

PRACTICAL

# ELECTRONICS

NOVEMBER 1977

45p

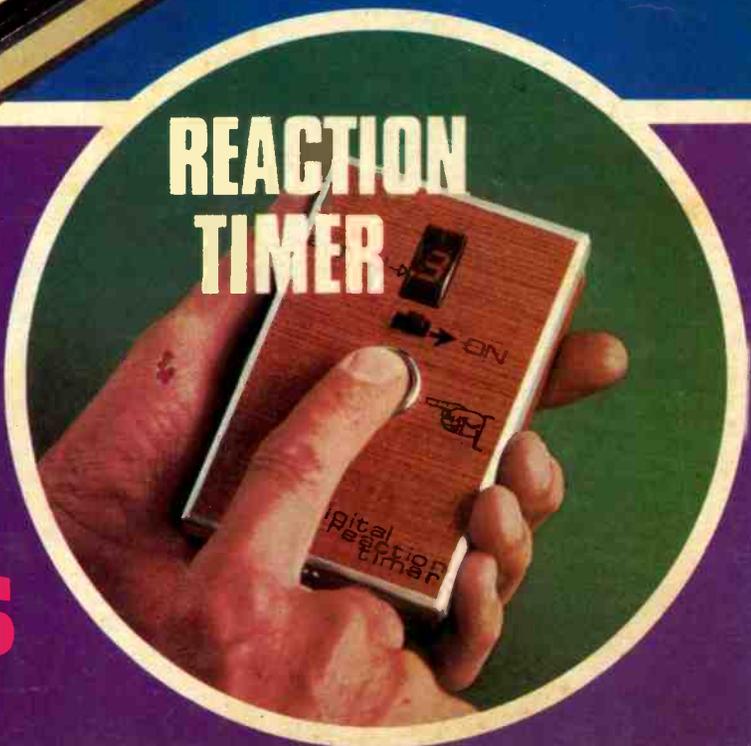
## 128 NOTE SEQUENCER

for SYNTHESISERS



*Special 8 Page  
Supplement...*

Thought - Provoking  
**IC SPECIALS**



REACTION  
TIMER

## DIY SPEAKER KITS

**15-WATT KIT IN CHASSIS FORM**  
When you are looking for a good speaker, why not build your own from this kit. It's the unit which we supply with the enclosures illustrated below Size 13" x 8" (approx.) woofer (EMI), tweeter, and matching crossover components. Power handling capacity 15 watts rms. 30 watts peak.  
**£17.00 PER STEREO PAIR**  
+ P & P £3.40

## EASY-TO-BUILD WITH ENCLOSURE

Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak-simulate enclosures, two EMI 13" x 8" (approx.) woofers, two tweeters and a pair of matching crossovers. Easily constructed, using a few basic tools. Supplied complete with an easy-to-follow circuit diagram, and crossover components. Input 15 watts rms. 30 watts peak, each unit.  
**£28.00 PER STEREO PAIR**  
(approx.) + P & P £5.50

## COMPACT\* FOR TOP VALUE

How about this for incredible bookshelf value from RT-VC! A pair of high efficiency units for only £7.50 - just what you need for low-power amplifiers. These infinite baffle enclosures come to you ready mitred and professionally finished. Each cabinet measures 12" x 9" x 5" (approx.) deep, and is in wood simulate. Complete with two 8" (approx.) speakers for max. power handling of 7 watts.  
**£8.50 per stereo pair**  
+ P & P £2.20

**SPEAKERS** Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/2" (approx.).

**★£34 PER PAIR**  
+ P & P £6.50

Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11 1/2" (approx.).

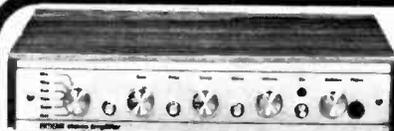
**★£52 PER PAIR**  
+ P & P £7.50

## EASY TO BUILD RECORD PLAYER KIT

Ideally suited for the constructor who requires a complete stereo unit at a budget price, comprising ready assembled stereo amp. module, Garrard auto/manual deck with cueing device, pre-cut and finished cabinet work. Output 4 watts per channel, phones socket and record / replay socket  
**£26.95**  
+ P & P £4.05

## CAR RADIO KIT

Complete with speaker, baffle and fixing strip. The Tourist IV for the experienced constructor only. The Tourist IV has five push buttons, four medium band and one for long wave band. The tuning scale is illuminated and attractive small aluminium control knobs are used for manual tuning and volume control. The modern style fascia has been designed to blend with most car interiors and the finished radio will slot into a standard car radio aperture. Size approx. 7" x 2" x 4 1/2". 12 volts pos or neg earth (altered internally). P & P £1.50  
**£12.50**  
Output 4 watts into 4 ohms.  
**★FREE TO PERSONAL SHOPPERS BUYING CAR RADIO KIT ELECTROMATE** Rear window heater modern line element all wiring and switch worth **£3.00**



**SPECIAL OFFER**

**TO PERSONAL SHOPPERS**  
See Below

## 20 x 20 WATT STEREO AMPLIFIER

Superb Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic. magnetic and crystal pick-ups, tape, tuner, and auxiliary. Rear panel features two mains outlets. DIN speaker and input sockets, plus fuse. 20 + 20 watts rms, 40 + 40 watts peak.  
**£29.90**  
P & P £2.50

## ★FREE To cash or cheque personal shoppers

A 4 channel Stereo Adaptor to all buyers of the Viscount 20 x 20 Amplifier at **£29.90** limited offer. Available separately at **£3.95**

## SPECIAL OFFER

For example - Duo 5 speaker system II or III Viscount Amplifier, MP60 type turntable complete

**DEDUCT 10% DEDUCT 15%**

Mastercard only (not on postage) Personal Shoppers only on complete stereo systems using starred Products

## ADD-ON STEREO CASSETTE TAPE DECK KIT

Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record/replay electronics with twin V.U. meters and level control ready for mating together with the mechanism.

Specifications: Sensitivity - Mic. 0.85mV @ 20K OHMS; Din. 40mV @ 400K OHMS; Output - 300mV RMS per channel @ 1KHz from 2K OHMS source; Cross Talk - -30db; Tape Counter - 3 Digit - Resettable; Frequency Response - 40Hz - 8KHz ± 6db; Deck Motor - 9 Volt DC with electronic speed regulations; Key Functions - Record, Rewind, Fast Forward, Play, Stop & Eject. P & P **£2.50**

Optional extras: Pair of Dynamic microphones **£3.95** + £1.00 P & P. Mains transformer **£2.50** + £1.00 P & P.

**STEREO CASSETTE** record/replay fully built P.C. board incorporating 4 I.C.s. **£275**

**GRUNDIG 5 1/2"** tape 1800 ft. **£1.20** each. 5 for **£5.00**

**PAIR STEREO 8 WATT SPEAKERS** 8" bass units with 3 1/2" approx. tweeters power handling 8 watts imp 8ohms. Size 16 1/2" x 11" x 8 1/2" approx. **£12.95**

**PLINTH & COVER BSR OR GARRARD TEAK FINISH** **£4.95**

**GOODMAN 5"** approx. 7 watt bass speaker **£2.70**

**A.M. F.M. TUNER P.C.B.** with Mullard L.P. 1186, 1185, 1181 modules **£9.50**

**100K** Multiturn Varicap tuning pots 6 for **£1.00**

**HEAVY DUTY FIBRE GLASS COPPER CLAD BOARD** **£1.90**

25" x 17" x 1/8" approx. per sheet only

**DECCA DC1000** Stereo Cassette Record deck P.C.B. complete with 295 switch oscillator coils and tape-heads and circuit diagrams. **£2.95**

**A.M. F.M. STEREO MULTIPLEX CAR RADIO/CASSETTE** player in dash fitting Negative earth 5 watts output **£36.00**

I.C. Stereo 8 Track to Cassette adaptor converts any 8 track player to cassette player. **£18.95**

**Personal Shoppers Only!**

## BSR TURNTABLES

**BSR MP60 TYPE** Single play record player (Chassis form) **£15.95** less cartridge. P & P **£2.55**

Cartridges to suit above  
**ACOS MAGNETIC STEREO** ..... **£4.95**  
**CERAMIC STEREO** **£1.95**

**BSR automatic record player deck** (Chassis form) with cueing device and stereo ceramic head. P & P **£2.55**

**TURNTABLE** illus. diamond stylus, and deluxe plinth and cover. **£29**  
Popular **BSR MP 60** type, complete with magnetic cartridge, Ready wired **★ £4.50**

## 30 x 30 WATT AMPLIFIER KIT

Specially designed by RT-VC for the experienced constructor, this kit comes complete in every detail. Same facilities as Viscount IV amplifier. Chassis is ready punched, drilled and formed. Cabinet is finished in teak veneer. Silver fascia and easy-to-handle aluminium knobs. Output 30 + 30 watts rms, 60 + 60 peak.  
**£29.00**  
P & P **£2.50**  
**★NOW AVAILABLE fully built and tested. £35.00 + P & P £2.50**

## DECCA 20 WATTS STEREO SPEAKER

This matching loudspeaker system is hand made. kit comprises of two 8" diameter approx. base drive unit, with heavy die cast chassis laminated cones with rolled P.V.C. surrounds, two 3 1/2" diameter approx. domed tweeters comp with crossover networks **£20.00**  
**£4.00 P & P stereo pair**

Order giving your credit card number ONLY

**ALL PRICES INC. VAT AT 12 1/2%**  
GOODS NOT DISPATCHED OUTSIDE UK  
All items subject to availability. Price correct at time of going to press and subject to change without notice. We are unable to show all our products, so



**RTVC**

323 EDGWARE ROAD, LONDON W2  
Personal Shoppers EDGWARE ROAD 9.30am - 5.30pm, Half day Thurs (210) HIGH STREET, ACTON, LONDON W3 6NG  
ACTON: Mail Order Only No callers

Send stamped addressed envelope for further details.

## PORTABLE MONO DISCO



with built-in pre-amplifiers  
Here's the big-value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. P & P **£6.50**  
Simply connects into your existing slave or external amplifier. **£64.00**

## 45 WATT MONO DISCO AMP

**£35.00**

+ P & P

**£2.50**

Size approx.

13 1/2" x 5 1/2" x 6 1/2"

Here's the mono unit you need to start off with. Gives you a good solid 45 watts rms, 90 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

## 70 & 100 WATT MONO DISCO AMP

Size approx.

14" x 4" x 10 1/2"

Sloping fascia, you can use the controls without fuss or bother. Brushed aluminium fascia and rotary controls. Five smooth acting, vertically mounted slide controls - master volume, tape level, mic level, deck level, PLUS INTER-DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre-fade level control (PFL) lets YOU hear next disc before fading. 70 watt in. in. VU meter monitors output level. 100 watt **£57**  
Output 100 watts RMS 200 watts peak. P & P **£4.00**



## BSR BDS95 SERIES

Belt drive turntable unit, 2 speed, semi automatic operation **£22.95**  
+ P & P **£2.55**

## PRACTICE GUITAR AMPLIFIER WITH BUILT-IN SPEAKER

This budget practice amplifier, has been specially designed for the amateur, who requires a quality self-contained unit with all facilities. 2 inputs - 1 for mic or guitar, the 2nd for record player or cassette deck, it also can be used for cine-sound amplification. 2 volume controls, 1 for each input, also base and treble controls. Power output with internal speaker, 10 watts RMS, with remote speaker (not supplied) 20 watts **£32.50**  
RMS. Size approx. 17 x 9" 11" + P & P **£3.00**

## HOME 8 TRACK CARTRIDGE PLAYER

Automatically switches programmes monitored by indicators, with manual override track selection. This unit will match with the Unisound modules and is compatible with the Viscount IV amplifier with Sim teak cabinet, approx. 9" x 8" x 3 1/2". P & P **£2.50** **£16.50**  
Output 125 Mw

## PYE STEREO GRAM CHASSIS

(Complete with circuit diagrams)  
Complete ready to install - Wave bands LM, VHF STEREO, VHF MONO. Controls for tuning volume, balance, bass and treble. Power output 7 watts R.M.S. per channel 14 watts peak 8 ohms 2" x 8" approx chassis speakers and BSR auto record player deck **£35.00**  
**PERSONAL SHOPPERS ONLY**

# PRACTICAL ELECTRONICS

VOLUME 14 No. 3 NOVEMBER 1977

---

## CONSTRUCTIONAL PROJECTS

- 128 NOTE SEQUENCER** *by D. G. Evans*  
A synthesiser pre-programmer for tunes of up to 32 pitches 162
- DIGITAL REACTION TIMER** *by D. C. Green*  
Can give an index of relative reaction delays 166
- TTL TESTER** *by T. J. Hill*  
A simple checker for quad-gate packages 172
- P.E. CHAMP—3** *by R. W. Coles and B. Cullen*  
Development system circuit description 185
- P.E. MASTERMIND—4** *by P. F. Turney*  
The scoring logic continued 192

## GENERAL FEATURES

- SEMICONDUCTOR UPDATE** *by R. W. Coles*  
A look at some recently released devices 176
- ANALOGUE LOG AMPLIFIERS** *by D. F. Bowers*  
Design techniques and calculations 180
- INGENUITY UNLIMITED**  
Wash-Wipe Controller—PA Preamplifier—Frequency Doubler—Car Systems Monitor—  
Logic Probe—Sequence Generator—Counter—Clock Touch Switches 197

## NEWS AND COMMENT

- EDITORIAL**—Window Gazing; A Choice Selection 161
- NEWS BRIEFS**  
System X—Name Change 169
- SPACEWATCH** *by Frank W. Hyde*  
Space Suits 170
- BOOK REVIEWS**  
Selected new books we have received 171
- MARKET PLACE**  
Interesting new products 175
- INDUSTRY NOTEBOOK** *by Nexus*  
What's happening inside industry 179
- PATENTS REVIEW**  
Thought provoking ideas on file at the British Patents Office 190
- READOUT**  
A selection of readers' letters 206

## SPECIAL 8-PAGE SUPPLEMENT

### ICs FOR THE EXPERIMENTER

A roundup of some neoteric i.c. packages

(between pages 184 and 185) 1-8

**Our December issue will be on sale on Friday, 11 November, 1977**

(for contents, see page 171)

---

© IPC Magazines Limited 1977. 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.



# Handy size Reels and Dispensers

**OF THE WORLD'S FINEST CORED SOLDER TO DO A PROFESSIONAL JOB AT HOME**

Ersin Multicore Solder contains 5 cores of non-corrosive flux that instantly cleans heavily oxidised surfaces and makes fast, reliable soldering easy. No extra flux is required.

**SAVBIT**  
handy solder dispenser  
Contains 2-3 metres approx. of 1.22mm Ersin Multicore Savbit Solder. Savbit increases life of copper bits by 10 times.  
**Size 5 49p**  
For soldering fine joints




handy size reels of **SAVBIT, 40/60, 60/40 and ALU-SOL** solder alloys

These latest Multicore solder reels are ideal for the toolbox. Popular specifications cover all general and electrical applications, plus a major advance in soldering aluminium. Ask for a free copy of 'Hints on Soldering' containing clear instructions to make every job easy.

**BIB WIRE STRIPPER and CUTTER**  
Fitted with unique 8-gauge selector and handle locking device. Sprung for automatic opening. Strips flex and cable in seconds.  
**Model 8B 86p**



Pat. No. 1443913

Two more dispensers to simplify those smaller jobs. PC115 provides 6.4 metres approx. of 0.71mm solder for fine wires, small components and printed circuits.  
**PC115 57p**  
Or size 19A for kit wiring or radio and TV repairs. 2.1 metres approx. of 1.22mm solder.  
**Size 19A 53p**

Ref.	Alloy	Diam. (mm)	Length metres approx.	Use	Price
Size 3	40/60 Tin/Lead	1.6	10.0	For economical general purpose repairs and electrical joints.	£1.79
Size 4	ALU-SOL	1.6	8.5	For aluminium repairs. Also solders aluminium to copper, brass etc.	£2.42
Size 10	60/40 Tin/Lead	0.7	39.6	For fine wires, small components and printed circuits.	£1.79
Size 12	SAVBIT	1.2	13.7	For radio, TV and similar work. Increases copper-bit life tenfold.	£1.79

**SOLDER-WICK**  
Absorbs solder instantly from tags, printed circuits etc. Only needs 40-50 watt soldering iron. Quick and easy to use. Non-corrosive.  
**Size 18 97p**



Sole U.K. Sales Concessionaires: **Bib Hi-Fi Accessories Limited**, Kelsey House, Wood Lane End, Hemel Hempstead, Herts. HP2 4RQ  
Prices shown are recommended retail, inc. VAT. From electrical and hardware shops. In difficulty send direct, plus 20p P. & P. Prices and specifications subject to change without notice.

**PHOENIX ELECTRONICS (SOLENT) LTD**  
46 Osborne Road, Southsea, Hants

All prices include VAT  
Include 20p extra for carriage

SOME SEMICONDUCTORS		RESISTORS	
BC107/8/9	11p	½W carbon film (10)	18p
BC177/8/9	15p	½W metal film (5)	18p
BC204/5/6	14p	<b>CAPACITORS</b>	
BC207/8/9	9p	Disc ceramic. Aluminium electrolytic. Tantalum bead.	
BDY56	£1.72	<b>PANEL HARDWARE</b>	
1N4001	7p	Connectors, lampholders, switches, fuses, knobs.	
1N4004	10p	<b>MISCELLANEOUS</b>	
1N4148	5p	Hand tools, instrument cases, Veroboard, relays, transformers.	
2N2218/19/21/22	22p	<b>SOLDERING EQUIPMENT</b>	
2N2904/5/6/7	24p	Weller and Adcola irons, tips, desoldering tools, instant-heat guns.	
2N3442	88p		
2N3702-11	12p		
<b>INTEGRATED CIRCUITS</b>			
DTL 930 series.			
TTL 74 series.			
Linear series.			
Consumer circuits.			

**C-MOS**

4000	20p	4070	50p	7410	20p	7492	54p	74172	86p
4001	20p	4071	25p	7411	30p	7493	44p	74173	187p
4002	20p	4072	25p	7412	20p	7494	88p	74174	100p
4005	114p	4073	25p	7413	38p	7495	65p	74175	98p
4007	50p	4076	118p	7414	98p	7496	90p	74176	123p
4008	99p	4077	48p	7415	40p	74100	120p	74178	110p
4009	57p	4061	20p	7416	74p	74104	73p	74179	138p
4010	57p	4082	25p	7417	20p	74105	73p	74180	108p
4011	20p	4093	95p	7418	26p	74107	36p	74181	282p
4012	20p	4502	123p	7419	32p	74109	75p	74182	83p
4013	51p	4510	138p	7420	107p	74110	50p	74184	234p
4014	107p	4511	150p	7421	74p	74111	88p	74185	187p
4015	114p	4512	81p	7422	26p	74116	251p	74190	134p
4016	51p	4514	284p	7423	32p	74121	35p	74192	118p
4017	114p	4515	284p	7424	29p	74122	53p	74193	115p
4018	110p	4516	123p	7425	118p	74123	61p	74194	107p
4019	62p	4518	123p	7426	38p	74125	59p	74195	102p
4020	115p	4520	123p	7427	38p	74126	59p	74196	134p
4021	101p	4522	122p	7428	20p	74128	98p	74197	130p
4022	99p	4526	122p	7429	69p	74132	75p	74198	124p
4023	20p	4527	140p	7430	130p	74142	302p	74199	198p
4024	79p	4528	115p	7431	130p	74143	348p	74221	109p
4025	20p	4531	115p	7432	105p	74144	348p	74246	205p
4026	155p	4543	115p	7433	38p	74145	90p	74247	195p
4027	60p	4555	115p	7434	74p	74148	148p	74248	171p
4028	95p	4558	115p	7435	20p	74149	150p	74249	171p
4029	123p	4581	348p	7436	20p	74150	150p	74251	170p
4030	55p	4582	140p	7437	20p	74151	78p	74255	94p
4033	155p	4584	99p	7438	20p	74153	78p	74278	331p
4034	347p	4585	108p	7439	20p	74154	138p	74279	75p
4035	118p			7440	33p	74155	90p	74283	84p
4040	132p			7441	30p	74156	90p	74284	712p
4041	84p			7442	33p	74157	82p	74285	712p
4042	69p			7443	33p	74158	140p	74290	122p
4043	99p			7444	46p	74159	285p	74293	122p
4044	91p			7445	125p	74160	102p	74298	173p
4046	137p			7446	95p	74161	102p	74365	93p
4049	55p			7447	119p	74162	102p	74368	93p
4050	55p			7448	128p	74163	102p	74367	93p
4051	140p			7449	33p	74164	115p	74368	93p
4052	140p			7450	34p	74165	115p	74380	189p
4053	140p			7451	43p	74166	115p	74393	189p
4060	140p			7452	79p	74170	213p	74480	254p

**TTL**

Full price list of linear, discretes, capacitors, resistors, potentiometers, tools, soldering irons and accessories available. Send 20p or large S.A.E. This list is sent free with the first order.  
Prices correct June 1977.

Terms C.W.O. Add VAT to prices at 8%. Post, etc.: U.K. 25p, overseas 75p. Access and Barclaycard, and all convertible currencies accepted.

**Buy More for Less Outlay with Our Bargain Packs**

Please send your 1977 catalogue—free!

Name .....

Address .....

**TIRRO ELECTRONICS**  
Grenfell Place, Maidenhead, Berks.  
Tel. (0628) 36229  
Mail order division of RITRO Electronics UK Ltd.

# The most economical, compact and convenient breadboards on the market!

They are the PROTO-BOARD® PB-6 and PB-100 solderless breadboard kits.

Buy them, and you are only minutes away from the first circuit.

Contacts are made from non-corrosive nickel-silver alloy, and are reliable for more than 10,000 insertions.

Contact resistance is a mere 0.4 mΩ, insertion force is typically 3ozs per lead, and interterminal capacitance is typically less than 5pF.

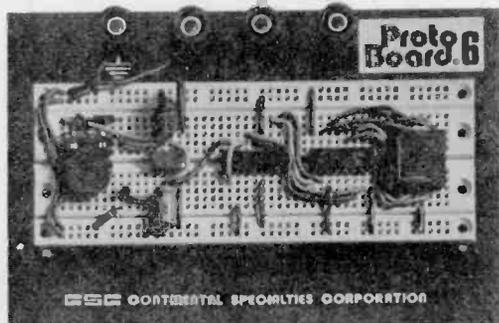
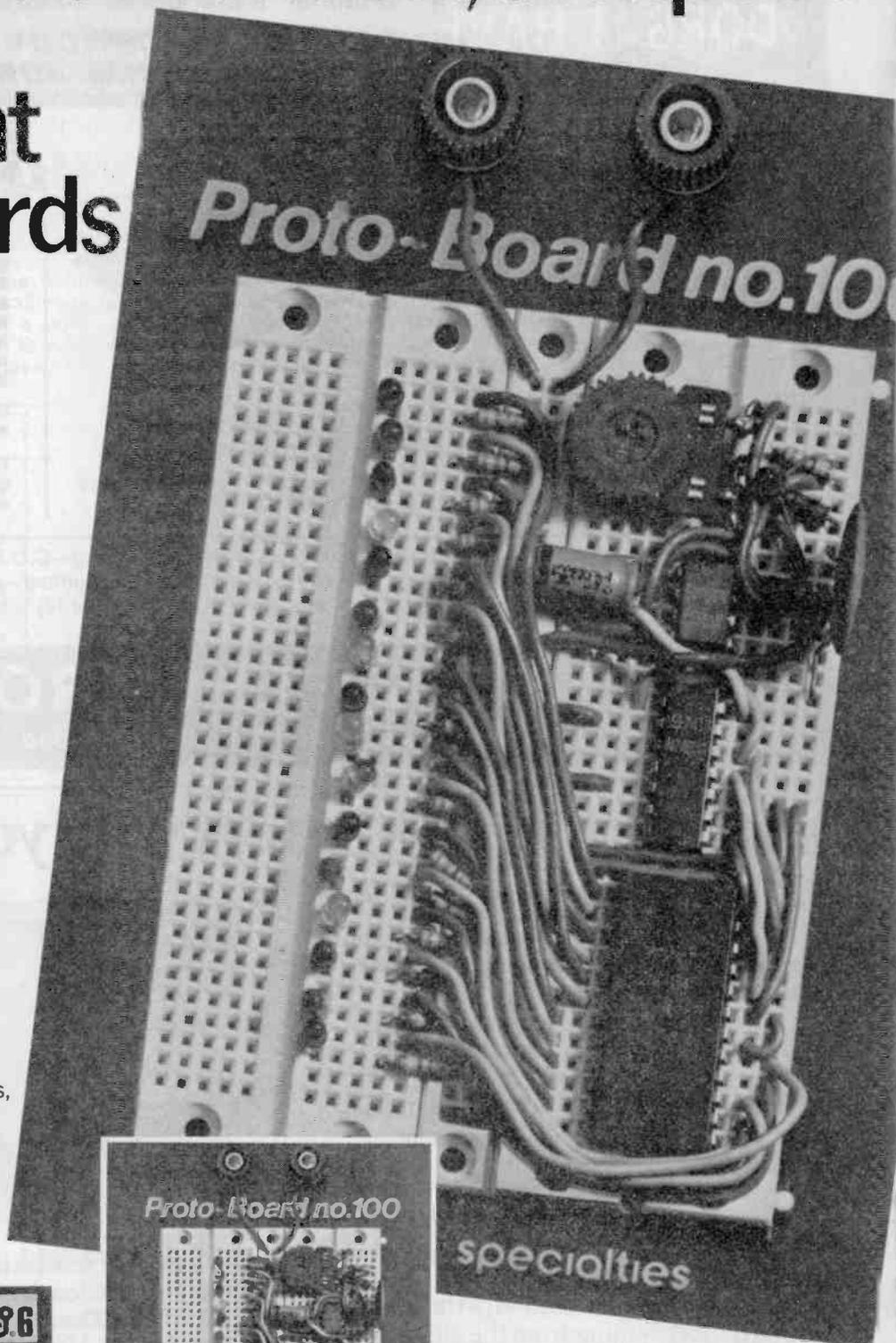
The kits are a must for experimental and development work in digital, audio, RF, video and beyond.

Resistors, capacitors, transistors, DIP's, LED's, transformers, pots, jumpers and any other component with leads between 0.015" and 0.032" will fit the contacts.

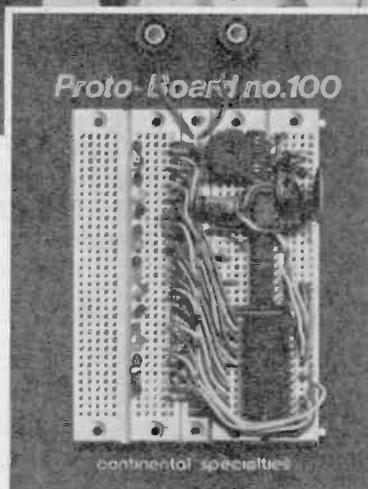
You can run circuits well beyond the recommended ambient operating temperature (100°C) if you wish, because the plastic used in the PROTO-BOARD is rated to over 200°C.

The kits come complete with instruction manual, assembly hardware, binding posts, non-scratch feet and the appropriate number of preassembled sockets and bus strips.

The sooner you order, the sooner you'll have that first circuit operating.



THE PB-6 630 SOLDERLESS CONTACTS. TAKES UP TO SIX 14-PIN DIP'S, OR EQUIVALENT IN LARGER AND SMALLER IC'S. FOUR 5-WAY BINDING POSTS. 6" x 4"  
**ONLY COSTS £10.47.**



THE PB-100 760 SOLDERLESS CONTACTS. TAKES UP TO TEN 14-PIN DIP'S, OR EQUIVALENT IN LARGER AND SMALLER IC'S. TWO 5-WAY BINDING POSTS. 6" x 4.5"  
**ONLY COSTS £13.50.**

Ring us (01-890 0782) with your Access, Barclaycard or American Express number and your order will be in the post that night. Alternatively, send a cheque, or postal order (don't send credit cards!) and it still only takes a few days. Otherwise ask for our complete catalogue. Our prices include VAT (8%) and postage. All prices and specifications correct at the time of going to press.



## BEFORE YOU BUY AN AMPLIFIER MODULE—CHECK:

# DOES IT HAVE

- ★ 30A power transistors
- ★ 2-year guarantee
- ★ 3A drivers (100W unit)
- ★ Integral output capacitor

Then compare with the Tamba range—excellent value—25, 50 and 100W R.M.S

TAM1000 100W 4 ohms 65V	£9.80
TAM500 50W 4 ohms 45V	£7.50
TAM250 25W 8 ohms 45V	£5.75

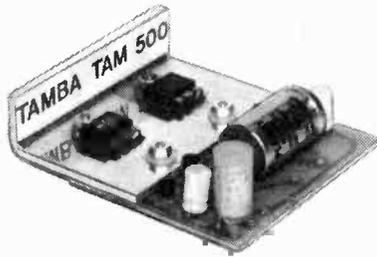
#### POWER SUPPLIES

For 1 or 2 TAM250/500	£7.50
For 1 or 2 TAM1000	£9.80

(Carriage 50p on supplies)

- Suits loads 4–16 ohms
- 20–20,000 Hz  $\pm$  1dB
- Silicon circuitry throughout
- Glass fibre P.C.B.
- High sensitivity (100mV 10k)

High grade components used throughout: Texas, Mullard, R.C.A., Plessey, etc.



- Low distortion (0.1%)
- Low profile (1in high 3½in x 3in)
- 75% efficient
- Accepts most mixer/pre-amplifiers
- Four simple connections

# NEW

## ALL PURPOSE MIXER/PRE-AMP.

(with 60mm slider volume)

- Suitable for multiple input systems
- High and low impedance inputs
- High sensitivity
- Built-in supply smoothing
- 20–20,000 Hz  $\pm$  1dB
- –80dB noise level
- Accepts a wide variety of inputs
- Wide range bass and treble controls

Use up to 10 PRE-AMPS with 1 power supply

Printed circuit board assembly with treble and bass controls plus slider volume control

**£6.50**

You may order as follows: C.W.O. (crossed cheques, P.O.s, M.O.s etc)—C.O.D. (60p extra). We accept Access and Barclaycard—send or telephone your number—do not send your card. Add VAT at 8% to orders for 50 and 100W systems and at 12½% for 25W systems.

Hours, 9.30 a.m.–5 p.m.  
Monday — Saturday.  
Callers welcome. Tel.  
(01) 684 0098

# TAMBA ELECTRONICS

Bensham Manor Road Passage, Bensham Manor Road, Thornton Heath, Surrey.

## You can work wonders with your free time.

There's immense satisfaction in making your own equipment. And you'll get excellent results with Heathkit.

Every kit is absolutely complete down to the last nut and bolt. The quality is the best. And each kit has an easy to follow instruction manual that explains exactly what to do at each step.

So you enjoy assembling your kit and you finish with first-class equipment every time.

That's why Heathkit are so successful. And that's why the range is the biggest in the world.

It's all in the new edition of the free Heathkit catalogue. Everything from the simplest to the most sophisticated. Alarms, digital clocks, testers, transceivers and lots more... even the tools are there!

See for yourself. Send the coupon now.

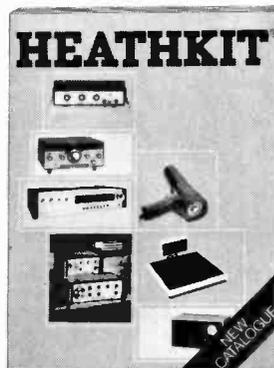
### NEW CATALOGUE

### NEW TEST INSTRUMENTS

### NEW DIGITAL BATHROOM SCALES

### NEW AMATEUR RADIO EQUIPMENT

### NEW AUDIO SYSTEMS AND MANY OTHER NEW ITEMS



### The new Heathkit catalogue. Out now FREE.

To: Heath (Gloucester) Ltd., Dept. PE117, Gloucester, GL2 6EE. Please send me my Heathkit catalogue.

I enclose an 11p stamp for postage.



Name \_\_\_\_\_

Address \_\_\_\_\_

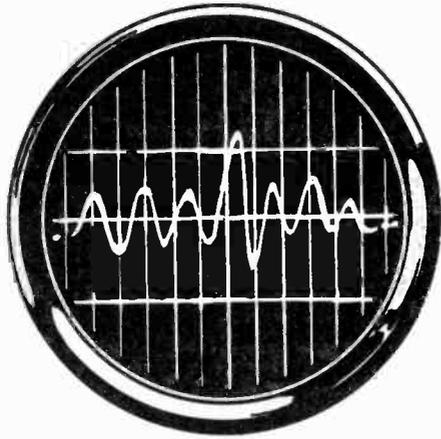
Postcode \_\_\_\_\_

**ACCESS AND  
BARCLAYCARD  
WELCOMED**

Showrooms at 233 Tottenham Court Road, London (Phone 01-636 7349) and Bristol Road, Gloucester (Phone Gloucester 29451).

# LOOK! Here's how you master electronics

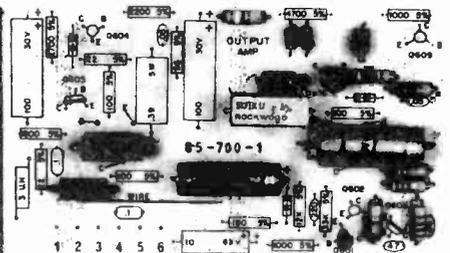
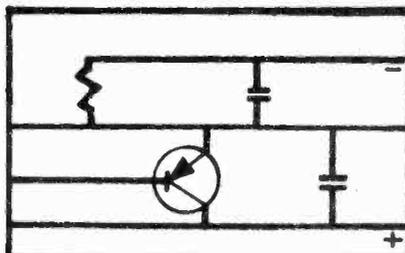
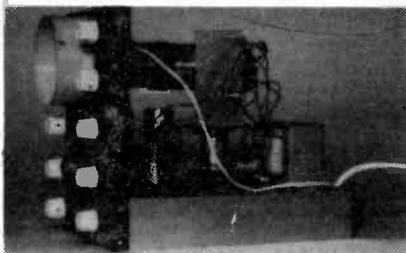
... the practical way



This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to further your career in electronics or as a self-employed electronics engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write, at any time, for advice or help during your work. A Certificate is given at the end of every course.



## 1 Build an oscilloscope

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.

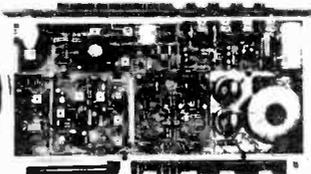
## 2 Read, draw and understand circuit diagrams

In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computers and countless other electronic devices and their servicing procedures.

## 3 Carry out over 40 experiments on basic circuits

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v. etc.

**FREE GIFT**



All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.

### British National Radio & Electronic School

P.O. Box 156, Jersey, Channel Islands.

NAME .....

ADDRESS .....

PEB11

Block caps please

**Free!**

# RST

## VALVE MAIL ORDER CO.

Climax House  
Fallsbrook Road, London SW16 6ED

**SPECIAL EXPRESS  
MAIL ORDER SERVICE**

Ep	Ep	Ep	Ep	Ep	Ep
AA119	0-20	BCY71	0-22	*MPSU01	0-32
AA130	0-13	BCY72	0-17	*MPSU06	0-40
AA132	0-15	BCZ11	1-50	*MPSU56	0-45
AA213	0-25	BD115	0-60	NKT401	2-00
AA215	0-31	BD121	1-50	NKT403	1-73
AA217	0-25	BD123	1-50	NKT404	1-73
AC107	0-75	BD124	1-00	NESS55	0-45
AC125	0-30	BD131	0-51	OA5	0-75
AC126	0-25	BD132	0-54	OA7	0-55
AC127	0-25	*BD135	0-35	OA10	0-55
AC128	0-25	*BD136	0-36	OA47	0-14
AC141	0-20	*BD137	0-37	OA70	0-30
AC141K	0-30	*BD138	0-40	OA79	0-30
AC142	0-20	*BD139	0-43	OA81	0-30
AC142K	0-25	*BD140	0-47	OA85	0-30
AC176	0-25	BD144	2-00	OA90	0-08
AC187	0-25	BD181	1-38	OA91	0-08
AC188	0-25	BD182	1-48	OA95	0-08
ACY17	0-85	BD237	0-80	OA200	0-10
ACY18	0-85	BD238	0-85	OA202	0-11
ACY19	0-85	BDX10	0-75	OA210	0-75
ACY20	0-85	BDX32	2-25	OA211	0-75
ACY21	0-85	BDY20	1-42	OA2200	0-85
ACY39	0-90	BF180	0-75	OA2201	0-85
AD148	0-70	BF115	0-30	OA2206	0-85
AD161	0-75	BF152	0-25	OA2207	0-85
AD162	0-75	BF153	0-25	OC16	1-25
AF106	0-45	BF154	0-25	OC20	2-00
AF114	0-25	BF159	0-35	OC22	2-50
AF115	0-25	BF180	0-30	OC23	2-75
AF116	0-25	BF167	0-30	OC24	3-50
AF117	0-25	BF173	0-30	OC25	0-90
AF139	0-40	BF177	0-38	OC26	0-90
AF186	1-40	BF178	0-45	OC28	2-00
AF239	0-50	BF179	0-48	OC29	2-00
AF211	0-25	BF180	0-30	OC35	1-50
AF212	0-75	BF181	0-45	OC36	0-90
AS226	0-45	BF182	0-45	OC41	0-50
AS227	0-45	BF183	0-45	OC42	0-50
AS215	1-25	BF184	0-30	OC43	1-50
AS216	1-25	BF185	0-30	OC44	0-50
AS217	1-25	*BF194	0-12	OC45	0-50
AS220	0-75	*BF195	0-11	OC71	0-45
AS221	1-50	*BF196	0-13	OC72	0-45
AU113	1-70	*BF197	0-14	OC73	1-00
AU110	1-70	BF200	0-32	OC74	0-75
BA145	0-15	*BF224	0-30	OC75	0-60
BA148	0-15	*BF244	0-35	OC76	0-50
BA154	0-10	BF257	0-37	OC77	1-20
BA155	0-12	BF258	0-42	OC81	0-75
BA156	0-13	BF259	0-45	OC81Z	1-00
BAW87	0-05	*BF336	0-50	OC82	0-75
BAK13	0-07	*BF337	0-50	OC83	0-55
BAK16	0-07	*BF338	0-55	OC84	0-60
BC107	0-12	BFS21	2-27	OC122	1-50
BC108	0-12	BFS28	1-38	OC123	1-55
BC109	0-13	*BFS61	0-25	OC130	2-25
*BC113	0-15	*BF598	0-25	OC140	1-95
*BC114	0-18	BFW10	0-90	OC141	2-25
*BC115	0-18	BFW11	0-90	OC170	0-60
*BC116	0-19	BFX64	0-38	OC171	0-60
*BC117	0-22	BFX85	0-41	OC200	1-00
*BC118	0-16	BFX87	0-35	OC201	1-50
*BC125	0-18	BFX98	0-32	OC202	1-25
*BC126	0-25	BFY50	0-28	OC203	1-25
*BC135	0-19	BFY51	0-28	OC204	1-25
*BC138	0-19	BFY52	0-28	OC205	1-75
*BC137	0-16	BFY64	0-30	OC206	1-75
*BC147	0-10	BFY90	1-32	OC207	1-25
*BC148	0-10	BSX19	0-34	OCP71	1-25
*BC149	0-13	BSX20	0-34	ORP12	0-70
*BC157	0-12	BSX21	0-32	*R2008B	2-25
*BC158	0-11	BT106	1-25	*R2009	2-25
*BC159	0-13	BTY79/400R	3-19	*R2010B	2-25
*BC167	0-13	*BU205	2-25	T1C44	0-36
*BC170	0-16	*BU206	2-25	T1C226D	1-30
*BC171	0-16	*BU208	2-50	T1L208	0-25
*BC172	0-13	BY100	0-45	*T1P29A	0-60
*BC173	0-15	BY126	0-14	*T1P30A	0-60
BC177	0-18	BY127	0-15	T1P31A	0-62
BC176	0-18	BZX61	0-20	T1P32A	0-75
BC179	0-20	Series		T1P33A	1-00
*BC182	0-11	Series	0-13	T1P44A	1-20
*BC183	0-11	Series		T1P41A	0-70
*BC184	0-12	CRS1/05	0-45	T1P42A	0-90
*BC212	0-14	CRS1/40	0-60	T1P2955	1-00
*BC213	0-14	CRS3/05	0-45	T1P3055	0-50
*BC214	0-17	CRS3/40	0-75	*T1S43	0-35
*BC237	0-17	CRS3/60	0-90	*ZS140	0-25
*BC238	0-12	GEX66	1-50	*ZS170	0-12
BC301	0-45	GEX541	1-75	*ZS178	0-54
BC303	0-60	GJ3M	0-75	*ZS271	0-22
*BC307	0-20	GJ5M	0-75	*ZS278	0-56
*BC308	0-18	GJ7M	0-75	*ZTX107	0-11
*BC327	0-22	GMO3378A	1-50	*ZTX108	0-10
*BC328	0-18	*KS100A	0-40	*ZTX109	0-11
*BC337	0-19	MJE340	0-58	*ZTX300	0-12
*BC338	0-18	MJE370	0-85	*ZTX301	0-13
BCY30	1-00	MJE371	0-81	*ZTX302	0-17
BCY31	1-00	MJE320	0-85	*ZTX303	0-17
BCY32	0-32	MJE521	0-75	*ZTX304	0-19
BCY33	0-90	MJE2955	1-25	*ZTX311	0-12
BCY34	0-90	MJE3055	0-75	*ZTX314	0-20
BCY39	0-30	*MPF102	0-30	*ZTX500	0-13
BCY40	1-25	*MPF103	0-30	*ZTX501	0-14
BCY42	0-30	*MPF104	0-30	*ZTX502	0-18
BCY43	0-32	*MPF105	0-30	*ZTX503	0-17
BCY58	0-20	*MPSA06	0-25	*ZTX504	0-20
BCY70	0-18	*MPSA56	0-25	*ZTX531	0-20

Open daily to callers: Mon.-Fri. 9 a.m.-5 p.m.  
Valves, Tubes and Transistors - Closed Saturday  
Terms C.W.O. only - Tel. 01-677 2424-7  
Quotations for any types not listed  
Post and Packing 25p per order + 8% V.A.T.  
Items marked \* 12½%

Plugs in socket  
—low profile 0-15  
8 pin DIL 0-15  
14 pin DIL 0-15  
16 pin DIL 0-17

Prices correct  
when going  
to press

**Random  
FLASHER UNIT**



Wired ready for use  
Complete with three  
100 watt coloured lamps  
that flash independently  
at random

**£18.95**

**TWIN BANK 6 LIGHT  
UNIT**  
(less lamps) LENGTH  
14 1/2 inches



BC Fitting **£9.55**  
EAC-  
ES Fitting **£10.35**  
EACH

**Sound to Light  
MASTER UNIT** 600  
WATTS  
PER  
CHANNEL



**£30.95**

INCLUDING CHANNEL  
OUTPUT PLUGS AND  
Mains INPUT SOCKET

**TYPE A SPOT**  
(less lamp)



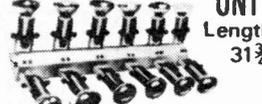
BC Fitting **£1.95** EACH  
ES Fitting **£2.12** EACH

**TYPE B 3 BANK UNIT**  
(Less Lamps)



BC Fitting **£6.90** EACH  
ES Fitting **£7.26** EACH

**TWIN BANK 12 LIGHT  
UNIT**  
Length  
31 3/4  
(less lamps)



BC Fitting **£15.60** EACH  
ES Fitting **£17.00** EACH

100 WATT SPOT LAMPS  
RED, YELLOW, GREEN  
BLUE  
CLEAR **£1.40** each  
3 lamps  
£4.20

B.C. or E.S. Fitting

ALL PRICES INCLUDE V.A.T. and POST & PACKING  
(These prices apply to the United Kingdom only)

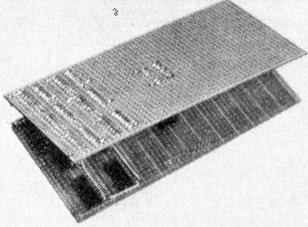
**ALBEN ENGINEERING CO. LTD.**  
DEPT. PE THE CRESCENT, WORSTHORNE,  
BURNLEY, LANCs. Tel: Burnley 20940

**V-Q**

**WAS MADE  
FOR YOU**

**VERO**

VERO QUAD BOARD was designed to provide  
a simple circuit board capable of accepting  
nearly all types of integrated circuits, plus  
transistors, resistors, capacitors and many  
other components.



ASK FOR V-Q - IT WAS MADE FOR YOU  
No track cutting. 1,624 holes on 0.1" x 0.1" matrix.  
Packed complete with layout sheet. Fits Vero Plastic  
Cases 1237, 1238 and 1239. Costs about 90p from your  
local shop or mail order company.  
Send for our booklet describing many other products  
made for you, S.A.E. 7" x 9" plus 10p to:

**VERO ELECTRONICS LTD. RETAIL DEPT.**  
INDUSTRIAL ESTATE, CHANDLERS FORD,  
HANTS. SO5 3ZR.



4½in x 3½in **METER**. 30µA, 50µA or 100µA, £4.75. 19p P. & P.

**MICROPHONES FOR TAPE RECORDERS**

DM228R 200 ohm with 3.5 and 2.5mm Jack Plugs £1.30  
 DM229R 50K with 3.5 and 2.5mm Jack Plugs £1.60  
 DM18D 200 ohm with 5 and 3 pin Din Plugs £1.75  
 Postage on above microphones 11p



**CARDIODY DYNAMIC MICROPHONE**

Model UD-130 Frequency response 50-15,000c/s. Impedance Dual 50K and 600 ohms, £8.02. 26p P. & P.

2in x 2in meters 1mA, 500mA, £2.92. 16p P. & P.

60 x 45mm meters 50µA, 100µA 500µA and 1mA VU meter, £4.14. 11p P. & P.

Edgewise meters 90mm x 34mm, 500µA, and 1mA, £3.40. 19p P. & P.

**MULTI-METER**

Model IT1-2 20,000 ohm/volt, £10.05. 33p P. & P.



**TRANSFORMERS Primary 240V**

6-0-6V	100mA	£0.75
9-0-9V	75mA	£0.75
12-0-12V	50mA	£0.85
12-0-12V	100mA	£1.05

Post on above transformers 30p.  
 9-0-9V 1A £1.80  
 12-0-12V 1A £2.15  
 15-0-15V 1A £2.36  
 30-0-30V 1A £3.10  
 6-3V 1½A £1.80  
 6-0-6V 1½A £2.20  
 Post on above transformers 45p.

All above prices include V.A.T. Send 40p for new fully illustrated catalogue, S.A.E. with all enquiries. Special prices for quantity quoted on request.

**M. DZIUBAS**

158 Bradshawgate · Bolton · Lancs. BL2 1BA

**complete digital clock kits**



**TEAK OR PERSPEX CASE**

NON ALARM £12.50  
 ALARM £15.50

**"DELTA"**  
 6in x 2½in x 3in

All prices include P. & P. and VAT

**FEATURES:** 4 LED digits ½in high. Red. ● 12 hour display with a.m./p.m. indication. ● Mains frequency accuracy. ● Easy to build: all components included. ● Beautiful real wood case or perspex: White, Black, Red, Blue and Green. ● Flashes to indicate power cuts.

**NON ALARM:** Complete kit including case, £12.50. Ready built, £14.50. Module kit excluding case, £9.50. Ready built, £10.00.

**ALARM:** Pulsed alarm tone. Automatic brightness control. 9 minute "Snooze". Simple setting. Complete kit including case, £15.50. Ready built, £17.00. Module kit excluding case, £13.00. Ready built, £13.50.

**TIMER FACILITY:** Use as stopwatch to 9 min 59 sec, extra 50p.

**EXCELLENT VALUE—GUARANTEED LIQUID CRYSTAL WATCH:** 5 function. Back light. Chrome case. Black strap. Excellent value, £17.28.

**DISPLAYS:** FND500 ½in LED, £1.19; 6 for £6.48. NSB 5430, ½in Red LED stick of 4 £4.32. 5LTO2, ½in Green Phosphor stick of 4 £5.67.

**CLOCK CHIPS:** 50253N Alarm 12/24 hour 4/6 digit, £5.67. 50362N Calendar clock, £7.75. MMS385N 12hr 4 digit Alarm £4.32. 6 Decade up/down counters, 50395/6/7 £13.10.

**MICROPROCESSORS:** Z80 CPU, £29.70. Z80 CTC, £15.70. 1702A UV Erasable PROM, £11.35. Z80 PIO £15.70. 2102NA 1K Static RAM £3.15. UV PROM ERAZER, £103 plus £5.P. & P. 4KXI 16 pin Dyn. RAM £7.05.

**RECHARGEABLE BATTERY SET:** Super Value £8.10. Includes 4 AA (1.2V) Nickel Cadmium batteries (separately £4.32). 3/6/9V switched Universal Mains Adaptor with 4 plug connector for most calculators (separately £3.78), plus battery holder.

**ELECTRONIC DOORBELL:** Warbling tone. Runs off PP3 £5.40.

payment with order to:

**BARON** (PE)

Southview House, 6 Gower Road  
 Royston, Hertfordshire

Telephone: Royston (0763) 43695



**Join the Digital Revolution**

Understand the latest developments in calculators, computers, watches, telephones, television, automotive instrumentation . . .

Each of the 6 volumes of this self-instruction course measures 11½in x 8½in and contains 60 pages packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra, to memories, counters and simple arithmetic circuits, and on to a complete understanding of the design and operation of calculators and computers.

Design of Digital Systems.



**£7.10**

plus 90p packing and surface post anywhere in the world.

Overseas customers should send for proforma invoice

Quantity discounts available on request. VAT zero rated.

Also available—a more elementary course assuming no prior knowledge except simple arithmetic.

Digital Computer Logic and Electronics

In 4 volumes:

**£4.60**

plus 90p P. & P.

1. Basic Computer Logic
2. Logical Circuit Elements
3. Designing Circuits to Carry Out Logical Functions
4. Flipflops and Registers

Offer Order both courses for the bargain price £11.10, plus 90p P. & P.—a saving of £1.50.

**Designer Manager Enthusiast Scientist Engineer Student**

These courses were written so that you could teach yourself the theory and application of digital logic. Learning by self instruction has the advantages of being quicker and more thorough than classroom learning. You work at your own speed and must respond by answering questions on each new piece of information before proceeding to the next.

**NEW** from Cambridge Learning Enterprises: **FLOW CHARTS AND ALGORITHMS**—use, design and layout; vital for computing, training, wall charts, etc. **£2.95** plus 45p P. & P.

**Guarantee**—If you are not entirely satisfied your money will be refunded.

Cambridge Learning Enterprises, FREEPOST, Unit 2, Rivermill Lodge, St. Ives, Huntingdon, Cambs. PE17 4BR

To: Cambridge Learning Enterprises, FREEPOST, Unit 2, Rivermill Lodge, St. Ives, Huntingdon, Cambs. PE17 4BR

\*Please send me . . . set(s) of Design of Digital Systems at £8.00 each, P. & P. included

\*or . . . set(s) of Digital Computer Logic and Electronics at £5.50 each, P. & P. included

\*or . . . combined set(s) at £12.00 each, P. & P. included

\*or . . . the Algorithm Writers Guide at £3.40 each, P. & P. included

Name .....

Address .....

\*delete as applicable  
 No need to use a stamp—just print FREEPOST on the envelope.

PE11

# TRANSFORMERS

ALL EX-STOCK—SAME DAY DESPATCH. VAT 8%

12 AND 24 VOLT OR 12-0-12V PRIMARY 220-240 VOLTS				
Ref	12V	24V	£	P & P
111	0-5	0-2	2-20	0-45
213	1-0	0-5	2-64	0-78
71	2	1	3-41	0-78
18	4	2	4-03	0-96
70	6	3	5-35	0-96
108	8	4	6-98	1-14
72	10	5	7-17	1-14
116	12	6	8-99	1-32
17	16	8	10-39	1-32
115	20	10	13-18	2-08
187	30	15	17-05	2-08
226	60	30	26-82	0A

50 VOLT RANGE				
Prim 220/240V Sec 0-19-25-33-40-50V				
Voltages available 5, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 50V or 25-0-25V				
Ref	Amps	£	P & P	
102	0-5	3-41	0-78	
103	1-0	4-57	0-96	
104	2-0	6-98	1-14	
105	3-0	8-45	1-32	
106	4-0	10-70	1-50	
107	6-0	14-82	1-84	
118	8-0	17-05	2-08	
119	10-0	21-70	0A	

MAINS ISOLATING (SCREENED)				
Prim 120/240 SEC 120/240 CT				
Ref	VA (Watts)	£	P & P	
07	20	4-40	0-79	
149	60	6-20	0-96	
150	100	7-13	1-14	
151	200	11-16	1-50	
152	250	12-79	1-84	
153	350	16-28	2-15	
154	500	19-15	2-15	
155	750	29-06	0A	
156	1000	37-20	0A	
157	1500	45-60	0A	
158	2000	54-80	0A	
159	3000	79-05	0A	

HIGH VOLTAGE MAINS ISOLATING				
Prim 200/220V or 400/440V				
Sec 100/120V or 200/240V				
V <sub>a</sub>	Ref	£	P & P	
50	243	5-89	1-32	
350	247	14-11	1-84	
1000	250	35-65	0A	
2000	252	54-25	0A	

30 VOLT RANGE				
Prim 220/240V Sec 0-12-15-20-24-30V				
Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V 15-0-15V, 12-0-12				
Ref	Amps	£	P & P	
112	0-5	2-64	0-76	
79	1-0	3-57	0-96	
20	3-0	5-27	0-96	
20	3-0	6-20	1-14	
21	4-0	7-44	1-14	
51	5-0	8-37	1-32	
117	6-0	9-92	1-45	
88	8-0	11-73	1-64	
89	10-0	13-33	1-84	

60 VOLT RANGE				
Prim 220/240V Sec 0-24-30-40-48-60V				
Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60V or 24-0-24V or 30-0-30V				
Ref	Amps	£	P & P	
124	0-5	3-88	0-96	
126	1-0	5-58	0-96	
127	2-0	7-60	1-14	
125	3-0	10-54	1-32	
123	4-0	12-23	1-84	
40	5-0	13-95	1-64	
120	6-0	15-66	1-84	
121	8-0	20-15	0A	
122	10-0	24-03	0A	
189	12-0	27-13	0A	

AUTO TRANSFORMERS				
Ref	VA (Watts)	Volts	£	P & P
113	20	0-115-210-240	2-48	0-71
64	75	0-115-210-240	3-59	0-96
4	150	0-115-210-240	5-35	0-96
66	300	0-115-210-240	7-75	1-14
87	500	0-115-210-240	10-00	1-64
84	1000	0-115-210-240	18-76	2-08
93	1500	0-115-210-240	23-36	0A
96	2000	0-115-210-240	34-82	0A
03	3000	0-115-210-240	48-00	0A

CASED AUTO TRANSFORMERS				
240V cable in & 115V USA 2 pin outlet				
VA	£	P & P	Ref	
20	4-96	0-96	113W	
150	8-48	1-14	4W	
200	9-92	1-45	65W	
250	10-49	1-45	69W	
350	12-53	1-64	53W	
500	15-73	1-64	87W	
750	18-55	1-76	83W	
1000	22-68	0A	84W	
2000	37-65	0A	95W	

SCREENED MINIATURES				
Ref	mA	Volts	£	P&P
225	200	3-0-3	1-99	0-55
212	1A, 1A	0-0-0-6	2-85	0-78
13	100	0-0-9	2-14	0-38
235	330, 330	0-0-9	1-99	0-38
207	500, 500	0-8-9-, 0-8-9	2-50	0-71
208	1A, 1A	0-8-9-, 0-8-9	3-53	0-78
236	200, 200	0-15-0-15	1-90	0-38
214	300, 300	0-20-0-20	2-56	0-78
221	700 (DC)	20-12-0-12-20	3-41	0-78
206	1A, 1A	0-15-20-0-15-20	4-63	0-96
203	500, 500	0-15-27-0-15-27	3-99	0-96
204	1A, 1A	0-15-27-0-15-27	5-39	0-96
S112	500	12-15-20-24-30	2-64	0-78

## PLUS

HIGH QUALITY MODULES		
10 WATT RMS AMPLIFIER	£4-04	
25 WATT RMS AMPLIFIER	£5-27	
35 WATT RMS AMPLIFIER	£6-95	
125 WATT RMS AMPLIFIER	£7-92	
PRE-AMP for 5-10 WATT	£15-90	
POWER SUPPLIES 5-10 WATT	£1-34	
POWER SUPPLIES 25 WATT	£4-60	
TRANSFORMER 5-10 WATT	£4-50	
TRANSFORMER 25 WATT	£6-43	

PRINTED CIRCUIT KIT		
PC Board, Circuit Marking Pen, Etchant	£2-40	
Crystals, Solvent	£2-40	

BLOB BOARD (Pack of 3)		
3-75" x 5-11" or 2-5" x 5-11" 15"	£0-75	
3-75" x 5-11" or 3-75" x 5-11" 15"	£1-14	
10" x 8" 1" or 10" x 6" 1-5"	£3-78	
4-8" x 3-2" 0-96	£4-75	
4-75" x 7-5" 1-21	£2-13	

ELECTRONIC CONSTRUCTION KIT		
10 projects (including electronic organ). No soldering needed! £7-29. VAT 8% P & 70p		

COMPONENT PACKS		
200 Mixed value resistors (count by weight)		
150 Mixed value capacitors (count by weight)		
30 Mixed value precision resistors 1/2W 2%		
15 Assorted pots		
10 Reed switches		
15 Wire wound resistors—mixed wattage		
1 Pack wire 50 metres assorted colours		
25 Pre-sets assorted types and values		
Please state pack required, 60p per pack		
VAT 12 1/2% P & P 40p		

Prices correct 23-6-77. Please add VAT after P & P.

BRIDGE RECTIFIERS		
200V 2A	£0-45	0-29
400V 2A	£0-55	0-29
200V 4A	£0-65	0-29
400V 4A	£0-80	0-29
400V 6A	£1-05	0-29
500V 10A*	£2-35	0-29
VAT 12 1/2% *VAT 8%		

TEST METERS		
AVO 8 MK5	£68-85	
AVO 71	£28-00	
AVO 73	£37-80	
AVO MM5	£21-94	
AVO TT169 in circuit Transistor Tester	£29-00	
U4315 Inc. case	£14-95	
VAT 8% P & P £1-15		
AVO cases and accessories		

MUSIC CENTRE CHASSIS		
FM (STEREO)/MW/LW 15 + 15W		
Musical Power Inc. Tran. Only		
£23-50. VAT 12 1/2%. P. & P. £1-20		

POWER UNITS		
Stabilised 3-6-7 5-9V/400mA		
multiple outlet	£5-95	
3300 fits into 13A socket 6-7-5-9V		
300mA multiple outlet	£3-30	
RBE 3, 4, 5, 6, 7-5, 9, 12V 500mA		
DC plug outlet	£5-32	
VAT 12 1/2% P & P 55p		

DECS SOLDERLESS BREAD-BOARDING		
S Dec 70 contacts	£1-90	
T Dec 208 contacts	£3-65	
U Dec "A" for I.C.s etc	£3-99	
U Dec "B" for I.C.s etc	£6-99	
VAT 8% P & P 40p		

ANTEX SOLDERING IRONS		
15W	£3-75	£3-75
18W	£3-40	£3-40
25W	£3-40	£1-40
Soldering Iron kit		£5-45
VAT 8% P & P 43p		

TI MINI-MULTIMETER		
DC-1000V AC-1000V DC-100mA		
Res-150kΩ/1000Ω/V Bargain £5-30		
VAT 8% P & P 62p		

STEREO FM TUNER WITH PHASE-LOCK LOOP		
4 Pre-selected stations supply		
20-35V 90mA Max £20-45		
VAT 12 1/2% P & P 40p		

AUDIO KIT 25W	
2+25W Amplifiers	
1+Pre-Amp	
1+Power supply	
1+Transformer	
1+Front Panel	
1+Kit of parts to include on-off switch, neon Ind. Stereo headphone socket. Plus instructions book £27-55.	
Teak veneered cabinet aluminum chassis, heat sink and front panel brackets plus back panel and sockets etc. £9-20	
P & P £1-73 VAT 12 1/2%	

RECORD DECK	
BSR P128R Single Player with Cartridge	£16-90 P&P £1-50
VAT 12 1/2%	

TRANSFORMERS SPECIAL OFFER	
(Limited Stocks)	
BE1 Prim 0-120, 0-120V (120 or 240V) Sec 24V 10A	£5-50 P & P £1-66
BE2 Prim 0-90-110-200-220-240V Sec 0-110V 0-20-24V 2-5A £2-25 P & P 95p, VAT 8%	
BE3 100V line to 0Ω 7/10W £2-05 P & P 66p	

CARTRIDGES	
AT55	£4-43
SONOTONE	£4-05
V100	£2-18
8TA	£2-63
9TAHC	£2-15
ACOS	£2-40
GP93-1	£2-15
GP96-1	£2-40
B.S.R.	£2-25
SX6M	£2-92
SC12M	£7-50
ADC K8	£10-42
SHURE	
M7565	£10-92
M55E	£12-42
VAT 12 1/2% P & P 35p	

**Barrie Electronics Ltd.**  
 3, THE MINORIES, LONDON EC3N 1BJ  
 TELEPHONE: 01-488 3316/7/8  
 NEAREST TELE STATIONS: ALDGATE & LIVERPOOL ST

Our wide range of transformers are too numerous to list, please call (open 9am-5pm Mon-Fri) or send your requirements. ElectroSil & semiconductor stockists. Panel, Multi Meters, Audio accessories, send 15p stamps for lists.



## THE "Manta" CAPACITIVE DISCHARGE ELECTRONIC IGNITION UNIT

FITS ALL CARS—IMPROVES PERFORMANCE—SAVES PETROL

Specifically designed for the Home Constructor, this top quality, high output unit incorporates the latest sophisticated electronic circuitry for the best consistent performance.

Developed from the popular P.E. "Scorpio Mk 11" (designed by Messrs. Gibbs and Shaw), but improved to give highest reliability. Uses only top quality components.

PRICE OF COMPLETE KIT NOW ONLY £15-50 (inclusive of VAT, P. & P.). After sales service available.

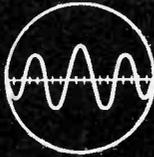
READY MADE UNIT ALSO AVAILABLE NOW ONLY £17-50 (inclusive of VAT and P. & P.). Full two year guarantee.

Do not confuse with cheaper electronic ignition units.

Send 7p stamp for full details and our six page explanatory brochure "Electronic Ignition—How it Works".

**ELECTRO SPARES**  
 Dept. P.E., 187a Sheffield Road, Chesterfield, Derbys.  
 S41 7JQ. Telephone: Chesterfield (0246) 36638

<b>ELECTRET MICROPHONE INSERT with FET Pre-Amp. £1-85.</b>	
<b>FM TUNER FRONT END with FET R.F. Stage, with conversion details to Aircraft Band or 2 metres. £3.</b>	
<b>WELL KNOWN MANUFACTURER OF HI-FI AMPLIFIERS.</b> Discontinued line consisting of major parts for 20 + 20 watt amplifier, as follows. Stereo Pre-Amp, Stereo Tone Board, 2 x Driver Boards, Volume and Tone Controls, on-off switch, 2 Push Button Assemblies, Rotary Switch etc., with Circuit Diagram, and suggested Construction. All for £8-60.	
<b>MAINS TRANSFORMER.</b> For Above, £3-50 plus 85p P. & P.	
<b>UNIUNIONIDN TRANSISTORS.</b> T1S43 Type, 20p; MEV21, 22p; 2N4871, 22p; MV4894, 22p; GE4JD5E29, 22p; Programmable UJT D13T1, 25p; 2N6028, 30p.	
<b>100 ASSORTED MULLARD C280 CAPACITORS</b> for 57p.	
<b>BF451 SILICON PNP 300MHz TRANSISTORS,</b> 8 for 35p.	
<b>50 BC107-8 9 TRANSISTORS.</b> Assorted untested for 57p.	
<b>TANTALUM BEAD CAPACITORS.</b> 0-1µF 35V W., 0-33µF 35V W., 1µF 35V W., 2-2µF 35V W., 3-3µF 16V W., 4-7µF 10V W., 4-7µF 35V W., 5µF 25V W., 6-8µF 25V W., 6-8µF 35V W., 10µF 25V W., 15µF 10V W., 20µF 6V W., 22µF 16V W., 33µF 25V W., 47µF 6V W., 68µF 3V W. All 9p each.	
<b>OPTO ISOLATOR LINTRONIX 1L-74</b> with data. 50p.	
<b>ELECTROLYTIC CAPACITORS.</b> Screw Terminal Type 680µF 160V W., 4 1/2 x 1 1/2in, 40p; 3300µF 63V W., 4 1/2 x 1 1/2in, 55p; 4700µF 100V W., 4 1/2 x 2in, £1; 15,000µF 40V W., 4 1/2 x 2in, £1; 33,000µF 16V W., 4 1/2 x 2in, 75p; 47,000µF 10V W., 4 1/2 x 2in, 75p. <b>TAG ENDED TYPE</b> 500µF 70V W., 2 1/2 x 1in, 30p; 500µF 100V W., 2 1/2 x 1in, 30p; 1000µF 100V W., 4 1/2 x 1in, 60p; 3000µF 25V W., 4 1/2 x 1in, 50p; 4700µF 25V W., 2 1/2 x 1in, 50p; 5000µF 30V W., 4 x 1 1/2in, 60p. <b>WIRE ENDED</b> 220µF 63V W., 20p; 330µF 40V W., 20p;	



# TUAC

TRANSISTOR UNIVERSAL AMPLIFICATION CO. LTD.  
PHONE 01-672 3137/672 9080  
MANUFACTURERS OF QUALITY AMPLIFICATION AND LIGHTING  
CONTROL SYSTEMS

PRICES INCLUDE VAT, P & P FREE  
correct at 1/9/77

TO ORDER BY POST

Make cheques/P.O.s payable to TUAC LTD. (PE 109) or quote  
Access/Barclaycard No. and post to TUAC LTD. (PE 109) 119  
Charlton Road, London SW17 9AB. We accept phone orders  
from Access/Barclaycard Holders. Phone 01-672 9080.

