fixed time is available on the device.

Echo added to a tape played at double speed will be twice as long when recorded at double speed and replayed at normal speed. Hence, a fixed reverberation time factor of  $\times 2$  is applied. Conversely, adding echo to a tape played at half-speed and recording at half-speed, will result in the echo being sharper and brighter when played at normal speed again. This facility is one in which a two speed machine is essential.

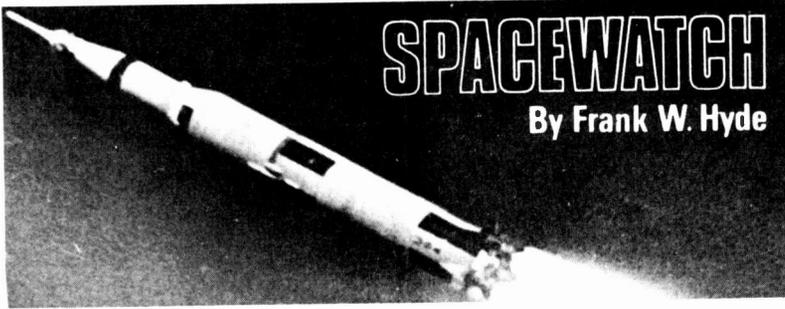
### **SPEED CHANGE**

Speed change plays an important part in sound treatment, not only for comic effect. Whilst it is a useful tool, often a change in speed is required without a change in pitch, or conversely, a change in pitch is required without alteration in the time scale. At first sight these two seem inseparable, but by means of a special piece of equipment this paradoxical problem can be overcome.

This equipment makes use of a head that rotates either in the direction of the tape movement or against it, at different selectable speeds.

With constant tape speed, and the head stationary, it behaves as a normal replay head and no pitch change is evident. Rotation in the same direction as tape movement causes a lowering of pitch, and in the opposite direction, of higher pitch. The tape can be driven at higher or lower speeds to decrease or increase time scales. The rotating head is used to maintain original tape/head speed ratio, and keeps the pitch constant.

Next month, special techniques in editing and obtaining sound effects and electronic music effects will be described.



# SPACEWATCH

By Frank W. Hyde

## ORBITING OBSERVATORY

The second orbiting astronomical observatory, which is making its first survey of the sky in the ultra violet region, has discovered that there is a hydrogen cloud round the nucleus of the new comet designated *Tag-Sato-Kosaka*. The first signals in the ultra violet region were picked up on January 14, and the observatory spent about ten minutes a day till the end of February locked on to the comet.

The team from Wisconsin University under the leadership of Dr A. Code is responsible for this work and, as this is the first time that the ionised hydrogen has been detected, it represents an important "first". Previously it had not been possible to detect this phenomena from ground based detectors and it is an indication of the vastness of the field opened up by space observatories. In this particular experiment it is hoped that more will be learned about the mass loss from the comet.

Comets in their journey round the sun at perihelion are subject to solar heating which drives off dust and gases. The characteristic tail is produced which can stretch for over one hundred million miles and up to ten million miles wide. The hydrogen cloud is suspected to be as large as the sun itself.

## MANNED ORBITING OBSERVATORY

In 1972 three men will be launched in the first of the manned observatories. The *Apollo* telescope mount will be one component of a vehicle which will consist of an *Apollo* command module and service module together with a *Saturn* workshop. The first flight will last 28 days and then the crew will return to earth to be replaced by another crew who will spend twice this period in orbit.

The vehicle, which will be the forerunner of the projected orbiting space station, will carry a number of instruments including a coronagraph designed by the staff of the high altitude laboratory at Boulder, Colorado. Two models have been made and delivered for testing; one will be tested in a 100ft vacuum tunnel with an artificial sun, and the other will be tested later at a height of 118,000 feet suspended from a helium balloon.

The coronagraph is an instrument designed by Lyot to produce artificial eclipses of the sun. The instrument is pointed at the sun and a disc in the tube adjusted to be equal to the image of the sun, allowing the corona to be studied.

When used as earth based instruments serious disadvantages are caused by the absorption and scattering of the sunlight by the earth's atmosphere. It is hoped that the spaceborne instruments will be able to photograph the corona out to a much greater distance from the sun. Dr G. Newkirk is hoping that it will be possible to study the corona out to a distance of six solar radii as compared to one to two solar radii with the best earth based instruments.

## X-RAY STAR

*Centaurus XR4* appeared in an area of sky in 1969 where no object had been seen before, and it is predicted by a group at Los Alamos Scientific Laboratory, who have studied it during its lifetime, that it will flare up again in the near future. This prediction is based on the knowledge of the behaviour of a *DQ Hucilis* type of Nova which has a double peaked light curve, and the behaviour of *Cen XR-4* which appears by observation to be similar.

If this prediction should prove to be true the way to the better understanding of one type of nova will be open.

## EARTH BULGE

The gravitational pull of the moon on the earth produces the ocean tides which are easily measured. Also, there is a corresponding tide of the earth's crust but this is very difficult to measure. The large errors which arise are because of wide changes in temperature and also the change of gravity brought about by the effects of the large bodies of water which are displaced by the tides.

A team from the Lamont-Doherty geological observatory have set up an array of 13 sensitive gravimeters on the 40th parallel and with the help of other colleges and universities have been able to continuously monitor changes for six months. The accuracy of the measurements are such that the changes in the radius of the earth can be assessed within one centimetre. The average change is about 30cm every 12 hours corres-

ponding with the tidal changes due to the pull of the moon.

It has been noted that the effects of the oceanic movements acts much farther inland than was thought to be the case. There is also the possibility that the movements in the crust are a contributory factor in earthquake outbreaks.

## INFRA-RED TELESCOPE READY

The 40in infra-red telescope built by the staff of Imperial College under the leadership of Prof. J. Ring, will shortly go into service at Silwood Park, Ascot, where the outstation of the group is situated.

The infra-red telescope is a flux collector and in technical jargon often referred to as a "light bucket". The 40in paraboloid is of novel design and the collector is a 60in flat which directs the infra-red light to the paraboloid.

Because there are difficulties in the production of a 60in flat in one piece it is made up of a circle of six hexagons with a hole in the middle where the seventh would be. It is through this that the rays are directed on to the detectors. Plans are already under way for a 60in paraboloid and the glass bank is being polished by Grubb Parsons.

Design studies are under way for an eventual 120in flux collector and the sites for the larger ones will need to be in areas where the water vapour problem is least. Two possible sites are one at Tenerife and another in the Sierra Mountains of Spain.

The improvement of the 60in over the 40in is considerable. While the 40in will have an image size of about thirty seconds of arc the 60in will be reduced to an image size one second of arc.

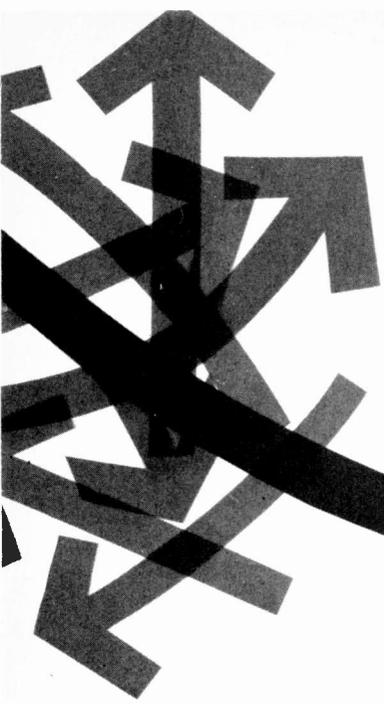
## REDUCTION OF FIRE RISK

Another spin off benefit from the space programme is the development of a chemical which is so resistant to flame and so versatile in use that it can be applied in industry, the home and transport. The material can be sprayed onto surfaces which will then resist temperatures up to twice the level at which they would normally catch fire.

This development arises out of the investigations into the fire in the *Apollo* spacecraft in which Grissom, White and Chaffee lost their lives.

The new product has the trade name of Fluorel, is a copolymer containing two fluorides whose action is to increase in resistance to heat as the temperature rises. It can be used as a solid, paint or foam and will fire-proof materials up to a temperature of 2,200 degrees Fahrenheit in an atmosphere of 100 per cent oxygen.

Some idea of this breakthrough can be gained by comparing the ignition point of paper 800 degrees Fahrenheit, plywood at 900 degrees Fahrenheit and canvas at 1,000 degrees Fahrenheit in an atmosphere of 20 per cent oxygen.



**A NEW  
SERIES FOR  
THE BEGINNER**

**THIS**

Thus, the resistance of an ordinary metallic conductor increases with temperature.

**LIQUID CONDUCTORS**

A liquid metallic conductor like mercury, or molten solder, behaves electrically in much the same way as a solid, but the term "conduction" is something of a misnomer when applied to chemical solutions.

Electrons are not, as is popularly supposed, transported through a solution by "ferryboat" atoms, but instead take part in a chemical reaction at the surface of electrodes which are dipped into the solution. Electrons are absorbed by one electrode and are given off by the other, but they do not pass through the solution.

When an acid is dissolved in water, to form a typical solution, a process called ionisation takes place.

**A**LL MATTER is made up of atoms, which are bonded together by electrical forces. An atom consists of a positively charged central core or nucleus, with negatively charged electrons circling around it in fixed orbits. An atom of a particular element is characterised by a specific number of orbital electrons—copper has 29—and the total electron charge cancels out the positive charge of the nucleus.

In certain circumstances, atoms can be encouraged to release or capture electrons, as well as share them with neighbouring atoms, and these exchanges determine the basic operating principle of any electronic device.

We are concerned here with only three classes of matter, conductors, insulators, and semiconductors. When copper atoms are united to form, say, a wire conductor, the binding force between the outermost electrons and the parent nuclei is weakened, and some electrons are freed to wander at random among the atoms.

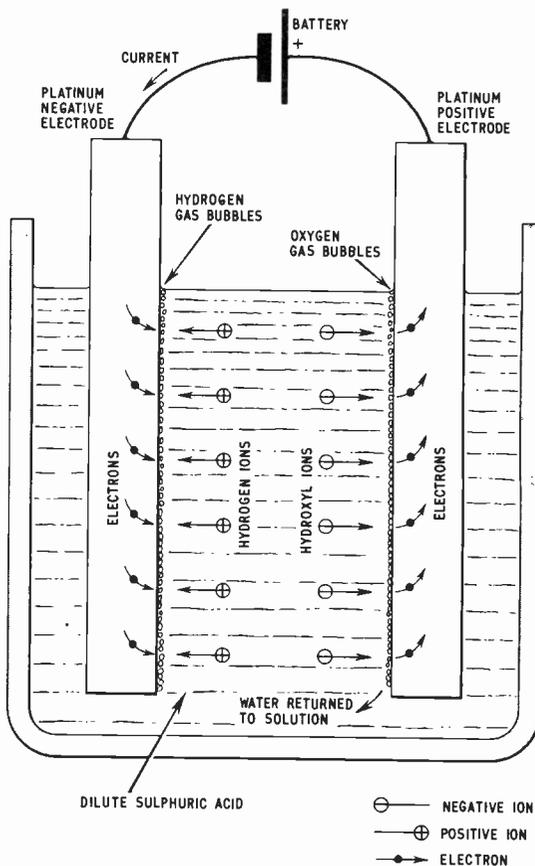
In the case of an insulator, the electrons remain tightly bound to the nuclei and are not available to act as carriers of an electric charge, except when released by high temperatures or high voltages.

Semiconductors can be explained, in a simplified way, by considering them as insulators which have been modified by the addition of impurity atoms to become a special type of conductor.

**METALLIC CONDUCTORS**

Atoms are arranged in a regular pattern or lattice in a solid metallic conductor, with free electrons distributed between the atoms. At absolute zero temperature, the atoms and free electrons are stationary, but room temperatures will cause the electrons to move about at random, and the atoms to vibrate within the confines of the lattice.

The most important consequence of thermal motion is that it increases the likelihood of collisions between free electrons and atoms. The resistance of a conductor depends on the number of free electrons available to act as carriers, and on the number of collisions.



**Fig. 2.1. Conduction in a liquid solution**

Certain atoms or groups of atoms take on an excess of electrons, while others lose electrons. In other words, the atoms become electrically charged and are termed ions.

The ionisation is purely a result of the acid going into solution, and has nothing to do with any external or internal electric current. Ions in a solution move very slowly under the action of an electric current, just a few thousandths of a centimetre per second.

If a battery is connected to two platinum electrodes which are immersed in acidulated water to form a cell, as in Fig. 2.1, electrons will flow into the negative electrode and attract positively charged hydrogen ions from the solution.

The electrons combine with the hydrogen ions to create hydrogen atoms, which are then given off in the

form of gas bubbles. At the same time, negatively charged hydroxyl ions are attracted from the solution to the positive electrode, where they liberate electrons and are converted into oxygen and water.

The oxygen bubbles off and the water is returned to the solution. The above description is simplified, but it does serve to show that so-called conduction in a solution really consists of an electro-chemical conversion process.

### CONDUCTION IN GASES

Ionisation also occurs in gases. In the absence of an e.m.f. between two electrodes in a gas, a trace of naturally occurring radioactivity will cause a few electrons to be knocked out of gas atoms, thus giving rise to positive ions.

# WAY TO ELECTRONICS 2

## CONDUCTION

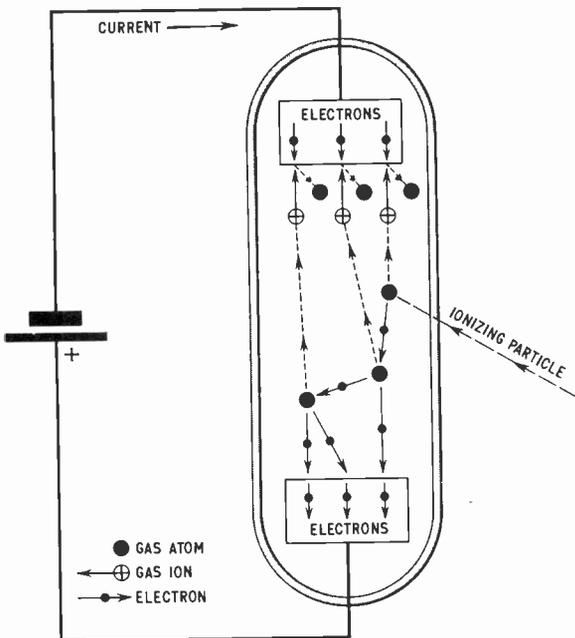


Fig. 2.2. Conduction in a gas

If a small voltage is applied to the electrodes, see Fig. 2.2, the positive ions will be attracted towards the negatively charged electrode, where they combine with electrons from the battery and are converted back into gas atoms. The few free electrons liberated by ionisation will move towards the positive electrode.

This very small migration of electrons and ions does form a minute current, but the gas can be regarded as a near perfect insulator.

Something happens when the voltage across the electrodes in a gas is increased to a threshold value. The few free electrons are accelerated to high velocities and they knock other electrons from gas atoms, thus causing further ionisation to occur. It is an avalanche effect, the more free electrons there are, the greater will be the number of electrons knocked out of gas atoms, and so on until a considerable number of electrons are arriving at the positive electrode.

### INSULATORS

There are hardly any free electrons in an insulator to carry electrical charges through the material, so an insulator offers a very high resistance. When enough heat is applied to an insulator, however, the point will be reached where the vigorously vibrating atoms will "throw off" electrons, which then become free to drift and act as current carriers.

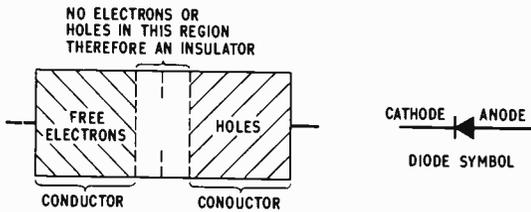
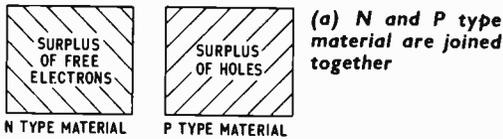
So, the resistance of an insulator tends to decrease with a rise in temperature. A good example is glass, which has a fairly low resistance when red hot.

### SEMICONDUCTORS

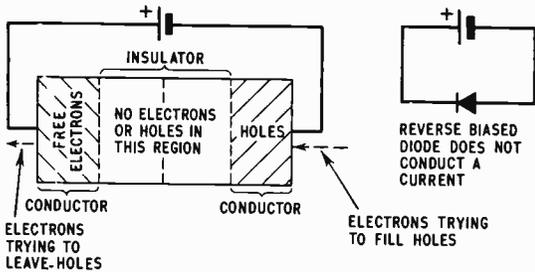
Semiconductors are certain solids which combine the properties of conductors and insulators. Examples are silicon and its carbide, germanium, copper oxide and sulphide, selenium, lead sulphide and telluride, cadmium sulphide, and zinc sulphide.

The resistance of a pure semiconductor decreases with a rise in temperature, like an insulator, but is low enough at room temperatures for the material to be classified as a conductor. The implications are that heat causes electrons to be "thrown off" by vibrating semiconductor atoms at a much lower temperature than

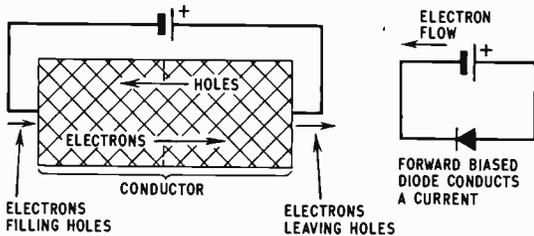
# DIODE



(b) Narrow region of insulation between N and P materials



(c) Reverse bias applied to diode. Electrons try to move but are blocked by "insulator" region



(d) Free flow of electrons when forward biased

Fig. 2.3. Semiconductor diode principle

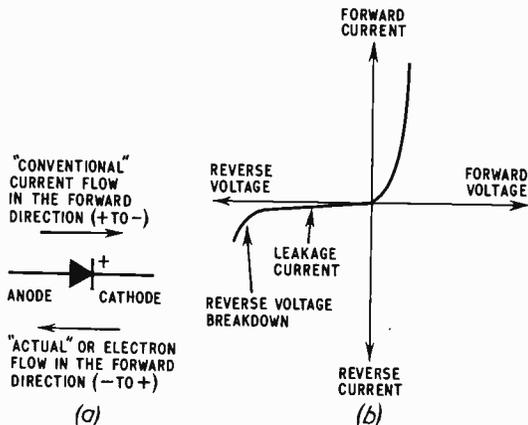


Fig. 2.4. Current flow and voltage/current characteristic of a diode

insulator atoms, thus providing a source of free electrons to carry a current.

An atom which has an abnormal number of electrons is an ion and, in solutions or gases, these ions are free to move around and carry charges to electrodes. The atoms of a semiconductor are fixed in position, so all they can do is to "trade" electrons.

When an electron breaks free from its parent atom it leaves behind a space or "hole" which can be filled by another electron. In a semiconductor there will be some thermally generated free electrons and the same number of holes.

Suppose now that atoms of an impurity such as phosphorus are added to a pure silicon semiconductor, this will result in the existing holes being filled by donated electrons from the phosphorus, but will leave the number of free electrons virtually unchanged.

Alternatively, if boron is added to silicon, the free electrons will be accepted by the impurity to leave only holes.

## TWO DISTINCT TYPES

There are therefore two distinct types of modified semiconductor, the *n* or negative type with an excess of free electrons, and the *p* or positive type with an excess of holes. The addition of donor or acceptor impurity atoms does not cause a piece of semiconductor material to become electrically charged, as might be expected, because the charge on the impurity nuclei exactly cancels the charge, due to a surplus or deficiency of electrons in the material.

A *p* type semiconductor with a surplus of holes will conduct a current just as well as an *n* type, because holes like free electrons are a form of carrier.

If all free electrons and holes are removed from a semiconductor material, it would be transformed into a perfect insulator. One method of achieving this transformation is to encourage free electrons to combine with holes.

## PN JUNCTION OR DIODE

If *p* and *n* type semiconductors are joined together, in such a way that both form part of one continuous crystal structure, electrons can only flow across the resulting junction in one direction; this forms the basis of an important device called a diode or rectifier.

