

PRACTICAL

# ELECTRONICS

JANUARY 1973

20p

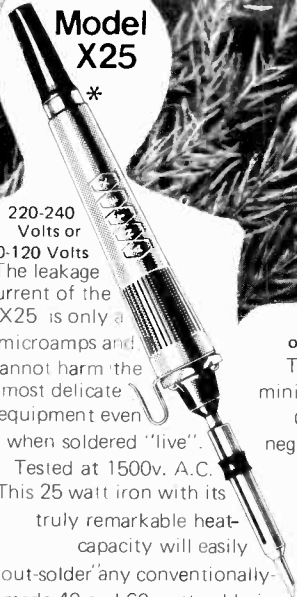


Audio  
Amplifier

Audio  
Generator

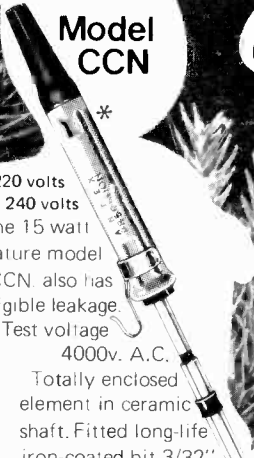
# BIOLOGICAL AMPLIFIER

# Solder a friendship! Give Antex this Christmas



**Model X25**  
\*

220-240 Volts or 100-120 Volts  
The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live".  
Tested at 1500v. A.C. This 25 watt iron with its truly remarkable heat-capacity will easily "out-solder" any conventionally-made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8". 2 other bits available 3/32" and 3/16" Totally enclosed element in ceramic and steel shaft Bits do not "freeze" and can easily be removed PRICE: £1.75 (rec. retail)  
Suitable for production work and as a general purpose iron



**Model CCN**  
\*

220 volts or 240 volts  
The 15 watt miniature model CCN also has negligible leakage.  
Test voltage 4000v. A.C.  
Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32"  
4 other bits available, 1/8" 3/16" 1/4" and 1/16"  
PRICE: £1.80 (rec. retail)  
OR Fitted with triple-coated, (iron, nickel and Chromium) bit 1/8" £1.95 (rec. retail)



**Model CN**  
\*

Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 1/16" to 3/16".  
Voltages 240, 220, 110, 50 or 24  
PRICE £1.70 (rec. retail)

## Model SK.1 Kit

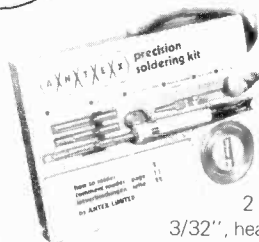
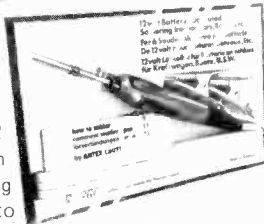
contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE £2.75 (rec. retail)



## Model MES Kit

Battery-operated 12v. 25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet with booklet "How to Solder". PRICE £1.95 (rec. retail) \*



## Model SK.2 Kit

contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, and "How to Solder" booklet.

PRICE £2.40 (rec. retail)



From radio or electrical dealers, car accessory shops or, in case of difficulty direct from: **ANTEX LIMITED FREEPOST** (no stamp required) **PLYMOUTH,** PL1 1BR Tel: 0752 67377

- Please send the ANTEX colour catalogue.  
 Please send the following

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I enclose cheque/P.O./Cash (Giro No. 258 1000)

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_



PE1

# PRACTICAL ELECTRONICS

VOLUME 9 No. 1 JANUARY 1973

---

## CONSTRUCTIONAL PROJECTS

- I.C. LINEAR OHMMETER** *by G. Griffiths* 26  
Simple instrument with three switched ranges from 0-100k  $\Omega$
- BIOLOGICAL AMPLIFIER** *by D. Bollen* 32  
Demonstrating how neuro systems and electronic systems can interact
- P.E. PIANO—5** *by A. J. Boothman* 44  
Cabinet construction and tuning
- P.E. DIGI-CAL—7** *by R. W. Coles* 61  
Clock generator board

## GENERAL FEATURES

- CEEFAX** 52  
A proposed new broadcasting service
- DESIGNING WITH I.C.s—4** *by A. Foord* 57  
Schmitt Trigger
- AUDIO FAIR** *by M. A. Colwell* 69  
Current hi fi scene as seen and heard at Olympia

## NEWS AND COMMENT

- EDITORIAL—Down To Earth** 25
- SPACEWATCH** *by Frank W. Hyde* 30  
Commentary on latest developments in space
- ON THE FRINGE** *by Gerry Brown* 43  
The more unusual aspects of electronics
- INDUSTRY NOTEBOOK** *by Nexus* 54  
What's happening inside industry
- PATENTS REVIEW** 60  
Thought provoking ideas on file at the British Patents Office
- POINTS ARISING** 66  
I.C. Intercom
- BOOK REVIEWS** 74  
Selected new books we have received
- ANNOUNCEMENT** 31  
Notices of special interest to all readers

Our February issue will be published on Friday, January 12, 1973

---

© IPC Magazines Limited 1973. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press. Subscription Rates including postage for one year, to any part of the world, £2-65.

# RTVC THE

## THE FABULOUSLY SUCCESSFUL VISCOUNT III AUDIO £52 complete

14 + 14 watts r.m.s. 40Hz to 40kHz  $\pm$  3dB. Total distortion at 10 watts at 1kHz — 0.1%.

This is real value for money! We have designed 2 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For both systems we have chosen the famous Garrard SP25 Mk. III deck, with fitted magnetic cartridge, which comes complete with simulated teak plinth and tinted acrylic cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo 11's for the smaller room or the big Duo 111's for real bass response.

### SPEAKERS

**Duo Type 11** Size approx. 17in.  $\times$  10 $\frac{1}{2}$ in.  $\times$  6 $\frac{1}{2}$ in. Drive unit 13in.  $\times$  8in. with parasitic tweeter. Max power 10 watts, ohms. Simulated Teak cabinet. £14 pair + £3 p & p.

**Duo Type 111** Size approx. 23 $\frac{1}{2}$ in.  $\times$  11 $\frac{1}{2}$ in.  $\times$  9 $\frac{1}{2}$ in. Drive unit 13 $\frac{1}{2}$ in.  $\times$  8 $\frac{1}{2}$ in. with H.F. speaker. Max power 20 watts 8 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32 pair + £3 p & p.

### SPECIFICATION R101

14 watts per channel into 3 to 4 ohms (suitable 3-15 ohms). Total distortion @ 10W @ 1kHz 0.1%. P.U.1. (for ceramic cartridges) 150mV into 3 Meg. P.U.2. (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within  $\pm$  1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power.) Tape out facilities: headphone socket, power out 250mW per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal-to-noise ratio: (all controls at max) — P.U.1. and radio — 65dB, P.U.2 — 58dB. Cross talk better than — 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13 $\frac{1}{2}$ in.  $\times$  9in.  $\times$  3 $\frac{1}{2}$ in. Send S.A.E. for fully illustrated brochure. 12 MONTHS' WRITTEN GUARANTEE. British made. S.A.E. for illustrated leaflet.

### PRICES: SYSTEM 1

Viscount III R 101 amplifier	£22.00 + 90p p&p
2 $\times$ Duo Type 11 speakers	£14.00 + £2 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23.00 + £1.50 p&p
<b>Total</b>	<b>£59.00</b>

Available complete for only £52 + £3.50 p & p

### PRICES: SYSTEM 2

Viscount R 101 amplifier	£22.00 + 90p p&p
2 $\times$ Duo Type 111 speakers	£32.00 + £3 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23.00 + £1.50 p&p
<b>Total</b>	<b>£77.00</b>

Available complete for £69 + £4 p & p

**— ONLY FROM US**



# MUSIC MAKERS

## UNISOUND FOR THE NEW SOUND

AT £25



S.A.E. for illustrated leaflet

The whole system is complete including superb cabinets in simulated teak—just simply screw together the components and you save pounds!

Amplifier is based on the famous Mullard Unilex system. Garrard 2025TC turntable complete with stereo ceramic cartridge, teak simulated plinth and tinted acrylic cover. Plus the big 13in. x 8in. EMI Twin-cone speakers ready for mounting in their elegant cabinets, which simply need screwing and gluing together. All glue and screws supplied. Easy to follow step-by-step instructions guide you quickly and effortlessly to taking the wraps off truly realistic stereo sound.

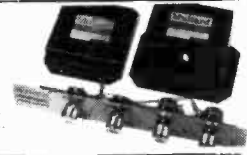
£25 complete plus £2-80 p. & p. Diamond Stylus £1-25 extra.

Power output: 4 watts per channel into 8 ohms. Inputs: 120 mV (for ceramic cartridges). Stereo headphones with adaptor £4-00.

### UNISOUND MODULES ONLY £6-95

If you prefer, you can buy the three modules—pre-amplifier power supply/dual power amplifier, and control panel—by themselves for only £6-95. P. & P. 50p extra.

No soldering, just simply screw together with screwdriver supplied. Their overall specification is the same as shown for the complete Unisound console, using the high efficient I.C. monolithic power chips to ensure very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum.



AN **R T V C** EXCLUSIVE DESIGN

## A 'NATURAL' ONLY FROM **R T V C** THE TOURIST PB CAR RADIO KIT

Apart from the output stage, which is an integrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulated IF stages which are pre-aligned before despatch. As well as electronic components, this kit also contains 2 diamond-spun aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles. It covers the full medium and long wave bands. Four push-buttons for medium wave, one for long wave. It is permeability tuned and sturdily constructed. Output is a full 2.5 watts into an 8 ohm speaker. But the Tourist PB will operate into any loud-speaker from 8 to 15 ohms. Power consumption is less than 1 amp.

The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale for easy reading at night. Chassis size is: 7in wide, 2in. high and 4½ in. deep (excluding front panel, etc.).

★ Circuit diagram and comprehensive instructions 50p, free with parts.

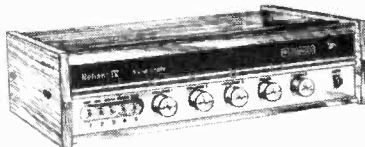
★ Fully retractable lockable car aerial £1-25 post paid.

PRICE ONLY £7-+ p & p 50p

8 ohm speaker with baffle and fixing strips £1-50 + 25p p & p, post free if brought with the kit.  
Send for illustrated leaflet

If you can solder on printed circuit board, you can build this push-button car radio kit. It's simple—just follow the step-by-step instructions.

ONLY  
**£7.00**



## RELIANT MK.IV

★ 5 Electronically Mixed Inputs. ★ 3 Individual Mixing Controls. ★ Separate bass and treble controls common to all 5 inputs. ★ Mixer employing F.E.T. (Field Effect Transistor). ★ Solid State Circuitry. ★ Attractive Styling. ★ Sides finished in solid teak.

**INPUTS:**—1. Crystal Mic. or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram., Tuner, Monitor, Organ, etc.). All 250mV sensitivity.

**CONTROLS:**—3 Volume controls. Bass control range: 13dB @ 60Hz. Treble control range: ±12dB @ 15KHz. Separate ON/OFF Switch. Neon indicator. **POWER OUTPUT:**—12 Watts R.M.S. into 3 to 4 ohms speaker. **SIGNAL NOISE:**—Better than -60dB on inputs 3, 4 and 5 & -50dB on 1 & 2. **SUPPLY:**—220-250 A.C. Mains. **SIZE:**—12½in. x 6in. x 3½in. **NEW VERSION:** 20 watts into 8 ohms £13-50 + 60p p & p plus p & p 60p

**£10-50**

## VISIT OUR SHOWROOMS



Radio and TV Components (Acton) Ltd.  
21D High St., Acton, London W3 6NG  
323 Edgware Road, London, W.2

Mail orders to Acton · Terms C.W.O. · All enquiries S.A.E.  
Goods not dispatched outside U.K.

# The revolutionary new Supertester 680R.

By it for what it is.  
Or buy it for what it can be.

The Supertester 680R is a completely new concept in measuring instruments. In itself a high quality test meter with eighty ranges on a 128mm mirror backed scale it is also the basis of a complete measurement system. With the addition of the appropriate accessories it can measure a wide range of values including light, temperature, gauss and phase sequence. And there are other accessories to greatly extend the 680R's range. The 680R System offers many advantages over conventional test meters including tremendous versatility and economy.

ACCESSORIES TO CONVERT THE SUPERTESTER 680R TO THE FOLLOWING:

## Amperclamp



For measuring a.c. currents from 250mA to 500A £11 95

## Signal Injector

Producing 1kHz and 500kHz signals £5 95

## Temperature Probe

Covering the range 30°C to -200°C £11 95

## Light Meter

Range 0-16,000 Lux

## Gauss Meter

For measuring magnetic field strengths £11 95

## Phase Sequence Indicator

To indicate the phase sequence of a 3-phase supply £5 95

## Electronic Voltmeter

Input resistance 11MΩ £18 00

## Transistor Tester

For transistors and diodes £11 95



SUPERTESTER 680R SPECIFICATION:

13 d.c. ranges from 0.1 to 2000V 12 ranges from 50µA to 5A 20,000:1/V Accuracy 1% 11 a.c. ranges from 2 to 2500V 10 ranges from 250µA to 5A 4,000:1/V Accuracy 2% Resistance: 6 ranges from 50mΩ to 100MΩ Reactance: 1 range of 0-10M Frequency: 2 ranges of 0-50 and 0-5000Hz Output Volts: 9 ranges from 10 to 200V Decibels: 10 ranges from -24 to +70dB Capacitance: 6 ranges 4 ranges from 20 to 20,000mF from internal battery and 2 ranges from 50 000 to 500 000pF using mains £18.50 complete with case and probes

SHUNTS D.C. 25, 50 AND 100A. £4-50 each. CURRENT TRANSFORMERS A.C. 25 AND 100A. £7 00 each. E.H.T. PROBE. Extends d.c. voltage to 25,000V. £5 95

ELECTRONIC BROTHERS LTD 49-53 Pancras Rd., London NW1 2QB. Tel. 01-837 7781

## 4-STATION INTERCOM

Solve your communication problems with this 4-Station Transistor Intercom system (1 Master and 3 Subs), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 40p.

**£7.25**

## MAINS INTERCOM

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control with lock system. Price £12.40. P. & P. 55p extra.

## INTERCOM/BABY ALARM

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 14p. P. & P. 25p.

**£3.35**

## Transistor TELEPHONE AMPLIFIER

Why not boost business efficiency with this incredible De-Luxe Telephone Amplifier. Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume control. Battery 14p extra. P. & P. 22p. Full price refunded if not satisfied in 7 days.

**£2.99**

WEST LONDON DIRECT SUPPLIES (PE/1)  
189 KENSINGTON HIGH STREET, LONDON, W.8

## Vary the strength of your lighting with a DIMMASWITCH

The DIMMASWITCH is an attractive and efficient dimmer unit which fits in place of the normal light switch and is connected up in exactly the same way. The white mounting plate of the DIMMASWITCH matches modern electric fittings. Two models are available, with the bright chrome knob controlling up to 300 w or 600 w of all lights except fluorescents at mains voltages from 200-250 v, 50Hz. The DIMMASWITCH has built-in radio interference suppression:

600 Watt—£3.20. Kit Form £2.70  
300 Watt—£2.70. Kit Form £2.20

All plus 10p post and packing.  
Please send C.W.O. to:—

## DEXTER & COMPANY

1 ULVER HOUSE, 19 KING STREET  
CHESTER CH1 2AH Tel. 0244-25883

As supplied to H.M. Government Departments

## OSMABET LTD.

We make transformers amongst other things

### AUTO-TRANSFORMERS

500W, £2.85; 750W, £12; 1,000W, £15; 1,500W, £21; 2,000W, £27; 3,000W, £37.50; 4,000W, £52.50.

### LOW VOLTAGE TRANSFORMERS

Prim. 200/240V a.c. 6.3V 1.5A, £1.05; 3A, £1.30; 6A CT, £2.05; 12V 1.5A, £1.85; 3A CT, £2.15; 6A CT, £2.80; 18V 1.5A CT, £2.15; 24V 1.5A CT, £2.15; 3A CT, £2.80; 5A, £4.30; 8A, £6.75; 12A, £9.40; 40V 3A CT, £3.75; 50V 6A CT, £10.

### MIDGET RECTIFIER TRANSFORMERS

For FW rect., 200/240V a.c. 9-0-9V 0.3A, 12-0-12V 0.25A or 20-0-20V 0.15A, £1.45 each; 9-0-9V 1A, £1.15; 12-0-12V 1A or 20-0-20V 0.75A, £1.35 each.

### POWER TRANSFORMERS FOR POWER AMPLIFIERS

P.P. sec. tapped 3-7.5-15 ohms, A-A 6.6 KΩ 30W (KT66, etc.), £4.65; A-A 3KΩ 50W, £7.50; 100W (EL34, KT88, etc.), £12.50. Multi O/P 10W, £2.25.

### MAINS TRANSFORMERS POWER AMPLIFIERS

Prim. 200/240V a.c., TX 6 sec, 425-0-425V 500 Ma, 6.3V CT 6A, 6.3V CT 6A, 0-5-6.3V 3A, £14.25; TX1 425-0-425V 250Ma, 6.3V CT 4A, 6.3V CT 4A, 0-5-6.3V 3A, £9. 250V 100Ma, 6.3V 2A, £2.70.

### G.E.C. MANUAL OF POWER AMPLIFIERS

Covering valve amplifiers of 30 to 400W, with price list of transformers and chokes specified, 30p. Bernardes Amplifier Manual, 5 to 1,000W, 75p.

### LOUDSPEAKERS FOR POWER AMPLIFIERS

FANE 15W w/tweeter, £4.99; 50W, £10.90; 60W, £12.90; 100W, £22.50; BAKER 25W, £2.40; 35W, £7.20; Hi-Fi Major Module, 20W w/tweeter and Xover 30-17kHz, £9.20; EMI 13in x 8in, £2.25; 8in x 6in 8n, £1.85; Goodmans Tweeter 3Ω, £2.

### LOUDSPEAKERS

2 1/2in 16n, 2 1/2in 25n, 3in 30n, 75p; 3 1/2in 3 or 15n, 4in 8 or 15n, 5 1/2in 3, 8, 15 or 25n, 5 1/2in x 3in 3, 8, 15 or 25n, £1.05 each; 6 1/2in 3n, 6 1/2in x 4 1/2in 3 or 25n, 7 1/2in x 4 1/2in 3 or 15n, 8 x 2 1/2in 3n, £1.25; 8in x 5in 3, 8, 15 or 25n £1.50; 10in 15Ω, £2.50; 10 x 6in 3Ω, £2.25.

### SPEAKER AUTO MATCHING TRANSFORMERS

12W, 3 to 8 or 15n, up or down, £1.05.

### BULK TAPE ERASERS

Instant erasure, tape spools, cassettes, demagnetises tape heads a.c. 200/240V, £2.50 plus 25p P. & P.

### RELAYS

Sub mini, 15, 20 or 30V d.c., 2 C.O.'s 50p each.

### 12V DC FLUORESCENT LIGHTING

Silicon transistor inverter for 20W tube, £5.75.

### PAPER CONDENSERS

Tubular W/E 2-2 mfd, 500V Xovers, etc., 15p, £5 100. Block 4 mfd, 800V, 75p, 1,900V, £1.25.

Carriage extra on all orders, etc.

S.A.E. ENQUIRIES-LISTS. MAIL ORDER ONLY  
46 Kenilworth Road, Edgware, Middx. HA8 5YQ  
Tel. 01-858 9314

# SAXON ENTERTAINMENTS

STANDARD and CUSTOM-BUILT AUDIO and ELECTRONIC EQUIPMENT  
NEW and SECONDHAND MUSICAL INSTRUMENTS. MAIN DISTRIBUTORS  
FOR A.K.G. HIGH QUALITY MICROPHONES

## SA25-SA35-SA100

LOW-PRICED AUDIO MODULES FOR  
DOMESTIC and COMMERCIAL USE



THESE THREE MODULES HAVE ENJOYED UN-  
PARALLELED SUCCESS DURING THE FIRST FEW  
MONTHS OF THEIR BEING MADE AVAILABLE TO  
THE GENERAL PUBLIC. WE ARE PLEASED TO  
ANNOUNCE THAT WE CAN NOW OFFER FAST  
DISPATCH ON MOST OF OUR ADVERTISED ITEMS,  
INCLUDING THESE THREE MODULES.

**SA25 £2.95** carr. free

25 WATTS R.M.S. 7 transistors, 7 diodes

**SA35 £4.45** carr. free

35 WATTS R.M.S. 7 transistors, 7 diodes

**SA100 £10.90** carr. free

100 WATTS R.M.S. 11 transistors, 6 diodes

ALL THREE MODULES HAVE OPEN AND SHORT  
CIRCUIT PROTECTION, AND THE SA100 IS PROOF  
AGAINST OVER-DISSIPATION AND FAULTY IN-  
DUCTIVE LOADS.

ONLY ADVANCED DESIGN TECHNIQUES MAKE  
THESE EXTRAORDINARILY LOW PRICES POSSIBLE.

### BRIEF SPEC. FOR ALL THREE MODULES

Freq. response	15-40,000Hz $\pm$ 1dB
Distortion	0.2% at 1kHz
Loads	4 to 16 ohms
Quiescent current	15mA
Noise	Better than -75dB
Supply voltage	25-45V, SA25/35 40-70V, SA100
Size	4 1/2 in $\times$ 4 in $\times$ 1 in (SA100) 4 in $\times$ 3 in $\times$ 1 in (SA25, SA35)

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

### POWER SUPPLIES FOR THE SA25/35 and SA100 AUDIO MODULES

<b>PS45</b>	Stabilised module for 2 SA25's or two SA35's, £35.0, carr. free
<b>MT45</b>	Transformer for above, heavy duty, £2.85, carr. 20p
<b>MT30</b>	Transformer for unstabilised supply complete with rectifier diodes mounted, £3.50, carr. 20p
<b>PU70</b>	Unstabilised supply for one or two SA100, £7.75, carr. 40p
<b>PS70</b>	Stabilised supply module for one or two SA100's, £4.90, carr. free
<b>MT70</b>	Transformer for PS70, £4.90, carr. 40p

ALL MODULES ARE BUILT ON GLASS FIBRE P.C.  
BOARD

CALLERS AND MAIL  
ORDER:  
351 Whitehorse Road  
West Croydon, Surrey  
CRO 2HS Tel. 01-689 3685

CALLERS ONLY:  
OUR NEW DISTRIBUTORS.  
**CIRCLE SOUND**  
328-330 The Banks  
Rochester.  
Medway 404199

BUSINESS  
HOURS:  
9.30 a.m. to  
5.30 p.m.

TERMS OF BUSINESS: **C.W.O.** or  
**C.O.D.** (35p extra). All cash in regd.  
envelopes please! Telephone orders  
to our CROYDON BRANCH. TRADE  
AND EXPORT ENQUIRIES  
INVITED

## OTHER SAXON PRODUCTS . . .

### 120 WATT HEAVY DUTY MODULE

Featuring a rugged class A driver stage, this module will run  
from all our mixers etc., and most other makes of mixer. It  
delivers 120W into an eight ohm load and employs 4 TO3  
can (115W) output transistors.

#### SPECIFICATION

Power output	120W into 8 ohms
Freq. response	20-20,000Hz $\pm$ 2dB
Input sensitivity	200mV into 10K
Construction	Fibreglass board
Size	8in $\times$ 4in $\times$ 4in (5in with supply)

Low distortion parallel push-pull output stage.

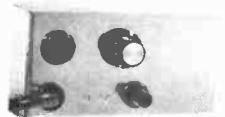
£13.90 + 20p carr. or with  
supply £18.95 + 40p carr.



NEW: 160 Watt version + supply £27.90

### SINGLE CHANNEL SOUND/LIGHT CONVERTER

This compact and reliable unit operates from amplifiers with  
outputs from 5-100W. Does not impose a heavy load on  
the amplifier, or, if connected in the wrong polarity, cause  
any damage, as with some units.



£8.90 carr. free

Operation is simplicity itself and the unit is fully fused. The  
unit is supplied to function from bass notes but may easily be  
converted to respond only to treble or mid-range notes by  
the addition of components costing less than 5p.

### THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3,000W (3kW) this unit is unique for its price in that not only bass middle  
and treble but also master controls are provided. Two amplifier sockets eliminate the need for  
split leads, etc. Supplied in tough white steel case with a blue  
steelevite hooded cover. Fully guaranteed.

£19.75 carr. 30p

MONO VERSION £6.50, carr. 20p  
(As illustrated below. S.A.E. details. 9V operation)  
OUTPUTS UP TO 1V RMS



£15.80 carr. 30p  
**SAXON STEREO  
CONTROL UNIT**

Two decks, and full headphone monitoring. The unit is mains operated and measures 17 1/2 in  $\times$  3 in  
 $\times$  4 in deep and is finished with a smart white on black facia. The controls are: Left/Right deck  
fader, volume, bass, treble, headphone selector and volume, microphone volume, bass, treble,  
mains on/off. **THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCO  
THEQUE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE.**

### COMPLETE AMPLIFIERS

**THE CS 100. £34.90 carr. free**

This versatile unit is now available in a black vnydine  
case and so represents even better value than ever,  
delivering speech and music powers of up to 100W  
R.M.S. and continuous signal outputs of 70W.

Two individually controlled inputs with wide range  
bass and treble controls. Ideal for small groups, D.J.'s, etc.



**The SAXON 100. £48.50, carr. free.**



With an R.M.S. output of 120W speech and music,  
100W continuous power, four individually controlled  
F.E.T. input stages and wide range bass and treble  
controls, this amplifier has established itself as a  
unit offering quality and reliability at low cost.

### LOUDSPEAKERS British made bargains !!!

12in 25W 8/15 ohms £5.95, carr. 30p. 15in 50W 8/15 ohm, £14.50, carr. 50p.

12in 40W 15,000 gauss magnet system 8/15 ohm, £11.50, carr. 40p.

A.K.G. MICROPHONES suitable for disco, group or general P.A. use

D11DHL r.r.p. £11, our price £9.45 post free.

D190C High Z r.r.p. £21.50, our price £17.45 post free.

D1000C 24 ct. gold plate r.r.p. £37, our price £32 post free.

SEND S.A.E. FOR  
OUR A.K.G. PRICE  
LIST. DISCOUNTS  
ON ALL MICS.

# DISCOUNTS UP TO

# 60%

**Global's GOLDEN Guarantee**

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

## GARRARD SP25 Mk. III

**SPECIAL OFFER**  
Garrard SP25 Mk. III £17.45  
Goldring G800  
Teak plinth and tinted cover.  
All leads supplied.  
Please add £1.25 for P. & P.

## TURNTABLES

Please add 75p for P. & P.

Garrard SP25 Mk. III	£9.95
Garrard AP76	£17.45
Garrard SL65B	£13.95
Garrard 401	£25.80
Garrard Zero 100 (Auto)	£26.90
Garrard Zero 100 (Single)	£35.90
BSR MP60	£9.40
Goldring GL72	£21.60
Goldring GL72/P	£28.35
Goldring GL75	£26.90
Goldring GL75/P	£33.90
Goldring 101/P.C.C.	£26.90
Wharfedale Linton + cart.	£26.50
Thorens TD125AB Mk. II.	
New product.	£91.75
Thorens TD150 Mk. II	£26.95
Thorens TD150A Mk. II	£32.95

## TUNERS

Please add 75p for P. & P.

Amstrad Multiplex 3000	£28.65
Armstrong 523	£39.50
Armstrong 524	£31.45
Rogers R/brook FET4 (Chassis)	£31.00
Rogers R/brook FET4 (Cased)	£34.95
Rogers R/bourne FET4 (Chassis)	£43.00
Rogers R/bourne FET4 (Cased)	£47.50
Sinclair PR060 (Module)	£35.75
Sinclair 2000/3000 Tuner	£31.00
Leak Delta FM (Cased)	£53.50
Leak Delta AM/FM (Cased)	£60.75
Alpha Highgate FT150	£34.95

## TUNER/AMPLIFIERS

Please add 75p for P. & P.

Alpha Highgate 150	£44.25
Armstrong 525 (Teak cased)	£69.45
Armstrong 526 AM/FM (Teak cased)	£77.75
Leak Delta 75	£120.95
Philips RH781	£50.00
Philips RH702	£82.50
Teleton 2100	£29.45
Goodmans One Ten	£98.00
Rogers Ravensbrook (Teak cased)	£77.50
Rogers R/brook (Chassis)	£72.00
Alpha FR 3000. New product	£66.00

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



# GLOBAL AUDIO DISCOUNT WAREHOUSES

Dept. (PE1) 174 Pentonville Road, London, N1. Telephone 01-278 1769  
Or: 4 High View Parade, Redbridge Lane East, Woodford Avenue, Ilford, Essex. Tel: 01-550 1086.

Open Monday to Saturday 9.30 a.m. to

6 p.m. LATE NIGHT FRIDAY 7 p.m.

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

## AMPLIFIERS

Please add 75p for P. & P.

Amstrad 8000 Mk. II	£14.95
Amstrad IC2000	£26.95
Amstrad Integra 4000	£21.95
Armstrong 521 (Teak cased)	£44.40
Alpha Highgate 212	£24.95
Alpha Highgate FA300	£30.95
Alpha Highgate FA400	£34.50
Leak Delta 30	£44.85
Leak Delta 70	£54.95
Metrosound ST20E	£24.15
Metrosound ST60	£45.80
Pioneer SA600 & 610	£57.00
Pioneer SA900	£85.00
Pioneer SA1000	£93.00
Rogers R/brook (Chassis)	£35.80
Rogers R/brook (Cased)	£38.00
Rogers R/bourne (Chassis)	£41.80
Rogers R/bourne (Cased)	£48.35
Sinclair PR060 2 x Z30/PZ5	£14.70
Sinclair PR060 2 x Z30/PZ6	£16.70
Sinclair PR060 2 x Z50/PZ8	
Trans	£20.95
Sinclair AFU (Filter Unit)	£4.20
Sinclair 605	£17.90
Sinclair 2000 Mk. II	£21.40
Sinclair 3000 Mk. II	£28.90
Wharfedale Linton	£42.75
Teleton SAQ 307	£22.50
Rotel RA310	£33.75
Rotel RA610	£50.75

## SPEAKERS

Please add £1.25 for P. & P. Price per pair

Amstrad I38	£14.70
Wharfedale Denton 2	£28.75
Wharfedale Linton 2	£35.75
Wharfedale Melton 2	£47.45
Wharfedale Dovedale 3	£59.75
Celestion Ditton 120	£38.50
Celestion Ditton 15	£52.00
Celestion Ditton 25	£65.50
Celestion County (new prod.)	£35.50
Goodmans Double Maxim	£47.85
Goodmans Mezzo 3	£46.95
Goodmans Magister	£76.95

£3.20\*



Plus 35p P. & P.  
Finished in teak veneer with tinted dust cover. (Fully assembled).  
For Garrard SP25; 2025TC; 3000; AT60; 2000; 2500; 3500; 5100; 1025; SL65B; Also for BSR, McDonald MP60 and others.  
For AP76; AP75; SL72B; SL75; SL95B\*. £4.20 plus 35p P. & P.  
Also finished in walnut to match Japanese equipment - no extra.

## CARTRIDGES

Please add 10p for P. & P.

Goldring G850	£3.25
Goldring G800	£5.50
Goldring G800E	£7.50
Goldring G800 Super E	£14.15
Shure M3D	£3.85
Shure M44E	£4.85
Shure M55E	£5.60
Shure M75E Type 2	£10.50
Sonotone 9TAHC	£1.75

## FM TUNER THOUSANDS NOW IN USE NELSON-JONES Reduced prices

Approved parts of this outstanding design (W.W. April 1971). Featuring 0.75µV sensitivity. Mosfet front end. Ceramic I.F. strip. Triple gang tuning, ½V r.m.s. output level, suitable for phase locked decoder, as below. Designer's own P.C.B.  
**NEW** Solid State Tuning Indicator and Dial-Chassis Kit. Tuner parts with box. Less than £11.50. S.A.E. please for lists.  
**High Performance Decoder** also available.  
**NEW** IC Stabilised PSU. SC, overload protected, low ripple. £3.55 p.p. 19p.

## ELECTRONIC CALCULATOR MODEL BC806 Pocket Size

**MOS LSI Calculating Chip with 8 Digit Led Display, Overflow and Negative Number Indicators. Leading Zero Suppression.**  
Full 4 Function—will perform Addition, Subtraction, Multiplication and Division including Chain or Mixed Multiplication or Division as well as true credit balance. **Constant Key:** Fixed or Floating decimal point.  
Calculator dimensions: 6in. x 3½in. x 1½in.  
Weight: 8oz.  
THE BC806 IS FULLY ASSEMBLED, TESTED AND GUARANTEED FOR 12 MONTHS, AND IS SUPPLIED COMPLETE WITH BATTERIES AND FULL OPERATING INSTRUCTIONS.

**PRICE ONLY £46.25 (POST FREE)**

A.C./D.C. Adaptor available shortly.  
Leather Carrying case supplied FREE with calculator.

## LIGHT EMITTING DIODES (Red)

Improved Type panel or PCB mounting with free mounting clip—clear or black. Order LEDIA. Please add postage.  
**Monsanto** miniature PCB mounting with radial leads. Order LED2. Please add postage.  
**NOW ONLY 35p each with connection data.**  
**RESISTORS.** ½W 5% Low Noise Carbon Film, 10 ohms-4.7M E12. 1-9 1p, 10-99 0.9p each. Please add postage.

**INTEGREX LIMITED, DEPT. P.E.**  
P.O. BOX 45, DERBY DE1 1TW. Tel. 0283 89 3580

## GUNTON ELECTRONIC IGNITION KIT £7.95 35p P. & P.

**READY BUILT UNIT GUARANTEED 5 YEARS £9.95 + 35p P. & P.**  
Patents Pending. 12 volt only—state pos. or neg. earth. Capacitive discharge ignition is recognised as being the most efficient system and will give you:  
★ **Continual Peak-Tuned Performance**  
★ **Up to 20% reduced fuel consumption**  
★ **Easier All-weather Starting**  
★ **Increased Acceleration and Top Speed**  
★ **Longer Spark Plug Life**  
★ **Increased Battery Life**  
★ **Elimination of Contact Breaker Burn**  
★ **Purer Exhaust Gas Emission**  
Kit includes absolutely everything for assembly: Case, Cables, Coil Connectors, Silicon Grease, etc. 8 page illustrated instructions cover fitting of all types of tachometers. Call in for a workshop demonstration, S.A.E. all enquiries please, or Phone 33652. (Many letters from satisfied customers).  
**SCORPIO:** Transformer £1.85 + 25p P. & P. P.C.B. 65p + 10p P. & P. Special interference filter 65p + 10p P. & P.



## ALUMINIUM BOXES

Complete with baseplate and screws

AT DIRECT FROM MANUFACTURERS' PRICES WITH RETURN OF POST SERVICE

Type No.	L	W	D	Price	P. & P.
7*	5½	2½	1½	25p	15p
8*	4	4	1½	25p	15p
9*	4	2½	1½	25p	13p
10*	5½	4	1½	29p	18p
11	4	2½	2	25p	13p
12	3	2	1	22p	13p
13	6	4	2	35p	18p
14	7	5	2½	42p	19p
15	8	6	3	54p	26p
16	10	7	3	61p	26p

\* These sizes accept standard veroboard range.  
Nos. 12 to 16 available 15th January onwards.

Dept. PE, ELECTRONICS DESIGN ASSOCIATES  
82 BATH STREET, WALSALL WS1 3DE



# BI-PRE-PAK

## COMPLETE TELEPHONES



EX. G.P.O. NORMAL  
HOUSEHOLD TYPE

**ONLY 95p**

POST & PACKING 35p EACH

## TELEPHONE DIALS



Standard Post Office type  
Guaranteed in working order.

**ONLY 25p**

POST & PACKING 15p

## TESTED AND GUARANTEED PAKS

- |     |     |   |     |
|-----|-----|---|-----|
| B2  | 4   | Photo Cells, Sun Batteries. 0.3 to 0.5V, 0.5 to 2mA       | 50p |
| B79 | 4   | 1N4007 Sil. Rec. diodes. 1,000 PIV 1 amp. plastic         | 50p |
| B81 | 10  | Reed Switches, mixed types large and small                | 50p |
| B99 | 200 | Mixed Capacitors. Approx. quantity, counted by weight     | 50p |
| H4  | 250 | Mixed Resistors. Approx. quantity counted by weight       | 50p |
| H7  | 40  | Wirewound Resistors. Mixed types and values               | 50p |
| H40 | 20  | BY 50/2, 2N696, 2N1613, NPN Silicon uncod TO-5            | 50p |
| H9  | 2   | OCPT Light Sensitive Photo Transistor                     | 50p |
| H28 | 20  | OC200/1, 2/3 PNP Silicon uncod TO-5 can                   | 50p |
| H30 | 20  | 1 Watt Zener Diodes, Mixed Voltages 6.8-43V               | 50p |
| H35 | 100 | Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked | 50p |
| H38 | 30  | Short lead Transistors, NPN Silicon Planar types          | 50p |
| H39 | 10  | Integrated circuits 6 gates BMC 962, 4 flip flops BMC 945 | 50p |

## UNMARKED UNTESTED PAKS

- |     |     |  |     |
|-----|-----|--|-----|
| B1  | 50  | Germanium Transistors PNP, AF and RF                             | 50p |
| B66 | 150 | Germanium Diodes Min. glass type                                 | 50p |
| B83 | 200 | Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ. | 50p |
| B84 | 100 | Silicon Diodes DO-7 glass equiv. to OA200, OA202                 | 50p |
| B86 | 100 | Sil. Diodes sub. min. IN914 and IN916 types                      | 50p |
| B88 | 50  | Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, B5Y95A, etc.      | 50p |
| H6  | 40  | 250mW. Zener Diodes DO-7 Min. Glass Type                         | 50p |
| H15 | 30  | Top Hat Silicon Rectifiers. 750mA. Mixed volts                   | 50p |
| H16 | 15  | Experimenters' Pak of Integrated Circuits. Data supplied         | 50p |
| H17 | 20  | 3 amp. Silicon Stud Rectifiers, mixed volts                      | 50p |
| H20 | 20  | BY126/7 Type Silicon Rectifiers 1 amp. plastic. Mixed volts      | 50p |
| H34 | 15  | Power Transistors, PNP, Germ. NPN Silicon TO-3 Can               | 50p |

## MAKE A REV COUNTER FOR YOUR CAR

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system.

**£1 each**



**1,000,000 TRANSISTORS IN STOCK**

We hold a very large range of fully marked, tested and guaranteed Transistors, Power Transistors, Diodes and Rectifiers at very competitive prices. Please send for Free Catalogue.

**600,000 Silicon Planar Plastic Transistors,** unmarked, untested,

factory clearance. A random sampling showed these to be of remarkably high quality.

AUDIO PNP, similar to ZTX500, 2N3702/3, BCY70, etc. AUDIO NPN, similar to ZTX300, 2N3708/9, BC107/8/9, BC168/9, etc. RF NPN and SWITCHING NPN types also.

Please state type of Transistor required when ordering.

ALL TYPES: 500 for £3  
1,000 for £5  
10,000 for £40  
P & P 10p for 1,000

## OUR VERY POPULAR 3p TRANSISTORS

TYPE "A" PNP Silicon Alloy, TO-5 can.  
TYPE "B" PNP Silicon, plastic encapsulation.  
TYPE "E" PNP Germanium AF or RF.  
TYPE "F" NPN Silicon plastic encapsulation.  
TYPE "G" NPN Silicon, similar ZTX300 range.  
TYPE "H" PNP Silicon, similar ZTX500 range.

## POWER TRANSISTOR PRICE BREAKTHROUGH!

Plastic Cased Silicon Power Transistors of latest design. 40 watts and 90 watts. PNP and NPN types. All types available at the most shatteringly low prices of all time. All are fully tested, marked and guaranteed!

		1-12	13-25	26-50
40W	NPN	20p	18p	16p
40W	PNP	21p	19p	17p
90W	NPN	24p	22p	20p
90W	PNP	25p	23p	21p
PAKS complementary pairs:				
MP40	40W + 40W	50p	48p	46p
MP90	90W + 90W	60p	58p	56p

## A CROSS HATCH GENERATOR FOR £3.50!!!

YES, a complete kit of parts including Printed Circuit Board. A four position switch gives X-hatch, Dots, Vertical or Horizontal lines. Integrated Circuit design for easy construction and reliability. This is a project in the September edition of Practical Television.

**This complete kit of parts costs £3.50, post paid.**

A MUST for Colour T.V. Alignment.

## Our famous PI Pak is still leading in value for money.

Full of Short Lead Semiconductors & Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

Please ask for Pak P.I. Only 50p.  
10p P & P on this Pak.

**FREE CATALOGUE FOR**

TRANSISTORS,  
RECTIFIERS,  
DIODES,  
INTEGRATED  
CIRCUITS,  
FULL PRE-PAK  
LISTS



**8 RELAYS FOR VARIOUS TYPES P. & P. 25p £1**

## INTEGRATED CIRCUITS

Clocked Flip Flop.	BMC931	20p	18p	16p
Ex. 2/4-input Buffer.	BMC932	12p	11p	10p
2/4-input Expander.	BMC933	12p	11p	10p
Hex. Inverter.	BMC934	12p	11p	10p
Hex. Inverter.	BMC935	12p	11p	10p
Hex. Inverter.	BMC936	12p	11p	10p
Hex. Inverter.	BMC937	12p	11p	10p
Decade Counter.	BMC938	25p	23p	21p
Div. by 16 Counter.	BMC939	25p	23p	21p
Hex. Inverter.	BMC940	12p	11p	10p
Hex. Inverter.	BMC941	12p	11p	10p
Type D Flip Flop.	BMC942	20p	18p	16p
Ex. 2/4-input Power.	BMC944	12p	11p	10p
Clocked Flip Flop.	BMC945	20p	18p	16p
4/2 Input Nand Gate	BMC946	11p	10p	9p
Clocked Flip Flop.	BMC948	20p	18p	16p
4/2 Input Nand Gate	BMC949	12p	11p	10p
Pulsed Trig. Binary.	BMC950	20p	18p	16p
Monostable Multivib.	BMC951	25p	23p	21p
Dual J/K Flip Flop.	BMC953	20p	18p	16p
Dual J/K Flip Flop.	BMC955	20p	18p	16p
Dual J/K Flip Flop.	BMC956	20p	18p	16p
Quad. 2-input Power.	BMC958	12p	11p	10p
2/4-input Gate.	BMC961	12p	11p	10p
3/3-input NAND Gate.	BMC962	11p	10p	9p
3/3-input NAND Gate.	BMC963	12p	11p	10p
Audio Amp. 3-watts.	SL403D	£1.50	1.40	£1.36
Linear Op. Amp. 709C.		25p	20p	15p
Decade Counter; SN7490		65p	60p	55p

## LOW COST DUAL IN LINE I.C. SOCKETS

14 pin type at 15p each | Now new low 16 pin type at 16p each | profile type.

## BOOKS

We have a large selection of Reference and Technical Books in stock.

These are just two of our popular lines:  
B.P.I. Transistor Equivalents and Substitutes: 40p  
This includes many thousands of British, U.S.A., European and C.V. equivalents.  
The Iliffe Radio Valve & Transistor Data Book 9th Edition: 75p  
Characteristics of 3,000 valves and tubes.  
4,500 Transistors, Diodes, Rectifiers and Integrated Circuits. Post and Packing 21p  
Send for lists of these English publications.

Please send me the FREE Bi-Pre-Pak Catalogue.

NAME .....

ADDRESS .....

MINIMUM ORDER 50p. CASH WITH ORDER PLEASE. Add 10p post and packing per order. OVERSEAS ADD EXTRA FOR POSTAGE.

**BI-PRE-PAK LTD**

DEPT. A. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX  
TELEPHONE: SOUTHEND (0702) 46344









# JAMES SCOTT

## SALE OF SURPLUS ELECTRONIC EQUIPMENT

The following items are available for immediate delivery at very competitive prices—

### SCANNING ALARM INDICATOR

Can be used for Automatic Monitoring of All Types of Test Points (Up to 25)

Incorporates: Auto and Manual Facilities  
Illuminated Digital Input Identification  
Double Pole Gold Plated Contacts on Uniselectors

Units Supplied Untested Less Indicating Meter. Price £25 00  
Carriage and Insurance (U.K. only) £1 50



### DOSIMETER CHARGING UNIT TYPE 200

PORTABLE INSTRUMENTS USED TO CHARGE QUARTZ FIBRE TYPE POCKET DOSIMETER TO ZERO. SUITABLE FOR USE WITH ALL STANDARD TYPES OF QUARTZ FIBRE DOSIMETERS HAVING A MAXIMUM OUTSIDE CHARGING END DIAMETER OF 0.805mm. TELEPHONE TYPE A.C. AND GENERATOR THE OUTPUT OF WHICH IS RECTIFIED AND CHARGES UP A RESERVOIR CAPACITOR TO A MAXIMUM POTENTIAL OF ABOUT 300 VOLTS D.C. SUPPLIED LESS GENERATOR HANDLES. PRICE £1 50. P & P 20p



### SEALED RELAYS (NATO APPROVED)

GEC 4 pole c/o 24V 670 ohm. GEC 2 pole on/off 24V 670 ohm. GEC 2 pole c/o 65V 5,000 ohm. STC 2 pole c/o 12V 170 ohm. Price each 75p. P & P 10p

PC102 Supply voltage 220-250V a.c. Output voltages 21 Volts d.c. at 330MA  
21 Volts a.c. at 540MA



### NEWMARKET TRANSISTORS

NKT351	73p	NKT12329	27p	2N2222	18p	NKT218	23p
NKT352	25p	NKT12429	27p	NKT12	30p	NKT221	30p
NKT406	60p	NKT13329	27p	NKT72	25p	NKT222	18p
NKT420	£1 80	NKT13429	27p	NKT73	22p	NKT223	25p
NKT450	30p	NKT16229	27p	NKT121	21p	NKT224	22p
NKT603	22p	NKT20329	29p	NKT124	28p	NKT227	25p
NKT813F	28p	NKT80111	85p	NKT125	38p	NKT237	29p
NKT874	30p	NKT80113	85p	NKT126	35p	NKT238	18p
NKT877	18p	NKT80125	80p	NKT127	23p	NKT249	28p
NKT713	27p	BC107	8p	NKT128	18p	NKT261	19p
NKT734	24p	BC108	8p	NKT129	22p	NKT270	18p
NKT736	30p	BCY70	13p	NKT135	24p	NKT271	18p
NKT773	23p	BFY51	17p	NKT137	30p	NKT272	15p
NKT0216	20p	BSY95A	10p	NKT142	48p	NKT273	18p
NKT3055	23p	2N697	13p	NKT143	48p	NKT274	18p
NKT8917	27p	2N706	8p	NKT212	23p	NKT275	21p
NKT10339	23p	2N914	15p	NKT213	23p	NKT278	18p
NKT10419	17p	2N918	28p	NKT214	21p	NKT301	70p
NKT10439	25p	2N930	22p	NKT215	18p	NKT302	85p
NKT10519	20p	2N1990	22p	NKT217	48p	NKT303	70p
						NKT304	78p

### S.T.C. RELAYS—BRAND NEW



TYPE	CONTACT FORM	NOMINAL COIL VOLTAGE	COIL RESISTANCE (OHMS)	PRICE EACH
250 ARO	4 CHANGEOVER	6V d.c.	52	£0 88
250 ABO	4 CHANGEOVER	8V d.c.	2,500	£0 88



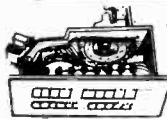
TYPE	CONTACT FORM	COIL VOLTAGE	SWITCHING CURRENT	PRICE EACH
SL722212	3 Pole on/off	12V a.c.	10A at 440V a.c.	£1 00
SL7622715	2 Pole C/O	220V a.c.	10A at 440V a.c.	£0 87



TYPE	CONTACT FORM	COIL VOLTAGE	COIL RESISTANCE	PRICE EACH
SP13372	Single Pole C/O	6V d.c.	140 ohm	£0 40
SP13366	Single Pole C/O	12V d.c.	350 ohm	£0 40
11301D	Single Pole C/O	18V d.c.	875 ohm	£0 40

### UNISELECTOR SWITCHES

6 bank 25 way. 75 coil 50V d.c. operation. Mounted on Modular Type Chassis with front panel containing 20 illuminated Push Button Switches. Completely wired for operation. Price £15 P & P £0 55



### AUTOMATIC CYCLER UNIT

This unit generates stepping pulses (50V d.c.) at intervals of 6 pulses per min. to 120 pulses per min.—continuously variable. Can be used for Automatic Stepping of one or more uniselector switches shown above. Price £12 50 P & P £0 45

### NEWMARKET PACKAGED AUDIO AMPLIFIER

PC1 150mW Audio Amplifier. Price £1 06 each. P & P £0 10  
PC10 Magnetic replay head amplifier supply voltage 8V d.c. Input impedance 150. Price £0 90 each. P & P £0 10

WE HAVE A LARGE RANGE OF CAPACITORS AND RESISTORS PLEASE SEND A STAMPED AND ADDRESSED FOOLSCAP ENVELOPE FOR YOUR CATALOGUE

POST & PACKING OVER £2—FREE. OVER £1 AND UNDER £2—15p. UNDER £1—10p UNLESS SPECIFICALLY MENTIONED. P. & P. U.K. ONLY

JAMES SCOTT (ELECTRONIC ENGINEERING) LIMITED  
CARNYNE INDUSTRIAL ESTATE, GLASGOW G32 6AB  
TEL: 041-778 4206

# JERMYN BARGAIN OFFERS

Price WAS ~~£1.75~~ NOW ~~£1.50~~

Part No.	Price	Price
3½ Watt Audio Amplifier with p.c.b.	PA263	£1.75 £1.50
SCR 1.6 amp 25 volt. T05	C6U	.17 .14
Triac 15 amp 400 volt press fit	PT415	£2.36 £1.00
Mounted into isolated heat sink	PT415/1057 4.5	£2.90 £1.45
Transistor Gen. Purpose (hfe 55-110). Red	2N2926	.10 .06
Photo Darlington	2N5777	.26 .12
Zener Diode 12 volt 400 mW 5%	1S2120A	.13 .07



All prices subject to 15p handling Post and packing. If total order is below £1.00 add 25%

4th Edition **SCR MANUAL** HALF PRICE offer £1  
Jermyn Industries  
10 Vesty Estate Sevenoaks Kent

## NEW LIGHT SENSITIVE SWITCHES

TWO NEW LITE-IC'S—COMPLETE LIGHT SWITCHES CONSISTING OF PHOTODETECTOR + AMPLIFIER + TRIGGER + DRIVER—All in a single 4mm. dia. can.

NEW FEATURES: WIDER VOLTAGE SUPPLY RANGE—LITE-IC 1 11V to 20V LITE-IC 3 20V to 30V HIGHER OUTPUT CURRENT DRIVE—to 40mA.



APPLICATIONS INCLUDE: Relay, Triac or Logic Drive. Automatic Light Switching and Door Control. Beam/Break Detection—Burglar Alarm. Batch Counting and Code Reading.

PRICE ONLY 95p each with full operating instructions. 10 off for 80p each. Postage free in the U.K. P.O./CHEQUES made payable to ELBON and crossed (with order). LITE-IC, ELBON, SUMMERFIELD, THE CRESCENT, WEST WITTERING, SUSSEX

## LOW COST BRIDGE RECTIFIERS

DC output		Type Nos.
Amps	Volts	
10 when mounted	60	PM7A1
	125	PM7A2
	250	PM7A4
	375	PM7A6
15 when mounted	60	PM7A1Q
	125	PM7A2Q
	250	PM7A4Q
	375	PM7A6Q

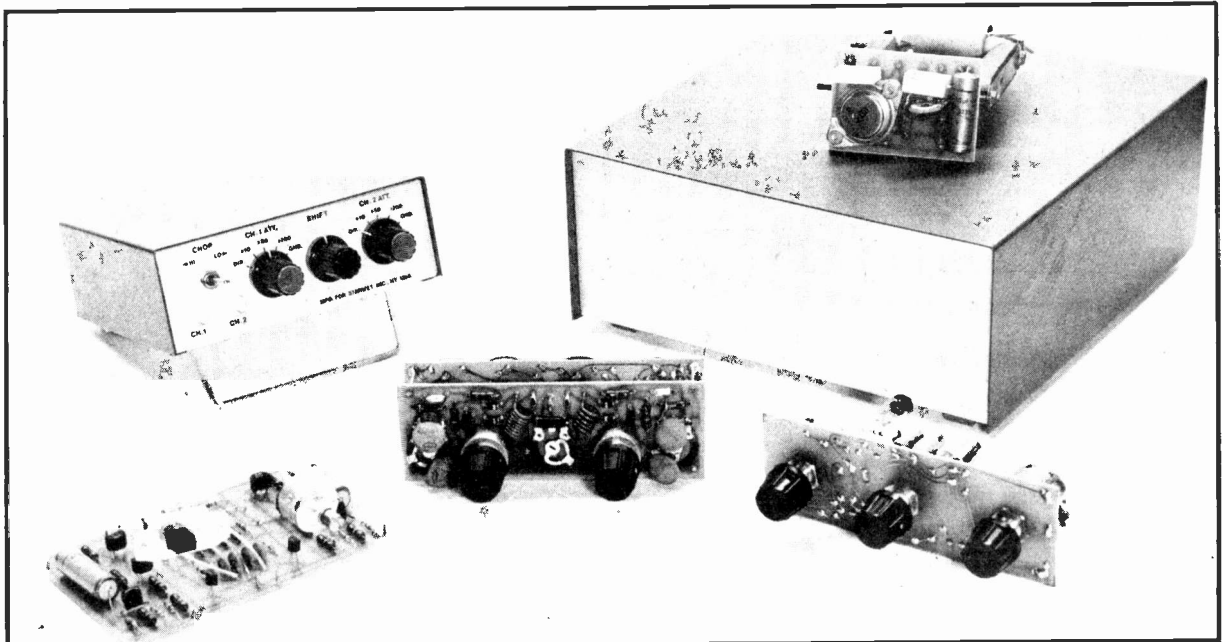


AVAILABLE EX STOCK

**AEI** SEMICONDUCTORS

AEI Semiconductors Limited  
Carholme Road Lincoln

AMP tags electrically isolated from mounting bracket. Mount them on a chassis, the equipment box, transformer housing etc.



**2HZ to 20MHZ SOLID STATE BEAM SWITCH**

Completely assembled P.C. Board, ready to use on any standard commercial oscilloscope. Size 4½in × 3¼in, **£9.25 each.** P & P 25p. Completely encased with attenuators and BNC connectors **£25 each.**

**20HZ to 200KHZ SINE WAVE GENERATOR**

In four ranges. Wein bridge oscillator, thermistor stabilised, amplitude control, 3V peak to peak. Completely assembled P.C. board, ready to use. 9 to 15V supply required. **£4.85 each.** P & P 25p. Sine and Square Wave version of above, **£6.85 each.** P & P 25p.

**TRANSISTOR INVERTOR**

12V to 1.5kV 2 MA AC. Size 1½in × 2½in × 4in. **ONLY £2.95 each.** P & P 25p.

**MODERN INSTRUMENTS CASES**

All aluminium construction, etched chassis with removable blue vinyl cover.

**Small case**

Size 4½in wide, 1½in high, 4¼in deep with 2 position tilted hinged rest, **95p each.** P & P 15p.

**Large case**

Size 8in wide, 3in high, 7½in deep. Price **£1.87 each.** P & P 25p.

**STABILISED POWER UNIT**

For BC 221 Frequency meter. Slide-in and connect. **ONLY £3.75 each.** P & P 75p.

The advertised Beam Switch and Sine Wave Generator will fit the smaller case.

**LARGE RANGE OF OSCILLOSCOPES ALWAYS AVAILABLE WRITE FOR LISTS**

**WOBBULATOR**

For displaying response of 10.7MHZ (FM receiver I.F.'s) and 30-40MHZ (TV I.F. alignment). Requires 6.3V AC and any general purpose oscilloscope. Instructions supplied. Completely assembled P.C. Board, **£9 each.** P & P 25p.

**CLEARANCE SALE OF ELECTRONIC EQUIPMENT—CALL AND SEE WHAT MUST GO**

**CHILTMEAD LTD**

7/9 ARTHUR ROAD, READING, BERKS. (rear Tech. College) Tel.: Reading 582605/65916

# Now! A FAST EASY WAY TO LEARN BASIC RADIO & ELECTRONICS



Build as you learn with the exciting new **TECHNATRON** Outfit! No mathematics. No soldering—you learn the **practical way.**

Learn basic Radio and Electronics at home—the fast, modern way. Give yourself essential technical "know-how"—like reading circuits, assembling standard components, experimenting, building—quickly and without effort, and enjoy every moment. B.I.E.T.'s simplified study method and the remarkable **TECHNATRON** Self-Built Outfit take the mystery out of the subject, making learning easy and interesting.

Even if you don't know the first thing about Radio now, you'll build your own Radio set within a month or so!

... and what's more, you will understand exactly what you are doing. The **TECHNATRON** Outfit contains everything you need, from tools to transistors—even a versatile Multimeter which we teach you to use. All you need give is a little of your spare time and the surprisingly low fee, payable monthly if you wish. And the equipment remains yours, so you can use it again and again.

**You LEARN—but it's as fascinating as a hobby.**

Among many other interesting experiments, the Radio set you build—and it's a good one—is really a bonus. This is first and last a teaching course, but the training is as fascinating as any hobby and it could be the springboard for a career in Radio and Electronics.

A 14-year-old could understand and benefit from this course—and it teaches the real thing. The easy to understand, practical projects—from a burglar-alarm to a sophisticated Radio set—help you master basic Radio and Electronics—even if you are a "non-technical" type. And, if you want to make it a career, B.I.E.T. has a fine range of courses up to City and Guilds standards.

### Specialist Booklet

If you wish to make a career in Electronics, send for your FREE copy of "NEW OPPORTUNITIES". This brand new booklet—just out—tells you all about **TECHNATRON** and B.I.E.T.'s full range of courses.



## FREE

### BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Dept. BD49, ALDERMASTON COURT, READING RG7 4PF

*Accredited by the Council for the Accreditation of Correspondence Colleges.*

**POST THIS COUPON FOR FREE BOOK**

BD49

AGE .....

NAME  
(BLOCK CAPITALS)

ADDRESS

SUBJECT OF INTEREST .....

## SOUND BARGAINS

**BEST OF ALL WORLDS**

VHF FM, AM, A.F.C. AIR BAND, PUBLIC SERVICE AND WEATHER BANDS

**BATTERY CHECK INDICATOR**

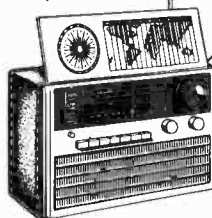
**GIANT POWER MULTI-WAVEBAND COMMUNICATIONS RECEIVER**

WITH 3 IN 1 AC/DC POWER SUPPLY SYSTEM  
MAINS/BATTERY plus BUILT-IN BATTERY BOOSTER

**OUR PRICE £10.50**  
+40p P. & P.

**THIS NEW 1972 RADIO.** No less than 3 VHF BANDS. Picks up Aircraft Transmissions, Pop Pirates, Taxis, Ambulances, Local Radio, Continental and all BBC, VHF Stations plus fascinating Public Service Transmissions we are not allowed to mention! Even TV sound in certain areas. PLUS A SPECIAL WEATHERBAND. Frequency ranges: MW540-1600kHz, FM88-108MHz, Airband 108-145 MHz, VHF 145-175 MHz, 23 semiconductors—12 transistors, 11 diodes and thermistors. Automatic frequency control. 3.1in telescopic aerial. Runs off mains a.c. 230/250V or off 4 U11 batteries, or use re-chargeable nickel alkali cell. Finished in strong leather grained case with carrying handle. Approx. size 10 1/2in x 6 1/2in x 3 1/2in. Written guarantee. Special magnetic ear-pieces for personal listening, dry batteries free. **HURRY!** Limited quantity only from Sonic Sound.

**OUR PRICE £28.95**  
+50p P. & P.



**8 WAVEBANDS AND WORLD MAP & TIME ZONE DIAL**

Tune into the world with this amazing communications receiver. A truly exceptional unit in performance and looks—leatherette with Stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220-240V domestic mains supply. 14 transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the 8 WAVEBANDS. Complete with Hi-Fi earphone for personal listening. Frequency ranges: Long wave 150-350 kHz. Medium 353-1605 kHz. Marine 1.6-4.5 MHz. Short Wave 12-24 MHz. FM/VHF 88-108 MHz. Aircraft 108-135 MHz. PUBLIC SERVICE BANDS 135-174 MHz. Fully guaranteed. *N.B. The Ministry of Post & Telecommunications has pointed out that a licence (not generally available to the public) is required for reception of transmissions by Fire Brigade, Aircraft, Shipping, etc.*



**SONIC SOUND AUDIO LTD.**

(Dept. PE8), 372 EDGWARE ROAD  
LONDON, W.2. Tel. 01-723 0094  
Calls welcome Mon. to Sat. 9 a.m.-6 p.m.

## Save on FERRANTI

All devices Tap grade Brand new. Fully guaranteed.

BF559	13p	ZTX313	10p	* DIODES *	* ZENERS *
BF560	18p	ZTX314	11p	ZS120	7p KS030A
BF561	18p	ZTX320	28p	ZS121	9p KS033A
BF596	13p	ZTX330	13p	ZS122	11p KS036A
BF597	21p	ZTX331	14p	ZS123	14p KS039A
BF598	18p	ZTX382	11p	ZS124	16p KS043A
ZTX107	8p	ZTX383	13p	ZS140	22p KS047A
ZTX108	7p	ZTX384	16p	ZS141	39p KS051A
ZTX109	10p	ZTX450	15p	ZS142	30p KS056A
ZTX114	20p	ZTX451	15p	ZS170	9p KS062A
ZTX212	12p	ZTX500	10p	ZS171	11p KS068A
ZTX213	12p	ZTX501	11p	ZS172	14p KS075A
ZTX214	13p	ZTX502	15p	ZS174	15p KS082A
ZTX300	10p	ZTX503	12p	ZS176	21p KS091A
ZTX301	11p	ZTX504	39p	ZS178	34p KS100A
ZTX302	15p	ZTX510	15p	ZS270	10p KS110A
ZTX303	12p	ZTX530	19p	ZS271	14p KS120A
ZTX304	19p	ZTX531	20p	ZS272	16p KS130A
ZTX310	8p	ZTX550	15p	ZS274	17p KS150A
ZTX311	9p	ZTX551	15p	ZS276	23p KS180A
ZTX312	9p	2N3055	65p	ZS278	33p

MOTOROLA. MJE2955, £1.06; MJE3055, 65p; 2N4444, £2.25.  
R.C.A. CA3075, £1.35; CA3090Q, £4.30.  
GEMINI TUNER. Full set of semiconductors, £7.60.