## PRE AMPLIFIERS

Designed for use with TUAC power amplifier modules.



### VA08

Vol. Treb. Mid. and Bass controls. HI. IMP. FET. I/P suitable Mid.  
Guitar, Radio Crystal/Ceramic P.U. Sensitivity 4mV. Treble +35dB at  
16kHz. Mid +20 -15dB at 1kHz. Bass +20 -10dB at 40Hz.

### VA06

Vol. Treb. and Bass controls. Sensitivity 8mV. Treb +28 -15dB at  
12kHz. Bass ±18dB and 40Hz

### SVA08 STEREO PRE AMP

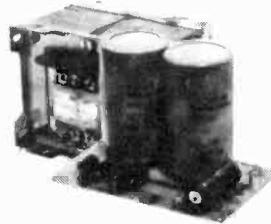
Vol. Treb. Mid and Bass controls. I/P suitable Guitar, Radio,  
Crystal/Ceramic P.U. Sensitivity 4mV. Treble +35dB at 16kHz. Mid +  
20 -7dB at 4kHz. Bass +20 -18dB at 30Hz Plus Full Balance Control.  
Fully I/C operation supply voltage ±25VDC.

£9.00

£7.75

£15.00

## POWER SUPPLIES



Vacuum varnish impregnated. Transformers  
with supply board incorporating pre-amp supply:

PS250 for supplying 2 TP125s £28.50

PS200 for supplying 2 TP100s £28.50

PS60/60 for supplying 2 TL60s £25.00

PS125 ±45 volts for TP125 £17.75

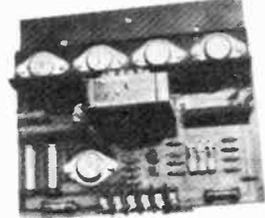
PS100 ±43 volts for TL100 £16.25

PS60 ±38 volts for TL60 £15.25

PS30 ±25 volts for TL30 £11.75

PSU 2 for supplying disco mixer £7.50

## AMPLIFIER MODULES



### TL30 D.C. COUPLED 5 × 5 × 1 1/4 in.

• 35 watt R.M.S. continuous sine wave output  
• 8 transistors 4 diodes

£12.75

### TL60 5 × 5 × 3 in

• 60 watt R.M.S. continuous sine wave output  
• 2 R.C.A. 110 watt 15 amp transistors

£18.25

### TL100

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

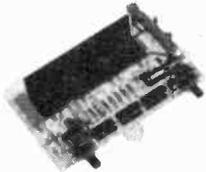
£20.75

### TP125 7 × 6 1/2 × 3 in

• 125 watt R.M.S. continuous sine wave output  
• 4 R.C.A. 150 watt 15 amp output transistors

£25.75

## 4 CHANNEL SOUND TO LIGHT SEQUENCE CHASER - 4LSM1



- Full wave control
- RCA 8A Triacs
- 1000W per channel
- Fully suppressed and fused
- Switched master control for sound operation from 1/2W to 125W
- Speed control for fixed rate sequence from 8 per minute to 50 per second
- Full logic integrated circuitry with optical isolation for amplifier protection

£20.75

Model 501 500W per channel as above without  
sound triggering

£12.25

## FRONT PANEL FOR LIGHTING EFFECT MODULES

(complete with switches, neons and knobs)  
as illustrated



For S1LMB £6.50  
Size 8" x 4 1/2"



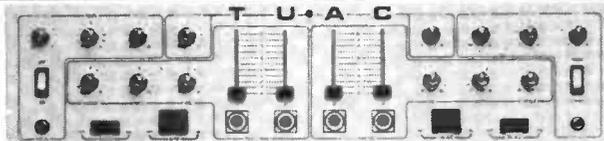
4LSM1 £5.50  
Size 8 1/2" x 4 1/2"



FUZZ LIGHTS  
Red, Green, Blue,  
Amber. £23.50



S1LMB £7.50  
Combined with 3SDM1  
Size 9" x 4 1/2"



## STEREO DISCO MIXER

With touch sensitive switching and auto fade

INPUTS: Four identical stereo inputs available with any equalisation. Two magnetic and two flat supplied as standard. High quality slider control on each channel. Volume, treble and bass controls for each pair of sliders. Sensitivity mag., 3mV (R.I.A.A. comp.). Flat 50mV at 1kHz. Bass controls ±18dB at 60Hz. Treble controls ±18dB at 15kHz.

OUTPUT: Up to 3 volts (+12dB) available. Attenuated output for TUAC Power Modules. Rotary master and balance controls. Band width 15Hz - 25kHz ± dB.

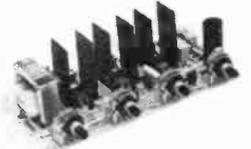
P.F.L.: Output 250mV into 8 ohms. Rotary volume control. Monitoring facility for all 4 channels. Selection via touch sensitive illuminated switches. Switched visual cue indicator.

Miscellaneous Facilities: Two illuminated deck on/off switches. Mains illuminated on/off switches. Auto fade illuminated on/off switch. Mains powered with integral screen and back cover. Complete with full instructions

Size: 25in long x 6in high x 3in deep.  
Mono Disco Mixer with autofade £45.00

£129.00

## 3 CHANNEL LIGHT MODULATOR SILMB



## THE PIEZO SUPER HORN £10.95

- NEEDS NO CROSS-OVER NETWORK
- FREQUENCY RESPONSE 4,000 - 30,000 Hz ± 3dB
- PATENTED MOMENTUM DRIVE PRINCIPLE • NO VOICE COILS OR MAGNETS • HIGH INTERNAL IMPEDANCE • ADAPTS TO ANY SYSTEM • HIGH ACOUSTIC OUTPUT • MANY CAN BE CONNECTED IN SERIES TO FORM AN ARRAY - INCREASED OUTPUT • POWER HANDLING CAPACITY 25 volts RMS - see chart

POWER HANDLING GUIDE	
System Impedance	Capacity
2 ohms	312 watts
4 ohms	156 watts
8 ohms	78 watts
16 ohms	39 watts



3 1/8 × 3 1/8 × 2 7/16 ins

- RCA 8A Triacs
- 1000W per channel
- Each channel fully suppressed and fused
- Master control to operate from 1W to 125W
- Full wave control

£20.25

Single Channel Version 1500 Watts £9.75

## ADD SEQUENCE CHASING + DIMMING EFFECTS FOR TUAC 3 CHANNEL LIGHT MODULATOR



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

3SDM1

£14.50

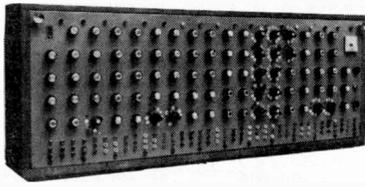
## STOCKISTS - CALLERS ONLY

A1-Music, 88 Oxford Street, Manchester (Tel. 061-236 0340)  
Geo Mathews, 85/87 Hurst Street, Birmingham (Tel. 021-822 1941)  
Bristol Disco Centre, 25 The Promenade, Gloucester Road (Tel. Bristol 41666).  
Soccodi, 9 The Friars (Tel. Canterbury 60948)  
Cookies Disco Centre, 132 West Street (Tel. Crewe 47399).  
Garland Bros. Ltd., Deptford Broadway, London 01-692 4412  
Luton Disco Centre, 88 Wellington Street, Luton (Tel. Luton 411733)  
Mitchell Electronics, 7 Queen Street (Tel. Salisbury 23689).

Session Music, 163 Mitcham Road, Tooting (Tel. 01-672 3413).  
Mon-Sat 10 a.m. - 6 p.m. Closed Wed.

SUPPLIERS TO H.M. GOVT. DEPTS. MANUFACTURED AND ASSEMBLED IN GT. BRITAIN FULLY TESTED AND GUARANTEED  
SEND NOW FOR OUR FREE 20 PAGE ILLUSTRATED CATALOGUE. S.A.E. STAMPED PLEASE

# KITS FOR SYNTHESISERS, SOUND EFFECTS



**COMPONENTS SETS** include all necessary resistors, capacitors, semiconductors, potentiometers and transformers. Hardware such as cases, sockets, knobs, etc. are not included but most of these may be bought separately. Fuller details of kits, PCBs and parts are shown in our lists.

**CIRCUIT AND LAYOUT DIAGRAMS** are supplied free with all PCBs designed by Phonosonics.

**PHOTOCOPIES** of the P.E. texts for most of the kits are available—prices in our lists.

# PHONOSONICS

MAIL ORDER SUPPLIERS OF QUALITY PRINTED CIRCUIT BOARDS, KITS AND COMPONENTS TO A WORLD-WIDE MARKET.

## P.E. MINISONIC Mk. 2 SYNTHESISER

A portable mains-operated Miniature Sound Synthesiser, with keyboard circuits. Although having slightly fewer facilities than the large P.E. Synthesiser the functions offered by this design give it great scope and versatility. Consists of 2 log VCOs, VCF, 2 envelope shapers, 2 voltage controlled amps, keyboard hold and control circuits, HF oscillator and detector, ring modulator, noise generator, output amp and mixer, power supply.

Set of basic component kits from £84.25  
Set of printed circuit boards £9.71

## P.E. SYNTHESISER (P.E. Feb. 73 to Feb. 74)

The well acclaimed and highly versatile large-scale mains-operated Sound Synthesiser complete with keyboard circuits. Other circuits in our lists may be used with the Synthesiser to good advantage, notably P.E. Minisonic, Phasing Unit, Wind and Rain, Rhythm Generator, Sound Bender, Voltage Controlled Filter, Guitar Effects Pedal and Overdrive, Fuzz, Tremolo and Wah-Wah units.

**The Main Synthesiser:** PSU, 2 linear VCOs, 2 ramp generators, 2 input amps, sample hold, noise generator, reverb amp, ring modulator, peak level circuit, envelope shaper, voltage controlled amp. Full details in lists.

Set of basic component kits £83.03  
Set of printed circuit boards £13.20

**The Synthesiser Keyboard Circuits** (can be used without the Main Synthesiser to make an independent musical instrument): 2 logarithmic VCOs, divider, 2 hold circuits, 2 modulation amps, mixer, 2 envelope shapers and additional PSU. Full details in our lists.

Set of basic component kits £48.18  
Set of printed circuit boards £7.66

## GUITAR EFFECTS PEDAL (P.E. July 75)

Modulates the attack, decay and filter characteristics of an audio signal not only from a guitar but from any audio source, producing 8 different switchable effects that can be further modified by manual controls. Possibly the most interesting of all the low-priced sound effects units in our range. Circuit does not duplicate effects from the Guitar Overdrive Unit.

Component set with special foot operated switches £7.59  
Alternative component set with panel mounting switches £4.96  
Printed circuit board £1.43

## SOUND BENDER (P.E. May 74)

A multi-purpose sound controller, the functions of which include envelope shaper, tremolo, voice-operated fader, automatic fader and frequency-doubler.

Component set for above functions (excl. SWs) £7.84  
Printed circuit board £1.81

Optional extra—additional Audio Modulator, the use of which, in conjunction with the above component set, can produce "jungle-drum" rhythms.

Component set (incl. PCB) £2.88

## PHASING UNIT (P.E. Sept. 73)

A simple but effective manually controlled unit for introducing the "phasing" sound into live or recorded music.

Component set (incl. PCB) £2.87

## PHASING CONTROL UNIT (P.E. Oct. 74)

For use with the above Phasing Unit to automatically control the rate of phasing.

Component set (incl. PCB) £4.48

## SOPHISTICATED PHASING AND VIBRATO UNIT

A slightly modified version of the circuit published in "Elektron", December 1976, and includes manual and automatic control over the rate of phasing and vibrato.

Component set £17.69  
Printed circuit board £2.33

## WAH-WAH UNIT (P.E. Apr. 76)

The Wah-Wah effect produced by this unit can be controlled manually or by the integral automatic controller.

Component set (incl. PCB) £3.55

## AUTOWAH UNIT (P.E. Mar. 77)

Automatically produces Wah-pedal and Swell-pedal sounds each time a new note is played.

Component set, PCB, special foot switches £7.27  
Component set and PCB, with panel switches £4.83

## P.E. JOANNA (P.E. May/Sept. 75)

A five-octave electronic piano that has switchable alternative voicing of Honky-Tonk piano, ordinary piano, harpsichord, or a mixture of any of the three, together with facilities including fast and slow tremolo, loud and soft pedal switching, and sustain pedal switching. The power amplifier typically delivers 24 watts into 8 ohms. The PCBs have been redesigned by ourselves making improved use of the space available.

Main power supply, tone generator, 61 envelope shapers, voicing and pre-amp circuits.

Set of basic component kits for above £75.29  
Set of printed circuit boards for above £20.35  
Power amplifier £15.97  
Printed circuit board for power amp 95p

## ELECTRONIC ORGAN

5-octave electronic organ with 5 basic voices that can be used individually or together, 5 pitches (2ft, 4ft, 8ft, 16ft, 32ft), variable attack, tremolo, vibrato, phasing, and variable sustain. Details in our list.

## ORGAN CONVERSION KIT

Converts the P.E. Joanna electronic piano to also provide most of the facilities offered by the above electronic organ.

Basic component set and PCB £12.34

## SYNTHESISER TUNING INDICATOR (P.E. July 77)

A simple 4-octave frequency comparator for use with synthesisers and other instruments where the full versatility of the P.E. Tuning Fork is not required.

Component and PCB (but excl. sw.) £7.45

## GUITAR FREQUENCY DOUBLER (P.E. Aug. 77)

A modified and extended version of the circuit published. Details in list.

SEE OTHER PAGE FOR KEYBOARDS, AND OUR LISTS FOR OTHER COMPONENTS AND ACCESSORIES STOCKED

## WIND AND RAIN UNIT

A manually controlled unit for producing the above-named sounds.

Component set (incl. PCB) £3.72

## GUITAR OVERDRIVE UNIT (P.E. Aug. 76)

Sophisticated, versatile Fuzz unit, including variable and switchable controls affecting the fuzz quality whilst retaining the attack and decay, and also providing filtering. Does not duplicate the effects from the Guitar Effects Pedal and can be used with it and with other electronic instruments.

Component set using dual slider pot £6.86  
Component set using dual rotary pot £6.20  
Printed circuit board £1.62

## FUZZ UNIT

Simple Fuzz unit based upon P.E. "Sound Design" circuit.

Component set (incl. PCB) £2.03

## TREMOLO UNIT

Based upon P.E. "Sound Design" circuit.

Component set (incl. PCB) £3.84

## TREBLE BOOST UNIT (P.E. Apr. 76)

Gives a much shrier quality to audio signals fed through it. The depth of boost is manually adjustable.

Component set (incl. PCB) £2.40

## P.E. TUNING FORK (P.E. Nov. 75)

Produces 84 switch-selected frequency-accurate tones. A LED monitor clearly displays all beat note adjustments. Ideal for tuning acoustic and electronic musical instruments alike.

Main component set (incl. PCB) £15.59  
Power supply set (incl. PCB) £7.03

## P.E. SYNCHRONOME (P.E. Mar. 76)

An accented-beat electronic metronome, providing duple, triple and quadruple times with full control over the beat rate. Can also be used as a simple drum-beat rhythm generator. Includes power supply.

Component set (incl. loudspeaker) £11.62  
Printed circuit board £2.04

## TAPE NOISE LIMITER

Very effective circuit for reducing the hiss found in most tape recordings. All kits include PCBs

Standard tolerance set of components £2.96  
Superior tolerance set of components £3.76  
Regulated power supply (will drive 2 sets) £4.69

## ENVELOPE SHAPER WITHOUT VCA (P.E. Oct. 75)

Provides full manual control over attack, decay, sustain and release functions, and is for use with an existing voltage controlled amplifier.

Component set (incl. PCB) £4.66

## ENVELOPE SHAPER WITH VCA (P.E. Apr. 76)

This unit has its own voltage controlled amplifier and has full manual control over attack, decay, sustain and release functions.

Component set (incl. PCB) £6.68

## TRANSIENT GENERATOR (P.E. Apr. 77)

An envelope shaper, without VCA, having the usual attack, decay, sustain and release functions, and in addition it also provides a "Repeat Effect" enabling a synthesiser to be programmed to imitate such instruments as a mandolin or banjo.

Component set £4.52  
Printed circuit board £1.82

## WAVEFORM CONVERTER

Slightly modified from a circuit published in a German edition of "Elektron". Converts a saw-tooth waveform into four different waveforms: sine-wave, mark-space saw-tooth, regular triangle form, and squarewave with an externally variable mark-space ratio.

Component set (incl. PCB but excl. sw's) £8.19

## VOLTAGE CONTROLLED FILTER (P.E. Dec. 74)

Part of the P.E. Minisonic now released as an independent kit for use with other synthesisers.

Component set (incl. PCB) (Order as Kit 65-1) £8.22

## RING MODULATOR (P.E. Jan. 75)

Part of the P.E. Minisonic now released as an independent kit for use with other synthesisers.

Component set (incl. PCB) (Order as Kit 59-1) £5.50

## NOISE GENERATOR (P.E. Jan. 75)

Part of the P.E. Minisonic now released as an independent kit for use with other synthesisers.

Component set (incl. PCB) (Order as Kit 60-1) £3.35

## SOPHISTICATED POWER SUPPLIES

A wide range of highly stabilised low noise power supply kits is available—details in our lists.

## MICROPHONE PRE-AMP (P.E. Apr. 77)

Component set (incl. PCB) £3.78

## VOICE OPERATED FADER (P.E. Dec. 73)

For automatically reducing music volume during "talk-over"—particularly useful for Disco work or for home-movie shows.

Component set (incl. PCB) £3.97

## DYNAMIC RANGE LIMITER (P.E. Apr. 77)

Automatically controls sound output to within a preset level.

Component set (incl. PCB) £4.58

## POST AND HANDLING

U.K. orders—under £15 add 25p plus VAT, over £15 add 50p plus VAT. Keyboards £2.00 plus VAT.  
Optional insurance for compensation against loss or damage in post, add 35p in addition to above post and handling.

Eire, C.I., B.F.P.O., and other countries are subject to Export postage rates.

## DON'T FORGET VAT!

Add 12½% (or current rate if changed) to full total of goods, post and handling. (Does not apply to export orders).

EXPORT ORDERS are welcome, though we advise that a current copy of our list should be obtained before ordering as it also shows Export postage rates. All payments must be cash-with-order, in Sterling and preferably by International Money Order or through an English Bank. To obtain list send 40p.

PHONOSONICS · DEPT. PE5N · 22 HIGH STREET · SIDCUP · KENT DA14 6EH

MAIL ORDER AND C.W.O. ONLY  
SORRY BUT NO CALLERS PLEASE

# AND OTHER PROJECTS

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

LIST—Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBs, kits and other components.

OVERSEAS enquiries for list: Europe—send 20p; other countries—send 40p.



## KEYBOARDS AND CONTACTS

**Kimber-Allen Keyboards** as required for many published circuits, including the P.E. Joanna, P.E. Minisonic, and P.E. Synthesiser. The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C. The keys are plastic, spring-loaded and mounted on a robust aluminium frame.

3 Octave (37 notes) £25.50. 4 Oct (48 notes) £32.25. 5 Oct (61 notes) £39.75.

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

Contact	Each	3 Octave Set	4 Octave Set	5 Octave Set
SP	24p	£ 8.88	£11.76	£14.64
2P	27p	£ 9.99	£13.23	£16.47
4PS	53p	£19.61	£25.97	£32.33

**PRINTED CIRCUIT BOARDS** for use with the above contacts and thus eliminating most of the inter-wiring required, are available. Details in our lists.

## MORE NEW KITS!

### NEW RHYTHM GENERATOR

Redesigned, improved and extended version of the PE 1974 design and including new automatic rhythm programme selector.

### TUNE-PROGRAMMABLE SEQUENCER

(PE Nov. 77) The new music unit currently being published.

### FORMANT SYNTHESISER

(Elektron Magazine 1977). Very sophisticated music synthesiser for the advanced constructor and for whom cost is secondary to performance.

### GUITAR SUSTAIN UNIT

(PE Oct. 77). Details in lists. Please send S.A.E.

### SOUND-TO-LIGHT (P.E. Aurora) (P.E. Apr.—Aug. 71)

Four channels each responding to a different sound frequency and controlling its own light. Can be used with most audio systems and lamp intensities.

Basic component set (excl. thyristors) £15.92  
Printed circuit board for above £3.90  
Power supply £5.78  
PCB for power supply £1.79

### 3-CHANNEL SOUND-TO-LIGHT (P.E. Apr. 76)

A simple but effective sound-to-light controller capable of operating 3 lamps each of approximately 700 watts. Includes power supply, thyristors, and by-pass switches.

Component set (incl. PCB) £11.95

### DISCOSTROBE (P.E. Nov. 76)

4-channel light-show controller giving a choice of sequential, random, or full strobe mode of operation.

Basic component set £18.19  
Printed circuit board £3.45

### BIOLOGICAL AMPLIFIER (P.E. Jan./Feb. 73)

Multi-function circuits that, with the use of other external equipment, can serve as lie-detector, alphaphone, cardiophone etc.

Pre-Amp Module Component set (incl. PCB) £4.22

Basic Output Circuits—combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feedback lampdriver circuits £6.59  
Audio Amplifier Module Type PC7 £7.35

### SEMI CONDUCTOR TESTER (P.E. Oct. 73)

Essential test equipment for the enterprising home constructor. While stocks last.

Set of resistors, capacitors, semiconductors, potentiometers, makaswitches and PCB £9.63  
Panel meter (500µA) £5.70

## TRANSISTORS

AC128	26p
AC176	26p
BC107	14p
BC108	14p
BC109	14p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	29p
BCY71	22p
BD131	44p
BD132	44p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MD8001	172p
OC28	60p
OC71	20p
OC72	25p
OC84	25p
ORP12	70p
ZTX107	12p
ZTX108	9p
ZTX501	13p
ZTX503	15p
ZTX531	15p
2N1705	13p
2N1914	22p
2N1304	22p
2N2219	27p
2N2905	35p
2N2905A	36p
2N2907	22p
2N3053	18p
2N3054	16p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N5245	51p
2N5459	33p
2N5777	45p

AC128	21p
AC127	21p
AC128	21p
AC127	21p
AC187	23p
AC188	23p
AC300	37p
AD181	50p
AD182	50p
AF114	25p
AF115	27p
AF116	25p
AF117	22p
AF118	30p
AF124	42p
AF239	53p
BC107	14p
BC108	14p
BC109	14p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	29p
BCY71	22p
BD131	44p
BD132	44p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MD8001	172p
OC28	60p
OC71	20p
OC72	25p
OC84	25p
ORP12	70p
ZTX107	12p
ZTX108	9p
ZTX501	13p
ZTX503	15p
ZTX531	15p
2N1705	13p
2N1914	22p
2N1304	22p
2N2219	27p
2N2905	35p
2N2905A	36p
2N2907	22p
2N3053	18p
2N3054	16p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N5245	51p
2N5459	33p
2N5777	45p

AC128	21p
AC127	21p
AC128	21p
AC127	21p
AC187	23p
AC188	23p
AC300	37p
AD181	50p
AD182	50p
AF114	25p
AF115	27p
AF116	25p
AF117	22p
AF118	30p
AF124	42p
AF239	53p
BC107	14p
BC108	14p
BC109	14p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	29p
BCY71	22p
BD131	44p
BD132	44p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MD8001	172p
OC28	60p
OC71	20p
OC72	25p
OC84	25p
ORP12	70p
ZTX107	12p
ZTX108	9p
ZTX501	13p
ZTX503	15p
ZTX531	15p
2N1705	13p
2N1914	22p
2N1304	22p
2N2219	27p
2N2905	35p
2N2905A	36p
2N2907	22p
2N3053	18p
2N3054	16p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N5245	51p
2N5459	33p
2N5777	45p

AC128	21p
AC127	21p
AC128	21p
AC127	21p
AC187	23p
AC188	23p
AC300	37p
AD181	50p
AD182	50p
AF114	25p
AF115	27p
AF116	25p
AF117	22p
AF118	30p
AF124	42p
AF239	53p
BC107	14p
BC108	14p
BC109	14p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	29p
BCY71	22p
BD131	44p
BD132	44p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MD8001	172p
OC28	60p
OC71	20p
OC72	25p
OC84	25p
ORP12	70p
ZTX107	12p
ZTX108	9p
ZTX501	13p
ZTX503	15p
ZTX531	15p
2N1705	13p
2N1914	22p
2N1304	22p
2N2219	27p
2N2905	35p
2N2905A	36p
2N2907	22p
2N3053	18p
2N3054	16p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N5245	51p
2N5459	33p
2N5777	45p

## INTEGRATED CIRTS.

709 TO5	40p
709 8-pin DIL	48p
723 TO5	105p
741 8-pin DIL	32p
748 TO5	63p
748 8-pin DIL	63p
µA7805 TO220	205p
µA7808 TO220	205p
µA7812 TO220	205p
µA7815 TO220	205p
µA7818 TO220	205p
AY-1-0212	650p
AY-1-67216	195p
CA3046	90p
MC3340	150p
SG3402N	262p

## PHONOSONICS

PRICES ARE CORRECT AT TIME OF PRESS.  
E. & O. E. DELIVERY SUBJECT TO AVAILABILITY.

## SPECIAL OFFER

NO  
EXTRA  
CHARGES

FOR THIS MONTH  
Portable Cassette  
Condenser Micro-  
phone with remote  
control  
£3.35

All  
Prices Inc.  
VAT and  
P. & P.  
U.K. only

TTL	74 Series	7494 83p	CMOS	R.C.A.	CD4050 80p	CD4082 23p
7400 13p	7441 74p	7495 79p	CD4000 16p	CD4022 94p	CD4054 190p	CD4086 24p
7401 15p	7442 74p	7496 79p	CD4001 16p	CD4023 21p	CD4055 140p	CD4088 POA
7402 18p	7443 74p	7497 79p	CD4002 16p	CD4024 83p	CD4056 140p	CD4091 POA
7403 16p	7444 123p	7498 79p	CD4003 16p	CD4025 26p	CD4057 80p	CD4092 130p
7404 22p	7445 123p	7499 79p	CD4004 16p	CD4026 83p	CD4058 170p	CD4093 80p
7405 22p	7446 130p	7500 79p	CD4005 16p	CD4027 80p	CD4059 210p	CD4094 170p
7406 44p	7447 192p	7501 79p	CD4006 87p	CD4028 90p	CD4060 87p	CD4095 80p
7407 44p	7448 192p	7502 79p	CD4007 87p	CD4029 110p	CD4061 87p	CD4096 80p
7408 23p	7449 192p	7503 79p	CD4008 87p	CD4030 62p	CD4062 87p	CD4097 80p
7409 23p	7450 192p	7504 79p	CD4009 87p	CD4031 62p	CD4063 87p	CD4098 80p
7410 18p	7451 192p	7505 79p	CD4010 87p	CD4032 62p	CD4064 87p	CD4099 80p
7411 24p	7452 192p	7506 79p	CD4011 87p	CD4033 62p	CD4065 87p	CD4100 80p
7412 24p	7453 192p	7507 79p	CD4012 29p	CD4034 62p	CD4066 87p	CD4101 80p
7413 36p	7454 192p	7508 79p	CD4013 29p	CD4035 62p	CD4067 87p	CD4102 80p
7414 41p	7455 192p	7509 79p	CD4014 29p	CD4036 62p	CD4068 87p	CD4103 80p
7415 33p	7456 192p	7510 79p	CD4015 29p	CD4037 62p	CD4069 87p	CD4104 80p
7416 33p	7457 192p	7511 79p	CD4016 29p	CD4038 62p	CD4070 87p	CD4105 80p
7417 33p	7458 192p	7512 79p	CD4017 29p	CD4039 62p	CD4071 87p	CD4106 80p
7418 33p	7459 192p	7513 79p	CD4018 29p	CD4040 62p	CD4072 23p	CD4107 80p
7419 33p	7460 192p	7514 79p	CD4019 29p	CD4041 62p	CD4073 23p	CD4108 80p
7420 23p	7461 192p	7515 79p	CD4020 19p	CD4042 62p	CD4074 16p	CD4109 80p
7421 28p	7462 192p	7516 79p	CD4021 19p	CD4043 62p	CD4075 16p	CD4110 80p
7422 28p	7463 192p	7517 79p	CD4022 19p	CD4044 62p	CD4076 16p	CD4111 80p
7423 28p	7464 192p	7518 79p	CD4023 19p	CD4045 190p	CD4077 16p	CD4112 80p
7424 28p	7465 192p	7519 79p	CD4024 19p	CD4046 190p	CD4078 24p	CD4113 80p
7425 28p	7466 192p	7520 79p	CD4025 19p	CD4047 190p	CD40	

**NEW**

8th EDITION

# BEGINNER'S GUIDE TO RADIO

GORDON J. KING



Introduces the reader in easy step-by-step stages to all aspects of radio technology, from simple electromagnetic theory to the full range of radio components and circuits.

Completely rewritten and updated, the 8th edition contains all the latest developments in radio technology.

Written in a non-technical style with a minimum of mathematics, this new edition will develop the reader's knowledge and interest and enable him to use radio equipment with confidence and skill.

- \* **CONTENTS:** Electricity and magnetism. Radio signals. Signal propagation and reception. Transmitter principles. Receiver principles. Radio components. Valves, solid-state devices and transistors. Integrated circuits. Microphone, pickup and loudspeaker. Modern radio receivers. Index.

\* Sept. 1977 . 240 pages . £2.75



Order now from your local bookseller or from:

**NEWNES TECHNICAL BOOKS**  
Borough Green, Sevenoaks, Kent TN15 8PH

ANOTHER RECENT TITLE  
**Beginner's Guide to Integrated Circuits**  
 I.R. Sinclair

CONTENTS:  
 What is an Integrated Circuit?  
 Production of i.c.s.  
 Simple Voltage Amplifier i.c.s.  
 Simple Digital i.c.s.  
 MOS i.c.s.  
 Domestic Uses of i.c.s.  
 Other Specialised i.c.s.  
 Practical Construction  
 Index  
 1977 192 pages  
 £2.75

## BARGAIN PARCELS SAVE POUNDS

Huge quantities of electronic components must be cleared as space required, 1000's of Capacitors, Resistors, Transistors, etc. and ex equipment Panels, etc. Covered with valuable components. No time to sort, so must sell by weight, 7lb £4.35, 14lb £6.95, 28lb £11.95, 56lb £19.95, 112lb £25.45,  
**UHF TRANSISTOR TV TUNERS**  
 Four Pushbutton £2.50. Rotary Type with slow motion drive £2.50.

### BARGAIN PACKS

300 Mixed Resistors 1 & 1/2 watt	£1	5lb Ferric Chloride	£4
100 Mixed Diodes, IN4148 etc	£1	12 Gen. Purp. PNP	£1
100 Mixed Diodes including Zener and Power types	£3.95	1 Dalo Pen, etch resist	90p
100 New and Marked Signal Transistors inc. BC148, BF194, etc	£3.95	40 OA91/95 type Glass Diodes	£1
200 New and Marked Transistors Inc. AC128, 2N3055, BFY50, BD131	£6.95	4 Aluminium Boxes 128 x 44 x 38mm. Ideal for Signal injectors etc	£1
200 Unmarked Mixed Transistors Inc. H.F. and Power types	£4.50	BR101 Full Spec.	5 for £1
Send 60p for samples		DY51 E.H.T. Rec.	£1
11b Ferric Chloride	£1	Aluminium Coax Plugs	10 for £1
		20mm Fuses 500mA to 3-15 Amp	15 for £1
		In stock (Can be mixed)	

Add 35p P & P on all items. Over £10 P & P FREE

### DELUXE FIBRE GLASS BOARD P.C. KITS

Refill Pack for P.C. Kit 150 sq. in. F/9 Board £1.50  
 INC. 150 sq in Copper Clad F/G Board, 11b Ferric Chloride, A. Dalo Pen, Abrasive Cleaner, 2 Mini Drill Bits, Etch Tray and Instructions. Only £5.30 inc. P & P. Send cheque or P.O. with order to:

**SENTINEL SUPPLY, 20A Waddon Road, Croydon, Surrey**

## BURGLAR ALARM EQUIPMENT SUPPLIES (TRADE)

Bell boxes plastic coated steel	£5.25	Heavy duty 6in bell 12V	£7.75
Magnetically operated door switch surface type	£0.85	Siren 12V	£6.00
Magnetically operated door switch flush type	£0.60	3in bell	£2.25
Vibro sensitive switch	£2.75	Key switch two pole + chrome plate	£3.00
Pressure pads large 29in x 15in 4 wires	£1.75	Battery for above large HP1	£2.50
Pressure pads stair tread size 4 wires	£1.50	Kojak horn	£16.00
Aluminium window foil 100ft self adhesive	£3.00		
Take off blocks for window foil per pair	£0.40		

### CONTROL UNITS

Battery operated model	£14.00
Battery and mains model	£19.00
B.S. 4737 model battery + mains	£32.00
D.I.Y. battery model	£11.00
D.I.Y. battery and mains	£15.00

ALL PRICES + 12 1/2% VAT. NO VAT EXPORTS. POST FREE  
 DISCOUNTS PER ITEM: 5+ 10%, 25+ 15%, 100+ 20%.  
 S.A.E. FOR FREE LIST OF SPECIAL EQUIPMENT

### ASTRO ALARMS

25 STOCKTON ROAD, SUNDERLAND  
 TYNE AND WEAR, ENGLAND.  
 TEL. 0783 77825

## V.D.U./MACRO COMPUTER - With so many features

Look at these features



- \* Rock Steady Pictures
- \* Crystal Controlled
- \* Expandable Number of Lines
- \* Telephone Interface
- \* Tape Programmable
- \* Software Available
- \* Ideal for Education
- \* Expandable Memory
- \* Games and Things on Tape
- \* Ready-Built or in Kit Form
- \* Video or UHF Output
- \* Selectable Flashing Characters
- \* Forward and Reverse Typing Mode
- \* Repeat Facility
- \* Tab Key
- \* Automatic Tape Stop/Start

COME ALONG AND PLAY MASTERMIND or S.A.E. FOR INFORMATION



**Crofton Electronics Limited**

35 GROSVENOR ROAD, TWICKENHAM  
 MIDDLESEX  
 Tel: 01-891 1923

# 15-240 WATTS!

## HY5 Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc.) are catered for internally, the desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

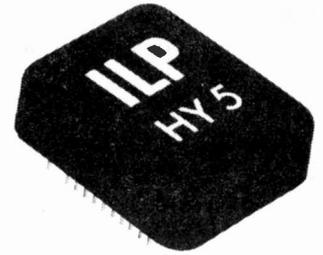
**FEATURES:** complete pre-amplifier in single pack; multi-function equalisation; low noise; low distortion; high overload; two simply combined for stereo.

**APPLICATIONS:** hi-fi; mixers; disco; guitar and organ; public address.

**SPECIFICATION:** Inputs—magnetic pick-up 3mV; ceramic pick-up 30mV; tuner 100mV; microphone 10mV; auxiliary 3-100mV; input impedance 47k $\Omega$  at 1kHz. Outputs—tape 100mV; main output 500mV R.M.S. Active Tone Controls—treble  $\pm$ 12dB at 10kHz; bass  $\pm$ 12dB at 100Hz. Distortion—0.1% at 1kHz; signal/noise ratio 68dB. Overload—38dB on magnetic pick-up. Supply Voltage— $\pm$ 16-50V.

Price  $\pounds$ 5.22 + 65p VAT. P. & P. free

HY5 mounting board B.1. 48p + 6p VAT. P. & P. free



## HY30 15W into 8 $\Omega$

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of: I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up to date technology available.

**FEATURES:** complete kit; low distortion; short, open and thermal protection; easy to build.

**APPLICATIONS:** updating audio equipment; guitar practice amplifier; test amplifier; audio oscillator.

**SPECIFICATION:** Output Power—15W R.M.S. into 8 $\Omega$ . Distortion—0.1% at 15W. Input Sensitivity—500mV. Frequency Response—10Hz-16kHz -3dB.

Price  $\pounds$ 5.22 + 65p VAT. P. & P. free

## HY50 25W into 8 $\Omega$

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

**FEATURES:** low distortion; integral heatsink; only five connections; 7 amp output transistors; no external components.

**APPLICATIONS:** medium power hi-fi systems; low power disco; guitar amplifier.

**SPECIFICATION:** Input Sensitivity—500mV. Output Power—25W R.M.S. into 8 $\Omega$ . Load Impedance—4-16 $\Omega$ . Distortion—0.04% at 25W at 1kHz. Signal/Noise Ratio—75dB. Frequency Response—10Hz-45kHz -3dB. Supply Voltage— $\pm$ 25V. Size—105 x 50 x 25mm.

Price  $\pounds$ 6.82 + 85p VAT. P. & P. free



## HY120 60W into 8 $\Omega$

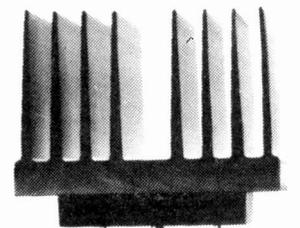
The HY120 is the baby of I.L.P.'s new high power range, designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

**FEATURES:** very low distortion; integral heatsink; load line protection; thermal protection; five connections; no external components.

**APPLICATIONS:** hi-fi; high quality disco; public address; monitor amplifier; guitar and organ.

**SPECIFICATION:** Input Sensitivity—500mV. Output Power—60W R.M.S. into 8 $\Omega$ . Load Impedance—4-16 $\Omega$ . Distortion—0.04% at 60W at 1kHz. Signal/Noise Ratio—90dB. Frequency Response—10Hz-45kHz -3dB. Supply Voltage— $\pm$ 35V. Size—114 x 50 x 85mm.

Price  $\pounds$ 15.84 +  $\pounds$ 1.27 VAT. P. & P. free



## HY200 120W into 8 $\Omega$

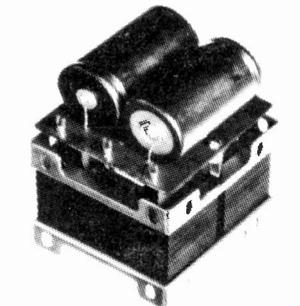
The HY200 (now improved to give an output of 120 watts) has been designed to stand the most rugged conditions such as disco or group while still retaining true hi-fi performance.

**FEATURES:** thermal shutdown; very low distortion; load line protection; integral heatsink; no external components.

**APPLICATIONS:** hi-fi; disco; monitor; power slave; industrial; public address.

**SPECIFICATION:** Input Sensitivity—500mV. Output Power—120W R.M.S. into 8 $\Omega$ . Load Impedance—4-16 $\Omega$ . Distortion—0.05% at 100W at 1kHz. Signal/Noise Ratio—96dB. Frequency Response—10Hz-45kHz -3dB. Supply Voltage— $\pm$ 45V. Size—114 x 50 x 85mm.

Price  $\pounds$ 23.32 +  $\pounds$ 1.87 VAT. P. & P. free



## HY400 240W into 4 $\Omega$

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 $\Omega$ ! It has been designed for high power disco or public address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

**FEATURES:** thermal shutdown; very low distortion; load line protection; no external components.

**APPLICATIONS:** public address; disco; power slave; industrial.

**SPECIFICATION:** Output Power—240W R.M.S. into 4 $\Omega$ . Load Impedance—4-16 $\Omega$ . Distortion—0.1% at 240W at 1kHz. Signal/Noise Ratio—94dB. Frequency Response—10Hz-45kHz -3dB. Supply Voltage— $\pm$ 45V. Input Sensitivity—500mV. Size—114 x 100 x 85mm.

Price  $\pounds$ 32.17 +  $\pounds$ 2.75 VAT. P. & P. free

**POWER SUPPLIES:** PSU36—suitable for two HY30s  $\pounds$ 5.22 + 65p VAT. P. & P. free. PSU50—suitable for two HY50s  $\pounds$ 6.82 + 85p VAT. P. & P. free. PSU70—suitable for two HY120s  $\pounds$ 13.75 + 1.10 VAT. P. & P. free. PSU90—suitable for one HY200  $\pounds$ 12.85 +  $\pounds$ 1.01 VAT. P. & P. free. PSU180—suitable for two HY200s or one HY400  $\pounds$ 23.16 +  $\pounds$ 1.85 VAT. P. & P. free.

I.L.P. Electronics Ltd., Crossland House, Nackington, Canterbury, Kent CT4 7AD

## TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

I.L.P. Electronics Ltd.  
Crossland House,  
Nackington, Canterbury  
Kent CT4 7AD  
Tel (0227) 63218

Please supply .....

Total Purchase price .....

I Enclose: Cheque  Postal Orders  Money Order

Please debit my Access account  Barclaycard account

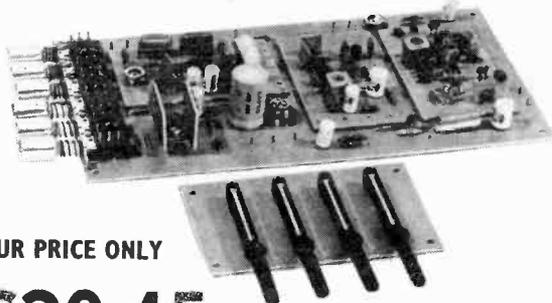
Account number .....

Name and Address .....

Signature .....

Registered office No. 1032630

# BI-PAK High quality audio



OUR PRICE ONLY

**£20.45**

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, by simply changing the settings of the pre-set controls.

Used with your existing audio equipment or with the BI-KITS STEREO 30 or the MK60 Kit etc. Alternatively the PS12 can be used if no suitable supply is available, together with the Transformer T461.

The S450 is supplied fully built, tested and aligned. The unit is easily installed using the simple instructions supplied.

## STEREO FM TUNER

*Fitted with Phase Lock-loop*

- ★ FET Input Stage
- ★ VARI-CAP diode tuning
- ★ Switched AFC
- ★ Multi turn pre-sets
- ★ LED Stereo Indicator

**Typical Specification:**  
Sensitivity 3µ volts  
Stereo separation 30db  
Supply required 20-30v  
at 90 Ma max.

## STEREO PRE-AMPLIFIER PA100



A top quality stereo pre-amplifier and tone control unit. The six push-button selector switch provides a choice of inputs together with two really effective filters for high and low frequencies, plus tape output.

Frequency Response + 1dB  
20Hz-20KHz.  
Sensitivity of inputs:  
1. Tape Input 100mV into 100K ohms  
2. Radio Tuner 100mV into 100K ohms  
3. Magnetic P.U. 3mV into 50K ohms  
P.U. Input equalises to RIAA curve within 1dB from 20Hz to 20KHz. Supply 20-35V at 20mA.  
Dimensions—299mm x 89mm x 35mm.

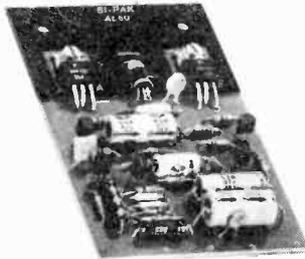
**£13.75** p & p 45p

### MK60 AUDIO KIT:

Comprising: 2 x AL60's, 1 x SPM80, 1 x BTM80, 1 x PA100, 1 front panel and knobs. 1 Kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklet. COMPLETE PRICE £35.00 plus 62p postage.

### TEAK 60 AUDIO KIT:

Comprising: Teak veneered cabinet size 16½" x 11½" x 3½", other parts include aluminium chassis, heatsink and front panel bracket plus back panel and appropriate sockets etc. KIT PRICE £13.25 plus 62p postage.



**AL 60**

25 Watts (RMS)

**VAT ADD 12½%**

- Max Heat Sink temp. 90C.
- Frequency response 20Hz.
- Distortion better than 0.1 at 1kHz.
- Supply voltage 15-50v.
- Thermal Feedback.
- Latest Design Improvements.
- Load—3,4,5, or 16ohms.
- Signal to noise ratio 80db.
- Overall size 63mm. 13mm.

Especially designed to a strict specification. Only the finest components have been used and the latest solid-state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

ONLY

**£4.35**

## Stabilised Power Supply Type SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watts (r.m.s.) per channel simultaneously. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1.5A at 35V. Size: 63mm, 105mm, 30mm. Incorporating short circuit protection.

**INPUT VOLTAGE** 33-40V. A.C.  
**OUTPUT VOLTAGE** 33V. D.C. Nominal  
**OUTPUT CURRENT** 10mA-1.5 amps  
**OVERLEAD CURRENT** 1-7 amps approx.  
**DIMENSIONS** 105mm x 63mm x 30mm  
**TRANSFORMER BMT80** £5.40 + 86p postage

**£3.75**

## STEREO 30 COMPLETE AUDIO CHASSIS



### 7 + 7 WATTS R.M.S.

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, mains switch, fuse and fuse holder and universal mounting brackets enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available. Ideal for the beginner or the advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty (can be installed in 30 mins.).

**TRANSFORMER** £3.25 plus 50p p & p

**TEAK CASE** £5.45 plus 70p p & p

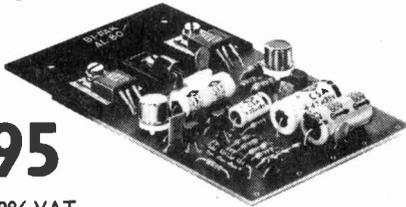
**£16.25** P & P 45p.

# equipment mono and other modules for Stereo

## THE MEDIUM POWERED AL 80

35<sup>RMS</sup> W power Amp!

ONLY £6.95 + 8% VAT



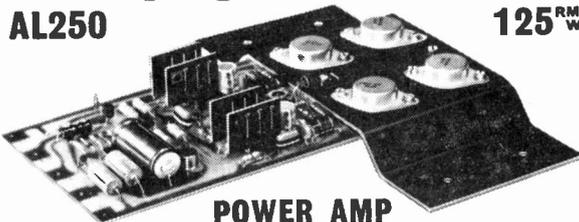
A High Fidelity Power Amplifier with a maximum Power Output of 35 watt R.M.S., which has a maximum operating voltage of 60v. A MUST for all HI-FI users.

Maximum supply voltage	15-60v
Power output for 2% THD	35 watts R.M.S.
Harmonic distortion	0.1%
Load impedance	3-8-16 ohm
Input impedance	50K ohm
Frequency response +3dB	20Hz-40KHz
Sensitivity for 25 watts O/P	280mV R.M.S.
Max. Heat sink temperature	90°C
Dimensions	102mm x 64mm x 15mm
Mounting	2, 4BA fixing holes in heat sink
Fuse requirements	1.5A

## AND for those who need more P-O-W-E-R

AL250

125<sup>RMS</sup> W



### POWER AMP

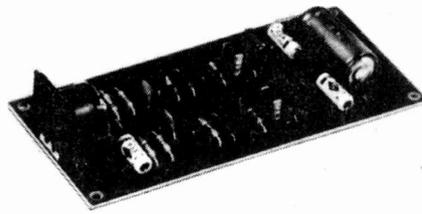
Specially designed for use in— Disco Units, P.A. Systems, high power Hi-Fi, Sound reinforcement systems

#### SPECIFICATION:

Output Power: 125 watt RMS Continuous	Total harmonic distortion 50 watts into 4 ohms: 0.1%
Operating voltage: 50-80	50 watts into 8 ohms: 0.06%
Loads: 4-16 ohms	S/N ratio: better than 80dBs
Frequency response: 25Hz-20kHz Measured at 100 watts	Damping factor, 8 ohms: 65
Sensitivity for 100 watts output at 1kHz: 450mV	Semiconductor complement: 13 transistors 5 diodes
Input impedance: 33K ohms	Overall size: Heatsink width 190mm, length 205mm, height 40mm

ONLY £15.95 + 8% VAT

## MPA 30



Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the new Bi-Pak M.P.A. 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only. Used in conjunction are 4 low noise high gain silicon transistors. It is provided with a standard DIN input socket for ease of connection. Supplied with full, easy-to-follow instructions.

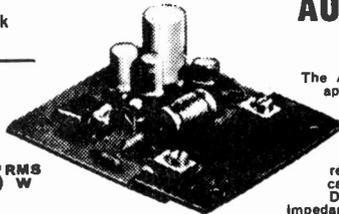
£2.85

VAT ADD 12 1/2%

### POSTAGE & PACKING

Postage & Packing add 25p unless otherwise shown. Add extra for airmail. Min. £1.00

## AL 20-30 AUDIO AMPLIFIER MODULES



The AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 5 to 10 watts R.M.S. The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the home. Harmonic Distortion Po = 3 watts f = 0.25% Load impedance 8-16 ohm

Frequency response ± 3dB Po = 2 watts 50Hz-25KHz. Sensitivity for Rated O/P—Vs = 25v. RL = 80 ohm. f=1KHz 75mV, RMS. Size: 75mm x 63mm x 25mm.

AL20: 5w £2.95 R.M.S. AL30: 10w £3.25 R.M.S.

## PA12

£6.70

NEW PA12 Stereo Pre-Amplifier completely redesigned for use with AL20-30 Amplifier Modules. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output. Frequency Response 20Hz-20KHz (-3dB) Bass and Treble range ±12dB Input impedance 1 meg ohm Input Sensitivity 300mV Supply requirements 24V, 5mA Size 152mm x 44mm x 33mm

## PS12

Power supply for AL20-30, PA12, S450 etc. Input voltage 15-20v A.C. Output voltage 22-30v D.C. Output Current 800 mA Max. Size 60mm x 43mm x 26mm. £1.30

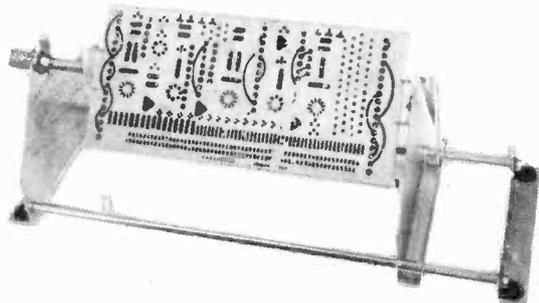
Transformer T538 £3.20

# BI-PAK

DEPT. P.E.11 P.O. BOX 6 WARE HERTS  
COMPONENT SHOP: 18 BALDOCK STREET, WARE

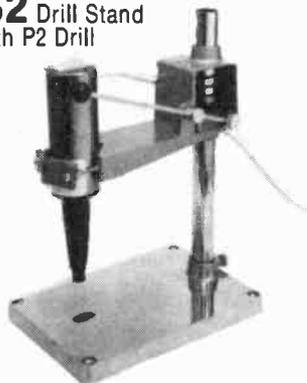
# NEW for electronic design engineers!

## FIX-PRINT for printed circuits



Invaluable for holding P.C.B.s and other panels when inserting and soldering components. Can be adjusted to suit work up to 280mm, rotated to gain access to reverse side and locks in any position. All metal. Price £10 inc. VAT. P. & P. £1. Write or phone for full details.

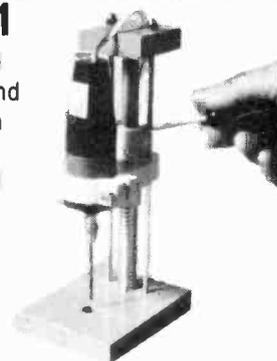
## S2 Drill Stand with P2 Drill



Robust, all metal with ample throat dimensions. Adjustable height cantilever with lever actuated feed. Spring return. Will accept both P1 and P2 drills. Price £18.50 inc. VAT. P. & P. £1.06. P2 Drill £16.50 inc. VAT. P. & P. 86p.

## S1

Drill Stand with P1 Drill



Constructed to take the popular P1 drill and ensure a high degree of accuracy in all types of electrical precision work. Price £5.13 inc. VAT. P. & P. 38p. P1 Drill £9.67 inc. VAT. P. & P. 38p.



Sole UK Distributors

## PRECISION PETITE LTD

119a HIGH STREET TEDDINGTON MIDDLESEX TW11 8HG  
TEL: 01-977 0878

## TECHNICAL TRAINING IN ELECTRONICS AND TELECOMMUNICATIONS

ICS can provide the technical knowledge that is so essential to your success; knowledge that will enable you to take advantage of the many opportunities open to trained people. You study in your own home, in your own time and at your own pace and if you are studying for an examination ICS guarantee coaching until you are successful.

### City & Guilds Certificates:

Telecommunications Technicians  
Radio, TV, Electronics Technicians  
Technical Communications  
Radio Servicing Theory  
Radio Amateurs  
Electrical Installation Work  
MPT Radio Communications Certificate

### Diploma Courses:

Colour TV Servicing  
Electronic Engineering and Maintenance  
Computer Engineering and Programming  
Radio, TV, Audio Engineering and Servicing  
Electrical Engineering, Installation and Contracting

POST OR PHONE TODAY FOR FREE BOOKLET

To: International Correspondence Schools

ICS Dept. 772N Intertext House, London SW8 4UJ or telephone 622 9911

Subject of Interest \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

Tel. \_\_\_\_\_

Age \_\_\_\_\_

## CHINAGLIA DINO—ELECTRICAL AND ELECTRONIC TEST EQUIPMENT MANUFACTURERS

PRESENT THE

## DOLOMITI

20k $\Omega$ /V a.c. and d.c.

A NEW HIGH SENSITIVITY MULTIMETER WITH ALL THE FEATURES YOU WILL EVER NEED



Accuracy: D.C. ranges,  $\pm 2.0\%$ , A.C. &  $\Omega$  ranges  $\pm 2.5\%$ .  
39 ranges: d.c. V, 0-150mV, 500mV, 1-5V, 5V, 15V, 50V, 150V, 500V, 1-5kV;  
d.c.I, 0-50 $\mu$ A, 500 $\mu$ A, 5mA, 50mA, 0-5A, 5A; a.c. V, 5V, 15V, 50V, 150V, 500V, 1-5kV; a.c.I, 5mA, 50mA, 0-5A, 5A; dB - 10 to + 65 in 6 ranges.  $\Omega$  0-0.05k $\Omega$ , 5k $\Omega$ , 50k $\Omega$ , 500k $\Omega$ , 5M $\Omega$ , 50M $\Omega$ , pF 50kpF, 500kpF.

Automatic overload protection and high current range fusing. Scale mirror and fine pointer for accuracy of reading. Single knob main range switching and all panel controls. C.E.I. Class 1 movement with sprung jewel bearings. Extended 92mm scale length for extra clarity. Compact ABS case 125 x 131 x 37mm. Weight 750g with batteries. Supplied complete with carrying case, fused leads, handbook and full 12-month guarantee. Optional 30kV d.c. probe available.

Meter £45.90 incl. VAT (£1 P. & P.)  
30kV Probe £12.85 incl. VAT

For details of this and the many other exciting instruments in the Chinaglia range, including multi-meters, component measuring, automotive and electronic instruments please write or telephone.

## ALCON Instruments Ltd.

19 MULBERRY WALK, LONDON SW3 6DZ TEL: 01-352 1897

## WINDOW GAZING

ANY student of electronics knows what a difficult task it is keeping up with the ever expanding range of monolithic circuit devices. Manufacturers' literature, ranging from single data sheets and application notes to impressive tomes of hundreds of pages, reveals a staggering variety of purpose-designed chips covering a multitude of applications including newly opened-up fields. It is all mouth-watering. But all too frequently, we can only gaze at the goods and not touch.

Some LSI devices hit the headlines, become household names, and feature almost continuously in constructional projects. But there is a far greater number of lesser-known i.c.s which have not been so well exposed in the constructor area, although they may be commonplace in the industrial scene.

Included amongst the latter will be a host of intriguing devices which have been designed for equipment manufacturers' specific requirements, and have no immediate obvious application outside this intended area. Yet unsuspected possibilities do often come to light when these chips are subjected to scrutiny by independent and unbiased eyes. Give the amateur enthusiast a chance, and it is almost a certainty that he will come up with a new idea for exploiting some such device beyond its originally intended purpose.

In terms of devices produced, it is clear that we in the constructor area have seen only the tip of the iceberg.

It is more by luck than plan when custom designed i.c.s find their way into amateur hands. More is the pity; not only for the constructor himself, but also the manufacturer and supplier. These commercial interests stand to gain by a fuller exposure of these devices.

Microcircuit manufacturers ought to consider the advantages of making their products more widely known and accessible to the amateur market. By doing so, they will be doing themselves a favour. They will be interfacing with a large body of uncommitted technical free-thinkers. Any worthwhile achievements arising from these non-professional endeavours must help increase the value, repute, and sales of specific devices.

This topic was briefly touched on here last month. But it is a matter of fundamental importance and deserves underlining from time to time. And this month is particularly opportune, since we have included an extra 8-page supplement entitled *I.C. Specials*.

## A CHOICE SELECTION

Some examples of the kind of devices we have in mind are mentioned in this supplement. It has been possible to include only a few, but these have been selected to cover a variety of applications and interests.

Musical interests are well catered for and this reflects the i.c. industry's current large commitment to this expanding area of home entertainment. What's good for

the commercial organ maker is equally good for the constructor. Electronic delay lines represent an important technical development, and have endless possibilities apart from "flanging", so this particular "bucket brigade" chip does not have to be confined to the musical domain.

Temperature controllers and fluid detectors bring us into the strictly workaday area of instrumentation. Timing requirements ranging from 5 milliseconds to over 3 months are provided for by one single chip—a device which should satisfy an awful lot of requirements. And of course TV games. Our selection would not be complete without some representation from this growing area.

There's plenty of food for thought in our supplement. It provides just a small sampling of notable devices currently available but will trigger off sufficient ideas to keep our imaginative readers busy for quite awhile.

## PRICE INCREASE

As readers will have discovered, the cover price of PRACTICAL ELECTRONICS has been increased to 45p as from this issue. News of this decision came too late for mention in last month's issue. We very much regret the need for this increase, which is due to factors beyond our control.

F. E. BENNETT,  
*Editor.*

## EDITORIAL

### Editor

F. E. BENNETT

G. C. ARNOLD Assistant Editor

D. BARRINGTON Production Editor

G. GODBOLD Technical Editor

M. ABBOTT Technical Sub Editor

J. D. POUNTNEY Art Editor

D. J. GOODING Technical Illustrator

R. J. GOODMAN Technical Illustrator

K. A. WOODRUFF General Artist

Editorial Offices:  
Fleetway House,  
Farringdon Street, London EC4A 4AD  
Phone: Editorial 01-634 4452  
Telex: 915748 MAGDIV-G

## ADVERTISEMENTS

### Advertisement Manager

D. W. B. TILLEARD

Phone: 01-634 4504

P. J. MEW Representative

Phone: 01-634 4181

C. R. BROWN Classified Manager

Phone: 01-261 5762

MAKE-UP and COPY DEPT.

Phone: 01-634 4372

Advertising Offices:  
Fleetway House,  
Farringdon Street, London EC4A 4AD  
Phone: Advertisements 01-634 4504  
Telex: 915748 MAGDIV-G

## Back Numbers and Binders

Copies of our June 1977 and subsequent issues are available from: Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, at 65p each including Inland/Overseas p & p.

Binders for PE are available from the same address at £2.85 each to UK addresses, £2.85 overseas including postage and packing, and VAT where appropriate. Orders should state the year and volume required.

Cheques and postal orders should be made payable to IPC Magazines Limited.

## Letters

Queries regarding articles published in PE should be addressed to the Editor, at the Editorial Offices, and a stamped, addressed envelope enclosed. We cannot undertake to answer questions regarding other items, nor to answer technical queries over the telephone.



# 128 NOTE

Can be added to Minisonic for sequencing melodies or rhythm pattern

**T**HE sequencer circuit to be described will enable a voltage controlled synthesiser to automatically play a pre-programmed tune, consisting of up to 32 pitches, in a sequence up to 128 notes long. All programs are keyboard initiated.

## BLOCK DIAGRAM

The heart of the sequencer is an NMOS RAM (random access memory) capable of storing 128 eight bit words of data. The circuit operation can best be understood by referring to the block diagram of Fig. 1. Here the RAM is driven from a clocked binary counter. The binary number at the output of this defines the position in the memory that is present at the data terminals. The sequence is written into the memory via a modified 49 note keyboard which converts the 32 possible pitches into five bit words.

The 128 note sequence is built up by stepping the counter each time a new note is written in. When a sequence is complete, it is played by clocking the counter at a steady rate by means of the clock oscillator. The five bit words are then read out from the memory into a digital to analogue converter (D-A) which produces a 32 level output. This is used to drive the v.c.o. in the synthesiser.

## SEQUENCE LENGTH

Although the maximum sequence length available is 128 notes, it is often desirable to use a shorter sequence. For example, if the tune to be written consists of 32 bars with three beats to the bar, it is obvious that the total number of beats would be only 96. To cope with this type of situation the circuit was designed so that the counter could be reset at any desired point in a sequence, thus producing tunes of any length from 1-128 beats.

Only five of the eight bits of memory are used to produce a control voltage for the v.c.o., the other three bits are available to perform other functions. One of these spare bits is used to provide the variable reset function, and the other two bits are used to generate trigger pulses for envelope shapers, thus adding rhythm to the generated melody.

## CLOCK OSCILLATOR AND COUNTER

The complete circuit is shown in Fig. 2. Here clock pulses are produced by a simple transistor astable multi-vibrator. The frequency may be varied over a wide range by adjusting VR1. Clock pulses are fed to the binary counter via S1, the stop/run switch.

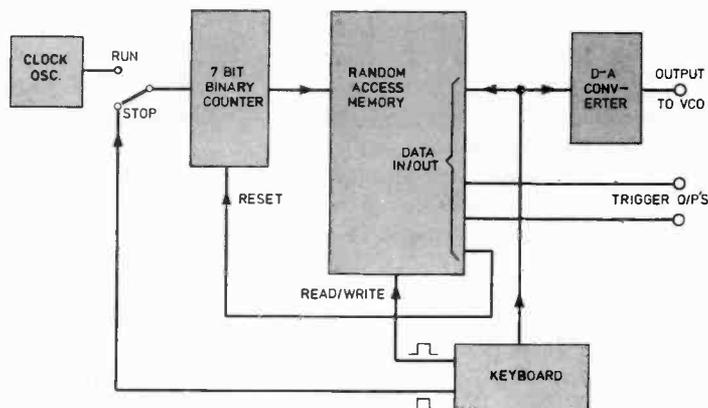


Fig. 1. Block diagram of sequencer

D. G. EVANS

# SEQUENCER

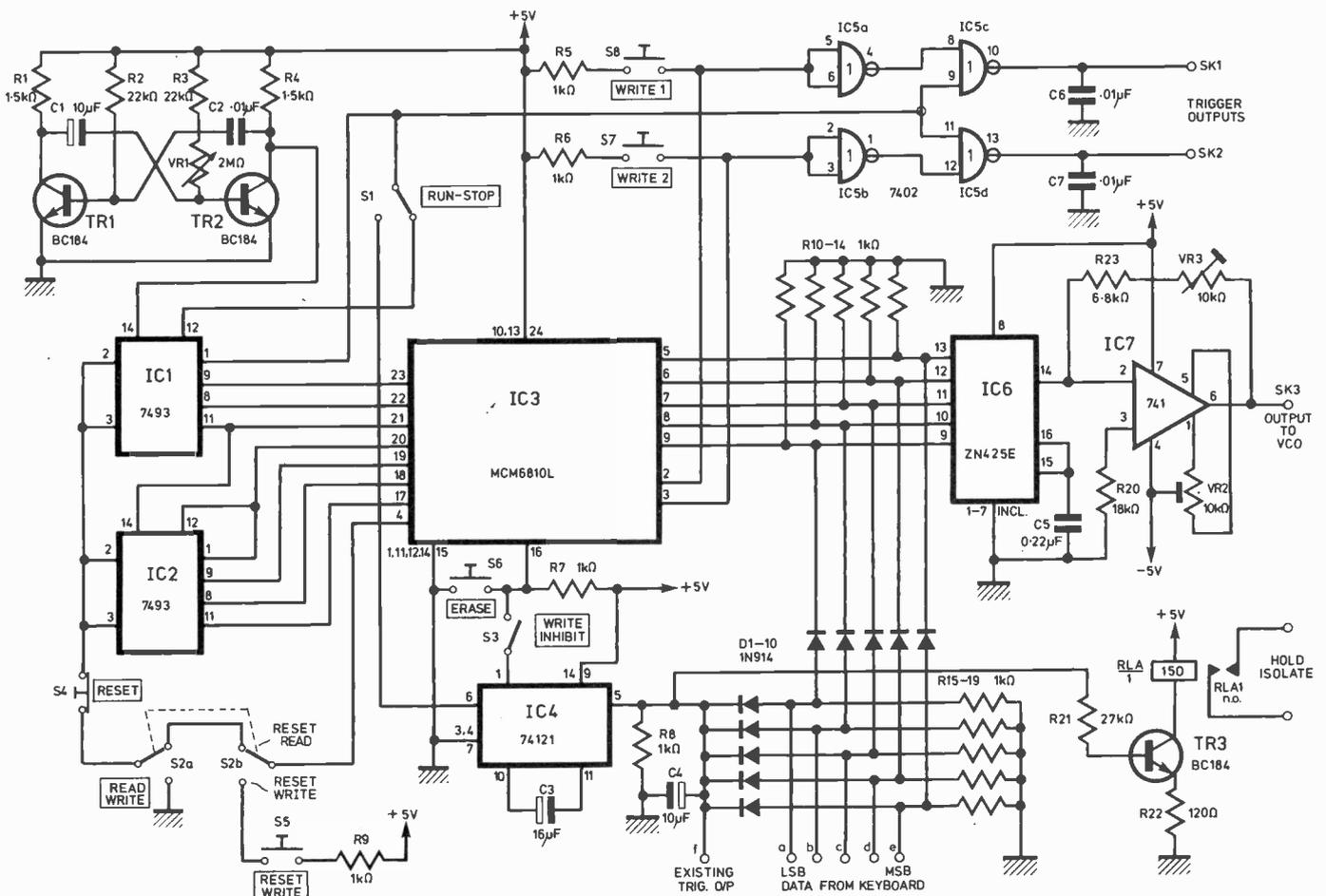


Fig. 2. Complete circuit of sequencer

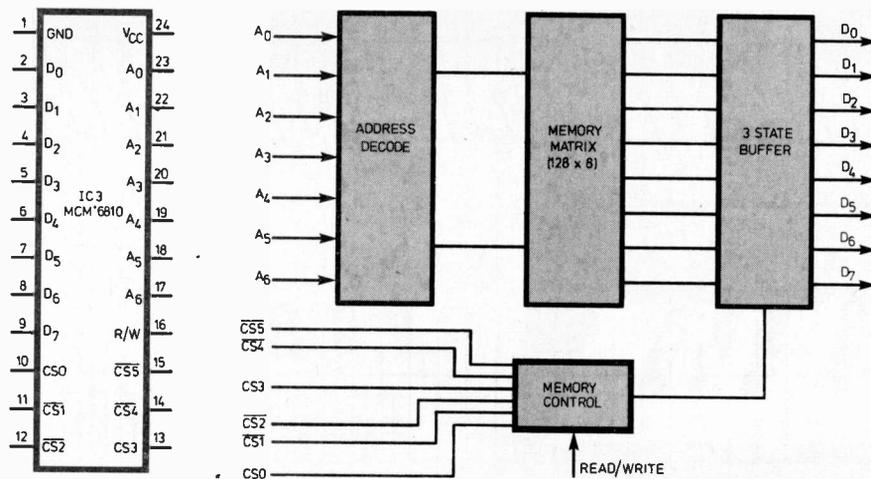


Fig. 3. IC3 pin-outs and internal block diagram

IC1 and 2 are cascaded to form a seven bit binary counter which drives the address inputs of the RAM. The stop/run switch disconnects the first stage of the counter and instead provides the counter with pulses from the keyboard. The reset inputs of IC1 and 2 are connected via S4 and S2 to one of the data lines of the RAM, the

automatic reset pulse is written into this line by selecting "Reset Write" with S2 and depressing S5.