To see how the *pn* combination works, refer to Fig. 2.3. When the two blocks of semiconductor material (Fig. 2.3a) are joined together in a special way, free electrons and holes will drift a short distance across the junction and will then disappear as they combine, shown in Fig. 2.3b.

There will exist on each side of the junction a narrow region without free electrons or holes, which is therefore an insulator. The interesting property of such a semiconductor insulator is that it can be varied by applying an e.m.f.

When a battery is connected to the diode as in Fig. 2.3c, free electrons will be attracted towards the positive battery terminal, and holes towards the negative terminal, and they will move away from the insulator region, thus increasing its effective width. As long as the insulator exists, a current cannot flow.

Now look at Fig. 2.3d. If the battery connections are reversed, free electrons and holes will be attracted towards the junction, thus tending to reduce the thickness of the insulator region. If the battery e.m.f. is more than, say,  $\frac{1}{2}$  volt, the insulator region disappears altogether, and electrons begin to flow through the diode.

## DIRECTION OF FLOW

Before J. J. Thompson discovered the electron in 1897, it was generally assumed that an electric current flowed from positive to negative. Even then it would have meant a major upheaval to correct all existing books, circuit diagrams, and graphs, so the problem was shelved.

At the present time, "conventional flow" from positive to negative is still applied to the majority of circuit diagrams and general descriptions of circuits, while "actual flow" from negative to positive is mainly used in discussions of basic electron theory.

The diode circuit symbol naturally suggests that the direction of flow is pointed by the arrowhead shape, but this is conventional flow from positive to negative. Confusion can be avoided if the following rule is memorised. A diode will conduct a current when the arrowhead (anode) is more positive than the bar (cathode), see Fig. 2.4a.

The graph in Fig. 2.4b shows that a diode has not got a perfect characteristic; it will offer some resistance to a forward current, and will "leak" a small current when a reverse e.m.f. is applied.

## ALTERNATING CURRENT

All the circuits given thus far have made use of a unidirectional flow of electrons, or a direct current (d.c.) from batteries. But there are many applications in electronics where an oscillatory, or to and fro motion of electrons is encountered, called alternating current (a.c.).

If the value of an alternating current is plotted against time on a graph, it might look something like Fig. 2.5a, rising from zero to a maximum or peak positive value, then falling through zero to a similar but negative peak value. So, an alternating current is continuously changing and reversing, usually many times a second.

How then can a.c. be measured if it is never steady? One way is to feed the a.c. to a resistance and see how much heat it produces; then compare this with the heat generated by a direct current.

It is found that a direct current gives 1.4 times the heat output of an alternating current of the same peak value. Therefore, to achieve parity, and to allow Ohm's and Joule's Laws to be applied to a.c. calculations, it is necessary to divide peak values by 1.4, to give what is called the root mean square or r.m.s. value. An alternating current of 1 amp r.m.s. has the same heating effect as a direct current of 1 amp.

Most a.c. measuring instruments are already calibrated for r.m.s. values, thus eliminating the need for conversion. It is usually taken for granted that any quoted a.c. voltage or current (for example, the 240 volt mains supply) is an r.m.s. value, unless otherwise stated.

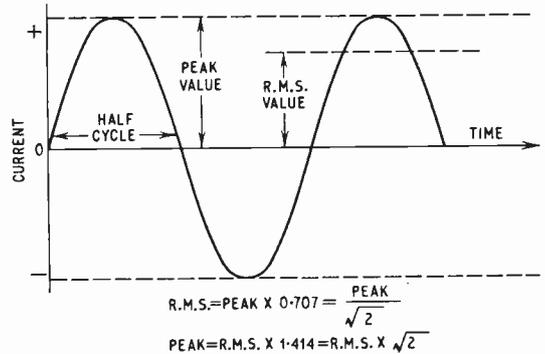
## DIODE RECTIFYING CIRCUITS

Now let us see what effect a diode has on an alternating current.

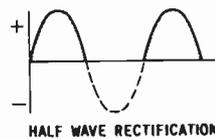
Diodes are often used as rectifiers, to convert an alternating current into a direct current, by inverting or suppressing alternate half waves of a.c., see Fig. 2.5b.

The half-wave rectifier circuits in Fig. 2.6 work by charging the capacitor with unidirectional pulses of current, which are only allowed to pass during alternate half-cycles. The capacitor stores energy, and acts as an electrical reservoir when the alternating current input has fallen temporarily to zero. The full wave circuits of Fig. 2.6 make use of both half cycles of the alternating current, and are therefore more efficient.

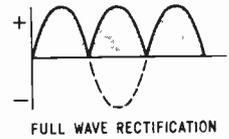
# RECTIFICATION



(a) Peak and r.m.s. values of an a.c. sine wave.  $1\frac{1}{2}$  cycles are shown

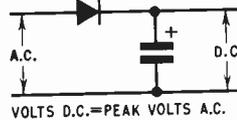


(b) Half-wave rectification suppresses alternate half-cycles

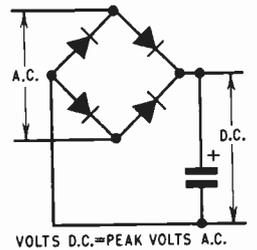


(c) Full-wave rectification inverts alternate half-cycles

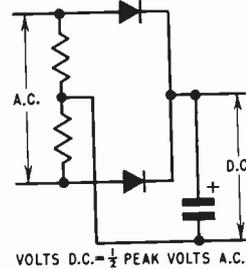
Fig. 2.5. Sine wave a.c. waveform and rectification



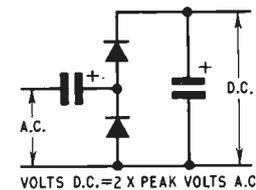
(a) Half-wave with one diode



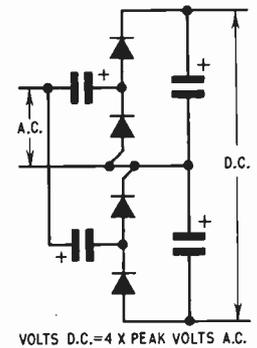
(c) Full-wave rectifier bridge with four diodes



(b) Full-wave with two diodes

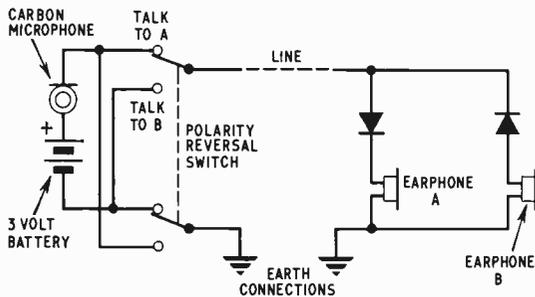


(d) Voltage doubler

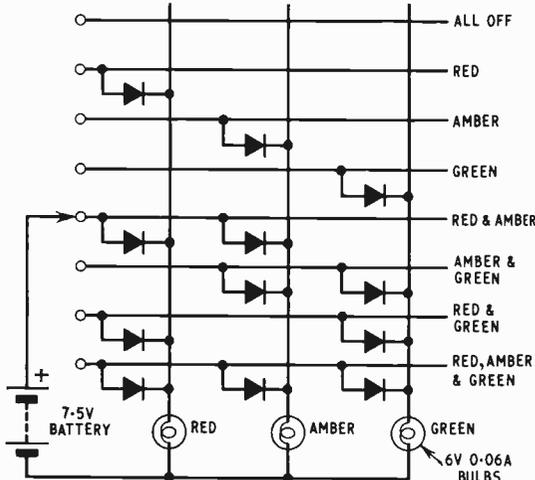


(e) Voltage quadrupler

Fig. 2.6. Various types of rectification



(a) Selective telephone circuit for a party line



(b) Diode matrix for lamp signalling

Fig. 2.7. Two examples of other uses of the diode

It is possible to obtain very large d.c. voltages from a.c. supplies by adding on or cascading extra rectifier circuits, rather like placing a number of batteries in series. The quadrupler circuit of Fig. 2.6 is really two voltage doublers placed end to end.

### OTHER USES

There are many other uses for diodes, apart from rectification. The selective telephone circuit of Fig. 2.7 uses diodes to prevent speech signals from reaching both receiving stations (earphones) at the same time, even though the signals travel along a single line (shown dotted). When the switch is in the "talk to A" position, the diode in series with earphone A is forward connected, and introduces very little resistance into the circuit, but the diode of earphone B is reverse biased by the battery polarity, so that it acts as an insulator and prevents the passage of speech signals.

The diode matrix of Fig. 2.7 will give pre-selected combinations of three coloured lamps without the need for a complicated multi-way switch. The diodes serve to "route" currents from the battery to appropriate lamps, depending on where they are placed inside the matrix. The diode matrix principle can be extended to cover very complicated arrangements of lamps for giving alphabetical or numerical readouts and moving news message displays.

Next month we shall be looking at extensions of the diode principle, where two diodes formed on a single common semiconductor material can control currents.

### CORRECTION

In Part I last month the drawings for Fig. 1.3c and Fig 1.4c should be transposed.

# Order NOW FOR THE JUNE ISSUE...

## TRANSISTORISED MULTIMETER



A highly useful and reliable piece of test equipment for the home constructor. The multimeter employs a solid state amplifier to drive a moving coil meter, thus increasing the sensitivity of the meter by up to 100,000 times and at the same time protecting it against overload. The testmeter covers the d.c. voltage range 2mV to 500V f.s.d. and the d.c. current range 200mA to 500mA. An external adapter for a.c. measurements can be added.

## Also: SOUND TRIGGER FOR PHOTO FLASH

Opens up new fields to the amateur and professional photographer. Record in vivid detail the agony of a bursting balloon, the complex patterns of smashing glass, in fact almost any impact phenomena which can be set up under controlled conditions.

This compact self-contained synchroniser unit, for connection to an electronic flash gun, uses few components and is inexpensive to build.

**PRACTICAL  
ELECTRONICS**

JUNE ISSUE ON SALE MAY 15



# BOOK REVIEWS

## USING SEMICONDUCTORS

By J. Hughes, B.Sc. and T. M. Johnston, B.Sc.  
Published by Heinemann Educational Books Ltd.  
124 pages, 9in x 6in. Price 25s.

SOME beginners in electronics tend to start construction of fairly simple (or even complex) projects without really knowing what each component is used for or how it functions. Simple do-it-yourself experiments are given in this book to illustrate the functions of semiconductor diodes and transistors, followed progressively by more complex circuits.

Whilst this is an excellent practical book, the authors admit in the Preface that any shortcomings are their own. Of these, explanations of certain terms used are lacking and, for the likes of teenage students, this may be a drawback.

Attempts have been made to over-simplify some descriptions, and yet the physics of semiconducting plunges the reader into the deep end as early as Chapter 3. Experimenters in elementary circuitry could pass over the Hall Effect for the time being and go on to rectification. However, this section fails to explain why the peak inverse voltage is 1.4 times the r.m.s. voltage and does not say what r.m.s. means.

Chapter 4 introduces transmitter theory and demonstrates amplification in d.c. terms. Calculus knowledge is assumed; the delta symbols are used with no explanation.

These are just examples of some shortcomings that are not confined to this book alone. On setting out to write for beginners, a distinction between theory and practice should be obvious; theory should be basic and in line with the purposes of the practical projects.

Since the practical parts of this book are highly commendable, it would be a pity for beginners to be deterred by the theoretical approach. Readers are recommended to browse through the pages before buying.

Chapters 1 and 2 deal with the apparatus, tools, and components required and describe the construction method suggested. Later chapters race on to amplifiers, oscillators, radio reception and specialised semiconductors, the latter in brief terms with no circuit applications.

Three appendices are included, giving lists of apparatus, components, suppliers, and construction templates.

M.A.C.

## ITV 1970

Published by the Independent Television Authority  
240 pages, 9in x 7½in. Price 10s 6d.

**1969** was probably the most important year for the Independent Television Authority since its birth fifteen years previous. On November 15, the

confidence of the ITV companies, to convince Parliament of the need for colour on 625 lines along with BBC-1, burst into the realisation of a fully prepared colour service. By the beginning of 1970 almost half the population in the fourteen programme company areas were within reach of colour reception.

The I.T.A. further predict that almost four-fifths of the population would be covered by 1972.

The Authority also announces that ten million pounds is being spent on the change in line standards equipment to 625-lines. Programme Companies are equalling this expenditure on their studio needs. The first new u.h.f. transmitter for I.T.V. was switched on at Crystal Palace, London, on September 5, 1969. Standards converters were also installed to maintain the 405-line service.

What with all this innovation, plus the new Emley Moor tower and additional advertising levies in excess of £25 million, one cannot help asking what the financial status of the Authority is now in 1970. But, like all well organised companies, the I.T.A. and its subsidiary programme companies have a powerful conviction of their abilities; indeed they must have to compete with the equally mighty BBC.

The appropriation of revenue is a complicated affair which is briefly described, but one can assess that the public purse is well fed and still leaves the Authority with considerable assets of more than £18 million.

A word on programmes, which are adequately described and lavishly illustrated; the scope and quality of programmes continues to improve. Perhaps this is largely due to the tremendous efforts of JICTAR and TOP (Television Opinion Panel Ltd.), the latter being a newly set up audience research unit to complement JICTAR on programme reaction.

Particularly commendable are the documentaries and the ITN programmes, which consistently appear in the Top Ten ratings.

M.A.C.

## DOCUMENTARY PROGRAMMES ON TAPE

By P. Bastin  
Published by Print and Press Services Ltd.  
47 pages, 7in x 4½in. Price 5s.

A USEFUL pocket book describing how to get the best out of recording documentaries with full sound effects. Hints and tips are given on planning a programme, setting up equipment, narration, and adding other sound tracks. The style of writing is friendly but elementary.

## TAPE RECORDERS A-Z

Published by A.P.A. Publishing (Catalogues) Ltd.  
164 pages, 12in x 8½in. Price 20s.

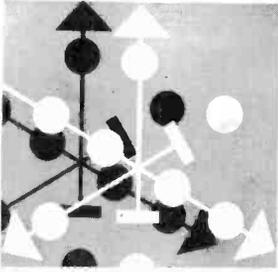
THIS is a detailed list of video, professional, domestic and high fidelity tape recorders currently available on the U.K. market. Photographs and manufacturers' specifications are given.

## AUDIO ANNUAL 1970

Published by Link House Publications Ltd.  
138 pages, 11in x 8½in. Price 7s 6d.

THIS is virtually an enlarged version of *Hi Fi News* containing 30 pages of feature articles and 52 pages of equipment reviews, taken from issues previously published.

# ELECTRONORAMA



**T**HE 1970 Physics Exhibition took place at Alexandra Palace from March 2 to 5. Some of the more interesting electronic systems and devices displayed are described and illustrated below.

## Talking to a Computer

ONE of the current trends in the use of computers is the degree of interaction between the user and the computer. Since man uses speech to communicate, why shouldn't the computer do likewise. Work has been carried out to persuade the computer to talk, using synthetic speech, but if it is to understand man, it must learn to recognise forms of speech sound.

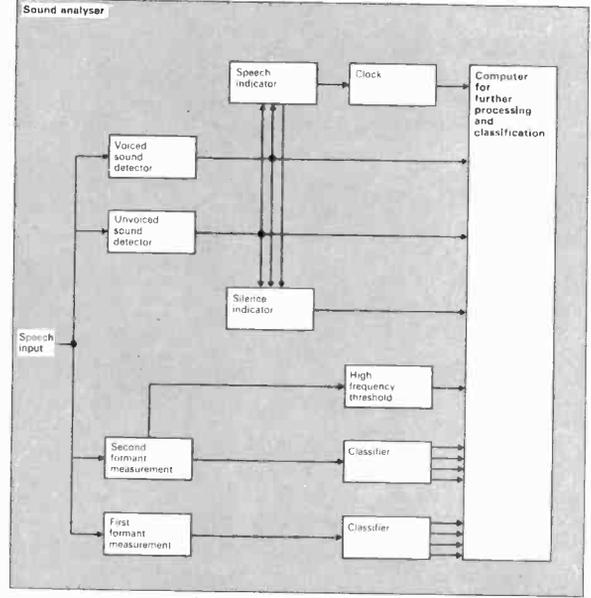
One way of doing this is to split the speech signal into several parallel signals that indicate the presence or absence of particular formants. Relative energy contents of voiced sounds and unvoiced sounds can be recognised by a computer.

The voiced sound is a vowel-like sound produced by vibrating vocal chords. Unvoiced sounds are those produced by air passing through shaped orifices in the mouth or throat.

There are other types of sound that are recognised; these are classified into four frequency levels determined by measurement of the lowest formant frequencies. Another circuit will detect high frequency sounds, such as "s".

Thus, by using a simple language, the computer can be made to recognise certain words. In the demonstration, a sound analyser was coupled to a telephone and a computer. A pre-arranged programme of conversation and questions was "written" on a screen by the computer. The answers and interjections, based on the words "yes", "no", "stop", and "wrong" were spoken by the visitor into the telephone.

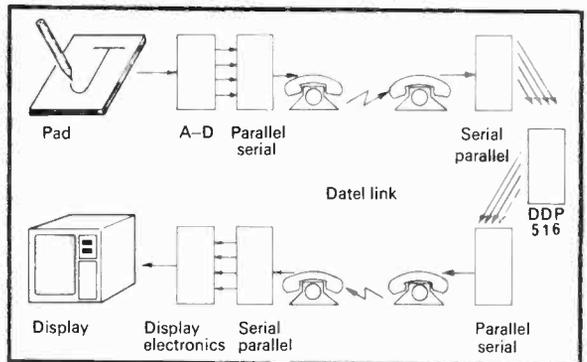
On receipt of an answer, the computer can comment or proceed to the next topic, depending on the answer received. The block diagram (top right) shows the system of speech analysis used with an ICL 4120 computer, similar to that shown below.



## Writing Detection and Display

A NEW system of "writing" display using a pressure operated co-ordinate generator is based on the variable pressure applied to a pencil by the writer. No wires are attached to the pencil since the detector is under the pencil tip.

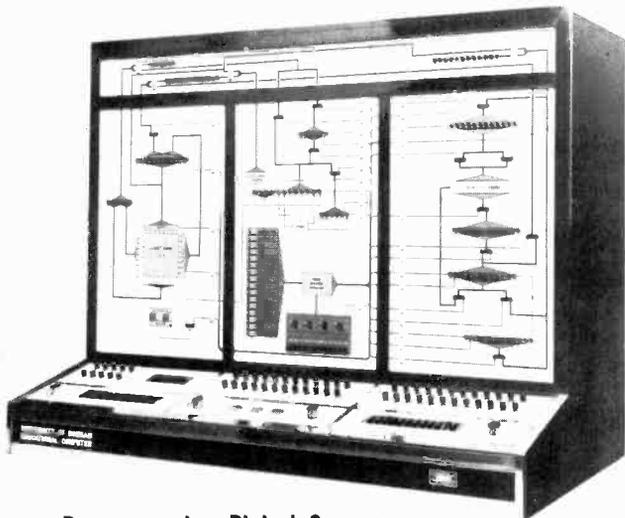
The device consists of two resistive strips separated by air. Writing pressure on the upper strip, which is flexible, deforms it into contact with the lower strip. Shorting electrodes are connected across the strip ends so that, when a current pulse is passed through one strip a uniform voltage gradient is developed along its length. The



voltage at the point of contact is proportional to the distance from the ends.

An electrical analogue is processed to a storage tube unit fed with X and Y signals derived from a pair of binary counters as shown in the block diagram above. The pad and display are shown in the photograph on the right.

# VISITS PHYSICS EXHIBITION



## Demonstration Digital Computer

THERE are several courses available to teach computer programming, but when it comes to demonstrating the functions and working of a digital computer in schools, colleges, and universities, commercial models tend to be too expensive or too fast, with no visual display of processing.

A new simplified computer, with a core storage capacity of 128 words (12 bits per word), has been designed and developed by two lecturers from the University of Durham and Darlington College of Technology. This development, which is being supported by N.R.D.C., has a visual display panel which indicates the flow of information and the contents of the registers. The panel layout is designed so that the functions of individual parts can be learnt before tackling the complete machine, shown above.

Five modes of operation are demonstrated: these are manual, one-shot, automatic instruction slow, automatic instruction fast and automatic programme.

Although the output is in the visual display form it is expected that a tape punch or printer could be coupled to it. Other likely additions include magnetic tape store, tape or teleprinter input/output, enlarged core store.

