PRACTICAL

# ELECTRONICS

DECEMBER 1975

35p


## GUITAR AMPLIFIER

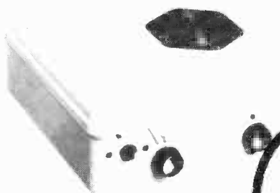
## CHRISTMAS LIGHTS FLASHER

# RADIO EXCHANGE LTD.

**ALL PRICES INCLUDE VAT**
We regret we cannot for the time being accept Overseas Orders. Open to U.K. and Ireland residents only.

## NEW EDU-KIT MAJOR

**COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT**
**BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER**



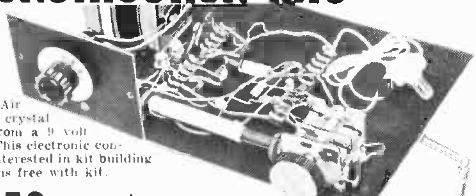
- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN—PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker Radio MW/LW
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- Batteryless Crystal Radio.
- One Transistor Radio.
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier.

● 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc ● Parts price list and plans 55p (free with parts)

TOTAL BUILDING COSTS **£10·30** P.P. & Ins. 65p

## ELECTRONIC CONSTRUCTION KITS

### E.C.K. 1

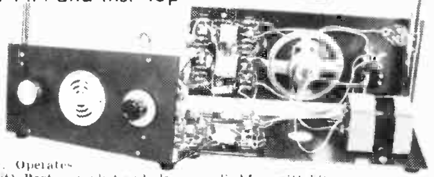


**3 Transistor Easy Stage Earpiece Receiver Kit.** Full medium wave coverage. Complete with ready wound ferrite rod aerial, high efficiency Air spaced tuning capacitor. Sensitive crystal earpiece and gain control. Operates from a 9 volt P.P. 7 battery (not supplied with kit). This electronic construction kit is a good starter for those interested in kit building and soldering. Parts price list and plans free with kit.

Complete kit of parts **£4·50** P.P. and Ins. 45p

### E.C.K. 2

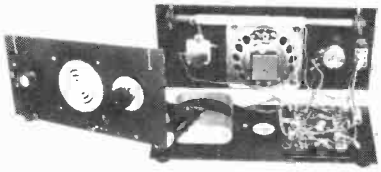
**Self Contained Multi-Band V.H.F. Receiver Kit.**



8 transistors and 3 diodes. Push pull output. 3in loudspeaker, gain control, superb 9 section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit). Parts price list and plans supplied free with kit

Complete kit of parts **£7·95** P.P. and Ins. 55p

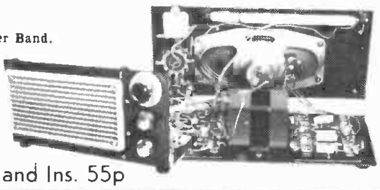
### E.C.K. 3



**5 Transistor Medium Wave Receiver Kit.** Class "A" output with 3½in loudspeaker. Simple to operate with full medium wave coverage. Ready Wound 8in ferrite rod aerial. No external aerial required. 7 stages, 5 transistors and 2 diodes. Tuning capacitor, gain control, etc. Operates from a 4½ volt Battery (not supplied). Parts price list and plans free with kit.

Complete kit of parts **£5·40** P.P. and Ins. 45p

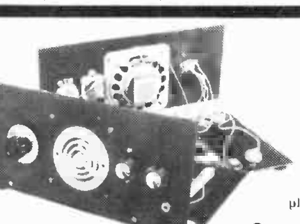
### E.C.K. 4



**7 Transistors. 6 tuneable wavebands. MW, LW, Trawler Band. 3 Short Wave Bands. Receiver Kit.** With 5in × 3in loudspeaker. Push pull output stage, gain control, and rotary switch. 7 transistors and 4 diodes. 6 section chrome-plated telescopic aerial. 8 in sensitive ready wound ferrite rod aerial, tuning capacitor, resistors, capacitors, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit). Parts price list and plans supplied free with kit.

Complete kit of parts **£7·25** P.P. and Ins. 55p

## EDU-KIT JUNIOR



**Completely Solderless Electronic Construction Kit.** Build these projects without Soldering Iron or Solder. ● Crystal radio medium wave coverage—No battery necessary. ● One transistor radio. ● 2 transistor regenerative radio. ● 3 transistor earpiece radio medium wave coverage. ● 4 transistor medium wave loudspeaker radio. ● Electronic noise generator. ● Electronic metronome. ● 4 transistor push pull amplifier. All parts including loudspeaker, earpiece, MW ferrite rod aerial, capacitors, resistors, transistors, etc., plus parts price list and plans free with kit.

Complete kit of parts **£7·50** P.P. and Ins. 45p

## V.H.F. AIR CONVERTER KIT

Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the long wave band and operating as shown in the instructions supplied free with all parts.

Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc.

All parts including case and plans **£4·35** P.P. & Ins. 40p

## ROAMER TEN MARK 2

**WITH VHF INCLUDING AIRCRAFT**

Now with free earpiece and switched socket. 10 transistors. Latest 4in 2 watt ferrite magnet loudspeaker. 9 tuneable wavebands, MW1, MW2, LW SW1, SW2, SW3, trawler band, VHF and local stations, also aircraft band. Built in ferrite rod aerial for. MW/LW. Chrome plated 6 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push pull output using 600mW transistors. Car aerial and tape record sockets. 10 transistors plus 3 diodes. Ganged tuning condenser with VHF section. Separate coil for aircraft band. Volume on/off. Wave Change and tone controls. Attractive Case in black with silver blocking Size 9in × 7in × 4in. Easy to follow instructions and diagrams. Parts price list and plans 50p free with parts.

Total building costs **£11·87** P.P. & Ins. 65p

## RADIO EXCHANGE LTD.

To: RADIO EXCHANGE LTD.
61A High Street
Bedford MK40 1SA

**Tel.: 0234 52367, REG NO. 788372**

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

I enclose £ .................. for ..................

Name ..................

Address ..................

.................................... PE12

PRACTICAL
# ELECTRONICS

VOLUME 11 No. 12 DECEMBER 1975

## CONSTRUCTIONAL PROJECTS



## GENERAL FEATURES



## NEWS AND COMMENT





**Our January issue will be published on Friday, December 12, 1975**
(for details of contents see page 995)

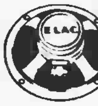
# CRESCENT RADIO LTD.

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

**MAIL ORDER DEPT.**
**1 ST. MICHAELS TERRACE, WOOD GREEN**
**LONDON N22 4SJ Phone 888-4474**

**BARGAIN PROJECT BOX**
A plastic box with moulded extrusion rails for PC or Chassis panels with metal front plate fitted with four screws (all supplied).
An ideal box to give a small project a professional finish.
SIZE (internal 81mm × 51mm × 28mm.
OUR PRICE 40p. + 8 %.

**10in 8ohm DUAL CONE L/S**




Manufactured by "ELAC" to a very high standard these loud speakers are a real bargain.
SPEC:—Size—10in. Dual Cone Power—10 Watts. Frequency—40-12000Hz. + 25%. Our price £3·75 ea.

**I.C. SOCKETS + 8%**
**D.I.L.**

| | |
|---|---|
| 8 pin—13p | 24 pin—24p |
| 14 pin—14p | 28 pin—28p |
| 16 pin—14p | 36 pin—36p |

## MINIATURE RELAYS

Brand new range of British made relays, size: 1½in × 1in × ⅞in.
All two changeovers with 250V 1·5A contacts and suitable for fitting on 0·1m veroboard.

| Type | Volts | Current | Ohms | |
|---|---|---|---|---|
| 27/A | 12V | 17M/A | 700 | All |
| 21/A | 12V | 28M/A | 430 | £1·30 |
| 12/A | 6V | 33M/A | 185 | each |

+ 8%.

**MINI LOUDSPEAKERS**

2½" 80 ohm 60p
2½" 40 ohm 60p
2½" 8 ohm 60p
+ 25%.

**LOW PRICE TRANSISTORS**

| | | | |
|---|---|---|---|
| BF303B | 15p | TIP42A | 75p |
| AC142R | 25p | OC75 | 22p |
| BC149B | 15p | AA129 | 6p |

**I.C.**
**EXTRACTION TOOL**
Saves damage to valuable I.C.s
ONLY 40p + 8% VAT

**CRESCENT BUBBLE LIGHT SHOW**
This budget system compares very favourably with more sophisticated and higher priced models.
Specification:
Projector—150W convection cooled. At 30ft the projected image is 16ft.
Motor—1 rev. per 2 min.
Liquid Wheel—6in diameter multi colour.
The motor is fitted to the projector and can only be purchased as a single unit.
The liquid wheel is our standard model and may be purchased separately.
A bargain at: Projector, £15; Wheel, £5; Total £20. Plus 75p carr. + 8%.

**CABLE LESS SOLDERING IRON**
**WAHL "ISO-TIP"**
★ Completely portable.
★ Solders up to 150 joints per charge.
★ Recharges in its own stand.
★ Fine tip for all types of soldering.
★ Only 8in long and weighs just 6 ozs.

OUR PRICE £9·75 + 8%.
(Spare bits are available)

**"CRESCENT" 100 WATT R.M.S.**
**ALL PURPOSE AMPLIFIER**
**U . BUILD . IT**
We supply the three modules for you to build this Disco-Group-P.A. amplifier into the cabinet of your choice.

**★ THE POWER AMP MODULE**
170W r.m.s. sq. wave 300W instantaneous peak into 8 ohm (60W into 16 ohm).

**★ THE PRE-AMP MODULE**
Four control pre-amp, Vol. Bass, Treble. Middle controls. Designed to drive most amplifiers using F.E.T. first stage.

**★ THE POWER SUPPLY**
Is supplied complete with the mains transformer. Complete fixing instructions are supplied and no technical knowledge is required to connect the three ready wired modules. A fantastic bargain. £27·50, carr. £1·20. Send S.A.E. for further details on this or our ready built amplifiers. + 8%.

**12-0-12V 500M/A**
240V primary transformer bargain. Approx. size: 60mm × 40mm × 50mm; fixing centres: 75mm. Our price £1·20. + 8%.

**FERRIC CHLORIDE**
Anhydrous ferric chloride in double sealed one pound poly packs.
Our Price 65p per lb. + P/P + VAT @ 8%.

**LOW NOISE, LOW PRICE CASSETTES**
Good quality tape in well made screw type cassettes. Presented in single plastic cases.
C60 31p C90 42p C120 53p
10% discount on ten or more cassettes of one type. + 8%.

**ABS PLASTIC BOXES**
Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels. 1005, 105mm × 73mm × 45mm 55p; 1006, 150mm × 75mm × 47mm 72p; 1007, 184mm × 124mm × 60mm £1·28; 1021, 106mm × 74mm × 45mm (sloping front) 55p. + 8%.

**P.C. ETCHING KIT**
This kit contains all that the constructor will need to etch the circuits of his own design. Contents: Plastic etching dish. Sample copperclad board. Lamininate Cutter. 1 lb Ferric Chloride. Large Plastic Spoon. Etch Resist Pen. Full Etching Instructions. Complete and Big Kit Value at £3·75 + 8% VAT.

**2in. PANEL METERS**
Size 59mm × 46mm

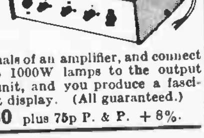
| | |
|---|---|
| 0-50μA —ME6 | 0-100mA—ME13 |
| 0-100μA—ME7 | 0-500mA—ME14 |
| 0-500μA—ME8 | 0-1A —ME15 |
| 0-1mA —ME9 | 0-50V —ME16 |
| 0-5mA —ME10 | 0-300V a.c.—ME17 |
| 0-10mA—ME11 | S meter —ME18 |
| 0-50mA—ME12 | V.U. meter—ME19 |

£3 each. + 8%.

**POWER PACKS**
PP1 Switched 3-4½-6-7½-9 and 12V at 500M/A with on/off switch and pilot light. Size 130M/M × 55M/M × 75M/M, only £4.
PP2 Switched 6-7½-9V Battery Eliminator. Approx. size 2⅞in × 2⅛in × 3⅛in. Ideal for cassette recorders, £3·25.
PP3 Car converter. From 12V Pos. or Neg. to = 6-7½-9V. Easy to fit and transistor regulated, £3·90. + 8%.

**TELESCOPIC AERIAL**
Nine section fully swivelling telescopic aerial with 4BA single bolt fixing or two hole fixing bracket. Fully extended 43". Fully closed 7". Our Price 50p + P/P + VAT @ 25%.

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



£18·50 plus 75p P. & P. + 8%.

| U.K. CARRIAGE 50p UNLESS OTHERWISE STATED | VAT—All prices are excluding VAT. Please add to each item the VAT rate indicated. | SEND 30p FOR A CRESCENT CATALOGUE |
|---|---|---|

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**Left School or College in the last 2 years?**

# COMPUTER CAREER OPENING

The London Training Division of Control Data Corporation, who make the world's most powerful computer, have vacancies on training-entry scheme for alert, determined people between 18-30, who will be trained and helped to find career positions in programming, computer engineering, or computer operations.
Backed by Control Data, the applicants selected will be making a completely new start in a field which offers high progressive salaries, really interesting work and rapidly expanding prospects.
They must be prepared to train intensively for 5 months and they will be asked to repay the cost of training out of their subsequent salary. They must also be prepared to begin their selection as soon as possible by attending an information evening, and they will need to arrange to do this by talking to a machine!
We believe a lot of people have talents which are not being used. That's why we decided, as a computer manufacturer, to make this scheme available. If you feel this is an opportunity worth examining be ready to take notes and call.

**DAVID SPRING**

01-637 2171

WE LOOK FORWARD TO MEETING YOU

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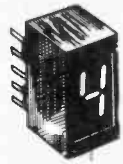
**ANOTHER PRICE BREAKTHROUGH!**

# 6 DIGIT CLOCK KIT

**£6·95**
+75p Airmail postage



Readout shown actual size

★ SLOW SET
★ FAST SET
★ TIME HOLD
★ 12/24 HOUR
★ 50/60HZ
★ BRIGHT LEDS

From the people who brought you the world's first Digital Wristwatch Kit, comes another fine quality timepiece at a remarkably low price. You get only prime quality, tested components with all our kits.

## KIT COMPRISES

1—NATIONAL MM5314 clock chip 12/24 hour, 50/60Hz option.
6—FAIRCHILD Readouts, bright red, 0·27in character height.
7—Npn + 6 pnp silicon transistors.
4—1N4001 rectifier + 1—1N914 switching diodes.
9—Carbon film resistors.
1—1000μF/25V filter cap + 2 disc caps.
2—Pushbutton switches for slow and fast settings.
1—Slide switch for time hold.
2—Etched and drilled printed circuit boards.
1—Illustrated assembly instructions manual.

NO KNOWLEDGE OF ELECTRONICS REQUIRED TO BUILD THIS KIT. All you need to provide is a 9–15V/200mA transformer and a case of your choice. SATISFACTION GUARANTEED.
The above price shown in British £'s is the approximate equivalent of U.S. $16·50 for the kit including airmail postage. Send Bank Draft of International Money Order in U.S. funds. The prices quoted do not include any taxes leviable by a purchaser's country of residence.

**EURAY TRADING, INC.,** P.O. Box 64683, Dallas, Tx. 75206, U.S.A.

# MAPLIN ELECTRONIC SUPPLIES

# P.O. BOX 3, RAYLEIGH, ESSEX

**Tel: Southend-on-Sea (0702) 44101**

# SUPERSONIC SAME-DAY SERVICE!

## QUALITY COMPONENTS -FAST!

## ALL PRICES INCLUDE VAT & POSTAGE & PACKING

(U.K. only)

**(20p handling charge if order under £2)**

PRICES: Some prices shown on this page may change after November 30, 1975. For details send s.a.e. for our latest newsletter (see back cover). Overseas customers deduct VAT; details in our newsletter.

**Visit our shop 284 London Road Westcliff-on-Sea Essex**

## Fane POP 50

8Ω 50W 12 inch
Bass Speaker
Frequency Response
50Hz-8kHz
Flux Density 13,000 Gauss
£12.45

** *Please note: No discount vouchers given on this item.*

## MAINS TRANSFORMERS

Conform to BS 415. Split bobbin construction.

| | Order as | |
|---|---|---|
| * 0-6V, 500mA, 0-6V 500mA | MIN TR 6V | £1.55 |
| * 0-12V 250mA, 0-12V 250mA | MIN TR 12V | £1.55 |
| * 0-20V 150mA, 0-20V 150mA | MIN TR 20V | £1.55 |

* Size 38 x 38 x 46mm fix centres 54mm.

* 0-15-20V 1A; 0-15-20V 1A (MT206)
£3.90.

*for quantities over 25 special discounts are available*

## VEROBOARD

| Size (mm) | No. of holes mes (matrix) | Order code | |
|---|---|---|---|
| 127 x 63 | 50 x 24 (0.1'') | VERO 10345 | 42p |
| 95 x 63 | 37 x 24 (0.1'') | VERO 10346 | 38½p |
| 127 x 95 | 50 x 36 (0.1'') | VERO 10347 | 48p |
| 95 x 95 | 37 x 36 (0.1'') | VERO 10348 | 42p |
| 95 x 63 | 25 x 16 (0.15'') | VERO 43P16 | 31p |
| 127 x 95 | 33 x 24 (0.15'') | VERO 45P16 | 54p |

Uncoppered boards

| | | | |
|---|---|---|---|
| 149 x 114 | 58 x 42 (0.1'') | SRBP 0.1in. | 48½p |
| 127 x 95 | 33 x 24 (0.15'') | SRBP 0.15in. | 34p |
| Vero Spot Face Cutter | | TOOL 2022 | 62p |

Terminal Pins (Packs of 36 pins)

| | | |
|---|---|---|
| For 0.1'' Veroboards Single sided | PIN 2145 | 13p |
| Double sided | PIN 2144 | 13p |
| For 0.15'' Veroboards and both uncoppered boards Single sided | PIN 2141 | 20½p |
| Double sided | PIN 2140 | 20½p |

## P.E. JOANNA

P.C.B.'s 14-board set £17.50
See our latest newsletter (send s.a.e.) for details of our special offer on the bulk components, and all the other parts you need

## L.E.D's

High-brightness with panel clip
0.2in Red 16p
Green 43p
Yellow 43p

## PLUGS and SOCKETS

**CO-AX**

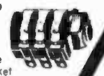
| | |
|---|---|
| Co-ax Plug | |
| Aluminium | 14p |
| Plastic barrel | 10p |
| Co-ax Socket | |
| Panel fixing | 11p |
| Flush fixing | 20p |

**PHONO**

| | |
|---|---|
| Plug Plastic top | 9p |
| Plug Screened | 15p |
| Chassis Socket Single | 6p |
| Chassis Socket Twin | 10p |
| Line Socket Screened | 16p |

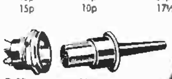
**JACKS**

| | |
|---|---|
| 2.5mm Plastic Plug | 11p |
| 2.5mm Screened Plug | 16p |
| 2.5mm Open-type Chassis Socket | 9½p |
| 2.5mm Screened Line Socket | 16p |
| 3.5mm Plastic Plug | 11p |
| 3.5mm Screened Plug | 16p |
| 3.5mm Open-type Chassis Socket | 9½p |
| 3.5mm Plastic Line Socket | 11p |
| 3.5mm Screened Line Socket | 17p |
| Std ¼in. Plastic Mono Plug | 14p |
| Std ¼in. Screened Mono Plug | 26p |
| Std ¼in. Plastic Stereo Plug | 19½p |
| Std ¼in. Screened Stereo Plug | 35½p |
| Std ¼in. Open-type Mono Chassis Socket | 15p |
| Std ¼in. Open-type Stereo Chassis Socket | 19½p |
| Std ¼in. Moulded Mono Chassis Socket with 2 break contacts | 15p |
| Std ¼in. Moulded Stereo Chassis Socket with 3 break contacts | 19½p |
| Std ¼in. Plastic Mono Line Socket | 21½p |
| Std ¼in. Screened Mono Line socket | 28p |
| Std ¼in. Plastic Stereo Line Socket | 24p |
| Std ¼in. Screened Stereo Line Socket | 43p |



| DIN | Plug | Chassis Socket | Line Socket |
|---|---|---|---|
| 2-pin L/S | 10p | 9p | 12½p |
| 3-pin | 11p | 10p | 14p |
| 4-pin | 15p | 10p | — |
| 5-pin A (180°) | 15p | 10p | 17½p |
| 5-pin B (240°) | 15p | 10p | 17½p |
| 6-pin | 15p | 11p | 21p |
| 7 pin | 15p | 10p | 17½p |

**MAINS**

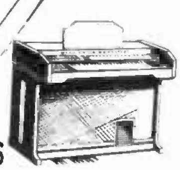


| | |
|---|---|
| 5A Chassis Mounting 3-pin Plug SA2190 | 37½p |
| 5A Line 3-pin Socket SA1862 (suits SA2190) | 44p |
| 5A Chassis Socket and Line Plug (sold only together) P437 | 94p |
| 1½A Chassis Plug and Line Socket (sold only together) P360 | 51p |
| 1½A Chassis Socket and Line Plug (sold only together) P438 | 60p |
| 2-pin Flat Pin Line Plug (USA Mains Plug) | 22p |
| 2-pin Flat Pin Chassis Socket (Flat Pin M/S) | 18½p |
| 2-pin Flat Pin Line Socket (Flat Pin Conn) | 22½p |

## SWITCHES

| | |
|---|---|
| Slide sub-min DPDT | 13p |
| Slide std DPDT | 14p |
| Push to make non-locking SPST | 15p |
| Push to break non-locking SPST | 38p |
| Microswitch 5A 250V AC | 16p |
| Push-on, Push-off Locking DPST 250V 4A | 39p |
| Rocker DPST 250V 10A White | 45½p |
| Toggle Sub-miniature 2A 250V (Type A) SPDT | 65p |
| Toggle Sub-miniature 2A 250V (Type E) DPDT | 90p |
| Toggle DPDT 250V 1.5A with ON/OFF Plate | 27p |
| 10 position BCD output slide switch | £1.49 |

## ORGAN COMPONENTS



Keyboards Morelli — as used by the professionals.

| | |
|---|---|
| 49-note C to C | £20.49 |
| 61-note C to C | £25.99 |
| Swell pedal with 10k log pot | £7.91 |
| Pedalboard 13-note C to C | £20.98 |
| — with changeover contacts fitted | £25.98 |
| * Spring Line Unit (Short) | £3.81 |
| * Spring Line Unit (Long) | £10.36 |
| * Reverberation Driver Module | £6.67½ |

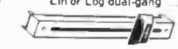
* S.a.e. please for full details: Leaflet MES 24.

| | |
|---|---|
| Gold-clad phosphor bronze wire | 32½ per metre |
| Palladium earth bar per octave length | 16p |
| Contact Blocks changeover single pole (GJ) | 24p |
| two pole make (GB) | 27½p |
| three pole make (GC) | 33p |
| four pole make (GE) | 41p |
| five pole make (GH) | 54p |
| Stop Tabs unengraved (black, grey, red or white) with DPDT switch (rocker type) | 74p |

## POTS

Rotary miniature carbon track ¼in. spindle.
Values available: 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M

| | |
|---|---|
| Lin single gang (+ 1k) | 23½p |
| Log single-gang | 23½p |
| Lin or Log single with switch | 40½p |
| Lin or Log dual-gang | 73½p |



Slide 60mm track. Metal cased: overall length 86mm
(knob extra 12½p)
Values available: 1k, 5k, 10k, 25k, 50k, 100k, 250k, 500k
Single-gang Lin: 47½p, Log: 52½p
Dual-gang Lin and Log: 61p

Presets: 0.1W Vertical or Horizontal 100, 220, 470 ohms, 1k, 2k2, 4k7, 10k, 22k, 47k, 100k, 220k, 470k, 1M .......... 9p each

## ● THE AMAZING DMO2

A ready-built, tested and guaranteed digital master oscillator. Accurately generates the top 13 notes for your organ system and reduces the complete tuning of your organ to ONE SIMPLE adjustment. New design gives selectable C to C output ranges of (approx.) 4k to 8k (highest) or 2k to 4k or 1k to 2k, etc. right down to 16Hz to 32Hz! And this new compatible design is even smaller: Only 3.5in. x 3.7in. including gold-plated edge connexion.

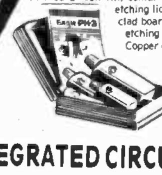
DMO2T includes built-in variable depth and rate frequency shift tremulant.

DMO2 £15.31. DMO2T £17.81.

SAJ 110: 7-stage frequency divider in 14-pin DIL package. Sine or square wave input. Square wave output may be converted to saw-tooth. £1.94 each or 6 for £10.74 or 12 for £19.61.

## OMNIUM GATHERUM

| | |
|---|---|
| 12-way 5 Amp Terminal Block | 17p |
| PVC Insulation Tape (19mm x 10m), Black, Red, Blue, Green, Brown, White | 19½p |
| Dalo PCB Pen | 85p |
| Printed Circuit Kit, contains polishing powder, etch resist, etching liquid, resist remover, flux, copper clad board, stencil knife, spatula and etching tray | £3.62 |
| Copper clad SRBP board (200 x 100mm) | 64p |
| Copper clad fibreglass board | £1.04 |
| Probe Clips (1 red, 1 black) | 42p |
| Solder 10m of 22swg | 28p |



## RESISTORS

**CARBON FILM**
⅓W (MIN RES) 1 ohm to 1M: 5%; 1M2 to 10M: 10% E12 .......... 2p each
½W (STD RES) 1 ohm to 10 ohm: 5%, 1M2 to 10M: 10% E12 — 11 ohm to 1M: 5% E12 and E24 .......... 2p each
**METAL OXIDE**
½W (OXIDE) 10 ohm to 1M: 2% E12 and E24 .......... 5p each
**WIREWOUND**
3W (W/W MIN) 0.22, 0.27, 0.33, 0.47 ohms, 1 ohm 5% .......... 11p
1.2 ohm to 270 ohm: 5% E12 .......... 15p

Also 1% Oxide, 1W Carbon Film, 5W and 10W Wirewound types stocked.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades.
E24: 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades.

## ELECTROLYTIC CAPACITORS

| Cap (uF) | Voltage (V) | Case Size | Cap (uF) | Voltage (V) | Case Size | Cap (uF) | Voltage (V) | Case Size |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 63 | 3 | 47 | 63 | 6 | 330 | 16 | 00 |
| 1.5 | 63 | 3 | 68 | 6.3 | 3 | 330 | 63 | 03 |
| 2.2 | 63 | 3 | 68 | 16 | 4 | 470 | 6.3 | 6 |
| 3.3 | 63 | 3 | 68 | 63 | 00 | 470 | 10 | 00 |
| 4.7 | 63 | 3 | 100 | 4 | 3 | 470 | 25 | 01 |
| 6.8 | 40 | 2 | 100 | 10 | 4 | 470 | 40 | 02 |
| 6.8 | 63 | 3 | 100 | 25 | 5 | 680 | 6.3 | 00 |
| 10 | 25 | 2 | 100 | 40 | 6 | 680 | 16 | 01 |
| 10 | 63 | 4 | 100 | 63 | 01 | 680 | 25 | 02 |
| 15 | 16 | 2 | 150 | 6.3 | 4 | 680 | 40 | 03 |
| 15 | 40 | 3 | 150 | 16 | 5 | 1000 | 4 | 00 |
| 15 | 63 | 4 | 150 | 25 | 6 | 1000 | 10 | 01 |
| 22 | 10 | 2 | 150 | 40 | 00 | 1000 | 16 | 02 |
| 22 | 25 | 3 | 150 | 63 | 01 | 1000 | 25 | 03 |
| 22 | 63 | 5 | 220 | 4 | 4 | 1500 | 6.3 | 01 |
| 33 | 6.3 | 2 | 220 | 10 | 5 | 1500 | 10 | 02 |
| 33 | 16 | 3 | 220 | 16 | 6 | 1500 | 16 | 03 |
| 33 | 40 | 4 | 220 | 25 | 00 | 2200 | 6.3 | 02 |
| 47 | 4 | 2 | 220 | 40 | 01 | 2200 | 10 | 03 |
| 47 | 10 | 3 | 220 | 63 | 02 | 3300 | 6.3 | 03 |
| 47 | 25 | 4 | 330 | 4 | 5 | 4700 | 4 | 03 |
| 47 | 40 | 5 | 330 | 10 | 6 | | | |

**Case Sizes (mm)**

| Case Size | Length | Diameter | Price |
|---|---|---|---|
| 2 | 12.5 | 4.8 | 7½p |
| 3 | 12.5 | 6.1 | 7½p |
| 4 | 20 | 6.7 | 7½p |
| 5 | 20 | 8.3 | 7½p |
| 6 | 20 | 10.3 | 10p |
| 00 | 33 | 10.4 | 22½p |
| 01 | 33 | 12.9 | 25p |
| 02 | 33 | 15.4 | 40p |
| 03 | 33 | 18.4 | 44p |

## INTEGRATED CIRCUITS

| | | | | | |
|---|---|---|---|---|---|
| AY-1-0212 | £5.94 | MVR15 (TO 3) | £1.73 | uA7805 (TO 3) | £1.89 |
| AY-5-1224 | £4.59 | M252 | £8.10 | uA7815 (TO 3) | £1.89 |
| CA3046 (14-pin DIL) | 86p | NE555V (8-pin DIL) | 65p | ZN414 (TO 18) | £1.50 |
| LH0042C (TO 99) | £3.78 | SG1495 (14-pin DIL) | £4.99 | CD4001AE | 23p |
| LM301A (8-pin DIL) | 49p | SG3402 (14-pin DIL) | £2.17 | CD4007AE | 23p |
| LM308 (8-pin DIL) | 98p | TBA810S | £1.25 | CD4011AE | 23p |
| LM380 (14-pin DIL) | £1.23 | uA709C (TO 99) | 42p | CD4016AE | 56p |
| LM381 (14-pin DIL) | £1.79 | uA723C (TO 99) | 65p | 7400 | 17p |
| LM3900 (14-pin DIL) | 65p | uA723C (14-pin DIL) | 65p | 7413 | 42p |
| MC1310P (14-pin DIL) | £2.35 | uA741C (8-pin DIL) | 45p | 7447 | 91p |
| MC1496 (14-pin DIL) | 95p | uA741C (14-pin DIL) | 56p | 7473 | 36p |
| MC3302P (14-pin DIL) | £1.35 | uA747C (14-pin DIL) | £1.06 | 7474 | 33p |
| MFC4000B | 74p | uA748C (8-pin DIL) | 49p | 7490 | 55p |
| MFC6040 | £1.04 | uA78L05 (TO 92) | 65p | 7493 | 55p |
| MM5314 (24-pin DIL) | £4.79 | uA78L15 (TO 92) | 65p | 74121 | 42p |
| MVR5 (TO 3) | £1.73 | uA78M05 (Plastic) | £1.13½ | | |
| MVR12 (TO 3) | £1.73 | uA78M15 (Plastic) | £1.13½ | | |

## TRANSISTORS & DIODES

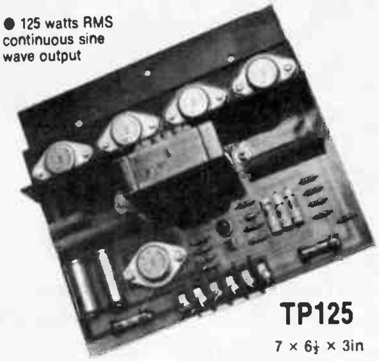
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AC127 | 19½p | BC213L | 19p | BFY51 | 24p | 2A 400PIV Bridge | 55p |
| AC128 | 19½p | BC214L | 22½p | BFY52 | 21½p | 2N2219 | 33½p |
| AC176 | 18½p | BC327 | 27½p | BY164 | 61p | 2N2646 | 48½p |
| AD161/2MP | £1.07 | BC328 | 26p | BZX61 series | 24p | 2N2905 | 35½p |
| AF117 | 27p | BC337 | 27½p | BZY88 series | 13p | 2N2926 Or, Ye | 15p |
| BAX13 | 6p | BC338 | 25p | C106D1 | 59½p | and Gn | 16p |
| BC107 | 12p | BCY71 | 24p | MCR102 | 36p | 2N3053 | 19½p |
| BC108 | 11p | BD131 | 49p | MJ2955 | 92p | 2N3054 | 72½p |
| BC109 | 14p | BC132 | 57p | MJE2955 | £1.21 | 2N3055 | 53p |
| BC142 | 25p | BD131 2MP | £1.20 | MJE3055 | 73p | 2N3702 | 16p |
| BC143 | 28p | BD135 | 45p | MPF102 | 45p | 2N3703 | 15p |
| BC147 | 12½p | BD139 | 61p | OC71 | 25p | 2N3704 | 17½p |
| BC148 | 12½p | BD140 | 86p | SC146D | 95p | 2N3705 | 16p |
| BC149 | 15p | BF258 | 38p | ST2 | 35½p | 2N3706 | 15p |
| BC168C | 15p | BF259 | 27p | TIS43 | 35p | 2N3707 | 17½p |
| BC169C | 15p | BFX29 | 32½p | WOO5 | 32½p | 2N3708 | 10p |
| BC178 | 18½p | BFX30 | 35p | W04 | 35½p | 2N3819 | 27½p |
| BC179 | 19½p | BFX84 | 32½p | ZIJ | 94p | 2N3866 | 92p |
| BC182L | 12½p | BFX85 | 35p | ZTX108 | 11p | 2N3903 | 25p |
| BC183L | 15p | BFX87 | 32½p | IN914 | 5p | 2N3904 | 27½p |
| BC184L | 15p | BFX88 | 34½p | IN4148 | 5p | 2N5245 | 56p |
| BC212L | 17½p | BFY50 | 21½p | 2A 50PIV Bridge | 48½p | 2N5459 | 64p |

# TUAC

TRANSISTOR UNIVERSAL AMPLIFICATION CO.LTD.
163 MITCHAM RD·LONDON SW17 9PG 01·672 3137 9080

## TUAC POWER MODULES offering more power and quality than ever before

- 125 watts RMS continuous sine wave output

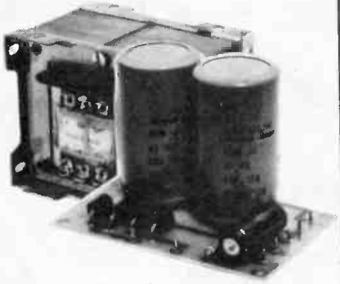


**TP125**
7 × 6½ × 3in
**£19·50**

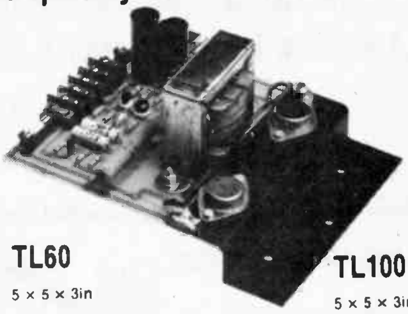
- 4 R.C.A. 150 watt 15 amp output transistors

- Rugged layer wound driver transformer
- Short—Open—and Thermal overload protection
- Only 6 connections

Power supplies vacuum impregnated Transformers with supply board incorporating pre-amp supply:



| | |
|---|---|
| PS 125 ± 45 volts for TP125 | £12·25 |
| PS 100 ± 43 volts for TL100 | £11·25 |
| PS 60 ± 38 volts for TL60 | £10·00 |
| PS 30 ± 25 volts for TL30 | £5·90 |
| PSU 2 for supplying disco mixer | £4·75 |



**TL60**
5 × 5 × 3in

- 60 watts RMS continuous sine wave output
- 2 R.C.A. 110 watt 15 amp transistors

**£12·50**

**TL100**
5 × 5 × 3in

- 100 watts R.M.S. continuous sine wave output
- 2 R.C.A. 150 watt 15 amp transistors

**£15·00**

Specification on all power modules: All output power ratings ±0·5dB; Output impedance 8–15 ohms; THD at full power 2% typically 1%; Input sensitivity 60mV into 10kΩ; Frequency response 20Hz–20kHz ±2dB; Hum and noise better than −70dB.

## TUAC DISCOTHEQUE MIXER WITH AUTO FADE


Designed for the discerning D.J. of professional standard. Offering a vast variety of functions. Controls: Mic Vol; Tone, over-ride depth; auto/Manual Sw; Tape Vol; L & R Deck Faders; Deck Volume; Treble and Bass; H. Phon Vol Selector; Master Vol On/Off Sw. Max output 1V RMS.

Specification: Deck Inputs—50mV into 1MΩ; Deck Tone Controls—treble +20 − 10dB at 12kHz, Bass +22 − 15dB at 40Hz; Mic Input—200 ohms upwards, 2mV into 10kΩ; Mic Tone Control—Total Variation Treble 15dB, Total Variation Bass 10dB; Tape Input—30mV into 47kΩ; Power Requirements—30–50 volts at 50mA.

**£31·50**
PANEL SIZE
18 × 4½in
DEPTH 3in

**1976 STEREO DISCO MIXER £75** *Send for specification and details*

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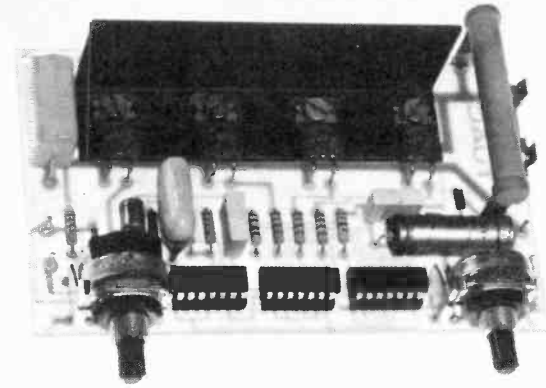


## 4 CHANNEL SOUND TO LIGHT SEQUENCER—4LSMI

- RCA 8A Triacs
- 1000W per channel
- Fully suppressed and fused
- Switched master control for sound operation from ½W to 125W
- Speed control for fixed rate sequence from 8 per minute to 50 per second
- Full logic integrated circuitry with optical isolation for amplifier protection
- Full wave control
- 13 easy connections

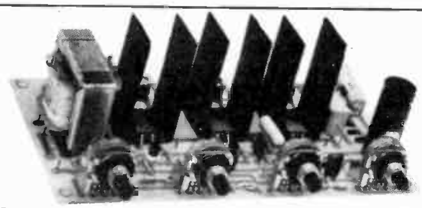
Patents applied for

**£22·00**

## 3 CHANNEL LIGHT MODULATOR

● R.C.A. 8A Triacs ● 1000W per channel ● Each channel fully suppressed and fused ● Master control to operate from 1W to 100W ● Full wave control ● 12 easy connections.

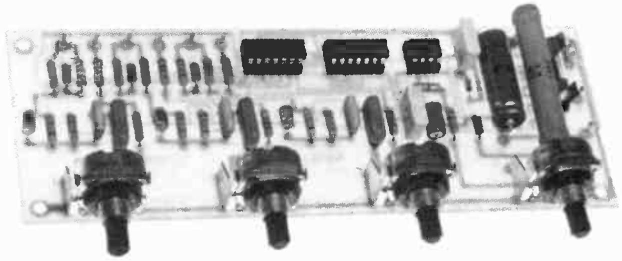
Single Channel Version 1500 Watts £7·25 **£15·50**



## ADD SEQUENCE AND DIMMING EFFECTS TO YOUR TUAC 3 CHANNEL LIGHT MODULATOR

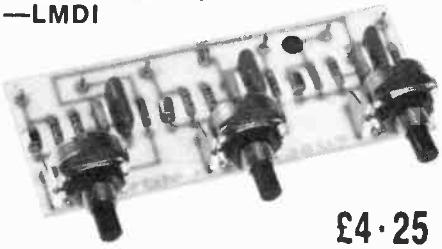
### SEQUENCE DIMMER MODULE —3SDMI

**£9·50**



Speed Control 3 per min. to 10 per sec. Dimmer control to each channel. Full logic integrated circuitry. 9 easy connections

### DIMMER MODULE —LMDI



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25½ × 11 × 6½in

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**LO-LINE 60** .. .. .. .. .. .. .. .. **£65**
Output power 60 watts R.M.S.
2 high gain + 2 low gain inputs
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# TUAC

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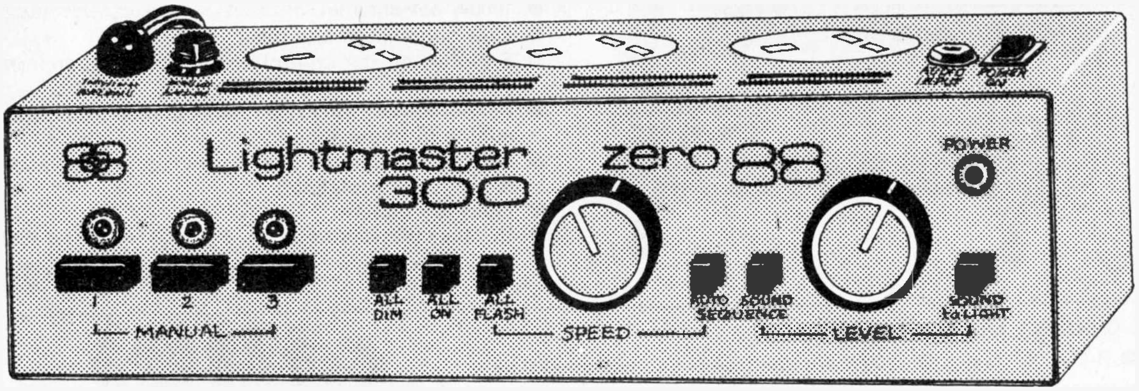
# LIGHTING EFFECTS UNIT




**THE ZERO 88 LIGHTMASTER 300**
**IS THE LIGHTING CONTROLLER WITH THE PROFESSIONAL FACILITIES**

Any of the 5 effects may be selected singly or together by means of the front panel push button. The dim button reduces the output of all channels and works on all effects. Because of the highly effective 'set and leave' circuitry, only one control is required to set up the 3 channel, 12dB/octave sound to light. Completely automatic operation of the effects is ensured by the use of CMOS logic control and I.C. filters. The fully floating audio input is on a ¼ inch jack, (sensitivity from 100mV preamp level, to 100V P.A. speaker lines). 13 amp sockets are provided for the three 1000watt outputs, each of which has an L.E.D. indicator. The 120 amp surge rated triacs are protected by 5 amp quick blow fuses, and the whole unit is controlled by a 15 amp mains switch and fuse. The LIGHTMASTER 300 is constructed in a free standing steel case and is provided with panel mounting brackets, which may be reversed to form protective handles. The unit is completely free from R.F. and mains interference.