Returning S2 to the "Reset Read" position reconnects the data line to the counter resets. Thus, when the end of a sequence is reached, the reset data line goes high and the counters reset to zero.

## COMPONENTS . . .

### Resistors

R1	1.5k $\Omega$	R20	18k $\Omega$
R2	22k $\Omega$	R21	27k $\Omega$
R3	22k $\Omega$	R22	120 $\Omega$
R4	1.5k $\Omega$	R23	6.8k $\Omega$ (see text)
R5-19	1k $\Omega$ (14 off)		
All $\frac{1}{2}$ W 5% carbon			

### Capacitors

C1	10 $\mu$ F elect. 25V	C4	10 $\mu$ F elect. 25V
C2	0.01 $\mu$ F	C5	0.22 $\mu$ F
C3	16 $\mu$ F elect. 25V	C6, 7	0.01 $\mu$ F

### Integrated Circuits

IC1	7493	IC5	7402
IC2	7493	IC6	ZN425E
IC3	MCM6810L	IC7	741
IC4	74121		

### Transistors and Diodes

TR1-3	BC184 or similar
D1-90	Any general purpose type

### Relay

RLA	D.i.l. reed relay, single pole (R.S. Components)
-----	--

### Variable Resistors

VR1	2M $\Omega$ pot. (lin.)
VR2	10k $\Omega$ min. preset
VR3	10k $\Omega$ min. preset

### Switches

S1	s.p.c.o. miniature toggle
S2	d.p.c.o. miniature toggle
S3	single pole miniature toggle
S4	miniature push to break switch
S5	miniature push to make switch
S6	miniature push to make switch
S7	miniature push to make switch
S8	miniature push to make switch

### Miscellaneous

PCB board, front panel material	
Veroboard for diode mounting	

## RANDOM ACCESS MEMORY

Integrated circuit IC3 is a RAM, type MCM6810 designed for use with the M6800 microprocessor system. The block diagram and pin outs of the device are shown in Fig. 3. Pins 4-9 are data input/output terminals, the state of pin 16 deciding whether the device is in the read or write mode.

Pins 17-23 are the memory address inputs. The binary code fed to these pins determines which of the 128 memory cells is connected to the data terminals. Thus, when the clock and counter are running, each memory cell in turn is presented at the data terminals of the chip.

## KEYBOARD BINARY CODER

In the prototype synthesiser a four octave keyboard is used to write the required sequence of notes into the memory. This accomplished by diode keying circuitry of Fig. 4. It will be seen from this that each contact connects the five data lines to the five volt rail via a combination of diodes.

These are arranged so that a binary number corresponding to the number of the key pressed appears on the data lines. The five data lines, plus an extra line for key one are also routed through diodes to a monostable IC4 which generates a read/write pulse at pin 16 of the RAM, so that whenever a key is pressed, the binary code appearing on the data lines is written into the memory.

IC4 also produces a clock pulse which drives the counter. Therefore operation of any key causes three things to happen:

1. A binary number corresponding to the number of the key will appear on the data lines.
2. A write pulse will occur at pin 16 of IC3.
3. The trailing edge of the pulse from IC4 will clock the counter and hence step the memory on one position.

## ENVELOPE TRIGGER OUTPUTS

There are eight data lines in the RAM. As already mentioned, five of these are used to produce pitch information, and one to provide the automatic reset facility. The two spare data lines are used in the prototype to store trigger pulses for the synthesiser's envelope shapers.

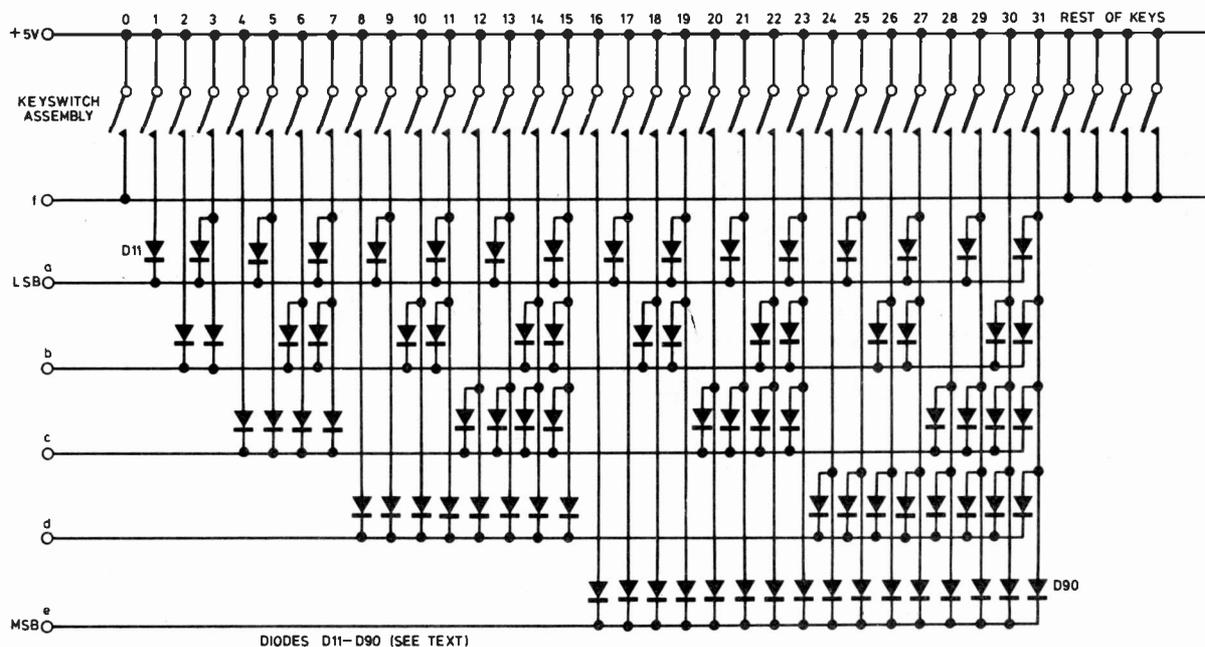


Fig. 4. Diode keying from keyboard to main sequencer circuit

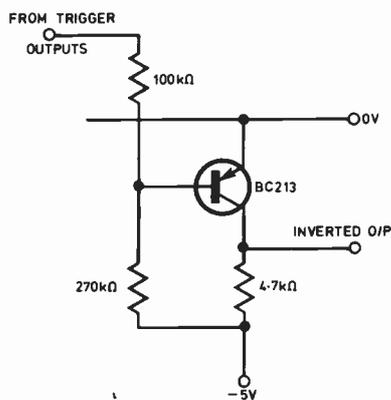


Fig. 5. Trigger inverter

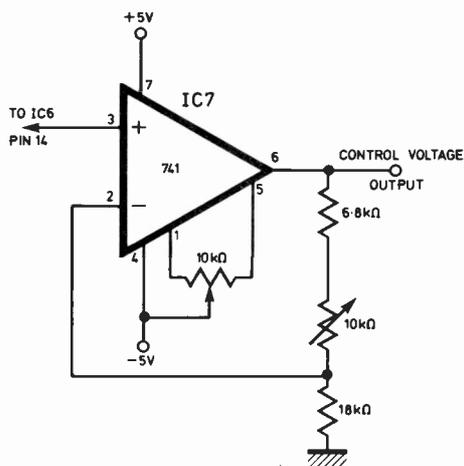


Fig. 6. Alternative output circuitry

Push button switches S7 and S8 are used to write in the trigger pulses when required. When the circuit is in the read mode, the outputs from pins 3 and 2 of IC3 are gated in IC5 with clock pulses. This ensures that whenever two consecutive pulses are written, two separate pulses appear at the output. Without the gating, only one long pulse would be produced.

It should be noted that the trigger pulses produced are positive-going, and are suitable for driving either of the ADSR envelope shaper circuits that have appeared recently in this magazine. The ES/vca circuits of the Minisonic however, require negative-going pulses. These can be produced, if necessary, by the simple circuitry of Fig. 5 (three of these are needed).

The keyboard is fitted with two sets of contacts, one being used to drive the coding diodes, the other to drive a resistor chain for normal playing. For normal playing, a separate envelope trigger output is provided from the point which drives IC4. If the keyboard isolating relay (Minisonic Mk. 2) is being used it can be driven as shown in the main circuit diagram. (If not TR3 and associated components may be omitted.)

#### D-A CONVERTER

Early versions of the prototype utilised a number of different D-A converters, all of them using discrete components. All the circuits tried suffered from one problem or another, and all had the disadvantage of needing close tolerance resistors to function accurately. The integrated circuit D-A finally decided upon solved all these problems, although at somewhat increased cost.

The D-A chip feeds an inverting op-amp with gain and offset controls. The voltage at the output of the op-amp is of the correct sense for the Minisonic v.c.o.s, i.e. it is negative going for increasing pitch. For oscillators requiring positive-going control voltages the alternative output circuitry of Fig. 6 can be used.

**NEXT MONTH: Construction and programming detail.**

**T**HIS battery powered unit displays a subject's reaction time on a "non related" scale from one to nine, and although pocket sized, it is simple to construct, costing in the region of five pounds.

It should be made clear that the device is *not* intended to indicate reaction delay on a true scale of time, such as in milliseconds, because generally speaking the usefulness of a simple reaction timer lies not in measuring reactions precisely in fractions of a second, but in comparing them.

If the object of the exercise is to sharpen one's personal reaction time, or to compare yours with another's, then it is of little consequence if the readout is, for example, 170ms, since this may mean little to a subject in any case!

# Digital REACTION TIMER

D. C. GREEN



This novel and robust unit was designed to fill the slot requiring simple indication, and not expensive precision timing. Digital operation with numerical display was chosen however, because this eliminates argument over the results. It also precludes the possibility of a declining reading due to a discharging capacitor while the argument takes place, something which can happen with some analogue types.

The scale factor can be set to measure only those reaction times likely to be attained, and when the one to nine range of this device has been expanded to the desired time limit, it will be found to have adequate resolution, leaving no scale redundancy. This freedom to adjust the "difficulty" aspect should be found useful.

## USING THE TIMER

A reaction timer must provide the user with a subtle, but clear signal to which he can react. In this circuit, it takes the form of the seven segment display decimal point, which lights up after a semi-random time delay. After switching on, the display either remains blank, or shows a spurious number. The user then pushes the button on the front panel, and waits. Any number on the display will then be cleared.

When the signal i.e.d. illuminates, he must release the button as quickly as possible. Providing he was not so slow as to be "unclassified", his response time will remain displayed, and the lower the figure, the better. Should he attempt to cheat, or if he misses the signal altogether, the display merely remains blank. For another try, the button is pushed again, whereupon the display resets and the signal is awaited once more.

## COMPONENTS . . .

### Resistors

R1, R2	1k $\Omega$ $\frac{1}{4}$ W 5%
R3	100k $\Omega$ $\frac{1}{4}$ W 5%
R4	47 $\Omega$ $\frac{1}{4}$ W 5%
R5-R11	220 $\Omega$ (7 off) $\frac{1}{4}$ W 5%

### Potentiometers

VR1	220 $\Omega$ 0.1W vert min preset
VR2	1k $\Omega$ 0.1W vert min preset

### Capacitors

C1-C3	100 $\mu$ F 10V elect (3 off)
C4	0.1 $\mu$ F

### Semiconductors

IC1	7413	TR1	BC108
IC2	7400	D1	1N4148
IC3	7493	D2	1N4001
IC4	7447	X1	DL707

### Switches

S1	Min slide switch ( $\frac{1}{2}$ A)
S2	Push-to-make push button

### Miscellaneous

- Aluminium box 100 x 70 x 38mm (type AB9, available Maplin)
- Printed circuit board
- Offcut of plain matrix board
- Piece of copper laminate board
- Battery holder for four HP7 cells, and connector stud
- Socket, d.i.l. 14 pin
- Four stand-off pillars (approx 23mm)



# DIGITAL REACTION TIMER

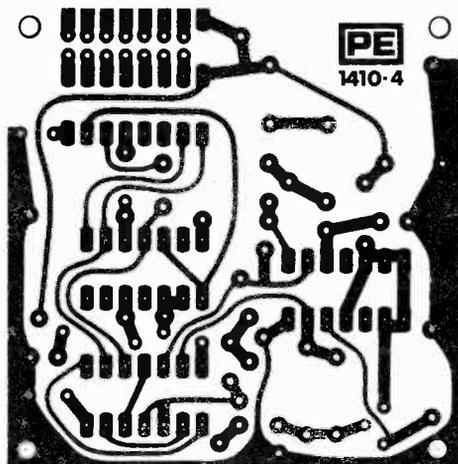


Fig. 2. Printed circuit board (full size)

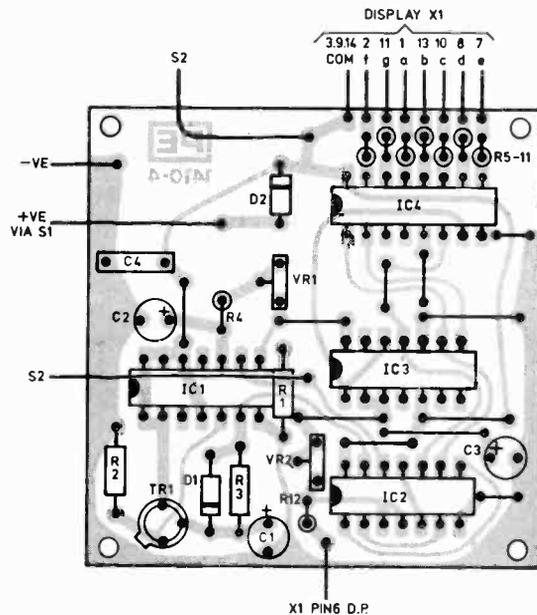
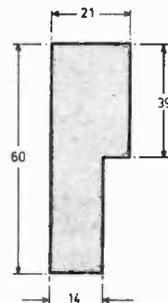
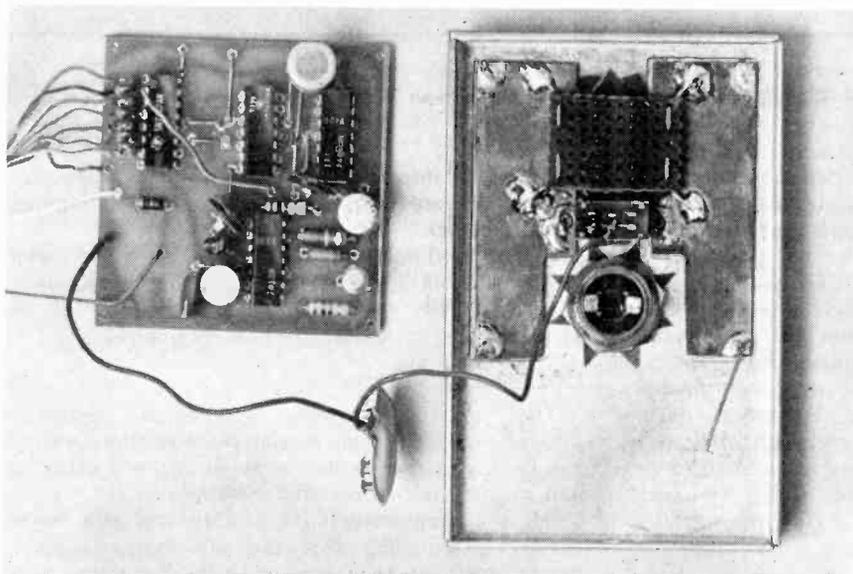
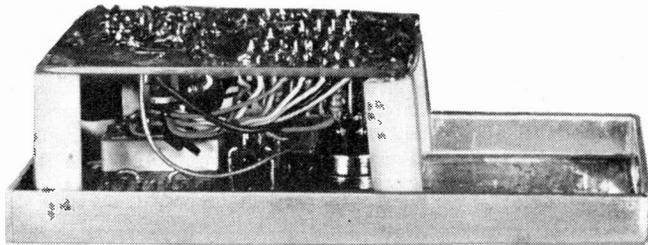


Fig. 3. Component layout and interwiring to off-board components



The left-hand blank p.c.b. plate is shown in detail above, and can be seen in position with the right-hand plate in the adjacent photograph



The method of fixing everything together can be seen in the incidental photographs. Two pieces of blank p.c.b. are cut out and stuck to the lid around the switch and display holes, with the copper side facing upwards. The display unit is mounted on a small piece of unclad perforated board (0.1 inch pitch), and a 14-way i.c. holder is pushed on from behind to secure it. Loops of tinned copper wire can now be passed through the perforated board and soldered to the copper cladding. A piece of red tinted plastics film can be placed over the display before fastening it. The switch S1 can also be soldered to the cladding by means of its mounting lugs.

When assembling the p.c.b., it is quite in order to solder the i.c.s directly to the board, providing this is done with care. Nevertheless, a socket ought to be used for X1, as this allows it to be disconnected from the flying leads to the p.c.b. during wiring up. Flying leads also connect the p.c.b. to push button S2, the battery positive via S1, and battery negative.

#### FINAL ASSEMBLY

At this point, with all the connections made, the unit may be tested, and if all is well, the p.c.b. can be attached to the lid. First solder four pieces of stout wire perpendicularly to the lid, on the copper clad plates previously glued to same. Position them in a square configuration to match the mounting holes of the p.c.b. A stand-off pillar is then placed over each, and the p.c.b. is threaded over the protruding wires, onto the pillars, and soldered at each corner. The p.c.b. is mounted component side down; so the stand-off pillars must be long enough to keep the components clear of the display socket, yet not so long as to exceed the space within the box. If you have an expired ball point pen of the hexagonal plastics tube type, this could be cut to provide the spacers.

Finally, snip off any surplus wire from the p.c.b. and tape the bottom of the box to prevent shorts occurring. The battery holder should fit tightly into the recommended box, and require no other fastening, but precautions may be necessary to prevent the self-tap screw from biting into one of the cells when this lid is finally secured.

#### ADJUSTMENTS

There are only two of these; namely clock frequency, and commencement delay, controlled by VR1 and VR2 respectively. Both of these presets are accessible with the p.c.b. in place.

It is entirely up to the user as to how these are set, but the most useful setting is realised with a relatively high clock frequency, and the delay adjusted so that an average reaction time scores 5 or 6. The higher the clock frequency, the higher the resolution ★

# NEWS BRIEFS

## System X

CONTRACTS worth £20 million have been placed by the Post Office with British manufacturers, as the next step in the System X project, the biggest development ever undertaken in British telecommunications.

It covers the design of trunk, tandem, and small/medium capacity local exchange equipment, based on microelectronic and software control technologies, and will carry the telephone system into the 21st Century.

Already some 500 engineers are involved in System X, a modular system which should lay the foundations for an expanding range of future customer facilities, and is expected to cost more than £100 million.

## GES No Longer

ON September 1st, 1977, Combined Electronic Services Ltd, the service company for Philips and Pye household products, changed its name to "Philips Service".

Now part of the recently announced Philips Industries' new Central Merchandising Management Group, Philips Service (claimed to be the largest manufacturers service organisation of its kind in the UK), will continue to be responsible for the total provision of after sales service support for the Philips and Pye Consumer Division.

A new computerised order handling system was introduced, which is a customisation of a package already used in Europe by Philips Services. The basic philosophy is to provide the best possible service support on a local basis, by the creation of 25 Service Centres.

# PE

## A Volume of Practical Know-how

... can be made using these new-look self binders for PRACTICAL ELECTRONICS to become your most valuable source of reference. With the Easi-Binder current copies can be inserted as they are received, without waiting for the completion of twelve issues.

They are attractively made with the title blocked in gold on the spine with the current (or last) volume number and year. For any previous volume numbers, please advise year and volume and a separate set of gold transfer figures will be supplied.

At £2.85 inc. VAT and postage they are obtainable from:

Post Sales Department, IPC Magazines Ltd.  
Lavington House, 25 Lavington Street  
London SE1 0PF

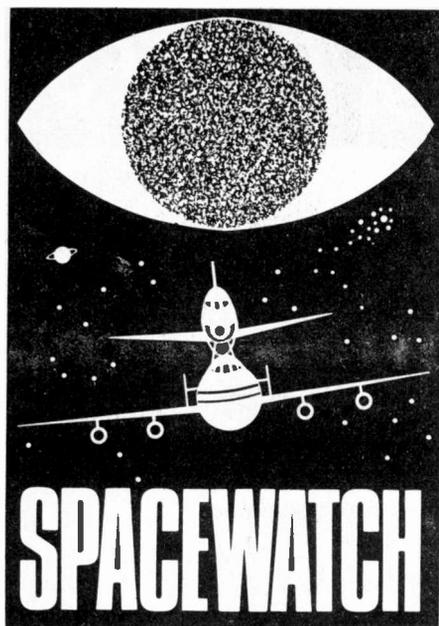
I enclose P.O./cheque value.....for.....binders at  
£2.85 each for Practical Electronics Vol. No's.....

Name .....

Address .....

Date .....

# PE



**FRANK W. HYDE**

### SPACE SUITS

The advent of the space shuttle brings many changes in space methods and activity. One of the most important of these changes is that of the space suit. The *Apollo* suits had certain disadvantages which became apparent in use and were costly indeed since each suit was virtually tailored to fit and made one mission only. The same applied to the backpacks and life support systems. The new suits will be less than half the cost.

Contrasting with the *Apollo* suits, the new generation of space suits will have a life of fifteen years. Many missions will be flown during that time. The new suits have a rather different arrangement from the moon suits. For example, the moon suits were pressurized and designed for the 1/6 gravity of the moon. With the extra vehicular activity (EVA) of *Spacelab* and similar missions, zero gravity will be the norm. Also a quick turn round is necessary. The *Apollo* suits required about 90 minutes to don and check but the new ones will take only 15 minutes. The actual donning time is about 5 minutes.

### CONSTRUCTION

The construction of the new suits is such that there are two parts. The torso and backpack are integral and hard. This allows life support systems to be solid and internal as against flexible and external in the moon suits. The lower half is soft and is "stepped into". In dressing the lower half is donned first and then the arms head and torso are "inserted" in the top half which is in a support on the wall. The two halves of the suit are closed by a ring.

Added to the ease of dressing is the extra mobility which is obtained using joints of constant volume in place of the pulley joints in the *Apollo* suit. There is also another important advantage in that whereas the *Apollo* suit worked against the effort of the astronaut the constant volume system enables free movement without great effort.

Another basic difference between the *Apollo* suit and the shuttle suit is the fact that *Apollo* had zippers which could leak whereas the shuttle ring closures are virtually leakproof. The pressure bladder used in *Apollo* is now replaced by a polyurethane bladder which has seams sealed by heat. The *Apollo* suit had latex bladders which were tape and glue sealed.

### MONITORING

The new suit will be easier to monitor, as to status, than the old ones. A microprocessor/light emitting diode unit will tell the astronaut whether there is a problem with the suit systems and what to do about them. The *Apollo* suits had an electric warning system but no instruction readout to tell the astronaut what to do about it. The microprocessor, which is carried in the chest pack, is a great advantage in the new suit.

The joints in all the suit electronics are solderless. These necessary joints caused trouble in the *Apollo* suits. The arrangement of suit/backpack design places all controls where the astronaut can see them. The 12 character readout display replaces the *Apollo* "cuff card" systems where warnings from the suit had to be checked by reading procedure lists carried on the sleeve.

The new suits will not be allocated to individuals. Each astronaut will choose the one he or she likes. The suits will be in three basic sizes allowing for the accommodation of male or female participants. A different urine collection system will be required but the final details will await the choosing of female astronauts.

### COOLING

The liquid cooling garment which is worn by the astronaut is fitted with ventilation tubes. Oxygen is fed in through the helmet and taken to the hands and feet then returned through the backpack for reuse after conditioning. The initial length of extra-vehicular activity for the missions can be up to 7 hours. Oxygen pressure will be 4.1 psi. Astronauts will have to pre-breathe oxygen at 4.1 psi for 3 hours before extra-vehicular activity to denitrogenate the blood to avoid "bends". As little work will be required to be done with their legs, as on *Apollo* moon mission,

there is less loading and metabolic activity.

Recharging of the systems will take only a few minutes. Battery recharging will only take an hour while replacement takes only a few minutes. Crew and specialists will wear suits for their activities but if it should be necessary to move other personnel to or from shuttle to installation this will be done in a sphere manoeuvred by astronauts.

### SPINNING SOLAR SAIL

Another propulsion system, for the mission to Halley's comet in 1986, is being studied by NASA. This is a rotating sail system. It consists of 12 sails each 4 miles long by 28ft wide.

The sails would be unfurled by centrifugal force after deployment of the vehicle from the space shuttle. The pressure of the solar wind would spin the sails and gradually accelerate the craft to the rendezvous point. The time of spin is expected to be one revolution every three minutes.

This system is now favoured over the square sail version. It is competing with the ion motor. A decision is expected soon.

### SPACE TELESCOPE

Lockheed-Missiles and Space have been chosen to build the new space telescope. The optics are to be supplied by Perkin-Elmer. Among these will be the 94in diameter primary mirror. The space telescope is large being 43ft long and 14ft in diameter. The shuttle will launch it into Earth orbit in 1983.

### JUPITER ORBITER PROBE

The house of representatives voted out the funds for the Jupiter orbiter probe mission. There has been a reversal of that decision now and the budget for 1978 has been restored. The orbiter Jupiter Probe is now ratified by the Senate Appropriations Sub-committee.

This is an important mission in view of a number of new facts regarding the largest planet in the solar system. The cost of the two spacecraft and ancillary requirements including launching is estimated at some 450 million dollars.

Orbiters will be launched by shuttle and will be the first payload to go into deep space. It will also be the first payload to be boosted by the upperstage. The probable date of launch will be January 1982 and the encounter with the planet will be late 1984.

An aeroshell will be released to descend into the Jovian atmosphere from where radio information will be received for the first time.



## BOOK REVIEWS

### SIMPLE ELECTRONICS FOR MODELLERS

By I. R. Sinclair

Published by Argus Books Ltd.

110 pages, 140 × 215mm. Price £2.95

IN times gone by, it would have seemed ridiculous to electronically control something like a model railway, using valves and relays as large as the locos themselves. But the birth of microcircuits has reversed this situation to create a new branch of interest, and this book is based on such techniques, covering current and voltage control, generating signals and delays, measurement, counting and logic circuits, motor speed control, power supplies and p.c.b.s.

In the book, which is intended as a "methods" source rather than an instructional manual, the author proposes that many of the skills required by the modeller, are similar to those required for modern electronics construction.

M.A.

### RADIO CONTROL FOR MODELS

By R. H. Warring

Published by Pitman Publishing Ltd.

213 pages, 194 × 255mm. Price £6.95

EXTENSIVELY revised, this second edition of Radio Control For Models is mainly about "proportional" control, and starts with some historical notes which prepare you for a chapter on basic radio theory; but it's not too technical! In fact, the aim of the book is to show that you can treat all the electronics as simple black boxes, and just concentrate on the modelling aspect of the hobby.

There are no constructional features, although diagrams and photos of R/C "bits and pieces" are included, along with explanations of their basic principles. Practical workshop hints are given, and it is in this chapter that a jolly photograph appears showing various types of miniature switches compared to a threepenny piece—for those who can remember them!

M.A.

### ELECTRONICS FAULT DIAGNOSIS

By I. R. Sinclair

Published by Argus Books Ltd.

108 pages, 138 × 216mm. Price £2.75

CIRCUITS in this book are graded, starting with the most simple and working upwards. There is no particular tendency towards domestic equipment, since much of the servicing guidance given applies to industrial or communications type electronics. This book should be useful to students studying the C & G 272 and 222 courses.

The chapters are: Power Supplies, Audio Frequency Amplifiers, Timing Circuits, Measuring Circuits, Oscillators, Trigger Circuits, Control and Interface Circuits, and Digital and Counting Circuits.

Each chapter comprises one or more circuit diagrams with corresponding sets of voltage readings, or oscillograms, for certain points. After taking in the circuit description, it is then up to you to deduce which set of readings is correct.

The answers are in the back of the book, along with an explanation of which component failures would have caused the other *incorrect* readings shown.

The effect on voltages of various types of measuring instrument is also covered, and in some tables you are expected to take such loadings into account when seeking the right answer. This book is not for the absolute beginner.

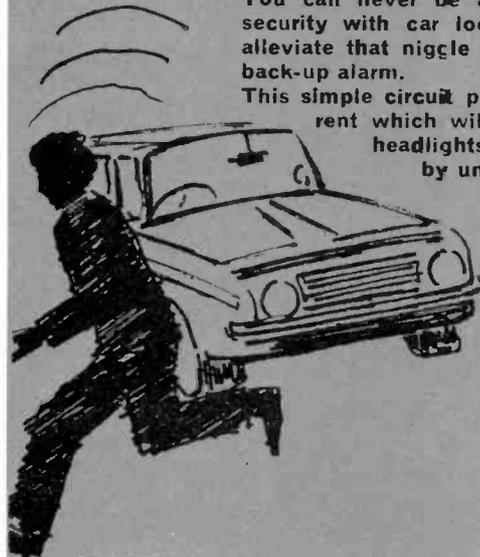
M.A.

# Next Month

## CAR BURGLAR ALARM

You can never be assured of total security with car locks so why not alleviate that niggle of doubt with a back-up alarm.

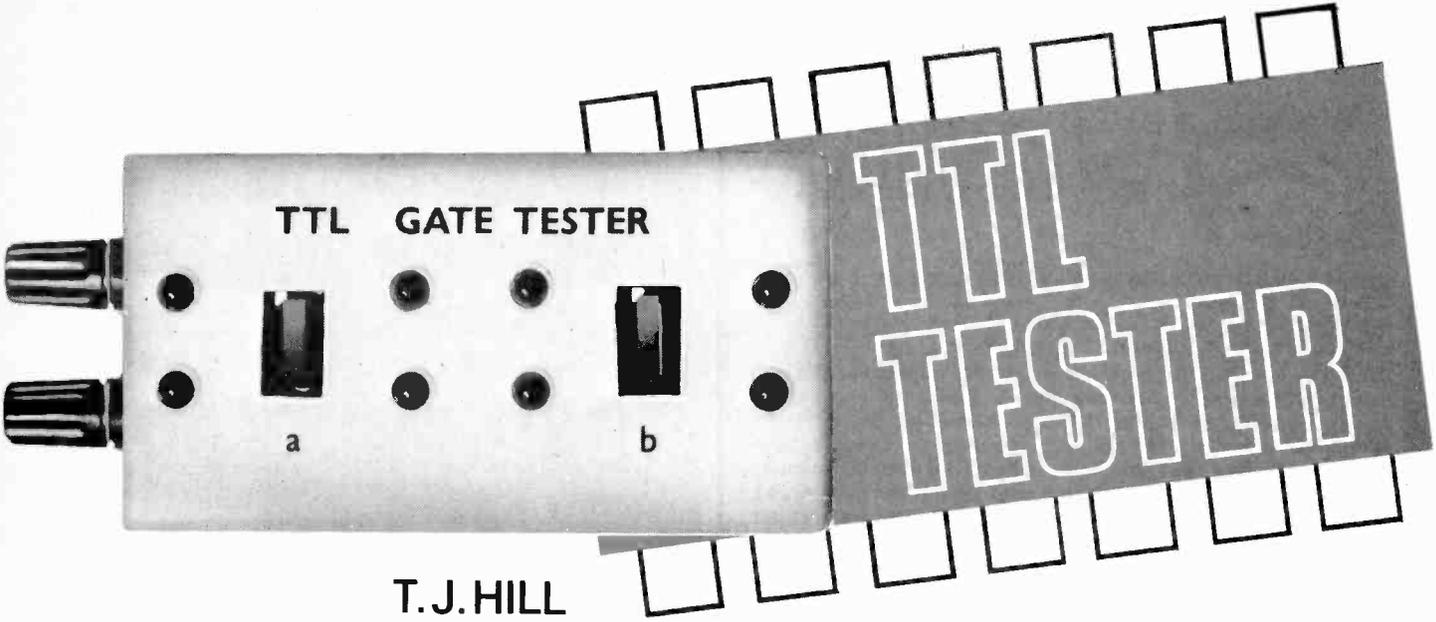
This simple circuit promises a deterrent which will blip horn and headlights when activated by unlawful intrusion.



...Your  
**INDEX** for Volume 13  
in this issue

## PRACTICAL ELECTRONICS

OUR DECEMBER ISSUE WILL BE ON SALE FRIDAY,  
NOVEMBER 11



## FOR 74 FAMILY OF QUAD-GATE PACKAGES

**T**HIS gate tester was designed to be cheap, and to be capable of testing a wide range of simple QUAD-GATE packages. The unit works by applying to each gate in the i.c. under test, every possible combination of inputs, and monitoring the outputs with l.e.d.s.

### TEST SOCKETS

There are two basic pinout configurations used in the 7400 series of quad gate packages, and these are illustrated in Fig. 1, where the 7400, and the 7401 are shown.

Two i.c. sockets are fitted in this tester, to accommodate each pin arrangement.

### THE CIRCUIT

Referring to Fig. 2, the 555 timer (IC1) is wired as an astable multivibrator with a frequency of about 2Hz. The output from this is fed to a 7470 flip-flop (IC2), which divides the signal by two. This, and the original oscillator signal are taken to every gate in the i.c. under test; each

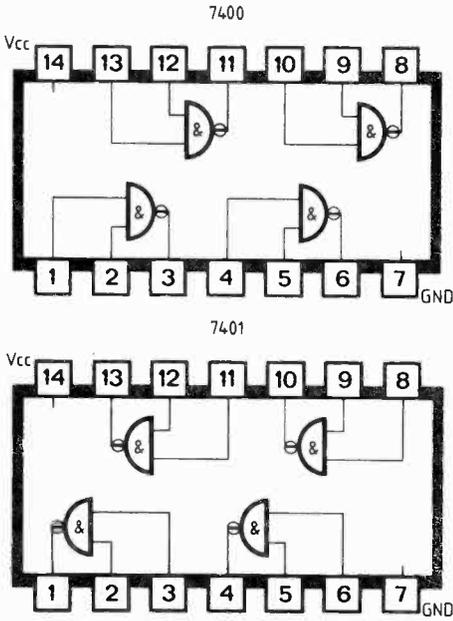
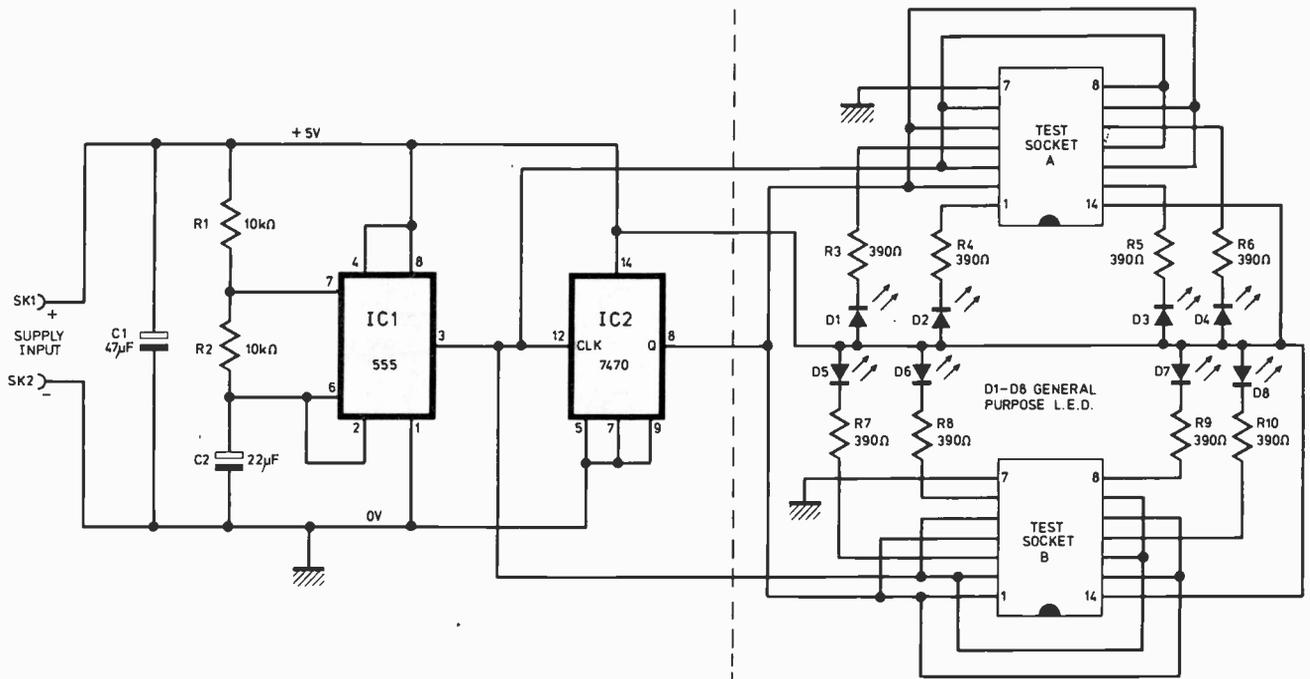


Fig. 1. Pin configurations of the 7400 and 7401

## COMPONENTS . . .

- Resistors**
  - R1, R2 10kΩ ¼W 5% (2 off)
  - R3-R10 390Ω ¼W 5% (8 off)
- Capacitors**
  - C1 47µF 10V elect
  - C2 22µF 10V elect
- Semiconductors**
  - D1-D8 0.2in red l.e.d.
  - IC1 NE555 Timer
  - IC2 7470
- Miscellaneous**
  - Verobox type 65-2518H
  - Veroboard 0.1in
  - Red 4mm terminal (SK1)
  - Black 4mm terminal (SK2)
  - 14 pin d.i.l. sockets for test positions (2 off)

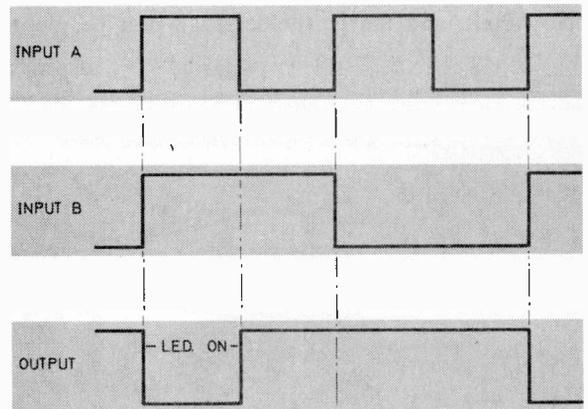


**Fig. 2. Circuit diagram of the TTL tester. A capacitor of 0.01μF connected from IC1 pin 5 to ground may be found necessary for reliable operation**

signal going to each of the two inputs. These input waveforms are shown in Fig. 3, and the correct output for a 7400 is shown as an example.

The outputs, drive l.e.d.s. D1 to D8, causing them to illuminate when the signal generated by the gate under test is low, thus allowing open collector type gate to be tested with this system.

Testing a 7400, it can be seen from Fig. 3 that the output l.e.d.s should be on for one quarter of the total waveform period. This, and the relationships for other quad gate packages, can be seen in Table 1.

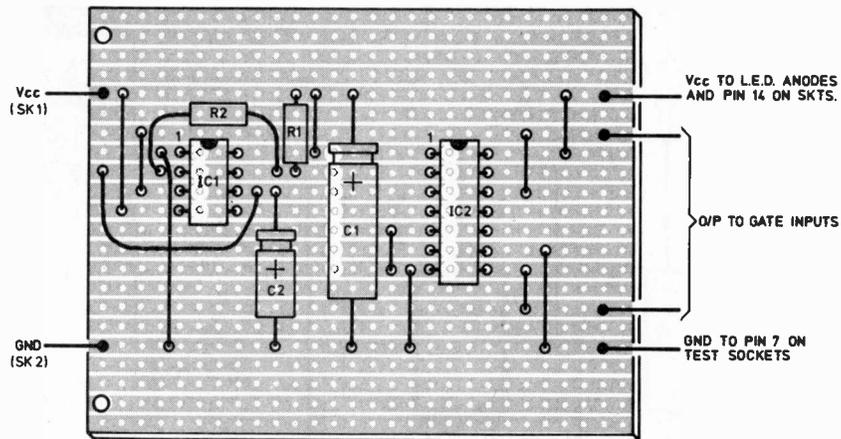


**Fig. 3. Test waveforms applied to each gate. The correct output for a 7400 is shown**

**Table 1. Output l.e.d. illumination times for correctly operating gates. Ten 74 series quad gate packages are shown**

Package type	Test socket	l.e.d. duty cycle
7400	B	25%
7401	A	25%
7402	A	75%
7403	B	25%
7408	B	75%
7409	B	75%
7428	A	75%
7432	B	25%
7433	A	75%
7438	B	25%





**Fig. 4. Stripboard layout of prototype**

## CONSTRUCTION

The basic circuit was assembled on a piece of stripboard (see Fig. 4), which was then mounted in a small polystyrene case, by the integral mounting pillars.

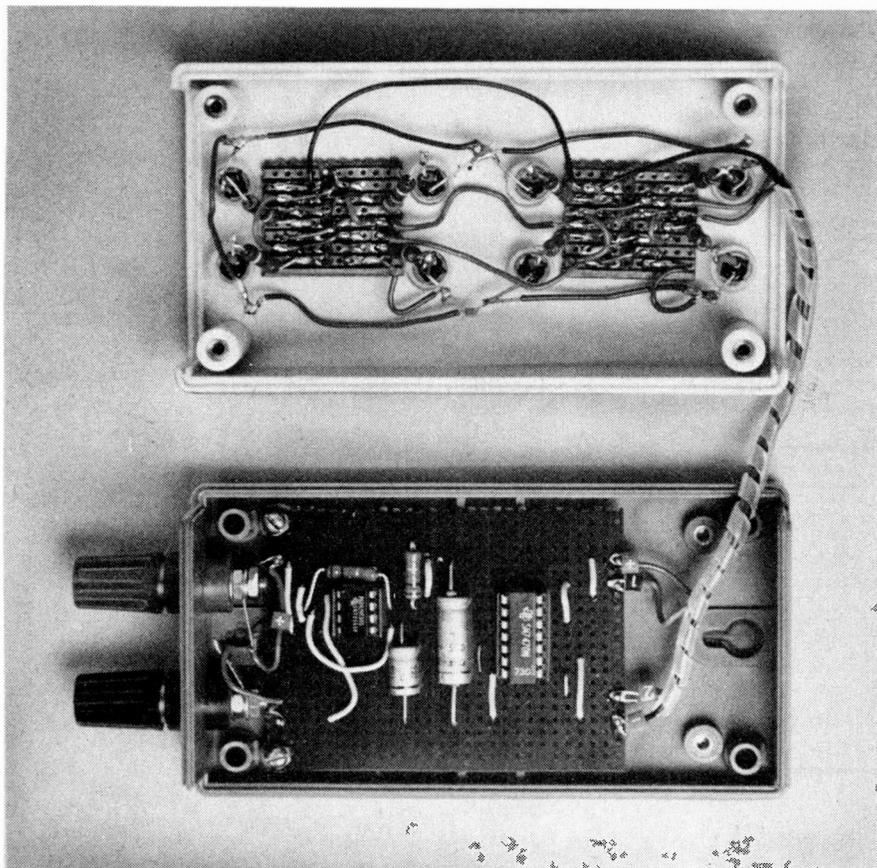
The lid of the case was cut to accommodate two 14 pin i.c. holders, and the eight l.e.d.s. Dimensions will depend upon the type of l.e.d.s preferred, and i.c. holders used, but the photographs will show the general layout involved.

The l.e.d.s can be fixed, either by adhesive, or using the proper bezels, and the i.c. holders will best be mounted

each on a small square of stripboard, to which they can be soldered. The plate so formed, can then be used to glue the holder to the lid.

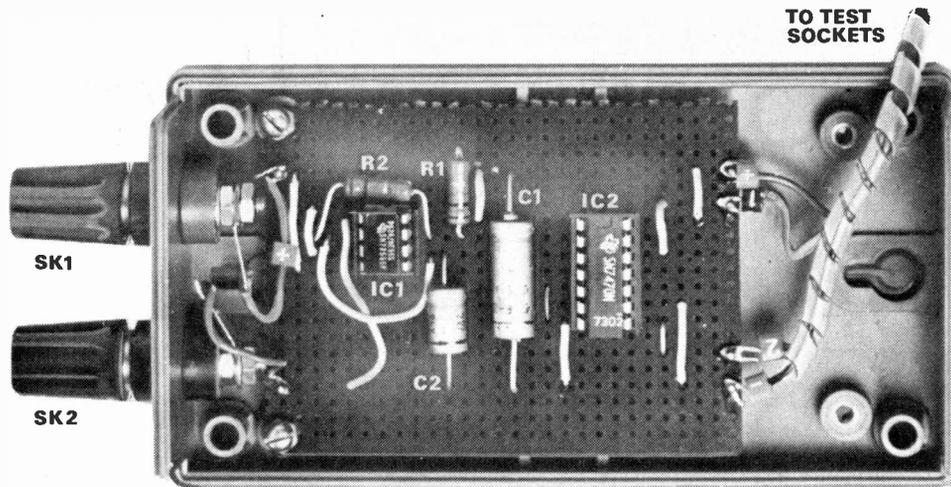
Cut holes for the two 4mm socket terminals (SK1 and SK2), and mount these. Next drill the main component board so that it can be mounted in the base of the box.

A harness of four wires should be formed, to link the main board to the i.c. socket boards. This will carry the two signal lines, and the two supply lines. Wire both the i.c. socket units for +5V and 0V, and next, the two signal



**In the prototype, the i.c. sockets were soldered to pieces of Vero-board which were then glued to the lid. The sockets and l.e.d.s were linked directly using the 390Ω resistors**

**Power is applied via the 4mm terminals, but using a larger box would allow room for operation from an internal battery. An on/off switch could be mounted in place of the terminals**



lines to all the appropriate pin numbers detailed in Fig. 2. The +5V line should also be wired common to all the i.e.d.s (check for correct polarity), and the other side of each i.e.d. wired to its respective i.c. socket pin, by means of a 390Ω resistor (R3-R10).

The i.e.d.s should be wired up so that they are adjacent to the outputs they represent. The lid was lettered using dry letter transfers sprayed with laquer, and it may be advantageous to put the related pin numbers against each i.e.d.

Finally, do not forget to connect up the two 4mm terminals for the supply input.

## OPERATION

In use, the i.c. to be tested is inserted in the appropriate socket (use Table 1), power is applied, and the i.e.d.s will indicate the condition of the i.c.

A gate with a faulty output stage will cause the incorrect flashing of its associated i.e.d., and a gate with a damaged input stage will possibly cause *all* the i.e.d.s to flash incorrectly. The operator can learn to interpret the meaning of the various indications.

The prototype is powered by an external supply, but since current consumption is only about 30mA average, battery operation is feasible. ★

# MARKET PLACE

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

## CONDUCTIVE PAINT

After five years of selling exclusively to industry, **Industrial Science Ltd.**, are now introducing one of their most successful products—**Elecolit 340**—into the consumer electronics market.

This is a pure, silver filled, electrically conductive acrylic paint. It exhibits excellent conductivity because of the pure silver and outstanding environmental protection due to its acrylic base and sets by solvent evaporation similar to most good lacquer systems forming a tough film with good adhesion to ceramics, glass, rubber, plastics and most plastics films.

Typical applications include r.f. shielding, printed circuit repair, use as a conductive ink, prototype circuit manufacture

and one of the most interesting and unusual applications of all which is to repair the rear window demister of a car by means of painting over the existing track which may have either broken or shorted out.

Although it is air drying, conductivity can be improved by heating.

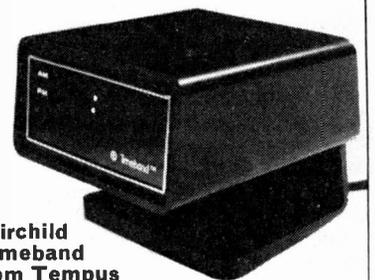
The shelf life is a minimum of 1 year in a closed container, and the operating temperature is from -60°C to +175°C.

It can be applied by painting, silk screening or roller, and if necessary it can also be thinned with a solvent to lower the viscosity.

Details of price and further information can be obtained from **Industrial Science Ltd.**, Leader House, Dept. P.E., 117-120 Snargate Street, Dover, Kent.



The Elecolit 340 conductive paint from Industrial Science



Fairchild Timeband from Tempus

## ALARM CLOCK

A particularly elegant digital alarm clock, the Fairchild Timeband is available from Tempus.

Available in white or black, and taking up little more space on your bedside table than an old-fashioned mechanical alarm clock, the Timeband offers timekeeping and alarm accurate to the second.

The readout is on large seven-segment i.e.d. displays, showing hours and minutes or, at the touch of a button, last minute digit and seconds. Indicators are provided for AM/PM, Mains Failure, and Alarm On. The alarm should be loud enough to waken the heaviest sleeper, and includes a "doze" feature which can call you up to six times in an hour.

The Timeband costs £14.95, including VAT, post, packing and insurance, from Tempus, 19-21 Fitzroy Street, Cambridge, CB1 1EH.

# Semiconductor UPDATE...

FEATURING : TMM142C H.L.C.D. 0024 LM194

R.W. Coles

## FORGET ME NOT

The nice thing about old fashioned magnetic core stores was that, like the elephant, they never forgot. Fill them full of lovely binary data and then hit the mains-off switch, and next week when you switched on again it would all be just as you left it (brings tears to my eyes!).

Problem was, of course, that their uncanny resemblance to the elephant extended also to their physical bulk and their rather slow response, and those little drawbacks soon got them the chop when fast, cheap semiconductor RAM chips emerged from the undergrowth.

With semiconductor RAM of course, if you hit the power-off-switch all you end up with is a garbage, a problem the data processing industry decided it would have to live with if it wanted the other goodies on offer.

Where loss of data was a problem, non volatility *could* be arranged by providing battery back-up supplies, or by transferring crucial data to permanent storage media such as magnetic tapes or discs, but this proved either expensive or a headache for the software designers. In recent years the CMOS RAM has emerged to make the battery back-up solution more viable, with a stand-by life measured in years now possible with quite small batteries, but CMOS RAMs are expensive, slower, and less dense than their NMOS cousins and so the problem of volatility is still not completely solved.

A new solution to this problem has recently been introduced by Toshiba in the form of their TMM142C 256 × 4 RAM chip which uses a double cell in each bit position, to provide the rapid access read/write capability of standard RAM combined with the non-volatility of the MNOS electrically alterable ROM technology.

The MNOS (Metal Nitride Oxide Semiconductor) alone is certainly non-volatile but it can't be used in place of standard RAM because writing and erasing data is slow and requires high voltages. By combining MNOS devices with conventional RAM circuitry the best of both worlds can be achieved. With power up, normal fast read/write access is possible, but when a power fail condition is detected the RAM data is transferred to the MNOS devices where it will remain for very long periods. When power is restored the stored data is duplicated in the RAM array ready for instant use. The data also remains in the

MNOS latches and must be erased before re-use by means of a positive pulse applied to the MG input.

## THE DRIVER

Liquid crystal displays are pretty, popular, offer extremely low power drain, and are, unfortunately, excruciatingly difficult to drive.

Take a standard clock or voltmeter chip with multiplexed BCD or seven segment outputs and any fool can interface it with the l.e.d., Minitron, or gas discharge display of his choice, but the thought of hooking it up to a 3½ digit liquid crystal panel makes brave amateurs buckle at the knees and even experienced designers cough nervously.

The l.c.d.s require an a.c. display drive supply of about 30 to 100Hz, and they *cannot* be multiplexed, a combination completely alien to most likely display sources. To interface to a clock chip, for example, you would first have to demultiplex and latch each display digit, then wire these to the l.c.d. via decoders and exclusive OR gates, and finally provide an l.f. backplane drive source. A glance at the serried ranks of standard CMOS chips that you would need to hang around your clock chip might well convince you that l.e.d.s are not so bad after all!

Well, you know what I was going to say next, didn't you. Yes, somebody has gone out and done it all for us again, a complete multiplexed BCD input, to decoded seven segment l.c.d. output display system on a single chip. Hughes Microelectronics are the people to blame, and the device in

question is the H.L.C.D. 0024 which is made using CMOS technology and lives in a 40 pin plastics package.

On its inputs, the H.L.C.D. 0024 talks directly to the BCD and digit strobes produced by most clock and voltmeter chips, on its outputs, it speaks parallel seven segment a.c. drive liquid crystal. Two extra uncommitted drivers are available for use with plus/minus signs, decimal points or a.m. p.m. displays, and leading digit zero blanking is provided internally.

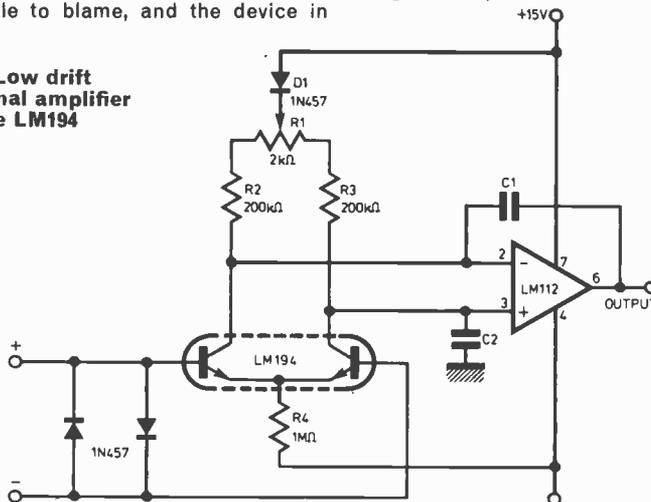
## THE PERFECT COUPLE

I remember spending hours with an AVO transistor analyser and a few dozen OC29 germanium power transistors trying to get a matched pair for use in an audio amplifier output stage. Well, I'm not sure that it was much help in the end, but I enjoyed myself anyway, there is something rather satisfying.

As a close approach to the perfect matched pair, National now produce the LM194 "Supermatch pair" which consists of two monolithic npn silicon transistors in a TO5 metal can. The emitter-base voltage match is within 50 microvolts, the current gain match to within 1 per cent, and the offset drift is less than 0.1 micro volts per degree C which as far as I remember, is a hell of a lot better than I was able to do with my OC29s!

Match pairs such as the LM194 are useful where extremely high performance operational amplifiers or high accuracy analogue multipliers must be assembled.

Fig. 1. Low drift operational amplifier using the LM194



### SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in x 18in £2-93. Post and VAT 60p. 13in x 10in £2-33. Post and VAT 50p.



### CONTROL DRILL SPEEDS

#### DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3-45 including post and VAT. Made up model £1 extra.

### MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6V, 9V, 12V for up to 500mA (Class D working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only £1-50. VAT and postage 50p.

### SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £7-95 plus 95p VAT and postage.



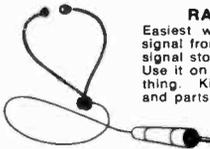
### MICRO SWITCH BARGAINS

Rated at 5 amps 250V, ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 for £1, VAT and post paid.



### RADIO STETHOSCOPE

Easiest way to fault find, traces signal from aerial to speaker, when signals stop you've found the fault. Use it on Radio, TV, amplifier anything. Kit comprises transistors and parts including probe tube and twin stetho-set. £3-95, VAT and postage incl.



### MULTISPEED MOTORS

Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is 3/8 in diameter and approximately 1 in long. 230/240V. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor. Price approx. 2 in dia. x 5 in long. Size £2 including post and VAT.



### MAINS RELAYS

With triple 10 amp changeover contacts—operating coil wound for 230V a.c., chassis mounting, one screw fixing, ex unused equipment 60p each, 10 for £5 post and VAT paid.



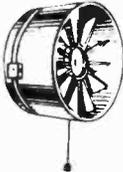
### TELESCOPIC AERIALS

for portable car radio or transmitter. Chrome plated—six sections, extends from 7 1/2 to 47in 50p + 15p post and VAT. K L MODEL FORM F.M. 80p + 17p post and VAT.



### EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic feet per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc. It's so quiet it can hardly be heard. Compact, 5 1/2 in casing comprises motor, fan blades sheet-steel casing, full switch, mains connector and fixing brackets. £5-25 including post and VAT. Monthly list available free, send long stamped envelope.



### BLACK LIGHT

As used in disco's and stage effects etc.—virtually no white light appears until rays impinge on white collars and cuffs etc.—we offer mains B.L. lamps, 175 watts plugs into any lamp holder requires no choke or control gear price £7 + 95p post and VAT or for glamorising rock specimens, looking for watermarks etc. a 9in 6 watt tube with starter, choke lamp holds, etc. all for £4-50 post and VAT paid.

### NEED A SPECIAL SWITCH

Double lead contact. Very slight pressure, closes both contacts 12p each... Plastic push-rod supplied for operating 10p each. 10 for 60p.



### HUMIDITY SWITCH

American made by Ranco, their type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp at 250V a.c. Overall size of the device approx. 3 1/2 in long 1 in wide and 1 1/4 in deep. 65p.



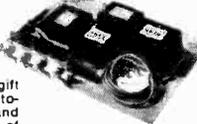
### PP3/PP9 REPLACEMENT MAINS UNIT

Japanese made in plastic container with leads size 2in x 1 1/4 in x 1 1/4 in, this is ideal to power a calculator or radio. It has a full wave rectified and smoothed output of 9V suitable for loading of up to 100mA. £2-53.



### MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £14 including VAT and postage.



### SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis, front panel and all the parts £1-90—crystal earphone 55p including VAT and postage.



### DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2-75, VAT and postage 85p.



### 25A ELECTRIC PROGRAMMER

Learn in your sleep. Have radio playing and kettle boiling as you wake—switch on lights to ward off intruders—have a 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 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2-95, VAT and postage 60p, or with glass front, chrome bezel, £1-50 extra.



### WINDSCREEN WIPER CONTROL

Very speed of your wiper to suit conditions. All parts and instructions to make. £3-75 post and VAT paid.



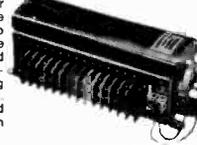
### THIS MONTH'S SNIP

Breakdown Parcel—four unused, made for computer units containing most useful components and these components unlike those from most computer panels, have wire ends and of useable length. The transistors for instance have leads over 1in long—the diodes have 1in leads.

List of the major components is as follows: 17 assorted transistors; 38 assorted diodes; 60 assorted resistors and condensers; 4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which were made to receive these units). The price of this four units parcel is £1 including VAT and post (considerably less than value of the transistor or diodes alone). DON'T MISS THIS SPLENDID OFFER.

### MOTORISED DISCO SWITCH

With six 10 amp changeover switches. Multi adjustable switches are rated at 10 amp each so a total of 200W can be controlled and this would provide a magnificent display. For mains operating £4-25 post and VAT paid. Ditto 9 switch £4-95 post and VAT paid. Ditto but 12 switch £5-75 post and VAT paid.



### 8 POWERFUL BATTERY MOTORS

For models, Meccano's, drills, remote control planes, boats, etc. £2.



### ROTARY PUMP

Self priming, portable, fits drill or electric motor pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertilizer, chemicals, anything liquid. Hose connectors each end. £2 post paid.



### MERCURY BATTERIES

Bank of 7 Mercury cells type 625 which are approx. 1/2 in diameter by 1 1/4 in thick in plastic tube, giving a total of 10-7V. Being in a plastic tube it is very easy to break up the battery into separate cells and use these for radio control and similar equipment. Carton of 25 batteries £1-80.



### MICRO AMPLIFIER

Ex behind the ear deaf aids, complete with volume control £2-16.

### TERMS:

Cash with order—under £8 must add 50p to offset packing etc. BULK ENQUIRIES INVITED. Tel: 01-688 1833.

**J. BULL (ELECTRICAL) LTD**  
(Dept. PE), 103 TAMWORTH RD.  
CROYDON CR9 1SG

### IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—It's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lists.

### Mullard Audio Amplifiers

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output £1-50 including Post & VAT. Model 1172 1W power output £1-85 including Post & VAT. Model EP9000 4 watt power output £2-90 including Post & VAT. EP 9001 twin channel or stereo pre-amp. £2-90 including Post & VAT.

### Room Thermostat

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage. Covers the range 0-30°C. Special snip this month £2-50, post and VAT paid.

Mains Transformer upright mounting with top tagboard primary 0-115, 210, 240, two secondaries 115 volts 5mA, and 8.5 volt 1.25A. Note this transformer is ex-new equipment. Price £2 + 16p. Post 30p + 2p.

Mains Transformer, primary 0-110, 127, 150, 180, 220, secondaries (1) 3, 15-0-3, (2) 2-5V, (3) 0-220V. Fitted primary screen. This is a 30W transformer, ex equipment £2-50 + 20p. Post 40p + 3p.

Ferric Chloride Crystals, for etching copper, making printed circuit boards, etc. Special purchase enables us to offer this in 1lb bags at 50p + 4p. Post 20p + 2p.

Reed Relay with double wound coil 12 volts one coil will close the reed switch, 12 volts on the other coil will open the contact or still further close it depending upon whether the current is opposing or assisting. Price £1-50 + 12p. Post 20p + 2p.

Relay, Clare Elliott 670 ohm. Coil sealed in metal can size approx. 1 1/2 in by 1 1/2 in x 1 1/2 in two pairs of changeover contacts. This type of relay is mounted by its own leads. £1 + 8p.

Desk Instrument Case with sloping front, overall size of sloping front is 4in wide and 5in long. Mounted on a heavy base for stability, base size 4 1/2 in x 4in with flex lock. The heavy base is easily removed if required. The average depth below sloping panel 3in approx. Price £1-50 + 12p. Post 50p + 4p. Note the sloping front will be supplied with each of these cases but this already has quite a lot of holes in it, however, it is a simple matter to cut and bend new aluminium front if you use this as a pattern.

Remember 7029. We are rapidly running out of this and if you have not put any into stock then this could well be your last chance. The price for 100 metre coil £9-50 + 76p. Carriage £2-50 + 20p.

Engine Revolution Counter. This is ex-Air Ministry item, beautifully made. As a revolution counter it is driven by a flexible shaft and having a permanent magnet field the voltage output would be dependent upon the speed. Of course it will also run as a low voltage d.c. motor and its speed will be dependent upon the applied voltage. This is dustproof and almost waterproof so it will still run in adverse conditions. One point however, is there are no brushes fitted to these motors, these are special and as yet we have not been able to find a supplier, so you will buy without brushes. The Air Ministry ref. number of the motor is 6A/7A2. We would like to hear from any customer who met this during his service career and who knows of a possible source of brushes. Price £2 + 16p. Post 40p + 4p.

Nicad Battery Charger in neat plastic case size 4 1/2 in x 3 1/2 in x 2 1/2 in approx. with mains input lead and charging output lead terminated with din plug. This is a dual output charger but contains useful mains transformer which makes it easily adaptable for many voltage cells. If not wanted as a charger could very easily be rebuilt as a power unit for receiver or other device. The plastic case has a neon indicator. Price £2-50 + 20p. Post 40p + 4p.

7 Digital Counter. Another special purchase enables us to offer this mains-operated counter for only about a quarter of its proper price. It works off 240V 50Hz mains and requires no step down. There is only one point about this—it counts in even numbers only 2, 4, 6, 8, 10, etc. If you want to count single you must divide the final figure by 2. Price 50p + 4p. Post 10p + 1p.

Garrard 4 Pole Motor, probably made for record player or tape recorder, this is 140V 40-60 cycle. We do not know the Garrard ref. no. but the figure 12 is pressed on the bottom bearing cover. Price £2 + 25p. Post 30p + 4p.

Simmerstat by Sunvic for 2500 watts Sunvic ref. 230707/10776. This is a larger than usual simmerstat dimensions approx. 2 1/2 in square by 2 1/2 in deep. Price £1-50 + 12p. Post 20p + 2p.

Flash Ernie is the name we have given to our latest disco light display because it is a random flasher and is very effective especially with coloured bulbs. Kit consists of motorised stud switch, master control switch, anti spark caps, 9 lamp holders, connecting wire and wiring diagram. Price £5 + 40p. Post 60p + 6p.

Car Cassette Power Kit. This has a stabilised output of 6V, 9V or 12V—this kit consists of transistors—zener, diodes and all resistors and condensers, case, and data price is only £2-60 including post and VAT.

Burglar Alarm—The heart of many of these is an infra red beam operated switch—and we offer a bit to make this switch complete with relay for latching and sounding alarm bell—this can also be used for door opening—counting light or dark switching etc., but consists of photo cell—relay, all resistors and condensers and constructional data only £2-25 including post and VAT.