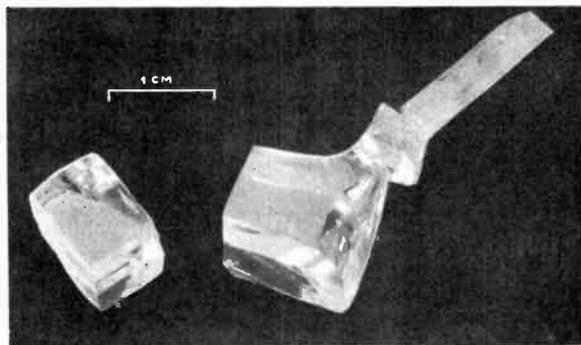


## Light Modulation Crystals

A METHOD of growing KTN Crystals has been developed at Mullard Research Laboratories by R. W. Whipps. KTN, a mixture of the ferro-electric compounds, potassium tantalate and potassium niobate, is a transparent solid having optical properties that can be changed by the application of a voltage; this effect can be used for the electrical deflection or modulation of a beam of light. KTN is much more sensitive than materials previously used and thus lower voltages can be used to achieve a useful electro-optic effect.

Crystals of KTN are, however, very difficult to prepare in useful sizes since the material decomposes below its melting point (approximately 1,300°C) and must be grown from solution.

KTN optical modulators and switching devices can be used for laser-beam communication systems and are of potential use for flat-screen televisions and in high-speed computers. A photograph of Mullard KTN crystals is shown below. A division equal to 1 centimetre is shown for size comparison.



## British Equipment for German Police

THE police forces of three of the states of the Federal Republic of Germany have recently installed fingerprint facsimile transmission equipment manufactured by Muirhead Limited of Beckenham, Kent.

Fingerprint photographs can now be transmitted within minutes between the Bundeskriminalamt in Wiesbaden and the Landeskriminalaemter in Dusseldorf (Nordrhine/Westphalia), Stuttgart (Wuttenburg), and Hannover (Niedersachsen) over normal telephone lines.

With this equipment a fingerprint picture 8 inches square can be transmitted with extremely high definition in 14 minutes. The picture received is fully processed inside the receiver, so there is no need for dark-room facilities.

The picture below shows one of the fingerprint picture transmitters.



# 50 PLUS 50

# HIGH POWER AMPLIFIER

## PART THREE

By R. D. PALMER

IN THIS, the concluding article, modifications are provided to extend the input capability of the amplifier. A fault finding table is also given to assist those constructors who might experience difficulties in getting a satisfactory performance.

Whilst this table is not intended to be exhaustive it should provide enough information to locate the most likely faults and provide guidelines to their rectification.

The item of test gear required is a 50,000 ohm per volt multimeter.

### EXTENDING THE INPUTS

If more than two inputs per channel are required the circuit terminating at pins N'7 and N'1 in Fig. 6 should be substituted with that given in Fig. 19. Here three inputs are given but in fact this can be extended to any number, the limiting factor being a reduced sensitivity with serial additions. For example, with five of the input circuits added the sensitivity of each one will be about 10mV with an input impedance of 1 megohm. As more circuits are added, this input figure for the rated output will have to be increased.

### FAULT FINDING TABLE

Table 1 gives a number of common faults, and their diagnoses. To use it, take, for example, the overall symptom of no output from both channels when signals are applied to the inputs.

Since this is most likely to be a power supply fault we refer to the column under the heading of "Local Symptom" in the power supply block.

The first symptom "56V rail zero" points the way to our first voltage check with the multimeter. If in fact, the supply voltage does read zero then proceed on to the column listing the possible fault conditions.

Here are given a number of items of circuitry which are likely to be faulty. If the fuse FS1 has blown, the mains transformer should be checked for short-circuited windings. If this proves to be all right, next check the bridge rectifiers D7-D10 for short circuits.

By following through the fault list we narrow down the search for the offending component or components. To assist in this a number of static voltage check lists are included. Unless otherwise stated, all of these have been measured with respect to earth. It should be emphasised that when a fuse has blown, no attempt should be made to replace it until the fault has been located. With the exception of TR7 and TR8 all the transistors can be expected to have a  $V_{be}$  (base to emitter voltage) of approximately 0.65 volts. This can be measured with a 50,000 ohms per volt meter without greatly upsetting the biasing.

Finally, in the amplifier circuit (Fig. 6), TR6, TR9, and TR12 can be type BFY51. ★

### COMPONENTS . . .

#### Resistors

R53-R55 10M $\Omega$  (3 off)  
All 10%, ½ watt carbon

#### Potentiometers

VR8-VR10 1M $\Omega$  carbon log (3 off)

#### Capacitors

C23-C25 0.1 $\mu$ F polyester (3 off)

#### Sockets

JK3-JK5 Standard jack socket (3 off)

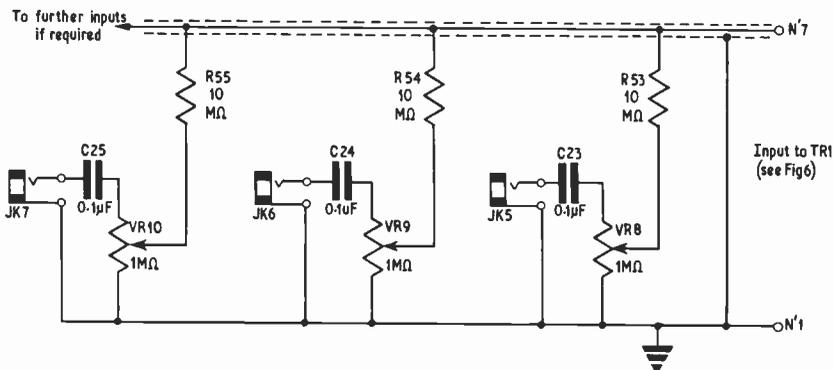
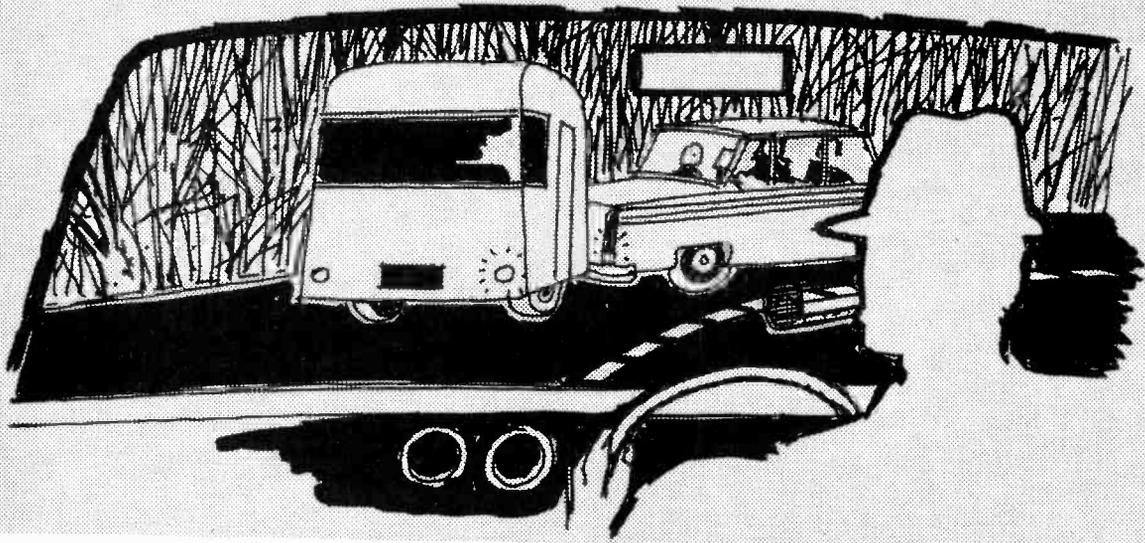


Fig. 19. Extension circuit for more than two inputs





# CAR CONVERSION FOR TOWING

By J.J.A. TENNANT

**T**HOUSANDS of motorists today tow a boat, caravan or some form of trailer. In order to do this, their cars have been fitted with a towing bracket that strengthens the vehicle and takes the universal 50mm tow-ball.

The cars have also been converted to provide outputs for the rear brake and direction indicator lights of the towed vehicle. It is normal practice and legally necessary, for vehicles registered after 1965, to operate all direction indicator lamps—that is, front and back on the vehicle as well as the tow and this normally means the provision of a special heavy duty flasher unit.

This article describes a simple method of electrical conversion for tow indicators that can be completed in a few hours, using a minimum of components and giving warning lights.

## WIRING OF TOWED VEHICLE

In general, the tow will be acquired with all lights and wiring fitted and, if modern, will be wired as Fig. 1 to the international standard with a seven pin plug (PL1). If the tow has no lights, approved patterns must be obtained from most garages and, although any wiring system could be adopted, it is strongly advised that the standard system is followed.

## CAR CONVERSION

The standard seven pin socket (SK1) should be fitted to the car as close to the tow point as practicable and wired as Fig. 2, the main earth wire (white—pin 31) being taken to a good clean chassis connection. The car wiring cable form should be examined at the branch point to find the red wire to the side lights and a

wire connected from this lead (preferably to the snap connectors at the lights themselves) to pins 58 and 58C. Also find the green/purple trace lead to the brake stop lights and connect this to pin 54.

## DIRECTION INDICATOR WARNING LAMPS

Reference to the car wiring diagram will indicate a point at which a heavy duty connection can be made after the ignition switch (Fig. 3). A lead is taken from this point through fuse FS3 to pin 54G, SK1 (internal lighting auxiliary supply) and also to the warning lamp unit fitted to the dash or on a small panel.

## AUXILIARY WARNING LAMP UNIT

The resistors R3 and R4 (Fig. 3) are chosen to drop approximately 1 volt when carrying the full indicator lamp current, i.e.  $1\frac{1}{2}$  amps for 18W lamps on a 12 volt supply. The value of approximately  $\frac{1}{3}$  ohm is made up of a 0.68 ohm 1 watt wire wound resistor. Transistors TR1 and TR2 are *npn* types capable of carrying the full switch on warning lamp current of 800mA and are bottomed by the voltage across R3, R4 and so operate the warning lamps LP1 and LP2 which are 12V 2.2W types. These are placed in series with resistors R1 and R2 to limit the lamp current to approx.  $\frac{2}{3}$  normal rating to increase lamp life.

## SWITCHING UNIT

The main tow indicator lamps are switched with transistors TR3 and TR4 which are *pnp* power types. Since the lamp switch on current is several times greater than the normal current, it is necessary to select a transistor of adequate current rating, i.e. 6 amps.

TR3 and TR4 are bottomed by a signal current taken from the standard wiring of the car and do not require large heat sinks: the base current is the lamp current, i.e. 1½ amps, divided by the gain of the transistor; if this is of the order of 30, the additional load of 50 milliamps on the car flasher unit does not materially affect its performance.

If only low gain transistors are available then two Darlingtons pair configurations can be employed in

place of TR3 and TR4. Transistors TR3 and TR4 should be totally insulated from the car chassis, mounted in a small box equipped with fuses and fitted close to SK1.

The base leads are taken to the car wiring cable form (at the rear indicator lamps), the left or nearside indicator being green/red trace and right or offside indicator being green/white trace.

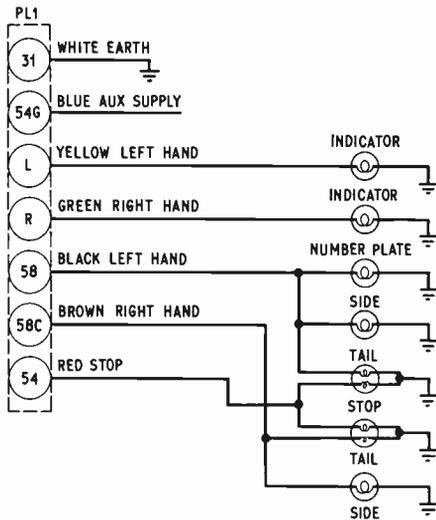


Fig. 1. Wiring diagram for the tow. All wiring should be carried out using heavy duty insulated connecting wire

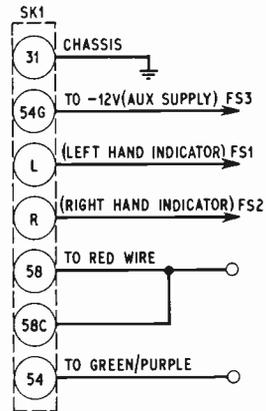


Fig. 2. Connections between SK1 and the car wiring loom. As in Fig. 1 heavy duty wire must be used

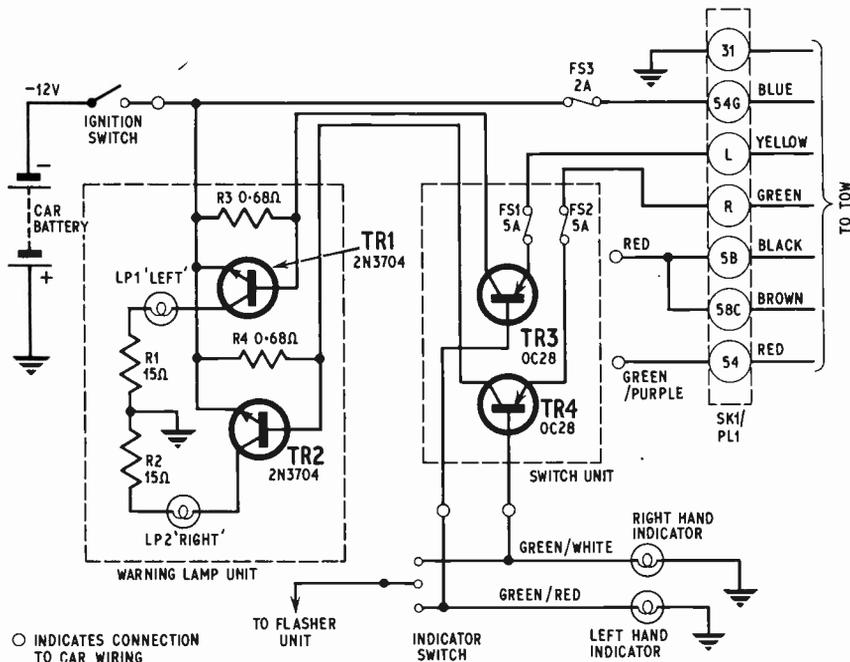


Fig. 3. Complete circuit diagram of the car conversion for towing. This circuit is for positive earth 12V car systems

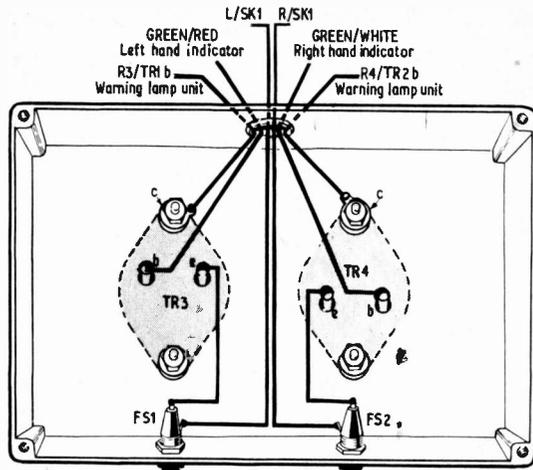
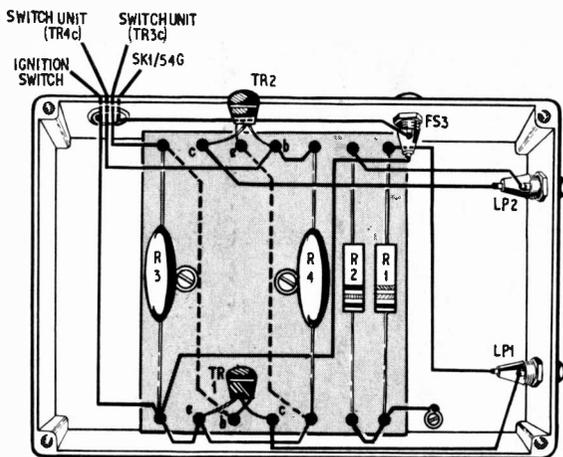


Fig. 4. Warning lamp circuit, layout and wiring diagram Fig. 5. Switch unit circuit, layout and wiring diagram

## COMPONENTS . . .

### Resistors

- R1 15Ω ¼W ±10%
- R2 15Ω ¼W ±10%
- R3 0.68Ω 1W
- R4 0.68Ω 1W

### Transistors

- TR1 2N3704
- TR2 2N3704
- TR3 OC28 or equivalent
- TR4 OC28 or equivalent

### Fuses

- FS1 Miniature fuse holder and 5A fuse
- FS2 Miniature fuse holder and 5A fuse
- FS3 Miniature fuse holder and 2A fuse

### Miscellaneous

- LPI, 2 12V 2.2W bulbs and holders
- SK1/PL1 seven way plug and socket (standard tow connecting type)
- Seven way tagboard
- Transistor insulating kit for OC28 (2 off)
- Die cast case 4.25in × 2.25in × 1in (2 off)
- 4B.A. fixings
- Heavy duty insulated connecting wire
- ¼in grommets (2 off)

## CONSTRUCTION

Both the warning lamp unit and the switch unit can be housed in small die cast cases. It is important that the warning lamp unit is earthed to the car chassis and that TR3 and TR4 are completely insulated from the chassis and die cast case.

The warning lamp circuit is constructed on a seven way tagboard as shown in Fig. 4. The wiring between the ignition switch, the switch unit, FS3 and SK1 should be made with wire capable of carrying 7 amps.

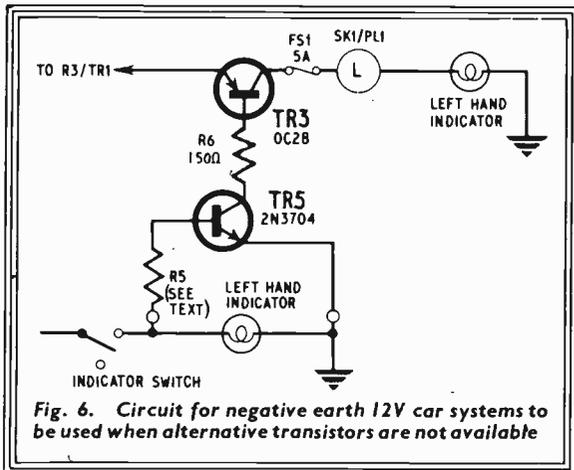


Fig. 6. Circuit for negative earth 12V car systems to be used when alternative transistors are not available

The tagboard is fixed inside the die cast case, by two 4B.A. fixings, on ¼in. spacers. The complete unit must be mounted in view of the driver so that LP1 and LP2 are visible.

The switch unit is also housed in a small die cast case to which TR3 and TR4 are mounted via insulating washers (Fig. 5). Wiring from TR3, TR4, FS1 and FS2 must be of heavy duty wire as indicated previously. When complete the case should be mounted near SK1 and the rear indicator lamps in a position such as that FS1 and FS2 can be easily replaced.

The cases (collectors) of TR3 and TR4 must never be shorted to earth and this should be remembered when siting the switch unit; stray tools inside the car boot could easily short the unit if TR3 and TR4 are exposed.

## CARS WITH NEGATIVE EARTH

In general the wiring system for negative earth cars is identical with the above and if suitable inverse type transistors can be obtained (ACY19 for TR1 and TR2, 2N3055 for TR3 and TR4) the system can be copied. However, only *pn-p* type power transistors may be available, in which case the wiring to the switch transistors must be as shown in Fig. 6. The base of TR3 is connected to earth (-ve) via R6 by the action of TR5 which is turned on by the voltage across the car direction indicator lamp when on. R5 is adjusted to allow TR3 to bottom. TR4 must be connected up in a similar manner.