### P.E. ELECTRONIC PIANO—SPECIAL BULK PRICES!

350 ZS170, £20; 110 ZTX300, £9.50; 24 ZN7474E, £14.40; 14 KS047A, £2.30; ZT3055, 65p each; ZT3053, 16p each.

We can supply all Ferranti semiconductor devices used in this instrument.

Postage and packing 10p. Free over £2. Send S.A.E. for Ferranti data.

WE CAN SUPPLY ANY FERRANTI DEVICE. Send S.A.E. for quotation.

WE SELL ONLY THE BEST

**DAVIAN ELECTRONICS**

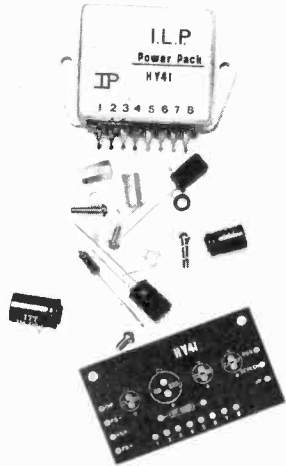
PO BOX 38, OLDHAM, LANCS. OL2 6XJ.





# I.L.P. (Electronics) Ltd

## THE HY41



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

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

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

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

**OUTPUT POWER:** British Rating 40 WATTS PEAK, 20 watts

R.M.S. continuous.

**LOAD IMPEDANCE:** 4–16 ohms.

**INPUT IMPEDANCE:** 30K ohms at 1KHz.

**VOLTAGE GAIN:** 30db at 1KHz

**TOTAL HARMONIC DISTORTION:** less than 0.15% (typical 0.05%) at 1KHz.

**FREQUENCY RESPONSE:** 5Hz–50KHz  $\pm$  1db.

**SUPPLY VOLTAGE:** + 22.5volts D.C.

**SUPPLY CURRENT:** 0.8 amps maximum.

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

## UNIQUE HYBRID PRE-AMPLIFIER

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

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

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

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

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

### INPUTS

Magnetic Pick-up (within  $\pm$ 1db RIAA curve)

2mV. 47K  $\Omega$

Tape Replay (external components to suit

head). 4mV. 47K  $\Omega$

Microphone (flat) 10mV. 47K  $\Omega$

Ceramic Pick-up (equalized and compen-

satable) 20–2000mV. variable.

Tuner (flat) 250mV. 100K  $\Omega$

Auxiliary 1 250mV. 47K  $\Omega$

Auxiliary 2 2–20mV. 100K  $\Omega$

### OUTPUTS

Main Pre-amp output 500mV.

Direct tape output 120mV.

### ACTIVE TONE CONTROLS (Bexendall)

Treble  $\pm$  12db.

Bass  $\pm$  7.2db.

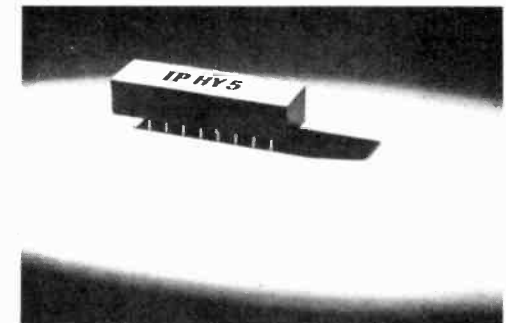
### INTERNAL STABILIZATION

Enables the HY5 to share an unregulated supply with the Power Amplifier.

### SUPPLY VOLTAGE

16–25 volts

PRICE: MONO: £3.60



### SUPPLY CURRENT

6mA approx.

### OVERLOAD CAPABILITY

better than 26db on most sensitive input infinite on tuner and aux1.

OUTPUT NOISE VOLTAGE: 0.5mV.

STEREO: £7.20

## POWER SUPPLY PSU45

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

### Specification

Input: 200–240 Volts.

Output:  $\pm$  22.5 Volts at 2 amps.

Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

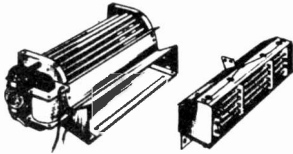
PRICE: £4.50 inc. P. & P.



CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT

CANTERBURY 63218

# LINDAIR (ELECTRO-TECH) LTD



## TANGENTIAL HEATER

Silently driven by a shaded pole Mycalex motor. Compact, powerful and quiet running with aluminium impeller (outlet  $3\frac{1}{2} \times 1\frac{1}{2}$ ). Mains voltage. PLUS matching heater unit with spiral element. May be switched for 500 or 1,000 watts. **PRICE ONLY £1.60** P. & P. 50p

## SYNCHRONOUS AUTO-RESET PROCESS TIMER

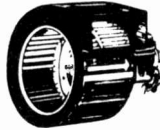


By LONDEX LIMITED

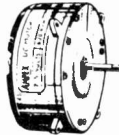
Type IMP Mk. 2 Brand New and Boxed. These well known timers are already in world-wide use and are perfect for Industrial Electronic Timing. Research and for all machine control timing problems. Repetitive accuracy better than 0.5% of full scale setting. Two or more can be interconnected to give control of a series of processes. 250/250V. 50Hz, also available 60Hz. 15 minutes full scale, 15 secs. per division. Driven by self-starting sync. motor. Contact rating 5 amp at 250V a.c. Incorporates solenoid operated clutch also lever actuated micro switches. Normal price probably in excess of £16. Complete with multi-pin connector as illustrated.

OUR PRICE ONLY

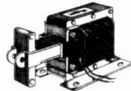
£6.50



"PRECISION FAN CO." (Smiths Industries) DOUBLE EXTRUDED CENTRIFUGAL FAN/BLOWER. This is a beautifully balanced, particularly quiet running unit giving approx. 90 cubic ft./min. The motor is a 2 pole shaded pole 240V Mycalex, drawing only 240ma on run. Weight only 240ma. Draws 60ma on run. 2 1/2lb. Sizes: Case dia. 3 1/2in., width (case only) 3 1/2in., width overall (inc. motor) 5 1/2in., aperture 3 1/2in. by 1 1/2in. Offered well below makers' price at £2.95 P. & P. 25p.



AMPEX 7.5V D.C. MOTOR. This is an ultra-precision tape motor designed for use in the AMPEX model AG20 portable recorder. Torque 450GM/CM. Stall load at 500ma. Draws 60ma on run. 600 rpm  $\pm 5\%$  speed adjustment. Internal AF/RF suppression, 1" dia.  $\times$  1" spindle, motor 3" dia.  $\times$  1 1/2". Original cost £16.50. Our price £4.25. P. & P. 25p. Large quantity available (special quotations). Mu-metal enclosure available 75p each.



"SORENG" MAINS SOLENOID. 1" travel, 18lb. pull (approx.). Size: 2 1/2" long  $\times$  2 1/2"  $\times$  2" high. Powerful £1.75. P. & P. 25p.

"DAVENSET" MAINS SOLENOID. 1" travel, 8lb. pull (approx.). Size: 2 1/2" long  $\times$  2 1/2"  $\times$  2" high. Similar in appearance to "SORENG" £1.25. P. & P. 25p.

### NEW AND UNUSED

Postal or carriage charges are for Great Britain only. We welcome orders from established companies, educational depts., etc. All orders under £2.50, cash with order please.

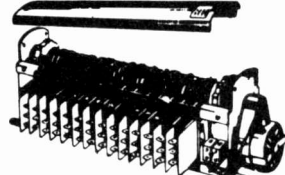
## FURTHER BULK PURCHASE SILVANA MAGNETIC SWITCH



NOW COMPLETE WITH REFERENCE MAGNET! A magnificently activated switch. Vacuum sealed in a glass envelope. Silver contacts normally closed, rated 3 amp at 120V, 1 amp at 240V. Size (approx.) 1 1/4" long 1" dia. Ideal for Burglar Alarms, Security systems, etc., and wherever non-mechanical switching is required. **New Lower Price. Only £2.10 for 12. £8 for 50 or £15 for 100 complete with magnet.**

£2.10

## PROGRAMMER TIMER BY HONEYWELL



A bank of 15 micro-switches are each independently operated by 15 pairs of cams which in turn are individually adjustable to give switching periods of zero to 12 seconds with infinitely variable combinations. A mains synchronous motor drives the cam shaft at 1 rev. per 12 seconds (G. R. P. M.). Designed originally for vending machines at a cost of £15.00 plus. Many applications where continuous sequence programmes are required, such as lighting effects, etc. New in original makers' cartons. First class value at £5.75 plus 25p P. & P.

£5.75

315 EDGWARE ROAD, LONDON W.2. Tel. 01-723 5667 Open 9 a.m.-6 p.m. MON. to SAT.

## COMPARE OUR PRICES

Speaker Bargains	£p
E.M.I. 13in $\times$ 8in 3, 8 & 15 ohms plain	2.00
with tweeter	2.25
twin tweeter	3.50
Type 350-20 watt with tweeter 8 ohms, P.P. 37p.	7.50
8in $\times$ 5in 3, 8 & 15 ohms	1.80
7in $\times$ 4in 3 & 8 ohms	1.05
FANE 8in 8 ohm, dual cone	2.30
CELESTION 8in 15 ohm	1.80
GOODMANS 8in $\times$ 6in 3 ohm	1.80
BAKER GROUP 25 12in 25W 8 or 15 ohm	5.75
Postage 25p per speaker	
2 1/2in 8 or 64 ohm P.P. 10p	50
Kil-lorm cabinets, teak (17in $\times$ 10in $\times$ 6in) with a 13in $\times$ 8in or 8in cut out (12in $\times$ 12in $\times$ 6in) with a 8in $\times$ 5in or 8in cut out.	2.75
(please specify cut out)	
2 1/2in 8 or 64 ohm P.P. 10p	2.25
Add 35p per Cabinet for post & packing	
Microphone Bargains	£p
MIC45 "ACOS" metal case, crystal hand	95
CM 20 Crystal Hand	45
DX 166 Dynamic Stick	90
DX143 Dynamic, cassette-type stick	1.00
MIC60 "ACOS" stick crystal	1.00
CM70 PLANET stick metal, switch crystal	1.45
DM160 Dynamic uni-dir, ball metal	3.75
UD180 50K/600 ohm uni-dir, ball metal	4.50
TW209 Lesson dual imp ball metal uni-dir	5.75
Guitar mike	45
Lapel type, crystal	40
Postage 17p each	
Panel Meters	
2in sq.	
0-500mA, 0-1mA, 0-10mA, 0-100mA	
0-500mA, "8" METER	£1.50
Postage 17p each	

Cartridges—with standard fittings & styli	£p
ACOS GP91/28C or (GP91/38C) stereo compatible	1.65
ACOS GP94 stereo ceramic	1.90
ACOS GP93 stereo crystal	1.85
9THAC Sonotone stereo ceramic (diamond)	2.00
ACOS GP67/2C mono crystal	65
ACOS GP101 compatible crystal	75
19-TI Sonotone stereo crystal	90p
Postage 5p per cartridge	
Multitesters	£p
1,000 ohms/volts	£2.50
2,000 ohms/volts	£2.75
10,000 ohms/volts	£5.00
50,000 ohms/volts	£10.00
100,000 ohms/volts with transistor tester	£15.00
Postage 17p each	

Tapes—"MYLAR" base finest quality British made.	£p
5in 600ft	36p
5in 900ft	45p
5in 1200ft	60p
5 1/2in 900ft	49p
5 1/2in 1200ft	55p
5 1/2in 1800ft	65p
7in 1200ft	65p
7in 1800ft	80p
7in 2400ft	95p
Postage 17p each	

**THIS MONTH'S SPECIAL OFFER**

**CAR STEREO SPEAKERS**  
(5in speaker, 8 ohm) in cabinets, for 8-track stereo players—**£3.95** a pair P. & P. 25p

## TESL (ELECTRONICS)

37 TALGARTH ROAD, LONDON, W.14

MAIL ORDER ONLY

THE ONLY "SPEC" OF DIFFERENCE IS THE LOWER PRICE BRAND NEW FULLY GUARANTEED

### RESISTORS

Full range of ISKRA carbon film resistors. All 5% (except values over 4.7M $\Omega$ )—high stability—very low noise—E12 values.  $\frac{1}{2}W$ ,  $\frac{1}{4}W$  (1p);  $1W$  2p.

### POTENTIOMETERS

Carbon track 5K $\Omega$  to 2M $\Omega$  log or linear. Single 12p; Dual gang (stereo) 38p; Single D.P. switch 23p.

### SLIDER POTENTIOMETERS

Overall length 86.6mm. Fixing centres 80mm. Single 10K, 25K, 50K, 100K, 35p each. Dual gang dual values as above, 50p each. Knob for above, 10p each.

### TRANSISTORS

AC125	12p	AF114	14p	BC147	9.5p
AC126	12p	AF115	14p	BC148	9.5p
AC127	11p	AF116	14p	BC149	9.5p
AC128	11p	AF117	14p	2N2218A	13p
AC132	12p	BC107	7p	2N2222	13p
AC187	14p	BC108	7p	2N2222A	13p
AC188	14p	BC109	7p	2N3014	13p

Any one type  
Discounts 25+ 100+ 1,000+  
10% 20% 40%  
Wholesale enquiries welcome

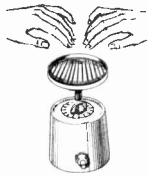
### DIODES

ZENER—400mW 5% 3.3V to 30V	12p each	709C	25p each
SIGNAL—CA90, 4p; OA91, 4p		723	51p each
RECTIFIER—IN4001, 4p; IN4004, 7p		741C	30p each

Terms: C.W.O. please. P. & P. please add 10p for orders below £2. Discount 7 1/2% for orders above £10. Full CATALOGUE on request. S.A.E. appreciated.

**RIVERSDALE ELECTRONICS**  
ALL OUR MERCHANDISE IS FULLY GUARANTEED

Mail Order Dept. E1/73,  
P.O. Box 470,  
Manchester M60 4BU  
SEND 25p FOR  
COMPLETE CATALOGUE  
GUARANTEED



## AMAZING MAGIC MUSIC BOX

make electronic music waving your hands about

**ONLY £2-75**

Everyone's heard the weird, wonderful, but beautiful music used in Science Fiction, Horror Films, etc. also on Radio & Television. This unearthly, eerie music is almost always produced by a little known electronic device measuring only a few inches... called a Thereinin. All you have to do is switch on your radio (almost any type will do) and place the Thereinin close by. Switch on the Thereinin and proceed to wave your hands mysteriously in the air like a magician. The most fantastic musical sounds are then produced, and with a little practice people can learn to play all the well known tunes. Apart from its musical value, its small size allows it to be used to best advantage at parties, gatherings of friends, etc., where it attracts tremendous interest. Provides hours and hours of pleasure to young and old. Uses standard PP3 battery which lasts ages. The 3 Transistor circuit, though fairly advanced is simple to build with our pictorial step-by-step plans. No soldering necessary. Easily built in an hour or so using our special terminal board (Pat. applied for). All parts including nuts, bolts, case, etc., **ONLY £2-75** + 25p P. & P. (Parts available separately.)



## INGENIOUS ELECTRONIC SINGING & WARBLING CANARY!

**ONLY £4-50**

Actually whistles and warbles like a real live 'canary'. Amazing circuitry faithfully reproduces the Canary's magnificent song. Just switch on and leave it—whistling down scale for some seconds, suddenly breaking into a delightful warble, then several seconds later shutting off for a second or two—only to start automatically again in a few seconds. People listen to the delightful song all day and never get bored! Relax, as the sweetest, nerve-soothing birdsong takes you to leafy woods and glades. Provides countless hours of joy to young and old alike. Standard self-contained battery lasts ages. Easily built in an hour or so with special pictorial step-by-step plans. No soldering necessary. All parts including terminal board (Pat. applied for), transformers, loudspeaker, transistors, nuts, screws, wire, etc., plus case (which fits under cage—cage and toy bird not supplied). **ONLY £4-50** + 25p P. & P. (Parts available separately.)



## The amazing SOUND OPERATED FLASH "Phototron"

**ONLY £4-50**

Take flash pictures at the exact instant of the bursting of a balloon. A champagne cork leaving the bottle. The split second a hammer strikes a light bulb. The mind boggles at the possibilities of the "Phototron"... the only limit is your imagination. Now that inexpensive flash guns are on the market in quantity, it has made possible, with the help of electronics the production of a wide variety of exciting photography effects, once strictly limited to the professionals. The duration of an electronically produced flash is extremely brief and normally measured in milliseconds. Now, providing the camera shutter is left open in a dark or subdued light, it is the timing of the flash that determines what is imprinted on the film—not necessarily anything done by the camera. As electronic flash guns are fired by making a switched connection then it becomes obvious that one of the latest Silicon Controlled Rectifiers can be used. If we make this S.C.R. operate by sound (with variable sensitivity control for soft/loud sounds) some real "wow out!" photography effects can be captured forever on film. Easily built in a couple of hours or so, the "Phototron" will solid state, uses self contained PP3 battery. No soldering necessary using our special terminal board (Pat. applied for). All parts including special pictorial step-by-step plans, transistors, microphone, S.C.R., potentiometers, switches, test lamp, case, nuts, screws, etc., **ONLY £4-50** + 25p P. & P. Made up must be worth at least £10. (Parts available separately.)

## Eavesdrop on the exciting world of Aircraft Communications—

### V.H.F. AIRCRAFT BAND

**CONVERTER ONLY £2-85**

Listen in to AIRLINES, PRIVATE PLANES, JET-PLANES. Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower. Hear for yourself the disciplined voices hiding tensions on talk-downs. Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including HEATHROW, GATWICK, LUTON, RINGWAY, PRESTON, WICK, etc. CLEAR AS A BELL. This fantastic fully transistorised instrument can be built by anyone over nine in under two hours. No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables) NO CONNECTIONS WHATSOEVER NEEDED. SEND ONLY £2-85 + 20p p & p for kit including case, nuts, screws, wire, etc. etc. (Parts available separately.)

## FIND BURIED TREASURE!

### Transistorised Treasure Locator

This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with tone audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECE ETC. Extremely sensitive, will signal presence of certain objects buried several feet below ground! No knowledge of radio or electronics required. Can be built with ease in one short evening by anybody from nine years of age upwards, with the clear, easy-to-follow, step-by-step, fully illustrated instructions—uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2-85** + 25p p & p. (Special handle as illustrated 95p extra.) Parts available separately. Made up looks worth £15!

**ONLY £2-85**

## TREASURE LOCATOR MODULE

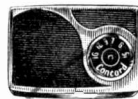
**ONLY £4-50**

FULLY TRANSDUCED METAL DETECTOR MODULE. Uses PP3 battery and phones. Put it in a case, screw a handle on and YOU HAVE A PORTABLE TREASURE LOCATOR. EASILY WORTH ABOUT £20! Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. So sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN, £4-50 + 30p p & p. For KIT. (High quality Danish Stethoscope headphones £2-75 extra if required.)

## SHORTWAVE TRANSISTOR RADIO

**ONLY £2-75**

Anyone from 9 years up can follow the step-by-step, easy as ABC, fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3in x 4in x 1 1/2in. **ONLY £2-75** + 20p p & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately.)



## UNIQUE RADIO FOR BEDROOM OR OFFICE

No batteries, no electricity. **ONLY £1-70**

never wears out

Tune in your favourite programmes or the news, or sports in the Office or in your bedroom. Uses sensitive, germanium diode originally evolved from wartime radar. Never buy a battery. Never use electricity. Never replace. Covers all medium waves. Clear beautiful tone. Size 4 1/2" x 2 1/2" x 1 1/2" in beautiful case. **ONLY SEVEN CONNECTIONS AND IT'S WORKING!** No soldering necessary. CAN BE BUILT ALMOST BLINDFOLD IN UNDER 15 MINUTES! Ideal for absolute beginner from 8 years of age upwards. SPECIAL PRICE TO CLEAR STOCKS OF COMPONENTS, **ONLY £1-70** + 20p P. & P. for all parts including beautiful case. Germanium semi-conductor, tuning condenser, personal phone, wire, nuts, screws. SIMPLE AS ABC INSTRUCTIONS (Parts available separately.)

## "READ PEOPLE'S MINDS"—TEST THEIR NERVES—BEAT THEM AT CARDS, ETC. WITH THIS ASTONISHING ELECTRONIC BRAIN BOX only £2-87

With this "Brain-box" you will be able to perform mind-boggling feats. THE MIND READING DEVICE will make people swear that they have "telepathic" powers. THE AMAZING CARD TRICK UNIT completely mystifies and baffles from one to six people. You correctly "guess" the two cards each person has selected at random from a pack they themselves shuffled. THE ELECTRONICS NERVES TESTER puts your friends to a very lively test. It gives out fail and finish signals (the winner is the person with lowest number of fail signals). Can be adjusted from the weakest to strongest person. THE ELECTRONIC MAZE tests the mental ability of the player because it uses psychology with an electronic twist to it. You can change the maze pathways in seconds to prevent the most brilliant from stalling after lot of use. Completely safe and foolproof. Size 18in x 12in x 6in (max.). You can play all these games and more besides after building the "Brain-box". No soldering, you get pictorial, easy as ABC step-by-step instructions. **ONLY £2-87** + 33p P. & P. for all parts including chassis, switches, stylus, signalling lights, wire, nuts, screws, etc. Uses standard battery. Presentation box 33p extra as illus. if reqd. (PARTS AVAILABLE SEPARATELY) FULL OPERATING DIRECTIONS WITH EACH OF THE PROJECTS.

## NOW YOU CAN CATCH SHOALS OF BIG FISH

with new electronic miracle

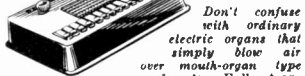
special introductory offer **£2-50**

First time marketed in England, this exciting electronic instrument the "Decoytronic" is the one responsible for starting the electronic fish lure rage in the U.S.A. just recently. Uses ingenious double-beam method of attracting all kinds of fish from hundreds and hundreds of feet away in saltwater or freshwater. Why this device is so fantastically successful is because it actually imitates the sound of wet insects milling about the surface. These sound waves spread out hundreds of feet in all directions. Although this peculiar sonic frequency won't sound like much to you—to all the fish in the area it's their dinner bell! But that's not all... electroluminescence neon tubes cunningly flicker intermittently, penetrating the area for hundreds of feet around, at a frequency fish are unable to resist. The fish mistake this flickering glimmer for the soft phosphorescence glow given out by plankton—a favourite food of most fish! All you do is switch on, lower into the water (it's completely water resistant) allow around 5 minutes—then start reeling 'em in. We'll bet you won't be able to reel 'em in fast enough. Self-contained batteries last ages—cost pence. Kit of all parts including special easy as a.b.c. directions only **£2-50** + 25p P. & P. (Parts available separately.)

## BUILD 5 RADIO AND ELECTRONIC PROJECTS

**ONLY £2-45**

Amazing Radio Construction set! Become a radio expert for £2-45. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc., all you need. Presentation box 45p extra (if required) (parts available separately) no soldering necessary. Send **£2-45** + 20p p & p.



Don't confuse with ordinary electric organs that simply blow air over mouth-organ type reeds, etc. Fully transistorised. SELF-CONTAINED LOUD-SPEAKER. Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne", etc. etc. You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED. No soldering necessary, simple as ABC to make. Anyone over nine years can build it easily in one short evening following the fully illustrated, step-by-step, simple instructions. **ONLY £3-25** + 25p p & p for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

## SOOTHE YOUR NERVES RELAX WITH THIS AMAZING RELAXATRON

CUTS OUT NOISE POLLUTION—SOOTHS YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, ALWAYS HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so simple that batteries last almost a shelf-life). CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones, Components, nuts, screws, wire, etc., no soldering. **£2-75** + 25p P. & P. (Parts available separately.)

## INGENIOUS ELECTRONIC SLEEP INDUCER

**ONLY £3-25**

Can't sleep at nights? Do you wake up in the night and can't get off to sleep again? Would you like to be easily put off to a satisfying sleep every night? Then build this ingenious electronic sleep inducer. It even stops by itself so you don't have to worry about it being on all night! The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sounds gradually become less and less—until they eventually cease altogether, the effect it has on people is amazingly very similar to hypnosis. A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about 15 minutes. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. No soldering necessary. Works off standard batteries, extremely economical. Size only 3in x 4in x 1 1/2in—like it anywhere. Kit includes case, nuts, screws, wire, etc. SEND **£3-25** + 25p P. & P. (Parts available separately.)

CONCORD ELECTRONICS LTD. (PEI), 8 Westbourne Grove, London, W.2. (Callers welcome. 9 a.m.-5.30 p.m.)





# TRANSFORMERS

**MAINS ISOLATING SERIES**  
 Primary 200-250 Volts Secondary 240 Volts Centre  
 Tapped (120V) and Earth Shielded  
**ALSO AVAILABLE WITH 115/120V SEC. WINDING**

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	P & P £ p
07	20	1 11	7.0 x 6.0 x 6.5	1.61 30
100	60	3 8	8.0 x 8.0 x 7.7	2.39 36
61	100	5 12	10.2 x 8.9 x 8.3	2.82 52
30	200	9 8	12.0 x 10.3 x 10.0	4.39 52
62	250	12 4	9.5 x 12.7 x 11.4	5.80 67
55	350	15 0	14.0 x 10.8 x 12.4	7.77 82
63	500	27 0	17.1 x 11.4 x 15.9	11.20 *
92	1000	40 0	17.8 x 17.1 x 21.6	20.63 *
128	2000	63 0	24.1 x 21.6 x 15.2	34.10 *

## AUTO SERIES (NOT ISOLATED)

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	Auto Taps	P & P £ p
113	20	1 11	7.3 x 4.3 x 4.4	0-115-210-240	0.85 22
64	75	1 14	7.0 x 6.4 x 6.0	0-115-210-240	1.66 30
4	150	3 0	8.9 x 6.4 x 7.6	0-115-200-220-240	2.00 36
66	300	6 0	10.2 x 10.2 x 9.5	.. ..	3.89 52
67	500	12 8	14.0 x 10.2 x 11.4	.. ..	5.78 67
84	1000	16 0	11.4 x 14.0 x 14.0	.. ..	10.49 82
93	1500	28 9	13.5 x 14.9 x 16.5	.. ..	15.20 *
95	2000	40 0	17.8 x 16.5 x 21.6	.. ..	19.84 *
73	3000	45 8	17.4 x 18.1 x 21.3	.. ..	26.99 *

**TOTALLY ENCLOSED 115V AUTO TRANSFORMERS**  
 115V 500 Watt totally enclosed auto transformer, complete with mains lead and two 115V outlet sockets, £7.87, P & P 67p.  
 Also available a 20 Watt version. £1.67, P & P 22p.

## LOW VOLTAGE SERIES (ISOLATED)

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Windings	P & P £ p
111	0.5	0.25	7.6 x 5.7 x 4.4	0-12V at 0.25A x 2	0.85 22
213	1.0	0.5	8.9 x 5.1 x 5.1	0-12V at 0.5A x 2	1.01 22
71	2	1 0	7.0 x 6.4 x 5.7	0-12V at 1A x 2	1.33 22
18	4	2 2	8.3 x 7.0 x 7.0	0-12V at 2A x 2	1.86 36
70	6	3 12	10.2 x 7.6 x 8.6	0-12V at 3A x 2	2.24 42
108	8	4 5	10.0 x 8.3 x 8.2	0-12V at 4A x 2	2.48 52
72	10	5 3	7.9 x 10.8 x 10.2	0-12V at 5A x 2	2.94 52
17	16	8 7	11.4 x 9.5 x 10.2	0-12V at 8A x 2	4.58 52
115	20	10 11	12.1 x 11.4 x 10.2	0-12V at 10A x 2	5.78 67
187	30	15 16	13.3 x 12.1 x 12.1	0-12V at 15A x 2	10.67 82
226	60	30 34	17.0 x 14.5 x 12.5	0-12V at 30A x 2	19.61 *

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
112	0.5	1 4	8.3 x 3.7 x 4.9	0-12-15-20-24-30V	1.01 22
79	1.0	2 0	7.0 x 6.4 x 6.0	.. ..	1.35 36
3	2.0	3 2	8.9 x 7.0 x 7.6	.. ..	2.01 36
20	3.0	4 6	10.2 x 8.9 x 8.6	.. ..	2.48 42
21	4.0	6 0	10.2 x 10.0 x 8.6	.. ..	2.94 52
51	5.0	6 8	12.1 x 10.0 x 8.6	.. ..	3.66 52
117	6.0	7 8	12.1 x 10.0 x 10.2	.. ..	4.36 52
88	8.0	10 0	14.0 x 11.7 x 10.0	.. ..	5.64 67
89	10.0	12 2	14.0 x 10.2 x 11.4	.. ..	7.14 67

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
102	0.5	1 11	7.0 x 7.0 x 5.7	0-19-25-33-40-50V	1.33 30
103	1.0	2 10	8.3 x 7.3 x 7.0	.. ..	1.94 36
104	2.0	5 0	10.2 x 8.9 x 8.6	.. ..	2.69 42
105	3.0	6 0	10.2 x 10.2 x 8.3	.. ..	3.65 52
106	4.0	9 4	12.1 x 11.4 x 10.2	.. ..	4.83 52
107	6.0	12 4	12.1 x 11.1 x 13.3	.. ..	7.14 67
118	8.0	18 6	13.3 x 13.3 x 12.1	.. ..	9.32 97
119	10.0	19 12	16.5 x 11.4 x 15.9	.. ..	11.68 97

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
124	0.5	2 4	8.3 x 9.5 x 6.7	0-24-30-40-48-60V	1.35 36
126	1.0	3 0	8.9 x 7.6 x 7.6	.. ..	1.88 36
127	2.0	5 6	10.2 x 8.9 x 8.6	.. ..	2.94 42
125	3.0	8 8	11.9 x 9.5 x 10.0	.. ..	4.48 52
123	4.0	10 6	11.4 x 9.5 x 11.4	.. ..	5.78 67
120	6.0	16 12	13.3 x 12.1 x 12.1	.. ..	8.37 82
122	10.0	23 2	16.5 x 12.7 x 16.5	.. ..	13.85 *

Ref. No.	Amps.	Weight lb oz	Size cm.	P & P £ p
45	1.5	1 9	7.0 x 6.0 x 6.0	1.34 30
5	4.0	3 11	10.2 x 7.0 x 8.3	2.03 42
86	6.0	5 12	10.2 x 8.9 x 8.3	3.07 52
146	8.0	6 4	8.9 x 10.2 x 10.2	3.49 52
59	12.5	11 14	13.3 x 12.1 x 12.1	5.20 67

All ratings are continuous. Standard construction: open with solder tags and wax impregnation. Enclosed styles to order.

BC107/108/109 9.0p each	2N 3055 68p each	AD 161/162 60p pair
25+ 7p	+ mica and bushes	+ mica and bushes
100+ 6.5p	25+ 55p	25+ 55p
500+ 6p	100+ 45p	100+ 50p
Minimum order 10 pieces this range.	500+ 40p	500+ 45p
		1000+ 40p

## AVOMETERS · MAINS KEYNECTOR ELECTROSIL RESISTORS

\*CARRIAGE VIA BRB

# BARRIE electronics

11 MOSCOW ROAD, QUEENSWAY  
 LONDON W2 4AH Tel: 01-229 6681/2  
 NEAREST TUBE STATIONS: BAYSWATER, QUEENSWAY

# ELECTROKIT

Now available from one company are complete kits for many of the articles published in the Electronics, Radio and TV Journals. Examples of our range are:

**SCORPIO IGNITION SYSTEMS** (P.E. Nov. 1971), £10.50, including P. & P. This kit includes all the parts for the assembly of this popular and reliable system. The hardware and instruction data are included.

**ELECTRONIC PIANO** (P.E. Sept. 1972). We can supply the various sections for this article in kit form. Power supply, price £6.50. Preamp and Tremolo £3.20. Main Amplifier (left speakers) £3.30. 13 Pitch boards £39.50 (less inductors).

**DRILL SPEED CONTROLLER** (E.E. Aug. 1972). Kit consists of resistors, rectifiers, thyristor and tag board as specified in the article, price £1.05, including P. & P. Kit with M.K. box, plate and switch, price £2.05, including P. & P. We shall also be offering kits for most articles published in the P.E. and other popular electronics magazines and will be pleased to quote prices.

Send for details of all other kits available (please enclose S.A.E.).

# ELECTROKIT

12 Lauderdale Road, London, W.9  
 Telephone 01-286 0011

**POTENTIOMETERS** Lin. or Log, 12p; with DP switch, 23p; Dual ganged, 36p; Special offer 5K with DP switch, 15p; **WAVECHANGE SWITCHES**, 22p; Special offer miniature, 4p, 3W 16p. **AMPLIFIERS**: 1 Valve (EL84), £3; ½W Transistorised, £1; 10W Transistorised, £3.75. J83 Junction Box, £1.20. 5in Plastic Library Cases, 10p. 500µA **TUNING METERS**, 50p. **CARTRIDGES**: Compatible ACOS GP91-3SC, 90p; Stereo GP93-1, £1.15; Ceramic with Diamond Stylus, £1.80. **CAPACITORS**: 100mF 25V 5p; 220mF 25V 5p; 400-200-50-16mF 300V, 30p; 0.1 500V D.C. 300V a.c. 30p.

**MINIATURE INDICATOR LAMPS** (5 colours), 11p; 6V or 12V Bulbs for above, 4p. **MAINS NEONS** panel mounting (red, green, clear), 15p. 100 **MIXED RESISTORS**, 45p. **ROTARY SWITCHES** (on/off) 250V 2A, 10p. **PLUGS**: Jack Standard, 10p; Screened, 13p; 2.5mm and 3.5mm, 6p; Screened, 8p. **HEADPHONES**: High Impedance (2,000 ohm), 90p; STEREO, 8 ohm. £1.95; STEREO 8/16 ohm £2.10.

**MICROPHONES**: Lapel 28p; ACOS MIC. 45, 90p; Dual Impedance, Dynamic 600 ohm and 50k, £4.50. **RECORDING TAPE**: 5in LP 900ft, 45p; 5½in L.P. 1,200ft, 60p; 7in L.P. 1,800ft, 81p. **RESISTORS** carbon film 5%, 1½p. **ALUMINIUM CHASSIS** from 6in x 3in to 16in x 10in all 2½in deep. Transistors, Rectifiers, etc.

Large S.A.E. for list No. 4. Special Prices for quantity quoted on request. Add 10p for P. & P. on orders under £5.

# M. DZIUBAS

158 Bradshawgate, Bolton, Lancs. BL2 1BA.

**ALMOST UNBELIEVABLE!** Think of the year 1984 and what might be produced then—now get the fantastic **ASTRAD 17** and **SEE** for yourself that the incredible Russians have done it all **NOW!** It's the radio perfectionist's dream come true! **THIS ONE SUPERSEDES ALL EARLIER MODELS!** It will probably make your present radio seem like a "crystal set"! Complete with optional battery eliminator for both battery and mains use! We're almost giving them away at only £20.75—a mere fraction of even today's Russian miracle price! We challenge you to compare performance and value with that of £80 radios! \*Test 7 days, we'll refund instantly if you are not astounded! Elegant black & chrome finish facia, set in fabulous Cabinet built case—constructed of fine Russian hardwood in beautiful Teak Veneer finish—prevents vibration, ensures purer & sweeter tone than ever! Volume controlled from a whisper to a roar that would fill a hall! Much wider band spread, for absolute "pin-point" station selection! Plus "MAGIC EYE" tuning level indicator for ultra perfect tuning sensitivity! Yes, the Russians have surpassed themselves, proving again their fantastic ability in the field of electronics and brilliantly reflecting their advanced micro-circuitry techniques in the field of spaceship and satellite communications. **Yes, EVERY WAVEBAND** instantly at your fingertips including Standard Long, Medium, Short and Ultra Short Waves to cover the four corners of the earth 24 hours a day including all normal transmissions. VHF, AM, FM, MW, LW, USW, plus local & new stations not yet operational, and messages from all over the world! Expensive **TURRET TUNER** side control waveband selection unit (as used on expensive T.V.'s!). Every waveband clicks into position giving incredible ease of station tuning! Genuine push-pull output! ON/OFF volume and separate Treble and Bass tone controls for utter perfection of reproduction and tone! Press-button dial illumination! Take it anywhere—runs economically on standard batteries (obtainable everywhere) or direct through battery eliminator from 220/240v AC mains supply. Internal ferrite rod aerial plus built-in "rotatable" telescopic aerial extending to 39ins approx. It's also a fabulous **CAR RADIO**. Can also be used through extension amplifier, tape recorder or public address system. **SIZE** 14ins x 10ins x 4ins overall approx. Magnificently designed, made to give years of perfect service. (U.K. service facilities & spares available for years & years to come, if ever necessary!). With **WRITTEN GUARANTEE** manual with simple operating instructions & circuit diagram. **ONLY £20.75** (with mains/battery eliminator £1.48 extra) **BOX, POST, ETC. 50p.** \***BUT WAIT**, for only 55p extra you get the sensational "COMPUTERISED" **WORLD TUNING GUIDE** (It enables you to time, pinpoint & get transmissions the whole world over—even a child can do it in a flash—it even lets you know when to tune into the U.K. when abroad. **NO GUESSING! NO MESSING!**) **PLUS** Standard "longlife" batteries **PLUS** ultra sensitive earphone for personal listening. (Sorry—We cannot change these new radios for any earlier model purchased.) **HURRY!** Send today and test 7 days—refund if not delighted. Or call.

**JUST ARRIVED!** **THIS YEAR'S NEW \*RUSSIAN MIRACLE! \*COMPUTERISED!**

**BRAND NEW SPACE AGE model**  
—SO FAR AHEAD OF ITS TIME IT WILL STILL BE MAKING MANY LOOK OUT OF DATE IN 1984!

**THE FABULOUS ASTRAD 17**

**THIS OFFER ONLY FROM US!**

**WORLD WIDE RECEPTION**  
THOUSANDS OF TRANSMISSIONS & STATIONS POUR IN FROM THE FOUR CORNERS OF THE EARTH!

**PORTABLE RADIO & COMMUNICATIONS RECEIVER**

**28 TRANSISTORS AND DIODES!**  
**WAVEBANDS:**  
STANDARD LONG and MEDIUM  
**Plus 5 SHORT WAVEBANDS**  
**Plus ULTRA SHORT WAVES**  
(V.H.F. AM, FM, MW, LW, USW.)



\*COMPARE ITS PERFORMANCE with £80 RADIOS!

**£20.75**  
BOX POST ETC. 50p  
**MAINS/BATTERY ELIMINATOR £1.48 extra**

**FIRST TIME EVER!**  
\*NOW AVAILABLE WITH **"COMPUTERISED" WORLD TUNING GUIDE!**  
**NO MORE GUESSWORK—INSTANT DATA at your fingertips—enables you to TUNE IN A FLASH to transmissions the world over!**

**BUY ONE FROM US!** **SAVE £20.25 NOW!**  
**fabulous BRAND NEW SOLID STATE**  
This equipment's got EVERYTHING!  
**BATTERY/MAINS AC Combined V.H.F. AM/FM RADIO and CASSETTE TAPE RECORDER & PLAYER**  
RECOMMENDED RETAIL PRICE £44  
**OUR PRICE £23.75** CARR. ETC. 35p  
WITH REMOTE CONTROL MICROPHONE

Shopertunities "thunder" ahead with an offer that's **FANTASTIC** (even by our standards!). We've snapped up 500 magnificent machines. Latest sensation in the world of sound! First-class makers! Fabulous **VHF, AM/FM Radio AND Cassette Tape Recorder & Player** combined & it also runs off standard batteries or mains. (Simply plug in the 220/240V AC line cord. Record and play back anytime, anywhere!) Even tape direct from the Radio as you listen! **RECOMMENDED RETAIL PRICE GENUINELY £44!** **WE OFFER AT ALMOST HALF PRICE!** Wonderful features: \* Press-button Keyboard Control Panel or latest **MASTER SWITCH CONTROL!** \* "MAGIC EYE" Visual Battery check/recording level indicator or built-in automatic Leveller! \* Separate ON/OFF and HI-LO volume controls! \* Heavy duty built-in speaker! \* Earphone (for personal listening, or "country" use) and extension sockets! \* Remote control microphone! \* Built-in swivel telescopic extension aerial (24in approx.!) Magnificently made case with carry handle. (DESIGNS VARY SLIGHTLY.) Takes standard 30, 60, 90 or 120-minute Cassette Tapes obtainable everywhere. **AND** the amazing built-in full circuit **VHF, AM/FM Radio** gives you superb clarity of tone, incredible station selection. Unique rotating Station Selector Dial—get all local city and regional stations in every part of the country plus B.C. National VHF. Picks up dozens of foreign stations. Fabulous in your car! You could pay £££'s more for a Car Radio or Car Cassette player ALONE! £23.75, CARR. ETC. 35p. Complete with simple instructions, remote control microphone with on/off switch and microphone stand. **WITH WRITTEN GUARANTEE.** Send today or call at either store. Send & test 7 days, refund if not delighted. Or call. **BONUS OFFER:** Batteries and Cassette Tape 5p extra if required.

**FIRST TIME EVER! SAVE £14.48!**  
**BRAND NEW AC/DC BATTERY/MAINS**  
**Cassette TAPE RECORDER & PLAYER**  
FIRST CLASS MAKERS  
With remote control microphone.  
WE COULD CHARGE UP TO £26.97!  
**OUR PRICE £12.49** POST ETC. 31p

THE ONE STEP FORWARD EVERYONE HAS WAITED FOR! **NOW** a superb deluxe portable **BATTERY/MAINS** tape recorder and player—and incredible Shopertunities bring it to you for **ONLY £12.49!** Due to our cut price we cannot name first-class makers—but rest assured you're getting one of the **BEST!** Expensive "PIANO KEYBOARD" CONTROL PANEL (or latest **MASTER SWITCH** control) **AND** **AUTOMATIC LEVEL CONTROL.** No fiddling with awkward tape and reels, just "slap-in" a cassette and off you go! (Takes 30, 60, or 90 minute standard cassette tapes obtainable everywhere!) Amazing performance ensures perfect tapings and superb reproduction! Remote control microphone. Rapid Rewind! Fast forward! Beautiful tone from a whisper to a roar! Completely self contained—record anywhere, indoors or out! Runs on standard batteries **AND 220/240V AC** mains. Separate jacks for remote control microphone, etc. Size 9 1/2in x 5in x 2 1/2in approx. Design can vary slightly. With carry handle. **WRITTEN GUARANTEE** and full instructions. **ONLY £12.49** post, etc., 31p. \* Refund if you don't agree we could charge up to £26.97! **BONUS OFFER** (one per customer)—Cassette tape, set of standard batteries **AND** microphone stand all for 50p extra, if required. Send & test 7 days; refund if not delighted. Or call. Order by post to Uxbridge Road address or call at either store. Bargains galore at both stores.—(COMMERCIAL TRAVELLERS PLEASE **NOTE:** Merchandising office at Holborn Store.)

**SHOPERTUNITIES LTD.**

Dept. PE/24, 164 UXBIDGE RD. (facing Shepherds Bush Green), LONDON W12 8AQ. (Thurs. 1, Fri. 7). Also at 37/39 HIGH HOLBORN (opposite Chancery Lane), LONDON, W.C.1. (Thurs. 7 p.m.) BOTH OPEN MON. TO SAT. 9 A.M. TILL 6 P.M.

# CRESCENT RADIO LTD

11 & 40 MAYES ROAD, LONDON N22 6TL 888 3206

MAIL ORDER DEPT.  
No. 11  
MAYES RD.  
LONDON  
N22  
6TL

## COMPONENTS AND HI FI FOR THE HOME CONSTRUCTOR

OUR SHOPS ARE OPEN ALL DAY FROM 9 A.M. TO 6 P.M. 6.30 P.M. ON FRIDAY (WE CLOSE ALL DAY THURSDAY)

13 SOUTH MALL, EDMONTON, N.9 803 1685

### LOW VOLTAGE AMPLIFIER

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



**£1-75**  
plus 13p P. & P.

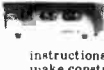
### TRI-VOLT BATTERY ELIMINATOR

Enables you to work your Transistor Radio, Amplifier or Cassette, etc., from the a.c. mains through this compact Eliminator. Just by moving a plug you can select the voltage you require, 6, 7½ or 9 volt. This means all your transistor power pack applications can be handled by this one unit. Approx. size 2½in x 2½in x 3½in. Our Price **£2-75** plus 10p P. & P. Same model suitably wired for the Philips Cassette **£3** plus 10p P. & P.



### DIGITAL CLOCK KIT

24-hr. Nixie dig. clock kit. We supply: a complete set of components; a complete set of easy to follow instructions, printed circuits made to make construction as simple as possible; a cabinet and front panel to give a professional finish. All for the price of the components. **£22-50** + 50p P. & P. Please send S.A.E. if you require more information.



### EA1000 3 WATT AUDIO AMPLIFIER

An Audio Amplifier designed around the TA952 Linear I.C. — Supply Voltage 9-24V Speaker Imp. 8-16 ohm Frequency 50Hz-25kHz Overall Size 2in x 3in x 1½in Ideal Amplifier for radios, record players, stereo units, etc. Full technical data and diagrams with each module. All guaranteed and a bargain at **£2-63** + 5p P. & P.



### CRESCENT MINI-STROBE

● Approx. 1 Joule output  
● Variable speed  
● A.C. 220-250V  
● Approx. size—6" x 4" x 4"  
Ideal for Discos., etc. Working and Guaranteed **£16-50** + 38p P. & P.  
For more details send a S.A.E.



### TRI-VOLT CAR SUPPLY

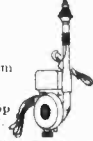
Enables you to work your Transistor Radio, Amplifier or Cassette, etc. from the 12 volt car supply. Positive or negative earth. Approx. size = 2in. x 3½in. x 1½in. This converter supplies 6, 7½ or 9 volts and is transistor regulated. A real money saving device for **£2-50** plus 10p P. & P.

### MINIATURE RELAY

6 volt 70 ohm. Single Pole Changeover = **40p** plus 6p P. & P. Approx. size = 1½in. x 1in. x ½in.

### ADD LUXURY TO YOUR CAR WITH A MOTOR DRIVEN CAR AERIAL

Spec.: 5 Section Extended Length 100cm Length under Pender 40cm Cable Length 120cm Supplied complete with Fixing Bracket and plus 35p Control Switch. **£5-75** P. & P.



### MINI LOUDSPEAKERS

2½in 8 ohm 50p  
2½in 80 ohm 50p  
3½in 40 ohm 50p  
Please include 5p P. & P. on each L.S.

### PRINTED CIRCUIT KIT

**BARGAIN S.C.R.** Treated Thyristor. 400V, 3amp. Printed 45p each. 5for **£2**. Circuits **£1-40** plus 10p P. & P.



### CRESCENT CASSETTES

Top quality cassettes at unbeatable prices (complete with standard storage case): C60 28p, C90 38p, C120 48p plus 5p P. & P.

### PSYCHEDELIC LIGHT CONTROL UNIT

Three Channel: Bass—Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 500W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed) **£18-50** plus 38p P. & P.  
If you require more information please send S.A.E.



### "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 TP100W** 170W r.m.s. sq. wave 300W instantaneous peak into 8 ohm (60W into 16 ohm). **£14-28** carr. 40p  
★ **THE PRE-AMP MODULE** Four control pre-amp, Vol, Bass, Treble, Middle controls. Designed to drive most amplifiers using F.E.T. first stage. **£3-96** carr. 25p  
★ **THE POWER SUPPLY MODULE PS100** Is supplied complete with the mains transformer. **£9-66** carr. 50p Complete fixing instructions are supplied and no technical knowledge is required to connect the three ready wired modules. A fantastic bargain. If you purchase all three modules. **£25** carr. 75p  
Send S.A.E. for further details on this or our ready built amplifiers.

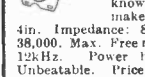
### EMI LOUDSPEAKER 450

10W 13in x 8in ± two 2-2½in tweeters and cross-over. All wired and ready for use. This ever-popular 450 in 3-8-15 ohm imp. **£3-50** plus 38p P. & P. each.



### 7" x 4" LOUDSPEAKER

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



## become a RADIO-AMATEUR!

learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence

**free!** Brochure, without obligation to:  
**BRITISH NATIONAL RADIO SCHOOL**  
READING, BERKS

NAME: \_\_\_\_\_ EB13  
ADDRESS: \_\_\_\_\_  
BLOCK CAPS please

The most accurate pocket size CALCULATOR in the world

The 66 inch OTIS KING scales give you extra accuracy. Write today for free booklet, or send £4-65 for this invaluable spiral slide rule on approval with money back refund if not satisfied.

**CARBIC LTD.** (Dept. PE 44)  
54 Dundonald Road, London SW19 3PH

**FREE BOOKLET ON REQUEST**

### STEREO IC DECODER

HIGH PERFORMANCE PHASE LOCKED LOOP (as in 'W.W.' July '72)  
**MOTOROLA MC1310P**  
**EX STOCK DELIVERY**

Specn. Separation: 40dB 50Hz—15kHz. Distortion: 0.3%. I/P level: 560mV rms. O/P level: 485mV rms per channel. Input impedance: 50k. Power requirements: 8-12V @ 16mA. Will drive up to 75mA stereo 'on' lamp or LED.

**KIT COMPRISES FIBREGLASS PCB** (Printed and tinned), Resistors, I.C., Capacitors, Preset Potm. & Instructions. Only **£3-50** post free.

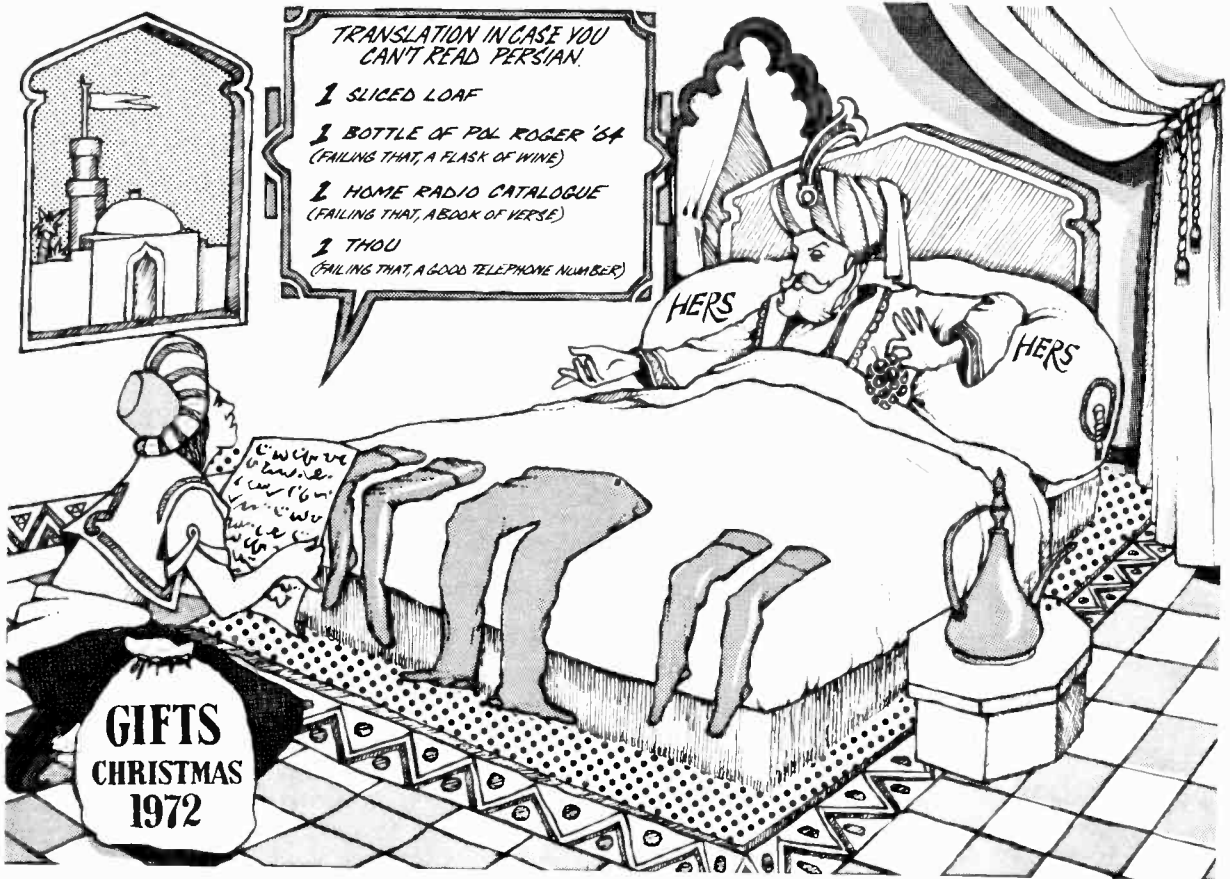
**LIGHT EMITTING DIODE (Red)** Suitable as stereo 'on' indicator. For above with panel mounting clip and instructions. Only **35p** + p.p.  
**MC1310P only £2-77** + p.p. 6p

**SPECIAL OFFER**  
IN4001 50V 1A RECT. DIODES. Full Specification Devices. **ONLY 5p** each  
709' DIL 14 PIN OP AMPS. Full Specification Devices. **ONLY 34p** each

**Fi-Comp Electronics**  
BURTON ROAD, EGGINTON, DERBY DE6 6GY







For the benefit of those who have a scientific rather than a literary bent, may we explain! Omar Khayyam was a Persian Tent Maker who lived in the 11th Century. He was also a Poet, Philosopher and Astronomer. Thanks to the fine translation by Edward Fitzgerald, his best known work is the exquisite "Rubaiyat". It was first produced in England as a pamphlet and offered at sixpence. It didn't sell and was reduced to twopence. As there are only three known copies left in existence you may imagine what they are worth today!

One of the best known verses runs as follows:

*"Here with a loaf of Bread beneath the Bough,  
A Flask of Wine, a Book of Verse and Thou  
Beside me singing in the Wilderness;  
And Wilderness is Paradise enow."*

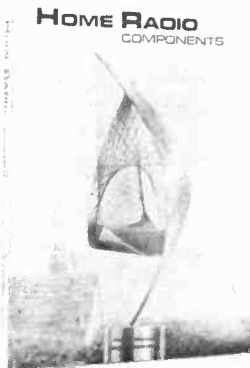
We hope that throws some light on our cartoon. If you read the poem you are bound to come to the conclusion that O.K. liked his tittle—obviously a thoroughly "good type".

What's all this to do with Electronics? You may well ask!!!

Nothing really, but after all this is the Christmas Number, so we should be able to let our hair down. In any case we are sure you must already know that we produce an excellent Components Catalogue which will make interesting holiday reading for you, listing as it does some 6,785 items (over 1,750 illustrated) and costing only 75p including postage and packing (only 55p if you collect it). It also contains 10 vouchers (each worth 5p when used as directed). Are you convinced? No? Well you'd better go out and buy Omar's "Rubaiyat" instead!

Our "new look" catalogue is hot off the press! Larger pages, many new items and pictures. Now, more than ever, it is a "must" for every keen constructor. Full details of our popular Credit Account Service are given in the catalogue.

The price of 75p applies only to catalogues purchased by customers in the UK and to BFPO addresses.



**POST THIS COUPON** with your cheque or postal order for 75 pence

Please write your Name and Address in block capitals

Name .....

Address .....



**HOME RADIO (Components) LTD.**  
Dept. PE, 234-240 London Road, Mitcham CR4 3HD

## DOWN TO EARTH

**T**HE obvious sometimes obscures other parts of the picture. The main purpose of a constructional article is to give all information necessary to enable any suitably experienced constructor to produce for himself a correctly functioning replica of a proven prototype equipment.

Obvious and true; but this is far from all. In fulfilling its purpose a constructional article demonstrates in the most effective and objective manner possible how circuits can be applied in practice. Interesting and unusual applications of the technology are frequently first brought to the attention of the reader through a constructional design. The Biological Amplifier described in this month's issue is a good example of this, since it opens a door to an area of activity perhaps totally unfamiliar to many readers.

Purely theoretical articles are essential and they play their important part in explaining new concepts for circuit design and in suggesting lines for experimentation with new circuit devices. But when it comes to the nitty gritty business of determining precise facts, no amount of theorising can be as convincing, nor as reliable, as the detailed technical description of an actual model, with every component value stated and a performance already established, not merely calculated or predicted.

Amongst our readers there will be a sizeable number who confine their interest in electronics mainly to a study of circuitry and its uses in the abstract—and we suspect they include quite a few who have never held a hot soldering iron in their hand. We believe it would be a great error were they to skip the pages devoted to practical designs. The old saw that an ounce of practice is worth a pound of theory is very relevant even when considering general or non-constructing readers, simply because they do rely exclusively upon the printed word and diagram for knowledge.

Constructional articles help to infuse reality into a subject which, because of the impalpable nature of its workings, is all too liable to be elevated into rarefied regions—with the ready connivance of some of the technical intelligentsia, it has to be admitted. No matter whether we build a particular project or not, careful examination of the text and diagrams will usually teach us something; and certainly help us keep the whole of electronics in true perspective and our own feet firmly on the ground.—F.E.B.

### Editor

F. E. BENNETT

### Editorial

M. A. COLWELL *Assistant Editor*  
D. BARRINGTON  
G. GOBOLD  
S. R. LEWIS B.Sc.

### Art Dept.

J. D. POUNTNEY *Art Editor*  
J. A. HADLEY  
R. J. GOODMAN  
S. W. R. LLOYD

### Advertisement Manager

D. W. B. TILLEARD (*Manager*)  
Phone: 01-634 4202  
P. J. MEW  
Phone: 01-634 4210  
C. R. BROWN, *Classified*  
Phone: 01-634 4301

### Editorial & Advertising Offices:

Fleetway House, Farringdon St.,  
London EC4A 4AD  
Phone: *Editorial* 01-634 4452  
*Advertisements* 01-634 4202

A linear ohmmeter is an essential piece of equipment for carrying out accurate resistance measurements on thermistors, l.d.r.s, resistive transducers, motor field and armature windings, heating elements, etc. Such an instrument is also extremely useful for checking resistors and resistance combinations, or for batch selection from low tolerance components.

The instrument described in this article is ranged 0-5Ω f.s.d. to 0-100kΩ f.s.d. in 10 ranges utilising a divide by two facility. These ranges will cover most applications from measuring low resistance motor armature windings to thermistors and transducer tracks.

The circuit is extremely stable but built-in calibration is provided to compensate for drift as a result of battery deterioration or extreme environmental effects. Battery life is six months or more and the indication can be guaranteed to have an accuracy ±1 per cent of full scale deflection.

### PRINCIPLE OF OPERATION

The principle of operation is well established and is based on the simplified circuit diagram shown in Fig. 1.

The resistance to be measured ( $R_x$ ) is fed by a constant current generator ( $I_g$ ) to give an input voltage  $V_i$ . This is then amplified and the output voltage  $V_o$ , proportional to the input resistance value  $R_x$ , is measured on a moving coil meter calibrated in ohms. The operational amplifier is connected in its non-inverting mode and has sufficient feedback to ensure good stability of operation, and satisfactory input and output impedance values.

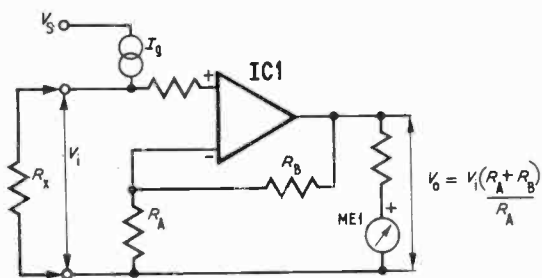


Fig. 1. Simplified circuit diagram of the ohmmeter

### THE COMPLETE CIRCUIT

The circuit diagram of the ohmmeter is given in Fig. 2. The constant current generator TR1 is adjusted by VR1, VR2 or VR3 to give the required outputs which may be passed through the test resistance  $R_x$  or through the standard range resistors R1 to R5 by selection of switch S1a or S1b. A fine setting is achieved by adjustment of VR4 to give an accurate full scale meter deflection when the standard resistors (calibrated input) are selected. By scale calibration prior to test readings the accuracy of the system is dependent only on the standard range resistors and the meter.

The operational amplifier IC1 is connected to give the required closed loop gain by adjusting the resistor values at the range selection switches S2c and S2d.