**Price £63** (+ £5·04 VAT). P. & P. £1·10

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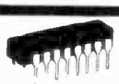

| | | | | | |
|---|---|---|---|---|---|
| 7400 | £0·11 | 7448 | £0·80 | 74150 | £0·75 |
| 7401 | 11 | 7450 | 12 | 74151 | 60 |
| 7402 | 11 | 7451 | 13 | 74153 | 71 |
| 7403 | 11 | 7453 | 13 | 74154 | 1·05 |
| 7404 | 13 | 7454 | 14 | 74155 | 95 |
| 7405 | 13 | 7460 | 11 | 74156 | 71 |
| 7406 | 22 | 7464 | 21 | 74157 | 71 |
| 7407 | 22 | 7465 | 21 | 74161 | 95 |
| 7408 | 14 | 7472 | 22 | 74163 | 1·05 |
| 7409 | 14 | 7473 | 26 | 74164 | 1·25 |
| 7410 | 11 | 7474 | 26 | 74165 | 1·25 |
| 7411 | 16 | 7475 | 41 | 74166 | 1·15 |
| 7413 | 35 | 7476 | 26 | 74173 | 95 |
| 7415 | 22 | 7483 | 70 | 74175 | 95 |
| 7416 | 22 | 7485 | 80 | 74176 | 95 |
| 7417 | 22 | 7486 | 24 | 74177 | 85 |
| 7420 | 11 | 7489 | 1·50 | 74180 | 80 |
| 7422 | 22 | 7490 | 45 | 74181 | 2·50 |
| 7423 | 22 | 7491 | 71 | 74182 | 80 |
| 7425 | 22 | 7492 | 44 | 74184 | 1·55 |
| 7426 | 23 | 7493 | 44 | 74185 | 1·45 |
| 7427 | 22 | 7494 | 49 | 74190 | 95 |
| 7430 | 12 | 7495 | 49 | 74191 | 95 |
| 7432 | 22 | 7496 | 55 | 74192 | 90 |
| 7437 | 25 | 74100 | 1·25 | 74193 | 85 |
| 7438 | 21 | 74105 | 60 | 74194 | 95 |
| 7440 | 11 | 74107 | 27 | 74195 | 80 |
| 7441 | 60 | 74121 | 32 | 74196 | 1·00 |
| 7422 | 55 | 74122 | 50 | 74197 | 75 |
| 7443 | 55 | 74123 | 55 | 74198 | 1·70 |
| 7444 | 60 | 74125 | 50 | 74199 | 1·70 |
| 7445 | 75 | 74126 | 50 | 74200 | 3·90 |
| 7446 | 85 | 74141 | 68 | | |
| 7447 | 80 | 74145 | 75 | | |

### LOW POWER

| | | | | | |
|---|---|---|---|---|---|
| 74L00 | £0·16 | 74L51 | £0·16 | 74L90 | £0·93 |
| 74L02 | 16 | 74L55 | 18 | 74L91 | 80 |
| 74L03 | 16 | 74L71 | 18 | 74L93 | 89 |
| 74L04 | 18 | 74L72 | 27 | 74L95 | 89 |
| 74L06 | 18 | 74L73 | 38 | 74L98 | 1·53 |
| 74L10 | 16 | 74L74 | 38 | 74L164 | 1·53 |
| 74L20 | 16 | 74L78 | 44 | 74L165 | 1·53 |
| 74L30 | 16 | 74L85 | 85 | | |
| 74L42 | 89 | 74L86 | 38 | | |

### HIGH SPEED

| | | | | | |
|---|---|---|---|---|---|
| 74H00 | £0·16 | 74H21 | £0·16 | 74H55 | £0·20 |
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| 74H04 | 16 | 74H30 | 18 | 74H61 | 21 |
| 74H08 | 16 | 74H40 | 16 | 74H62 | 20 |
| 74H10 | 16 | 74H50 | 16 | 74H74 | 32 |
| 74H11 | 16 | 74H52 | 18 | | |
| 74H20 | 16 | 74H53 | 20 | | |

### 8000 SERIES

| | | | | | |
|---|---|---|---|---|---|
| 8091 | £0·33 | 8214 | £0·93 | 8811 | £0·38 |
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| 8095 | 76 | 8230 | 1·42 | 8822 | 1·42 |
| 8121 | 49 | 8520 | 71 | 8830 | 1·42 |
| 8123 | 88 | 8551 | 91 | 8831 | 1·42 |
| 8130 | 1·20 | 8552 | 1·37 | 8836 | 27 |
| 8200 | 1·42 | 8554 | 1·37 | 8880 | 73 |
| 8210 | 1·92 | 8810 | 44 | | |

### 9000 SERIES

| | | | | | |
|---|---|---|---|---|---|
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50-60 Hz — 4 to 6 digit — 12-24 HR — fast and slow set controls — 24 pin DIP with socket .. **£2-25**

### CALCULATOR CHIPS

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| | | |
|---|---|---|
| 1103 | 1024 bit RAM | £1-00 |
| 5261 | 1024 bit RAM | £1-00 |

### DISPLAYS

| | | |
|---|---|---|
| Hp 5082 7405 | 4 digit display | £1-10 |
| Hp 5082 7415 | 5 digit display | £1-15 |

### ½ PRICE SALE

| TTL | | LINEAR | |
|---|---|---|---|
| 7475 | 21p | 339 | 46p |
| 7490 | 23 | 555 | 22p |
| 74123 | 28 | 556A | 45p |
| 74141 | 34 | 567 | 60p |
| 74193 | 43 | 747 | 22p |

### MEMORIES w/data

| | | |
|---|---|---|
| 1101 | 256 bit RAM MOS | £0·96 |
| 1103 | 1024 bit RAM MOS | 2·72 |
| 5203 | 2048 bit erasable PROM | 13·68 |
| 5260 | 1024 bit RAM Low Power | 2·16 |
| 7489 | 64 bit RAM TTL | 1·50 |
| 8223 | Programmable ROM | 2·72 |

### CALCULATOR & CLOCK CHIPS w/data

| | | |
|---|---|---|
| 5001 | 12 DIG 4 funct fix dec | £1·46 |
| 5002 | Same as 5001 exc btry pwr | 1·95 |
| 5005 | 12 DIG 4 funct w/mem | 2·42 |
| MM5725 | 8 DIG 4 funct chain & dec | 1·10 |
| MM5736 | 18 pin 6 DIG 4 funct | 2·42 |
| MM5738 | 8 DIG 5 funct K & Mem | 2·42 |
| MM5739 | 9 DIG 4 funct (btry sur) | 2·92 |
| MM5311 | 28 pin BCD 6 dig mux | 2·42 |
| MM5312 | 24 pin 1 pps BCD 4 dig mux | 1·94 |
| MM5313 | 28 pin 1 pps BCD 6 dig mux | 2·42 |
| MM5314 | 24 pin 6 dig mux | 2·42 |
| MM5316 | 40 pin alarm 4 dig | 2·42 |

### LED'S

| | | |
|---|---|---|
| MV10B | Red TO 18 | £0·14 |
| MV50 | Axial leads | 8 |
| MV5020 | Jumbo Vis. Red (Red Dome) | 18 |
| | Jumbo Vis. Red (Clear Dome) | 18 |
| ME4 | Infra red diff. dome | 18 |
| MAN 1 | Red 7 seg. .270" | 1·38 |
| MAN 2 | Red alpha num .32" | 2·72 |
| MAN 4 | Red 7 seg. .190" | 1·18 |
| MAN 5 | Green 7 seg. .270" | 1·62 |
| MAN 6 | .6" high solid seg. | 3·81 |
| MAN 7 | Red 7 seg. .270" | 74 |
| MAN 8 | Yellow 7 seg. .270" | 2·17 |
| MAN 64 | .4" high solid seg. | 2·45 |
| MAN 66 | .6" high spaced seg. | 2·55 |
| MCT2 | Opto-iso transistor | 38 |

### MULTIPLE DISPLAYS

| | | |
|---|---|---|
| NSN33 | 3 digit .12" red led 12 pin fits IC skt. | £·90 |
| HP5082 7405 | 5 digit .11 led magn. lens com. cath | 1·80 |
| HP5082 7414 | 4 digit .11 LED magn. lens comm. cath. | 1·70 |
| FNA37 | 9 digit 7 seg led RH dec clr. magn. lens | 2·75 |
| SP-425-09 | 9 digit .25" neon direct interface with MOS/LSI, 180 VDC, 7 seg | ·98 |

### DTL

| | | | | | |
|---|---|---|---|---|---|
| 930 | 10 | 937 | 10 | 949 | 10 |
| 932 | 10 | 944 | 10 | 962 | 10 |
| 936 | 10 | 946 | 10 | 963 | 10 |

### LINEAR CIRCUITS

| | | | |
|---|---|---|---|
| 300 | Pos V Reg (super 723) | TO-5 | £0·43 |
| 301 | Hi Perf Op Amp | mDIP TO-5 | 18 |
| 302 | Volt follower | TO-5 | 43 |
| 304 | Neg V Reg | TO-5 | 49 |
| 305 | Pos V Reg | TO-5 | 52 |
| 307 | Op AMP (super 741) | mDIP TO-5 | 38 |
| 308 | Micro Pwr Op Amp | mDIP TO-5 | 60 |
| 309K | 5V 1A regulator | TO-3 | 91 |
| 310 | V Follower Op Amp | TO-5 mDIP | 65 |
| 311 | Hi perf V Comp | mDIP TO-5 | 58 |
| 319 | Hi Speed Dual Comp | DIP | 71 |
| 320 | Neg Reg 5.2, 12, 15 | TO-3 | 74 |
| 322 | Precision Timer | DIP | 60 |
| 324 | Quad Op Amp | DIP | 1·07 |
| 339 | Quad Comparator | DIP | 92 |
| 340K | Pos. V reg (5, 6, 8, 12, 15, 18, 24) | TO-3 | 1·20 |
| 340T | Pos Volt Reg (6V-8V-12V-15V-18V-24V) | TO-220 | 1·07 |
| 370 | AGC/Squelch AMPL | TO-5 or DIP | 65 |
| 372 | AF-IF Strip detector | DIP | 44 |
| 376 | Pos. V Reg | mDIP | 33 |
| 377 | 2w Stereo amp | DIP | 1·47 |
| 380 | 2w Audio Amp | DIP | 81 |
| 380-8 | .6w Audio amp | mDIP | 69 |
| 381 | Lo Noise Dual preamp | DIP | 98 |
| 382 | Lo Noise Dual preamp | DIP | 98 |
| 550 | Prec V Reg | DIP | 54 |
| 555 | Timer | mDIP | 44 |
| 556A | Dual 555 Timer | DIP | 89 |
| 560 | Phase Locked Loop | DIP | 1·94 |
| 562 | Phase Locked Loop | DIP | 1·94 |
| 565 | Phase Locked Loop | DIP | 1·20 |
| 566 | Function Gen | mDIP | 1·20 |
| 567 | Tone Decoder | mDIP | 1·20 |
| 709 | Operational AMPL | DIP | 27 |
| 710 | Hi Speed Volt Comp | DIP | 21 |
| 711 | Dual Difference Compar | DIP | 44 |
| 723 | V Reg | DIP | 38 |
| 739 | Dual Hi Perf Op Amp | DIP | 65 |
| 741 | Comp Op AMP | mDIP TO-5 | 27 |
| 747 | Dual 741 Op Amp | DIP or TO-5 | 44 |
| 748 | Freq Adj 741 | mDIP | 27 |
| 1304 | FM Mulpx Stereo Demod | DIP | 65 |
| 1307 | FM Mulpx Stereo Demod | DIP | 45 |
| 1458 | Dual Comp Op Amp | mDIP | 38 |
| LH2111 | Dual LM 211 V Comp | DIP | 1·07 |
| | Audio preamp | DIP | 44 |
| 3900 | Quad Amplifier | DIP | 33 |
| 7524 | Core Mem Sense AMPL | DIP | 1·04 |
| 7534 | Core Mem Sense Amp | DIP | 1·42 |
| 8864 | 9 DIG Led Cath Drvr | DIP | 1·37 |
| 75451 | Dual Perepheral Driver | mDIP | 21 |
| 75452 | Dual Peripheral Driver | mDIP | 21 |
| 75453 | (351) Dual Periph. Driver | mDIP | 21 |
| 75491 | Quad Seg Driver for LED | DIP | 50 |
| 75492 | Hex Digit Driver | DIP | 55 |

### CMOS

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| 74C04 | 41 | 74C107 | 82 | 74C164 | 1-92 | 4006A | 96 | 4016A | 40 | 4030A | 32 | 4073A | 28 |
| 74C08 | 41 | 74C151 | 1-59 | 74C173 | 1-59 | 4007A | 19 | 4017A | 85 | 4035A | 90 | 4075A | 28 |
| 74C10 | 36 | 74C154 | 1-92 | 74C195 | 1-65 | 4008A | 1-27 | 4020A | 1-06 | 4042A | 1-05 | 4078A | 28 |
| 74C20 | 36 | 74C157 | 1-20 | 80C95 | 82 | 4009A | 41 | 4021A | 98 | 4049A | 42 | 4081A | 19 |
| 74C42 | 1-18 | 74C160 | 1-78 | 80C97 | 82 | 4010A | 38 | 4022A | 78 | 4050A | 42 | 4082A | 25 |
| 74C73 | .85 | 74C161 | 1-78 | | | 4011A | 21 | 4023A | 18 | 4066A | 63 | 4528A | 1-14 |
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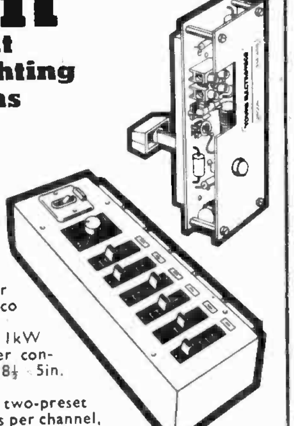

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| BC168 | 14p |
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| BC172 | 13p |
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| 2N929 | 22p |
| 2N930 | 20p |
| 2N1132 | 25p |
| 2N1302 | 30p |
| 2N1303 | 30p |
| 2N1304 | 30p |
| 2N1305 | 30p |
| 2N1306 | 30p |
| 2N1307 | 30p |
| 2N1308 | 30p |
| 2N1309 | 30p |
| 2N1613 | 30p |
| 2N1711 | 30p |
| 2N1890 | 60p |
| 2N2145 | 15p |
| 2N2147 | 90p |
| 2N2160 | 80p |
| 2N2217 | 25p |
| 2N2218 | 25p |
| 2N2219 | 25p |
| 2N2222 | 20p |
| 2N2222A | 25p |
| 2N2306 | 70p |
| 2N2369A | 50p |
| 2N2477 | 30p |
| 2N2646 | 50p |
| 2N2846 | £1·50 |
| 2N4904 | 25p |

| | |
|---|---|
| 2N2905 | 30p |
| 2N2906 | 25p |
| 2N2907 | 25p |
| 2N2925 | 13p |
| 2N3053 | 25p |
| 2N3055 | 50p |
| 2N3232 | £1·35 |
| 2N3525 | £1·10 |
| 2N3553 | £1·40 |
| 2N3643 | 30p |
| 2N3702 | 12p |
| 2N3703 | 12p |
| 2N3704 | 12p |
| 2N3705 | 12p |
| 2N3706 | 12p |
| 2N3707 | 12p |
| 2N3708 | 14p |
| 2N3709 | 14p |
| 2N3771 | £1·50 |
| 2N3772 | £1·60 |
| 2N3792 | £1·00 |
| 2N3794 | 30p |
| 2N3819 | 35p |
| 2N3820 | 55p |
| 2N3823 | 70p |
| 2N3866 | 35p |
| 2N3904 | 22p |
| 2N3905 | 25p |
| 2N3906 | 25p |
| 2N4014 | 30p |
| 2N4036 | 62p |
| 2N4037 | 44p |
| 2N4058 | 14p |
| 2N4059 | 14p |
| 2N4060 | 12p |
| 2N4061 | 12p |
| 2N4062 | 12p |
| 2N4126 | 18p |
| 2N4280 | 25p |
| 2N4287 | 25p |
| 2N4288 | 27p |
| 2N4289 | 30p |
| 2N4290 | 25p |
| 2N4291 | 32p |
| 2N4302 | 45p |
| 2N4444 | £1·90 |
| 2N4871 | 35p |
| 2N4903 | £1·30 |
| 2N4919 | 90p |
| 2N5069 | £1·30 |
| 2N5191 | 95p |
| 2N5192 | £1·20 |
| 2N5194 | £1·10 |
| 2N5195 | £1·40 |
| 2N5245 | 45p |
| 2N5296 | 55p |
| 2N5298 | 50p |
| 2N5457 | 35p |
| 2N5458 | 35p |
| 2N5459 | 40p |
| 2N5485 | 55p |
| 2N5490 | 55p |
| 2N5555 | 65p |
| 2N5777 | 40p |

QTY. DISCOUNTS 12 + 10%; 25 + 15%, 100 + 20%

PERSONAL CALLERS ALWAYS WELCOME

### S.C.R.s

| | |
|---|---|
| CRS1 05 | 40p |
| CRS1 10 | 56p |
| CRS1 20 | 80p |
| CRS1/40 | 65p |
| CRS1 60 | 90p |
| CRS3/10 | 62p |
| CRS3/20 | 62p |
| CRS3/40 | 90p |
| CRS7/400 | £1·00 |
| CRS16/100 | 85p |
| CRS16/200 | 90p |
| CRS16/600 | £1·60 |
| C106B | 45p |
| C106D | 70p |
| 40669 | 90p |
| TIC44 | 35p |
| 2N4444 | £1·90 |
| BT10/500A | 90p |

### BRIDGE RECTIFIERS

| | |
|---|---|
| W02 1A 200V | 38p |
| BY164 1·4A 200V | 57p |
| MDA952/2 6A 100V | 80p |

### ZENER DIODES

| | |
|---|---|
| BZY88 Series 400mW 3 3V–33V, 5% | 11p |
| 1·5W range | 25p |
| 10W range | 45p |

### L.E.D.

| | |
|---|---|
| TIL209 | 38p |
| HP5082 | 28p |
| MA2082R | 20p |

### L.D.R.

| | |
|---|---|
| ORP12 | 60p |

| | |
|---|---|
| NE555 Timer | 80p |

### TRIACS

| | |
|---|---|
| TXL228B 8A 400V | 85p |
| SC40D | £1·40 |
| SC40E | £1·65 |
| SC45D | £1·70 |
| SC45E | £2·10 |
| SC50D | £2·42 |
| SC50E | £2·70 |
| DIAC | 25p |

### LINEAR I.C.s

| | |
|---|---|
| LM304 Neg. Voltage Reg. | £2·10 |
| LM309K 5V 1A Voltage Reg. | £2·10 |
| LM723C 2·37V 150mA Voltage Reg. | £1·05 |
| MFC4000 250mW Audio | 75p |
| TBA800 5 Watt Audio | 93p |
| 709C Op Amp D.I.L./TO99 | 45p |
| 741C Op Amp 8/14 D.I.L./TO99 | 35p |
| 748C Op Amp D.I.L. | 75p |
| 747C Dual Op Amp | £1·20 |
| ZN414 Radio I.C. | £1·25 |
| TAD100 Radio I.C. inc. Filter | £1·90 |
| CA3014 | £1·55 |
| CA3018 | £1·00 |
| CA3028 | £1·20 |
| CA3036 | £1·00 |
| CA3046 | 80p |
| CA3048 | £2·35 |
| CA3075 | £1·60 |
| CA3090Q | £4·85 |
| MC1303L | £2·20 |
| MC1310P | £2·80 |

### TO3 VOLTAGE REGULATORS

L005 5V 650mA
L036 12V 500mA
L037 15V 450mA — £1·80 each

## VEROBOARD

| | 0·1 | 0·15 |
|---|---|---|
| 2½ × 3¾ | 32p | 23p |
| 2½ × 5 | 35p | 35p |
| 3¾ × 3¾ | 35p | 35p |
| 3¾ × 5 | 40p | 41p |
| 17 × 2½ | £1·05 | 90p |
| 17 × 3¾ | £1·43 | £1·12 |
| 17 × 5 | £1·84 | |
| PIN INS. TOOL | 72p | 72p |
| SP.F. CUTTER | 52p | 52p |
| 100 PINS SS | 30p | 30p |
| 100 PINS DS | 30p | 30p |
| 500 PINS SS | £1·55 | £1·55 |
| 500 PINS DS | £1·55 | £1·55 |

## ALSO STOCKED

**BNC PLUGS** at 35p each
**UHF (N) PLUGS** at 50p each.

U.H.F. V.S.W.R. probes ex U.H.F. transmitters £5 each + 8% VAT
All the above are new in original packets. Please add 8% VAT P & P 30p.

## Potentiometers

| Linear or Log | Single | Double |
|---|---|---|
| Rotary Pots | 17p | 45p |
| Rotary Switched | 25p | — |

## ★★SPECIAL OFFERS★★

**MINIATURE MAINS TRANSFORMER.** PRI 240V SEC. 12V 100mA Manuf.: Hinchley. Size: 36 × 45 × 40mm F.C. 53mm. Price 1—65p. 100—60p ea. 1,000—50p ea. 10,000—40p ea. 8% VAT.

**MINIATURE MAINS TRANSFORMER.** Primary 115/240V Sec. 18W/250mA at 80p ea. + VAT and postage 33p. 8% VAT.

**MULLARD POT CORE TYPE FX2241** at 60p ea. + 33p p.p. 8% VAT.

**24V D.C. SOLENOID** by MAGNETIC DEVICES 60p each. 2¼in long × ¾in × ⅞in + 8% VAT.

**240V A.C. SOLENOID.** Reversible operation; twin coil. Size approx. 2¾ × 1½ × 1¾in 90p.

30 unmarked OC71 transistors £1·90

25 unmarked 250mW Zener diodes, 4·7V, 5·1V, 6·2V, 7·5V, 9·1V, 10V, Measured and tested £1·00

Please state voltage required.

50 GE Diode OA47 equivalent £1·00

8µF 600V WKG **PAPER CAPACITORS**, ideal for Strobe Constructors £1·50 each + 8% VAT + 33p post.

Many other values of **PAPER CAPACITORS** in stock. Phone for details.

**JACKSON AIRSPACED CAPACITORS** to suit ¼in spindle:
100pF Two Gang at 55p + 25% VAT
500pF Two Gang at 75p + 25% VAT.

**MULLARD TUBULAR CERAMIC UHF TRIMMERS (PROFESSIONAL)**

| Type | | |
|---|---|---|
| 092 | 0·8–2·2pF | Price 10p ea. |
| 801 | 0·8–2·2pF | |
| 991 | 0·5–1·3pF | |

QUANTITY DISCOUNTS PLEASE TELEPHONE

1,000pF Feedthrough capacitor 5p ea.

Miniature tubular P.C. trimmers
3·5-13pF
6-30pF 10p ea.
4p c/o Varley 700Ω relay 50p ea.

Gold Flashed professional **TRANSISTOR SOCKETS.** To suit small signal TO18, etc. 30 for £1·00 + 8% VAT.

**W. WOUND POTS** 1Ω–100KΩ at 30p each Colvern or Reliance styles + 25% VAT.

**VERO EDGE CONNECTOR** 24 way 0·1in pitch 30p each + 8% VAT. All the other sizes in stock.

**SIEMENS VARLEY RELAY 4P C/O** 700Ω 24V 50p each.

**PLESSEY RELAY 2P C/O** 6V operation 40p each.

**MODERN DISC CERAMICS** £1·00 a hundred, £8·00 a thousand + 25% VAT. Phone or write for list.

**ACCESSORIES**

DIL SOCKETS. 8 pin 14p, 14 pin 14p, 16 pin 14p. Mica Washers + 2 Bushes (TO3 or TO66) 4p.

## METAL BOXES

**ALUMINIUM BOXES IDEAL FOR VEROBOARD WITH BASE AND P.K. screws**

| | Length | Width | Height | |
|---|---|---|---|---|
| AB7 | 2¾in | 5¼in | 1½in | 55p |
| AB8 | 4in | 4in | 1½in | 55p |
| AB9 | 4in | 2¾in | 1½in | 55p |
| AB10 | 4in | 5¼in | 1½in | 55p |
| AB11 | 4in | 2½in | 2in | 65p |
| AB12 | 3in | 2in | 1in | 50p |
| AB13 | 6in | 4in | 2in | 77p |
| AB14 | 7in | 5in | 2½in | 90p |
| AB15 | 8in | 6in | 3in | £1·16 |
| AB16 | 10in | 7in | 3in | £1·32 |
| AB17 | 10in | 4½in | 3in | £1·10 |
| AB18 | 12in | 5in | 3in | £1·32 |
| AB19 | 12in | 8in | 3in | £1·80 |

**ALUMINIUM BOXES WITH SLOPING TOP PANEL—IDEAL FOR PRE-AMPS, ETC., USING SLIDER CONTROLS**

AB20 8in Long 9in Wide 3¼in High at back £2·20
2in High at front 6in Slope to front With P.K. Screws
AB21 As above but 10in long £2·20
AB22 As above but 12in long £2·50

## TTL (full stocks available)

| | |
|---|---|
| SN7400 | 18p |
| SN7401 | 16p |
| SN7402 | 20p |
| SN7403 | 20p |
| SN7404 | 20p |
| SN7405 | 20p |
| SN7406 | 30p |
| SN7407 | 30p |
| SN7408 | 20p |
| SN7409 | 40p |
| SN7410 | 13p |
| SN7411 | 23p |

| | |
|---|---|
| SN7412 | 22p |
| SN7413 | 40p |
| SN7416 | 30p |
| SN7417 | 30p |
| SN7420 | 20p |
| SN7422 | 38p |
| SN7423 | 33p |
| SN7425 | 38p |
| SN7427 | 42p |
| SN7428 | 50p |
| SN7430 | 20p |
| SN7432 | 42p |

| | |
|---|---|
| SN7433 | 70p |
| SN7437 | 50p |
| SN7438 | 50p |
| SN7440 | 20p |
| SN7441AN | 75p |
| SN7442 | 75p |
| SN7443 | £1·00 |
| SN7445 | £1·79 |
| SN7446 | £2·00 |
| SN7447 | £1·50 |
| SN7448 | £1·75 |
| SN7450 | 20p |
| SN7451 | 20p |

| | |
|---|---|
| SN4753 | 20p |
| SN7454 | 20p |
| SN7460 | 20p |
| SN7470 | 30p |
| SN7472 | 30p |
| SN7473 | 40p |
| SN7474 | 48p |
| SN7475 | 55p |
| SN7476 | 45p |
| SN7480 | 80p |
| SN7481 | £1·25 |
| SN7482 | 87p |
| SN7483 | £1·00 |

| | |
|---|---|
| SN7451 | 20p |
| SN7483 | £1·00 |
| SN7484 | 90p |
| SN7489 | 45p |
| SN7490 | 75p |
| SN7491AN | £1·00 |
| SN7492 | 75p |
| SN7493 | 75p |
| SN7494 | 80p |
| SN7495 | 80p |
| SN7496 | £1·00 |
| SN7497 | £2·25 |

## ★ ★ SPECIAL OFFERS ★ ★

**MULTICORE CABLE.** 20 way 14/0076 plus Screen at 70p per yard plus postage by weight.

**MULTICORE CABLE.** 25-way, individually screened, 14/0076, £1·00 per yard plus V.A.T. Postage by weight.

**3 CORE PVC INSULATED MAINS CABLE.** GREY ML6650, 3 × 7/0·2mm. Price 100m £4·50; 1,000m £35; 10,000m £330.

**METAL OXIDE RESISTORS TR4/5/6** in stock. All values. 1-off price 3p each. Discount on quantity.

**10 TURN TRIMPOTS** by Bourns, Mec, Painton, etc. All values in stock. 50p each. Discount on quantity.

**KOKUSAI MECHANICAL FILTER.** 455 kc/s, 5 kc/s overall. Ideal for A.M. £5 each inc. VAT. Postage 33p each.

**TRANSFORMER** 240V a.c. Primary 1185-0-1185V at 360mA Secondary. £12 plus 8% VAT plus £1·50 postage.

**OMRON OCTAL RELAY 240V A.C.** 3P c/o 75p each plus 8% VAT.

**SLEEVING** 2000 pieces approx. size ⅛in × 2mm. Price £1·60 plus 33p P. & P. plus VAT 8%.

We are open from 9.30 a.m.—6.00 p.m. Monday–Saturday

**We have the largest retail selection of components available. Phone or write if you are in difficulties obtaining a particular component.**

**C.O.D. service welcome. All mail order by return. Official orders welcome by Government establishments, Education authorities, etc.**
**Tel. 01-994 6275**

# BI-PAK SEMICONDUCTORS

## TRANSISTORS

### BRAND NEW FULLY GUARANTEED

| Type | Price |
|---|---|
| AC107 | 0·20 |
| AC113 | 0·19 |
| AC115 | 0·20 |
| AC117K | 0·30 |
| AC122 | 0·12 |
| AC125 | 0·18 |
| AC126 | 0·18 |
| AC127 | 0·19 |
| AC128 | 0·19 |
| AC132 | 0·15 |
| AC134 | 0·15 |
| AC137 | 0·15 |
| AC141 | 0·19 |
| AC141K | 0·30 |
| AC142 | 0·19 |
| AC142K | 0·26 |
| AC151 | 0·16 |
| AC154 | 0·20 |
| AC155 | 0·20 |
| AC156 | 0·20 |
| AC157 | 0·25 |
| AC165 | 0·20 |
| AC166 | 0·20 |
| AC167 | 0·20 |
| AC168 | 0·25 |
| AC169 | 0·15 |
| AC176 | 0·20 |
| AC177 | 0·25 |
| AC178 | 0·29 |
| AC179 | 0·29 |
| AC180 | 0·20 |
| AC180K | 0·30 |
| AC181 | 0·20 |
| AC181K | 0·30 |
| AC187 | 0·22 |
| AC187K | 0·23 |
| AC188 | 0·22 |
| AC188K | 0·23 |
| ACY17 | 0·26 |
| ACY18 | 0·20 |
| ACY19 | 0·20 |
| ACY20 | 0·20 |
| ACY21 | 0·20 |
| ACY22 | 0·17 |
| ACY27 | 0·19 |
| ACY28 | 0·19 |
| ACY29 | 0·36 |
| ACY30 | 0·29 |
| ACY31 | 0·29 |
| ACY34 | 0·21 |
| BC173 | 0·15 |
| BC174 | 0·15 |
| BC175 | 0·22 |
| BC177 | 0·19 |
| BC178 | 0·19 |
| BC179 | 0·19 |
| BC180 | 0·25 |
| BC181 | 0·25 |
| BC182 | 0·15 |
| BC182L | 0·15 |
| BC183 | 0·15 |
| BC183L | 0·15 |
| BC184 | 0·20 |
| BC184L | 0·20 |
| BC186 | 0·29 |
| BC187 | 0·29 |
| BC207 | 0·11 |
| BC208 | 0·11 |
| BC209 | 0·12 |
| BC212L | 0·13 |
| BC213L | 0·13 |
| BC214L | 0·17 |
| BC225 | 0·26 |
| BC226 | 0·36 |
| BC301 | 0·28 |
| BC302 | 0·25 |
| BC303 | 0·31 |
| BC304 | 0·37 |
| BC440 | 0·31 |
| BC460 | 0·37 |
| BCY30 | 0·25 |
| BCY31 | 0·27 |
| BCY32 | 0·31 |
| BCY33 | 0·21 |
| BCY34 | 0·26 |
| BCY70 | 0·15 |
| BCY71 | 0·20 |
| BCY72 | 0·15 |
| BCZ10 | 0·20 |
| BCZ11 | 0·26 |
| BCZ12 | 0·26 |
| BD115 | 0·63 |
| BD116 | 0·81 |
| BD121 | 0·61 |
| BD123 | 0·67 |
| BD124 | 0·70 |
| BD131 | 0·51 |
| BD132 | 0·61 |
| BD133 | 0·67 |
| BD135 | 0·41 |
| BFY53 | 0·18 |
| BSX19 | 0·16 |
| BSX20 | 0·16 |
| BSY25 | 0·16 |
| BSY26 | 0·16 |
| BSY27 | 0·16 |
| BSY28 | 0·16 |
| BSY29 | 0·16 |
| BSY38 | 0·19 |
| BSY39 | 0·19 |

| Type | Price |
|---|---|
| BSY40 | 0·29 |
| BSY41 | 0·29 |
| BSY95 | 0·13 |
| BSY95A | 0·13 |
| BU105 | £2·04 |
| C111E | 0·51 |
| C400 | 0·31 |
| C407 | 0·26 |
| C424 | 0·26 |
| C425 | 0·51 |
| C426 | 0·36 |
| C428 | 0·20 |
| C441 | 0·31 |
| C442 | 0·31 |
| C444 | 0·36 |
| C450 | 0·22 |
| MAT100 | 0·19 |
| MAT101 | 0·20 |
| MAT120 | 0·19 |
| MAT121 | 0·20 |
| MJE521 | 0·56 |
| MJE2955 | 0·88 |
| MJE3055 | 0·57 |
| MJE3440 | 0·51 |
| MPF102 | 0·43 |
| MPF104 | 0·38 |
| MPF105 | 0·38 |
| OC19 | 0·36 |
| OC20 | 0·65 |
| OC22 | 0·47 |
| OC23 | 0·49 |
| OC24 | 0·57 |
| OC25 | 0·39 |
| OC26 | 0·30 |
| OC28 | 0·51 |
| OC29 | 0·51 |
| OC35 | 0·43 |
| OC36 | 0·51 |
| OC41 | 0·20 |
| OC42 | 0·25 |
| 2N918 | 0·31 |
| 2N929 | 0·21 |
| 2N930 | 0·21 |
| 2N1131 | 0·20 |
| 2N1132 | 0·22 |
| 2N1302 | 0·15 |
| 2N1303 | 0·15 |
| 2N1304 | 0·18 |
| 2N1305 | 0·18 |
| 2N1306 | 0·21 |
| 2N1307 | 0·21 |
| 2N1308 | 0·24 |
| 2N1309 | 0·24 |
| 2N1613 | 0·20 |
| 2N1711 | 0·20 |
| 2N1889 | 0·32 |
| 2N1890 | 0·46 |
| 2N1893 | 0·38 |
| 2N2147 | 0·73 |
| 2N2148 | 0·58 |
| 2N2192 | 0·36 |
| 2N2193 | 0·36 |
| 2N2194 | 0·36 |
| 2N2217 | 0·22 |
| 2N2218 | 0·20 |
| 2N2219 | 0·20 |
| 2N2220 | 0·22 |
| 2N2221 | 0·20 |
| 2N2222 | 0·20 |
| 2N2368 | 0·18 |
| 2N2369 | 0·15 |
| 2N2369A | 0·15 |
| 2N2411 | 0·25 |
| 2N2412 | 0·25 |
| 2N2646 | 0·48 |
| 2N2711 | 0·21 |
| 2N2712 | 0·21 |
| 2N2714 | 0·21 |
| 2N2904 | 0·18 |
| 2N2904A | 0·21 |
| 2N2905 | 0·21 |
| 2N2905A | 0·21 |
| 2N2906 | 0·16 |
| 2N2906A | 0·18 |
| 2N2907 | 0·20 |
| 2N2907A | 0·22 |
| 2N2923 | 0·15 |
| 2N2924 | 0·15 |
| 2N2925 | 0·15 |
| ACY35 | 0·21 |
| ACY36 | 0·29 |
| ACY40 | 0·18 |
| ACY41 | 0·19 |
| ACY44 | 0·36 |
| AD130 | 0·39 |
| AD140 | 0·49 |
| AD142 | 0·49 |
| AD143 | 0·39 |
| AD149 | 0·51 |
| AD161 | 0·36 |
| AD162 | 0·36 |
| AD161 & AD162(MP) | 0·69 |
| ADT140 | 0·51 |
| AF114 | 0·25 |
| AF115 | 0·25 |
| AF116 | 0·25 |
| AF117 | 0·25 |

| Type | Price |
|---|---|
| AF118 | 0·36 |
| AF124 | 0·31 |
| AF125 | 0·31 |
| AF126 | 0·29 |
| AF127 | 0·29 |
| AF139 | 0·31 |
| AF178 | 0·51 |
| AF179 | 0·51 |
| AF180 | 0·51 |
| AF181 | 0·51 |
| AF186 | 0·36 |
| AF239 | 0·38 |
| AL102 | 0·68 |
| AL103 | 0·68 |
| ASY26 | 0·26 |
| ASY27 | 0·31 |
| ASY28 | 0·26 |
| ASY29 | 0·26 |
| ASY50 | 0·26 |
| ASY51 | 0·26 |
| ASY52 | 0·26 |
| ASY54 | 0·26 |
| ASY55 | 0·26 |
| ASY56 | 0·26 |
| ASY57 | 0·26 |
| ASY58 | 0·26 |
| ASY73 | 0·26 |
| ASZ21 | 0·41 |
| BC107 | 0·08 |
| BC108 | 0·08 |
| BC109 | 0·08 |
| BD136 | 0·41 |
| BD137 | 0·46 |
| BD138 | 0·51 |
| BD139 | 0·56 |
| BD140 | 0·61 |
| BD155 | 0·81 |
| BD175 | 0·61 |
| BD176 | 0·61 |
| BD177 | 0·67 |
| BD178 | 0·67 |
| BD179 | 0·71 |
| BD180 | 0·71 |
| BD185 | 0·67 |
| BD186 | 0·67 |
| BD187 | 0·71 |
| BD188 | 0·71 |
| BD189 | 0·77 |
| BD190 | 0·77 |
| BD195 | 0·87 |
| BD196 | 0·87 |
| BD197 | 0·92 |
| BD198 | 0·92 |
| BD199 | 0·98 |
| BD200 | 0·98 |
| BD205 | 0·81 |
| BD206 | 0·81 |
| BD207 | 0·98 |
| BD208 | 0·98 |
| BDY20 | £1·02 |
| BF115 | 0·25 |
| BF117 | 0·46 |
| BF118 | 0·71 |
| BF119 | 0·71 |
| BF121 | 0·46 |
| BF123 | 0·51 |
| BF125 | 0·46 |
| BF127 | 0·51 |
| BF152 | 0·56 |
| BF153 | 0·46 |
| BF154 | 0·46 |
| BF155 | 0·71 |
| BF156 | 0·49 |
| BF157 | 0·56 |
| BF158 | 0·56 |
| BF159 | 0·61 |
| BF160 | 0·41 |
| BF162 | 0·41 |
| BF163 | 0·41 |
| BF164 | 0·41 |
| BF165 | 0·41 |
| OC44 | 0·16 |
| OC45 | 0·13 |
| OC70 | 0·10 |
| OC71 | 0·10 |
| OC72 | 0·15 |
| OC74 | 0·15 |
| OC75 | 0·16 |
| OC76 | 0·16 |
| OC77 | 0·26 |
| OC81 | 0·16 |
| OC81D | 0·16 |
| OC82 | 0·16 |
| OC82D | 0·16 |
| OC83 | 0·20 |
| OC139 | 0·20 |
| OC140 | 0·20 |
| OC169 | 0·26 |
| OC170 | 0·26 |
| OC171 | 0·26 |
| OC200 | 0·26 |
| OC201 | 0·29 |
| OC202 | 0·29 |
| OC203 | 0·26 |
| OC204 | 0·26 |
| OC205 | 0·36 |
| OC309 | 0·41 |
| OCP71 | 0·44* |
| ORP12 | 0·44* |
| ORP60 | 0·41* |

| Type | Price |
|---|---|
| ORP61 | 0·41* |
| P20 | 0·51* |
| P346A | 0·20 |
| P397 | 0·43 |
| ST140 | 0·13 |
| ST141 | 0·18 |
| TIP29 | 0·44 |
| TIP30 | 0·52 |
| TIP31A | 0·56 |
| TIP32A | 0·68 |
| TIP41A | 0·68 |
| TIP42A | 0·81 |
| TIS43 | 0·31* |
| UT46 | 0·28* |
| ZN414 | 1·11 |
| 2G301 | 0·19 |
| 2G302 | 0·19 |
| 2G303 | 0·19 |
| 2G304 | 0·25 |
| 2G306 | 0·41 |
| 2G308 | 0·36 |
| 2N2926 G | 0·13 |
| 2N2926 Y | 0·11 |
| 2N2926 O | 0·10 |
| 2N2926 R | 0·10 |
| 2N2926 B | 0·10 |
| 2N3010 | 0·71 |
| 2N3011 | 0·15 |
| 2N3053 | 0·18 |
| 2N3054 | 0·47 |
| 2N3055 | 0·42 |
| 2N3319 | 0·15 |
| 2N3391 A | 0·17 |
| 2N3392 | 0·15 |
| 2N3393 | 0·15 |
| 2N3394 | 0·15 |
| 2N3395 | 0·18 |
| 2N3402 | 0·21 |
| 2N3403 | 0·21 |
| 2N3404 | 0·29 |
| 2N3405 | 0·43 |
| 2N3414 | 0·16 |
| 2N3415 | 0·16 |
| 2N3416 | 0·29 |
| 2N3417 | 0·29 |
| 2N3525 | 0·77* |
| 2N3614 | 0·69 |
| 2N3615 | 0·76 |
| 2N3616 | 0·76 |
| 2N3646 | 0·09 |
| 2N3702 | 0·12 |
| 2N3703 | 0·12 |
| 2N3704 | 0·13 |
| 2N3705 | 0·12 |
| 2N3706 | 0·12 |
| 2N3707 | 0·13 |
| 2N3708 | 0·08 |
| 2N3709 | 0·09 |
| 2N3710 | 0·09 |
| 2N3711 | 0·09 |
| 2N3819 | 0·29 |
| 2N3820 | 0·51 |
| 2N3821 | 0·36 |
| 2N3823 | 0·29 |
| 2N3903 | 0·29 |
| 2N3904 | 0·31 |
| 2N3905 | 0·29 |
| 2N3906 | 0·28 |
| 2N4058 | 0·12 |
| 2N4059 | 0·10 |
| 2N4060 | 0·12 |
| BC113 | 0·10 |
| BC114 | 0·16 |
| BC115 | 0·16 |
| BC116 | 0·16 |
| BC117 | 0·19 |
| BC118 | 0·10 |
| BC119 | 0·31 |
| BC120 | 0·81 |
| BC125 | 0·12 |
| BC126 | 0·19 |
| BC132 | 0·12 |
| BC134 | 0·19 |
| BC135 | 0·16 |
| BC136 | 0·16 |
| BC137 | 0·16 |
| BC139 | 0·41 |
| BC140 | 0·31 |
| BC141 | 0·31 |
| BC142 | 0·31 |
| BC143 | 0·31 |
| BC145 | 0·46 |
| BC147 | 0·10 |
| BC148 | 0·10 |
| BC149 | 0·12 |
| BC150 | 0·19 |
| BC151 | 0·20 |
| BC152 | 0·18 |
| BC153 | 0·29 |
| BC154 | 0·31 |
| BC157 | 0·19 |
| BC158 | 0·12 |
| BC159 | 0·12 |
| BC160 | 0·46 |
| BC161 | 0·51 |
| BC167 | 0·12 |
| BC168 | 0·12 |
| BC169 | 0·12 |
| BC170 | 0·12 |
| BC171 | 0·15 |

| Type | Price |
|---|---|
| BC172 | 0·15 |
| BF167 | 0·22 |
| BF173 | 0·22 |
| BF176 | 0·36 |
| BF177 | 0·36 |
| BF178 | 0·31 |
| BF179 | 0·31 |
| BF180 | 0·31 |
| BF181 | 0·31 |
| BF182 | 0·41 |
| BF183 | 0·41 |
| BF184 | 0·26 |
| BF185 | 0·31 |
| BF187 | 0·28 |
| BF188 | 0·41 |
| BF194 | 0·12 |
| BF195 | 0·12 |
| BF196 | 0·15 |
| BF197 | 0·15 |
| BF200 | 0·46 |
| BF222 | 0·98 |
| BF257 | 0·46 |
| BF258 | 0·61 |
| BF259 | 0·87 |
| BF262 | 0·56 |
| BF263 | 0·56 |
| BF270 | 0·36 |
| BF271 | 0·31 |
| BF272 | 0·81 |
| BF273 | 0·36 |
| BF274 | 0·36 |
| BFW20 | 0·61 |
| BFX29 | 0·28 |
| BFX84 | 0·22 |
| BFX85 | 0·31 |
| BFX86 | 0·22 |
| BFX87 | 0·25 |
| BFX88 | 0·22 |
| BFY50 | 0·20 |
| BFY51 | 0·20 |
| BFY52 | 0·20 |
| 2G309 | 0·37 |
| 2G339 | 0·20 |
| 2G339A | 0·17 |
| 2G344 | 0·19 |
| 2G345 | 0·17 |
| 2G371 | 0·17 |
| 2G371B | 0·12 |
| 2G373 | 0·18 |
| 2G374 | 0·18 |
| 2G377 | 0·31 |
| 2G378 | 0·17 |
| 2G381 | 0·17 |
| 2G382 | 0·17 |
| 2G401 | 0·31 |
| 2G414 | 0·31 |
| 2G417 | 0·26 |
| 2N388 | 0·36 |
| 2N388A | 0·56 |
| 2N404 | 0·20 |
| 2N404A | 0·29 |
| 2N524 | 0·43 |
| 2N527 | 0·50 |
| 2N598 | 0·43 |
| 2N599 | 0·46 |
| 2N696 | 0·13 |
| 2N697 | 0·14 |
| 2N698 | 0·25 |
| 2N699 | 0·36 |
| 2N706 | 0·08 |
| 2N706A | 0·09 |
| 2N708 | 0·12 |
| 2N711 | 0·31 |
| 2N717 | 0·36 |
| 2N718 | 0·25 |
| 2N718A | 0·51 |
| 2N726 | 0·29 |
| 2N727 | 0·29 |
| 2N743 | 0·20 |
| 2N744 | 0·20 |
| 2N914 | 0·15 |
| 2N4061 | 0·12 |
| 2N4062 | 0·12 |
| 2N4284 | 0·18 |
| 2N4285 | 0·18 |
| 2N4286 | 0·18 |
| 2N4287 | 0·18 |
| 2N4288 | 0·18 |
| 2N4289 | 0·18 |
| 2N4290 | 0·18 |
| 2N4291 | 0·18 |
| 2N4292 | 0·18 |
| 2N4293 | 0·18 |
| 2N5172 | 0·12 |
| 2N5194 | 0·56 |
| 2N5294 | 0·56 |
| 2N5296 | 0·56 |
| 2N5457 | 0·32 |
| 2N5458 | 0·32 |
| 2N5459 | 0·41 |
| 2N6122 | 0·69 |
| 28301 | 0·51 |
| 28302A | 0·43 |
| 28302 | 0·43 |
| 28303 | 0·56 |
| 28304 | 0·71 |
| 28305 | 0·80 |
| 28306 | 0·80 |
| 28307 | 0·80 |
| 28321 | 0·75 |