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Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.	Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.
1	1µF	6	4d			45	350	12	9d		
2	4µF	25	4d			46	20/4	275	1/-		
3	4µF	4	4d			47	250	50	2/-		
4	6µF	6	4d			48	500	25	1/6		
6	64µF	9	4d			49	400	15	1/-		
7	20µF	6	4d			50	400	2-5	3d		
11	8µF	6	4d			51	64	275	1/9		
16	32	150	9d			52	32/32	350	2/6		
17	64	2-5	3d			53	8/8/8	275	1/9		
18	100/200/200/50	275	7/6			54	500	6	6d		
19	50/80	300	3/-			55	64	275	1/3		
21	24	275	1/-			56	25	6	3d		
22	10	25	3d			57	100	9	6d		
23	125	2-5	3d			58	400	50	2/-		
25	16/32	350	2/6			59	400	30	1/6		
26	32	275	1/6			60	500	4	3d		
28	75/75/75/75	40	2/6			61	150	30	1/6		
30	12-5	40	9d			62	64/32/8	275	2/6		
32	3,000	35	7/6			64	40	6-4	3d		
33	3,000	15	3/-			67	30	6	3d		
34	3,000	30	7/-			68	100/100/50	275	5/-		
35	250	70	2/-			69	50/50/50	350	4/-		
36	2,500	9	2/-			70	40/40/20	275	2/-		
38	750	12	1/9			71	400	6-4	3d		
39	100µF	275	2/6			72	320	10	3d		
40	30µF	10	3d			73	32/32	275	2/6		
42	16µF	50REV	2/-				+25	25	2/6		
43	16/16	275	2/-								
44	16	275	1/-								

Total:—

## RESISTORS. EXCELLENT QUALITY. MAINLY 5%. 7/6 per 100 of any one value.

2/- per dozen of any one value. Smaller quantities 3d each.

Tick the values required.

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

Total:

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3-9pF	6pF	15pF	27pF	58pF	82pF	140pF	190pF	330pF	800pF	1,100pF	2,700pF
4pF	8pF	18pF	30pF	62pF	100pF	158pF	200pF	500pF	820pF	1,500pF	3,000pF
4-7pF	10pF	22pF	39pF	72pF	125pF	170pF	240pF	600pF	900pF	2,200pF	6,200pF

Total:

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Total: \_\_\_\_\_

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BY127, 2/6 each. 24/- dozen. £7/10/- per 100. £50 per 1,000

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ACOS GP67/2, 15/- (Mono)

GP91/3, 20/- (Compatible)

GP93/1, 25/- (Stereo)

GP94/1, 30/- (Stereo, ceramic)

GP93/1 with diamond needle, 32/6

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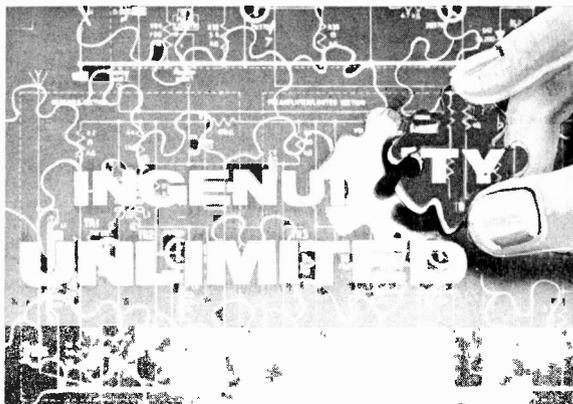
Spot Face Cutter 7/-, Pin Insert Tool, 9/6.

Terminal Pins, 3/6 for 36.

Spot Face Cutter and 5 1/2 x 1in boards, 9/9.

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

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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.

## SPARK PLUG MONITOR

ANYONE who has ever ventured out in a small craft with a two stroke outboard engine, will know that one of the most common annoyances occurs if the spark plugs oil up or break down, possibly leaving one "stranded" in an awkward location; it is, however, a simple matter to monitor the plugs whilst the engine is running and can save considerable time, as well as increasing safety to have such a device on board.

By using a spark plug monitor on any multi cylinder engine, considerable time can be saved if ignition troubles occur, the guilty cylinder showing itself immediately.

Let us assume that the engine to be monitored has four spark plugs (e.g. ordinary motor car). If we wish to monitor all four plugs we will require four low

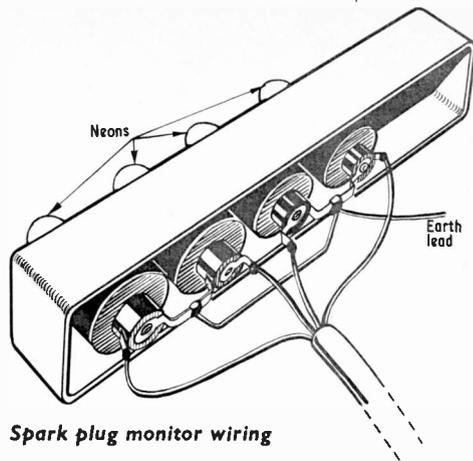


Fig. 1. Spark plug monitor wiring

voltage neons (NT2's) and several feet of four-core cable. The neons are first soldered into standard type holders as shown in Fig. 1 and the four holders located on a suitable panel. The neons are marked 1 to 4 to correspond to the cylinder being monitored.

One side of each neon is grounded to the car chassis either via the mounting panel or directly (a good earth connection must be made). The other side of each neon is connected to one of the cores of the four-core cable. About 12in of the outer casing of the cable at the engine is stripped off and each individual wire is wound around one of the spark plug h.t. leads. About ten turns are required on each cylinder but this may vary with different cars and the exact number is best found by experiment.

When the engine is running the neons will glow steadily but in the event of failure to spark of one or more of the plugs the neon corresponding to the plug at fault will flicker erratically.

D. W. Nelson,  
Merstham, Surrey.

## TREMOLO UNIT

ENCLOSE details of a tremolo unit which I have designed and which your readers may be interested in.

In the circuit, Fig. 1, transistors TR1 and TR2 form an astable multivibrator whose frequency can be varied by VR1, between approximately 5Hz and 0.2Hz. The resulting square wave appearing at the collector of TR2 is fed to VR2. The output from VR2 (depth control) is fed to TR3 base which switches the transistor on and off.

The collector emitter junction of TR3 acts as a variable resistor in the potential divider circuit between

input and output thus varying the output, the output signal being proportional to the base emitter voltage of TR3. Capacitors C3 and C4 remove the harmonics from the square wave which would otherwise cause clicks in the output.

This circuit has three main advantages over other tremolo units. Firstly, the unpleasant "thump" often heard in tremolo units is suppressed by C3 and C4 without the necessity for complex filtering circuits.

When the power supply is disconnected, the signal passes through the unit unaffected and hence if S1 is a foot switch operated by the instrumentalist, the tremolo can be switched in and out at will.

Finally, the power supply requirements are very modest, and at 9V the current drain is approximately 1mA. The unit works reliably down to about 4V.

Transistors TR1-TR3 were BC108's in the prototype, but any general purpose *npn* silicon transistors should work satisfactorily.

A. T. Barker,  
Sheffield.

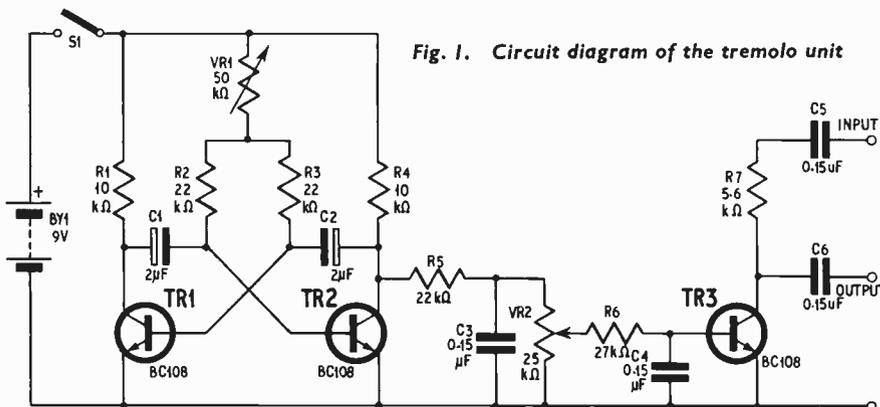


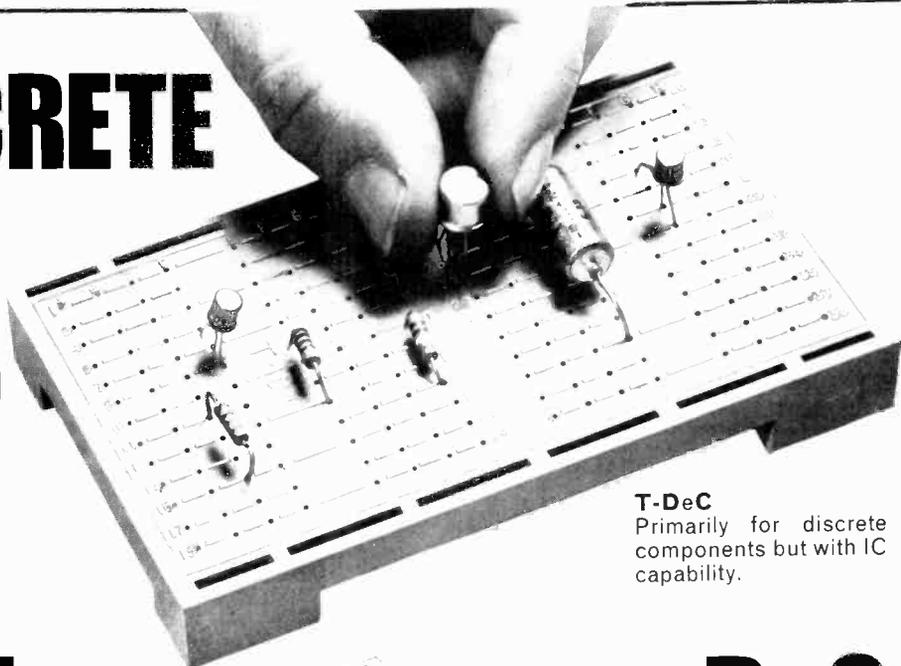
Fig. 1. Circuit diagram of the tremolo unit

# DISCRETE

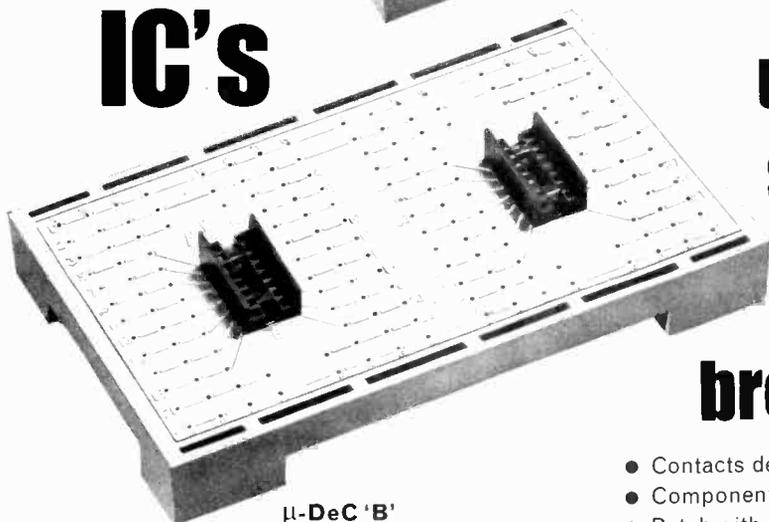
# or

# IC's

# use DeC solderless modular breadboards

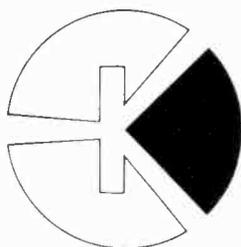


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The board to use if breadboarding with one package type.  
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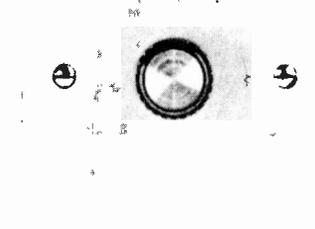
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## DIMMASWITCH



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

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

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

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Twin Panel: 19in. £7.15, 23in. £10.19.6.

New: 17in. £5.19.6, 19in. £6.19.6, 21in. £7.19.6, 23in. £9.10.

Twin panel: 19in. £9.10, 23in. £12.

Panorama: 19in. £8.10, 23in. £11.10.

All tubes covered by 2-year guarantee. All types in stock. Carr. & ins., 15/-.

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GP91-1 21/-, GP91-3 equiv. types (TC8 H and M., BSR X3H, X3M, X5H) 21/- inc. purchase tax.

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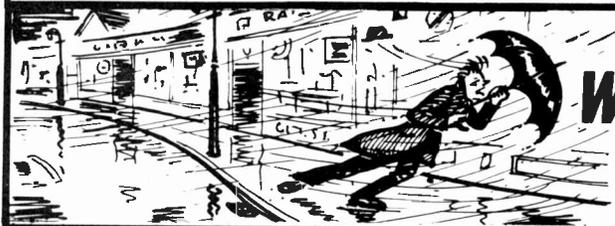
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AC107 3/-	OC81 2/6	OA200 1/6
AC128 2/6	OC81D 2/6	OA202 1/6
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# MARKET PLACE

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.

## LOW-COST UTRASONIC CLEANER

Virtually unknown only ten years ago, ultrasonic cleaning is now widely used in industry because of its effectiveness in removing even the most tenacious dirt from complex components in a matter of minutes.

Until recently ultrasonic cleaning equipment has only been a viable proposition to industry due to its prohibitive costs and involved filtration units required. But now Dawe

to a liquid, they give rise to the continuous creation and collapse of millions of microscopic vapour bubbles. This so-called cavitation results in very intense although hardly visible agitation of the liquid, which "scrubs" all dirt off any object dipped into it. Because cavitation affects all surfaces which the liquid can wet, ultrasonics can clean components and assemblies too delicate even for the finest brush.

Ordinary water is adequate for many cleaning jobs and a little household detergent can cope with most stains or grease. Other types of unwanted particles can be removed with any appropriate liquid solvent.

Full details and cost of the Sonicleaner type 6442A can be obtained from Dawe Instruments Ltd., Concord Road, Western Avenue, London, W.3.

## BEGINNERS' EXPERIMENTAL CONSTRUCTION KIT

A new experimentation course in basic electronics for beginners has just been introduced by Heathkit.

schematic symbol, so that the experimenter can learn how to read circuit diagrams. The manual also includes a dictionary of common electronic terms, and the international morse code.

The Heathkit JK-18 is available at most component shops or direct from Daystrom Ltd., Heathkit Division, Gloucester, price £13 18s, plus 5s carriage charge.

## LOW VOLTAGE IRON

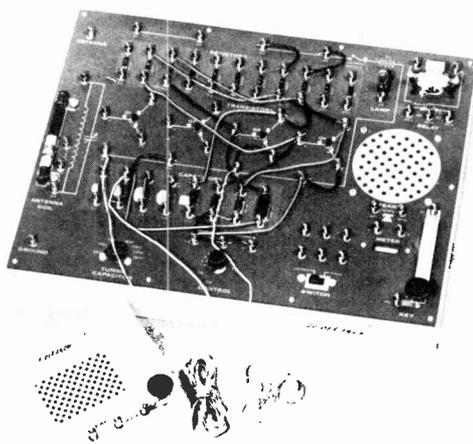
Of particular interest to our seafaring and motoring readers is the new Adcola Model L107 low voltage soldering iron.

Ideal for temporary electrical repairs on the boat and when the car breaks down miles from anywhere, low voltage irons have in the past suffered from lack of sufficient power output. However, the model L107 is rated at 27 watts, which we found ideal when tested in our workshop.

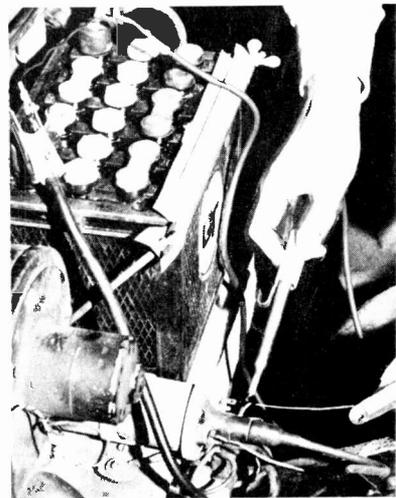
The L107 iron is fitted with 12ft of cable with suitable large battery clips attached and operates from a 12V car battery. The recommended retail price is 49s 6d.



Sonicleaner type 6442A marketed by Dawe Instruments



Heathkit JK-18 junior experimenter's constructional kit



Miniature 12V 27W soldering iron from Adcola

Instruments have marketed a range of cleaning units which, at less than £100, are within the reach of some workshops, hobbyists, collectors of coins and antiques, jewellers or anyone wishing to clean delicate components.

Known as the Sonicleaner type 6442A it contains a transistorised generator, special transducers and a stainless steel tank of 5 pints (approx. 3 litres) capacity, all housed in a case measuring 7½in × 12in × 9in. The generator incorporates automatic tuning circuits and apart from the 240V mains on/off switch there are no other controls.

Ultrasonic frequencies are used for cleaning because, when applied

Designated the Heathkit JK-18, it features 35 experiments using the "learn-by-doing" technique, ranging from a transistor tester to a simple electronic organ.

All parts are mounted on a "breadboard" and then various circuits are constructed according to instructions by connecting them with ordinary wire, provided in the kit. For speed and easy circuit assembly, solderless spring-clip connectors are used throughout.

Supplied with the kit is an illustrated manual which describes the operation of the circuit for each experiment. All parts used in any experiment are identified by both a pictorial diagram and the standard

If readers have any difficulty in obtaining the iron, details of local stockists can be obtained from Adcola Products Ltd., Adcola House, Gauden Road, London, S.W.4.

## TAPE SPLICER

With the increasing popularity of cassette tape recorders Multicore Solders have introduced the Bib Model 24 tape splicing kit. The kit is contained in a plastics wallet; the block has a ¼in channel and is fitted with chromium plated clamps for holding the tape when making diagonal or butt splices. Also included in the kit is a razor cutter,



**Bib Model 24 cassette tape splicer kit by Multicore Solders**



**Selection of audio components marketed by Ré-An Products**



**Alarm equipment manufactured by Digitation**

tape marker, a device for withdrawing the tape from the cassette and of course, a reel of splicing tape.

Believed to be the first marketed for  $\frac{1}{4}$  in tape, the kit is intended for use in joining tape, editing, and is particularly useful when the recording has been made to be synchronised with cine films or slides. The playing time of pre-recorded cassettes can be extended.

The recommended retail price of the Bib Model 24 tape splicer kit is 29s.

Adding still further to their range of Bib tape accessories, Multicore have also introduced the Bib "Five" Tape Cassette Case, designed for easy storage of tape cassettes.

The case holds five cassettes and is a convenient size for keeping in the car, and for storing in the home. Made from p.v.c. it has a clear hinged top, through which cassette titles can easily be read.

Available from audio dealers and music shops the cassette case costs 5s 11d, including purchase tax.

### AUDIO COMPONENTS

Readers who are building their own electric guitars and audio equipment may be interested in the range of miniature components available from Ré-An Products.

Among their range of components are special "off-set" switches, ideal for solid body guitars where the amount of depth is limited. Other products include miniature jack plugs and sockets, control knobs, trimmers and slide switches, etc.

Full particulars can be obtained from Ré-An Products Ltd., Burnham Road, Dartford, Kent.

### BURGLAR ALARM

A new range of burglar alarms for the home has just been announced by Digitation Ltd. Three basic models are available and various other versions which operate from a "standby" battery supply, including a car alarm version.

The basic kits contain a control box housing a printed circuit board and associated circuitry, a 3in alarm bell and bell transformer, miniature magnetic detector switches, sufficient cable to connect all units and a comprehensive booklet covering the installation and operation of the system.

Kits are available for use with both magnetic switches (magnet and reed switch) and pressure pads, and for use with infra-red beam units. Extra magnetic switches, complete with mounting accessories, and a 6in alarm bell can be supplied at an additional cost.

The price of the basic kits vary from £19 10s to £30. Details can be obtained from Digitation Ltd., 117 Church Lane, Rickmansworth, Herts. Callers can view the alarms at

Digitation's Installation Department, Page and Girling Works, 111 Midhurst Road, West Ealing, London, W.13.

### LITERATURE

The new 464-page edition of the 1970 Electronics Constructor's Catalogue is now available from **Electroniques**, Edinburgh Way, Harlow, Essex, price 10s plus 3s postage and packing, or from local components dealers.