# I.C. LINEAR OHMMETER

By G. GRIFFITHS B.Sc. (Eng)



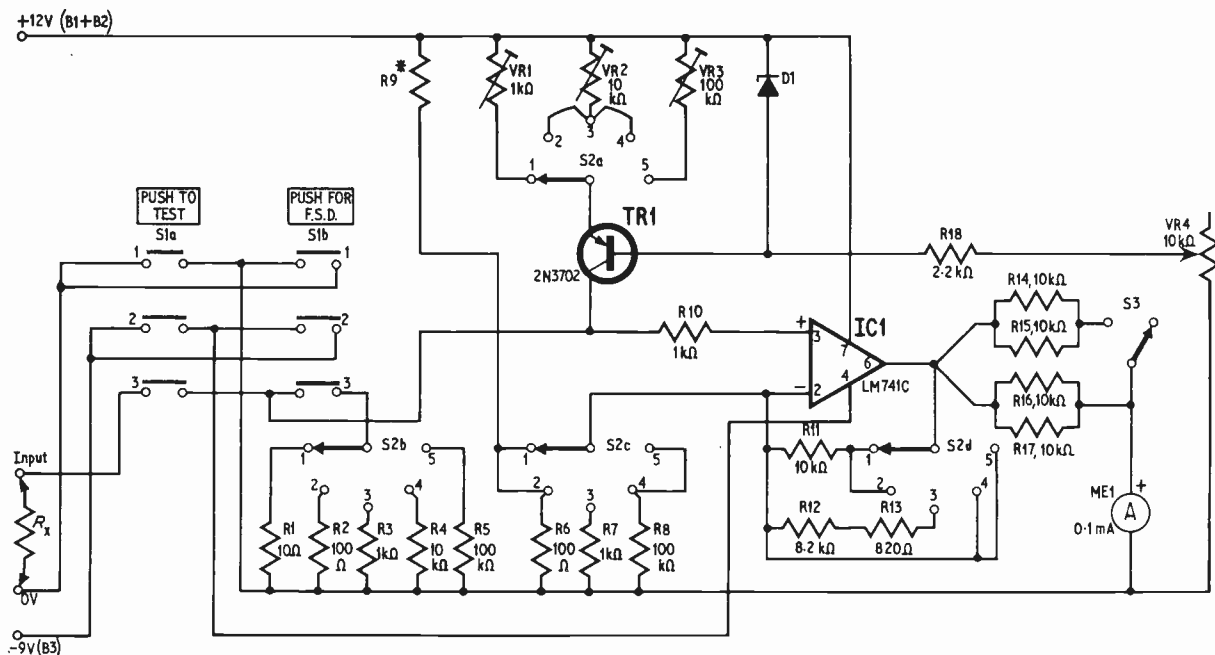


Fig. 2. Circuit diagram of the linear ohmmeter

The amplifier has a minimum input resistance of 25 megohms and 400 megohms in the unity gain condition so that input resistance ranges of up to 10 megohms may be measured without loss of accuracy. The output resistance is never greater than 10 ohms so a 1 milliamp meter movement may be used without loading the amplifier unduly. The use of such an indicator, used with appropriate series resistors, offers better accuracy and shock resistance as well as being cheaper than a more sensitive movement.

The divide by two switch S3 gives a full scale deflection of 2.5V when selected and so expands the range of the instrument. The operating conditions as referred to Fig. 1 are shown in Table 1.

### COMPONENTS

Many of the resistors as shown in Fig. 2 are of high tolerance and stability. It is, of course, of para-

mount importance to have accurate standard range resistors, as the instrument read-out accuracy is dependent on these.

The current generator is constructed from three presets, a Zener diode and a transistor. The presets may be the Cermet type or the skeleton type, but any silicon *pn-p* transistor and any 5.1V 400mW Zener will suffice.

The amplifier used in this circuit is preferably the LM741C, but a  $\mu$ A709 may be used with appropriate frequency dependent feedback components. If the latter is used it may be necessary to decouple the supply rails to prevent parasitic oscillation.

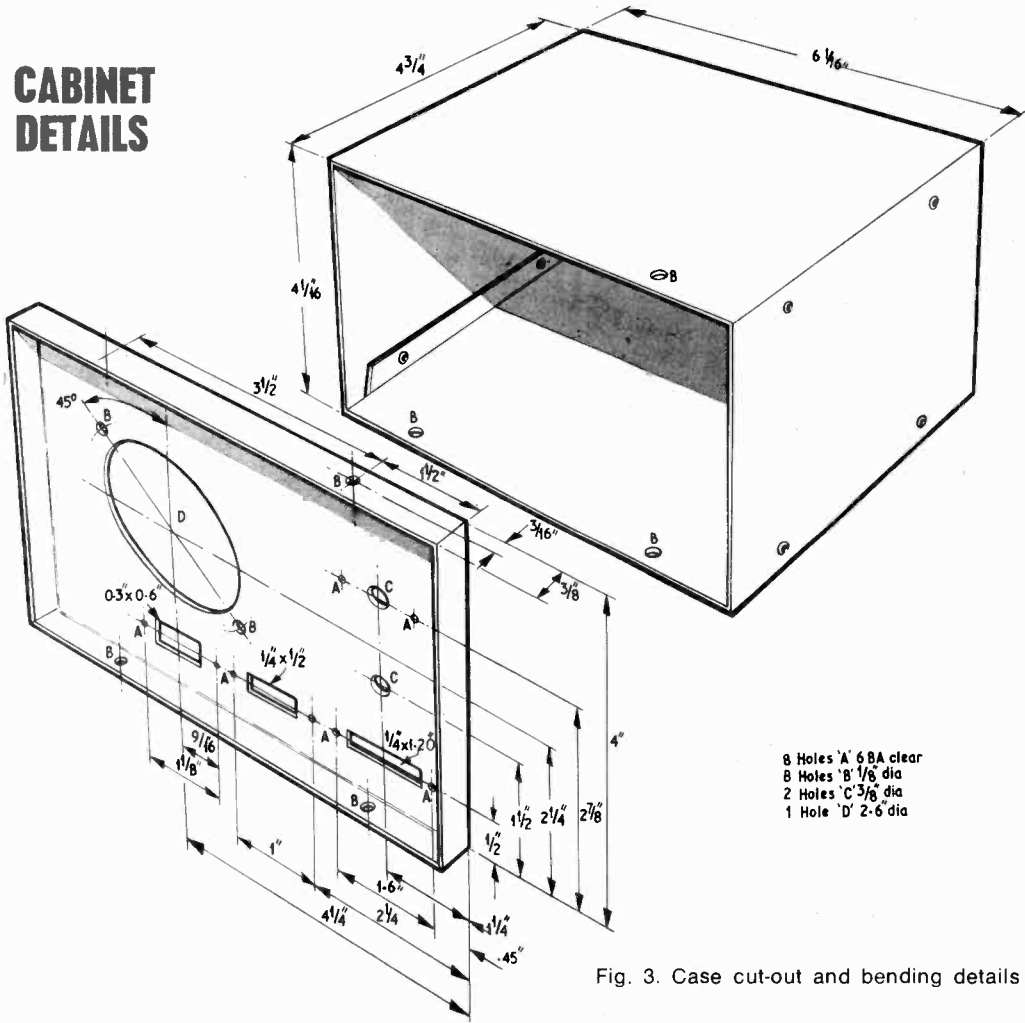
The function/on-off switch S1 consists of two, unit assembled three-pole wavechange switches with three functions: f.s.d., test and off.

The range switch S2 is made up of four, single-pole 6-way wafers one way of each not being used. S3 is a single pole on/off slide switch.

Table 1: OPERATING CONDITIONS

Switch Position	Resistance Range	$V_i = [I_g R_x]$	Amplifier Gain = G	$R_A$	$R_B$	$I_g$	$V_o$
1	10Ω	50mV	100	100Ω	10kΩ	5mA	5V
2	100Ω	50mV	100	100Ω	10kΩ	500μA	5V
3	1kΩ	500mV	10	1kΩ	9kΩ	500μA	5V
4	10kΩ	5V	1	100kΩ	0	500μA	5V
5	100kΩ	5V	1	100kΩ	0	50μA	5V

# CABINET DETAILS

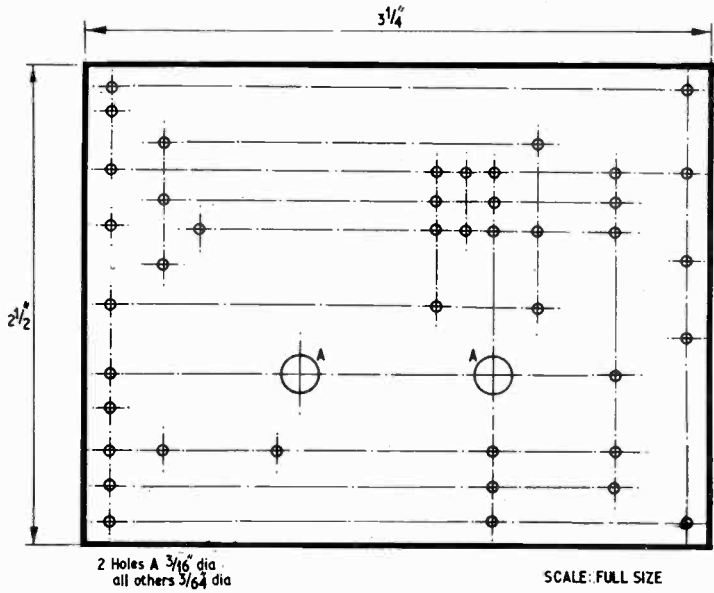


- 8 Holes 'A' 6 BA clear
- 8 Holes 'B' 1/8" dia
- 2 Holes 'C' 3/8" dia
- 1 Hole 'D' 2.6" dia

Fig. 3. Case cut-out and bending details

# BOARD DETAILS

Fig. 4. Drilling details for small component mounting board



2 Holes A 3/16" dia  
all others 3/64 dia

SCALE: FULL SIZE

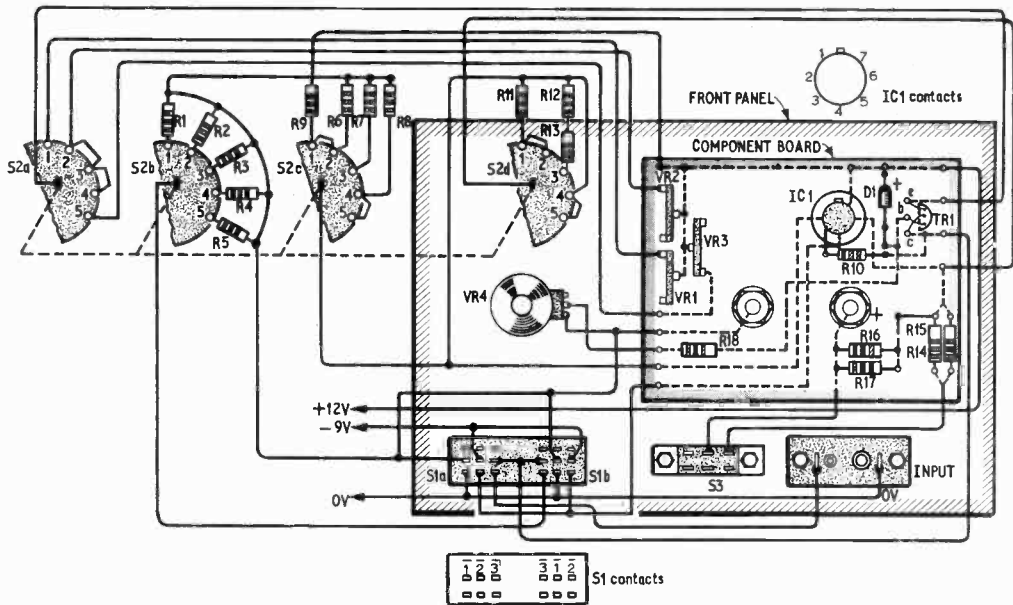


Fig. 5. Component assembly and wiring details. Wafer switch wiring is shown separate for clarity

## COMPONENTS . . .

### Resistors

R1	10Ω 1%	R10	1kΩ 5%
R2	100Ω 1%	R11	10kΩ 2%
R3	1kΩ 1%	R12	8.2kΩ 2%
R4	10kΩ 1%	R13	820Ω 2%
R5	100kΩ 1%	R14	10kΩ 2%
R6	100Ω 2%	R15	10kΩ 2%
R7	1kΩ 2%	R16	10kΩ 2%
R8	100kΩ 5%	R17	10kΩ 2%
R9*	See text	R18	2.2kΩ 5%

All  $\frac{1}{4}$  watt carbon resistors

### Potentiometers

VR1	1kΩ vertical preset
VR2	10kΩ vertical preset
VR3	100kΩ vertical preset
VR4	10kΩ carbon linear

### Diode

D1 5.1V 400mW Zener diode

### Transistors

TR1 2N3702

### Integrated Circuit

IC1 LM741C

### Switches

S1	2-bank, 3-pole, 2-way wavechange switch
S2	Switch kit with four 1-pole, 6-way wafers
S3	Single pole on/off slide type

### Meter

ME1 1mA moving coil meter 100mm × 80mm (SEW type)

### Batteries

B1, B2	6 volt style PP1 (2 off)
B3	9 volt style PP9

### Miscellaneous

Aluminium sheet 20 s.w.g. 6in × 4in and 15½in × 13½in

## OPERATION

To operate the instrument, S2 is first selected to give the required range (if known). The function switch S1b is then pushed to give full scale deflection on the meter which, if necessary, is adjusted by means of VR4.

The unknown resistance may be connected and the test function switch S1a depressed. Should the ensuing reading be less than half full scale deflection the divide by two facility may be used to give better accuracy of reading.

## PRACTICAL CONSIDERATIONS

In the design stage it was envisaged that leakage currents would not give a significant output reading with both inputs grounded, that is, in the zero input resistance condition. However on test it was found that some i.c.s gave up to 40μA leakage under maximum gain conditions.

Under these circumstances it will be necessary to introduce a small offset voltage to the inverting input to give zero output deflection. This may be done by adding resistor R9 as shown in Fig. 2.

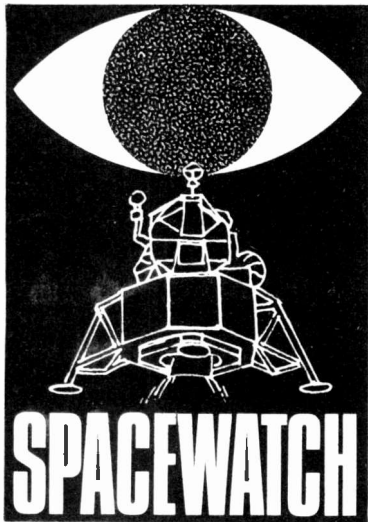
To calculate this resistance use the equation as follows, referring to Table 1 for the appropriate unknown values.

$$R_9 = \frac{12 R_A G}{V_0}$$

where  $R_A$  = appropriate value to setting (e.g.  $R_A = 100$  when  $G = 100$ )  
 $G$  = gain setting  
 $V_0$  = indicated leakage output voltage (0-5V f.s.d.)

Finally, for low resistance measurements, it must be remembered to take into account lead resistance. This was 0.18 ohms in the prototype unit.

*continued on page 59*



BY FRANK W. HYDE

### CAMBRIDGE TELESCOPE

Within a few days of operation after the official opening of the Cambridge five kilometres radio telescope at Lords Bridge, new maps were made available.

While the telescope was in construction radio astronomers in America had announced the discovery of radio waves emanating from the bright star Algol. This source has provided the Cambridge workers with the means of calibration much more accurate than hitherto. The radio coordinate system they use is now to be held to a figure better than 0.1 second of arc relative to Algol.

The position of Cygnus X-3 has now been measured to within 0.15 second of arc so that there is now a possibility of identifying the X-ray star with an optical object.

The future prospects for this new telescope are very exciting and with its versatility and resolution potential it will bring a great deal of data for analysis.

The resolving of two of the extragalactic objects 3C 86A and 3C 295 gives some idea of the telescope potential, for these two objects had not previously been properly resolved. The object 3C 295 is of particular interest because of its large red shift. The new maps show that this is in fact two units spaced some 4.5 seconds of arc apart.

Interest in galactic sources has greatly increased since the molecular lines and infra-red emission from dust clouds have been discovered. One of the new maps using a frequency of 5GHz has shown, in the contours of NGC 7538, an intense source in addition to the extended emission. This source is a galactic hydrogen cloud and the resolving of the main extended source and the intense source, will enable important deductions to be made.

### PULSARS

The Jodrell Bank programme for the study of pulsars continues to extend the known catalogue. The total is now in excess of 100 pulsars that can be identified. The programme under the leadership of Prof. J. D. Davies added some 18 more to the list during September and October 1972.

Among the new finds was one pulsar that was within 0.6° of the centre of an extensive nebula known as IC 443. This nebula is a remnant of a supernova which came into being about 65,000 years ago. It is a powerful radio source by reason of the high energy electrons in strong magnetic fields which compose the remnant.

A check on the rotational period of the pulsar showed that it was faster than average yet slowing. The period was 0.334 seconds. Over a period of seven weeks this slowed by 0.33 microseconds. This lengthening of the rotational period is characteristic and is due to the rotational energy of the pulsar being converted into high energy radiation. From the slowing down it is estimated that the pulsar is about 125,000 years old.

The distance from the solar system, based on the dispersion of the radio pulses, would appear to be something of the order of 5,000 light years.

A clue to future methods of search for pulsars is given by the fact that the pulsar is some 50 light years from the point of the original explosion of the supernova. The fact that the pulsars can be thrown out with a large amount of momentum would suggest that search for pulsars should take place outside the supernova remnants as well as within the known area of activity.

### OLD GALAXIES AND QUASARS

There has been an attack on the exponents of the theory that quasars and "new" galaxies can be formed from the exploding of "old" galaxies. There would appear to be some doubt as to whether galaxies are in fact interconnected or that quasars are connected to galaxies.

The 46 metre dish at the Algonquin radio observatory operating at wavelengths of 2.2 and 4.2cm was not able to detect any interaction. The fact that the radio spectra were normal and no unusual radio effects appeared suggests that there were no violent reactions to provide the birth of a new galaxy much less a quasar. It is also possible that the "bridges" thought to exist between some galaxies may in fact be optical illusions.

### SOVIET PROBE VENUS-8

The results of the findings from the latest Soviet exploration of

Venus indicates that there are similarities between the planet and earth.

The Soviet Academician Vinogradov, already familiar with the analysis of moon rocks, said that the material at the Venus landing site seems to be similar to terrestrial granites. The surface soil contained potassium to 4.0 per cent, uranium 0.0002 per cent, and thorium 0.00065 per cent. These measurements were made by the gamma ray techniques.

Although one spot cannot be taken as representing the whole surface it is likely that the surface has been formed from basic igneous rocks that have undergone metamorphosis. The density of the soil at the landing area was about half that of the earth. The figure obtained for Venus was 1.5g per cm<sup>3</sup>.

In the planet's atmosphere there were traces of ammonia (about 0.1 per cent) at the level of the cloud cover. The measurements were made at 33 and 44Km altitude. The apparatus used was a silica gel column saturated with a sensitive dye for indication. No details of the composition of the cloud cover is available, but measurements of density shows that there is a detectable difference between night and day and that there is evidence that the light from the sun does reach the surface.

### MOON MAGNETISM

Explanations of the residual magnetic field trapped in the rocks brought back from the moon has been examined by various workers. At the moment there are a number of difficulties which prevent a satisfactory explanation to enable a model to be offered for the evolution of the interior of the moon.

To produce the conditions for a magnetic field to have come into being would require that the moon at one time revolved very much faster than earth. This however, would have resulted in its destruction.

There are suggestions regarding the magnetic field which involve certain conditions having been fulfilled during the formation and or the acquisition of the moon. One such theory involves the simultaneous formation of the earth and the moon.

At the present time every hypothesis put forward has faced one or other impossible condition and the field is therefore still wide open. Most of the ideas put forward have involved a liquid core, similar to that of the earth. It could be that this is not a prime requirement and that some other condition existed. The fact that there is no means by which the core of the moon can be examined in detail is the main difficulty.



-another PE first!

# SOUND SYNTHESISER

An impressive instrument for the musician, composer, sound effects producer, and all keen experimenters in sound and electronics.

*Create exciting controversial avant garde music*

*Imitate conventional musical instruments*

*Produce startling effects, ranging from commonplace everyday sounds to way-out space age sounds.*

Such possibilities are at your finger-tips once you have built the P.E. Sound Synthesiser, which includes a four octave monophonic keyboard. Modular design simplifies the construction and permits flexibility and choice of facilities available.

The first part of this important constructional series appears next month.

## AND THE LATEST IN RADIO RECEIVER DESIGN

PE Trifid

A complete a.m. radio using a unique receiver i.c. with only one simple coil and a power amplifier.

This high quality, easy to build, low cost receiver is the only published design of its kind presented by the designer of the Ferranti integrated circuit.

# FREE!

INSIDE  
EVERY  
ISSUE

## CAPACITOR IDENTICHART

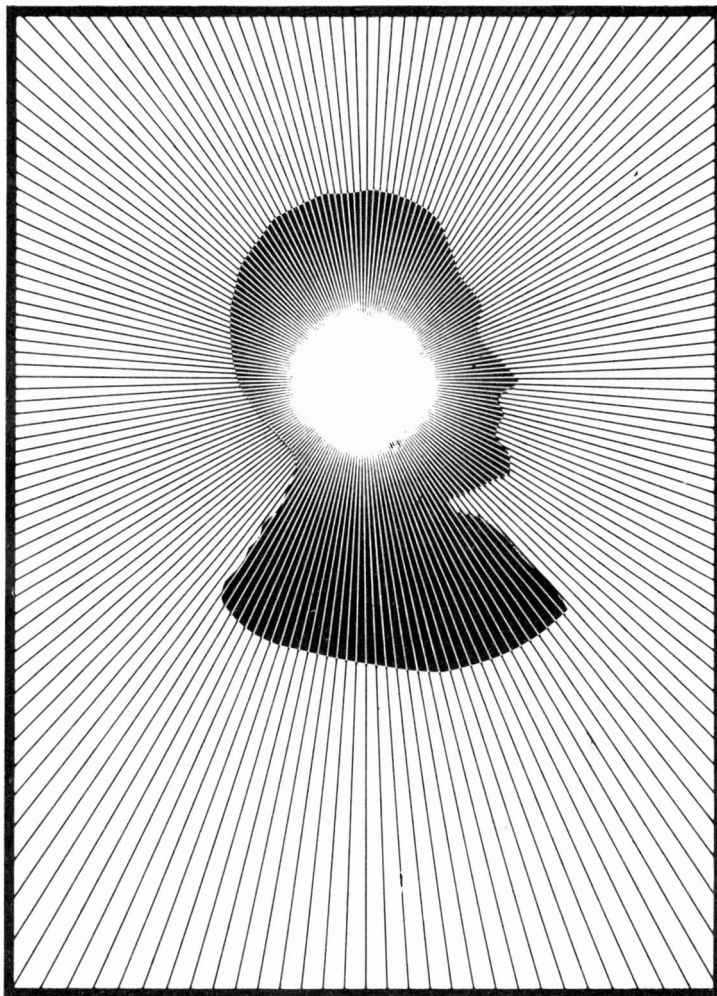
Shows major characteristics of the more important types of fixed capacitors used in amateur electronics.

Measuring 21in. x 15½in., this wall chart is a companion to previous identicharts specially prepared for quick reference in the workshop.

# PRACTICAL ELECTRONICS

FEBRUARY ISSUE ON SALE JANUARY 12

Ensure your copy by ordering in advance from your newsagent



# Biological Amplifier

**This experimental project can demonstrate how neuro systems and electronics can be made to interact and influence certain muscular functions.**

**By D. BOLLEN**

**E**LECTRICAL signals from the human body have been used for many years to diagnose certain illnesses and to monitor the condition of a patient during treatment. However, the possibility of using such signals for non-medical applications is a recent development.

The alphaphone, or electroencephalophone, is currently being used by mystics and others to achieve "instant" relaxation, by feeding back brain signals. A similar instrument can also serve as a lie detector monitoring the level of brain signals during interrogation.

Car drivers, athletes, and other people subject to stress, can learn to control their heart rate consciously with a cardiophone, which establishes an external feedback loop between heart and brain.

The biological pre-amplifier described in this article was designed as a general purpose module for detecting very low frequency signals from electrodes placed on the skin. Also described are a selection of output stages for specific projects, which include the alphaphone, lie detector, and cardiophone.

## **SKIN SIGNALS**

Brain and nerve cells are similar to logic circuits in that they operate by emitting pulses of electrical energy. Under certain conditions, a group of cells will "fire" together in synchronism, to give a combined output either in the form of a large amplitude pulse (heartbeat) or slow sinusoidal waveform (brain

rhythm). The nerve cells of a tensed muscle emit a stream of random pulses.

As a rough guide to signal levels from a pair of electrodes damped with salt water and placed on the skin, the chest will yield a heartbeat pulse of, say, 500 microvolts peak, the forehead an eyeblink pulse of 200 microvolts peak, and the crown of the head an alpha rhythm amplitude of around 50 microvolts r.m.s.

Other brain rhythms, with the exception of delta, tend to be of low amplitude, generally not more than 10 microvolts, and there is also a rapid, low voltage asynchronous activity when the subject is concentrating or excited.

The very approximate frequency range and psychological characteristics of some brain rhythms are as follows:

**ALPHA** Frequency 1-4Hz for infants, 4-7Hz for children and 8-12Hz for adults. This frequency can be modified by intake of certain drugs. Alpha is normally present when the subject is relaxed with eyes closed, and signal is reduced or eliminated by seeing, sleep, unfamiliar sounds, anxiety, and mental concentration. A high level of alpha associated with deep meditation and pain immunity.

**BETA** Frequency 18-25Hz. Amplitude increased by anxiety and reduced during the initiation of movements and by muscular activity.

**DELTA** Frequency 2-3Hz. Strictly speaking, the name applies only to a type of rhythm associated with brain damage, but signals of similar frequency occur during sleep, accompanied by short bursts or "spindles" at around 14Hz.

**THETA** Frequency 4-7Hz. Thought to be related to creative thinking and problem solving activities, and with disappointment and frustration in young people.

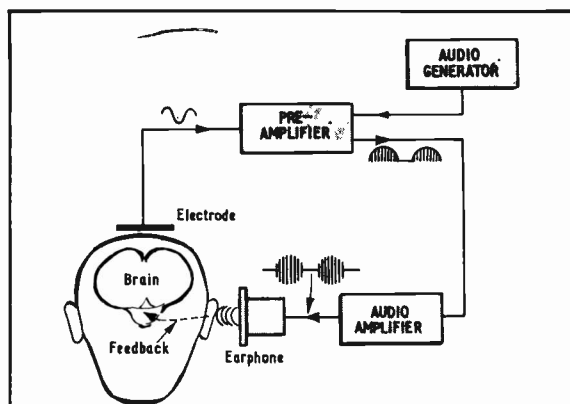


Fig. 1a. Graphical illustration showing the aural feedback path

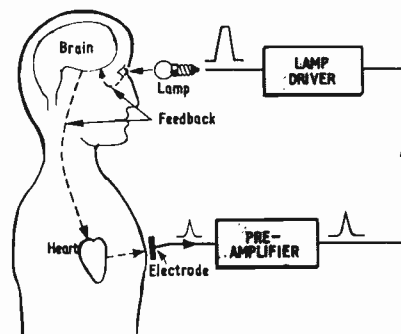


Fig. 1b. Graphical illustration showing the visual feedback path

## BIO-FEEDBACK

Experiments currently being conducted in the U.S.A. seem to indicate that bio-feedback techniques can be used to alleviate symptoms arising from stress (of which there are many), to reduce heartrate and blood pressure, as well as provide a short-cut to the benefits arising from meditative practices such as Yoga.

The two most convenient ways of feeding signals back to the brain is via the ears or eyes. Fig. 1a shows the aural feedback alphaphone, which picks up subsonic alpha waves from the brain, uses them to modulate an audio signal, and feeds the resulting output to the ears.

The direct link between ear and brain is the feedback path, and the brain itself appears to be capable of adjusting a signal phase to positive or negative. With the alphaphone, the user quickly learns to reinforce his alpha waves, or reduce them, at will.

In the second example of bio-feedback (Fig. 1b), the heartbeat pulse is made to flash a light and the eye feeds this light pulse back to the brain. In time, the subject finds it possible to reduce or increase his heartrate by several beats per minute.

Visual feedback can also be achieved by watching an oscilloscope display, or meter readout of a biological signal.

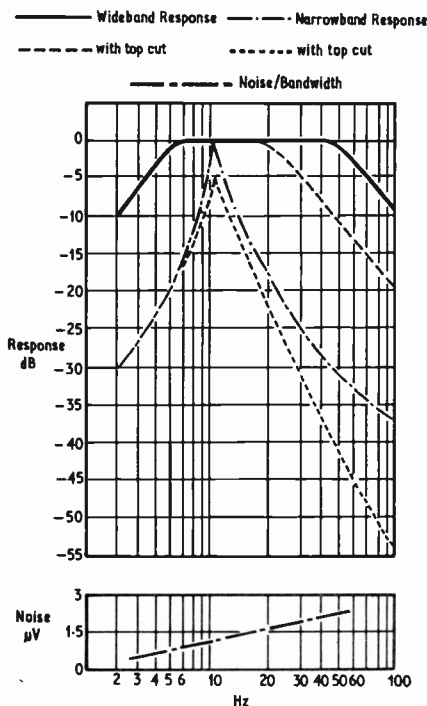


Fig. 2. Graphs of frequency response and noise of the biological pre-amplifier

Table 1. TUNED FILTER

	C5, C6 ( $\mu\text{F}$ )	C7 ( $\mu\text{F}$ )	Circuit tuned to
Alpha rhythms (muscle pulses)	0.47	1.0	10Hz ✓
Beta rhythms	0.22	0.47	20Hz ✓
Delta rhythms	2.2	4.7	2.5Hz ✓
Theta rhythms	1.0	2.2	5Hz ✓

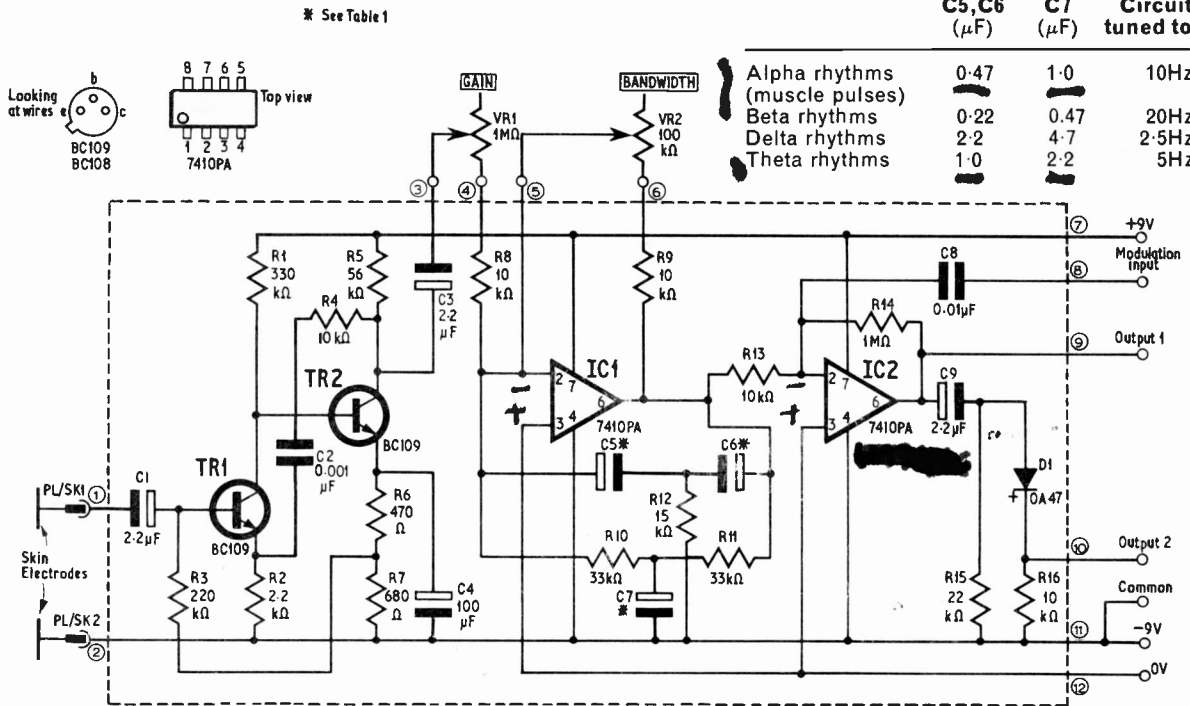


Fig. 3. Circuit of the biological pre-amplifier with component values of C5, C6 and C7 for different rhythms

**CIRCUIT CONSIDERATIONS**

Professional electroencephalographs (brain rhythm recorders) are carefully screened and operated under controlled conditions to achieve a typical noise-bandwidth performance of 2 microvolts at 0 to 75Hz. There is usually some provision for reducing bandwidth by means of switched filters to improve hum and noise rejection.

A noise performance only slightly inferior to that of a professional electroencephalograph is achieved with the biological pre-amplifier described here by sacrificing d.c. coupling. Flicker noise from transistors rises very steeply at sub-audio frequencies, and a considerable reduction in total noise can be obtained by giving the circuit a response roll-off below about 5Hz.

The pre-amplifier also incorporates a continuously variable bandwidth control which can be set to exclude mains interference in ordinary domestic environments and reduce amplifier noise.

Response and noise curves are shown in Fig. 2. At maximum bandwidth (-3dB at 4 and 60Hz) noise is less than 2.5 $\mu\text{V}$ , while at minimum bandwidth, this figure is reduced to less than 0.5 $\mu\text{V}$ .

In its basic form, the pre-amplifier is tuned to 10Hz to give good resolution of alpha signals, but will also handle large amplitude beta, theta, and muscle pulses when set to wideband. However, the circuit can be modified quite easily for narrowband handling of beta, theta, delta, and low frequency alpha signals by altering the values of three capacitors.

All of the circuits given here are battery powered with outputs of less than 6 volts r.m.s., because it is potentially very dangerous to conduct electrode experiments with mains powered equipment. Even

so, a mere 6 volts applied to the scalp is sufficient to cause visual strobing effects, twitching of facial muscles, an unpleasant tingling under the electrodes, and a mild headache if prolonged.

**As a general policy, therefore, it is inadvisable to touch any circuit wiring while wearing head electrodes, and the temptation to couple bio-amplifiers to, say, audio amplifiers or flashing light systems, should be strictly avoided.**

**PRE-AMPLIFIER CIRCUIT**

The circuit of the biological pre-amplifier is shown in Fig. 3. Input transistor TR1 has a collector current of 50 $\mu\text{A}$  for low noise working with typical skin electrode impedances of around 5 kilohms.

A proportion of TR2 emitter voltage is fed back to TR1 base via R3, to set the d.c. operating points of TR1 and TR2. C2 and R4 reduce the gain of the input stage above 100Hz to combat noise and instability. At 10Hz, the combined voltage gains of TR1 and TR2 is approximately 300.

A resistance placed between the inverting input and output of an operational amplifier will determine its gain. In the circuit in Fig. 3, an operational amplifier (IC1) uses a twin-T filter between input and output (C5-C7, and R10-R12) to offer a near infinite impedance at the frequency to which it is tuned; a low impedance is presented at other frequencies. Hence, the gain of IC1 is very high at the centre frequency and the amplifier behaves like a high-Q tuned circuit.

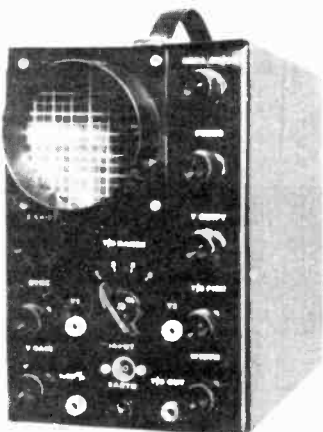
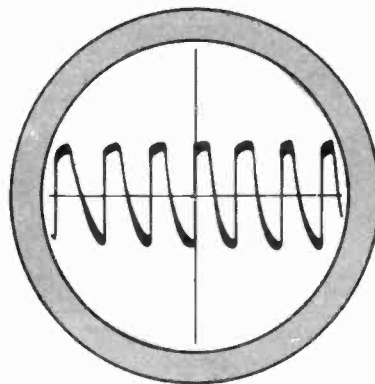
The bandwidth of IC1 is controlled by a variable resistance VR2 placed in parallel with the twin-T filter. With VR1 at minimum and VR2 at maximum resistance, stage gain is eleven, and can be reduced

# look!

# electronics really mastered

... practical  
... visual  
... exciting!

no previous knowledge  
no unnecessary theory  
no "maths"



RAPY

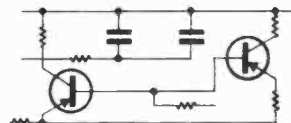
## BUILD, SEE AND LEARN

step by step, we take you through all the fundamentals of electronics and show how easily the subject can be mastered. Write for the free brochure now which explains our system.

### 1/ BUILD AN OSCILLOSCOPE

You learn how to build an oscilloscope which remains your property. With it, you will become familiar with all the components used in electronics.

### 2/ READ, DRAW AND UNDERSTAND CIRCUIT DIAGRAMS



as used currently in the various fields of electronics.

### 3/ CARRY OUT OVER 40 EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS & SEE HOW THEY WORK, including:

valve experiments, transistor experiments, amplifiers, oscillators, signal tracer, photo electric circuit, computer circuit, basic radio receiver, electronic switch, simple transmitter, a.c. experiments, d.c. experiments, simple counter, time delay circuit, servicing procedures.

This new style course will enable anyone to really understand electronics by a modern, practical and visual method—no maths, and a minimum of theory—no previous knowledge required. It will also enable anyone to understand how to test, service and maintain all types of electronic equipment, radio and TV receivers, etc.

**FREE** POST NOW  
for  
BROCHURE

or write if you prefer not to cut page

To BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, P.O. BOX 156, JERSEY. Please send your free brochure, without obligation, to: we do not employ representatives

NAME

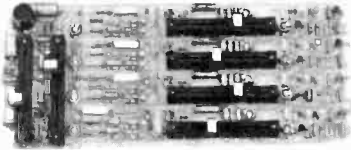
BLOCK CAPS

ADDRESS

PLEASE EL13

**special free gift also to all our students**

# PCB'S FROM



(ILLUSTRATION:  
AURORA 4 CHANNEL CONTROL)

# PHONOSONICS

All PCB's Fibreglass, Drilled, Roller Tinned  
Circuit Diagram and Assembly Notes Free with each PCB  
PCB-Mounting Slider Pots with Knobs Supplied as  
Alternative to Rotaries at Extra Cost where indicated

PCB'S DESIGNED BY PHONOSONICS EXCEPT WHERE  
STATED OTHERWISE  
DESIGNS PUBLISHED IN P.E.

**AURORA (Apr./Aug. 71)** Multichannel Sound Controlled Light  
S/c's (excl. SCRs), Rs, Cs, Cores, Pots, 8 ch., £17.75; 4 ch., £10.15. Slider  
Pots and Knobs alternative extra, 8 ch., £3.70; 4 ch., £2.20. Power Supply  
(supplies 8 chans.), unstabilised, £2.85; stab., £3.65. PCB (4 1/2in x 11in) for  
Pre-amp and 4 Chans. incl. all pots, £2.35. PCB (4 1/2in x 6 1/2in) for PSU,  
Sync Gen, 8 cores, 8 SCRs, £1.35.

**CALLERCOD (Jul./Aug. 72)** Automatic Answering Machine  
S/c's, Rs, Cs, Pots, Switches, Relays, Transformer, £12.15. PCB (4in x  
7 1/2in) holds circuit, relays, edgeconnectors, £1.50. Parrot Tape Recorder,  
£6.95. Pips Gen with PCB, £1.50.

**DOOR BELL YODELLER (Apr. 71)**—S/c's, Rs, Cs, Pots, £4.20.  
Transformer, £1.30. Loudspeaker, £1.30. PCB (3in x 3 1/2in), 90p.

**ELECTRONIC PIANO (Series commencing September 1972)**  
Pre-Amp—Rs, Cs, Pots, £1.90. PCB as published, £1.20. Power Supply—  
Rs, Cs, £1.15. PCB as published, 95p. Pitch 1-12 Rs, Cs, £2.10 each set, Pitch  
13 Rs, Cs, £1.50. Pitch PCB as published £1.85 each. Discounts for Qty.

**GEMINI STEREO AMP (Nov. 70/Mar. 71)** Stereo Sets and PCBs  
Pre-Amp—S/c's, Cs, Pots, Maka-Sw's—with 1W 25% M.O. Rs, £13.45—with  
1/2W 5% C.F. Rs, £11.20—with 1/4W 5% C.F. Rs, £10.75—with Slider Pots and  
Knobs extra, £1.65. PCB (3 1/2in x 10 1/2in) for kits with 1/4W M.O. or 1/2W C.F.  
Rs. Holds pots and Maka-Sw's, £2.10. Main Amp—Rs, Cs, Pots, £4.30.  
PCB (3 1/2in x 5in), £1.40. Power Supply—Rs, Cs, Pot, £3.70. PCB (2in x  
4in), 75p.

**GEMINI STEREO TUNER (Apr./Jun. 72)**  
Rs, Cs, Pot, £3.20. PCB as published, £1.80.

**LOGICAL RADIO CONTROL (Dec. 71/Jan. 72)**—Sets incl. Rs, Cs, S/c's  
and Pots (where req.) but excl. I.C.'s. Coder 1 and Clock Pulse Generator,  
£2.95. Coder 2A, £2.80. Coder 2B, £3. Decoder, 55p. PCBs as published,  
75p each.

**MODEL SERVO CONTROL (Feb./Mar. 72)**—Sets incl. Rs, Cs, S/c's and  
Pots (where req.) but excl. I.C.'s. Servo Amps: "A", £1.40; "B", £2.55;  
"C", £1.30. Fail Safe, 65p. PCBs as published: "A" and "B", 60p each;  
"C" and F/Safe, 50p each.

**MICROPHONE MIXER (Apr. 69)**—S/c's, Rs, Cs, Pots, £2.90. Slider Pots  
and Knobs extra, £1.15. PCB (3 1/2in x 4 1/2in)—holds pots, £1.20.

**PHOTOPRINT PROCESS CONTROL (Jan./Feb. 72)**  
Finds exposure, controls timing, stabilises mains voltage.  
S/c's, SCR, LDR, Rs, Cs, Pots, Relay, Sw's, T/former, £7.60. PCB (3 1/2in x 5 1/2in)  
also holds pots, relay, Keyswitch, £1.20.

**TAPE NOISE LIMITER (Feb. 72)**—Mono Circuit  
S/c's, Rs, Cs, Pot, PCB (1 1/2in x 3in), £2.20. Regulated Power Supply (will  
feed 2 units) and PCB (1 1/2in x 2 1/2in), £3.20.

**ULTRASONIC TRANSMITTER-RECEIVER (May 72)**  
Rs, Cs, Pot, S/c's (incl. T/ducers and Relay), £6.65. PCB's: T/mtr. (0.8in x  
1.9in), R/cvr. (1.9in x 4.8in). Total: 75p.

**VERSATILE LIGHT EFFECTS UNIT (Jun. 72)**—Single Channel Sound  
Controlled Light—also has built-in variable strobe generator. S/c's (excl.  
SCR), Rs, Cs, Pots, T/formers, Keyswitch, £8.85. PCB (5 1/2in x 5 1/2in) also  
holds Pots, Sw, T/former (T/77), £1.50. Slider Pots and Knobs (excl. 25R Lin.  
—Rotary only), £1.10.

## SOME OTHER DESIGNS AVAILABLE

**REVERBERATION UNIT (Practical Wireless Nov.-Dec. 72)**  
Rs, Cs, S/c's, Slider Pots, T/former, £5.95 (with rotary pots £4.80). PCB  
(2in x 1 1/2in) also holds sliders (compatible with pub. panel), £1.20.

**8 WATT SILICON AMPLIFIER (Practical Wireless Nov. 72)**  
Main Amplifier—Rs, Cs, Pot (Mono Set), £1. PCB (2 1/2in x 3in) (Mono). 60p.  
Pre-amp—S/c's, Rs, Cs, Pots, Maka-Sw. Mono, £2.50; Stereo, £5.20. Slider  
Pots and Knobs extra, Mono, £1.26; Stereo, £1.52. PCB (3 1/2in x 7 1/2in)  
(Stereo)—also holds all pots and Maka-Sw's, £1.50.

**I.C. 2-TW STEREO AMPLIFIER (Radio Constructor July 71)**  
Rs, Cs, Pots, I.C.'s complete with heatsinks, £7.50. PCB (4 1/2in x 5in) holds  
stereo circuit (excl. PSU) and Pots, £1.20. Power Supply, £2.85. Slider  
Pots and Knobs extra, £1.35.

**AURORA AUXILIARY CONTROL UNIT (2 variable frequency  
strobe generators and 4 variable amplitude frequency generators).**  
Rs, Cs, Pots, S/c's £3.25. Slider Pots and Knobs extra, £2.34. PCB (3 1/2in x  
5 1/2in) holds all generators plus pots, £1.35.

Lists for these and latest new designs—send foolscap S.A.E. Orders: U.K. 10p  
P. & P. Overseas at cost. Mail Order only.

Dept. P.E.I., 25 Kentish Road, Belvedere, Kent DA17 5BW

# XMAS FREE POSTAGE TRA FREE PACKING

**TWO MOTION SWITCH UNIT\***  
Action (electro mechanical) lifts 3 pairs of wipers 0-10 steps and rotates wipers  
0-11 steps, integral tag board wired ready for use. 50V d.c. £6.80.

**UNISELECTORS\***  
4 bank 25 way plus drive bank, £1.

RELAYS		Coil (ohms)	Volts
No.	Tips		
*S1	1M	1k/400	3-50
S2	2C/O	1k/1k	10-50
S3	1B/2C/O	100	10-20
S4	2M/1B	2k	36
S5	4M	50	6-12
*S6	2M/1B/2C/O	1.3k	30
Twin	1M/1C/O	630	15
S7	1M/1B/1C/O	2k	36
P1	1M	175	28
P2	2C/O	650	28
P3	1M	200	24
P4	1M		24
P5	2M	350	15
P6	3C/O	500	14
P7	3M	300	3A

Take your pick. Any 3 50p. Any 7 £1.

SEALED RELAYS		Coil (ohms)	Volts
No.	Tips		
HS1	4C/O	450	24
HS2	2M	3.5k/3.5k	30-50
*HS3	2M/2B	800	

Any 3 £1.  
Synchronised Choppers fully adjustable, 50p.

**VIBRATORS**  
VSI Hermetically sealed 6V. 10p each, 6 for 50p, 13 for £1.  
V82 Hermetically sealed 12V, 15p.  
V01 Open (buzzer type) fully adjustable, 10p.

**RESISTORS**  
3 each 30 values 10 ohms—1 Meg., 50p. 10 each 30 values 10 ohms—1 Meg, £1.25,  
250 Mixed, 50p.

**CAPACITORS**  
3 each 30 values 1-3,000pf, 50p. 10 each 30 values 1-3,000pf, £1.25, 250  
Mixed, 50p.

**POTENTIOMETERS**, 8 assorted, 50p.

**METERS**, 3 various with broken glass, 50p.

\*Denotes ex-equipment.

**READER MAIL SERVICE**  
20 ELSMERE ROAD, DIDSBURY  
MANCHESTER M20 0FL. TEL. 061-445 3303

# BEDFORD ELECTRONICS

2 GROVE PLACE, BEDFORD

(continuation of Lurke Street)  
Tel.: Bedford 51961

**MULLARD C296 POLYESTER FILM CAPACITORS**  
400V: 0.001, 0.0015, 0.0022, 0.0033, 0.0047, 21p. 0.0068, 0.01, 0.015, 0.022,  
0.033, 3p. 0.047, 0.068, 0.1, 4p. 0.15, 51p. 0.22, 7p. 0.33, 101p. 0.47,  
12p.  
160V: 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 3p. 0.1, 31p. 0.15, 4p. 0.22,  
41p. 0.33, 51p. 0.47, 7p. 0.68, 10p. 1.0, 12p.

**MULLARD C280 METALLISED FILM CAPACITORS 250V**  
0.01, 0.015, 0.022, 3p. 0.033, 0.047, 0.068, 31p. 0.1, 4p. 0.15, 0.22, 41p.  
0.33, 6p. 0.47, 7p. 0.68, 10p. 1.0, 12p. 1.5, 18p. 2.2, 21p.

**CERAMIC CAPACITORS 50V (Square plaquette body)**  
E12 Series 22pF-1,000pF, 11p. E6 series 0.0015-0.01, 2p. E6 series 0.015-  
0.047, 21p.

**HIGH VOLTAGE CAPACITORS 1000V d.c. (300V a.c.)**  
0.001, 0.0022, 0.0033, 0.0047, 7p. 0.0068, 0.01, 0.022, 10p. 0.047, 0.1, 12p.  
0.22, 20p. 0.47, 22p.

**POLYSTYRENE CAPACITORS 125V, 21%**  
Values in pF: 5, 10, 15, 22, 33, 47, 56, 68, 100, 150, 220, 330, 470, 560, 680, 820,  
1000, 31p.

**SOLID TANTALUM RESIN DIPPED BEAD CAPACITORS**  
µF/V: 0.1/35, 0.22/35, 0.47/35, 1.0/35, 2.2/35, 4.7/35, 10/6.3, 10/16, 10/25,  
22/16, 47/6.3, 100/3, 15p.

**MULLARD 015/016/017 ELECTROLYTICS (Replaces C426/C437)**  
µF/V: 1/63, 1.5/63, 2.2/63, 3.3/63, 4.7/63, 6.8/63, 10/25, 10/63, 15/10, 15/63,  
22/25, 22/63, 33/16, 33/40, 47/10, 68/16, 100/4, 100/10, 100/25, 150/16, 220/16,  
5p. 47/63, 470/6.3, 51p. 68/63, 330/16, 9p. 100/63, 150/63, 680/16,  
1500/6.3, 11p. 220/63, 470/40, 1000/16, 15p. 330/63, 680/40, 1000/25,  
1500/16, 2200/10, 3300/6.3, 18p.

RESISTORS	Type	Tolerance	Range	Values	Price each
ISKRA 1/2W		5%	4R7-2M2	E24	1p
ISKRA 1/2W		10%	3M3-10M	E12	1p
MULLARD 1/3W		10%	1R-3R9	E12	1p
MULLARD 1/5W		5%	4R7-1M	E24	1p
METAL FILM 1W		5%	27R-1M	E12	11p
WIREWOUND 2.5W		10%	R22-R33, R47	E12	9p
WIREWOUND 2.5W		5%	1R-270R	E12	7p
PRESETS 100R, 250R, 500R and Decades to 5M, 0.1W, 5p. 0.25W, 6p.					

Post and packing 10p on orders under £2; overseas at cost.  
FULL CATALOGUE ON REQUEST.

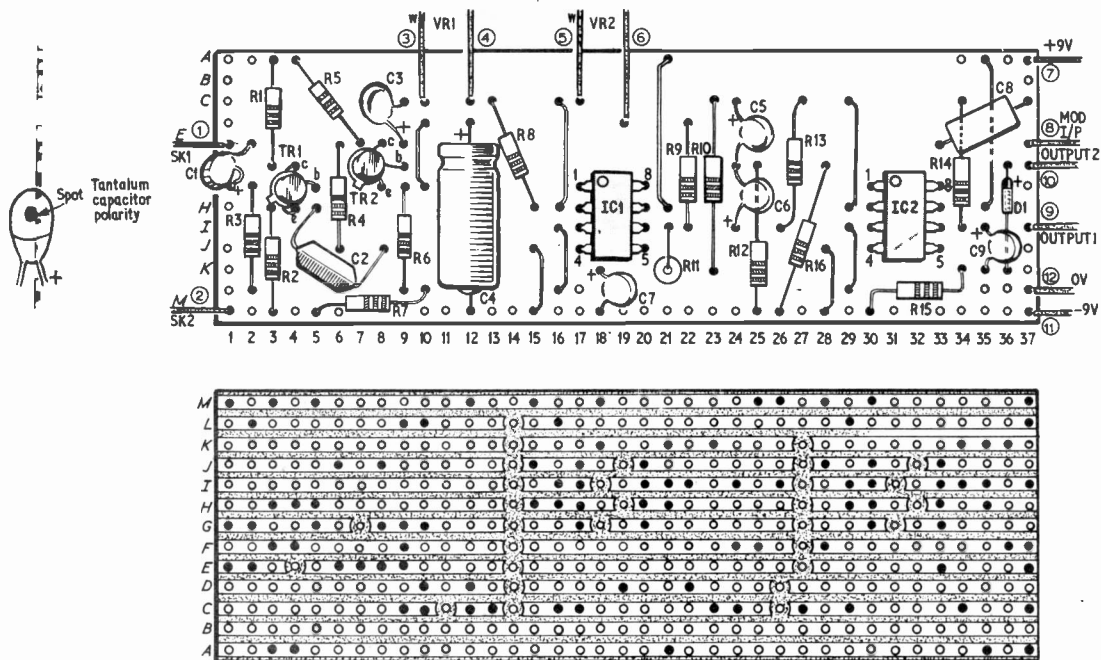


Fig. 4. Layout and wiring of the pre-amplifier board

to less than unity when VR1 is at maximum resistance.

The values listed for C5-C7 in Table 1 with Fig. 3 will give centre frequencies to suit different brain rhythms, but a frequency of 10Hz will serve for general purpose use, including muscle activity.

Output stage IC2 is another operational amplifier set for a voltage gain of 100, making the total gain of the pre-amplifier 330,000. Capacitor C8 has a dual purpose role, firstly as a modulation input whereby the subsonic bio-frequencies can be rendered audible after demodulation by diode D1, and secondly to act as an additional top-cut filter when connected to output 1, depending on the type of output circuit used with the pre-amplifier.

As it is not practicable to use conventional decoupling techniques with very high gain low frequency circuits, owing to the large values of coupling capacitance required, the pre-amplifier is independently powered by two miniature 9 volt batteries, with output circuits separately powered to avoid interaction.

## CONSTRUCTING THE PRE-AMPLIFIER

Pre-amplifier components can be assembled on a 3.7in by 1.3in piece of 0.1in matrix Veroboard, see Fig. 4. Having cut the circuit board to size, cut the copper strips where shown with a spot face cutter or sharp knife, then proceed to mount and solder components in position.

Take care not to let solder bridge the gaps between copper strips (a miniature soldering iron is essential here) and ensure that capacitor and diode polarities are correctly observed. To complete the panel, solder 3in lengths of 20 s.w.g. tinned copper wire as circuit board leads, in positions numbered 1 to 12 in Fig. 4.

For preliminary testing of the pre-amplifier module, join leads 3 and 4, and also leads 5 and 6. Spread out the remaining leads so that they do not touch, and connect leads 7, 12, and 11 to two 9 volt batteries. Polarity is shown in Fig. 3.

## COMPONENTS . . .

### PRE-AMPLIFIER

#### Resistors

R1	330k $\Omega$ $\frac{1}{2}$ watt metal oxide.	R9	10k $\Omega$
R2	2.2k $\Omega$	R10	33k $\Omega$
R3	220k $\Omega$	R11	33k $\Omega$
R4	10k $\Omega$	R12	15k $\Omega$
R5	5.6k $\Omega$	R13	10k $\Omega$
R6	470 $\Omega$	R14	1M $\Omega$
R7	680 $\Omega$	R15	22k $\Omega$
R8	10k $\Omega$	R16	10k $\Omega$

All - 10%  $\frac{1}{2}$ W carbon except R1

#### Potentiometers

VR1	1M $\Omega$ preset knob trimmer
VR2	100k $\Omega$ preset knob trimmer

#### Transistors

TR1, TR2 BC109 (2 off)

#### Integrated circuits

IC1, IC2 741OPA or equivalent (2 off)

#### Diode

D1 OA47 or 1B40

#### Capacitors

C1	2.2 $\mu$ F tantalum 35V
C2	1,000pF polystyrene
C3	2.2 $\mu$ F tantalum 35V
C4	100 $\mu$ F elect. 6V
C5, C6, C7	35V tantalum (see text and Fig. 3)
C8	0.01 $\mu$ F polyester
C9	2.2 $\mu$ F tantalum 35V

#### Miscellaneous

Veroboard 0.1in matrix, 3.7in  $\times$  1.3in. Two 2mm plugs and sockets.

Now, with a 20 kilohms-per-volt testmeter, measure the voltage relative to lead 11 of the following: TR1 case (1.9V), TR2 case (11V), IC1 pin 6 (9V), IC2 pin 6 (9V). A variation of about  $\pm 0.5V$  can be allowed on the above voltages.

Disconnect the batteries and place the pre-amplifier on one side for use with the projects to be described next.

## ALPHAPHONE

The purpose of the alphaphone is to apply bio-feedback to the brain to increase the level of alpha rhythms and thus promote those "good feelings" which, for some people, are associated with alpha.

Commercial versions of the alphaphone retail in the U.S.A. for £100 or more, but the version shown in Fig. 5 can probably be built for under £10 if a pair of headphones are already available.

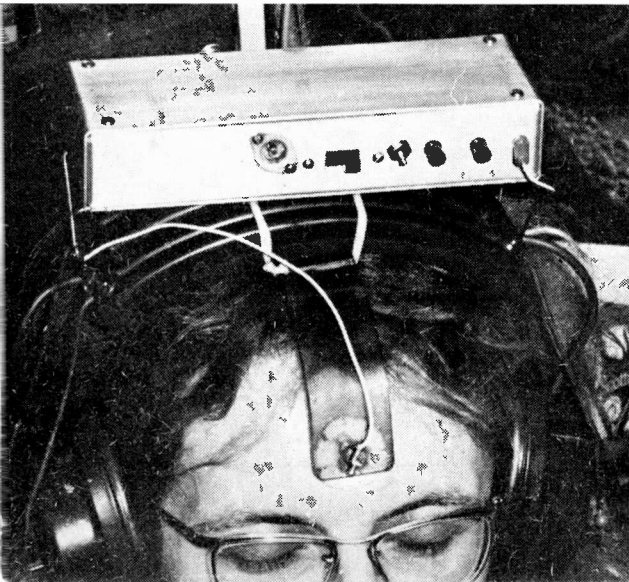
It is important that the sound heard by the alphaphone user should not be harsh, otherwise this will tend to interfere with relaxation. Another important point is that the alpha signal may have to compete with a background of external, domestic sounds which tend to distract the user and "block" his alpha. Ordinary stereophones, with their soft ear cushions, are excellent for attenuating noise, and a pair may be to hand. Alternatively, cheap mono phones with good sound insulation can be purchased for use with the alphaphone.

Referring back to the pre-amplifier circuit (Fig. 3) if white noise or an audio note is fed to the modulation input (lead 8) it will be mixed with the sub-sonic alpha signal at the input of IC2, and the intensity of this noise or note will vary in sympathy with the alpha signal after being passed through a non-linear diode DI.

In preference to an audio note, which is tedious to listen to for long periods, the alphaphone circuit (Fig. 5) uses a simple white noise generator (D2, R17, R18) to supply a restful "chuff-chuff" sound in the headphones, rather like a distant steam locomotive.

An output taken from the pre-amplifier demodulator diode (lead 10) is taken by way of R19 and C10 to a standard type of pre-built audio amplifier. The low alpha frequency is removed by C10 to leave only the higher frequency white noise, which is then amplified and fed to the phones.

The alphaphone fitted to the headband



## LISTENING AMPLIFIER

Almost any small 9V amplifier, of about 50mV sensitivity and  $\frac{1}{2}$  watt output into 8 ohms, will serve. The author used a Newmarket module PC7+. The value of R17 (Fig. 5) can be adjusted to raise or lower the sound output in the phones, and it may be necessary to reduce the value of C10 with audio amplifiers of high input impedance, to give the required alpha frequency rejection.

The output socket, SK3 in Fig. 5, is shown wired for mono and stereo phones, to drive mono earpieces in parallel, and stereo earpieces in parallel.

The alphaphone should be well screened to minimise interference and instability. A suggested layout, inside a metal box, is included in Fig. 5, and this will give an instrument small enough to fit in a large pocket, and light enough to be carried by a stereo-phone headband.

The pre-amplifier module can be supported on its stiff wire leads, with a rectangle of s.r.b.p. under the Veroboard copper strips to prevent contact with the base of the metal box.

The PC7+ amplifier can be held in place with two screws, on stand off spacers. VR1 and VR2 may be glued to the front panel with a semi-flexible adhesive, which is easy to prise apart if one of the sub-miniature potentiometers needs to be replaced.

## HEAD ELECTRODES

Electrodes held in place with sticky tape tend to pull at hair and leave adhesive behind on the skin, so the arrangement adopted here was to use spring loaded electrodes mounted on a shaped headband; see Fig. 6.

The electrode configuration shown, with one on the forehead and one on the crown of the head, is suitable for all brain rhythms except beta, and will pick up a good eyeblink pulse. A couple of layers of lint covering the electrode discs will retain the salt water conductive liquid for long periods without attention.

The electrode headband is a strip of  $\frac{1}{16}$  in sheet Perspex measuring approximately 10in by  $1\frac{1}{4}$  in and shaped in a steam jet or boiling water to be a loose fit on the top of the head. Holes are drilled at each end of the strip to take the spring loaded electrodes.

The eyeblink pulse is useful to test that equipment is in working order, but it may interfere with brain rhythm experiments, in which case the forehead electrode can be resited near the top of the head by drilling another hole in the Perspex strip. The complete electrode assembly is held in place on the head either with an elastic strap under the chin, or when mounted on a stereophone headband.

Electrode leads should preferably be of twisted or "side-by-side" insulated wire, as ordinary screened cable generates several microvolts of low frequency noise when bent or pulled. Even so, some amount of electrode lead noise is unavoidable if the alphaphone user moves his head around or touches the leads with his hands.

When using the electrodes, the lint covering is first soaked in salt water, and good contact is made with the crown of the head by soaking the patch of intervening hair with salt water. Natural skin grease acts as an insulator and should be removed with hair shampoo or surgical spirit.



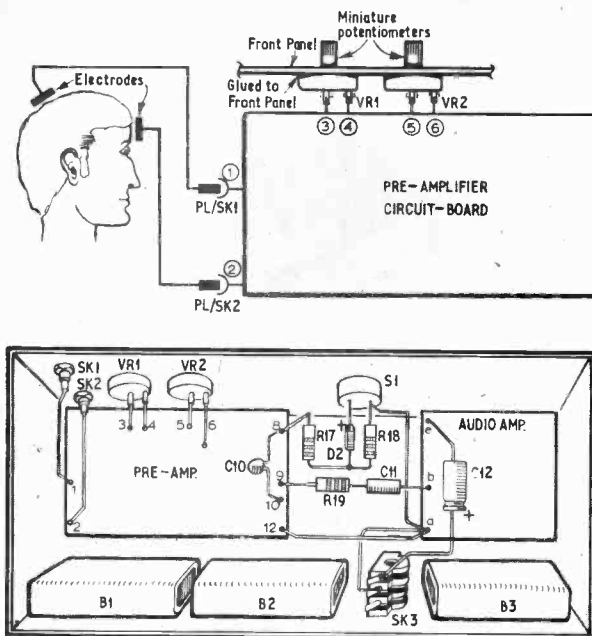


Fig. 5. Practical circuit of the alphaphone

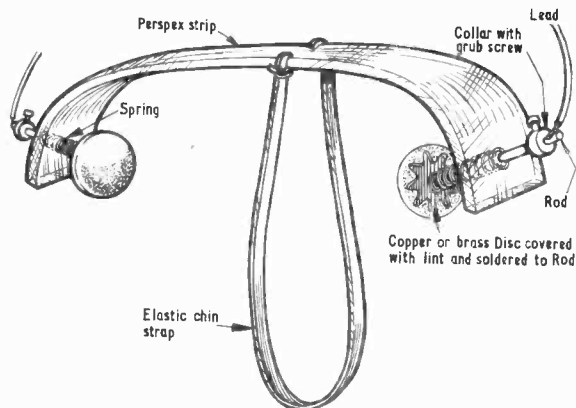


Fig. 6. Construction of the head electrode assembly

### USING THE ALPHAPHONE

When ready to use the alphaphone, insert the headphone jack in SK3, but leave the head electrodes disconnected from SK1 and SK2. Set VR1 to mid-resistance and VR2 to minimum resistance (wide-band) and switch on. A low, steady hiss should just be audible in the headphones. If there is humming, or buzzing sounds, this will probably be mains interference, so try resiting the alphaphone away from house wiring.