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| 7401 | 0·14 | 0·13 | 0·12 | 7450 | 0·14 | 0·13 | 0·12 | 74123 | 0·69 | 0·68 | 0·65 |
| 7402 | 0·14 | 0·13 | 0·12 | 7451 | 0·14 | 0·13 | 0·12 | 74141 | 0·79 | 0·76 | 0·73 |
| 7403 | 0·14 | 0·13 | 0·12 | 7453 | 0·14 | 0·13 | 0·12 | 74145 | £1·20 | £1·16 | £1·11 |
| 7404 | 0·14 | 0·13 | 0·12 | 7454 | 0·14 | 0·13 | 0·12 | 74150 | £1·39 | £1·30 | £1·20 |
| 7405 | 0·14 | 0·13 | 0·12 | 7460 | 0·14 | 0·13 | 0·12 | 74151 | £1·02 | 0·97 | 0·93 |
| 7406 | 0·36 | 0·31 | 0·29 | 7470 | 0·30 | 0·27 | 0·25 | 74153 | 0·93 | 0·88 | 0·83 |
| 7407 | 0·36 | 0·31 | 0·29 | 7472 | 0·30 | 0·27 | 0·25 | 74154 | £1·57 | £1·43 | £1·48 |
| 7408 | 0·23 | 0·22 | 0·21 | 7473 | 0·38 | 0·36 | 0·32 | 74155 | £1·11 | £1·06 | £1·02 |
| 7409 | 0·23 | 0·22 | 0·21 | 7474 | 0·38 | 0·36 | 0·32 | 74156 | £1·11 | £1·06 | £1·02 |
| 7410 | 0·14 | 0·13 | 0·12 | 7475 | 0·56 | 0·54 | 0·52 | 74157 | 0·93 | 0·88 | 0·83 |
| 7411 | 0·23 | 0·22 | 0·21 | 7476 | 0·41 | 0·40 | 0·39 | 74160 | £1·30 | £1·25 | £1·20 |
| 7412 | 0·26 | 0·25 | 0·24 | 7480 | 0·56 | 0·54 | 0·51 | 74161 | £1·30 | £1·25 | £1·20 |
| 7413 | 0·30 | 0·29 | 0·28 | 7481 | 1·02 | 0·97 | 0·93 | 74162 | £1·30 | £1·25 | £1·20 |
| 7416 | 0·28 | 0·27 | 0·26 | 7482 | 0·83 | 0·79 | 0·74 | 74163 | £1·30 | £1·25 | £1·20 |
| 7417 | 0·28 | 0·27 | 0·26 | 7483 | £1·11 | £1·06 | 0·97 | 74164 | £1·67 | £1·62 | £1·55 |
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| 7422 | 0·28 | 0·27 | 0·26 | 7485 | £1·48 | £1·44 | £1·39 | 74166 | £1·48 | £1·44 | £1·39 |
| 7423 | 0·37 | 0·36 | 0·35 | 7486 | 0·32 | 0·31 | 0·30 | 74174 | £1·48 | £1·44 | £1·39 |
| 7425 | 0·37 | 0·36 | 0·35 | 7489 | £3·70 | £3·47 | £3·24 | 74175 | £1·02 | 0·97 | 0·93 |
| 7426 | 0·37 | 0·35 | 0·33 | 7490 | 0·60 | 0·58 | 0·56 | 74176 | £1·16 | £1·11 | £1·06 |
| 1427 | 0·37 | 0·35 | 0·33 | 7491 | £1·02 | 0·97 | 0·93 | 74177 | £1·16 | £1·11 | £1·06 |
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| 7440 | 0·14 | 0·13 | 0·12 | 74104 | 0·56 | 0·54 | 0·51 | 74192 | £1·81 | £1·76 | £1·71 |
| 7441 | 0·69 | 0·66 | 0·59 | 74105 | 0·56 | 0·54 | 0·51 | 74193 | £1·81 | £1·76 | £1·71 |
| 7442 | 0·69 | 0·66 | 0·59 | 74107 | 0·41 | 0·39 | 0·37 | 74194 | £1·20 | £1·16 | £1·11 |
| 7443 | £1·11 | £1·06 | £1·02 | 74110 | 0·56 | 0·51 | 0·46 | 74195 | £1·02 | 0·97 | 0·93 |
| 7444 | £1·11 | £1·06 | £1·02 | 74111 | 0·83 | 0·81 | 0·78 | 74196 | £1·11 | £1·06 | £1·02 |
| 7445 | £1·48 | £1·44 | £1·39 | 74118 | 0·93 | 0·88 | 0·83 | 74197 | £1·11 | £1·06 | £1·02 |
| 7446 | £1·11 | £1·06 | £1·02 | 74119 | £1·39 | £1·30 | £1·20 | 74190 | £2·55 | £2·50 | £2·45 |
| 7447 | £1·02 | 0·99 | 0·97 | 74121 | 0·46 | 0·44 | 0·41 | 74199 | £2·31 | £2·21 | £2·11 |

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| BP932 | 0·15 | 0·14 | 0·13 | BP945 | 0·28 | 0·26 | 0·23 | BP9093 | 0·42 | 0·40 | 0·38 |
| BP933 | 0·15 | 0·14 | 0·13 | BP946 | 0·14 | 0·13 | 0·12 | BP9094 | 0·42 | 0·40 | 0·38 |
| BP935 | 0·15 | 0·14 | 0·13 | BP948 | 0·28 | 0·26 | 0·23 | BP9097 | 0·42 | 0·40 | 0·38 |
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| 72709 | 0·23 | 0·21 | 0·19 | SL702C | 0·46 | 0·42 | 0·37 | 76003 | £1·39 | £1·34 | £1·30 |
| 72709P | 0·19 | 0·18 | 0·17 | TAA263 | 0·74 | 0·65 | 0·56 | 76023 | £1·39 | £1·34 | £1·30 |
| 72710 | 0·32 | 0·31 | 0·28 | TAA293 | 0·93 | 0·88 | 0·83 | 76660 | 0·88 | 0·86 | 0·83 |
| 72741 | 0·28 | 0·27 | 0·26 | TAA350A | £1·71 | £1·67 | £1·57 | LM380 | 0·93 | 0·90 | 0·88 |
| 72741C | 0·26 | 0·25 | 0·24 | uA703C | 0·26 | 0·24 | 0·22 | NE555 | 0·45 | 0·43 | 0·40 |
| 72741P | 0·28 | 0·27 | 0·26 | uA709C | 0·19 | 0·18 | 0·17 | NE556 | 0·88 | 0·86 | 0·83 |
| 72747 | 0·79 | 0·74 | 0·61 | uA711C | 0·32 | 0·31 | 0·28 | TBA800 | £1·39 | £1·34 | £1·30 |
| 72748P | 0·35 | 0·33 | 0·31 | uA712C | 0·32 | 0·31 | 0·28 | ZN414 | £1·11 | — | — |
| SL201C | 0·46 | 0·42 | 0·37 | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|
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| 200 | 0·06 | 0·09 | 1N4003 | 0·07 | 0·12 | 0·20 | 0·23* | 0·93* |
| 400 | 0·07 | 0·14 | 1N4004 | 0·08 | 0·14 | 0·28 | 0·35* | £1·25* |
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| 20 | 0·15 | 0·18 | — | — | — | — | — | — | — | — |
| 30 | 0·19 | 0·22 | — | — | — | — | — | — | — | — |
| 50 | 0·22 | 0·28 | 0·20 | 0·25 | 0·36 | 0·36 | 0·48 | 0·51 | 0·54 | £1·18 |
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| BA100 | 0·10 | BY127 | 0·16 | CG651 (OA70-OA79) | 0·07 | OA202 | 0·07 |
| BA116 | 0·21 | BY128 | 0·16 | OA5 Short Leads | 0·21 | SD10 | 0·06 |
| BA126 | 0·22 | BY130 | 0·17 | OA10 | 0·14 | SD19 | 0·06 |
| BA148 | 0·15 | BY133 | 0·21 | OA47 | 0·07 | 1N34 | 0·07 |
| BA154 | 0·12 | BY164 | 0·51 | OA70 | 0·07 | 1N34A | 0·07 |
| BA155 | 0·15 | BYX38/30 | 0·43 | OA79 | 0·07 | 1N914 | 0·06 |
| BA156 | 0·14 | BYZ10 | 0·36 | OA81 | 0·07 | 1N916 | 0·06 |
| BA173 | 0·15 | BYZ11 | 0·31 | | | 1N4148 | 0·06 |
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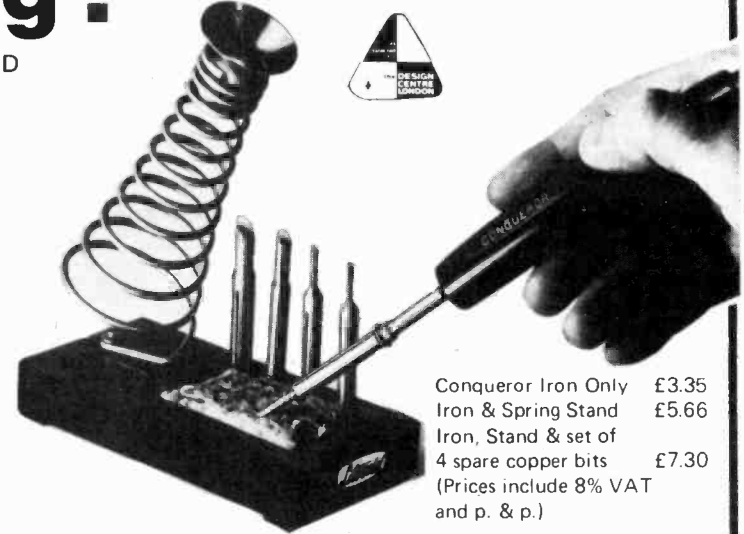


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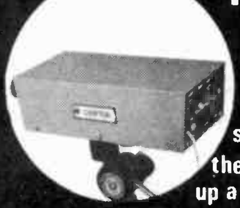

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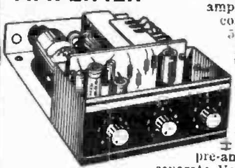

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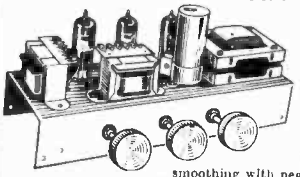

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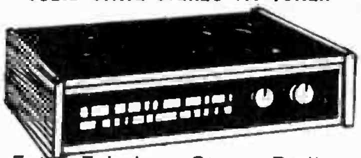

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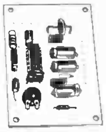

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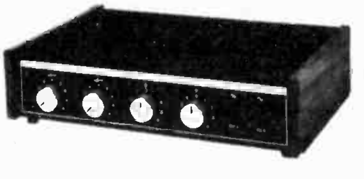

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12–15,000 Hz. Bass, boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

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| AMPLIFIER KIT | £15·00 | P. & P. 55p |
| (Magnetic input components 33p extra) | | |
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If all three units purchased at same time total P.&P. £1·00
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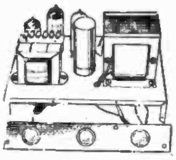
*Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.*

**3-VALVE AUDIO AMPLIFIER HA34 MK II.**



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £7·75. P. & P. 85p.
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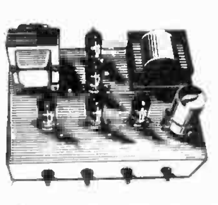
**10/14 WATT HI-FI AMPLIFIER KIT**



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p × SAE (Free with parts). All parts sold separately. ONLY £12·00. P. & P. £1·25. Also available ready built and tested £16·50. P. & P. £1·20.

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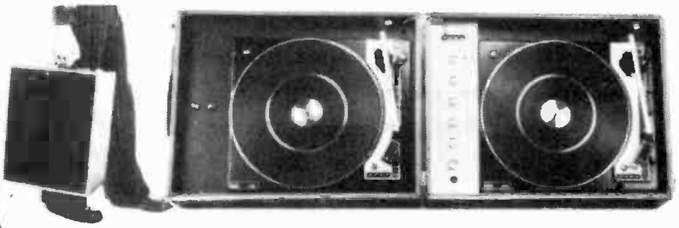

**TECHNICAL SPECIFICATION:**
**Pre amp** – Output – 200mV. Auxiliary inputs – 200mV and 750mV into 1 meg. Mic input – 6mV into 100K. 240 volt operation. **Turntables capacity** – 7", 10" or 12" records. **Rumble, wow and flutter** Rumble Better than –35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter). **Finish** – Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

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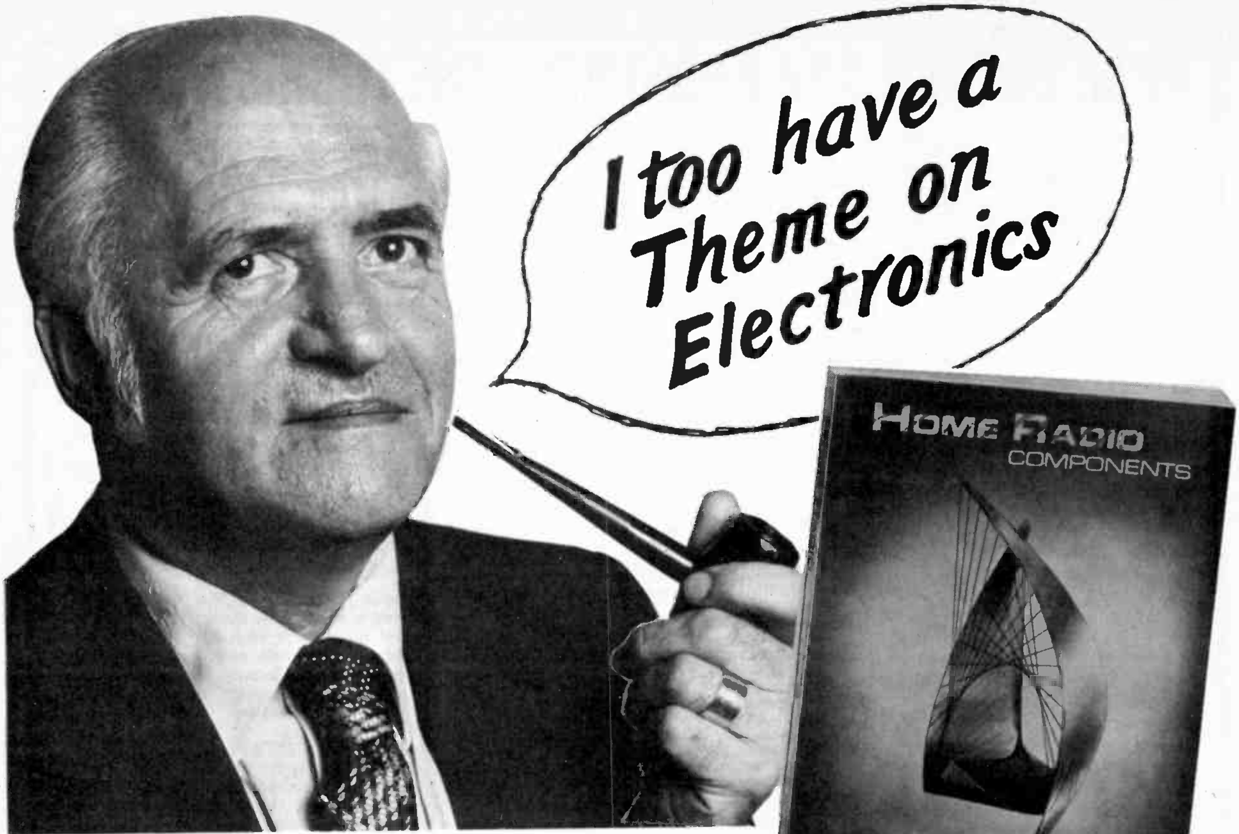



As you may already know, the front cover of the Home Radio Components catalogue features a colour picture of the striking modern sculpture "Theme on Electronics" by the Late Dame Barbara Hepworth. The original sculpture, incidentally, was commissioned in 1957 by Mullards for their Electronics Centre showroom.

If you asked me for *my* theme on electronics I'd say that experience has taught me that the simplest and most satisfactory way of getting electronic components is to buy them from Home Radio Components—either over the counter at their shop in Mitcham or by Mail Order. Ninety-nine times out of a hundred they can supply just what you want immediately from stock—at very keen prices too. If you're likely to require bits and pieces fairly regularly it will be worth your while to make use of their Credit Account Service. This is a fairly new service provided by Home Radio Components, but they tell me that already about a thousand customers are using it. That doesn't surprise me. I for one have found that it saves me time and money in several ways. No space to give details here, but full information and an application form are given in the catalogue. Whether or not you use the Credit Account Service, you'll certainly need the catalogue, and at £1·30 (85p plus 45p post and packing) it's a real bumper bargain. Its 240 pages list about 6,000 components with nearly 2,000 illustrations. What's more the catalogue contains vouchers worth 70 pence when used against orders, so you can soon recover a good slice of your investment.

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# PE

## TIME FOR CHANGE?

THAT thousands of Christmas stockings will contain a pocket calculator this year seems a safe bet. But how many Christmas's are to pass before the digital wristwatch replaces the miniature calculator as a stocking filler? Not many, we hazard a guess.

The spectacular success of the pocket calculator is about to be repeated by the digital wristwatch. That much is clear. The industry is no doubt licking its lips anticipating another technological over-kill in the vast consumer market. But there is a difference. The pocket calculator was an entirely new device and it had no opponent in the field. Once a market was established an avalanche was set in motion and new i.c. techniques and mass production soon brought prices tumbling. They have probably just about bottomed-out now. The five-quid general purpose calculator is just around the corner. More sophisticated instruments for complex functions are still bargains at around the thirty pound mark or so. Prices can hardly fall much more.

The digital readout wristwatch in some ways offers a parallel to the calculator. The market has now been primed and manufacturers are vying with one another in a battle of prices and of superlatives in their advertisements which accredit their wares as direct spin-offs from space technology, etc., etc. The potential market is greater (in numbers) than that for calculators—everyone is a prospective wearer. But it is a replacement market since the two-wristwatch man (or woman) is not commonly encountered—as yet. Valuable examples of the skills of traditional chronometer makers are not likely to be disposed of before their normal life span has expired, thus the actual market narrows considerably. Yet it remains vast by any reckoning and must increase as the digital wristwatch becomes fashionable particularly with the young. Fashionable, we say advisedly. Fashion rarely recognises practicality or logic. Often the reverse. A wristwatch is often viewed as an accessory to clothes and so comes within that most susceptible and volatile of all fashion areas.

To suggest that digital wristwatches will rely upon the whims of fashion to make their impact is not to run in the face of advancing technology, but rather to recognise the plain fact that analogue time pieces apart from being traditional are generally far more convenient in use.

Electronics may very well make an over-kill in the wristwatch market and so change the time honoured customs and habits of generations. Perhaps this is a natural extension from the digital readouts of calculators we have all become accustomed to. And it is a fact that the digital clock has already won acceptance in many homes. Yet a universal adoption of digital displays at the expense of analogue readout has little to commend it in terms of user convenience. Does advancement in electronics inevitably rule out any analogue form of display, or is it just a question of waiting for fashion to change, yet again?

F.E.B.


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# SPECIFICATION . . .

**Power Output**
50 watts r.m.s. into 8 ohms

**Frequency Response (at full power)**
+0dB −1dB 30Hz to 20kHz

**Sensitivity**
15mV each channel for maximum output

**Distortion (at full power)**
less than 0.4 per cent

**Noise Level**
−63dB

**Tone Controls**
Bass ± 10dB  Treble + 13dB − 12dB

# IC50 GUITAR AMPLIFIER

By B.W. TERRELL & C.F. TERRELL

THIS article describes the construction of a 50 watt r.m.s. two-channel mono amplifier for use in pop groups, bands, etc. for amplifying the output from lead or bass electric guitars; it is also suitable for P.A. work but may need a component value change (see later) to obtain maximum output from low output microphones. Fifty watts was found more than adequate for playing in clubs, pubs and medium-sized halls.

No claim is made that the amplifier is up to hi-fi standard but then this is not needed for the purpose for which it was designed. Nevertheless, the quality is as good as, if not better, than many 50 watt amplifiers costing far more than the *IC50*.

From the outset it was decided to keep the design, layout and construction as simple as possible. At one time it was thought that a second channel was superfluous, because, as those of you that are members of a group/band will know, each member is usually equipped with his own amplifying gear—amplifier and speaker cabinet—and therefore needs only one channel. But a second channel is often invaluable in the event of another member's equipment developing a fault. Experience has proved this to be true. Besides, the additional cost and complexity is minimal. If more input channels are required, the preamplifier section can be duplicated and mixed in the same way as the two in the *IC50*.

### I.C.s AND P.C.B.s

In a determined effort to maintain simplicity, integrated circuits have been used throughout, two differential operation amplifiers for each preamplifier and a thick-film hybrid audio power intergrated


## COMPONENTS . . .

**Resistors**

| | | | | | |
|---|---|---|---|---|---|
| R1, 101 | 47kΩ | R5, 105 | 10kΩ | R9, 109 | 1·5kΩ |
| R2, 102 | 1kΩ | R6, 106 | 10kΩ | R10 | 10Ω |
| R3, 103 | 47kΩ | R7, 107 | 100kΩ | R11 | 820Ω ½W |
| R4, 104 | 1·8kΩ | R8, 108 | 1·8kΩ | R12 | 820Ω ½W |

All ¼W carbon ±5% except where otherwise stated

**Capacitors**

| | | |
|---|---|---|
| C1, 101 | 2μF 10V | elect |
| C2, 102 | 10pF | ceramic |
| C3, 103 | 0·047μF | " |
| C4, 104 | 0·047μF | " |
| C5, 105 | 2,000pF | ceramic or polystyrene |
| C6, 106 | 2μF 10V | elect |
| C7 | 10μF 10V | elect |
| C8 | 22μF 50V | elect |
| C9 | 1μF 100V | elect or metallised polyester |
| C10 | 0·047μF | ceramic |
| C11 | 1,000μF 25V | elect |
| C12 | 1,000μF 25V | elect |
| C13 | 2,000μF 50V | elect |
| C14 | 2,000μF 50V | elect |
| C15 | 2,000μF 50V | elect |
| C16 | 2,000μF 50V | elect |

**Potentiometers**

VR1, 101 470kΩ carbon lin.
VR2, 102 100kΩ carbon lin.
VR3, 103 10kΩ carbon lin.
VR4 10kΩ carbon lin.

**Semiconductors**

IC1, 101 op-amp type 748 8 pin d.i.l.
IC2, 102 op-amp type 741 8 pin d.i.l.
*IC3 SI-1050G 50 watt thick film integrated circuit amplifier
D1 BZY88C15 15V 400mW Zener diode
D2 BZY88C15 15V 400mV Zener diode
D3 1N5401
D4 1N5401
D5 1N5401
D6 1N5401

**Miscellaneous**

†T1 Mains/25-0-25V 1·5A secondary (type 1116)
S1 D.P.D.T. rotary mains switch
LP1 mains panel neon with built-in resistor
SK1, 2 jack socket type R26/1 (Rean Products)
SK3 standard jack socket
FS1, 2 2A
FS3 1A
Printed circuit boards (3 off); board mounting fuseholders (2 off); panel mounting fuseholder (1 off); 8 pin d.i.l. integrated circuit holders (4 off); knobs (8 off); aluminium for chassis and front panel; 6BA nuts, bolts and shakeproof washers (20 off); 6BA 5mm long spacers (12 off); rubber grommet; chassis fixing cable clips (2 off); mains cable; chassis mounting solder tag; materials for case; handle; rubber feet (4 off).

*£12 (including VAT and p & p) Special Offer to P.E. Readers
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†£6.25 (including VAT and p & p)
Post From: Zeta Windings Ltd., 26, All Saints Road, London, W.11
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Acknowledgement: we should like to thank Lesney Products Co. Ltd., for loan of models depicted on this and front cover pages

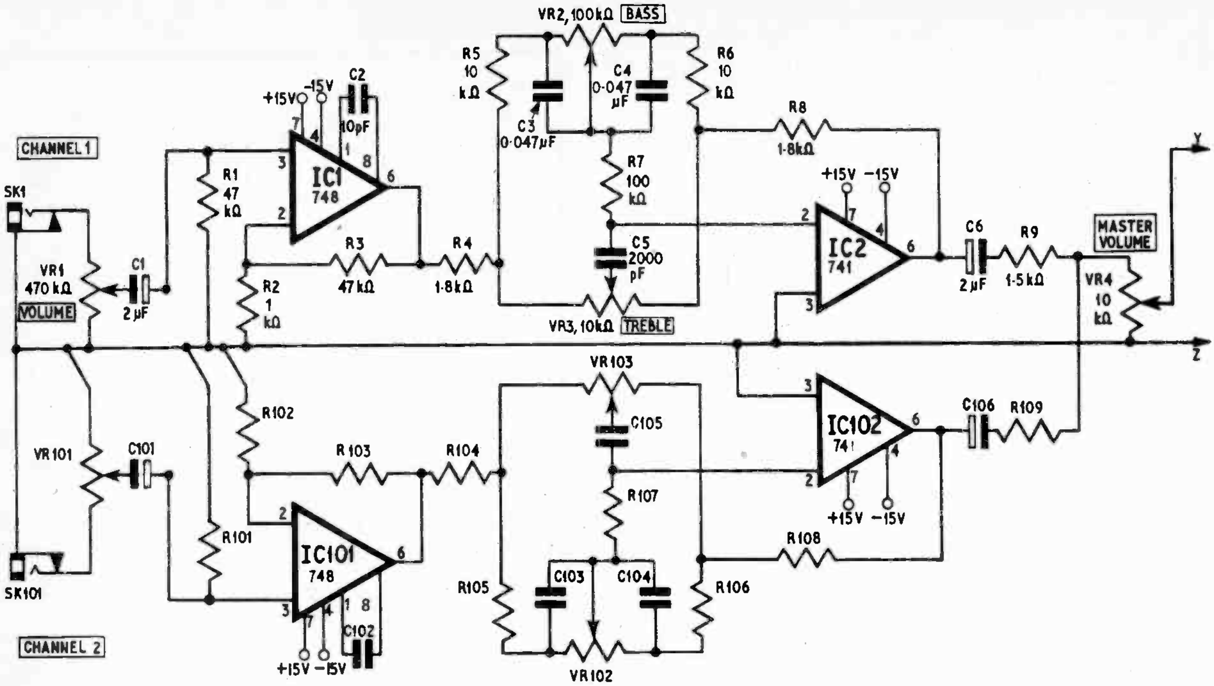



**Fig. 1. Circuit diagram of the pre-amplifier**

circuit as the output stage. Also, to help simplify construction, printed circuit boards have been designed for each section (see later). The latter were home-made with the aid of printed circuit transfers which were specially designed to be "rubbed" straight onto the copper clad side of the printed circuit board, rather like Letraset. These transfers, available in a wide range of pad and wiring patterns, actually form the resist to the ferric chloride solution (etchant) and are easily cleaned off afterwards using a light abrasive powder (e.g. Ajax, Vim, etc.).

## PREAMPLIFIER

The complete circuit diagram of the preamplifier section is shown in Fig. 1 and is seen to consist of two identical channels (completely independent) their outputs being mixed across the Master Volume Control, VR4.

Due to the wide range of voltage outputs available from the pick-ups of electric guitars, it was decided to incorporate an overload or "input trimming" control in the form of VR1. The signal on the wiper of VR1 is coupled via d.c. blocking capacitor C1, to the input of the differential amplifier IC1 wired as an inverting amplifier, the gain of which is controlled by the values of R2 and R3 and is given by:

$$\text{gain} = \frac{R2 + R3}{R2}$$

In the prototype these values were arranged so that this stage had a gain of approximately 50. Thus an input signal of 15 millivolts r.m.s. results in an output of approximately 700 millivolts r.m.s. which is necessary to drive the power amplifier to obtain maximum output, i.e. 50 watts. For inputs larger than 15mV, VR1 will need to be adjusted so that the maximum output without limiting can be obtained when the master control is turned fully on. For input signals less than 15mV, the value of R3 will need to be increased according to its level, see gain equation above.

The output from IC1 is fed to IC2 connected as a non-inverting amplifier with feedback of the Baxandall type which theoretically gives a gain of unity for all frequencies when the tone controls VR2 and VR3 are set midway. The controls are virtually independent of each other and provide both boost

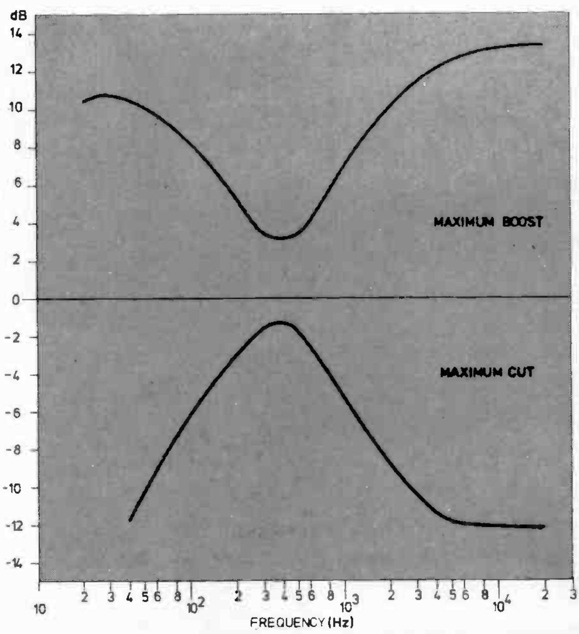
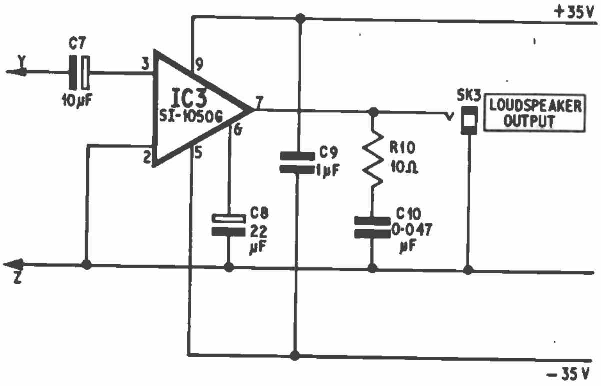



**Fig. 2. Tone control characteristics**



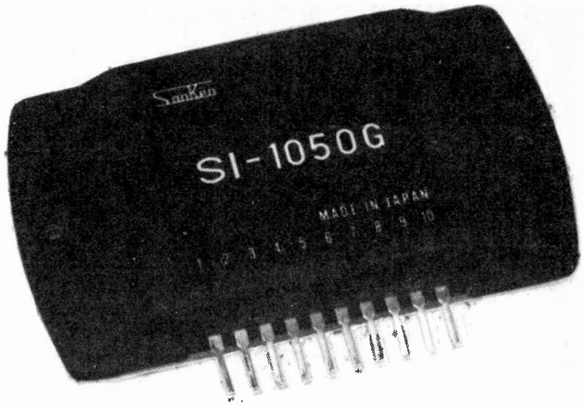




**Fig. 3. Output stage details**

and cut of treble and bass frequencies, the degree of boost or cut depending on the angle of rotation of the controls. The performance of these controls was designed to suit the requirements of guitarists and is depicted in Fig. 2.

## POWER AMPLIFIER

The power amplifier section consists of a hybrid integrated circuit (IC3) type SI-1050G which can be operated with either a single or double-sided power supply system. In this particular application a double-sided supply is employed thereby reducing the number of external components. The power output stage section is shown in Fig. 3.

Input is via d.c. blocking capacitor C7 to pin 3 of IC3. Capacitor C8 determines the lower roll-off frequency while C9 reduces the possibility of high frequency oscillation. The output (pin 7) is taken to a standard jack socket to enable a loudspeaker (8 ohms) to be connected. If one wishes to use a pair of loudspeakers, SK3 should be replaced by a pair of jack sockets wired (i) in parallel, if they are 15 ohm speakers or (ii) in series, if they are 4 ohm speakers. On no account should the total speaker load be less than (i) above. Components R10 and C10 across the output form a Zobell network.

The SI-1050G has built-in current sensing protection to prevent internal damage in the event of the output being shorted. The i.c. is robustly encapsulated with in-line connection pins clearly marked.

A heatsink is necessary for satisfactory operation and results, and in the prototype, the chassis was constructed of sufficient volume of aluminium to comply with the recommended heat-sinking and thus forms the heat sink.

## POWER SUPPLY

The power supply circuit diagram is shown in Fig. 4 and is a conventional mains derived unstabilised type. Mains voltage is stepped down at T1 with the centre-tapped secondary being followed by bridge rectifier D3 to D6 giving full-wave rectification for both negative and positive supply rails. Smoothing for each rail is accomplished by means of two 2,000μF capacitors wired in parallel giving a net value of 4,000μF. This was found adequate for satisfactory results.

The positive and negative supplies for the pre-amplifier section are derived from the power amplifier supplies by Zener diodes D1 and D2 and associated series resistors. Additional smoothing is afforded by capacitors C11 and C12.

**Next Month: Wiring details and case construction**

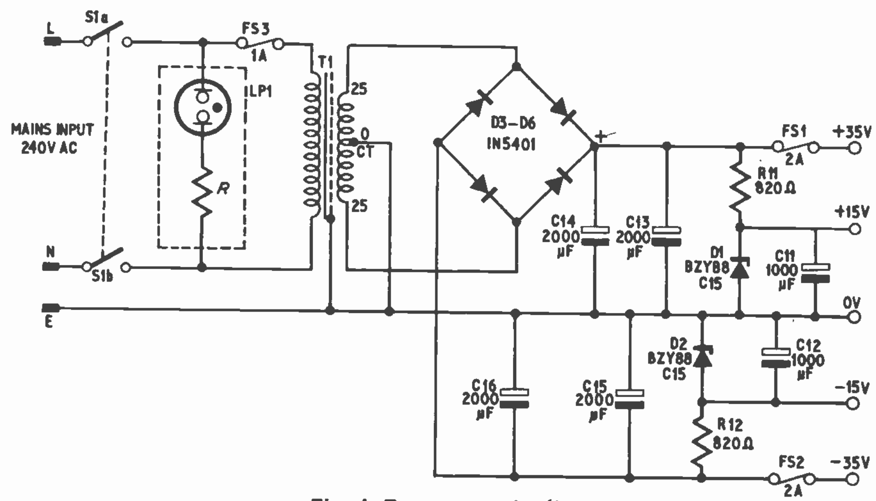



**Fig. 4. Power supply circuit**

# UNIVERSAL THERMOSTAT

By R. A. DIX

## A versatile thermostat with a multiplicity of applications

MANY applications can be found in the home and elsewhere, for a cheap, simple thermostat. These range from beer and wine brewing to amateur photography, from tropical fish tank temperature control to room temperature control; the list is endless.

### OPERATION

From the block diagram in Fig. 1 it can be seen that the unit consists of a power supply, a level detector and an output stage. The power supply provides smoothed and regulated +12V and −6V rails.

The detector is constructed round a comparator i.c. (the 710 OPA) one of whose inputs is connected to the thermistor, the other to a reference voltage derived from the negative supply line.

### CIRCUIT

The circuit diagram is shown in Fig. 2. The thermistor R7 has a resistance that varies with temperature which causes a voltage change proportional to temperature to appear at the inverting input of the comparator. The voltage on the non-inverting input of the i.c. is preset with VR1. The comparator output goes high causing the relay RLA1 to switch on via TR3, when the voltage across the thermistor drops below that preset by VR1.

The relay is arranged to switch on a heater (the type of heater will depend upon the application). Accurate temperature control can be achieved in this fashion.

In fact, control to within 0·01 degrees centrigrade is possible if very low thermal differentials between the heating element, the material to be heated and the thermistor, are maintained.

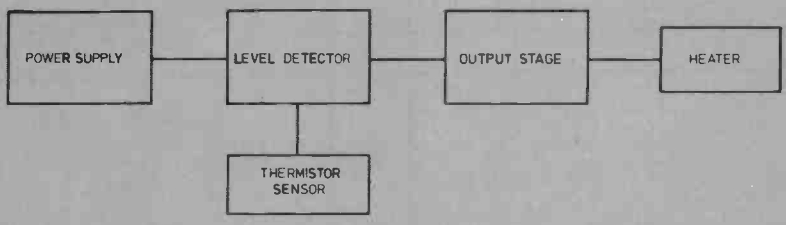



**Fig. 1. Block diagram of the Thermostat unit**

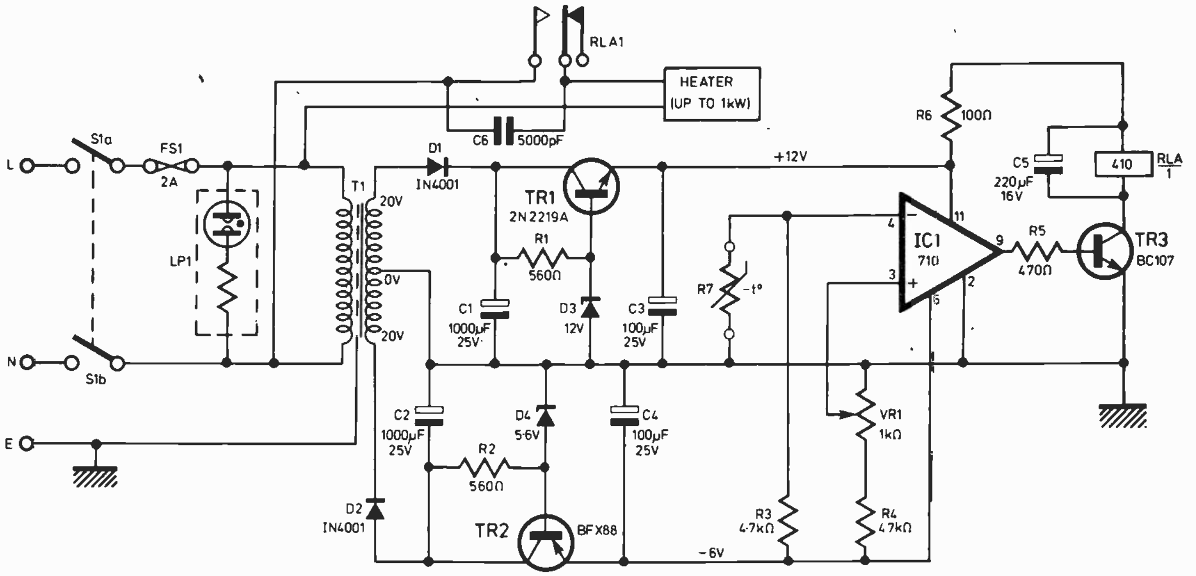



**Fig. 2. Circuit diagram. Note that C6 is connected directly across the relay contacts**

## CONSTRUCTION

The printed circuit master and component layout is shown in Fig. 3. Circuit layout and cabinet are not critical, nor is any screened lead necessary. Heat sinks are not required for the 2N2219A or the BFX88 under normal conditions.