Apart from the exhaustive range of S.T.C. components and numerous other manufacturers' items, the section on educational kits should be of interest to readers. These kits are known as Knight Mini-Kits, and range from a 2-pole motor kit to a telegraph key, buzzer and bell kit. Also available is a 100-in-1 Electronic Science Lab kit.

The fourth edition of the **Motorola Semiconductor Data Book** is now available through the **Modern Book Co.**, 19 Praed Street, London, W.2.

This latest 2,160-page edition has been re-designed and given a better layout, making it far easier to locate particular devices. Instead of a number of product categories, discrete device specifications are presented in alpha-numeric sequence in three major sections, namely: 1N, 2N and 3N prefixed devices; and Motorola's own numbered types. A short form specification is given with all devices listed.

To enable particular application requirements to be directly related to semiconductor device numbers, a 50-page selection guide is included.

The Motorola Semiconductor Data Book costs £3, plus 6s postage.

### CHEAP TRANSISTORS

**WEL Components Ltd.** have recently reduced their price of 2N2926 transistors.

The device is colour coded to achieve tight gain spread with five gain selections:

$h_{FE}$ :	35-70	55-110	90-180
Colour	Brown	Red	Orange
	150-300	235-470	
	Yellow	Green	

Further data and information is obtainable from **WEL Components Ltd.**, 5 Lovelock Road, Reading, Berks.

### P.E. ANALOGUE COMPUTER KIT

Readers and educational establishments who have begun or are contemplating the construction of the **PEAC** computer, and are having difficulty in obtaining components, might contact **Linstead Electronics**, who will be pleased to quote for complete kits. They emphasise that they will only undertake this service if there is sufficient demand. Enquiries should be made in writing, to **Linstead Electronics** at Roslyn Road, Braemar Road, London, N.15.

# Complete stereo system — £29.10.0

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

## Type 1 SPECIFICATION:—

Impedance 3, 8 or 15 ohms (state requirement), high flux 6" x 4" speaker and 2½" tweeter. Teak finish 12" x 6½" x 5½". 4 guineas each. 7/6d. p. & p. Type 2 as type 1. Size 17½" x 10½" x 6½". Incorporating 10½" x 6½" bass unit and 2½" tweeter. 3 ohms impedance £6.6.0 plus 15/- p. & p.

Garrard Changers from £7.19.6d. p. & p. 7/6d. Cover and Teak finish Plinth £4.15.0d. 7/6d. p. & p.

**Duetto** Integrated Transistor Stereo Amplifier **£9.10.0**  
plus 7/6d. p. & p.

The Duetto is a good quality amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.

## SPECIFICATION:—

R.M.S. power output: 3 watts per channel into 10 ohms speakers.  
INPUT SENSITIVITY: Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.  
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.  
TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.



These 5 items can be purchased together for £29.10 + P. & P. £1.10



## The Classic

Teak finished case  
**£9**  
Plus P. & P. 7/6

## SPECIFICATION:

Sensitivities for 10 watt output at 1KHz into 3 ohms. Tape Head: 3mV (at 32 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, 2½in high. Built and tested.

## THE RELIANT Mk. II SOLID STATE GENERAL PURPOSE AMPLIFIER

**£6.16.0** Plus P. & P. 7/6  
In teak finished case

**SPECIFICATION:** Output: 10 watts into a 3 ohms speaker.

Inputs: (1) for mike (10mV). Input (2) for gram. radio (250mV) individual bass and treble control. Transistors: 4 silicon and three germanium. Mains input: 220/250 volts. Size: 10½ x 4½ x 2½in. Mk. I. £5.15.0 plus 7/6 P. & P. Less teak finished case.

## THE ELEGANT SEVEN Mk. III (350mW Output)

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

**Price £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. Super-het portable with baby alarm facility. Set of parts. The latest modulated and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in. **MAINS POWER PACK KIT: 9/6 extra.**



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



## The Viscount INTEGRATED HIGH FIDELITY TRANSISTOR STEREO AMPLIFIER £14.5.0

Plus P. & P. 7/6

**SPECIFICATION:** Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts monoral). Input: 6-position rotary selector switch (3 pos. mono and 3 pos. stereo). P.U., Tuner, Tape and Tape Rec. out. Sensitivities: All inputs 100mV into 1-8M ohm. Frequency Response: 40Hz-20KHz ±2dB. Tone Controls: Separate bass and treble controls. Treble 13dB lift and cut [at 15KHz]. Bass: 15dB lift and 25dB cut [at 60Hz]. Volume Controls: Separate for each channel. A.C. Mains Input: 200-240V, 50-60Hz. Size: 12½ x 6in 2½in teak-finished case. Built and tested. P. & P. 7/6.  
**Viscount Mark II** for use with magnetic pick ups specification as above. Fully equalised for magnetic pick ups. Suitable for cartridges with minimum outputs of 4mV/cm/sec. at 1kc. Input impedance 47k. 15 gns. plus 7/6 P. & P.

## SPECIAL OFFER

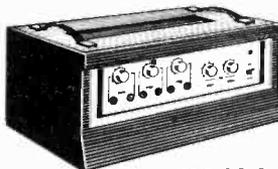
Complete stereo systems comprising BALFOUR 4 speed auto player with stereo head, 2 DUO speaker systems size 12 x 6½ x 5½in. Plinth (less cover) and the DUETTO stereo amplifier. All above items

**£25** Plus P. & P. £2

## NEW COMPLETE HI-FI STEREO SYSTEM £41

Comprising SP 25 Garrard Mk. II with diamond stereo cartridge or 2025 TC, Viscount amplifier Mk. I, Two type 2 speakers, Plinth and cover. £41 plus P. & P. £2.10

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



**Price £28.10.0**

Plus 20/- P. & P.

An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

**TECHNICAL SPECIFICATIONS**  
3 electronically mixed channels, with 2 inputs per channel, enables the use of 6 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES:** Channels 1 & 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars. Channels 3 & 4 300 mV at 1m. Suitable for most high output instruments (gram, tuner, organ etc.). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS.** Bass Boost +12dB at 60 Hz/s. Bass Cut -13dB at 60 Hz/s. Treble Boost +11dB at 15 KHz/s. Treble Cut -12dB at 15KHz/s. With bass and treble control central -3dB points are 30Hz/s and 20 KHz/s. **POWER OUTPUT.** For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sine wave 38.5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3.2% at 1KHz/s. Total distortion at 20 watts 0.15% at 1KHz/s. **NEGATIVE FEED BACK** 20dB at 1KHz/s. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES.** Adjustable from 200-250V. A.C. 50-60Hz/s. A protective fuse is located at the rear of unit. Output impedance 3, 8 and 15 ohms.

RADIO & TV COMPONENTS  
**R+TV**  
(ACTON) LIMITED

## RADIO & TV COMPONENTS (ACTON) LTD.

Post orders to:—21d High Street, Acton, London, W.3

Also at 323 Edgware Road, London, W.2

Goods not despatched outside U.K.

Terms C.W.O.

All Enquiries S.A.E.

### 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-alloy, mostly resin filled. Kit A—15-20 w. 19/8. Kit B—30-40 w. 19/8. Kit C—80 w. 23/6. Kit E—65 w. 19/8. Kit MF1 is for 6in., 9in. and 12in. miniature tubes, 19/8. Postage on Kits A and B, 4/6 for one or two kits then 4/8 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

### REED SWITCHES

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

**Miniature.** 1in. long x approximately 1/16in. diameter. Will make and break up to 1/2 A up to 300 volts. Price 2/6 each. 24/- dozen.  
**Standard.** 2in. long x 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price 8/- each. 18/- per dozen.  
**Flat.** Flat type, 2in. long, just over 1/16in. thick, approximately 1/16in. wide. The Standard type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price 6/- each. 48/- per dozen.  
 Small ceramic magnets to operate these reed switches 1/9 each. 18/- dozen.

### TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7 1/2 to 47in. Held in bottom for GB A screw. 7/8. **KNUCKLED MODEL FOR F.M. 9/8.**

### TOGGLE SWITCH

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

### MINIATURE EAR PIECE

As used with imported pocket radios. 1/6 each. 15/- doz.

### ISOLATION SWITCH

20 amp. D.P. 250V. Ideal to control water heater or any other appliance. Neon indicator shows when current is on. 4/8. 48/- per dozen.

### 15/20 AMP CONNECTORS

Polythene insulated 12-way strip. 2/6 each 24/- doz.

### 13 AMP FUSED SWITCH

Made by G.E.C. For connecting water heater etc., into 13 amp ring main. Flush type 3/6 each 30/- per dozen. Metal boxes for surface mounting 1/6 each 15/- doz.

### MICRO SWITCH

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

### SUPPRESSOR CONDENSER TCC

0-1 mfd. 250V a.c. working metal cased with fixing lug. 1/9 each 18/- doz.

### REED RELAY

Glass encapsulated reed switch in 24-volt solenoid, neatly enclosed in neat metal case, size 2 1/2in. x 1 1/2in. x 3/8in. Operates from 24 volts D.C. or from A.C. mains using rectifier, resistor and condenser (8/6 extra).

### SHEET PAXOLIN

Ideal for transistor projects, panels 12in. x 6in., 1/9 each, 15/- dozen.

### G.E.C. MULTIPLE SWITCHES

Metal boxes (with cable knockouts) sprayed silver with cover in grey. For 12 switches 6/-, 6 switches 5/-, 4 switches 4/-, 2 switches 3/6.

### G.E.C. Clipper Switches

For the above boxes, 5 amp A.C. rating, one-way 1/6, 2-way 2/-, intermediate 2/6, secret 2/6, 15 amp one-way 2/6.

### THERMOSTAT

Continuously variable 30°-90°C. Has sensor bulb connected by 33in. of flexible tubing. On operation a 15 amp 250V a.c. switch is opened and in addition a plunger moves through approx. 1in. This could be used to open valve on ventilator, etc. 29/6 plus 4/6 p. and ins.

### 15, 30 & 100 WATT HI FI SPEAKERS

**FULL FI 12 INCH LOUDSPEAKER.** This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.  
 Flux Density 11,000 gauss—Total Flux 44,000 Maxwells  
 Power Handling 15 watts R.M.S. Core Moulded fibre—Freq. response 30-10,000 c.p.s.—Impedance 3 or 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—12in. over mounting lugs—Baffle hole 11in diam.—Mounting holes 4, holes 1/2in diam. on pitch circle 11 1/2in diam.—Overall height 5 1/2in. A 26 speaker offered for only **£3.19.6** plus 7/8 p. & p. Don't miss this offer. 15in 25 watt **£7.19.6** 18in 100 watt **£19.10.0.**



### DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets and on/off switch with standard 13 amp fused plugs. Supplied complete with 7 feet of heavy cable. 39/6 wired up, ready to work plus 4/6 post and insurance.

### STANDARD WAFER SWITCHES

Standard size 1 1/2in. wafer—silver-plated 5-amp contact, standard 1/2in. spindle 2in. long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	10 way	12 way
1 pole	6/8	6/8	6/8	6/8	6/8	6/8	6/8	6/8
2 poles	6/8	6/8	6/8	6/8	6/8	6/8	10/8	10/8
3 poles	6/8	6/8	6/8	6/8	10/8	10/8	14/8	14/8
4 poles	6/8	6/8	6/8	10/8	10/8	10/8	18/8	18/8
5 poles	6/8	6/8	10/8	14/8	14/8	14/8	22/8	22/8
6 poles	6/8	10/8	10/8	14/8	14/8	14/8	26/8	26/8
7 poles	10/8	10/8	10/8	18/8	18/8	18/8	30/8	30/8
8 poles	10/8	10/8	10/8	18/8	18/8	18/8	34/8	34/8
9 poles	10/8	10/8	14/8	22/8	22/8	22/8	38/8	38/8
10 poles	10/8	10/8	14/8	22/8	22/8	22/8	42/8	42/8
11 poles	10/8	14/8	14/8	26/8	26/8	26/8	46/8	46/8
12 poles	10/8	14/8	14/8	26/8	26/8	26/8	50/8	50/8

### THIS MONTH'S SNIP

A parcel of integrated circuits made by the famous Plessey Company. A once in a lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first grade device definitely not sub-standard or seconds. The ICs are all single silicon chip General Purpose Amplifiers. Regular price of which is well over £1 each. Full circuit details of the ICs are included and in addition you will receive a list of 50 different ICs available at bargain prices 5/- upwards with circuits and technical data of each. Complete parcel only **£1** post paid or List and all data 10/- post free.

### 1 WATT AMPLIFIER & PREAMP

5 transistors—highly efficient, made for use with tapehead G4 but equally suitable for microphone or pick up—limited quantity 29/6. Full circuit diag. also shows tape controls 5/-.

### 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. 2 amp **£4.19.6**, 5 amp **£7.19.6**, 8 amp **£12.19.6**, 10 amp **£16.19.6**, Carr. extra. Note some of these are panel mounting types.

### OUR COUNTERS

If you wish to know how long your equipment has been switched on then this will help you. Counts running time up to 999 hours. 50c/mains operation. 49/6 plus 3/6 post and insurance. Resettable type 69/6 plus 3/6 p. & i.

### THE PETRON HEATING/VENTILATING CONTROL

This neat unit contains all the controls needed for a gas-fired central heating system as follows:—  
 (a) A clock switch giving 2 on/off periods per 24 hours.  
 (b) A thermal delay switch to prevent cold air being blown while fire warms up.  
 (c) Auto transformer to vary voltage and thus control fan speed.  
 (d) A 24-volt transformer to provide the low voltage necessary to operate solenoid of gas valve.  
 (e) A changeover switch to bypass the clock.  
 (f) Changeover switch to cut off heat so allowing cold air to be blown for Summer ventilation. (g) Neon indicator and fuses. The unit has a circuit diagram and five leads labelled "Mains," "Fan," "Thermostat 1," "Thermostat 2," "Gas valve." **£5.19.6** plus 4/6 postage and insurance.

### INFRA-RED MONOSCOPE

This equipment is complete and portable. Basically it consists of an infra-red image converter tube with optical lenses for focusing the image and a Zambini pile to provide the necessary E.H.T. The monoscope is housed in a hide case size 9 x 6 x 4in. approx. Made originally for the army for night observations, sniping, etc., this equipment has many scientific and practical applications; a limited quantity only is available in original sealed carton. Price **£9.19.6**. Note. Although unused in fact still in original sealed cartons. The equipment is approx. 25 years old and consequently the Zambini pile may not be operating. Drying out might help, but a better idea might be to replace it with a battery operated power unit; there is plenty of room.

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

### 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, 110-regulating temperature control. 10/- post free.

### CONTROL DRILL SPEEDS

Drill Controller Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by fingertip control. Kit includes all parts, case, everything and full instructions 19/8, plus 2/6 post and insurance. Made up model also available 37/6 plus 2/6 p. & p.

### MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters etc. New and perfect. Snip at 3/6. Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

### 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.

### COOKER CLOCK WITH TEMPERATURE CONTROLLER

This is as the clockwork described above but with additional panel which incorporates oven thermometer and thermostatic switch. The thermostatic switch may be set anywhere between 50°C and 90°C. Made for high-class continental cooker, this is a very fine instrument. **£4.19.6** plus **£1.10.0** for oven sensor unit.

### 0-0005mFd TUNING CONDENSER

Proved design, ideal for straight or reflex circuits 2/6 each. 24/- doz.

### SUB-MINIATURE MOVING COIL MICROPHONE

As used in behind-the-ear deaf aids. Acts also as earphone, size only 1 1/2in. x 1 1/2in. x 1 1/2in. Regular price probably £3 or more. Our price 19/6. Note these are ex-equipment but if not in perfect working order they will be exchanged.

### 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 18/6 plus 3/6 postage.

### PP3 BATTERY ELIMINATOR

Run your small transistor radio from the mains—full wave circuit—made up ready to wire into your set and adjustable high or low current. 8/6 each.

### BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits. 6/6 each, **£3.10.0** doz.

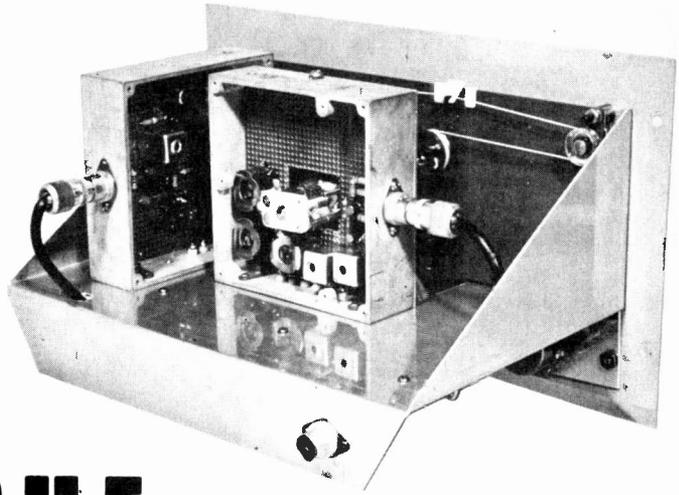
85 Watt tubular element. Very well made unit. The element is wound on a porcelain former then encased in a brass tube terminated with beaded leads 12in. long. Normal mains voltage. Price 8/- each or 84/- per doz.

**ELECTRONICS (CROYDON) LTD**  
 Dept. PE, 266 London Road, Croydon CR0 2TH  
 Also 102/3 Tamworth Road, Croydon

THE modules described in the following paragraphs form the Local Oscillator Unit for the Main Receiver. This unit is basically a stable signal generator tuning over the frequency range 36 to 64MHz; however, the tuning dial is calibrated from 2MHz to 30MHz indicating the aerial frequency at which the receiver is tuned. This can be readily appreciated by referring to the block schematic of Fig. 8.1. Some constructors may have a variable oscillator of the required frequency range and this can be used, instead of the local oscillator unit, to supply the main receiver.

The local oscillator unit comprises three modules and a main chassis. The modules are:

- (a) Variable oscillator module, 2 to 30MHz, split into five ranges (A to E).
- (b) Crystal oscillator, 34MHz.
- (c) A combined mixer and high pass filter.



# P.E. WIDEBAND H.F. COMMUNICATIONS RECEIVER

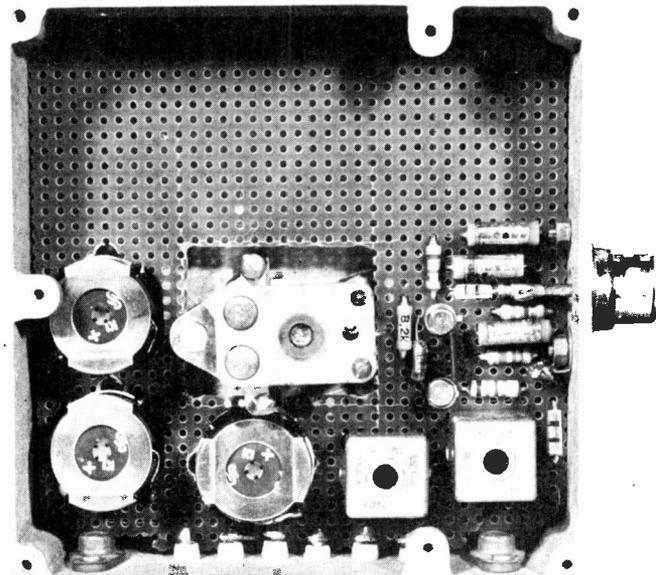
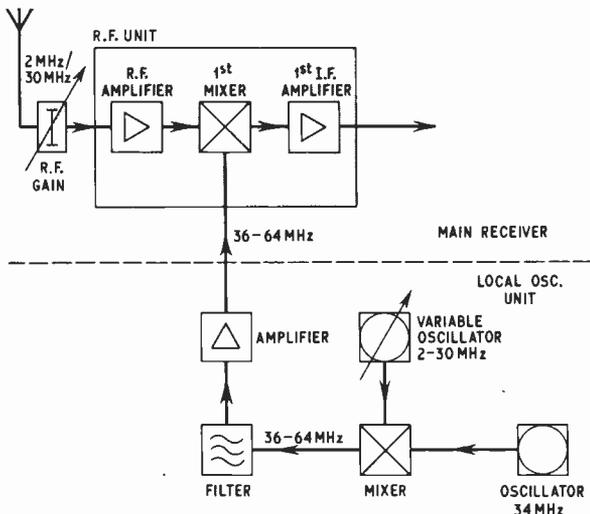
By R. HIRST S.T.C. LTD. PART EIGHT

LOCAL OSCILLATOR

## VARIABLE OSCILLATOR MODULE

A two stage emitter coupled L.C. oscillator circuit forms the basis of the variable oscillator module (Fig. 8.2) using TR1 and TR2. The collector load comprises the tuning coils L1 to L5 and a variable

capacitor, VC1. Each range is tuned in approximately a 1.6 to 1 ratio by VC1 but this ratio varies slightly due to the effect of stray capacity. The output tunes over the range 2 to 30MHz and is fed into the mixer module via SK1 to the base of TR7 (Fig. 8.4).