Emergency Light. Works from mains but automatically switches to battery should mains fail—with this your place never will be in darkness—uses PP9 battery (not supplied) otherwise complete kit with data £3-50 including post and VAT. Wall or ceiling mounting case £1-50 extra.

Stereo Gram Cabinets. Long, low, modern teak-veneered cabinet, size approximately 4ft 2in by 15ft 5in. Probable cost to make today over £20. We have a few of these, they are slightly second, at prices ranging from £5 each, depending on condition—sorry but these are for callers only.

# B. BAMBER ELECTRONICS

Dept PE. 5 STATION ROAD, LITTLEPORT, CAMBS., CB6 1QE  
Telephone: ELY (0353) 860185 (2 lines) Tuesday to Saturday

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

18V DC RELAYS, 4 pole change-over (double contacts) (will work from 14-24V DC). Brand New, boxed, good quality, made by AEI 40p each.

Slider Switches, 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

Smart Min. Rectangular Push to Make Switches, black rectangular surround with white rectangular button, overall size 12 x 17mm, 3 for 50p.

### A NEW RANGE OF QUALITY BOXES & INSTRUMENT CASES.

Aluminium Boxes with Lids.		
AB10	5 1/2 x 4 x 1 1/2	60p
AB13	6 x 4 x 2	80p
AB14	7 x 5 x 2 1/2	£1-00
AB15	8 x 6 x 3	£1-30
AB16	10 x 7 x 3	£1-50
AB17	10 x 4 1/2 x 3	£1-30
AB25	6 x 4 x 3	£1-00

Vinyl Coated Instrument Cases  
Light Blue tops and White lower sections. Very smart finish.

WB1	5 x 2 1/2 x 2 1/2	60p
WB2	6 x 4 1/2 x 1 1/2	£1-10
WB3	8 x 5 x 2	£1-60
WB4	9 x 5 1/2 x 2 1/2	£1-80
WB5	11 x 6 1/2 x 3	£2-00
WB6	11 x 7 1/2 x 3 1/2	£2-25
WB7	12 x 6 1/2 x 5 1/2	£2-60
WB853	8 x 5 1/2 x 3 1/2	£2-00

MAGNETIC DEVICES PROGRAMMERS. Contain 9 fully adjustable cams and 9 change over micro-switches (rated approx. 1A at 240VAC). Needs slow-motion motor to drive (not supplied). Ideal for disc lights, sequence switching, etc. ex equipment £1-50 each.

CALIBRATOR XTALS 100kHz + 1MHz in one 10-X can. £1-00 each.

MAINS TRANSFORMERS. Type 60/2. Mains Input 200-210-220-230-240-250V a.c. output 0-20-40-60V at 2A, in Metal and Plastic case, approx. 7 1/2 x 4 1/2 x 4, fully fused (ideal for PSU) £3-00 each.

MAINS TRANSFORMERS. Type 15/300 240V input, 15V at 300mA output, £1-50 each.

MAINS TRANSFORMERS. Type 45/100, 240, 220, 110, 20. 0V Input, 45V at 100mA output, £1-50 each.

RED LEDs (Min. type) 5 for 70p.

VIDICON SCAN COILS (Transistor type, but no delay) complete with vidicon base £8-50 each. Brand New.

FULL RANGE OF BERNARDS/BABANI ELECTRONICS BOOKS IN STOCK. S.A.E. FOR LIST.

NEW FOR THE VHF CONSTRUCTOR. A range of tuned circuits on formers with slugs and screening cans. Frequencies quoted are approximate, and range can be greatly extended by using varying capacitors in parallel.

Type S (1/2in. square, dummy type).  
Type SA 20 to 30MHz (when 33pF fitted in parallel).  
Type SB 35 to 50MHz (with link winding).  
Type SC 70 to 100MHz (with link winding).  
Type SD 135 to 175MHz (with link winding).  
Type M (Min. 1/2in. square types).  
Type MA 19 to 28MHz (when 33pF fitted in parallel).  
Type MB 22 to 32MHz (when 33pF fitted in parallel).  
Type MC 25 to 35MHz (when 33pF fitted in parallel).  
Type MD 38 to 50MHz (when 33pF fitted in parallel).  
Type ME 45 to 60MHz (when 33pF fitted in parallel).  
Type MF 100 to 200MHz (without slug) when 0 to 30pF variable fitted in parallel.  
All the above coils available in packs of five only (same type) at 50p per pack of 5.

PLASTIC PROJECT BOXES with screw on lids (in black ABS) with brass inserts.  
Type NB1 approx. 3in. x 2 1/2in. x 1 1/2in. 40p each.  
Type NB2 approx. 3 1/2in. x 2 1/2in. x 1 1/2in. 50p each.  
Type NB3 approx. 4 1/2in. x 3 1/2in. x 1 1/2in. 60p each.

MULLARD 85A2 85V STABILISER VALVES (Brand New) 70p each or 2 for £1-20.

TO3 transistor insulator sets, 10 for 50p

BSX20 (VHF Osc/Mult), 3 for 50p.  
BC108 (metal can), 4 for 50p.  
PBC108 (plastic BC108), 5 for 50p.  
BFY51 Transistors, 4 for 60p.  
BCY72 Transistors, 4 for 50p  
PNP audio type TO5 Transistors, 12 for 25p.  
BF152 (UHF amp/mixer), 3 for 50p.  
2N3819 Fet., 3 for 60p.  
BC148 NPN SILICON, 4 for 50p.  
BC158 PNP SILICON, 4 for 50p.  
BAV31 Signal Diodes, 10 for 35p.  
BA121 Varicap Diodes, 4 for 50p.

741CG op amps by RCA, 4 for £1.

PERSPEX TUNER PANELS (for FM Band 2 tuners) marked 88-108MHz and Channels 0-70, clear numbers, rest blacked out, smart modern appearance, size approx. 8 1/2in x 1 1/2in., 2 for 35p.

### PLUGS AND SOCKETS

N-Type Plugs 50 ohm, 60p each, 3 for £1-50.  
PL259 Plugs (PTFE), brand new, packed with reducers, 85p each.  
SO239 Sockets (PTFE), brand new (4-hole fixing type), 50p each.

SOLDER SUCKERS (Plunger type). Standard Model, £5. Skirted Model £5-50. Spare Nozzles 60p each.

### WELLER SOLDERING IRONS

EXPERT. Built-in-spotlight illuminates work. Pistol grip with fingertip trigger. High efficiency copper soldering iron.  
EXPERT SOLDER GUN £1000 £9-90.  
EXPERT SOLDER GUN KIT (spare bits, case, etc.) £12-90.  
Spare bits 35p pair.

### NEW MARKSMAN RANGE OF SOLDERING IRONS.

S115D 15W 240V £3-80.  
S125D 25W 240V £3-80.  
S140D 40W 240V £4-20.  
S125DK 25W 240V + bits etc., KIT £4-90.  
SPECIAL 12V version S125-12 25W 12V £3-80.  
BENCH STAND with spring and sponge for Marksmen irons £2-30.  
Spare bits MT9 (for 15W) 50p, MT5 (for 25W) 45p, MT10 (for 40W) 50p.

ALL PRICES + 8% VAT.  
TEMPERATURE CONTROLLED IRON. Temperature controlled iron and PSU. £30 + VAT (£2-40).

### SPARE TIPS

Type CC single flat. Type K double flat fine tip. Type P, very fine tip. £1 each + VAT (8p).  
MOST SPARES AVAILABLE.

### MULTICORE SOLDER

Size 5 Savbit 18 s.w.g. in alloy dispenser, 32p + VAT (3p).  
Type C15AV18 Savbit 18 s.w.g., 56p + VAT (4p).  
1 Kg. (1-1lb) 60 x 40, 20 s.w.g. on plastic reel £3 + VAT (24p).

14 DIL REED RELAYS, 5 to 12V DC, 450 ohm coil. Designed to work directly from TTL Logic, Single Pole Change over. Contact ratings 28V 1/2A 3W. £1-75 each.

A LARGE RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES, S.A.E. FOR LIST.

MIXED COMPONENT PACKS, containing resistors, capacitors, pots, etc. All new. Hundreds of items. £2 per pack, while stocks last.

ALU-SOL ALUMINIUM SOLDER (made by Multicore). Solders aluminium to itself or copper, brass, steel, nickel or tinplate, 16 s.w.g. with multicore flux, with Instructions, Approx. 1 metre coil 40p pack. Large reel £2-75.

VARICAP TUNERS Mullard type ELC1043/05. Brand New, £4-40 + 12 1/2% VAT.

BARGAIN PACK OF LOW VOLTAGE ELECTROLYTIC CAPACITORS. Up to 50V working. Seatronix Manufacture. Approx. 100. £1-50 per pack + 12 1/2% VAT.

OSMOR REED RELAY COILS (for reed relays up to 1/2in dia., not supplied) 12V, 500 ohm coil, 2 for 50p.

We now stock Spirax Tools for the electronic enthusiast. Screwdrivers, Nut spanners, BA and Metric sizes, pop rivet guns, etc. S.A.E. for list.

TWIN I.F. CANS, approx. 1in. x 1/2in. x 1in. high, around 3-5-5MHz, 2 separate transformers in 1 can. Internally screened, 5 for 50p + 12 1/2% VAT.

DuBilier Electrolytics, 50uF, 450V, 2 for 50p.  
DuBilier Electrolytics, 100uF, 275V, 2 for 50p.  
Plessey Electrolytics, 470uF, 63V, 3 for 50p.  
TCC Electrolytics, 1000uF, 30V, 3 for 60p.  
DuBilier Electrolytics, 5000uF, 35V, 50p each.  
DuBilier Electrolytics, 5000uF, 50V, 60p each.  
ITT Electrolytics, 6800uF, 25V, high grade, screw terminals, with mounting clips, 50p each.

PLEASE ADD 12 1/2% VAT TO ALL CAPACITORS.

### TV PLUGS AND SOCKETS

TV Plugs (metal type), 4 for 50p.  
TV Sockets (metal type), 4 for 50p.  
TV Line Connectors (back-to-back sockets), 4 for 50p.  
Please add 12 1/2% VAT.

Terms of Business: CASH WITH ORDER. MINIMUM ORDER £2. ALL PRICES INCLUDE POST & PACKING (UK ONLY). SAE with ALL ENQUIRIES Please. PLEASE ADD VAT AS SHOWN. ALL GOODS IN STOCK DESPATCHED BY RETURN. CALLERS WELCOME BY APPOINTMENT ONLY.

# PHILIPS YOU & PHILIPS HI-FI KITS



The top sellers for home assembly in Europe - now available in the U.K.

Now - read all about the Philips range of quality kits for home assembly - mixers, amplifiers, speakers, etc, etc. Send today to S.S.T. Distributors (Electronic Components) Ltd., West Road, Tottenham, London N17 0RN

Please send me, quickly, the new colour catalogue. PE111

Name

Address

Postcode



free SEND TODAY!

S.S.T. Distributors is a member of the Philips Group of Companies.



# Wilmslow Audio

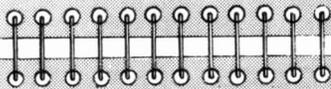
THE firm for speakers!

SEND 10p STAMP FOR THE WORLD'S BEST CATALOGUE OF SPEAKERS, DRIVE UNITS, KITS, CROSSOVERS, ETC. AND DISCOUNT PRICE LIST

ACT ● AUDAX ● BAKER  
BOWERS & WILKINS ● CASTLE ● CELESTION  
CHARTWELL ● COLES ● DALESFORD  
DECCA ● EMI ● EAGLE ● ELAC ● FANE  
GAUSS ● GOODMANS ● HELME ● I.M.F.  
ISOPHON ● JR ● JORDON WATTS  
KEF ● LEAK ● LOWTHER ● MCKENZIE  
MONITOR AUDIO ● PEERLESS ● RADFORD  
RAM ● RICHARD ALLAN ● SEAS  
TANNOY ● VIDEOTONE ● WHARFEDALE

WILMSLOW AUDIO (Dept. P.E. 8)  
SWAN WORKS, BANK SQUARE, WILMSLOW,  
CHESHIRE SK9 1HF

Discount Hi-Fi, etc. at 5 Swan Street and 10 Swan Street  
Tel.: Wilmslow 29599 for Speakers Tel.: Wilmslow 26213 for Hi-Fi



# INDUSTRY NOTEBOOK

By NEXUS



## DIGITAL INSTRUMENTS

The digital instrument market is becoming even more competitive. Never has so much been offered by so many companies, and prices are still tumbling. For any price range there is better value in specifications and facilities and you can now get a professional quality instrument for £100. Even that troublesome measurement of true r.m.s. can be yours for £150.

The dilemma facing the manufacturers is whether to cut prices to the bone or hold them and build in more performance for the money. Those taking the middle course are giving their instruments an enhanced performance with a modest price cut.

In the scramble to present instruments in the best possible light there are some big claims being made. The thing to remember is that even with the latest LSI techniques which cut instrument assembly costs, long term accuracy still costs money. If you go for price alone, don't expect too much. And prices, as advertised, can be misleading. One instrument, for example, looks world-beating value with a boldly displayed price tag of under £50. But with carrying case and accessories, plus value-added tax, you can end up paying over £60.

The new trend is towards liquid crystal displays and smaller and smarter cases. For sheer smallness there is one digital multimeter on the market which measures 48mm x 68.5mm x 99mm. It has a 7.5mm l.e.d. display described as "big".

Another model has its rear moulded to conform to the wrist and back of the hand so it can be strapped on like a wrist watch. The idea is that you can work with both hands probing a circuit and right there in front of you on your wrist is the voltage or current or resistance read-out, this one with l.c.d. Another variation on the same

theme is for the whole of the multimeter to be built into the test probe.

In the UK it is estimated that over 60 per cent of low cost and general purpose digital instruments are now sold through instrument distributors as off-the-shelf items. And when you see that a digital panel meter can be bought in one-off quantities for as little as £25 you can understand the reason why.

## DISPLAYS

Electronic displays have become an industry within an industry with their own specialised exhibition and conference in London extending over three days. The displays sector of the electronics market is currently expanding at 25 per cent per year.

For sheer volume the calculator, clock and watch makers are the leading customers consuming billions of digits per year. The next huge market breakthrough, somewhat delayed but beginning to materialise, is the automotive market world-wide. The oldest form of electronic display of all, the cathode ray tube, has been given a new lease of life by the enormous growth of computer graphics and visual display units.

The problem of l.c.d.s being rather drab compared with l.e.d.s looks like being solved by a fluorescence activated l.c.d. developed by the West German Institute of Applied Solid State Physics. The new technique is said to give l.c.d.s comparable brilliance to l.e.d.s and a bonus is that a choice of colours in red, green or orange will be available. The product will be mass-produced by Siemens next year.

## LOBBIES

Pressure groups, lobbies, call them what you will, multiply like bacteria. Do they do any good or do they neutralise themselves? I note that the anti-Far East electronics lobby is now counterbalanced by the International Consumer Electronics Association which represents importers and distributors of electronic goods from overseas including the powerful Japanese companies. ICEA members fear for the safety of their incomes if imports are restricted.

In all the sometimes secret, sometimes public wrangling, the poor old consumer often gets forgotten. The one irrefutable argument is that if the Japanese or any other nation can produce a better product at a cheaper price surely the man-in-the-street should be given the choice of buying it. Meanwhile, the free-traders and the protectionists seem to be winning.

The other great battle between lobbyists is the vexed question of Citizen's Band Radio. A statement released from the office of the Prime Minister concludes with, "It is a question of balance, and at present the Government feel that the balance of the argument is against the introduction of Citizen's Band".

The operative words are "at present", so this leaves the door slightly ajar and the respective lobbies will battle on, each hoping for final victory.

## SAFETY FIRST

The "Earth Leakage Circuit Breaker" (ELCB) described by K. A. Smith in the July 1977 issue of P.E. seems to have aroused a lot of interest including a word of warning in our correspondence columns.

On the professional front B & R Relays have been making them for years. But it has been a long uphill struggle getting the sales message across to potential users. Everybody wants safety but when it comes to the point, few want to pay for it.

The Health and Safety at Work Act of 1975 is beginning to change the situation and now Kevin Walker, B & R's sales manager, is forecasting an immediate UK market of about £1 million rising to £5 million or more by 1980. B & R are expecting to capture 25 per cent of the business.

Walker has made a good start by selling £60,000 worth of ELCB's to Watney Mann to protect the barman and barmaids against faults on electric beer pumps in the Watney Mann chain of pubs. The next move will possibly be to fit them to the catering equipment in pubs.

They are currently working on six new models of ELCB's, all designed for ease of fit and designed to trip within 25 milliseconds of detection of a fault.

I note that K. A. Smith says that his intention was to fit a commercial model in his colour processing darkroom—"but the frustration of trying to buy such an article for private use made me determined to make one for myself". Anyone interested in buying the commercial product could try contacting B & R Relays, Temple Fields, Harlow, Essex.

## BPO BLOODHOUNDS

The Post Office's Radio Interference Service which includes a fleet of specially equipped vehicles to sniff out illegal transmissions, man-made static and other forms of interference to radio and TV reception is in process of modernisation.

The Marconi Instruments and Racal Instruments are among the firms which will benefit. MI is supplying 94 type TF2015 signal generators and RI a similar number of their type 9915 frequency meters.

The controlling authority for the Service is the Home Office so the technical requirement was drawn up by the Home Office's Directorate of Radio Technology. Both companies are delighted that their products passed evaluation tests with flying colours.

# ANALOGUE / LOG AMPLIFIERS

D. F. BOWERS, BSc

**M**OST voltage amplifiers in present use are designed to have a linear transfer characteristic—in other words, to multiply the voltage at the input by a fixed factor—and to have well-defined impedances at the input and output. There are, however, amplifiers which are termed “non-linear”, which multiply input voltages by a factor in some way dependent on the magnitude of the input voltage.

Many non-linear amplifiers are designed for specialist applications, but certain types which have more general transfer characteristics are useful in wider fields. In the latter category, one of the most interesting is an amplifier having a logarithmic or exponential transfer characteristic.

Because many sensing devices obey exponential laws (thermistors and photodiodes, for example), logarithmic amplifiers find uses here. Compression of a wide range of voltages into a more easily handled spread is also a common use of logarithmic amplifiers. In analogue computers, they are used in conjunction with exponential amplifiers to perform multiplication and division.

## WHAT IS A LOGARITHMIC AMPLIFIER?

If an amplifier has input voltage  $V_{in}$  and output voltage  $V_{out}$ , and if  $V_{out} \propto \log(V_{in})$ , then the amplifier is said to be a logarithmic amplifier. If  $V_{out} \propto \exp(V_{in})$ , [ $\exp(V_{in}) = e^{(V_{in})}$ ] or  $\log(V_{out}) \propto V_{in}$ , then the amplifier is said to be exponential or antilogarithmic.

A logarithmic amplifier in the feedback path of an operational amplifier converts the op. amp. into an exponential amplifier. Similarly an op. amp. with an exponential amplifier in its feedback path becomes a logarithmic amplifier. Hence, we need only find a way of achieving one type of transfer to create both types of amplifier.

## SHOCKLEY'S EQUATION

Although very expensive logarithmic amplifiers may use intermediate digital techniques, the vast majority of analogue logarithmic amplifiers rely on the intrinsic logarithmic behaviour of a semiconductor  $p-n$  junction when subjected to low bias voltages.

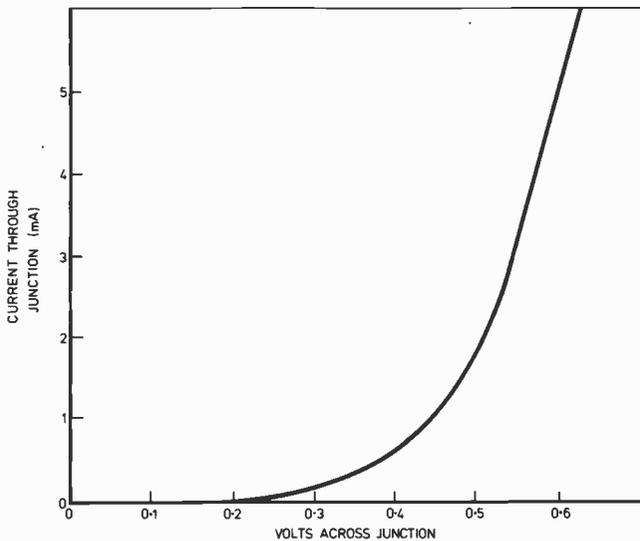


Fig. 1. Forward bias current curve for a typical silicon diode

The familiar transfer curve for a typical silicon diode in the forward bias mode is shown in Fig. 1. As the voltage across the diode increases from zero to about half a volt, very little current flows, but above about 0.6V the current increases rapidly. The inverse of this curve is shown in Fig. 2, where it can be seen that the voltage across the diode increases rapidly as the current approaches  $I_0$ , and then more slowly until several milliamps is achieved, when the diode's bulk resistance becomes important. Between these two current values, the voltage increases (approximately) in proportion to the logarithm of the current.

To explain this, it is necessary to investigate an equation derived from statistical considerations by W. Shockley, which states:

$$I = I_0 \left( \exp\left(\frac{qV}{kT}\right) + 1 \right) \dots (1)$$

where

$I$  = Current through junction (amps)

$I_0$  = Theoretical reverse current (amps)

(This is the same  $I_0$  as previously described)

$V$  = Voltage across junction (volts)

$q$  = Charge on the electron (coulombs)

$k$  = Boltzmann's constant

$T$  = Junction temperature (kelvin)

If  $qV \gg kT$ , a condition normally satisfied, then:

$$V = \frac{kT}{q} (\ln I - \ln I_0) \dots (2)$$

(where  $\ln = \log_e =$  the natural or Naperian logarithm)

and hence we obtain logarithmic behaviour. Departure from this equation is mainly due to  $qV$  approaching  $kT$  at low currents, to the effect of the bulk resistance at high currents, and to misbehaviour of the semiconductor junction in between.

The latter problem can be solved to some extent by using diodes designed to have a good logarithmic behaviour (such as type G130), but not very much can be done to better the

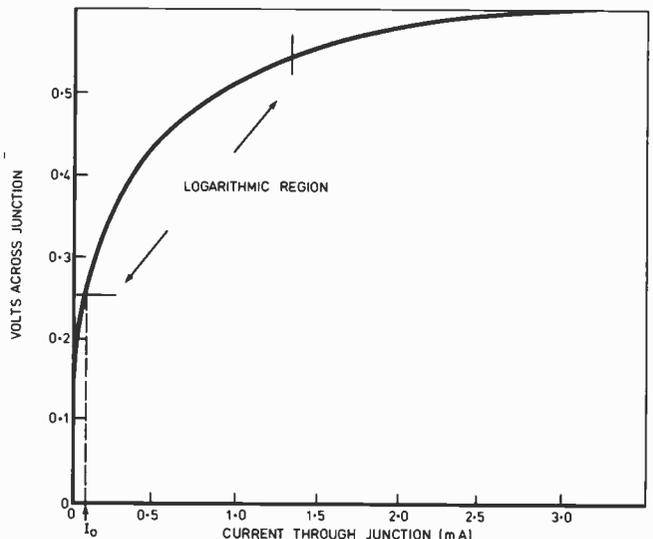
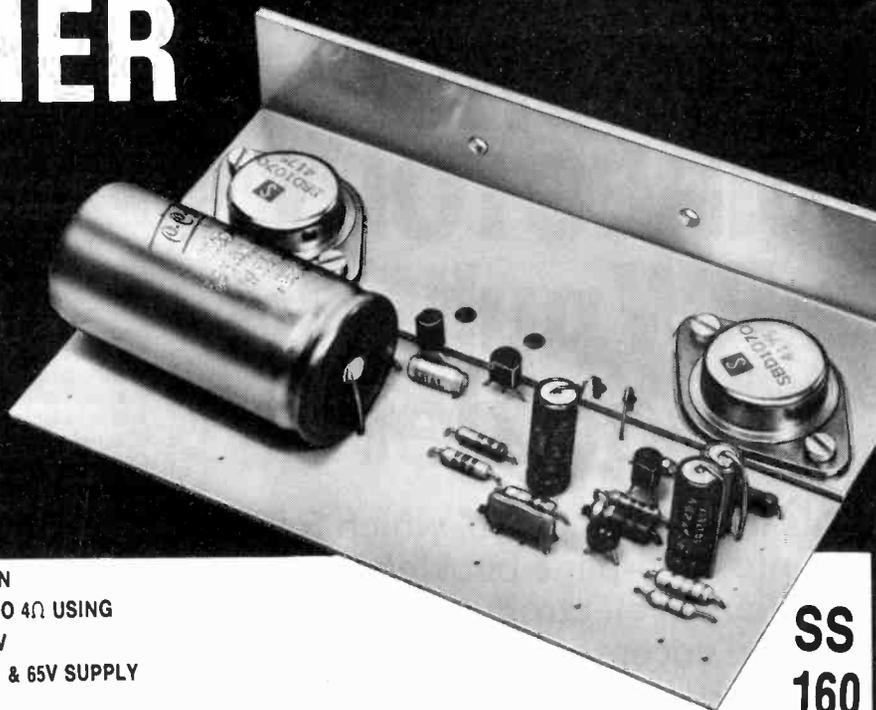


Fig. 2. Forward bias voltage curve for a typical silicon diode

# A NEW 60 WATT R.M.S AMPLIFIER FROM Stirling Sound



**SS  
160**

- A COMPLETELY NEW DESIGN
- 60 WATTS R.M.S. ( $\pm 1$ dB) INTO  $4\Omega$  USING  
50V: 35 W.R.M.S. INTO  $8\Omega/50V$
- WILL OPERATE BETWEEN 20 & 65V SUPPLY  
(Output varies accordingly)
- T.H. DISTORTION BETTER THAN 0.3%  
(TYPICALLY  $-0.1\%$ )
- FREQUENCY RANGE 10 to 50,000Hz  
-3dB AT 10Hz: -3dB AT 50kHz
- INPUT 350mV FOR FULL OUTPUT

## Another Stirling Sound winner

Coming between SS.140 and SS.1100, the new SS.160 fills a gap in power amplifier modules (3 to 100 watts r.m.s.) that will particularly please those wanting a not-so-big disco or P.A. system as well as those with speakers needing plenty of power to drive them. With circuitry developed around a self-centering mid-rail, excellent results will come from using as little as 18 volts power supply. (Power output will vary accordingly). Because we use good quality components capable of operating beyond our claimed specifications, you can buy and build with confidence. **YOUR SS.160 IS READY NOW AND WE HAVE MADE A NEW POWER SUPPLY UNIT (SS.360) SPECIALLY FOR IT.**

**£8.50 INC. V.A.T.  
POST FREE**

Multi-finned large heat sink,  
inc. V.A.T. post free

**75p**

## ■ SPECIAL STIRLING SOUND OFFER

Bought separately SS.160 costs £8.50, SS.360  
£12.75, heatsink 75p (total—£22.00). Buying all  
three together, inc V.A.T. it costs you only  
(post free)

**£21.00**

## ■ And the SS.1100 money saver

SS.1100—£10.50: SS.370—£14.75: Large heat sink—£1.50 (total—  
£26.75). Buying all three together saves you £2.00—inc. V.A.T.  
(post free)

**£24.75**

## ■ USE COUPON TO ENSURE PROMPT DELIVERY

**THE POWER SUPPLY  
YOU WANT IS HERE**

With 13–15 volt stabilised take-off points on  
all models except SS.312. Outputs quoted  
unloaded.

SS.312	12V/1A	£6.60
SS.318	18V/1A	£6.95
SS.324	24V/1A	£7.65
SS.334	34V/2A	£8.75
SS.345	45V/2A	£10.75
SS.350	50V/2A	£11.75
SS.360	60V/2A	£12.75
SS.370	70V/2A	£14.75

SS.310/60 Stabilised power supply; 10V  
to 50V/2A £17.75

SS.300 Power stabilising unit 10/50V  
adjustable for adding to unstabilised  
supply units. £5.50

**POWER AMPS**

Outputs rated in watts, R.M.S.  $\pm 1$ dB.

SS.103 3W/one I.C./mono	£2.85
SS.103-3 Stereo of above	
using two I.C.s	£5.00
SS.105 5W/3 $\Omega$ /13.45V	£3.95
SS.110 10W/4 $\Omega$ /24V	£4.65
SS.120 20W/4 $\Omega$ /34V	£5.15
SS.125 25W/8 $\Omega$ /50V	£7.25
SS.140 40W/4 $\Omega$ /45V	£6.50
SS.160 60W/4 $\Omega$ /50V	£8.50
SS.1100 100W/4 $\Omega$ /70V	£10.50

**TONE CONTROL/PRE-AMPS**

SS.100 Active control/bass/ treble	£3.00
SS.101 Stereo Pre-amp for ceramic P.U.	£2.75
SS.102 Stereo P.A. for mag. P.U.	£4.45

**UNIT ONE Stereo Pre-Amp/Tr./  
Bass/Vol./Bal.** £9.00

**UNIT TWO As Unit One but  
for mag. P.U.** £12.50

**F.M. STEREO DECODER**

SS.203 Phase lock loop with LED indicator	£5.25
--	-------

## PAY ONLY THE PRICE YOU READ

All prices quoted include V.A.T. Goods sent post free in U.K. Owing to time between sending our  
ad. to this journal and its appearing to the public, prices may be subject to alteration without  
notice. E. & O.E.

# Stirling Sound

Dept. PE117, 37 VANGUARD WAY, SHOEBURYNNESS, ESSEX  
Telephone: (03708) 5543

SHOP—220–240 West Rd., Westcliff-on-Sea, Essex SS0 9DF  
Telephone: Southend (0702) 351048

To Stirling Sound, 37 Vanguard Way, Shoeburyness, Essex

Please supply: .....

for which I enclose £..... or by Access/Barclaycard

NAME .....

ADDRESS .....

PE117 .....

*Where to get it!*

# COMPONENT SOURCE DIRECTORY a PW pull-out booklet

This invaluable guide, which folds into a 24-page booklet, lists suppliers of electronic components and accessories and is just what you need when you're buying components.

## AND HERE'S YOUR CHANCE TO USE IT

### Wide-range Voltmeter

AC-DC, reliable, 6 ranges to 1000V. Input impedance of 11M $\Omega$  plus a variety of probes for measurement at RF.

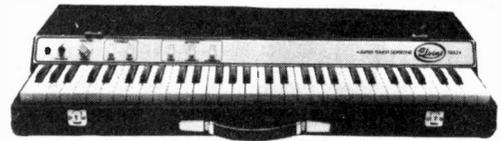
### RF Resonance Indicator

indicates resonant frequency of a tuned circuit up to around 30MHz. Also selects values of capacitance and inductance for a given frequency.

Tune in to

# PRACTICAL WIRELESS

November issue on sale 1 October 45p



### SUPER TOUCH—SENSITIVE PIANO

We have shown our special brand of skill and expertise in designing this piano featuring:—

Wide range of touch-sensitive response ESU design.

Free from breakthrough noise.

Choice of keyboard C-C or F-F with Transpose Control.

Two models are available. Model TS50 is a touch-sensitive piano only. Model TS53 has extra effects of Honky-tonk,

Harpichord with fast and slow tremolo.

#### KIT SECTION PRICE LIST

ESU5 + 5 Keyer Units **£11·95** each, 5 required.

ESU5 + 6 Keyer Unit **£13·95**, 1 required.

Power Supply **£9·50**

Keyboard and Switches **£29·00**

Toneforming, Headphone and Voltage Regulator **£14·50**

Loud and Soft Pedal **£7·95**

Master Tone Generator **£15·00**

Tremolo Unit **£3·75**

Cabinet switches, etc. **£32·50**

Can you afford £750 for an electronic piano? If the answer is NO why not visit our showroom and try our electronic pianos, discuss the technicalities in detail without obligation.

**WE GUARANTEE TO SAVE YOU MONEY. IT IS SIMPLE ONCE YOU KNOW HOW.**

Showroom: 12 Brett Road, Hackney, London E8 1JP.

Tel. 01-986 8455.

Component shop: 40a Dalston Lane, Dalston Junction, E8 2AZ. Tel. 01-249 5624.

#### Parts for organ builders

4-Octave C-C keyboard **£26·00**

5-Octave C-C keyboard **£28·00**

5-Octave F-F keyboard **£28·95**

5-Octave F-F piano keyboard **£30·00**

13 note pedal board **£25·00**

25 note pedal board **£55·00**

stop switches **75p**

#### Tone Generator Units

GD500/5 with 73 outputs **£39·95**

GD500/6 with 85 outputs **£48·50**

GD500/7 with 96 outputs **£52·50**

#### Diode Gate Sustain and Distribution Units

4-Octave with 3 pitches **£32·00**

4-Octave with 4 pitches **£38·00**

5-Octave with 3 pitches **£33·00**

5-Octave with 5 pitches **£60·00**

5-Octave with 6 pitches **£65·00**

4-Octave with 9 pitches **£88·00**

5-Octave with 9 pitches **£96·00**

#### Toneforming Units

3 pitches with 10 voices **£24·00**

4 pitches with 10 voices **£26·00**

4 pitches with 15 voices **£27·50**

5 pitches with 10 voices **£38·40**

6 pitches with 19 voices **£65·95**

9 pitches with 10 voices **£40·50**

#### Rotating Speaker Units

Bass unit **£68·00**

Mid Range **£75·00**

Hi-Fi Horn **£89·00**

Prices include VAT.

Other useful components in stock for organ work. Send S.A.E. for lists.



**ELECTRONIC MUSICAL INSTRUMENTS**

12 Brett Road, Hackney, London, E8 1JP.

01-986 8455

extremes. Even so, a range of over seven decades of current can be accommodated if great care is taken in the design of the logarithmic amplifier.

### SIMPLE LOGARITHMIC AMPLIFIERS

A simple logarithmic amplifier based on the principles described is shown in Fig. 3. Assuming a positive input signal, the inverting input of the op. amp. will be maintained at virtual earth (by normal feedback action), and so the input current is  $V_{in}/R$ . This current must also flow through the diode, and hence we can show that:

$$V_{out} = -(\ln \frac{V_{in}}{R} - \ln I_0) \frac{kT}{q}$$

$$= -(\ln V_{in} - \ln R - \ln I_0) \frac{kT}{q} \dots (3)$$

Thus there is a region where (at constant temperature) the output is proportional to the logarithm of the input. In this region, the output moves about 60mV (at 25°C) for every decade change in input voltage, but this can be increased by using several diodes in series. The main drawback of this arrangement, however, is temperature dependence.

Besides the  $kT/q$  term outside the brackets, the term  $I_0$  is also very dependent on temperature, and on the physical construction of the junction. It effectively causes the output level to shift up and down with small fluctuations in temperature. Although this can be corrected with simple amplifiers of this type, it is more common to replace the diode with a transistor, the base-emitter junction being used as the logarithmic law generator. A "differential" compensation method is then relatively simple to implement. Details of a practical amplifier will now be given, for the benefit of those who may wish to experiment.

### A COMPENSATED LOGARITHMIC AMPLIFIER

Although the temperature problems can be solved by "ovening" the junction to keep it at a constant temperature (as in the G. D. Shaw monolithic oven used in the PE *Sound Synthesiser*), this arrangement is not always satisfactory, and can be difficult to set up. We will therefore explore an alternative system.

If  $qV \gg kT$ , then the relationship between the collector current ( $I_c$ ) and base-emitter voltage ( $V_{BE}$ ) of a transistor will be:

$$I_c = I_0 \exp\left(\frac{qV_{BE}}{kT}\right) \dots (4)$$

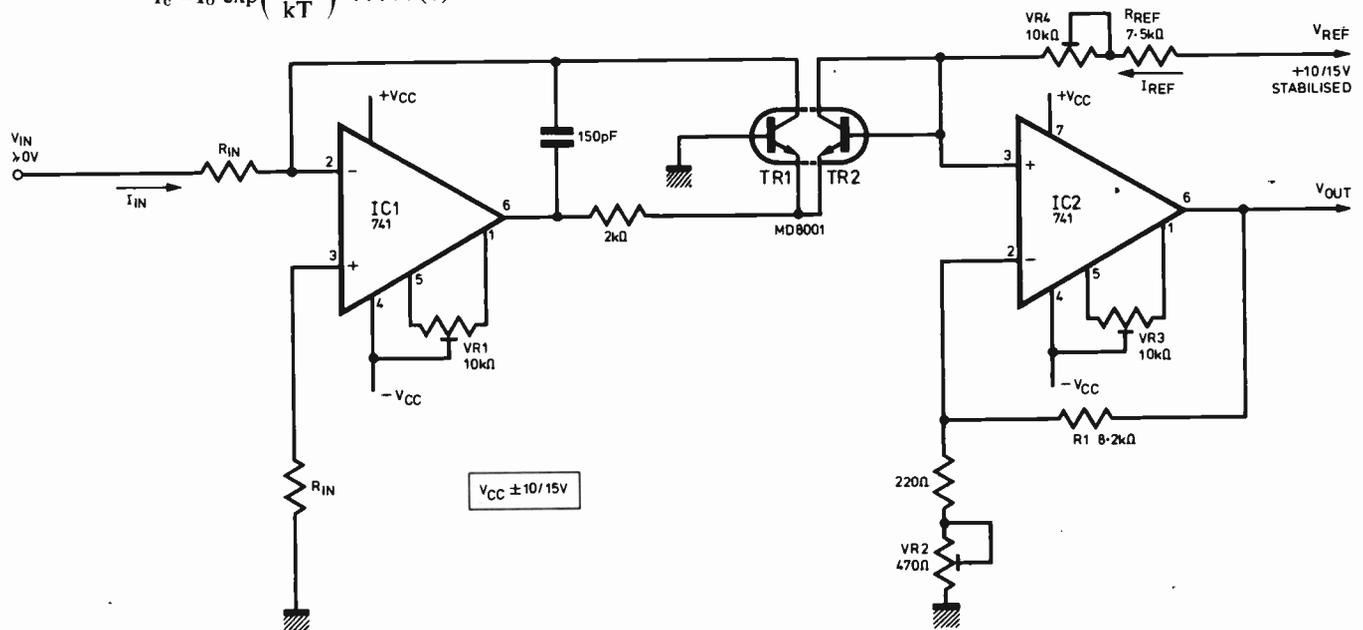


Fig. 4. Practical logarithmic amplifier utilising the differential compensation technique

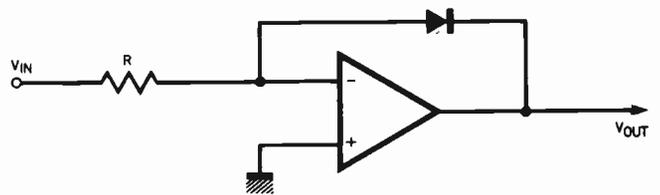


Fig. 3. Simple logarithmic amplifier using the properties of a silicon diode

and for two identical transistors operating at different collector currents, the difference in  $V_{BE}$  ( $\Delta V_{BE}$ ) will therefore be:

$$\Delta V_{BE} = -\frac{kT}{q} \ln\left(\frac{I_{c1}}{I_{c2}}\right) \dots (5)$$

Note that the troublesome  $I_0$  plays no part in this relation.

A practical amplifier based upon this principle is shown in Fig. 4. Transistors TR1 and TR2 should be a thermally connected matched pair, or preferably a dual transistor (such as type MD8001).

The potential at TR2 collector is equal to  $\Delta V_{BE}$  since the collector of TR1 is held at virtual earth.

So:

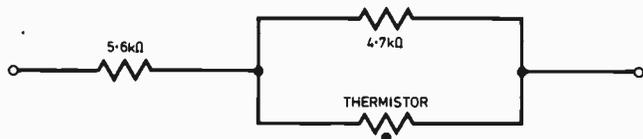
$$V_{out} = -\frac{R_1 R_2}{R_2} \frac{kT}{q} \ln \frac{I_{in}}{I_{ref}} \dots (6)$$

This again gives 60mV/decade  $\times$  gain of IC2, and by adjustment of VR2, the output can be set between 0.75V/decade and 2.3V/decade.

### SETTING UP PROCEDURE

First, the value of  $R_{in}$  must be fixed. Since our upper current limit is 1mA (by bulk resistance considerations), then  $R_{in} = V_{max}/I$  in kilohms. In this case,  $V_{max}$  is the largest input voltage to be accommodated. Next, a temporary resistor of about 10 kilohms should be connected between pins 2 and 6 of IC1 and (with no input) VR1 adjusted to give precisely zero volts at the output of IC1.

Remove the temporary resistor and set  $V_{in}$  so that 1mA flows through  $R_{in}$ . Adjust VR4 so that 1mA flows through  $R_{ref}$ , then adjust VR3 to give zero volts at pin 6 of IC2. Next set  $V_{in}$  so that 100 $\mu$ A flows through  $R_{in}$ . Adjust VR2 to give 1V at IC2 output (for a 1V/decade scale factor), or 2V at IC2 output (for a 2V/decade scale factor). The amplifier is now ready for use.



**Fig. 5. Thermistor compensation circuit to be used in place of R1 in Fig. 4. The thermistor should have a resistance of 10kΩ at 25°C**

**AN IMPROVED AMPLIFIER**

The form of logarithmic amplifier described above has three major drawbacks which limit its overall performance.

1. The dynamic range is limited to about three decades of input voltage, due largely to the relatively high input offset (about 2mV) and bias current (about 100nA) of IC1.

The former can be improved by using as large an input signal as possible, together with a high value for R<sub>in</sub>. To improve the latter, however, an f.e.t.-input op. amp. (such as the NE536T) should replace IC1. It should be possible to achieve over six decades range with this configuration.

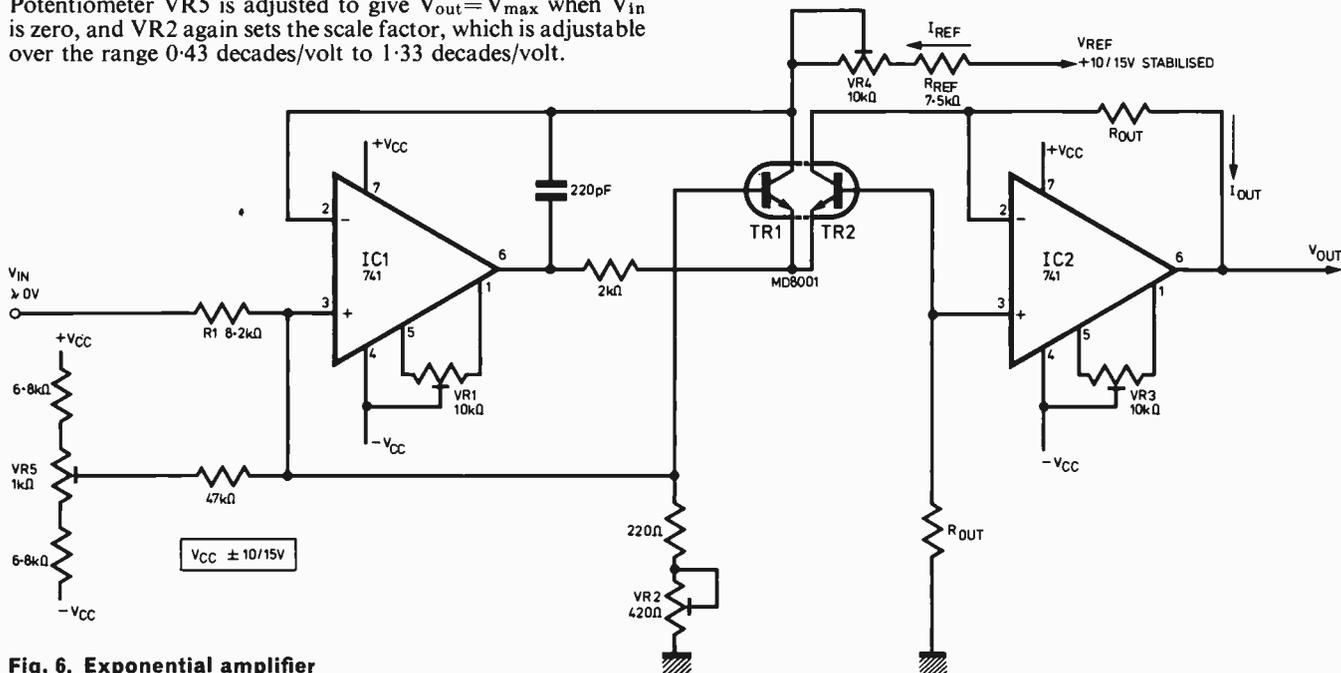
2. The current I<sub>ref</sub> does not remain constant, because the non-inverting input of IC2 is not a true virtual earth. This is not too important with power supplies in the range 10–15 volts, but for greater accuracy V<sub>ref</sub> and R<sub>ref</sub> could be replaced by a 1mA current source.

3. Last, but not least, the kT/q term in equation (5) introduces a temperature dependence. This causes the scale factor to alter with variations in absolute temperature. The error over normal domestic temperature variations will not exceed about ±2.5 per cent, which will be adequate for many applications.

Special temperature proportional resistors have been developed to compensate for this error over wide temperature ranges, but these are neither easy to obtain, nor cheap. In Fig. 5 is shown a method of compensation using a resistor-thermistor network in place of R1 in Fig. 4. This circuit was designed by a colleague, Mr C. R. Francis of Sheffield University, and provides good compensation over the limited temperature range of a domestic environment, if greater accuracy is required.

**EXPONENTIAL AMPLIFIER**

To obtain an exponential amplifier, it is only necessary to rearrange the components of Fig. 4, as shown in Fig. 6. If V<sub>max</sub> is the maximum output voltage, then I<sub>out</sub> = V<sub>max</sub>/1kΩ. Potentiometer VR5 is adjusted to give V<sub>out</sub> = V<sub>max</sub> when V<sub>in</sub> is zero, and VR2 again sets the scale factor, which is adjustable over the range 0.43 decades/volt to 1.33 decades/volt.



**Fig. 6. Exponential amplifier**

The amplifier system described, with its need for closely matched transistors and good op. amps., would seem a good subject for integration, and indeed this has been done by several manufacturers. Unfortunately, i.c. logarithmic amplifiers of good quality are not very cheap, but two which have proved to be good all-round performers are the Intersil 8048 (logarithmic) and 8049 (exponential) amplifiers.

The configuration of these amplifiers is basically a monolithic version of those already described, with dual f.e.t.-input op. amps. Fine temperature compensation is carried by means of a specially designed thin film resistor instead of the resistor-thermistor network, and this is effective from 0°C to 70°C. The 8048 features a 60dB voltage input range, and a 120dB current input range.

**BANDWIDTH CONSIDERATIONS**

Bandwidth is always a problem where semiconductor junctions operate at low currents, due to capacitive phenomena across the narrow junction. To a first approximation, the bandwidth of a logarithmic amplifier will increase proportionately to the average current through the junction concerned, assuming that the perturbations are small.

It follows that to obtain the best frequency response from a logarithmic amplifier, it should be used over the upper section of its input range. Even so, it is difficult to obtain a -3dB bandwidth past 100kHz over three decades. Over five decades, the -3dB point may well be only a few kilohertz. For large fluctuations of input signal the situation is even worse, and usually less predictable.

**CONCLUSION**

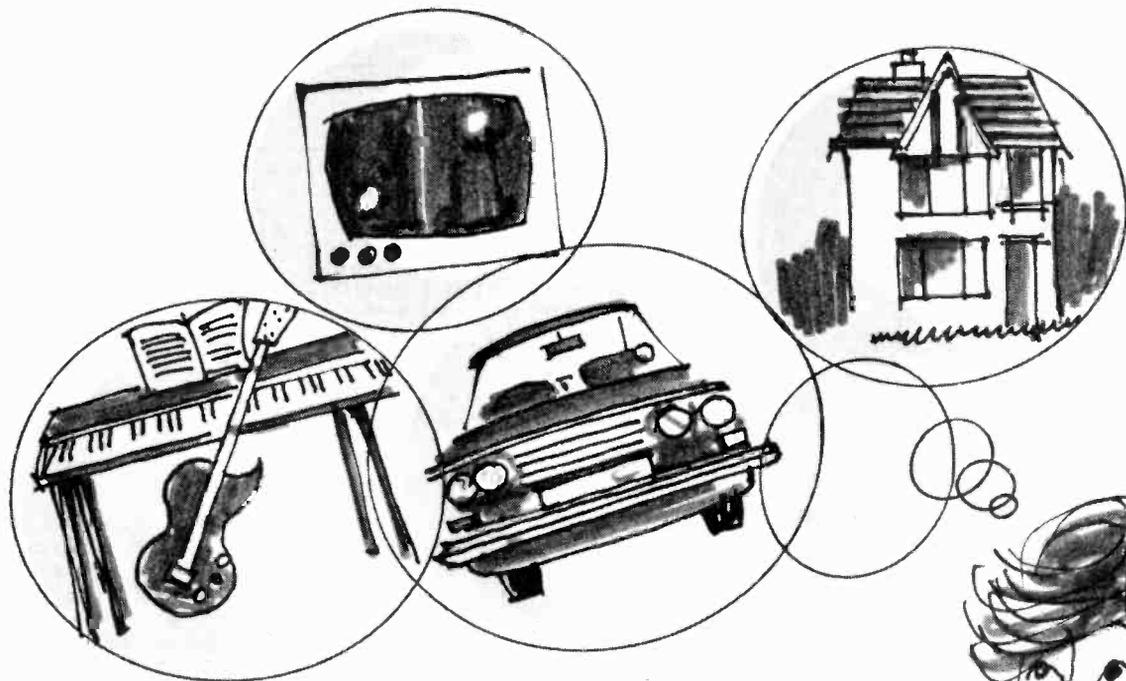
Although logarithmic circuits are not the easiest to implement, a good quality logarithmic amplifier is not over difficult to make, provided care is taken in the setting up process. It is hoped that this article will have provided a useful introduction to the subject.

**ACKNOWLEDGEMENTS**

Thanks are due to Mr W. Gibbons and Mr C. R. Francis, both of Sheffield University, for help given in the preparation of this article. ★

# ICS

## FOR the EXPERIMENTER



*This supplement brings together a selection of specialised linear and digital integrated circuits having important and useful potentialities to the experimenter and constructor.*

*The areas of application embrace TV Games—Electronic Musical Instruments—Hi Fi—Control—Special Sound Effects, and Motor Cars.*

*It is hoped that the information and in-circuit examples of the devices might be the catalyst for additional ideas and further experiment, but it should be borne in mind that any "in-depth" information on device parameters should be obtained from manufacturer's literature.*

*Almost all of the i.c.s given are available from our advertisers and approximate prices are given where applicable.*





# AUDIO AMPLIFIER

## TDA2020

THE TDA2020 monolithic operational amplifier is a front runner in the power game. It is intended for use as a low frequency class B power amplifier providing 20W into 4Ω at 1 per cent total harmonic distortion with a ±15V supply. This is a guaranteed output. At lower power levels—less than 8W—the distortion does not exceed 0.2 per cent and at most frequencies is about 0.1 per cent.

The absolute maximum voltage is ±26V. Although higher voltages are likely to damage the i.c. it will operate quite correctly from supply voltages down to ±5V.

The 14 pin (alternative quad or d.i.p. plastic packages available), incorporates short circuit protection which automatically limits the output transistors to their safe operating area if, say, the output was short-circuited. Thermal overload protection is also incorporated which allows more economic heatsink

design as the risk of thermal runaway found in discrete amplifier designs does not exist. All of this makes the device virtually indestructible.

Unlike most audio amplifiers the TDA2020 does not require a coupling capacitor from output pin to loudspeaker (see Fig. 1) which means a saving in money and space. The omission does make it necessary to maintain the quiescent output potential to prevent d.c. flowing through the speaker. This of course means balanced power supplies but the possibility of switch on "thump" is reduced.

A single 180W channel using a 4Ω loudspeaker can be built around two TDA2020's. This type of circuit (Fig. 2) is known as a bridge or push-pull amplifier. As can be seen the component count is small for such a large output.

The i.c. package includes a copper insert which is normally clamped to an external heatsink to remove circuit power dissipation. A range of heatsinks appropriate to different voltages is available from Redpoint and assembly of these is facilitated by the spacer and screws supplied with each device so that heatsink and chip will securely mate to a p.c.b.

The TDA2020 can be obtained from Technomatic Ltd., 54 Sandhurst Road, London, NW9, approximate price £4.20.

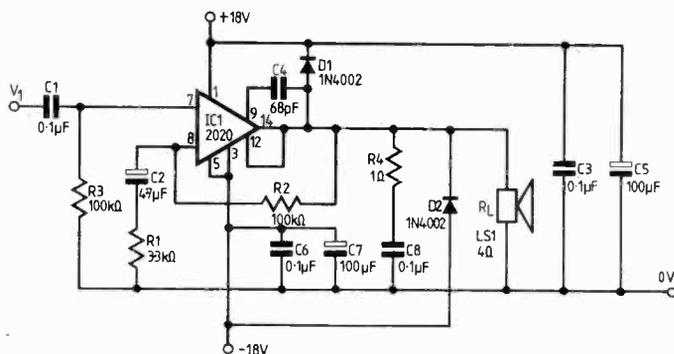


Fig. 1. The TDA2020 used in a basic 20W configuration

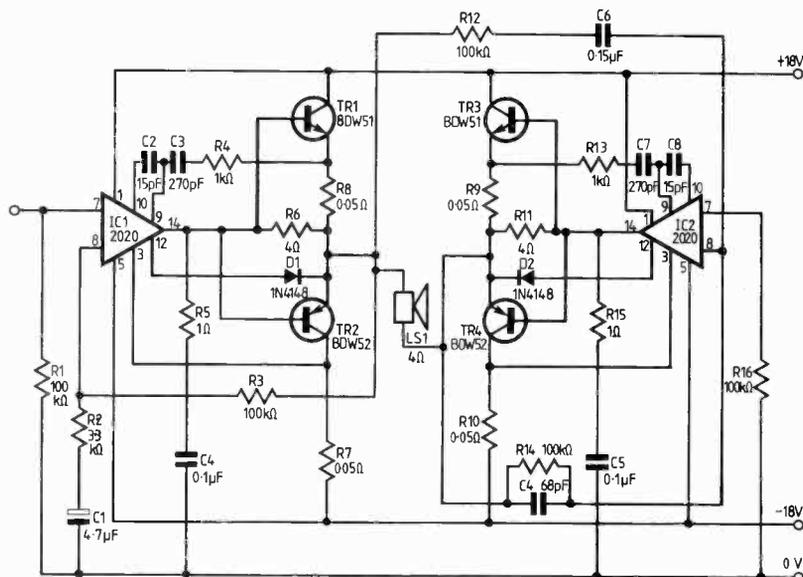
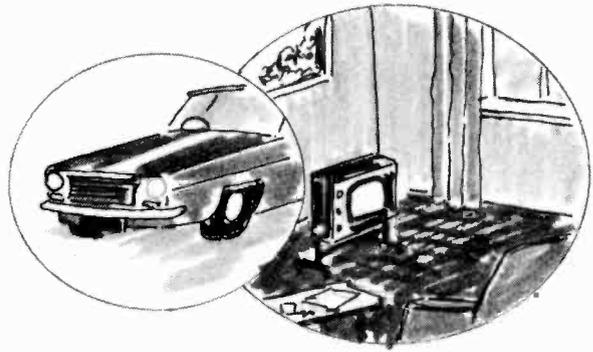
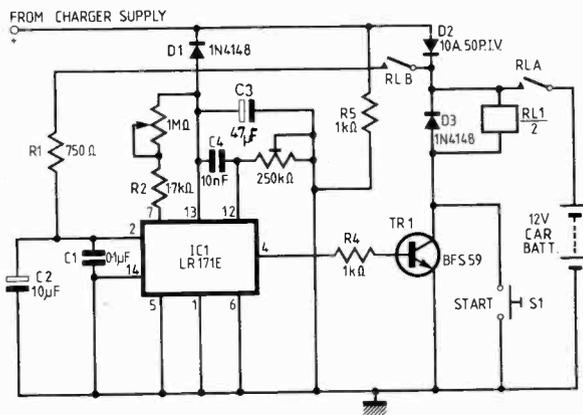


Fig. 2. A single channel 180W hi fi audio amplifier

# LONG DELAY TIMER



## LR171E



**Fig. 3.** A 10A battery charger timer (20 minutes to 2 days). When start button is activated RLA energises and connects the battery to the charging supply and the timer to the battery, holding RLA through TR1. At the end of the timing period the circuit switches off

Some suggested applications by Elremco for the motorist are:

1. A time delay can be set by the user within a 0-24hr range after which the parking lights automatically switch on.
2. The parking lights can be switched on and off in a 0-24hr period.
3. A set number of minutes after switching off the ignition the headlights are automatically switched off. This prevents parking with headlights left on.
4. The car radio can be made to switch on after a preset time delay acting as an alarm clock or to synchronise with a favourite programme.
5. Providing control for a combined windscreen wiper/washer.

**A**BOUT four years ago Elremco launched their 14 pin LR171E timer chip which took two years in gestation and £100,000 in development. Since then the price of the device has fallen by more than a third—currently £7.50.

Long duration electronic time delays using conventional CR methods require resistance of hundreds of megohms and capacitance of hundreds of microfarads. To connect components together of this dimension presents all sorts of problems most of them being inherent so that accurate timing is virtually impossible. The LR171E cleverly overcomes this using simple digital techniques to provide time delays from 5ms to over 3 months with a repetitive timing accuracy of  $\pm 0.015$  per cent.

Even more astonishing, if a second LR171E is added in series the period can really be pushed out—in this configuration an external time constant of 1s (10k $\Omega$ /1nF) would produce a six month delay.

Basically the i.c. contains a timing oscillator to which external CR components are added to determine the timing period. A chain of 12 binary dividers follows which effectively multiplies the external CR time constant by a factor of 4095.

A digital to analogue converter connected to the final six divider stages allows external meter monitoring of the elapsed time from the moment the timer is triggered. Outputs from the last three dividers in the chain provide facilities for specialised timing from  $\frac{1}{8}T$  to  $\frac{7}{8}T$  in steps of  $\frac{1}{8}T$  where T is the pre-set time. If you combine this with the eight possible operational modes it can be seen that the device will suit almost all timing requirements.

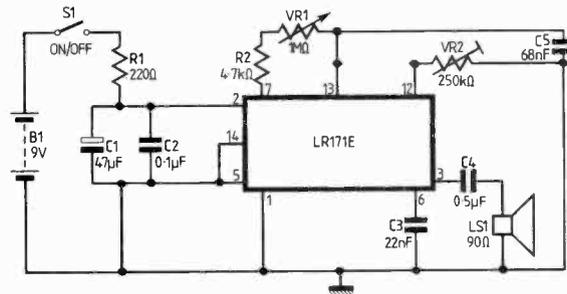
With a suitable dropping resistor the device can work from a wide supply range since the on-chip voltage requirement is stabilised. Typical unloaded consumption is 5mA.

In the home it can be arranged to switch off any manual over-ride facility for domestic central heating.

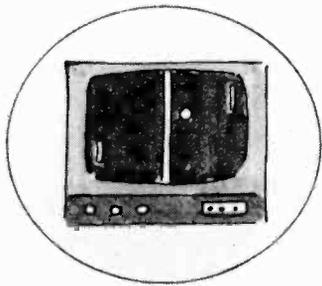
Central heating and night storage systems are normally controlled by a programme time switch which the user presets. When heating or hot water is required outside the programme times the manual over-ride is used but usually left on with consequent fuel wastage.

The LR171E can be time adjusted for this to switch the system back to automatic. Switching on a morning kettle or radio alarm are other applications.

**The approximate price of the LR171E is £7.50. For more information refer to Elremco Ltd., P.O. Box 10, Bush Fair, Harlow, Essex.**



**Fig. 4.** Battery operated alarm timer from 2 seconds to 5 minutes duration



# TV GAMES

**MM57100—LM1889—MM53104—AY-3-8550—AY-3-8600—AY-3-8700**

A FEW years ago the TV games market did not exist—today it is a multi-million pound industry and growing all the time.

Recently we published a design featuring the GIM AY-3-8500 games chip. It offered three basic games; tennis, soccer and squash. Additional discrete circuitry was required—a clock generator and a u.h.f. modulator for interfacing to a monochrome receiver.

A more elegant games circuit available is the National MM57100 i.c. This offers hockey, tennis and handball in colour plus a lot more unpredictable play as a ball reflection from a bat can appear at eight possible angles. Complete game assembly is eased with the LM1889 video modulator i.c. and MM53104 clock generator i.c.

Of course, the LM1889 is a very useful chip in its own right since it can be used for relaying information from video tape recorders, closed circuit t.v. cameras or test equipment for display on monochrome or colour receivers.

A variant of the AY-3-8500 is the AY-3-8550 which provides the same basic games but the players' bats can be moved both vertically and horizontally requiring a lot more skill. The AY-3-8600 improves on the basic four games with basketball, hockey and gridball and increases in sophistication.

A spin-off from the popular micro-processor unit-based "tank battle" videogame commonly seen in amusement arcades is the GIM AY-3-8700.

This offers a two player "tank battle" where each player has a completely steerable tank with forward and reverse speed controls and a firing button. The screen "battlefield" includes anti-tank barricades and exploding mines to retard each tank's progress. The object of the game is to score as many hits as possible on your opponent's tank. The first player with 31 hits ends the game. Shell firing, explosion and tank sounds all add to the excitement.

All the above mentioned devices are available from A. Marshall (London) Ltd., 40-42 Cricklewood Broadway, NW2 3ET.

The MM57100 and MM53104 are available as Kit No. SK1122 for £17.18.



# SOUND EFFECTS

**SAD1024/TDA1022—DELAY LINES**

IN THE consumer area probably one of the most exciting chips to appear is the digital or analogue delay line otherwise known as a "bucket-brigade" device (b.b.d.).

Some of the effects that can be achieved with these are the generation of chorus—where single instruments or voices are made to multiply which has become a popular sound usually associated with the string synthesiser; "Flanging" or "phasing", another effect similar to chorus but in performance equivalent to the sound produced when using a variable comb-filter; Vibrato which is defined as a 5-10Hz cyclic pitch variation used generally to add richness to a sound produced and finally the synthesis of reverberation which is probably the most obvious application.

Of the devices around the two most readily available are the Mullard TDA1022 a PMOS circuit and the NMOS Reticon SAD1024. Both are in 16 pin d.i.l. packages.

Simply explained a "bucket brigade" delay consists of 512 capacitors separated by f.e.t.s. A sample of the incoming audio waveform is stored in the first capacitor end to the command of a clock pulse, the sample moves down the capacitor chain, to emerge 512 clock pulses later as delayed audio. For fidelity the number of samples per second clocked should be twice the band width of the incoming signal.

The successive samples can be likened to buckets of charge moving down the capacitor chain hence the analogy with the old fire-fighting "bucket brigade" line. The original signal is normally retrieved by passing the output through a low pass filter to remove the clock frequency.

The sampling frequency is very much related to the reverberation time of the bucket brigade the delay for N "buckets" being  $N/2f$  seconds, where f is the clock frequency in hertz.

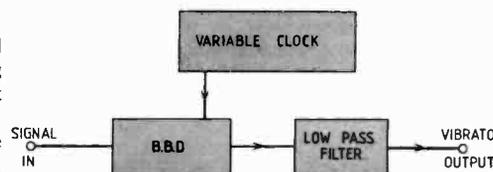


Fig. 5. Achieving a vibrato effect with a bucket brigade device (b.b.d.)

Reverberation is the echo effect produced by a sound after it has ceased and accounts for the richness in "live" performance. By using b.b.d.s in parallel or serial form it is possible to add artificial reverberation to existing music systems and so enhance the sounds produced.

A typical set-up for vibrato with a b.b.d. is shown in Fig. 5. By changing the clock rate in a slow cyclical manner (5-10Hz) the delay through the device and hence the pitch varies in manner analogous to the Doppler effect when

the clock frequency is high, delay time is low and vice versa.

For chorus or multiple voice effects a typical block arrangement would be as shown in Fig. 6.

Chorus produced by delay alone is likely to sound lifeless because each reproduction is a replica of the previous signal. If the clock rates of the b.b.d.s are varied slightly there is enough difference between the direct and delayed signal to make them appear to come from separate sources or "chorus" together. There are obviously lots of variations to this—the clock oscillators could be modulated in antiphase or run irregularly, say, from noise passed through a narrow band filter or another b.b.d. could be added.

A "flanger" or "phaser" can be created by combining an input signal with a slightly delayed version of itself as shown in Fig. 7. Obviously the magnitude of the effect is controlled by the ratio of delayed to undelayed signal (Balance Adjust) and the amount of delay which can be varied with control of the clock frequency. These are only some of the exciting possibilities of the b.b.d. but it obviously is a device we are going to see a lot more of in the future.

The SAD1024 is available for approximately £18 from Herbert Sigma Ltd, Spring Road, Letchworth, Herts.

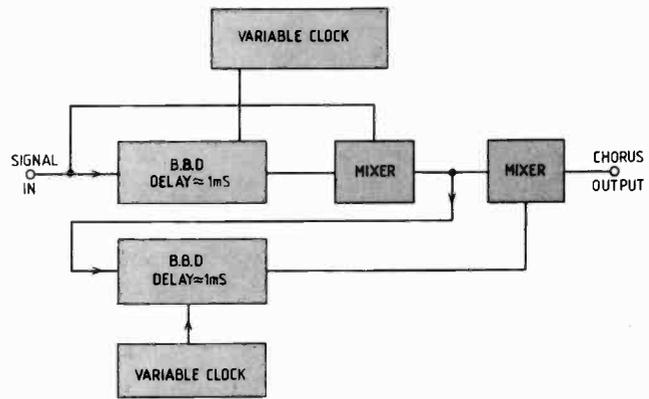


Fig. 6. A block diagram for setting up chorus effects

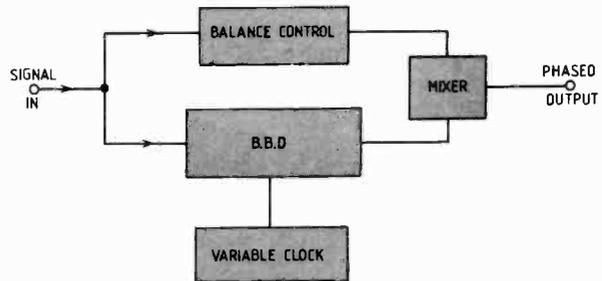
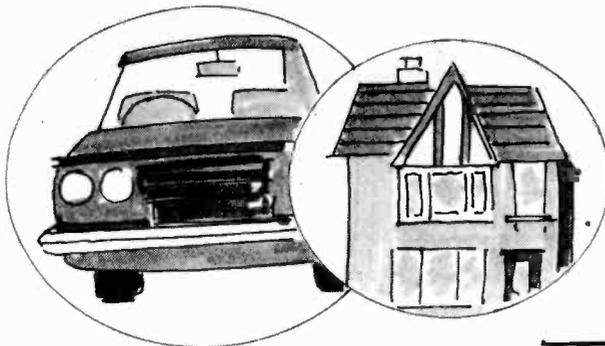


Fig. 7. Block diagram for phasing effects



## MONITORING

### LM1830—FLUID DETECTOR

THE National LM1830 is a 14 pin monolithic bipolar i.c. for use in liquid detection systems. Application areas include sump pumps, aquaria, radiators, boilers, etc. in fact anywhere where high or low fluid levels need to be detected.