# COMPONENTS . . .

**Resistors**

| | |
|---|---|
| R1–2 | 560Ω ¼W |
| R3–4 | 4·7kΩ |
| R5 | 470Ω |
| R6 | 100Ω |
| R7 | TH-B15 (RS Components) |

All resistors ¼W 10% unless otherwise stated.

**Potentiometer**

| | |
|---|---|
| VR1 | 1kΩ lin |

**Capacitors**

| | |
|---|---|
| C1–2 | 1,000μF 25V elect. |
| C3–4 | 100μF 25V elect. |
| C5 | 220μF 16V elect. |
| C6 | 5,000pF 400 V Ceramic |

**Semiconductors**

| | |
|---|---|
| D1–2 | IN 4001 |
| D3 | 12V 400mW Zener diode |
| D4 | 5·6V 400mW Zener diode |
| IC1 | 710 OPA (RS Components) |
| TR1 | 2N2219A |
| TR2 | BFX88 |
| TR3 | BC107 |

**Miscellaneous**

| | |
|---|---|
| T1 | 20–0–20 to 240V Min. mains (RS Components) |
| RLA1 | Type 912 (RS Components) |

## CALIBRATION

Calibration of the unit is straightforward. A scale can be fitted to the unit and calibrated in degrees against a fairly accurate thermometer (say with subdivisions of 0·1 degrees). One must remember however, that to obtain really accurate temperature control adequate stirring and thermal feedback must be obtained (i.e. fans or automatic stirrers must be employed to ensure good heat circulation). Of course, if the reader wishes to heat a fish-tank it is obvious he cannot fit a stirrer, but in this case the temperature need only be controlled to say ±0·5 degrees and the water filter pump will probably create sufficient turbulence to achieve this.

## BREWING

The optimum point for thermal feedback can be found by experimentation, the heater should cycle once every few seconds or even faster if possible.

A 200W bulb will suffice as a heating element in a brewing cabinet, and the best point for the thermistor was found to be about two inches below the lamp. The heater then cycles at about 1Hz.

## INVERSE OPERATION

The unit (as shown in the circuit) is wired to switch off a load when the temperature reaches a pre-set value. For some applications however, the opposite is required, i.e. that the thermostat switches on at a certain temperature.

This can be accomplished in two ways. In the first, one merely uses the normally closed contacts of the relay rather than the normally open ones. The other method requires changing over the operation of the comparator by rewiring it such that all connections to the non-inverting input now go to

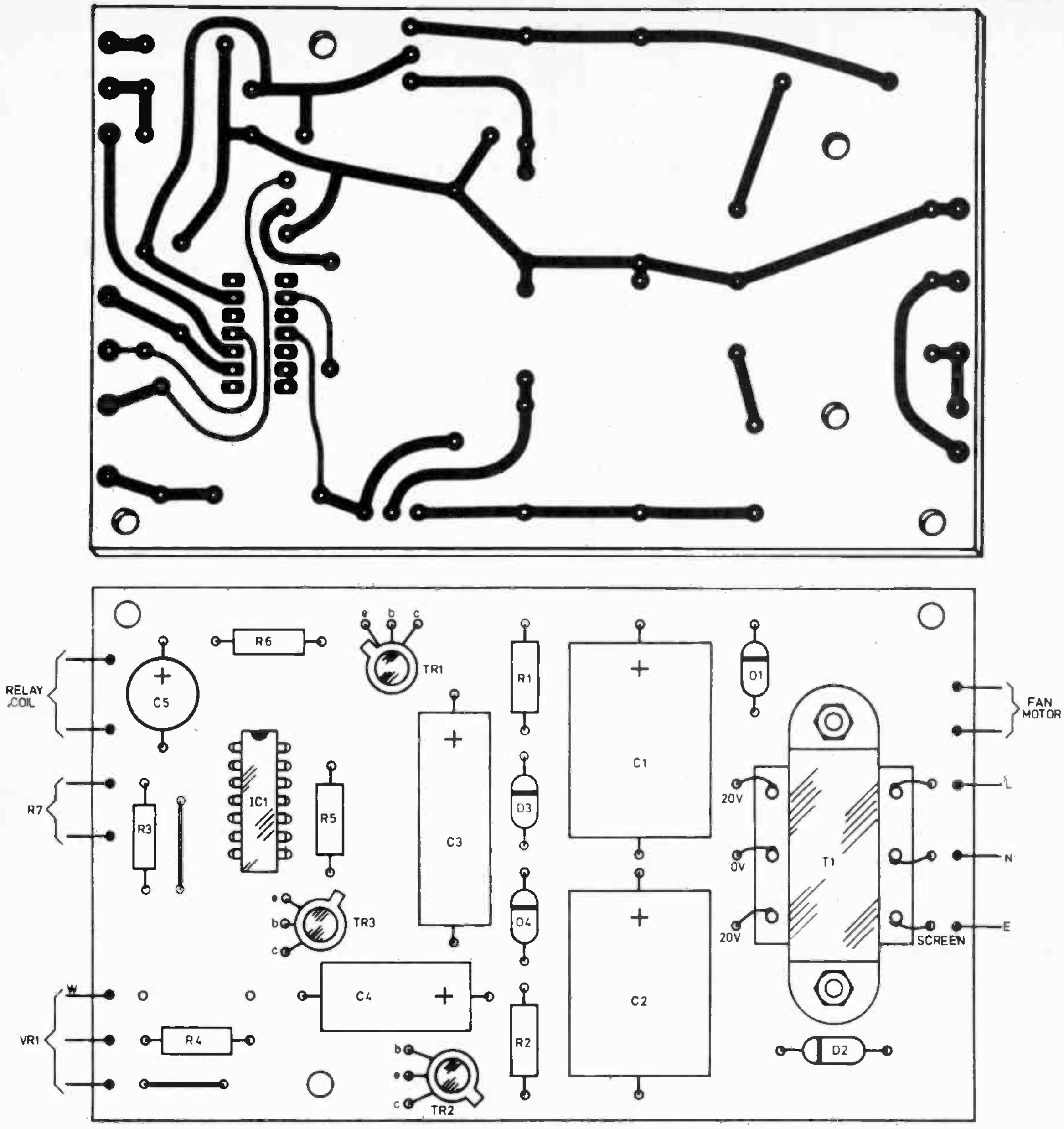



**Fig. 3. Printed circuit board layout and master**

the inverting input, and those originally on the inverting input now go to the non-inverting input. The same relay contacts are used in this instance.

This will result in the comparator turning on the relay when the temperature has risen to the pre-set value. Applications for this arrangement include overtemperature detection, fire detection etc.

## RANGE

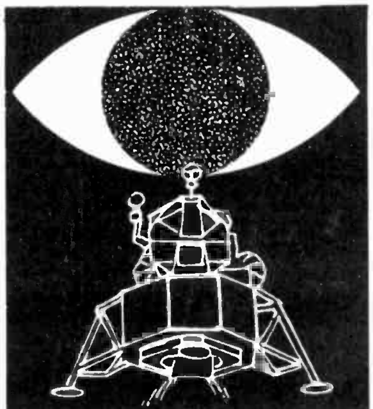
The range of the unit can be increased from approximately 0 to 100° degrees to about 15 to 160° degrees by replacing VR1 with a 5kΩ potentiometer. Increasing the value further increases the temperature range, but it is not recommended to go above about 250° degrees centrigade. ★

## POINTS ARISING

**ENVELOPE SHAPER** *(October 1975)*
Pin 7 of IC1 (741) should be connected to S2b and pin 4 to S2a. On Fig. 3 the third Vero strip from the top is connected to S2b and not to B1−.

**LIGHT MODULATION UNIT** *(October 1975)*
There should be no reference to Fig. 3 on page 831.

**P.E. TUNING FORK** *(November 1975)*
We should like to thank Chappell's of New Bond St., for use of the Piano depicted on our November 1975 front cover.



# SPACEWATCH

BY FRANK W. HYDE

## NEW NOVA

The northern sky has a new look for there is a bright new star where a faint one existed before. This nova, now named after its discoverer the Japanese amateur astronomer Honda, appears a little removed from the bright star Deneb in Cygnus. The new star is easily visible to the naked eye and David Strickland at Herstmonceux has been observing the nova with the Isaac Newton telescope. There are emission lines in the spectra and also some absorption lines. This indicates that there may be a shell of plasma moving away from the star at a speed of several thousand kilometres a second.

It is unfortunate that very few novae have been observed using spectroscopic techniques during the brightening period. The data now being gathered, does not have much past data with which to compare. However, at the moment Dr Strickland is trying to determine whether the nova is consuming part of itself and thus making it a true nova, or if it is the result of a vast explosion making it a supernova and perhaps leaving a neutron star to mark its place.

## IS THIS THE BLACK HOLE DISCOVERED?

The X-ray star that flared up on August 3 may well be associated with a condensed star. Professor Pounds, whose group at Leicester discovered the X-ray source, thinks that the now steady emmission of X-rays comes from the impinging of matter on a star that is already condensed to its limit.

It is possible that it is only 300 parsecs away, but it is much more likely to be three or four times that distance. If this should be so, then the energy would indicate that the central object is indeed a black hole.

The object was identified optically by two graduate students at Kitt Peak, Arizona, using the 56in telescope. The final exact positions were determined by the X-ray satellites *SAS 3* and *Ariel 5*. Jodrell Bank located the radio source on August 18 but this soon began to fade though the X-ray energy continued undiminished. It is important to know the distance and if the rate at which the energy is emitted can be determined, the distance can be calculated.

## STORM ON JUPITER

A small white spot appeared on the South Equatorial belt of Jupiter during the first days of July. The disturbance moved southwards and on July 5 it was at 15° South latitude. By July 7 photographs showed that it was extending eastwards in longitude.

These disturbances have occurred a number of times in the last 50 years or so. Such disturbances are not properly understood but it may be that they are associated in some way with the areas of high thermal emission low down in the planet's atmosphere.

Normally these disturbances last about two months during which time the whole belt is transformed. This should give ample time for amateurs to watch the everchanging conditions.

## TUNGUS METEORITE AGAIN

Following the report that Soviet scientists had located the possible line of flight of the Tungus catastrophe of 1908, the data now being studied suggests that it was a cometary body.

The two scientists studying the data, Academician Georgi Terov and Dr Vladimir Stulov, are now convinced that the body could not be an iron or stone meteorite. This is based on the findings by previous investigators which showed that there were no craters in the impact areas.

Although it has been stated before that the area is a very marshy one and therefore unlikely to maintain rigid craters, it has also been pointed out that the pre-impact explosion would have produced very small particles as the remains of a nucleous of some sort. That the explosion took place before any impactation is now recognised by the majority of workers. This would result in an extremely violent shock wave quite able to cause the widespread devastation that has been a feature of this event.

The two scientists have now reached a quite definite conclusion about the event. The model they have created is that of a body of snow or ice about 300 metres radius with a density not less than a hundredth of a gramme per cubic centimetre. This entered the denser layers of the Earth's atmosphere at a great initial velocity at a specific angle to the horizon.

The ice ball moved down through the atmosphere quite intact till it reached the altitude of between 40 and 60 kilometres, though the frontal surface was already melting and vapourising due to the friction of the air. Due to the braking effect of the atmosphere the rate of evaporation increased sharply and resulted in the formation of a gaseous cloud of intense pressure which increased the effect of braking still further.

The frontal wave continued carrying with it the heated air and at an altitude of about 10 kilometres the main body evaporated and dissipated the remaining kinetic energy in the surrounding atmosphere. The ongoing pressure wave would be sufficient to cause the damage observed, and leave no physical part of itself.

This model agreeing, as it does, with present thinking about cometary nuclei, does perhaps in fact add practical proof to that hypothesis.

## MOON SATELLITE

The Russian *Luna-22* orbiting sub-satellite has been in orbit round the Moon for 18 months actively transmitting data back to Earth.

At the end of August the trajectory was modified so that the peri-centre of the orbit was brought to within 30 kilometres of the Moon's surface to enable a special programme of observations to be carried out. When the experiments were completed the satellite was put into its present orbit of a 3 hour period at a perigee of 100 kilometres, an apogee of 1,286 kilometres and an inclination to the Moon's equator of 21 degrees.

## MAGNETIC REVERSAL DATE

It has been generally accepted that the reversal of the Earth's magnetic field takes place at intervals of about 100,000 years. This being the case the effect on mankind of such events was negligible. However, some recent finds suggested that one may have occurred within 20,000 years.

An even more exciting find under the Gothenburg botanical gardens gave a date of 12,000 years. This was not accepted by many earth scientists. It was found that readings taken at a number of different sites gave confirmation of the time period. Now finally a core taken from the southern part of the Atlantic Ocean floor has been confirmed at 12,350 years.

# SEMICONDUCTOR UPDATE... By R.W. COLES

MC1445
CA311
5082–4732
ZN424

## TON-UP TIMERS

Within the 4000 series of c.m.o.s. devices manufacturers secondsource each other to a large extent but when it comes to the "complex-function" series of devices there seems to be a trend towards manufacturers "doing their own thing", and in consequence, lots of interesting new designs are appearing, particularly in the Motorola McMOS family.

An example of an interesting "off-beat" complex function device is the **MC1445** quad precision timer/driver which consists of four separate divide-by-100 counters driven from a common clock, each with separate set inputs and driver output stages.

The divide-by-100 counters are not conventional since they are not directly accessible to the outside world, their purpose being to generate time delays synchronised to the main clock and thus to each other. Typically, the clock would run continuously, and could be provided by any source with a frequency of up to 1MHz. The four outputs start from the reset (low) state, but are driven high by a set input to their associated counter. The output remains high until the counter has counted 100 clock pulses, whereupon it is reset.

The object of the exercise is to generate long output pulses which are each 100 times longer than the clock period, although each pulse can be initiated independently and at any time. Extra inputs are provided to modify the starting logic of the count stages and to inhibit the outputs, giving a total of four possible modes of operation in all.

The chip is housed in a 16-pin d.i.l. and could be useful for generating accurate, synchronous time intervals, particularly in control systems.

## SNAPPY L.E.D.

If you take a comparator i.c. and connect an l.e.d. to its output and a reference potential to one of its inputs, you have the makings of a very useful voltage or current sensor. All you have to do is connect the second input of the comparator to the voltage line to be sensed, and then whenever this voltage rises above the reference potential the l.e.d. will snap on, and whenever it falls below the reference the l.e.d will snap off.

If the sensed voltage is developed across a resistor by a *current* source, then the indicator can detect increases in current above some threshold set by the value of the resistor.

A simple snap-on snap-off indicator of this type can be used for "press-to-test" battery condition indication, power supply current-overload indication, and can, in many cases, replace meters where a simple go/no-go type display is sufficient.

Well, now that I have convinced you about what a useful little circuit you can build with one comparator i.c., one l.e.d., one Zener reference, assorted resistors and perhaps a piece of Veroboard, you will no doubt be interested in my next offering, the Hewlett-Packard **5082-4732** which stuffs the whole shooting-match into a single, standard, T1 l.e.d. package with two terminals!

As it comes the 4732 has a fixed threshold voltage of about 2·5V and is ready for insertion into a display panel in standard l.e.d. fashion. For many voltage sensing applications it will be desirable to alter the 2·5V threshold to some other value, and this can be achieved by connecting a Zener, a forward biased diode, or a preset potentiometer in series. There is no need for the current limiting resistor usually mandatory for l.e.d. lamps, since the 4732 has a built in current source.

As far as I can see at the moment, only red devices are available, but no doubt green and yellow will follow, because this is a device with a bright future!

## COMPARATIVELY SPEAKING

Speaking of comparators, if you feel you really would like a "snappy l.e.d." circuit, but don't fancy the idea of having Hewlett-Packard make all the interesting bits, you might be interested in the RCA **CA311**.

This device is a very handy comparator circuit in a TO5 can which is useful for all sorts of things, as can be seen in the data sheet where no fewer than *sixteen* applications examples are recorded (No "snappy l.e.d.s" though!).

The CA311 is interesting because it doesn't seem to have been optimised for computer-memory applications like so many of its cousins. With this chip you get a really "beefy" output stage which can switch currents of up to 50mA at 50V, making relay and lamp driving no problem at all. Add to this a 200ns response time and the ability to work from a wide range of supplies right down to a single 5V logic line, and you can see that this is a useful general purpose device to have around.

## HI-FI GAIN

741's are great. At the price, there can't be many better bargains around, but 741's and similar operational amplifier i.c.s. do have limitations for some applications. The sheer number of transistors in a 741 results in a fairly high noise figure, and the class-B output stage can introduce a certain amount of distortion.

If those sort of things worry you at all, the new Ferranti **ZN424** might enable you to catch up on some sleep, because it has a low distortion class-A output stage, and a creditably low noise figure making it ideal for use in critical audio applications.

The data sheet on this new i.c. carefully avoids the words "Operational-Amplifier" but despite its various novel features, Operational Amplifier is how most people would describe it! It's un-741-like circuit boasts an ability to work from only a 5V logic supply if required, and includes a very interesting gating circuit which makes it possible to inhibit the output of the chip by controlling the gate input.

The gating facility could come in handy in synthesiser-type circuits when it might be useful, for instance, to connect the outputs of several ZN424's together to form a sort of "analogue bus" with audio signals being gated on or off the bus by means of a counter or shift register controlling the gate inputs.

I think that this new device makes a refreshing addition to the "old-faithful" op-amp. ranges, and with a one-off price of £1·20 (in the 14-pin plastic package) we could be seeing a lot more of this device, especially in hi-fi and music circuits.


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. Any idea published will be awarded payment according to its merits. Why not submit YOUR IDEA?

## MULTI PURPOSE OSCILLATOR

An oscillator whose function is determined by the value of C1 is shown in Fig. 1. Low values (0·02$\mu$F) produce oscillations in the audio range, whilst higher values (2–10$\mu$F) cause it to work as a metronome. VR1 adjusts the frequency of oscillation. The transistor used can be almost any *pnp* type and the transformer any output type with a centre-tapped primary (such as those used in transistor radio output stages).

Operation of the circuit is as follows: C1 charges via VR1 until TR1 turns on. This causes a short pulse to appear across the speaker producing a sound similar to the characteristic metronome "click" (when operated as a metronome). As C1 is reduced the clicks become closer and closer together until the unit operates at audio frequencies.

A. R. Winstanley,
S. Humberside.

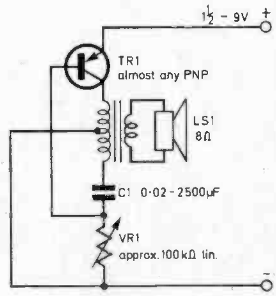



**Fig. 1**

## V.C.O. PROGRAMMER

This device (Fig. 1) can be plugged into the external control input of a v.c.o. and a 16-note melody produced.

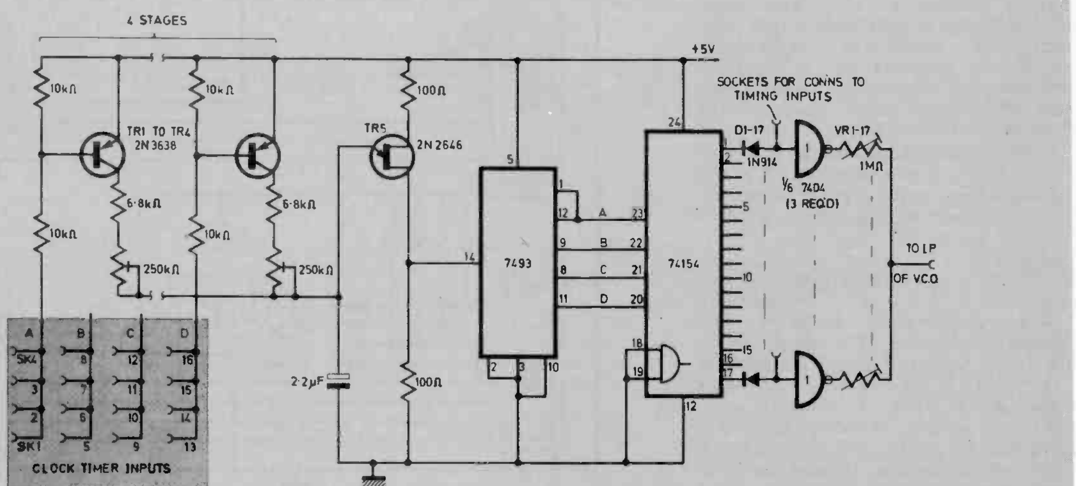
It consists of a unijunction clock pulse generator (TR5) with a variable pulse length feeding, counting and decoding circuitry.

The 7493 four-bit binary counter (IC1) counts the clock pulses and sends a binary output after each pulse to the decoder. The 16-line decoder SN74154 (IC2) sends a 0V pulse from each output in turn. After an output from pin 17, the sequence will be repeated.

Sixteen jumpers are required in all to connect each output from the decoder to the input of the clock timer. The pulse from pin 1, when connected to the clock timer, will set the pulse length for the output of pin 2. Four different pulse lengths are provided for, but more or less can be used.

The outputs from the decoder are each taken via a diode to a socket for correction, to the timing circuits. The diode is needed to isolate each output from the others. This is then taken to an inverter to obtain a +5V output for trimming (0–5V) by the preset potentiometers.

J. Stott, Manchester



## SIMPLE UP-DOWN COUNTER

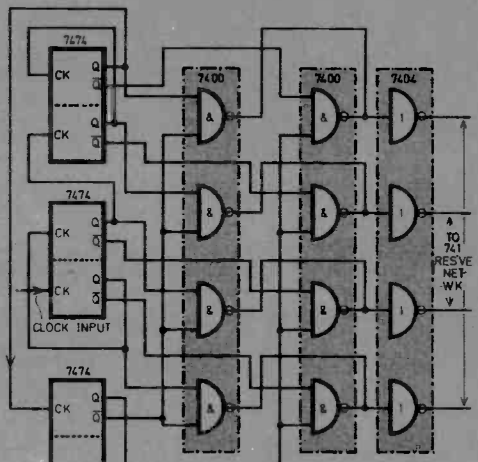



Fig. 1

THE counter consists of four flip-flops whose Q and $\bar{Q}$ outputs are utilised to give a complete cycle in 30 counts. After 15 counts the Q output of the last divider switches a flip-flop whose Q and $\bar{Q}$ outputs gate four NAND gates each.

The second input of the NAND gates are fed from the counter. Therefore when 15 is reached one NAND is closed off and the other opened and the count proceeds in the opposite direction, i.e. 15-0. When the counter again reaches 15 the switch is changed over and the counter counts up again.

Each complete cycle appears on a 7404 which in turn is connected to the D/A converter which will then produce a variable slope triangular waveform. The clock which drives the counter can be quite slow and divided down further; each divide circuit output driving a separate counter. If each output is connected to a lamp drive circuit, although synchronous, the lamps appear to brighten and dim at random.

P. A. Durrant, Chester

## CLOCK MOD

READERS who built the P.E. Digital Clock (December, 1970) may be interested in the following modification to the alarm circuit. The original circuit lacked alarm operation from 10.00 o'clock to 10.50. This modification gives alarm operation over the full day, and can be built as a part of the thumbwheel switches with no modification to the rest of the circuit.

When the 1's of hours counter indicates zero in the display, its binary output is 1001 and when IC16 in the alarm comparator adds one to this, the binary code becomes 1010. To produce the 1111 code to trigger the alarm, the thumbwheel for the 1's of hours must produce a code of 0101. That is:

1001 From 1's hours counter
+1 $C_{in}$ hours comparator = 1
+0101 Required 1's hour thumbwheel switch output when set to "0"

1111 Output from hours comparator.

The thumbwheel, however, produces a code of 1111 when set to 0. The solution is to detect the 1111 code from the switch and then change it to 0101. Fortunately common BCD1248 thumbwheels have two sets of output contacts; normal and complemented. I used the complemented outputs to detect the 0 state—refer to circuit diagram. When set to 0, the complemented outputs are grounded via the common terminal. This turns TR1 off and enables TR2 and TR3 to ground the 8 and 2 outputs of the thumbwheel producing the required 0101 code. For all other thumbwheel positions, TR1 is turned on by current flowing through at least one of the R1–R4 and D1–D4.

I have had a slight problem with mains-borne interference causing the clock to gain slightly. This has been solved by connecting a 0·5µF capacitor (polycarbonate 250V) across the secondary winding of the transformer supplying the 5V regulator and doing the same for the winding supplying 6·3V 50Hz to the main clock board.

A. J. Roxburgh,
Dunedin, N.Z.

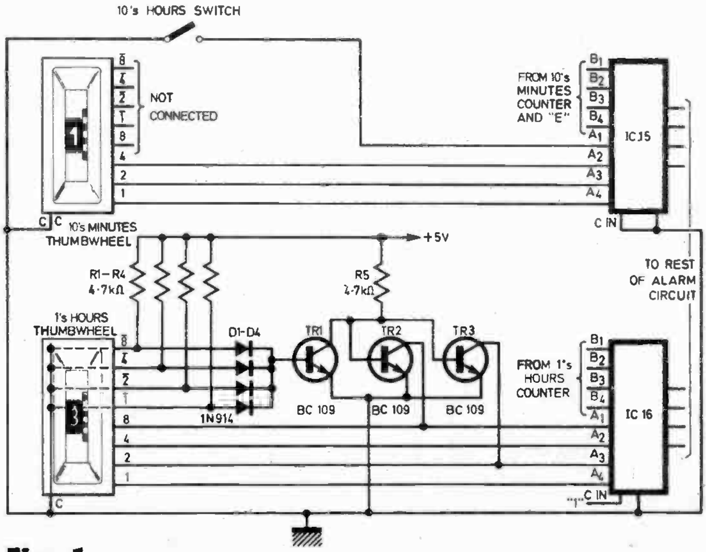
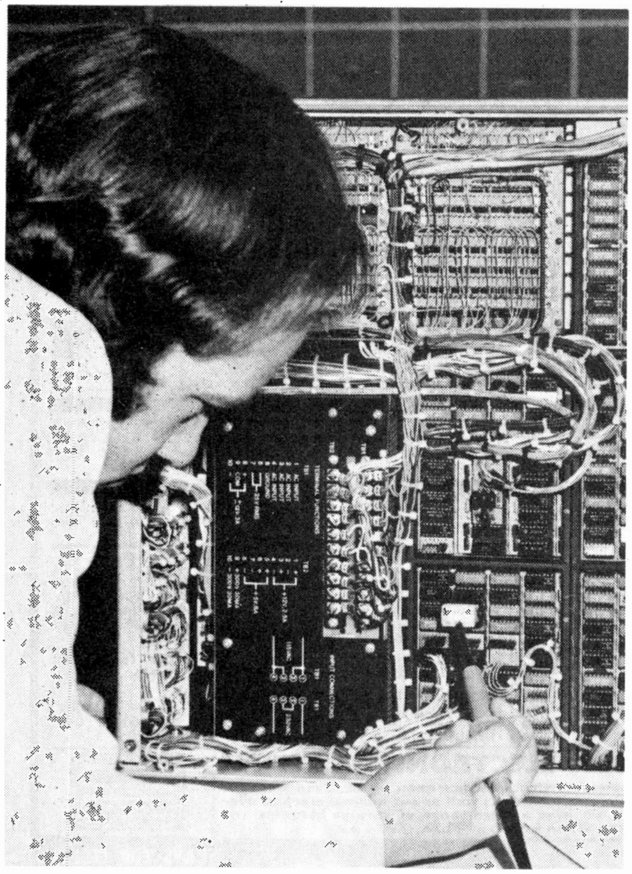



Fig. 1



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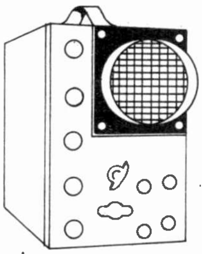

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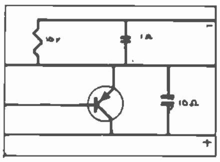

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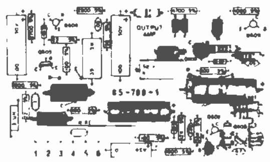

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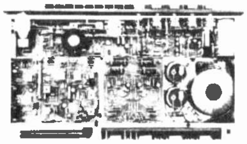

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FLASHING lamps are a popular form of display for Christmas trees, shop windows and the like. It is usual to employ some kind of thermal device to generate the switching action; this may consist of a special bulb or a separate unit. In either case, the heating of a bimetal strip, caused by the passage of lamp current, forces it to bend, so breaking a contact and switching off the lamps. Subsequent cooling allows the contact to make again after a short interval, and the cycle repeats.

The disadvantages of such a method of flashing lamps are fairly obvious. It is unreliable, the contact tending to stick closed or not open properly; interference is caused whenever the contact makes or breaks; the rate of flashing is either fixed or depends on the rating of the load; and, in the case of the special bulb, spares can be difficult to obtain and in any case, only the lamps for which it is intended can be controlled effectively.

A solid state unit is described here that suffers from none of these drawbacks and has, as a bonus, some advantages of its own. These are a flash rate that not only is under the control of the user but has the appearance of being random. It is not strictly so, in point of fact, but with careful adjustment is is possible to obtain a sequence of flashing that would require close monitoring to detect repetitions—and that is hardly likely in the situations in which the unit will be used.

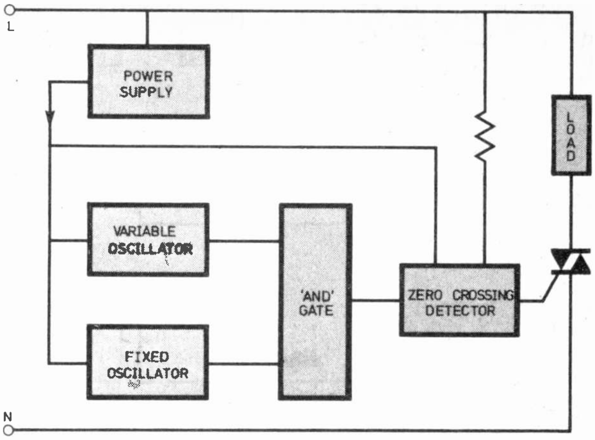
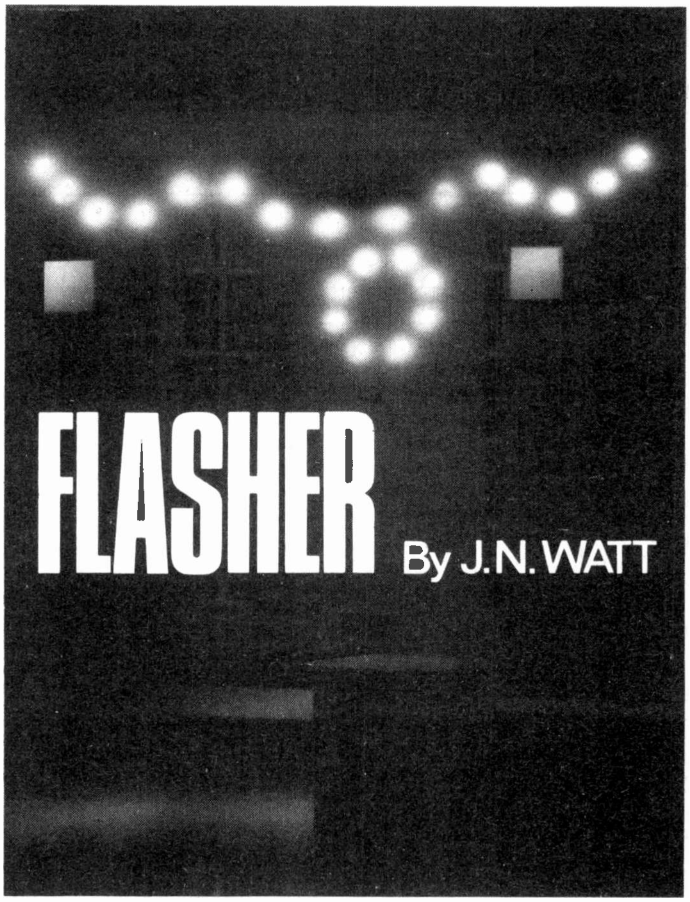



**Fig. 1. Block diagram of the Flasher**

## BLOCK DIAGRAM

Fig. 1 shows a block diagram of the Flasher. There are two oscillators; one runs at a set frequency, the other is adjustable in frequency and mark-space ratio. Their outputs are fed to an AND gate, which will either inhibit or permit the zero crossing circuit to pass pulses to the triac. These pulses occur at a rate of 100Hz, and coincide with zero crossing of

# CHRISTMAS LIGHTS FLASHER



By J.N. WATT

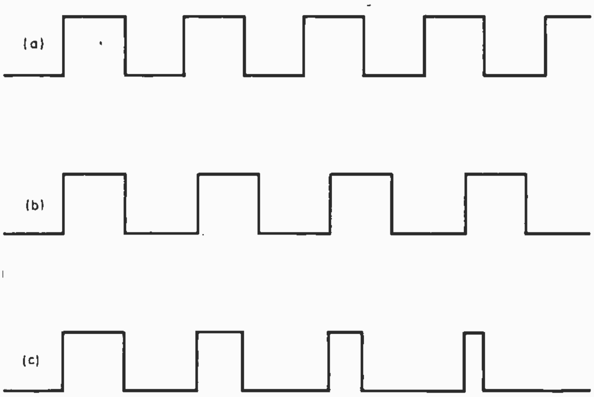



**Fig. 2. Timing waveforms. (a) first oscillator; (b) second oscillator and (c) output of an AND gate with (a) and (b) applied**

the mains voltage waveform. They switch on the triac so that it passes full power to the load: when the pulses are inhibited, no power is passed. Since the switching on of the triac always takes place at close to mains zero crossing, no interference is caused.

It is the use of two oscillators and an AND gate that generates the pseudo-random flashing, and this can be explained by reference to the timing diagram of Fig. 2.

## WAVESHAPES

Waveform (a) represents the output of an oscillator with equal on and off timing, while (b) similarly represents a second oscillator with unequal timings and which also runs at a slightly lower rate. The overall effect of applying each of these waveforms to one input of a two input AND gate is to generate the waveform (c). It can be seen that the latter voltage goes high whenever both (a) and (b) are high; when either or both are low, (c) is low.

Due to the relative timings of the two input waveforms, it will be many cycles before a repetition occurs in (c), and for present purposes it can be considered random. In the present application, when the waveform (c) is high, the display lamps are on.

## CIRCUIT DIAGRAM

A single CMOS integrated circuit is employed for the two oscillators. The particular device chosen, a CD4011, consists of four, two input, NAND gates in a single dual-in-line package; each oscillator employs two NAND gates.

The first oscillator is of fixed duration and utilises gates G1 and G2 in an astable configuration. In many ways the operation of the circuit is similar to a transistor multivibrator, with each gate corresponding to a single transistor, for each of them is an inverting amplifier. Imagine that, at switch on, G1 output is high (that is, at positive rail voltage), and therefore the output of G2 is low (at negative rail voltage). Capacitor C1 charges through R1 until its voltage is high enough for the inputs of G1 to cause that gate's output to change rapidly to the low state. Now C1 charges through R1 with opposite polarity until G1 can switch back again to a high condition at its output. The cycle then repeats.

The second oscillator is basically of the same general configuration, but with a different arrangement for the charging resistor. Part of the total resistance is shunted by a diode, so that when current is flowing in one direction during one half cycle, diode D1 is forward biased and R2 makes no contribution to the charge time of C2. During the

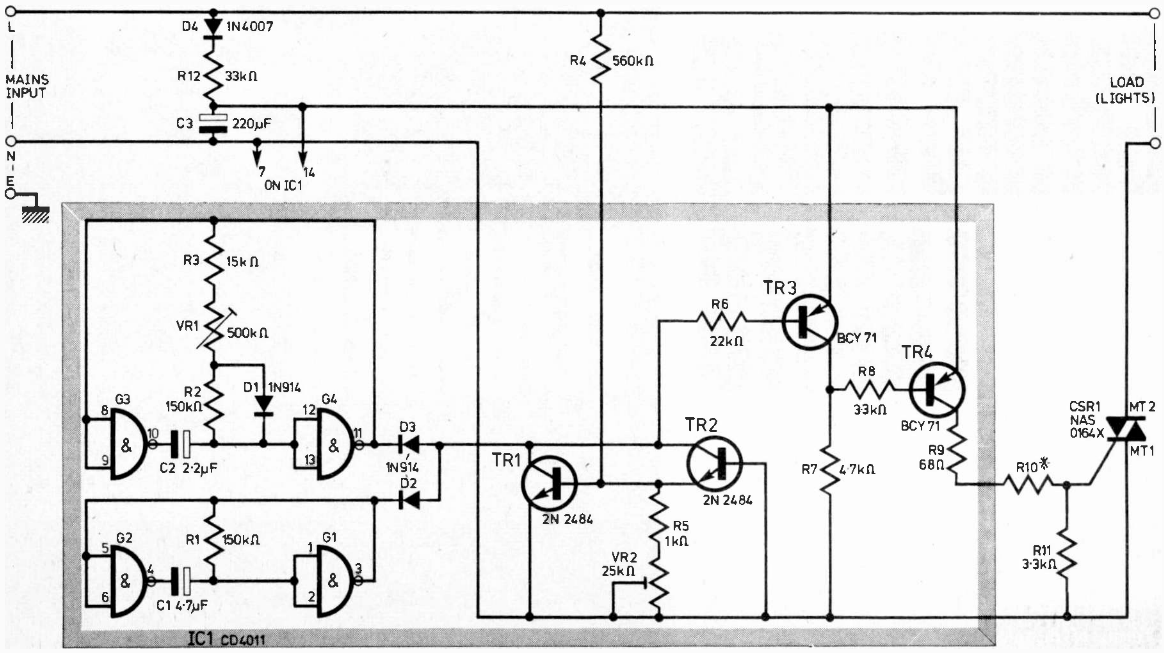



**Fig. 3. Circuit diagram of the Christmas Lights Flasher. The shaded area encloses components on the circuit board**

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| AD149 | 45p | BC137 | 20p | *BC321 | 14p | BCY21 | 62p | BD195 | 56p |
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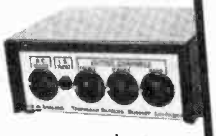

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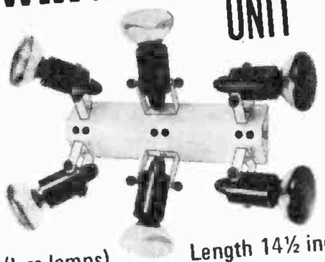

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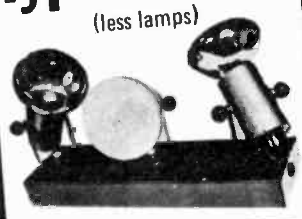

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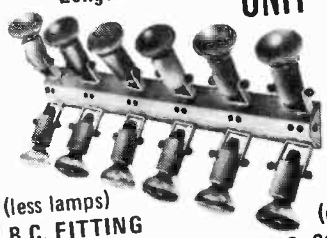

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## ZERO CROSSOVER

It is when the outputs of both oscillators are high that the remainder of the circuit comes into operation. The resistor chain consisting of R4, R5 and VR2 is across the mains supply. Whenever the voltage at the lower end of R4 is more positive than the neutral line by about 0·7 volt, TR1 base-emitter junction is forward biased and so TR1 becomes conductive. Similarly, when the lower end of R4 is more negative than the neutral line by about 0·7 volt, TR2 becomes conductive. While either TR1 or TR2 conduct for most of the time, neither does so whenever line and neutral voltages are almost equal. Such a situation occurs only close to zero crossing of the mains supply and the effect is to switch TR3 to its non-conducting state during that time. At times far removed from zero crossing, with either TR1 or TR2 conducting, TR3 rapidly switches to its conducting state also. Thus a train of pulses appears at TR3 collector, each pulse starting just before the mains zero crossing and ending just after. The actual width of each pulse is determined by the setting of VR2, which varies the proportion of mains voltage actually applied to TR1 and TR2.

## TRIAC DRIVER

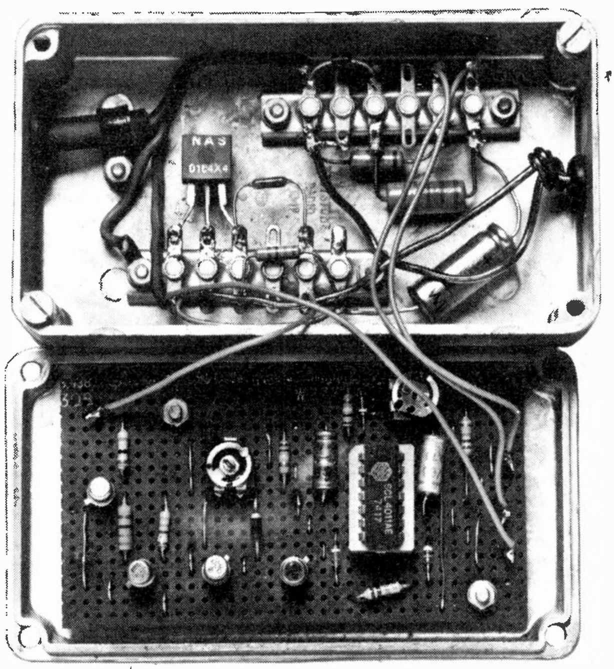
Since the pulses present at TR3 collector are not of the desired polarity and are also at too high an impedance, a further stage of amplification, TR4 is included. Whenever TR4 is switched to its low impedance state by a pulse from TR3, the effect is to inject a current pulse into the triac gate at a time close to mains zero crossing, so causing it to conduct.