Advance VR1 to the point where low frequency noise from the pre-amplifier is just audible. When a 4.7 kilohm resistor is inserted across SK1 and SK2, pre-amplifier noise should disappear.

Wet the electrodes and place them on the head, and connect to SK1 and SK2. A sharp sound should now be heard every time the eyes are blinked, and a crackling noise from jaw muscles when the teeth are clenched, against a background of random brain noise.

Relax with the eyes closed and listen for the "chuff chuff" alpha signal; initially this will tend to come and go in short bursts, but with practice the alpha can be maintained at a steady, high level.

## COMPONENTS . . .

### ADDITIONAL COMPONENTS FOR ALPHAPHONE

#### Resistors

R17 100kΩ  
R18 10kΩ  
R19 1kΩ  
All ±10% ½W carbon

#### Capacitors

C10 47pF polystyrene  
C11 0.033μF polyester  
C12 100μF elect. 12V

#### Diode

D2 OA70

#### Switch

S1A, B, C 3-pole, 2-way miniature wafer

#### Socket

SK3 3-pole jack

#### Batteries

B1, B2, B3 9 volt style PP3 (3 off)

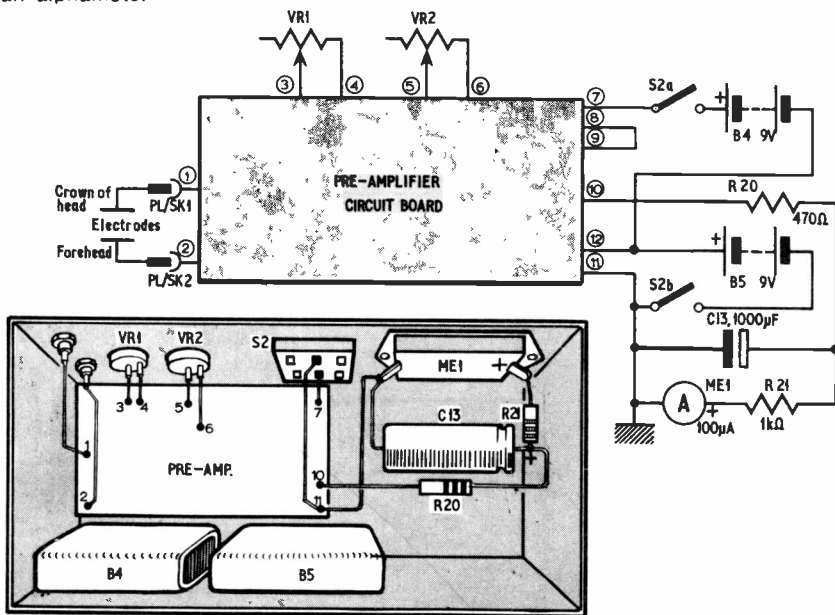
#### Audio amplifier

Newmarket PC7+ or similar (see text)

#### Miscellaneous

8 ohm mono or stereo headphones  
Electrodes (see text)  
Battery connectors  
Metal box (see text)

Fig. 7. Suggested wiring of the pre-amplifier for an alphameter



## COMPONENTS . . .

### ADDITIONAL COMPONENTS FOR ALPHAMETER

#### Resistors

R20 470 $\Omega$   
R21 1k $\Omega$   
Both  $\pm 10\%$   $\frac{1}{2}$ W carbon

#### Capacitor

C13 1,000 $\mu$ F elect. 3V

#### Meter

ME1 100 $\mu$ A edgewise type level indicator

#### Switch

S2 Double-pole change-over slide

#### Batteries

B4, B5 9 volt style PP3 (2 off)

#### Miscellaneous

Battery connectors  
Electrodes (see text)  
Metal box (see text)

If mains interference is impossible to avoid, decrease gain (VR1) and reduce bandwidth (VR2) until a satisfactory signal is obtained. The tendency of the pre-amplifier to oscillate at 10Hz when VR2 is near minimum bandwidth can be checked by blinking the eyes. If there is appreciable ringing after an eyeblink (several cycles of 10Hz oscillation) increase bandwidth.

## ALPHAMETER

The circuit in Fig. 7 can be variously employed as a relaxation meter, lie detector, and sleep threshold monitor, on the principle that alpha rhythm amplitude varies inversely with anxiety, and is reduced to zero by sleep.

Diode D1 in the pre-amplifier module here acts as a meter rectifier, to feed ME1 in Fig. 7 via series resistors R20 and R21, while C13 provides a time constant of 2-3 seconds to smooth out signal fluctuations. C8 in the pre-amplifier module is linked to output 1 (leads 8 and 9) for additional top-cut (see Fig. 2) to reduce interference and unwanted brain noise. Low frequency roll off is also increased by the meter load placed on output capacitor C9 in the pre-amplifier circuit, to remove delta type sleep rhythms.

## CONSTRUCTING AND USING THE ALPHAMETER

If ME1 is a miniature edgewise meter, small enough to mount on the front panel, the alphameter can be housed in a metal box of the same dimensions as that used for the alphaphone. A suggested layout is shown in Fig. 7, with ME1 and C13 taking up the space previously occupied by the packaged amplifier.

To use the alphameter as a relaxation meter, set VR1 to maximum gain and VR2 to wideband. Place the electrode assembly on the head, after wet-

ting with salt water, and switch on. When the subject's eyes are open, a reading of about 5% of full scale should be obtained, assuming that there is little or no mains interference.

Now ask the subject to close his eyes and relax, whereupon the meter reading should rise to about half full scale, indicating a state of moderate relaxation. A gentle tap on a door will cause the meter reading to fall back towards zero, by alerting the subject out of his relaxed state, and the same applies if the subject is asked to do mental arithmetic.

It is interesting to note the increase of meter reading when the subject's eyes are open and he becomes excited, caused by a rise in "brain noise" and theta.

## LIE DETECTION

A similar technique to the above is employed for lie detection, with the virtue that the instrument cannot be misused against the will of the person being interrogated because nervousness or tension obliterates the alpha signal, and renders the lie detector inoperative.

With the subject relaxed and showing a consistently high meter reading, interrogate with a series of simple, undemanding questions, with a short pause allowed between question and answer. If a significant question is suddenly interposed, which calls for a devious answer, the meter reading will fall dramatically towards zero, despite the apparent outward calm of the subject.

To use the alphameter as a sleep threshold detector, the subject is asked to compose himself for sleep, and when the eyes are closed alpha rhythms will initially be generated, causing the meter to read. Just before sleep, the alphameter reading will start to become erratic, and will fall to near zero at the onset of unconsciousness.

**Part 2 will describe a brain rhythm frequency meter and cardiophone.**

# The Big Discount House!

<b>AMPLIFIERS</b>	
Amstrad Integra 4000	£22 70
Amstrad 8000	£13 95
Amstrad IC2000	£27 00
Cambridge P50	£72 00
Cambridge P100	£115 00
Dulci 20T	£16 50
Dulci 20T7M	£19 25
Eagle TSA150	£18 25
Eagle AA2	£25 00
Eagle AA4	£35 50
Eagle AA6	£47 25
Ferrogaph F307 Chassis Mk II case	£41 00
Ferrogaph F307 Mk II (wood case)	£44 00
Leak Delta 30	£45 90
Leak Delta 70	£55 90
Linear 806	£17 25
Linear L766	£18 75
Linear 505	£13 75
Metrosound ST2E	£24 25
Metrosound ST60	£45 75
Philips RH580	£19 90
Philips RH590	£35 40
Philips RH591	£53 90
Pioneer SA500A	£35 00
Pioneer SA600	£58 00
Pioneer SA700	£58 50
Pioneer SA800	£75 50
Pioneer SA900	£92 00
Pioneer SA1000	£93 50
Pioneer SC700	£40 00
Pioneer SF700	£56 75
Pioneer SM700	£43 00
Rogers R'brook CH	£36 00
Rogers R'brook Cased	£40 00
Rogers R'bourne CH	£17 95
Rogers R'bourne Cased	£48 50
Rotel RA210	£23 00
Rotel RA310	£30 50
Rotel RA610	£48 00
Revox A78	£104 00
Sansui, Full range in stock	
Sinclair PRO605	£18 00
Sinclair 2000	£21 00
Sinclair 3000	£28 25
Sinclair A F U.	£4 25
Sinclair ST60 + 2 Z30 IP25	£14 75
Sinclair ST60 + 2 Z30 IP26	£16 75
Sinclair ST60 + 2 Z50 PZ8	£18 00
Trans	£21 00
Wharfedale Linton	£39 00
Quad 303-33	£90 00
(Carriage and packing 50p)	
<b>TUNER AMPLIFIERS</b>	
AKAI AA650	£187 95
AKAI AA680	£104 00
AKAI AA630	£92 00
AKAI AA620	£71 95
Wharfedale 100 1	£89 00
Sonab R4000	£130 00
Sansui, Full range in stock	
Pioneer SX2500	£250 00
Pioneer SX9000	£218 00
Pioneer SX1500TD	£169 00
Pioneer SX6000	£166 95
Pioneer SX990	£138 95
Pioneer LX860	£120 00
Pioneer SX770	£106 00
Pioneer LX440	£84 75
Pioneer SX440	£77 95
Philips RH901 (with spkrs)	£89 00
Goodmans Module 80	£99 00
Goodmans One Ten	£124 00
Leak Delta 75	£78 50
Rogers R'brook Cased	£64 95
Rotel Fax 331A	£76 95
Rotel Fax 550A	£76 95
Rotel Fax 660A	£83 75
Rotel RX150	£49 50
Rotel RX200	£67 00
Rotel RX400	£70 50
Sharp STA32L	£89 95
Scan Dyna, Full range in stock	
Carriage and packing 50p	
<b>TUNERS</b>	
Amstrad MLX3000	£28 00
Leak Delta FM	£53 90
Leak Delta AM FM	£65 90
Korting T600	£39 75
Philips RH690	£31 50
Pioneer TX1000	£108 00
Pioneer TX900	£109 00
Pioneer TX800	£91 25
Pioneer TX700	£82 00
Pioneer TX600	£75 00
Pioneer TX500A	£51 00
Sinclair Project 60	£15 70

<b>Continued</b>	
Sinclair 2000/3000	£31 00
Rogers R'brook Cased	£35 00
Rogers R'brook CH	£30 75
Rogers R'bourne Cased	£47 95
Rogers R'bourne CH	£42 25
Rotel RT320	£38 00
Rotel RT620	£68 00
Sansui, Full range in stock	
Revox A78FM	£150 00
TUNERS carriage and packing 50p	
<b>SPEAKERS</b>	
Bowers & Wilkins DM1	£54 00 A
Bowers & Wilkins DM2	£87 00 B
Bowers & Wilkins DM3	£117 00 C
Bowers & Wilkins Model 70	£220 00 CC
Cambridge R.40	B
Cambridge R.50	CC
Celestion Ditton 15	£53 00 B
Celestion Ditton 44	£72 50 B
Celestion Ditton	£36 00 B
County	
Celestion Ditton 25	£96 00 B
Celestion Ditton 66	£137 00 CC
Celestion Ditton 10	£36 00 A
MK II	
Decca Deram	£34 00 A
Goodmans Magister	£77 50 B
Goodmans Magnum Kil	£58 50 C
Goodmans Mezzo 3	£44 75 B
Goodmans Dimension 8	£87 00 C
Goodmans Double Maxim	£48 00 B
Goodmans Heaven	£39 50 B
Kef, Full range in stock	
Kelatron KN400	£13 00 A
Kelatron KN600	£21 00 A
Kelatron KN800	£26 00 A
Kelatron KN1100	£32 00 B
Kelatron KN1600	£40 00 C
Kelatron KN2100	£50 00 C
Metrosound Duplex 15	£43 00 B
Metrosound Duplex 25	£75 00 C
Leak 800	£66 00 C
Leak 250	£47 00 B
Leak 150	£36 95 A
Philips RH407	£87 00 C
Philips RH406	£50 00 B
Philips RH412	£28 00 A
Philips RH411	£18 00 A
Ste-Ma Hi-F 5	£85 95 C
Ste-Ma 350	£54 00 C
Ste-Ma 450	£42 00 B
Tannoy Chatsworth	£97 50 C
Tannoy 12in Lancaster	£104 00
Tannoy 15in Lancaster	£114 00
Tannoy 3 L2	£87 00 B
Wharfedale Denton 2	£28 00 A
Wharfedale Linton 2	£38 00 B
Wharfedale Triton 3	£48 50 B
Wharfedale Melton 2	£47 75 B
Wharfedale Doveclate 3	£60 00 B
Sinclair 016	£12 00 A
Eagle D167	£30 00 A
Vicory VSE10	£25 00 A
Vicory VSE2	£20 00 A
Vicory VSM15	£32 00 B
Vicory VSM5	£12 00 A
Vicory VSM20	£25 00 A
Vicory Major	£50 00 B
Ferrogaph S1 Monitor (stand inc)	£137 00 CC
Quad Electrostatic	£112 50 CC
Carriage and Packing A-75p B-£1 25 C-£2 B-£2 50.	
<b>SPEAKER KITS AND CHASSIS</b>	
Full selection in stock including	
	Price per pair
Kef K2	£38 00 B
Kef K3	£57 00 C
Kef 115 Mk II	£8 75 A
Kef 127	£18 00 B
Kef B200	£15 00 A
Kef B110	£14 00 A
Kef B138 Mk II	£18 00 A
Tannoy Mon Gold 12in	£59 00 B
Tannoy Mon Gold 15in	£71 00 C
Wharfedale Unit 3	£18 00 A
Wharfedale Unit 4	£24 00 B
Wharfedale Unit 5	£35 00 B
Peerless 2-8 Kit	£10 50 A

<b>Continued</b>	
Peerless 10-2 Kit	£18 00 A
Peerless 3-25 Kit	£30 00 C
Peerless 20-2 Kit	£20 00 B
Peerless 20-3 Kit	£31 00 B
Peerless 3-15 Kit	£21 00 B
Peerless 430/2 Kit	£44 00 B
Carriage and Packing A-75p B-£1 B-£1 50	
<b>COMBINATION UNITS/COMPACT SYSTEMS</b>	
Philips GF826 (inc spkrs)	£83 00
Philips GF808 (inc spkrs)	£77 00
Philips GF805 (inc spkrs)	£59 00
Philips GR908 (inc spkrs)	£117 00
Philips RH811 (inc spkrs)	£95 00
Philips RH814 (inc spkrs)	£109 00
Philips RF825 (inc spkrs)	£54 00
Philips RF836 (inc spkrs)	£72 00
Philips RH802	£110 00
Philips RH891	£151 00
Fidelity UA1	£72 00
Decca Compact 3	£103 00
Decca Sound 614	£48 00
Decca Sound 1204	£75 00
Decca Sound 1203	£71 00
Decca Compact 3	£103 00
Goodmans Compact 80 (White)	£132 00
Goodmans Compact 80 (Teak)	£124 50
(Carriage and Packing £1 50)	
<b>PRECISION PICK-UP ARMS</b>	
SME New range in stock	
SME 3012/52 (HE)	£27 00
SME SP2	£12 20
SME P1 Spacer	£1 00
Audio Technica AT1005 Mk II	£14 95
Audio Technica Lift L2	£3 00
Amstrad International	£19 00
Golding L89	£8 50
Golding L75	£9 50
Ortofon AS212	£24 25
Neat C36	£11 95
Neat C30B	£13 95
Neat Lift	£3 10
Transcriptor Fluid	£24 00
(Carriage and Packing 15p)	
<b>PLINTHS &amp; COVERS</b>	
SME 2000 System in Teak.	
Walnut or Rosewood	£37 50 B
Vicory De Luxe for Garrard AP76 SL958 Zero, 100 Base	
Teak-Top Persepe Size	
Approx D 38½ W 38cm H 18cm	£5 75 A
Standard Version	£4 00 A
Vicory De Luxe for Garrard AP76 SL958 Base	
Teak-Top Persepe Size	
D 32cm W 37cm H 18cm	£4 50 A
Standard Version	£2 95 A
<b>HOWLAND AND WEST—Full range in stock</b>	
PLINTHS & Covers (Carriage and Packing A-50p B-£1)	
<b>TURNTABLES</b>	
Garrard SP25 Mk III	£10 00
Garrard SL72B	£18 00
Garrard SL75B	£18 95
Garrard 2051CT with Sonatone 9TAHCD	£8 25
Garrard Zero 100S	£38 00
Garrard Zero 100A	£37 00
B.S.R. MP60	£9 50
B.S.R. MP60 TP02	£17 00
B.S.R. H770	£19 00
B.S.R. H770 P/W	£28 00
Transcriptors Saturn	£54 00
Transcriptors Hydraulic REF	£75 00
Transcriptors Hydraulic REF with 9in or 10in Arm	£87 50
Transcriptors Sweep Arm	£3 75
Transcriptors Stylus Brush	£2 50
Transcriptors Stylus Scales	£3 70
Golding GL85/P (with lid)	£81 00
Golding GL75	£27 00

<b>Continued</b>	
Golding GL75/P	£34 00
Golding GL85/P	£22 00
Golding GL72	£22 00
Golding GL72/P	£28 50
Golding GL Lid	£5 00
Golding G125A	£7 00
Golding G101/P-C	£20 00
Golding GR90	£20 00
Thorens TD150A	£37 00
Thorens TD150	£33 00
Thorens TX11	£4 00
Thorens TD150	£27 00
Thorens TD125 Mk II	£80 00
Thorens TD125AB Mk II	£92 00
Thorens TX25	£9 50
Pioneer PL12AC	£33 75
Pioneer PL15C	£48 75
Pioneer PL25	£62 50
Philips GA202A (with Cart)	£48 00
Philips GA212	POA
Philips GA308 (Less Cart)	£31 00
Philips GA180 (with Cart)	£30 00
Sansui and Sonab, Full range in Stock	
Carriage and Packing 50p	
<b>HEADPHONES</b>	
Koss PRO 800 AAA	£23 00
Koss PRO 4AA	£20 25
Koss KO 727B	£12 00
Koss K6	£9 00
Koss K6/LC	£10 00
Koss K711	£7 00
Koss KP56	£33 00
Koss KP9	£49 00
Koss KO747	£49 00
Koss headphones for personal callers only	
AKAI CR800	£3 90
Amstrad HP55A	£8 70
Amstrad HP57A	£4 90
AKAI ASE 9	£3 25
AKAI ASE 22	£7 25
AKAI ASE 20	£4 00
Rogers R'brook	£13 00
Pioneer SE50	£12 50
Pioneer SE30A	£8 00
Pioneer SE50A	£4 95
Pioneer SE100	£19 00
Pioneer UB100	£12 00
Pioneer SE-L40	£14 00
Pioneer SE-L20	£12 75
Rotel 600	£4 50
Rotel 700	£7 25
Sannheiser HD414	£8 25
Wharfedale DD1	£8 35
Sansui, Full range in stock	
Stax SR3	£38 75
Tripletone TSH1500	£11 00
Grovesonic	£10 00
Philips LBB9001	£4 50
Eagle SE5	£2 25
Eagle SE30	£5 75
Eagle SE80	£12 50
Eagle SE100	£13 35
H'West CIS250	£4 25
H'West CIS300	£8 50
H'West CIS500	£10 00
AKG K120	£4 50
AKG K60	£10 25
Carriage and Packing 15p	
<b>TAPE DECKS &amp; RECORDERS</b>	
AKAI GX365	£280 00 BA
AKAI X200SD	£209 00 BA
AKAI X180SD	£110 00 BA
AKAI X2000	£106 00 BA
AKAI 4000D	£81 25 B
AKAI 172L	£56 75 B
AKAI GX200D	£16 95 BA
AKAI GX280D	£221 00 BA
Ferrogaph 702/704 P/W	£186 00 BA
Ferrogaph 722/724 P/W	£187 00 BA
Ferrogaph 722H P/W	£187 00 BA
Ferrogaph 702H P/W	£175 00 BA
Ferrogaph 702/4 Dolby P/W	£224 00 BA
Ferrogaph Dolby 702 P/W	£233 00 BA
Ferrogaph Dolby 722 P/W	£255 00 BA
Ferrogaph Dolby 722H P/W	£284 00 BA
Philips N4307	£34 00 A
Philips N4308	£41 25 A
Philips N4404	£35 75 A
Philips N4407	£81 75 B

<b>Continued</b>	
Philips N4418	£159 00 B
Philips N450	£227 00 B
Philips 4303	£29 00 A
<b>STANDARD SERIES (3M-7 1/2 i.p.s.)</b>	
Revox 1102A	£190 00 AB
Revox 1302/4	£226 00 AB
Revox 1122/4	£228 00 AB
Revox 1322/4	£228 00 AB
Revox 1222/4	£229 00 AB
Revox High Speed Series (7 1/2-15 i.p.s.) UK Conversions	
Revox (State Choice of NAB IEC Equalization)	
Revox H1102A	£229 00 AB
Revox H1302/4	£229 00 AB
Revox H1122/4	£229 00 AB
Revox H1322/4	£250 00 AB
Revox 1222/4	£260 00 AB
Revox High Speed Series (7 1/2-15 i.p.s.) Ex-Factory Version	
Deck only H110E (NABEQ)	£250 00 AB
2-track only H110E (IECEQ)	£259 00 AB
Deck Plus 10 Watt Arms H112E (NABEQ)	£278 00 AB
2-track only H112E (IECEQ)	£278 00 AB
Suitcase Complete H122E (NABEQ)	£287 00 AB
2-track only H122E (IECEQ)	£287 00 AB
Revox Dolby DL1302/4	£255 00 AB
Carriage and Packing A-50p B-£1	
<b>CASSETTE &amp; 8-TRACK DECKS/RECORDERS</b>	
AKAI CR800	£80 00 B
AKAI CS50	£83 00 B
AKAI CS50D	£78 00 B
AKAI GX40	£82 25 B
AKAI GX40D	£87 75 B
Philips EL302A	£15 00 A

# RST

**VALVE MAIL ORDER CO.**  
 16a WELLFIELD ROAD, LONDON SW16 2BS  
**SPECIAL EXPRESS MAIL ORDER SERVICE**  
 Express postage 1p per transistor, over ten post free  
 INTEGRATED CIRCUITS 5p + 1p each added

sp	sp	sp	sp	sp	sp
1N21	0-17	AFZ12	1-00	BYZ10	0-85
1N23	0-20	ASV28	0-25	BYZ11	0-32
1N85	0-88	ASV27	0-82	BYZ12	0-30
1N953	0-50	ASV28	0-82	BYZ13	0-25
1N258	0-50	ASV28	0-82	BYZ15	1-00
1N645	0-25	ASV36	0-25	BYZ16	0-62
1N725A	0-20	ASV50	0-17	BYZ8CAV3	0-25
1N914	0-07	ASV61	0-40	0A2246	0-28
1N4007	0-20	ASV63	0-20	0A2290	0-33
1B113	0-15	ASV65	0-25	0C16	0-85
1B130	0-18	ASV62	0-25	CR81/05	0-25
1B131	0-13	ASV66	0-33	CR11/40	0-45
1B202	0-88	ASZ21	0-42	CR4B	2-50
2Q371	0-82	ASZ23	0-75	CS10B	1-13
2Q381	0-25	AUY10	0-88	DD000	0-15
2Q414	0-80	AUY10	1-50	DD003	0-15
2Q417	0-82	BC107	0-10	DD006	0-18
2N404	0-20	BC107	0-10	DD007	0-40
2N697	0-15	BC109	0-10	DD008	0-38
2N698	0-40	BC113	0-15	GD3	0-33
2N708	0-10	BC115	0-20	GD4	0-05
2N708A	0-12	BC116	0-25	GD5	0-33
2N708	0-15	BC118A	0-30	GD8	0-25
2N709	0-33	BC121	0-10	GD12	0-45
2N1091	0-33	BC121	0-20	GET102	0-30
2N1131	0-25	BC122	0-20	GET103	0-82
2N1132	0-25	BC125	0-65	GET113	0-80
2N1302	0-18	BC126	0-65	GET114	0-15
2N1303	0-18	BC140	0-65	GET115	0-45
2N1304	0-82	BC147	0-15	GET118	0-50
2N1305	0-82	BC149	0-15	GET129	0-25
2N1306	0-25	BC149	0-15	GET872	0-30
2N1307	0-25	BC157	0-15	GET875	0-25
2N1308	0-25	BC158	0-12	GET880	0-37
2N2147	0-75	BC160	0-68	GET881	0-25
2N2148	0-60	BC169	0-13	GET882	0-25
2N2150	0-80	BC191	0-35	GET885	0-60
2N2218	0-20	BCY32	0-85	GEX44	0-08
2N2219	0-20	BCY32	0-85	GEX45/1	0-10
2N2389A	0-15	BCY33	0-25	GEX94A	0-15
2N2444	1-99	BCY34	0-30	GJ3M	0-25
2N2418	0-28	BCY38	0-40	GJ4M	0-38
2N2849	0-45	BCY40	0-45	GJ5M	0-25
2N2904	0-20	BCY40	0-50	GJ7M	0-37
2N2904A	0-25	BCY42	0-25	HG1005	0-50
2N2906	0-20	BCY70	0-15	H8100A	0-20
2N2907	0-23	BCY71	0-20	MAT100	0-25
2N2924	0-23	BCZ10	0-35	MAT101	0-30
2N2925	0-20	BD101	0-80	MAT120	0-30
2N2926	0-10	BD121	0-85	MAT121	0-30
2N3054	0-50	BD123	0-80	MJE820	0-87
2N3055	0-75	BD124	0-75	MJE2955	1-37
2N3702	0-10	BDY11	1-62	MJE3055	0-87
2N3705	0-10	BF115	0-25	NKT128	0-35
2N3706	0-33	BF117	0-50	NKT129	0-30
2N3707	0-12	BF167	0-25	NKT211	0-25
2N3709	0-10	BF173	0-25	NKT213	0-25
2N3710	0-10	BF181	0-35	NKT214	0-15
2N3711	0-10	BF184	0-20	NKT216	0-37
2N3819	0-85	BF185	0-20	NKT217	0-35
2N3927	0-80	BF184	0-17	NKT218	0-33
2N5088	0-33	BF195	0-15	NKT210	0-20
2B301	0-50	BF198	0-15	NKT222	0-20
2B304	0-75	BF197	0-15	NKT224	0-22
2B501	0-37	BF898	0-28	NKT251	0-24
2B502	0-62	BF898	0-28	NKT271	0-25
AA129	0-20	BFX12	0-20	NKT272	0-25
AA212	0-30	BFX13	0-20	NKT273	0-20
AA213	0-12	BFX29	0-25	NKT274	0-20
AC107	0-37	BFX30	0-25	NKT275	0-25
AC126	0-20	BFX35	0-98	NKT277	0-20
AC127	0-25	BFX63	0-50	NKT278	0-25
AC128	0-20	BFX84	0-25	NKT301	0-40
AC185	0-25	BFY55	0-20	NKT304	0-20
AC188	0-25	BFX86	0-25	NKT403	0-75
ACY17	0-30	BFX87	0-25	NKT404	0-55
ACY18	0-25	BFX88	0-20	NKT678	0-30
ACY19	0-25	BFY10	1-00	NKT713	0-25
ACY20	0-20	BFY11	1-25	NKT773	0-25
ACY21	0-20	BFY17	0-25	NKT777	0-38
ACY22	0-10	BFY18	0-25	07B3	0-38
ACY27	0-25	BFY19	0-25	0A5	0-20
ACY28	0-17	BFY24	0-45	0A6	0-12
ACY39	0-50	BFY44	1-00	0A47	0-10
ACY40	0-18	BFY60	0-22	0A70	0-10
ACY41	0-15	BFY61	0-20	0A71	0-10
ACY44	0-25	BFY62	0-22	0A73	0-10
AD140	0-50	BFY63	0-17	0A74	0-10
AD149	0-50	BFY64	0-42	0A79	0-10
AD161	0-37	BFY90	0-65	0A81	0-08
AD162	0-37	BSX27	0-50	0A85	0-12
AF106	0-30	BSX60	0-30	0A86	0-15
AF111	0-25	BSX76	0-18	0A90	0-08
AF115	0-25	BSY26	0-18	0A91	0-07
AF116	0-25	BSY27	0-17	0A95	0-07
AF117	0-25	BSY61	0-50	0A200	0-07
AF118	0-62	BSY85A	0-12	0A202	0-10
AF119	0-20	BSY95	0-12	0A210	0-25
AF124	0-25	HT102/500R	0-12	0A211	0-50
AF125	0-20	BTY42	0-75	0A2200	0-55
AF126	0-17	BTY42	0-92	0A2201	0-50
AF127	0-17	BTY79/100R	0-92	0A2202	0-42
AF139	0-80	BTY79	0-75	0A2203	0-42
AF176	0-25	BTY79/400R	0-92	0A2204	0-50
AF179	0-65	BY101	1-25	0A2205	0-42
AF180	0-52	BY100	0-15	0A2206	0-42
AF181	0-42	BY126	0-15	0A2207	0-47
AF186	0-40	BY127	0-17	0A2208	0-32
AFY19	1-13	BY182	0-85	0A2209	0-32
AFZ11	0-60	BY213	0-25	0A2210	0-32

Open daily to callers : Mon.-Fri. 9 a.m.-5 p.m.  
 Valves, Tubes and Transistors - Closed Sat. 1 p.m.-3 p.m.  
 Terms C.W.O. only Tel. 01-677 2424-7

**NOT JUST A RADIO BUT A COMPLETE COMMUNICATIONS RECEIVER**

**BATTERY/MAINS PORTABLE RECEIVER**

WHAT RADIO PRICED AT UNDER £120 GIVES YOU SUCH A VARIED CHOICE OF TRANSMISSIONS?

Picks up ALL THE USUAL BBC Programmes. All the new local radio stations. Continental Pop Pirates. Radio Hams. Aircraft. Shipping. Police. Taxicabs. RAC. Fire Brigades. TV Sound. Ambulances and 1,000s more.

**CASH PRICE £49.50** + 50p P. & P. or £14.50 dep. + 50p P. & P. and 6 months at £7 (£56.50).

THE BEST PORTABLE RADIO EVER MADE! We think so. As well as the standard long and medium wavebands it has three short wave bands (including the Marine and Trawler Band) AND NO LESS THAN THREE VHF BANDS. Listen to your favourite BBC programme and then—at the flick of a switch—tune into the control tower and hear a "crippled airliner" being talked down to safety. Or listen to the trawlers and ocean-going liners—Eavesdrop on the taxi-cabs, fire brigades, ambulances, AA, RAC and 100s of other RT mobiles! Extensive shortwave coverage can give you Australia, Pakistan, North America, France, etc., etc. World famous manufacturer, FULL 3-YEAR WRITTEN GUARANTEE. Beautifully finished in Teak Wood and Stainless Steel. Portable 12in x 9in x 4in, using standard batteries—or can be plugged directly into mains. 14 transistors, 6 diodes, 1 thermistor, internal ferrite rod aerial PLUS two external telescopic antennae—with sockets for additional aeriols, or car aeriols. Automatic Drift-Free Reception. Sliding tone control. Hi-Fidelity earphone for private listening. Local DX switch. FREQUENCIES: Long W 150-350kHz, Medium W 540-1605kHz, Marine 1.6-4 MHz, Short W 3.7-9MHz, Short W 2.9-22MHz. F.M. (VHF) 88-108MHz. Aircraft (VHF) 108-136MHz. Public Service (VHF) 148-174MHz. NOTE.—The Ministry of Posts & Telecommunications state a Licence (not generally available to the public) is required for the reception of transmissions by Fire Brigade, Aircraft, Shipping, etc.

**PROFESSIONAL 2 CHANNEL WALKIE-TALKIE SYSTEM**

JUST ARRIVED—a NEW system from Switzerland—the home of precision built electronics equipment. GENUINE 2-WAY WALKIE-TALKIE SYSTEMS. Ideal for all crowd control, doctors, fishermen and general marine use. The telescopic antenna pulls in the voice at 1 mile with crystal clear clarity—even 8 miles away! Frequency 29.9MHz. (interchangeable according to your licence stipulation). Battery-operated—no wires. A tremendous time and money saver. 2 Units complete with FREE carrying cases. Terms: £19 dep. & 6 months at £9 (Total £73). NOTE: Licence required to operate.

**SCIENTIFIC & TECHNICAL (PEI), 507-511 LONDON ROAD, WESTCLIFF, ESSEX**

**PRICES UNCHANGED**

Our price list compiled in 1971 is still current

5TH EDITION ISSUE ONE  
 SEND NOW FOR A

**CATALOGUE**

5TH EDITION  
 and  
**DISCOUNT VOUCHERS**

25p post free (U.K.)  
**W.E.C. LTD.**  
 High Street, Ripley, Surrey  
 ESTABLISHED 1954

**6 WATT STEREO**

Base your own stereo system on one of these super quality stereo amplifiers. With low distortion levels (typically 0.2%) and total power of 6W r.m.s. (8 load 3W/channel) they will give you a stimulating dynamic performance worthy of good speakers. These amplifiers bring you up-to-date integrated circuit technology to provide 100mV sensitivity/channel and with a band width of 50-15kHz, are ideal for tuners and crystal pick-ups. The circuit features controls for Bass, Treble, Volume, and Mains on/off, together with rectifier and smoothing circuits all P.C. board mounted. All leads and Din Plugs and Sockets can be supplied. All units fully guaranteed.

602 Amplifier as above (5inW x 6inD) £7.48  
 601 Amplifier as above but with single tone control (8inW x 2inD) £5.95  
 Mains Transformer (14V) for 600 series amps 98p  
 Lead, plug and socket set 38p  
 Cheques, P.O.'s. plus 25p post and packing. to:

**the AUTOTRON company, Hixon, Stafford**

Gerry Brown . . .  
**ON THE FRINGE**

**BAROMETERS 'N' THINGS**

My younger daughter came to me some months ago indignant that her sister ought to be able to know (instinctively) that the weather was going to be awful, particularly as Nanny always reckoned she could tell!

My answer was that her sister probably didn't suffer with rheumatics and that I fancied many people might have this ability, certainly it was no stranger to me. But, I wondered, had anyone bothered to see if there was any correlation between aches and pains, and low (whatever that may mean) barometric pressure.

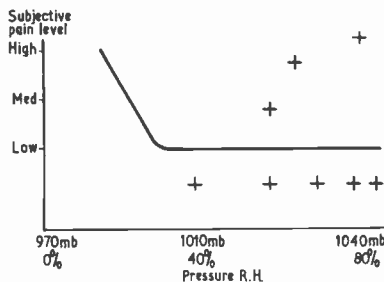


Fig. 1. Curve shows response vs pain level. Crosses indicate RH.

A relatively diligent search reveals that a high proportion of individuals from almost all ages maintain that they are able to indicate with fair accuracy when the weather is going to take a turn for the worse. However, not content with this (and feeling that relative humidity, RH, might play a hand in it too) I determined over the next few months to plot a graph (Fig. 1) of pressure and RH versus the subjective level of "ouch", averaged for several people.

It is a particularly interesting fact that although relative humidity doesn't seem to influence things very much, discomfort is definitely related to low pressure, that is pressures much below 1006 millibars (see Fig. 1). Sure, temperature effects have

not been mentioned, but at the time of preparing the graph (during Summer) no great temperature excursions were recorded.

Don't ask me what causes the effect, but there may be some connection with the fact that bone is piezoelectric. This, however, is a subject to which we must return in a later column.

Perhaps in future times, homes will be pressurised so that no one will be able to predict weather conditions, but then they probably won't care either. In the meantime we must either tolerate bouts of "the screws", or go on frequent diving holidays to avoid "weather forecasts"!

**POSITION FIX**

Some of the most elegant concepts in engineering are delightfully simple in actuality. No exception to this is an (old, British Rail?) idea recently tested as a feasibility exercise by the U.S. Department of Transportation, New Jersey, to reduce the high costs incurred by existing highway aid systems.

Dear old Britain resorts to motorway telephones spread at intervals of about a third of a mile from one another; but let's face it, this just wouldn't do if our country was even half the size of the United States. The way they have beaten the problem, and simultaneously raised the number of call-points per mile too, has been to adopt the scheme shown simply in Fig. 2.

Initial tests were performed along an 8 mile stretch of "freeway", cables being buried either side of the road. Each cable, which carried two wires, was broken by a current-monitoring position at four miles, and these stretches were interrupted at intervals of about 200ft by paralleled push-button switches. At a distance farthest from the monitoring point the cables were terminated in a 100 ohm resistor.

Prior to testing, the line-current (with no buttons pressed) was nulled out. Subsequent operation of any switch thus resulted in a current value corresponding to its position. Hence, a switch near to the monitoring point gave a higher current indication than one operated farther down the cable.

Clearly the whole exercise is based upon a bit of economic thinking, I just hope that when this system is installed on the large scale no more than one button gets pressed at a time!

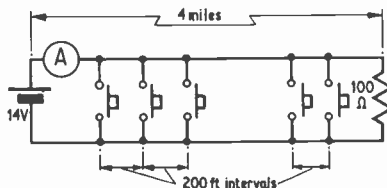


Fig. 2.

**ELECTROPHONIC HEARING**

What it's called now, I really couldn't say, but back in 1953 a paper bearing the title "Electro-Phonic Hearing", and written by Gordon Flottorp of the Psycho-acoustics laboratories at Harvard University, made pretty compelling reading. The effect he discussed, electro-phony, was first observed in the early nineteenth century by Volta and others. They found that the sensation of hearing could be evoked by passing low currents through the head. Of course, only d.c. was available at that time, although a.c. effects, more recently investigated, show better promise.

Flottorp reported that in later experiments an "indifferent" electrode was usually connected to the fore-arm while the second electrode could have sites as varied in location as the roof of the mouth or the nape of the neck. Sometimes the tests have been performed using dampened electrodes, while at other times the results have been blessed with greater success when dry ones were employed; actually, under certain conditions, good results were achieved with a moving electrode too.



Quite wide frequency ranges have been obtained; e.g., 200Hz to 17kHz, although the intensity does not appear to have been very large. This was typically little more than a whisper at about 30dB above the threshold of hearing, but, significantly, a discernible signal.

Considerable difficulty has been experienced in all attempts to establish an exact mechanism for electro-physics, since, when passing current directly through the head, the number of possible paths must be very high. It is, therefore, likely that both the 8th cortical (auditory) nerve and the (sensory) organ of Corti are stimulated simultaneously. Indeed, there is a distinct possibility that the skin itself could take the role of a transducer, the sound it produces being sensed as "direct" hearing!

The voltages employed in these experiments have been kept within the range 1 to 5 volts at currents no greater than 30mA. Although at higher levels of V and I things are certain to become a little bit excruciating, it does rather look as if the effect ought to be re-examined as a possible aid to the deaf, always assuming that the neural function is intact in the first place.

# ELECTRONIC PIANO

## Part 5

By A. J. Boothman B.Sc.



**T**HE final part of the series describes the complete mechanical construction of the piano, together with details on tuning and a number of points concerning the use of the instrument.

### KEYBOARD

Since the commencement of this series of articles F-F keyboards have become available, but as a number of constructors will have purchased C-C Keyboards we now give modification details as promised in the first part of the series.

### MORELLI-A KEYBOARD MODIFICATION

To modify the Morelli-A keyboard to F-F it was necessary to remove the lower C-E section from the main assembly. The wire which acts as a spindle for all the keys was withdrawn from the bottom end by first hammering a nail, whose point was positioned on the end of the spindle, at the top end of the compass. The spindle was then pulled out from the bottom end with a pair of pliers. Prior to this all springs had been released from their bottom clips in order to ease the pressure on the spindle.

In this state all the keys are loose and should be placed on a clean flat surface in the order in which they are removed from the frame. With all keys removed the frame can be cut at the appropriate point with a hacksaw. On completion the keys are replaced in position with the lower C-E section now positioned at the top end.

The wire spindle is replaced from the bottom end, and the final top key (which was originally a C) is now put back to act as the top F. This key will require to be made captive since it is free to move up the rod, and for the prototype a brass collet was obtained from a model shop, and clamped on to the end of the rod using the grub screws tapped into the collet.

The frame should now be very carefully stored prior to mounting on the subframe, since the only mechanical linkage between the two parts of the keyboard is the spindle which could easily be accidentally bent.

The author has not attempted to modify the Morelli-B keyboard, but it should be possible to follow a similar procedure to that outlined above.

### KIMBER-ALLEN SWEDISH KEYBOARD MODIFICATION

The Kimber-Allen keyboard is considerably different in construction to the two previously mentioned models, but as in their cases it is not possible to simply rearrange the keys, since the spacing of the fulcrum slots varies over an octave, and it is therefore necessary to cut the frame in order to remove the bottom C-E section and to fix it to the upper end (see photograph).

The first task is to remove some of the keys from the frame by first removing the springs at the rear of the board, which then frees the metal levers which are slotted into the keys. It is then necessary to remove the actuator pegs from the keys by pulling away from the keys. The actuators are a nylon plastic with push fit pegs into two holes in the key. The keys can then be removed.

In order to reduce the risk of damaging any keys, a fairly large area should be cleared—from C to B-flat at the lower end, and B to F at the top end—having first noted the position of E and F keys at the bottom. It would be wise to pencil the key letters on to the alloy frame opposite the relevant actuator holes.

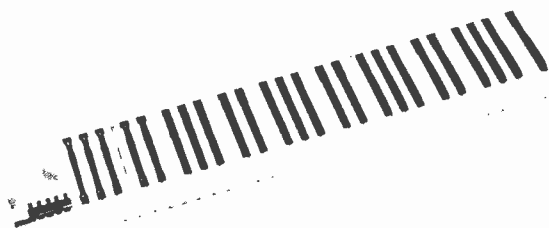


Fig. 5.1. The Swedish keyboard with the section C-E separated

The cut when made will be immediately to the left (viewing the keyboard from the front) of the hole corresponding to note E. This then leaves about half an inch of frame protruding beyond the bottom F key when the assembly is complete, which makes for easy mounting to the wooden sub-frame. For the same reason the line should be drawn to run close to the edge of the hole to leave the maximum amount possible on the piece being cut off, since this part acts as the mounting for the upper end of the keyboard when complete.

Three cuts are necessary, the first being to remove the unpunched section from the bottom end. A line should be drawn to the left of the first (C) hole and a sawcut made keeping the hacksaw vertical. Care should be taken not to damage the fulcrum slot, and to protect the fulcrum knife edge to the left of the slot. The second cut is made in the position described above—i.e. alongside the bottom E hole. Again the saw should be kept as vertical as possible. The third cut is made at the top end of the keyboard and removes the section containing half an actuator hole.

This is necessary in order to finish with the correct spacing between keys. The cut should be made  $\frac{1}{4}$ in to the right of the last complete actuator hole, but it is important that the slot in the plastic spacer at the front of the frame is preserved by leaving some plastic protruding beyond the keyboard ( $\frac{1}{4}$ in). When the new section is fitted its plastic can be cut back slightly in order to accommodate the protruding piece. The slot in the plastic is important in that it acts as the front key locator, preventing lateral movement.

The C-C board has two spare actuator holes at the top end which will now take C and D, having swapped the bottom C key with the previous top C key. The new section will accommodate E flat, E and F (the old top C key), with one surplus actuator hole at the top.

## JOINING PLATES

Three steel plates should now be cut and drilled as shown in Fig. 5.2, and mounted as follows:

- Plate with four holes not countersunk—inside front edge.
- Plate with four holes countersunk—inside rear edge.
- Plate with two holes countersunk—outside rear top. This plate should be mounted as far back as possible so as not to interfere with the keyswitch assembly.

Holes should be drilled in the keyboard frame to line up with the metal plates, with the transferred section of frame positioned such that the distance between the two adjacent edges of the actuator holes is  $\frac{1}{4}$ in.

If all sawcuts have been made in a square manner there should be a gap between the two sections, however it is unlikely that such a degree of squareness can be achieved with a handsaw, and it may be necessary to make slight adjustments with a file.

The four holes on the front edge of the frame should be countersunk and the screws inserted from the front. The rear edge screws should be inserted from underneath the frame, and the top screws from the top, using the countersink in the plates. When all screws have been tightened the D, E-flat, and E

keys should be tried on the frame in order to check that they do not catch each other, thus requiring further adjustment of the joint.

All keys can then be replaced and the actuators pressed back into position.

## SUB-FRAME FOR MORELLI-A KEYBOARD

The construction of the Morelli-A keyboard sub-frame, which carries the keyboard, key switch contacts, and terminal strips, is shown in Fig. 5.3.

Assembly of the sub-frame is best carried out using the large baseboard on which to screw down the unit thus ensuring a fully square frame during the process. Particular attention should be paid to this point when fixing the end cheeks which should be both glued and screwed. Using parts obtained from the materials list given the following procedure should be followed.

1. Take the large baseplate and mark out the position for front and rear  $2\text{in} \times 1\text{in}$  battens, and the end cheeks as shown in Fig. 5.3.
2. Cut the front and rear battens, the end cheeks, the terminal strip mount and the  $1\text{in} \times \frac{1}{2}\text{in}$  hardwood strip as shown in Fig. 5.3.
3. Screw both battens to the baseboard, and glue and screw the end cheeks to the battens.
4. After the glue has been allowed to set remove the frame from the baseboard and fix the  $1\text{in} \times \frac{1}{2}\text{in}$  hardwood strip and the terminal strip mount.
5. The front of the keyboard frame is fixed to the  $1\text{in} \times \frac{1}{2}\text{in}$  strip with nuts and bolts, whilst woodscrews are used on the rear batten fixing. Holes should be drilled in the metal framework to accommodate the fixings.

Should it later be found that the downward travel of the white keys is restricted by the front  $2\text{in} \times 1\text{in}$  batten, metal washers should be inserted between the keyboard frame and the  $1\text{in} \times \frac{1}{2}\text{in}$  hardwood strip in order to raise the front of the keyboard. This results in a very slight keyboard tilt which gives a comfortable playing position. Checks on the freedom of the key travel should only be made when the sub-frame is screwed down to the baseboard as the procedure given automatically results in some movement of the hardwood strip as the outer sub-frame is screwed home.

It is recommended that wherever possible the keyboard and sub-frame assembly should be kept on the baseboard whilst the project continues in order to avoid the possibility of mechanical distortion of the assembly, which still depends largely on the base for its mechanical rigidity.

## KIMBER-ALLEN KEYBOARD SUB-FRAME

Fig. 5.4 shows the construction of the sub-frame for the Kimber-Allen keyboard. Again the simplest procedure is to lay out the battens on the main baseboard and glue and screw the four pieces together. The keyboard is fixed to the sub-frame at the ends using long screws passing through  $\frac{7}{8}\text{in} \times \frac{7}{8}\text{in}$  packing pieces. The latter prevent too much stress being applied to the alloy frame when inserting the screws. For additional strength screws can be inserted into the front and rear legs into their respective battens.

Holes of approximately  $\frac{3}{8}\text{in}$  diameter should be drilled at an angle as shown to take the wires from

the keyswitch to the terminal strips on the rear of the assembly. The terminal strips are cut into groups of six, one for each main p.c.b., and depending on the thickness used for the interconnecting wire either one or two holes per strip will be necessary.

The 2in × 1in planed front bar and side plates are separate from the sub-frame and form part of the main frame which is described in more detail later. Again it is recommended that the keyboard sub-frame assembly should be stored on the base-board to avoid mechanical distortion occurring.

### THE KEYSWITCH ASSEMBLY

The keyswitch assembly consists of a printed circuit board which anchors gold plated springy wires, and carries the touch sensitivity resistors, and seven rod supports which carry two gold plated rods. Fig. 5.5 shows the arrangement of the various components of the assembly.

Before assembling the parts together, the p.c.b. should be placed on the underside of the keyboard, and used as a template for drilling the  $\frac{1}{8}$ in holes required to take the self-tapping screws which fix the switch assembly to the frame.

The front edge of the switch assembly should be placed approximately  $\frac{1}{4}$ in from the keyboard actuators, and should be centralised over its length with respect to the actuators. In the case of the Morelli keyboards the p.c.b. pads will roughly line up with the actuators, whilst in the case of the Kimber-Allen keyboard, which is longer, the overall length of the keyswitch is less than the total span of the actuators.

When the gold plated wires are attached they will be bent to fan out towards the extreme ends of the keyswitch, thus resting on the centre of each actuator.

## MATERIAL AND COMPONENTS FOR KEYBOARD SUB-FRAMES AND MAIN CABINET ASSEMBLY

### SUB-FRAME

	MORELLI-A	KIMBER ALLEN
Front Batten	$34\frac{3}{4}$ in × $1\frac{7}{8}$ in × $\frac{7}{8}$ in	$35$ in × $\frac{7}{8}$ in × $\frac{7}{8}$ in
Rear Batten	$34\frac{3}{4}$ in × $1\frac{7}{8}$ in × $\frac{7}{8}$ in	$35$ in × $1\frac{7}{8}$ in × $\frac{7}{8}$ in
End Cheek (2)	$6\frac{7}{8}$ in × $2\frac{3}{4}$ in × $\frac{3}{4}$ in Block	$3\frac{1}{8}$ in × $\frac{7}{8}$ in × $\frac{7}{8}$ in
Packing Piece (2)	—	$3\frac{1}{2}$ in × $\frac{7}{8}$ in × $\frac{7}{8}$ in
Mounting Strip	$34\frac{3}{4}$ in × 1in × $\frac{1}{2}$ in	—
Terminal Mount	$31\frac{1}{2}$ in × $\frac{7}{8}$ in × $\frac{7}{8}$ in	—
Terminal Strips—6 contact	12 off	12 off
Terminal Strips—2 contact	2 off	2 off

### MAIN CABINET

Baseboard	42in × $20\frac{1}{2}$ in × $\frac{1}{2}$ in	Chipboard
Side Pieces (2)	$20\frac{1}{2}$ in × $6\frac{3}{4}$ in × $\frac{3}{4}$ in	Blockboard
Front Bar	$40\frac{1}{2}$ in × $1\frac{7}{8}$ in × $\frac{7}{8}$ in	
Rear Panel	42in × $7\frac{1}{2}$ in × $\frac{3}{8}$ in	Plywood
Rear Panel strip	$40\frac{1}{2}$ in × $\frac{1}{2}$ in × $\frac{1}{2}$ in	
Top Panel standard version	$40\frac{1}{2}$ in × $13\frac{3}{4}$ in × $\frac{1}{8}$ in	Plywood
Top Panel Strip	$40\frac{1}{2}$ in × $\frac{3}{8}$ in × $\frac{3}{8}$ in	
Mains Panel (3)	$5\frac{1}{2}$ in × 2in × $\frac{1}{8}$ in	Plywood
Mains Panel Cover	$2\frac{1}{4}$ in × 2in × $\frac{1}{8}$ in	Plywood
Speaker Panel Support (2)	$2\frac{1}{2}$ in × $\frac{7}{8}$ in × $\frac{7}{8}$ in	
Switch Panel (2)	X × Y × $\frac{1}{8}$ in	Plywood
Panel Support (2)	2in × $\frac{1}{2}$ in × $\frac{1}{2}$ in	
Speaker Panel	$40\frac{1}{2}$ in × $3\frac{1}{2}$ in × $\frac{1}{4}$ in	Plywood
Panel Stiffners (2)	14in × $\frac{7}{8}$ in × $\frac{7}{8}$ in	
Main Amplifier Support	$2\frac{1}{2}$ in × $\frac{7}{8}$ in × $\frac{7}{8}$ in	
Lid Panel	$40\frac{1}{2}$ in × $6\frac{1}{2}$ in × $\frac{1}{4}$ in	Plywood
Lid Panel	$40\frac{1}{2}$ in × 8in × $\frac{1}{8}$ in	Plywood
Music Support Panel	$39\frac{1}{2}$ in × 7in × $\frac{1}{8}$ in	Hardboard
Lid End Pieces	$6\frac{1}{4}$ in × $3\frac{1}{2}$ in × $\frac{1}{4}$ in	Plywood
36in Piano hinge		
2 Carrying handles		
4 Cupboard catches		
4 24in legs		
Covering Material		



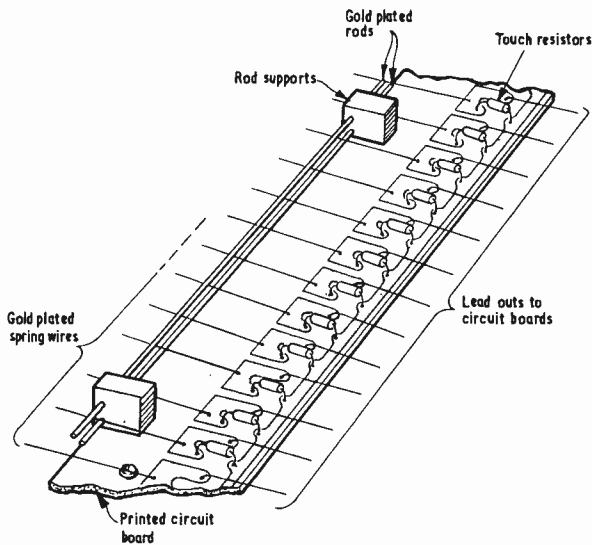
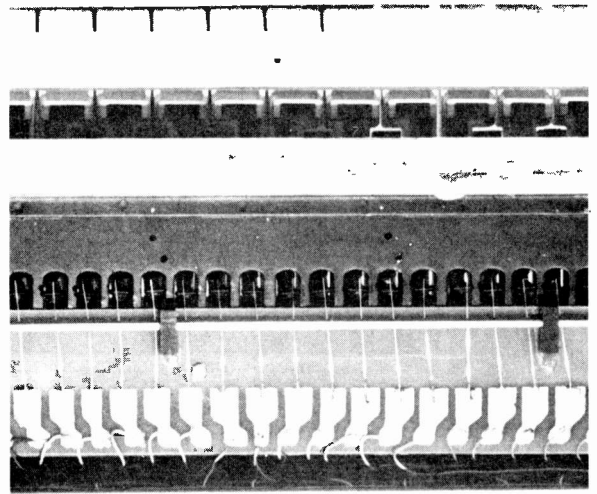


Fig. 5.5. Keyswitch assembly is screwed to the underside of the keyboard so that the actuators press against the spring wires

### MAKING IT UP

When the holes have been drilled, and the p.c.b. removed from the frame, the keyswitch is assembled as follows:

1. Slide the seven rod supports on to one rod, using the hole nearest the face marked with a "B".
2. Insert the second rod through the remaining rod holes, and space the supports roughly opposite the holes which have been countersunk from the non-copper side of the p.c.b.
3. Fix the rod supports to the copper side of the p.c.b., using the countersunk screws, nuts and locking washers, with the support face marked "B" closest to the p.c.b.
4. Solder resistors to the pads provided, one on the common positive rail, and the other on the land which also carries the gold plated spring wire. The remaining land is used to anchor the output leads.
5. Solder wire links between the bottom rod and the negative printed track, and the top rod and positive printed track.
6. Cut the gold plated wire into 61 lengths of  $1\frac{1}{4}$ in, and tin approximately  $\frac{1}{4}$ in of one end of each wire. Some wire will be left over to provide longer lengths where necessary.
7. Pass each wire between the two rods and solder the tinned end to a main pad. About  $\frac{1}{4}$ in should be left to hang over the front edge of the p.c.b. The wire should be pressed flat to the p.c.b. close to the main pad using a match stick, and the soldering iron applied to the wire and land for as short a time as possible.



View of the key contacts at the underside of the keyboard

### MATING WITH THE KEYBOARDS

The assembly can now be fixed to the underside of the keyboard using the self-tapping screws, and a first attempt made to line up each gold wire with the centre of its corresponding actuator.

Some wires will require resoldering to the pads in a different position in order to avoid obstacles such as the rod supports. In certain cases a considerable amount of bending will be required, and it may be necessary to use some of the spare wire to give longer lengths in these instances. The apparently complicated dog leg shapes are perfectly satisfactory in operation.

The final process is to adjust the bend of each wire to ensure that it seats satisfactorily against each rod in turn, whilst gently resting on the actuator in the non-depressed state. As a further precaution to avoid the wires springing off the actuators, small slots can be filed in the centre of each actuator to prevent the wires sliding.

### WIRING THE SUB-FRAME

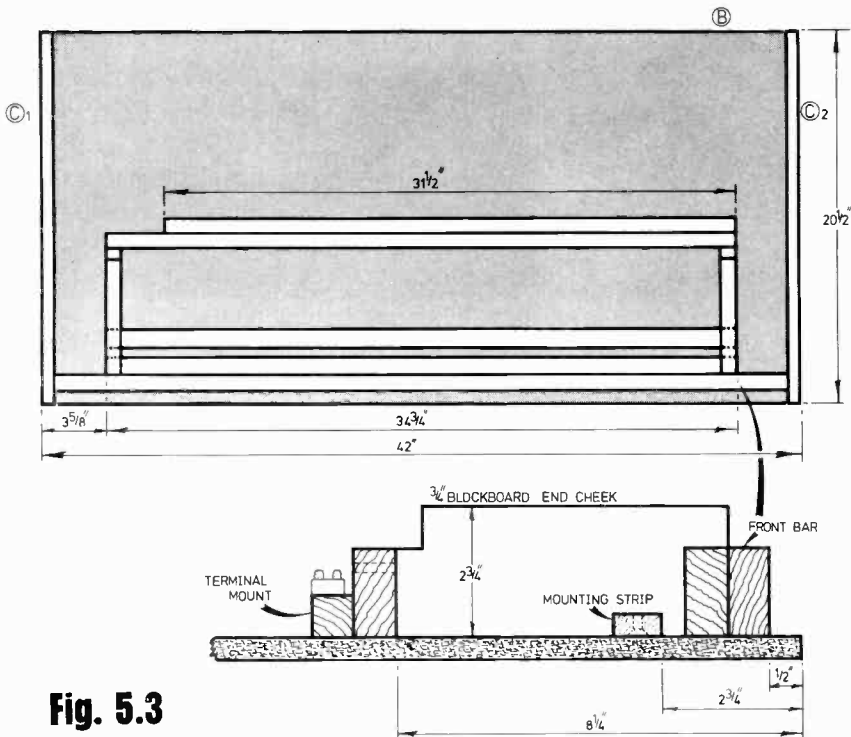
To complete the keyboard sub-frame assembly wires must be taken from each switch pad to the corresponding terminal strip at the back of the assembly. The pads are labelled with the note concerned and as suggested earlier one or two holes have been drilled against each terminal strip which carries all octaves of a particular note.

A single link is also required between the sixth contact on each of the terminal strips, as this acts as the common sustain connection. Wires are also taken from the positive and negative pads on the keyswitch p.c.b. to a two contact terminal strip mounted on the left hand (power supply) end of the keyboard sub-frame.

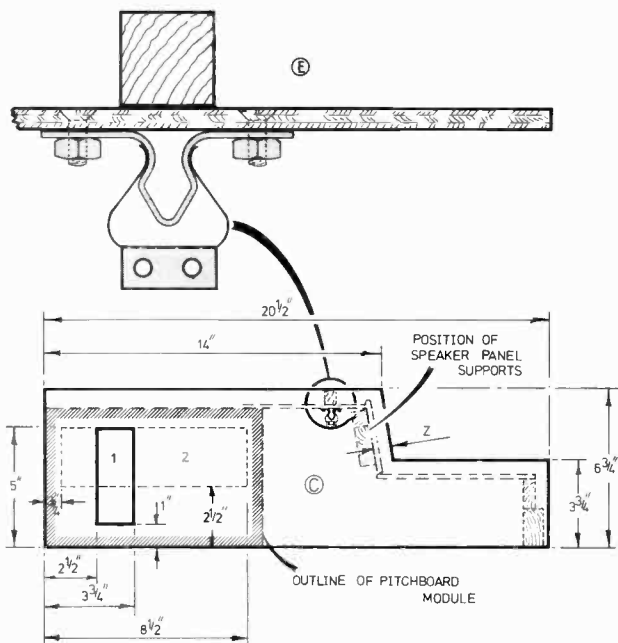
### CABINET ASSEMBLY

The general layout of the cabinet is shown in Figs.5.2 to 5.9.

The cabinet construction has been kept deliberately simple, whilst achieving some aesthetic quality.