The basic circuit of the chip is shown in Fig. 8. To complete the oscillator circuit a capacitor is connected across pins 1 and 7. The frequency of oscillation is inversely proportional to this capacitor value. Pin 13 is normally connected to the probe via a capacitor so that there is no chance of probe plating.

The oscillator output amplitude is approximately  $4_{be}$  so that the emitter-base junction detector will be switched on when the probe resistance to ground is equal to the  $13k\Omega$  resistor.

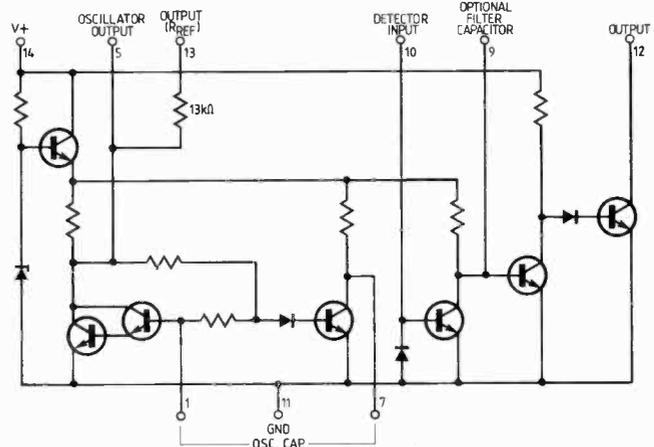


Fig. 8. Schematic of the LM1830 fluid detector i.c.

The diode at the detector transistor base symmetrically limits the input signal so that the probe is excited with  $\pm 2V_{be}$  from a  $13k\Omega$  source. If the  $13k\Omega$  source is incompatible with the probe resistance range a variable resistor, say  $0-100k\Omega$  could be connected from pin 5 to the probe coupling capacitor.

Fig. 9 shows an application where an audio warning is given when a conductive liquid falls below a certain level, for example, the water level in a car radiator. When the liquid falls below the probe tip the resistance will rise between probe and radiator causing the oscillator to conduct the oscillator tone to the loudspeaker. An l.e.d. could equally be used in this position.

In such car applications the internal regulator on the LM1830 provides protection against supply transients.

An example of the device being used for sump pump drive or drain valve opening when a liquid is high is shown in Fig. 10. Here the relay or solenoid drive is arranged to be switched off when

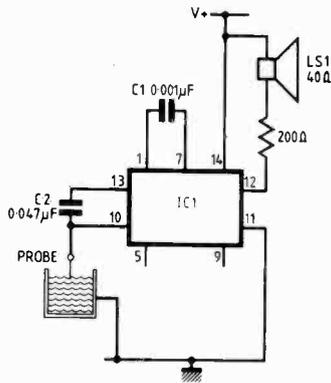


Fig. 9. Low liquid level alarm using the LM1830

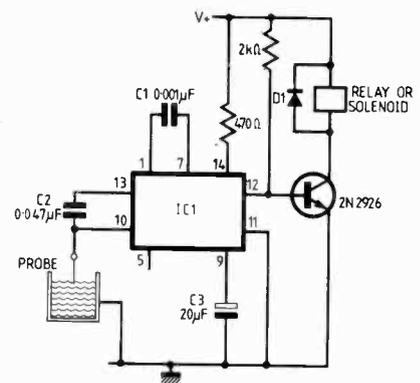


Fig. 10. High liquid level alarm suitable for opening a drain valve

the liquid level is below the probe. With the probe tip immersed it switches on. The filter capacitor ensures on-off switching.

Although the LM1830 is designed primarily for use in sensing conductive

fluids, a phototransistor, l.d.r. or thermistor could readily be substituted for the probe path.

The LM1830 is available from A. Marshall (London) Ltd (see below), approximate price £1.72.

## LM3911—TEMPERATURE CONTROLLER

WHEN making up a thermistor thermometer bridge the greatest single problem is maintaining any sort of linearity in the meter scaling. This arises because of the intrinsic non-linearity of this transducer.

If a silicon junction diode is used as a sensor this usually requires amplification as the sensitivity is only around 2.5 to 3.5mV per degree Centigrade but there is an improvement in linearity. The usual circuit configurations are either amplification across a bridge configuration with the diode in one arm, or simply an op amp differentiating between a fixed set voltage at one input and the temperature variable diode voltage.

All of these problems have been neatly overcome in the National LM3911. Fabricated on a single monolithic chip it includes a temperature sensor, a stable voltage reference and an optional amplifier which can be used for both temperature measurement and control over a range of  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

The output voltage is directly proportional to temperature at 10mV per degree Centigrade with tracking linearity of 0.5 per cent. By using the internal op amp with external resistors any temperature scale factor is easily obtained.

By operating the device as a comparator the output will switch as the temperature traverses any set-point making the device useful as an on-off temperature controller. Lamps or a relay can be driven from the op amp

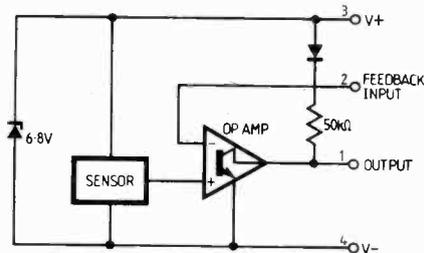


Fig. 11. Block diagram of the LM3911

output as this can be returned to a 35V rail.

The LM3911 itself has a 6.8V Zener reference for its sensing system. This allows the use of any power supply voltage with suitable external dropping resistor.

Block layout of the device is shown in Fig. 11 with an example of a basic

temperature controller in Fig. 12 and a centigrade thermometer in Fig. 13. The unity gain comparator allows for zero setting of an attached meter.

The LM3911 can be obtained from A. Marshall (London) Ltd, 40-42 Cricklewood Broadway, NW2 3ET, approximate price £1.03.

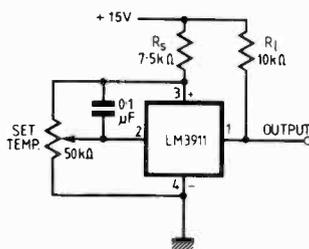


Fig. 12. Circuit of a temperature controller

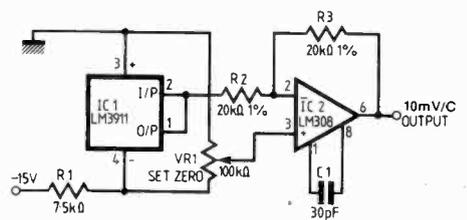
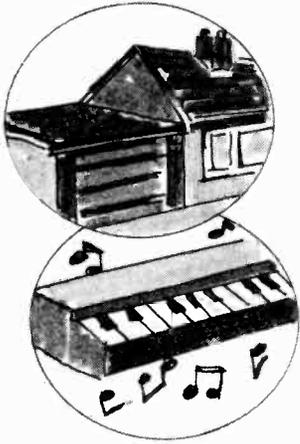


Fig. 13. A centigrade thermometer using the LM3911

# ENTERTAINMENT



## PIANO CIRCUITS

AY-1-0212  
AY-1-5050  
AY-1-1007B  
AY-1-1320

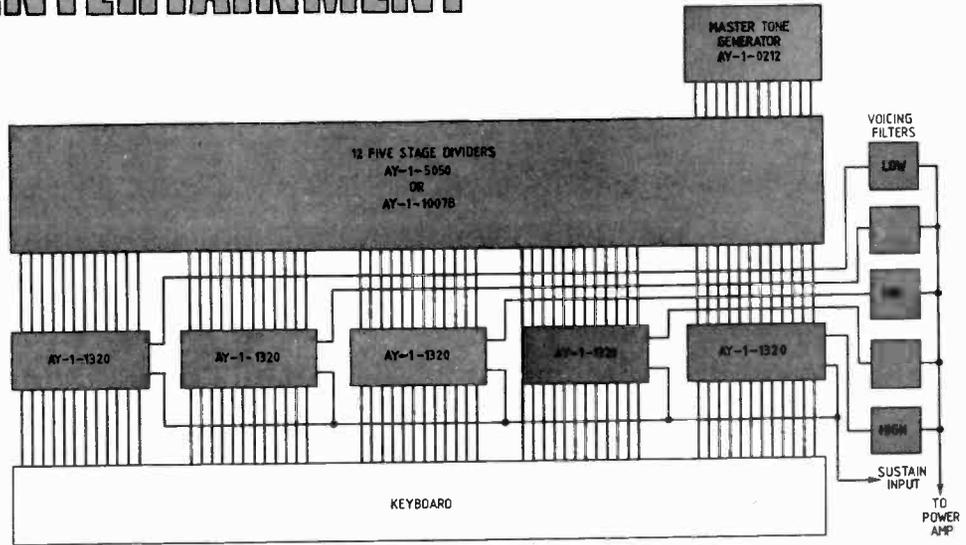


Fig. 14. Block diagram showing front end of an electronic piano

THE modern electronic piano has all the features and more of the conventional strung instrument. It has a sustain and soft pedal, usually a choice of additional voices such as honky-tonk piano or harpischord, but most important of all special circuitry that ensures the loudness and tonal quality of a note sounded is proportional to the velocity of the keys as in a conventional instrument.

A strung piano also produces complex harmonic resonances which means that for successful electronic synthesis the sound produced needs to die away at a realistic rate.

To achieve this special envelope shape it has required in the past a great deal of discrete circuitry. Because of the component intensity in this area and obvious advantage of reducing assembly cost and increasing instrument reliability with an appropriate integrated circuit substitute, GIM have developed the AY-1-1320 piano envelope or keyer circuit.

This 40 pin d.i.l. package reduces the hard work of electronic piano assembly to keyboard contact wiring and discrete voicing circuitry.

A typical electronic piano block arrangement is shown in Fig. 14. Here because of harmonic variations over the conventional instrument keyboard the voicing filters are divided giving more high harmonic at the low frequency end, and lower harmonic content for the top octaves.

The twelve note top octave generator directly feeds the top keyer and twelve five stage i.c. dividers to give 60 frequencies to the keyers which is the

keyboard range plus one top note to complete the compass of a normal 61 note keyboard.

One chip keyer circuit is shown in Fig. 15. When the key is up C1 is charged to -12V. When the key is depressed C1 is first disconnected and starts to discharge through the 390kΩ with a time constant of 18ms. When the key is grounded the C1's voltage has been transferred to C2 via the gates TR2 and TR3. The faster the key velocity the larger the initial voltage on C2 and the louder the note.

The d.c. voltage on C2 is chopped via R1 and the output from a divider to give the decaying chopped waveform shown which is fed to the voicing circuit.

When the key is released the 50kΩ damping resistor is optionally connected across C2 to damp the notes with a 110ms time constant. Different values of R1 are used for each octave to give variation in decay time across the compass.

A negative pedal voltage applied to the sustain input dampens the output with a time constant of 180ms when the key is released. This input simulates the action of the loudpedal in a piano.

The AY-1-0212 (£6.50) and the AY-1-5050 (£2.50) is available from Technomatic Ltd, 54 Sandhurst Road, London, NW9.

A complete i.c. kit based on Fig. 14 is available from Semiconductor Specialists (UK) Ltd, Fairfield Road, Yiewsley, Middlesex, price £36.25.

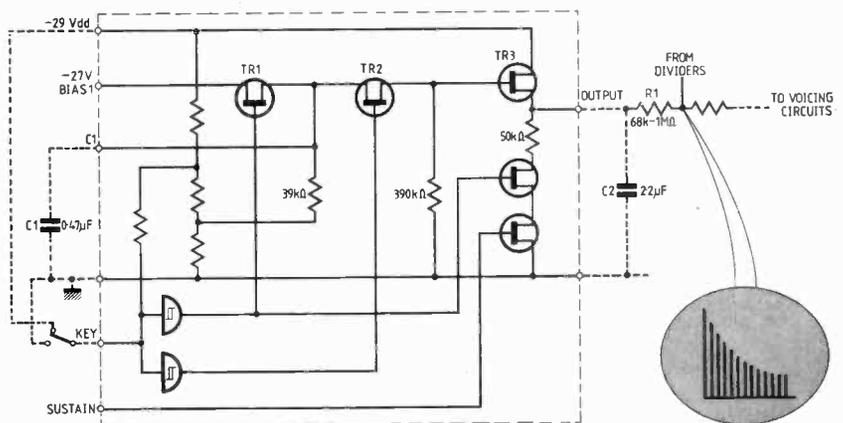


Fig. 15. The basic piano keying circuit

# AY-1-0212—AY-5-1317A—TBA 0470-D—ORGAN CIRCUITS—M147—AY-5050/1—AY-1-6721/5/6

## Top Octave Generator

The hearts of any electronic organ are the main oscillators from which all the distinctive voices derive. Years ago in the free phase system a separate oscillator was used for each note which represented an awful problem in tuning. Today, in what is known as the divider organ system, a digital tone generator produces from a single input frequency a full octave of twelve frequencies which with subsequent division can provide all the frequencies required by an electronic music synthesiser such as an organ or piano.

A good example of an i.c. top octave generator is the General Instrument Microelectronics 16 pin AY-1-0212. It is made up of twelve divider circuits which divide a typical input frequency of about 2MHz into twelve notes. If any one of the adjacent figures of division in Fig. 16 are divided they will be seen to approximate to  $^{12}\sqrt{2}$  so that the whole makes up a well tempered chromatic octave.

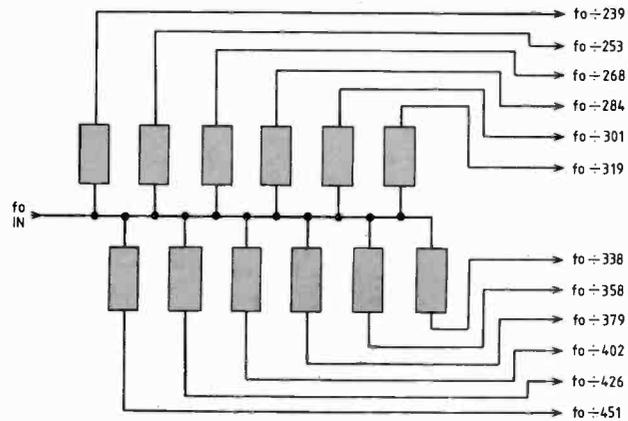


Fig. 16. Block schematic of top octave generator AY-1-0212

## Frequency Dividers

Another component intensive area which has surrendered to integration is the subsequent dividers to the Top Octave Generator which in combination with the latter give all the required instrument notes. GIM provide a whole range of 4-5-6 or 7 stage frequency divider in 14, 10 or 12 lead packages which have the same specification and are wholly compatible with each other to fulfil any arrangement of division. All circuits can be driven from a sine or square wave from, say, the AY-1-0212.

Choice of configurations are: AY-1-5050—7 stage frequency divider 3+2+1+1; AY-1-5051—4 stage frequency divider 2+1+1; AY-1-6721/5—5 stage frequency divider 3+2; AY-1-6721/6—6 stage frequency divider 3+2+1

## Distribution

In an organ there can be several contacts under a key which when closed simultaneously route the various signals to the busbars, from the dividers, and then onto the voicing filters. The trouble is key contacts corrode and are therefore electrically unreliable, producing as they do, all sorts of nasty noises over the years. The current trend in electronic organs is to replace these contacts with electronic gates so that pressing a key and a single contact, octave related notes from a divider can be passed onto a selected voicing filter.

On this simple idea ITT came up with the TBA 0470-D organ gate which makes

it possible to reduce a ten contact key assembly to one per key. The circuit simply consists of ten transistors, each transistor is a gate which is d.c. switched with the input signal information via each emitter.

## Priority Latching

One bit of electronics which makes organ playing a lot easier is priority latching. This is a LSI subsystem which can be applied to pedals or keyboard but is probably more appropriate to pedals. The M147 from SGS-ATES is an example of a latch pedal sustain i.c. This has 24 pins with 13 pins for input stub pedals. When a pedal is depressed the corresponding square wave frequency spread over five octaves is immediately present at five pins. These outputs remain when the pedal is released until a new pedal is depressed. When two or more pedals are depressed only the left

one is accepted—corresponding to the lower frequency. This priority pedal produces a trigger percussion pulse when depressed and a sustain trigger with which the output sounds can be tailored.

## Chord Generator

Some would say the most magical innovative thing about organs is the chord generator; as besides generating static chords the chip can be multiplexed internally to provide a walking bass, rhythm arpeggio or alternating bass.

A block diagram of the GIM 40 pin AY-5-1317A is shown in Fig 17. Here the bottom twelve notes of the divided top octave generator are fed to the chord multiplexer.

All the above devices are available from Technomatic Ltd, 54 Sandhurst Road, London, NW9.

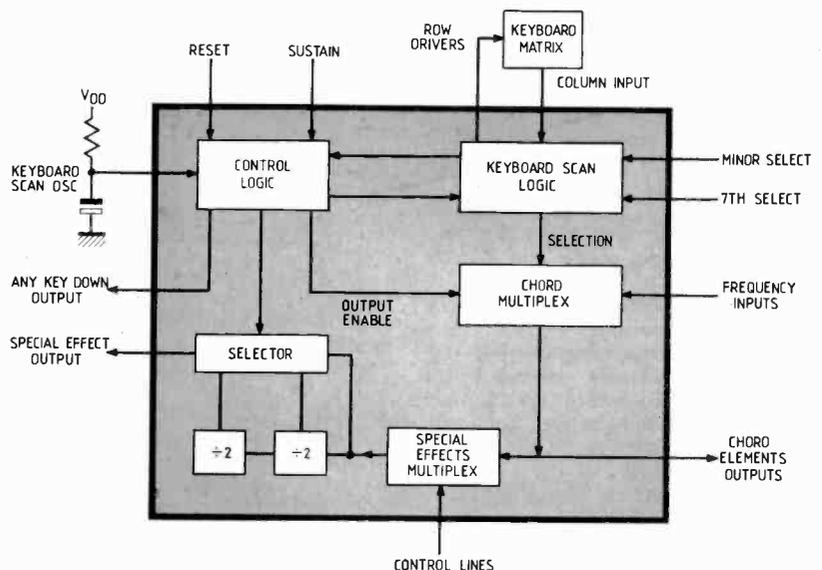
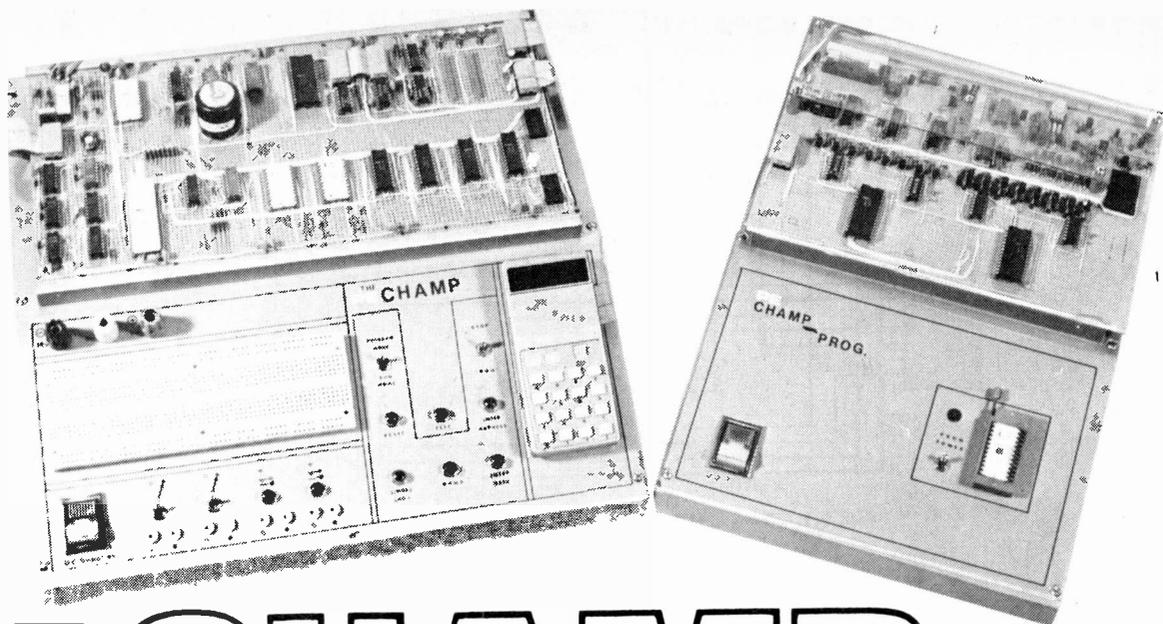


Fig. 17. Block diagram of the AY-5-1317A chord generator



# PE CHAMP

R.W. COLES  
B. CULLEN

## PART THREE

LAST month we looked at the operation of the main system components used on the CHAMP board, including the 4040 MPU chip itself, and we are now about ready to look at the operation of the circuit in more detail. Before we start to discuss the hardware at the "gates and wire" level though, a word about the system operation as defined by the CHOMP software would be helpful.

### SYSTEM OPERATION

When considering CHAMP as a development system, i.e. with the CHOMP program running, there are a number of specific tasks to be performed which can be listed as follows:—

- (a) Refresh 8-character 7-segment l.e.d. display at a rate which eliminates flicker.
- (b) Accept and store hexadecimal keyboard entries of up to three characters.
- (c) Scan the control panel to detect any of the following switch closures:—  
ENTER DATA, ENTER ADDRESS, DUMP, RUN-MODE, TEST.
- (d) In response to *ENTER DATA*, take data from temporary keyboard storage and load into the RAM location pointed to by the "current address pointer" register, then increment the pointer.
- (e) In response to *ENTER ADDRESS*, take data from temporary keyboard storage and load it into the "current address pointer" register.
- (f) In response to *DUMP*, read data in the program location pointed to by the "current address pointer" register and load it into the display buffer, then increment the pointer.

- (g) In response to *RUN MODE*, leave the CHOMP program by jumping to the start of a user program in the first program RAM location (Address 200 Hex).
- (h) In response to *TEST*, leave the CHOMP program by jumping to the start of a program in the second PROM chip (Address 100 Hex). This would normally be the PROMPT programmer firmware if fitted.

The important thing to remember about the operations listed above is that they are controlled by *software*, or to be more correct, *firmware* and are *not* purely hardware operations like *RESET*, *RUN/STOP*, or *SINGLE STEP*.

This means that although I shall be discussing the circuitry as it relates to these operations, you should bear in mind that *you* can use the circuitry for other purposes, providing you produce the software to do it.

This means, for example, that when you switch to *RUN*, *your* program can redefine *ENTER DATA* as "change points", *ENTER ADDRESS* as "sound horn", and *DUMP* as "pull the flush", without you having to change a single wire!

### CIRCUIT DETAIL

Referring to Fig. 2.3 (last month), let's start with IC1, the 4201 clock generator. This device is fully described starting on page 5-77 of the users manual, but in outline it is a CMOS chip in a 16-pin package which contains the oscillator and dividers necessary to produce the 4040 two-phase clock signals and the logic for the *SINGLE STEP* and *RESET* operations.

The important point about this chip is that it provides high current clock outputs capable of driving the phase 1 and phase 2 inputs of a *complete* 4040 system, and this leads to a requirement for special decoupling circuitry.

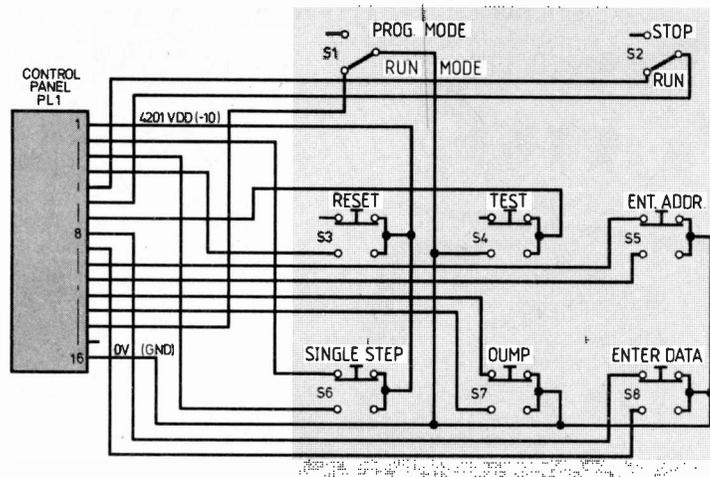


Fig. 3.1. The CHAMP control panel connections

R1, and C1, C2 isolate the drive current pulses from the supply line and R2, R3 help to reduce the rise time of the clock waveforms when a complete set of 4040 system components is not used, as is the case with CHAMP. The insertion of R1 produces a separate 4201  $V_{DD}$  node and since the RESET switch and the SINGLE STEP switch require a  $V_{DD}$  connection, it is to this node that they must be connected.

Pin 5 on the 4201 is a mode control pin which changes the division ratio of the internal counter to slow down the resultant clock output. Since there are tangible advantages in sticking to a 10.8 microsecond clock cycle this pin is permanently connected to +5 volts in CHAMP. Pins 2 and 16 are clock outputs at TTL rather than MOS levels, and are unused in the CHAMP system, R5 and C3 provide the "power-on-reset" time constant and can be altered as necessary to set an appropriate delay which ensures that the complete system is reliably "cleared" whenever power is first applied.

#### 4040 CHIP

The MPU chip, the centre of the CHAMP system, is of course IC2. Note that pins 1, 2, 3, and 4 carry the four-bit multiplexed bus which is the key to 4040 operation and which of course was covered in detail in Part 2 last month. This bus provides communication with the 4002 data RAMs, the 4265 I/O chip, the 4289 program memory interface chip, and can also be accessed via the sockets for system expansion when required. Note the SYNC output, pin 16, and its interconnection to the other system components, and also the STOP input, the STOP ACKNOWLEDGE output, and the RESET input which link to the 4201 clock generator. TEST, pin 13, is an input which can be tested directly with software (e.g. "JUMP IF TESTS EQUALS LOGIC ONE") and is a unique 4004/4040 feature.

The COMMAND RAM lines, pins 17, 18, 19 and 20 can each control a data RAM bank which in turn may consist of four 4002s, or three 4002s and one 4265. Only  $CM_0$  is used on the CHAMP board, but CHAMP PROG uses banks 1 and 2 for the two extra 4265s. These lines are activated using the DCL instruction and are used to increase the address range over that possible with only

an 8-bit SRC operation. The 4040 also has two COMMAND ROM lines so that two separate ROM banks can be used to allow a total of 8K of program if needed. In CHAMP only  $CM ROM_0$  is used to control a single 4289, and it is considered unlikely that  $CM ROM_1$  would ever be used in a CHAMP derived system.

#### NEGATIVE LOGIC

When first introduced the 4004 and 4040 were defined with respect to a negative logic convention, because this is more "natural" in a PMOS system where a transistor turned "on" produces a positive output level and a transistor turned "off" allows its output to be pulled down to a negative level. Inside a 4040 system this convention still holds, so that for example, a logic 1 on the DATA BUS is actually represented by a negative level, but on the inputs and outputs from the 4265 the more familiar positive logic convention is employed.

This means that a logic inversion takes place inside the 4265, so that if for example your program writes binary 1111 (F in Hex) to 4265 port Z you can expect to see four TTL-compatible positive logic levels on the output pins even though they passed over the bus as negative levels. The 4289 PROM address and data, and the I/O and CS pins are also defined in positive logic to make life easier, and so usually you don't have to worry about which convention applies for interfacing operations, you can assume good old TTL-type positive logic.

The main exception as far as external interfacing is concerned is the 4002 RAM output port which is defined in negative logic, although this port is really only a secondary facility anyway, and only becomes available when a second 4002 is added to the system. It is of course always advisable to check in the MCS-40 User's Manual what the logic convention is on individual pins like INT or INT ACK before connecting these to external circuitry.

#### CONTROL PANEL INTERFACE

In Fig. 3.1 we show the interconnection of the CHAMP control panel switches, which of course are mounted on the plinth and hooked up to the CHAMP main board

via a 16-way flat strip cable. The RESET, RUN/STOP and SINGLE STEP switches connect directly to the 4201 chip IC1, but the other four switches are wired into the system via the ROM I/O lines and some TTL conditioning circuitry which forms, collectively, a special kind of four-bit input port.

The ENTER DATA, ENTER ADDRESS and DUMP push switches directly control the PRESET and CLEAR inputs of 7474 D-type flip-flops (IC11-IC13) which are used as latches to "debounce" the switch operations and provide a clean positive-going edge for each press. The outputs from these latches are used to "clock" further D-type flip flops which have logic 1s hard-wired to their D inputs, and the  $\bar{Q}$  outputs of these pass via a 74125 tri-state buffer, IC14 to the 4289 I/O bus. This second set of three latches can be cleared via a *WRR* instruction since they are controlled by what is, in effect, a ROM output port (part of IC24 and IC25).

Suppose the ENTER DATA switch is pressed, this sets the Q output of its associated latch to a 1 and this in turn clocks a 1 into the second flip-flop whose  $\bar{Q}$  output is then available at the input to the 74125. This sequence of events in itself initiates no further action, since the 4040 will not realise that anything has happened until it carries out an *RDR* instruction which strobes the 74125 and allows all four switch data bits to be transferred via the 4289 and the DATA BUS to the accumulator.

### WAIT LOOP

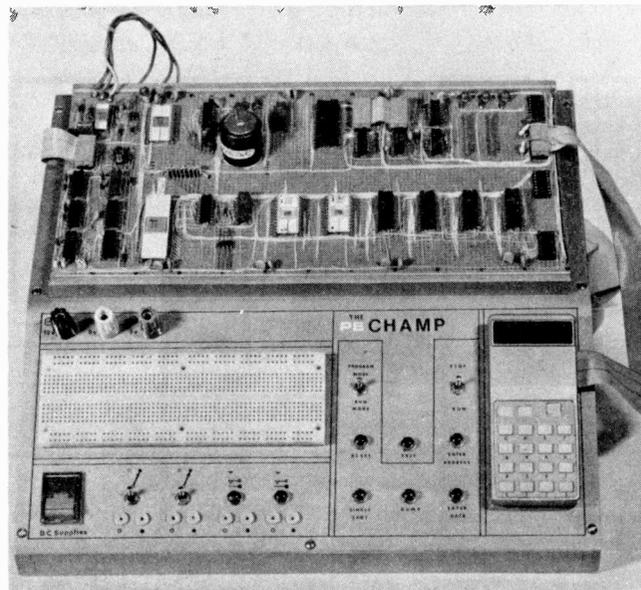
There won't be long to wait of course, and normally the 4040 sits in a "wait loop" which is embodied in the CHOMP software, continuously carrying out a read and check operation on these very control switches. When the ENTER DATA closure is recognised the 4040 jumps to a part of CHOMP which deals with the entry of data, and one of the first things this section of the program does is to clear all the switch flip-flops via the 4289 and part of IC24 and IC25. This is necessary to prevent multiple recognitions of the same switch closure, and points to the reason for the second D-type, since with this arrangement no matter how long you keep the switch pressed it can only be recognised once.

Note that the PROG MODE/RUN MODE switch is not provided with TTL latch conditioning circuitry since it is a toggle switch and is not used repetitively like the others; its contacts are connected directly to the 74125. We have termed the switch conditioning circuitry, just described, the switch FLAGS and in future we will use this shorthand name, and refer to the 74125 as the FLAG PORT.

### KEYBOARD INTERFACE

The on-board keyboard interface, comprising IC7-IC10, interposed is between the 4265 ports and the keyboard sockets SK3, and also between the 4040 interrupt lines and SK3. The 4265 is connected to this interface circuitry via a 16-way flat strip jumper which connects SK7 to SK8 when the keyboard is in use. As mentioned in Part 1, this jumper can be removed for direct access to the 4265 when "custom" interfacing is required for user programs.

The keyboard produces a ready encoded hexadecimal output on four lines together with a common strobe, and the display section requires eight-segment anode drives (a-g & d.p.) and a clock and data input to the internal digit-strobe shift register (see Fig. 3.2). The internal circuitry of the keyboard will be covered in detail later on.



The four hexadecimal keyboard outputs connect directly to the 4265 port W which is defined as a mode 9 input port during 4265 initialisation under CHOMP, but the common strobe is fed to the 74123 dual monostable to produce a de-bounced strobe which sets the interrupt latch (half of IC9) aid is also used to enter the hex code into the part W input latches via the port Z1 asynchronous strobe line (See MCS-40 User's Manual, pages 5-36 for further details.)

### DISPLAY REFRESH

The display refresh drive is achieved by loading the next eight segment bits into output ports X and Y and then clocking the shift-register produced digit strobe along to the next common-cathode digit line. This operation has to be repeated eight times for the complete eight-character display, and has to be carried out rapidly enough to prevent display "flicker". The digit strobe is in effect a logic 1 shifting through a field of 0s, a new logic 1 being presented to the shift-register via 4265 output line Z3 under software control at the start of a new display sequence.

The shift-register clock pulses are provided by output Z2 which is a synchronous strobe produced when port Y is loaded with segment data during a *WR2* instruction. IC7 and IC8 are special i.e.d. anode driver arrays (75491) which provide the high-current segment drive needed by the multiplexed display, the cathode drives (75492) are contained within the keyboard case and are of course driven by the shift-register outputs. R51-R58 perform the usual i.e.d. current-limiting function and therefore control the display brightness.

### PROGRAM RAM

The original 4004 microprocessor expected its program in a ROM and its data in a RAM and never the twain shall meet, but CHAMP is a development system which requires programs to be easily modified and kept in RAM and so

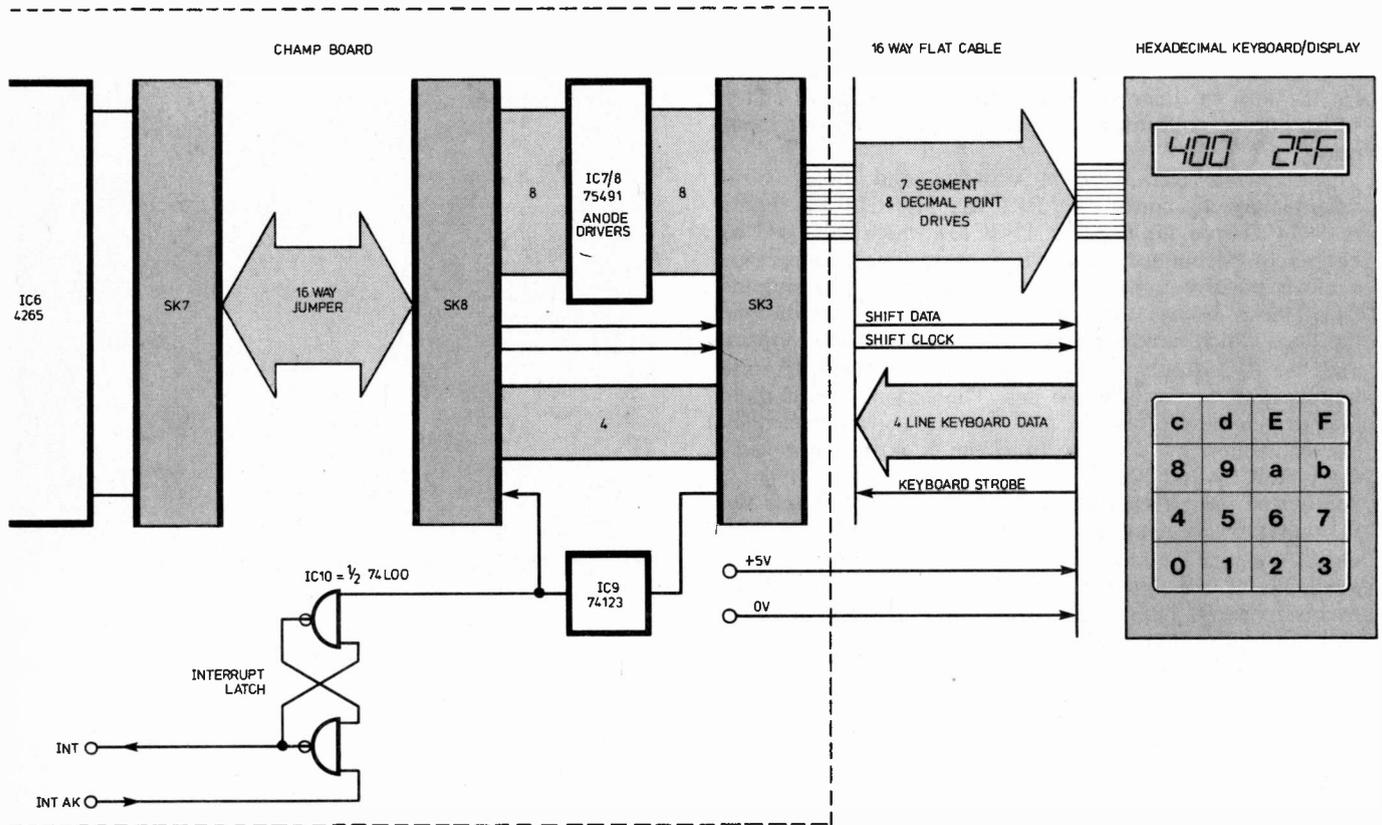


Fig. 3.2. The CHAMP board/keyboard interface

some special arrangements have to be made to provide this facility. Fortunately the 4040 does have instructions for writing to and reading from RAM program memory, namely *WPM* and *RPM* respectively, but since the 4040 deals with four-bit nibbles while its program comes in 8-bit bytes, some jiggery-pokery is still required to allow painless operation of the *ENTER DATA* and *DUMP* commands which of course are used to modify and examine program RAM when required.

When a program in RAM is actually *running* the program RAM is addressed via the 4289 just as if it were PROM, and eight-bit instructions are fetched from RAM via the 4289 without the MPU ever knowing the difference. The need for "special treatment" arises when the so-called transitive read or write operations using the *RPM* and *WPM* instructions are undertaken because of the nibble/byte conflict.

To achieve proper operation of the transitive instructions the 4289 contains a *FIRST/LAST* flip-flop which is toggled by each use of *WPM* or *RPM*. The output of this flip-flop is used externally to steer a nibble to either the *FIRST* half-byte or the *LAST* half-byte of a program RAM location during transitive *write* operations, or used internally to send the *FIRST* half-byte or *LAST* half-byte of program RAM data back to 4040 over the data bus during transitive *read* operations. To accommodate this mode of operation CHAMP program RAM is organised so that it may be *read* as a byte-orientated array of  $512 \times 8$  bits but *loaded* as a nibble-orientated array of  $1024 \times 4$  bits.

The program RAM write operation is achieved using the 4289 i/o bus to transfer the data a nibble at a time, the correct half-byte of RAM being selected using a logical combination of the 4289 outputs *F/L*, *PM*, and *OUT* to produce individual write strobes for each of the two  $256 \times$

4 RAM chips which together form the equivalent of a single 4702A PROM chip. This gating logic is performed by the remaining parts of IC24 and IC25.

### ADDRESSING PROGRAM MEMORY

As mentioned last month, the 4289 is used to demultiplex the 4040 bus to produce a 12-bit wide address output to program memory. The lower 8 bits of this address are wired directly to each program memory device via what we shall call the 4289 address bus (pins 23 to 30 from 4289). The upper four bits are decoded by a 3205 TTL decoder to produce a unique *CHIP SELECT* strobe for each of the two 4702A PROM chips and each of the two pairs of 5101 RAM chips so that only one "memory chip" (one 4702A or two 5101s) can be enabled at one time.

The 12-bit address is provided by the 4040 program counter during normal operations, but when a transitive read or write is carried out the eight low order address bits must be provided by an *SRC* operation, and the four chip-select bits must be provided via an output port. In CHAMP the port employed for this purpose is the 4002 output port from IC4, buffered by a 74L00 gate IC3, which also provides the necessary logic level inversion.

We now have two possible sources for the four chip-select bits, either pins 31 to 34 of the 4289 (normal operation) or pins 13 to 16 of the 4002 (transitive operation) and so the 74157 quad two-line to one-line data selector (IC16) is interposed between the two sources and the 3205 decoder. The 74157 *SELECT* input is controlled by the 4289 *PM* output which is active only during transitive operations, so that proper selection of the source of chip-select data is maintained.

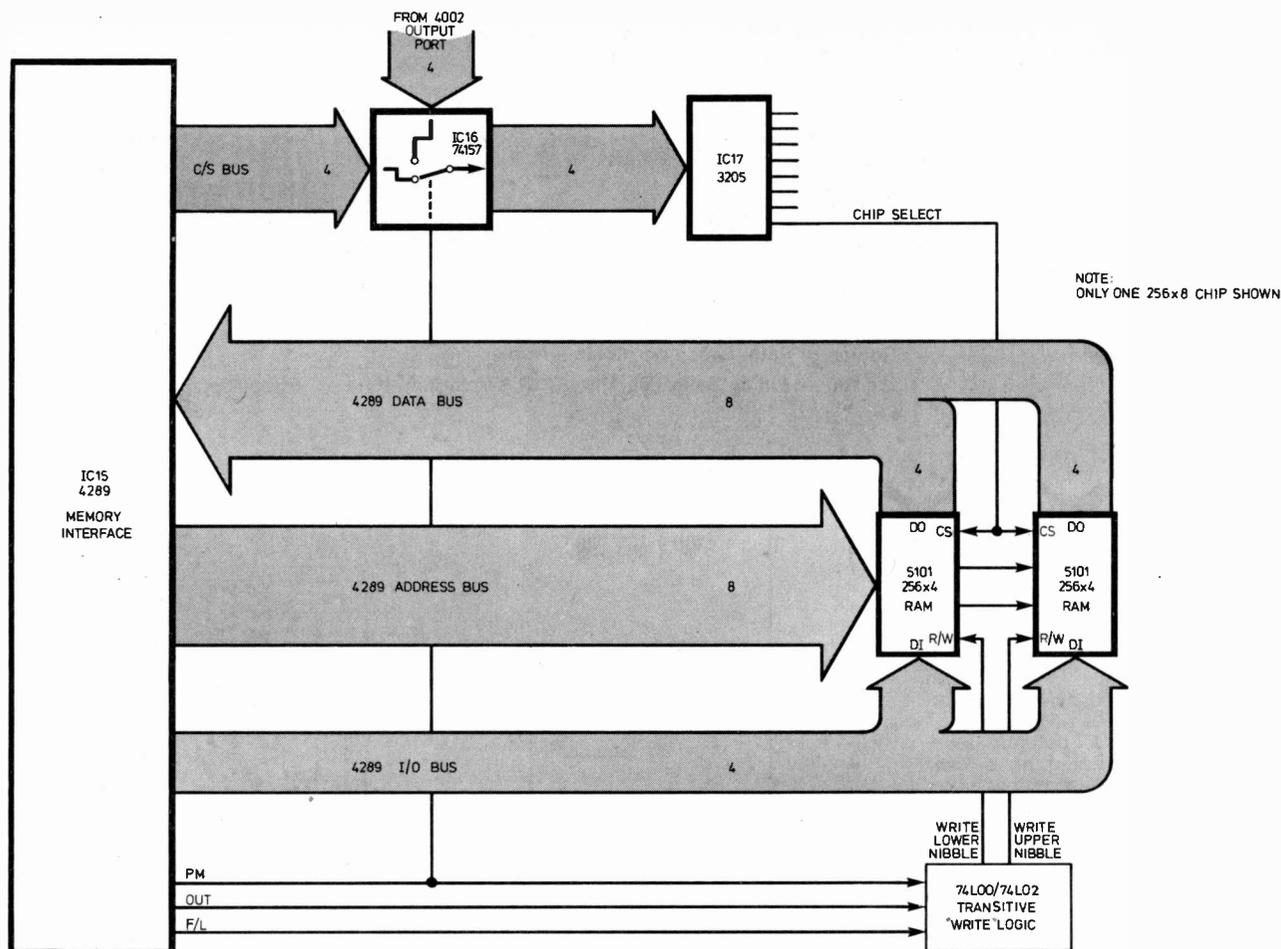


Fig. 3.3. Simplified schematic diagram of addressing CHAMP RAM program memory

To carry out a transitive write then, as required by an *ENTER DATA* command, the following sequence is necessary.

1. Select 4002 port
2. Write chip code to 4002 port
3. *SRC* to select location within chip
4. *WPM* to write first half-byte
5. *WPM* to write second half-byte.

A similar procedure is necessary to achieve a transitive read, as required by the *DUMP* command. Further details of the intricacies of addressing program memory can be gained from the 4289 data sheet, although of course to use CHAMP as a development system it is not essential to be familiar with these. See Fig. 3.3 for simplified circuit operation.

### BATTERY BACK-UP

The 5101 program RAM chips are CMOS devices which have extremely low standby current drain. Components B1, D19, D20 and R40 form a battery supply circuit which will power the 5101s with the CHAMP main supplies turned off. B1 is a three-cell DEAC nickel cadmium battery which provides about 4 volts and is recharged via D20 and R40 when the power is on. When power is removed D20 becomes reverse biased, isolating the 5101s from the +5V line, and D19 becomes forward biased to supply the memory standby current. Note that a dry cell battery of 4.5 volts could be used instead of the DEAC

if R40 is left out, although you could end up losing data when the battery eventually runs flat. It is difficult to say just how long this would take.

### POWER FAIL DETECT

To ensure that the memory is not corrupted by write transients during power failure or recovery, it is necessary to raise the  $CE_2$  input to the 5101s only when the main 5 volt supply is available, and to achieve this control a "power-fail-detection" circuit formed by D13, R32, R33, TR1, R34 and part of IC10 is provided. The transistor is held on by the conduction of D13 until the 5 volt line starts to drop. When it drops below about 4.5 volts D13 and TR1 turn off and  $CE_2$  is grounded via the 74L00 gate.

### USING OTHER MEMORIES

If you can do without the non-volatile feature made possible by the 5101 devices for all or part of your program RAM, then you can leave out the battery circuit and the power fail detect circuit and plug in 2101 devices which are available at very low cost. The 2101s are completely compatible with the rest of the CHAMP circuit and have been tried on the prototype.

One final note, the 5101 CMOS devices must not have their inputs taken negative more than a few hundred millivolts, and this is the reason for clamp diodes D1 to D12. The use of good quality germanium devices in these locations is essential.

**NEXT MONTH: CHAMP Keyboard, power supplies, construction**





# Next Month's issue!

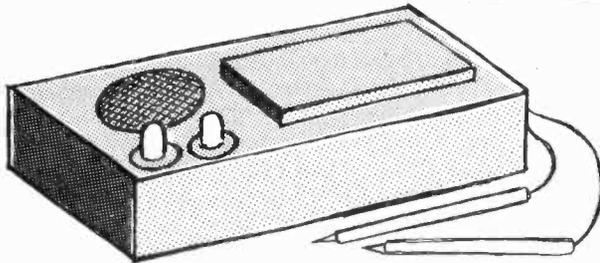
**SPECIAL  
OFFER**

**SOLDERING  
IRON**



**PROBE-LESS  
CONTINUITY  
TESTER**

Provides immediate visual indication  
of condition of component, fuses, etc.



**FIND THE PAIR!**

Frustrate your friends with this electronic  
game. Ideal for fund-raising at school  
fetes



**ULTRASONIC REMOTE  
CONTROL SYSTEM**

For remote control of mains and battery powered electrical equipment  
such as garage doors drive motor, porch light . . . also an intruder alarm

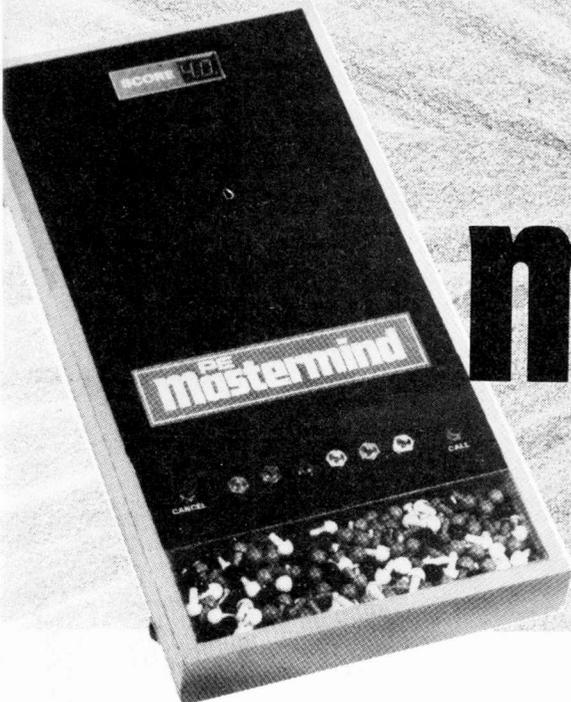
**V.H.F. PORTABLE RADIO**

A six transistor super-regenerative receiver for  
a.m. transmissions

# Everyday ELECTRONICS

THE NOVEMBER ISSUE  
WILL BE ON SALE  
FRIDAY, OCTOBER 21

**Only 40p.**



# PE Mastermind\*

P. F. TURNEY

## Part Four

In the last issue, the timing circuits were described and an introduction was given to the operation of the scoring logic, where the "P" flip flops were discussed. The description of the scoring logic is to be continued this month, commencing with the details of four flip flops that are used to produce the results for the number of coloured pegs correct for colour but incorrect for position, the "I" results.

### COMBINATIONS THAT CAN OCCUR

At this stage it is worthwhile considering the various combinations of entries and internal colours that may occur in a typical game, as it is the nature of this combination that determines the particular mode in which the scoring logic will operate. The combinations that may occur can be divided into four categories:

- (a) The entries may be non-repeated and the internal colours may be non-repeated,
- (b) the player may repeat the colours in a deduction,
- (c) there may be repeated colours within the machine, and
- (d) a combination of (b) and (c).

Each of these categories may be sub-divided to include the cases where there are only "I", "P", or "I" and "P" results occurring.

Fig. 4.1 is the overall functional diagram of the scoring logic, and this will be referred to extensively throughout the description of the operation.

### THE "I" FLIP FLOPS

Four flip flops, called the "I" flip flops, are used to produce the "I" results. These flip flops are clocked by signals  $C_1\bar{C}$  to  $C_4\bar{C}$ , for  $I_1$  to  $I_4$  respectively, so as to eliminate any adverse effects that may otherwise have been produced by time delays inherent in the comparator logic, had signals  $C_1$  to  $C_4$  been used instead. This point was discussed in detail last month.

With reference to Fig. 4.1 it will be seen that the E (Equality) signal (from IC15) is common to the "J" inputs of all "I" flip flops, so that if, for example,  $C_1\bar{C}$  and E are present simultaneously,  $I_1$  will be set on the trailing edge of  $C_1\bar{C}$ . The "K" inputs to these flip flops are connected to logical zero, so that a flip flop may only be cleared by the application of logical zero to the clear input.

A simple example, in category (a), showing the collective action of the "I" and "P" flip flops, is illustrated in Table 4.1.

An example in category (b) is shown in the simplified diagram of Fig. 4.2(iii). Here the player has entered two blue pegs, the first of which will set  $P_1$  and  $I_1$ ; the second one will produce no further change. However, according to the rules of play,

Table 4.1

ENTRIES		X CODES			
		Black	Red	White	Green
Red	K	K = 1	K = 1	K = 1	K = 1
	$C_1$	$C_1 = 1$	$C_2 = 1$	$C_3 = 1$	$C_4 = 1$
	E	E = 0	E = 1	E = 0	E = 0
	$P_1$	$P_1 = 0$	$I_2 = 1$	$I_3 = 0$	$I_4 = 0$
Black	L	L = 1	$L = 1$	L = 1	L = 1
	$C_1$	$C_1 = 1$	$C_2 = 1$	$C_3 = 1$	$C_4 = 1$
	E	E = 1	E = 0	E = 0	E = 0
	$I_1$	$I_1 = 1$	$P_2 = 0$	$I_3 = 0$	$I_4 = 0$
Blue	M	M = 1	M = 1	$M = 1$	M = 1
	$C_1$	$C_1 = 1$	$C_2 = 1$	$C_3 = 1$	$C_4 = 1$
	E	E = 0	E = 0	E = 0	E = 0
	$I_1$	$I_1 = 1$	$I_2 = 1$	$P_3 = 0$	$I_4 = 0$
White	N	N = 1	N = 1	N = 1	$N = 1$
	$C_1$	$C_1 = 1$	$C_2 = 1$	$C_3 = 1$	$C_4 = 1$
	E	E = 0	E = 0	E = 1	E = 0
	$I_1$	$I_1 = 1$	$I_2 = 1$	$I_3 = 1$	$P_4 = 0$

$I_1$ ,  $I_2$  and  $I_3$  are set, indicating that the score is three white key pegs

\* Mastermind is the registered trade mark of Invicta Plastics Ltd

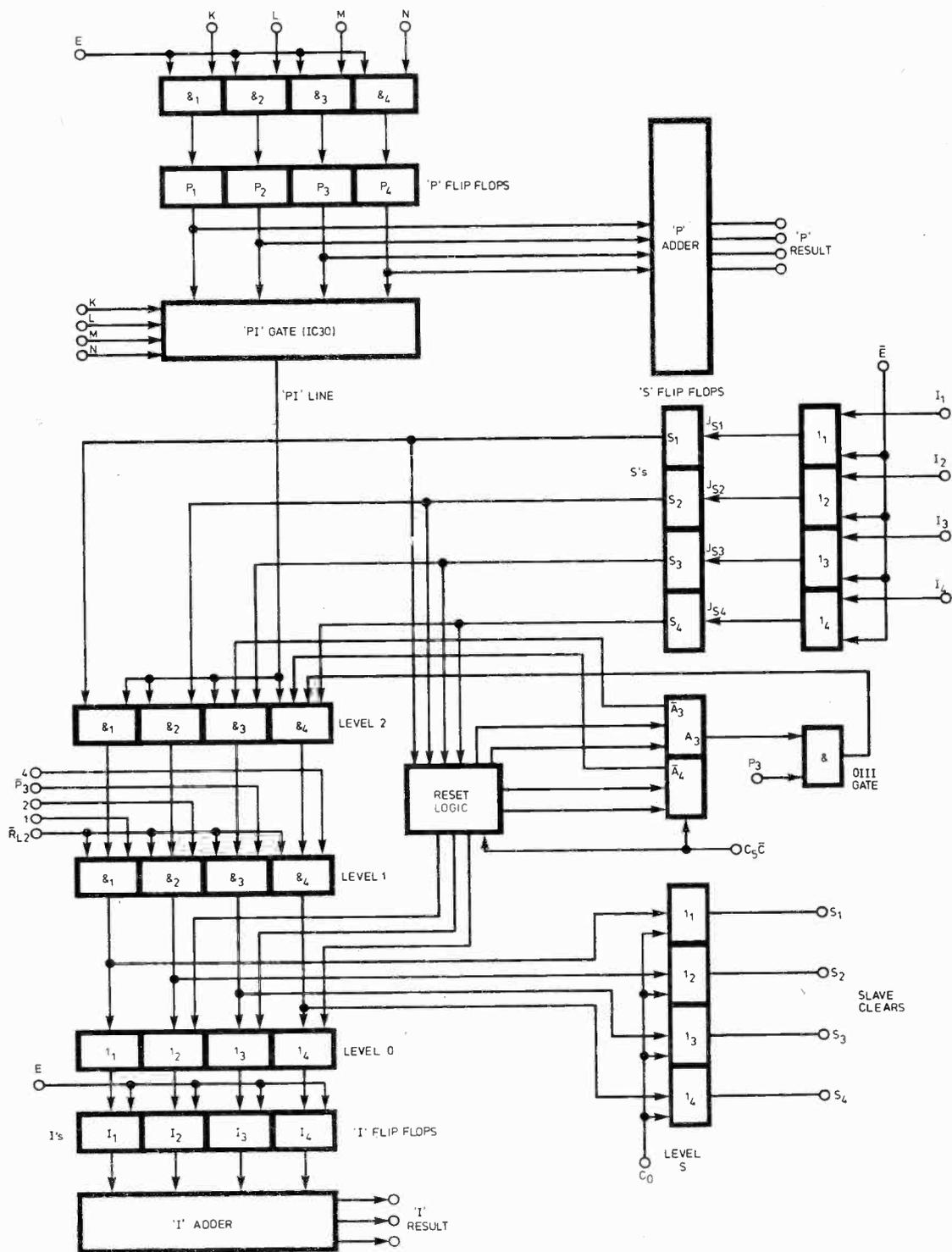


Fig. 4.1. Overall functional diagram of the scoring logic

only  $P_1$  must remain set. Correct operation is ensured by arranging that when a given "P" flip flop sets its corresponding "I" flip flop,  $I_1$  in this case, is cleared and inhibited for the remainder of the deduction. A "P" correct entry is therefore a dominant one, as shown in Fig. 4.2(iv).

This dominance of a "P" flip flop over its corresponding "I" flip flop can be seen in Fig. 4.1, since the complements of

the "P" outputs are connected to the inputs of the NAND gates labelled "Level 1". If, therefore,  $P_1$  has set, then  $P_1=0$  acts to inhibit  $I_1$  via the NOR gates of "Level 0".

A further example in category (b) is shown in Fig. 4.2(v), where there are repeated "I" correct entries. The first blue entered sets  $I_1$  and the subsequent blue entries are then ignored, since  $I_1$  can only set once.

Category (b) has now been fully explored, but before proceeding to (c) it is firstly necessary to describe the hierarchy of gates serving to clear the "I" flip flops.

## RESET LEVELS

There are three levels, of four gates each, serving to generate the various resets required for correct operation of the scoring logic, see Fig. 4.1.

"Level 0", comprised of NOR gates, is an unconditional level, since a logical one applied to any gate input will clear the corresponding "I" flip flop. One input to each gate of this level is derived from "Level 1", whilst the other input is connected to the logic labelled "Reset Logic", to be described next month.

"Level 1" is likewise an unconditional level, since a logical zero applied to any input sends the gate's output high and clears an "I" flip flop via "Level 0". The four signals  $\bar{P}_1-\bar{P}_4$  are each taken to a gate in this level, performing the "clear and inhibit" function mentioned previously.

The clear line,  $\bar{R}_{L2}$ , is also connected to these gates, so that since this signal is taken low whenever the scoring logic has to be cleared, all "I" flip flops are reset unconditionally to zero.

The third set of inputs to the gates of "Level 1" comes from "Level 2". This is a conditional reset level, since all inputs to a given gate must be high in order to clear an "I" flip flop via levels 1 and 0.

## THE "S" FLIP FLOPS

Just how these reset levels function in the logic will be discussed later, but in order to proceed with the description of "Level 2" the four "slave" or "S" flip flops must be introduced. Briefly, these flip flops serve to indicate which of the "I"s have set in response to any particular entry made by the player. Examples Fig. 4.2(i) and (ii) illustrate why these additional flip flops are required. Note that these are both examples in category (c).

In 4.2(i) the first colour the player enters will set flip flops  $P_1, I_2, I_3$  and also  $S_2$  and  $S_3$ , the "slaves" corresponding to  $I_2$  and  $I_3$ . The fact that both  $S_2$  and  $S_3$  are set indicates that two "I" flip flops have been set in response to a single entry.

Example (ii) illustrates why this information cannot always be gained from the "I" flip flops themselves, since they contain not only a record of the current entry but also of any previous entries.

In both of these examples a single entry is seen to set both an "I" and a "P" flip flop. However, one entry, by the rules of play, cannot be counted as being correct for colour and position and yet correct for colour and incorrect for position at the same time, albeit with two identical internal colours in different positions. Both examples therefore give an incorrect score. It is the main function of "Reset Level 2" to overcome this problem.

Since a "P" correct entry is dominant it is necessary to clear any "I" flip flops that may also have been set by the entry. Therefore, in Fig. 4.2(i), both  $I_2$  and  $I_3$  must be cleared. To do this the PI signal is used, which, it may be remembered, produces a logical one output whenever a "P" correct entry has been made (until such time as a subsequent entry is made).

		X CODE				
		R	R	R	B	
ENTRIES	R	P	I	I	0	(i)
	Y	0	0	0	0	
	W	0	0	0	0	
	G	0	0	0	0	

		X CODE				
		G	R	R	B	
ENTRIES	B	0	0	0	I	(ii)
	R	0	P	I	0	
	Y	0	0	0	0	
	W	0	0	0	0	

		X CODE				
		B	R	G	W	
ENTRIES	B	IP	0	0	0	(iii)
	B	I	0	0	0	
	Y	0	0	0	0	
	Y	0	0	0	0	

		X CODE				
		B	R	G	W	
ENTRIES	B	<del>IP</del>	0	0	0	(iv)
	B	<del>I</del>	0	0	0	
	Y	0	0	0	0	
	Y	0	0	0	0	

		X CODE				
		B	R	G	Y	
ENTRIES	W	0	0	0	0	(v)
	B	I	0	0	0	
	B	<del>I</del>	0	0	0	
	B	<del>I</del>	0	0	0	

Notice that comparisons that are "ignored" or "erased" are deleted in the above tables

Fig. 4.2. Examples showing collective action of "P" and "I" flip flops

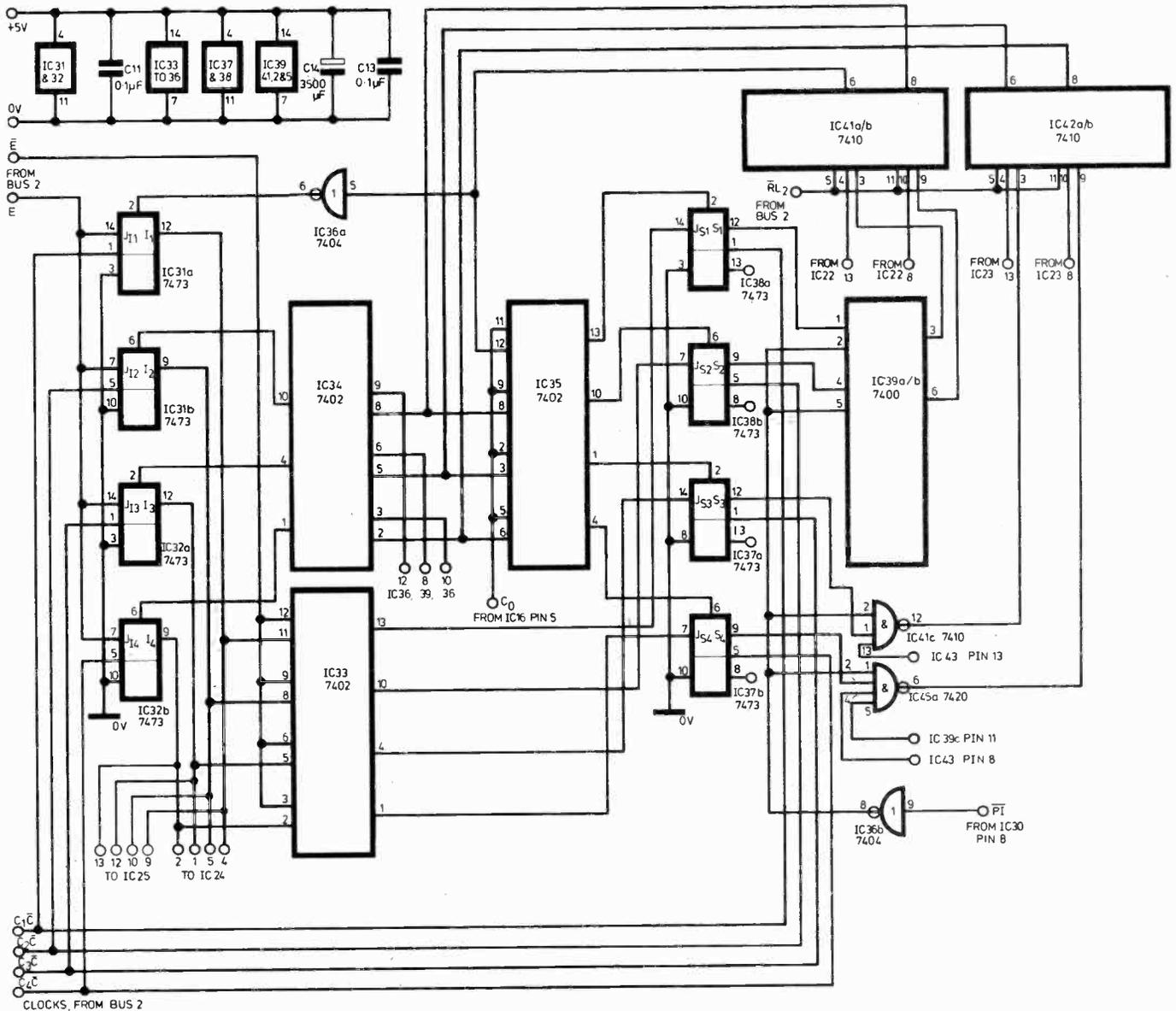


Fig. 4.3. Scoring logic circuitry

This signal is used to enable "Reset Level 2" in order to gate the outputs of the "S" flip flops to clear those "I" flip flops whose "S" flip flops have set. It will be seen from Fig. 4.1 that gates 3 and 4 of "Level 2" have three and four inputs respectively. The additional inputs are inhibit inputs and will be described next month. For the moment they may be regarded as being held at logical one.

The operation of the system, with reference to Fig. 4.2(i), is now as given below.