The triac, once conducting, continues to do so until the end of the mains half cycle. If a further pulse is present at its gate at next zero crossing, then it continues to conduct for the next half cycle, and so on. If no such pulse occurs, then triac conduction ceases. Note that both start and finish of triac conduction, and hence of load current flowing, always take place very close to mains zero crossing, so that by using the circuit described here, interference to radio and TV is eliminated.

Should the output of either oscillator be low at any particular zero crossing, then the corresponding diode in the AND gate, D2 or D3, will conduct, so preventing the operation of the zero crossing detector. Thus both oscillator outputs need to be high for the triac to switch on.

The transistors specified for TR1 and TR2 are a high gain type to ensure that, despite the low level of base-emitter current provided by the large value resistor R4, sufficient collector current flows into the base of TR3 to ensure reliable circuit operation.

Resistor R4 is quoted as being of ¾ watt rating; such a power rating is required, not because that level of dissipation is present, but because the greatest voltage it is possible to apply to lower power resistors is less than the voltage present here.



Resistor R11 merely serves to provide a continuous d.c. path between gate and the appropriate main terminal of the triac and serves no other part in circuit operation.

## PROVIDING A SUPPLY

The inherent low power consumption of CMOS i.c.s is used to advantage in the design of the flasher. Since we are faced with the problem of providing low voltage supplies in an item of mains driven equipment, two alternatives are available.

Firstly, a transformer could be used. Now, the total current consumption of all the circuitry present is only 3mA. A suitable transformer would in fact probably have a 50mA secondary and would be almost as large as, and far heavier than, the remainder of the components employed. The alternative of a series résistive dropper is attractive, especially since one side of the output is necessarily connected to one side of the mains in any case. It is this second method that is used here. The total power wasted in the series dropper R12 is about ½ watt. (It is difficult to measure or calculate this accurately due to the very distorted waveforms present.)

It is not only the use of CMOS that contributes to the low power dissipation, for the employment of pulses to gate on the triac in place of wasteful d.c. reduces the power consumption at that point to about 10 per cent of what it might otherwise have been.

## SMOOTHING

Very simple supply rail smoothing is all that is required, and due to the large contribution made to the relevant time constant by R12 being so large, C3 is correspondingly smaller than usual. The hum level is about 80mV but this is of little importance.

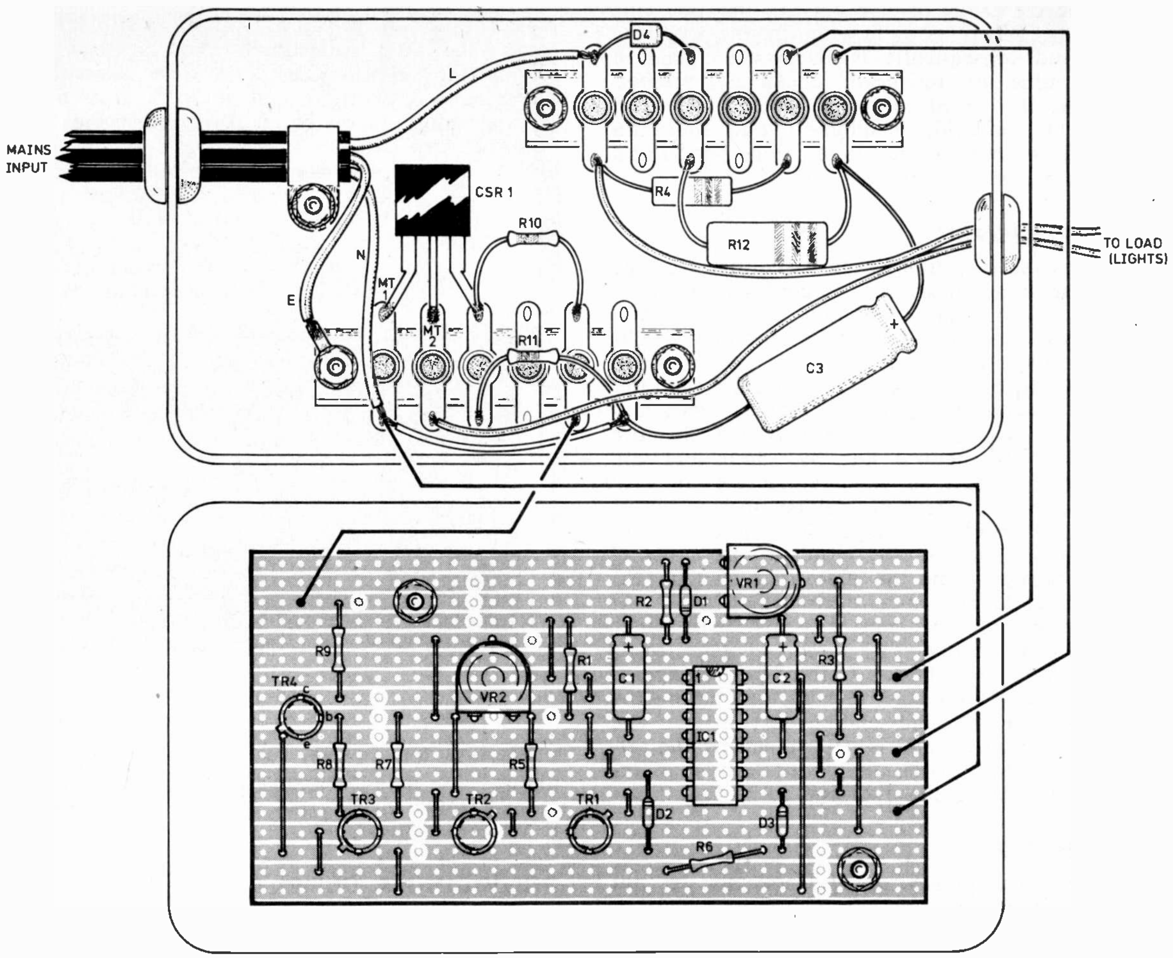



**Fig. 4. Circuit board assembly and peripheral wiring**

The values of the capacitors and resistors used in the oscillators gave, in the prototype, about 35 flashes in 30 seconds, with the exact rate depending on the setting of VR1. However, it should be remembered that the tolerance on the value of electrolytic capacitors is very large and consequently it may be that such a rate of flashing will not be repeated in units made elsewhere. Further, readers may care to alter the flash rate to suit individual requirements and for this it is suggested that a little experimenting be undertaken.

The triac called for is 1·6A rating. Since the switching on of cold lamps causes heavy surge currents to flow, loads of no greater than, say, 0·3A should be employed. This corresponds to about 70 watts—ample for normal Christmas tree lights which are usually of 26 watts to 40 watts rating. If greater loads are to be controlled, then a triac of greater current handling capacity will have to be used. The circuit has been tested with 6A triacs and found to be capable of supplying sufficient gate current to switch them on, although in one case R10 needed to be reduced to zero ohms.

It is unlikely that a heat sink will be required with larger triacs (none is needed in the present design), since it is greater surge rating that is then obtained, and because current is passed to the load only for about half the time, so reducing the average dissipation.

## SAFETY FIRST

Practical construction is quite straightforward, but there are a number of points to be borne in mind, of which the question of safety deserves to be dealt with first.

One side of the mains is connected to the negative rail of the circuit, and to reduce the chance of breakdown of the insulation between that rail and the metal box housing the unit, the side of the mains so connected should be the neutral. At all times bear in mind that there is a direct connection to the mains, and remember to take the appropriate precautions, that is: *withdraw the unit's mains plug before undertaking any modifications or adjustment.*

## CONSTRUCTION

The unit is constructed in a die-cast box, measuring $4\frac{1}{2}$in × $2\frac{1}{2}$in × $1\frac{1}{4}$in; this provides good protection to enable the unit to withstand knocks without damage, and also prevents accidental contact with the internal parts—an important safety point.

## COMPONENTS . . .

**Resistors**

| | | | | | |
|---|---|---|---|---|---|
| R1 | 150kΩ | R5 | 1kΩ | R9 | 68Ω |
| R2 | 150kΩ | R6 | 22kΩ | R10* | see text |
| R3 | 15kΩ | R7 | 4·7kΩ | R11 | 3·3kΩ |
| R4 | 560kΩ 1W | R8 | 3·3kΩ | R12 | 33kΩ |

All 5% $\frac{1}{4}$W, except where otherwise stated

**Capacitors**

C1 4·7μF 16V elect.
C2 2·2μF 16V elect.
C3 220μF 16V elect.

**Semiconductors**

| | |
|---|---|
| IC1 | CD4011 |
| TR1, TR2 | 2N2484 |
| TR3, TR4 | BCY71 |
| CSR1 | NAS 0164X (400V 1·6A) |
| D1, D2, D3 | 1N914 |
| D4 | 1N4007 |

**Potentiometers**

VR1 500kΩ 0·1 watt pre-set
VR2 25kΩ 0·1 watt pre-set

**Miscellaneous**

Die-cast box, 4½in × 2½in × 1¼in
Tag strips
Veroboard, 0·1in pitch
Dual in line i.c. socket, 14-way

All the components contained within the dotted line in Fig. 3 are built on a piece of 0·1in pitch Veroboard, 3½in × 1⅞in. A 14 pin dual-in-line i.c. holder is employed to carry the CMOS circuit, so that the latter can be kept safely until required. The Veroboard is secured to the box lid by means of two screws; these are fastened to the lid by nylon nuts, which thereby provide insulation. The screws are of such a length that sufficient thread remains for the board to be retained by two further nuts. Before placing the Veroboard in position, a piece of similarly shaped thick card with two appropriately placed holes is slipped over the screws to ensure that nothing of the board's copper side touches the box lid.

Connections are made from the Veroboard to the remainder of the circuitry via the correct size Veropins inserted from the copper side. Two well insulated tag strips are fitted to the bottom of the box and mounted on them are all the components subjected to high voltages, i.e. the triac and its gate resistors R10 and R11, power supply rectifier D4, smoothing capacitor C3 together with resistors R12 and R4.

## FINAL CHECKS

With all the components except R10 assembled and with the i.c. still not yet inserted, carry out a final visual check that the box is firmly earthed and that nothing else is in electrical contact with it. Fit the lowest rating of fuse available in the mains plug, and connect a 25 watt mains lamp as a load. This is preferable to a string of typical tree lights at this stage due to the tendency of such an array of going open circuit at inconvenient times. With VR1 and VR2 at mid-travel, switch on. Monitor the d.c. voltage present at C3 positive terminal. It should be about 13V positive with respect to mains neutral, and any large departure should be investigated and corrected before proceeding further.

Next, fit a low value resistor temporarily for R10; a value of 33 ohm or 47 ohm will probably be suitable. The voltage at C3 will this time rise to about 7V and the lamp load should come on after a few seconds (the delay is due to the time taken for C3 to charge to its working voltage). If it does not, or flickers rapidly (actually at 50Hz) then the pulses from the zero crossing detector are of insufficient time duration to cause the triac to conduct its minimum holding current before the pulse ceases; the cure is adjustment of VR2 until a position is found where the lamp is on at full brilliance.

Exceptionally, adjustment of VR2 may not bring this about. The reason is insufficient current drive to the gate of the particular triac used, in which case a wire link in place of R10 should introduce a cure. It is emphasised that such a step is unlikely; out of five triacs tried by the author, only one was of such a low sensitivity and then only when in a cold room. It was persuaded to function as desired by making R10 a short circuit.

## HANDLING CMOS

Now comes the time to fit the CMOS i.c.

A great deal has been written about the need for elaborate precautions when handling these devices. However, do you remember the tales we were told about always using heat sinks when soldering transistors? How about that advice to keep the leads of f.e.t.s. shorted together until wired in? The author started off with CMOS by following the advice on handling given by the makers—and finished up by ignoring most of them. Nevertheless, I strongly suggest that constructors follow the advice below and take chances at their own risk:

1. Before removing any CMOS device from its protective foam, earth yourself to discharge any static built up on the body. Touching a good earth is probably sufficient although an earthed wire permanently connected to a finger ring or metal watch strap is better.
2. Make circuit changes with the device removed; use a socket (as in the present design) to assist with this.
3. Insert the i.c. with all power off.
4. Use an earthed soldering iron.
5. Do not permit unused inputs to float. In the present case, both inputs of each of the four gates are tied together as a pair.

So, fit the i.c. and then switch on. After the usual few seconds delay to allow C3 to charge, lamp flashing will start and settle down to a rate determined by the actual values of the timing capacitors and the setting of VR1. If all is well, replace the 25 watt lamp with the actual load it is required to run. Try a larger value resistor for R10 and choose the largest convenient value that gives reliable operation; this selection of R10 ensures that the triac gate is not overdriven, so giving long term reliable circuit operation.

The rate of flashing, its randomness and on-off ratio can all be varied at will by selection of the values of timing components in the two oscillators and of course by variation of the setting of VR1. Increasing the capacity of C1 and C2 will give an overall slower flash rate, while alteration of the values of R1, R2 and R3 will vary the on-off ratio and the degree of randomness to a wide extent.

As the unit is small and dissipates so little waste heat, it can be stowed unobtrusively almost anywhere. ★

PART 3

# PE Engine Analyser

## FOR ECONOMY MOTORING

By D. HALEY

To complete this series of articles, the design and construction of circuits required for stroboscopic testing of the ignition timing will be described, followed by some notes on the instrument in use.

### IGNITION TIMING LIGHT

The timing of the ignition on a car engine is set in relation to the top dead centre position of No. 1 piston, and timing marks are usually put onto a visible part of the main crankshaft and engine, to indicate the correct position of the crankshaft when No. 1 spark plug fires. One mark will be on a part of the rotating crankshaft assembly, usually the fan belt pulley, and another mark on the main body of the engine. When the two marks coincide the distributor contacts should open. This adjustment may be carried out by turning the engine by hand and rotating the distributor so that the contacts are just opening.

By using a stroboscopic flash fired from the spark applied to No. 1 cylinder, the timing marks of the engine are illuminated by the flash at the instant of firing and the motion is visually frozen. By this means the ignition timing and automatic advance may be checked under dynamic conditions. A high intensity Xenon strobe tube is used to produce a flash bright enough for use in daylight. However, the timing marks will be seen more easily if they are painted white. A word of warning: the ignition timing marks are usually in the vicinity of the fan, which will be rotating at a high speed and capable of causing serious injury or damage. The strobe light may make the fan appear stationary, so take great care to keep hand, leads, etc. well clear of the fan and pulley.

### CIRCUIT DESCRIPTION

The strobe tube requires several hundred volts ionisation potential and a large positive pulse of several kilovolts on the trigger electrode to initiate ionisation. Once fired, the gas will only be extinguished when the ionisation volts fall to zero.

The 600 volt supply is produced by a Class C oscillator circuit. The oscillator uses a 2N3055 transistor with peak to peak rectification of the transformer secondary pulses. During the period between flashes, C11 charges to the full 600 volts, and discharges through the strobe tube when ionisation occurs. Series resistor R24 prevents ionisation being maintained after the initial discharge of C11. R25 provides a discharge path for C11 when the analyser is switched off (Fig. 3.1).

The high voltage trigger pulse is provided by a circuit comprising voltage step up coil T3, capacitor C12, resistor R27, and a silicon controlled rectifier CSR1. CSR1 is fired from No. 1 spark plug via a ferroxcube ring coupling unit.

On firing the s.c.r. discharges C12 through the low voltage section of T3. The pulse produced is stepped up to a sufficiently high voltage to trigger the strobe tube. Zener diode D12 limits the anode voltage applied to CSR1 to 150 volts.

(Note that in Fig. 2.1, T2 should be T3.)

### TUBE HOUSING

The strobe tube with its triggering coil, connected to a 3ft lead, is mounted in a 12 inch length of $\frac{3}{4}$in diameter Paxolin tube. This assembly can be conveniently held by hand, or clamped in the best position for illuminating the timing marks. Two small slots $\frac{1}{8}$in wide × $\frac{1}{4}$in deep are cut in one end

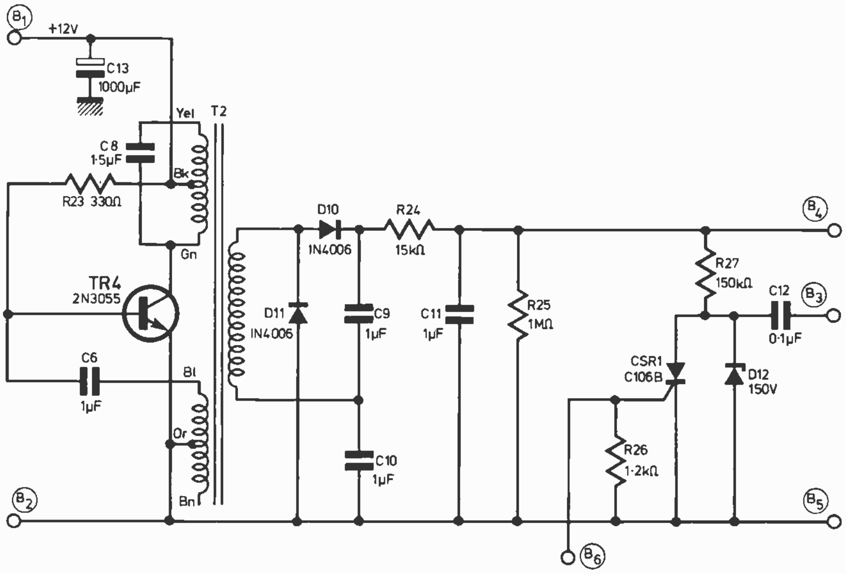



**Fig. 3.1. Ignition Timing circuit. For connections see Fig. 1.2**

of the tube, diametrically opposite, into which the two outer connections of the strobe tube will fit. The lead and coil are pushed into the Paxolin tube from the slotted end until the strobe tube rests in the two slots. It can then be fixed in position with Araldite or wax.

Finally, use a small plastic cup or shroud about $1\frac{1}{4}$in diameter by 2in long, cut a $\frac{3}{4}$in diameter hole in the bottom, fit this into position to form a hood over the strobe tube. Connect the other end of the three core lead to the three pin socket which mates with the strobe plug on the front panel. The pin connections for the socket are shown in Fig. 1.2.

## TRIGGER PICK-UP COIL

The trigger pulse for the strobe tube is picked up through a coil on a 1in ferroxcube ring inductively coupled to the No. 1 spark plug lead. The coil is made by winding about 10 turns of 7/·0076 wire round the ferroxcube core, and fastening the two leads together with adhesive tape.

About 7ft of wire is used, and the ten turns made about the centre. The remaining wire can then be twisted together to give about 3ft of connecting lead to the trigger sockets on the instrument front panel. Solder two banana plugs to the ends of the leads.

## BOARD ASSEMBLY

The layout of components is shown in Fig. 3.2. The board is a piece of Veroboard with 0·2in pitch track, measuring 6·4in by 3·4in. It is bolted to one side of the oscillator transformer. Since this makes the bottom fixing holes of the transformer rather inaccessible, the board is mounted on four $\frac{1}{2}$in long 4BA tapped spacers, fixed with $\frac{1}{4}$in screws from each end. The holes in the transformer frame are slotted. To position the spacers correctly, first bolt them to the four 4BA fixing holes in the centre of the board. Next fix to the transformer frame, tighten the bolts on the transformer side, and remove the board leaving the spacers on the transformer. The transformer can then be bolted in position on the chassis and the printed board replaced.

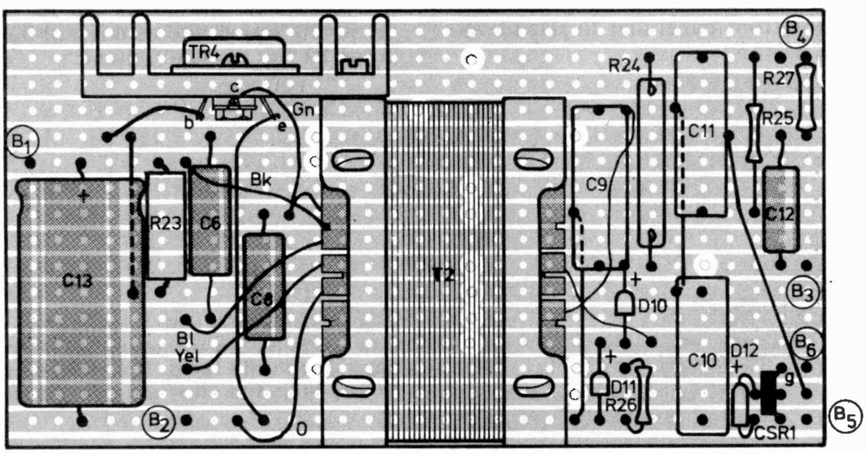
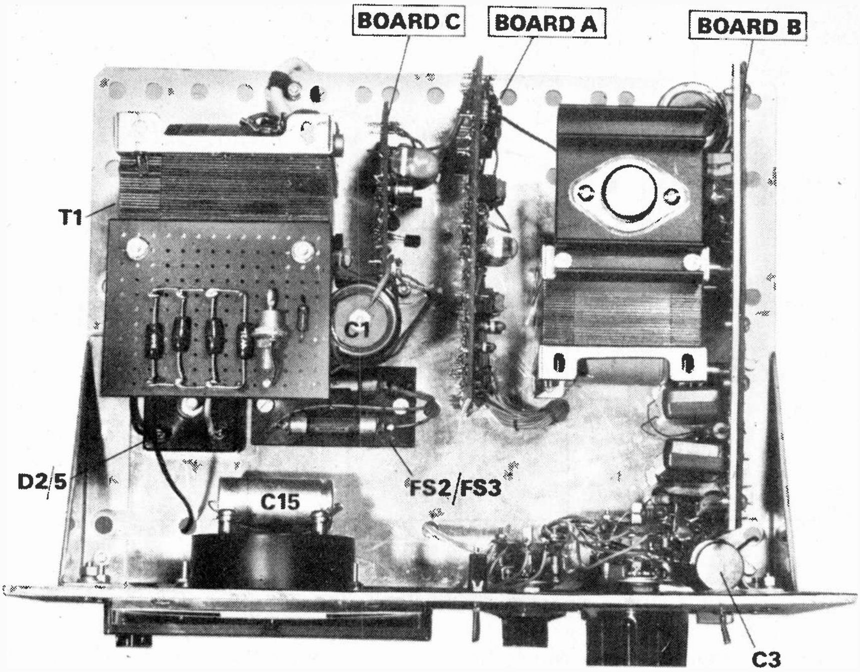



**Fig. 3.2. Board B component assembly. For external connections see Fig. 1.2**




**Positioning of boards on chassis**

## WIRING IN

The transformer connections to the board should now be made, to the colour coding shown on the circuit diagram. The brown lead is not used and should be taped up and tucked out of the way. The 2N3055 power transistor is mounted on its heat sink bolted to the rear top flange of the transformer frame. Two 4BA clearance holes must be drilled in the heat sink to line up with the holes on the transformer.

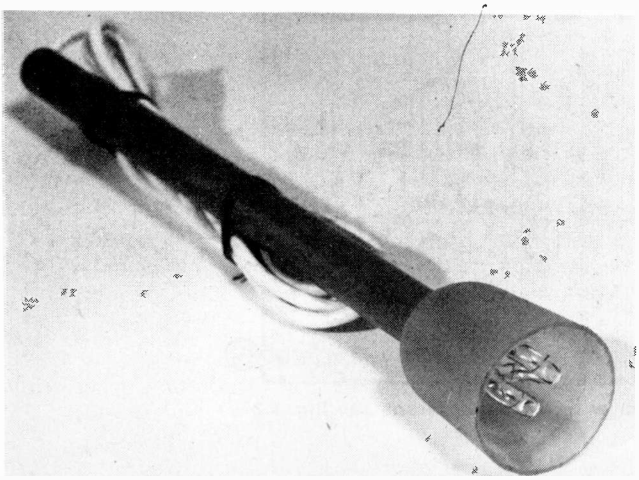
When bolting the transistor to the heat sink, the mica washer and bushes must be used to insulate the transistor case (collector) from the heat sink. Check that there are no burrs which might puncture the mica washer and cause a short circuit. Place a 6BA solder tag under one of the transistor fixing bolts for making connection to the collector. When fixed in position, the transistor connections to the appropriate points on the printed circuit board should be made. It now only remains to make the connections to the sockets on the front panel and to the 12 volt unregulated supply, after S3.

## TESTING

The strobe circuit may be tested on the bench. Connect the instrument to the mains and switch the function switch to "Strobe". If the oscillator is running, a high pitched whistle will probably be heard from the region of the transformer. A check can be made with a high voltage meter at R24 or pin $B_4$, where a reading of about 650 volts should be obtained. To check the triggering, connect a 0·01 microfarad capacitor between CSR1 trigger electrode and +12 volts, using a clip lead in the socket connected to $B_6$. The strobe tube should flash each time the capacitor is touched onto the +12 volt supply.

## USING THE ENGINE ANALYSER

The analyser can be supplied from the 240 volt mains or, for engine tuning, from the 12 volt car battery (but not from a 6 volt battery). Be careful not to connect the battery to the "Battery" sockets the wrong way round as this will damage a transistor in the 10 volt regulator circuit.



**The Paxolin tube which carries the strobe lamp LP2 also contains the triggering transformer. This can be bought with the lamp. It should be connected to the Xenon tube and all wires sleeved**

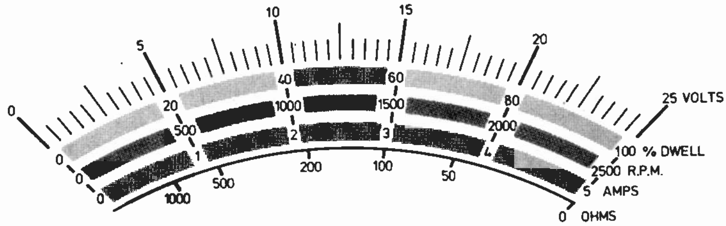



**Fig. 3.3. Exact size meter sealing. This can be cut out and stuck down**

To use the battery charge facility, connect the battery terminals to the "Battery" sockets, set the function switch to "Battery Charge" and connect the instrument to the mains. The meter will indicate the charging current which can be switched for 2 or 4A with the "High/Low" switch. If the battery is known to be flat, start in the "Low" position to avoid excessive current on switching on, which may blow the 5A fuse.

For use as a voltmeter, no power is required. The leads should be used in the meter sockets, with the function switch set on d.c. volts.

## CONTINUITY AND RESISTANCE CHECKS

In this application power is required either from mains or a 12 volt battery. When carrying out checks on a car wiring, it is essential that the battery be disconnected from the car. This is necessary because the car wiring may be live at 12 volts and would cause errors in reading or even a short-circuit of the battery, with spectacular though undesirable results. The leads for ohmmeter use are plugged into the meter sockets.

Before commencing tests, set the meter to read zero ohms with the leads shorted together, by adjusting the "Set Ohms" control.

## DWELL AND TACHOMETER MEASUREMENT

For making measurements of dwell angle and r.p.m., the following connections are made. Connect the E terminal to the car chassis and c.b. socket to the c.b. terminal on the car ignition coil. If the circuits are to be supplied from the 12 volt car battery, this should be connected to the battery sockets. Set the "Earth" switch to whichever terminal of the battery is connected to car chassis. With the function switch set to "Dwell", start up the engine. The meter will indicate, on the percentage dwell scale, the proportion of the ignition cycle for which the contacts are closed.

For dwell measurement it is not essential to have the number of cylinders selected but it should not be set to a number less than that for the engine under test. For checking revolutions per minute, the "No. of Cylinders" switch must be set to the correct number. When the function switch is turned to "Tach" position the meter will indicate engine speed on the rev/min scale.

## IGNITION TIMING CHECK

Here we must repeat the warning that this test involves holding the strobe lamp in the vicinity of the fast rotating fan blades and great care must be taken to keep well clear of them or a nasty accident might occur. The timing marks will be much more easily seen if they are marked with a dab of white paint or chalk. The equipment is set up for the test as follows.

Remove the lead from No. 1 spark plug, pass it through the ferroxcube ring of the trigger coil, and reconnect it to the plug. Connect the trigger coil to its sockets on the front panel. Plug the strobe lamp assembly into the front panel. If adjustment of the timing is to be carried out, slacken off the distributor clamping bolt, but leave the distributor approximately correctly set, otherwise the engine will not run. It will be necessary to monitor engine speed while setting the ignition timing as the automatic advance comes into action above about 1,000 r.p.m.

## ADJUSTING THE DISTRIBUTOR

Start the engine and carefully hold the strobe head so as to illuminate the timing marks. If convenient it might be easier to tie the lamp in position before starting the engine. Run the engine at the speed specified in the car manual for ignition timing, usually 500–600 r.p.m. The moving timing mark should appear stationary in the light of the strobe tube, and rotating the distributor body will alter its position relative to the fixed mark. Adjust the distributor until the two marks coincide. When the engine is speeded up, the mark on the pulley will move anticlockwise to a more advanced spark position, indicating the proper functioning of the automatic advance mechanism. Switch off the engine and tighten the distributor clamp. If triggering is uncertain or irregular, reverse the trigger coil on No. 1 spark plug lead.

## CAPACITOR CHECK

It sometimes happens that the 0.22 microfarad capacitor connected across the points in the distributor goes faulty, causing poor running and bad contact wear. By closing the switch above the c.b. socket on the instrument, an extra 0.22 microfarad capacitor will be connected across the contacts. If this results in better running, the distributor capacitor should be suspected. ★

# Strictly Instrumental

## by K. Lenton-Smith

TO a mathematician, electronics might appear to be an excellent application. In many branches of electronics, this assumption would be justified, but Electronic Music is (among others) certainly an exception. In this case there are subjective considerations that come into play and, however theoretically perfect the circuitry may be, critical faculties may reject the end product.

The eye may accept a monochrome photograph of a London bus as correct, but a colour print where the red deviates in the slightest will be found lacking: combining technical and aesthetic aspects is often a problem as the beholder (or listener) becomes more acutely aware. Worse still, he may not like either the composition or its execution—in the pictorial or musical sense!

### IDYLLIC SOUND

An organist friend once heard a really beautiful sound that a given stop on the local church organ produced, and he was determined to have the same stop on his home-built electronic organ. He loaded the back of his car with expensive recording equipment, went to the church and made a perfect tape of his idyllic sound.

Back in his workshop, the tape was played into a scope and careful tracings of the waveform were made. From this point, it was a simple matter to synthesise the waveform, it would seem. The outcome of this story was that, despite achieving a perfect replica of the waveform at various frequencies, the musical sound bore no resemblance to the original!

Even worse things can happen to organ builders—like the chap who found a sudden change in the wall-paper pattern when a large electrolytic exploded at the back of the organ....

### EASTERN PROMISE

The synthesiser represents one of the best forms of combination of technical and aesthetic aspects.

It may seem a little unusual to find a Japanese musician highly proficient in Western classical music: Isao Tomita's two albums have a different approach to the classics. Whereas Walter Carlos usually tries to produce the sound of a full orchestra, Tomita employs a fair amount of licence with Debussy (Snowflakes are Dancing: RCA ARL1-0488) and Moussorgsky (Pictures at an Exhibition: RCA ARL1-0838).

Owners of synthesisers will find the equipment schedule for "Snowflakes" interesting, especially the use of Mellotron to supplement the Moog. The record sleeve points to the fact that, apart from sheer technical ability at the keyboard, multi-recording facilities of a complex nature are a vital necessity.

Both records are extremely expressive in their treatment of these composers works. Followers of Pop Groups will probably not care for them any more than the strict classics devotees will—but they are different, at any rate. I find them encouraging as I do not believe that Electronic Music should be totally immersed in light music, as it tends to be for the most part.

### TAPE RECORDING

If the reader is a practising musician, he will appreciate that there is no finer form of criticism than listening carefully to tape recordings of his own efforts! Fluffy fingering, dominant sevenths that should have been diminished and ragged timing all come over with demoralising clarity. "Play it again, Sam", as the man said....

The average commercial tape recorder is not ideal for synthesiser recordings: even a stereo machine, as both amplifiers normally have to be switched into the same mode. There may be sound on sound facilities but a second machine might have to be used—with the attendant problem of small differences in capstan speeds.

A purpose designed recorder with four heads would be the ideal. One set of heads could be arranged to operate across the whole tape width, the second pair being stacked. Careful arrangement of head switching would enable each track to be laid down in turn and the resultant build-up monitored at any stage.

With the mixer facilities of the P.E. Minisonic, for example, the last track could be played "live" with the recording of the previous tracks. Most readers will have found that re-recording from one machine to another soon reduces quality to an alarming degree so that stacked heads and independant R/P amplifiers are essential.

It would be interesting to hear how readers who have completed the P.E. Synthesiser or Minisonic are coping with this problem.

### MECHANICAL VIBRATO

When readers write for advice on making a Leslie-type speaker, they have to be warned that the task is not as simple as it would appear. Despite there being various sophisticated electronic vibrato methods, the combination of f.m. and a.m. given by rotating devices is in demand—the sound of the Leslie 145, for example. The manufacturers will be heartened by my having to report that the average organ-builders workshop looks like a Leslie graveyard—rotors and horns tried, tested and rejected!

It is fairly simple to make a small rotor from foamed polystyrene (or even manage to buy one occasionally) but these absorb a good deal of the signal, even if easy to drive at the required vibrato speed with a small synchronous motor.

A heavier, wooden rotor is preferable but requires a more powerful drive: motors with brushes have to be ruled out owing to noise and it is normally difficult to find a sufficiently powerful synchronous type. Ball races will give rise to noticeable rumble, so that Oilite sleeve bearings mounted in rubber would be a better choice.

Wind noise is always a problem, especially with rotating horns. Two horns, one a dummy for balancing, can be made from fibreglass tissue: by arranging these above a cross-over-fed driver unit, strong high-frequency vibrato can be obtained.

Alternatively, a pair of back-to-back miniature speakers on the end of a rotating arm might be simpler to arrange, using slip rings for signal connection. In this case, a counter-balance on the arm will be necessary, but the choice will depend on how quietly and efficiently this section of the speaker system can be made to work.

### INFINITE BAFFLE

Reverting to the bass speaker, some alleviation of the considerable attenuation of the infinite baffle can be arranged by a small, felt covered slot at one edge of the baffle. The whole job demands good engineering of a mechanical, rather than electronic, nature: the constructor will soon discover why the commercial version is relatively expensive—in short, know-how!

# NEXT MONTH

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**Warning is given by a flashing l.e.d. mounted on the car dashboard.**

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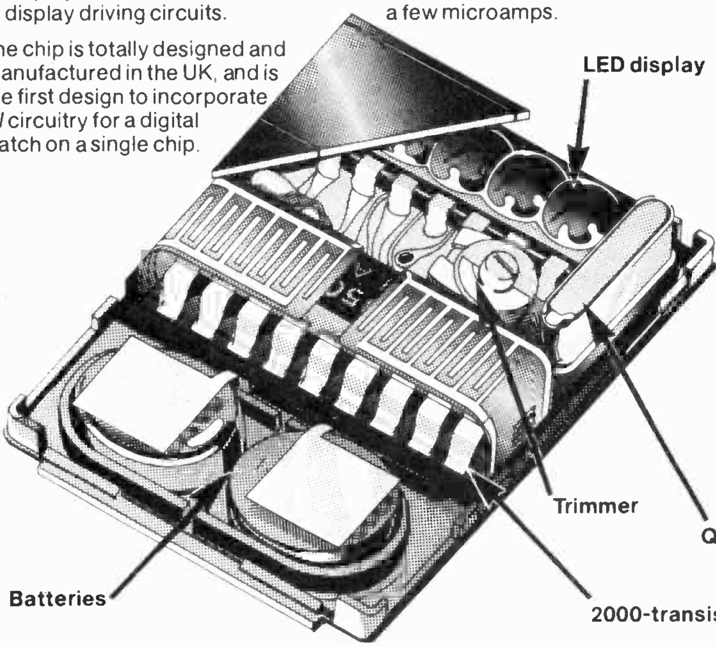

LED display
Trimmer
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Batteries
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# MINIMIX6


## By G. D. SHAW

- ***Panning between channels***
- ***Twin VU meters for visual monitoring***
- ***Headphone amplifiers for aural monitoring***
- ***Switchable pre-fade monitoring offers a cueing facility***
- ***Extension facilities enable extra channels to be added***

**A miniature, battery operated, six-channel-into-two stereo mixer**

LAST month we looked at the circuit details and facilities of the Minimix 6; this month construction and final testing are dealt with.

### CONSTRUCTION

The details given for the construction of the Minimix 6 are based on the use of the instrument case illustrated. The instrument itself is extremely compact and there is thus very little margin for dimensional error in cutting the front panel or in assembly of the various major components. Similarly the components such as the potentiometers and switches specified should be used, otherwise there can be no guarantee that the electronic sub-assemblies will fit cleanly into the instrument case.

Constructors who might feel too constrained by the above requirements can take heart from the fact that there is no reason, in principle, why a larger case and alternative controls cannot be employed. Indeed, some constructors who might be in process of building a modular synthesiser may find it an advantage to incorporate the Minimix 6 circuits in place of the generally simpler mixing circuits normally employed.

The design of the p.c.b.s is such that alternative spacing between channels may easily be arranged for during the preparation for etching. This applies particularly to the p.c.b. used for the monitoring switches where these latter items are to be located symmetrically within the channel spacing on the front panel of the mixer.

### FRONT PANEL

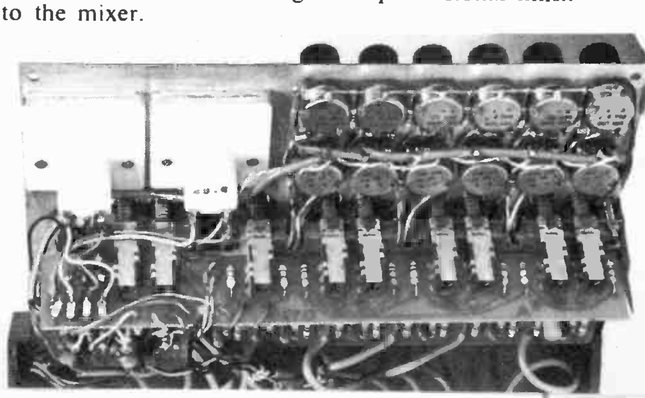
Prepare the front panel first of all from the details given in Fig. 3. The lettering and other panel markings can be done at this time. On the prototypes all panel markings were done with Letraset as follows:

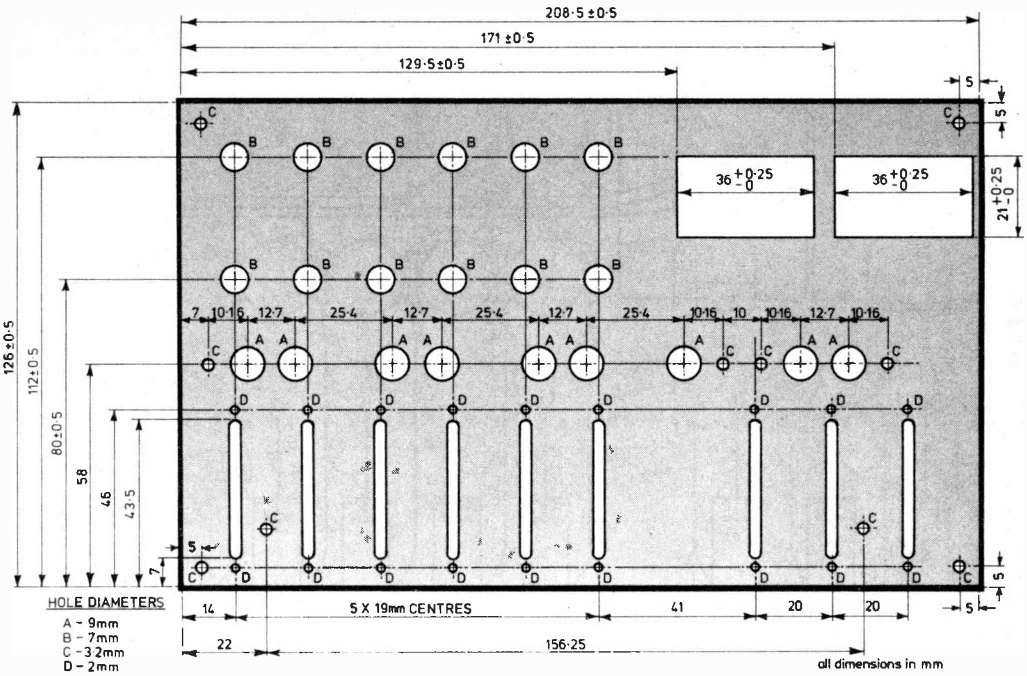
42 point Manuscript Capitals Sheet 2564 for "Minimix 6".
10 point Helvetica Medium for other lettering Sheet 1560.
Direction Arrows Sheet 2450.
Line Rules Sheet 2826.

When setting out the slider potentiometers markings note that the separation of the lines on sheet 2826 is exactly suited to the signal attenuation levels shown marked between channel 6 and the left channel master fader. These rulings can therefore be laid down in one go.

When all rulings and lettering are complete they should be thoroughly burnished down using the Letraset backing sheet and ideally given a protective coating of clear lacquer such as Letracote gloss or, better still, "101" which is an exceptionally durable fixative.

Make sure that the lacquering is applied to the panel under relatively dust-free conditions and that it is given a good chance to dry. When this has been done, not only will the Letraset be protected, but it will also provide a surface which can be easily cleaned—and of course it gives a professional finish to the mixer.





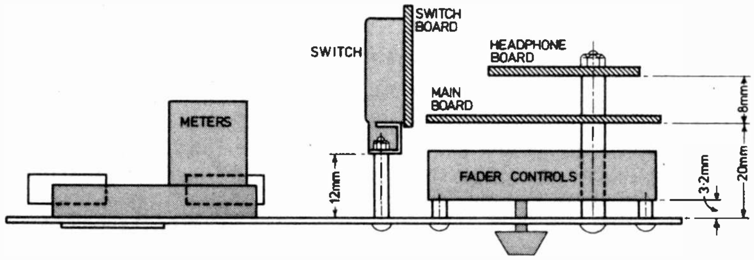




**Fig. 3. Drilling details for the front panel**

**Fig. 4. Side view of the front panel showing spacer dimensions**

## P.F.L. SWITCHES

The next stage is to assemble the Jean Renaud switches into their mounting frame and check that they line up accurately with their respective cutouts. The switch p.c.b. may then be fitted onto the switch contacts and soldered into position. Note that the tag contacts on the upper or white face of the switch should be bent over the side of the switch as shown in the photograph. This is preferable to snipping off the contacts since this may loosen the assemblies within the switch and can cause problems at a later date.