Variable Oscillator Module

Fig. 8.1. Block schematic diagram of the local oscillator unit

# VARIABLE OSCILLATOR

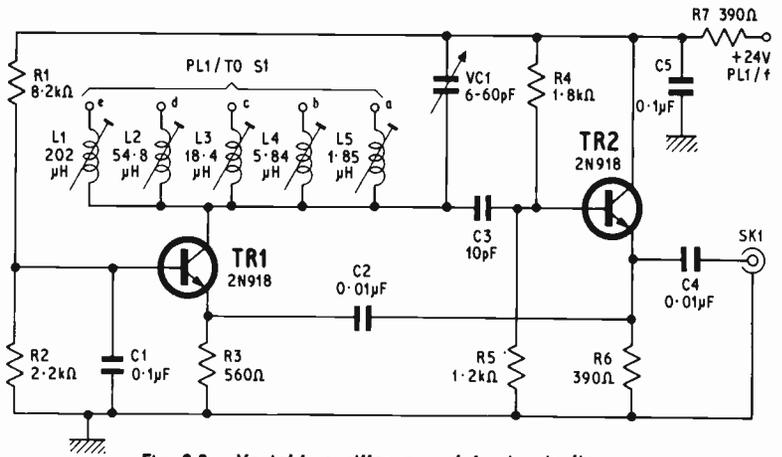


Fig. 8.2. Variable oscillator module circuit diagram

# CRYSTAL OSCILLATOR

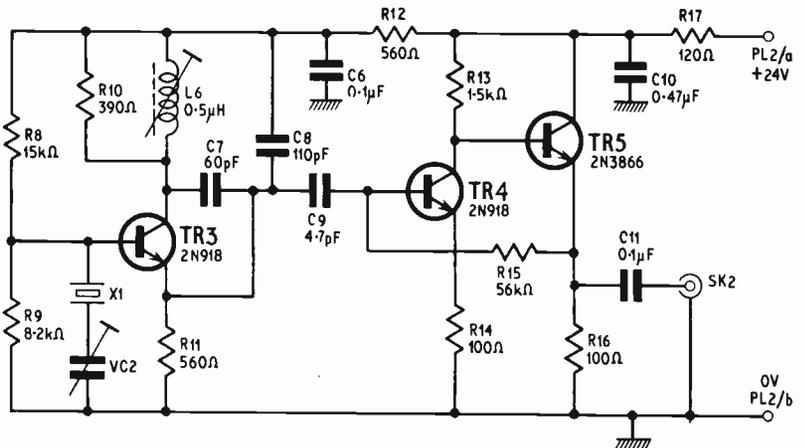


Fig. 8.3. Crystal oscillator module circuit diagram

# MIXER AND FILTER

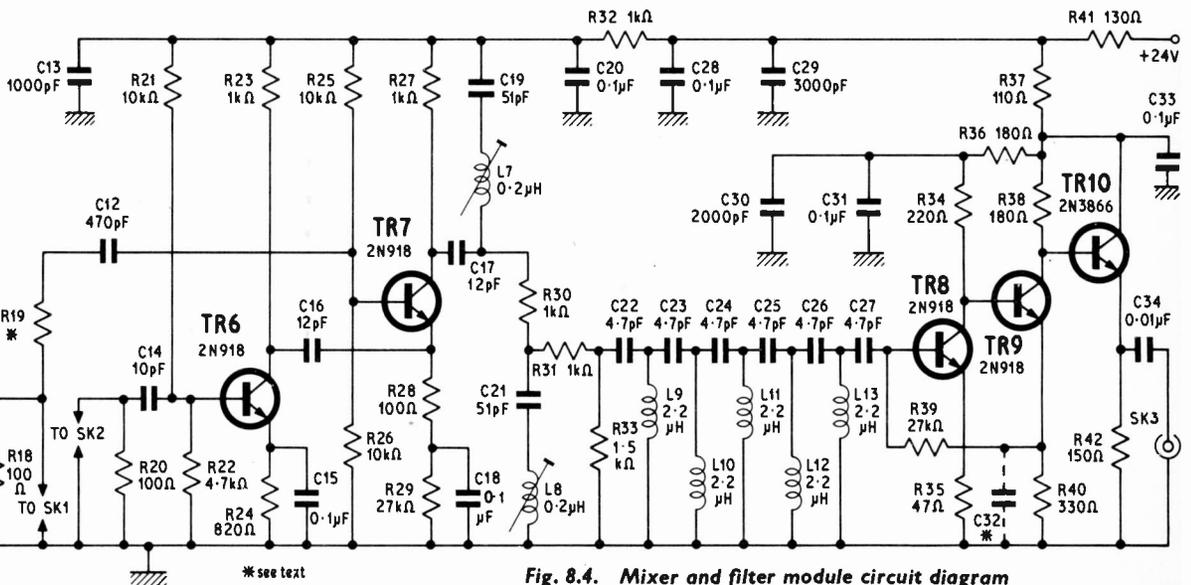
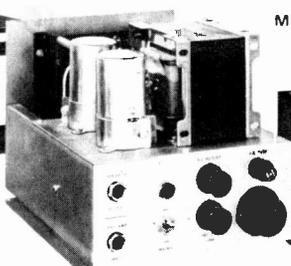


Fig. 8.4. Mixer and filter module circuit diagram

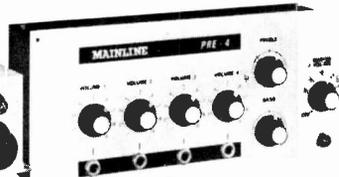
# Mainline set the NEW standard in amplifiers



Mainline 70ABD £64.0.0.



Mainline 70AB power amplifier £35.0.0.



Mainline Pre-4 mixer pre-amp control unit £24.0.0.

## Mainline 70ABD

The 70ABD is a fully integrated Pre-amplifier and Power Amplifier to the specifications of the Pre-4 and 70AB. Size 6 $\frac{3}{4}$ " x 15 $\frac{1}{2}$ " x 4 $\frac{3}{4}$ ".

**Recommended Retail Price £64.0.0.**

## Mainline 70AB power amplifier

The MAINLINE 70AB is a high fidelity power amplifier, which is in every respect one of the finest units available on the market today, regardless of price. One of the main features of this remarkable amplifier is its elaborate protection against short and open circuit, and we can guarantee that it is virtually indestructible. Allied to this is the very high power output (70 watts RMS) a frequency range that is superb, and distortion well below 1% even at full output. The unit is suitable for use in discotheques, groups, P.A., etc., or anywhere that high quality, high output is required. Coupled to our Pre-4 Control Unit the results are quite remarkable. The Mainline 70AB main amplifier can be used with any other good quality control unit.

### Specification

**POWER OUTPUT** 70 watts RMS  $\pm 1$  db at 8 OHMS.

**FREQUENCY RESPONSE** 20-20,000 HZ  $\pm 1$  db.

**SIGNAL/NOISE RATIO** -70 db at full output.

**HARMONIC DISTORTION** less than 5% at full output.

**INPUT SENSITIVITY** 700 mV at 20-30 K OHMS.

**SIZE** 7" - 9" - 6 $\frac{1}{4}$ ".

**A.C. FUSE** 1.5 amps (British Standard).

**Recommended Retail Price £35.0.0.**

## Mainline Pre-4 mixer pre-amp control unit

The MAINLINE Pre-4 is a high quality control unit, which has been designed specifically for use where mixing facilities are essential, and features many facilities not normally found on control units of this type.

The unit has four individual inputs each with its own gain control, plus separate bass, treble and master volume controls, for versatility in use. Inputs 3 and 4 are duplicated on the back panel so that if the unit is panel mounted the two auxiliary inputs (which are suitable for P.U. Tuners, Tape-recorders, etc.) may be connected from the rear. As the Pre-4 is self-powered it can be used with any other Power Amplifier, but has been designed basically as the control unit for our MAINLINE 70AB Amplifier Module.

### Specification

**INPUTS VOL. 1** 8 mV at 50K OHMS (mic).

**VOL. 2** 8 mV at 50K OHMS (mic).

**VOL. 3** 50 mV at 500K OHMS (aux).

**VOL. 4** 50 mV at 500K OHMS (aux).

50 OHM and 600 OHM Mic inputs may be

ordered at £2.0.0, extra per Input.

1 or 2 meg OHM aux inputs may be ordered at no extra cost.

**FREQUENCY RESPONSE** 30-20,000 HZ  $\pm 3$  db.

**SIGNAL/NOISE RATIO** Better than - 65 db.

**HARMONIC DISTORTION** Less than 5% at 1 volt.

**BASS** Continuously variable 20 db at 100 HZ.

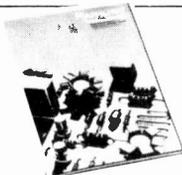
**TREBLE** Continuously variable 30 db at 10 KHZ.

**SIZE** 12 $\frac{1}{2}$ " - 6" x 4 $\frac{1}{2}$ ".

**CUT OUT REQUIRED** 11 $\frac{1}{2}$ " - 5".

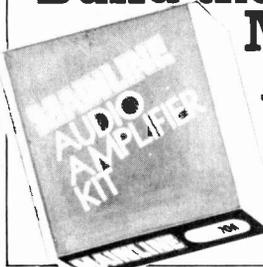
**FUSE** 60 ma internally mounted.

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*As described in Practical Electronics*



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2G306	8/6	2N3402	5/6	3N143	19/6	BC158	3/6	BFY75	6/-	NKT237	7/-
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2G371	4/-	2N3405	9/-	40050	18/6	BC167	3/6	BFY85	9/-	NKT241	5/6
2G381	4/6	2N3414	5/6	40250	12/6	BC168	3/6	BFY90	12/6	NKT10419	6/-
2N404	4/6	2N3416	5/6	40253	17/6	BC169	3/6	BFW58	5/6	NKT10439	6/-
2N696	4/6	2N3417	9/6	40254	10/6	BC171	3/6	BFW60	5/6	NKT10519	7/6
2N697	5/-	2N3570	17/6	40309	9/6	BC172	3/6	BPX25	37/-	NKT20329	6/6
2N698	5/-	2N3572	17/6	40310	13/6	BC175	6/-	BPX29	3/6	NKT20329	9/6
2N706	2/6	2N3605	5/6	40311	10/6	BC182	4/6	BPY10	29/-	NKT20339	9/6
2N708	3/-	2N3606	5/6	40312	13/6	BC183	4/6	BSX19	3/6	NKT20339	7/6
2N709	12/6	2N3607	4/6	40313	10/6	BC184	4/6	BSX20	3/6	NKT20339	7/6
2N718	6/-	2N3663	8/-	40316	10/6	BC121L	7/6	BSX21	7/6	NKT80111	15/6
2N726	5/-	2N3702	3/6	40317	11/-	BCY12	5/6	BSX27	10/6	NKT80113	19/6
2N727	5/-	2N3703	4/6	40319	15/-	BCY30	5/6	BSX28	6/6	NKT80212	18/6
2N914	3/6	2N3704	4/6	40320	10/6	BCY31	5/6	BSX60	12/6	NKT80213	18/6
2N916	3/6	2N3705	4/6	40323	10/6	BCY32	7/6	BSX61	12/6	NKT80214	18/6
2N918	6/-	2N3706	4/6	40324	12/6	BCY33	4/6	BSX77	6/6	NKT80215	18/6
2N929	4/6	2N3708	5/6	40329	7/6	BCY34	4/6	BSY29	6/6	NKT80216	18/6
2N930	7/-	2N3708	5/6	40329	7/6	BCY35	4/6	BSY29	6/6	NKT80217	18/6
2N987	10/6	2N3709	3/6	40344	8/6	BCY39	7/6	BSY10	5/6	NKT80218	18/6
2N1090	6/6	2N3710	4/6	40347	9/6	BCY40	6/6	BSY11	5/6	NKT80219	18/6
2N1091	6/6	2N3711	4/6	40348	11/6	BCY42	3/-	BSY24	4/-	NKT80220	18/6
2N1131	5/6	2N3819	9/-	40360	14/6	BCY43	3/-	BSY25	4/-	NKT80221	18/6
2N1132	5/6	2N3823	27/6	40361	12/6	BCY54	7/6	BSY26	4/-	NKT80222	18/6
2N1302	3/6	2N3825	4/6	40362	14/6	BCY58	4/6	BSY27	4/-	NKT80223	18/6
2N1303	3/6	2N3826	4/6	40363	14/6	BCY59	4/6	BSY28	4/-	NKT80224	18/6
2N1304	4/6	2N3855	5/6	40467	16/6	BCY60	19/6	BSY29	4/-	NKT80225	18/6
2N1305	4/6	2N3855A	6/-	40468A	16/6	BCY70	4/6	BSY32	5/-	NKT80226	18/6
2N1306	5/-	2N3856	6/-	AC107	6/-	BCY71	8/6	BSY36	5/-	NKT80227	18/6
2N1307	5/-	2N3856A	7/-	AC126	4/6	BCY72	4/6	BSY37	5/-	NKT80228	18/6
2N1308	6/-	2N3858	5/6	AC127	5/6	BCZ10	5/6	BSY38	4/6	NKT80229	18/6
2N1309	6/-	2N3858A	6/-	AC128	4/6	BCZ11	5/6	BSY39	4/6	NKT80230	18/6
2N1507	5/6	2N3859	5/6	AC154	5/6	BDY10	22/6	BSY40	8/6	NKT80231	18/6
2N1613	8/6	2N3859A	6/6	AC176	5/6	BDI18	22/6	BSY51	8/6	NKT80232	18/6
2N1631	8/6	2N3860	6/-	AC187	12/-	BDI21	17/6	BSY52	9/6	NKT80233	18/6
2N1632	8/6	2N3866	30/-	AC188	12/-	BDI23	21/6	BSY53	8/6	NKT80234	18/6
2N1637	8/6	2N3877A	8/-	AC175	5/6	BDI24	12/6	BSY54	10/6	NKT80235	18/6
2N1638	7/6	2N3877A	8/-	AC175	5/6	BDY10	27/6	BSY56	18/6	NKT80236	18/6
2N1639	7/6	2N3878	8/-	AC179	5/6	BDY11	37/6	BSY78	9/6	NKT80237	18/6
2N1711	6/6	2N3900A	8/-	ACY20	5/6	BDY12	37/6	BSY79	9/6	NKT80238	18/6
2N1889	6/6	2N3901	19/6	ACY21	5/6	BDY18	49/6	BSY82	10/6	NKT80239	18/6
2N1893	8/6	2N3903	7/6	ACY22	4/6	BDY19	62/6	BSY90	11/6	NKT80240	18/6
2N2147	17/6	2N3904	7/6	ACY28	4/6	BDY20	22/6	BSY95A	2/6	NKT80241	18/6
2N2148	12/6	2N3905	7/6	ACY40	4/6	BDY38	19/6	BSW41	8/6	NKT80242	18/6
2N2160	11/6	2N3906	7/6	ACY41	5/6	BDY60	36/6	BSW70	5/6	NKT80243	18/6
2N2193	5/6	2N4055	5/6	AD100	8/-	BDY61	36/6	D16R2	7/6	NKT80244	18/6
2N2193A	10/6	2N4059	5/6	AD140	8/-	BDY62	27/6	D16R2	8/6	NKT80245	18/6
2N2194A	4/6	2N4060	5/6	AD149	11/6	BF115	5/6	D16P3	7/6	NKT80246	18/6
2N2217	5/6	2N4061	4/6	AD150	15/-	BF117	9/6	D16P4	8/6	NKT80247	18/6
2N2218	6/-	2N4062	4/6	AD161	7/6	BF163	7/6	GET102	6/-	NKT80248	18/6
2N2219	6/-	2N4244	9/6	AD162	7/6	BF167	5/6	GET113	4/6	NKT80249	18/6
2N2220	5/6	2N4255	8/6	AF106	9/6	BF173	7/6	GET114	4/6	NKT80250	18/6
2N2221	5/6	2N4255	7/6	AF106	9/6	BF177	11/6	GET118	4/6	NKT80251	18/6
2N2222	5/6	2N4285	3/6	AF115	6/6	BF178	10/6	GET120	6/6	NKT80252	18/6
2N2227	21/6	2N4286	3/6	AF116	5/6	BF179	14/6	GET120	6/6	NKT80253	18/6
2N2297	6/-	2N4287	3/6	AF117	5/6	BF180	7/6	GET873	3/6	NKT80254	18/6
2N2303	5/6	2N4288	3/6	AF118	12/6	BF181	6/6	GET880	6/6	NKT80255	18/6
2N2368	5/6	2N4289	3/6	AF119	4/6	BF184	7/6	GET887	4/6	NKT80256	18/6
2N2369	5/6	2N4290	3/6	AF124	4/6	BF185	5/6	GET889	4/6	NKT80257	18/6
2N2369A	5/6	2N4291	3/6	AF125	4/6	BF194	5/6	GET890	4/6	NKT80258	18/6
2N2410	8/6	2N4292	3/6	AF126	4/6	BF195	5/6	GET891	4/6	NKT80259	18/6
2N2483	5/6	2N5027	10/6	AF127	3/6	BF196	5/6	GET897	4/6	NKT80260	18/6
2N2484	6/6	2N5028	11/6	AF139	7/6	BF197	5/6	GET898	4/6	NKT80261	18/6
2N2539	4/6	2N5029	9/6	AF178	12/6	BF198	5/6	MAT100	6/-	NKT80262	18/6
2N2540	4/6	2N5030	8/6	AF179	11/6	BF200	10/6	MAT101	6/-	NKT80263	18/6
2N2613	7/6	2N5172	7/6	AF180	12/6	BF224	6/6	MAT120	6/-	NKT80264	18/6
2N2614	11/6	2N5173	10/6	AF218	6/6	BF225	6/6	MAT121	6/-	NKT80265	18/6
2N2646	11/6	2N5175	10/6	AF239	7/6	BF246	8/6	MJ400	21/6	NKT80266	18/6
2N2696	6/6	2N5176	9/-	AF279	16/6	BF238	6/6	MJ420	22/6	NKT80267	18/6
2N2711	6/-	2N5232	5/6	AF280	16/6	BFX12	5/6	MJ421	22/6	NKT80268	18/6
2N2712	6/-	2N5232A	6/-	AFZ11	5/6	BFX13	5/6	MJ430	20/6	NKT80269	18/6
2N2713	5/6	2N5245	12/6	AFY26	5/6	BFX29	8/-	MJ440	19/6	NKT80270	18/6
2N2714	6/-	2N5246	12/6	ASV27	8/6	BFX30	9/-	MJ480	20/6	NKT80271	18/6
2N2715	6/-	2N5247	13/6	AFY28	8/6	BFX43	8/6	MJ481	27/6	NKT80272	18/6
2N2904	7/6	2N5249A	13/6	ASV29	5/6	BFX44	8/6	MJ490	22/6	NKT80273	18/6
2N2904A	8/-	2N5265	6/6	ASV36	5/6	BFX68	13/6	MJ491	29/6	NKT80274	18/6
2N2905	8/-	2N5266	5/6	ASV50	5/6	BFX84	8/6	MJ1800	43/6	NKT80275	18/6
2N2905A	9/-	2N5267	5/6	ASV51	6/6	BFX85	8/6	MJ340	15/-	NKT80276	18/6
2N2906	6/6	2N5305	7/6	ASV53	5/6	BFX85	10/6	MJ520	19/6	NKT80277	18/6
2N2906A	6/6	2N5306	8/-	ASV54	3/6	BFX86	8/6	MJ521	19/6	NKT80278	18/6
2N2907	6/6	2N5307	7/6	ASV62	5/6	BFX87	10/6	MPF102	8/6	NKT80279	18/6
2N2923	3/6	2N5308	7/6	ASV63	3/6	BFX88	10/6	MPF103	7/6	NKT80280	18/6
2N2924	3/6	2N5309	12/6	ASV72	5/6	BFX89	12/6	MPF104	7/6	NKT80281	18/6
2N2925	3/6	2N5310	8/6	ASV83	5/6	BFX92A	12/6	MPF105	7/6	NKT80282	18/6
2N2926	3/6	2N5354	5/6	ASV86	6/6	BFY10	4/6	MPS3638	6/6	NKT80283	18/6
2N2927	3/6	2N5355	5/6	ASZ20	7/6	BFY11	4/6	NKT0013	9/6	NKT80284	18/6
2N2928	3/6	2N5356	6/6	ASZ21	7/6	BFY12	4/6	NKT124	8/6	NKT80285	18/6
2N301	12/6	2N5365	6/6	AY110	3/6	BFY25	4/6	NKT125	5/6	NKT80286	18/6
2N301A	12/6	2N5366	10/6	BC107	3/6	BFY27	4/6	NKT126	6/6	NKT80287	18/6
2N3014	6/6	2N5367	11/6	BC108	3/6	BFY18	4/6	NKT128	5/6	NKT80288	18/6
2N3053	5/6	2N5457	7/6	BC109	3/6	BFY19	4/6	NKT135	5/6	NKT80289	18/6
2N3054	12/6	25005	15/-	BC113	6/6	BFY20	12/6	NKT137	6/6	NKT80290	18/6
2N3055	15/-	25020	37/6	BC115	6/6	BFY21	8/6	NKT210	6/6	NKT80291	18/6
2N3133	6/6	25102	6/6	BC116	12/6	BFY24	9/6	NKT211	6/6	NKT80292	18/6
2N3134	5/6	25103	6/6	BC117	12/6	BFY25	9/6	NKT212	6/6	NKT80293	18/6
2N3135	5/6	25104	6/6	BC121	4/6	BFY26	4/6	NKT213	6/6	NKT80294	18/6
2N3136	5/6	25104	6/6	BC122	4/6	BFY29	10/6	NKT214	4/6	NKT80295	18/6
2N3340	19/6	25501	3/6	BC125	11/-	BFY30	10/6	NKT215	4/6	NKT80296	18/6
2N3349	26/-	25502	3/6	BC126	11/6	BFY41	10/6	NKT216	7/6	NKT80297	18/6
2N3390	7/6	25503	3/6	BC140	7/6	BFY43	12/6	NKT217	8/6	NKT80298	18/6
2N3391	5/6	3N83	37/6	BC147	3/6	BFY50	4/6	NKT219	6/6	NKT80299	18/6
2N3391A	6/6	3N128	18/6	BC148	3/6	BFY51	4/6	NKT223	5/6	NKT80300	18/6