- (1) Enter first colour—Red.  $K$  (from IC20) = 1.
- $KC_0$  — All logic cleared.
  - $C_1\bar{C}$  —  $P_1$  set,  $I_1$  and  $S_1$  cleared and inhibited.  $PI = 1$ .
  - $C_2\bar{C}$  —  $I_2$  and  $S_2$  set.  $PI$  gates  $S_2$  via levels 2, 1 and 0 to clear both  $I_2$  and  $S_2$ .
  - $C_3\bar{C}$  — As for  $C_2\bar{C}$  but with  $I_3$  and  $S_3$ .
  - $C_4\bar{C}$  — No change.

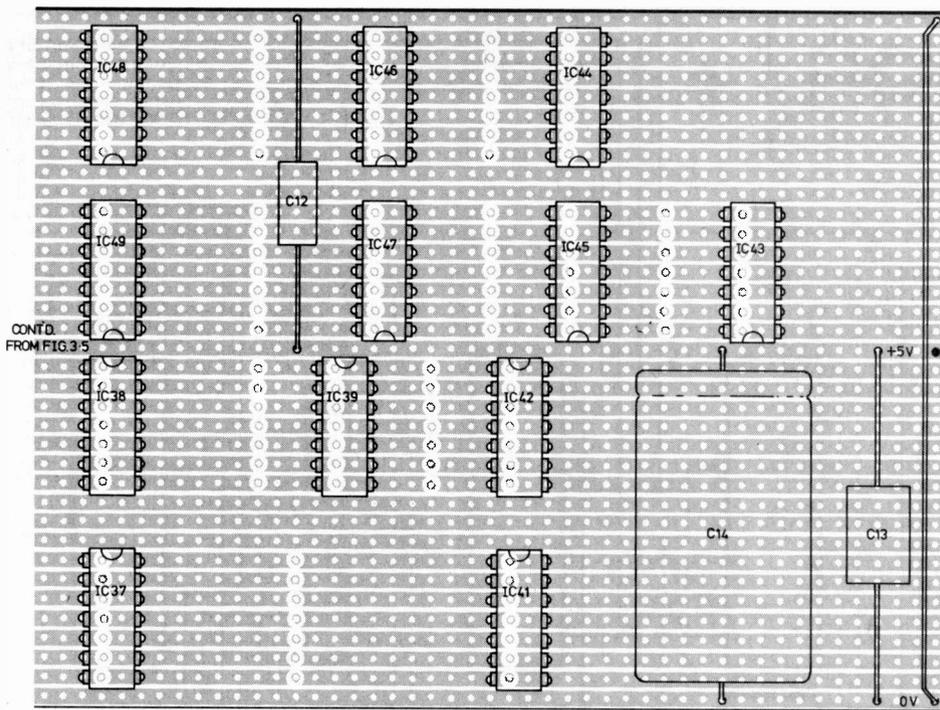
(2)–(4) No change. Only  $P_1$  remains set, which is the correct score for this deduction.

Referring to the latter sequence of events, it is seen that when  $PI$  gates  $S_2$  to clear  $I_2$ ,  $S_2$  is also cleared, and similarly for  $S_3$  following  $C_3\bar{C}$ . The precise reasons for this will be examined next month, but it is important to note that the reliability of these resets depends solely on the existence of a time delay around the reset loop. Hazard free operation can only, therefore, be assured if "on spec" gates are used. The clearing of the "S" flip flops as described may be seen in Fig. 4.1, since the outputs of "Level 1" are connected to "Level S", which serves to clear the "S" flip flops.

The "S" flip flops must only provide a record of those "I"s set in response to a single entry, so they are cleared by  $C_0$ , connected to "Level S", at the start of each entry.

### CONSTRUCTION

The positions of this month's i.c.s are shown in Fig. 4.4. Construction is fairly straightforward, reference being made to the circuit diagram of Fig. 4.3 as well as to Fig. 4.4.



**Fig. 4.4. Prototype component layout for "C" section of main board (see photo last month). For assembly details one should refer to the circuit diagram**

A number of input connections cannot be completed until next month and it is therefore recommended that these be left completely unconnected for the moment.

The best order in which to complete the construction is as follows: IC31-39, 41c, 45a, 41 and 42 respectively.

The outputs from the "I" flip flops are taken to the "I" adder, described last month. Connection details are given in Fig. 4.3.

Note that  $\bar{E}$  and NOT E is taken to IC33, and also that  $\bar{PI}$ , from IC30, is inverted by IC36b.

### "S" FLIP FLOP J INPUTS

Again due to the fact that these flip flops must only provide a record of those "I"s set by the current entry, an "S" flip flop must not set if its corresponding "I" flip flop has set in response to a previous entry. This is arranged by gating the  $J_s$  inputs such that  $J_{s1} = E\bar{I}_1$ ,  $J_{s2} = E\bar{I}_2$ , etc.

## COMPONENTS . . .

### Integrated Circuits

IC31-32	SN7473N (2 off)
IC33-35	7402 (3 off)
IC36	7404
IC37-38	7473 (2 off)
IC39	7400
IC41-42	7410 (2 off)
IC45	7420

### Capacitors

C11-C13	0.1 $\mu$ F (3 off) 10V ceramic
C14	3,500 $\mu$ F 10V electrolytic

This gating is performed by IC33 which is a 7402 quad two input NOR gate.

The circuit diagram is shown in Fig. 4.3. All flip flops are JK types SN7473N. The reset levels are implemented as follows:

- $\frac{2}{3}$  IC34 + IC36a—Level 0
- $\frac{1}{2}$  IC39 + IC41c + IC45a—Level 2
- $\frac{2}{3}$  IC41 +  $\frac{2}{3}$  IC42—Level 1
- IC35—Level S.

### TESTING

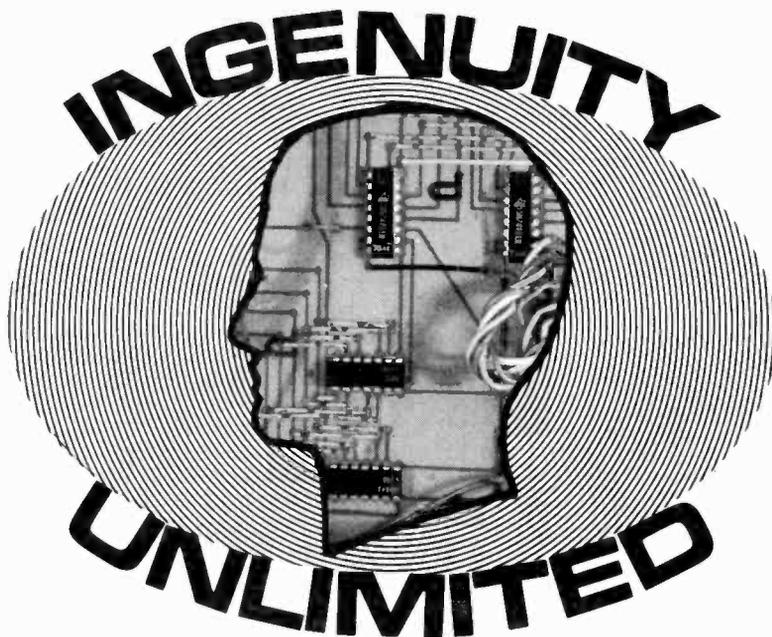
Testing is somewhat complicated by the fact that a number of connections have not yet been made. For example, the "I" flip flops are always held "clear" owing to the floating inputs to IC34, awaiting connections from the "reset logic". However, provided that the constructor connects pins 9, 6 and 3 of IC34 temporarily to 0V, then very worthwhile testing may be performed by simply playing the game and noting the scores (the "I" flip flops are enabled by these temporary connections).

The randomly generated codes may firstly be monitored using a d.c. voltmeter. These codes are contained in i.c.s 3-6.

The "P" results may be "read" from Veropins 16-18 and the "I" results from pins 13-15 (see Fig. 3.5).

The scoring given by the machine should follow the rules of the game in all cases except where there are certain repeated codes within the machine, that is a combination in category (c) or (d). Remember that fault tracing can be enhanced by slowing down the internal clock, as described last month, should any problems be encountered.

**NEXT MONTH:** The final part of this series of articles will deal with the remainder of the scoring logic and the display circuits.



A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

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

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

Each idea submitted must be accompanied by a declaration to the effect that it is the original work of the undersigned, and that it has not been accepted for publication elsewhere.



## WASH-WIPE CONTROLLER

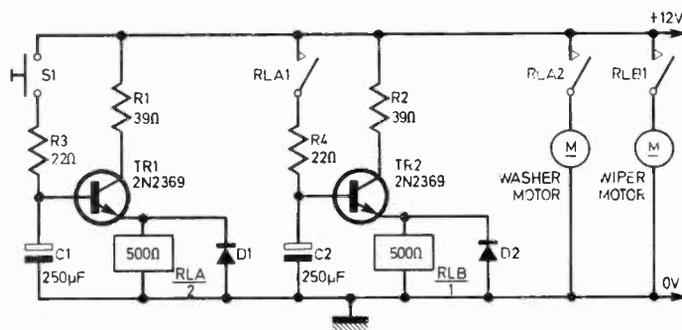


Fig. 1

A CLEAR windscreen is essential for safe driving. However, on some older cars, operating the windscreen washer and wipers simultaneously while still remaining in perfect control, is not easy.

The circuit in Fig. 1 is designed to wash the screen and then wipe it clear, having switched off the washer; all at the touch of a button. When S1 is pushed, C1 charges up almost instantly, which holds TR1 on, and operates RLA. Consequently RLA1 charges up C2 and turns on TR2, thus energising RLB also. At this point both washer and wipers are working.

When C1 has lost enough charge through the base of TR1, RLA will drop

out, leaving C2 fully charged and RLB still energised. At this point, just the wipers are left operating. Eventually, when C2 has lost sufficient charge, RLB will drop out to switch off the wipers, and then the sequence is complete.

The values of C1 and C2 are a matter of choice, but with the values shown (250μF), the washer and wipers should run together for about five seconds, and then just the wipers for a further five seconds. The resistance of the relay coils will affect this timing relationship.

Any 12 volt relay should be suitable as long as the coil current does not exceed the rating of the transistors used. When

considering the contact ratings of the selected relay, remember that the stall (starting) current of the washer or wiper motor, may well be several times the running current.

A convenient position for the Wash-Wipe Controller switch is on the steering column, similar to indicator or headlamp flasher switches. If the button is pressed before the cycle is complete, the sequence will begin again irrespective of how far the process has gone.

J. R. Ellis,  
Hitchin,  
Herts.

## SIMPLE LOGIC PROBE

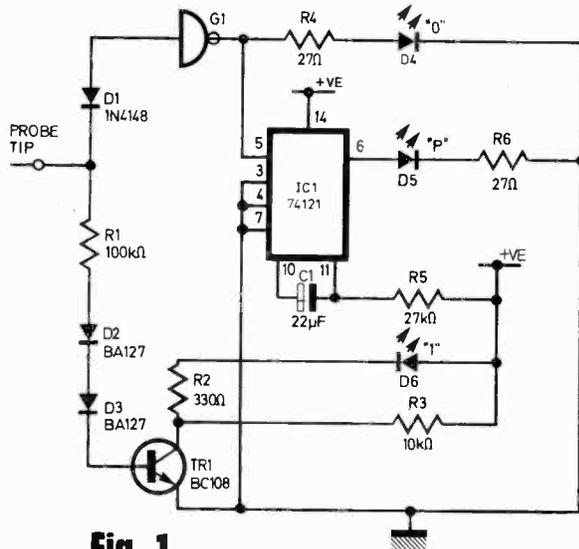


Fig. 1

A logic probe is a vital instrument in the checking of digital equipment. The circuit of Fig. 1 shows a simple three-function probe which can be built very economically.

A high logic level at the probe tip causes TR1 to conduct, illuminating the l.e.d. marked "1". A low logic level produces a high at the output of the inverter G1, causing the l.e.d. marked "0" to be lit.

If, however, the logic level at the probe tip is being pulsed, either a 0 pulsing to 1, or a 1 pulsing to 0, the monostable IC1 will detect the pulses and stretch them to about 0.4s duration. The l.e.d. marked "P" will then flash briefly.

The whole circuit was constructed on Veroboard and mounted in a small metal pill box, using three 1.5V batteries to supply the power. The inverter G1 can be one section of any TTL package, such as a 7400, 7402 or 7404, which may be to hand, with inputs paralleled if appropriate.

A. C. Hay,  
Bristol

SEQUENCE generators find wide application as counters, and in the field of digital communications. One form of sequence generator is the feedback shift register, comprising a shift register with combinational logic feedback from its outputs to its input. This feedback determines the next logical state to be entered into the register.

## SEQUENCE GENERATOR

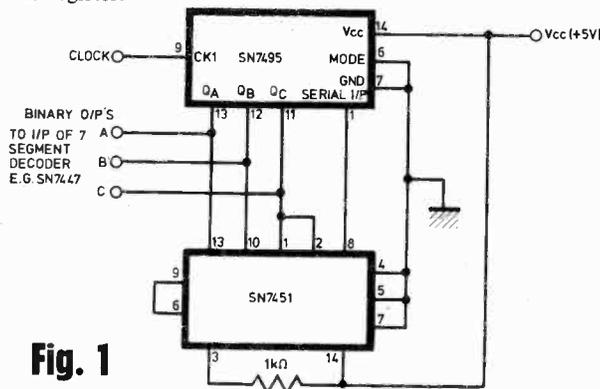


Fig. 1

The circuit diagram of Fig. 1 uses an SN7495 4-bit shift register, operating in the serial in, parallel out mode, and is suitable for use as the binary number generator for a digital die. As the shift register is clocked, its three outputs follow the 6-state cyclic sequence shown in Fig. 2.

The SN7451 dual, 2-wide, 2-input AND-OR-INVERT gate forms the combinational logic feedback network which processes the outputs A, B and C to determine the next logical state for the register. This combinational logic performs the Boolean function:

$$F = \overline{AC} + \overline{BC}$$

A suitable clock source is shown in Fig. 3. This consists of a simple unijunction relaxation oscillator, plus a pulse amplifier to boost its output. Closing S1 activates the oscillator and thus creates the "roll" effect for the die. An important characteristic of this clock source is that when S1 is released, the effect of any contact bounce does not appear at the output of the clock source. Such contact bounce can cause the register to clock spuriously, leading to unwanted output combinations appearing, i.e. 000 or 111.

P. Hutchinson,  
Brockenhurst,  
Hants.

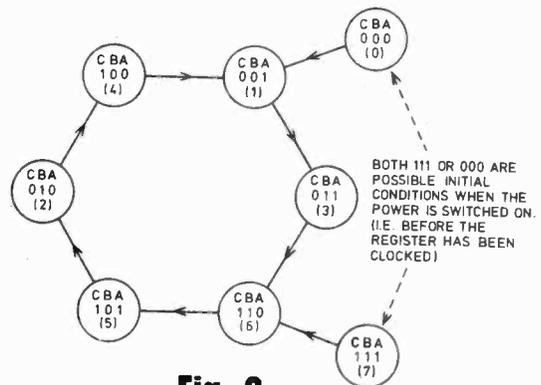


Fig. 2

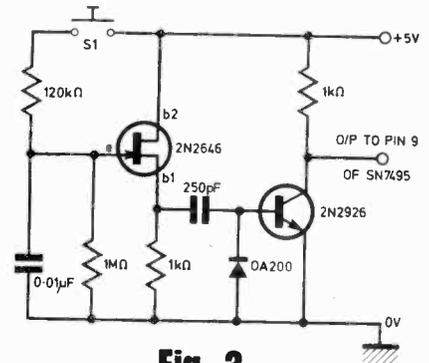
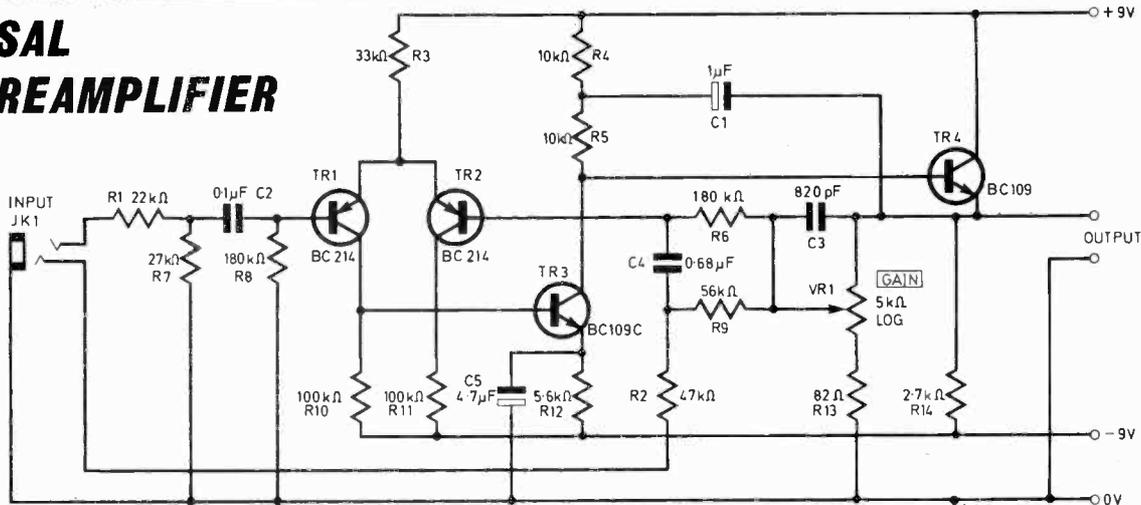


Fig. 3

# UNIVERSAL P.A. PREAMPLIFIER

Fig. 1



THE circuit of Fig. 1 was developed to provide improved dynamic range, distortion and signal-to-noise ratio on an otherwise conventional 741-based, 16-channel mixer. It also incorporates a number of novel features which simplify the input switching requirements for the mixer.

This preamplifier will handle signal levels ranging from less than 1mV, such as might come from a high-quality microphone, up to several volts r.m.s., as can be produced by a high output guitar pick-up. The differential input provided by TR1 and TR2 operates over this range with low distortion, and allows a balanced input to be achieved without the expense and inconvenience of a microphone transformer.

The arrangement of the input connections eliminates the need for switching between balanced and unbalanced modes. A stereo jack is used, providing two signal connections for a balanced lead, connected by means of a stereo jack-plug. The signals are then fed via R1 and R2, giving a differential input impedance of about 90kΩ.

Fig. 2



An unbalanced signal source would be connected via a mono jack-plug, whose sleeve will short R2 to earth, so that the amplifier functions as a non-inverting single-ended input stage, with an input impedance of about 45kΩ.

For input impedances less than those quoted above, a loading resistor  $R_L$  should be connected across the input ends of R1 and R2 so that the resultant paralleled value approximates to that required (e.g.  $R_L = 680\Omega$  for 600Ω line). This resistor could be inserted by means of a front panel switch, but a simpler and more versatile solution is to wire an  $\frac{1}{4}$ W resistor inside the actual jack-plug, as shown in Fig. 2. A robust screened jack-plug with solder terminals should be used, and colour-coded tape applied to the cable to show that it has been "pre-loaded" and now matches a standard high impedance input on virtually any amplifier.

The input stage feeds a high gain common-emitter voltage amplifier, TR3, with a bootstrapped collector load for increased efficiency. This is followed by an emitter-follower based on TR4, which provides a low-impedance output for tight control of the feedback circuit, and is capable of driving channel fader or tone controls without detriment to the signal, which is closely balanced about earth.

Gain is variable between unity and 60 (36dB), providing a minimum output of 50mV r.m.s. for further amplification. Several such preamplifiers could be incorporated into a mixer or public address amplifier, with tone and volume controls and mixing-with-gain based on i.c. op. amps. The balanced supplies could then be derived from the op. amp. supply, decoupled and Zener-stabilised as appropriate.

P. J. Willcox,  
London W11.

# TTL FREQUENCY DOUBLER

THE circuit shown in Fig. 1 is a frequency doubler using TTL gates. It provides two complete output pulses for one complete input pulse.

On the positive-going edge of the input pulse, the output for IC1a goes low and this sudden change is passed through C2 to turn D1 hard on. This causes IC1 pin 5 to go low and pin 6 to go high. If no further changes are made at the input, C2 discharges and the output returns to the low condition. On the negative-going edge of the input pulse, D2 is turned on

via C1, causing the output of IC1b to go high again, returning to low shortly after.

The two diodes are included to prevent excessive voltages being applied to the inputs of IC1b. The values of C1 and C2 depend upon the input frequency being used. The table gives a rough guide to the actual values required for four different frequency ranges.

The shape of the output pulse may be improved by using a Schmitt NAND gate (such as the 7413) for IC1b.

P. J. Hambridge, Ilford.

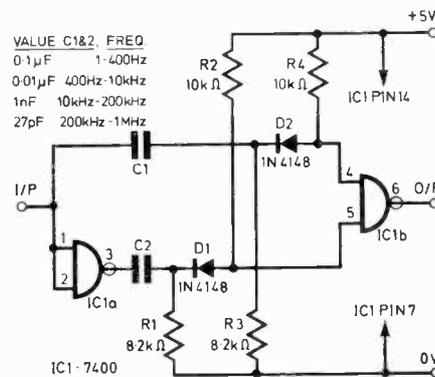
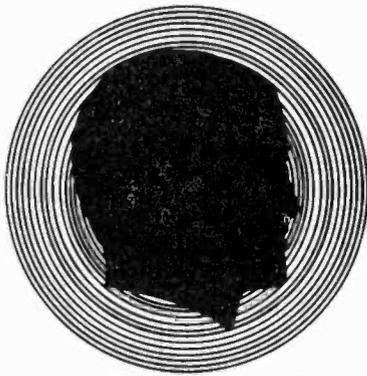


Fig. 1

# CAR SYSTEM MONITOR



## INGENUITY UNLIMITED

THE circuit in Fig. 1 uses a seven segment i.e.d. display to show characters that indicate a car system fault, such as low hydraulic fluid or coolant, and are accompanied by an audible tone. Altogether, these eight characters and their meanings are shown in table 1.

When any one of the sensor outputs falls to logical 0 (when a fault occurs) the output of the 7430 eight

input gate, goes high. This enables a simple three gate oscillator, and TR1 drives the loudspeaker. The 7430 output also enables the seven segment display drivers (7401s). The original sensor output pulls its associated driver gate (7407) output to ground. This output pushes down the 7401 driver inputs via the diode matrix. When the drivers are enabled, the output is at ground level, therefore switching on that segment connected to it, the DL707 being a common anode display.

Sensor circuits of the type used with the display are shown in Figs. 2 to 5. Fig. 2 shows a spark plug monitor. This has a discrete i.e.d. which will glow when that plug is firing. The coil picks up impulses which are fed via an amplifier to a monostable which fires for about 0.7 second. This charges up a capacitor and produces a logical 1 at the Schmitt gate input. Missing pulses will allow the capacitor to discharge, changing the state of the Schmitt trigger, and causing a final display of "S". One circuit can be used for each plug, each feeding into the SN7413.

Fig. 3 shows an oil pressure monitor. When the input falls to zero volts, the first transistor switches off and the second transistor switches

LIST OF SYMBOLS PRODUCED	
	= COOLANT LEVEL
	= BRAKE FLUID LEVEL
	= OIL PRESSURE
	= TEMPERATURE
	= BATTERY LEVEL
	= SPARK PLUG NOT FIRING & LED DISPLAY
	= HEAD AND REAR LAMPS
	= BRAKE LIGHTS

on. This produces a zero at the "0" input of the display circuit. The preset must be adjusted so that the display comes on only when the input is at exactly zero volts.

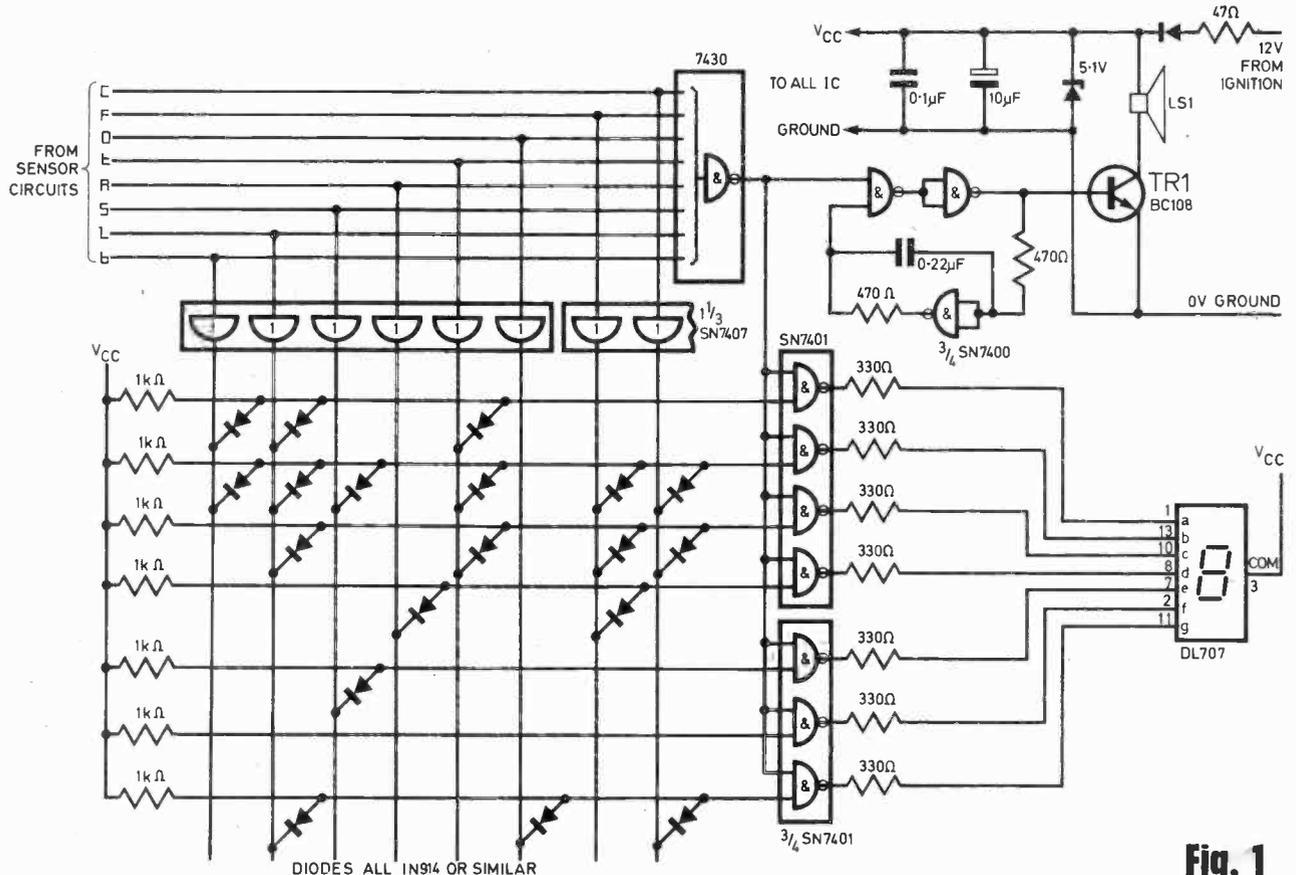


Fig. 1



# COUNTER

It is often a requirement to reset a 7490 counter to one instead of zero. The 7490 is in fact two separate counters in one package, with an external connection required between the A output of the divide-by-two stage and the B input of the divide-by-five stage.

These counters change state on a negative-going edge, so that if an inverter is put in the external loop between the stages, and the output of the inverter (A' in Fig. 1) is now read as the output of the divide-by-two stage; on reset the output count will read one.

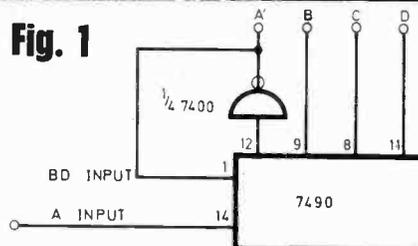
TRUTH TABLE

Basic Count	A	A'	B	C	D	Modified Count
0	0	1	0	0	0	1
1	1	0	1	0	0	2
2	0	1	1	0	0	3
3	1	0	0	1	0	4
4	0	1	0	1	0	5
5	1	0	1	1	0	6
6	0	1	1	1	0	7
7	1	0	0	0	1	8
8	0	1	0	0	1	9
9	1	0	0	0	0	0

Outputs to decoder

After the first input pulse, the A' output will go to a low logic level, and as this is a negative-going edge

Fig. 1



the B output will go high, giving an output count of two.

It can be seen from the truth table that the normal counting sequence will be followed, but running from one through to zero instead of zero through to nine.

M. R. Oakley,  
Walsall.

# DIGITAL CLOCK TOUCH-SWITCHES

A MAINS alarm clock using the MK50253 clock chip was built, and it was decided that touch-switches were desirable for all functions. The high input impedance, low power consumption and cost, of CMOS i.c.s made them ideal for this purpose, and in fact they worked out cheaper than ordinary push switches!

Two CD4011 quad 2 input NAND gates (G1 and G2) were used. Most of the switches consist of simple refinements to Fig. 1, which is that used for the SNOOZE control. A 10MΩ resistor (R1) holds both the inputs of G1a high, thus giving a low at the output. By placing a finger

across the input and ground, the output goes high, thereby enabling the respective pin on the clock i.c.

The circuit for setting MINUTES, TENS-OF-MINUTES, and HOURS (Fig. 2), is similar, except that two diodes connected to the inputs of G1b and G1c allow the MINUTES to be advanced.

For the RUN, STOP, ALARM SET function, three gates and two diodes are required (Fig. 3). Diodes D3 and D4 are necessary to allow pin 15 of the clock i.c. to be floating when in the RUN mode.

The ALARM ON/OFF circuit shown in Fig. 4 is a simple flip-flop. The l.e.d. D5, and TR1, allow visual indication when the alarm is set.

Power can be derived straight from the existing supply if it does not exceed about 16 volts. TR1 can be any cheap p.n.p. transistor such as a 2N3703. Diodes D1 to D4 are small signal silicon diodes such as 1N914.

For the touch-plates, pairs of "defunct" metal cased TO18 transistors were used. The heads were passed through small holes in the top of the case, and the appropriate wire soldered to the collector lead, which is usually connected internally to the case of the transistor. This gives a very neat appearance.

G. Watts,  
Bordon,  
Hants.

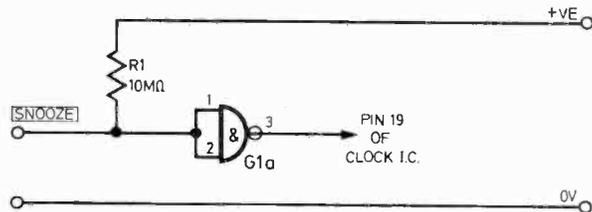


Fig. 1

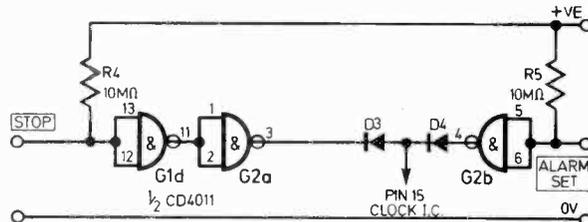


Fig. 3

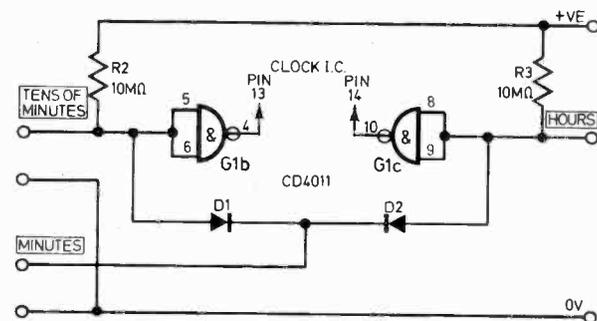


Fig. 2

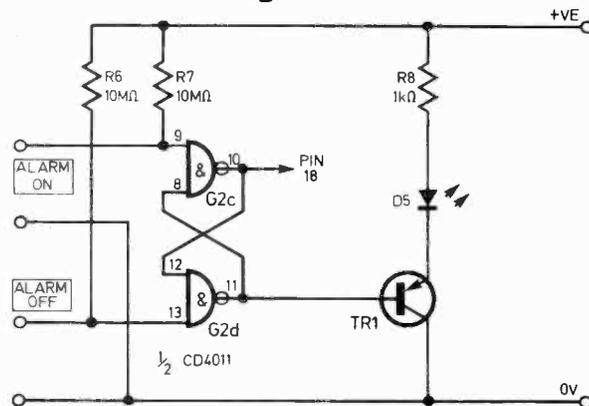


Fig. 4

# U.K. RETURN OF POST MAIL ORDER SERVICE *also* WORLDWIDE EXPORT SERVICE

## R.C.S. 10 WATT AMPLIFIER KIT



This kit is suitable for record players, tape play back, guitars, electronic instruments or small P.A. systems. Two versions are available. The mono kit uses 13 semiconductors. The stereo kit uses 22 semiconductors. Both kits have printed front panel and volume, bass and treble controls. Spec. 10W output into 8 ohms, 7W into 15 ohms. Response 20c/s to 30kc/s, input 100mV. High imp. Size 9½ x 3 x 2in. A/C mains operated.

Mono kit **£11.25** Stereo kit **£18** Post 45p  
Easy to build. Full instructions supplied.



## ELAC 10 inch £4.50

Ribbed cone. Large ceramic magnet. 50-16,000 c/s. Bass resonance 55 c/s. 10W. 15 ohm impedance.

**ELAC 9 x 5in HI-FI £3.45**  
SPEAKER TYPE 59RM Post 35p  
This famous unit now available. 10W, 8 ohm.

## ELAC HI-FI SPEAKER 8in TWIN CONE

Dual cone plastic roll surround. Large ceramic magnet. 50-16,000 c/s. Bass resonance 40 c/s. 8 ohm impedance. 15 watts RMS. **£5.95** Post 35p

## MAINS TRANSFORMERS

	ALL POST
250-0-250V 70mA, 6-3, 2A	£3.45
250-0-250 80mA, 6-3V 3 5A, 6-3V 1A or 5V 2A	£4.60
350-0-350 80mA, 6-3V 3 5A, 6-3V 1A or 5V 2A	£5.80
300-0-300 120mA 2 x 6-3V 2A C.T., 6-3V 2A	£5.50
220V 45mA, 6-3V 2A	£1.75
HEATER TRANS. 6-3V 3A, £1.45. ½ amp. £1.00	
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2A 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V	£5.30
1A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£5.30
2A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£5.50
3A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£11.00
5A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£14.50
5, 8, 10, 16V ½A £1.2V 100mA £1.12V 300mA £1.12V 750mA £1.40V 2A tapped 10V or 80V £2.95. 20V 3A £2.40V 2A £2.95. 30V 5A + 34V 2A ct. £3.75. 2 x 18V 6A £1.11.	
20-0-20V 1A £2.95. 30V 1½A £2.75 20V 1A £2.20.	
60V, 40V, 20V or 20-0-20V, 1A £3.50.	
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £5; 250W £6; 400W £7; 500W £8.	
CHARGER TRANSFORMERS. Input 200/250V for 6 or 12V 1½A £2.75; 4A £4.60.	
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs 1½A 50p; 2A 35p; 4A 85p. HALF WAVE 12V 1½A 25p	

## GOODMAN'S COMPACT 12in BASS WOOFER

Standard 12in diameter fixing with cut sides 10in square. 14,000 gauss magnet. 30 watt r.m.s. 4 ohm impedance. Bass resonance 30 c/s. Frequency response: 30-8,000 c.p.s. £10.95 each—Post £1.00.



## PERIOD LOUDSPEAKER CABINETS

Two styles available. Regency and Queen Anne. Size approximately 34 x 19 x 16in. These cabinets are slightly soiled and are priced from £10 each. Callers only.

ADASTRA 3+3W STEREO AMPLIFIER. 10 Transistor Push-Pull Ready built with volume, treble and bass controls. 240V operated. Size 8 x 3 x 6in. **£10.95**

## HEATING ELEMENTS WAFER THIN

Size 10½ x 8½ x ¼in. Operating voltage 200/250V a.c. 250W approx. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos.

ONLY **40p** EACH (FOUR FOR £1.50)  
ALL POST PAID—Discounts for quantity.

## E.M.I. 13½ x 8in SPEAKER SALE!

With tweeter. And crossover. State 7 or 8 ohm.

**10W Model £7.95** Post 45p  
**15W model £10.50** Post 65p  
**20W model £11.50** Post 65p  
4 or 8 or 15 ohms.



## TEAK VENEER HI-FI SPEAKER CABINETS

MODEL "A". 20 x 13 x 12in. For 12in. dia. or 10in. speaker. Illustrated. **£14.50** Post £1.60

MODEL "B". BOOKSHELF For 13 x 8in. or 8in. speaker. **£8.50** Post £1

R.C.S. BOOKSHELF SPEAKERS Size 14 x 9 x 6in. approx. Response 50 to 14,000 cps 6 watt rms 8 ohms. **£16 pair** Post £1.30

ACOUSTIC WADDING 18in. wide, 20p ft.

## KUBA-KOPENHAGEN STEREO



### TUNER-AMPLIFIER CHASSIS AM-FM 5+5 WATT

This Continental 4-band radiogram chassis uses first class quality components throughout. Features: Large fascia panel with 7 push buttons for medium, long, short, VHF-FM, AFC, phono, mains on-off. 4 rotary controls, tuning, volume, tone, balance. Facia size 17 x 4¼in. Chassis size 17 x 4¼ x 5¼in. DIN-connector sockets for tape record/playback, loudspeakers, phono pick-up, external FM-AM aerials. Automatic stereo beacon light. Built-in ferrite rod aerial for medium/longwave. **£33.50** Post £1.50 a.c. 240V mains. Circuit supplied.

## BAKER MAJOR 12 INCH £15



30-14,500 c/s. 12in double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s. Rated 25W. NOTE: 4 or 8 or 16 ohms available.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle, 19 x 12¼in. instructions. As illustrated. **£19** Post £1.60

## "BIG SOUND" BAKER SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups and discos. Useful response 30-13,000 c/s. Bass Resonance 55 c/s.

### GROUP "25"

12in 30W 4, 8 or 16 ohms **£12** Post £1

### GROUP "35"

12in 40W 4, 8 or 16 ohms **£14** Post £1

### GROUP 50/12in

12in 60W 4 or 8 or 16 ohms with aluminium presence dome. **£21** Post £1.60

### GROUP 50/15in

15in 75W 8 or 16 ohms. **£26** Post £1.60

Disco, Group + PA Cabinets in stock. Send for Leaflet: Cabinet Fittings, Handles, Corners, Feet, Covering Material all in stock.

## BAKER 150 WATT ALL PURPOSE TRANSISTOR AMPLIFIER



Ideal for Groups, Disco, P.A. and Musical Instruments. 4 inputs speech and music. 4 way mixing. Output 4/8/16 ohm. a.c. Mains Separate **£72** Carr. £1.50

### NEW "DISCO 100 WATT" £59

ALL TRANSISTOR AMPLIFIER CHASSIS Carr. £1.50  
2 inputs. 4 outputs separate volume treble and bass controls. Ideal disco or slave amplifier chassis. Made by Jennings BLACK CARRYING CABINET AVAILABLE £9.

## PW SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three 1,000W chimes. As featured in Practical Wireless. **£14.00** CABINET extra £3.

## GOODMANS CONE TWEETER

18,000 c/s 25W 8 ohm. Price **£3.25**  
E.M.I. 5in. mid range 25W £4.95.  
E.M.I. 13 x 8in. 25W Bass Unit £10.50

## R.C.S. 100 WATT VALVE AMPLIFIER CHASSIS



Professional model. Four inputs. Treble, Bass, Master Volume Controls. Ideal disco, P.A. or groups. S.A.E. for £94 details. 5 speaker outputs. 3 or 8 or 15 ohm. 100V line to order. Suitable carrying case £18.50. plus £2.50 carr.

LOW VOLTAGE ELECTROLYTICS  
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p. 500mF 12V 15p; 25V 20p; 50V 30p. 1000mF 12V 17V; 25V 35p; 50V 47p; 100V 70p. 2000mF 6V 25p; 25V 42p; 50V 57p. 2500mF 50V 62p; 3000mF 25V 47p; 50V 65p. 3900mF 100V £1.60. 4700mF 50V £1.20. 5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 5600mF 78V £1.60.

## R.C.S. LOW VOLTAGE STABILISED POWER PACK KITS

All parts and instructions with Zener diode, printed circuit rectifiers and double wound mains transformer. Input 200/240V a.c. Output voltages available 6 or 7.5 or 9 or 12V d.c. up to 100mA or less. Size 3 x 2½ x 1½in. Please state voltage required. **£2.95** Post 45p

## R.C.S. POWER PACK KIT

12V, 750mA. Complete with printed circuit board and assembly instructions. 12V 300mA KIT. £3.15. 9V 1 amp KIT. £3.35. Post 30p **£3.35**

## R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER—BRITISH MADE £1.45

Ideal for Mike. Tape. P.U., Guitar. Battery 9-12V or H.T. line 200-300V d.c. operation. Size 1½ x 1½ x 2in. 25 c/s to 25 kc/s. 26 dB gain. For valve or transistor equipment. Instructions supplied.

## ELECTRO MAGNETIC PENDULUM MECHANISM 95p

1.5V d.c. operation over 300 hours continuous on SP2 battery, fully adjustable swing and speed. Ideal displays, teaching electro magnetism or for metronome, strobe, etc.

## BSR HI-FI AUTOCHANGER



Plays 12in, 10in or 7in records Auto or Manual. A high quality unit backed by BSR reliability with 12 months guarantee. a.c. 200/250V. Size 13½ x 11½in. Above motor board 3¼in. Below motor board 2¼in. With STEREO/MONO CARTRIDGE. **£11.95** All Post 75p

Single Player version £13.50. BSR P128 with Magnetic Cartridge GARRARD MINICHANGER plays all records BSR P163 BELT DRIVE DECK, less carriage **£8.95**

## BSR DE LUXE AUTOCHANGER



Features balanced arm. Cueing device, stylus pressure gauge 3 speed plays all size records. Fitted with stereo ceramic cartridge. Size: 13 x 12in. **£17.50** Post £1.



## R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop, stereo/cartridge. Baseplate. Size 11 x 8¼in. Turntable. Size 7in diameter. a.c. mains 220/250V. 3 speeds plays all size records **£6.95** Post £1.50

## HEAVY METAL PLINTHS

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Silver grey finish. Model "A". Size 12½ x 14½ x 7½in. Post £1.30  
Model "B". Size 16 x 13½ x 7in. £7.50. Extra Large Plinth and Cover. For transcription decks. See 20 x 17½ x 9in. uncut board. Callers only £18.50. **£6.50**

TINTED PLASTIC COVERS ONLY  
Size: "A"—14½ x 12½ x 4¼in. £3. "B"—20½ x 12½ x 4¼in. £3.75. "C"—17½ x 13½ x 3¼in. £3.75. "D"—16½ x 14 x 4in. £4. "E"—19 x 14½ x 4¼in. £4. 15 x 13½ x 3in. £3.50. Ideal for record decks, tape decks, etc. Post 75p.

## BAKER HI-FI SPEAKERS

HIGH QUALITY—BRITISH MADE

### SUPERB 12in 25 watt £22

Quality loudspeaker, low cone resonance ensures clear reproduction of the deepest bass. Special copper drive and concentric tweeter cone. Full range reproduction with remarkable efficiency in the upper register. Bass Resonance 25 c/s  
Flux Density 16,500 gauss  
Useful response 20-17,000 c/s  
8 or 16 ohms models.



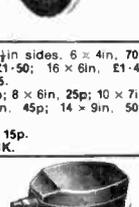
### AUDITORIUM 12in 35 watt £21

A full range reproducer for high power. Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Discotheques. Bass Resonance 35 c/s  
Flux Density 15,000 gauss  
Useful response 25-16,000 c/s  
8 or 16 ohms models.



### AUDITORIUM 15in 45 watt £26

Blank Aluminium Chassis. 18 s.w.g. 2½in sides. 6 x 4in, 70p; 8 x 6in, 90p; 10 x 7in, £1.15; 14 x 9in, £1.50; 16 x 6in, £1.45; 12 x 3in, 87p; 16 x 10in, £1.70; 12 x 8in, £1.35. ALUMINIUM PANELS, 18 s.w.g. 6 x 4in, 15p; 8 x 6in, 25p; 10 x 7in, 30p; 12 x 5in, 30p; 12 x 8in, 40p; 16 x 6in, 45p; 14 x 9in, 50p; 12 x 12in, 55p; 16 x 10in, 75p. ALUMINIUM ANGLE BRACKET, 6 x ¼ x ¼in. 15p. ALUMINIUM BOXES, MANY SIZES IN STOCK.



THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. a.c. mains 200/240V. Leaflet S.A.E. **£4.95** Post 40p

# RADIO COMPONENT SPECIALISTS 337 WHITEHORSE ROAD, CROYDON, U.K. Tel. 01-684 1665

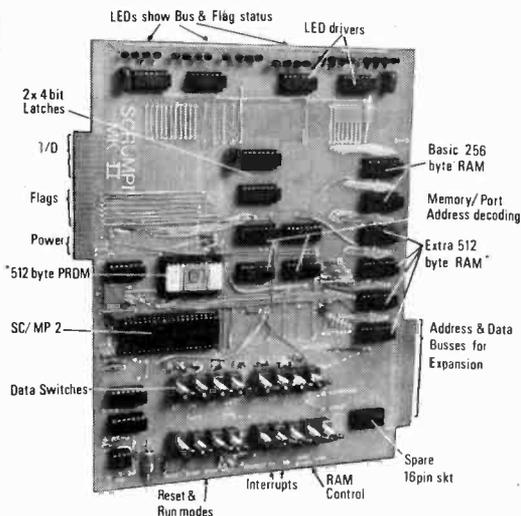
Minimum post 30p. Access/Eurocard and Barclaycard/Visa. Same day despatch. Radio Books and Components Lists 20p. Open 9-6 Wed. 9-1 Sat. 9-5 (Closed for lunch 1.15-2.30)

# SCRUMPI is good for you!

Education, Training,  
Development, In-  
circuit testing,

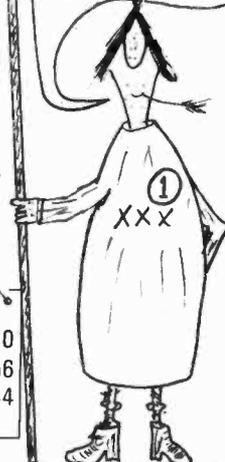
I'm the new (and larger)  
SCRUMPI 2. Play with  
my PROM, conduct my  
buses, ewes my extra\*  
RAM.

\*Only with 2F kit.



All component & sockets included in Basic kit except those marked \* (Full kit only).

I'm SCRUMPI 1,  
the lowest cost MPU  
kit available!  
See PE, Aug 77 for review.



SC/MP  
MPU Chips  
by  
**NATIONAL**

PRICES: £	
SCRUMPI 1	46.30
SCRUMPI 2B	55.56
SCRUMPI 2F	69.44
8% VAT Excluded.	

## We also stock:

E.T.I. System 68 MPU kits, VDU kits, Case kit.  
Comprehensive selection of Hardware & Soft-  
ware support. Digital clock chips, kits, displays.  
Please send SAE for our catalogue.

## Products from:

Fairchild, General Instruments,  
Liton, Litronix, Mostek,  
Motorola, National Semi.  
S.M.C., Vero.

# BYWOOD

ELECTRONICS

68 Ebbens Road, Tel. 0442-62757  
Hemel Hempstead, HP3 9QR.

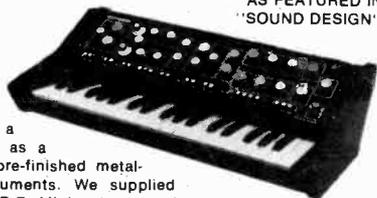
## The Amazing Mk. 2 MINISONIC

IS HERE  
TO STAY

A sound investment and a  
pleasure to build, available as a  
complete kit, module kits, pre-finished metal-  
work kit or complete instruments. We supplied  
components for the original P.E. Minisonics, now let  
us supply yours.

Send S.A.E. for full price structure.

Kits for the P.E. Sound Synthesiser are still available.



AS FEATURED IN  
"SOUND DESIGN"

## BUY FROM THE SPECIALISTS . . .

### EATON AUDIO

P.O. Box 3 (6 Jutland Rise)  
St. NEOTS, CAMBS. PE19 3JB

TERMS: MAIL ORDER ONLY. C.W.O.  
MINIMUM ORDER £1. VAT. Please add 12%  
to value of order inc. P. & P. unless otherwise  
stated. Cheques or P.O.s payable to Eaton  
Audio. Orders over £5 free of P. & P.,  
otherwise please add 10p in the £1. Callers by  
appointment only.

## WIRE THREADING INTROKIT

£6.60

Oryx temp. cont. iron and stand	£11.50
Microshear cutters (with safety clip)	£4.50
Quality tweezers	£1.50
Conductive paint 3g tube 'Elecolit 340'	£2.50

TERMS: Add 35p P. & P. per order (Oryx iron and stand 45p  
P. & P.). Add 8% VAT to all orders—Overseas—Allow £1 extra  
for P. & P. airmail.

MAIL ORDER ONLY: Access available. Trade enquiries  
welcome.

ZARTRONIX, 115 Lion Lane, Haslemere  
Surrey GU27 1JL

## For Semi-Conductors

including

Small Signal Transistors  
Power Semi-conductors  
TTL, CMOS, I.C.s  
Linear I.C.s  
Signal and Power Diodes  
Zener Diodes  
Magneto Resistors  
Hall-effect devices  
Magnetic Proximity Switches  
Opto-electronic devices

Go to

### ELECTROVALUE

TO MAKE THE BEST OF

## For passive components

including

Plastic Film Capacitors  
Electrolytics  
Semi-precision capacitors  
Transformers  
Pot Cores  
R. M. Cores  
Ring Cores, etc.

Go to

### ELECTROVALUE

THE PROJECTS YOU BUILD

## The Open Door to Quality

It's the Electrovalue Catalogue No. 8 (4th  
edition black and white cover) with com-  
pletely up-dated prices. 144 pages, well  
illustrated. 40p post free with 40p voucher  
usable on orders for £5 or more. Send for  
yours now and order in confidence.  
**GOODS SENT POST FREE IN U.K. FOR  
C.W.O. ORDERS.** Keenly competitive  
prices plus **ATTRACTIVE DISCOUNTS**  
and only best quality goods.

### ELECTROVALUE LTD

(Dept. PE11) 28 St. Jude's Road, Englefield Green,  
Egham, Surrey TW20 0HB.  
Tel. Egham 3603. Telex 264475.  
North: 680 Burnage Lane, Burnage, Manchester.  
Tel. (061) 432 5945

**T.T.L. 74 I.C.'s By TEXAS, NATIONAL, I.T.T., FAIRCHILD etc**

7400	14p	7426	25p	7473	30p	74121	25p	74151	65p	74179	140p
7401	14p	7427	25p	7474	30p	74122	40p	74153	65p	74180	100p
7402	14p	7428	40p	7475	30p	74123	60p	74154	120p	74181	200p
7403	14p	7430	15p	7476	30p	74125	50p	74155	70p	74182	75p
7404	14p	7432	25p	7483	85p	74126	50p	74156	70p	74184	150p
7405	14p	7437	25p	7485	100p	74130	130p	74157	70p	74185	150p
7406	40p	7438	25p	7486	30p	74131	100p	74160	90p	74188	350p
7407	40p	7440	15p	7489	250p	74132	65p	74161	90p	74189	350p
7408	20p	7441	65p	7490	35p	74135	100p	74162	90p	74190	140p
7409	20p	7442	65p	7491	75p	74136	80p	74163	90p	74191	140p
7410	15p	7445	80p	7492	45p	74137	100p	74164	125p	74192	120p
7411	20p	7446	85p	7493	40p	74138	125p	74165	125p	74193	120p
7412	20p	7447	75p	7495	60p	74139	100p	74166	125p	74194	100p
7413	30p	7448	70p	7496	70p	74141	60p	74167	325p	74195	100p
7414	60p	7450	15p	74100	95p	74142	270p	74170	200p	74196	100p
7416	30p	7451	15p	74104	40p	74143	270p	74173	150p	74197	100p
7417	30p	7453	15p	74105	40p	74144	270p	74174	100p	74198	185p
7420	15p	7454	15p	74107	30p	74145	75p	74175	75p	74199	185p
7422	20p	7460	15p	74109	50p	74147	230p	74176	100p		
7423	25p	7470	30p	74118	90p	74148	160p	74177	100p		
7425	25p	7472	25p	74120	90p	74150	120p	74178	140p		

**CMOS**

4000	20p	4030	60p
4001	20p	4032	150p
4002	20p	4043	220p
4006	120p	4046	150p
4007	20p	4047	115p
4009	70p	4050	50p
4011	20p	4050	50p
4012	20p	4054	130p
4013	55p	4055	140p
4015	90p	4056	145p
4018	55p	4060	130p
4017	110p	4066	55p
4018	250p	4069	30p
4020	140p	4071	30p
4022	180p	4072	30p
4023	20p	4081	20p
4024	100p	4082	30p
4025	20p	4510	145p
4026	200p	4511	200p
4027	85p	4516	140p
4028	155p	4518	110p
4029	130p	4528	130p

**SPECIAL OFFERS**

IN4148 100 for £1.50  
 555 Timers 35p each  
 (100 for £30.00)  
 741 op. amps. 25p each  
 (100 for £20.00)  
 7410 I.C.'s 10 for £1.00  
 (100 for £9.00)

PLEASE NOTE ALL  
 PRICES INCLUDE  
 POSTAGE AND VAT  
 AT 8 OR 12% AS  
 APPROPRIATE

**MULLARD POT CORES**

LA3 100-500kHz 75p  
 LA4 10-30kHz 100p  
 LA5 30-100kHz 100p  
 LA7 8 10kHz 100p  
 LA13 for W.W. Oscilloscope 200p

**WIRE WOUND RESISTORS BY VTM**

5K 9 Watts  
 10 for £1.00  
 100 for £6.00  
 1,000 for £50.00  
 10,000 for £400.00

**XEROZA RADIO**

306 ST. PAUL'S ROAD,  
 HIGHBURY CORNER, LONDON N.1

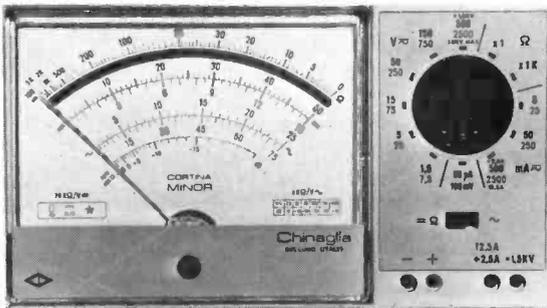
Telephone: 01-226 1489

Easy access to Highbury via Victoria Line (London Transport) British Rail

**A SPECIAL OFFER FROM**

**ALCON**

The MINOR professional multimeter by Chinaglia available at **£28.40 inc. VAT**



This 33-range instrument uses a Class 1.5 movement with 20kΩ/V d.c. and 4kΩ/V a.c. sensitivity. Accuracy is 2.5% d.c. and 3.5% a.c. Self-powered and pocket-sized, the Minor is guaranteed for 12 months and there is an optional 30kV probe available at £9.70.

**SAVE NOW—BUY WHILST STOCKS LAST**

**ALCON Instruments Ltd.**

19 MULBERRY WALK, LONDON SW3 6DZ TEL: 01-352 1897

**Sparkrite mk2**  
 Capacitive discharge  
 electronic ignition kit

VOTED BEST  
 OF 8 SYSTEMS  
 TESTED BY  
 'POPULAR  
 MOTORING'  
 MAGAZINE  
 OCT. 74



- \* Smoother running
- \* Instant all-weather starting
- \* Continual peak performance
- \* Longer coil/battery/plug life
- \* Improved acceleration/top speeds
- \* Optimum fuel consumption

Sparkrite Mk. 2 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 15/30 mins.

Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

**THE KIT COMPRISES EVERYTHING NEEDED**

Ready drilled pressed steel case coated in matt black epoxy resin, ready drilled base and heat-sink, top quality 5 year guaranteed transformer and components, cables, coil connectors, printed circuit board, nuts, bolts, silicon grease, full instructions to make the kit negative or positive earth, and 10 page installation instructions.

**OPTIONAL EXTRAS**

Electronic/conventional ignition switch. Gives instant changeover from "Sparkrite" ignition to conventional ignition for performance comparisons, static timing etc., and will also switch the ignition off completely as a security device, includes: switch connectors, mounting bracket and instructions. Cables excluded. Also available RPM limiting control for dashboard mounting (fitted in case on ready built unit).

**CALLERS WELCOME.** For Crypton tuning and fitting service — phone (0922) 33008.

**PRICES INCLUDE VAT, POST AND PACKING. Improve performance & economy NOW**

NOTE—Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.35 inc. VAT, post & packing  
 ELECTRONICS DESIGN ASSOCIATES, 82 Bath St., Walsall, WS1 3DE

**POST TODAY!**

**Quick installation**  
 No engine modification  
 required

Electronics Design Associates, Dept. PE11  
 82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 33652

Name .....  
 Address .....

Mk. 2 DIY Ass. Kit @ £11.80	QUANTITY REQD.	I enclose cheque/PD's for <b>£</b>
Mk. 2 Ready Built Negative Earth @ £14.97		
Mk. 2 Ready Built Positive Earth @ £14.97		Cheque No.
Ignition Changeover switches @ £4.30		Send SAE if brochure only required.
R.P.M. Limit systems in above units @ £2.42		

# Readout —

## A SELECTION FROM OUR POSTBAG

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

### DOUBLE-SIDED BOARD

Sir—There are many cases where double-sided printed circuit board is a necessity, such as to provide a ground plane, or to meet the requirements of certain r.f. circuits. Another situation, where a double-sided p.c.b. would be useful to overcome a logic layout problem is shown in Fig. 1, in which a printed data bus is to feed various i.c.s. To do this on single-sided board would require many tedious and untidy hard wired links. The use of conventional double-sided p.c.b. would call for

considerable care to be taken that both sides aligned correctly.

The difficulty can be overcome using single-sided board, by placing a strip of Veroboard, track-side down, on the copper clad surface of the circuit board. The position of the Veroboard is maintained by clamping it to the circuit board via pins inserted in diagonally opposite holes drilled through both boards simultaneously. As shown in Fig. 2, now that the Veroboard is held in register the copper surface can be marked through the Vero-holes with a sharp point. Next the printed circuit can be marked out, incorporating the points made through the Veroboard

(Fig. 3), and then etched in the usual way.

After etching, the Veroboard is replaced on the aligning pins, and used as a template to drill the p.c.b. holes. Finally the Veroboard is stuck to the p.c.b. plain side, once again using the aligning pins, but this time with the addition of pins soldered through to make the necessary connections; see Fig. 4.

This process should work out considerably cheaper and simpler than conventional double sided p.c.b.s.

R. M. Henderson,  
Newcastle upon Tyne.

### RIGHT DISPLAY

Sir—I would be grateful if any of your readers can explain to me why there are always two versions of 7-segment display available? I refer to the l.h. and r.h. decimal point options.

If only they were manufactured with the decimal point (d.p.) "half way up", we could turn them through 180 degrees and make them into l.h. or r.h. decimal point as required.

A little further thought on the pinout would ensure that no alteration need be made to the segment connections either.

C. P. Finn,  
Beverley.

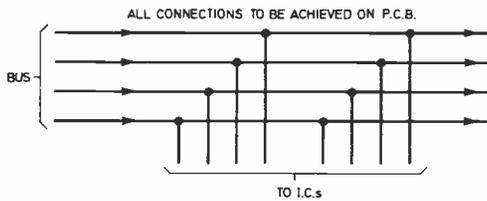


Fig. 1

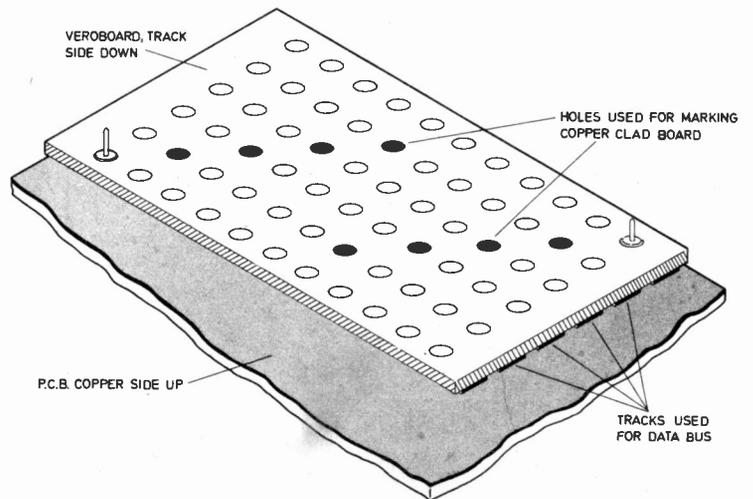


Fig. 2

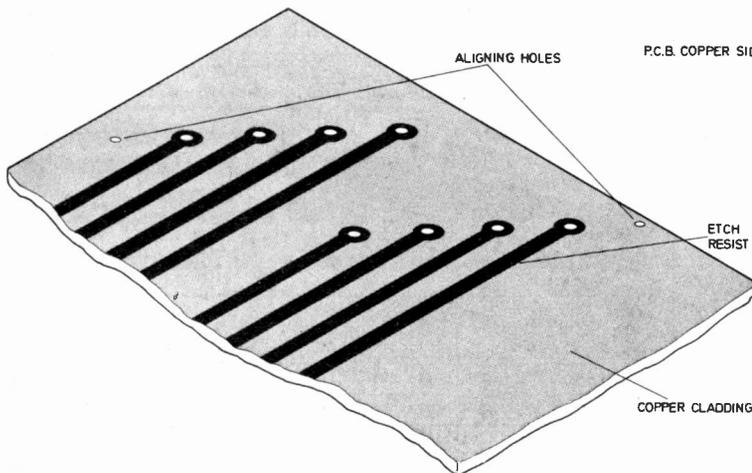


Fig. 3

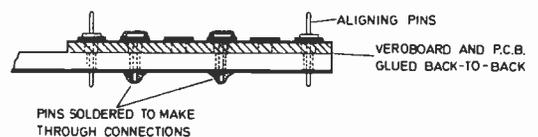
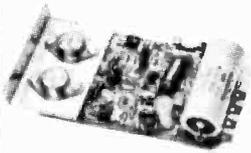


Fig. 4

# SAXON ENTERTAINMENTS LTD

## SYSTEM 7000—GUARANTEED MODULES FOR ALL DISCO/P.A. APPLICATIONS

### POWER AMPLIFIER MODULES 30—240 WATTS



- Fully tested and guaranteed.
- Full RMS Sine Wave output.
- Distortion typically 0.2%.
- 10 Transistors, 4 Diodes.
- Response 30Hz-30kHz.
- Fully short and open circuit proof.
- Sensitivity suits most mixers.
- Built-in surge suppression and compensation.
- Twin d.c. and output fuses.
- Top-grade components throughout.

30 Watts rms	60 Watts rms		120 Watts rms		240W rms
SA308 30W rms/ 8 ohms £9.50	SA604 60W rms/ 4 ohms £12.50	SA608 60W rms/ 8 ohms £13.50	SA1204 120W rms/ 4 ohms £14.50	SA1208 120W rms/ 8 ohms £21.00	SA2404 240W rms/ 4 ohms £25.50

POWER SUPPLIES FOR THE ABOVE MODULES—READY WIRED AND FUSED ON GLASS FIBRE PCB

PM301 For 1/2	PM601/4 For 1/2	PM601/8 For 1/2	PM1201/4 For 1	PM1201/8 For 1	PM1202/4 For 2	PM1202/8 For 2	PM2404/1 For 1
SA604 £9.90	SA608 £12.50	SA1204 £12.50	SA1208 £12.50	SA1204 £19.50	SA1208 £19.50	SA2404 £19.50	SA2404 £19.50

### SYSTEM 7000 COMPLETE DISCO MIXERS (With Autofade) Mono or Stereo



- Ready to plug in and use
- Automatic Mic override
- Two tone panel
- Twin deck and mic and tape inputs
- Left/Right deck fader
- 20Mz-20kHz Noise -77dB

The choice of the professional D.J.

Controls: Mic volume, Bass, Treble, A/Fade Depth, Tape, L/Deck, R/Deck volumes, Bass, Treble, Master, Headphone volume, Selector and On/Off.

Mono 18V £37.50 Mains £43.50 Stereo 18V £53.50 Mains £59.50

**IN MODULAR FORM—** All you require is front panel (see below) knobs and sockets etc. All electronics are assembled and tested.

■ Specification as for complete mixer ■ All Potentiometers supplied and fitted ■ Low cost do it yourself with step by step easy to follow instructions.  
Mono £19.50 Stereo £29.50 Panel £3.50 Supply unit £8.50

### SYSTEM 7000 LIGHTING CONTROL UNIT MK II (Four channel)



Has your light unit got?

- 4,000W handling
- Sequence facility
- Smart 2 tone panel
- Advanced IC circuitry
- Top grade components
- All your needs in one superbly designed unit
- Integral dimmers
- Automatic audio level

**OURS HAS!**

**ONLY £42.50**

**IN MODULAR FORM—THE QUADRAFACT**

£29.50 (Panel £2.50)

As with the mixers Mk II L.C. unit may be purchased in module form with all controls, requiring only a panel, case and knobs etc. There are 13 simple connections.  
■ 1-240W Audio ■ 8A RCA triacs ■ 0.5-20Hz Sequence ■ Fully suppressed

**CUSTOM MIXER MODULES** (Complete or in printed circuit form only) Make your own mixer, mono or stereo, up to 2 channels, with full monitoring facilities, and provision for echosend/return etc.