The remaining components on the switching p.c.b. can also be added at this stage including the wire links for signal and power rail routing to the other p.c.b.s (see Fig. 7). These should be about 80mm long—a generous estimate—and trimmed to length when the other boards are fitted.

The Pre-Fade links to the line amplifier circuit board may be omitted since it is easier to attach these to the line amplifier board and connect them to the underside of the switching board at the appropriate time.

The switching sub-assembly may now be fitted to the front panel ensuring that the spacing between the front face of the switch mounting frame and front panel is at least 12mm.

## FITTING THE SLIDER AND ROTARY POTENTIOMETERS

Assembly of the front panel continues with the fitting of the rotary and slider potentiometer. These latter items should be carefully checked to ensure that they are correctly orientated in the panel.

If the Tocosa potentiometers are used, terminal 1 is at the earthy end and should be towards the base of the front panel. Fig. 4 shows the stand-off distance required.

Because these potentiometers are very small it was decided to employ 20k ohm stereo types and to strap the tracks in parallel to improve the contact area. In practice, comparison between potentiometers prepared in this way shows a remarkably consistent performance.

Terminals 1 and 3 should be trimmed so that they are the same length as the plastic stand-offs at the ends of the potentiometer. On the channel and master faders only, the two terminals should be bent over flush with the underside face of the potentiometer and overlapped. The lower terminal will have to be trimmed by about 3–4mm in order that the overlap is clean.

In the case of the monitor fader the two terminals should be bent outwards.

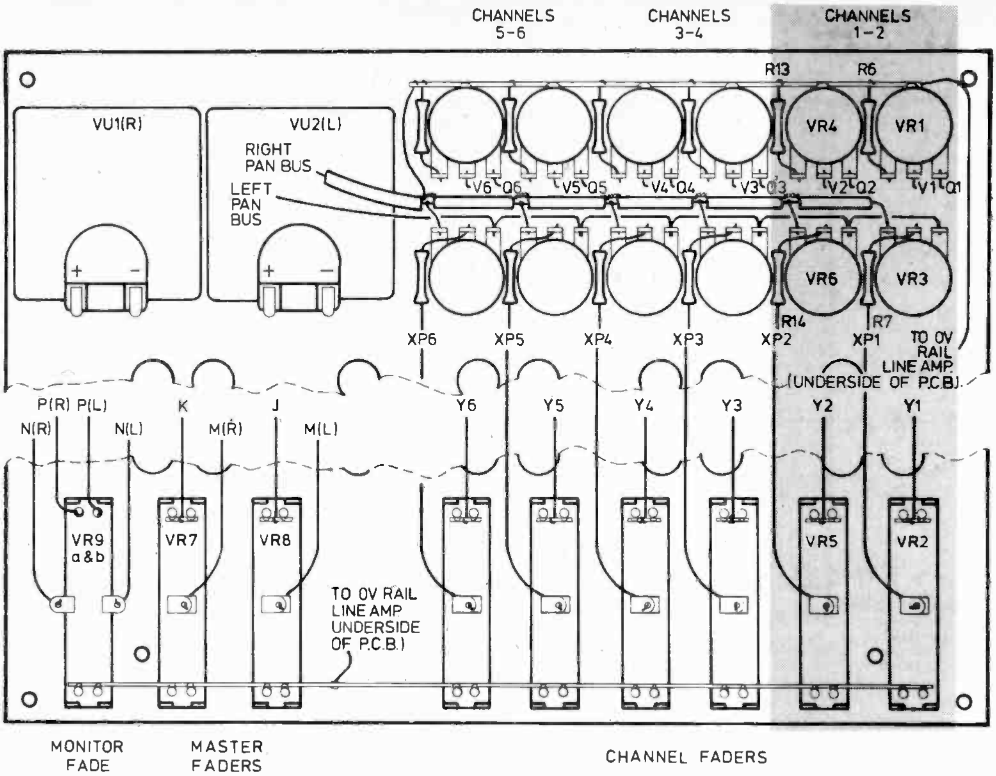



**Fig. 5. Wiring arrangement of rotary pots and slider controls**

### WIRE LINKS

Attach all wire links as shown in Fig. 5. Those marked N(R); P(R); P(L); N(L); K; J; M(R); M(L) and Y1–Y6 should be about 100mm long and bent up at right angles so that they lie parallel with and against the under face of the switching p.c.b. XP1–XP6 should also be about 100mm long and pass beneath the switch mounting frame, flush with the front panel, routed to the left-hand side of the cut-outs for their respective pan-pots.

### ROTARY POTENTIOMETERS

The rotary controls may now be fitted and wired as shown in Fig. 5. The cases of the gain controls should be joined with a stout copper wire soldered to the corner of the case and to which are attached the 100 ohm resistors on the earthy end of the gain controls. This is the ground, or 0V, link and a flexible lead should connect it to the 0V rail on the underside of the line-amp p.c.b.

Wire leads Q1–Q6 and V1–V6 should be about 100mm in length, routed through the openings in the switch mounting frame and then bent up at right angles to the front panel close to the underside of the switching p.c.b. As with the other leads, these will be connected to the line amplifier p.c.b. when it is fitted. The 100k ohm resistors should now be attached to the wiper terminals of the pan-pots.

A short piece of insulated sleeving is fitted to the resistor lead-out wire where it passes adjacent to the body of the pan-pot. With the resistors in position and the other lead-out wire trimmed to about 6mm, the leads XP1–XP6 from the channel faders should be trimmed and connected to their respective resistors after first passing a length of insulated sleeving over them in order to protect and insulate the joints once they have been made.

## COMPONENTS . . .

### CHANNEL AMPLIFIERS

**Resistors**

| | | | |
|---|---|---|---|
| R1–4 | 100kΩ (4 off) | R8–11 | 100kΩ (4 off) |
| R5 | 3·9MΩ | R12 | 3·9MΩ |
| R6 | 100Ω | R13 | 100Ω |
| R7 | 100kΩ | R14–16 | 100kΩ (3 off) |

All resistors 5% ¼W carbon

**Capacitors**

C1 0·47μF 35V Tantalum
C2 680pF Ceramic
C3 0·47μF 35V Tantalum
C4 680pF Ceramic

***Potentiometers**

VR1 10kΩ log. miniature rotary
VR2 10kΩ log. (made from parallelling tracks of Tocosa 20kΩ 35mm travel stereo slider controls. See text)
VR3 10kΩ lin. rotary
VR4 10kΩ log. miniature rotary
VR5 10kΩ log. as VR2 above
VR6 10kΩ lin. miniature rotary

**Integrated Circuits**

IC1–2 741 8 pin d.i.l. (2 off)

***Switches**

S1–2 Channel switch. Jean Renaud 2-pole change-over switches (6 off)

**Sockets**

SK1–7, 9 180 5 pin DIN sockets (8 off)

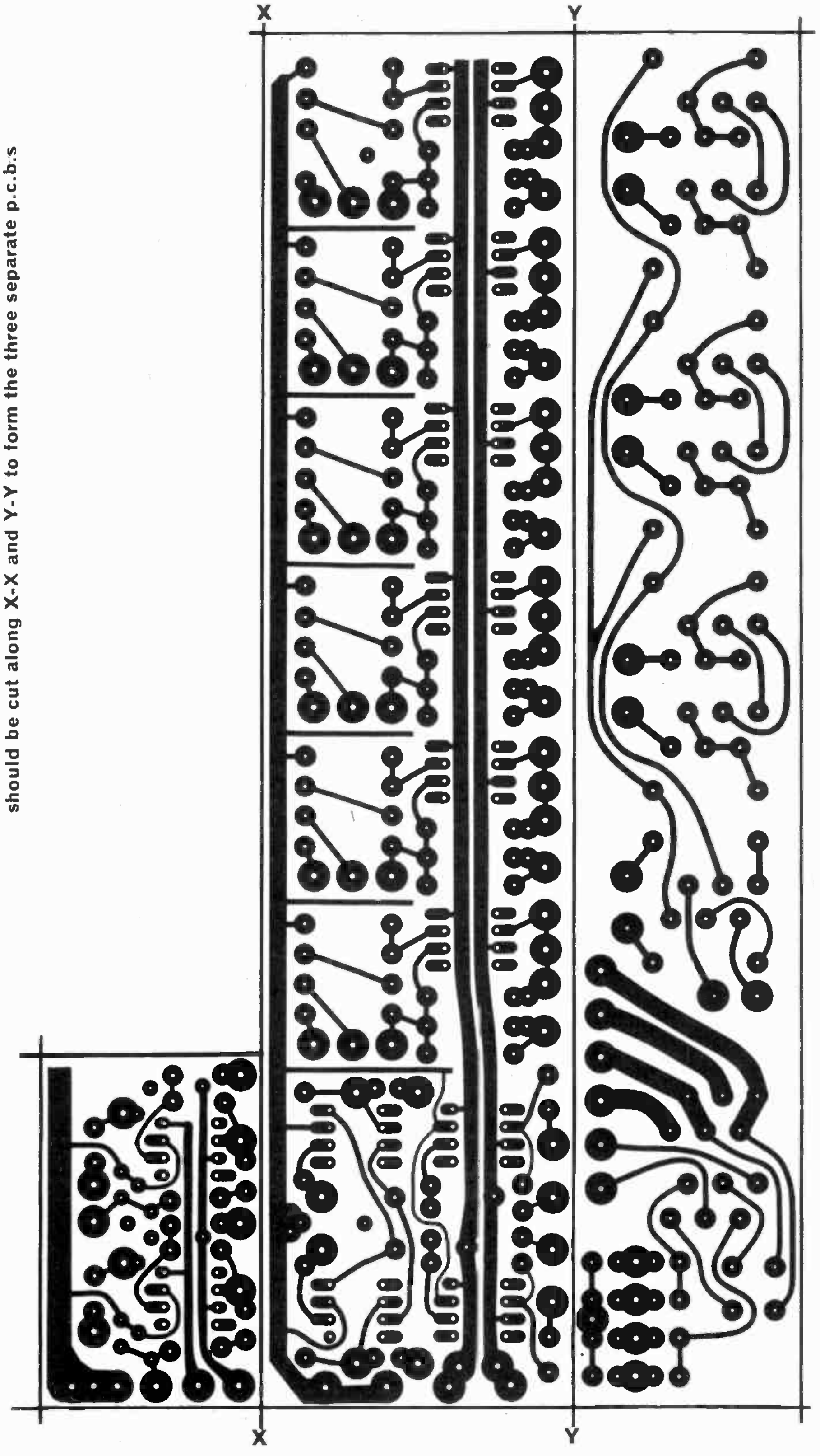



**Fig. 6. Full-size p.c.b. master for the Minimix 6. Note that the board should be cut along X-X and Y-Y to form the three separate p.c.b.s**

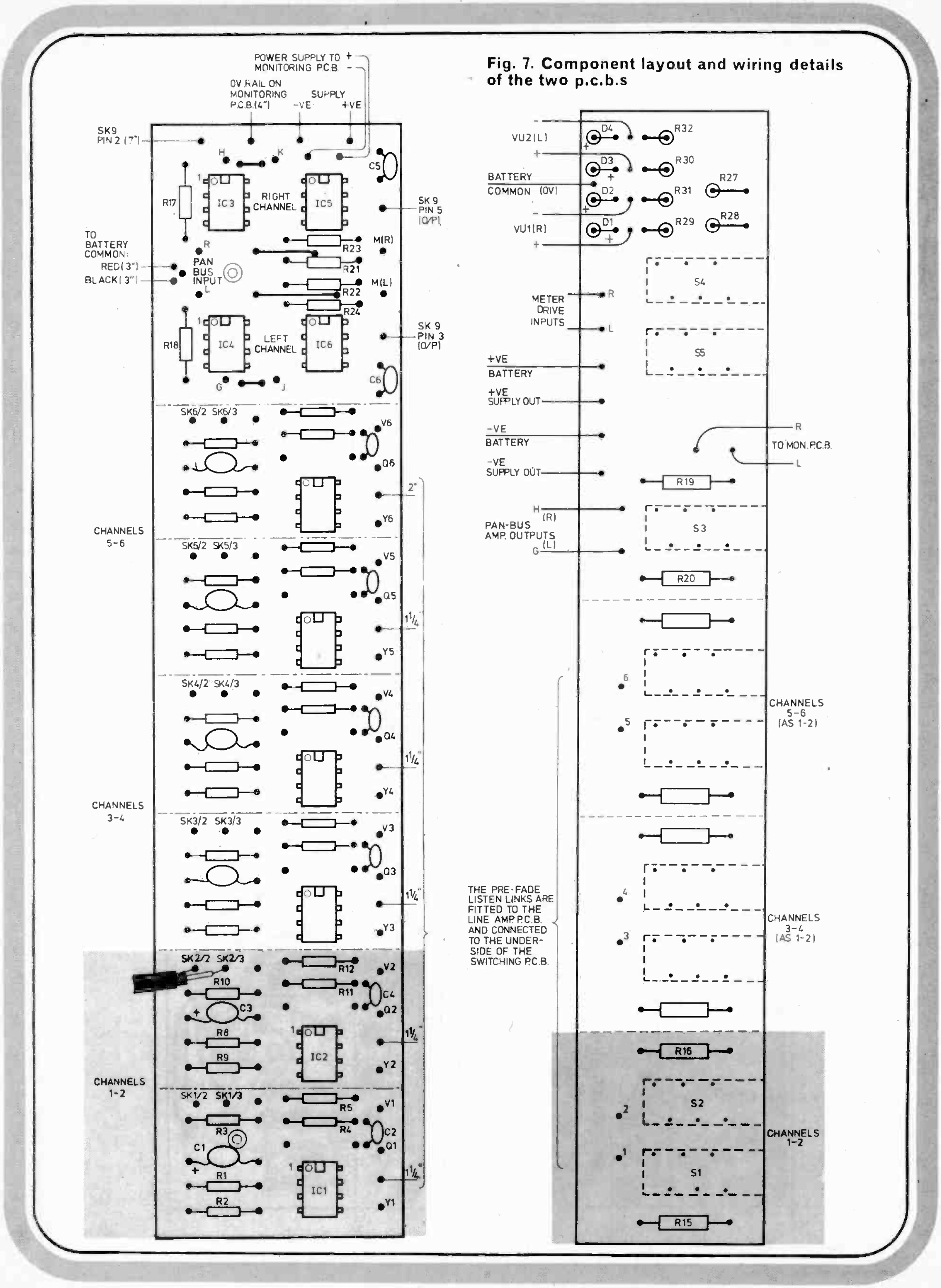



**Fig. 7. Component layout and wiring details of the two p.c.b.s**

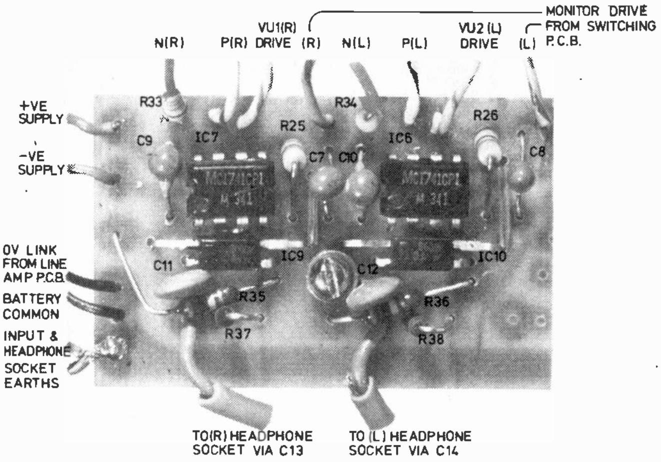



**Fig. 8. Details of the monitoring p.c.b.**

The pan busses are now made up as shown in Fig. 5. In order to keep cross-talk down to a minimum one of the busses is made up with screened wire, the screen itself being linked to the ground or 0V rail on the gain pots. The flying bus leads should be left about 180mm in length.

## V.U. METER MOUNTING

The V.U. meters are secured to the rear of the front panel by means of a contact adhesive. Follow the normal procedures for glueing making sure that the mating surfaces are slightly roughened and free from grease. A smear of glue should be placed on the top edge of the meter in addition to the flat area housing the movement. When the glue has set the meters may be linked to their respective lead-out wires from the switching p.c.b. The line-amplifier p.c.b. may now be assembled in accordance with the layout given in Fig. 7.

Input and ouput leads should be in the form of screened wire 180mm in length. Attach the wire leads (p.f.l.) for connection to the switching p.c.b. On channels 1 to 5 these should be 30mm long and 50mm long in the case of channel 6. Position the p.c.b. loosely across the top of the slider potentiometers and trim the connecting wires passing over the underside of the switching p.c.b. so that they can be formed into a 12mm diameter loop. Bend them over and solder to their respective channels.

Connect the power supply, input/output monitoring links and trim and connect the pan busses. Finally, on this board, connect the 0V link to the gain controls and sliders, a 180mm 0V link for connection to the output socket, a 100mm 0V link from the switching p.c.b. and, lastly, the p.f.l. links to the underside of the switching p.c.b.

## LINE AMPLIFIER P.C.B.

The line amplifier p.c.b. may now be secured to the front panel making sure that sufficient spacers have been added to the screws. In the case of the end directly below the meters a 6BA × 40mm screw will be required since this will also provide support for the meter drive and monitoring p.c.b.

Construct this latter p.c.b. following the scheme shown in Fig. 8. The output leads to the headphone socket should be in screened wire about 180mm long. With all links connected as shown in the schematics, this p.c.b. may be secured in place and attention given to the preparation of the case.

# COMPONENTS . . .

### BUS AMPLIFIERS AND OUTPUT STAGES

**Resistors**

| | | | |
|---|---|---|---|
| R17–22 | 20kΩ (6 off) | R33–34 | 33kΩ (2 off) |
| R23–26 | 100kΩ (4 off) | R35–36 | 10kΩ (2 off) |
| R27–28 | 12kΩ (2 off) | R37–38 | 10Ω (2 off) |
| R29–32 | 1·2kΩ (4 off) | | |

All resistors 5% $\frac{1}{4}$W carbon.

**Capacitors**

C5–6 10μF 16V Tantalum (2 off)
C7–8 1μF 35V Tantalum (2 off)
C9–10 2·2μF 35V Tantalum (2 off)
C11–12 2,000pF Ceramic (2 off)

***Potentiometers**

VR7–8 10kΩ log. (made from parallelling tracks of Tocosa 20kΩ 35mm travel stereo slider controls. See text) (2 off)
VR9 Tocosa 20kΩ 35mm travel stereo slider control

**Semiconductors**

D1–4 OA90

**Integrated Circuits**

IC3–8 741 (6 off)
IC9–10 MFC4000B (2 off)

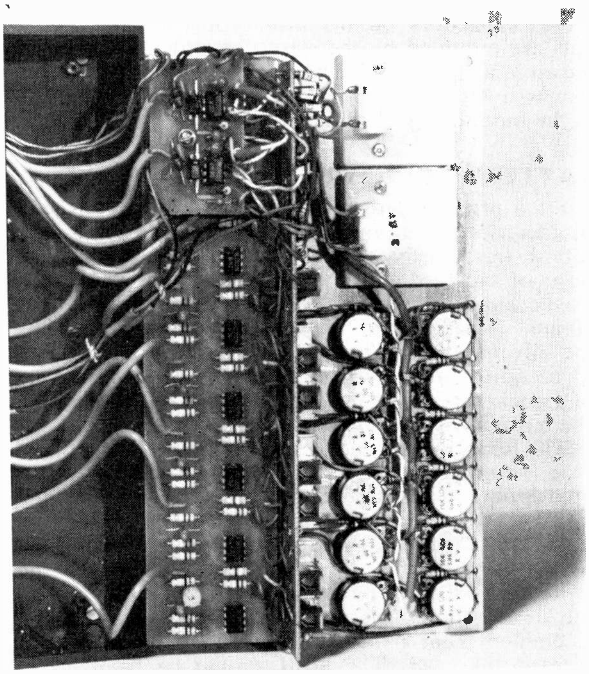
***Switches and Socket**

SK8 0·25 stereo jack socket

**Miscellaneous**

*Printed circuit boards, *VU1-2 Flush mounting type 3 (Lasky's), control knobs, sundry 6BA nuts and screws. *Instrumental case type 22 (R.S.) or Vero case 6525523E

*Eaton Audio (see advertisement)



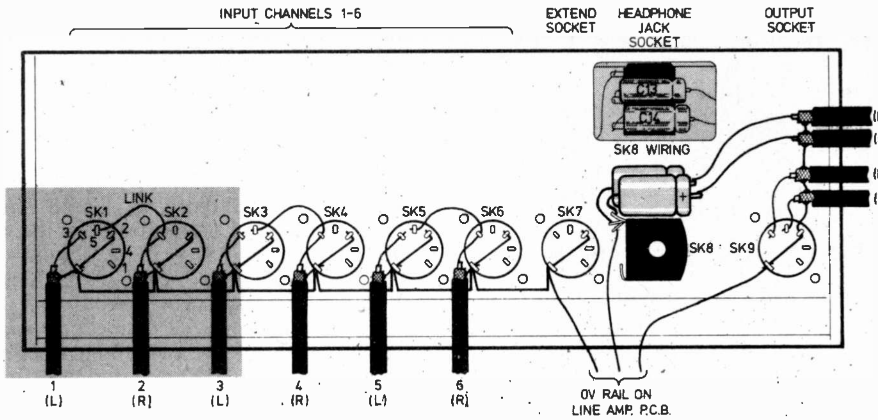



**Fig. 9. Rear panel layout**

## FITTING THE DIN SOCKETS

The specified case is manufactured from ABS and is thus very easily worked. Layout of the input and output sockets is shown in Fig. 9. Note that 6BA screws may be used to secure the DIN sockets in position and that if the holes for the screws are made slightly smaller in diameter than the screws themselves (i.e. 2·5mm), then the screws may be self-tapped into the case and will hold the sockets securely. This method is preferable to fitting back nuts to the screws since the very small space involved makes this latter procedure rather difficult.

Link pin 2 of the DIN sockets with the tab on the case and then all the tabs together, for the input and extend sockets only, leaving a 180mm flying lead for connection to the p.c.b. Pin 5 on each of the odd numbered sockets should then be linked to pin 3 on its associated even numbered socket. The 330$\mu$F capacitors on the monitoring amplifier outputs are mounted on the stereo headphone socket as shown and glued into position. From this socket also is a separate 180mm 0V lead to be connected to the monitoring amplifier p.c.b.

## BATTERY MOUNTING

Final preparations on the case entail the provision of facilities for mounting the batteries. In the prototype this consisted of fitting eight screws to the floor of the case and linking these across with stout elastic bands having an unstretched length of about 80mm. This method of securing the batteries has the advantage of being very simple and has proved to be quite adequate in normal use. Insulated pairs of battery press-stud assemblies are used to connect the batteries to the circuit boards.

The black lead from one assembly and the red lead from the other should be connected to the appropriate coloured leads coming from the 0V rail on the line amplifier p.c.b. The remaining leads from the press-stud assemblies are connected to the 80mm leads of similar colour fitted to the switching p.c.b. Connection of the input and output leads should be made with the base of the assembled front panel close against the front lower face of the case. The leads should be trimmed so that they are just long enough to pass across the base of the case and up to the highest terminal (2) on the sockets.

## CHECKING THE MINIMIX 6

Assembly is now complete and the batteries may be inserted. Checking out performance entails the provision of an input signal in turn to each channel. A typical procedure is outlined below.

Switch on and observe that there is no reading on either V.U. meter.

Close the battery check switch and observe a reading of about +1V.U. on each meter.

Set all gain controls fully anticlockwise.

Set all sliders to infinity.

Set the pan controls on channels 1, 3 and 5 fully clockwise and those on channels 2, 4 and 6 fully anticlockwise.

Set the input/output monitor switch to "input" and close the p.f.l. switch on channel 1.

Apply a signal of 1V r.m.s. to channel 1 and observe that the V.U. meter reading is 0V.U. Both meters will record under these conditions. If a 1V signal source is not available adjust the gain control on channel 1 until a 0V.U. reading is obtained.

Close the p.f.l. switch on channel 2. The reading on the right-hand V.U. meter should fall to −20V.U. (no deflection).

Set the input/output monitor switch to "output". Both meters should read −20V.U. (no deflection).

Advance the slider control on channel 1 to the 0dB calibration. The left channel meter should now, once again, read 0V.U.

Operate the pan control on channel 1 through its full travel observing on the meters that the signal transfers smoothly from the left to the right channel.

Restore the controls to the starting point again and repeat these tests for all channels.

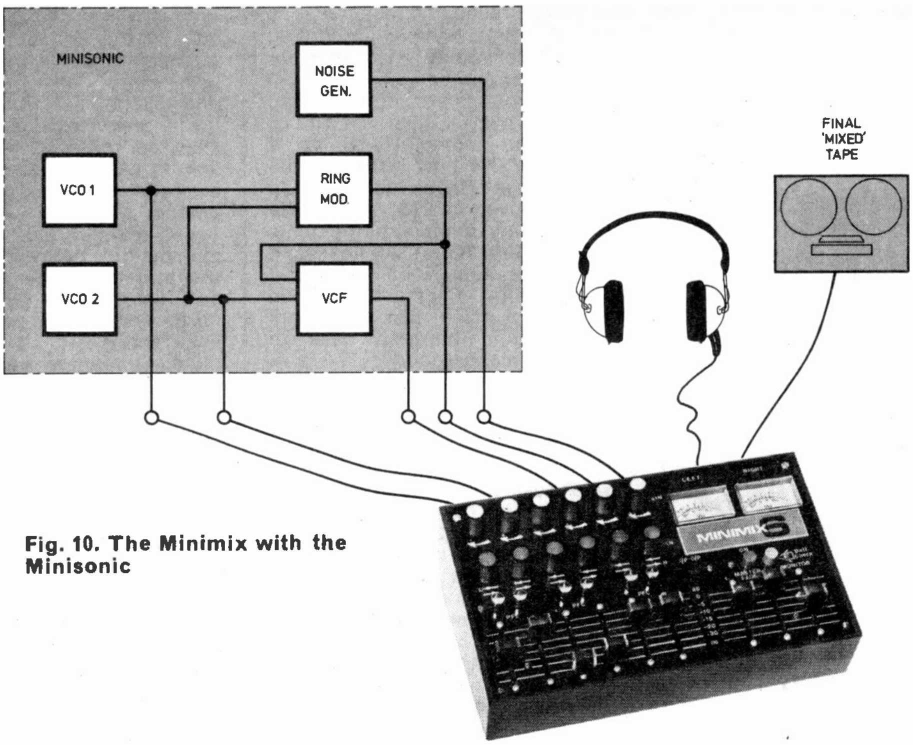



**Fig. 10. The Minimix with the Minisonic**

At some point it should be ascertained that signals are available at the output socket, in the correct orientation, and similarly at the headphone socket.

## THE "EXTEND" FACILITY

The facilities offered by the Minimix 6 may be extended by the provision of additional channels and an "Extend" socket has been included for this purpose. A further series of input channels may be assembled within a separate box. The pan and monitor busses would be terminated in a DIN socket with the pan busses linked, say, to pins 3 (left) and 5 (right) and the monitor busses linked to pins 1 (left) and 4 (right). Pin number 2 would, of course, link the 0V rail.

In the Minimix 6 main box the extend socket would be coupled directly into the pan and monitor busses in accordance with the wiring scheme chosen for the extension box and the two units linked by a standard 5-way audio lead. In this way the monitoring facilities in the Minimix 6 main box may be used to monitor a virtually unlimited number of additional channels.

## INPUT SOCKETS

The arrangement of the input sockets on the mixer is such that, although each channel may be operated individually as a mono unit, channels may be operated in pairs from a standard stereo-wired DIN plug by means of the link which joins pin 5 on odd-channel input sockets with pin 3 on the even-channel inputs. This facility enables stereo signals to be handled without the necessity of separate signal leads for each channel.

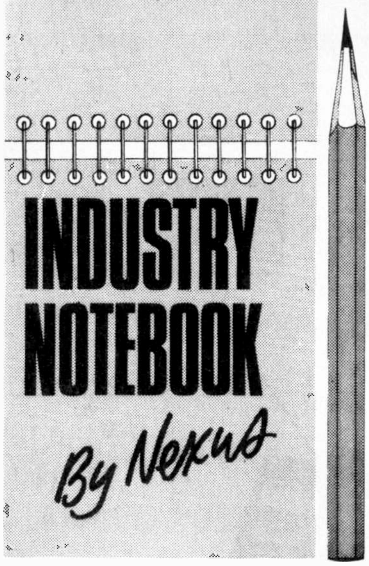
## USE WITH A SYNTHESISER

The Minimix 6 may be employed in a great many different ways but limitations of space do not make it practicable to consider them all. Since the instrument was specificially designed to be compatible with the P.E. Minisonic Synthesiser, however, we will illustrate two possible methods of operation in combination with a synthesiser. Fig. 10 shows how the synthesiser itself can provide five outputs (more if required) to drive the Minimix 6.

If the instance illustrated a mono recording is being made using two VCO's a VCF, a ring modulator and the noise generator. Let us say, for example, that the VCO's are tuned apart by a fifth. The output of the ring modulator will then be a complex chord. This output is sampled and routed to the VCF where it is combined with the output of VCO 2. If the filter is programmed from the keyboard so that its output passband varies in accordance with the note being played we then have four distinct sounds all having a direct relationship with one another but vastly different in aural effect.

Finally we have the output of the noise generator which provides the characteristic rushing effect of white noise. Using the mixer in this way enables a series of variations to be played and reorded very easily either by repeating a phrase using the individual channels separately or by mixing, in varying degree the signals present in all five input channels.

**Note:** in the circuit diagram which appeared in part 1, the resistor below R17 should be R18 and that below R21 should be R22. The input to channel 3 should be SK3 pin 3, to channel 4 SK4 pin 3, to channel 5 SK5 pin 3 and to channel 6 SK6 pin 3. Pin 2 on all sockets are earth. ★




## PEOPLE

The electronics industry both at home and internationally is only as good as its people. Happily, as the old timers pass on there are plenty of thrusting young managers ready to take their place. And although there may be fewer opportunities to start up in the garage or the spare bedroom with £100 of savings or an equivalent loan from your father-in-law, it is still a possibility.

A. Edwin Stevens started in the back bedroom of a semi with the legendary £100. It was in 1935 and his project was the first electronic hearing aid to be worn on the body rather than carried round in a suitcase. It still weighed over 2lb., against today's jobs weighing well under half an ounce, but it started his company Amplivox on the way to success. He has just retired but stays on as a consultant to the company he founded. He was hearing aid consultant to Sir Winston Churchill for the last 12 years of Sir Winston's life.

In entertainment electronics one of Europe's most respected leaders was Dr. Böhme who died unexpectedly last September at the age of 68. He was an example of the German "economic miracle". His family business at Dresden was destroyed by bombing. In the post-war period he came to Körting Radio and built it up in 20 years from a turnover of 8 million D-Marks to its present 340 million D-Marks. Körting's main factory at Grassau in the foothills of the Bavarian alps is the most beautifully sited I have ever seen and Böhme had the rare distinction (for a non-Bavarian) of being made an Honarary Citizen of Grassau on his 60th birthday. Körting's mania for quality and reliability resulted in a big export business including thousands of colour TV sets for British rental companies.

Of the youngsters now coming into their own I cite David C. Elsbury who joined Racal as a junior tester. He now heads up the newly formed Racal-Tacticom Ltd with a turnover of £30 million, the two subsidiary manufacturing units Racal-BBC and Racal-Mobilcal, and he also has a seat on the Racal Group main board. A child prodigy? Not at all, just hard work and gumption. More a case of "local boy makes good".

Then there is Richard Gatehouse who left the army in 1955 and set up Brookes and Gatehouse in 1956. He is this year's Gold Medal winner of the Royal Institute of Navigation.

Gatehouse brought electronics to the small boat owner with a range of direction finders and echo sounders, an electronic log and speedometer and, more recently, an analogue computer for the sporting yachtsman which allows even a novice to sail to windward to best advantage and also indicates whether the craft is sailing at optimum speed off the wind. In fact Gatehouse has developed such a range of navigational aids that they have virtually transformed navigation for small craft. Perhaps the greatest compliment to the equipment is that some of it is disallowed under ocean racing rules!

## OIL BONANZA

One reason why the professional sector of the industry is holding up so well is the spate of activity in North Sea Oil. Everything is big in the oil industry. Where lesser industries talk in hushed tones of spending a million, the oil men talk in tens of millions. Those great platforms are like small towns, needing all facilities from crew accommodation through to their own airports and, of course, communications.

The problem here is that the distances to the land mass are too great for v.h.f. or microwave, and too short for reliable use of h.f. radio. So those companies able to supply tropospheric scatter equipment are doing rather well. In the past three years Marconi Communications Systems has taken orders worth £5 million for tropo equipment. BP, Burmah, Occidental, Mobil, Phillips, Signal and Total have all majored on the equipment.

The most complex to date is the network for Phillips Group centred on the 1.75 acre rig at Ekofisk. This rig separates gas from oil, the gas being piped to Emden in West Germany and the oil piped to Teeside in the UK. So tropo links are needed to keep the rig in touch with shore bases in both the UK and Germany. But, in addition, there are two gas compressor sites en route to Germany so the link in the south-east direction is in three hops taking in the compressor sites.

Yet another link will give communication between the Ekofisk platform to another platform in the cod field, some 50 miles to the north-west. The capacity of the links varies but all are being supplied with spare capacity. For example the Ekofisk-Emden link is engineered for 72 voice channels although it will only carry 24 in the first instance.

Meanwhile, sister company Marconi International Marine has been busy with the mobile communications. All the h.f. and v.h.f. required for communication with supply ships and helicopters, and also radar transponders and homing beacons for the helicopters.

And in a world where terrorism is now the rule rather than the exception these rigs will need defending. More radars and other electronic sensors, and possibly missile launchers, will be needed.

## IEE/CEI SPLIT

The Institution of Electrical Engineers, long disenchanted with the Council of Engineering Institutions, has finally given notice that it will withdraw at the end of next year. As the second largest member institute of the CEI and contributing some 15 per cent of total income, said to be £30,000, this dramatic move could be the beginning of a break-up for the CEI.

The IEE view is that the CEI should represent the views of individual chartered engineers and not, as at present, those of the 15 chartered institutions which form the governing board. The CEI have rejected the scheme which, in effect, would have given chartered engineers direct proportional representation. The CEI point out that if the IEE withdraws then IEE members would lose their entitlement to call themselves chartered engineers. Few IEE members will worry over a detail like that as the whole world recognises the abilities of those attaining IEE membership. But the IEE say that they have no confidence in the success of an organisation preserving the present concept of a governing board after 13 years experience of it.

The door may now be closed but I believe it not to be locked. There could yet be a reconciliation.

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| 2N696 | 0·22 | 2N3392 | 0·15 | 2N5457 | 0·49 | AF124 | 0·30 | BC237 | 0·16 | BF178 | 0·35 | 14DIL | 0·40 | ORP12 | 0·55 |
| 2N697 | 0·16 | 2N3393 | 0·15 | 2N5458 | 0·46 | AF125 | 0·30 | BC238 | 0·15 | BF179 | 0·43 | LM710 | 0·47 | R53 | 1·80 |
| 2N698 | 0·82 | 2N3394 | 0·15 | 2N5459 | 0·49 | AF126 | 0·28 | BC239 | 0·15 | BF180 | 0·35 | LM723C | 0·90 | SL414A | 1·80 |
| 2N699 | 0·59 | 2N3402 | 0·18 | 2N5492 | 0·58 | AF127 | 0·28 | BC251 | 0·25 | BF181 | 0·36 | LM741 | | SL610C | 1·70 |
| 2N706 | 0·14 | 2N3403 | 0·19 | 2N5494 | 0·58 | AF139 | 0·65 | BC253 | 0·25 | BF182 | 0·35 | TO99 | 0·40 | SL611C | 1·70 |
| 2N706A | 0·16 | 2N3414 | 0·20 | 2N5496 | 0·61 | AF186 | 0·46 | BC257 | 0·16 | BF183 | 0·55 | 8DIL | 0·40 | SL612C | 1·70 |
| 2N708 | 0·17 | 2N3415 | 0·21 | 2N5777 | 0·45 | AF200 | 0·65 | BC258 | 0·16 | BF184 | 0·30 | 14DIL | 0·38 | SL620C | 2·60 |
| 2N709 | 0·42 | 2N3416 | 0·24 | 2N6027 | 0·45 | AF239 | 0·65 | BC259 | 0·17 | BF185 | 0·30 | LM747 | 1·00 | SL621C | 2·60 |
| 2N711 | 0·50 | 2N3417 | 0·29 | 3N128 | 0·73 | AF240 | 0·90 | BC261 | 0·25 | BF194 | 0·12 | LM748 | | SL623 | 4·59 |
| 2N718 | 0·23 | 2N3440 | 0·59 | 3N139 | 1·42 | AF279 | 0·70 | BC262 | 0·25 | BF195 | 0·12 | 8DIL | 0·60 | SL640C | 3·10 |
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| 2N720 | 0·57 | 2N3442 | 1·40 | 3N141 | 0·81 | AL102 | 1·00 | BC300 | 0·38 | BF197 | 0·15 | LM3900 | 0·70 | SN76003N | 2·92 |
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| 2N916 | 0·28 | 2N3638A | 0·15 | 40361 | 0·40 | BC107 | 0·14 | BC302 | 0·29 | BF200 | 0·40 | LM7812 | 2·50 | SN76023N | 1·60 |
| 2N918 | 0·32 | 2N3639 | 0·27 | 40362 | 0·45 | BC108 | 0·14 | BC303 | 0·54 | BF225J | 0·23 | LM7815 | 2·50 | SN76033N | 2·92 |
| 2N929 | 0·37 | 2N3641 | 0·17 | 40363 | 0·88 | BC109 | 0·14 | BC307 | 0·17 | BF244 | 0·21 | LM7824 | 2·50 | ST2 | 0·20 |
| 2N930 | 0·22 | 2N3702 | 0·12 | 40389 | 0·46 | BC113 | 0·15 | BC308A | 0·15 | BF245 | 0·45 | MC1303 | 1·50 | TAA263 | 1·10 |
| 2N1302 | 0·19 | 2N3703 | 0·13 | 40394 | 0·56 | BC115 | 0·17 | BC309C | 0·20 | BF246 | 0·58 | MC1310 | 2·50 | TAA300 | 1·80 |
| 2N1303 | 0·19 | 2N3704 | 0·15 | 40395 | 0·65 | BC116 | 0·17 | BC317 | 0·12 | BF247 | 0·65 | MC1330P | 0·90 | TAA350 | 2·10 |
| 2N1304 | 0·26 | 2N3705 | 0·15 | 40406 | 0·44 | BC116A | 0·18 | BC318 | 0·12 | BF254 | 0·19 | MC1351P | 0·80 | TAA550 | 0·60 |
| 2N1305 | 0·24 | 2N3706 | 0·15 | 40407 | 0·35 | BC117 | 0·21 | BC337 | 0·20 | BF255 | 0·19 | MC1352P | 0·80 | TAA611C | 2·18 |
| 2N1306 | 0·31 | 2N3707 | 0·18 | 40408 | 0·35 | BC118 | 0·14 | BC338 | 0·20 | BF257 | 0·47 | MC1466 | 3·50 | TAA621 | 2·03 |
| 2N1307 | 0·30 | 2N3708 | 0·14 | 40409 | 0·52 | BC119 | 0·29 | BCY30 | 0·80 | BF258 | 0·53 | MC1469 | 2·75 | TAA661B | 1·32 |
| 2N1308 | 0·47 | 2N3709 | 0·15 | 40410 | 0·52 | BC121 | 0·35 | BCY31 | 0·85 | BF259 | 0·55 | ME0402 | 0·20 | TBA641B | 2·25 |
| 2N1309 | 0·47 | 2N3710 | 0·15 | 40411 | 2·00 | BC125 | 0·16 | BCY32 | 1·15 | BFR39 | 0·24 | ME0404 | 0·13 | TBA651 | 1·69 |
| 2N1671 | 1·54 | 2N3711 | 0·15 | 40594 | 0·74 | BC126 | 0·23 | BCY33 | 0·85 | BFR79 | 0·24 | ME0412 | 0·18 | TBA800 | 1·40 |
| 2N1671A | 1·67 | 2N3712 | 1·20 | 40595 | 0·84 | BC132 | 0·30 | BCY34 | 0·79 | BFS21A | 2·30 | ME4102 | 0·11 | TBA810 | 1·40 |
| 2N1671B | 1·85 | 2N3713 | 1·20 | 40601 | 0·67 | BC134 | 0·13 | BCY38 | 1·00 | BFS28 | 1·36 | ME4104 | 0·11 | TBA820 | 1·15 |
| 2N1711 | 0·45 | 2N3714 | 1·38 | 40602 | 0·61 | BC135 | 0·13 | BCY39 | 1·50 | BFS61 | 0·27 | MJ480 | 0·95 | TBA920 | 2·30 |
| 2N1907 | 5·50 | 2N3715 | 1·50 | 40603 | 0·58 | BC136 | 0·17 | BCY40 | 0·97 | BFS98 | 0·25 | MJ481 | 1·20 | TIL209 | 0·30 |
| 2N2102 | 0·60 | 2N3716 | 1·80 | 40604 | 0·56 | BC137 | 0·17 | BCY42 | 0·28 | BFX29 | 0·30 | MJ490 | 1·05 | TIP29A | 0·49 |
| 2N2147 | 0·78 | 2N3771 | 2·20 | 40636 | 1·10 | BC140 | 0·68 | BCY58 | 0·30 | BFX30 | 0·27 | MJ491 | 1·45 | TIP29C | 0·80 |
| 2N2148 | 0·94 | 2N3772 | 1·80 | 40669 | 1·00 | BC141 | 0·68 | BCY59 | 0·32 | BFX84 | 0·24 | MJ2955 | 1·00 | TIP30A | 0·58 |
| 2N2160 | 0·90 | 2N3773 | 2·65 | 40673 | 0·73 | BC142 | 0·23 | BCY70 | 0·17 | BFX85 | 0·30 | MJE340 | 0·48 | TIP30C | 0·85 |
| 2N2218A | 0·22 | 2N3789 | 2·06 | AC126 | 0·20 | BC143 | 0·25 | BCY71 | 0·22 | BFX87 | 0·28 | MJE2955 | 1·20 | TIP31A | 0·62 |
| 2N2219 | 0·24 | 2N3790 | 2·40 | AC127 | 0·20 | BC147 | 0·14 | BCY72 | 0·15 | BFX88 | 0·25 | MJE3055 | 0·75 | TIP31C | 1·00 |
| 2N2219A | 0·26 | 2N3791 | 2·35 | AC128 | 0·20 | BC148 | 0·14 | BD115 | 0·75 | BFX89 | 0·90 | MJE370 | 0·65 | TIP32A | 0·74 |
| 2N2220 | 0·25 | 2N3792 | 2·60 | AC151V | 0·27 | BC149 | 0·15 | BD116 | 0·75 | BFY50 | 0·23 | MJE371 | 0·75 | TIP32C | 1·25 |
| 2N2221 | 0·18 | 2N3794 | 0·24 | AC152V | 0·49 | BC153 | 0·18 | BD121 | 1·00 | BFY51 | 0·23 | MJE520 | 0·60 | TIP33A | 1·01 |
| 2N2221A | 0·21 | 2N3819 | 0·37 | AC153 | 0·35 | BC154 | 0·18 | BD123 | 0·82 | BFY52 | 0·21 | MJE521 | 0·70 | TIP33C | 1·45 |
| 2N2222 | 0·20 | 2N3820 | 0·64 | AC153K | 0·40 | BC157 | 0·16 | BD124 | 0·67 | BFY53 | 0·18 | MP8111 | 0·32 | TIP34A | 1·51 |
| 2N2222A | 0·25 | 2N3823 | 0·78 | AC154 | 0·25 | BC158 | 0·16 | BD131 | 0·40 | BFY90 | 0·75 | MP8112 | 0·40 | TIP34C | 2·60 |
| 2N2368 | 0·25 | 2N3904 | 0·27 | AC176 | 0·30 | BC160 | 0·60 | BD132 | 0·50 | BRY39 | 0·38 | MP8113 | 0·47 | TIP35A | 2·90 |
| 2N2369 | 0·20 | 2N3906 | 0·27 | AC176K | 0·40 | BC167B | 0·15 | BD135 | 0·43 | BSX20 | 0·21 | MPF102 | 0·39 | TIP36A | 3·70 |
| 2N2369A | 0·22 | 2N4036 | 0·67 | AC187K | 0·35 | BC168B | 0·15 | BD136 | 0·47 | BSX21 | 0·29 | MPSA05 | 0·25 | TIP41A | 0·79 |
| 2N2646 | 0·55 | 2N4037 | 0·42 | AC188K | 0·40 | BC168C | 0·15 | BD137 | 0·55 | BU104 | 2·00 | MPSA06 | 0·31 | TIP41C | 1·40 |
| 2N2647 | 0·98 | 2N4058 | 0·18 | ACY18 | 0·24 | BC169B | 0·15 | BD138 | 0·63 | BU105 | 2·25 | MPSA12 | 0·35 | TIP42A | 0·90 |
| 2N2904 | 0·22 | 2N4059 | 0·15 | ACY19 | 0·27 | BC169C | 0·15 | BD139 | 0·71 | C106D | 0·65 | MPSA55 | 0·25 | TIP42C | 1·60 |
| 2N2904A | 0·24 | 2N4060 | 0·15 | ACY20 | 0·22 | BC170A | 0·15 | BD140 | 0·87 | CA3018A | 0·85 | MPSA56 | 0·31 | TIP49C | 0·70 |
| 2N2905 | 0·25 | 2N4061 | 0·15 | ACY21 | 0·26 | BC171 | 0·16 | BD529 | 0·80 | CA3020A | 1·80 | MPSU05 | 0·65 | TIP53 | 1·70 |
| 2N2905A | 0·26 | 2N4062 | 0·15 | ACY28 | 0·20 | BC172 | 0·17 | BD530 | 0·80 | CA3028A | 0·79 | MPSU06 | 0·58 | TIP2955 | 0·98 |
| 2N2906 | 0·19 | 2N4126 | 0·21 | ACY30 | 0·58 | BC177 | 0·28 | BDY20 | 1·05 | CA3035 | 1·37 | MPSU55 | 0·63 | TIP3055 | 0·50 |
| 2N2906A | 0·21 | 2N4289 | 0·34 | AD142 | 0·57 | BC178 | 0·27 | BF115 | 0·36 | CA3046 | 0·70 | MPSU56 | 0·80 | TIY43 | 0·28 |
| 2N2907 | 0·22 | 2N4919 | 0·95 | AD143 | 0·68 | BC179 | 0·30 | BF117 | 0·55 | CA3048 | 2·11 | NE555V | 0·70 | ZTX300 | 0·13 |
| 2N2907A | 0·24 | 2N4920 | 1·10 | AD149V | 1·20 | BC182 | 0·12 | BF121 | 0·35 | CA3052 | 1·62 | NE556 | 1·30 | ZTX301 | 0·13 |
| 2N2924 | 0·20 | 2N4921 | 0·83 | AD150 | 1·15 | BY182L | 0·12 | BF123 | 0·35 | CA3089E | 1·96 | NE560 | 4·48 | ZTX302 | 0·20 |
| 2N2925 | 0·20 | 2N4922 | 1·00 | AD161 | 0·50 | BC183 | 0·12 | BF125 | 0·35 | CA3090Q | 4·23 | NE561 | 4·48 | ZTX500 | 0·15 |
| 2N2926 | | 2N4923 | 1·00 | AD162 | 0·50 | BC183L | 0·12 | BF152 | 0·20 | LM301A | 0·48 | NE565A | 4·48 | ZTX501 | 0·13 |
| Green | 0·12 | 2N5190 | 0·92 | AD161 } | PR | BC184 | 0·13 | BF153 | 0·25 | LM308 | 2·50 | OC23 | 1·35 | ZTX502 | 0·18 |
| Yellow | 0·12 | 2N5191 | 0·96 | AD162 } | 1·20 | BC184L | 0·13 | BF154 | 0·20 | LM309K | 1·88 | OC28 | 0·76 | ZTX530 | 0·23 |