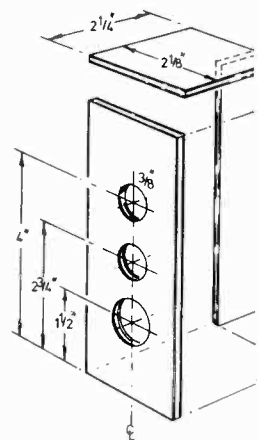


**Fig. 5.3**

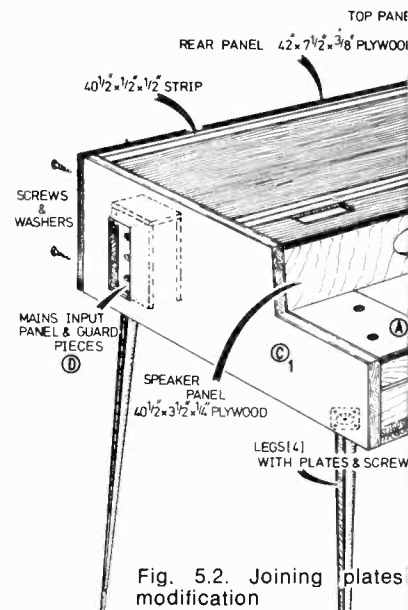


**Fig. 5.7**

# PIANO CAB



**Fig. 5.8**



**Fig. 5.2. Joining plates modification**

**Fig. 5.3. Baseboard layout and end view of sub-frame assembly**

**Fig. 5.4. Baseboard layout and end view of sub-frame**

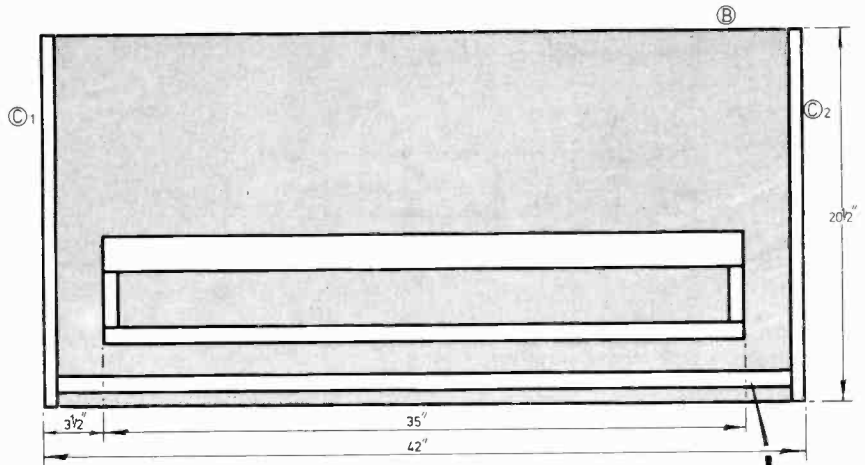
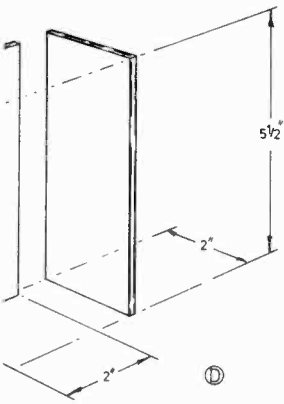
**Fig. 5.6. General assembly panel dimension in parent keyboard only**

**Fig. 5.7. End pieces for the board. Two are required. endpiece (mains input). endpiece**

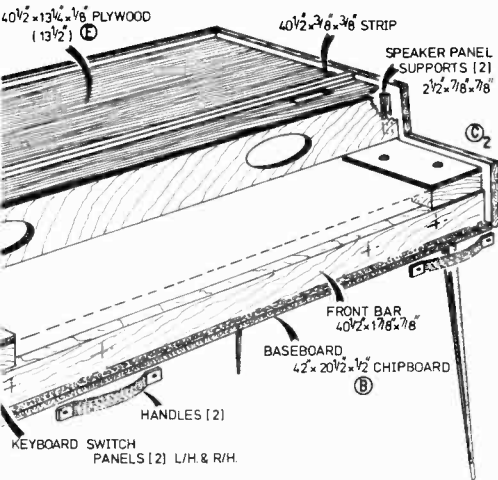
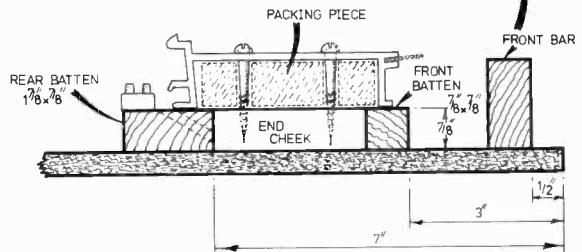
**Fig. 5.8. Mains input panel from 1/8 in plywood**

**Fig. 5.9. Keyboard control panel is shown**

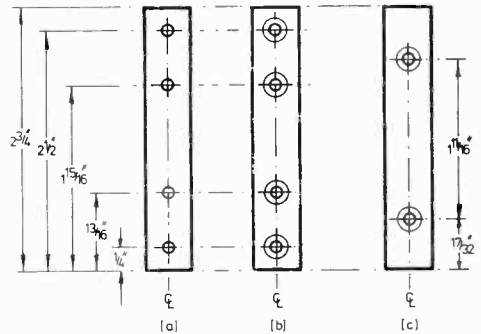
# NET DETAILS



**Fig. 5.4**



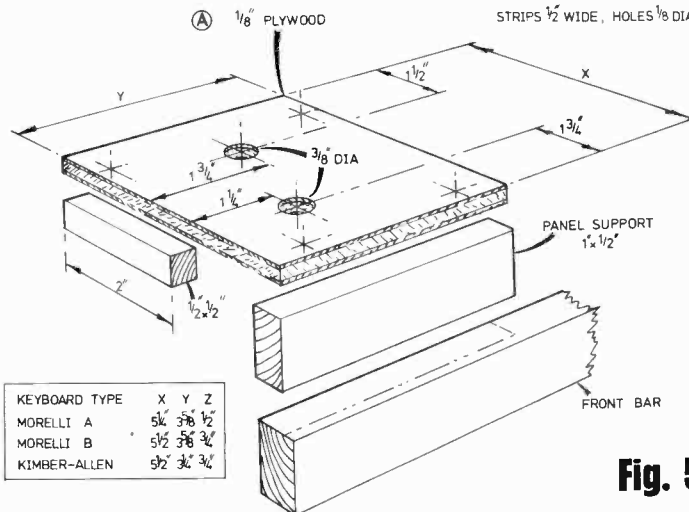
**Fig. 5.6**



STRIPS 1/2 WIDE, HOLES 1/8 DIA CSK IN b & c

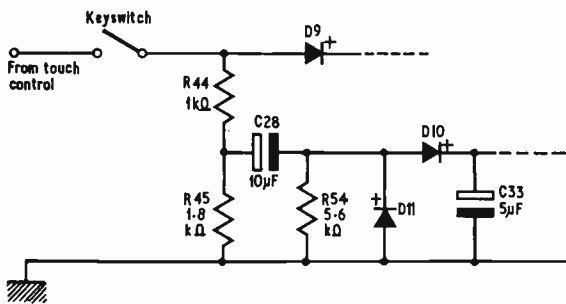
**Fig. 5.2**

or Kimber-Allen keyboard  
for Morelli-A keyboard and  
assembly  
for Kimber-Allen keyboard  
of the cabinet. The top  
thesis is for the Morelli-A

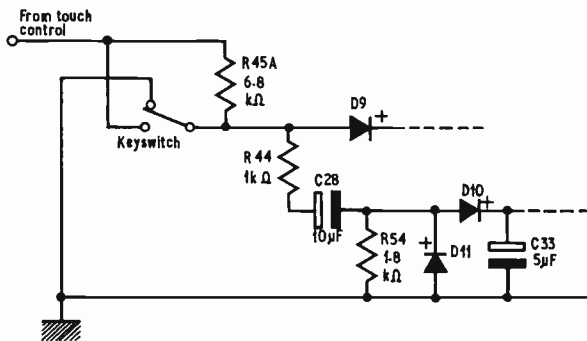


KEYBOARD TYPE	X	Y	Z
MORELLI A	5 1/4	3 7/8	1 1/2
MORELLI B	5 1/2	3 7/8	3/4
KIMBER-ALLEN	5 1/2	3 1/4	3/4

**Fig. 5.9**



(a) Envelope input circuit as used during the initial setting up procedure on the pitch board



(b) Modified envelope input circuit to give touch sensitivity. R45A is mounted on the keyswitch assembly as shown in Fig. 5.5

Fig. 5.10. Circuit changes to give individual key touch sensitivity

The two end pieces are permanently fixed to the baseboard, joined by the front bar. All other parts are detachable in order to give easy access to the various sub units.

Two end pieces should be cut from  $\frac{3}{4}$ in block board, each one requiring a different cut out as shown in Fig. 5.7. The position of the speaker panel supports is also indicated in this diagram. The two pieces should be glued and screwed to the chipboard base, with the front bar positioned  $\frac{1}{2}$ in from the front edge of the base board.

The mains input panel should be cut and drilled from  $\frac{1}{4}$ in plywood as shown in Fig. 5.8. The other three pieces shown form a box which covers the back of the mains switch, etc. to avoid the danger of electric shock.

The speaker panel was covered earlier, and is a removable unit which seats on the supports shown.

The rear panel has a  $\frac{1}{2}$ in  $\times$   $\frac{1}{2}$ in strip glued along its top edge which acts as a retainer for the top panel. The rear panel is screwed to the end pieces and is easily removable.

The top panel is retained in position by the strip attached to the rear panel, and by spring clips positioned at the front, with the female part screwed to the end pieces. The clips used were of the common cupboard door type and are shown in Fig. 5.7. The slots cut in the top panel allow heat to be released from the power supply and main amplifier, whilst the  $\frac{1}{2}$ in  $\times$   $\frac{1}{2}$ in strip acts as location for the lid when used in the music stand position.

Dimension W is dependant on the keyboard used, and if the constructor uses the Morelli-A keyboard he may like to add a  $\frac{1}{2}$ in strip on the sloping edges of the end pieces in order to retain the same styling as achieved when the other keyboards are used.

## CONTROL SWITCH PANELS

Fig. 5.9 shows details of the construction of the keyboard level switch panels. Dimensions X and Y depend on which keyboard is used, and dimension Z from Fig. 5.7 is also given in the table. The  $2\text{in} \times \frac{1}{2}\text{in} \times \frac{1}{2}\text{in}$  support strips should be glued to the side pieces. Using the dimensions given it should be possible to line up the front edge of the keys, when fitted on the keyboard sub-frame assembly, with the front edge of the keyboard switch panels.

## COVERING THE CABINET

The choice of finish to use on the cabinet greatly depends on finances. To give maximum wear and a smart appearance a heavy grade of black p.v.c. sheeting was used on the prototype, with speaker fabric covering the whole of the speaker panel. Other alternatives could be a Contact/Fablon type material, or paint.

## TOUCH SENSITIVITY

Individual touch sensitivity is achieved on each key by the use of a keyswitch assembly which is effectively 6I single pole changeover switches. The two contacts are actually busbars, common to all switches, one at ground and the other at the attack potential. See Fig. 5.10.

Referring to Fig. 5.10b the keyswitch is normally in the grounded busbar position. When a key is depressed the switch leaves the grounded busbar, thus allowing C28 to charge via R45A, the bottom end of which had previously been shorted to ground. The attack level passed on to C33 is determined by the attack voltage from the touch control, reduced by the voltage across C28.

The attack voltage is applied when the second busbar is reached, and the voltage across C28 increases as the time taken to traverse between the two busbars increases. The attack level passed on to C33 is therefore reduced as the time to traverse increases, and is therefore proportional to the average speed of key travel after it is depressed.

This is not of course exactly the same mode of touch sensitivity as on a conventional piano, where the final speed of key travel is the important parameter, but this system does give a degree of realism. The range of touch is considerably less than on a string instrument, but both classical and pop pianists have demonstrated a noticeable level of expression in their playing of the second prototype, relying solely on the keyboard touch sensitivity without access to the soft pedal.

In order to bring the touch sensitivity into operation the value of R54 is altered and R45 removed from the pitch board. R45A is mounted on the keyswitch assembly as described earlier.

Some constructors may find it interesting to experiment with the values of R44, R45A and R54 in order to vary the dynamic range of the touch sensitivity.

## TREMOLO PRESET DEPTH

With all units interconnected the preset tremolo depth control (VR6 in Fig. 2.5) can be set. With VR2 in the maximum position and the tremolo on, adjustment of VR6 will produce zero tremolo effect at one extreme, and reduce the signal output to zero at the other extreme. A position can be found where maximum tremolo swing is obtained.

## TUNING

Tuning can only be carried out by someone with the so called 'musical ear', so if you do not have one you will need to involve a friend or professional tuner.

Commence with A (the first above middle C) using a tuning fork A440. Strike the tuning fork against the cabinet, and use the top panel as a sound board. The pitch board test jig is used to hold the board under alignment, first using the capacitor values suggested in the table, and then small value changes made until A can be achieved with the inductor setting approximately in mid position.

The 'A' board is then put into the pitch module frame and a second board put in the test jig. The author preferred to tune the F board next by comparison with the 'A' and thus listening to a major third interval. Again the values given for 'F' in Table 1 (last month) are tried first with modifications as necessary.

When the 'F' board seems satisfactory it is inserted into the module, and the 'C' board put into the test jig. The major chord F-A-C is easy to recognise and adjustments to both 'C' and 'F' (now in the module) can be made to give a satisfactory sound. 'A' should not be adjusted, but can be checked a number of times against the tuning fork in order to satisfy the constructor that he has tuned it correctly.

Using 'C' as the base, 'E' can now be tuned (major third) followed by 'G' in the major chord C-E-G.

Using 'G' as the base, 'B' can be tuned (major third) followed by 'D' in the major chord G-B-D, thus completing the white notes.

Two approaches are now possible to tune Eflat. Some would find evaluation of the F7 chord F-A-C-Eflat to be relatively easy, whilst others may prefer to use the major third B to Dsharp (Eflat)—that is using B as the root.

Bflat can be tuned from the major chord Eflat-G-Bflat.

A choice exists again to tune Aflat, either using the Bflat seventh chord Bflat-D-F-Aflat or the major third E-Gsharp (Aflat). The full major chord E-Gsharp-B can be used to make judgement easier.

Fsharp can be tuned using the major third interval D-Fsharp, with A completing the major chord.

Csharp can be tuned using the A major chord A-Csharp-E.

The cycle may need repeating a number of times, and other chords will probably produce some out of tune effects which small adjustments in tuning will bring into line. Tuning the piano should not be any more difficult than tuning a guitar, but it will take longer, and requires patience.

## FINAL ASSESSMENT

The piano can now be played, and an evaluation made by the constructor of the properties of his instrument. Probably the most important observation will be an assessment of the relative outputs

from each note on the keyboard using a constant playing action. If the constructor is dissatisfied he can adjust individual notes or complete pitch boards for increased or reduced output by variation of the resistors quoted in an earlier part of the series.

## USING THE PIANO

Whilst the accent in the early part of the series was on constructing an instrument to use in the home, the electronic piano has very great potential for use in modern groups or bands, particularly since the pitch of pianos normally present in private rooms in hotels is often very flat, which can cause very great difficulties for wind instrumentalists in the same band.

The piano can be connected directly to a public address or guitar amplifier thus offering the pianist power capabilities much higher than he has known before. In this connection it is important that very heavy duty speakers are always used when high amplification is involved.

The author uses an amplifier rated at 25 watts r.m.s. driving a speaker with a nominal rating of 50 watts (Fane POP-50). This has withstood a considerable amount of hard work with the piano and three microphones on the same system.

Rating of loudspeakers in this application can be very misleading, since music power is the important factor, and a 25 watt r.m.s. amplifier is capable of driving 50 watts of music power thus requiring a suitably rated loudspeaker.

## PLAYING THE PIANO

To close some comments are now made on the technique of playing the piano.

The normal switch setting when using the touch sensitive system is maximum attack. The other attack positions can be used to give a less percussive characteristic for variety.

It is vitally important that the use of the keyboard level control is fully understood. Five positions are offered, but position one must only be used for single note solos, since the power output in this position is the same as a five note chord in position two.

Considerable distortion will occur if this is ignored.

With position two selected, the volume control should be set to give the maximum required listening level. Selection of level for any particular passage is then controlled by the keyboard switch and the foot pedal. The volume control is not varied during a performance.

The natural tendency when trying to achieve greater attack on a piano is to hit the keys harder, up to a stage where great physical effort is involved. This tendency should be resisted on the electronic piano where as mentioned earlier the attack function is different.

It will be found after practice that the touch can be very light, leading in some cases to an easier playing technique, whilst retaining a range of expression. ★

**Note:** There are a number of resistor value corrections in Fig. 3.1. These are: R84 should be 100 k $\Omega$ , R85-R88, 56 k $\Omega$  (4 off) and R110, 270 $\Omega$ . Also, in Fig. 3.4, TR16 collector, base and emitter are labelled in reverse.

# CEEFAQX

## A PROPOSED NEW BROADCASTING SERVICE

IMAGINE sitting down in front of your television set, and at the touch of a switch seeing the latest news, up to the minute stockmarket prices or a list of the day's television programmes with a summary of each. Just a pipedream? Not any more, for the BBC has developed a system which can allow you to do just that, and demonstrations should be underway as early as the middle of 1973.

### THE CEEFAQX SYSTEM

The system is known as Ceefax and the form that it will take is shown in the photograph. Fig. 1 shows how the Ceefax system fits into the existing television transmission network. At the transmitting end it will mean incorporating a terminal into the broadcasting system so that the pages to be sent out are mixed with the normal picture signals. This will probably mean using the frame synchronisation pulses on which are superimposed the digital signals.

At the receiving end the user will have to purchase a storage and display unit which will probably have a storage capacity of up to 30 pages. The general block diagram of the terminal is shown in Fig. 2.

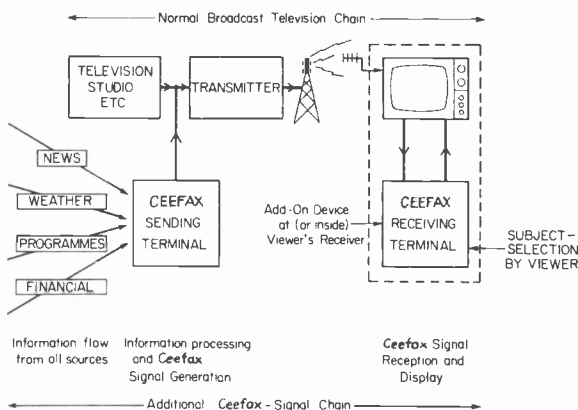


Fig. 1. The Ceefax programme material is injected into the normal television transmission in digital form

The user will type out whichever of the 30 pages he requires and it will immediately appear on the screen, in a teleprinter type format, either on a blank background or superimposed on the normal television picture.

### COST TO THE CONSUMER

The cost of the additional electronics to the domestic user will undoubtedly decrease as technology develops but it is estimated that in quantity production the cost will be approximately the same as a monochrome set or a tape recorder.

Any of the pages stored in the receiving unit can be updated in a matter of seconds, and some pages could be updated every few seconds to present information in book form or perhaps to provide subtitles for television programmes in foreign languages when we enter the Common Market.

### INFORMATION AVAILABLE

Examples of the information which can be transmitted using the Ceefax system are limitless but some of the more obvious are: specialised weather

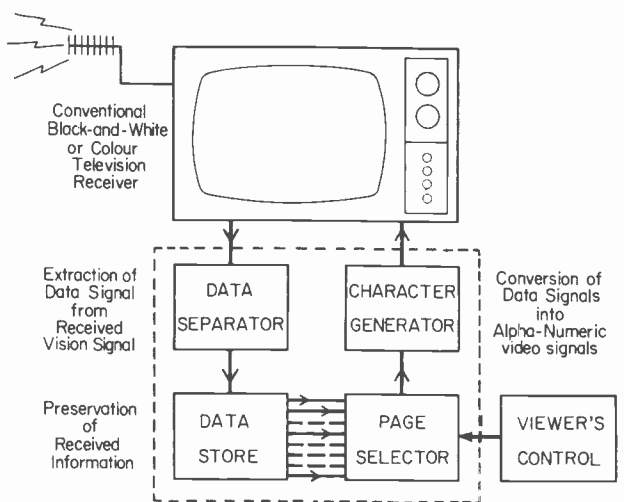


Fig. 2. The domestic receiver uses an add-on decoder and store ready for selected display on the screen

forecasts; a list of the day's television programmes with summaries; specialised programme news for the coming week; facts and figures relevant to current affairs programmes; public notices; up to the minute news (with the option of a flash service whereby important events are flashed onto the screen over the normal programmes), commercial news such as stockmarket prices; sports information; and entertainment in the form of recipes or crossword puzzles.

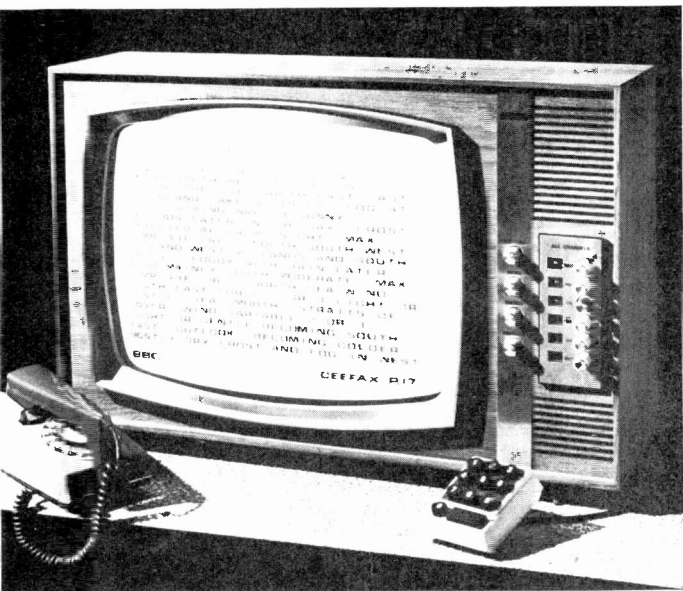
In the future it is hoped to co-ordinate Ceefax with the Post Office so that pages of information can be received over the normal telephone lines. This will bring the television set into the realms of the computer terminal and no doubt eventually personal facts stored in a computer, such as bank statements, will be at the fingertips of the user through the Ceefax system.

### OTHER POSSIBILITIES

There is also no reason why educational institutions should not use one of the available channels for passing information on to the students, in reply to queries made over the phone. The telephone system could also be useful for receiving telegrams and telex messages, there being no need for the recipient to be present when the message is sent.

Although the Ceefax system seems at first like a simple development it is one of those advances, like the introduction of the telephone system, which could have a profound effect upon all our lives as it brings centres of information within easy reach of everyone. It could easily mean the end of newspapers as we know them today for they would be unable to provide such an immediate source of news and would probably only serve to give deeper insight into the news.

The first trials will probably use equipment manufactured by the BBC, but industry will have the opportunity of producing Ceefax units for a public service operation.



# NEW from Goodmans for constructors

## Din 20 Kit

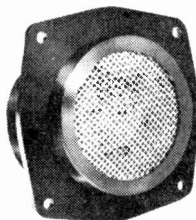
20 watt, high fidelity loudspeaker kit contains all parts necessary to complete the system, except timber and other material for the cabinet itself, with detailed, illustrated instructions.

**Specification:** 20 Watts DIN, 4 ohms impedance, 8 ins bass unit, dome HF radiator, crossover frequency 4,000 Hz.



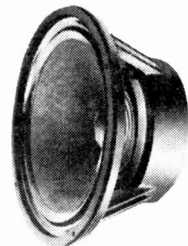
## Axent 100

Dome HF Radiator with integral crossover. Capable of high frequency sound reproduction with negligible distortion in systems rated up to 30 Watts DIN, this 'state of the art' drive unit has an integral crossover which cuts frequencies below 3kHz at a rate of 12dB/Octave.



## Audiom 100

12 inch high fidelity bass loudspeaker. For use as a bass unit in two-way systems, the sensitivity and high frequency roll-off of the Audiom 100 has been tailored to match the Axent 100.



# Goodmans

Sound reasoning.

THORN

A member of the Thorn Group

Please send Free leaflets on Constructors Equipment

Name .....

Address .....

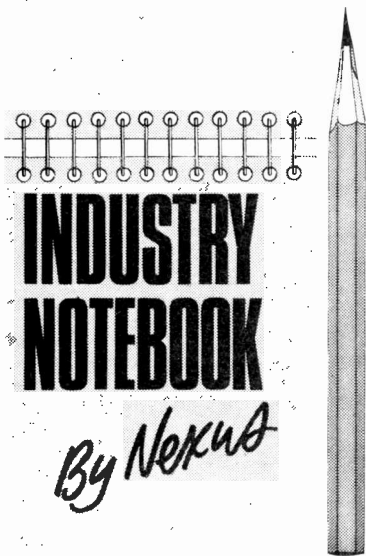
PE1

Goodmans Loudspeakers Ltd.,  
Downley Road, Havant, Hampshire PO9 2NL

## NEW BOSS AT MULLARD

Look out for the name Akerman. You'll hear a lot about him and a lot from him starting on January 1, 1973. For that's the date that Jack Akerman takes up his new role as managing director of Mullard Ltd. in succession to Dr. F. E. Jones who leaves to join the Board of Philips Industries Ltd.

Akerman is no newcomer to Mullard—he joined the company in 1936—but it is only in recent years that he has become prominent. Five years ago he moved into the higher echelons through his appointment to the Board of Associated Semiconductor Manufacturers Ltd., an associated company of Mullard. In 1969 he became head of Mullard's consumer electronics division and a year later, in 1970, he became commercial director and a member of the Mullard Board.



Dr. F. E. Jones came to wide public notice through the celebrated "Brain Drain" report which came out during the Wilson administration. But he was well known in the electronics industry long before that both as a brilliant engineer and businessman—a rare combination. He joined Mullard from the Royal Aircraft Establishment, Farnborough, where he was deputy director. After six years as technical director he became MD in 1962 so he has had a full ten years of the top job during which major expansion has been almost a routine.

Jack Akerman comes to the top job at an interesting time. Business is on the upturn and it is not only the consumer component side of Mullard business that is now doing well after the recession. Professional components are also booming and delivery times are lengthening.

## LED PRICE BATTLE

Last month I mentioned the bright outlook for optoelectronic devices. Since then I have met Mike Meltzer, in London for a few days representing Monsanto interests in light-emitting diodes and associated devices.

Monsanto announced price cuts of typically 30 per cent but in a few cases up to more than 40 per cent on standard product lines. Not to be outdone, Sperry announced in the U.S.A. cuts of up to 40 per cent on some of their devices and Litronix, another US company, has also joined in the price battle.

How far prices will tumble is anybody's guess but most companies in the LED business now believe that the time is ripe to go for a huge volume market. Monsanto's Meltzer told me that if pocket calculators fall again in price next year, as they are likely to do, then that one single market could generate a demand for 100 million digits a year.

A real enthusiast on his subject, Meltzer spoke of the untold millions of digits which will be needed for as yet untapped markets like cars and the telephone industry. One of Meltzer's forecasts is that by 1980 the LED industry will be as large as the whole semiconductor industry today. Nice work for the survivors after the price war has taken its toll.

## NEW FIELDS

Ever anxious to tap new markets, the industry is queuing up to get orders from oil companies. These new rigs scattered round the North Sea are becoming big business. Not so much a drilling platform, more a small town by the sound of things, and there are now over 40 of them all needing not only high grade communications systems but also beacons and other devices for bringing in helicopters as well as surface vessels.

One company, Marconi Marine is doing well supplying complete packaged radio stations including radio officers. Other companies tend to supply individual pieces of equipment.

## THE VALVE IS NOT DEAD

Biggest output in the U.K. of any single component group is still in the field of domestic receiving valves and tubes which are running at a rate of £60 million per year. Industrial valves and tubes are worth another £25 million per year. Despite the advent of solid state, valve and tube manufacturers are still doing excellent business.

If you think there is nothing new in the pipeline I suggest you

remember the initials CFA and FWI of which you may hear more in the next few years. CFA stand for Crossed Field Amplifier and FWI stands for Fast-Wave Interaction. CFA and FWI valves are reported under development at English Electric Valve Company.

The CFA combines the advantages of the magnetron and the travelling wave tube and could open up a new range of advanced radar systems. The FWI could open the way to much higher microwave power.

## PRODUCTION SHOW BREAKS RECORDS

The fifth Internecon Show at Brighton again broke all records. It concentrates almost entirely on packaging and production techniques for the electronics industry and is supported by a full-scale conference. This year it attracted over 14,500 visitors including a large number from overseas, some 1,000 of these having registered on the first day.

The Necon shows are popular world wide and are money spinners for the organiser as well as the exhibitors who seem so well pleased with results that they come back every year for more despite rising costs.

January sees the second Internecon held in Tokyo. Ten British companies will be exhibiting. Then next June, the organisers will be launching the first European edition in Brussels which will be called Internecon Europe 73. Sixty British companies are expected to be there as one of the national groups. This will be followed in October by the usual show in Brighton for which many of this year's exhibitors have already booked space.

## EXPANSION TARGET

Semicomps Ltd., the component distributors recently acquired by Simms Motor Division of Joseph Lucas, is embarking on a five-year plan to expand its business to £8 million a year turnover. Managing director Bill Richardson, founder of Semicomps, is confident that the new financial backing he now enjoys will ensure he attains his objective.

The big turnover will be achieved by setting up extra companies to give complete U.K. coverage. The parent company, based in the South East, already has a subsidiary in the North and another in Ireland. More will be set up and each will be expected to contribute £750,000 to £1 million turnover to the group total. First two areas to see new Semicomps companies will be the Midlands and Central Southern England.



## JUST PUBLISHED '73 AUDIO-TRONICS

The great new 1973 edition of Lasky's famous Audio-Tronics catalogue is now available—FREE on request. The 48 newspaper size pages—many in full colour—are packed with 1,000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast, Electronics hobbyist, Serviceman and Communicator's Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio Accessories, see the great new Lasky's Credit Plan Scheme—enabling you to buy your ideal choice of equipment on easy terms. Send your name and address and 15p for post and inclusion on our regular mailing list.

### LEAK TEAK CASES

Teak or Walnut case for Stereofonic tuner only.  
LIST PRICE **LASKY'S £2.50** C & P  
£7.30 PRICE 25p

Double case to hold Stereo 30 or Stereo 70 and Stereofonic tuner in Teak or Walnut.

LIST PRICE **LASKY'S £4.95** C & P  
£10.37 PRICE 35p

### LEAK TRUSPEED

2-speed 45 and 33 $\frac{1}{2}$  rpm belt drive turntable complete with plinth, cover and Shure cartridge.

LIST PRICE £69.50

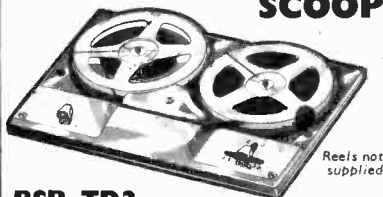
**LASKY'S £47.50** C & P  
PRICE £1.50

### SINCLAIR PHASE LOCK LOOP STEREO FM TUNER

Incorporates varicap diodes, printed circuit, coils, squelch circuit I.C. Decoder, etc., supplied completely built and tested and ready to be mounted into any cabinet you choose. It may be used with any High Fidelity Amplifier. Power requirements 25/30V DC.

LIST PRICE **LASKY'S £15.75** C & P  
£25.00 PRICE 25p

### BSR TAPE DECK SCOOP



Reels not supplied

### BSR TD2

FANTASTIC VALUE, ONLY Lasky's can offer you a tape deck at such an amazing price. The BSR TD2 tape deck operates by a simple reliable mechanism using the minimum of controls.

With  $\frac{1}{2}$  track mono heads. Incorporates fast wind and fast rewind, records at 3 $\frac{1}{2}$  ips. giving up to 3 hrs playing time, takes up to 5 $\frac{1}{2}$  in. spools. Size 13in. 8 $\frac{1}{2}$ in. front to rear, 2 $\frac{1}{2}$ in. below plate, 1 $\frac{1}{2}$ in. above plate.

ALSO SUITABLE FOR USE AS A TAPE TRANSPORTER

**LASKY'S £8.95** C & P 35p  
PRICE

### BELTEK C5700 8 TRACK

Stereo car Player  
Accepts all standard pre-recorded 8 track stereo cartridges. Features include automatic head cleaner, channel select and channel repeat push buttons, slider type volume and tone controls, channel balance. Output 5 watts per channel, frequency response 50Hz-10kHz. Output imp. 4 ohms, size 4 $\frac{1}{2}$ (W) x 1 $\frac{1}{2}$ (H) x 6 $\frac{1}{2}$ (D) in. Operates on 12V DC negative earth. Beautifully styled with black ivory and chrome trim.



**BELTEK C5700** complete with mounting brackets and 8 track pre-recorded demonstration cartridge.

**£21.00** C & P 30p

### BELTEK R5310 FM TUNING ADAPTOR

Matches the C5700, the ideal car stereo system.

**LASKY'S PRICE £18.95** C & P 25p

Add £3.75 to any BELTEK car player for pair of FANTAVOX KS701 car speakers.



**AKAI 4000D** illustrated

List Price £93.65

**AKAI 1720L**

List Price £87.36

**AKAI X1800SD**

List Price £162.79

**AKAI X200D**

List Price £157.93

**2 CSS-8 Speakers**

List Price £25.00 (pair)

**2 ADM 11/8 mics.** Suitable for use on all Akai tape recorders. List Price £11.90.

**Lasky's Price £15.95** C & P 50p

**Lasky's Price £7.50.** C & P 15p.

### AKAI TAPE RECORDER SCOOP!

(C & P 75p on all Tape Decks.)

**Lasky's Price £61.50**

**Lasky's Price £58.95**

**Lasky's Price £102.50**

**Lasky's Price £100.50**

## NEW WELLER MINI WORKSHOP KIT MODEL 600K

**LASKY'S PRICE £17.95** C & P 35p

Powered by a 25,000 rpm, 115V, 75A Universal motor. This small versatile, easy to handle, power tool is ideal for handymen, hobbyists and professionals. The wide selection of bits helps you grind, sharpen, drill, rout, cut, etc. Perfect for delicate work and hard to reach places. The complete MINI-WORKSHOP is housed in a strong plastic carrying case. For 240V a.c. mains operation.

**MODEL 600K** place Kit contains: ● Model 600 Power Unit ● Accessory Caddy ● 8 Grinding/Sharpening Bits ● 3 polishing Wheels ● 4 Cleaning Bits ● 8 Abrasive Discs ● 3 Abrasive Bands ● Expanding Drum ● Drill Bit ● Mandrell ● Chuck Wrench ● Dressing Stone ● Plastic polish ● Jewellers Rouge ● Complete with owners' manual ● Size of power unit only 7 $\frac{1}{2}$ in.

### LEAK SPEAKERS

150 Speakers (pair) ..... £39.90 C & P  
250 " " " " ..... £52.00 £2.50  
600 " " " " ..... £69.95

### DIGITAL CLOCK

EXCLUSIVELY FROM LASKY'S  
The clock measures 5 $\frac{1}{2}$ " (W) x 2 $\frac{1}{2}$ " (H) x 3" (D) (overall from front of drum to back of switch). SPEC: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions.



**NOW WITH ILLUMINATED DIAL COMPLETE WITH KNOBS**  
FEATURES: ● MAINS OPERATION ● 12-HOUR ALARM ● AUTO "SLEEP" SWITCH ● HOURS, MINUTES AND SECONDS READ-OFF ● FORWARD AND BACKWARD TIME ADJUSTMENT ● SILENT OPERATION ● SHOCK AND VIBRATION PROOF ● BUILT IN ALARM BUZZER

SPECIAL QUOTES **LASKY'S £6.50** C & P  
FOR QUANTITIES PRICE 25p

### BSR TD8S

8 TRACK STEREO CARTRIDGE PLAYER

The TD8S is suitable for use with most modern stereo amplifiers and delivers a pre-amp output of 125mW. Power requirements: 210/250V A.C. 50Hz. Frequency response: 50Hz-10KHz. 4 pole dynamically balanced synchronous motor. Black and woodgrain plastic cabinet. Size: 8 $\frac{1}{2}$ (W) x 3 $\frac{1}{2}$ (H) x 10 $\frac{1}{2}$ (D) in.



LIST PRICE £24.20 **LASKY'S PRICE £17.50**

### Garrard Record Players

SP25 Mk. III  
Deck Only



SP25 Mk III ..... £10.85  
AP76 ..... £18.85  
SL95B ..... £32.50  
SL95B on base with 9TA cart. .... £44.00  
SL72B ..... £23.95  
401 ..... £28.95  
40B ..... £9.50  
2025TC with stereo 9TA cart. .... £7.95  
Zero 100 ..... £39.95  
Zero 100S ..... £37.50

### NEW RECORD PLAYER MODULES

These new "Module" systems from Garrard and Lasky's enable you to buy your record player complete with attractive wood plinth, tinted acrylic dust cover and high quality compatible stereo magnetic cartridge — together offering optimum performance and appearance.

#### GARRARD MODULES

Garrard SP25 Mk. III turntable with Shure M75/6 cartridge ..... £23.95  
Garrard AP76 turntable with Shure M75/6 cartridge ..... £33.95  
Garrard AP96 turntable (single play version of SL95B) ..... £38.75  
Garrard Zero 100S turntable with Shure M93/E cartridge ..... £52.75  
C. & P. 75p.

#### LASKY MODULES

Lasky's (Garrard) SP25 Mk. III turntable with Goldring G800 cartridge ..... £20.50  
Lasky's (Garrard) AP76 turntable with Goldring G800 cartridge ..... £30.50  
Lasky's (Goldring) GL75 turntable with Goldring G800 cartridge ..... £45.00  
Lasky's (Goldring) GL75 turntable with Goldring G800/e cartridge ..... £49.50  
C. & P. 75p.

# Lasky's

MAIL ORDERS AND CORRESPONDENCE  
3-15 CAVELL STREET  
LONDON E1 2BN 01-790 4821

West End and City Branches

42-45 TOTTENHAM CT. RD., LONDON, W.1 Tel: 01- 636 0845

207 EDGWARE ROAD, LONDON, W.2. Tel: 01-723 3271

33 TOTTENHAM CT. RD., LONDON, W.1. Tel: 01-536 2605

Open all day 9a.m. - 6p.m. Monday to Saturday.

109 FLEET STREET, LONDON, E.C.4 Tel: 01-353 5812

Open all day Thursday, early closing 1p.m. Saturday



# Designing with Integrated Circuits

BY A. FOORD

## Schmitt Trigger

4

In many applications it is necessary to drive TTL circuits from a non-TTL input. How this may be achieved will depend on the input signal, but one possible arrangement is shown in Fig. 4.1. This is suitable for many input waveforms and there is no danger of the logic level for the integrated circuit being exceeded.

When the transistor is turned on its collector is pulled down to the logical 0 level for the gate, producing a 1 at the output. This circuit can be used where the rise and fall times of the input are faster than  $1\mu\text{s}$ . Unfortunately when high speed gates are driven directly by input signals which have a slow rise or fall time it is possible for oscillations to occur while the input signal passes through the linear region of the input/output characteristic.

The gate acts as a linear amplifier with a high gain, and various feed back paths exist which contribute to instability and consequent false outputs.

One solution for slow rise time inputs is to use a Schmitt trigger. The basic Schmitt trigger has a positive feedback arrangement which introduces hysteresis to the input/output characteristic, and its snap action prevents oscillation.

### SCHMITT TRIGGER USING GATES

A Schmitt trigger can be constructed by using gates as in Fig. 4.2, but this circuit is not temperature stable, needs to be driven from a low impedance source, and requires discrete components.

### THE SN7413

The SN7413 consists of two identical Schmitt trigger circuits, similar to the usual transistor arrangement. Each functions as a four input NAND gate with different input threshold levels for positive and negative going signals. This hysteresis is typically 800mV. The SN7413 is fully compatible with the other TTL circuits in the range.

Propagation delay from input to output is typically 16ns. The package details and parameters are shown in Table 4.1. It has built-in temperature compensation to maintain high stability of the threshold levels

**HYSTERISIS** Having a different switching threshold for increasing and decreasing signals.

**INTERFACE** A circuit or "black box" which joins dissimilar systems.

Table 4.1. Package details and parameters for the SN7413N Schmitt trigger (looking at top)

Supply voltage (nominal)	5V
Fan-out from each output	10
Positive going threshold	1.7V
Negative going threshold	0.9V
Hysteresis	0.8V
Logical 1 output	3.3V
Logical 0 output (max)	0.4V

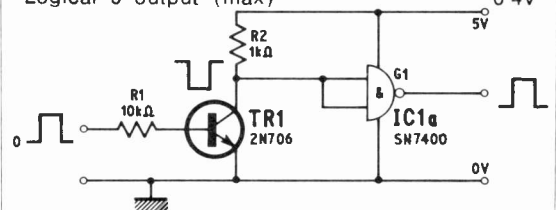


Fig. 4.1. One arrangement for driving logic from a non-TTL source

and can be triggered from the slowest of input waveforms and still give a jitter-free output.

### PULSE SHAPER

The SN7413 can be used as a pulse shaper interface between slow waveforms and fast TTL circuits as shown in Fig. 4.3a and b.

### SINE TO SQUARE WAVE CONVERSION

This is perhaps one of the simplest applications of the Schmitt trigger, and is shown in Fig. 4.4. The input of the circuit is biased midway between the upper and lower threshold points by R1 and R2 which gives a 50 per cent output duty cycle for sinusoidal inputs. The circuit can also be operated in a self biased mode, Fig. 4.5. These circuits can be used up to 5MHz or more.

Although the input impedance is not high these circuits can usually be driven directly from an oscillator; care should be taken that the input logic levels are not exceeded.

### R-C MULTIVIBRATOR

The circuit of Fig. 4.6 can be used over a wide frequency range for experimental work with TTL circuits, and makes a reliable oscillator from 1Hz to 1MHz by selection of the capacitor value. Suppose that initially the capacitor is discharged and the output is at logical 1. The capacitor then charges towards  $V_{cc}$  through resistor R1 until the upper threshold voltage is reached. The output then changes to a logical 0 and the capacitor discharges through R1 to the lower threshold voltage, and the cycle repeats.

The duty cycle is 2 : 1 rather than 1 : 1 because the internal 4 kilohms resistor on the base of the input multi-emitter transistor acts as a current source. The capacitor required for a given frequency is best found empirically, typical values are shown in Fig. 4.7. This circuit only has a fan-out of two and should be buffered by the other Schmitt trigger in the package or by a SN7400 if a larger fan-out is required.

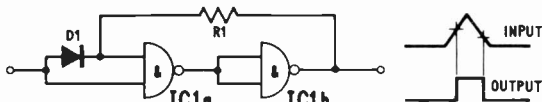


Fig. 4.2. A Schmitt trigger using gates and discrete components

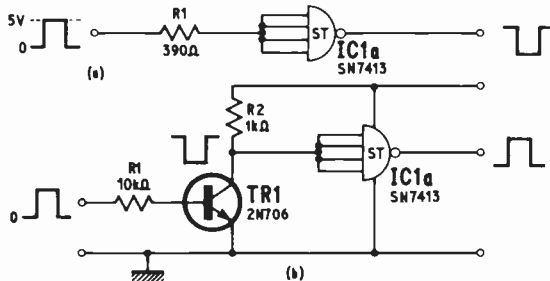


Fig. 4.3. Arrangements using the SN7413 for driving logic from a non-TTL source

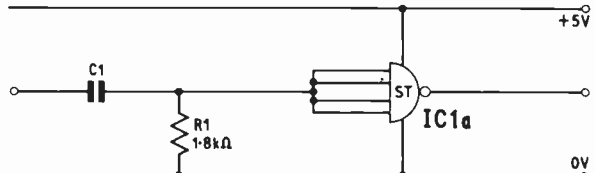


Fig. 4.5. Sine to square wave conversion using the SN7413 in a self biased mode

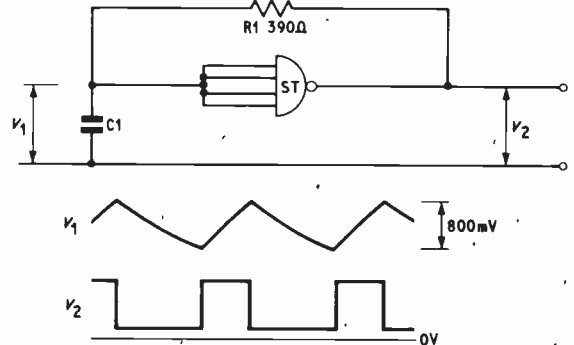


Fig. 4.6. The SN7413 as a multivibrator

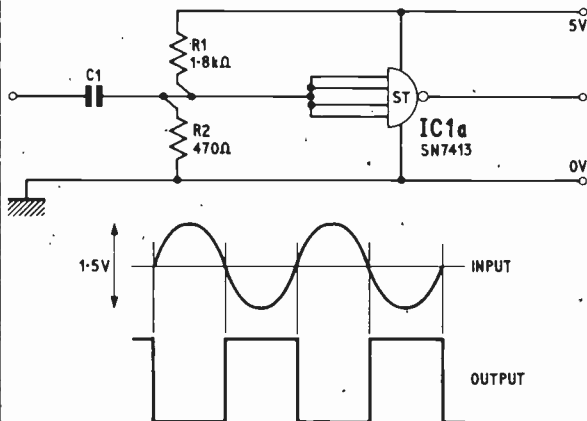


Fig. 4.4. Sine to square wave conversion using the SN7413

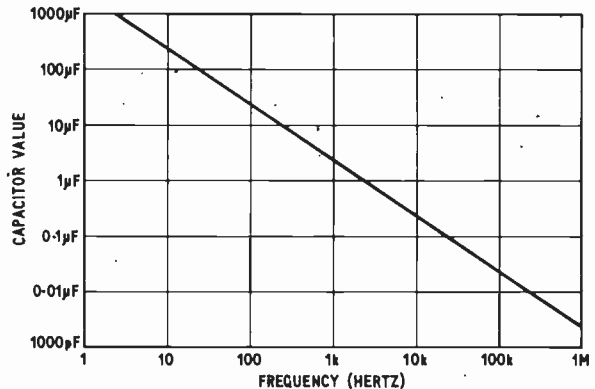


Fig. 4.7. The capacitor values required for various frequencies of oscillation in Fig. 4.6

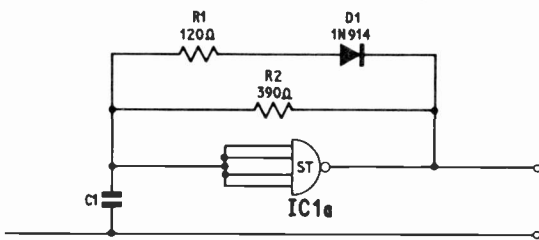


Fig. 4.8. The circuit in Fig. 4.6 modified for an approximately 1 : 1 mark to space ratio

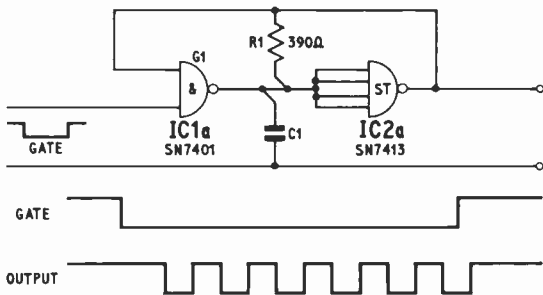


Fig. 4.9. The SN7413 used as a gated multi-vibrator

The circuit can be modified for an approximate 1 : 1 mark to space ratio as in Fig. 4.8, but the best way to obtain an exact 1 : 1 mark to space ratio is to generate twice the required frequency and divide by two.

### GATED OSCILLATOR

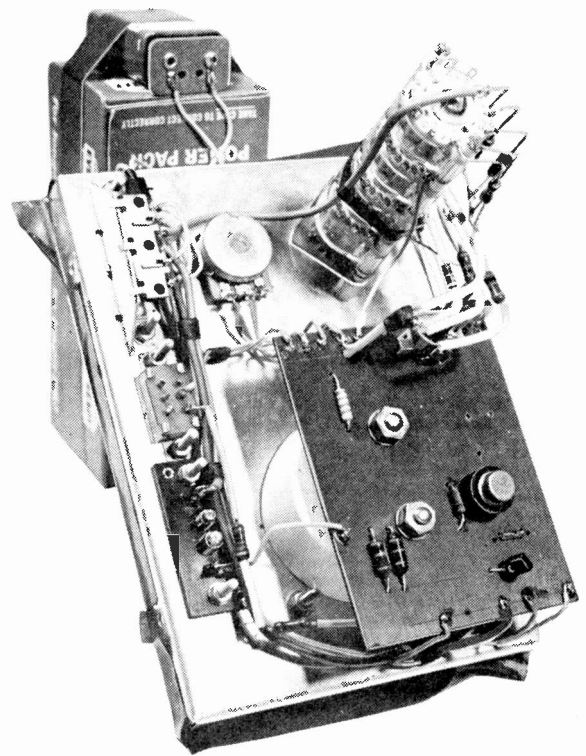
The basic multivibrator can be gated by adding an SN7401 open collector NAND gate, Fig. 4.9. The feedback path from the output of the SN7413 to the input of the SN7401 prevents the gate signal from acting until the output of SN7413 is at a logical 1, so that the oscillator will always produce a complete number of cycles.

When the oscillator is released the capacitor has to charge up from ground to the upper threshold level of the Schmitt trigger, so that there is a delay between the negative going edge of the start pulse and the beginning of the output pulse train. This delay is very approximately 0.7 of the total period of oscillation.

### CONCLUSION

This article has shown several applications of the SN7413 Schmitt trigger, but it is especially useful as a straightforward wide range oscillator for future experiments.

**Next month: Operational amplifiers with power stages**



Underside of ohmmeter control panel. Note the strapped battery pack assembly

### CONSTRUCTION

The case is made from 22 s.w.g. aluminium and cut out as shown in Fig. 3. The front panel is cut out and drilled from 20 s.w.g. aluminium sheet.

A piece of paxolin, 2½in by 3½in is drilled according to Fig. 4. Wiring pins should be added to the board's extremities as seen in Fig. 5 and components assembled and inter-wired according to the dotted lines.

All control panel components should now be mounted, which includes the wafer switch assembly S2.

The component board is bolted onto the meter terminals and connections from these to the appropriate board pins made. Final wiring should be carried out according to Fig. 5.

To make up the power supplies a battery pack consisting of one 9V and two 6V batteries are strapped together (see photograph) and housed in the case.

### SETTING UP

The resistance settings of VR1, VR2 and VR3 to give the required current generator outputs are approximately 900Ω, 9kΩ and 90kΩ respectively. These may be roughly set before switching on. Fine adjustment may then be carried out with the instrument on, to give full scale deflection.

The output should, of course, be perfectly linear but this may be checked by testing with some high accuracy resistors.



# PATENTS REVIEW...

## LIFE TESTING

The not particularly cheerful but daily more pressing question of a definite test for life applicable to medical transplant techniques is raised by E. Roy John of New York in BP 1 257 114. Obviously the need for a definitive "absence of life" test is crucial in transplant surgery. If removal of the transplant organ is delayed unnecessarily, the organ will be useless. If the organ is removed too early, the doctor will be acting immorally and illegally.

The original test for life was the existence of breath and heartbeat, but this is clearly outdated. Attempts are being made to use electroencephalograph and electrocardiograph readouts for sensing brain and heart activity respectively. But amplifier noise can be mistaken for brain activity—or more important, it may be mistakenly assumed that what is in fact brain activity, is simply amplifier noise.

The most recent technique is to stimulate the brain and detect response; but to avoid false results, due to areas of the brain being damaged, three of the major sensory systems have to be tested. All this can become very time consuming and time is of the essence in transplant surgery.

The patent suggests using digital and analogue systems for evaluating the EEG and ECG readouts after visual, auditory and somatic stimuli. To this end a graphic recorder is used which has at least three recording channels. An EEG has its input electrode connected to the patient and its output con-

nected to the first of these channels. An ECG has its input electrode connected to the patient and its output connected to the second of the channels.

Finally, a data averaging device has its input connected to the outputs of both the EEG and ECG and its output connected to the third channel of the graphic recorder.

By using data averaging techniques a response signal can be separated from noise even though visual inspection of the "raw" readouts from the EEG and ECG will show no signs of response to stimulus. Brain response to a flashing light may, for instance, be indistinguishable when viewed on an oscilloscope but will be revealed by an average response computer. So by applying this average response data to the graphic recorder in addition to the "raw" readouts from the EEG and ECG, the doctor will be in a far better position to make a positive decision without delay.

## SOUND RESPONSIVE CIRCUIT

ARRANGING for electric lights to be illuminated in response to the presence of sound above a selected threshold level can be useful in many areas. The sounding of telephone or doorbells can be detected (e.g., when the user is deaf or has hi-fi headphones on); and burglar alarm systems can be devised which rely on noise detection.

In BP 1 279 335 Novar Electronics Corporation of Ohio, USA, also suggest that audio actuated

## BP 1 279 335

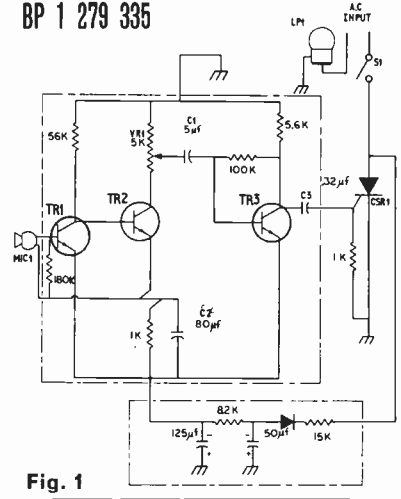


Fig. 1

light can help the deaf learn to speak.

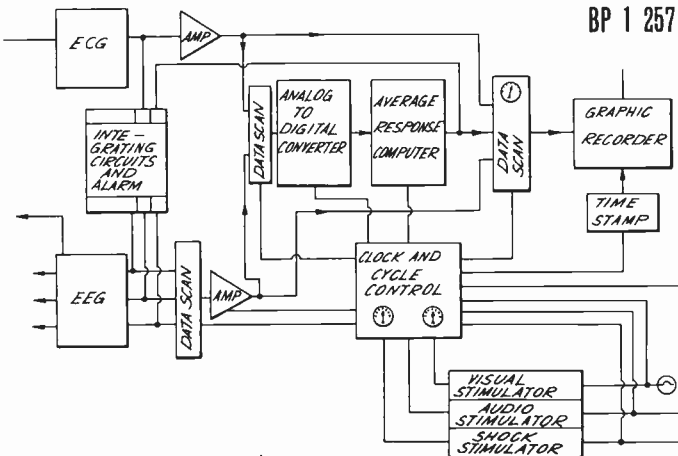
Their proposed basic circuitry is fairly simple and is shown in Fig. 1 above. An a.c. source is connected to the input terminals. The anode and cathode terminals of CSR1, being in series with the lamp and the power supply thus operate as a switch to block or pass current to the lamp.

The microphone picks up sounds, converts them into an audio output which is amplified and impressed on the gate electrode of CSR1.

In one possible circuit the first stage amplifier transistor TR1 is coupled to TR2 with its load resistor being the track of the 5K control VR1. The wiper of VR1 is coupled via a 5µF capacitor C1 to a third amplifier transistor TR3, the latter being coupled to the thyristor gate via the 32µF capacitor.

In the absence of sound at the microphone no trigger signal is present at CSR1 gate and the lamp LP1 stays off. But any signal from the microphone is amplified and if the peaks at gate are greater than the gate firing voltage, the lamp will be illuminated during that part of each half cycle of the a.c. source in which the anode and cathode terminals of the CSR are forward biased.

The potentiometer VR1 of course, controls sensitivity, and thus can effectively decide between either continual illumination or flickering during speech as well as basic sensitivity to telephone bells.



## BP 1 257 114

THE subject of this month's article is the clock generator board which has the function of generating a range of timing pulses for use throughout the arithmetic operations. A single capacitor is used to control the speed at which the whole system operates and this fact means that by running the system at slow speed, faults become relatively easy to trace.

### CLOCK BOARD

The circuit and logic of the clock pulse generating board is more interesting than, say, the shift register boards because of the diversity of the logic operations performed. The tasks which this circuit is called upon to carry out are listed below:

- (a) Generate batches of ten clock pulses for the A, Z, and AD boards when instructed to do so by the programme. During addition or subtraction a single batch is required whereas during multiplication or division batches are produced continuously until detection logic decides that the arithmetic operation has been completed.
- (b) Generate a single batch of  $n$  (or  $10-n$ ) clock pulses when instructed to do so at the beginning of the MULTIPLICATION programme and the end of the DIVISION programme respectively to clock the A, Z, and AD boards. These clock pulses are used for decimal point positioning purposes, where  $n$  is less than ten and is determined by the setting of the decimal point thumbwheel.
- (c) Provide an ungated clock pulse output to operate the programme counter and the ENTRY register normalisation system.
- (d) Generate a single output pulse for every batch of ten clock pulses produced so that the number of batches can be counted during the MULTIPLICATION and DIVISION programmes. This pulse to be generated *during* the batch generation time, to offset propagation delay problems.
- (e) Generate a single output pulse at the *end* of each batch of clock pulses for use with the OVERFLOW detection logic.
- (f) Generate an output to restart the programme sequence at the end of the series of additions or subtractions carried out during multiplication and division.
- (g) Provide an isolated buffering circuit for the large load represented by the A board PRESET input. (This buffer is not connected with any of the other clock circuits.)

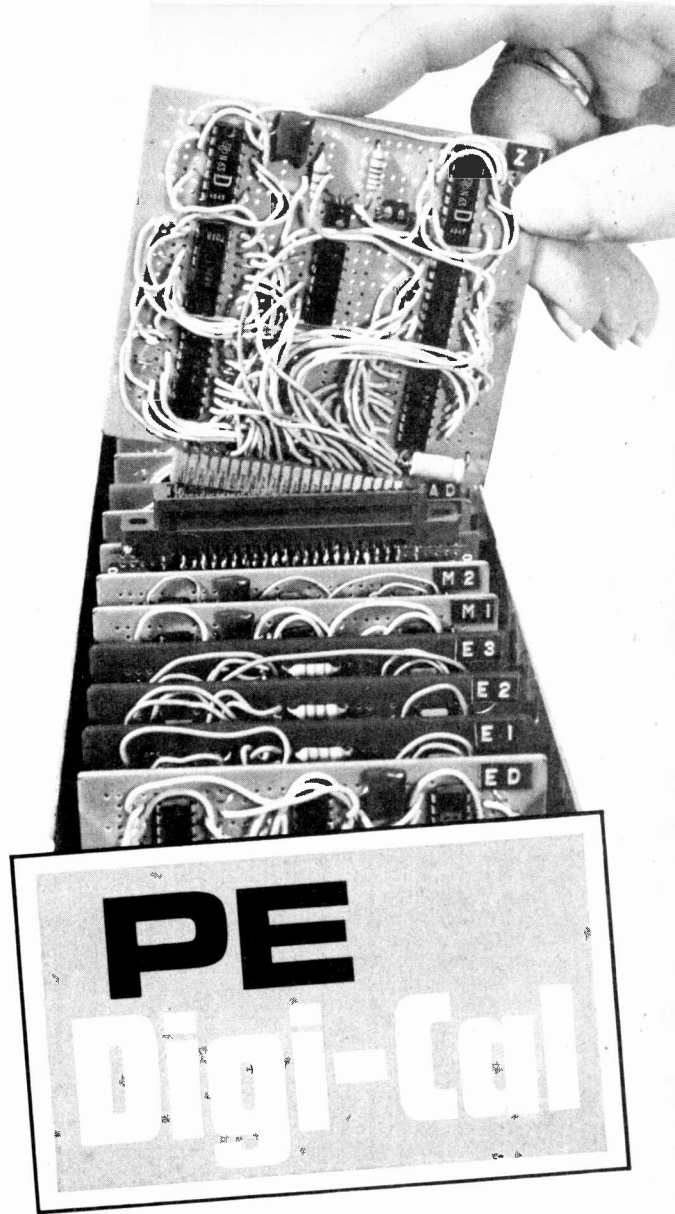
### BASIC CIRCUIT

The heart of the CLOCK board is the circuit which produces a batch of ten pulses on demand, all other requirements being met by modification of this basic logic arrangement, which is shown in Fig. 7.1.

The "clock" shown in Fig. 7.1 is simply a square wave oscillator, and this is used to trigger a four-stage, decade counter via a single gate.

The counter will register each of the clock pulses until the tenth one sets the decade counter back to the 0000 state.

This event is detected by the output of the D counter stage falling, and is used to clock a D type flip-flop which has its data input (D) connected to a level "1" gate output (STOP CLOCK signal). When



## By R.W. COLES PART 7 CLOCK GENERATOR BOARD

the counter clocks the flip-flop in this way the STOP clock input causes the flip-flop Q output to go to a "1" level and its  $\bar{Q}$  output to go to a "0" level.

The "0" level output from the  $\bar{Q}$  side of the flip-flop is connected back to the gate in series with the clock input to the counter, and has the effect of preventing any further pulses from getting through to the trigger input.

If at some future time another batch of ten pulses is required, the flip-flop can be reset via its CLEAR input, whereupon the sequence is repeated.

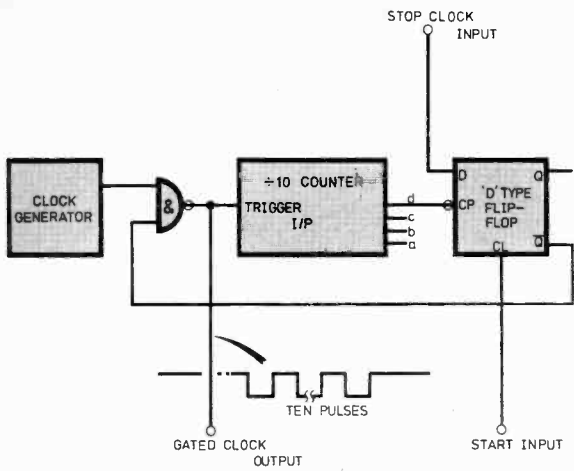


Fig. 7.1. This diagram shows the heart of the clock generator board

If more than one batch of ten pulses is required the STOP CLOCK input can be left in the "0" state so that when the flip-flop is clocked at the end of ten pulses, its  $\bar{Q}$  output remains in the "1" state.

When sufficient batches have been produced the STOP CLOCK input can be taken to the "1" condition so that at the end of the next batch the clock is shut off.

Note that with this system no matter how long the clock is allowed to run before being stopped the total number of clock pulses produced will always be divisible by ten, and this is obviously essential for the correct operation of Digi-Cal.

If a smaller number of clock pulses were produced during any batch, the answer produced would be in error by one or more powers of ten.