# VARIABLE OSCILLATOR

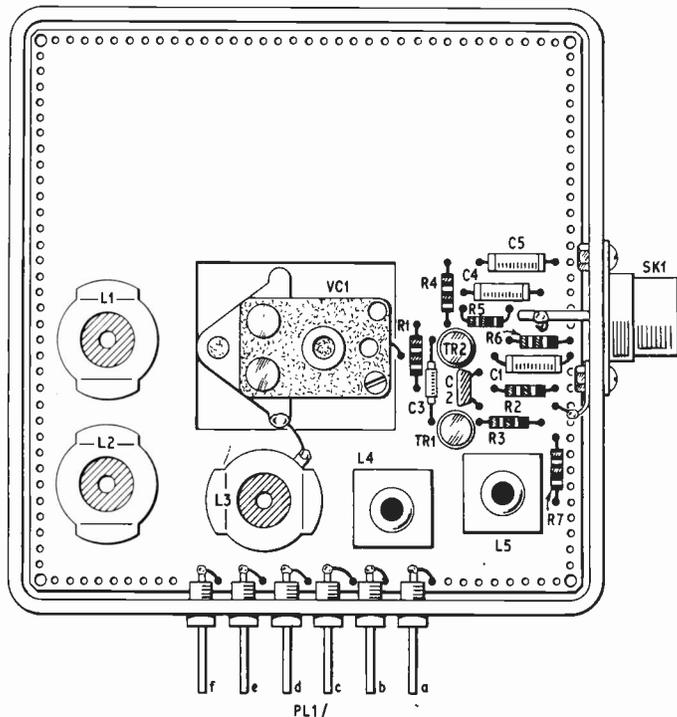


Fig. 8.5. Variable oscillator module layout and wiring

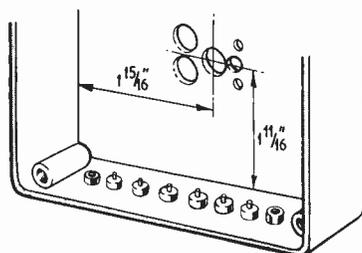


Fig. 8.6. Module case drilling details

## COMPONENTS . . .

### Resistors

- R1 8.2k $\Omega$
- R2 2.2k $\Omega$
- R3 560 $\Omega$
- R4 1.8k $\Omega$
- R5 1.2k $\Omega$
- R6 390 $\Omega$
- R7 390 $\Omega$
- All  $\frac{1}{3}$ W, 5% high stability, carbon film

### Capacitors

- C1 0.1 $\mu$ F paper or foil
- C2 0.01 $\mu$ F ceramic
- C3 10pF mica  $\pm 2.5\%$
- C4 0.01 $\mu$ F ceramic
- C5 0.1 $\mu$ F paper or foil
- VC1 6-60pF twin ganged 3-30pF variable capacitor (wired in parallel)

### Transistors

- TR1, 2 2N918 (2 off)

### Miscellaneous

- L1-5 inductors, see Fig. 8.11 (5 off)
- SK1 coaxial output socket
- PL1/a-f lead through connectors (6 off)
- Veroboard  $3\frac{1}{2}$ in  $\times$   $3\frac{1}{2}$ in, 0.1in grid

# CRYSTAL OSCILLATOR

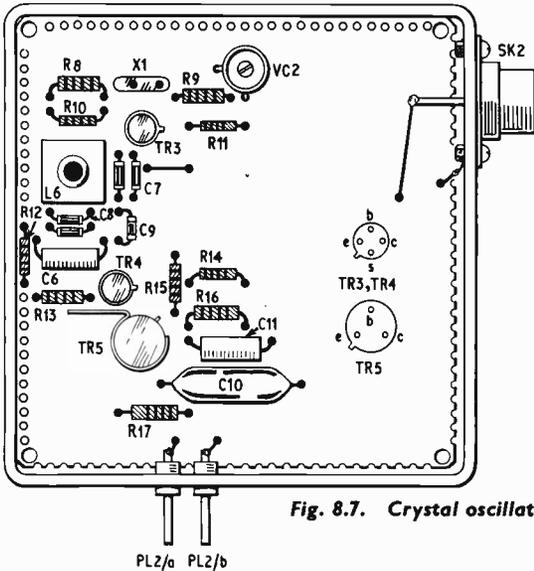


Fig. 8.7. Crystal oscillator module layout and wiring

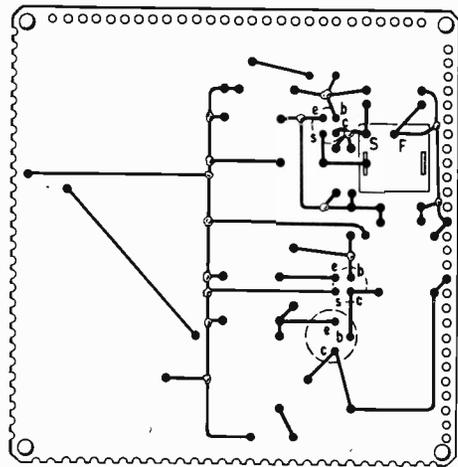


Fig. 8.8. Module case details

## COMPONENTS . . .

### Resistors

R8	15k $\Omega$	R13	1.5k $\Omega$
R9	8.2k $\Omega$	R14	100 $\Omega$
R10	390 $\Omega$	R15	56k $\Omega$
R11	560 $\Omega$	R16	100 $\Omega$
R12	560 $\Omega$	R17	120 $\Omega$

All  $\frac{1}{3}$ W, 5% high stability, carbon film

### Capacitors

C6	0.1 $\mu$ F polyester or foil
C7	60pF polystyrene $\pm 2.5\%$ (39pF and 22pF in parallel)
C8	110pF polystyrene $\pm 2.5\%$ (100pF and 10pF in parallel)
C9	4.7pF polystyrene $\pm 2.5\%$
C10	0.47 $\mu$ F polyester or foil
C11	0.1 $\mu$ F polyester or foil
VC2	6-24pF ceramic trimmer

### Transistors

TR3, 4	2N918 (2 off)
TR5	2N3866

### Miscellaneous

X1	overtone crystal 34MHz
SK2	coaxial output socket
TO5	heatsink
PL2/a, b	lead through connectors (2 off)
Veroboard	3 $\frac{1}{2}$ in $\times$ 3 $\frac{1}{2}$ in, 0.1in grid

## CRYSTAL OSCILLATOR MODULE

The crystal oscillator module is very similar to the second oscillator module described earlier in this series where the output frequency was 36MHz. However, in this instance the output frequency is 34MHz which is produced by the basic oscillator, TR3 and associated components (Fig. 8.3).

The following stage TR4 and TR5 forms a directly coupled amplifier giving an output of approximately 0.5 volts at 34MHz to switch the mixer module.

## MIXER MODULE

The mixer module can be broken down into three separate circuit configurations, these are as follows:

- Mixer.
- High Pass Filter.
- Output Amplifier.

The mixer section comprises TR6 and TR7 (Fig. 8.4) functioning in the following manner. The 2 to 30MHz signal from the variable oscillator module is fed into the base of TR7 via C12 and is mixed, in TR7, with

34MHz from the crystal oscillator module which is injected into the emitter of TR7. Due to the very low impedance at the emitter of TR7, a further stage, TR6 is introduced which current feeds TR7 via C16. Capacitor C14 is adjusted so that the signal level across R20 is at the level stipulated in the setting-up instructions given later.

The output at the collector of TR7 is made up of a number of frequencies depending upon the output of the variable oscillator module. If the frequency of the variable oscillator module is 2MHz the following frequencies are present in the collector circuit:

- Direct signal (34MHz)
- 34MHz + 2MHz (36MHz)
- Direct signal (2MHz)
- 34MHz - 2MHz (32MHz)

If the output frequency of the variable oscillator module is changed to 30MHz the frequencies present in the collector circuit of TR7 will now be:

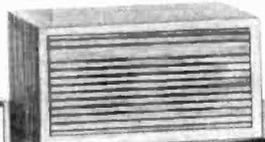
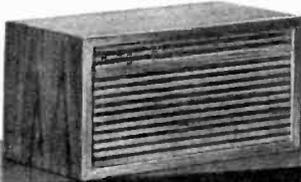
- Direct signal (34MHz)
- 34MHz + 30MHz (64MHz)

# COMPLETE STEREO SYSTEM

FOR ONLY

# 39 GNS

CARRIAGE 35/-



The Premier Stereo System "ONE" consists of an all transistor stereo amplifier, Garrard 2025T/C auto/manual record player unit fitted stereo/mono cartridge and mounted in teak finish plinth with per-pex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor Amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector, Power on/off, stereo/mono switch. Brushed aluminium front panel. Black metal case with teakwood ends. Size 12" x 5 1/2" x 3 1/2" high. PREMIER STEREO SYSTEM "ONE" 39 GNS. Carr. 35/- (Amplifier available separately if required £14.19.6. Carr. 7/6).

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A small but powerful amplifier designed for stereo hi-fi reproduction. Incorporates 16 transistors and diodes. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble, Stereo Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price £28.7.0

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Teleton SAQ203E Amplifier (as above)	£23 2.0
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As system "ONE" above but with Garrard SP25.

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Mono Model 59/6 Stereo Model 69/6 P. & P. 2/6

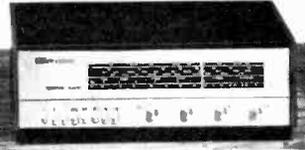
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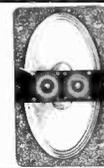
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DT3 3 1/2' 600' POLYESTER	11/6	TT6 5 1/2' 2400' POLYESTER	37/6
SP5 5' 600' P.V.C.	8/6	SP7 7' 1200' P.V.C.	12/6
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200μF	6V	25μF	10V	10μF	12V	10μF	25V	50μF	40V
320μF	6V	25μF	10V	16μF	15V	16μF	25V	10μF	64V
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Miniature 0.3 watt 1/- each.

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# MIXER AND FILTER

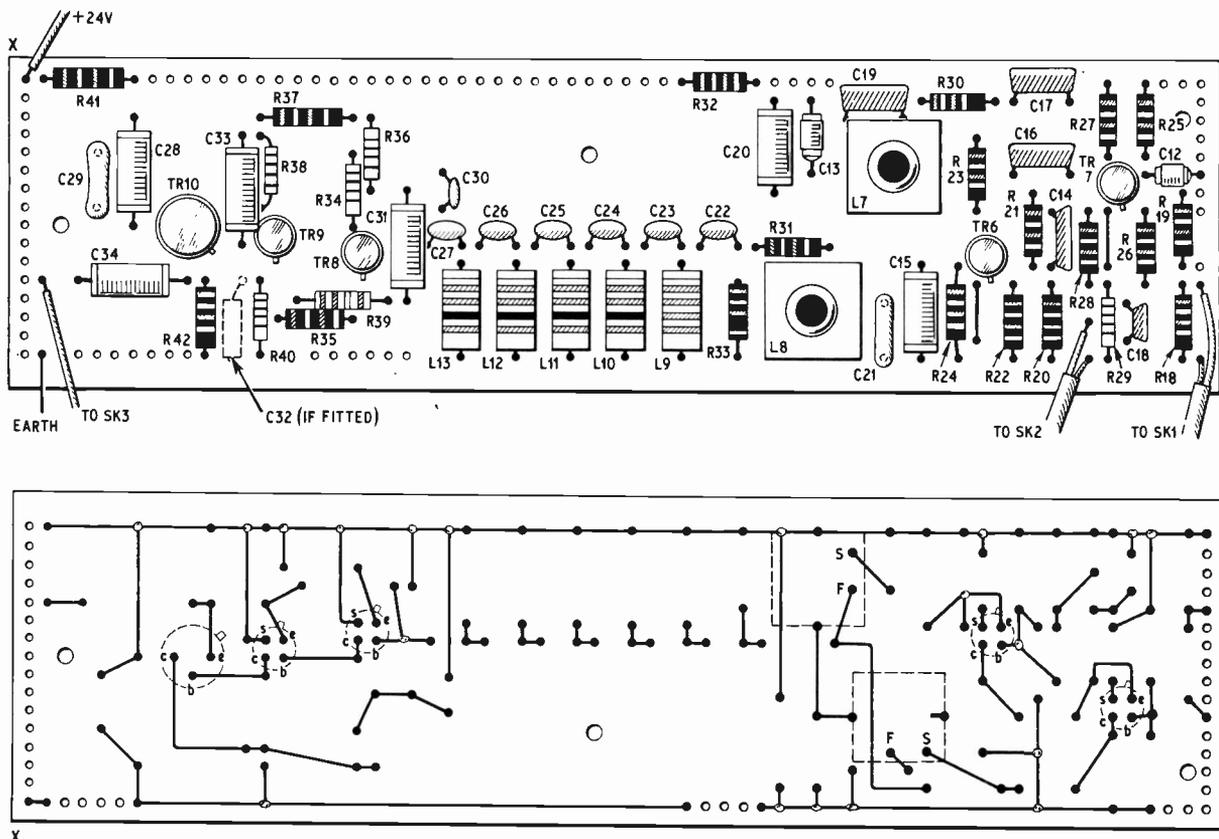


Fig. 8.9. Mixer and filter module layout and wiring

## COMPONENTS . . .

### Resistors

R18	100Ω	R31	1kΩ
R19	see text	R32	1kΩ
R20	100Ω	R33	1.5kΩ
R21	10kΩ	R34	220Ω
R22	4.7kΩ	R35	.47Ω
R23	1kΩ	R36	180Ω
R24	820Ω	R37	110Ω
R25	10kΩ	R38	180Ω
R26	10kΩ	R39	27kΩ
R27	1kΩ	R40	330Ω
R28	100Ω	R41	130Ω
R29	27kΩ	R42	150Ω
R30	1kΩ		

All resistors  $\frac{1}{4}$ W, 5% high stability, carbon film

### Capacitors

C12	470pF polystyrene $\pm 2.5\%$
C13	1,000pF polystyrene $\pm 10\%$
C14	10pF polystyrene or mica $\pm 2.5\%$
C15	0.01μF ceramic
C16	12pF mica $\pm 2.5\%$
C17	12pF mica $\pm 2.5\%$
C18	0.1μF paper or foil
C19	51pF mica $\pm 2.5\%$
C20	0.1μF mica $\pm 2.5\%$
C21	51pF mica $\pm 2.5\%$
C22	4.7pF ceramic or mica
C23	4.7pF ceramic or mica
C24	4.7pF ceramic or mica
C25	4.7pF ceramic or mica
C26	4.7pF ceramic or mica
C27	4.7pF ceramic or mica
C28	0.1μF paper or foil
C29	3,000pF ceramic
C30	2,000pF ceramic
C31	0.1μF paper or foil
C32	see text
C33	0.1μF paper or foil
C34	0.01 ceramic

C21	51pF mica $\pm 2.5\%$
C22	4.7pF ceramic or mica
C23	4.7pF ceramic or mica
C24	4.7pF ceramic or mica
C25	4.7pF ceramic or mica
C26	4.7pF ceramic or mica
C27	4.7pF ceramic or mica
C28	0.1μF paper or foil
C29	3,000pF ceramic
C30	2,000pF ceramic
C31	0.1μF paper or foil
C32	see text
C33	0.1μF paper or foil
C34	0.01 ceramic

### Transistors

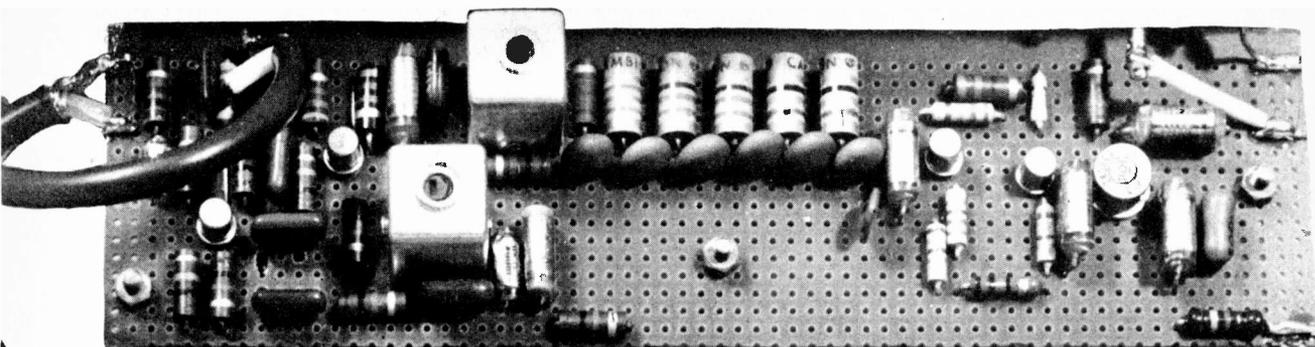
TR6-9	2N918 (4 off)
TR10	2N3866

### Inductors

L7, 8	see Fig. 8.11 (2 off)
L9-13	2.2μH Cambion chokes (5 off)

### Miscellaneous

SK3	coaxial output socket
Veroboard	6 $\frac{1}{2}$ in $\times$ 1 $\frac{1}{2}$ in, 0.1in matrix



Mixer and Filter Module

- (c) Direct signal (30MHz)
- (d) 34MHz — 30MHz (4MHz)

In both the instances the required frequency is shown in bold letters and is above all the other frequencies therefore, a high pass filter, set to the correct frequency range, will accept the required frequencies above 36MHz and reject those below. As the 34MHz signal is of a considerable level, required for switching, and is relatively close to the wanted frequency at the lower end of the band, the rejection at 34MHz achieved by the high pass filter is not sufficient. To reduce the level of the 34MHz signal, two rejector circuits, L7, C19 and L8, C21 are included, effectively, in the collector load of TR7. These two rejectors, when correctly tuned, give a rejection of approximately 46dB at 34MHz and coupled with the rejection of the high pass filter, the overall rejection is in the order of 54dB at 34MHz.