- Inputs for low and high 2 mic, ceramic and magnetic cartridge etc.
- Up to 20 input modules per single mixing module
- Feed most types of amplifier—accepts all inputs
- Professional low noise circuitry 20Hz-30kHz
- Infinitely adaptable—Extremely economical



**COMPLETE MODULES** With fascia panel, knobs and sockets, Monitor buttons, Ready wired and tested

Mono input £8.50 Mono mixing stage £8.50  
Stereo input £12.00 Stereo mixing stage £12.00

**PRINTED CIRCUIT MODULES** With controls fitted, requires only sockets, fascia and knobs

Mono input £5.50 Mono mixing stage £5.50  
Stereo input £9.00 Stereo mixing stage £9.00

Power supply for up to 20 channels—PPM18—£8.50.

### SYSTEM 7000 SOUND—LITE (3-CHANNEL) IN COMPLETE OR MODULAR FORM (Modular form illustrated)

- Complete unit similar to Mk II unit above
- Long established and proven design
- 3 Channels—100W per channel
- RCA 8A Triacs—individual channel fuses
- 1-240W input—master audio level plus Bass/Middle/Treble

**COMPLETE UNIT—Fully cased with rear terminations—just plug in and go!** £24.75  
**MODULAR FORM** Facia and knobs etc. Needs only 11 simple connections plug in and go! £16.50 (Panel £2.50)



### COMPLETE DISCO SYSTEMS (With two year guarantee—low interest credit)

From only **£16.06** deposit

#### Centaur 100W **STEREO**

with twin loudspeakers, sound to light sequence plus display

**£225** + £10 carr.

Dep. £28.80, 12 months at £21.38 or 24 months at £12.01

#### Super Centaur 200W **STEREO**

As above but with 200W output and larger twin cabinets

**£275** + £10 carr.

£32.80 12 months at £29.39 or 24 months at £15.21

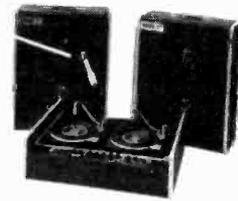
#### GXL Centaur 200W **STEREO**

As the Super Centaur but with extra large twin 200W cabinets, deck lights, deck starts and superior decks

**£349** + £10 carr.

Deposit £42.72 12 months at £36.58 or 24 months at £20.54

- Cue light + head-phone monitoring
- Mic and tape inputs
- Crossfade and override
- Logic circuitry lightshow
- Complete and ready to use
- Extremely rugged construction
- Twin BSR decks



Send today for free illustrated leaflet on Saxon complete discos and package PA systems

All equipment subject to a two year guarantee

Deliveries in the U.K. by our own vans

50W Mini Disco £139.50 + £5 carr. (Dep. £16.06, 12 months at £113.30 or 24 months at £7.46)

100W Mini Disco £159.50 + £5 carr. (Dep. £22.66, 12 months at £14.73 or 24 months at £8.27)

Two extremely compact mono systems complete with loudspeakers and leads  
■ Twin BSR decks ■ Headphone monitoring ■ Mic input  
100W package P.A. £145 + £7.50 carr. with twin loudspeakers and Piezo Horns (Dep. £19.70, 12 months at £13.78 or 24 months at £7.73)

**ACCESSORIES:** Condenser mics ECM77 600 ohm £13.50; ECM81 Dual impedance £14.95; Crown headphones £6.75; Heavy duty boomstand £14.50.

10% DEPOSIT, LOW INTEREST CREDIT ON ORDERS OVER £150

### SYSTEM 7000 MINOTAUR 100—All Purpose Wide Range Amplifier



- 100W rms—1dB
- Standard 8 ohm output
- Twin mixed inputs accept a wide range of signals
- 30Hz-30kHz ±2dB
- 23dB bass/treble
- Four individually mixed inputs
- Wide range bass/treble + master

An extremely compact and versatile amplifier with full protection and a clean, attractive appearance. Ideal for all groups, discos and clubs



**£49.50**

**SAXON 150 HEAVY DUTY AMPLIFIER £59.00**

### SUPERSTROBE £19.75

- 2-3 Joules
- 80W Tube for long life
- Compact 4in x 4in x 4in

### PRO-STROBE £32.50

- 6-8 Joules
- External trigger
- Long Life tube timer circuit



### 150 WATT LIQUID WHEEL PROJECTOR

- Accepts all accessories
- C/w with wheel and motor plate
- Sturdy steel construction
- Remarkable value—Sold elsewhere at £39.50. Our price is only: **£33.00**

### PIEZO HORNS!

Up to 150W handling No X-over required £7.50 each

All prices subject to VAT at 8% except SA308/PM301, mics. and headphones (12½%). Add 50p post and packing on all orders except where already shown  
Ordering: By Telephone—Access, Barclay Card or COD Ring (01) 684 6385/0098  
By post —Send cheque or crossed P.O.'s or 60p for COD or send in your Access/Barclay card NUMBER ONLY

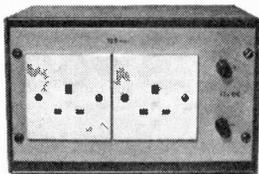
MAIL ORDERS AND CALLERS TO: **CROYDON**

327-333 Whitehorse Road, Croydon, Surrey CR0 2HS  
24 Hour Ansafone service (01) 684 6385

Exporters to 17 countries—enquiries welcomed  
Ring Sue Abegg on (01) 684 6385 for U.K. trade enquiries

## INVERTORS

KIT FORM or BUILT UP.



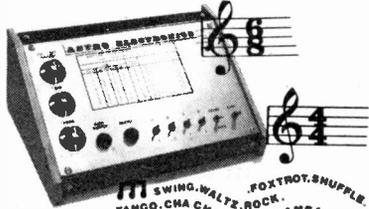
240v-50Hz from your 12v car battery.

O/P Powers available. 25W-40W-75W-150W-300W-400W-500W-1kW-1.5kW. Various battery I/P voltages available.

## AUTOMATIC INVERTORS

These units have built-in battery charger which functions whilst mains are healthy. Upon mains failure unit automatically switches to inverter operation ensuring no interruption of supply. Send S.A.E. for price lists.

## RHYTHM GENERATOR



SWING, WALTZ, ROCK, FOX TROT, SHUFFLE, TANGO, CHA CHA, MARCH, MAMBA, WACH.

15 different rhythms. 9 percussion instruments. Tempo range 15 to 100 bars/min. Full kit of parts available at £39.50 + £1.20 P. & P. + VAT at 8%. Price assembled and tested add £12. Parts available separately, send S.A.E.

We reserve the right to alter published prices in the event of component or postal increases.

## P.E. ORION STEREO AMPLIFIER & TUNER



May be mounted slim line or stacked as above. Parts available separately for both units.

20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0.1% 100Hz-10kHz. Frequency response  $\pm 1$ dB 20 Hz to 20kHz. Hum level virtually nil with volume full on. This is a power amplifier of superb quality incorporating the very latest design features. Professional hi-fi enthusiasts have classed it as fantastic and real value for money. The CCT incorporates a low flux transformer and inputs for disc, tape, tuner, etc.

## TUNER UNIT

May be purchased separately in matching slim line case. As full kit or individual parts.

Send S.A.E. for price list and specification sheets.



## LOUDSPEAKERS

8 inch system

This system is designed for use with above amplifiers rated up to 25W r.m.s. per channel at 8 $\Omega$ . May be incorporated in an enclosure 295 x 490 x 295mm (11.5 x 19.3 x 11.5in) approx. external, constructional details of which are given with each bass unit, to provide an overall frequency response of 50Hz to 22kHz. Four-element cross-over, ready constructed on p.c.b. Output leads have push-on receptacles to suit speaker tags. Cross-over frequency is 2-8kHz approx.

## POWER UNIT

Regulated



Voltage adjustable from 1-35v at 2 amps. Short circuit protected. Voltage and current meters incorporated. Full Kit of parts £48 + 8% VAT or assembled and tested £58 + 8% VAT.

## ASTRO IGNITION



SAVE FUEL

Complete kit of parts for this proven and tested system. (£11.90 + 60p P. & P.) + 8% VAT or ready built with only two connections to alter.

(£14.90 + 60p P. & P.) + 8% VAT.

Consider the advantages:

Fuel economy. Faster acceleration. More power. Excellent cold starting. Smoother running. No contact breaker burning. Less exhaust gases.

## TRANSFORMERS

SPECIAL OFFER

Miniature Mains Trans.

6-0-6v-6VA.

12-0-12v-6VA.

(£1.29 + 25p P. & P.) + 8% VAT

Transformer and coils manufactured to customer specifications both in High Volume and Small Order capacity.



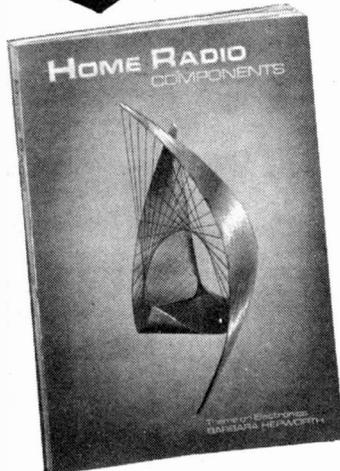
TRADE AND EXPORT ENQUIRIES WELCOMED ON ALL PRODUCTS:

## ASTRO ELECTRONICS

Springbank Road  
Chesterfield (31475)  
Derbyshire

N.B.—DELIVERIES ON ALL ITEMS MAY TAKE UP TO 28 DAYS, DEPENDING ON AVAILABILITY AND DEMAND. CASH IN REGISTERED ENVELOPE OR POSTAL ORDERS CAN REDUCE TIME BY NOT HAVING TO CLEAR CHEQUES

**THIS is the Catalogue you need to solve your component buying problems!**



- The finest components catalogue yet published.
- Over 200 A-4-size pages.
- About 5,000 items clearly listed and indexed.
- Nearly 2,000 illustrations.
- Bargain List sent free.
- At £1.40, incl. p. & p., the catalogue is a bargain.

Send the coupon below now.

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

Please write your Name and Address in block capitals

NAME .....

ADDRESS .....



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

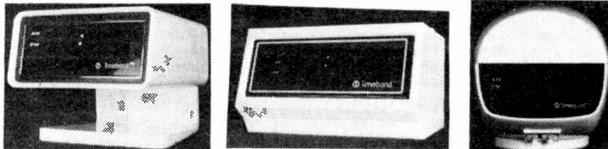
Regd No  
917966 London

## NEW FROM CASIOTRON

A new range of these superb watches, available from October. Full details and photographs are not available yet but they should knock spots off all the competition. All with at least 9 functions including backlight, plus Stopwatch to 13 hours. Some will have a Dual Time Zone feature and some a full Chronograph measuring lap times to One Hundredth of a second. Slimmer than ever, around  $\frac{1}{2}$  inch thick in some cases. We will also be having a Casiotron Alarm Watch with five way programming of the alarm. These watches will be All Stainless Steel with Mineral Glass face and Water Resistant to 3 atmospheres, 100 feet. We anticipate they will have a battery hatch with one battery lasting 15 months or more.

Fairchild Timeband Mains Digital Alarm Clocks

C500 (left) black or white £14.35; C6110 (centre) £15.90; C500 (right) £24.95



NEW FROM IBICO. Slim 6 digit 6 function watch plus backlight and CHRONOGRAPH.  $\frac{1}{100}$  second to 1 hour. Lap and Net times. In the all Stainless Steel 402 ES Water Resistant case. 451 ES £49.95. On leather strap 451 ELB £48.50

I.C. New low cost 6 digit watch with  $\frac{1}{100}$  second stopwatch £32.50  
Solar powered version with Tritium "Beta Light" night light. £44.50

ACCURIST. New slim-line quartz analogue (stepping motor). round face. Stainless Steel or Gold Plated on strap or matching Bracelet. Luminous. R R Price around £55.

CITIZEN. Once the same Company as Seiko. Wide range of these superb quartz analogue and digitals including Solar Powered analogue. PRICES ON APPLICATION.

SPECIAL OFFERS. Spend over £20 on CASIO products and we give you a Brushed Chrome PAPERMATE pen worth £3.90. Casio ST-1 £24.95. CQ-1 £29.95 MQ-1 £34.95. Full range of Casio Scientific calculators. Last month's prices. Gold Plated Pen and Pencil Set, or two pens, worth £11.90 with any of these watches: Timeband TC410 £27.95, TC412 £31.95, TC413 £28.95, National Semiconductor DACS YS £25.90, DACS YB £28.50, DAB5 WB £32.50, DAB5 YB £38.50, IBICO 405 ILB £26.50, 405 IS £27.50, 450 HS Chronograph £47.50, INSTAR 2 $\frac{1}{2}$  function LCD. Gold Plated on matching bracelet £15.50.

Send 15p for our illustrated catalogue. Car clocks, TV games, etc.

Offers subject to availability. All items advertised are in stock or on order at copy date. Prices include VAT. P. & P. Send cheque, P.O. or phone your credit card No. to:

# TEMPUS

Dept. PE  
19/21 Fitzroy Street  
Cambridge CB1 1EH  
Tel. 0223 312866

POST THIS COUPON with cheque or P.O. for £1.40

Get a great deal from

# Marshall's

Call in and see us 9-5.30 Mon-Fri 9-5.00 Sat

Trade and export enquiries welcome

A. MARSHALL (LONDON) LTD. DEPT. P.E.  
 LONDON—40-42 Cricklewood Broadway NW2 3ET  
 Tel: 01-452 0161. Telex: 21492  
 & 325 Edgware Rd W2. Tel: 01-723 4242/3  
 GLASGOW—85 West Regent Street G2 2QD  
 Tel: 041-332 4133  
 BRISTOL—1 Straits Parade, Fishponds Rd BS16 2LX  
 Tel: 0272 654201

## CATALOGUE NEW 1977 AUTUMN

COMPLETE BUYERS GUIDE TO  
 ELECTRONICS COMPONENTS  
 PRICE 35p POST PAID. 25p FOR CALLERS

### TOP 400 SEMICONDUCTORS FROM THE LARGEST RANGE IN THE U.K.

EXPRESS M.O. SERVICE BY RETURN POST—all  
 orders received despatched same day on stock items

Please add VAT to your order. P. & P. 40p

2N696	0-35	2N3703	0-15	2N6126	0-45	BC159	0-16	BD116	1-20	BFX85	0-35
2N697	0-30	2N3714	0-15	40362	0-50	BC160	0-35	BD131	0-51	BFX87	0-30
2N698	0-53	2N3705	0-15	40362	0-55	BC161	0-12	BD135	0-37	BFX89	0-25
2N699	0-55	2N3706	0-16	40363	1-30	BC167	0-12	BD136	0-37	BFX90	0-25
2N700	0-28	2N3707	0-18	40406	0-60	BC168	0-12	BD137	0-38	BFX91	0-25
2N705A	0-28	2N3708	0-13	40407	0-52	BC169	0-12	BD138	0-38	BFX92	0-30
2N708	0-28	2N3709	0-15	40408	0-75	BC170	0-18	BD139	0-40	BFX93	0-34
2N709	0-50	2N3710	0-16	40409	0-75	BC171	0-16	BD140	0-40	BFX94	0-35
2N718	0-27	2N3711	0-16	40410	0-15	BC172	0-14	BD206	0-29	BD209	0-40
2N718A	0-50	2N3712	1-26	40411	2-85	BC177	0-20	BD209	0-40	BD210	0-45
2N720A	0-50	2N3713	2-30	40594	0-80	BC178	0-20	BD241	0-45	BSX20	0-32
2N914	0-35	2N3714	2-45	40595	0-90	BC179	0-23	BD241	0-45	BSX21	0-32
2N916	0-30	2N3715	2-55	40673	0-75	BC182	0-11	BD242	0-50	BU105	1-40
2N918	0-38	2N3716	3-30	AC126	0-45	BC182L	0-14	BD243	0-60	BU205	2-20
2N918	0-38	2N3717	3-30	AC127	0-45	BC183	0-11	BD244	0-60	ME0402	2-20
2N929	0-25	2N3771	1-95	AC128	0-45	BC183L	0-14	BD245	0-65	ME0404	1-15
2N930	0-26	2N3772	2-00	AC128	0-45	BC184	0-12	BD246	0-66	ME0412	2-20
2N1131	0-30	2N3773	2-20	AC151V	0-40	BC184L	0-12	BD246	0-66	ME4102	1-10
2N1132	0-37	2N3789	2-90	AC152V	0-50	BC184L	0-14	BD259	0-45	ME4102	1-10
2N1613	0-30	2N3790	3-10	AC153	0-55	BC207	0-16	BD530	0-50	ME4104	1-10
2N1711	0-30	2N3791	3-10	AC153K	0-55	BC208	0-16	BD530	0-50	MJ481	1-55
2N1893	0-38	2N3792	3-50	AC176	0-50	BC212	0-17	BF115	0-38	MJ490	1-55
2N2102	0-98	2N3819	0-36	AC187K	0-60	BC212L	0-17	BF115	0-38	MJ491	1-55
2N2218	0-36	2N3820	0-38	AC188K	0-60	BC213	0-14	BF123	0-55	MJ491	1-55
2N2218A	0-36	2N3820	0-38	AC188K	0-60	BC213L	0-16	BF152	0-25	MJE340	0-58
2N2219	0-35	2N3823	0-80	AD161	1-00	BC214	0-16	BF153	0-25	MJE370	0-58
2N2219A	0-36	2N3904	0-21	AD162	1-00	BC214L	0-17	BF154	0-25	MJE371	0-60
2N2220	0-35	2N3906	0-22	AF106	0-55	BC237	0-14	BF159	0-35	MJE520	0-65
2N2221	0-25	2N4036	0-67	AF109	0-75	BC238	0-12	BF160	0-30	MJE521	0-65
2N2221A	0-26	2N4037	0-55	AF124	0-65	BC253	0-15	BF161	0-60	MJE295S	1-50
2N2222	0-25	2N4058	0-20	AF125	0-65	BC251	0-16	BF166	0-40	MJE305S	0-95
2N2222A	0-25	2N4059	0-15	AF126	0-65	BC253	0-22	BF167	0-35	MJE323K	0-66
2N2368	0-25	2N4060	0-20	AF139	0-69	BC257A	0-17	BF173	0-35	MP8112	0-40
2N2369	0-25	2N4061	0-17	AF186	0-50	BC258A	0-17	BF177	0-25	MP8113	0-45
2N2369A	0-25	2N4062	0-18	AF200	1-20	BC259B	0-18	BF178	0-25	MP8102	0-30
2N2646	0-75	2N4126	0-17	AF239	0-85	BC261A	0-24	BF180	0-35	MPSA05	0-25
2N2647	1-40	2N4289	0-20	AF240	1-14	BC262B	0-24	BF180	0-35	MPSA06	0-25
2N2904	0-36	2N4519	0-65	AF279	0-80	BC263C	0-30	BF181	0-35	MPSA12	0-40
2N2904A	0-37	2N4920	0-75	AF280	0-85	BC300	0-40	BF182	0-35	MPSA55	0-25
2N2905	0-37	2N4921	0-50	BC107	0-15	BC301	0-40	BF183	0-40	MPSA56	0-25
2N2905A	0-38	2N4922	0-55	BC108	0-15	BC303	0-50	BF184	0-38	MPSU05	0-50
2N2906	0-38	2N4923	0-70	BC109	0-15	BC307	0-15	BF185	0-35	MPSU06	0-56
2N2906A	0-35	2N5190	0-60	BC113	0-20	BC308	0-15	BF186	0-35	MPSU55	0-55
2N2907	0-25	2N5191	0-70	BC115	0-20	BC309C	0-15	BF195	0-15	MPSU66	0-60
2N2907A	0-25	2N5192	0-75	BC116	0-19	BC317	0-14	BF196	0-15	TIP29A	0-45
2N2924	0-15	2N5195	0-90	BC116A	0-20	BC318	0-13	BF197	0-17	TIP29C	0-60
2N2925	0-17	2N5245	0-34	BC117	0-22	BC327	0-20	BF198	0-18	TIP30A	0-49
2N3019	0-55	2N5294	0-40	BC118	0-20	BC328	0-19	BF200	0-35	TIP30C	0-65
2N3053	0-26	2N5295	0-40	BC119	0-30	BC337	0-17	BF253	0-25	TIP31A	0-50
2N3054	0-60	2N5296	0-40	BC121	0-65	BC338	0-21	BF254	0-35	TIP31C	0-66
2N3055	0-70	2N5298	0-40	BC132	0-30	BC339	0-17	BF245	0-40	TIP32A	0-55
2N3390	0-20	2N5447	0-15	BC134	0-20	BC548	0-12	BF246	0-75	TIP32C	0-75
2N3391	0-20	2N5448	0-15	BC135	0-20	BC549	0-13	BF254	0-24	TIP33A	0-80
2N3391A	0-20	2N5449	0-19	BC136	0-19	BCY30	1-00	BF255	0-24	TIP33C	1-10
2N3392	0-16	2N5457	0-32	BC137	0-20	BCY31	1-00	BF257	0-37	TIP34A	0-90
2N3393	0-15	2N5458	0-33	BC140	0-35	BCY32	1-00	BF258	0-45	TIP34C	1-20
2N3394	0-15	2N5459	0-29	BC141	0-35	BCY33	1-00	BF259	0-49	TIP35A	2-50
2N3439	0-88	2N5484	0-34	BC142	0-30	BCY34	1-00	BF259	0-50	TIP36A	2-80
2N3440	0-64	2N5486	0-38	BC143	0-30	BCY36	2-00	BF259	0-50	TIP41A	0-70
2N3441	0-81	2N6027	0-60	BC147	0-12	BCY42	0-60	BF259	0-50	TIP41C	0-90
2N3442	1-35	2N6101	0-45	BC148	0-12	BCY58	0-25	BF258	1-38	TIP42A	0-80
2N3638	0-16	2N6107	0-42	BC149	0-14	BCY59	0-25	BF258	1-38	TIP42C	1-00
2N3638A	0-16	2N6109	0-50	BC153	0-62	BCY70	0-30	BF258	1-38	TIP295	0-65
2N3639	0-30	2N6121	0-38	BC154	0-27	BCY71	0-26	BF259	0-35	TIP305S	0-55
2N3641	0-20	2N6122	0-41	BC157	0-14	BCY72	0-26	BFX20	0-35	TIS43	0-43
2N3702	0-13	2N6123	0-43	BC158	0-14	BD115	0-80	BFX84	0-35	LM748B	0-55

### INTEGRATED CIRCUITS

CA3020	2-00	LM1800	1-76	TA5A70	2-30
CA3020A	2-29	LM1808	1-92	TA5A11B	1-85
CA3028B	1-20	LM1828	1-75	TA5A21	2-15
CA3028A	1-10	LM3301N	0-85	TA5A61A	1-50
CA3030	1-35	LM3302N	1-40	TA5A61B	1-50
CA3030A	2-00	LM3401	0-70	TA5A61C	1-50
CA3045	1-40	LM3800	0-75	TA5A93A	1-30
CA3046	0-89	LM3905	1-60	TA5A93B	1-30
CA3046	2-23	LM3909	0-68	TAD100	1-95
CA3049	1-80	MC1035	1-75	TBA120	0-75
CA3050	2-42	MC1303	1-03	TBA400	2-90
CA3052	1-52	MC1304	1-40	TBA500	2-21
CA3080	0-75	MC1305	1-40	TBA500Q	2-21
CA3080A	1-88	MC1310	1-91	TBA510	2-21
CA3086	0-80	MC1327	1-54	TBA510Q	2-21
CA3088	1-70	MC1330	1-00	TBA520	2-21
CA3089	2-52	MC1350	0-90	TBA520Q	2-21
CA3090	4-00	MC1351	1-20	TBA530	1-98
CA3130	0-98	MC1352	1-10	TBA530Q	1-98
LM301A	0-67	MC1458	1-91	TBA540	2-21
LM301N	0-40	NE555	0-40	TBA540Q	2-30
LM304	2-45	NE556	1-10	TBA550	3-13
LM307N	0-85	NE565	1-30	TBA550Q	3-22
LM308C	1-62	NE566	1-65	TBA560Q	3-22
LM308N	0-85	NE567	1-80	TBA570	1-20
LM3130	1-95	SAS350	2-50	TBA570Q	1-38
LM317K	3-50	SAS350	2-50	TBA641B	2-70
LM318N	1-70	76018K	1-50	TBA651	1-20
LM372N	1-70	76023N	1-25	TBA700	1-52
LM373N	2-80	76023ND	1-46	TBA700Q	1-61
LM374N	3-10	76033N	2-20	TBA720Q	2-30
LM377N	1-75	76110N	1-18	TBA750	1-98
LM378N	2-25	76115N	1-51	TBA750Q	2-07
LM379S	3-95	76118N	1-66	TBA750Q	2-07
LM380B	0-80	76131N	1-20	TCA160B	1-85
LM380N	0-98	76226N	1-56	TCA270	2-25
LM381A	2-25	76227N	1-20	TCA280A	1-30
LM381N	1-60	76228N	1-41	TCA290A	3-13
LM382N	1-25	76530N	0-75	TC420A	1-84
LM384N	1-45	76532N	1-40	TC730	3-22
LM386N	0-80	76533N	1-20	TC740	2-76
LM387N	1-05	76544N	1-44	TC750	2-30
LM388N	0-90	76545N	1-65	TC760	1-38
LM389N	1-00	76546N	1-44	TC800	3-13
LM702C	0-75	76550N	0-35	UAA170	2-00
LM709C	0-65	76552N	0-55	UAA180	2-00
LM709N	0-65	76570N	0-60		
LM710N	0-60	76620N	1-10		
LM723C	0-85	76660N	0-60		
LM723N	0-75	76665N	0-92		
LM741C	0-65	TAA320A	1-00		
LM741N	0-40	TAA350A	2-48		
LM741R	0-40	TAA350	1-60		
LM747N	0-90	TAA522	1-90		
LM748B	0-55	TAA550	0-60		
LM748N	0-55	TAA560	1-75		

### MICROPROCESSOR COMPONENTS

# ORCHARD ELECTRONICS

**SERVICE SECOND TO NONE  
TRY US AND SEE**

NEW BIG CAT 50p + Refundable Vouchers

SUPPLIERS TO D.O.E., A.E.R.E., U.K.A.E.A.  
Government Depts., Universities, Schools and equipment manufacturers.

Stock list FREE with S.A.E.



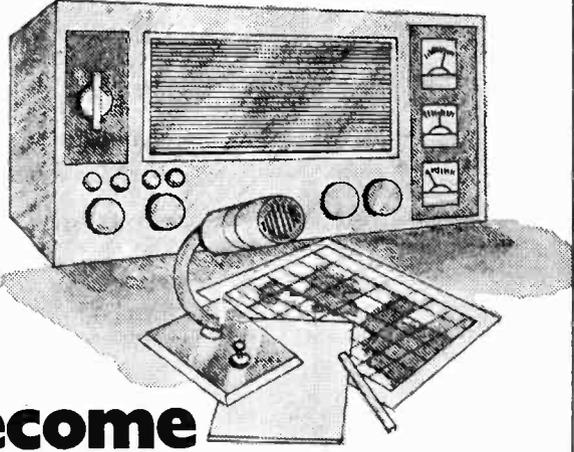
Flint House, High Street, Wallingford, Oxon (Tel. 0491 35529)

Post and packing 25p. Discounts £5 = 5%, £10 = 7%, £15 = 10%. VAT \* add 12%. Rest at 8%

TRANSISTORS				CAPACITORS ELEC. MFDV				CERAMICS 50V				I/C LINEAR				TTL DIGITAL			
AA119	0-04	BC178B	0-18	BF167	0-21	OC71	0-35	2N3703	0-14*	1/25	0-10*	2, 2, 4, 7, 6, 10, 22, 33, 39, 47, 100, 200, 555	0-49p	7400	15p	74191	2-10p		
AC125	0-26	BC179B	0-19	BF173	0-20	DC72	0-45	2N3704	0-13*	1/53	0-10*	709 (T099)	0-35p	7401	20p	74192	1-60p		
AC126	0-26	BC182B	0-12*	BF178	0-24	OC74	0-45	2N3705	0-14*	5/16	0-10*	709 (8 PIN DIL)	0-40p	7402	18p				
AC127	0-28	BC182L	0-11*	BF183	0-25	OC81	0-60	2N3707	0-12*	2/25	0-10*	10000 47000pF 1MFD 10V. All at 6p*	0-26p	7403	18p				
AC128	0-29	BC183B	0-10*	BF183	0-34	OC82	0-70	2N3708	0-12*	2/263	0-10*	AY-5-1224	3-75p	7404	23p				
AC151	0-35	BC183L	0-10*	BF184	0-25	ORP12	0-58	2N3709	0-14*	2/564	0-10*	AY-3-8500 T.V.		7407	18p				
AC153	0-35	BC184B	0-12*	BF185	0-28	TIP28A	0-47*	2N3710	0-11*	4/716	0-08*	Game	6-00p	7408	24p				
AC176	0-22	BC184L	0-11*	BF194	0-10*	TIP30A	0-56*	2N3711	0-11*	4/763	0-10*	CA 3130	0-87p*	7410	18p				
AC187	0-22	BC186	0-25	BF195	0-10*	TIP31A	0-57	2N3819E	0-25*	5/10	0-10*	LM 301AN	1-50p	7411	21p				
AC188	0-20	BC187	0-26	BF196	0-12*	TIP32A	0-67	2N3820	0-45*	5/16	0-11*	LM 308	1-40p	7412	25p				
AD117	0-88	BC204A	0-16*	BF197	0-12*	TIP33A	0-94	2N3823E	0-25*	6/825	0-18*	LM 309K	2-00p	7413	28p				
AD149	0-68	BC209B	0-13*	BF199	0-15*	TIP34A	1-13	2N4058	0-40	6/840	0-10*	LM 324	2-85p	7414	36p				
AD151	0-52	BC212A	0-13*	BF229	0-28	TIP42A	0-90	2N4059	0-10*	10/16	0-09*	LM 380 SL60745	1-29p*	7416	32p				
AD162	0-52	BC212L	0-15*	BF230	0-25	TIP295S	0-97	2N4061	0-12*	10/25	0-09*	LM 381N	2-00p*	7417	36p				
AD163	0-52	BC213B	0-12*	BF240	0-28	TIP305S	0-60	2N4124	0-20*	10/35	0-10*	LM 555	0-49p	7420	18p				
AF116	0-24	BC213L	0-14*	BF244	0-22	TIS43	0-35*	2N4126	0-30*	10/64	0-10*	LM 723	0-59p	7421	26p				
AF117	0-28	BC214	0-15*	BF248	0-22	ZTX109	0-14*	2N4259	0-50	10/250	0-12*	MC 1310 CA1310E	0-99p	7427	32p				
AF124	0-30	BC214L	0-17*	BF250	0-25	ZTX300	0-13*	2N4547	0-50	15/40	0-10*	MC 1327 SN76227	1-35p*	7428	36p				
AF195	0-95	BC237A	0-16*	BF251	0-25	ZTX301	0-13*	2N4548	0-40	15/400	0-35*	MC 1330P	0-75p*	7432	28p				
AF239	0-46	BC238A	0-15*	BF252	0-25	ZTX302	0-18*	2N4549	0-40	16/10	0-10*	MC 1350P	0-75p*	7437	42p				
AU113	2-20*	BC261A	0-16*	BF252	0-25	ZTX303	0-18*	2SC1172	3-00*	20/15	0-10*	NE 555	0-49p	7440	18p				
BC107	0-11	BC262A	0-19	BU108	2-50*	ZTX502	0-18*	40361	0-50	20/70	0-10*	SK 1122 T.V.		7442	60p				
BC107A	0-12	BC267A	0-17	BU126	3-00*	ZTX504	0-25*	40363	0-88	20/270	0-10*	Game	18-00p	7443	1-00p				
BC107B	0-13	BC268B	0-17	BY126	0-16	ZTX500	0-23*	40673	0-85	22/16	0-10*	SN 7803N	2-80p*	7444	1-00p				
BC108	0-10	BC269	0-17	BY127	0-16	1N914	0-05	25/25	0-11*	2200/6V3	0-30*	SN 78033N	1-60p*	7444	1-00p				
BC108A	0-08	BC267	0-28	BY133	0-20	1N4001	0-05	33/50	0-12*	2200/40	0-60*	SN 78013N	1-75p*	7447	1-00p				
BC108B	0-11	BC300	0-35	BY164	0-40	1N4002	0-06	47/6V3	0-10*	2500/15	0-45*	SN 78023N	1-75p*	7448	1-00p				
BC108C	0-12	BC301	0-34	ME0401	0-18*	1N4003	0-07	47/10V	0-10*	3300/30	0-45*	SN 78023ND	1-60p*	7451	1-00p				
BC109	0-12	BC303	0-35	ME0402	0-18*	1N4004	0-08	47/15	0-10*	5000/12	0-45*	SN 78033N	2-75p*	7460	1-00p				
BC109B	0-13	BC327	0-20*	ME0411	0-18*	1N4005	0-09					SN 78660	0-90p*	7470	1-00p				
BC109C	0-13	BC328	0-18*	ME0412	0-19*	1N4006	0-10					TAA 550	0-60p*	7472	30p				
BC117	0-18*	BC338	0-18*	ME0413	0-15*	1N4007	0-11					TBA 120ASQ	1-30p*	7473	35p				
BC136	0-16*	BC310	0-16*	ME0414	0-15*	1N4148	0-05					TBA 395	2-25p*	7474	35p				
BC142	0-24	BC340	0-15*	ME0461	0-21*	1N5400	0-13					TBA 480Q	1-25p*	7475	48p				
BC143	0-24	BC461	0-35	ME0462	0-21*	1N5401	0-13					TBA 520Q	1-70p*	7476	32p				
BC147A	0-09*	BC357	0-15*	ME4001	0-14*	1N5404	0-21					TBA 520Q	1-90p*	7480	85p				
BC147B	0-10*	BC358	0-15*	ME4010	0-11*	1N708	0-20					TBA 540Q	0-90p*	7481	1-00p				
BC148	0-09*	BC359	0-15*	ME4012	0-11*	1N7613	0-30					TBA 550Q	3-40p*	7485	1-30p				
BC148B	0-10*	BCY70	0-15	MJE305S	1-25*	2N1171	0-30					TBA 560CQ	2-30p*	7486	43p				
BC149	0-10*	BCY71	0-18	MJF102	0-40*	2N1210	0-50					TBA 641	2-25p*	7490(A)	55p				
BC149B	0-11*	BCY72	0-14	0A5	0-71	2N2119	0-30					TBA 750	1-90p*	7492	55p				
BC149C	0-11*	BD123	0-90	0A10	0-82	2N2222	0-20					TBA 750C	1-35p*	7493	55p				
BC153	0-18*	BD124	0-90	0A47	0-14	2N3646	0-85					TBA 810SQ	1-40p*	7496	46p				
BC154	0-18*	BD131	0-42	0A81	0-30	2N2960	0-13*					TBA 820Q	1-20p*	7497	30p				
BC157	0-12*	BD132	0-42	0A90	0-07	2N2966	0-15*					TBA 920Q	2-80p*	74121	46p				
BC157B	0-12*	BD139	0-54*	0A91	0-08	2N3053	0-25					TBA 950Q	2-50p*	74123	49p				
BC158A	0-14*	BD140	0-54*	0A95	0-08	2N3054	0-58					TCA 270T	2-20p*	74124	80p				
BC158B	0-12*	BD155	0-75*	0A200	0-10	2N3663	0-28					U 14552 300mW		74145	1-15p				
BC172A	0-15*	BD120	0-80	0A202	0-11	2N3055	0-90					Audio with data 0-35p*		74151	85p				
BC173B	0-16*	BF115	0-22	OC35	0-20	2N3643	0-17*					2N414	1-40p*	74174	1-20p				
BC177	0-17	BF158	0-20*	OC44	0-45	2N3646	0-17*					2102	2-50p	74180	1-20p				
BC177B	0-18	BF166	0-38	OC45	0-45	2N3702	0-11*					2513UC	8-50p	74190	1-60p				

## 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: **PEK11**  
**BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL,**  
 P.O.Box 156, Jersey, Channel Islands.  
 NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_ (Block caps please)

# TRAMPUS

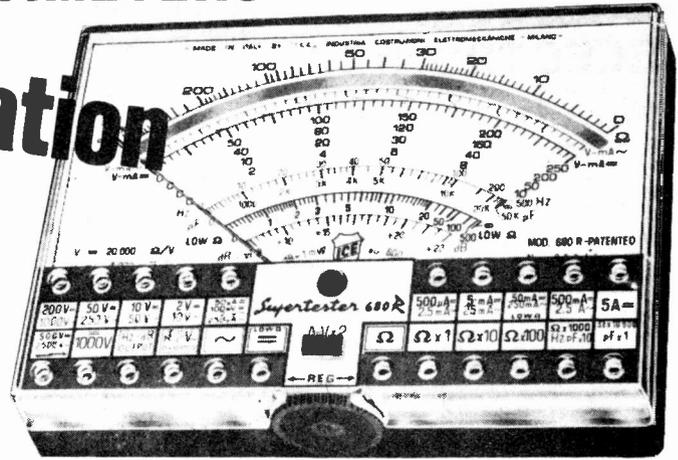
**A SEMICONDUCTOR POWER HOUSE**  
**TRAMPUS ELECTRONICS LTD., 58-60 GROVE ROAD, WINDSOR**  
 BERKS. SL4 1HS. (Trade, export & retail.)  
 Tel: Windsor (07535) 54525. Callers welcome. Mon-Sat. 9 am - 5 pm.  
 Fast service. On ex stock product same day despatch normally. Quality devices, manufacturers specifications, lowest prices. Barclay Card and Access by post or telephone £5 minimum. VAT: add 8% to prices marked \*. Add 12% VAT to all other prices. Post and packing 20p U.K. Send C.W.O. except Gov. depts. etc. Money back if not satisfied. Catalogue sale list free, send S.A.E.

IC's	All price each	BC109B or C	15p*	Pak N: 25 x OA8191	£1*
555 DIL 8 Timer	37p*	BC147/8/9	12p	Pak M: 3 x 2 amp. PNP/NPN	
723 T099 Reg.	47p*	BC167/8/9	10p	Pairs 60V (Total 6)	£1*
723 DIL 14 pin	69p*	BC177/8/9	20p	Pak W: 20X mixed 10V	
741 DIL 8 pin op. amp.	25p*	BC182/3/4 A or L	14p	electrolytic 2-100uF	£1
741 DIL 14 or TO9	36p*	BCY12/3/4 A or L	10p	More Paks in free lists	
747 Dual 741	89p*	BCY170/172	20p*	SCR and TRIACS: ST2 25p*	
748 DIL 14 pin	29p*	BD131 or 132 each	39p*	BR100 40p*, C10A 400V	
748 DIL 8 pin	49p*	BFY50, 51 or 52	20p*	55p*, 1A 400V 50p*, 1A	
7805 plastic or TO3	£1*	MJ2955 (PNP 305S)	£1-50*	800V 69p*	
7812 or 15 plastic	£1-50*	MJE2955	£1-40*	<b>DISCO TRIAC 10A 400V 80p*</b>	
7803 or 76023	£1-69	MJE3055	55p*	<b>VERO. All stocked i.e. 0.1in.</b>	
8038 Sig. Gen.	£5*	ORP12	50p*	21 x 31in 42p*, 31 x 5in 56p*	
AY51224 Clock	£2-50*	OP29, 30, 31, 32C	60p*	31 x 17in £2-50*, 2 x 4in DIL	
LM340	50p*	TIP41A or 42A	65p*	75p*, 6 x 4in DIL Bread Board	
LM301 DIL 14 pin	29p*	TIP41C or 42C	£1*	£2-44* Pots 25p; Presets	
LM301 DIL 8 pin	59p*	TIP295S	65p*	9p; Resistors 2p.	
LM309K TO3 5V	£1*	TIP305S	55p*	<b>CAPACITORS: Ceramic 5p;</b>	
LM318 70V U.S.	£2-25*	TIS43 UJT	30p	Electrolytic, 1uF-100uF 7p.	
LM3800 TW A.F.	£1	2N2961 UJT	50p*	Heatsinks: TO18/TOS 5p*, TO3	
LM3900 Quad op. amp.	75p*	2N2904 OR5	30p*	29p.	
MC1310 Yes only	75p*	2N2926 YG	15p	Solder Dispenser 18 S.W.G.	
NE555 Timer	37p*	2N3053	24p*	35p*.	
NE556 2 x 555	£1*	2N3055 115W	£1-50*	<b>Soldercon 100 45p*, 1000 £4*.</b>	
SN76411 and 80 IF	£1-25	SN76412 120V 305S	£1-50*	DIL Sockets 8, 14 or 16 15p*	
TB810 TW A.F.	£1	2N3702/5/6	10p	CMOS: Many stocked i.e.	
LEDs 1/4in and 0.2in dia.	11p*	2N3704	18p	4001 or 2 23p*, 4003/10 59p*.	
Red no clip	11p*	2N3819E or 23E	18p	4011 20p*, 4049 or 69 23p*.	
0.2in Red and clip	15p*	2N3904/5/6	20p		
Colour LEDs	29p*	2N5457 FET	50p		
<b>DISPLAYS (Red LED)</b>	65p*	INS Bush Sets	each 10p*	<b>TTL 7400N SERIES</b>	
0.3in DL704/2	65p*	Matching, add	20p*	7400 14p*, 7485 86 10p*	
0.3in DL707/2	65p*			7401 9p*, 7490 49p*	
0.5in DL747/2	£1*			7404 20p*, 7491 50p*	
TGS308 Gas Detector	£5*	DIODES OA81/91	5p	7408/9 10p*, 7493/5 50p*	
390pF Med./Short Tuner	£1*	IN4001			

# TWICE the information in HALF the size

## I.C.E. MULTIMETERS

The I.C.E. range of multimeters provide an unrivalled combination of maximum performance within minimum dimensions, at a truly low cost. Plus, a complete range of add-on accessories for more ranges, more functions.



### Supertester 680R (illustrated)

- \* 20kΩ/V, ±1% fsd on d.c.
- 4kΩ/V, ±2% fsd on a.c.
- \* 80 Ranges - 10 Functions
- \* 140 × 105 × 55mm

**£25.25 + VAT**  
(For Mail Order add 80p P&P)

### Supertester 680G

- \* 20kΩ/V, ±2% fsd on d.c.
- 4kΩ/V, ±2% fsd on a.c.
- \* 48 Ranges - 10 Functions
- \* 109 × 113 × 37mm

**£19.95 + VAT**  
(For Mail Order add 80p P&P)

### Microtest 80

- \* 20kΩ/V, ± 2% fsd on d.c.
- 4kΩ/V, ±2% fsd on a.c.
- \* 40 Ranges - 8 Functions
- \* Complete with case - only 93 × 95 × 23mm

**£14.95 + VAT**  
(For Mail Order add 80p P&P)

All I.C.E. multimeters are supplied complete with unbreakable plastic carrying case, test leads, etc. and a 50-plus page, fully detailed and illustrated Operating and Maintenance Manual. Now available from selected stockists. Write or phone for list, or for details of direct mail-order service.



Electronic Brokers Ltd.  
49-53 Pancras Road, London NW1 2QB  
Tel: 01-837 7781

## CHAMP COST CUTTERS

- 4040 4 bit Microprocessor **£5.90**
- 4702A 256 × 8 bit EPROM **£11.50**
- 4289 Memory interface **£8.50**
- 5101-8 256 × 8 CMOS RAM **£7.50**

Please add 8% VAT plus 40p P. & P. to total. For a full list of components, computers, terminals, floppy disk and tape memory. Plus software, technical services and assistance in our Microprocessor Users Group magazine, send S.A.E. to:

Computabits Ltd, 41 Vincent Street, Yeovil, Somerset. Tel. (0935) 26522.

## P.E. JOANNA ELECTRONIC PIANO



**ALL PARTS CAN BE SUPPLIED**

Keyboard, Keyswitch, P.C.B.s, Hardware, Semiconductors, Resistors, Capacitors, Cabinets  
Complete kits or easy stages  
Send S.A.E. for details

**Clef Products**  
16 Mayfield Road  
Bramhall, Stockport, Cheshire SK7 1LY

All prices include V.A.T. Carriage & packing add 25p (U.K.) Add extra for overseas. Cash with order only. Discounts over £5 less 5%, over £10 less 10%, over £25 less 15%, over £50 less 20%

## ASTRA-PAK

92 GODSTONE ROAD  
WHYTELEAF SURREY CR3 0EB

BEAD TANTALUM		ELECTROLYTICS			
.1	.22	10V	25V	50V	63V
1	0.04p	05p	05p	05p	06p
2	2	0.04p	05p	05p	06p
3	3	0.04p	05p	05p	06p
4	4	0.04p	05p	05p	06p
5	5	0.04p	05p	05p	06p
6	6	0.04p	05p	05p	06p
7	7	0.04p	05p	05p	06p
8	8	0.04p	05p	05p	06p
9	9	0.04p	05p	05p	06p
10	10	0.04p	05p	05p	06p
11	11	0.04p	05p	05p	06p
12	12	0.04p	05p	05p	06p
13	13	0.04p	05p	05p	06p
14	14	0.04p	05p	05p	06p
15	15	0.04p	05p	05p	06p
16	16	0.04p	05p	05p	06p
17	17	0.04p	05p	05p	06p
18	18	0.04p	05p	05p	06p
19	19	0.04p	05p	05p	06p
20	20	0.04p	05p	05p	06p
21	21	0.04p	05p	05p	06p
22	22	0.04p	05p	05p	06p
23	23	0.04p	05p	05p	06p
24	24	0.04p	05p	05p	06p
25	25	0.04p	05p	05p	06p
26	26	0.04p	05p	05p	06p
27	27	0.04p	05p	05p	06p
28	28	0.04p	05p	05p	06p
29	29	0.04p	05p	05p	06p
30	30	0.04p	05p	05p	06p
31	31	0.04p	05p	05p	06p
32	32	0.04p	05p	05p	06p
33	33	0.04p	05p	05p	06p
34	34	0.04p	05p	05p	06p
35	35	0.04p	05p	05p	06p
36	36	0.04p	05p	05p	06p
37	37	0.04p	05p	05p	06p
38	38	0.04p	05p	05p	06p
39	39	0.04p	05p	05p	06p
40	40	0.04p	05p	05p	06p
41	41	0.04p	05p	05p	06p
42	42	0.04p	05p	05p	06p
43	43	0.04p	05p	05p	06p
44	44	0.04p	05p	05p	06p
45	45	0.04p	05p	05p	06p
46	46	0.04p	05p	05p	06p
47	47	0.04p	05p	05p	06p
48	48	0.04p	05p	05p	06p
49	49	0.04p	05p	05p	06p
50	50	0.04p	05p	05p	06p
51	51	0.04p	05p	05p	06p
52	52	0.04p	05p	05p	06p
53	53	0.04p	05p	05p	06p
54	54	0.04p	05p	05p	06p
55	55	0.04p	05p	05p	06p
56	56	0.04p	05p	05p	06p
57	57	0.04p	05p	05p	06p
58	58	0.04p	05p	05p	06p
59	59	0.04p	05p	05p	06p
60	60	0.04p	05p	05p	06p
61	61	0.04p	05p	05p	06p
62	62	0.04p	05p	05p	06p
63	63	0.04p	05p	05p	06p
64	64	0.04p	05p	05p	06p
65	65	0.04p	05p	05p	06p
66	66	0.04p	05p	05p	06p
67	67	0.04p	05p	05p	06p
68	68	0.04p	05p	05p	06p
69	69	0.04p	05p	05p	06p
70	70	0.04p	05p	05p	06p
71	71	0.04p	05p	05p	06p
72	72	0.04p	05p	05p	06p
73	73	0.04p	05p	05p	06p
74	74	0.04p	05p	05p	06p
75	75	0.04p	05p	05p	06p
76	76	0.04p	05p	05p	06p
77	77	0.04p	05p	05p	06p
78	78	0.04p	05p	05p	06p
79	79	0.04p	05p	05p	06p
80	80	0.04p	05p	05p	06p
81	81	0.04p	05p	05p	06p
82	82	0.04p	05p	05p	06p
83	83	0.04p	05p	05p	06p
84	84	0.04p	05p	05p	06p
85	85	0.04p	05p	05p	06p
86	86	0.04p	05p	05p	06p
87	87	0.04p	05p	05p	06p
88	88	0.04p	05p	05p	06p
89	89	0.04p	05p	05p	06p
90	90	0.04p	05p	05p	06p
91	91	0.04p	05p	05p	06p
92	92	0.04p	05p	05p	06p
93	93	0.04p	05p	05p	06p
94	94	0.04p	05p	05p	06p
95	95	0.04p	05p	05p	06p
96	96	0.04p	05p	05p	06p
97	97	0.04p	05p	05p	06p
98	98	0.04p	05p	05p	06p
99	99	0.04p	05p	05p	06p
100	100	0.04p	05p	05p	06p
101	101	0.04p	05p	05p	06p
102	102	0.04p	05p	05p	06p
103	103	0.04p	05p	05p	06p
104	104	0.04p	05p	05p	06p
105	105	0.04p	05p	05p	06p
106	106	0.04p	05p	05p	06p
107	107	0.04p	05p	05p	06p
108	108	0.04p	05p	05p	06p
109	109	0.04p	05p	05p	06p
110	110	0.04p	05p	05p	06p
111	111	0.04p	05p	05p	06p
112	112	0.04p	05p	05p	06p
113	113	0.04p	05p	05p	06p
114	114	0.04p	05p	05p	06p
115	115	0.04p	05p	05p	06p
116	116	0.04p	05p	05p	06p
117	117	0.04p	05p	05p	06p
118	118	0.04p	05p	05p	06p
119	119	0.04p	05p	05p	06p
120	120	0.04p	05p	05p	06p
121	121	0.04p	05p	05p	06p
122	122	0.04p	05p	05p	06p
123	123	0.04p	05p	05p	06p
124	124	0.04p	05p	05p	06p
125	125	0.04p	05p	05p	06p
126	126	0.04p	05p	05p	06p
127	127	0.04p	05p	05p	06p
128	128	0.04p	05p	05p	06p
129	129	0.04p	05p	05p	06p
130	130	0.04p	05p	05p	06p
131	131	0.04p	05p	05p	06p
132	132	0.04p	05p	05p	06p
133	133	0.04p	05p	05p	06p
134	134	0.04p	05p	05p	06p
135	135	0.04p	05p	05p	06p
136	136	0.04p	05p	05p	06p
137	137	0.04p	05p	05p	06p
138	138	0.04p	05p	05p	06p
139	139	0.04p	05p	05p	06p
140	140	0.04p	05p	05p	06p
141	141	0.04p	05p	05p	06p
142	142	0.04p	05p	05p	06p
143	143	0.04p	05p	05p	06p
144	144	0.04p	05p	05p	06p
145	145	0.04p	05p	05p	06p
146	146	0.04p	05p	05p	06p
147	147	0.04p	05p	05p	06p
148	148	0.04p	05p	05p	06p
149	149	0.04p	05p	05p	06p
150	150	0.04p	05p	05p	06p
151	151	0.04p	05p	05p	06p
152	152	0.04p	05p	05p	06p
153	153	0.04p	05p	05p	06p
154	154	0.04p	05p	05p	06p
155	155	0.04p	05p	05p	06p
156	156	0.04p	05p	05p	06p
157	157	0.04p	05p	05p	06p
158	158	0.04p	05p	05p	06p
159	159	0.04p	05p	05p	06p
160	160	0.04p	05p	05p	06p
161	161	0.04p	05p	05p	06p
162	162	0.04p	05p	05p	06p
163	163	0.04p	05p	05p	06p
164	164	0.04p	05p	05p	06p
165	165	0.04p	05p	05p	06p
166	166	0.04p	05p	05p	06p
167	167	0.04p	05p	05p	06p
168	168	0.04p	05p	05p	06p
169	169	0.04p	05p	05p	06p
170	170	0.04p	05p	05p	06p
171	171	0.04p	05p	05p	06p
172	172	0.04p	05p	05p	06p
173	173	0.04p	05p	05p	06p
174	174	0.04p	05p	05p	06p
175	175	0.04p	05p	05p	06p
176	176	0.04p	05p	05p	06p
177	177	0.04p	05p	05p	06p
178	178	0.04p	05p	05p	06p
179	179	0.04p	05p	05p	06p
180	180	0.			

# LYNX ELECTRONICS (LONDON) LTD

92 Broad Street, Chesham, Bucks. Tel. (02405) 75154

P. & P. 30p—Overseas 90p—Matching 20p per pair.  
VAT 8% except \* which are 12½%. Prices correct at 30 September 1977.

**RETURN  
POST  
SERVICE  
ACCESS  
WELCOME**

Price list 20p

## THYRISTORS

Piv	1A	3A	3A	4A	6A	8A	10A	16A
(TO5)	(STUD)	(C106)	(TO220)	(TO220)	(TO220)	(TO220)	(TO220)	(TO220)
200	0.35	0.50	0.45	0.40	0.58	0.50	0.68	1.14
400	0.40	0.80	0.50	0.45	0.87	0.88	0.89	1.40
600	0.65	0.85	0.70	—	1.09	1.19	1.26	1.80

BT106 £1.00, BT107 £1.60, BT108 £1.60, BT109 £1.00, BT116 £1.00, 2N325 £0.50

## TRIACS—Plastic TO-220 Package Isolated Tab

	4A		6.5A		8.5A		10A		15A	
	(a)	(b)								
100V	0.60	0.60	0.70	0.70	0.78	0.78	0.83	0.83	1.01	1.01
200V	0.84	0.84	0.75	0.75	0.87	0.87	0.97	0.97	1.17	1.17
400V	0.77	0.78	0.80	0.83	0.97	1.01	1.13	1.19	1.70	1.74
600V	0.96	0.99	1.01	1.10	1.21	1.26	1.42	1.50	2.11	2.17

N.B. Column (a) without internal trigger; (b) with internal trigger.

## TTL 7400 SERIES

7400	0.16	7480	0.55
7401	0.16	7482	0.75
7402	0.16	7486	0.32
7403	0.16	7489	2.02
7404	0.18	7490AN	0.49
7405	0.18	7491AN	0.65
7408	0.18	7492	0.57
7409	0.18	7493	0.45
7410	0.16	7494	0.85
7412	0.25	7495	0.67
7413	0.40	7496	0.82
7414	0.72	74100	1.07
7417	0.43	74107	0.35
7420	0.16	74121	0.34
7425	0.30	74122	0.47
7427	0.30	74123	0.65
7430	0.16	74141	0.78
7432	0.28	74145	0.68
7437	0.30	74154	1.30
7441AN	0.76	74164	0.93
7442	0.65	74165	0.93
7445	0.90	74174	1.40
7447AN	0.81	74175	0.94
7448	0.81	74180	1.06
7470	0.32	74181	2.70
7472	0.26	74191	1.33
7473	0.30	74192	1.20
7474	0.32	74193	1.35
7475	0.47	74194	1.20
7476	0.36	74196	1.64

## LINEAR I.C.s

301A	0.40*
307	0.55*
380	0.90*
381	1.60*
3900	0.70*
709	0.27
741	0.28
748	0.35
NE555	0.45
NE565	2.00*
NE566	1.50*
NE567	2.00*
CA3045	0.85*
CA3046	0.80*
CA3130	0.90
MC1304P	1.60*
MC1307P	0.85*
MC1310P	1.60*
MC1351P	1.20*
MC1352P	0.75*
MC1353P	0.75
MC1458P	0.77
MC1496L	0.82*
SAS560	2.25
SAS570	2.25
TAA300	1.61
TAA310A	1.38
TAA550	0.45*
TAA611B12	
	1.25*
TAA861	0.65
TBA530	1.85*
TBA530Q	1.90*
TBA560	2.80*
TBA570	0.98
TCA270SQ	
	1.95*



## MEMORIES

2102A-6	3.60
2112A-4	4.75
6508	7.95
2102	2.50
2107	10.00
2112	4.50
2513	8.50
2602	2.50

## SPECIAL OFFER SECTION

**NPV TO-3 POWER TRANSISTORS.**  
Fully tested but unmarked. Similar to 2N3055 except BVCEO = 50. HFE (gain) = 20 + at 3A. VCE SAT < 1.3V at 3A. 5 pcs £1; 25 pcs £4; 50 pcs £7.50; 100 pcs £13.

**TO-18 NPN TRANSISTORS.**  
Medium voltage high gain. Similar to BC107/8/9—unmarked. 25pcs £1.20; 100 pcs £3.50.

**TO-3 HARDWARE.** Mica. washers, solder tag, nuts, bolts. 50 sets £1.

**RECTIFIERS. DO-4 PACKAGE.** 10A 50V 45p; 10A 100V 50p; 10A 200V 60p; 10A 400V 75p. Please specify Polarity, Stud Cathode or Stud Anode. Ideal for power supplies, inverters etc.

## CLOCK CHIPS

MMS514	3.25
MMS516	3.85
AA5-1224A	3.25
AA5-4007D	9.95

## I.C. SOCKETS

8 PIN	0.13
14 PIN	0.14
16 PIN	0.15
24 PIN	0.45
40 PIN	0.80

## REGULATORS

723	0.45
7805	1.50
7812	1.50
7815	1.50

## OPTOELECTRONICS

DISPLAYS Class II	
704	0.99
707	0.99
727	1.95
728	1.95
747	1.80
750	1.80

## THE HOME COMPUTER FORUM

Our Seminar will be held on 26th November at the Wembley Conference Centre 10 a.m.-5 p.m. We hope to have five speakers from various backgrounds but all specialists in the micro-computing/software field. The NASCOM I micro-computer will be launched at the seminar. Tickets at £3.50 each are now available together with a newsheet on the seminar. Please write or telephone for details. Only 40p seats are available and 115 have been sold at press time.

## SPECIAL NOTICE

Don't miss this fabulous offer. For a limited period up to 31 October, 1977, all schools, colleges and universities may deduct 10% off all orders.

## SUPER SAVERS

SG309K	0.96
MC1310P	0.95
TL200	0.10
2 Clear led	0.10
MM5314	3.25
MM5316	3.85
FCS8000	
3 1/2 Digit Dspl	2.95
FCS8024	
4 Digit Dspl	3.50

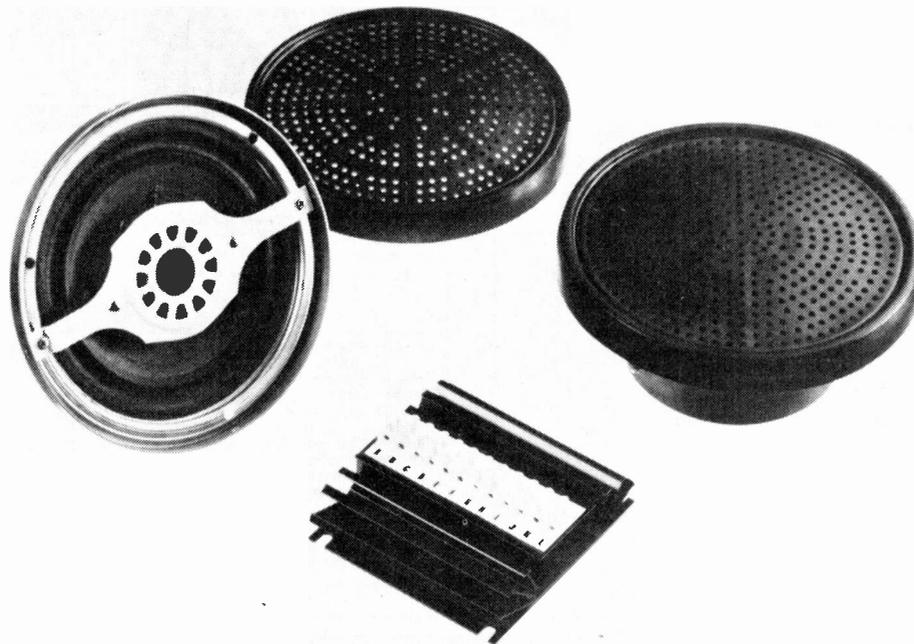
## TRANSISTORS

AC126	0.15	BC117	0.19*	BC300	0.34	BDY20	0.80	BFY40	0.50	OC71	0.35	2N2905	0.18
AC127	0.16	BC119	0.25	BC301	0.32	BDY38	0.80	BFY41	0.60	OC72	0.22	2N2906A	0.22
AC128	0.16	BC125	0.18*	BC302	0.40	BDY60	1.70	BFY50	0.20	OC84	0.40	2N2905A	0.18
AC128K	0.25	BC126	0.20*	BC303	0.46	BDY61	1.65	BFY51	0.18	OC139	1.30	2N2925	0.14*
AC141	0.22	BC140	0.32	BCY30	0.55	BDY62	1.15	BFY52	0.19	OC140	1.30	2N2926Q	0.09*
AC141K	0.34	BC141	0.28	BCY31	0.55	BDY95	2.14	BFY53	0.25	OC170	0.23	2N2926R	0.10*
AC142	0.18	BC142	0.23	BCY32	0.55	BF121	0.50	BFY64	0.35	TIP23A	0.44*	2N2926Y	0.09*
AC142K	0.32	BC143	0.23	BCY33	0.55	BF123	0.50	BFY90	0.90	TIP30A	0.52*	2N2926Q	0.10*
AC176	0.16	BC144	0.30	BCY34	0.55	BF179	0.30	BSX19	0.16	TIP31A	0.54	2N3053	0.20
AC176K	0.32	BC147	0.09*	BCY38	0.50	BF180	0.30	BSX20	0.18	TIP32A	0.64	2N3055	0.50
AC187	0.18	BC148	0.09*	BCY39	1.15	BF181	0.30	BSX21	0.20	TIP41A	0.68	2N3137	1.10
AC187K	0.36	BC149	0.09*	BCY40	0.75	BF182	0.30	BSY52	0.28	TIP42A	0.72	2N3440	0.56
AC188	0.18	BC152	0.25*	BCY42	0.30	BF183	0.30	BSY53	0.29	2N404	0.40	2N3442	1.20
AC188K	0.32	BC153	0.18*	BCY54	1.60	BF184	0.20	BSY54	0.33	2N696	0.20	2N3570	3.60
AD149	0.80	BC157	0.09*	BCY70	0.12	BF185	0.20	BSY55	0.74	2N697	0.20	2N3702	0.10*
AD161	0.35	BC158	0.09*	BCY71	0.18	BF194	0.10*	BSY65	0.30	2N705	0.15	2N3703	0.10*
AD162	0.35	BC159	0.09*	BCY72	0.12	BF196	0.12*	BSY85A	0.16	2N718	0.22	2N3704	0.10*
AF114	0.20	BC160	0.32	BD115	0.55	BF197	0.12*	BU105	1.80*	2N929	0.16	2N3705	0.10*
AF115	0.20	BC161	0.38	BD131	0.36	BF224A	0.18*	BU105.02	1.90*	2N1131	0.15	2N3706	0.10*
AF116	0.20	BC168	0.09*	BD132	0.40	BF244	0.17*	BU108	3.00*	2N1132	0.16	2N3707	0.10*
AF117	0.20	BC169	0.12*	BD135	0.36*	BF257	0.30	BU109	2.50*	2N1302	0.40	2N3708	0.09*
AF118	0.50	BC169C	0.14*	BD136	0.39*	BF258	0.35	BU128	1.60*	2N1303	0.40	2N3709	0.09*
AF124	0.25	BC182	0.11*	BD137	0.40*	BF259	0.48	BU133	1.60*	2N1304	0.45	2N3710	0.10*
AF125	0.25	BC182L	0.12*	BD138	0.48*	BF259	0.35*	BU204	1.60*	2N1305	0.45	2N3711	0.10*
AF126	0.25	BC183	0.10*	BD139	0.58*	BF337	0.32*	BU205	1.90*	2N1306	0.50	2N3715	1.70
AF139	0.35	BC183L	0.10*	BD144	2.20	BF338	0.45*	BU206	2.40*	2N1307	0.50	2N3716	1.80
AF239	0.37	BC184	0.11*	BD157	0.60	BFW30	1.25	BU208	2.60*	2N1308	0.80	2N3717	1.60
AL102	1.45	BC184L	0.12*	BD181	0.86	BFW59	0.30	MJ480	0.80	2N1309	0.80	2N3772	1.90
AL103	1.30	BC186	0.20*	BD182	0.92	BFW60	0.36	MJ481	1.05	2N1711	0.24	2N3773	2.10
AU107	3.30*	BC187	0.24*	BD183	0.97	BFX29	0.26	MJ490	0.90	2N1712	0.44	2N3819	0.28*
AU110	1.75*	BC207B	0.12*	BD184	1.20	BFX30	0.30	MJ491	1.15	2N2217	0.30	2N4347	1.10
AU113	1.60*	BC212	0.11*	BD232	0.60	BFX84	0.23	MJE530	0.40*	2N2369	0.14	2N4348	1.20
BC107	0.09	BC212L	0.12*	BD233	0.48	BFX85	0.25	MJE521	0.55	2N2369A	0.14	2N4370	0.35*
BC107B	0.12	BC213	0.12*	BD237	0.55	BFX86	0.25	OC43	0.95	2N2483	0.20	2N4871	0.35*
BC108	0.12	BC213L	0.14*	BD238	0.60	BFX87	0.20	OC44	0.32	2N2484	0.16	2N4878	0.60*
BC108B	0.12	BC214	0.14*	BD410	0.60	BFX88	0.20	OC45	0.32	2N2646	0.50	2N4879	0.70*
BC109	0.12	BC214L	0.15*	BDX32	2.30	BFX89	0.90	OC46	0.20	2N2711	0.15	2N4920	0.50*
BC109B	0.12	BC237	0.16*	BDY10	1.50	BFY11	1.10	OC70	0.30	2N2712	0.15	2N4922	0.58*
BC109C	0.15	BC238	0.16*	BDY11	2.00	BFY18	0.50			2N2904A	0.20	2N4923	0.46*

## CMOS PLASTIC

4000BE	0.20
4001BE	0.20
4002BE	0.20
4006BE	0.05
4007BE	0.20
4008BE	0.93
4009BE	0.52
4010BE	0.52
4011BE	0.20
4012BE	0.20
4013BE	0.50
4014BE	1.00
4015BE	0.95
4016BE	0.54
4017BE	1.00
4018BE	1.00
4019BE	0.50
4020BE	1.12
4021BE	1.03
4022BE	0.95
4023BE	0.20
4024BE	0.86
4026BE	0.55
4027BE	0.42
4028BE	0.91
4029BE	1.10
4030BE	0.55
4041BE	0.80
4042BE	0.83
4043BE	1.00
4044BE	0.94
4046BE	1.32
4049BE	0.54
4050BE	0.54
4069BE	0.30
4070BE	

# THE DYNAMIC DUO



The C15/15 is a unique Power Amplifier providing Stereo 15 watts per channel or 30 watts Mono and can be used with any car radio/tape unit. It is simply wired in series with the existing speaker leads and in conjunction with our speakers S15 produces a system of incredible performance. A novel feature is that the amplifier is automatically switched on or off by sensing the power line of the radio/tape unit hence alleviating the need for an on/off switch. The amplifier is sealed into an integral heatsink and is terminated by screw connectors making installation a very easy process. The S15 has been specially designed for car use and produces performance equal to domestic speakers yet retaining high power handling and compact size.