### FULL CIRCUIT

The full clock circuit is shown in Fig. 7.2 and as can be seen a considerable amount of extra gating has been added to modify the basic circuit to enable it to perform all the tasks listed earlier. To make

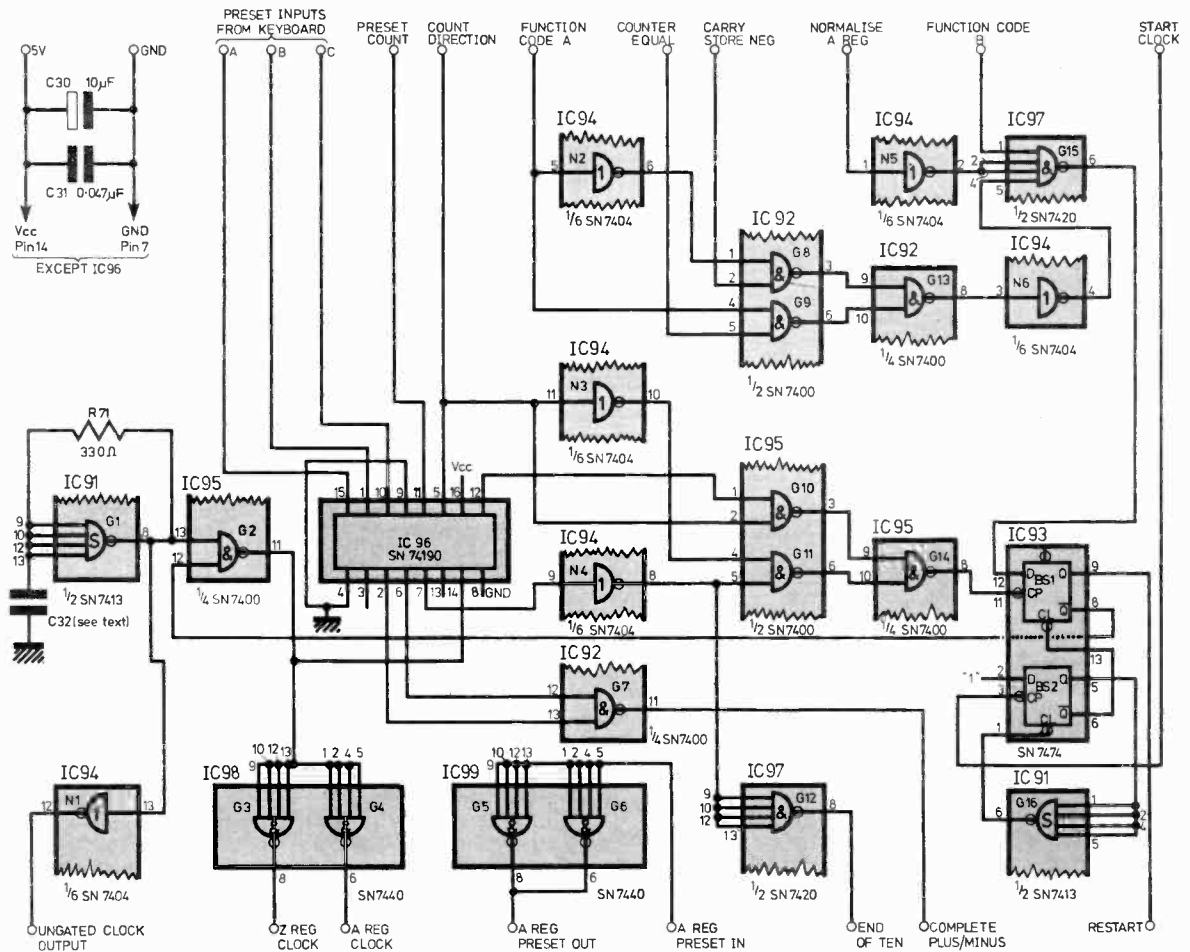


Fig. 7.2. The full circuit diagram of the clock generator board



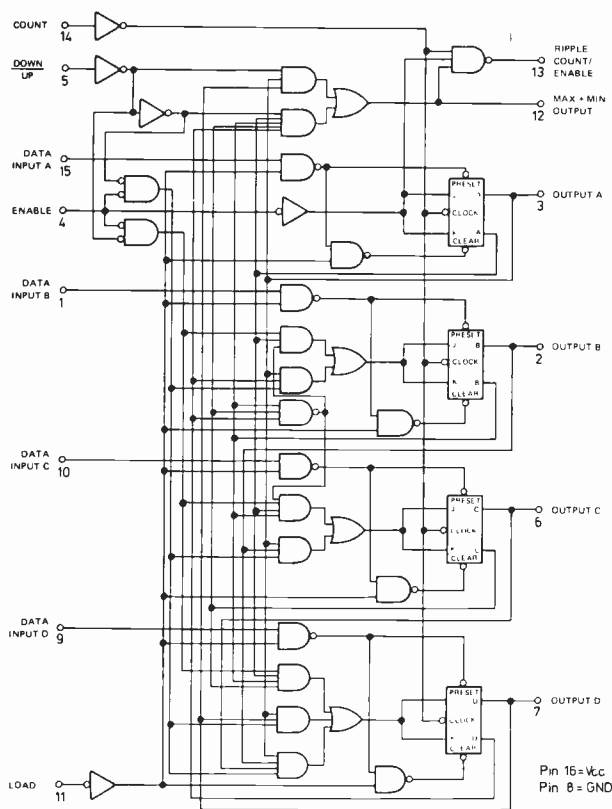


Fig. 7.3. The internal logic of the SN74190 reversible counter with pin numbers of the D.I.L. package

the circuit easier to follow, the gates have not been rigidly constrained within a square box as they have been in previous circuits. That kind of approach can make the whole thing look more complicated than it really is where a lot of gating logic is employed.

### UP/DOWN COUNTER

The decade counter used on this board is not the ubiquitous SN7490 as may be expected, because although this type of counter would perform satisfactorily in the basic circuit already discussed, it could not be modified to allow it to carry out task (b).

The counter chosen is in fact the SN74190 which incorporates several extra facilities including the ability to count down as well as up, and the provision of parallel data inputs which allow the starting count to be preset to any b.c.d. number from zero to nine.

The logic diagram of this counter is shown in Fig. 7.3 and a glance at this will serve to confirm that being able to buy one of these in a 16 pin package saves a lot of time and money over having to construct such a circuit from separate gates and flip-flops!

Note that apart from the usual clock input and data outputs, there are parallel data inputs and a wide variety of control inputs and outputs whose functions are listed as follows.

- DOWN/UP** Decides count direction (i.e. 0 to 0 or 9 to 0)
- ENABLE** Allows counting to take place (not required in Digi-Cal)
- LOAD** Presets the counter to the condition on the DATA INPUTS
- MAX/MIN** Goes to a logic "1" if the counter contains 9 and is counting UP, or 0 and is counting DOWN
- RIPPLE COUNT ENABLE** Output used for cascading SN74190 (not required in Digi-Cal)

### CLOCK OSCILLATOR

The clock oscillator is very simple and takes advantage of the useful properties of the SN7413 dual, four input, Schmitt trigger gate. The gates in this package have regenerative feedback applied so that they can be operated from slowly changing d.c. inputs without any spurious oscillations being produced as can sometimes occur with the standard TTL gate circuit.

The hysteresis embodied in the input characteristic of the SN7413 makes it ideal for use as a free-running multivibrator for use between 1Hz and 30MHz.

The only components required to form such a multivibrator, in addition to one of the gates in an SN7413 package, are a 330 ohm resistor and a capacitor of suitable value to set the frequency to the required range.

When Digi-Cal is completed the clock frequency will be left set to one value, but during the testing phase it is handy to be able to alter the frequency to a much lower value so that things happen more slowly.

To assist constructors in the choice of capacitor for low frequency operation, Fig. 7.4 shows a graph for reading frequency against capacitor value.

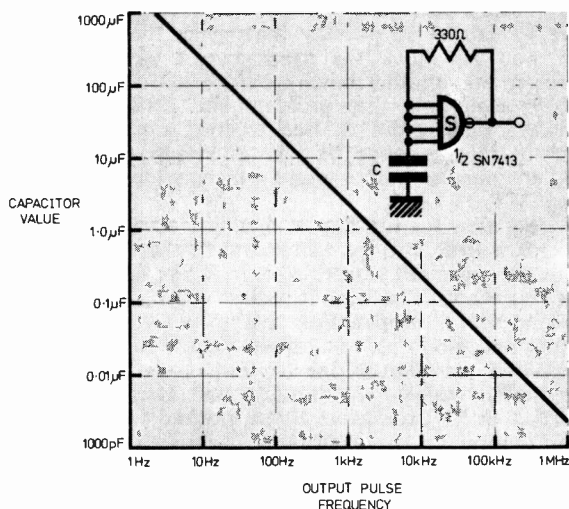


Fig. 7.4. This graph shows the relationship between the clock frequency and the value of the timing capacitor

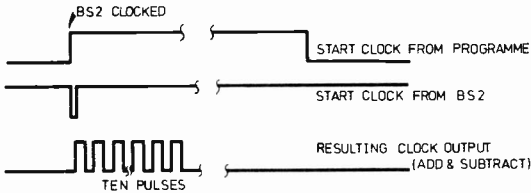
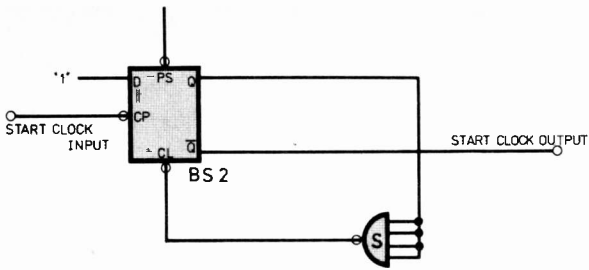


Fig. 7.5. Detail of Fig. 7.2 showing the flip-flop and Schmitt gate used to generate a narrow pulse

## COUNTER OPERATION

Using the output of the counter to clock the D-type latch flip-flop is complicated in the full circuit by the need to use different clock stimuli depending on the count direction. This is taken care of by gates G10, G11, G14 and inverters N3, N4 which, depending on the state of the UP/DOWN control line select either the D output or the MAX/MIN output of the counter to feed the SN7474 clock input.

The operation of the counter when generating batches of ten clock pulses is the same as that of the basic circuit, but some extra logic is necessary to start the sequence.

The START CLOCK command arrives as a long pulse from the programme circuits, and because of its length it cannot be used directly to clear BS1. If it was used for this purpose it would start the clock generation satisfactorily, but the ten clock pulses are generated so quickly that when the time came to stop the clock the START CLOCK would still be present and another batch would begin.

To overcome this problem the necessarily long START CLOCK pulse is used to trigger a monostable circuit in the shape of BS2 and G16, which gives a very narrow output pulse which is ideal for clearing BS1.

The use of a flip-flop and a gate as a monostable seems a little strange and to make the operation of this arrangement a little clearer it has been redrawn as Fig. 7.5. The circuit relies upon the normally troublesome "propagation delays" associated with all gates and flip-flops, to allow its operation.

When the rising edge of the START CLOCK pulse arrives it triggers the flip-flop and causes the open circuit or "1" condition to be clocked through from the D input to the Q output. The rising Q output is then used to operate the flip-flop CLEAR input via the SN7413 gate which acts as an inverter and a delay element.

When the flip-flop is cleared the circuit returns to its starting condition, ready to be retriggered in the future. The output pulse width (which could be

taken from either the Q or the  $\bar{Q}$  output) is dependent on the delay in the gate and the delay between a CLEAR input and a corresponding output (this varies from device to device), but gives a pulse of about 30 to 40 ns in practice.

## STOP CLOCK INPUTS

The logic decision whether or not to allow the STOP CLOCK input to BS1 to go to a "1" level is a function of five board inputs, and depends on the arithmetic operation in progress.

The logic producing the STOP CLOCK signal comprises gates G8, G9, G13, G15, and inverters N2, N5, N6. The FUNCTION CODE B input (which is a "0" level during ADDITION and SUBTRACTION) and the NORMALISE A REGISTER input (which is a "0" level during the MULTIPLICATION and DIVISION decimal point positioning period) have a direct effect and stop the clock at the end of one batch of pulses.

The COUNTER EQUAL input (which is the basic STOP signal during MULTIPLICATION) and the CARRY STORE NEGATIVE input (which is the basic STOP signal during DIVISION) are allowed to stop the clock when sufficient batches of ten pulses have been produced, and are selected according to the programme used, by the FUNCTION CODE A input. This input is a "0" level for MULTIPLY and a "1" level for DIVIDE.

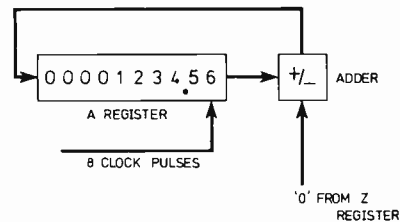


Fig. 7.6. This diagram shows the basic A register and adder sections to illustrate how virtual left shifts are managed

## NORMALISATION

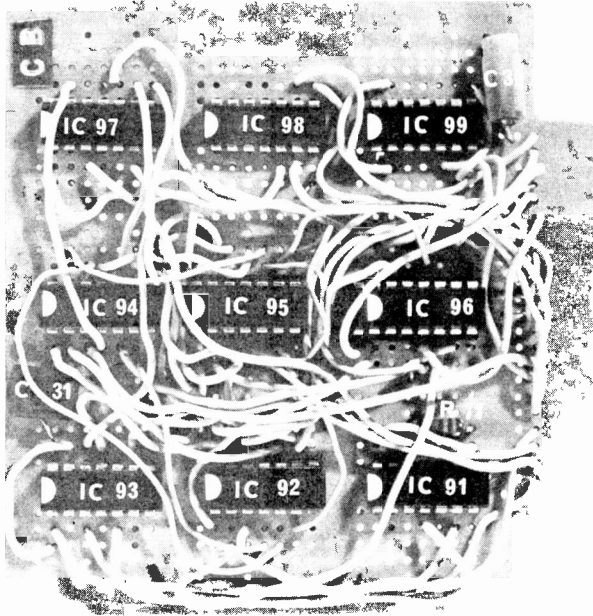
The arithmetic section of Digi-Cal does not take account of decimal fractions directly, and treats all numbers as integers. Thus, 2.5 times 2.0 is treated as 25 times 20, giving an answer of 500 which, when displayed, appears as 50.0, instead of 5.0 as required.

The answer reached in this way obviously needs correction, and this is achieved by shifting it to the right by the number of decimal places selected on the thumbwheel. This part of the programme sequence is called NORMALISATION, and is achieved in a different way during DIVISION.

Division of 2.5 by 0.5 leads to an initial answer of 0.5, which suggests a left shift of one place is required, but in practice it is necessary to left shift not the ANSWER, but the DIVIDEND, before the arithmetic process starts. In this way, 2.5 divided by 0.5 becomes 25.0 divided by 0.5, which gives the correct answer of 5.0 without correction.

Left and right shifts such as those described above obviously require a batch of less than ten clock pulses, and this is where the PRESET inputs of the SN74190 are used to advantage. Before looking at

# CLOCK GENERATOR BOARD



Z CLOCK	23
SWITCH CODE	{ C 24
	{ B 25
	{ A 26
PRESET CNT	27
CNT DIR'N	28
FUNCTION A	29
CARRY STORE NEG	30
CNT EQUAL	31
FUNCTION B	32
GND	33
+5V	34
END OF TEN	35
spare	36
NORM A REG	37
A REG PRESET (OUT)	38
A REG PRESET (IN)	39
A REG CLOCK	40
ADD/SUB COMPLETE	41
RESTART	42
UNGATED CLOCK	43
START CLOCK	44

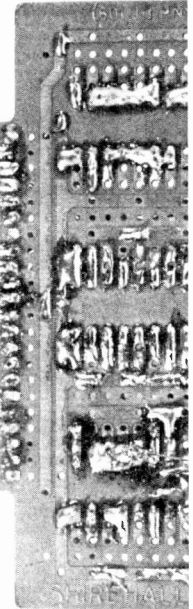


Fig. 7.7. Layout of the components on the clock generator board and function of the edge contacts. Also shown is the wiring details of the edge connector (below left)

## COMPONENTS . . .

### CLOCK GENERATOR BOARD

#### Resistors

R71 330Ω ¼W ±10% carbon

#### Capacitors

C30 10μF 15V elect.

C31 0.047μF

C32 see text

#### Integrated Circuits

IC91 SN7413

IC92 SN7400

IC93 SN7474

IC94 SN7404

IC95 SN7400

IC96 SN74190

IC97 SN7420

IC98, IC99 SN7440 (2 off)

#### Printed Circuit Board

Type DL109/22 (Shirehall)

1	23	Z1/21, Z2/21
2	24	C
3	25	B
4	26	A
5	27	P'SET CNT (fr prog)
6	28	CNT DIR'N (fr prog)
7	29	FUNC CODE A (fr kbd)
8	30	AD/36
9	31	M1/17
10	32	FUNC CODE B (fr kbd)
11	33	GND
12	34	+5V
13	35	TO O'FLOW LOGIC
14	36	not used
15	37	NORM A REG (fr prog)
16	38	A1/43, A2/43
17	39	P'SET A REG (fr prog)
18	40	A1/40, A2/40
19	41	M1/22
20	42	RESTART (to kbd)
21	43	UNGATED CLK (to prog)
22	44	START CLK (fr prog)

○  
CB

the generation of these shortened batches, it is necessary to look at just how the normally right-shifting A register is made to shift left.

## VIRTUAL LEFT SHIFTS

The way in which left shifts are achieved is best studied with the aid of Fig. 7.6 which shows the basic Digi-Cal A REGISTER and ADDER.

The requirement is to shift the number 1234.56 two places to the left, because DIVISION is in progress and the thumbwheel is set to two.

To turn the A REGISTER into a bi-directional type at the hardware level would require considerable numbers of extra gates, not to mention the preclusion of the use of SN7496 devices, and for this reason any such move is undesirable.

Fortunately, by employing what amounts to a programming "dodge" it is possible to turn a hardware right shift into a virtual left shift, and this is achieved by clocking the register with 10 minus  $n$  pulses.

By applying only eight pulses to the register in Fig. 7.6, and by leaving the output of the ADDER unmodified by the Z REGISTER input, the A data recirculates until it ends up as 123456.00.

This system relies on the fact that there are at least  $n$  zeros to the left of the number to be shifted, and provides one reason why the A and Z registers are ten digits long.

## GENERATING LESS THAN TEN CLOCK PULSES

To generate the  $n$  pulses needed during the MULTIPLICATION NORMALISATION the counter PRESET COUNT input is taken to a "0" level which loads the true thumbwheel code into the SN74190, e.g. DCBA equals 0011 for a setting of three.

Next, the COUNT DIRECTION input is taken to a "1" level to set the count direction to DOWN, and the START CLOCK input initiates the sequence.

The counter will then count 2, 1, 0, whereupon the MAX/MIN output of the SN74190 will go to "1" clocking BS1 and stopping the clock via G2, only three pulses having been produced in all.

To generate the 10 minus  $n$  pulses required during DIVISION NORMALISATION the counter is loaded with the same code as before but in this case the count direction is set to UP, and the sequence for the example of three is, 4, 5, 6, 7, 8, 9, 0, producing a total of seven pulses. The D output of the counter is used to trigger BS1 in this case, not the MAX/MIN output.

## BOARD OUTPUTS

There are several outputs from the CLOCK board, some of which (such as the A and Z register buffered clock lines), are self-explanatory. Gate G7 is used to detect counts six and seven to give a negative-going edge after clock seven to trigger the counter boards used during MULTIPLICATION and DIVISION. A trigger for this purpose is produced early in the sequence to allow the COUNTER boards and COMPARATOR to register an equality during MULTIPLICATION and still have time to stop the clock at the end of its run.

This output is called PLUS/MINUS COMPLETE. Gate G12 is used to buffer the pulse produced after each

batch of ten clock pulses to give the END OF TEN output required by the error detection, or OVERFLOW logic.

The RESTART output is taken from the Q output of BS1 and is used to restart the programme during MULTIPLICATION or DIVISION when the series of additions or subtractions have been completed.

The A register PRESET buffer gates are included on this board for convenience, and have no logic connection with it. They are parallel connected to provide the high drive capability required by the PRESET function of the SN7496.

## CONSTRUCTION

This circuit is built on a DL109/22 card, which has a 22-way edge contact on the printed side of the board. The component layout and edge contact wiring is shown in Fig. 7.7.

Wiring-up follows the same pattern as was outlined for previous boards.

The value of the capacitor used to set the clock frequency is about 3,000pF for the completed Digi-Cal (three 001 $\mu$ F capacitors in series were used in the prototype) but during testing procedure it is often convenient to use a very slow clock to enable the exact operation of the programme for instance to be traced using only the display and perhaps a voltmeter as indication.

The prototype has been tested with values as high as 1,000 $\mu$ F and still operated correctly, if rather slowly! For this reason it is better not to wire in a capacitor permanently at this stage since a suitable component can be connected when required.

Next month: The Adder Board

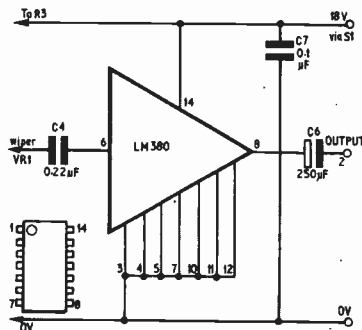
# POINTS ARISING

## I.C. INTERCOM (October 1972)

It has been brought to our notice that the PA234 i.c. is no longer available. A suitable alternative (not substitute) is the LM380, a 2W amplifier with its gain preset at 50. It requires fewer external components than the PA234 (R4, R5, R6, and C5 are not necessary) as shown below.

Minor alterations to the Veroboard layout are required. Pins 3, 4, 5, 10, 11 and 12 must be connected to a heatsink for 2W. It is recommended that a piece of copper be soldered to these pins under the panel if the i.c. is to be used at high power for any length of time. (This i.c. will drive an 8 ohm speaker.)

The LM380 is available (£1.45) from D.T.V. Group Ltd., 126 Hamilton Road, London, S.E.27.



# FREE

\*Information on our sophisticated but low-cost kits . . .

\*New 1214 Audio Range. Build your system in a few evenings.

\*New loudspeaker range.

\*Unbeatable quality and specifications.

\*Incredibly good value for your money.

\*New continuous credit and no-deposit terms. Even includes instruments.

\*Over 30 new models.

\*Over 130 models in range.

\*Packed full of invaluable information about the world's finest electronics . . .

It's New. It's the biggest Audio/Instrument kit catalogue in the U.K. And it's absolutely FREE.

Our new jumbo size Heathkit catalogue is full of good things: low-cost Testers and Instruments, Metal Detectors, Electronic Calculator, Intercoms., Amplifiers, Tuner/Amplifiers, Tuners and Loudspeakers – there's even a Battery Charger.

You name it, Heathkit can supply. What's more, you can build everything yourself. Heathkit help you each step of the way. Simply follow the Heathkit step-by-step construction manual. It's like painting by numbers but with something unique at the end of it. Fantastically satisfying, and less expensive than buying readymade. Our products are advanced in specification and performance. And they're regularly reviewed by leading journals. You have to be good to merit that sort of treatment.

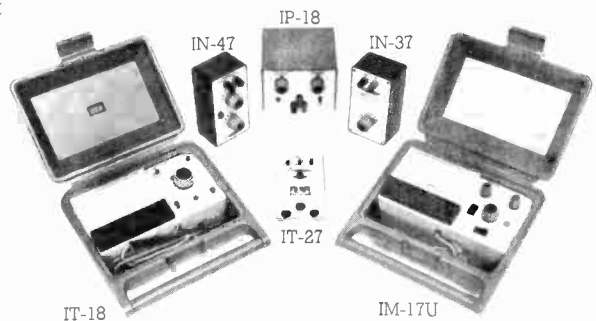
We guarantee that by using the Heathkit step-by-step construction method you can build a piece of electronic equipment without needing to know the first thing about electronics.

Mail the coupon today for your copy of the free Heathkit catalogue. The kits shown take just one or two evenings, and we promise that whichever kit you choose it'll be more rewarding than washing the car or watching television.



Want to know more?

Mail the coupon for a **FREE CATALOGUE**. Don't forget . . . This includes Instruments and low-cost Testers.



Why not visit your Heathkit Electronics Centres . . . and see our Instruments and Testers.

**London** 233 Tottenham Court Road. Telephone: 01 636 7349  
Open hours: Monday – Saturday 9-6.00 p.m.

**Birmingham** 17-18 St. Martin's House, Bull Ring.  
Telephone 021 643 4386 Open hours: Friday – Saturday 10-5.30 p.m.

**Gloucester** Cole Avenue Roundabout, Bristol Road.  
Telephone 0452 29451 Open hours: Monday – Friday 9-5.00 p.m.  
Saturday 9-12.30 p.m.

Please send me the FREE Heathkit catalogue

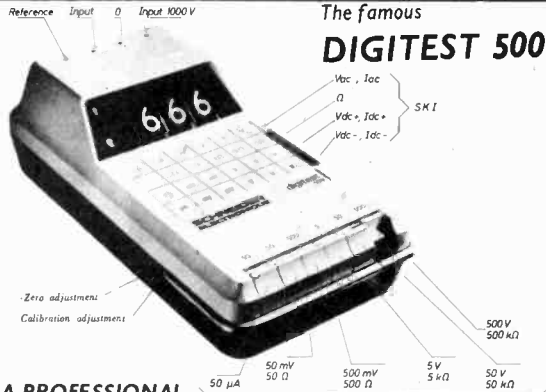
Name .....

Address .....

HEATH  
Schlumberger

HEATH (Gloucester) Ltd.,  
Dept. PE 1/73  
Gloucester GL2 6EE

# 1000's OF TEST EQUIPMENT BARGAINS!



## The famous DIGITEST 500

### A PROFESSIONAL DIGITAL MULTIMETER

BRAND NEW AT A FRACTION OF THE ORIGINAL PRICE!  
3 digit plus polarity indicator. Its 17 positions allow it to measure in the following ranges: d.c. volts 100μV to 999V; a.c. volts 100μV to 420V; d.c. 100μA; a.c. 100μA. Resistance 0.1Ω to 999kΩ. Operates from 230V 50Hz. 12V d.c. external. Dry cells or Ni Cad batteries. Original Price £89. **OUR PRICE £55** PLUS 50p P. & P.

### BRAND NEW DIGITAL PANEL VOLTMETERS

10mV to 1.99V, 199 measuring points. Input Z = 100MΩ Automatic zeroing. Dimensions 72mm H x 72mm W x 155mm D. Original Price £52. **OUR PRICE £24.50** PLUS 50p P. & P.

Zenith 2A Variacs 0-270V a.c. panel mounting with dial and knob in very good condition only £4. Plus 50p P. & P.  
Modern styled instrument case with quality large scale (5in) mirror backed 50 micro amp meter dimensions of case 10in x 6in x 6in make very useful multi meter P.S.U., etc. A real bargain at £4. Plus 50p P. & P.  
Landis & Gyr 4 Digit impulse counters with electrical reset count 10 impulses per second works between 12-48V d.c. for count, 80V d.c. for reset, used but perfect condition, price £1-50.

### PREPARE NOW FOR POWER CUTS

Limited quantity of high-power fluorescent light inverters available. 24V d.c. input, 240V output at high frequency for efficiency. For normal 40W fluorescent tubes only. Brand new and boxed units **£3.50** post paid

### 10-15V D.C. REGULATED, STABILISED P.S.Us.

Rating 1A. Measurements: 8in x 5in x 4in. Limited quantity, cannot be repeated. Brand new units only **£6.50** post paid

### 4X250 POWER TUBE BASES WITH CHIMNEY

Brand new and boxed. Silver plated. Complete with mounting clips **£3.25** each

### 0-150 AUDIO WATTMETER

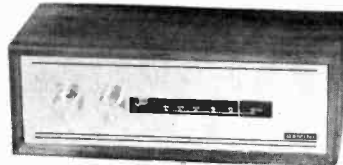
Dual range 0-50 and 0-150W. 15 ohms impedance. Dimensions 10in x 7in x 4in. Ideal for determining output power of P.A. systems, audio amplifiers, etc., etc. Supplied as new **£16.50** post paid

**P. F. RALFE** IPE 11

10 CHAPEL STREET, LONDON, N.W.1  
Tel. 01.723 8753

# A.M.C. ELECTRONICS LTD.

## "GEMINI" FM STEREO TUNER



All components to build this outstanding phase lock, easily aligned tuner. As described in April/May/June P.E. We are offering an optional chassis and wood sleeve. Complete kit, as illustrated, including chassis and solid wood sleeve **£33.90** post paid.

All components available separately. Send S.A.E. for details and itemised price list.

## SCORPIO ELECTRONIC IGNITION

Complete kit with comprehensive construction and fault finding data. **£11.** Post paid. Data 10p. Itemised prices, S.A.E. please.

**AMCEL, MAIL ORDER, 160 DRAKE ST., ROCHDALE**  
Tel. 0706-46234

## QUALITY COMPONENTS - BUDGET PRICES

### TRANSFORMERS

Hygrade filament 0-245V tapped primary, 2 x 6.3V, 1.8A secondaries **£1.95**  
Miniature mains 0-250V primary, 2 x 12V, 6VA secondaries **£1.10**  
Sub-miniature mains 0-240V primary, 2 x 12V, 50mA secondaries **£1.25**

### RESISTORS

10% Carbon, E12 values, 10-10M, 1/4W ... 1 1/2p  
1W ... 3p  
5% Hystab, E24 values, 10-1M, 1/4W ... 2 1/2p  
1W ... 3 1/2p  
2% M.O. E24 values, 10-1M, 1/4W ... 4p

### VOLUME CONTROLS

Small size, LOG or LIN  
5, 10, 25, 50, 100, 520, 500kΩ  
1MΩ  
Only 16p each

### CAPACITORS

Tantalum—μF/V: 0.1/35, 0.22/35, 0.47/35, 1/35, 2.2/35, 4.7/35, 10/63, 10/25, 10/16, 22/16, 47/6.3, 100/3.  
All at one price 17p  
Moulded polyester 250V: 0.01, 0.022, 0.033, 5p; 0.047, 0.068, 0.1, 7p; 0.22, 10p; 0.33, 12p; 0.47, 15p; 0.68, 18p; 1.0, 22p; 2.2, 35p.  
Printed circuit electrolytic—μF/V: 0.47/63, 1.0/63, 2.2/63, 4.7/40, 10/63, 22/40, 7p; 47/40, 10p; 100/63, 13p; 100/10, 7p; 220/40, 470/16, 13p; 1,000/16, 15p.

### FIXED VOLTAGE REGULATORS

TO3 case. Gives stabilised supply. MVR 5V, MVR 12V, MVR 15V. All at £1.50

### STRANDED CABLE

16/0.2mm, 3p per metre; 11 colours, 1 metre of each, 33p per pack  
21 colours, 1 metre of each, 60p per pack  
Extra flexible wire, for testmeter leads, red or black, 4p per metre  
Probe clips, for testmeters, red or black, 12p each  
Lightweight screened wire. Single, 7p per metre. Twin, 10p per metre

### VEROBOARD

0.1 0.15  
2 1/2in x 3 1/2in 20p 16p  
3 1/2in x 5in 24p 20p

### SERVICING AIDS—AEROSOLS

Freezer ... 60p  
Contact fluid ... 75p  
Insulating lacquer ... 80p

The above shows only a very small selection from our

### CATALOGUE

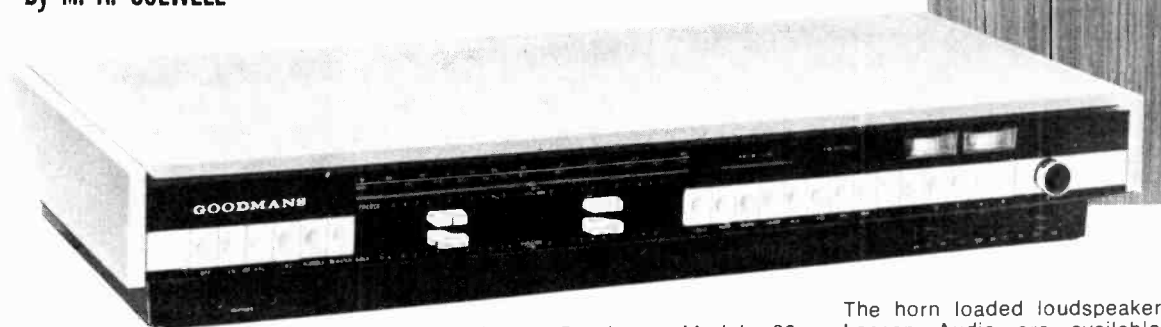
price 25p post free by return  
All orders over 50p post free in U.K. S.A.E. with all queries  
We can supply ALL R.S. COMPONENTS, mostly by return of post

## CELECTRON-E

P.O. Box No. 1, Llantwit Major, Glamorgan, CF6 9YN

# AUDIO FESTIVAL AND FAIR

A look at some of the hi fi developments seen and heard at Olympia  
By M. A. COLWELL



The slimline Goodmans Module 90 a.m./f.m. stereo tuner/amplifier

The horn loaded loudspeakers from Lecson Audio are available in a variety of finishes

ARE WE so immersed in the technicalities of hi fi equipment that we are sometimes guilty of spurning the real purpose of that equipment?

This poignant remark heard at this year's Audio Fair at Olympia is perhaps more significant in its implications than in the statement itself. It was a further cause for ponderance on tasting some of the lectures held simultaneously with the exhibition. These were enthusiastically attended and the presentation by the speakers was generally of a high standard. But one must hold some sympathies with the lay public who in some cases found the technical content some justification for not staying to the end.

On further analysis one can conclude that those keenly interested in hi fi equipment are extremely knowledgeable on the technical aspects. So much so that this is largely responsible for the cool reactions so far to quadraphonic reproduction in this country.

There has so far been a continuous air of "wait and see how it goes," while the Japanese persistently try to convince the British public that their systems are "proof of the pudding." If one was to assess quadraphonic sound on what one hears at Olympia then there can be little surprise at disillusionment, with comments like . . . "But who wants to sit in the middle of the orchestra."

## SIMULATED AMBIENCE

To sell quadraphonic sound, not only does the cost have to be fully justified, but also the ultimate accommodation in the home has to be compatible with normal domestic requirements. With necessary furnishings to blend with, both acoustically and visually, successful four-channel ambience is largely dependent on room dimensions and acoustic properties. A pseudo mock-up in a crowded stereotype

cubicle does not give a fair indication to the listener of what quadraphonic ambience should be like in a domestic setting and all too often these demonstrations were valueless. As one exhibitor put it: The speaker system is only as good as the room that loads it. The addition of ten or twenty listeners in the room adds further influence.

Only a trickling of British companies are offering four-channel facilities, usually in the form of a matrix decoder fed from two-channel equipment. The merits of this method lie only in the convenience of adaptability from existing equipment to suit "quadraphonic" recordings. The major drawback is some loss of channel separation. True quadraphonic ambience is only really authentic when derived from *totally* independent channels. The CD-4 discrete recorded four-channel system is the recommended version that uses this method.

Those offering quadraphonic equipment at the Audio Fair include the following (the code letters indicate equipment origin): J—Japan, WG—West Germany, UK—United Kingdom, USA—United States of America, DM—Denmark.

## BRITISH FOUR-CHANNEL EQUIPMENT

Goodmans Module 90 tuner amplifier (UK)—an impressive piece of equipment with excellent styling. This unit receives m.w. and f.m. bands by preset or variable tuning and contains a 45+45 watt r.m.s. amplifier with less than 0.1 per cent total harmonic distortion.

The model shown in our photograph is the white finish version and has elegant push-button arrays, twin level meters and slider controls. The "4D ambiophonic capability" will require two additional speaker units, while the main circuitry incorporates many of the features of the slightly

more expensive Models One-Ten and Module 80 (f.m.). Four f.m. band presetting controls are provided at the bottom right-hand end which are selected by four push-buttons above them. Two power output meters are also fitted.

Compared with some units this represents good value at £121 (white finish).

## FOREIGN QUAD

Grundig (WG) have an integrated tuner/amplifier complete for four-channel sound and including all the necessary decoder and amplifier circuitry ready for connection to four speakers. This is called the "Studio 2000b," has all the features expected of its kind, but is priced at £238-60, which includes a Dual 1216 transcription auto-changer fitted with a Shure M75 MBD magnetic cartridge.

The tuner has seven v.h.f. pre-selectors, each with its own tuning scale and short, medium and long wave reception. This might be classed as budget equipment of superior quality although the distortion figures ought to be better.

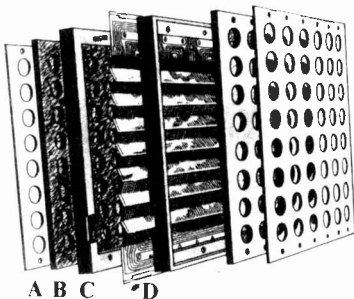
An alternative version without the transcription unit and of lower output (12.5W r.m.s.) is the Grundig RTV 800, and the RTV 900 at 25W r.m.s. per channel is similar in appearance. Similar push buttons are used as in the Goodmans unit and slider controls are also preferred. The photograph shows the RTV 800 with the individual tuning scales to the left of the main scale.

All three of these models are large, at least 22in long, the Model 2000b being larger. The RTV 800 is priced at £135-80 and the RTV 900 at £177-25.

Other ranges of quadraphonic equipment shown were from National Panasonic (J), JVC Nivico (J), Pioneer (J), Sansui (J), Sanyo (J), Siemens (WG), Sony (J), most of whom have demonstrated this technique before in some form. Golding Skandia (J) also had cartridge players quoted as "simulated quadphonic" at various prices.



Marantz Model 19 stereo receiver



A Steel Plate      B Rubber Magnet  
C Inert Plastic Frame      D Unique Diaphragm

The layers of the isodynamic headphone structure by Rank Wharfedale. Note the printed circuit style diaphragm at D

## ISODYNAMIC HYBRID

In taking an overall view of the equipment on show it is evident that manufacturers are coming close to the ultimate performance versus cost factor and innovations such as have been regular occurrences in the past are now very thin on the ground.

Probably one of the most significant commercial developments though shown this year is the Isodynamic Stereo Headphone made by Rank Wharfedale. High quality stereo headphones have so far been somewhat heavy for long term listening, but this one weighs only 13 ounces (375 grammes). It is a semi-hybrid whereby the whole diaphragm is driven evenly and freely as in the electrostatic principle, but is influenced by an anisotropic ceramic/synthetic rubberised sheet magnetised perpendicular to the diaphragm.

The diaphragm is a polyimide film with flexible printed circuit style metallic grid. The electro-magnetic influences caused by the sound signal passing through this grid, in conjunction with the magnetised rubber, make the diaphragm move.

Subjective measurements on these phones show no violent variation in spectral response and the frequency response using a standard "artificial ear" shows -3dB points at 40Hz and 15kHz. The price is competitive at £19-95.

## RAPID DEVELOPMENT

With the expansion of stereo broadcasting to Radio 2 (from early November) and the likelihood of commercial sound broadcasting to come, one would have expected to see a strong emphasis on advanced tuner developments using integrated circuits. There were surprisingly few; the general trend seems to be to integrate the complete tuner with the amplifier in one case. Very few separate tuners were evident.

However, Lecson Audio (a promising newcomer) have in less than 12 months produced some superb high quality equipment in revolutionary new styling. The tuner TF1 is a self-powered unit with preset v.h.f. tuning and variable tuning controls for stereo or mono broadcasts.

The controls take the form of sliding bars matching the case styling. The performance is specified as 1.5µV sensitivity for 30dB quieting; a.m. rejection 42dB; signal-to-noise ratio better than 60dB; audio frequency response  $\pm 1$ dB 20Hz to 14.5kHz.

## LOW DISTORTION

The matching control unit pre-amplifier, also self-powered with slide controls and electronic switching, is a two-channel stereo unit with two four-channel configurations for a supplementary matrix decoding surround-sound unit, to be made available. The performance is claimed to be so impressive that the sceptics will probably need convincing.

There are the usual input facilities to be expected with signal-to-noise ratios of 70dB (magnetic pickups) and 80dB for others. Outputs supply 500mV into 1kΩ loads for pick-up and radio; 100mV for tape; 2W into 8 ohms for headphone use. Distortion is quoted as typically less than 0.02 per cent; frequency response  $\pm 0.5$ dB 10Hz to 25kHz.

The power amplifiers AP1 and AP2 boast distortion figures of less than 0.005% at 1kHz at 35W, less than 0.02% at 50W and better than 0.05%.







## ORGAN KITS

Build your own Electronic Organ, if you want the best value for your money. Yes you really save over 50% and get the best and up-to-date designs. There are four models to choose from.

- ★ Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, at £145.29.
- ★ Console—5 octave keyboard with 10 voices, 3 pitches. Keyboard can be split into solo and accompaniment. Vibrato built in amplifier and 50 watt 12" Goodmans speaker at £199.75.
- ★ Console—2 x 4 octave keyboards and 13 note pedal boards, 29 voices, Vibrato, Delay Vibrato, Sustain Reverberation, percussion, Wah Wah, etc. at £406.00.
- ★ Console—2 x 5 octave keyboards and 32 note pedal boards, 32 voices. Vibrato, Delay Vibrato, Sustain Reverberation, Percussion, 3 Couplers, etc. at £553.60.

ALL COMPONENTS CAN BE BOUGHT SEPARATELY. SEND 50p FOR LATEST CATALOGUE, WHICH INCLUDES SPECIALISED COMPONENTS, HI-FI EQUIPMENT AND ELECTRICAL HOUSEHOLD APPLIANCES.

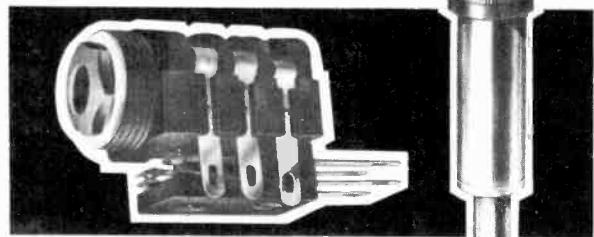
## ELVINS ELECTRONIC MUSICAL INSTRUMENTS

8 PUTNEY BRIDGE RD., LONDON  
S.W.18 TEL. 01-870 4949

Also at 12 Brett Road, London, E.8

Business hours: 10 a.m. to 7 p.m. Monday to Saturday. Thursday closed.

## Are you alright for Jacks?



Ask for Rendar Jack plugs and sockets at your local stockist. They come in a wide variety of configurations, and in cases of difficulty can be ordered DIRECT from the Rendar factory.

Standard, mini and sub-miniature sizes... plugs in both screened and unscreened versions... socket bodies in high melting point thermoplastic... several unique features (some protected by UK and US Patents)... Post Office and NATO specifications.

If you want to study all the facts and figures, all the ingenious construction details, send for the Rendar Electronic Components Catalogue of technical data sheets covering their entire range of products.

The cost of the catalogue is 25p, including P & P, and it's money very well spent!



### RENDAR®

Rendar Instruments Ltd., Victoria Road  
Burgess Hill, Sussex. Tel. Burgess Hill 2642-4  
Cables: Rendar, Burgess Hill



## for fast, easy reliable soldering

Ersin Multicore Solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.

### IDEAL FOR HOME CONSTRUCTORS



Size 1 cartons all at 25p each  
in 40/60, 60/40,  
or Savbit alloys in 7 gauges.

### EASY-TO-USE DISPENSERS



Size 5  
(Savbit) 18swg,  
18p (illustrated)  
Size 19A  
(60/40 alloy)  
18swg, 18p  
Size 15  
(60/40 alloy)  
22swg, 22p

## BIB WIRE STRIPPER AND CUTTER



Model 3A. Strips insulation from cable or flex without nicking wire. 4 different settings, 4 & 6 BA spanner ends, ground cutting edges. Price 32p. Also available, de luxe Model 8. Price 58p.

**NEW!**

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

at all other frequencies and power levels. Transient distortion effects are claimed to be non-existent, while noise is quoted at less than 90dB below 35W.

The two models AP1 (50W per channel) and AP2 (minimum 70W per channel) are housed in decorative cylindrical cases. Prices match performance: The tuner is £70, AC1 control unit £95, AP1 £75, AP2 £90, and the excellent horn loudspeaker introduced earlier this year £89. Distribution is through appointed dealer only network.

The new AR1214 a.m./f.m. stereo receiver from Heath (Gloucester) Ltd. has an integral 15W + 15W r.m.s. power amplifier and, as in the case of the P.E. Gemini Tuner, uses two integrated circuits, two ceramic filters, a phase locked multiplex demodulator, and a pre-assembled ready aligned f.m. tuning head to provide 2 $\mu$ V sensitivity. The kit price is £69.80.

## PRICED PERFORMANCE

Prices of equipment generally at the Fair were high when compared with the forerunners; some may be justified, others perhaps taking advantage of a booming market. It is a strange fact that the high quality goods attract some very high prices.

It is now not unusual to find a single unit costing more than £100 and some tuner/amplifiers combined at more than £200. One even goes as high as £775 and, when £125 is donated to Government funds in the form of purchase tax, the buyer will be asked to find £880—almost the price of a reasonably comfortable family car.

This particular model is the Marantz Model 19 f.m. stereo receiver. The Marantz demonstrator went to great pains to illustrate that all their amplifiers gave an identical sound (and so it seemed to be at Olympia); the reason for the variation in prices was said to be in the facilities offered.

Comparing this Model 19 with their a.m./f.m. stereo receiver Model 2215 at £186, an immediate difference is apparent: the 2215 has an f.m. sensitivity of 4.5mV against 1.8mV, stereo separation at 30dB against 45dB, t.h.d. and intermodulation distortion at 0.5% against 0.15%.

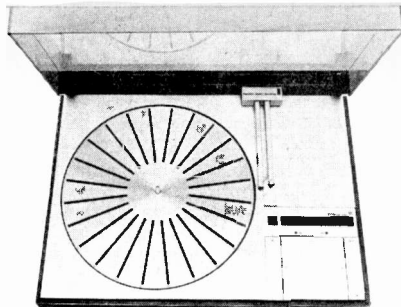
There are others, but do they really add up to nearly £600 worth of extra materials or technical expertise? They also seem to believe that users will frequently need to check amplifier performances on the built-in oscilloscope in the Model 19. Surely this should not be necessary at this price. This American company builds its equipment in Belgium and distributes in the UK through Pysers-Britex (Swift) Ltd., of Edenbridge, Kent.

By comparison with some British units the cost/performance factor of these units and the new Model 1030 and 1060 amplifiers is generally on the high side.

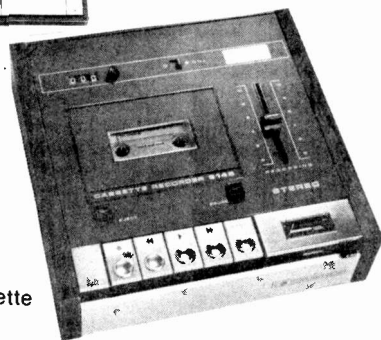
## SERVO TRANSCRIPTION

One would not have thought that there was much more room for development on the transcription unit, but B & O attracted considerable attention with their Model 4000, mainly due to the electronically controlled tangential arm.

Disc cutting heads traverse the disc in a straight line along the radius by using the "lathe screw" principle of motion. The 4000 pick-up does likewise, but instead of having only one arm, it has two, one carrying a photocell which senses the presence, size, and specified playing speed of the disc.



Model 4000 tangential arm transcription unit with servo control by Bang & Olufsen



Pye 9145 stereo cassette recorder with DNL

In conjunction with a servo motor the pick-up lathe screw is driven in synchronism with the rotation of the disc, so avoiding drag friction and skating problems. Preset controls on a panel are set to feed basic data to enable correct operation to be carried out. Any error in setting up will inhibit operation.

Provided specially for this pick-up arm, the new SP15 cartridge has a sealed-in stylus which is factory fitted and tested as being the perfect match for the arm supplied. The price for the complete transcription unit is £179.50 (teak), £180.50 (rosewood), and replacement cartridges SP15 are £36.08.

## IN BRIEF

Following the success of the DM1 Monitor loud-speaker system by B & W Electronics at £37.39, they have now introduced the DM4 which has greater power handling capacity and extended bass response down to 30Hz. This model sells at £49.66.

BSR have produced an eight-track stereo tape cartridge player, the TD8-3V at £27.99.

New plinth systems have been designed and produced by SME, the Model 2000, which is available in component form to suit various Thorens transcription units and SME pick-ups. Prices vary, but for a complete plinth with Perspex cover you can expect to pay in the region of £50.

Garrard (part of the Plessey organisation) have also produced plinths with Perspex lids. These "modules" are supplied complete with the transcription units for which they are made, prices ranging from £23.49 for the SP25 Mk 3 (less cartridge) to £59.07 for the Z100S (less cartridge), including purchase tax.

Philips introduced their N2510 high quality stereo cassette deck recorder for chromium dioxide tape. It has twin meters, and sleek slider and push button controls.

The well-known Philips dynamic noise limiter circuit is included in the Philips N2506 and the equivalent Pye model 9145 stereo cassette recorders costing £65.

Other less expensive items of equipment were on show, but it seems that, like most things, new products are an accepted method of attracting higher prices, but that is another subject—not for this page.





# BOOK REVIEWS

## TRANSISTOR AUDIO AND RADIO CIRCUITS

Published by Mullard

283 pages, 8½in × 5½in. Price £1-80

THE GREAT popularity of the first edition of this excellent book published in 1969 has led Mullard to update and augment the information, and present it in a second edition. The appeal of the first edition must be attributed to the wealth of useful and really practical circuits presented. All the circuits are of proven design and the performance figures quoted are taken from the prototypes rather than merely theoretical calculations.

In addition to the established designs for 10W and 25W amplifiers there are three new circuits for 15W, 35W, and 50W amplifiers together with a preamplifier for these circuits.

Other additions to the first edition are a radio receiver, and amplifiers using integrated circuits. There is also a new chapter on loudspeakers, which discusses choosing a suitable speaker and design features of enclosures for high quality systems.

Other sections describe tape recorders with a design for a 4W machine, a circuit for a high quality f.m. tuner, and a chapter on a.f. amplifiers for car radios. Full details of all components are given as well as suppliers for the more difficult to obtain devices. No constructional details are given although where special care needs to be taken, as in the case of stereo amplifiers, this is more than adequately discussed.

Though not designed for the beginner this is a book from which everyone can learn, and a price that anyone can afford makes this an excellent, practical, reference work.

S.R.L.

## HI FI YEAR BOOK—1973

Edited by C. Sproxtton

Published by IPC Electrical-Electronic Year Book Ltd.

464 pages, 8½in × 6in. Price £1-50

A FURTHER 88 pages on top of last year's volume, packed with many more items of equipment and accessories for the audiophile. For those new to this regular work, the Hi Fi Year Book catalogues technical specifications and photographs of a wide range of domestic and studio hi fi equipment, following four introductory articles on the state of the art. The articles this year include an insight into specifications jargon, a selection of pre-recorded cassette tapes, an up to date look into quadrphony—its techniques and purpose, and a survey of loud-speaker development.

Included in the classified directory are added quadraphonic equipment, tape transport machines, decks, and players, tables on tape playing times and v.h.f. transmitters. The standard of production is well maintained, although equipment news released after September 1972 may not be included (for some of these refer to our Audio Fair report in this issue).

## BEGINNERS GUIDE TO TELEVISION

By Gordon J. King

Published by Newnes-Butterworths

211 pages, 5in × 7½in. Price £1-60.

DOMESTIC television receivers have for long had a special kind of fascinating appeal to electronics followers, probably due to the various "tricks" in achieving a satisfactory performance with some pruned down economic circuitry. Since transistors have to a substantial extent replaced valve circuits, I was surprised to find little more than a page devoted to this aspect, but then the majority of this book is concerned with general principles rather than detailed circuit theory. In the examples of valve circuits described, only the basic timebase and pulse circuits are explained, the remainder of the excellent diagrams are mainly illustrative of methods of system operation. The photographs are also of excellent quality, although one or two would probably rate as superfluous.

It is an interesting fact that the 32-page chapter on colour television forms a useful introduction to the colour techniques used, but in the U.K. and Europe the N.T.S.C. system is really only of academic interest. If this system is worth inclusion then, for comparative discussion, so too is SECAM. PAL is the main domestic system, and is briefly described, including delay line techniques; greater detail would have enhanced the value of this book to the service engineer.

Whilst being somewhat critical of contents selection, one must compensate by complimenting the down to earth writing style and presentation of this popular author. This book is still to be recommended on this account if it suits your requirements, but beginners beware—you do need some prior knowledge of general radio and electronics theory for some parts.

M.A.C.

## READER'S DIGEST REPAIR MANUAL

Published by The Reader's Digest Association

704 pages, 7½in × 10½in. Price £6-30

THOUGH the price of this book may be somewhat discouraging, the amount of information contained within its pages is really enormous, covering everything from jewellery to caravans. All practical details are explained with the aid of a multitude of clear, "comic-strip" type drawings and the section on renovating and restoring contains some excellent colour photographs.

To elucidate further on the contents, the main areas covered are: house repairs and decoration; renovating and restoring; repairs around the home and in the garden; electrical equipment; in the garage; and a reference section giving miscellaneous information and advice.

The section on electrical repairs assumes no technical knowledge and thus only deals with "mechanical" work. The chapter on cars contains some useful information on fitting suppressors to improve radio reception.

This book is not only for the do-it-yourself man but also includes lots of information that women would find very useful, not to mention the children.

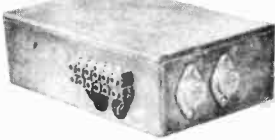
S.R.L.





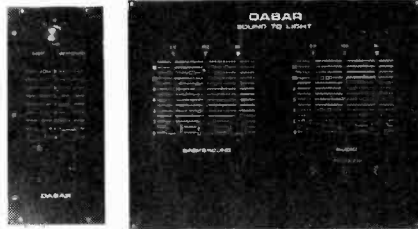


**PRACTICAL ELECTRONICS**  
**"SCORPIO"**  
**ELECTRONIC IGNITION**  
**SYSTEM**



This Capacitor-Discharge Electronic Ignition system was described in the November and December issues of Practical Electronics. It is suitable for incorporating in any 12V ignition system in cars, boats, go-karts, etc., of either pos. or neg. earth and up to six cylinders. The original coil, plugs, points and contact-breaker capacitor fitted in the vehicle are used. No extra or special components are required. Helps to promote easier starting (even under sub-zero conditions), improved acceleration, better high-speed performance, quicker engine warm-up and improved fuel economy. Eliminates excessive contact breaker point burning and the need to adjust point and spark-plug gaps with precision. Construction of the unit can easily be completed in an evening and installation should take no longer than half an hour. A complete complement of components is supplied with each kit together with ready-drilled roller-tinned professional quality fibre-glass printed-circuit board, custom-wound transformer and fully-machined die-cast case. All components are available separately. Case size 7 1/2 in x 4 1/2 in x 2 in. approx. Complete assembly and wiring manual 25p, refundable on purchase of kit. Price: £10.50 plus 50p P. & P.

**DABAR LIGHTING EFFECTS**  
**NEW! NEW! NEW! NEW! NEW! NEW!**



**SINGLE CHANNEL**  
**SOUND TO**  
**LIGHT UNIT**  
**STL/1**

Single channel "Sound to Light" unit with slider fader controls for audio trigger level and background load dimmer. Switchable for response to High, Mid and Low frequency audio input signals, selected by fascia control. D.J. Pulse-Flash push button fitted to fascia for manual flashing of lamp load. Neon load indicator fitted. Constructed on glassfibre printed circuit material with attractive black anodised fascia panel. Input and load connections via Cinch printed circuit connector. Maximum Load 1kW at 250V 50Hz. R.F.I. filtered. Price: £13 each post free U.K.

**THREE CHANNEL**  
**SOUND TO**  
**LIGHT UNIT**  
**STL/3**

Three channel "Sound to Light" unit with slider fader controls for audio trigger level and background load dimmer. An attractive unit with independent control of High, Mid and Low frequency audio trigger levels. Slider fader background or dimmer controls on each channel. D.J. Pulse-Flash push buttons on each channel together with neon load indicators. Constructed on glassfibre printed circuit material with attractive black anodised fascia panel. Input and load connections at rear so unit is ideally suited for mounting into disco-console. Maximum Load 1.5kW per channel at 250V 50Hz. R.F.I. filters incorporated. Price: £38.50 each post free U.K.

S.A.E. All Enquiries please

Trade enquiries Welcome

**PSYCHEDELIC LIGHTING**  
**UNIT Mk. 3**

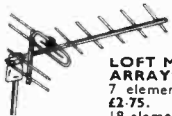


This unit represents a natural progression from our phenomenally successful Mk. 1 and 2 Units. As before the drive voltage is derived directly from the amplifier output or across the speakers. The unit converts the audio frequency signals into a three-coloured light display; the colour depending on the frequency of the signal and the intensity on the loudness of the audio source. The unit is constructed on professional fibre-glass printed-circuit board material and uses latest full-wave triac circuitry. There is a master-level control, together with independent sensitivity controls for each channel. The original minimum ambient light level controls have been redesigned permitting their use as faders; allowing dimming from max. to zero at the turn of a knob. R.F.I. suppression is now incorporated as standard as well as provision for D.J. "Pulse-Flash" controls. The choice of two inputs enables operation from both high and low power amplifiers. Max. power 1.5kW per channel at 240V a.c. Complete assembly built and tested. Size 9 in x 7 in x 3 in. Price £25 carr. paid.

**DABAR ELECTRONIC PRODUCTS**  
**98a Lichfield Street, Walsall**  
**Staffs. WS1 1UZ**  
**TELEPHONE: WALSALL 34365**  
**TELEGRAMS: DABELEC Walsall Staffs.**

**U.H.F. TV AERIALS**

SUITABLE FOR COLOUR & MONO-CHROME RECEPTION



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

**LOFT MOUNTING ARRAYS**

7 element £2.25. 11 element £2.75. 14 element £3.25. 18 element £3.75.

**WALL MOUNTING c/w WALL ARM AND BRACKET.** 7 element £3.25. 11 element £3.75. 14 element £4.25. 18 element £4.75.

**CHIMNEY MOUNTING ARRAYS c/w MAST AND LASHING KIT.** 7 element £4. 11 element £4.50. 14 element £4.75. 18 element £5.25.

**MAST MOUNTING arrays only** 7 element £2.25. 11 element £2.75. 14 element £3.25. 18 element £3.75. Complete assembly instructions with every aerial. **LOW LOSS** coaxial cable 9p yd.

**KING TELEBOOSTERS** from £3.75. **LABGEAR** all band V.H.F.—U.H.F.—F.M. radio mains operated pre-amps £7.50. State clearly channel number required on all orders. P. & P. on all aerials 50p accs. 15p. C.W.O. min. C.O.D. charge 25p.

**BBC-ITV-FM AERIALS**

**BBC** (band 1) Wall S/D £2. **LOFT** inverted 'T' £1.25. **EXTERNAL 'H'** array only £3. **ITV** (band 3) 5 element loft array £2.50. 7 element £3. **COMBINED BBC-ITV** lcft 1+5 £2.75. 1+7 £3.50. **WALL AND CHIMNEY UNITS** ALSO AVAILABLE. Pre-amps from £3.75.

**COMBINED U.H.F.-V.H.F. aerials** 1+5+9 £4. 1+5+14 £4.50. 1+7+14 £5. **F.M. RADIO** loft S/D £1. 3 element £3.25. 4 element £3.50. Standard coaxial plugs 9p. Coaxial cable 5p yd. Outlet box 30p. P. & P. all aerials 50p, accs. 30p. C.W.O. min. C.O.D. charge 25p. Send 5p for fully illustrated lists.

**CALLERS WELCOMED OPEN ALL DAY SATURDAY**  
**K.V.A. ELECTRONICS**  
**40-41 Monarch Parade, London Rd.**  
**Mitcham, Surrey**  
**Telephone 01-648 4884**

**NEW EDITION**

**TRANSISTOR AUDIO AND RADIO CIRCUITS**

for Radio Receivers • Radiograms • Record Players • Tape Recorders • Hi-Fi Equipment

**MULLARD**

£1.80. Postage 12p.

**HAM RADIO A BEGINNER'S GUIDE** by R. H. Warring. £1.60. Postage 10p.

**FIELD EFFECT TRANSISTORS** by Mullard. £1.80. Postage 10p.

**UNDERSTANDING ELECTRONIC COMPONENTS** by Ian R. Sinclair. £3.50. Postage 10p.

**BEGINNER'S GUIDE TO RADIO CONTROL** by R. H. Warring. £1.60. Postage 10p.

**CREATIVE TAPE RECORDING** by Vivian Capel. £3.50. Postage 10p.

**THE MAZDA BOOK OF PAL RECEIVER SERVICING** by D. J. Seal. £3.50. Postage 20p.

**TRANSISTOR MANUAL** by GE. £1.10. Postage 12p.

**TRANSISTORISED RADIO CONTROL FOR MODELS** by D. W. Aldridge. £2.50. Postage 10p.

**THE MODERN BOOK CO.**

BRITAIN'S LARGEST STOCKIST of British and American Technical Books

**19-21 PRAED STREET LONDON W2 1NP**

Phone 01-723 4185

Closed Saturday 1 p.m.

**MULTI MINI VICE AND STAND**



**£8.95**

26p P. & P.

This unique all purpose vice is just like a 'third hand' countless uses for the electronics enthusiast—assembly, soldering, gluing, wiring, drilling, etc. Firm base, positive grip for all shapes of work, with independently adjustable twin jaws.

Truly a precision made bargain.

Also single jaw model £5.45 (22p P. & P.)

**Freeborn Ltd. (Dept. PE/1/73)**  
**Beechfield House • West Bar**  
**Bapbury • Oxon**

Also available at your local model shop



# Build yourself a TRANSISTOR RADIO

WITH AFTER SALES SERVICE

## ROAMER 10 WITH VHF INCLUDING AIRCRAFT

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

Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated telescopic aerial, for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Fine tone moving coil speaker. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in x 7in x 4in.

Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS

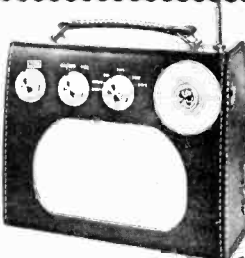
**£8.50**

P.P. & INS. 50p  
(OVERSEAS P. & P. £1)



## ROAMER EIGHT Mk. I

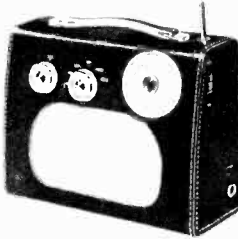
NOW WITH VARIABLE TONE CONTROL



7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Retractable chrome plated telescopic aerial for short waves. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9in x 7in x 4in approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS **£6.98** P.P. & INS. 45p (OVERSEAS P. & P. £1)

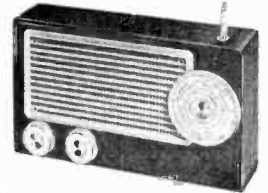
## ROAMER SEVEN Mk. IV



7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Extra medium waveband provides easier tuning of Radio Luxembourg, etc. Built-in ferrite rod aerial for MW and LW. Retractable 4 section 24in chrome plated telescopic aerial for SW. Socket for car aerial. Powerful push-pull output. 7 transistors and 2 diodes, including micro-alloy R.F. transistors. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9in x 7in x 4in approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS **£5.98** P.P. & INS. 45p (OVERSEAS P. & P. £1)

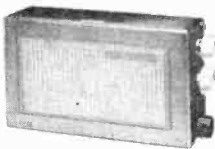
## ROAMER SIX



6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER BAND PLUS AN EXTRA MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages - 6 transistors and 2 diodes including micro-alloy R.F. transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9in x 5 1/2in x 2 1/2in approx. Easy build plans and parts price list 15p (FREE with parts).

TOTAL BUILDING COSTS **£3.98** P.P. & INS. 30p (OVERSEAS P. & P. £1)

## POCKET FIVE



3 TUNABLE WAVEBANDS: MW, LW, TRAWLER BAND WITH EXTENDED MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. 7 stages - 5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 2 1/2in x 1 1/2in x 3 1/2in. Easy build plans and parts price list 10p (FREE with parts).

TOTAL BUILDING COSTS **£2.29** P.P. & INS. 23p (OVERSEAS P. & P. 63p)

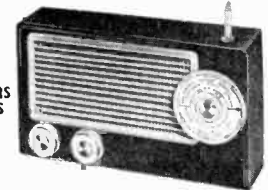
## TRANSONA FIVE



5 TRANSISTORS AND 2 DIODES  
3 TUNABLE WAVEBANDS: MW, LW AND TRAWLER BAND. 7 stage - 5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6 1/2in x 4 1/2in x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts).

TOTAL BUILDING COSTS **£2.50** P.P. & INS. 24p (OVERSEAS P. & P. 63p)

## TRANS EIGHT



8 TRANSISTORS AND 3 DIODES  
6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9in x 5 1/2in x 2 1/2in approx. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

TOTAL BUILDING COSTS **£4.48** P.P. & INS. 32p (OVERSEAS P. & P. £1)



## NEW! "EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT. Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 3" Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three 1/2in knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.

ALL PARTS INCLUDING CASE AND PLANS **£5.50** P.P. & INS. 32p (OVERSEAS P. & P. £1)

## RADIO EXCHANGE LTD

61a HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £ \_\_\_\_\_ please send items marked

ROAMER TEN	<input type="checkbox"/>	ROAMER SEVEN	<input type="checkbox"/>
ROAMER EIGHT	<input type="checkbox"/>	TRANS EIGHT	<input type="checkbox"/>
TRANSONA FIVE	<input type="checkbox"/>	ROAMER SIX	<input type="checkbox"/>
POCKET FIVE	<input type="checkbox"/>	EDU-KIT	<input type="checkbox"/>

Parts price list and plans for

Name \_\_\_\_\_

Address \_\_\_\_\_

P.E. 49

FULL AFTER SALES SERVICE

- ★ Callers side entrance "Lavell" Shop
- ★ Open 10-1, 2.30-4.30 Monday-Friday, 9-12 Saturday





# MULLARD BOOKS ON ELECTRONICS

## SECOND EDITION!

# TRANSISTOR AUDIO AND RADIO CIRCUITS

The continuing demand for the Mullard book "Transistor Audio and Radio Circuits" has made a second edition necessary. The new edition incorporates new circuits taking advantage of developments that have occurred since the first edition was published in 1969. In particular, new high-quality audio amplifiers, and amplifiers and a radio receiver using integrated circuits, have been added.

### Contents

Silicon and germanium transistors - Basic h.f. circuits - Basic a.f. circuits - Radiograms, record players and portable radios - Tape recorders - A.f. amplifiers for car radio - High quality audio equipment - High quality f.m. tuners - Loudspeakers - Test Equipment.

Size 8½" x 6" cloth bound, comprising 288 pages, illustrated.

£1.80 + 15p P&P

# FIELD EFFECT TRANSISTORS

Field-effect transistors have outstanding advantages over other transistors in many applications. This book describes the construction, properties and typical applications of the FET. It explains the nature of the two main types - the junction FET and the insulated gate FET (usually a MOS FET). Circuit theory is examined fully, and full practical details are given.

### Contents

Introductory Survey, terminology - Junction FET - Insulated gate MOS FET - Electrical properties of FETs - Applications, including basic circuits, amplifiers, matching networks, radiation detectors, switching circuits, d.c. amplifier, multivibrator, mixer, oscillator.

Size 8½" x 6" cloth bound, comprising 132 pages, illustrated.

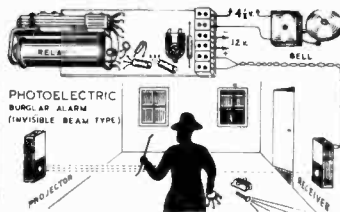
£1.80 + 15p P&P

## HOW TO GET YOUR COPY

From your local bookseller or cash with order plus postage and packing from:  
 Selray Book Company Limited, 60 Hayes Hill, Hayes, Bromley, Kent BR2 7HP.  
 Or send for full list of Mullard titles from Dept. CIH, Mullard Limited, New Road, Mitcham, Surrey CR4 4XY.

# PHOTOELECTRIC KIT

**CONTENTS:** 2 P.C. Chassis Boards, Chemicals, Etching Manual, Infra-Red Photo-transistor, Latching Relay, 2 Transistors, 3 Diodes, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation.



### PHOTOELECTRIC KIT

£2-60

Postage and Pack. 15p (U.K.)  
 Commonwealth: 15p  
 SURFACE MAIL 25p  
 AIR MAIL £1-10  
 Australia, New Zealand, S. Africa, Canada and U.S.A.  
 Also Essential Data Circuits and Plans for Building 10 Advanced Designs

### INVISIBLE BEAM OPTICAL KIT

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

**CONTENTS:** 2 lenses, 2 mirrors, 2 45-degree wooden blocks, Infra-red filter, projector lamp holder, building plans, etc. Price £1-25. Postage and Pack. 10p (U.K.). Commonwealth: Surface Mail 20p; Air Mail 50p.

### LONG RANGE INVISIBLE BEAM OPTICAL KIT

**CONTENTS:** As above. Twice the range of standard kit. Larger Lenses, Filter, etc. Price £1-85. Postage and Pack. 15p (U.K.). Commonwealth: Surface Mail 20p; Air Mail £1-10.

### JUNIOR PHOTOELECTRIC KIT

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

**CONTENTS:** Infra-Red Sensitive Phototransistor, 3 Transistors, Chassis, Plastic Case, Resistors, Screws, etc. Full Size Plans, Instructions, Data Sheet "10 Advanced Photoelectric Designs". Price £1-25. Postage and Pack. 10p (U.K.). Commonwealth 20p; Airmail 50p.

### JUNIOR OPTICAL KIT

**CONTENTS:** 2 Lenses, Infra-red Filter, Lampholder, Bracket, Plans, etc. Everything (except plywood) to build 1 miniature invisible beam projector and photo-cell receiver for use with Junior Photoelectric Kit.

Price 75p. Post and Pack. 10p (U.K.). Commonwealth: Surface Mail 20p; Air Mail 50p.

## YORK ELECTRICS Mail Order Dept.

335 BATTERSEA PARK ROAD, LONDON, S.W.11

Send S.A.E. for full details, a brief description of all Kits and Projects

## B.H. COMPONENT FACTORS LIMITED

### POLYESTER CAPACITORS MULLARD C280 250V

µF: 0.01, 0.015, 0.022, 0.033, 0.047, 3p each; 0.068, 0.1, 0.15, 4p each; 0.22, 5p;

0.33, 7p; 0.47, 8p; 0.68, 10p; 1.0, 13p; 1.5, 20p; 2.2, 23p.

### MULLARD POLYESTER CAPACITORS C296 SERIES

160V: (µF) 0.01, 0.015, 0.022, 2p; 0.047, 0.068, 3p; 0.15, 0.22, 4p; 0.33, 5p;

0.47, 6p; 0.68, 1.0, 10p.

400V: (µF) 0.001, 0.0015, 0.0022, 0.0033, 0.01, 2p; 0.015, 0.033, 3p; 0.068, 4p.

**MINIATURE ELECTROLYTIC MULLARD C426 SERIES (5p each)**

(µF/V) 0.64/64, 1.6/25, 4/10, 8/40, 10/40, 10/64, 16/40, 20/64, 25/25, 32/10,

40/16, 64/10, 80/16, 80/25, 100/6.4, 125/16, 200/6.4, 200/10, 320/6.4, 125/10.

**MULLARD C437: (µF/V) 64/64, 9p; 160/25, 9p; 160/40, 11p; 640/6.4, 9p;**

1600/6.4, 14p.

### ELECTROLYTIC CAPACITORS. Tubular and large can

(µF/V) 2.5/50, 3p; 4/10, 10/25, 16/15, 20/25, 25/15, 25/25, 40/6, 64/10, 200/6,

250/10, 4p; 10/6, 10/50, 25/50, 32/50, 50/10, 64/25, 100/25, 5p; 50/50, 64/40,

250/15, 1.000/3, 6p; 100/50, 250/25, 400/10, 500/10, 500/12, 640/10, 1.000/6,

8p; 500/25, 10p; 500/50, 12p; 1.000/12, 10p; 1.000/25, 2.000/12, 2.500/12, 15p;

1.000/50, 35p; 2.000/25, 25p; 2.500/25, 30p; 2500/50, 55p; 3.000/50, 65p;

5.000/50, 85p.

### CERAMIC PLATE CAPACITORS

750V: (pF) 5, 10, 25, 40, 70, 220, 2½p; (µF/V) 0.0047/30, 0.01/350, 2p;

0.047/30, 3p; 0.1/30, 4p; 0.1/100, 5p; 22pF=1000pF 50V, E12 Series; 1500pF=

0.022µF 50V, E6 Series 2p each.

### CARBON FILM RESISTORS ½W 5%, 10 ohms-2.2M, 1p each, or 100 for 55p.

**SPECIAL RESISTOR KITS (½W 5% CARBON FILM)**

10E12 Kit: 10 of each E12 value, 10 ohms-1M, a total of 610, £2.80 net

10E12 Kit: 25 of each E12 value, 10 ohms-1M, a total of 1,525, £6.50 net

**VEROBOARD** 0.1 0.15 IN4001 6p

2½ x 5in 25p IN4002 7p

2½ x 3½in 23p 17p IN4003 8p

3½ x 5in 29p 30p IN4004 9p

2½ x 3½in 25p 25p IN4005 6p

2½ x 1in 2 for 12p 12p µL914 30p

2½ x 5in (plain) — 12p OC71 12p

2½ x 3½in (plain) — 11p OC75 15p

5 x 3½in (plain) — 20p OC83 18p

Insertion tool 54p 54p Tunnel Diodes IN3717 £1; TD715, TD716 50p

Track cutter 40p 40p

Pins, pkt. 25 8p 8p

3 core circ. mains cable White, 3 yds. 24p

RF Chokes (µH) 0.22, 2.2, 12, 22 8p

PVC wire 7/0076, 5 x 10yd 30p

PVC wire 14/0076, 5 x 10yd 30p

Neon bulb 80V wire ended 5 for 20p

Min. push button, push to make 10p

Mains transformer 32-0-32 at 150mA 50p

### ELECTRONIC PIANO

½W RESISTOR KIT TOTAL OF 1050 £5

Other parts available at bulk buy prices. Please send for list

### C.W.O. only. P. & P. 10p on orders below £5.

Discount: £10-10%, £20-15%.

Dept. P.E. 61, CHEDDINGTON ROAD, PITTSIDE

Near LEIGHTON BUZZARD, BEDS, LU7 9AQ

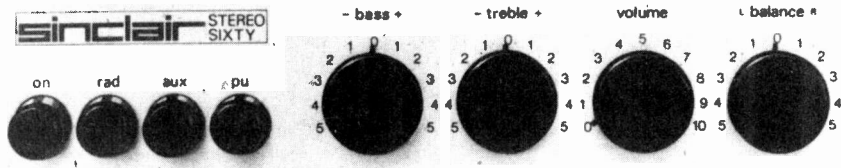
Tel.: Cheddington 668446 STD. (0296)

Inquiries—S.A.E. Catalogue 5p. Callers please phone first.



# Sinclair Project 60

## Stereo 60



Built and tested post free  
**£9.98**

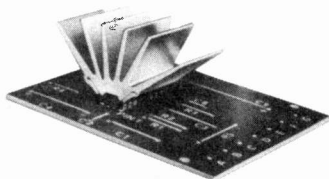
### pre-amplifier/control unit

The versatility of Project 60 high-fidelity modules is well demonstrated in this excellent unit. It provides the facilities essential to good stereo and will enhance the quality of any system it is used with, whether Project 60 or any other top line power amplifiers. Compact, yet robustly constructed, the unit is easily panel mounted and will operate satisfactorily from 18 to 35 volts supply. Silicon epitaxial transistors are used throughout to achieve a very high signal to noise ratio with excellent separation between channels. Distortion at maximum output is barely 0.02% with magnetic p.u. input. Accurate equalisation is provided for all inputs, which are selected by push buttons. For maximum effectiveness, the Sinclair A.F.U. is recommended for use with the Stereo 60 pre-amp/control unit. A comprehensive manual supplied with Project 60 modules makes installing and connecting easy and ensures best possible results from your system.

#### SPECIFICATIONS

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

### Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC. make possible. It is the equivalent of a 22 trans-

istor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

#### SPECIFICATIONS

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

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual.

**£2.98** Post free

### Project 605



### The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

Everything you need to assemble a superb 30 watt high fidelity stereo amplifier without having to solder.

Sinclair Radionics Ltd, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel: St. Ives 64311

# sinclair

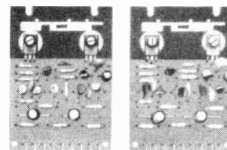
# the world's most advanced high fidelity modules

## Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual. Z.30 £4.48 Z.50 £5.48

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and are intended for use principally with other units in the Project 60 range. Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

**SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications).— Power Outputs:** Z.30 15 watts R.M.S. into 8 ohms using 35 volts; 20 watts R.M.S. into 3 ohms using 30 volts. Z.50 40 watts R.M.S. into 3 ohms using 40 volts; 30 watts R.M.S. into 8 ohms using 50 volts. **Frequency response:** 30 to 300,000Hz ± 1dB. **Distortion:** 0.02% into 8 ohms. **Signal to noise ratio:** better than 70dB unweighted. **Input sensitivity:** 250mV into 100 Kohms (for 15w into 8Ω). For speakers from 3 to 15 ohms impedance. **Size:** 14 x 80 x 57mm.

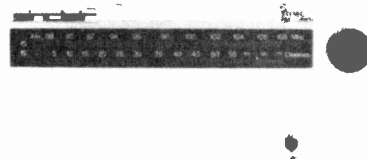


## Project 60 Stereo F.M. Tuner

Built and tested. Post free. £25

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

**SPECIFICATIONS—Number of transistors:** 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz. **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** Typically 20μV. **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10Hz - 15KHz (± 1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum. **Operating voltage:** 25-30VDC. **Indicators:** Stereo on; tuning. **Size:** 93 x 40 x 207mm.



## A.F.U. High & Low Pass Filter Unit

Built, tested and guaranteed. £5.98

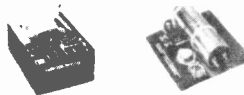
For use between Stereo 60 unit and two Z.30s or Z.50s. The unit is very easily mounted and is unique in that the cut-off frequencies are continuously variable. As attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. There are two filter sections - rumble (high pass) and scratch (low pass). H.F. cut-off (-3dB) variable from 28KHz to 5KHz. L.F. cut-off (-3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V supply) 0.02% at rated output. Operating voltage from 15 to 35V. Current 3mA. **Size:** 66 x 40 x 90mm.



## Power Supply Units

Designed specifically for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 or PZ.8 where a stabilised supply is essential.

PZ.5 30 volts un stabilised £4.98  
 PZ.6 35 volts stabilised £7.98  
 PZ.8 45 volts stabilised £7.98  
 (less mains transformer) £5.98



### Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control, etc.	£4.48
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control, etc.	£9.45
12W. RMS continuous sine wave stereo amp. for average needs	2 x Z.30s, Stereo 60; PZ.5	Crystal, ceramic or mag P.U., F.M. Tuner, etc.	£23.90
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	2 x Z.30s, Stereo 60; PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	£26.90
80W. (3 ohms) RMS continuous sine wave deluxe stereo amplifier. (60W. RMS into 8 ohms)	2 x Z.50s, Stereo 60; PZ.8, mains transformer	As above	£34.88
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£19.43

F.M. Stereo Tuner (£25) & A.F.U. (£5.98) may be added as required.

# sinclair

## Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

SINCLAIR RADIONICS, ST IVES, HUNTINGDONSHIRE PE173

Please send

I enclose cash/cheque/money order.

Name \_\_\_\_\_

Address \_\_\_\_\_







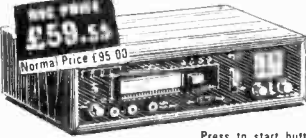
"Where can I get exclusive units at lowest prices?..."

# ROC ELECTRONICS!



**ROC PRICE £10.50**  
Normal Price £15.70

**OLSON AM408 4-WATT STEREO AMPLIFIER**  
Here's marvellous value for someone just starting to set themselves up in audio! At only £10.50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 20-20,000 Hz ± 3dB. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV, tuner/aux 80mV. Size 8" wide, 2 1/2" high, 4 1/2" wide.



**ROC PRICE £59.50**  
Normal Price £95.00

**8-TRACK STEREO CARTRIDGE TAPE DECK MODEL RP-1000ST**  
The popular near-Jet type recording unit is the heart of the fantastic RP-1000ST, which has full record and playback facilities. Automatic track change with manual over-ride.

Press to start button. Stereo headphone and Left and Right Mic sockets on front panel. Dual recording level meter, and Left and Right volume controls. Built-in pre-amp. Tape speed 3 3/8 ips (9.5 cms). Frequency response: playback 30-10,000 Hz, recording/playback 30-8,000 Hz. Line output: fully variable 0-500mV. The RP-1000ST incorporates all the features you'd expect on a top quality Cartridge Tape Deck. Size 16" wide, 4" high, 9" deep. Cabinet in walnut. Including connecting leads.



**ROC PRICE £28.00**  
Normal Price £35.70

**A-3000 36-WATT SOLID STATE STEREO AMPLIFIER**  
The A-3000 looks as good as it sounds! Giving you a big performance this superb audio amplifier has a full range of facilities on the front and rear panels. On the front - all the controls you're ever likely to need plus a headphone socket. On the rear - signal inputs, speaker output and a line fuse for circuit protection. Specifications: 18 watts rms per channel into 8 ohms. Frequency response 20-35,000 Hz (± 2db) Inputs: Magnetic, Ceramic, Tuner, Tape, Aux. Tape Play. Size: 345mm x 300mm x 130mm.

**REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500**  
A superb hi-fi amplifier with all the features you've ever wanted - for under £46-00. Saving over £10.00 on the normal retail value. Up-to-the-minute slider controls for bass and treble. Separate volume and balance controls. Headphone socket on front panel. Push-button input controls - magnetic phono (high/low) tuner, aux, mono, monitor. Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers. Noise filtering and tape monitoring facilities. Two auxiliary AC outlets. Frequency response 20-20,000 Hz ± 1 db at full power. 15 watts rms per channel. Walnut cabinet with satin aluminium trims. Inputs: phono 2.5mV and 5mV RIAA, tuner/aux 250mV. Hum and noise: phono - 50db; tuner/aux - 65db.

How's that for a specification!  
Size 14 1/2" wide, 3 1/2" high, 10 1/2" deep.



As reviewed in 'POPULAR HI-FI' February 1972

**ROC PRICE £35.20**  
Normal Price £55.50



**ROC PRICE £27.25**  
Normal Price £39.95 each

**25-WATT 3-WAY CHRYSLER 'LIVING AUDIO' SPEAKER CE-5B**  
This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units on 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s. into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10 1/2" x 7 1/2" x 8 1/2". Exactly right for matching the most modern decors.



**OLSON RA-310 AM/FM/MPX STEREO TUNER**

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as its good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10.00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz. AM: 525-1605 kHz. FM Sensitivities: FM, 3µV, AM, 250µV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11 1/2" wide, 4" high, 7 1/2" deep.



**ROC PRICE £27.55**  
Normal Price £42.00

**PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-18**  
This is one of the lowest priced stereo tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received - that's the time to switch to 'Stereo'! The SSA-18 has all the facilities you'd expect to find on tuners costing twice as much - separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz, AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4 1/2" high, 8" deep.

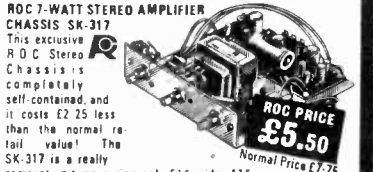
## CONSTRUCTORS' KITS

- TWO TRANSISTOR RADIO KIT**  
Complete with solar cell  
**£2.50**
- 10 PROJECT INTEGRATED CIRCUIT KIT**  
Build a radio, morse key, etc.  
**£3.50**

**SOLAR ELECTRONIC KIT**  
20 ways of harnessing the sun's energy  
**£4.50**

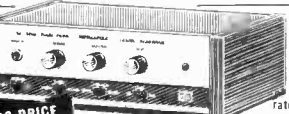
**TWO OCTAVE ELECTRONIC ORGAN KIT**  
Make your own music. Complete with speaker  
**£4.50**

**LIMITED STOCKS BUY NOW FOR XMAS!**



**ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317**  
This exclusive R O C Stereo Chassis is completely self-contained, and it costs £2.25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5 1/2" wide, 1 1/2" high and 8 1/2" deep. It contains its own mains power supply, and has a ganged volume control and separate treble controls for each channel. Specification: frequency response 40-17,000 Hz ± 3dB, output 3.5 watts music power per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45dB.

**ROC PRICE £5.50**  
Normal Price £7.75



**REALISTIC SA-100B 6-WATT STEREO AMPLIFIER**

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide x 3" high x 5 1/2" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/tuner and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut brown enamel. Frequency response is 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

### SPECIAL OFFER!

**TEC HR-807 HEADPHONE RADIO**  
When you want to listen to the radio all by yourself! Then this will solve the problem. Separate volume and tuning controls with easy-to-use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW.  
Normal Price £7.65 ROC PRICE £5.00

### EAGLE LC 07 STEREO MOVING-MAGNET CARTRIDGE

Here's your opportunity to own a transcription cartridge for the price of a ceramic! It's specially designed to match top quality tone arms, and to get the very best from your hi-fi amplifier. 0.7 mil diamond stylus. Output: 7mV per channel. Frequency range: 20-21,000 Hz. Channel balance: ± 1dB. Channel separation: 28dB. Compliance: 12 x 10<sup>-6</sup> cm/dyne.  
ROC PRICE £6.37



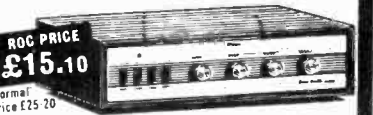
**OLSON AM-395 40-WATT STEREO AMPLIFIER**

An ideal unit for your new stereo separate system. It is more than £10.00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3.0mV RIAA, crystal phono 100mV, tape 180mV, tuner 180mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well - sounds even better!

**ROC PRICE £24.10**  
Normal Price £39.60



**R.446 3-WAY MATCHED SPEAKERS**  
These will do justice to your amplifier - and to your pocket. At only £17.80 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range 40 to 19,000 Hz. Size 14in. high, 9in. wide, 6 1/2in. deep.  
**ROC PRICE £17.80**  
Normal Price £29.00 per pair.



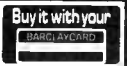
**ROC PRICE £15.10**  
Normal Price £25.20

**OLSON AM-372 18-WATT STEREO AMPLIFIER**  
Here's a really good amplifier at a really down-to-earth price - nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you - reproduces signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12 1/2" wide, 3 1/2" high, 7 1/2" deep.

## ROC ELECTRONICS LTD

N. JORY Esq. 193 EDGWARE RD, LONDON, W2 1ET. 01-723 6211  
CALLERS WELCOME 9-6 MON. TO SAT.  
ALSO AT 87 TOTTENHAM COURT RD. LONDON W1  
TEL: 01-580 3739 OPEN 9-6 MON.-FRI. SAT. 9-1

Return-of-post mail order service from Edgware Road Orders over £10 post free (UK only). Add 25p for p & to orders under £10. HP terms available for callers



**BELLING LEE INSULATED TERMINALS.** Red or Black, 5 amp. max. 10p pair, pp 34p

**BERECOSTAT WIREWOUND RHEOSTAT.** 60 volt, 800 Ω 25 watta, 2" dia. 25p. pp 71p.

**FINNED ALUMINIUM HEATSINK 9" x 11".** Ready Drilled. 20p, pp 61p

**SMITHS CIRCULAR TAPE POSITION INDICATORS** Resettable. 50p, pp 6p.

**G.E.C. 5 AMP 240 VOLT A.C. CIRCUIT BREAKER.** 75p, pp 104p.

**SUB MIN CROC CLIPS.** Red or Black, insulated 4p. Min. quantity, 6 pp 34p.

**GARRARD MAG TAPE DECKS:** 11ips, 50v solenoid operated brakes etc., Mains voltage motors £7-50 each, pp £1-23.

**41" PLAINAIR FANS.** Complete, capacitor, ex-equip. 2,800 r.p.m. £3-50, pp 40p.

**ELECTRIC MOTORS, HOOVER OR CROMPTON PARKINSON.** 250v. Single Phase A.C.

1 h.p. 1,440 r.p.m. £3-25 pp £1 00  
1 h.p. 1,425 r.p.m. or 2,800 r.p.m. £8-75 pp £1-25  
1 h.p. 1,440 r.p.m. £2-25 pp 75p

**AUDIO CONNECTORS**

3 pin Din Plug . . . . . 18p each  
5 pin Din Plug A type, B type . . . . . 18p ..  
2 pin Din Speaker Plug/socket . . . . . 10p ..  
3 pin Din Line Socket . . . . . 18p ..  
3.5mm Jack Plug Screened . . . . . 10p ..  
Standard Jack Plug . . . . . 10p ..  
Screened Standard Jack Plugs . . . . . 18p ..  
Stereo Jack Plug . . . . . 18p ..  
Screened Stereo Jack Plug . . . . . 18p ..

**Phono Plugs:** Red or Black 8p each.  
pp on above items 34p.

**MAINS NEONS.**  
Red or Green. Size: 1" x 1 1/2" 16p, pp 34p.

**LEVER ACTION P.O.1000 TYPE SWITCHES.**  
Lock 4-pole changeover 15p, pp 34p. (ex-equip.)

**Lock 2 Pole Changeover 10p pp 34p. (ex-equip.)**

**AUDIO LEADS**

Screened Phono Leads 46" long, 16p  
3.6 mm JACK/3.5mm JACK 7' 6" long 40p  
5-Pin Din & 3-Pin DIN A TYPE. Approx 5' long 70p. pp above items 91p

**MULLARD & MALLORY SCREW TERMINAL CAPACITORS** 4,500 ul 64v. 7,100 ul 40v. 50p each.  
20,000 30v, 25,000 25v. 35,000 15v. 30p each pp 10p.

## THE RADIO SHOP

16 Cherry Lane, Bristol BS1 3NG  
Tel.: Bristol 421196. STD Code 0272  
Your West Country shop for electronic components and solid state devices

**2 METRE PRE-AMPLIFIER**  
Single F.E.T. Pre-amp. neg. earth. Gain app. 12dB. Circuit, Instructions and Components. All you need is a tobacco tin. £1-20, post paid.

**AIRCRAFT BAND CONVERTER**  
Circuit, Instructions and Components. All you need is a tobacco tin. £1-27, p.p.

**TAPE RECORDER LEVEL METERS**  
500μA, size 1in x 1in x 3/4in. 55p, p.p.  
**LINEAR IC'S**  
μA 709 Op. amp. TOS or DIL 42p, P. & P. 5p.

**Transistor Equivalent Book** 44p, post paid.  
**Coil Design and Construction Manual** 34p, post paid  
**Tested Transistor Circuits (1972)** 44p, post paid.

**World's Short Wave, Medium Wave, FM and TV Listing.** 40p, p.p.  
**NUMICATORS**  
GNP-7AH, similar XN3, side reading clear. Send 5p for data. With data, 75p plus 10p P. & P., 4 post free.  
**WE STOCK "Wecco" Television Tubes.** 1972 CATALOGUE, 5p, Post Free

**EX COMPUTER PRINTED CIRCUIT PANELS**  
2in x 4in packed with semi-conductors and top quality resistors, capacitors, diodes, etc. Our price 10 boards 50p, P. & P. 7p. With a guaranteed minimum of 35 transistors. Data on transistors included.

**SPECIAL BARGAIN PACK.** 25 boards for £1, P. & P. 18p. With a guaranteed minimum of 85 transistors. Data on transistors included.

**PANELS** with 2 power transistors similar to OC28 on each board - components 2 boards (4 OC28) 50p, P. & P. 6p.

9 OA5, 3 OA10, 3 Pot Cores, 26 Resistors, 14 Capacitors, 3 GET 872, 3 GET 872B, 1 GET 875. All long leaded on panels 13in x 4in. 4 for £1, P. & P. 25p.

**709C OPERATIONAL AMPLIFIER TOS**  
8 lead I.C. 1 off 50p. 50 off 35p.  
100 off 20p.

**250 MIXED RESISTORS** 62p  
1/4 & 1/2 watt.

**150 MIXED HI STABS** 62p  
1/4, 1/2 & 1 watt 5% & better.

**QUARTZ HALOGEN BULBS**  
With long leads. 12V 55W for car spot lights, projectors, etc. 60p each. P. & P. 5p.

**GPO EXTENSION TELEPHONES**  
with dial but without bell. 95p each. P. & P. 30p.  
£1 75 for 2. P. & P. 50p.

**BARGAIN RELAY OFFER**  
Single pole change over silver contacts 25V to 50V. 2.5k Ω coil. 8 for 50p. P. & P. 5p.

**KEYTRONICS** mail order only  
44 EARLS COURT ROAD  
LONDON, W.8 01-478 8499

**SINCLAIR PROJECT 60**

Z30 £3-50  
Z50 £4-25  
PZ5 £3-97  
PZ6 £6-26  
Project 60 tuner £16-80  
AFU £4-50

Stereo 60 £7-80  
Project 60S £19-00



**PROJECT 60 KIT** £2-50  
Our extremely popular kit contains the extra capacitors, DIN plugs and sockets, cables and fuse holder needed to complete Project 60.

**S-DECS AND T-DECS**

S-DECS £1-40  
T-DECS £2-80  
μ-DEC A £3-00  
6811 IC carriers £1-25



**SINCLAIR SUPER IC12**

Complete with free printed circuit board and 44 page Instruction book.



Special price if bought with basic or deluxe kits below, only £1-80 plus 10p postage. (£2-00 if purchased separately)

**DELUXE KIT FOR THE IC12**  
Includes all parts for the printed circuit and volume, bass and treble controls needed to complete the mono version £1-30. Stereo version with balance control £3-00.

**BASIC KIT FOR THE IC12**  
Contains components for P.C. board and volume and simple tone controls. Mono version £1-10. Stereo model with balance control £2-80.

**POWER UNITS FOR THE IC12**  
A set of components to construct a 28V 0.5 Amp power supply £2-27. Also suitable Sinclair PZ5 fully constructed £3-97.

**LOUDSPEAKERS FOR THE IC12**  
Specially chosen for the IC12. 5" 8 ohm £1-00. 5" x 8" 8 ohm £1-45. 10" x 6" x 15 ohm £2-27.

**PREAMPLIFIER KITS FOR THE IC12**  
Type 1 for magnetic pickups, mics and tuners, with 3 position equalization switch. Mono model £1-20. Stereo model £2-20. Type 2 for ceramic or crystal pickups. Mono 48p. Stereo 96p.

**SEND S.A.E. FOR FREE LEAFLET ON KITS**

**IC RADIO CHIP TBA551**  
As featured in July Practical Wireless IC of the month feature. Contains RF Amp, oscillator, mixer, IF Amps, detector, voltage stabilizer and wide range AGC circuitry. Specially developed by SGS for high performance radios and car receivers. Complete with application data £2-00.

**AC/DC CONVERTOR SENSATION**  
Producing the most versatile AC/DC converter yet offered, with a high current output that makes it suitable for operating most battery tape recorders, record players, cassette recorders and shavers. Input 200/240 V. Output voltage selected by front panel switch may be 3V, 4.5V, 6V, 7.5V, 9V and 12V at 500 ma. Housed in a very strong, attractive plastic case and fully guaranteed for 12 months. £4-47.

**SINCLAIR EXECUTIVE CALCULATOR**

Weights only 2½oz. Fits the pocket. Runs for 3 months average use on one set of tiny hearing aid batteries. Contains 7000 transistors. Brilliant 8 digit display. Adds, subtracts, multiplies and divides. Constant multiplier facility. Floating point or fixed point with 2, 4 or 6 decimal places. Subject to manufacturer's complete 5 year guarantee. Comprehensive after sales back up is supplied by Sinclair's famous service dept. If any Executive purchased from us fails to give satisfaction and is returned undamaged in 10 days we undertake to refund the whole purchase price.

**SAVE £10.**  
**OUR PRICE ONLY £69 (List Price £79).**

**SWANLEY ELECTRONICS**  
32 Goldsel Road, Swanley, Kent  
Mail order only. Postage 10p per item.  
Our Hi-Fi colour catalogue is 10p post free

**FIELD ELECTRIC LIMITED**  
3 Shenley Road,  
Borehamwood, Herts.  
Adjacent Elstree Mainline Station  
Tel: 01-953 6009.

**ATTRACTIVE DISCOUNTS ON VERY MANY ITEMS WHEN YOU BUY FROM US**

# ELECTROVALUE

Electronic Component Specialists

**TRANSISTORS** Wide range. Up to date. Brand new —no 'seconds' or surplus. Highest quality and reliability.

1N4148	0-04	AF139	0-33
1N5399	0-24	AP239	0-38
2N2846	0-27	BC107	0-13
2N3055	0-65	BC108	0-12
2N3702	0-10	BC109	0
2N3703	0-10	BC148	
2N3704	0-10	BC177	
2N3819	0-25	BC184L	
2N4286	0-15	BC212L	
2N4289	0-15	BD13c	
2N4443	0-88	BT	
2N5082	0-42		
2N5088	0-42		
2N5192	0-48		
2N5195	0-42		
2N5457	0-0		
40361			
40382			
40432			
40512			
40659			
AC128			
AD142			
AD149			
AD161			
AD182			

**Minitron DIGITAL**

1 seg-  
com-  
and-  
ard  
power  
9 from  
filament  
give  
1 height plus decimal point.  
ent 8mA from 5V d.c. per  
ited number of alphabetical  
ailable. In 16 lead DIL case



**SOLDERSTAT SOLDER IRONS**

As appointed distributors for well-known Eremco-Wolfe "Solderstat" irons, we offer this model HMS in 16 or 24 watt, a.c. mains, net

**£1-87**  
INFINITELY VARIABLE TEMPERATURE CONTROLLED SOLDER IRON E9-20  
DE-SOLDER BRAID

Per 6ft length, net 50p.

**NIPPIBOARDS**

A useful board for circuit building.  
Type 1A. Single basic pattern 2-2" x 1-7", 15p.  
Type 2A. Two ptns. side by side, 28p.  
Type 2AB. Dual channel, 28p.  
Type 3A. 3 ptns. side by side, 36p.  
Type 4AB. Dual channel, 2 above 2, 44p.  
Types in stock up to 10 patterns.

**PUBLICATIONS**

Resistor Equivalents, 40p. Handbook  
Results (H. Ness), 40p. Radio &  
Codes & data wall chart, 15p.  
& Tables, 20p. (Add 3p  
bought separately.)

**TTL**

These prices are nett.

(7473)	46p
(7474)	45p
(7475)	45p
(7476)	45p
(7480)	68p
(7481)	87p
(7486)	1-28
(7487)	38p
(7490)	80p
(7491A)	1-28
(7492)	85p
(7493)	80p
(7494)	1-13
(7495)	87p
(7496)	1-43
(7497)	1-64
(7498)	43p
(7499)	58p
(7500)	48p
(7501)	1-80
(7502)	1-80
(7503)	1-74
(7504)	1-74

**It's more than just a catalogue—and we give you a 25p REFUND VOUCHER with it!**

**ELECTROVALUE Catalogue No.6**

The Electrovalue Catalogue No. 6 (4th printing—96 pages) is as much a manual of valuable technical information as it is a comprehensive, up-to-date catalogue of semiconductors, components, accessories, materials, tools, etc. All items are brand new and to makers' specifications. Prices are competitive, there are attractive additional discounts offered, and now we include a refund voucher for 25p available for spending on orders for £5 or more. Send 25p for latest Electrovalue Catalogue now, post free.

- Hundreds of today's most wanted transistors with data and outlines
- Diodes, thyristors and tri-acs fully detailed
- I.C.'s plus schematics, theoretical and connection diagrams
- Slide and rotary potentiometers, knobs, plates, etc.
- Resistors and capacitors in very wide ranges
- Siemens pot cores
- Connectors, switches, relays
- Transformers, solder irons, etc.
- S-Dec, T-Dec, mounting boards
- Materials, hardware, etc.

**RESISTORS**

Code	Power	Tolerance
C	1/20W	5%
C	1/8W	5%
C	1/4W	10%
C	1/2W	5%
C	1W	5%
MO	1/2W	2%
WW	1W	10%
WW	3W	±1/20Ω
WW	7W	5%

Codes: C = carbon  
MO = metal  
WW = wire  
Values: E12 denotes decades, E24 denotes their decades, and their decades, power rating, NOT minimum resistor order.

**BARANDAL**

As design: "Wireless special clip, 10 watt

Speaker unit: Pack flat cardboard finish with ins

**SIEMENS TE**  
0-8A-400V, 5.  
3A-400V, 60p.

**CARBON SKELETON**  
Small high quality, ty  
470Ω, 1K, 2K2, 4K7,  
47K, 1M, 2M2, 5M,  
mounting, 5p each.

**ZENER DIODES** 5% fd.  
2.7V to 36V, 14p each;  
1.5W: 4.7V to 75V, 48p each.  
Clip to increase 1.5W rating to 3W

**MINIATURE TOGGLE SWITCHES**  
2A/250V. DP/DT, 48p.

**MAINLINE AMPLIFIER KITS**  
70 watt power amp module kit, £12-60 net. 1 kit supply kit, 28-50 net.

PRICES APPEARING IN THIS ADVERTISEMENT ARE FOR GUIDANCE ONLY. CURRENT PRICES ARE THOSE IN LATEST CATALOGUE.

# ELECTROVALUE

(Dept. PE 1) 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB  
Hours: 9—5.30. Sat. 1 p.m. Tel.: Egham 3603 (STD 0784-3). Telex 264475  
ELECTROVALUE LTD.—AN INDEPENDENT COMPANY SINCE ITS ESTABLISHMENT IN 1965

# Practical Electronics Classified Advertisements

RATES: 9p per word (minimum 12 words). Box No. 20p extra. Semi-Display £7 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Manager, "Practical Electronics" IPC MAGAZINES LTD., Fleetway House, Farringdon Street, London EC4H 4AD

## BOOKS AND PUBLICATIONS



### THE PICTURE BOOK METHOD OF LEARNING

**BASIC ELECTRICITY 5pts £4.50. BASIC ELECTRONICS 6pts £5.40. BASIC TELEVISION 3pts £3.60**

(Postage and Packing included)

The Pictorial Approach Manuals assure the quickest and soundest method of gaining mastery over these subjects. The clear and concise illustrations make study a real pleasure. Your money refunded if not completely satisfied is your 100% Guarantee. Free Illustrated Prospectus on request.

Send now to **SELRAY BOOK CO., 60 HAYES HILL, BROMLEY BR2 7HP**

# FREE

ELECTRONIC COMPONENTS CATALOGUE

★Everything from nuts and bolts to I.C.'s★

ALL YOU HAVE TO DO IS

# PHONE

**03-742 79033**

Or write **MAPLIN ELECTRONIC SUPPLIES**  
P.O. Box No. 3, Rayleigh, Essex. No s.a.e. needed.

## SITUATIONS VACANT

**YOUNG MAN WITH STRONG INTEREST IN ELECTRONICS** is required by a major electronic components distributor in the Slough area. The job is to learn about the components we sell and then to answer customers' technical enquiries on the telephone. Applicants need not have electronics qualifications but must have the ability to learn quickly and will probably have electronics as main hobby.

Applicants should apply in writing or by telephone to: **J. BARNARD, Macro-Marketing Ltd., 396 Bath Road, Slough, Bucks.** Tel. Slough 35444.

## MEN! £50 p.w. can be yours

Jobs galore! 144,000 new computer personnel needed by 1977. With our revolutionary, direct-from-America, course, you train as a Computer Operator in only 4 weeks! Pay prospects? £2500+p.a. After training, our exclusive appointments bureau—one of the world's leaders of its kind—introduces you **FREE** to world-wide opportunities. Write or 'phone **TODAY**, without obligation.

London Computer Operators  
Training Centre

M81, Oxford House  
E87, Oxford Street, W.1.  
Telephone: 01-734 2874

127, The Piazza, Dept. M81  
Piccadilly Plaza, Manchester 1.  
Telephone: 061-236 2935

# Test Equipment Technician

We are one of the country's leading manufacturers of hybrid micro-circuits. Over the past six years our development team has pioneered many new devices and we are still expanding to meet new applications from customers.

The team now requires a young Technician to work with an experienced Engineer on the preparation of test equipment and specifications used to manufacture a very wide range of thick film circuits. The work will range from black box test equipment manufacture to the introduction of a fully automatic laser trim system.

Candidates should be aged 18 to 25, preferably with G.C.E. "A" level, C and G or O.N.C. and some practical experience of making electronic equipment or components.

Facilities are available to attend day release classes in electronics at local technical colleges. Hours 8.30 a.m. to 5.00 p.m., Monday to Friday, with an hour for lunch each day, although candidates will be expected to work overtime as and when required. Salary according to age, qualifications and experience. Assistance will be given in finding suitable accommodation in this pleasant resort where our laboratories overlook the sea front.

Write in confidence for an application form to **Mr. C. M. B. Newton, Personnel Officer, Erie Electronics Limited, South Denes, Great Yarmouth, Norfolk.**

ERIE

ELECTRONICS

LIMITED



## SERVICE SHEETS

**SERVICE SHEETS.** Radio, TV, etc., 8,000 models. List 10p. S.A.E. enquiries. **TELRAY, 11 Maudland Bank, Preston.**

**SERVICE SHEETS** for Televisions, Radios, Transistors, Tape Recorders, Record Players, etc., from 5p with free Fault-Finding Guide. S.A.E. orders/inquiries. Catalogue 15p. **HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.** Telephone Hastings 29066.



# TELEVISION TRAINING (MONOCHROME AND COLOUR)

This private College provides theoretical and practical training in Radio and TV Servicing. Courses of 16 months' duration, with daily attendance, are available for beginners and shorter courses for men with previous training in Electronics and Radio. Next course commences January 1st. Training courses in Marine Radiocommunication and Radar are also available. Write for prospectus to: London Electronics College, Dept. B/1, 20 Penywern Road, Farns Court, London SW5 9SU. Tel. 01-373 8721.

**FOR SALE**

**MORSE MADE EASY!!**

**FACT NOT FICTION.** If you start **RIGHT** you will be reading amateur and commercial Morse within a month (normal progress to be expected).

Using scientifically prepared 3-speed records you automatically learn to recognise the code **RHYTHM** without translating. You can't help it, it's as easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.

Beginner's Section only £3.30, complete course £4.50 (Overseas £1 extra) details only, 4p stamp. 01-660 2896 **G3HSC** (Box 19), 45 **GREEN LANE, PURLEY, SURREY**

**CATALOGUE NO. 18,** Electronic and Mechanical Components and manufacturers' surplus. Credit vouchers value 50p. Price **23p**, including post. **ARTHUR SALLIS RADIO CONTROL LTD.,** 28 Gardner Street, Brighton, Sussex.

**SEEN MY CAT?** 5,000 items. Mechanical and Electrical Gear, and materials. S.A.E. K. R. WHISTON, Dept. PE, New Mills, Stockport.

**SALE OF STOCK.** M.E.S. bulbholders, 200 for £1; spring terminals (useful for breadboard layouts), 10 for 30p; festoon lamps 12V 6W, 5 for 50p. S.A.E. for list. **METRILEX,** 20 Horny Lane, Winwick, Warrington, Lancs.

**COMPLETE SET P.E.** with binders but not gifts. Offers Box No. 45.

**NUMERATORS. USED MULLARD ZM1080,** 85p each plus 10p P. & P. Send S.A.E. For quantity quote: M. S. TURNER, 25 Roland Drive, Hempnall, Norfolk, NOR 64W.

**WANTED**

**TOP PRICES PAID** for new valves and components Popular T.V. and Radio types **KENSINGTON SUPPLIES** (B) 367 Kensington Street Bradford 8, Yorks.

**RECEIVERS AND COMPONENTS**

**SOUND SUPPLIES** (Electronics) Co. Ltd. P.A. EQUIPMENT. Marshall amps, instruments and guitars, etc. TOA and Eagle amps and accessories, Reslo mics, etc. COMPONENTS. Resistors, capacitors, plugs, sockets, cables, audio leads, semiconductors, valves, vero board, etc., for the constructor. Power packs and car droppers for the cassette recorder or radio. S.A.E. for list and enquiries. P.A. list 15p. 12 Smart's Lane, Loughton, Essex. Tel. 01-508 2715 Closed all day Thursday

**DRY REED INSERTS**

Overall length 1.85" (Body length 1.1"), Diameter 0.14" to switch up to 500 mA at up to 250v D.C. Gold clad contacts. 621p per doz.; £3.75 per 100; £27.50 per 1,000; £250 per 10,000. All carriage paid. **G.W.M. RADIO LTD.** 40/42 Portland Road, Worthing, Sussex 0903 34897

**METERS,** Motors, Relays, Valves, Electronics. At **ROGERS FASCINATING ESTABLISHMENT,** 31 Nelson Street, Southport.

**Trampos electronic**

All Brand New. Money back if dissatisfied. **Fast Service, 5V DIGITAL INDICATOR** 90P, with socket and red Filter **£1.39 NIXIE 99p.** **IC GAS DETECTOR.** Smoke, Butane, Vapor, etc. **£2.19,** data 9p. **ULTRASONIC TRANSDUCER.** Transmit or receive. **£2. LIGHT EMIT DIODE** visible red/panel clip/data, 39p.



**CALCULATOR** full function, 8 digit, £36.97, data free.

**IC digital clock**

28 pin DIL 12/24 hr. 4/6 digit. £11.50, data 9p. Kit £21. Indicators £1.29 ea. PCB £1.69, Case 35p. MOS/LSI IC data: Calculator 45p. DVM 85p.

**STEREO.**

**QUAD AUDIO** from stereo, matrix IC, £2.87. **MAGNETIC CARTRIDGE**, diamond 20-20kHz, £4.19. **DUAL IC PREAMP** £1.67. **FM HI-FI TUNER** £8. **MC1310P MPX FM** decoder, £2.89. **KIT** £3.45. **5W** dual amp tone/balance 50-20kHz £5.97. **FW Texan.** Kit less chassis, £21.49; **PAKS:** Res. 50p; ic/semiconductor, £7; caps, £2.49; transformers, £2.87.

**INTEGRATED CIRCUITS:** with data 741 DIL 28p; 709 TO5, 21p; DIL 28p; 710, 33p; 748, 33p; 723 57p; Photodetector/amp, 39p; Voltage Regulator 1µamp, 5 to 20V, 3 lead, £1.67; TAD100 RX, £1.79; Data 16p; 3.5W AF amp, £1.24. **74N TTL:** Data booklet, 15p.

7400/1234/5/10/20/30/40/50, etc., 15p; 7413, 29p; 7470/72, 30p; 7473/74/76, 40p; 7447, £1.49; 7490, 69p; 7492, 69p; 74121, 49p; 74141, £1. **DIL SOCKETS,** high or low profile, 14 or 16 pin, 13p. **SEMICONDUCTORS** **EN3055**, 40p; **BC107**, 8p; **BC108**, 8p; **BC109**, 8p; **AC129/6278**, **AC127/8**, **AC187/8**, **AF117**, 15p; **AD161/2**, 35p; **BC167/8/9**, 17p; **BC177/8/9**, 39p; **BC182/3/4**, 8p; **BC212/3/4**, 17p; **BCY70**, 18p; **BFY50/51/52**, 17p; **T1843 UJT**, 29p; **N706A**, 12p; **FET 2N3819**, 28p; **2N2926 C. O. Y.**, 30p; **2N3053**, 17p; **2N3702/3/4/5/6/7**, 15p; **2N3708/9/10/11**, 9p. **ME** 0411/2, 18p; **ME** 4001, 12p; **ME** 4102, 11p; **1N914**, 5p; **OA91**, 5p; **OA200/202**, 10p. **RECTS:** **1N4004**, 4p; **1N4004A**, 8p; **Bridge 100V**, 25p. **ZENERS:** **BZY88 400mW**, 11p; **10W5V**, 1V, 29p; **SCR's** 400V: **1A**, 23p; **3A**, 49p; **4A** 55p; **Triac** 6A, 68p. **CAPACITORS:** 25/30V Electrolytic. **10/50/100µF**, 5p; **200/500µF**, 8p; **1,000µF**, 15p. **DISC:** 22pF thro' to 0.047µF, 3p; 0-01 to 0, 6p. **RESISTORS** 1W 5%, 11p. **PRESETS** 0.25W, 4p. **WEATHER STATION** barometer, temp, humid, £2. **ELECTRONIC CAR IGNITION KIT** £6.67. **FREE CATALOGUE,** S.A.E. Data Sht, 6p each. **CWO, P. & P.** 7p, Overseas 35p. Discount 10+10%.

P.O. BOX 29, BRACKNELL, BERKS.

**MINIATURE CARBON FILM RESISTORS.** 5%, 1W, 1/2W, 1/4W, EEE Series. 2.0ohm to 3MΩ, 1p for 7p. 3p for 30p. Mixed values and wattages to your choice. **ELECTRONIC COMPONENTS, Lake Bargain Centre, 133 Park Road, Didcot.**

**100 WATT AMPLIFIER**

Fully protected, transformerless, 9 transistor circuit. Input 500 mV. Output into 8 ohms. 0.1% distortion. Printed circuit board and full instructions. **£1.45p + 10p P. & P.** S.a.e. for list of component bargains.

**EDMUNDS COMPONENTS, 134 NORTH END ROAD, LONDON, W14.** (Mail order only)

**MINI MAINS PACK KIT.** Safe double-wound mini transformer, silicon rectifiers, 1,000µF smoothing, instructions. Buildable to size of PPG, etc. 9V, 120mA, **80p**, U.K. post 5p. Mail order only. **AMATRONIX LTD.,** 396 Selsdon Road, South Croydon, Surrey, CR2 0DE.

**POLYSTYRENE CAPACITORS.** 125V-100, 120, 150, 160, 220, 270, 330, 390, 560, 680, 820, 1,200, 1,500, 1,800, 2,200, 2,700, 3,300, 3,900, 5,000, 6,800, 8,200, 0-01, 0-012, 20p doz., post 10p. 0-015, 0-018, 0-022, 0-027, 0-033, 30p doz., post 10p, when bought with other goods post paid.

**COMPUTER PANELS, AMERICAN.** 4-60p, post 12p with data. Panel type 773B, 8 silicon transistors, 40 diodes 20p; 701B, 6 silicon transistors, 16 diodes, etc. For full details of other types and components send large S.A.E.

**UNIT WITH 4LA2 POT CORES + CAPS,** 50p, post 15p. **LA2** ex. equip., 20p, new and boxed, 30p, C.P. **ORP12** ON PANEL EX. EQUIPT, 35p. C.P. **MC. METERS** 2 and 3in. three ass., £1.05, post 25p. **WIRES ENDED NEONS,** 10-45p, 20p, driver post 8p. **BANK OF FIVE WITH FIVE C407 DRIVER TRANSISTORS.** 45p, C.P. Bank of 30 with 30 transistors. £2.16, C.P. **NEW 46 WAY STEPPING SWITCH WITH RESET** for mains operation, £1.25, post 25p. **CROUZET GEARED SYN. MOTOR,** mains operation 15 r.p.m. a.c. wire, 75p, post 10p. **5-FIGURE RESETTABLE COUNTERS** 18/22V will work on 12V. £2, post 15p. **IC 7400 SERIES** on panel(s), 10-75p, post 10p. **NEW COIL PACK LMSW,** 8 piano key, no dope, 50p, post 20p. £2 POSITION **STEPPING SWITCH,** a.c. mains operated with reset, 80p, post 15p.

**ASSORTED COMPONENTS,** 7lb, £1.50, C.P. **ASSORTED COMPUTER PANELS,** 2lb, £1.50, C.P. **MIXED POLYSTYRENE, S/MICA CAPS,** 100-45p, C.P. **COPPER CLAD PAXOLIN PANELS,** 5 1/2in. x 5 1/2in. 6 for 30p, post 10p.

**J.W.B. RADIO**

75 HAYFIELD ROAD, SALFORD 6, LANCs.

**SPECIAL OFFER.** 100 mixed resistors. Preferred Values 1W and 1/2W £1.25, including postage. 2-2mF 250V WKG 10p each, including P/P. **ALEXANDERS,** 16 Inverness Street, London, N.W.1. Tel. 485 5322.

**PRECISION**

**POLYCARBONATE CAPACITORS**

**FRESH STOCK — FULLY TESTED**  
Close tolerance. High stability. All 63V d.c.  
0.47µF: ±5% 30p; ±2% 40p; ±1% 50p  
1.0µF: ±5% 40p; ±2% 50p; ±1% 80p  
2.2µF: ±5% 50p; ±2% 80p; ±1% 75p  
4.7µF: ±5% 70p; ±2% 80p; ±1% £1.15  
6.8µF: ±5% 95p; ±2% £1.15; ±1% £1.50  
10µF: ±5% £1.10; ±2% £1.40; ±1% £1.80  
15µF: ±5% £1.10; ±2% £1.10; ±1% £1.20

**TANTALUM BEAD CAPACITORS.** Values available 0.22, 0.47, 1.0, 2.2, 4.7, 6.8µF at 35V; 10µF, 25V; 1.5µF 20V, 22 at 15V; 33µF at 47µF 6V, 100µF 3V—all at 9p each; 6 for 50p; 4 for £1. Special pack 6 off each value 72 capacitors £2.

**NEW 1-TRANSISTORS.** BC107, BC108, BC109. All at 9p each; 6 for 50p; 14 for £1. All brand new and marked. Full spec. devices. May be mixed to qualify for quantity prices.

**POPULAR DIODES.** 1N914, 7p each; 8 for 30p; 18 for £1. 1N916, 9p each; 6 for 50p; 14 for £1. 1S44, 5p each; 11 for 50p; 24 for £1. All brand new and marked.

**NEW LOW PRICE — 400 mW Zeners.** Values available 4.7, 5.6, 6.8, 7.5, 8.2, 9, 1.0, 11, 12, 13.5, 15V. Tol. ±5% at 5mA. All new and marked. Price 10p each; 6 for 50p; 14 for £1. Special offer 6 off each voltage (66 zeners) £4.50.

**RESISTORS.** Carbon film 1/4W 5%. Range from 2-2Ω to 2.2MΩ in E12 series, i.e. 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, 47, 15V, 33p, £1 each. High stability, low noise. All at 1p each; 8p for 10 of any one value; 70p for 100 of any one value. Special development pack—10 off each value 2-2Ω to 2.2MΩ (730 resistors) £5.

**440V A.C. CAPACITORS.** 0.1µF, size 1 1/2in x 1/2in, 25p; 0.25µF, size 1 1/2in x 1/2in, 30p; 0.47 and 0.5µF, size 1 1/2in x 1/2in, 35p; 1.0µF, size 2in x 1 1/2in, 45p; 2.0µF, size 2in x 1 1/2in 75p.

**SILICON PLASTIC RECTIFIERS 1SA.** Brand new wire-ended DO27. 100µF at 8p each or 4 for 30p; 400µF at 9p each or 4 for 34p; 800µF at 14p each or 4 for 50p.

5p post and packing on all orders below £5. **V. ATTWOOD, DEPT. B6, P.O. BOX 8, ALRESFORD, HANTS**

YES YES YES YES YES

**Modern Computer Panels.** with TOS and plastic transistors, 6 for £1, 15p p. & p.

**P/C Board S/S** 5 1/2in x 5 1/2in. 10 for 50p + 15p p. & p.

**Transformers, 7.5 + 7.5V app. 1/2A, 60p, p.p.** 18-0-18V 200mA + 24V 40mA 70p, p.p.

**Potted Transformer, 1000-0-1000 @ 250 2A, £6, p.p.**

**F.M. Tuner, with RF stage with AGC.** 3 plug in transistors neg earth. Size 2 1/2in x 2in x 1 1/2in. With circuit, £1-25, p.p.

**Crouzet Geared Motors, 240 volt 10, 15, 30 or 60 rpm, new, £1-40, p.p.**

**Transformers, 52-0-52V 1A + 22-0-22V 0-2A, £2, p.p.** 34-0-34V 2A + 22-0-22V -2A, £2, p.p.

**3EG1 Scope Tube, new, £1-75, p.p.**

**UHF Tuners, transistorised, £1-50, p.p.**

**Veroboard 0-1 4in. x 2 1/2in. 10 for £1 + 15p p. & p.**

**R.T. SERVICES (Mail order only)**  
77 Hayfield Road, Salford 6

**NEW GUARANTEED DEVICES**  
**ORDER WITH CONFIDENCE**

**MICROCIRCUIT AMPLIFIERS:**  
709 28p; 710 36p; 723 55p; 741 28p;  
**14 SERIES TTL MICROCIRCUITS:**  
60 16p; 02 18p; 10 16p; 11 21p; 20 16p; 30 19p;  
34 1p; 74 33p; 90 72p; 92 67p.  
**CAMP RECTIFIERS:**  
50V 3 1/2p; 100V 4p; 200V 5p; 400V 6p; 800V 12p.  
**DIODES:**  
1N914 3p; OA47 7p; OA9J 5p; OA200 7p.  
**ZENERS:**  
1Z555 5p; 1Z557 5p; 1Z559 5p; 1Z561 5p; 1Z569 5p; 1Z571 5p; 1Z573 5p; 1Z575 5p; 1Z577 5p; 1Z579 5p; 1Z581 5p; 1Z583 5p; 1Z585 5p; 1Z587 5p; 1Z589 5p; 1Z591 5p; 1Z593 5p; 1Z595 5p; 1Z597 5p; 1Z599 5p; 1Z601 5p; 1Z603 5p; 1Z605 5p; 1Z607 5p; 1Z609 5p; 1Z611 5p; 1Z613 5p; 1Z615 5p; 1Z617 5p; 1Z619 5p; 1Z621 5p; 1Z623 5p; 1Z625 5p; 1Z627 5p; 1Z629 5p; 1Z631 5p; 1Z633 5p; 1Z635 5p; 1Z637 5p; 1Z639 5p; 1Z641 5p; 1Z643 5p; 1Z645 5p; 1Z647 5p; 1Z649 5p; 1Z651 5p; 1Z653 5p; 1Z655 5p; 1Z657 5p; 1Z659 5p; 1Z661 5p; 1Z663 5p; 1Z665 5p; 1Z667 5p; 1Z669 5p; 1Z671 5p; 1Z673 5p; 1Z675 5p; 1Z677 5p; 1Z679 5p; 1Z681 5p; 1Z683 5p; 1Z685 5p; 1Z687 5p; 1Z689 5p; 1Z691 5p; 1Z693 5p; 1Z695 5p; 1Z697 5p; 1Z699 5p; 1Z701 5p; 1Z703 5p; 1Z705 5p; 1Z707 5p; 1Z709 5p; 1Z711 5p; 1Z713 5p; 1Z715 5p; 1Z717 5p; 1Z719 5p; 1Z721 5p; 1Z723 5p; 1Z725 5p; 1Z727 5p; 1Z729 5p; 1Z731 5p; 1Z733 5p; 1Z735 5p; 1Z737 5p; 1Z739 5p; 1Z741 5p; 1Z743 5p; 1Z745 5p; 1Z747 5p; 1Z749 5p; 1Z751 5p; 1Z753 5p; 1Z755 5p; 1Z757 5p; 1Z759 5p; 1Z761 5p; 1Z763 5p; 1Z765 5p; 1Z767 5p; 1Z769 5p; 1Z771 5p; 1Z773 5p; 1Z775 5p; 1Z777 5p; 1Z779 5p; 1Z781 5p; 1Z783 5p; 1Z785 5p; 1Z787 5p; 1Z789 5p; 1Z791 5p; 1Z793 5p; 1Z795 5p; 1Z797 5p; 1Z799 5p; 1Z801 5p; 1Z803 5p; 1Z805 5p; 1Z807 5p; 1Z809 5p; 1Z811 5p; 1Z813 5p; 1Z815 5p; 1Z817 5p; 1Z819 5p; 1Z821 5p; 1Z823 5p; 1Z825 5p; 1Z827 5p; 1Z829 5p; 1Z831 5p; 1Z833 5p; 1Z835 5p; 1Z837 5p; 1Z839 5p; 1Z841 5p; 1Z843 5p; 1Z845 5p; 1Z847 5p; 1Z849 5p; 1Z851 5p; 1Z853 5p; 1Z855 5p; 1Z857 5p; 1Z859 5p; 1Z861 5p; 1Z863 5p; 1Z865 5p; 1Z867 5p; 1Z869 5p; 1Z871 5p; 1Z873 5p; 1Z875 5p; 1Z877 5p; 1Z879 5p; 1Z881 5p; 1Z883 5p; 1Z885 5p; 1Z887 5p; 1Z889 5p; 1Z891 5p; 1Z893 5p; 1Z895 5p; 1Z897 5p; 1Z899 5p; 1Z901 5p; 1Z903 5p; 1Z905 5p; 1Z907 5p; 1Z909 5p; 1Z911 5p; 1Z913 5p; 1Z915 5p; 1Z917 5p; 1Z919 5p; 1Z921 5p; 1Z923 5p; 1Z925 5p; 1Z927 5p; 1Z929 5p; 1Z931 5p; 1Z933 5p; 1Z935 5p; 1Z937 5p; 1Z939 5p; 1Z941 5p; 1Z943 5p; 1Z945 5p; 1Z947 5p; 1Z949 5p; 1Z951 5p; 1Z953 5p; 1Z955 5p; 1Z957 5p; 1Z959 5p; 1Z961 5p; 1Z963 5p; 1Z965 5p; 1Z967 5p; 1Z969 5p; 1Z971 5p; 1Z973 5p; 1Z975 5p; 1Z977 5p; 1Z979 5p; 1Z981 5p; 1Z983 5p; 1Z985 5p; 1Z987 5p; 1Z989 5p; 1Z991 5p; 1Z993 5p; 1Z995 5p; 1Z997 5p; 1Z999 5p.