The high pass filter, L9 to L13 and C22 to C26, starts to cut off below 36MHz and takes the shape of the curve shown in Fig. 8.10.

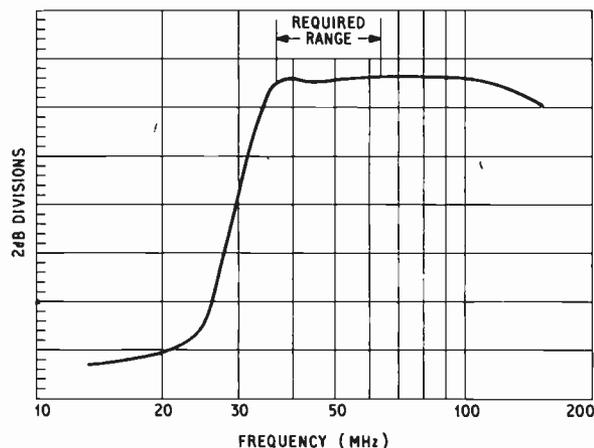


Fig. 8.10. High pass filter characteristic

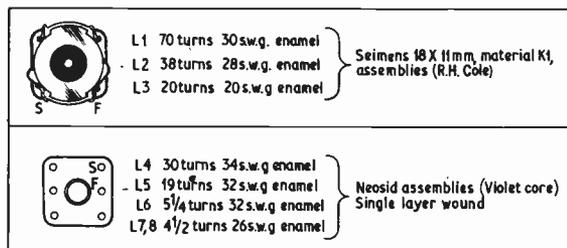


Fig. 8.11. Coil winding details

The output amplifier is directly coupled comprising three stages, TR8, TR9 and TR10, giving an output of 0.7 volts in the frequency range 34MHz to 64MHz. The input base of TR8 accepts the signal from the high pass filter via C27 and the signal is amplified in TR8 and TR9. The amplifier is terminated in an emitter follower TR10, to reduce the output impedance to something in the order of 10 ohms. The output at C34 is fed into the first mixer in the main receiver (via SK2), as shown in Fig. 8.1.

### POWER SUPPLY

A separate 24 volt supply could be used to power the local oscillator unit; however the 24 volts already provided in the main receiver has sufficient current capacity to drive both the local oscillator unit and the main receiver and hence this can be used.

### MECHANICAL AND WIRING DETAILS

It is essential that all the circuit wiring is kept as near to the layout diagrams as possible, as any extra capacity introduced due to lengthy leads will alter the tuning range of the overall unit. This is especially applicable to the variable oscillator module as the high frequency end of the band does include a certain percentage of stray capacity by necessity.

Both the variable oscillator unit and the crystal oscillator are built in module cases of the type detailed in Fig. 2.1. The only details that differ from the module cases described earlier are the number and spacing of the pin connectors and the drilling of mounting holes, in the variable oscillator module, for VCI; these details are shown in Figs. 8.6 and 8.8.

Before commencing construction of the variable oscillator module the five inductors should be wound to the details shown in Fig. 8.11 and the perforated board should be cut away to clear VCI which is mounted on the back panel of the module. The components can then be positioned and wired up as shown in Fig. 8.5; note the use of six connecting pins—the pin letters *a* to *e* correspond to the ranges of the receiver.

As mentioned previously the crystal oscillator module is a copy of the 2nd oscillator module in every detail except the pin connectors and X1 (now 34MHz); construction details for this module are given in Fig. 8.7.

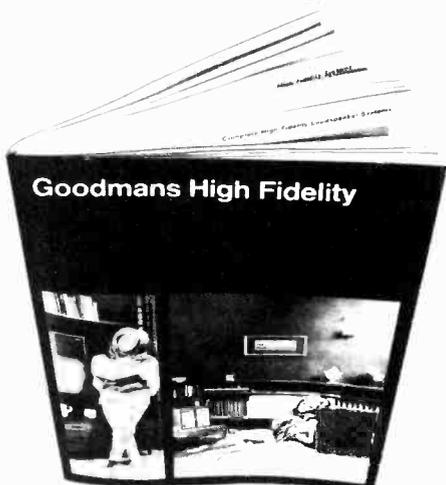
The mixer and filter unit is constructed on a piece of plain perforated Veroboard that is mounted on the chassis by three 1/2 in mounting pillars. As before inductors L7 and L8 should be wound before commencing construction, to the details given in Fig. 8.11. The layout and wiring of the mixer and filter unit is straightforward and is shown in Fig. 8.9. Capacitor C32 and Resistor R19 may need to be fitted when the unit is set up; details will be given next month.

**Next month: chassis and wiring details**

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Add 1/- to the above i.e.s. for data sheets if required (1/9 with SL403A, free with IC-10). Other data sheets (apart from IC-10) may be purchased separately at 1/6 per sheet, post free.

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This unit is available at only 36/- net, complete with descriptive leaflet or 70/- net per pair. Send for free leaflet.

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BC138	7/6	BF194	7/-	T1550	3/6	2N3704	3/9
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AC127	5/6	BF115	5/-	NKT143	5/6	OC139	5/-	2N388A	15/-	2N3525	21/9	25321	6/-
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ACY21	4/6	BF181	6/6	NKT213	6/-	OC206	10/6	2N696	4/6	2N3908	2/6	AA119	2/6
ACY22	2/9	BF184	7/-	NKT214	4/-	OC207	7/6	2N697	4/-	2N3709	3/6	AA111	2/-
ACY40	3/6	BF185	8/-	NKT215	4/-	OC309	12/-	2N698	6/-	2N3710	3/6	AAZ12	6/-
ACY41	4/4	BF194	3/6	NKT216	10/-	OC710	19/6	2N706	2/6	2N3711	3/6	AAZ13	2/6
ACY44	8/-	BF200	10/6	NKT217	13/-	ORP12	9/6	2N706A	2/6	2N3819	8/6	BA100	6/-
AD140	11/-	BFX13	5/-	NKT218	5/3	ORP60	8/-	2N708	4/-	2N3820	18/9	BA110	6/-
AD149	11/6	BFX29	8/-	NKT219	6/-	ORP61	8/-	2N711	7/6	2N3826	6/-	BA111	6/-
AD161	6/-	BFX40	8/4	NKT219	5/6	ORP63	9/6	2N714	7/6	2N3854	5/6	BA112	18/-
AD162	6/-	BFX84	7/6	NKT222	4/-	P346A	5/-	2N715	7/6	2N3854A	5/6	BA115	1/6
ADT140	12/6	BFX85	9/-	NKT223	3/6	RAS310AF	6/-	2N716	7/6	2N3855	5/6	BA130	3/-
AF102	12/6	BFX86	6/6	NKT224	4/6		6/-	2N743	4/6	2N3856	6/-	BAY31	2/6
AF106	7/6	BFX88	5/-	NKT225	3/6	RAS508AF	15/-	2N744	4/6	2N3855A	6/-	BAY38	3/-
AF114	5/-	BFY50	4/6	NKT226	10/-		15/-	2N753	5/6	2N3856A	6/-	BY100	5/6
AF149	11/6	BFY29	3/9	NKT219	5/6	S1M	19/-	2N914	4/6	2N3858	5/6	BY125	3/6
AF116	5/-	BFY52	4/6	NKT228	5/6	S4M	33/6	2N918	3/6	2N3857	5/6	BY127	3/6
AF117	5/-	BFY53	3/2	NKT261	4/3	ST140	3/-	2N929	5/6	2N3859	5/6	BY234	2/3
AF118	12/6	BFW57	6/-	NKT262	4/3	ST141	5/-	2N930	7/6	2N3859A	6/3	BYX10	3/-
AF121	6/-	BFW58	5/6	NKT264	4/3	ST2	9/9	2N1090	6/6	2N3860	6/-	BYX36/	
AF124	4/6	BFW59	5/6	NKT271	4/-	TI407	9/8	2N1091	6/6	2N3866	25/-	150	2/6
AF126	3/6	BFW60	4/6	NKT272	4/-	TIP31A	19/6	2N1131	6/6	2N3877	9/-	BYX36/	
AF127	3/6	BSX19	3/6	NKT273	4/-	TIP32A	22/6	2N1132	8/-	2N3879A	9/6	300	2/10
AF139	9/6	BSX20	4/6	NKT301	10/6	TSV30C	17/6	2N1302	10/6	2N3907	10/6	600	3/9
AF178	9/6	BSX21	7/6	NKT275	5/-	TS44	1/3	2N1303	4/-	2N3900A	6/-	300	3/9
AF179	11/6	BSX26	4/-	NKT276	3/6	TS45	1/3	2N1304	5/-			BY21	25/-
AF180	12/6	BSX77	6/6	NKT279A	2/6	TS46	3/3	2N1305	5/-	2N3903	7/-	BY23	26/3
AF181	8/6	BSX78	6/6	NKT281	5/-	TS47	3/3	2N1306	5/-	2N3904	7/-	BY25	31/9
AF186W	9/-	BSY22	4/-	NKT301	16/-	TS48	3/3	2N1307	5/-	2N3905	7/6	BY142	3/9
AF186G	9/-	BSY29	5/-	NKT302	10/-	TS49	3/6	2N1308	7/-	2N3906	7/6	BY210	3/9
AF239	7/6	BSY32	5/6	NKT303	10/6	TS50	5/6	2N1309	5/6	2N3907	15/6	BY212	6/6
AFY19	22/6	BSY36	5/-	NKT304	9/6	TS51	4/4	2N1496	3/4	2N4058	4/6	BY213	5/-
AFZ11	8/-	BSY37	5/-	NKT351	8/-	TS52	4/4	2N1507	4/8	2N4059	5/6	CG6E	4/6
AFZ12	10/-	BSY38	4/6	NKT352	7/6	TS53	6/6	2N1613	5/6	2N4060	5/6	CG63	2/-
AS26	5/-	BSY95A	3/6	NKT401	17/6	TS60	6/6	2N1671A	2N4061	4/6	CG64	2/6	
AS27	6/-	BSW41	8/6	NKT402	24/-	TS61	7/-	2N1711	29/6	2N4062	4/6	CG61	2/6
AS28	6/-	BSW42	8/6	NKT403	12/6	TS62	7/-	2N1893	6/6	2N4063	3/6	CG62	2/6
AS29	6/-	BTX39/600	5/6	NKT405	15/-	U23AAA	5/-	2N2147	10/6	2N4064	3/6	EA403	3/6
ASZ21	7/6	120/-		NKT405	15/-	U23AAA	5/-	2N2147	10/6	2N4286	3/6	EC401	5/6
AU10	30/-	BTX40/600		NKT406	15/-	V205	20/-	2N2152	27/6	2N4287	3/6	EC402	4/8
ATZ	40/-	120/-		NKT451	12/6	V405A	9/3	2N2148	12/6	2N4288	3/6	EB383	3/6
B1M	12/6	BTY87/150R		NKT452	12/6	XA102	6/-	2N2160	14/9	2N4289	3/6	GEX45/1	4/6
B3M	15/-	31/-		NKT453	10/-	ZE12V7	15/-	2N2243	26/-	2N4290	3/6	G3M	4/6
BC107	2/9	CI06FI	9/6	NKT453	10/-	ZE12V7	15/-	2N2243	26/-	2N4290	3/6	OAS	3/8
BC108	2/9	CI11	18/-	NKT674F	5/-	TZ22	19/-	2N2369	5/6	2N4292	3/6	OA10	6/-
BC109	2/9	CI11E	12/-	NKT675	5/-	ZT86	27/6	2N2369A	5/6	2N4871	6/9	OA47	1/6
BC113	5/-	C400	9/-	NKT676	5/-	TZ2270	19/6	2N2432	67/-	2N5027	10/6	OA70	1/6
BC115	6/6	C426	8/3	NKT677F	5/-	40250	12/6	2N2484	8/-	2N5028	11/6	OA73	1/6
BC116	8/-	C444	9/8	NKT703	8/-	40309	9/6	2N2613	7/6	2N5029	9/6	OA79	1/6
BC118	5/-	CI1T	10/-	NKT713	7/6	40310	13/6	2N2614	4/-	2N5030	8/6	OA81	1/6
BC125	11/-	GET102	4/6	NKT713	7/6	40311	10/6	2N2646	10/-	2N5034	3/6	OA85	1/6
BC126	11/-	GET113	4/6	NKT10339	4/6	40312	13/6	2N2711	10/6	2N5170	10/6	OA90	1/6
BC134	5/-	GET114	4/6		6/6	40314	10/6	2N2712	6/-	2N5175	10/6	OA91	1/6
BC135	6/-	GET120	4/6	NKT10419	4/6	40315	10/6	2N2713	5/6	2N5176	9/6	OA95	1/6
BC136	8/-	GET880	9/-		6/-	40316	13/-	2N2904	8/6	2N5232	5/6	OA200	2/-
BC137	8/-	GET887	4/-	NKT10429	40317	11/-	2N2904A	8/6	2N5249	13/6	OA202	2/-	
BC138	12/-	GET899	6/6	40319	3/6	40319	3/6	2N2905	10/-	2N5249A	SD19	7d	
BC140	3/3	GET890	6/6	NKT10519	40320	10/6	2N2905A	8/-	2N4291	13/6	TD716	12/-	
BC147	2/9	GET896	4/6		6/6	40323	10/6	2N2923	10/6	2N5305	7/6	IN134A	1/9
BC148	3/3	GET897	4/6	NKT16229	40324	12/6	2N2924	4/-	2N5306	8/-	IN60	4/6	
BC149	3/3	GET898	6/-		11/-	40326	10/6	2N2925	3/6	2N5309	12/6	IN64	4/6
BC154	12/-	GEX45/1	3/6	NKT20329	40329	7/6	2N2926	2/-	2N5354	5/6	IN82A	9/6	
BC167	3/6	MAT100	5/-		11/-	40344	8/-	Green	2/-	2N5355	5/6	IN87A	4/6
BC168	3/6	MAT101	5/6	OC20	19/6	40347	9/6	2N2926	2/-	2N5356	10/6	IN191	5/-
BC169	3/6	MAT120	5/6	OC22	8/-	40348	14/6	Yellow	2/-	2N5357	10/6	IN914	1/9
BC182L	3/6	MAT121	5/6	OC23	8/-	40360	11/6	2N2926	2/-	3N128	18/6	IN4001	2/-
BC183L	2/6	MJ400	21/6	OC24	8/-	40361	12/-	Orange	2/-	3N140	19/6	IN4005	4/6
BC184L	3/6	MJ420	22/6	OC25	7/6	40362	14/-	2N2926	2/-	3N141	21/6	IN4007	5/6
BC212L	3/9	MJ421	22/6	OC26	6/6	40370	8/6	Brown	2/-	3N142	16/6	IN4148	1/9
BCY10	10/6	MJ430	20/6	OC28	12/-	40406	16/-	3N3011	12/6	3N143	19/6	IS113	4/6
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BCY30	5/-	MJ480	20/6	OC36	12/6	40467	16/6	2N3053	5/6	3S001	10/-	IS130	2/6
BCY31	5/6	MJ481	20/6	OC41	4/6	40468A	16/6	2N3054	12/6	2S002	12/6	IS131	2/6
BCY32	10/-	MJ490	22/6	OC42	4/6	40602	9/9	2N3055	15/-	2S003	12/6	IS132	3/-
BCY33	4/-	MJ491	29/6	OC43	4/6	2G301	3/6	2N3133	6/-	2S004	15/-		
BCY34	5/-	MPP102	8/6	OC44	3/-	2G302	3/-	2N3135	6/-	2S005	15/-		
BCY38	6/-	MPP103	7/6	OC45	3/-	2G306	8/6	2N3136	6/-	2S006	15/-		
BCY40	10/-	MK104	17/6	OC70	2/6	2G339A	5/-	2N3235	28/6	2S012	25/-		
BCY42	4/-	MPP105	8/-	OC71	3/-	2G371	3/-	2N3234	27/6	2S012A	22/6		
BCY43	4/-	MPS3638	6/6	OC72	4/6	2G371B	3/-	2N3391A	3/-	2S017	15/-		
BCY54	7/6	NK70013	9/6	OC75	4/6	2G374	5/-	2N3392	5/-	2S018	17/6		
BCY70	4/6	NKT121	11/-	OC76	2/6	2G378	7/6	2N3393	5/-	2S019	19/6		
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BCY72	4/6	NKT123	6/-	OC81	4/6	2N109	11/-	2N3402	5/6	2S104	12/6		
BCY87	86/9	NKT125	6/-	OC81D	16/6	2N3403	5/6	2N3403	5/6	2S201	8/6		
BCZ11	7/6	NKT127	5/6	OC82	5/-	N2217	7/6	2N3404	7/6	2S202	10/6		
BD119	15/-	NKT128	5/6	OC82D	3/6	2N370	15/-	2N3414	5/6	2S303	10/-		
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## NEW! roamer eight mk 1 WITH VARIABLE TONE CONTROL

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

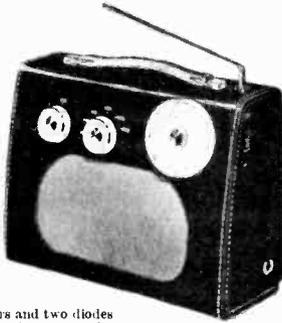
**Total building costs £6.19.6** P. & P. 7/6



## roamer seven mk IV

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

**Total building costs £5.19.6** P. & P. 7/6 Personal Earpiece with switched socket for private listening, 5/- extra.



## NEW! transeight

### SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 x 5 1/2 x 2 1/2 in. approx. Tunable on Medium and Long Waves, 3 Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 8 improved type transistors plus 3 diodes. Push-pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/- (FREE with parts).

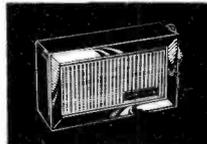
**Total building costs 89/6** P. & P. 5/6 Earpiece with switched socket for private listening 5/- extra.



## pocket five

### MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive black and gold case. Size 5 1/2 x 1 1/2 x 5 1/2 in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Easy build plans and parts price list 1/6 (FREE with parts).



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

## transona five

### MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2 in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).



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

## roamer six

### SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings. Size 7 1/2 x 5 1/2 x 1 1/2 in. Tunable on Medium and Long Waves, two Short Waves, Trawler Band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/- (FREE with parts).



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

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PE17



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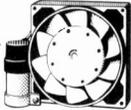
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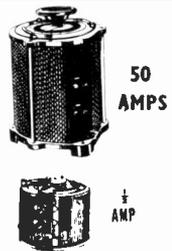
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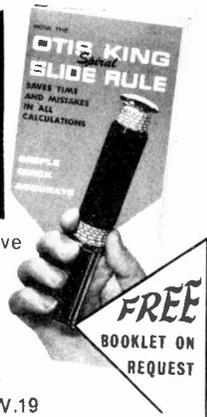
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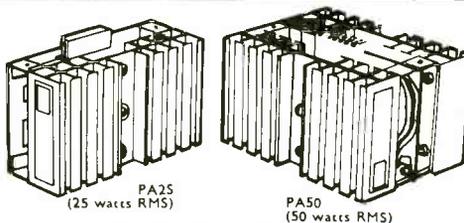
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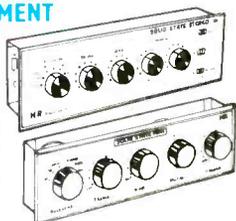
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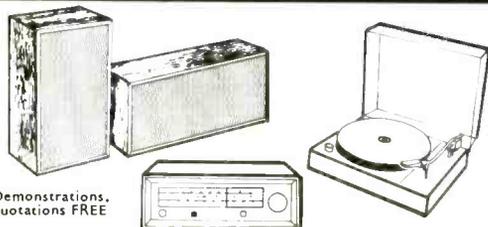
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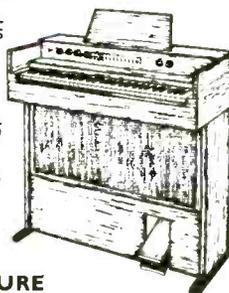
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