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| 2G371 | 0·75 |
| 2G381 | 0·22 |
| 2G414 | 0·30 |
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| 2N404 | 0·22 |
| 2N697 | 0·16 |
| 2N698 | 0·30 |
| 2N706 | 0·12 |
| 2N706A | 0·12 |
| 2N708 | 0·15 |
| 2N709 | 0·40 |
| 2N1091 | 0·55 |
| 2N1131 | 0·25 |
| 2N1132 | 0·24 |
| 2N1302 | 0·18 |
| 2N1303 | 0·18 |
| 2N1304 | 0·28 |
| 2N1305 | 0·22 |
| 2N1306 | 0·28 |
| 2N1307 | 0·28 |
| 2N1308 | 0·28 |
| 2N2147 | 0·78 |
| 2N2148 | 0·60 |
| 2N2160 | 0·78 |
| 2N2218 | 0·23 |
| 2N2219 | 0·25 |
| 2N2369A | 0·16 |
| 2N2444 | 1·99 |
| 2N2613 | 0·75 |
| 2N2646 | 0·50 |
| 2N2904 | 0·20 |
| 2N2904A | 0·25 |
| 2N2906 | 0·20 |
| 2N2907 | 0·23 |
| 2N2924 | 0·13 |
| 2N2925 | 0·15 |
| 2N2926 | 0·12 |
| 2N3054 | 0·48 |
| 2N3055 | 0·45 |
| 2N3702 | 0·11 |
| 2N3705 | 0·15 |
| 2N3706 | 0·11 |
| 2N3707 | 0·13 |
| 2N3709 | 0·10 |
| 2N3710 | 0·11 |
| 2N3711 | 0·11 |
| 2N3819 | 0·38 |
| 2N4289 | 0·30 |
| 2N5027 | 0·53 |
| 2N5088 | 0·33 |
| 2S301 | 0·59 |
| 2S304 | 1·15 |
| 2S501 | 0·75 |
| 2S703 | 1·00 |
| AA129 | 0·20 |
| AAZ12 | 0·75 |
| AAZ13 | 0·12 |
| AC107 | 0·51 |
| AC126 | 0·25 |
| AC127 | 0·25 |
| AC128 | 0·15 |
| AC187 | 0·21 |
| AC188 | 0·20 |
| ACY17 | 0·40 |
| ACY18 | 0·27 |
| ACY19 | 0·27 |
| ACY20 | 0·22 |
| ACY21 | 0·22 |
| ACY22 | 0·16 |
| ACY27 | 0·25 |
| ACY28 | 0·25 |
| ACY39 | 0·78 |
| ACY40 | 0·22 |
| ACY41 | 0·22 |
| ACY44 | 0·32 |
| AD140 | 0·50 |
| AD149 | 0·50 |
| AD161 | 0·44 |
| AD162 | 0·44 |
| AF106 | 0·30 |
| AF114 | 0·25 |
| AF115 | 0·25 |
| AF116 | 0·25 |
| AF117 | 0·24 |
| AF118 | 0·57 |
| AF119 | 0·20 |
| AF124 | 0·30 |
| AF125 | 0·30 |
| AF126 | 0·30 |
| AF127 | 0·30 |
| AF139 | 0·41 |
| AF178 | 0·55 |
| AF179 | 0·65 |
| AF180 | 0·55 |
| AF181 | 0·50 |
| AF186 | 0·48 |

| | £p |
|---|---|
| AFZ11 | 1·15 |
| AFZ12 | 2·00 |
| ASY26 | 0·25 |
| ASY27 | 0·33 |
| ASY28 | 0·25 |
| ASY29 | 0·30 |
| ASY36 | 0·25 |
| ASY50 | 0·20 |
| ASY51 | 0·40 |
| ASY53 | 0·20 |
| ASY55 | 0·20 |
| ASY62 | 0·25 |
| ASY66 | 0·33 |
| ASZ21 | 1·00 |
| ASZ23 | 0·75 |
| AU104 | 1·00 |
| AUY10 | 1·50 |
| BC107 | 0·14 |
| BC108 | 0·13 |
| BC109 | 0·14 |
| BC113 | 0·15 |
| BC115 | 0·20 |
| BC116 | 0·20 |
| BC116A | 0·23 |
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| BC121 | 0·20 |
| BC122 | 0·20 |
| BC125 | 0·68 |
| BC126 | 0·65 |
| BC140 | 0·55 |
| BC147 | 0·10 |
| BC148 | 0·08 |
| BC149 | 0·10 |
| BC157 | 0·14 |
| BC158 | 0·12 |
| BC160 | 0·63 |
| BC169 | 0·14 |
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| BCY39 | 1·50 |
| BCY40 | 0·80 |
| BCY42 | 0·30 |
| BCY70 | 0·18 |
| BCY71 | 0·22 |
| BCZ10 | 0·60 |
| BCZ11 | 0·65 |
| BD121 | 1·00 |
| BD123 | 1·00 |
| BD124 | 0·65 |
| BDY11 | 1·45 |
| BF115 | 0·20 |
| BF167 | 0·25 |
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| BF184 | 0·22 |
| BF185 | 0·22 |
| BF194 | 0·10 |
| BF195 | 0·13 |
| BF196 | 0·15 |
| BF197 | 0·15 |
| BF861 | 0·25 |
| BF898 | 0·25 |
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| BFX13 | 0·26 |
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| BFX35 | 0·98 |
| BFX63 | 0·50 |
| BFX84 | 0·25 |
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| BFX86 | 0·25 |
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| BFY18 | 0·45 |
| BFY19 | 0·55 |
| BFY24 | 0·45 |
| BFY44 | 1·00 |
| BFY50 | 0·21 |
| BFY51 | 0·20 |
| BFY52 | 0·20 |
| BFY53 | 0·17 |
| BFY64 | 0·36 |
| BFY90 | 0·81 |
| BR100 | 0·40 |
| BSX27 | 0·50 |
| BSX60 | 0·93 |
| BSX76 | 0·18 |
| BSY26 | 0·17 |
| BSY27 | 0·20 |
| BSY51 | 0·50 |
| BSY95A | 0·12 |
| BSY95 | 0·12 |
| BT102/500R | 0·75 |
| BTY42 | 0·92 |
| BTY79/100R | 0·75 |
| BTY79/400R | 1·50 |
| BY100 | 0·27 |
| BY126 | 0·14 |
| BY127 | 0·12 |
| BY182 | 0·85 |

| | £p |
|---|---|
| BY213 | 0·25 |
| BYZ10 | 0·45 |
| BYZ11 | 0·40 |
| BYZ12 | 0·40 |
| BYZ13 | 0·42 |
| BYZ15 | 1·25 |
| BYZ16 | 0·60 |
| BZY88 | 0·10 |
| C111 | 0·55 |
| CRS1/05 | 0·35 |
| CRS1/40 | 0·50 |
| CS4B | 1·90 |
| CS10B | 3·50 |
| DD000 | 0·15 |
| DD003 | 0·15 |
| DD006 | 0·25 |
| DD007 | 0·40 |
| DD008 | 0·38 |
| GD3 | 0·33 |
| GD4 | 0·10 |
| GD5 | 0·33 |
| GD8 | 0·25 |
| GD12 | 0·10 |
| GET102 | 0·50 |
| GET103 | 0·40 |
| GET113 | 0·35 |
| GET114 | 0·30 |
| GET115 | 0·90 |
| GET116 | 0·85 |
| GET120 | 0·50 |
| GET872 | 0·30 |
| GET875 | 0·40 |
| GET880 | 0·60 |
| GET881 | 0·25 |
| GET882 | 0·35 |
| GET885 | 0·40 |
| GEX44 | 0·08 |
| GEX45/1 | 0·45 |
| GEX941 | 0·45 |
| GJ3M | 0·50 |
| GJ4M | 0·50 |
| GJ5M | 0·25 |
| GJ7M | 0·50 |
| HG1005 | 0·50 |
| HS100A | 0·20 |
| MAT100 | 0·20 |
| MAT101 | 0·25 |
| MAT120 | 0·20 |
| MAT121 | 0·25 |
| MJE340 | 0·47 |
| MJE520 | 0·63 |
| MJE2955 | 1·27 |
| MJE3055 | 0·77 |
| MPF102 | 0·40 |
| MPF103 | 0·36 |
| MPF104 | 0·35 |
| MPF105 | 0·36 |
| NKT128 | 0·45 |
| NKT129 | 0·30 |
| NKT211 | 0·25 |
| NKT213 | 0·25 |
| NKT214 | 0·24 |
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| NKT278 | 0·25 |
| NKT301 | 0·65 |
| NKT304 | 0·75 |
| NKT403 | 0·70 |
| NKT404 | 1·00 |
| NKT678 | 0·30 |
| NKT713 | 0·30 |
| NKT773 | 0·25 |
| NKT777 | 0·38 |
| OA5 | 0·72 |
| OA6 | 0·12 |
| OA47 | 0·08 |
| OA70 | 0·10 |
| OA71 | 0·20 |
| OA73 | 0·15 |
| OA74 | 0·15 |
| OA79 | 0·10 |
| OA81 | 0·18 |
| OA85 | 0·15 |
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| OAZ241 | 0·25 |
| OAZ242 | 0·15 |
| OAZ244 | 0·25 |
| OAZ246 | 0·15 |
| OAZ290 | 0·38 |
| OC16 | 1·00 |
| OC16T | 1·00 |
| OC19 | 0·50 |
| OC22 | 1·00 |
| OC23 | 1·25 |
| OC24 | 1·10 |
| OC25 | 0·40 |
| OC26 | 0·40 |
| OC28 | 0·66 |
| OC29 | 0·65 |
| OC30 | 0·40 |
| OC35 | 0·55 |
| OC36 | 0·60 |
| OC41 | 0·35 |
| OC42 | 0·40 |
| OC43 | 0·70 |
| OC44 | 0·20 |
| OC44M | 0·17 |
| OC45 | 0·20 |
| OC45M | 0·18 |
| OC46 | 0·27 |
| OC57 | 0·60 |
| OC58 | 0·60 |
| OC59 | 0·60 |
| OC66 | 0·50 |
| OC70 | 0·18 |
| OC71 | 0·18 |
| OC72 | 0·28 |
| OC73 | 0·50 |
| OC74 | 0·30 |
| OC75 | 0·30 |
| OC76 | 0·30 |
| OC77 | 0·54 |
| OC78 | 0·25 |
| OC79 | 0·30 |
| OC81 | 0·29 |
| OC81D | 0·28 |
| OC81M | 0·20 |
| OC81DM | 0·18 |
| OC81Z | 0·45 |
| OC82 | 0·28 |
| OC82D | 0·25 |
| OC83 | 0·27 |
| OC84 | 0·30 |
| OC114 | 0·38 |
| OC122 | 1·00 |
| OC123 | 1·10 |
| OC139 | 0·40 |
| OC140 | 1·14 |
| OC141 | 0·80 |
| OC169 | 0·20 |
| OC170 | 0·30 |
| OC171 | 0·30 |
| OC200 | 0·75 |
| OC201 | 1·50 |
| OC202 | 1·50 |
| OC203 | 0·75 |
| OC204 | 1·50 |
| OC205 | 1·75 |
| OC206 | 1·10 |
| OC207 | 1·00 |
| OC460 | 0·20 |
| OC470 | 0·30 |
| OCP71 | 1·20 |
| ORP12 | 0·60 |
| ORP60 | 0·55 |
| ORP61 | 0·48 |
| SX68 | 0·20 |
| SX631 | 0·45 |
| SX635 | 0·55 |
| SX640 | 0·75 |
| SX641 | 0·75 |
| SX642 | 0·60 |
| SX644 | 0·85 |
| SX645 | 0·85 |
| TIC44 | 0·29 |
| V15/30P | 0·75 |
| V30/201P | 0·75 |
| V60/201 | 0·50 |
| V60/201P | 0·75 |
| XA101 | 0·10 |
| XA102 | 0·18 |
| XA151 | 0·15 |
| XA152 | 0·15 |
| XA161 | 0·25 |
| XA162 | 0·25 |
| XB101 | 0·43 |
| XB102 | 0·30 |
| XB103 | 0·35 |
| XB113 | 0·30 |
| XB121 | 0·43 |

| | £p |
|---|---|
| ZS170 | 0·10 |
| ZS271 | 0·18 |
| ZT21 | 0·25 |
| ZT43 | 0·25 |
| ZTX107 | 0·12 |
| ZTX108 | 0·10 |
| ZTX300 | 0·13 |
| ZTX304 | 0·24 |
| ZTX500 | 0·13 |
| ZTX503 | 0·16 |
| ZTX531 | 0·25 |

**INTEGRATED CIRCUITS**

| | |
|---|---|
| 7400 | 0·16 |
| 7401 | 0·16 |
| 7402 | 0·16 |
| 7403 | 0·16 |
| 7404 | 0·26 |
| 7405 | 0·22 |
| 7406 | 0·42 |
| 7407 | 0·42 |
| 7408 | 0·28 |
| 7409 | 0·28 |
| 7410 | 0·16 |
| 7411 | 0·25 |
| 7412 | 0·30 |
| 7413 | 0·36 |
| 7416 | 0·36 |
| 7417 | 0·36 |
| 7420 | 0·16 |
| 7422 | 0·25 |
| 7423 | 0·37 |
| 7425 | 0·37 |
| 7427 | 0·37 |
| 7428 | 0·40 |
| 7430 | 0·16 |
| 7432 | 0·37 |
| 7433 | 0·37 |
| 7437 | 0·37 |
| 7438 | 0·37 |
| 7440 | 0·22 |
| 7441AN | 0·92 |
| 7442 | 0·79 |
| 7450 | 0·16 |
| 7451 | 0·16 |
| 7453 | 0·16 |
| 7454 | 0·16 |
| 7460 | 0·16 |
| 7470 | 0·36 |
| 7472 | 0·38 |
| 7473 | 0·41 |
| 7474 | 0·42 |
| 7475 | 0·59 |
| 7476 | 0·45 |
| 7480 | 0·60 |
| 7482 | 0·87 |
| 7483 | 1·10 |
| 7484 | 1·00 |
| 7486 | 0·47 |
| 7490 | 0·55 |
| 7491AN | 1·00 |
| 7492 | 0·70 |
| 7493 | 0·70 |
| 7494 | 0·80 |
| 7495 | 0·80 |
| 7496 | 0·95 |
| 7497 | 3·87 |
| 74100 | 1·89 |
| 74107 | 0·45 |
| 74110 | 0·58 |
| 74111 | 0·86 |
| 74118 | 0·90 |
| 74119 | 1·68 |
| 74121 | 0·50 |
| 74122 | 0·70 |
| 74123 | 1·00 |
| 74141 | 0·90 |
| 74145 | 1·26 |
| 74150 | 1·75 |
| 74151 | 1·00 |
| 74154 | 2·00 |
| 74155 | 1·00 |
| 74156 | 1·00 |
| 74157 | 0·95 |
| 74170 | 2·52 |
| 74174 | 1·57 |
| 74175 | 1·10 |
| 74176 | 1·26 |
| 74190 | 2·00 |
| 74191 | 2·00 |
| 74192 | 2·00 |
| 74193 | 2·00 |
| 74194 | 1·30 |
| 74195 | 1·10 |
| 74196 | 1·20 |
| 74197 | 1·20 |
| 74198 | 2·77 |
| 74199 | 2·52 |

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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. All quoted prices are those at the time of going to press.

## NEW "CURRENT DUMPING" AUDIO AMPLIFIER

An amplifier using a new technique in the output stage termed "current dumping" is announced by **Quad.**

Basically, a current dumping amplifier consists of a heavy duty high power amplifier (the current dumpers) which provides most of the current drawn by the load, and a very high quality low power amplifier which provides the control, so arranged that any error in the output stage is exactly compensated by an error signal from the low power section. Performance is solely dependent upon the low power amplifier which can be made very good indeed.

Since the linearity of the output devices is not important, biasing is unnecessary and crossover and thermal tracking problems disappear. The output devices themselves need not be matched and inherently more reliable types may be used.

The Quad 405 is the first practical realisation of this new circuit. Designed to drive modern low efficiency loudspeakers, the 405 has an output of 100W per channel into 8 ohms with total distortion products of less than 0·01 per cent at mid-frequencies. Since there are no internal adjustments, nothing can ever go out of alignment and in the unlikely event of a component failure, replacement can be effected and performance restored without re-alignment.

The Quad 405 has a recommended retail price of £115·00 plus VAT and is available from Quad appointed retailers.

## CATALOGUE ROUND-UP

Now that most of the dust has settled after the great VAT storm, we have been inundated with new catalogues from distributors over the last couple of months. But even now prices are far from being stable and most companies are issuing price supplements on a quarterly basis.

The best solution to this problem is to always look through the *latest advertisements* appearing in this magazine or contact the company concerned before ordering any goods.

Unfortunately, as space is at a premium we can only give brief details of the excellent catalogues and brochures we have received.

The new look 200-page **Henry's Radio** Catalogue covers most requirements for the constructor from semiconductors and solder to discotheque and p.a. equipment.

The catalogue is nicely broken down into sections and is fully illustrated. It is good to see that they think our data charts are useful by devoting four pages to reproducing them. Why no acknowledgment though?

The catalogue costs 50p, plus 20p postage and packing, but includes a 50p redeemable voucher. Copies are available from **Henry's Radio, 303 Edgware Road, London W2 1BW.**

The second edition of the **Doram Electronics** Catalogue contains 100 pages and costs 60p including postage. It contains a 16-page data section and again is completely illustrated.

Included for the 60p is a free up-date product and price information service which, it is hoped, will be issued every March and December.

Copies of the Doram catalogue can be obtained from **Doram Electronics Ltd., P.O. Box TR8, Wellington Road Industrial Estate, Leeds LS12 2UF.**

With 244 pages the **Home Radio** Components Catalogue contains probably one of the largest selection of general purpose components, but is rather thin on the ground where semiconductor and i.c.s are concerned.

The price of the catalogue is 85p plus 45p post and packing and also includes 70p "save money" vouchers. Home Radio also issue a separate price supplement which is replaced free when new editions are published.

The address of **Home Radio (Components) Ltd.,** is **234-240 London Road, Mitcham, Surrey CR4 3HD.**

Two other catalogues received in the general components field worth investigating are the **Phoenix Electronics,** 200 pages, and the **Nobel Electronics,** 132 pages. No purchase price is quoted for these two catalogues.

For further information of the Phoenix and Nobel catalogues readers should write to: **Phoenix Electronics (Portsmouth) Ltd., 139/141 Havant Road, Drayton, Portsmouth, Hants PO6 2AA** or **Nobel Electronics, Nobel House, Bowater Road, London SE18 5TN.**

On the semiconductor front, we can recommend the **Electrovalue** Catalogue No. 8 This 144-page edition has a very comprehensive section on semiconductors and i.c.s and contains useful reference data, including device case outlines.

The Electrovalue catalogue costs 40p and includes a 40p voucher for use on orders over £10. Copies of the catalogue can be obtained from **Electrovalue Ltd., 28 St. Judes Road, Englefield Green, Egham, Surrey TW20 0HB.**

Of particular interest to our organ and synthesiser constructors is the 132-page **Maplin** Catalogue. This contains a section listing complete keyboards, stop tabs, gold contact wire, patch board and patch plugs and even a complete organ kit.

Also listed are complete circuits and numerous application notes for specific devices.

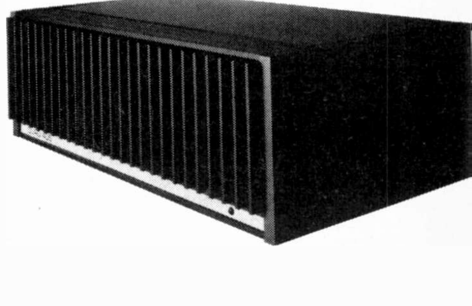
Available from **Maplin Electronic Supplies, P.O. Box 3, Rayleigh, Essex,** price 40p, they guarantee their prices for two months. For an additional 30p they will send, every two months, their latest price list together with information on any new additions and redeemable coupons.

Finally, our last item is aimed at the audio enthusiast. At first glance, if any reader cannot find an audio lead to suit his requirements in the **Audio Packs** Trade Reference catalogue then he must have a very strange set-up.

This 76-page catalogue must contain practically every possible combination of plugs, sockets and connecting leads you are likely to encounter in domestic audio equipment. Each plug, socket and lead is excellently illustrated and should help to solve a lot of the interconnecting problems associated with audio.

For the sum of £1 plus postage this trade catalogue would seem to be a good investment and is available from **Tape Recorder Spares Ltd., 206-210 Ilderton Road, London SE15 1NS.**

**The new 100W Quad 405. The amplifier uses novel techniques to overcome thermal and cross-over problems associated with Class AB designs.**



# Readout—

## A SELECTION FROM OUR POSTBAG

**Readers requiring a reply to any letter must include a stamped addressed envelope. We regret that we cannot answer any technical queries on the telephone.**

## Unbalanced

Sir,—While I go along with Mr. Ainslie's views in general on the subject of the D/A pulse response of the 8-channel Trace Multiplier, see *Readout* last month. I would suggest that the constant system impedance is only important in that it equalises the rise time of each bit of the converter, thus helping to eliminate overshoot on worst-case switching of the bits.

An example of such overshoot is provided by the photograph of the D/A converter output, in the August issue. An overshoot of almost one bit is seen between the fourth and fifth steps of the staircase, if the photograph is examined carefully. This corresponds to simultaneous changes in all the bits.

Incidentally, the blanking pulse to suppress such effects, generated by C8 and R32, would seem to have a width of about 13μs, which is longer than the clock period.

In the alternative circuit which I put forward in my letter last month, balancing impedance is less important than keeping impedances as low as possible. In fact, unbalanced impedance is used to advantage in minimising the rise time of the large flyback step which begins each scan.

J. R. Keneally,
Weymouth.

## Increased count

Sir—When using Mr Brewitt's excellent counter system (see Ingenuity Unlimited, May) in the higher frequency ranges, the number of 7493's has to be increased and it may become desirable to have more than the eight cross-connections provided by one 7430 between the 7493's and the reset circuit.

Two 7430's can provide up to sixteen such cross-connections but result in two outputs which need to be unified before being fed to the rest of the reset circuit.

These two outputs can be satisfactorily controlled by feeding them into the two inputs of one OR gate in a 7432 and taking the one output from the 7432 to the rest of the reset circuit as shown in Fig. 1.

N. H. Jeffery,
Derby.

## Constructors wanted

Sir — Congratulations on your Microprocessors articles. As Chairman of the British Amateur Electronics Club (B.A.E.C.) I am particularly interested as our current major project is the B.A.E.C. Computer.

Members are contributing articles and letters on the design to the B.A.E.C. "Newsletter", and there is considerbale enthusiasm for this major project, though some members think it is a waste of time!

When the design is completed, members in all parts of the country will be able to volunteer to make individual sections, with all the components provided by the B.A.E.C.

Naturally, computers are not the be-all and end-all of electronics, and all aspects are covered in the B.A.E.C. Newsletters and meetings. However, I hope our design will help members understand more about modern electronics, and perhaps even encourage them to solder properly!

In case any of your readers are interested, I would appreciate it if you would mention in your excellent magazine that further details of the British Amateur Electronics Club can be obtained from our Hon. Secretary, Mr J. G. Margetts, 11 Hazelbury Drive, Warmley, Bristol.

C. Bogod
Penarth.

## Calculator games!

Sir—Little pocket calculators have become so popular that they've even started playing "games" with them!

Have any of your readers heard the story of the Arab Sheik who had seven sons and ten daughters, with 77 grand-children, and 345 great-grand-children. Now, how did he manage to keep them all in the lap of luxury?

If you tap these figures out on your electronic calculator, and then turn it upside-down, the answer will be quite evident. Try it and see.

Douglas Byrne, G3KPO/FOBMN
Curator of the Wireless Museum
Shanklin, IoW.

## Easy Rider

Sir,—With reference to your P.E. Engine Analyser (October 1975). I am enquiring to ascertain whether or not the instrument is applicable to all engines? In particular motorcycle engines, which also require timing adjustments etc.

I would be pleased to see some mention of this in a further article or under a separate heading. I feel that the instrument has great potential, and if any alterations to the circuit are necessary could they be published in a future issue.

I would also like to point out that in the case of motorcycles there are a lot of 3 cylinder machines around. Notably our own British Triumph Trident not to mention the large number of Japanese triples on the road.

My point is this, if the analyser is useful for the motorcycle engine, which I think it is, I'm sure other readers would be very pleased to see some modification to the circuit to enable 3 cylinder engines to be tuned.

This would, of course, replace the 8 cylinder alternative which to date no one has put into use on a motorcycle. The 6 cylinder alternative could also be adapted if the 8 cylinder circuit was not suitable, but if you just happen to have a Benelli 750 six this would not be suitable.

I hope some of the suggestions could be taken up by Mr. Haley who is much more able than I where electronic design is concerned.

Thanks for an excellent magazine and hobby.

M. Simpson,
Sheffield.

In reply to Mr Simpson's letter, my knowledge of motor cycle engines is very limited, but I can see no reason why the Engine Analyser should not be used on any four-stroke engine, provided connection can be made to the contact breaker terminal of the coil when the engine is running.

To modify one of the cylinder switch positions for a 3-cylinder engine it is only necessary to change the value of the appropriate timing resistors associated with IC1.

The resistance should be

$$\frac{32}{\text{No. of cyls.}}\,\text{k}\Omega = 10{\cdot}7\text{k}\Omega$$

for 3-cylinders. Thus, if the 8-cylinder position is used, R20 and R21 should be changed to 6·8kΩ and 3·9kΩ. Alternatively, a six-position switch could be used to cover the whole range.—D.H.

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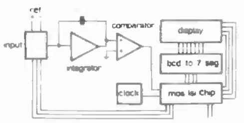


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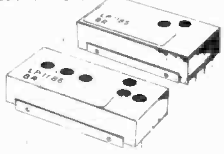


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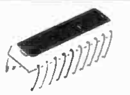

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| 74181 | £3.20 * | £2.50 * | £1.90 * |
| 74192 | £1.35 * | £1.14 * | 90p * |
| 74193 | £1.35 * | £1.14 * | 90p * |
| 74196 | £1.64 * | £1.34 * | 99p * |

## LINEAR I.C.'s

| | | |
|---|---|---|
| 555 (8 pin dip)V | 55p | * |
| 555 (TO-99)T | 81p | * |
| 556 (14 pin dip) | £1.29 | * |
| 703 (RF/IF Amp) | 68p | |
| 709 (8 pin dip) | 38p | |
| 709 (TO-99) | 45p | |
| 709 (14 pin dip) | 39p | |
| 710 (8 pin dip) | 39p | |
| 710 (TO-99) | 45p | |
| 710 (14 pin dip) | 44p | |
| 711(TO-99) | 51p | |
| 711 (14 pin dip) | 44p | |
| 720 (A.M.Radio) | £1.76 | |
| 723 (TO-99) | £1.09 | |
| 723 (14 pin dip | 74p | |
| 741 (8 pin dip | 36p | |
| 741 (TO-99) | 43p | |
| 741 (14 pin dip) | 36p | |
| 747 (14 pin dip) | £1.04 | |
| 748 (8 pin dip) | 42p | |
| 748 (TO-99) | 46p | |
| 748 (14 pin dip) | 49p | |
| 753 (F.M. Ist.I.F) | £1.08 | |
| 75491 | 88p | * |
| 75492 | £1.10 | * |
| **Regulators 100 mA** | | |
| 78105WC (TO-92) | 60p | * |
| 78L12WC (TO-92) | 60p | * |
| 78L15WC (TO-92) | 60p | * |
| **Regulators 100mA** | | |
| 78L05AWC (TBA625A) | 90p | * |
| 78L12AWC (TBA625B) | 90p | * |
| 78L15AWC (TBA625C) | 90p | * |
| **Regulators 500mA** | | |
| 78M05HC | £1.35 | * |
| 78M12HC | £1.35 | * |
| 78M15HC | £1.35 | * |
| 78M18HC | £1.35 | * |
| 78M24HC | £1.35 | * |
| **Regulators 1A** | | |
| 7805KC (TO-3) | £2.09 | * |
| 7812KC (TO-3) | £2.09 | * |
| 7815KC (TO-3) | £2.09 | * |
| 7818KC (TO-3) | £2.09 | * |
| 7824KC (TO-3) | £2.09 | * |
| **Regulators 1A** | | |
| 7805UC (TO-220) | £1.72 | * |
| 7812UC (TO-220) | £1.72 | * |
| 7815UC (TO-220) | £1.72 | * |
| 7818UC (TO-220) | £1.72 | * |
| 7824UC (TO-220) | £1.72 | * |
| ICL8030 | £3.52 | * |

| | | |
|---|---|---|
| AY-1-0212 | £6.93 | |
| AY-1-5051 | £1.44 | |
| AY-5-1224 | £3.95 | * |
| AY-5-3500 | £6.59 | * |
| AY-5-3507 | £6.59 | * |
| AY-5-4007 | £7.94 | * |
| BHA0002 | £3.01 | |
| CA2111 | £1.19 | |
| CA3045 | £1.69 | |
| CA3046 | 88p | |
| CA3053 | 59p | |
| CA3065 | £1.60 | |
| CA3075 | £1.64 | |
| CA3078 | £1.26 | |
| CA3080 | 59p | |
| CA3081 | £1.86 | |
| CA3082 | £1.86 | |
| CA3089E (TDA1200) | £2.43 | |
| CA3097E | £1.67 | * |
| CA3123E | £1.76 | |
| CA3130 | 84p | |
| CA3401E (LM3900) | 68p | |
| CA3600E | £1.44 | |
| CT7001 | £5.34 | * |
| L005T1 (TO.3) | £1.46 | * |
| L036T1 (TO.3) | £1.46 | * |
| L037T1 (TO-3) | £1.46 | * |
| L129 (SOT-32) | 85p | * |
| L130 (SOT-32) | 85p | * |
| L131 (SOT-32) | 85p | * |
| LM301T (TO-99) | 65p | |
| LM301S (8 pin dip) | 59p | |
| LM301A T(TO-99) | 67p | |
| LM301A S(8 pin dip) | 59p | |
| LM307 T (TO-99) | 59p | |
| LM307 S (8 pin dip) | 57p | |
| LM308 T (TO-99) | £1.96 | |
| LM308 S (8 pin dip) | 98p | |
| LM308A T (TO-99) | £7.92 | |
| LM308A S (8 pin dip) | £6.90 | |
| LM309K | £2.34 | * |
| LM339 | £2.25 | |
| LM370N | £2.85 | |
| LM371 | £2.08 | |
| LM372N | £1.99 | |
| LM373N | £2.99 | |
| LM377N | £2.71 | |
| LM380 | £1.25 | |
| LM381 | £1.85 | |
| LM382 | £1.66 | |
| LM703 | 68p | |
| LM1820 | £1.03 | |

| | | |
|---|---|---|
| LM2111 | £1.12 | |
| LM3900 | 69p | |
| LM3909 | 66p | * |
| MC1303L | £1.84 | |
| MC1306P | 80p | |
| MC1310P | £2.39 | |
| MC1312 | £2.42 | |
| MC1314 | £4.13 | |
| MC1315 | £4.62 | |
| MC1327 | £1.12 | |
| MC1330P | 83p | |
| MC1339P | £1.52 | |
| MC1350 | 64p | |
| MC1351 | 88p | |
| MC1352 | 88p | |
| MC1357 | £1.57 | |
| MC1358(CA3065) | £1.16 | |
| MC1375 | £1.48 | |
| MC1455 (555T) | 62p | * |
| MC1456CG | £1.68 | |
| MC1458CP1 | 84p | |
| MC1468G | £2.18 | * |
| MC1495L | £4.24 | |
| MC1496G | 96p | |
| MC3302P | £1.50 | |
| MC3401P | 74p | |
| MFC4000B | 87p | |
| MFC4060A | 79p | * |
| MFC6030A | 79p | * |
| MFC6040 | 96p | |
| MFC6070 | £1.66 | |
| MM5314 | £4.80 | * |
| MM5316 | £9.99 | * |
| MVR5V (TO-3) | £1.45 | * |
| MVR12V (TO-3) | £1.45 | * |
| MVR15V (TO-3) | £1.45 | * |
| NE540l | £1.25 | |
| NE546A | £1.16 | |
| NE555V | 73p | * |
| NE556 | £1.29 | * |
| NE560B | £5.06 | |
| NE561B | £5.06 | |
| NE562B | £5.06 | |
| NE563 | £2.96 | |
| NE565N | £2.63 | |
| NE566V | £1.87 | |
| NE567V | £2.63 | |
| SL414A | £2.09 | |
| SL415A | £2.75 | |
| SL437D | £7.50 | |
| SL440 | £2.84 | * |
| SN75491N | 88p | * |
| SN75492N | £1.10 | * |

ZN414 Leaflet free with devices (10p alone)

MC1310; 2, 4 & 5 Leaflet free with devices (10p alone)

| | | |
|---|---|---|
| SN76001N (TAA611) | £1.82 | * |
| SN76003N | £3.30 | |
| SN76013N | £1.98 | |
| SN76023N | £1.98 | |
| SN76 227N(MC1327) | £1.89 | |
| SN76532N | £1.86 | |
| SN76544N | £1.81 | |
| SN76550-2(TAA550) | 89p | |
| SN76552-2 | 81p | |
| SN76660N(TBA120) | 75p | |
| SN76666N (CA3065) | £1.12 | |
| TAA263 | £1.50 | |
| TAA300 | £2.16 | |
| TAA310A | £1.87 | |
| TAA320 | £1.44 | |
| TAA350 | £2.43 | |
| TAA370 | £3.45 | |
| TAA550 | 75 | |
| TAA570 | £2.75 | |
| TAA700 | £5.03 | |
| TBA120S | £1.25 | |
| TBA231 | £1.02 | |
| TBA281 (723) | £2.59 | |
| TBA500Q | £3.16 | |
| TBA520Q | £3.85 | |
| TBA530Q | £3.27 | |
| TBA540Q | £3.72 | |
| TBA550Q | £5.29 | |
| TBA560CQ | £5.29 | |
| TBA625A | £1.03 | * |
| TBA625B | £1.03 | * |
| TBA625C | £1.03 | * |
| TBA651 | £1.87 | |
| TBA720Q | £2.79 | |
| TBA750Q | £2.79 | |
| TBA800 | £1.11 | |
| TBA810S | £1.24 | |
| TBA810AS | £1.24 | |
| TBA820 | 86p | |
| TBA920Q | £4.71 | |
| TBA990Q | £4.71 | |
| TCA270Q | £5.24 | |
| TCA760 | £2.16 | |
| TCA800Q | £7.24 | |
| TCA830S | £1.04 | |
| TCA940 | £2.25 | |
| TDA1054 | £1.50 | |
| TDA1200 | £2.43 | |
| TDA1405 | 80p | * |
| TDA1412 | 80p | * |
| TDA1415 | 80p | * |
| TDA2010 | T.B.A. | |
| TDA2020 | T.B.A. | |
| ULN2111A | £1.52 | |
| ZN414 | £1.26 | |

## LED DISPLAYS

Litronix Double Digit Displays
0.5" Common Anode; 2 R/H Decimal Points
DL721 ± 1.9
DL727 0.0 to 9.9
Suitable for Clocks, Meters, Instruments, Channel Indicators
Our price £4.75 * each

NEW

Low cost Red GaAsP Motorola MLED 500 in a T092 package

15p.*

| | | C.Anode R/H Dec. pt. | C.Anode, L/H Dec. pt. | C.Anode ± 1 | C.Cathode R/H Dec. Pt. | | |
|---|---|---|---|---|---|---|---|
| 0.33" | Litronix DL 707 Series | ✓ | ✓ | ✓ | ✓ | all £1.82* each | (Red only) |
| 0.33" | Monsanto MAN 50/70/80/3600 | ✓ | ✓ | ✓ | ✓ | all £1.82* Each | (Red, green, yellow, Orange) |
| 0.33" | Xciton XAN 70 Series | ✓ | | ✓ | ✓ | all £1.49* Each | (Red Green, yellow) |
| 0.43" | Monsanto MAN 4000 Series | ✓ | ✓ | ✓ | ✓ | all £2.32* Each | (Red, Green, Yellow, Orange) |
| 0.63" | Litronix DL747 'Jumbo' Series | | ✓ | ✓ | | all £2.42* Each (Red only) | |

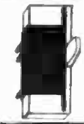
Common Cathode as Common Anode (Red only)

NOTE: MAN 4000 Series pin outs are 14 pin dil the same as MAN 50; 70 and 80 series.