**TRANSISTORS:**  
2N1696 14p; 2N1697 14p; 2N1713 16p; 2N1711 16p; 2N2219 19p; 2N2926 6p; 2N3053 15p; 2N3055 35p; 2N3702 10p; 2N3703 10p; 2N3704 10p; 2N3706 9p; 2N3710 9p; 2N4371F 9p; 2N4058 12p; AC127 10p; AC128 10p; AF124 17p; BC107 8p; BC108 8p; BC109 8p; BCY51 10p; ME401 19p; ME1120 16p; ME4101 10p; ME6001 12p; ME6101 14p; ME8001 14p; MP8111 32p; OC44 12p; OC45 12p; OC71 12p; OC72 12p; OC81 18p; 2N3819 28p.

**CONDENSERS:** 1p per pin—7p for 14!  
1/4W Carbon Resistors: 5p per 10 of one value.  
LED Panel Lamps 45p. DALO PC PEN 80p.  
Discounts begin at 10% for 10+

**JEF ELECTRONICS (P.E.I)**

York House, 12 York Drive, Grappenhall, Warrington WA4 2EJ. Mail Order Only. C.W.O. P. & P. 9p per order. Overseas 65p. Money back if not satisfied. List free on application.

**5—N-Channel FETs 3819E-£1**

Full specification devices complete with circuit details for building voltmeter, timer, ohmmeter, etc. Send 10p for full list of field effect transistors and other top quality transistors available at bargain prices.

**REDHAWK SALES LTD.**  
45 Station Road, Gerrards Cross, Bucks  
MAIL ORDER ONLY

**PRINTED CIRCUIT LAMINATE.** Glass with loz. copper. Guillotined to your size, 1p per sq.in. S.R.B.P. Price on application.

**ARTWORKS** manufactured from outline drawings. Artwork tapes and symbols available, enquiries invited.  
**PRINTED CIRCUIT BOARDS.** Prototype or production runs manufactured. Customer boards etched, roller-tinned, gold-plated or drilled as required.  
**PHOTOGRAPHIC** enlargements or reductions 4-1 max. Film size 2 1/2in x 2 1/2in.  
**MURPHY 820 RADIO-TELEPHONES** from £9, less microphone, untested. Spares available, enquiries invited.  
**HANDSETS** with switch, blue or black, suitable for radio-telephones, £6.  
**OFF-WHITE** press-to-talk microphones, £3-50 each.  
**VARIABLE VOLTAGE CONTROLLERS,** 1250V or 5A, less case but assembled and tested, £2-50.

Please write or phone for further details.  
**ELECTECHNIQUES, Selsey, Stroud**  
Glos. GL5 5JY Tel.: Stroud 3129

**Arbour Electronics Ltd.**

EAST HANNINGFIELD INDUSTRIAL  
ESTATE, Near CHELMSFORD, ESSEX

Telephone: Hanningfield 700  
**EX COMPUTER COMPONENTS**  
5 multi contact relays 2.5K ohm coil, 50p. P. & P. 10p.  
8 micro switches, mixed, 50p. P. & P. 10p.  
240V motor with governor and slipping clutch 90p each. P. & P. 20p.  
2.5A meters 3in x 3 1/2in. 75p each. P. & P. 10p.  
5 printed circuits 4in x 4in. approx. 100 semiconductors, 50p. P. & P. 10p.  
Memory core stores ferrite cores 25 x 50 £1-50 each, 30 x 30 £1-00 each. P. & P. 30p.

300 mixed resistors/capacitors as new, 65p. P. & P. 5p.  
Cable 14/0076 600V. 100 yds, 65p. P. & P. 10p.  
Instrument cases, 8in x 6in x 6in. blue with white front panel, £1-60. P. & P. 25p.

YES

**TAPE AMPLIFIERS**

Use 2 x ECC83, EL84, EZ80. Low impedance high sensitivity 1p. 3 ohm 2W O/P. Soldered operated single motor non-standard dec. 7in. x 4in. speaker. All in polished oak cabinet, £3 (£1) with cct.  
**RESISTORS:** 300 5%, 60p (15p); 200 5% Hi-Stabs, 60p (12p); 100 1% and 2%, 60p (8p); 100 metal oxide, 60p (8p). One of each, £2 (25p).  
**2W 5% R's:** 270, 470, 6k8, 15k, 27k, 33k, 82k, 100 for 50p (25p).  
**Meters:** 2 1/2in. 500V d.c., 40p (10p); 2 1/2in. 10V a.c., 40p (10p); 2 1/2in. 1500V electrostatic, 60p (10p); 2 1/2in. 12-0-12 1/2 100A, £1 (10p); 3 1/2in. 1mA, 75p (15p); 2 1/2in. 100V rect. (5mA FSD), 60p (10p); 5 1/2in. 0-15-50-150-300-500V mirror scale, £2 (40p).  
**Ferric chloride, 1lb, 40p (15p); 10lb, £3-50 (50p).  
µA709C, 25p; µA741C, 25p; 2N3055, 35p; BC107-8-9, 8p or 14 for £1; 80 + 80 + 20µF/350V, 10p, 10 for 75p (25p); 8µF/2,500V, £2 (40p); Reed switch unit, contains 31 250V 1 1/2A reeds mounted round a drum with magnet inside, also R's plugs, etc., £1 (25p); 2 for £1 65 (35p); reeds, 4p. µA723C, 40p; 2N1697, 12p.  
**TEST GEAR:** TF144C sig. gen. recalibrated as new, £20 (£2); decade res. box 0-9999 ohms, £7-50 (50p); BSR audio oscillator, 0-16kHz metered, £4.95 (£1).**

**GREENWELD ELECTRONICS (PE4)**  
**24 GOODHART WAY, W. WICKHAM, KENT.** Tel. 01777 2001. S.A.E. list. Post in brackets, small parts 3p. Callers welcome. Please ring first (up to 10.30 p.m.)

**RADIO & TELEVISION AERIAL BOOSTERS** £2-95, five television valves 45p. 50p bargain transistor packs, bargain £1 resistor and capacitor packs. UHF-VHF televisions £7-50. Carr. £1-50. S.A.E. for 3 leaflets. VEECO ELECTRONICS, Bridge St., Ramsbottom, Bury, Lanes.

**Professional quality at budget prices!**  
using Range 500 mixer modules.

m.510 Microphone amplifier (600Ω), £4;  
m.511 Equaliser (Bass & Treble), £4; m.512 Ceramic amplifier, £3-80; m.513 Line amplifier, £3-80; m.514 Buffer amplifier, £3-60; E.400 Phase amplifier, £3-30; B.30 Booklet on mixing circuits, 30p.  
12p P. & P. Above 5 units free, above 10 units 15% discount.  
Mixers and Effects equipment built to order.  
**CRAIG AUDIO EQUIPMENT**  
54 Charles Street, Herne Bay, Kent

**TV Line out-put Transformers**

Replacement types ex-stock.  
For "By-return" service, contact London 014948 3702.  
Tidman Mail Order Ltd., Dept. PE,  
236 Sandycroft Road,  
Richmond, Surrey TW9 2EQ  
Rectifiers and Frame-out-put Transformers also stocked.  
Callers welcome.

**BRAND NEW COMPONENTS BY RETURN.**

Electrolytics 16V or 25V, 1, 2, 2. 4-7, 10 mfd. 3 1/2p, 2, 4, 4p, 10p, 50p, 50V, 3p extra. Subminiature bead-type tantalums, 0-1/35V, 0-22/35V, 0-47/35V, 1/35V, 2/2, 35V, 4-7/35V, 10/16V, 8p. Mylar Film 100V, 0-001, 0-002, 0-005, 0-01, 0-02, 2p, 0-04, 0-05, 2 1/2p, 0-068, 0-1, 3p. Polystyrene 63V, 10pF—10,000pF, E12 series, 2p. Mullard miniature Carbon Film Resistors, E12 series, third watt 10—10 MΩ, 8 for 5p. Insured postage, 8p. THE C.F. SUPPLY CO., 127 Chesterfield Road, Sheffield, 88.

**FORTRONIC COMPONENT PACKS**

5 off 150µF 25V, 5 off 220µF 40V elect. cap., 70p. 50 off mixed pack OT2 1/Cs including 9930, 9933, 9945, 9948, 9932, 9944, 9946, £3-75. 10 off BC109, 10 off BC177, 5 off 2N3055, £1-75. 1,000 off Mullard CR25 resist made up of 20 different values (50 each bandoliered), £5. Post and packing 15p on any order. All components fully specified.

**FORTRONIC (FIFE) LTD**  
**113 KNOWEHEAD ROAD**  
**CROSSFORD, FIFE**

YES

**LADDERS**

**LADDERS,** 2 1/2ft £9-80, carr. 80p. Leaflet (Dept PE), HOME SALES LADDER CENTRE, Baldwin Road, Stourport, Worcs. Tel. 029-93 2574.

**MISCELLANEOUS**

**AT LAST YOU CAN TRANSMIT AND FORGET ABOUT LICENCE EXAMINATIONS**

because this Ministry approved transmitter/receiver kit does not use R.F.  
Your transmissions will be virtually SECRET since they won't be heard by conventional means. Actually it's TWO KITS IN ONE because you get the printed-circuit boards and components for both the transmitter AND receiver. You're going to find this a project REALLY FUN-TO-BUILD with the EASY-TO-FOLLOW instructions. An extremely flexible design with quite an AMAZING RANGE—has obvious applications for SCHOOL PROJECTS, LANGUAGE LABORATORIES, SCOUT CAMPS, etc.

GET YOURS! SEND £5-50 NOW (S.A.E. for details)  
**TO: 'BOFFIN PROJECTS'**  
DEPT. KE2010  
4 CUNLIFFE ROAD  
STONELEIGH, EWELL, SURREY

**FIBRE OPTICS**

FLEXIBLE LIGHT PIPE used to convey light to inaccessible positions for inspection, panel indicators, photo-electric and other applications. FIBROFLEX Type 1 glass fibre flexible light conduit 1.14mm active dia. bundle sheathed in P.V.C. Prices per metre (U.K. post free): 1-4, 70p; 5-9, 55p; 10-4, 40p. 25 metres £5 per reel. CROFON (Trade mark of Du Pont) Type 1610 plastic flexible light conduit now available. 64 filaments. Active dia. 1.80mm. Prices per metre: 1-4, £1-20; 5-9, £1; 10+ , 80p. 25 metres £16 per reel.  
Send S.A.E. for full range of products, price list and literature.

**FIBRE OPTIC SUPPLIERS**  
P.O. BOX 702, LONDON W10 6SL

**HOLIDAY FOR BOYS,** 14/16 years, Summer 1973. Tuition and practical work in electronics (and tape recording), engineering (kirting), and photography. 11 days in Norfolk, £17-50. Write for free brochure: INTER-SCHOOL CHRISTIAN FELLOWSHIP, c/o 1 Hubbard Road, London, SE27 9PJ.

## FREE! FREE! FREE! FREE!

WITH ORDERS FOR NIP-E-BOARD FOR P.E. projects (to reach us by Dec 30) we will send an extra board with compliments. This versatile and superior quality standardised printed circuit range was reviewed in Market Place, October issue. Examples of P.E. projects that can be made on NIP-E-BOARDS. Prices in brackets are for drilled boards. Planning chart supplied.  
Heating Owl, Variable Attack and Decay, IC Intercom Oscillator: srbp11EA 16p, 30p, glass fibre 11EB 19p (30p).

Rally, Driving Game, Square Wave Gen, A.F. Sig Gen, DR Bridge, srbp 12EA 27p (52p), glass fibre 12EB 32p (62p).

Designing with ICs, srbp21EA 16p (30p), glass fibre 19p (35p).

IC Intercom Amplifier, srbp 32EA 30p (58p), g' fibre 35p (68p). A few presentation wallets available since last month £3-95. NIP ELECTRONICS, P.O. Box 11, Beaconsfield Rd, St Albans, Herts

## AMPLIFIERS

60W rms £9.55	50W rms £8.90	35W rms £7.90
------------------	------------------	------------------

0.2% THD. IV approx. sens. into 11K. 4 or 8 ohms (state which).

These modules are ideal to centre your new guitar amp, pA or Hi-Fi system around. Only 8 x 10cm excluding heat-sink.

Mail Order only. Carr. 45p

**KG ELECTRONICS**  
155 KINGS GATE  
ABERDEEN

## RUN YOUR TAPE RECORDER OFF A.C. MAINS

Mains unit supplied complete and ready to plug into your cassette recorder. (State voltage, model and plug required.) P. & P. 15p. Also available for single outputs 6V, 9V, 12V, 18V, £2. P. & P. 15p.

**R.C.S. PRODUCTS (RADIO) LTD.**  
(Dep't. P.E.), 31 Oliver Road, London, E.17

## KIMBER-ALLEN KEYBOARDS

Stop key switches, contact blocks, rhodium busbars, etc.

Sole Agent for the constructor:

Alan Douglas, Lees Barn Road  
Radcliffe-on-Trent, Notts.

**P.E. GEMINI.** Etched aluminium fascia panels as detailed in latest publication. Printed circuit boards and other items. S.A.E. details. **RAMAR CONSTRUCTOR SERVICES**, 29 Shelbourne Road, Stratford-on-Avon, Warwick.

## PSYCHEDELIC MINI-STROBE

A very POWERFUL, POCKET-SIZED STROBE-LIGHT that is SELF-CONTAINED and you can take anywhere. Go to parties and really BRAIN-FREEZE them with DAZZLING PSYCHEDELIC EFFECTS and STOP MOTION FLASHES. Boffin's new MINI-STROBE kit constitutes a fully solid-state electronic device which is COMPLETE with FUTURISTIC case, reflector unit, printed-circuit board, electronics, and source-lamp—the only extra is a battery which you can buy locally. The whole thing can be easily built in a few hours.  
A veritable BICKERING FASCINATOR! Adjustable flash-rate.  
GET ONE (or two) NOW and BEGIN STEALING THE THUNDER at DISCOS and PARTIES with your own POCKET-LIGHTNING!  
SEND £1 95 for YOUR MINI-STROBE, to:

**Boffin Projects**

4 Cunliffe Rd., Stoneleigh, Ewell, Surrey

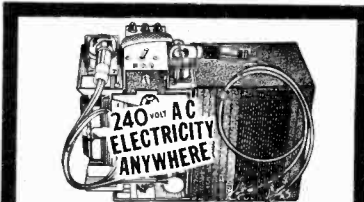


Build your next project in a BEC (Book End Chassis) — a new concept in chassis buying. Three sizes adaptable to all projects in P.W. and P.E. Texan, Gemini, etc. Gemini P.C. Boards, Full Sets, Fibre Glass, £3-35. Paper Base, £2-50, can be purchased separately. Send S.A.E. for details.

**H.M. ELECTRONICS**  
275a Fulwood Road  
Sheffield S10 3BD

**CLEARING LABORATORY**, scopes, V.T.V.M.'s, V.O.M.'s, H.S. recorders, transcription turntables, electronic testmeters, calibration units, P.S.U.'s, pulse generators, D.C. null-potentiometers, bridges, spectrum analysers, voltage regulators, sig-gens, M/C relays, components, etc. Lower Beeding 236.

**FOR ALL** your Electronic Component requirements. Send for free list to **B.C. ELECTRONIC SUPPLIES**, 7 Regent Road, Huddersfield, HD1 4NR.



**BEST EVER—INTERNATIONAL 230 VOLT A.C. "MAINS" PERFORMANCE** from 12 volt car battery. **R.C.A. INTERNATIONAL 230 volt A.C. POWER UNIT.** Wonderful 230 volt a.c. performance with low battery drain. Marvellous for **A.C. FLUORESCENT LIGHTING** and hundreds of makes and types of 200/240 volt **A.C.** and **UNIVERSAL A.C./D.C. APPLIANCES.** Can be used for re-charging battery by using an ordinary motorist's 4 amp battery charger. Total weight of unit 21 lbs. New improved model only £6-90, plus £1 delivery. C.O.D. with pleasure. 7 days approval against cash.

Dept. PE **BROADWAY DISTRIBUTORS, The Generator Centre, House of Time, 273 Broadway, Rossall, Fylde, Lancs.**

## ENAMELLED COPPER WIRE

S.W.G.	1/1b Reel	1/2lb Reel
10-14	£1-15	65p
15-19	£1-15	65p
20-24	£1-18	68p
25-29	£1-25	75p
30-34	£1-30	80p
35-40	£1-40	85p

The above prices cover P. & P. in U.K. Supplied by

## INDUSTRIAL SUPPLIES

102 Parrswood Rd., Wittington, Manchester 20  
Telephone No. 061-224 3553

**CONSTRUCTION AIDS.** Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards—masters, negatives and boards, one-off or small numbers. Send 6p for list. **RAMAR CONSTRUCTOR SERVICES**, 29 Shelbourne Road, Stratford-on-Avon, Warwks.

**REGORD T.V. SOUND** using our loudspeaker isolating transformer. Provides safe connection to recorder. Instructions included, £1 post free. **CROWBOROUGH ELECTRONICS (P.E.)**, Eridge Road, Crowborough, Sussex.

## ELECTRONICS FANATICS

whether beginner or advanced—we offer a range of over 35 SUPER projects.

Have you ever wanted to build A MACHINE THAT LEARNS? Or perhaps make a TEACHING DEVICE? Maybe you fancy the idea of an ELECTRONIC "Thing" capable of REPRODUCING ITSELF? Whatever your electronic turn-of-mind, there's just GOT TO BE LOADS TO INTEREST YOU in the science-fiction-world of BOFFIN.

GET YOUR CATALOGUE — SEND JUST 15p NOW! (S.A.E. for details).

**TO: BOFFIN PROJECTS**  
4 CUNLIFFE ROAD  
STONELEIGH, EWELL  
SURREY

Designs by GERRY BROWN and JOHN SALMON and presented on TV.

## ELECTRONIC MUSIC

**CIRCUIT ASSEMBLIES** for all your music projects, ready-to-use modules ideal for Synthesizers, Sound Effects, Organs, Instrument modifiers, and Disco Equipment.

**CHOOSE** from over 25 circuits, including our new range of I-C designs for Synthesiser work. **OUR CATALOGUE** contains full technical details, explanations and definitions, suggestions for projects, and discount price details.

**OUR PRICES** are the lowest in this field and represent unbeatable value for money. Send only 20p for our latest catalogue:

**TAYLOR ELECTRONIC MUSIC DEVICES**  
P.O. BOX 42, CHESTER CHI 2PW

## Build the Mullard C.C.T.V. Camera

Kits are now available with comprehensive construction manual (also available separately at 65p).

SEND 5" X 7" S.A.E. FOR DETAILS TO:

**CROFTON ELECTRONICS**  
15/17 Cambridge Road, Kingston-on-Thames, Surrey KT1 3NG

**METER REPAIRS.** Ammeters, voltmeters, multi-range meters, etc. Send to **METER REPAIRS**, 39 Chesholm Road, London, N16 0DS.

**OF INTEREST TO SCHOOLS,** libraries, colleges, etc. Complete set of P.E. from issue one. Bound and indexed, £20 o.n.o. Buyer collects. Telephone: Worcester 421369.

## PROFESSIONALIZE!

your constructional projects  
Professional Quality

## EDGE CONNECTORS

For 0-1 matrix construction board

32 Way	35p
24 Way	27p
16 Way	19p

Gold plated double sprung contacts. Complete with P.C. wiring attachment. P. & P. 10p on all orders please. Ex. Equip.

## DGB (PE) COMPONENTS

12 SOUTH LANE, HESSLE, YORKS.

## OPPORTUNITY FOR ENTHUSIASTS

Enthusiasts selling their small spare time public address company. Suitable for about four or more people (or Electronics Club?) to have fun and make money. No premises, so price well within your pocket.

FURTHER DETAILS Box 46.

## BYWOOD STOP PRESS RADIO CHIP

(Tomorrows World) 2nd Nov., 1972  
AM 10 trans TRF circuit in TO18 package, plus six components equals one radio, price £1.25 including P. & P.

DIL size switches:  
1p8w, 2p4w, 4p2w 4 @ 1p2w  
75p 80p 85p 90p + 12p P. & P.

NEW LED PRICES:  
TIL302 Large 7 seg display £3.50  
TIL312 1/2 inch 7 seg display £2.00  
TIL209 LED point, four for £1.00  
P. & P. on LEDs 12p

NO MORE ROOM—CATALOGUE 15p—NOW!

# BYWOOD

## ELECTRONICS

181 EBBERNS ROAD, HEMEL HEMPSTEAD, HERTS.  
0442 62757

### MUSICAL INSTRUMENTS

Touch Sensitive Envelope Shapers	£12.50
Keyboards from	£12.00
Electronic Piano Units	£6.50
Transistor 1'C Oscillators 8 octave	£5.50
Percussion Units	£4.75
Transistor 1'C Oscillators 4 octave	£3.50

Send 15p for Brochure

### DIGICHORD

Duffryn Glywd House, Elm Road,  
Tokers Green, Reading, Berks.  
Reading 479226

### LSI CLOCK

12/24 Hours.  
4/6 Digit Display.  
Seven Segment.  
50/60Hz Operation.

Can be made as small as 2½ × 2 × 1¼in using only 14 extra components to the basic chip. The chip is a 28 pin CMOS package with low power consumption.

Basic chip and circuit—  
MM5311 £11.50  
Set of sockets (28 and 14) £1.75  
BYWMMSKTS £1.35

### CALCULATOR KIT

Build a desk calculator with fixed and floating decimal point, constant switch, LED readout. This kit is complete (even solder) and makes up into a machine worth £79 for only 3-4 hours work in construction.

Kit £39 p.p. 75p  
Set of sockets (28 and 14 pin) BYWCALCSKTS £1.75  
Built and Tested £55 p.p. 75p



You may telephone your order and pay by Access.

### DISPLAYS

LED—  
1/2in (6) .. £18.00  
1/2in (4) .. £16.00  
1/2in (6) .. £22.00

### LIQUID CRYSTAL—

1/2in (4) .. £13.00  
All 7-Segment Units.  
Add 25p p.p.

### CALCULATORS

#### RAPID 800

£32 (a)

#### ADVANCE—

—MINI £45 (a)

With Mains Adaptor and Rechargeable Batteries

£52.50 (b)

EXEC 8 £60 (b)

„ 16 £72 (b)

16+1 £89 (b)

16+2 £110 (b)

16R £140 (b)

#### POST, ETC.

a 25p

b 75p

## MAKE YOUR OWN I.C.s !!!

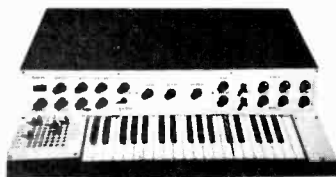
These D.I.P. pin headers are fully compatible with all 14 and 16 pin sockets. They can be used as plugs with our 16 way flat cable or discrete components may be soldered between the contact extensions to form a convenient plug-in package. The height of the low-profile models is 5mm and that of the high-profile 10mm. A hole in the top of the high-profile model allows for injection of a permanent potting compound. 3 for £1.00, p & p 12p.

DATA SHEETS 12p. CATALOGUE 15p. TERMS: CASH WITH ORDER OR ACCESS.

# BYWOOD

BYWOOD ELECTRONICS  
181 EBBERNS ROAD  
HEMEL HEMPSTEAD  
TEL. 0442-62757

# BUILD A PROFESSIONAL SYNTHESISER



You too can build a professional synthesiser like the one illustrated using the professionally-proven range of Dewtron modules. Countless possible patching combinations giving the range of effects now heard in Pop records.

WE SUPPLY ALL PARTS except cabinet. KEYBOARDS and contacts 3 or 4 octave.

VCO-2 STABLE, PRECISION V/C OSCILLATOR gives SINE, TRIANGULAR AND SQUAREWAVE outputs, 1 volt/octave voltage control. £22 each or £25 each 2 or more matched.

SHE-1 SAMPLE, HOLD AND ENVELOPE MODULE gives variable attack, sustain, touch-sensitive playing when used with VCO-2 signals. £15.

With over 7 years' unblemished reputation in these pages, Dewtron continues to lead in new technical developments in electronic sound effects! Ask any of our customers. See our products in the music stores, too. Suppliers of special equipment to a leading group. Our modules are used in professional equipment by other manufacturers! Send s.a.e. for synthesiser details or send 15p for full catalogue of our famous musical effects.

## D.E.W. LTD.

254 Ringwood Road, FERNDOWN, Dorset BH22 9AR

using **Dewtron** (Regd. Trademark)

### PROFESSIONAL MODULES

#### CASH SAVINGS

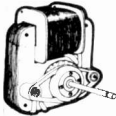
by buying modules and parts in bulk!

All modules are available separately:

Ring Modulator RM2, £8. Voltage-controlled Oscillator VCO1, £10.50, giving sawtooth and square-wave outputs. Envelope shapers, ES1, self-triggered or ES2 keyboard-triggered, either type £13. White noise type WN1, £7. Voltage-controlled amplifier VCA1, £10. Voltage-controlled selective amplifier (filter for waa-waa, etc.) SA1, £12. Voltage-controlled Phase PH1, £17. Automatic Announcement Fader module for fading of music by microphone announcement, AF1, £9, etc., etc. ALL MODULES ARE BUILT, TESTED AND SEALED FOR LONG LIFE. Simply connect coloured wire connections as per easy instructions, build cabinet and wire in controls and patchboard connections! Joystick controls £4.50. REVERB Module and spring unit £15.



## MAINS MOTOR

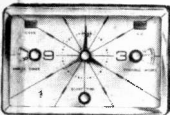


Precision made—as used in record decks and tape recorders—Ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 65p. Postage 20p for first one then 10p for each one ordered.



## MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 20p each £1-80 for ten, your assortment.



## ISA ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp, on/off switch. Switch on time can be set anywhere to stay on up to 8 hours. Independent 60 minute memory jogger, A beautiful unit. Price £1-85 + 20p p & p with glass front chrome bezel 75p extra.

## RESEALABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resealable fuse (auto circuit breaker) will pay for itself. Price only £1 each or

£11 per dozen, specify 5A, 10A or 15A—simply fit in place of switch.

## FLUORESCENT CONTROL KIT

Each kit comprises seven items—Choke, 2 tube ends, starter, holder, and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-alternist, mostly resin filled. Kit A—15–20W, £1. Kit B—30–40W, £1. Kit C—80W, £1-20. Kit E—65W, £1-20. Kit F for 8ft 125W tube £1-75. Kit MP1 is for 6in, 9in and 12in miniature tubes, £1. Kit MP2 for 21in 13W miniature tube, £1. Postage on Kits A and B 23p for one of two kits then 23p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p then 23p for each kit ordered. Kit MP1 18p on first kit then 15p on each two kits ordered.

## SOLDER GUN

A must for every busy man, gives almost instant heat also illuminated job. 100 watt £2-25 plus post and ins. 20p. BIG JOB 250W model £4-75 plus post and ins. 40p.

## WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 50p post free.

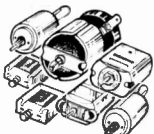
## MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6V, 9V, 12V for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer, rectifier, smoothing and load resistor, condensers and instructions. Real snip at only 83p, plus 20p postage.

## THERMOSTATS

Type "A" 15A for controlling room heaters, greenhouses, airing cupboards. Has spindle for pointer knobs. Quickly adjustable from 30–38 deg. F. 48p. Type "B" 10A. This is a 17in long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550 deg. F. Internal screw alters the setting so this could be adjustable over 30 deg. to 1,000 deg. F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flame-stat or fire alarm, 50p plus 12p post and insurance. Type "C". Simply clamp to tank, pipe, heatink, casing. Break temperature adjustable by calibrated knob 75p. Type "D". We call this the Ice-stat as it cuts in and out at around freezing point, 2/3A. Has many uses, one of which would be to keep the loft pipes from freezing, if a length of our blanket wire (18yd) 50p is wound round the pipes. 26p. P. & F. 5p. Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. 50p plus 5p post. Type "F". Glass encased for controlling the temperature of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50 deg. to 150 deg. F. Price 90p plus 10p post and insurance.

## BATTERY MOTORS



A bargain parcel of 7 motors for £1. Some not as large as a postage stamp and only  $\frac{1}{16}$ in thick, largest is  $1\frac{1}{2}$ in x  $\frac{1}{16}$ in dia. Some work off 11V some as high as 18V. These motors are used in racing cars, power toys, etc. The largest is so powerful that it will drive a Minidrill, model lathe, or similar. This is a 4 pole motor, optimum working 16.5V but very powerful even as low as 4V. Don't miss this wonderful snip.

## COMPUTER TAPE

2,400ft of the Best-Magnetic Tape money can buy—users claim good results with Video and sound.  $\frac{1}{4}$ in wide £1-00 plus 30p post and insurance, with cassette.  $\frac{1}{2}$ in wide £1-00 plus 30p post and insurance with cassette.  $\frac{1}{2}$ in wide 85p plus 25p post and insurance with cassette. Spare spools and cassettes—1in 75p,  $\frac{1}{2}$ in 75p each plus 20p post and insurance.

## TANGENTIAL HEATER UNIT

This heater unit is the very latest type, most efficient, and quiet running, is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need switch sp. £2-80, 3kW Model as above except 2kW £2-50. Don't miss this. Control Switch 85p, P. & P. 40p.



TIMAC 24 hour 15A Clock Switch. Self-contained unit for flex connection to the mains. Clock switches 2 on/off per 24 hours. Operates a 15A switch. All neatly made up in an ivory moulded case with outlet socket. The only snag is that the outlet socket is the continental type. Plugs for these can be bought in this country alternatively you can fit a connector strip in place of the outlet socket. Overall size of this unit is approx. 4in x 2 1/2in x 3in and the clock has a clear perspex cover which is easily removable for reprogramming. Ideal for blanket controller etc. Price £2-75 each.

## THYRISTOR LIGHT DIMMER

For any lamp up to 1kW. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price £2-95, plus 20p post and insurance.



## HORSTMANN "TIME & SET" SWITCH

(A 30A Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc. up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price £1-50 Post and ins. 23p.

## 3 STAGE PERMEABILITY TUNER

Made originally for Radionobile car radios. This is a medium wave tuner with a frequency coverage 16kc–525kc. Aerial, RF and oscillator sections (long wave coil available) small size, only 2 1/2in x 2in x 1 1/2in. Can be used with our IF module and AF modules and a few inter connection components to make a complete compact receiver. Circuit supplied. Price 65p less 10% for 10.

## THIS MONTH'S SNIP

Miniature mains driven blower centrifugal type blower unit by Woods, powerful but specially built for quiet running—driven by cushioned induction motor with specially built low noise bearings. Overall size of blower is approx. 4 1/2in x 4 1/2in x 4 1/2in. When mounted by its flange air is blown into the equipment but to suck air out mount it on the centre using a clamp, ideal for cooling electrical equipment, or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering, etc., etc. A real bargain at £1-85.

## MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output 65p. Model 1172 750mW power output 85p. Model EP9000 4W power output £1-45. Model EP9001 twin channel or stereo pre-amp £1-80. 10% discount if 10 or more ordered.

## MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of i.f. signals at 10.7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self-oscillating mixer for a.m. operation, in conjunction with external oscillator coil. 85p each. 10 for £7-85. 100 for £82-50p. With connection dig.

## MULLARD UNILEX

This D.I.Y. Stereo Amplifier is still available complete at £7 for the four Mullard Modules, or Modules can be bought separately as follows: 4W amplifier module (2 required) Mullard Ref. No. E.P.9000—£1-45 each. Pre-amp module Mullard Ref. No. E.P.9001—£1-80 each. Power module—Mullard Ref. No. E.P.9002—£2-80 each. In addition and made to Mullard Specification we offer: Standard Control Unit with escutechon—£2-50. Knobs—Set of 4—50p. De-Luxe Control Unit—£3-50, with escutechon. Set of 8 Knobs—75p. Mullard Unilex Handbook—25p.

## 1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4 1/2in x 3 1/2in, which can be set in minutes up to 1 hour. After preset the bell rings. Ideal for processing, a memory logger, or, by adding simple lever, would operate micro-switch. £1-15.

Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free S.A.E. with enquiries please.

## POCKET CIRCUIT TESTER

Test continuity of any low resistance circuit, house wiring, car electric. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied). 30p or 2 for 50p post paid.

## AMPLIFIER IN CASE WITH SPEAKER

Marketed by British Relay under the name Luxistor. This in a very neat looking cabinet and is ideal around the home or in the workshop for trouble shooting or for testing out a quick lash up. Size approx. 9 1/2in x 6 1/2in x 3 1/2in deep. Inputs via a matching transformer and volume control and amplifier may be powered by an internal 9V battery or an external 110V source. Speaker is an R-A elliptical 6in x 3 1/2in 10,000 gauss. The amplifier proper is a Newmarket model Ref. P.C.A. Price £3-50 each, 10 for £31-50. Post and insurance 20p.

## BAKELITE INSTRUMENT CASE

Size approx. 6 1/2in x 3 1/2in x 2 1/2in deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price 45p each.

## TELEPHONES

Complete as illustrated. Save your legs, time and temper, simply by putting in some telephones. Ex. G.P.O. not new—but guaranteed in good condition and serviceable. Supplied with diagram and instructions showing how to connect. Price 75p each + 50p post or 2 for £2 post paid. Also available separately, dials and handsets 50p each + 20p post.

## ROCKER SWITCH

13A self-fixing into an oblong hole. Size approximately 1 1/2in x 1/2in 6p each. 10 for 54p.



## SLIDE SWITCHES

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

## EDUCATIONAL KITS—all with pictorial instructions

THIS BALANCE KIT FREE. Eagle educational kits. Japanese made these are excellent value for money. We do not expect to be able to repeat this offer once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give FREE an accurate 1 1/2lb balance kit. Price of kits 40p each post paid. Special price for all 8 kits £3 with free balance kit.

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

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

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

KA6 2-Pole Motor Kit. Twenty-four parts including enamel wire, armature and pole piece, etc. Motor operates from 11V battery. Illustrates and teaches how electro-magnetism operates a motor.

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

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

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

KA10 Morse Key Buzzer and Bell Kit. Twenty-five part kit, easy to construct, simple to operate.

# J. BULL (ELECTRAL) LTD.

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

# C. HADLEY

24 WOODHILL  
HARLOW, ESSEX

Add 5p P. & P. Price list S.A.E.  
No callers please.

All our stocks are brand new with money back refund

TRANSISTORS			DIODES		
AC107 15p	AL102 50p	BD116 70p	OC44 13p	TIP33A 95p	2N3711 10p
AC126 11p	AL103 48p	BD121 50p	OC45 13p	TIP34A £1.80	40251 48p
AC127 11p	AU103 55p	BD130 46p	OC71 12p	2N697 18p	40636 55p
AC128 11p	AU111 95p	BD131 50p	OC78 13p	2N1171 24p	
AC176 25p	BC107 8p	BFY50 15p	OC81 13p	2N1304 28p	
AC141K 20p	BC108 8p	BSY51 12p	OC81D 13p	2N1305 25p	
AD14 40p	BC109 8p	BSY95A 15p	OC170 24p	2N2646 47p	
AD150 44p	BC154 20p	ME4042 18p	OC200 25p	2N2926 10p	
AD161 M/P50p	BC168 10p	ME4401 14p	OC201 25p	2N3053 20p	
AD162 10p	BC189 11p	ME4102 12p	OC25 25p	2N3702 12p	
AF114 15p	BC183L 8p	ME8002 14p	OC28 30p	2N3703 12p	
AF115 15p	BC183L 8p	ME8101 14p	OC29 30p	2N3704 12p	
AF116 15p	BC212L 8p	ME8102 14p	OC35 25p	2N3705 12p	
AF117 15p	BC214L 8p	ME8111 32p	OC36 30p	2N3706 10p	
		ME8112 32p	TIP29A 48p	2N3707 10p	
		MP8511 34p	TIP30A 55p	2N3708 9p	
		MP8513 45p	TIP31A 58p	2N3709 10p	
		OC41 13p	TIP32A 69p	2N3710 10p	

**CAPACITORS**  
MULLARD POLYESTER CAPACITORS C280 SERIES  
250V P.C. mounting: 0.01µF, 0.015µF, 0.022µF, 3p, 0.033µF, 0.047µF, 0.068µF, 3p, 0.1µF, 4p, 0.15µF, 0.22µF, 5p, 0.33µF, 6p, 0.47µF, 8p, 0.68µF, 11p, 1.0µF, 13p, 1.5µF, 20p, 2.2µF, 24p.

MULLARD POLYESTER CAPACITORS C296 SERIES  
400V: 0.001µF, 0.0015µF, 0.0022µF, 0.0033µF, 0.0047µF, 2p, 0.0068µF, 0.01µF, 0.015µF, 0.022µF, 0.033µF, 3p, 0.047µF, 0.068µF, 0.1µF, 4p, 0.15µF, 6p, 0.22µF, 7p, 0.33µF, 11p, 0.47µF, 13p.  
160V: 0.01µF, 0.015µF, 0.022µF, 0.033µF, 0.047µF, 0.068µF, 3p, 0.1µF, 3p, 0.15µF, 4p, 0.22µF, 5p, 0.33µF, 6p, 0.47µF, 7p, 0.68µF, 11p, 1.0µF, 13p.

ELECTROLYTIC CAPACITORS—MULLARD C426 SERIES 6p each  
(µF/V) 10/2.5, 20/2.5, 80/2.5, 160/2.5, 320/2.5, 300/2.5, 8/4, 32/4, 64/4, 125/4, 250/4, 400/4, 64/6.4, 25/6.4, 50/6.4, 100/6.4, 200/6.4, 320/6.4, 4/10, 16/10, 32/10, 64/10, 125/10, 200/10, 2.5/16, 10/16, 20/16, 40/16, 80/16, 125/16, 1.6/25, 6.4/25, 12.5/25, 25/25, 50/25, 80/25, 1/40, 4/40, 8/40, 16/40, 32/40, 50/40, 0.64/64, 2.5/64, 5/64, 10/64, 20/64, 32/64.

MULLARD C437 SERIES  
100/40, 150/25, 250/16, 400/10, 640/6.4, 800/4, 1,000/2.5, 9p, 100/64, 160/40, 250/25, 400/16, 640/10, 1,250/4, 1,000/6.4, 1,600/2.5, 12p, 180/64, 250/40, 400/25, 640/16, 2,000/4, 1,000/10, 1,600/6.4, 2,500/2.5, 15p, 250/64, 400/40, 640/25, 3,200/4, 1,000/16, 4,000/10, 2,500/8.4, 4,000/2.5, 18p.

Miniature Fixed Ceramic Plate 3p each.  
Preferred values from 1.8pF to 10,000pF.

## MINITRON DIGITAL INDICATOR TYPE 3015F

Reads 0-9 and decimal (Data Sheet on request)

ONLY £1.50 for one month only

16 D1L Socket 30p  
Driven by 7447 95p

**SUPER LOW PRICED LINEAR I.C.'S**  
301A To99 49p  
301A D1L 45p  
709C To99 25p  
709C D1L 30p  
723C To99 87p  
723C D1L 90p  
741C To99 35p  
741C D1L 34p  
741C 8p in D1L 40p  
747C D1L 40p  
748C To99 38p

TIL 208 LIGHT EMITTING DIODE. Made by TEXAS INST. (Red) 35p.

**VEROBOARD**  
0.15 Matrix 0.1 Matrix  
2 1/2in x 3 1/2in 17p 23p  
2 1/2in x 5in 25p 25p  
3 1/2in x 3 1/2in 25p 25p  
3 1/2in x 5in 30p 28p  
Vero Pins (Bag of 36) 20p  
Vero Cutter 45p  
Pin insertion Tools (-1 and -15 matrix) at 55p.

**SLIDE POTENTIOMETERS**  
38mm TRACK SINGLE GANGED, LOG or LIN 1k to 1M. 40p each. TWIN GANGED, LOG or LIN 1k to 500k. 60p each.

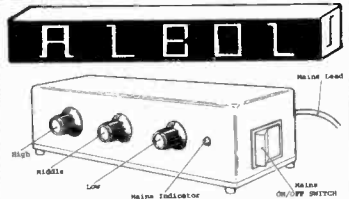
**SUPER PACKS**

Pack of 10 C169 (unmarked) but tested 30p each	Pack of 25 1N4148 50p	Pack of 10 BC108 (Plastic can) 50p	Pack of 10 AD161, Veroboard M/P 54p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 50p	BC107-BC109 8p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p
1-9 10 plus 9p	1-9 10 plus 9p	BC107-BC109 8p	BC107-BC109 7p

# NEW BOOKS

- ★ ABC'S OF INDUSTRIAL ELECTRONICS By J. A. Wilson £1-50
- ★ 1-2-3-4 SERVICING STEREO AMPLIFIERS By Forest H. Belt £2-50
- ★ TRANSISTOR-T.V. SERVICING GUIDE By Robert G. Middleton £2-25
- ★ SOLID-STATE SERVICING By A. N. Slood £2-50
- ★ MODERN DICTIONARY OF ELECTRONICS (New 4th Edition) By Rudolf F. Graf £6-50
- ★ 101 QUESTIONS AND ANSWERS ABOUT AM, FM, AND SSB By Leo G. Sands £1-75
- ★ 99 WAYS TO IMPROVE YOUR SHORTWAVE LISTENING By Len Buckwalter £1-75
- ★ HANDBOOK OF BASIC ELECTRONIC EQUIPMENT By W. Oliver £1-75
- ★ (Published: Foulsham Technical)
- ★ TRANSISTORISED RADIO CONTROL FOR MODELS By D. W. Aldridge £2-50
- ★ MAKING AND USING ELECTRONIC OSCILLATORS By W. Oliver £2-00

**FOULSHAM-SAMS TECHNICAL BOOKS**  
(W. FOULSHAM & CO. LTD.)  
YEovil RD., SLOUGH, BUCKS, ENGLAND



**ALBOL**

The ALBOL Sound-Light Control Unit connects directly to the loudspeaker output of a record player amplifier or tape recorder, and will allow three lamps connected to the unit, to vary in brightness according to the frequency of the music, etc. It is supplied complete with a lead for connecting the unit to the 240V a.c. mains supply. Size: 6 x 3 x 2in. Plastic Case Colours Selection: Red, Blue and Orange.

**TECHNICAL SPECIFICATION:**  
Mains voltage: 240V RMS 50-60Hz  
Input voltage: 2.5-5V max.  
Input impedance: 8 ohms  
Light intensity: each channel independently variable  
Maximum load on each channel: 500W  
Fuse rating: 5A  
Price £9-50, P. & P. 50p.

Send P.O. or cheques to:  
Albol Electronic & Mechanical Products Ltd.  
3 Crown Buildings, Crown Street, London, S.E.5  
Tel.: 01-703 3282.

Please mention  
**PRACTICAL ELECTRONICS**  
when replying to  
Advertisements

**INTER-LOCKING PLASTIC STORAGE DRAWERS**

NEAT! HANDY! TIDY!

**DISCOUNT PRICES**

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots/removable space dividers. Build up any size cabinet for wall, bench or table top.

**BUY AT TRADE PRICES!**

**SINGLE UNITS (1D)** (5ins x 2 1/2ins x 2 1/2ins) £1-35 DOZEN.

**DOUBLE UNITS (2D)** (5ins x 4 1/2ins x 2 1/2ins) £2-25 DOZEN.

**TREBLE (3D)** £2-35 for 8.

**DOUBLE TREBLE 2** drawers, in one outer case (6D2), £3-65 for 8, **EXTRA LARGE SIZE (6D1)** £3-30 for 8.

**PLUS QUANTITY DISCOUNTS!**

Orders £5 and over DEDUCT 5% in the £  
Orders £10 and over DEDUCT 7 1/2% in the £  
Orders £20 and over DEDUCT 10% in the £

PACKING/POSTAGE/CARRIAGE: Add 35p to all orders under £5. Orders £5 and over, packing/postage/carriage free.

QUOTATIONS FOR LARGER QUANTITIES ALL PRICES TAX PAID

**IVORYET LIMITED** (Dept. PE1) 124 Cricklewood Broadway, London, N.W.2  
Tel. 01-450 4844

# FREE!

## Over 150 ways to engineer a better future

HIGHER PAY

A BETTER JOB

SECURITY

### find out how in just 2 minutes

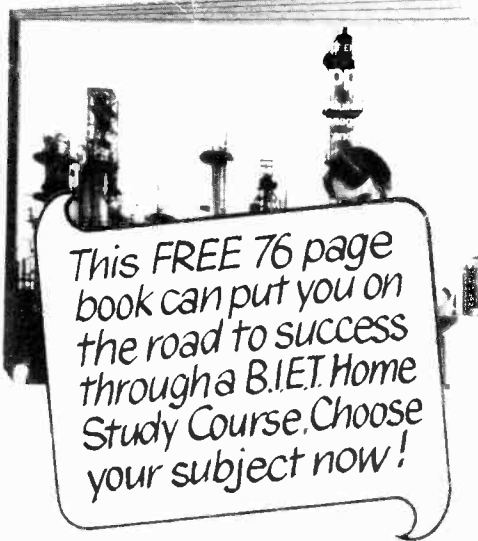
That's how long it will take you to fill in the coupon below. Mail it to B.I.E.T. and we'll send you full details and a free book. B.I.E.T. has successfully trained *thousands* of men at home - equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost B.I.E.T. home study course gets results fast - makes learning easier and something to look forward to. There are no books to buy and you can pay-as-you-learn. Why not do the thing that really interests you? Without losing a day's pay, you could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). No obligation and nobody will call on you... but it could be the best thing you ever did.

Others have done it, so can you

"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained - a view echoed by two colleagues who recently commenced the course".—Student D.I.B., Yorks.  
 "Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects".—Student J.A.O. Dublin.  
 "My training with B.I.E.T. quickly changed my earning capacity and, in the next few years, my earnings increased fourfold".—Student C.C.P., Bucks.

**FIND OUT FOR YOURSELF**

These letters - and there are many more on file at Aldermaston Court - speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help you. Write to B.I.E.T. Dept. BD37, Aldermaston Court, Reading RG7 4PF




This FREE 76 page book can put you on the road to success through a B.I.E.T. Home Study Course. Choose your subject now!

- |  |   |  |
|--|---|--|
| <p><b>MECHANICAL</b><br/>                 A.M.S.E. (Mech.)<br/>                 Boiler Inspection &amp; Operation<br/>                 C &amp; G Eng. Crafts<br/>                 C &amp; G Fabrication<br/>                 Diesel Eng.<br/>                 Eng. Inspection<br/>                 Eng. Metallurgy<br/>                 Inst. Eng. &amp; Tech.<br/>                 Inst. Motor Ind.<br/>                 Maintenance Eng.<br/>                 Mechanical Eng.<br/>                 Sheet Metal Work<br/>                 Welding</p> | <p><b>Man. Prod.—cont.</b><br/>                 Salesmanship<br/>                 Storekeeping<br/>                 Work Study<br/>                 Works Management</p> <p><b>DRAUGHTSMANSHIP</b><br/>                 A.M.I.E.D.<br/>                 Design of Elec. Machines<br/>                 Die &amp; Press Tool Design<br/>                 Electrical Draughtsmanship<br/>                 Gen. Draughtsmanship<br/>                 Jig &amp; Tool Design<br/>                 Technical Drawing</p> <p><b>RADIO &amp; TELE-COMMUNICATIONS</b><br/>                 Colour TV<br/>                 C &amp; G Radio/TV/ Electronics<br/>                 C &amp; G Telecomm. Tech.<br/>                 Prac. Radio &amp; Elec. (with kit)<br/>                 Radio Amateurs Exam.<br/>                 Radio Servicing &amp; Repairs<br/>                 Radio &amp; TV Eng.<br/>                 Transistor Course<br/>                 TV Main. &amp; Serv.</p> <p><b>AUTO &amp; AERO</b><br/>                 Aero Eng.<br/>                 A.M.I.M.I.<br/>                 A.R.B. Cert.<br/>                 Auto Engineering<br/>                 Auto Repair<br/>                 C &amp; G Auto. Eng.<br/>                 Garage Management<br/>                 MAA/IMI Diploma<br/>                 Motor Vehicle Mechanics</p> <p><b>CONSTRUCTION</b><br/>                 A.M.S.E. (Civil)<br/>                 Architecture<br/>                 Building</p> | <p><b>Constructional-cont.</b><br/>                 Building Drawing<br/>                 Building Foreman<br/>                 Carpentry &amp; Join.<br/>                 Civil &amp; Municipal Engineering<br/>                 Constructional<br/>                 Engineering<br/>                 Surveyors Institute<br/>                 Clerk of Works<br/>                 Council Eng.<br/>                 Geology<br/>                 Health Eng.<br/>                 Heat &amp; Vent.<br/>                 Hydraulics<br/>                 Inst. of Builders<br/>                 Inst. Clerk of Works<br/>                 Inst. Works &amp; Highway Supers.<br/>                 Painting &amp; Dec.<br/>                 Public Hygiene<br/>                 Road Engineering<br/>                 Structural Eng.<br/>                 Surveying</p> <p><b>GENERAL</b><br/>                 Agricultural Eng.<br/>                 Council of Eng. Insts.<br/>                 Farm Science<br/>                 General Education<br/>                 Gen. Plastics<br/>                 Pract. Maths<br/>                 Pract. Slide Rule<br/>                 Pure &amp; Applied Maths<br/>                 Refrigeration<br/>                 Rubber Technology<br/>                 Sales Engineers<br/>                 Tech. Report Writing<br/>                 Timber Trade University Ent.</p> |
|--|---|--|

**G.C.E.**  
 58 'O' & 'A'  
 LEVELS SUBJECTS  
 Over 10,000  
 group passes

*Coaching for many major exams, including HNC, ONC, C & G, etc.*

## POST TODAY FOR A BETTER TOMORROW



**BIET**

To B.I.E.T., Dept. BD37, Aldermaston Court,  
 Reading RG7 4PF

BD37

NAME \_\_\_\_\_  
 Block Capitals Please  
 ADDRESS \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

SUBJECT OF INTEREST \_\_\_\_\_

AGE \_\_\_\_\_

Accredited by the Council for the Accreditation of Correspondence Colleges.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Published approximately on the 10th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand: Gordon & Gotch (Aasia) Ltd., South Africa: Central News Agency Ltd., Rhodesia and Zambia: Kingstons Ltd., East Africa: Stationery and Office Supplies Ltd. Subscription rate (including postage): For one year to any part of the world £2.50 (£2.10.0). Practical Electronics is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

# U.K's LARGEST ELECTRONICS CENTRES!

## HENRY'S RADIO LTD. EDGWARE ROAD, LONDON, W.2.



### NOW OPEN!

404-406 ELECTRONIC COMPONENTS & EQUIPMENT 01-402 8381  
 354-356 HIGH FIDELITY & TAPE EQUIPMENT 01-402 5854/4736  
 309 PA DISCO LIGHTING HIGH POWER SOUND 01-723 6963  
 303 BARGAIN STORE SPECIAL OFFERS All Mail to: 303, Edgware Rd., London, W2 1BW.

ALL YOUR ELECTRONIC REQUIREMENTS WITHIN 200 YARDS. CALL IN AND SEE FOR YOURSELF.

## BUILD THE TEXAN

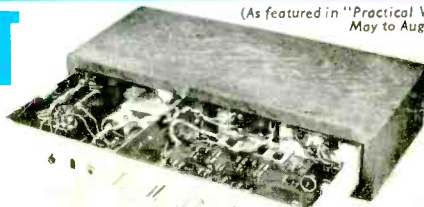
### 20 + 20 WATT INTEGRATED I.C. STEREO AMPLIFIER

★ FREE TEAK CASE with complete kits!

FEATURES: New slim design with 6 ICs, IC sockets, 10 silicon transistors, 4 rectifiers, 2 zeners. Special Gardners low field slim line transformer. Fibre glass PC panel. Complete chassis work.

HIGH QUALITY & STABILITY ARE PREDOMINANT FEATURES—DEVELOPED BY TEXAS ENGINEERS FOR PERFORMANCE, RELIABILITY AND EASE OF CONSTRUCTION.

FACILITIES: On/off switch indicator, headphone socket, separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, Input selector: Mag, P.U., Radio Tuner, Aux. Can be altered for Mic, Tape, Tape head etc. (Parts list Ref. 20 on request). Constructional Details Ref. No. 21. 30p.



(As featured in "Practical Wireless" May to August 1972)

SPECIAL KIT PRICE

£28.50 P. & P. 45p

SLIM DESIGN WITH SILVER TRIM

Overall chassis size 14½ in. x 6 in. x 2 in. high

COMPLETE WITH FREE TEAK CABINET

Designer approved kits distributed by Henry's!

### LOW COST HI-FI SPEAKERS



E.M.I. Size 13½in x 8½in and Ceramic Magnet

TYPE 150 6 watt, 3, 8 or 15 ohms £2.20. Post 22p.

TYPE 150TC Twin cone version £2.75. Post 22p.

TYPE 450 10 watt twin tweeters and crossover, 3, 8 or 15 ohms. £3.85. Post 25p.

TYPE 350 20 watt twin tweeter and crossover, 6 and 15 ohms. £7.70. Post 28p.

POLISHED CABINETS 150, 150TC, 450 £4.60. Post 30p.  
 ASSEMBLED IN POLISHED CABINETS (8 OHM) SERIES 6 (Assembled 150TC) per pair £16.50. Post 70p.  
 SERIES 8 (Assembled 450) per pair £18.95. Post 70p.

### ML3 MW/LW TUNER TO BUILD



Uses Mullard Module. Slow motion tuning. Built-in battery. Ferrite aerial.

Overall size 7in x 2½in x 3¾in. TOTAL COST TO BUILD £4.85. Post 15p. All parts sold separately—Leaflet No. 6.

### "BANDSPREAD" PORTABLE TO BUILD



Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bandspread for extra selectivity. 600mW push-pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance. TOTAL COST TO BUILD £7.98, p.p. 32p (Batt. 22p). All parts sold separately—Leaflet No. 2.

### CATALOGUE

Fully detailed and illustrated covering every aspect of Electronics—plus data, circuits and information. 10,000 Stock lines at Special Low Prices and Fully Guaranteed.

PRICE 55p Post paid (40p FOR CALLERS)

PLUS! FIVE 10p VOUCHERS

Send to this address—Henry's Radio Ltd. (Dept. PE), 3 Albemarle Way, London, E.C.1—for catalogue by post only. All other mail and callers to "303", see above.

MORE OF EVERYTHING ALWAYS AT HENRY'S

All the parts you need plus Data and Circuits. Get a Catalogue—it's all in there! Prices subject to change without notice. E. & O.E.

309-354-356-404-406 Open 6 days a week 9am - 6pm (303 closed Thurs.) All Stores open all day Saturday.

MORE OF EVERYTHING AT THE RIGHT PRICE ALWAYS AT HENRY'S

### RECORD DECKS CHASSIS (Post 50p)

SP25/3 £10.25 HT70 £14.50  
 MP60 £9.95 MP610 £12.95  
 AP76 £17.95 GL75 £32.50  
 PLINTH/COVERS (State Model)  
 SP25/MP60/G10 £3.30 (Post 40p)  
 AP76 £4.50 (Post 40p)  
 CART/PLINTH/COVER (Post 70p)  
 (HL) MP60/G800/IPC £18.50  
 MP610/G800/TPD/PC £19.95  
 AP76/M7565M/PC £32.50  
 AP96/M7565M/PC £39.95  
 (HL) AP76/G800/PC £28.95  
 (HL) SP25/G800/PC £18.95  
 HT70/G800/TPDI/PC £24.50  
 (HL) 2025/9TAHCD/PC £13.95  
 MP610/G800/M/PC £17.25  
 (HL) GL75/G800/PC £41.95  
 (HL) GL75/G800/PC £38.95

### ULTRASONIC TRANSDUCERS

Operate at 40kc/s up to 100 yds. Ideal remote switching and signalling. Complete with data and circuits. PRICE PER PAIR £5-90. Post 10p.

### MARRIOTT TAPE HEADS

4 TRACK MONO or 2 TRACK STEREO  
 "17" High Impedance £2.00  
 "18" Med. Impedance £2.00  
 "36" Med-Low Imp. £3.50  
 Erase Heads for above 75p  
 "63" 2 track mono — High Impedance £1.75  
 "43" Erase Head for above 75p

### POWER INTEGRATED CIRCUITS

Plessey SL403D—3 watt with 6-page data, layouts and circuits £1.50. P.C. Board 60p; Heat Sink 14p. Sinclair IC12—6 watt with data and circuits £1.80.  
 TH9013P—20 watt Power Amp Module £4.57.  
 TH9014P—IC Preamplifier £1.50. Data/Circuits (No. 42) for above 10p.

### 7 SEG & NIXIE TUBES

(Post 15p per 1 to 6)  
 XN3, XN13, GNG 0-9 side view with data, 85p.  
 GNP-7, GNP-8 0-9 side view with decimal points and data, 95p.  
 3015F 7 seg. £2 each, £7 per 4 with data.  
 12 and 20 hour clock circuits. Ref. No. 31 15p.

### MINIATURE AMPLIFIER

5 transistor. 300mW o/p. Fitted volume and sensitivity control 9 volt operated. £1.75 each, p.p. 15p.

### QUALITY SLIDER CONTROLS

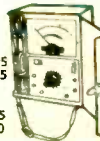
60mm stroke singles and ganged. Complete with knobs. 5kΩ, 10kΩ, 25kΩ, 100kΩ, 250kΩ, 500kΩ, 1 meg, Log and Lin. 40p each, 10kΩ, 25kΩ, 50kΩ, 100kΩ, 250kΩ, Log and Lin, ganged, 60p each.

### HI-FI AND TAPE EQUIPMENT

Acknowledged as U.K.'s Largest Stockists with Lowest Prices Plus 12 Months Guarantee. Write or call for FREE 16 page lists (Ref. No. 17)

### TEST EQUIPMENT

Just a selection  
 SE250R Pocket Pencil Signal Injector, £1.90  
 SE500 Pocket Pencil Signal Tracer, £1.50  
 THL33D Robust 2 K/Volt, £4.55; with case £4.95  
 TE15 Grid Dip Meter 440 KHz—280 MHz, £13.45  
 500 30 K/Volt Multimeter, £9.25; with leather case, £10.50  
 200H/20 K/Volt Multimeter, £4.20; with case £4.95  
 AF105 50K/V Multimeter, £8.50; with case, £9.50  
 U4341 AC/DC Multimeter with transistor tester with steel case, £10.50  
 TE200 RF Generator 120KHz—500MHz, £15.95. Carr. 35p  
 TE22D Audio Generator 20Hz—200KHz, £17.50. Carr. 35p  
 CI-5 3in Pulse Scope 10Hz—10MHz, £39.00. Carr. 50p  
 TE65 Valve Voltmeter 28 ranges, £17.50. Carr. 40p  
 ALL NOMBEX MODELS IN STOCK



### BUILD THIS VHF FM TUNER

5 TRANSISTORS 300kc/s BAND-WIDTH PRINTED CIRCUIT, HIGH FIDELITY REPRODUCTION, MONO AND STEREO. A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it—VHF FM gives the REAL sound. All parts sold separately.

Free Leaflet No. 3 & 4. TOTAL £6.97, p.p. 20p.  
 Decoder Kit £5.97. Tuning meter unit £1.75.  
 Mains unit (optional) Model PS900 £2.47. Post 20p.  
 Mains unit for Tuner and Decoder PS6/12 £3.25. Post 20p.



### PA—DISCO—LIGHTING

UK's Largest Range—Write phone or call in. Details and demonstrations on request.

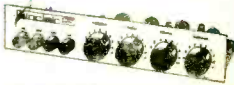
DJ30L 3 Channel sound to light unit, 3kW, £29.75  
 DJ40L 3 Channel Mic (Built-in) to light, 3kW, £38.75  
 DJ705 70 watt Disco amp/mixer, £49.95  
 DISCO AMP 100 watt Disco amp/mixer, £66.50  
 DJ1055 30 watt Disco amp/mixer, £32.75  
 Anti-Feedback Quality Mic., £11.50  
 DJ500 50 watt PA amplifier, £44.00  
 Group 300 150 watt rms Group Valve amplifier, £86.00  
 ● Portable discos—details on request  
 ● Credit terms for callers



FIBRE OPTICS LIGHTING • MICS EFFECTS • PROJECTORS SPOTS DIMMERS STANDS MIXERS SPEAKERS  
 Everything for PA—Disco—Lighting. FREE Stock List Ref. No. 18.

### SINCLAIR PROJECT 60 MODULES—SAVE POUNDS

Z30 £3.57 Z50 £4.37  
 STEREO 60 £7.97 PZ5 £3.97  
 PZ6 £6.37 PZ8 £4.77  
 Transformer for PZ8 £2.95.  
 Active Filter Unit £4.45.  
 Stereo FM Tuner £16.95.  
 IC12 £1.80 Q16's £15 pair.  
 Post, etc. 20p per item.



PACKAGE DEALS Post 25p  
 2 x Z30, Stereo 60, PZ5 £15.95  
 2 x Z30, Stereo 60, PZ6 £18.00  
 2 x Z50, Stereo 60, PZ8 £20.25  
 Transformer for PZ8 £2.95  
 PROJECT 605 KIT £19.95

TRANSISTORS — IC'S — SCR'S — RECTIFIERS — TRIACS, etc.  
 LATEST BROCHURE Ref. No. 36 on request or see our earlier page.