## DIGITAL SWITCH

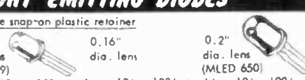
BCD encoded digital switch Reading 0 to 9. Suitable for digital clock alarm setting DVM input Scaling etc.

1 to 9. £1.49 each *



## LIGHT EMITTING DIODES

Free snap-on plastic retainer



| | 0.125" dia. lens (TIL209) 1+ | 10+ | 100+ | 0.16" dia. lens 1+ | 10+ | 100+ | 0.2" dia. lens (MLED 650) 1+ | 10+ | 100+ |
|---|---|---|---|---|---|---|---|---|---|
| Red | 16p | 15p | 13p* | 27p | 24p | 22p* | 18p | 16p | 14p * |
| Green | 27p | 24p | 22p* | 33p | 30p | 27p* | 30p | 27p | 25p * |
| Orange | 27p | 24p | 22p* | 33p | 30p | 27p* | 30p | 27p | 25p * |
| Yellow | 34p | 31p | 29p* | 35p | 32p | 29p* | 35p | 33p | 30p * |

## .......Cont'd

Our Bulk Buying Power enables a repeat of our Special Offer:
0.33" (LIT 707) 90p.*(inc. VAT)
0.63" (LIT 747) £1.99 .*(inc. VAT)

## OPTO-ISOLATORS

1L1 4N25 or TIL116
6 pin industry standard package
2.5KV isolation £1.00.*

## MAINS TRANSFORMERS

Secondaries

| | | |
|---|---|---|
| 6-0-6V | 100 mA | 97p. * |
| 9-0-9V | 100 mA | 97p. * |
| 12-0-12V | 100 mA | 97p * |
| 20-0-20V | 1 A | £4.55 * |
| 24-0-24V | 500 mA | £2.48 * |
| 28-0-28V | 1 A | £6.18 * |

| | ½A | 1A | 2A | 4A |
|---|---|---|---|---|
| 0-9-17 V | - | £1.95 * | £2.27 | £2.64 * |
| 0-12-15-20-24-30 V | - | £2.48 * | £4.15 | - * |
| 0-24-30-40-48-60 V | - | £5.18 * | £7.02 | - * |
| 0-19-25-33-40-50 V | £2.70 * | £3.40 * | £4.53 | - * |

p.p. on transformers 10% of price min. 20p

VAT INC

Items followed by a* inc. VAT at 8% all others include 25%

Overseas Customers deduct 2/27 from * items. 1/5 from others

postage & packing 20p. Orders for over £6. post free. Except transformers

Data Sheet and photocopy service available 10p. per page

Advert No. 1A of Series B

CALLERS WELCOMED

# RELAYS SIEMENS, PLESSEY, Etc. MINIATURE RELAYS

Col. (1) Coil ohms
Col. (2) Working d.c. volts
Col. 3 Contacts
Col. (4) Price
HD = Heavy duty

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| 52 | 4–8 | 2 c/o | 75p* |
| 58 | 5–9 | 6 c/o | 85p |
| 185 | 8–12 | 6M | 65p* |
| 230 | 9–18 | 2 c/o HD | 85p* |
| 430 | 15–24 | 4 c/o | 85p* |
| 700 | 12–24 | 2 c/o | 65p* |
| 700 | 16–24 | 4 c/o | 85p* |
| 1,250 | 18–36 | 2 c/o | 65p* |
| 2,500 | 31–43 | 2 c/o HD | 65p* |
| 2,500 | 36–45 | 6M | 65p |
| 9,000 | 40–70 | 2 c/o | 65p* |
| 15k | 85–110 | 6M | 65p* |

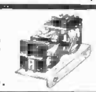
*Incl. Base. All prices incl. P. & P.

**OPEN TYPE RELAYS**
**6 VOLT D.C.** 1 make contacts **35p.** Post 15p.
**9 VOLT D.C. RELAY**
3 c/o 5 amp contacts. 70 ohm coil. **75p.** Post 15p.
**12 VOLT D.C. RELAY**
3 c/o 5 amp contacts. 120 ohm coil. **75p.** Post 15p.
**24 VOLT D.C.** 3 c/o **75p.** Post 15p.
**ENCLOSED TYPE RELAYS**
**24 VOLT D.C.** 3 c/o **75p.** Post 20p. Base **15p** extra.
**24 VOLT A.C.** Mfg. by ITT. 3 h.d. c/o contacts. **55p.** Post 20p. Base 15p.
**55 VOLT A.C. RELAY**
3 h.d. c/o contacts. Price **55p.** Post 20p. Base **15p.**
**100 VOLT A.C.** 3 c/o sealed type. **75p.** Post 20p. Base **15p.**
**240 VOLT RELAY**
3 h.d. c/o contacts. Price **75p.** Post 20p. Octal plug in base 15p extra.
**230/240 VOLT A.C. RELAY.** Mfg. by Arrow 2 h.d. 15 amp c/o contacts. Amp connectors. Price **£1.** Post 20p.
**220/240 VOLT A.C. RELAY**
3 c/o 5 amp contacts. Sealed. Mfg. ISKRA. **£1·25.** Post 20p. Base 15p extra.
**CLARE-ELLIOTT TYPE RP7641 G8**
Miniature relay. 675 ohm coil. 24 Volt D.C. 2 c/o. **70p** post paid.
110V. 2 c/o. 20 amp contacts. **£1·25.** Post 10p.
**Many others from stock—phone for details.**

## C/O MICRO SWITCH

VERY SPECIAL OFFER. Mfg. by C.E.M. 3 amp 250 volt. 10 amp 125 volt. 50 for £3. Post 36p. 100 for £5. Post 50p. 1,000 for £45. Post paid.
Bulk purchase means LOW! LOW! prices.
DOUBLE POLE C/O or 2 make/2 break micro switch. 10 amp 250v a.c. With detachable roller assembly. 10 for **£2·50.** Post 50p (min. order 10).

## LATCHING RELAY



Twin latching relay, "flip-flop" 2 c/o each relay. Mains contacts. 115V A.C. or 50V D.C. operation. 240V A.C. with 2·5K resistor. **85p.** Post 20p.

## 230/250 VOLT A.C. SOLENOID

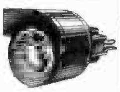
Approximately 1½lb pull. Size of feet 1⅞" × 1$\frac{5}{16}$". Price **£1·00.** Post 20p.
**HEAVY DUTY TYPE.** 10 lb. (approx.) pull. **£2·50.** Post 50p.

## 24 VOLT DC SOLENOIDS

**UNIT** containing 1 heavy duty solenoid approx. 25lb pull 1 inch travel. Two × approx. 1lb pull ½ inch travel. 6 × approx. 4oz. pull ½ inch travel. One 24 volt d.c., 1 heavy duty single make relay. Price **£2·50.** Post £1. **ABSOLUTE BARGAIN.**

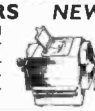
**600 WATT DIMMER SWITCH**
Easily fitted. Fully guaranteed by makers. Will control up to 600W of lighting except fluorescent at mains voltage. Complete with simple instructions. **£2·75.** Post 25p.
1,000 watt model, **£4.** Post 25p.
2,000 watt model, **£8.** Post 40p.

## CENTRIFUGAL BLOWER



Mfg by Smiths Industries. 230/240V a.c. Miniature Model. Series SE/200. Size 95mm × 82mm × 82mm. Aperture 38mm × 31mm. 12 c.f.m., **£2·75.** Post 50p.
Mfg. by Airflow Developments Ltd. Precision made, continuously rated, smooth running. 230/240V a.c. motor, 80 c.f.m. As illustrated but with round aperture, **£6·50.** Post 75p.
Mfg. by Woods.
Extremely powerful. 220/250V a.c. 0·3A 2,700 r.p.m. continuously rated. Capacitor start. Cast construction. Aperture 66mm × 50mm, O/A 200mm. **£12.** Post £1.

## INSULATION TESTERS *NEW!*



Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in, W.4in, H.6in, weight 6lb.
500V, 500 megohms, **£30.** Post 80p.
1,000V, 1,000 MΩ, **£36.** Post 80p.

All Mail Orders—Callers—Ample Parking
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**CHISWICK, LONDON W4 5BB**
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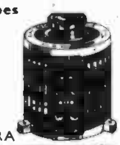
## VARIABLE VOLTAGE TRANSFORMERS

**INPUT 230/240V a.c. 50/60 OUTPUT**
**VARIABLE 0–260V** All Types
**SHROUDED TYPE**



200 watt (1 amp) **£10·00**
0·5 KVA (2½ amp) (MAX) **£11·50**
1 KVA (5 amp) (MAX) **£15·00**
2 KVA (10 amp) (MAX) **£27·50**
3 KVA (15 amp) (MAX) **£30·00**
4 KVA (20 amp) (MAX) **£60·00**
37·5 amp (MAX) **£102·50**
CARRIAGE AND PACKING EXTRA

## L.T. TRANSFORMERS

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|---|---|---|
| 0, 6, 12 Volt at 10 amp. | **£5·60.** | Post 70p. |
| 0, 10, 17, 18 Volt at 10 amp. | **£7·90.** | Post £1·00 |
| 0, 4, 6, 24, 32 Volt at 12 amp. | **£9·90.** | Post £1·00 |
| 0, 6, 12 Volt at 20 amp. | **£9.** | Post £1·00 |
| 0, 12, 24 Volt at 10 amp. | **£9·20.** | Post £1·00 |
| 0, 6, 12, 17, 18, 20 Volt at 20 amp. | **£10·40.** | Post £1·00 |

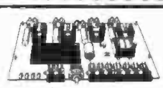
Other types to order at short notice—Phone your enquiries.

## STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.
HY-LYGHT STROBE MK III
For use in large rooms, halls and utilises a silica tube, printed circuit. Speed adjustable 0-20 f.p.s. Light output greater than many (so called 4 Joule) strobes **£14.** Post 75p.
**RANGE OF THREE OTHER STROBE KITS FROM STOCK. FROM £6·30 to £22.**
S.A.E. (Foolscap) for details.

**BIG BLACK LIGHT**
400 Watt. Mercury vapour ultra violet lamp. Powerful source of u.v. P.F. ballast is essential Price of matched ballast and bulb **£21**. Post £1·50. Spare bulb **£8.** Post 65p.
**BLACK LIGHT FLUORESCENT U.V. TUBES**
**4ft 40 watt, £5·50** (callers only).
**2ft 20 watt, £4·25.** Post 60p. (For use in standard bi-pin. MINI. **12in 8 watt, £1·60.** Post 25p. **9in 6 watt, £1·30.** Post 25p. Complete ballast unit and holders for 9in and 12in tube, **£1·70.** Post 30p. (9in and 12in measures approx.)

## SQUAD LIGHT



A new conception in light control. Four channels each capable of handling 750 watts of spot lights, flood lights or dozens of small mains lamps. Seven programs all speed controlled plus flash modulation, effectively giving 14 different displays. Makes sound-to-light obsolete. Completely electrically and mechanically noise free. Can be used on same circuit as radio mikes or sensitive amplifiers. A whole new range of lighting effects possible with astounding results. Already in use in London's foremost theatres, night clubs and discos. Conforms to all R.F.I. tests, including Common Market regulations. Supplied in tough, well designed case with embossed front panel. Price only **£60.** Post 75p. S.A.E. (Foolscap) for further details.

**U.D.I. SINGLE CHANNEL**
**750 WATT MANUAL/AUTO DIMMER**
750W Solid State Fader, with three functions. Manual fade; Auto fade-up; Auto fade-down. Automatic cycling up and down. Functions selected with 'three-position' rocker switch. Two ranges of cycling for 'Flashing' or 'Slow blending'. Ready built module 6" × 3" glass fibre board incorporating 10 amp TRIAC. Two or more modules for top quality colour blending and flashing effects. PRICE **£15.** Post 30p.

**WIDE RANGE OF DISCO LIGHTING EQUIPMENT**
6" colour wheels, 3½" cassettes. S.A.E. (Foolscap) for details.

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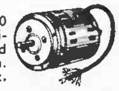
**MULTI RANGE METER.** A.C. volts 2·5–500, D.C. volts 2·5–500 (Sensitivity 2000Ω/V d.c. and a.c.). D.c. current 0/1/10/100 mA, Ohms range. Sturdy compact moving coil instrument with 21 ranges. Dimensions 120 × 80 × 44mm. Weight 0·32kg.
SERVICE TRADING CO. Price **£5·00.** Post 50p. (Total price inc. VAT and post **£5·94**).

## VAT

VAT AT 8% MUST BE ADDED TO ALL ORDERS FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE UNLESS OTHERWISE STATED

# SERVICE TRADING CO.

## REVERSIBLE MOTOR



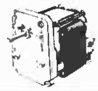
General Electric, 230V a.c. 1,600 r.p.m. 0·25A. Complete with anti-vibration mounting bracket and capacitor. O/A size 110mm × 95mm. Spindle $\frac{3}{16}$in. dia. 20mm long. Ex. equipment tested, **£3.** Post 50p.

**230/240 VOLT A.C. MINIATURE MOTOR. 20 R.P.M.** Price **£1.** Post 20p.

## BODINE TYPE N.C.I. GEARED MOTOR

**(Type J) 71 r.p.m.** torque 10 lb. in. **Reversible** 1/70th h.p. cycle 0·38 amp. **(Type 2) 28 r.p.m.** torque 20 lb. in **Reversible** 1/80th h.p. 50 cycle 0·28 amp. The above two precision made U.S.A. motors are offered in 'as new' condition. Input voltage of motor 115V A.C. Supplied complete with transformer for **230/240V A.C. input.**
Price, either type **£6·25.** Post 75p or less transformer **£3·75.** Post 65p.

## 'CARTER' 230 VOLT A.C. GEARED MOTOR



230/240V A.C., smooth, powerful, continuously rated. Two types: 32 r.p.m. or 110 r.p.m. Either type **£4·75.** Post 50p.

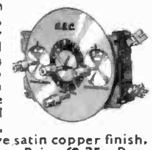
## ROTARY VACUUM AIR PUMP AND COMPRESSOR

Carbon vane, oilless, 100/115V a.c., $\frac{1}{12}$h.p. motor, 50/60 cycle, 2875/3450 r.p.m., 20 in vacuum, comp. 1·25 c.f.m., 10 p.s.i. (approx. figures). New unused surplus stock. Supplied with electrical connection data. FRACTION OF MAKERS' PRICE **£12.** Post **£1·00.** Suitable 110/240V, 150 watt auto transformer **£3·50.** Post 50p. (Both items together Post **£1·25**).

## PROGRAMME TIMERS

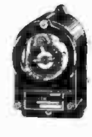
230/240V a.c. 15 r.p.m. Motors. Each cam operates a c/o micro switch. Ideal for lighting effects, animated displays, etc. Ex equipment tested.
2 cam model. 15 r.p.m. **£2·00** post 35p.
4 cam model. 15 r.p.m. **£2·50** post 40p.
8 cam model. 20 r.p.m. **£4·75** post 60p.
8 cam model, each cam fully adjustable. 6 r.p.m. M.f.g. by Magnetic Devices, **£7·50.** Post 60p.

## A.C. MAINS TIMER UNIT



Based on an electric clock, with 25 amp. single pole switch, which can be preset for any period up to 12 hrs. ahead to switch on for any length of time, from 10 mins. to 6 hrs. then switch off. An additional 60 min. audible timer is also incorporated. Ideal for Tape Recorders, Lights, Electric Blankets, etc. Attractive satin copper finish. Size 135mm × 130mm × 60mm. Price **£2·25.** Post 40p. (Total incl. VAT and Post £2·87).

## TIME SWITCH



'Horstmann' Type V Mk. II Time switch. 200/250 volt A.C. Two on/two off every 24 hours, at any manually preset time. 30 amp contacts. 36 hour spring reserve in case of power failure. Day omitting device. Fitted in heavy high impact case, with glass observation window. Built to highest Electricity Board Spec. individually tested. Price **£7·75.** Post 50p. (Total inc. VAT **£8·91**).

## TRIAC

Raytheon Tag symmetrical Triac. Type TAG. 250/500V, 10 amp, 500 p.i.v. Glass passivated plastic triac. Swiss precision product for long term reliability **£1·00.** Post 10p. (Inclusive of Data and application sheet.) Suitable Diac **18p.**

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**50 WATT** 1/5/10/25/50/100/250/500/1k ohm **£2·10.** Post 25p.
**100 WATT** 1/5/10/25/50/100/250/500/1k/1·5k/2·5k/3·5k/5k ohm **£3·30.** Post 35p.
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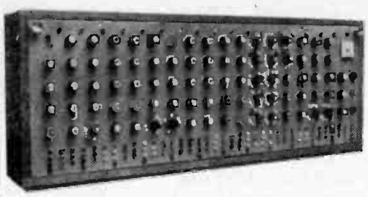
# SYNTHESISERS AND KEYBOARDS



## P.E. SYNTHESISER

(P.E. Feb. 1973 to Feb. 1974)

The well acclaimed and highly versatile large-scale mains-operated Sound Synthesiser complete with keyboard circuits. All function circuits may be used independently, or interconnected. The greater the number of circuits, the greater the versatility. Other circuits in our lists may be used with the Synthesiser to good advantage.

### THE MAIN SYNTHESISER

| | |
|---|---|
| **Stabilised Power Supply** | £12·05 |
| **Two Linear Voltage Controlled Oscillators** and one Inverter—all 3 circuits: | £16·28 |
| PCB (2 are required)—each | £1·48 |
| **Two Ramp Generators and Two Input Amplifiers**—all 4 circuits | £5·62 |
| PCB (holds all 4 circuits) | £1·38 |
| **Sample-Hold and Noise Generator**— | £6·52 |
| PCB (holds both circuits) | £1·64 |
| **Tone Control**, £2·43; **PCB**, 72p | |
| **Reverberation Amplifier** | £6·26 |
| Spring Line unit for Reverb Amp | £4·95 |
| **Ring Modulator** | £3·44 |
| **Peak Level Meter Circuit** | £1·50 |
| 100µA Panel Meter | £3·75 |
| PCB for Rev., R-Mod. & Meter Ccts., | £1·86 |
| **Envelope Shaper**, £5·24; **PCB**, £1·42 | |
| **Voltage Controlled Amp.** and Diff. Amp. | £6·70 |
| **PCB** (holds both circuits) | £1·26 |

**THE SYNTHESISER KEYBOARD CIRCUITS**
Can be used without the Main Synthesiser to make an independent musical instrument)

| | |
|---|---|
| **2 Log. Voltage Controlled Oscillators** | £14·51 |
| **PCB** for both log VCO's | £2·32 |
| **Divider, 2 Hold Circuits, 2 Modulation Amplifiers, Mixer and 2 Envelope Shapers** | £19·46 |
| **PCB** (Holds the first 6 circuits) | £1·80 |
| **PCB** for both Envelope Shapers | £1·50 |
| **Keyboard Stabilised Power Supply** | £7·30 |
| Printed Circuit Board | 94p |

## P.E. JOANNA

(P.E. May to Aug. 1975)

The new electronic piano that has switchable alternative voicing of Piano Honky-Tonk and Harpsichord. All PCB's are "as published"

| | |
|---|---|
| **Power Supply** | £8·85 |
| Tone Generator and Top C Envelope Shaper | £10·26 |
| **PCB** for above | £1·30 |
| **Envelope Shapers** | |
| 12 sets (full requirement) | £32·16 |
| Set of 12 PCB's (full requirement) | £15·00 |
| **Voicing and Pre-Amplifier Circuits** | £7·99 |
| **PCB** for above circuits | £1·80 |

Remaining circuits: prices in lists.

## KEYBOARDS

**Kimber-Allen Keyboards** as required for many published circuits, including the P.E. Joanna, P.E. Minisonic and P.E. Synthesiser. The manufacturers claim that these are the finest moulded plastic keyboards made.

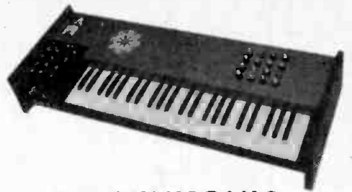
| | |
|---|---|
| 3 Octave Keyboard (37 notes C to C) | £20·50 |
| 4 Octave Keyboard (49 notes C to C) | £23·50 |
| 5 Octave Keyboard (61 notes C to C) | £27·00 |

**Contact Assemblies** for use with above keyboards: Single-pole change-over (SP) as for P.E. Joanna and P.E. Minisonic. Two-pole normally-open make-break (2P) as for P.E. Synthesiser. Special contact assembly (4PS) having 4 poles, 3 of which are normally-open make-break contacts and the fourth is a change-over contact—this special assembly enables **the same keyboard** to be used with the P.E. Synthesiser, P.E. Minisonic, and P.E. Synthesiser simultaneously thus avoiding the cost of more than one keyboard.

| Contact | Each | 3 Octave Set | 4 Octave Set | 5 Octave Set |
|---|---|---|---|---|
| SP | 20p | £7·40 | £9·80 | £12·20 |
| 2P | 24p | £8·88 | £11·76 | £14·64 |
| 4PS | 48p | £17·76 | £23·52 | £29·28 |

**Printed Circuit Boards** for use with the above contacts and thus eliminating most of the interwiring required, are available—details in our lists.

## PHONOSONICS



## P.E. MINISONIC

(P.E. Nov. 1974 to March 1975)

A portable, battery or mains operated, miniature sound synthesiser, with keyboard circuits. Although having slightly fewer facilities than the large P.E. Synthesiser, the functions offered by this design give it great scope and versatility.

| | |
|---|---|
| **Two Voltage Controlled Oscillators** | £5·14 |
| **Voltage Controlled Filter** and Voltage Reference Circuit | £3·35 |
| **Two Envelope Shapers and Two Voltage Controlled Amplifiers** | £7·29 |
| **Keyboard Controller and Hold Circuits** | £2·62 |
| **Keyboard Divider Resistors** (select type to suit keyboard used, all are 2% tolerance). 2 Octave, £1; 3 Oct., £1·48; 4 Oct., £1·96; 5 Oct., £2·44. | |
| **H.F. Oscillator and Detector** | £1·66 |
| **Ring Mod., Noise Gen. & Env. Inverter** | £4·96 |
| **Two Power Amplifiers and Two Mixers** | £3·51 |
| **Battery Eliminator** | £5·68 |
| **Temperature Stabiliser** | £1·47 |
| **PCB** to hold 2 VC0s, VCF and V-Ref | £1·84 |
| **PCB** to hold 2 ESs, 2 VCAs, 2 Mixers, Ring Mod, Keyboard Control and Hold | £1·99 |
| **PCB** to hold 2 Power Amps, Noise Gen, Envelope-Inverter, HF Osc. and Detector | £1·32 |
| **PCB** for Battery Elim. & Temp. Stab. | £1·25 |

FOR ADDRESS, INFORMATION REGARDING POST AND PACKING, VAT, LISTS, AND EXPORT TERMS SEE OUR OTHER ADVERTISEMENT ON OPPOSITE PAGE

Photos: 2 of our units containing some of the P.E. projects built from our kits and PCBs. (The cases were built by ourselves and are not for sale.)

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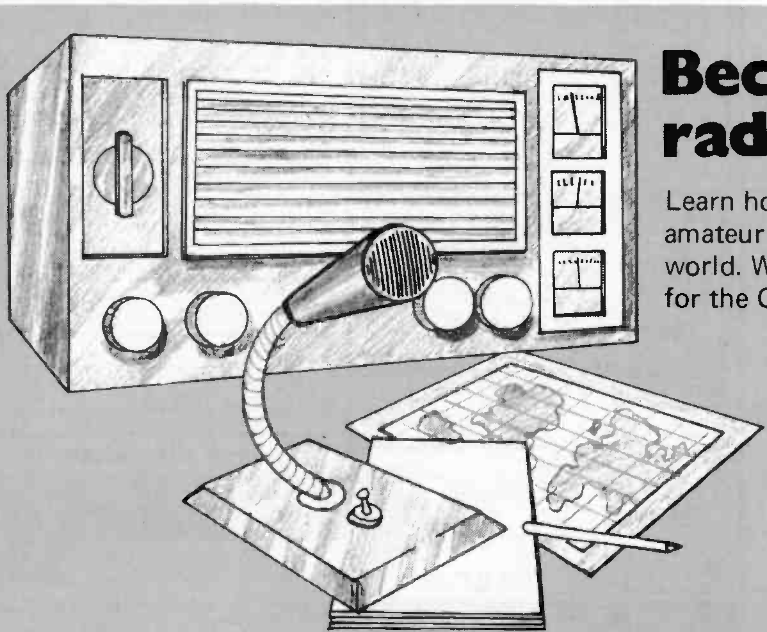

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| SINCLAIR OXFORD 200 *8 digit, %** | 14·75 |
| CBM 887D *8 digit, factor exchange, %** | 9·50 |
| CBM2GL987R *8 digit, %, factor exchange, green display, rechargeable* | 16·30 |
| DECIMO VATMAN MEMORY *8 digit, green display, %, factor exchange* | 18·90 |
| ROCKWELL 20R *8 digit, %** | 12·95 |
| ROCKWELL 21R *8 digit, %, rechargeable* | 16·20 |
| DECIMO COUNTER SPY *8 digit, %, pocket slim mini** | 15·60 |
| **SEMI-SCIENTIFIC FULL MEMORY** | |
| DECIMO SUPER VATMAN *8 digit, green display, $\sqrt{x}$, $x^2$, factor exchange, %, reciprocals** | 19·90 |
| CBM 989 *8 digit, green display $\sqrt{x}$, $x^2$, factor exchange, % reciprocals, rechargeable* | 21·80 |
| ROCKWELL 30R *8 digit, $\sqrt{x}$, $x^2$, factor exchange, %, reciprocals** | 14·75 |
| ROCKWELL 31R *As 30R but rechargeable* | 17·87 |
| DECIMO SUPER SPY *8 digit, $\sqrt{x}$, $x^2$, factor exchange, reciprocals, %, pocket slim mini** | 17·60 |
| **SCIENTIFICS, ALGEBRAIC LOGIC, DUAL FUNCTION KEYS** | |
| SINCLAIR OXFORD 300 *5 digit, 2 exponents, trig, log, $\pi$, $\sqrt{x}$, reciprocals, $x^2$, memory** | 21·95 |
| DECIMO 2001 *8 digit, trig, log, $\pi$, $\sqrt{x}$ reciprocals, memory, memory exchange, $y^x$, $e^x$, $x^2$, x-y, degrees, radians, pocket slim** | 22·50 |
| DECIMO VATMAN SCIENTIFIC *as 2001, but large green display* | 28·70 |
| DECIMO SCIENTIFIC SUPERMAN *8 digit, 2 exponents, log, 1 memory, 1 memory store, $y^x$, $e^x$, reciprocals, $\sqrt{\ }$, $x^2$, pocket slim** | 21·90 |
| CBM SR6120R *8 digit, 2 exponents, trig, log, $\pi$, $\sqrt{x}$, reciprocals, $e^x$, $x^2$, x-y, (parenthesis), exponent shift, mean and standard deviation, polar rectangular, co-ordinates, rechargeable, 2 memory stores* | 31·95 |
| ROCKWELL 61R *8 digit, large green display, trig, log, $\pi$, $\sqrt{x}$, reciprocals, memory, $e^x$, $y^x$, $x^2$, M + $x^2$, factor exchange, memory exchange, degrees, rad, rechargeable* | 27·50 |
| ROCKWELL 63R *8 digit, 2 exponent, same as 61R but in addition 2 level parenthesis, rechargeable* | 30·50 |
| **SCIENTIFICS, ALGEBRAIC LOGIC, SINGLE FUNCTION KEYS** | |
| TEXAS SR16 *8 digits, 2 exponent, logs, store memory, $y^x$, $\sqrt{x}$, $x^2$, reciprocals, factor exchange, rechargeable* | 31·50 |
| TEXAS SR50A *10 digit, 2 exponent, trig, log, $\pi$, $\sqrt{x}$, $x\sqrt{y}$, reciprocals, $x^2$, store memory, degree, rad, hyperbolic, factor exchange, $y^x$, $e^x$, factor key, rechargeable* | 43·50 |
| TEXAS SR51A *Same as SR50A but in addition has mean variance and standard deviation, 3 memories, %, permutations, linear regressions* | 64·50 |
| DECIMO 2001E *10 digit, 2 exponents, trig, log, $\pi$, $\sqrt{x}$, reciprocals, memory, degrees, rads, $y^x$, $x^2$, x-y, memory exchange, hyperbolics, pocket slim** | 24·90 |
| CBM SR4148R *same as SR6120R but in addition has 10 digits, 2 exponents, 2 store memory, and single function keys* | 39·95 |
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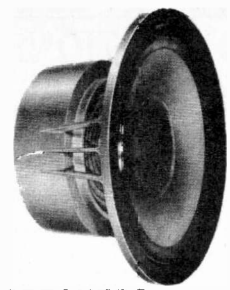

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| Fane Pop 25T 30W 12in | £7·50 |
| Fane Pop 50W 12in | £12·00 |
| Fane Pop 55 60W 12in | £13·95 |
| Fane Pop 60W 15in | £14·75 |
| Fane Pop 100W 18in | £25·95 |
| Fane Crescendo 12A 100W 12in | £34·50 |
| Fane Crescendo 12B bass | £36·50 |
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| Goodmans Hifax 750 | £16·00 |
| Goodmans Axent 100 tweeter | £8·44 |
| Goodmans Audiom 100 12in | £13·90 |
| Goodmans Axiom 402 12in | £20·00 |
| Goodmans Twinaxiom 8 | £10·14 |
| Goodmans Twinaxiom 10 | £10·75 |
| Jordan Watts Module | £17·06 |
| Kef T27 | £6·06 |
| Kef T15 | £6·94 |
| Kef B110 | £8·37 |
| Kef B200 | £9·50 |
| Kef B139 | £16·95 |
| Kef DN8 | £2·31 |
| Kef DN12 | £5·95 |
| Kef DN13 | £4·50 |
| Peerless Dome Tweeter KO10DT | £8·06 |
| STC 4001G Super Tweeter | £6·56 |
| Radford BD25 | £18·44 |
| Radford FN11a | £13·95 |
| Radford FN12a and 12b | £12·75 |
| Radford MD9 | £11·50 |
| Radford TD3 | £8·06 |
| Richard Allan CG8T d/c r/surr. | £7·50 |
| 2½in 64 ohm, 70mm 80 ohm, 70mm 8 ohm | £0·77 |
| 2½in 75 ohm | £0·59 |
| 7in × 4in 3 or 8 ohm | £1·63 |
| 8in × 5in 3 or 8 ohm | £1·75 |
| 10in × 6in 3, 8 or 15 ohm | £2·69 |

## SPEAKER KITS

| | |
|---|---|
| Baker Major Module | each £13·44 |
| Goodmans Mezzo twinkit | pair £47·19 |
| Helme XLK25 | pair £25·44 |
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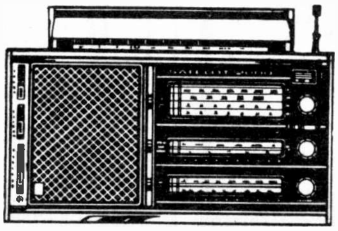

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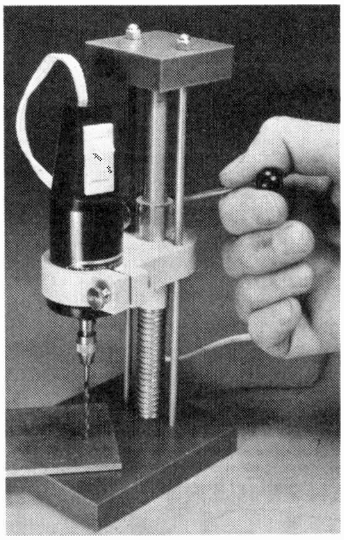

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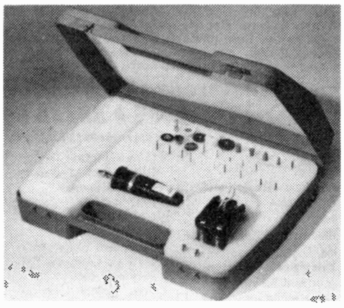

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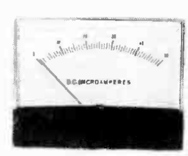

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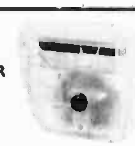

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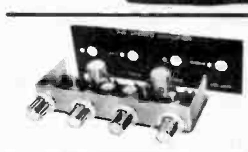

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| 32/500V ...60p | 8 + 8/350V ...50p | 350 + 50/325V ......85p |
| 25/25V ......15p | 8 + 16/350V ...50p | 100 + 50 + 50/350V 85p |
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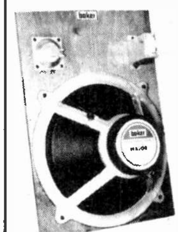

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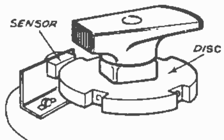


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115V or 240V sec. only*

| Ref. No. | VA (Watts) | £ | P & P p |
|---|---|---|---|
| 07* | 20 | 2·60 | 58 |
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| 151 | 200 | 8·13 | 1·12 |
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| 154 | 500 | 13·65 | 1·61 |
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| Ref. No. | Amps. 12V | 24V | £ | P & P p |
|---|---|---|---|---|
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| 71 | 2 | 1 | 2·29 | 58 |
| 18 | 4 | 2 | 2·86 | 72 |
| 70 | 6 | 3 | 4·12 | 72 |
| 108 | 8 | 4 | 4·56 | 85 |
| 72 | 10 | 5 | 5·14 | 85 |
| 116 | 12 | 6 | 5·52 | 97 |
| 17 | 16 | 8 | 7·28 | 97 |
| 115 | 20 | 10 | 10·39 | 1·61 |
| 187 | 30 | 15 | 13·59 | 1·41 |
| 226 | 60 | 30 | 16·83 | BRS |

**30 VOLT RANGE**
Prim. 200/240V. Sec. 0-12-15-20-24-30V

| Ref. No. | Amps. | £ | P & P p |
|---|---|---|---|
| 112 | 0·5 | 1·81 | 58 |
| 79 | 1·0 | 2·40 | 72 |
| 3 | 2·0 | 3·49 | 72 |
| 20 | 3·0 | 4·35 | 85 |
| 21 | 4·0 | 5·13 | 85 |
| 51 | 5·0 | 6·41 | 97 |
| 117 | 6·0 | 7·16 | 1·12 |
| 88 | 8·0 | 9·87 | 1·25 |
| 89 | 10·0 | 9·90 | 1·41 |

**50 VOLT RANGE**
Prim. 200/240V. Sec. 0-19-25-33-40-50V

| Ref. No. | Amps. | £ | P & P p |
|---|---|---|---|
| 102 | 0·5 | 2·58 | 58 |
| 103 | 1·0 | 3·38 | 72 |
| 104 | 2·0 | 4·63 | 85 |
| 105 | 3·0 | 5·81 | 97 |
| 106 | 4·0 | 7·60 | 1·12 |
| 107 | 6·0 | 12·10 | 1·25 |
| 118 | 8·0 | 12·98 | 1·61 |
| 119 | 10·0 | 16·99 | BRS |

**60 VOLT RANGE**
Prim. 200/240V. Sec. 0-24-30-40-48-60V

| Ref. No. | Amps. | £ | P & P p |
|---|---|---|---|
| 124 | 0·5 | 2·33 | 72 |
| 126 | 1·0 | 3·41 | 72 |
| 127 | 2·0 | 5·08 | 85 |
| 125 | 3·0 | 7·52 | 97 |
| 123 | 4·0 | 8·75 | 1·41 |
| 40 | 5·0 | 9·75 | 1·25 |
| 120 | 6·0 | 11·30 | 1·41 |
| 121 | 8·0 | 15·00 | BRS |
| 122 | 10·0 | 17·52 | BRS |
| 189 | 12·0 | 19·98 | BRS |

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| Ref. No. | VA (Watts) | Auto Taps | £ | P & P p |
|---|---|---|---|---|
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| 64 | 75 | 0-115-210-240 | 2·90 | 72 |
| 4 | 150 | 0-115-200-220-240 | 4·12 | 72 |
| 66 | 300 | 0-115-200-220-240 | 5·82 | 85 |
| 67 | 500 | 0-115-200-220-240 | 8·82 | 1·25 |
| 84 | 1000 | 0-115-200-220-240 | 13·68 | 1·61 |
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| 1000VA | £17·51 | P. & P. BRS | 84W |

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| Ref. | mA | Volts | £ | P&P p |
|---|---|---|---|---|
| 238 | 200 | 3-0-3 | 1·54 | 39 |
| 212 | 1A, 1A | 0-6, 0-6 | 1·84 | 46 |
| 13 | 100 | 9-0-9 | 1·41 | 25 |
| 235 | 330, 330 | 0-9, 0-9 | 1·56 | 25 |
| 207 | 500, 500 | 0-8-9, 0-8-9 | 1·92 | 51 |
| 208 | 1A, 1A | 0-8-9, 0-8-9 | 3·30 | 58 |
| 236 | 200, 200 | 0-15, 0-15 | 1·43 | 25 |
| 214 | 300, 300 | 0-20, 0-20 | 1·93 | 58 |
| 221 | 700 (d.c.) | 20-12-0-12-20 | 2·17 | 58 |
| 206 | 1A, 1A | 0-15-20-0-15-20 | 3·46 | 72 |
| 203 | 500, 500 | 0-15-27-0-15-27 | 3·00 | 72 |
| 204 | 1A, 1A | 0-15-27-0-15-27 | 3·85 | 72 |
| S112 | 500 | 12-15-20-24-30 | 1·88 | 58 |

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| VA. | Ref. | £ | P & P p |
|---|---|---|---|
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| 350 | 247 | 10·41 | 1·41 |
| 1000 | 250 | 27·06 | BRS |
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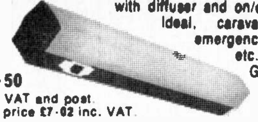

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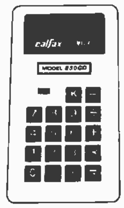

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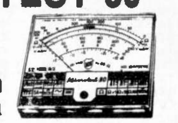

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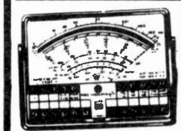

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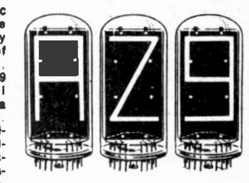

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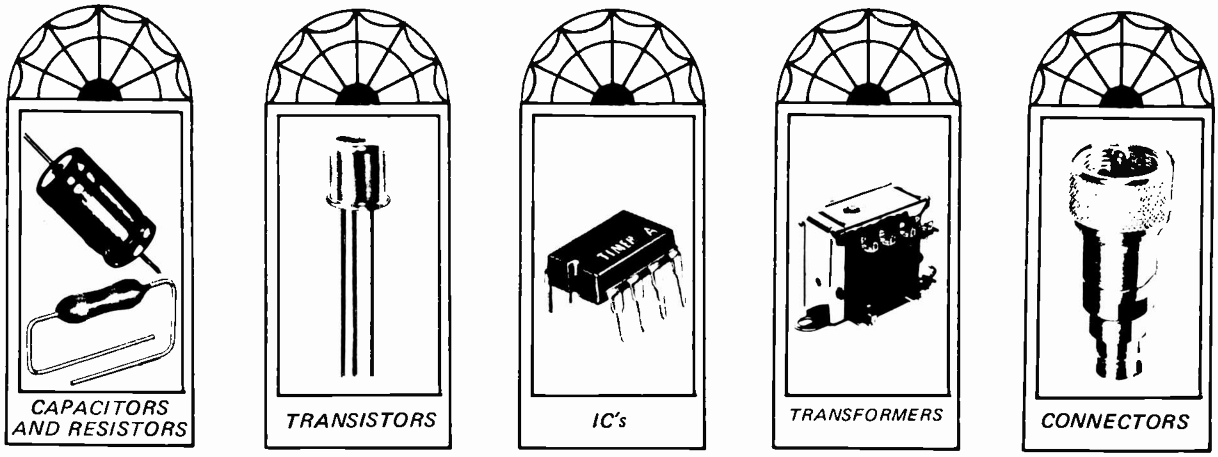




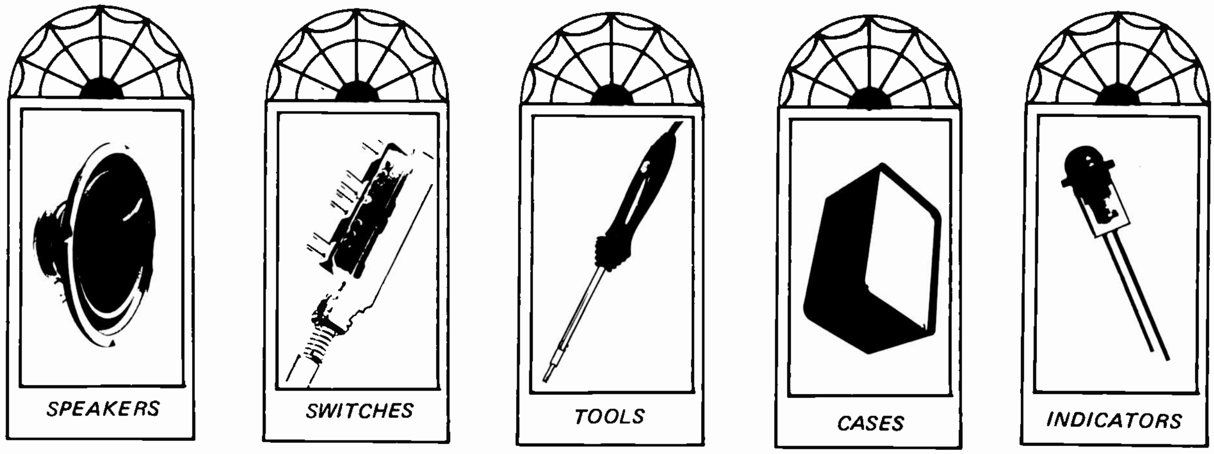







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