**C15/15**  
 15 watts per channel into 4Ω  
 Distortion 0.2% at 1kHz at 15 watts  
 Frequency response 50Hz-30kHz  
 Input Impedance 8Ω nominal  
 Input sensitivity 2V R.M.S. for 15 watts output  
 Power line 10-18V  
 Open and Short circuit protection  
 Thermal protection  
 Size 4 × 4 × 1 inches

**Data on S15**  
 6in Diameter  
 5½in air Suspension  
 2in Active Tweeter  
 20oz Ceramic magnet  
 15 watts R.M.S. handling  
 50Hz-15kHz frequency response  
 4Ω Impedance

C15/15 Price £17.74 + £2.21 VAT. P. & P. free

S15 Price per pair £17.74 + £2.21 VAT. P. & P. free

*TWO YEARS' GUARANTEE ON ALL OF OUR PRODUCTS*

**I.L.P. Electronics Ltd**  
**Crossland House**  
**Nackington, Canterbury**  
**Kent CT4 7AD**  
**Tel. (0227) 63218**

Please Supply .....  
 Total Purchase Price .....  
 I Enclose Cheque  Postal Orders  Money Order   
 Please debit my Access account  Barclaycard account   
 Account number .....  
 Name and Address .....  
 Signature .....

# Hi-Fi Newcomers Start here



How does the first-time buyer separate the hi-fi basics from the hi-fi mystique? This month Practical Hi-Fi & Audio gives basic advice on making the right choice of system, basic fault-finding and setting up, and publishes answers to the ten questions most frequently asked by newcomers.

## A System for £800

An evaluation of the new crop of moving-coil phono cartridges and their complementary voltage step-up devices. Among those tested are the Fidelity Research FR 3, Entré 1, Sony XL55, Ultimo 10A, and Nakamichi 1000, and 7 others.

## Win some Aiwa Super-fi

Another big competition, with the new Autumn range of Aiwa equipment to be won.

## Sirac Mk1 Valve Amplifier

Complete instructions for building Chris Rogers' outstanding new valve amplifier.

**PRACTICAL**  
**HI-FI & AUDIO**

November issue

out now

## CRESCENT RADIO LTD.

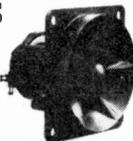
MAIL ORDER DEPT.  
1 ST. MICHAELS TERRACE, WOOD GREEN,  
LONDON N22 4SJ  
PHONE: 888-4474

**POPULAR HIGH POWER AMPLIFIER**  
70 watts R.M.S continuous into 8 ohms. Ready to use. S.A.E. for further details. Size: 540mm x 250mm x 145mm approx. Cost: £71 + 8% VAT.

### PIEZO ELECTRIC HORN UNITS

New High Quality. High Power tweeter (100 watts). No Xover required. Freq. response: 3-8kHz to 28kHz. Spec. sheet sent on receipt of S.A.E.

Our price: £9.35 each + 8% V.A.T.



### CLEAR PLASTIC PANEL METERS (FULL SCALE)

Size: 59 x 46 x 35mm. These meters require a 38mm dia. hole for mounting.

ME 6 = 0-50µA	ME13 = 0-100mA
ME 7 = 0-100µA	ME14 = 0-500mA
ME 8 = 0-500µA	ME15 = 0-50V DC
ME 9 = 0-7mA	ME17 = 0-300V AC
ME10 = 0-5mA	ME18 = 'S' METER
ME11 = 0-10mA	ME19 = 'VU' METER
ME12 = 0-50mA	

Our Price: £5.00 + 8% V.A.T.

### 'CRESCENT' 100 WATT R.M.S. AMPLIFIER KIT

This kit consists of three modules, power amp. module, pre-amp. module and power supply module including mains transformer. Requires no technical knowledge as full instructions are supplied. S.A.E. for further details.

Limited Stock—Buy Now While Stocks Last. Cost: £30 + 8% VAT.

ACCESS AND BARCLAYCARD ACCEPTED—PHONE ORDERS WELCOMED  
ALL PRICES INCLUDE POSTAGE—PLEASE ADD V.A.T. AS SHOWN—S.A.E. WITH ALL ENQUIRIES PLEASE

Personal callers welcome at: 164-166 High Road, Wood Green, N22. Phone: 888 3206  
and 13 South Mall, Edmonton N9. Phone: 803 1685

### EFFECTS PROJECTOR "150" (150 watt)

Ideal for disco work, this versatile machine takes a range of accessories and is of a sturdy metal construction. Comes complete with bulb and 6in. Liquid Wheel. Ready to use.



A bargain at £34 + 8% V.A.T.

### 3 KILOWATT PSYCHEDELIC LIGHT CONTROL UNIT (1000 Watt per channel)

Three channel: Bass, Middle, Treble. The input of this unit is connected to the loudspeaker terminals of an amplifier and the required lighting is connected to the output terminals of the unit thus enabling you to produce a fascinating sound to light display. Full instructions supplied or S.A.E. for details.

Fantastic Value at £20.00 + 8% V.A.T.

### LOUDSPEAKER SELECTION + 12½% V.A.T.

2½in. 8, 40, and 75 ohm at £1.10 (please state which impedance is required)  
5in. 8 ohm Ceramic at £1.70  
8in. Goodmans "Audiom 8PA" 8 ohm £5.26  
10in. "ELAC" Dual Cone 8 ohm 10 watt at £4.75

## G8CZW Digital Frequency Meter

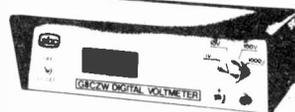


Complete 50MHz kit £54.00 inc. VAT, post free (U.K.)

ZN1040E Count/Display I.C.	£ 8.10
Integrated Circuit Pack	9.25
Displays and Filter Pack	7.78
Semiconductor and Diode Pack	2.47
Resistor and Capacitor Pack	3.10
Logic and Display P.C.B.s	4.84
5MHz Crystal	3.45
Transformer 8-0-0V 0.5A (+75p P. & P.)	2.48
Switches, Knob, BNC's etc.	4.15

Hardware and Wire Pack	£ 1.45
Case, Two-tone p.v.c.-faced steel, punched and lettered (+95p P. & P.)	5.75
Min BNC Sockets (50 ohm)	0.65
Min BNC Plugs (50 ohm)	0.70
500MHz Prescaler Kit	1.78
SP831B 500MHz I.C.	8.96
NES92 Wideband Video Amp	1.43
Hi-Z Buffer Kit	3.62
D.F.M. Reprint (post free)	0.50

## G8CZW Digital Voltmeter



Complete kit £44.30 inc. VAT, post free (U.K.)

ZNA116E 3½ Digit I.C.	£ 6.48
Integrated Circuit Pack	5.24
Displays and Filter Pack	7.78
Semiconductor and Diode Pack	2.60
Resistor Pack inc. cermet	4.64
Capacitor Pack	1.58
Logic and Display P.C.B.s	2.05
Voltage Attenuator Pack	0.68
Range Switch 6P. 4-way	2.38

Hardware and Wire Pack	£ 1.20
Case, Two-tone p.v.c.-faced steel, punched and lettered (+95p P. & P.)	5.75
I.C. Sockets Pack	1.08
Transformer (+75p P. & P.)	2.48
5V Reg., 2 Rect., 2,000µF Cap., Mains SW., Fuse and Holder	3.75
D.V.M. Reprint (post free)	0.35

All prices inc. VAT at the standard rate. Please add 20p P. & P. for packs. S.A.E. for full lists. Overseas—Deduct 8% off these prices.

Designer approved



**ELECTRONICS (OLDHAM) LTD.**

83 Lees Road, Oldham OL4 1JW

Tel. 061-624 8812

# GREENWELD

443 Millbrook Road Southampton  
SO1 0HX Tel: (0703) 772501

**BUY A COMPLETE  
RANGE OF COM-  
PONENTS AND  
THESE PACKS  
WILL HELP YOU**

- ★ **SAVE ON TIME—**  
No delays in wait-  
ing for parts to  
come or shops to  
open!
- ★ **SAVE ON MONEY**  
—Bulk buying  
means lowest  
prices—just com-  
pare with others!
- ★ **HAVE THE RIGHT  
PART—No guess-  
work or substitu-  
tion necessary!**

ALL PACKS CONTAIN FULL SPEC.  
BRAND NEW, MARKED DEVICES—  
SENT BY RETURN OF POST. VAT  
INCLUSIVE PRICES, JUST ADD 25p  
post FOR ANY NUMBER OF  
K-PACKS.

**K001** 50V ceramic plate capaci-  
tors, 5%. 10 of each value 22pF to  
1000pF. Total 210. £3-35

**K002** Extended range, 22pF to  
0-1µF. 330 values £4-90

**K003** Polyester capacitors, 10 each  
of these values: 0-01, 0-015, 0-022,  
0-033, 0-047, 0-068, 0-1, 0-15, 0-22,  
0-33, 0-47µF, 110 altogether for  
£4-75

**K004** Mylar capacitors, min 100V  
type, 10 each all values from 1000pF  
to 10,000pF. Total 130 for £4-45

**K005** Polystyrene capacitors, 10  
each value from 10pF to 10,000pF,  
E12 series 5% 160V. Total 370 for  
£12-30

**K006** Tantalum bead capacitors.  
10 each of the following: 0-1, 0-15,  
0-22, 0-33, 0-47, 0-68, 1, 2-2, 3-3,  
4-7, 6-8, all 35V; 10/25 15/16 22/16  
33/10 47/6 100/3. Total 170 tants for  
£14-20

**K007** Electrolytic capacitors 25V  
working, small physical size. 10  
each of these popular values: 1,  
2-2, 4-7, 10, 22, 47, 100µF. Total 70  
for £3-50

**K008** Extended range, as above,  
also including 220, 470 and 1000µF.  
Total 100 for £5-90

**K021** Miniature carbon film 5%  
resistors, CR25 or similar, 10 of  
each value from 10R to 1M, E12  
series. Total 610 resistors. £6-00

Our retail shops at 21 Deptford Broadway, London SE8 (01-692 2009) and 38 Lower  
Addiscombe Road, Croydon (01-638 2950) stock some of the advertised goods for  
personal callers only. Ring them for details.

All prices quoted include VAT and UK/BFPO postage except K-packs. Most orders  
despatched on day of receipt. SAE with enquiries please. Minimum order £1.  
Official Orders accepted from Schools, etc. (Minimum invoice charge £5).  
Export/Wholesale enquiries welcome. Surplus components always wanted.

**K022** Extended range, total 850  
resistors from 1R to 10M £8-30

**K041** Zener diodes, 400mW 5%.  
BZY88 etc. 10 of each value from  
27V to 36V, E24 series. Total 260 for  
£15-30

**K042** As above but 5 of each value  
£8-70

**POWER PACK**  
Wood grained metal case  
90 x 80 x 75mm containing mains  
transformer giving 6V at 200mA, 2  
co-ax sockets, PC Board with 1/2in  
fuseholder, Rs Cs etc. Only £1.

**PLASTIC CASE**  
Size 110 x 80 x 35mm with clear  
clip-on lid. Ideal for component  
storage or construction. 4 for £1; 10  
for £2; 25 for £4-50; 100 for £14.

**FLEX PACKS AND CABLE**  
5 different colours, 5 metres each,  
thick or thin. Total 25 metres 25p. 25  
way (14/0076) cable with braided  
overall screen and PVC sheath. 40p  
per metre.

**1977/78 CATALOGUE**  
Big new catalogue now ready. Full  
range of components at discount  
prices plus 50p discount vouchers.  
Only 30p plus 15p post.

**BRIDGE RECTIFIERS**  
50V 1A 26p; 400V 1A 36p; 400V 2A  
49p; 400V 2A 58p; 100V 4A 65p; 400V  
4A 80p; 100V 6A 74p; 400V 6A 98p;  
400V 10A £1-40.

**SCR PANEL**  
Has 12 60V 0-8A thyristors (gate  
current only 200µA), MEU21, 2N3904,  
1N4004 x 14, + Rs Cs etc. Only £1.

**MISCELLANEOUS ICs**  
MC3302P Quad Comparator plus  
data £1-20. ITT326 dual 2 plus dual  
3 input TTL nand gate plus data,  
10 for £1. ITT7105 Led digit driver  
plus data, 8 for £1. 710 T099 diff.  
comparator plus data 40p.

**VERO OFFCUTS**  
Pack A, All 0-1"  
Pack B, All 0-15"  
Pack C, Mixed  
Pack D, All 0-1" plain  
Each pack contains 7 or 8 pieces  
with a total area of 100 sq in. Each  
pack is £1-40. Also available by  
weight, 1lb £3-45, 10lb £28.

**FERRIC CHLORIDE**  
Anhydrous technical quality in 1lb  
double sealed packs. 1lb £1-10; 3lb  
£2-30; 10lb £5-60; 100 lb £39-00.

**PC ETCHING KIT MK III**  
Now contains 200 sq. ins. copper  
clad board, 1lb. Ferric Chloride,  
DALO etch-resist pen, abrasive  
cleaner, two miniature drill bits,  
etching dish and instructions,  
£4-25.

**7lb BARGAIN PARCEL**  
Hundreds of new components—  
pots, switches, resistors, capaci-  
tors, PC Boards with semiconduc-  
tors, loads of odds and ends.  
Amazing value at only £3-45.

# LIKE HUNDREDS OF NEW DORAM KIT AND COMPONENT IDEAS FREE?



Doram's new catalogue is one of the great events of the electronic year, 64 pages of new ideas in construction kits, capacitors, resistors, semi-conductors, wires and cables, transformers, plugs and sockets, hardware, indicators, switches, radio equipment, tools and test equipment, audio equipment, books. All top quality and terrific value because you can depend on Doram.

## DORAM

TAKE THE SHORT CUT.



Yes, please rush my free copy of the new Doram catalogue. I enclose 20p to cover post and packing.

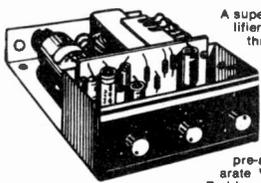
Name \_\_\_\_\_

Address \_\_\_\_\_

Post to: \_\_\_\_\_

Doram Electronics Ltd., PO Box TR8, PE/NOV  
Wellington Road Estate, Wellington Bridge, Leeds LS12 2UF

### SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz-30KHz  $\pm$  3dB. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3in high  $\times$  6in wide  $\times$  7in deep. AC 200/250V.

PRICE £15.00 P. & P. £1-20.

### HARVERSON MODEL P.A. TWO ZERO



An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1-5mV into 47k. Input 2-5mV into 47k (suitable for use with mic. or guitar etc.). Input 3 100mV into 1 meg. suitable for gram. tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12in. wide  $\times$  5in high  $\times$  7in deep.

Special introductory price £28-00 + £2-50 carriage and packing.

### SPECIAL OFFERS

Mullard LP1159 RF-IF module 470 kHz £2-25 + P. & P. 20p. Full specification and connection details supplied.  
Eye VHF/FM Tuner Head covering 88-108 MHz, 10-7 MHz I.F. output. 7.8V  $\pm$  earth. Supplied pre-aligned, with full circuit diagram with precision-gear F.M. gang and 323PF + 323PF A.M. Tuning gang only £3-15 + P. & P. 35p.

### MAINS OPERATED SOLID STATE AM/FM STEREO TUNER



200-240V Mains operated Solid State F.M. A.M. Stereo Tuner. Covering M.W. A.M. 540-1605KHz V.H.F. F.M. 88-108MHz.

Built-in Ferrite rod aerial for M.W. Full AFC and AGC on A.M. and F.M. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600mV R.M.S. into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8in wide  $\times$  4in high  $\times$  9in deep approx.

Limited number only at £28-00 + £1-50 P. & P.

### PRECISION MADE

Push Button Switch bank. 8 buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button plus 3 D/P C/O. Overall size 5in  $\times$  2in  $\times$  1in. Supplied complete with chrome finished switch buttons. 2 for £1-80 + 20p P. & P.

### 10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 $\Omega$  speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + S.A.E. (Free with parts). All parts sold separately. ONLY £13-50 P. & P. £1-40. Also available ready built and tested £18-00 P. & P. -40.

### "POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11in  $\times$  14in  $\times$  1.7in deep. Weight 19oz. Power handling 20W R.M.S. (40W peak). Impedance 8 ohm only. Response 40Hz-20KHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffles. Send S.A.E. for full details. Only £8-40 each + P. & P. (one 90p, two £1-10). Now available in either 8in round version or 4in  $\times$  8in rectangular, 100 watts R.M.S. 60Hz-20KHz £5-25 + P. & P. (one 65p, two 75p).

SPECIAL OFFER. 6in long throw, roll surround, ceramic magnet 8 ohm 10 watt speaker chassis. Specially suitable for Hi Fi. £3-95 + 75p P. & P.

2in PLASTIC CONE HF TWEETER 4 ohm. £3-50 per matched pair + 50p P. & P.

### HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts R.M.S. per channel into 5 ohms. Frequency response  $\pm$  3dB 12-30,000Hz. Sensitivity: better than 80mV into 1 M $\Omega$ . Full power bandwidth:  $\pm$  3dB 12-15,000Hz. Bass boost approx. to  $\pm$  12dB. Treble cut approx. to -16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1A overall size 12in wide  $\times$  8in deep  $\times$  2in high. Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT £13-50 P. & P. 80p (Magnetic input components 33p extra)

POWER PACK KIT £5-50 P. & P. 95p

CABINET £5-50 P. & P. 95p

SPECIAL OFFER—only £23-75 if all 3 items ordered at one time plus £1-25 P. & P.

Full after sales service Also available ready built and tested £31-25 P. & P. £1-50

### HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets and 5 pin din tape rec./play socket are mounted on the printed circuit panel. Size approx. 9in  $\times$  2in  $\times$  1in max. depth. Supplied brand new and tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only £9-00 + 50p P. & P. Mains transformer with an output of 17V a.c. at 500mA can be supplied at £1-50 + 40p P. & P. if required. Full connection details supplied.

Open 9.30-5.30 Monday to Friday, 9.30-5 Saturday Closed Wednesday.

Prices and specifications correct at time of press. Subject to alteration without notice

## HARVERSON SURPLUS CO. LTD.

(Dept. P.E.) 170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985

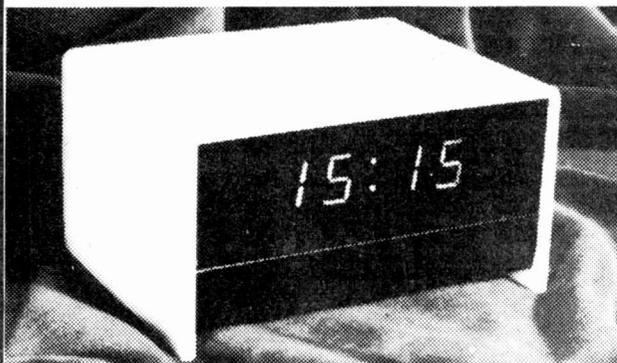
A few minutes from South Wimbledon Tube Station

(Please write clearly)

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

## THE METAC DIGITAL CLOCK

★ COMPLETE KIT ★



- Pleasant green display 12/24 Hour readout
- Silent Synchronous Accuracy Fully electronic
- Pulsating colon. Push-button setting
- Building time 1 hr. Attractive acrylic case
- Easy to follow instructions Size 10.5  $\times$  5.7  $\times$  8 cm
- Ready drilled PCB to accept components

KIT PRICE £9.60 + 76p VAT

SAME DAY DESPATCH: ORDERS RECEIVED BEFORE 2.00 P.M. ARE POSTED ON THE SAME DAY

SEND YOUR ORDER TO

DAVENTRY

UXBRIDGE

### METAC ELECTRONIC AND TIME CENTRE

67 HIGH STREET  
DENTON  
NORTHANTS.  
TEL. (032 72) 76545

3 THE NEW ARCADE  
HIGH STREET  
UXBRIDGE  
MIDDLESEX  
TEL. UXBRIDGE (0895) 56961

Cash, Cheque or Postal Order or if you wish to use Barclaycard or Access, simply quote name, address and card number when ordering. Shops open 9-5.30 daily.

## We can help you See and Solve your problems

### HONELIGHT

Universal Portable Inspection Light  
The shadowless Honelight utilises the principle of optical fibres, in a tube of virtually unbreakable material, insulated, transparent and resistant to alcohol.

It gives all-round illumination to otherwise inaccessible confined spaces and corners. Simple, lightweight and practical (weight with batteries 40 grammes approx.). Suitable for all professions—Electronics, Radio/TV—machines of all types.

Also useful in the realm of Medicine: general and specialised, Dentistry, Veterinary etc.  
(Operates from 2-1.5 volt batteries).



### Desoldering Tool "SPECIPROD"

High precision manufacture de-soldering pump. Available three sizes for all de-soldering requirements.

Chromed interior, nickel pump, teflon nozzle.

Three Sizes.

"Maxi Super" length 37cm, nozzle diameter 2mm.

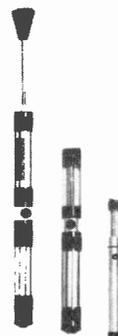
"Maxi Mini" length 22cm, nozzle diameter 1.5 mm.

"Maxi Micro" length 16cm (diameter body 12mm, nozzle diameter 1.5mm).

(The smallest de-soldering pump available).

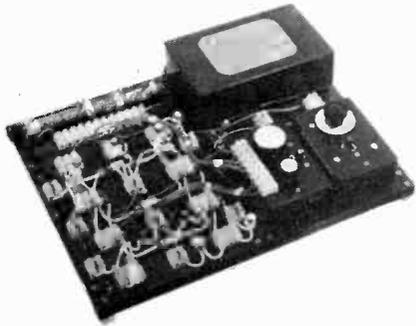
Literature and general catalogue available on request from:

Special Products Distributors Limited, 81 Piccadilly, London W1V 0HL  
Tel: 01-629 9556 Cables: Speciproduct London W1



# RADIO EXCHANGE LTD.

## NEW ELECTRONIC MASTER KIT



With special Multi-Band V.H.F. Tuner Module to construct. A completely Solderless Electronic Construction Kit, with ready drilled Bakelite Panels, Nuts, Bolts, Wood Screws, etc., Also in the kit: Transistors, Capacitors, Resistors, Pots, Switches, Wire, Sleeving, Knobs, Dials, 5in x 3in Loudspeaker and Speaker Case, Crystal Earpiece, etc. Also ready wound Coils and Ferrite Rod Aerial. These are the Projects you can build with the components supplied with the kit, together with comprehensive Instruction Manual Pictorial and Circuit Diagrams.

**PROJECTS:** V.H.F. Tuner Module • A.M. Tuner Module • M.W. L.W. Diode Radio • Six Transistor Multiband V.H.F. Earpiece Radio • One Transistor M.W. L.W. Radio • Two Transistor Metronome with variable beat control • Three Transistor and Diode Radio M.W. L.W. • Four Transistor Push Pull Amplifier • Eight Transistor Multiband V.H.F. Loudspeaker Receiver • Variable A.F. Oscillator • Jiffy Multitester • Four Transistor and Diode M.W. L.W. Radio • A.F. R.F. Signal Injector • Five Transistor Push Pull Amplifier • Sensitive Hearing Aid Amplifier • Three Transistor and Diode Short Wave Radio • Signal Tracer • Three Transistor Push Pull Amplifier • One Transistor Class A Output Stage to drive Loudspeaker • Sensitive Transistor Pre-amp • Transistor Tester • Sensitive Three Transistor Regenerative Radio • Four Transistor M.W. L.W. and Diode Tuner • Five Transistor M.W. L.W. Trawler Band Regenerative Radio • Five Transistor V.H.F. Multiband Tuner • Three Transistor Code Practice Oscillator • Five Transistor Regenerative Short Wave Radio • Four Transistor and two Diodes M.W. L.W. Loudspeaker Radio • Seven Transistor M.W. L.W. Radio with Loudspeaker Push Pull output • One Transistor Home Broadcaster.

**£14.99** + P. & P.  
£1.10

## NEW ROAMER TEN MODEL R.K. 3

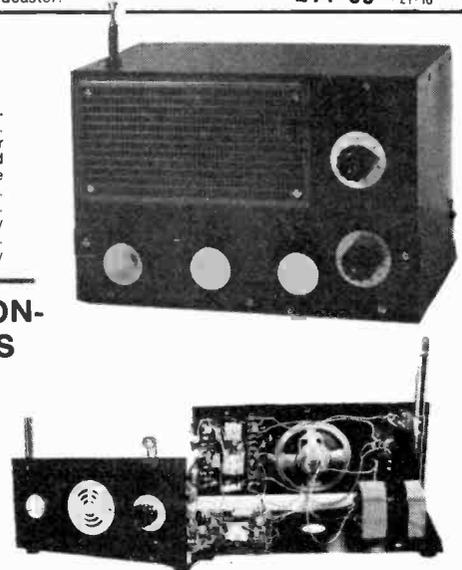
Multiband V.H.F. and A.M. Receiver. 13 Transistors and five Diodes. Quality 5in x 3in Loudspeakers. With Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Slow Motion drive Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W. Three Short Wave Bands S.W.1, S.W.2, S.W.3 and Trawler Band, Built-in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push-Pull output using 600mW Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Negative Feedback circuit and SPECIAL POWER BOOSTER SOCKET AND RESISTOR, to virtually double gain if required.

Complete kit of parts including carrying strap. Building Instructions and operating Manuals.

**£14.79** + £1.10 P. & P.

## ELECTRONIC CONSTRUCTION KITS E.C.K. 2

Self-Contained multi-band V.H.F. receiver kit. 8 transistors and 3 diodes. Push pull output. 3in loudspeaker, gain control, 7 section chrome plated telescopic aerial, V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P.7 battery (not supplied with kit).



Complete kit of parts **£7.95** P. & P. and ins. 90p

## NEW MODEL R.K. 1

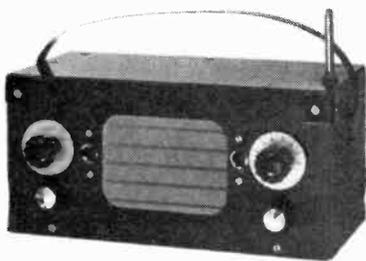
Multiband A.M. receiver. M.W. L.W. Trawler band and three short wave bands. Seven transistors and four diodes. Push pull output stage. 5in x 3in loudspeaker. Internal ferrite rod aerial. Kit includes all parts to build it up including case enclosure kit, carrying strap, rubber feet and ready drilled panels. Comprehensive instruction manual for stage by stage construction. Uses P.P.9—nine volt battery.



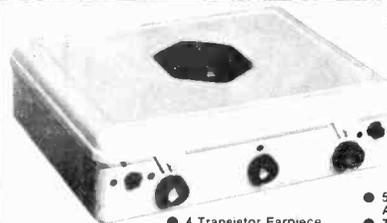
**£8.99** + P. & P. 90p

## NEW MODEL R.K. 2

M.W. L.W. and Air band receiver. Eight transistors and four diodes. 3in loudspeaker, telescopic aerial, internal ferrite rod aerial. Complete with case enclosure kit, carrying strap, and ready drilled panels and all components necessary for construction. A sensitive receiver with the additional luxury of an air band section to pick up aircraft from many miles away. Full instruction manual enables stage by stage construction. Uses P.P.9—nine volt battery.



**£9.99** + P. & P. £1.10



## NEW EDU-KIT MAJOR

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

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN—PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker Radio M.W.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- 24 Resistors • 21 Capacitors • 10 Transistors • 5in x 3in Loudspeaker • Earpiece • Mica Baseboard • 3 12-way Connectors • 2 Volume controls • 2 Slider Switches • 1 Tuning condenser • 3 Knobs • Ready Wound M.W. L.W. S.W. Coils • Ferrite rod • 64 yards of wire • 1 yard of sleeving, etc. Complete kit of parts including construction plans
- Batteryless Crystal Radio
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier.

Total building costs **£9.99** P. & P. and Ins. £1.10

## NEW Everyday Series

Build this exciting new design. E.V.6. 6 transistors and 2 diodes. M.W. L.W. Powered by 9V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in loudspeaker. Attractive case with red speaker grille. Size 9in x 5in x 2in approx. All parts including Case and Plans.



Total Building costs **£5.95** P. & P. + Ins. 90p

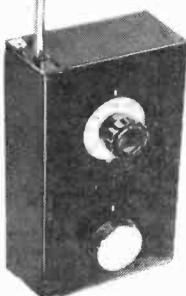
**ALL PRICES INC. VAT**

## V.H.F. AIR CONVERTER KIT

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

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

All parts including case and plans



**£4.95** P. & P. and Ins. 60p

To: RADIO EXCHANGE LTD, 61A High street, Bedford MK40 1SA

Tel: 0234 52367. REG NO. 788372.

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

I enclose £.....

Name .....

Address .....

PE1177

# BD1-The Connoisseur's Budget Choice



BD1 Kit & Completed BD1 Assembly



BD1 with Plinth, Cover & SME Arm.

The Connoisseur BD1 transcription turntable is a precision engineered product designed to provide top grade performance at a moderate cost. Simplicity is the main feature of this unit giving excellent performance and reliability. A slow speed synchronous motor is used and because of its construction the hum field is very low, so that even the most sensitive of pickups can be used, including the Connoisseur SAU2 or the SME 3009 Series II. Speed change is achieved by a press button unit at the rear of the platform which automatically moves the drive belt from one pulley groove to the other whilst the turntable is turning. The BD1 turntable kit can be assembled by the home constructor within the hour and when completed will give top quality performance. No soldering is required. Complete the unit with a modern BD1 plinth and cover. The plinth is finished in walnut veneer and fitted with spherical, anti-vibration feet. Add to this a strong Acrylic, bronze cover, hinged with 2-position lid stay and you have a first class turntable at a budget price!

## Connoisseur

Write for further details to:  
**A. R. Sugden & Co. (Engineers) Ltd.**  
 Manufacturers of Connoisseur Sound Equipment, Connoisseur Works, Atlas Mill Road,  
 Brighouse, West Yorkshire HD6 1ES  
 Telephone: Brighouse (0484) 712 142, Telex: 517144 Sugden Crighouse,  
 Telegrams & Cables: Connoisseur Brighouse.

IC's 	TRANSISTORS 	RESISTORS 
DESPATCHED ON DAY ORDER RECEIVED		
SWITCHES 	LAMPS 	PLUGS SOCKETS 



ACE MAILTRONIX LTD  
 Dept. PE, Tootal Street  
 Wakefield, W. Yorkshire WF1 5JR

**ORDERING IS EASY WITH THE UNIQUE COMBINED CATALOGUE/ORDER FORM**

SEND STAMP ADDRESSED ENVELOPE NOW FOR THE EASY TO USE ACE ORDER FORM CONTAINING 500 TOP QUALITY POPULAR ELECTRONIC COMPONENTS AT PRICES YOU CAN AFFORD. P&P FREE ON ORDERS OVER £2, OTHERWISE 20p. ALL PRODUCTS GUARANTEED ONE YEAR IF CORRECTLY USED. SOME EXAMPLES FROM THE COMPETITIVE ACE RANGE WITH VAT INCLUSIVE PRICES ARE SHOWN BELOW

BC107/108/109 Metal	13p	1/4W Resistors CF ±5%	3 for 6p
BC207/208/209 Plastic	11p	Minipresets Horiz./vert.	8p
2N3055	65p	Electrolytic 100µF 25v	10p
741 Op Amp - 8pin	30p	Polyester C280 0-1, F	8p
555 Timer	50p	LED Red 0.2"	15p
W04 1A Bridge	31p	Phono plugs	8p
7400 TTL	15p	Mintoggle SPST	80p
IN4148 Diode	4p	Wire - PVC Stranded 10m	25p
IN4001 Rec	5p	Veroboard 0-1 2.5x3-75	50p
BZY88 Zeners	12p	S-DEC Breadboard	216p

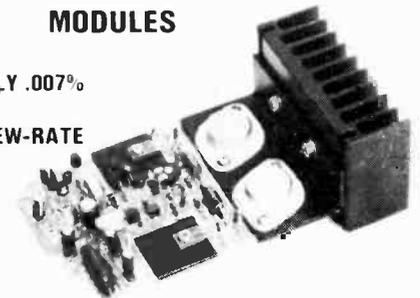
**Get an ACE up your sleeve!**

## AUDIBLY SUPERIOR AMPLIFICATION

**HIGH DEFINITION — 'MUSICAL' — POWER AMP MODULES**

- ★ T.H.D. TYPICALLY .007%
- ★ @ 10W, 500Hz
- ★ ZERO T.I.D. (SLEW-RATE LIMIT 16 V / - S)

Module size: 120 x 80 x 25 mm, using glass fibre pcb with ident and solder resist. Illustrated with light duty heatsink.



CRIMSON ELEKTRIK power amplifier modules are fast gaining a reputation as the best sounding, most musical modules available. Perhaps the most important features of this design are exceptional freedom from crossover distortion (due to the use of output triples) and zero T.I.D. The amplifier is protected against open and short circuit loads and yet will drive a highly reactive lower impedance load which is more representative of a real loudspeaker. Square waves maintain their rise times up to full power whilst simulated electrostatic loads are easily handled with negligible overshoot and a settling time of 12µs. Other specs: S/N > 110dB, Rise time 10µs, Sensitivity 775mV, DC coupled, 5Hz-35kHz (-3dB), THD < .015%, 100mW clipping, 500Hz.

CRIMSON ELEKTRIK power supplies are in kit form for maximum flexibility and feature a low field silmline toroidal transformer with a 120-240v primary and screen, two large capacitors bridge rectifier and all fittings. Heatsinks are attractive black anodised extrusions, 80mm wide.

### POWER AMP MODULES

CE 608 100Wrms 8 ohms	35v dc	£16.30	£16.30
CE 1004 100Wrms 4 ohms	35v dc	£19.22	£19.00
CE 1008 100Wrms 8 ohms	35v dc	£23.22	£22.70

### POWER SUPPLIES

CPS 1 For 2xCE608 or 1xCF1004	£12.85	£14.20
CPS 2 For 2xCE1004 or 2 or 4xCE608	£14.55	£17.90
CPS 3 For 2xCE1008	£15.85	£19.20

### HEATSINKS

Light Duty	50mm 2 C W	90	£1.30
High power	100mm 1.4 C W	£1.60	£2.40
Disc/group	1500mm 1.1 C W	£2.30	£3.65

## CRIMSON ELEKTRIK

(PE)  
 74 STATION ROAD  
 RATBY  
 LEICESTER, LE6 0JN  
 TEL: (0533) 386211

Home prices include VAT and carriage. Payment by cheque. PO COD: 60p (£50 limit). Export no problem. European prices include carriage, insurance and handling payment in Sterling by bank draft, P.O. International Giro or Money Order. Outside Europe please write for specific quote by return. Send SAE or two International Reply Coupons for full literature. Favourable trade quantity price list on request. Suitable pre-amp circuit 20p.

# AITKEN BROS

35 High Bridge, Newcastle upon Tyne  
Tel. 0632 26729

## TRANSISTORS

*AC125	£0-30	BU205	£2-20
*AC126	£0-25	ME0401	£0-18
*AC127	£0-25	ME0402	£0-15
*AC128	£0-28	ME0404	£0-15
*AC141	£0-30	MPF102	£0-32
*AC142	£0-32	MJ2955	£1-25
*AC176	£0-30	MJE2955	£1-50
*AC187	£0-30	MJE3055	£0-95
*AD188	£0-27	OC28	£1-50
AD140	£0-85	OC28	£1-40
AD148	£1-40	TIP29A	£0-47
AD181	£0-70	TIP30A	£0-56
AD182	£0-70	TIP31A	£0-57
AL102	£1-90	TIP2955	£0-97
AL103	£1-90	TIP3055	£0-55
BC107	£0-15	2N696	£0-35
BC108	£0-15	2N697	£0-30
BC109	£0-15	2N706	£0-28
*BC147	£0-12	2N1613	£0-32
*BC148	£0-12	2N1711	£0-32
*BC149	£0-14	2N2160	£1-40
*BC167	£0-13	2N2219A	£0-36
*BC168	£0-13	2N2220	£0-35
*BC189	£0-14	2N2221	£0-25
*BC182	£0-11	2N2221A	£0-28
*BC183	£0-11	2N2222	£0-25
*BC184	£0-12	2N2222A	£0-25
*BC212	£0-14	2N2646	£0-75
*BC213	£0-14	2N2904	£0-36
*BC214	£0-16	2N2904A	£0-37
BD115	£0-80	2N2905	£0-37
BD131	£0-50	2N2905A	£0-38
BD132	£0-50	2N2906	£0-26
BD140	£0-40	2N2906A	£0-35
BFW10	£0-68	2N2907	£0-25
BFW11	£0-68	2N2907A	£0-26
BFX84	£0-35	2N2926	£0-15
BFX85	£0-35	2N3053	£0-30
BFX88	£0-30	2N3054	£0-80
BFY50	£0-28	2N3055	£0-70
BFY51	£0-28	2N3702	£0-13
BFY52	£0-28	2N3703	£0-15
BU105	£1-50	2N3704	£0-15

## INTEGRATED CIRCUITS

*CA3080	£0-75	*LM710/14	£0-60
*CA3080A	£1-88	*LM723/TO99	£0-85
*CA3086	£0-80	*LM723/14	£0-75
*CA3088	£1-70	*LM741/8	£0-40
*CA3089	£2-52	*LM741/14	£0-40
*CA3090	£4-00	*LM741/TO99	£0-65
CA3130	£0-98	*LM747	£0-90
*LM301/8	£0-44	*LM748/8	£0-55
*LM301/TO99	£0-65	*LM748/14	£0-55
*LM308	£1-82	*LM748/TO99	£0-50
*LM308/TO99	£1-17	*LM3800	£0-75
*LM309	£1-85		
*LM380/8	£0-90	TTL + CMOS	
*LM380/14	£0-98	always in stock	
*LM709/8	£0-45	NE555	£0-53
*LM709/14	£0-45	NE556	£1-05
*LM709/TO99	£0-65	*ZN414	£1-50
*LM710/TO99	£0-80	*MC1310	£1-91

## THYRISTORS

TO92		Flat Plastic	
0-5A 25V	£0-32	4A 100V	£0-68
0-5A 50V	£0-32	4A 200V	£0-51
0-5A 100V	£0-46	4A 300V	£0-52
0-5A 200V	£0-46	4A 400V	£0-58
TOS			
1A 100V	£0-58	8A 50V	£0-54
1A 200V	£0-62	8A 200V	£0-67
1A 400V	£0-93	8A 400V	£0-82
1A 600V	£0-96	8A 600V	£0-74

## TRIACS 400V flat plastic

4A	£0-98	10A	£1-19
6A	£1-19	12A	£1-23

## DIODES

BAX13	£0-08	IN4003	£0-08
BY127	£0-18	IN4004	£0-10
BY133	£0-20	IN4005	£0-12
OA5	£0-75	IN4006	£0-12
OA10	£0-55	IN4007	£0-12
OA90	£0-10	IN5400	£0-12
OA91	£0-10	IN5401	£0-14
OA95	£0-10	IN5402	£0-16
OA200	£0-10	IN5403	£0-16
OA202	£0-10	IN5404	£0-18
IN814	£0-07	IN5405	£0-18
IN4148	£0-06	IN5406	£0-18
IN4001	£0-06	IN5407	£0-20
IN4002	£0-08	IN5408	£0-22

## SOLDERLESS BREADBOARDS

DECA		U-DEC "A"	£3-99
S-DEC	£1-98	U-DEC "B"	£6-99
T-DEC	£3-63		

Pots, capacitors, boxes, inst. cases, Din plugs, jack plugs, resistors always in stock. For details send 40p for our 100-page catalogue. 30p to callers. Prices less VAT. Please add 12p to items marked \*. All rest add 8p. Postage 20p extra.

Single Stage Stereo Preamp boards max. I/P 700mV (high Z) gain 26DB. 40p. Grundig Electret Microphone inserts with F.E.T. preamp, £1-50. A.M.I. FM 7 transistor tuner boards with var. cap., 5 way push button 10-7MHz filt. I.F.T.'s etc., suitable for spares, 75p. Model motors 1-5-6V d.c., 20p. 12V d.c. 5 pole, 40p. 115V a.c. min. motor 3 r.p.m. with gearbox, 30p. Grundig speaker 2 1/2" x 4 1/2" 8Ω, 80p. G.P.O. board with 64 BC107 type transistors, 2 reed, 1 mercury relays, diodes, etc., £2-00 + 55p P. & P. 500 metres, 2 core single strand wire, £4-00 + 85p P. & P. Savbit 500 gram cored solder, £2-50. 650kHz I.F. panels 6 I.F.s 3 trans. etc., 30p. 200pF twin dielectric var. capacitors—pin spindle, 30p. Stereo preamp. with controls ceramic input with CCT, £3-50. 200kHz, HC8U Xtals, 40p. 240V a.c. large solenoid 25lb pull 4in travel, £3-95. 12V d.c. solenoid 0-0375 travel, 65p. G.P.O. buzzers 6-12V, 30p. Miniature solid state buzzers, 6-9-12 or 24V d.c. 15mA, 75p. Omron 12V a.c. relays 11 pin, 3 pole c/o 5 amp, 85p. Miniature 220V a.c. sealed relay 2 pole c/o, 50p. 12V reed relay 4 make, 20p. 240V a.c. sealed relay, 11 pin, 3 pole c/o 5 amp, new, 80p. 6MH 3 amp. smoothing chokes, 30p. Veeder root reset 3 digit 240V a.c. counters, £1-95. 100-0-100µA level meters, 75p. Stereo tuning meters 100µA per mov., £2-75. Battery level meter 20mm x 15mm x 20mm, 60p. Smiths 270° 5mA meters 115mm dia. scaled in tons, £1-50. Mains transformers: 240V a.c. primary, 6-0-6V 100mA, 75p. 9-0-9V 75mA, 75p. 12-0-12V 50mA, 75p. 12V 500mA, 95p. 15-0-15V 1 amp, £2-00 + 35p P. & P. 0-12-15-20-24-30V 2A, £4-95 + 35p P. & P. 25V 2 amp, £1-75 + 35p P. & P. 35V 2 amp + 2-5V 2 amp toroid, £2-75 + 35p P. & P. 18V 1 amp rectified, £1-95 + 35p P. & P. 18V 1-5A + 12V 1A, £2-20 + 35p P. & P. 20V 2-5A, £2-20 + 35p P. & P. 80 watt auto tapped 240V-135-115-110-19V 80 watt, £1-75 + 35p P. & P. 300 watt auto 240-110V a.c., £3-50 + 50p P. & P. Tape Heads: Jap mono cassette, 90p. BSR MN1330 1/2 track dual imp./rec./ playback, 50p. BSR SRP90 1/2 track stereo rec./playback, £1-95. BSR TD10 dual head assemblies 1/2 track rec./playback staggered stereo with built in erase per head, £1-20. BSR 4SE 1/2 track erase heads, 30p. Computer capacitors, new: 14,000µ 35V d.c. 30,000 40V d.c., 4,200 100V d.c., 60,000 30V d.c., all 75p each. 20,000 45V d.c. ex. equip., 45p. 2,200mF 6-3V d.c. and 4,700mF 6-3V d.c. P.C. mounting 5p each type. 10mF 6-3V d.c. P.C. mtg. new £2-50 per 100 semiconductors. 741 8 pin dil. 23p. CD4051 CMOS, 50p. Motorola MRD3051 photo transistor, 35p. N channel fets sim. to 2N3819, 18p. Man 3A 3mm led display, 50p. Lucas 500V 5 amp NPN stud power transistor, 55p. 2in green led's, 12p. M203 dual matched pair mosfets, single gate per fet, 40p. SL301 dual matched pair silicon NPN trans. ft. 300MHz, 30p. Intel 1024 bit mos rams type C1103-1, 95p. BFX95 (equiv.), 20p. 2N1893, 20p. 3N140 mosfets, 50p. Texas plastic 50V 6 amp S.C.R. 30p. MP8512, 20p. 300V 2 amp S.C.R. TOS case, 45p. 400V 15A S.C.R. stud, 75p. CV7556 200V 150A stud recs., £1-25. 400V 3 amp sil. recs., 25p. CV2184 2 1/2in C.R.T. with P.D.A., £1-95. Board with 14 S.P. reed relays, £2-40. Curly leads, 7 core heavy 5 foot max. 30p. Switches: push to make 16 x 6mm, 15p. D.P.D.T. push-on push-off 25 x 9 x 7mm, 32p. D.P.D.T. min. rockers, 15p. S.P.S.T. 10 amp rockers, 12p. Radio-spares S.P. c/o push switches, 45p. G.P.O. keyswitch assy. 3 switches 2-3 way, 1-2 way, multi-pole, 35p. Bulgin roller micros, 15p. Sub min. micro 13 x 10 x 4mm, 20p. Glass reed switches No 28mm or 50mm 10 for 80p. Adjustable vinkors 250, 375µH, 20p. Pot cores 40mm dia. new, 30p. 260mH inductors, 12p. 1 pole 18 way thumb switch, 20p. E.T.P. 100 watt solder guns, £3-75. High imp. headphones 2kΩ, £1-65. Servisol switch cleaner aerosol 8oz, 55p. Servisol 'Freezit' aerosol 8oz, 50p. Newmarket power supply 240V a.c. input, 8V 250mA out, £1-95. Texas mosfet. Similar to 40673, 38p. Min. sealed relay 4 pole c/o. 36Ω coil 6V d.c. New with base, 45p. Monsanto 4640A. 3in LED display com. cath., £1. S. mica Capacitor—0-1mFd. 350 V d.c. 1% tolerance, 10p.

We stock a full range of components, project lists welcome. V.A.T. included in prices. Postage unless otherwise shown 30p P. & P. Excess postage will be refunded with order.

Order Address

**PROGRESSIVE RADIO**  
31 CHEAPSIDE  
LIVERPOOL 2  
051-236 0982

# We're at your service on the...

# RANK A823 COLOUR CHASSIS



Don't miss our detailed and comprehensive feature on this popular single standard colour chassis! We define all the faults you are likely to encounter and explain the remedies.

## Also TROUBLES WITH TRIPLERS

How they work, the different types, what actually goes wrong with them, and the warning symptoms of trouble.

Plus Part 2 of the Mono Portable TV set

# LOOK INTO TELEVISION

NOVEMBER ISSUE  
on sale Monday 17 October 50p



## NOTICE TO READERS

When replying to Classified Advertisements please ensure:

- That you have clearly stated your requirements.
- That you have enclosed the right remittance.
- That your name and address is written in block capitals, and
- That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

## RECEIVERS AND COMPONENTS

### BRAND NEW COMPONENTS BY RETURN

**Electrolytic Capacitors** 16V, 25V, 50V—0.47, 1.0, 2.2, 4.7, 10µF 10p; 22, 47 5µF (50V 8p); 100 7p (50V 8p); 220 8p (50V 10p); 470 11p (50V 10p); 1,000 (16V) 15p, 1,000 (25V) 18p, 1,000 (50V) 22p.  
**Subminiature Bead Tantalum Electrolytics**—0.1, 0.22, 0.47, 1.0, 2.2 at 35V, 4.7/25V 11p; 10/25V 18p; 22/16V, 47/16V and 100/3V 15p.  
**Mullard Min. Ceramic E12 Series** 63V 2%—10pF to 47pF—8p; 56pF to 330pF 4p.  
**Vertical Mounting Ceramic Plate** 50V—E12 series 22-1,000pF and E6 series 1,500-47,000pF 2p.  
**Polystyrene E12 Series** 63V Horizontal Mounting—10-1,000pF 8p; 1,200-10,000pF 4p.  
**Mullard Polyester 250V Vertical Mounting E6 Series**—0.01-0.1 4p; 0.15, 0.22 5p; 0.33, 0.47 8p; 0.68 11p; 1.0 13p; 15 20p; 2.2 22p.  
**Mylar (Polyester) Film** 100V Vertical Mounting—0.001, 0.002, 0.005 3p; 0.01, 0.02 4p; 0.04, 0.05 4.5p.  
**Miniature Resistors** Highalt E12 Series 5%, Carbon Film 0.125W, 0.25W 1Ω to 10MΩ (10% over 1M) 1p. Metal Film 0.125W, 0.25W and 0.5W 10Ω to 2MΩ 1p. Metal Film 1W 27Ω to 10MΩ 2p.  
**1N4148 3p; 1N4002 5p; 1N4006 7p; 1N4007 8p; BC107/8/9, BC147/8/9, BF157/8/9, BF194, 197 8p.**  
**Fuses** 20mm glass, 13in glass, 1in ceramic 8p.  
**Post 10p (free over £4). Prices inclusive of VAT.**

### THE C.R. SUPPLY CO.

127 Chesterfield Road, Sheffield S8 0RM

**VALVES**—Radio, TV, industrial, transmitting. We dispatch to any part of the world by return of post, Air or Sea Mail. 2,700 types in stock. 1950 to 1978 obsolete types a speciality. List 20p. Quotation S.A.E. Open to callers. Mon. to Sat. 9.30-5.00 closed Wed. 1.00. We purchase all types of new and boxed valves. COX RADIO (Sussex) Ltd., Dept. P.E., The Parade, East Wittering, Sussex, PO20 8BN. West Wittering 2023. (STD code 024366).

## ORCHARD ELECTRONICS

I.C.s. TTL. C/MOS. Linear. Capacitors. Resistors (E12). SIL/Rectifiers. Diodes. LED. Thyristors. Zeners. Voltage Reg. DIL Sockets. Bridge Rectifiers. Potentiometers. Presets. Triacs. Diac. Plugs. Sockets. Cable. Vero. Carefully selected range, excellent despatch service. Same day turn round. S.A.E. List. Suppliers to A.E.R.E. U.K.A.E.A. Government Depts. Schools. Universities. Manufacturers. Accounts opened for trade and amateur. Join the professionals. Phone by 4 p.m. Goods out 1st class by 5 p.m. Try us and prove it!

### ORCHARD ELECTRONICS

Flint House, High Street, Wallingford, Oxon  
 Telephone 0491-35529

**NOVEMBER ONLY** MJE3055, 40p; T1L209, 8p; 2102 (500NS), £1.50; 8080A, £16; MM5314, £2.95; BF195, 9p; BC213, 9p; BC183, 9p; CCP70, 16p; 7 way DIL switches 50p; 74H00 20p. Timers in 11 pin relay case, 13.5 secs-5mins approx + PCB Base 65p, P. & P. 10p. LB ELECTRONICS, 43 Westcott, Hayes, Middx UB4 8AH.

# SMALL ADS

The prepaid rate for classified advertisements is 18 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £6.00 per single column centimetre. All cheques, postal orders etc., to be made payable to Practical Electronics and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

## Precision Polycarbonate Capacitors

All High Stability—extremely Low Leakage

440V A.C. RANGE			63V D.C. RANGE			
Value	Dimen-	Price	Value	±1%	±2%	±5%
µF	(mm)	each	µF			
0.1	27	12.7 £1.34	0.01-0.2	£1.80	£1.22	88p
0.15	27	12.7 £1.52	0.22-0.47	£1.82	£1.24	90p
0.22	33	16 £1.66	0.68	£2.06	£1.38	£1.00
0.25	33	16 £1.78	1.0	£2.26	£1.52	£1.08
0.33	33	16 £1.92	2.2	£2.50	£1.68	£1.20
0.47	33	19 £2.08	3.3	£2.80	£1.94	£1.42
0.5	33	19 £2.24	4.7	£3.04	£2.12	£1.54
0.68	50-8	19 £2.48	6.8	£4.88	£3.36	£2.66
1.0	50-8	19 £2.64	10	£6.94	£4.68	£3.56
1.5	50-8	25.4 £3.14	15	£9.92	£6.48	£4.96
2.0	50-8	25.4 £3.74	22	£13.32	£9.98	£6.80

**TANTALUM BEAD CAPACITORS:** 0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1.0µF at 25/35V—10p; 1.5µF/35V—11p; 2.2µF/35V—12p; 3.3µF/35V—13p; 4.7µF/35V—15p; 6.8µF/35V—17p; 10µF 25V—17p; 10µF 35V—21p; 15µF/20V; 22µF/15V; 33µF/10V; 47µF/6.3V at 21p; 68µF 3V—17p; 100µF/3V—21p.

TRANSISTORS & I.C.'s		TIP32A		57p	
AC128	28p	BCY72	18p	TIP42A	79p
AC176	35p	BD131/132	41p	2N2926G/O/Y	17p
AD149	68p	BF115	42p	2N3053	42p
AF178	64p	BF173	27p	2N3054	97p
AF239	45p	BF178	42p	2N3055	65p
BC107/8/9	12p	BF184	28p	2N3702/3/4	17p
BC114	15p	BF194/195	12p	2N3705/6/7/9	17p
BC147/8/9	10p	BF196/197	15p	2N3819	42p
BC153	16p	BF200	32p	MPU131	35p
BC157/8/9	12p	BF212/263	40p	NE555	61p
BC177	12p	BF505/51/52	22p	741 8 pin DIL	38p
BC182/183	12p	BFX84/85	29p	ZN414	£1.65
BC184/212/3	13p	BFX86/87	31p	5N76013ND	£1.55
BC214	13p	BR101	41p	5N76023ND	£1.55
BC238	17p	GET872	15p		
BC267	25p	OC44/OC45	40p		
BC268A	12p	OC17/72	45p		
BC54	12p	TIP31A	55p		

**POPULAR DIODES:** BA145—18p; BA148—18p; BA155—18p; BA156—15p; BR100—28p; BY126—15p; BY127—16p; OA47—11p; OA81—15p; OA90 & 91—7p; IN914—7p; 10/66p; IN916—8p; 10/77p; IS44—7p; 10/60p; IN4148—6p; 10/55p; IN4001—9p; 002—61p; 003—7p; 004—7p; 005—8p; 006—9p; 007—10p; TL209—25p.

**LOW PRICE ZENER DIODES:** 400mW. Tol. ±5% at 5mA 3V; 3V; 3.6V; 4V7; 5V1; 5V6; 6V2; 6V8; 7V5; 8V2; 9V1; 10V; 11V; 12V; 13V; 13.5V; 15V; 16V; 18V; 20V; 22V; 24V; 27V; 30V; 33V (All at 10p each, 10 for 95p, 50 for £4.50, 100 for £8.00 (values may be mixed)).

**RESISTORS**—High stability, low noise carbon film 5% ±W at 40°C, 1W at 70°C. E12 series only—from 2.2Ω to 2.2MΩ. All at 2p each, 13p\* for 10 of any one value, 95p\* for 100 of any one value. SPECIAL PACK: 10 of each value 2.2Ω, 2.2MΩ (730 resistors) £6.50\*.

**SUBMINIATURE PRESETS** (Vertical or Horizontal)—0.1W only 50; 100; 220; 470; 680 ohm; 1k; 2k2; 4k7; 6k8; 10k; 15k; 22k; 47k; 68k; 100k; 220k; 470k; 680k; 1M; 2M2; 4M7. All at 7p each; 10 for 60p; 100 for £5.00\*.

PLEASE ADD 25p POST AND PACKING ON ALL ORDERS EXPORT—ADD COST OF SEA/AIRMAIL. Add 8% VAT to all items except those marked with \* which are 12½%.

Send S.A.E. for additional stock lists.

Wholesale price lists available to bona fide companies

### MARCO TRADING (Dept. P.11)

The Old School, Edstaston, Wem, Shropshire  
 Tel: Whixall 464/465 (STD 094 872)  
 (Proprs. Minicost Trading Ltd.)

**CARBON FILM RESISTORS** 5% E12 ¼W, ½W, 1W. Your mix, 90p per 100. Metal Film ¼W. £1.10/100. Mail Order Only. CANDAR, 9 Galloway Close, Betchley.

P.C.Bs Paxolin 9in X 7in, 45p. 12in X 9in 70p. 17in X 9in, £1. Fibre glass double sided 7in X 8in, 80p. 12in X 6in, £1. 12in X 12in, £1.90. 20 wire ended neons, £1.50. Five figure Resettable Counter 18/22V, works on 12V £3.20. 20 assorted 74 series I.C.s on panel(s), £1.35. Three assorted meters £2.20. 7 lb assorted components £2.95. List 15p. Refund on purchase. Over £1 post paid; under add 20p; insurance add 15p.

### J. W. B. RADIO

2 Barnfield Crescent, Sale, Cheshire, M33 1NL

BC351, BC207B, XK1152, BC204B, 8p. DIODE 1S940, 3p. Capacitors 0.1/600V, 3p. 1 Megohm Horizontal preset 0.25W, 12p. Bridge Rectifier 1a/50V, 17p. Min order £2. VAT inclusive. P. & P. 20p. HEWITT'S, 9 St. Peter's Street, Syston, Leics.

## CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

- Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.
- The publishers reserve the right to refuse or withdraw any advertisement.
- Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

**FREE** POSTAGE AND PACKING! BARCLAYCARD PHONE SERVICE AVAILABLE. EACH PACK ONLY £1 INCLUDING VAT.

TRANSISTORS		DIODES	
Qty.	(Per Pack)	Qty.	(Per Pack)
4	AC187/8K	20	IN4001 (50V)
3	AC187/8K	14	IN4004 (400V)
10	BC107/8/9C	10	IN4007 (1000V)
9	BC147/8/9	<b>TRIACS AND DIACS</b>	
9	BC157/8/9	1	400V 10A TRIAC (TO220)
8	BC177/8/9	5	BR100 DIAC
9	BC182/212L	<b>LED'S</b>	
7	BC701/1/2	4	741
1	BDY20	8	RED LED'S 3 or 5mm
6	BFY501/2/3	4	GREEN LED'S 3 or 5mm
2	TIP31/32/41/42A	4	YELLOW LED'S 3 or 5mm
4	TIS43	<b>LINEAR IC'S (DIL)</b>	
2	2N3055	4	741
<b>POLYESTER CAPACITORS 250V</b>		13	0-47µF
22	0-22µF	3	748
13	0-47µF	2	555
8	1µF	1	LM380

Please send two stamps for Catalogue if required.  
**FRASER-MANNING LTD.**  
 26 Harvey Street, Ipswich, IP4 2ES (Ipswich 50975)

**LED'S.** Mixed bags of 4 different sizes and 4 different colours. 50 at £5.25, 100 at £9.25 including VAT and post and packing. CWO. MICHAEL WILLIAMS ELECTRONICS, 47 Vicarage Avenue, Cheshire Hulme, Cheshire SK8 7JP.

## TOUCH CONTROLLED LIGHTING KITS

These KITS replace conventional light switches and control 300W of lighting. No mains rewiring required. Insulated Touch Plates. Easy to follow instructions. TSD300K—TOUCHSWITCH and DIMMER combined. ONE touch plate to switch light on or off. Brightness controlled by small knob—£4.95. TS300K—TOUCHSWITCH. TWO touch plates ON and OFF—£3.67. TSA300K—AUTOMATIC. One touch plate. Light turns off after preset delay—£3.67.

LD300K LIGHT DIMMER KIT £2.45

### SPECIAL OFFER

3 TRIACS 8A/400V Isolated Tab. ONLY—£2.25

CMOS—LOW PRICES			
4000	18p	4011	18p
4001	18p	4012	18p
4002	18p	4013	51p
4007	18p	4015	91p
		4025	18p
		4518	56p

TRIACS 400V Plastic	NE555 36p (3 for £1)
3A 63p	8-5A 79p
12A 84p	16A 105p
20A 165p	Diag 21p
6.5A with trigger	80p
	2N6027 (PUT) 34p
	2N3055 40p
	C106D 5A/400V 48p

**Clock/Appliance Timer Kit** inc. AY-5-1230, 0.5-LED display, triac, box, switches, etc. £15.95  
 AY-5-1230 Clock/Appliance Timer IC £4.85

### QUANTITY DISCOUNTS ON REQUEST

Add 8% VAT + 25p. P. & P.

Mail order only to:

### T. K. ELECTRONICS (PE)

106 Studley Grange Road, London W7 2LX

**COMPONENTS AND HARDWARE.** Wide range. Fast service. Catalogue—2 x 9p stamps. MAGENTA, J10, 61 Newton Leys, Burton on Trent, Staffs. DE15 0DW.

**Power Electrolytics,** 800µF, 450V (value not stamped on can). Single end connections with screw terminals, 2in dia. x 4in high, including studs. Min. order, 4 for £2 inc. VAT (add 80p P. & P.). Sub-Min Mains Transformers, 12-0-12V, 50 mVA, 28mmW, 20mmH, 26mmD 82p. Bridge Rectifiers, 2A/100V, 34mm x 34mm 40p. Op. Amps, Motorola MC 150G 65p. Transistor, 2N 2401. Min. 8 for £1. Thyristor, C106B1, 4A/200V. Min. 3 for £1. Dual Transistor, 2N 2643 50p.

(Items 2-7, prices include VAT, add 20p P. & P.)  
**LINEWAY ELECTRONICS,** 843 Uxbridge Road, Hayes End, Middx., UB4 8HZ. Tel: 01-573 3677  
 VISIT OUR SELF-SERVE RETAIL PREMISES AT THE ABOVE ADDRESS.  
 (9.45-6.0—closed Weds.)

**SPECIAL OFFER** BC107/8, 10p; 1N4148, 4p; BC307, 9p; SNF400 11p; for further lists S.A.E. to: C & M ELECTRONICS, 60 Marshallstown Road, Carrickfergus. P. & P. 20p.

TTL AT NEW LOW PRICES!			
All full spec. by famous manufacturers			
ALL PRICES INCLUDE VAT			
7400	13p	7472	22p
7401/2/3	14p	7473/4/6	27p
7404/5	16p	7475	43p
7406	36p	7480	38p
7408	18p	7483	70p
7410/20	14p	7484	90p
7411/2	19p	7485	£1.00
7413	30p	7486	27p
7414	61p	7489	£2.20
7417	29p	7490/2/3	44p
7422	18p	7491	58p
7425/7	28p	7495	60p
7430	15p	7496	64p
7432/7	28p	74100	97p
7440	30p	74107	31p
7441	67p	74109	40p
7442	53p	74121	31p
7445/7/8	75p	74122	40p
7450/3/4	15p	74123	53p
7460	15p	74125/6	44p
		74141	58p
		74145	69p
		74150	£1.09
		74151/3	64p
		74154	£1.08
		74155	67p
		74157	64p
		74160	75p
		74164	£1.06
		74174	94p
		74175	75p
		74181	£2.56
		74190	£1.24
		74191	£1.06
		74192/3	£1.00
		74195	67p
		74196	84p
		1N4148	2p
		DL707E	69p
		2102A-662-50	

S.A.E. for full lists. P. & P. (1st class) 20p. C.V.O. J. C. JONES (PE27)  
Mail order only  
46 Burstellars, St. Ives, Cambs., PE17 4XX

**TURN YOUR SURPLUS** capacitors, transistors, etc., into cash. Contact COLES-HARDING & CO., 103 South Brink, Wisbech, Cambs. Tel. 0945 4188. Immediate settlement.

**SOLAR CELLS**

2.25" Dia. 250mW at 0.5V — £8.00  
1.00" Dia. 35mW at 0.5V — £4.50  
5.3 x 6.3mm 2.5mW at 0.5V — £1.25

Cells are supplied with leads attached, and are coated with varnish. "Solar Cells" booklet 75p. Data sheets on above devices 20p. Mail Order only. Speedy service.

**EDENCOMBE LIMITED**  
16 Princes Avenue, Kingsbury, London NW9 9JB

**FOR SALE**

**SET OF PRACTICAL ELECTRONICS** from Volume 1 No. 1 (November/64) to Volume 12 No. 8 (August/76). Offers. PAUL PLEASANTS, 7 Barleycroft Lane, Dinnington, Sheffield. Tel. Dinnington 4257.

**HARTLEY 13A OSCILLOSCOPE** (+ spares), 3 Volumes Practical Electronics (1970-73), 100 Appli cation Notes. Offers. Tel. Bolton 47908.

**NEW ISSUES** of "Practical Electronics" available from April 1974 edition up to date. Price 65p each. Post free. BELL'S TELEVISION SERVICES, 190 Kings Road, Harrogate, N. Yorkshire. Tel. (0423) 55885.

**213 copies** of R.C., P.E., P.W. from 1958 including 9 complete years. Offers. Box No. 71.

**T.T.L. IC's** approx. 1/2 price, ex board, tested. S.A.E. list to: MITSU HOKU, #7 Partridge Lane, Formby, Merseyside. Tel. Formby (87048) 71749.

**P.E. MULTIMETER**  
LD130 chip and other components  
Competitively priced  
S.A.E. for list  
**SPARKS DEVELOPMENTS**  
53 North Street, Melbourne, Derby.

**FOR SALE** 92 issues Practical Electronics from November 1964 to September 1972. 3 missing. Offers—SHARP, 48 Highbury Road East, St. Annes, Lancs.

**MELCOM 83 COMPUTER**, excellent condition tape punch-read, teletype, 30,000 word store, 10 boxes of paper. £450 o.n.o. Tel.: Hailsham 844666.

**OSCILLOSCOPE**, Heathkit 10-102 5MHz, £90 o.n.o.; ID-101 Electronic Switch, £30 o.n.o.; both hardly used, excellent order, plus manuals. Also IG-1271 Function Generator Kit unused as new, £70. EMERY, 33 Belwell Lane, Sutton Coldfield. Tel. 021-308 4832.

**30 NOTE** Pedal Board and Bench for Piano or Organ. Suitable for Electronic Conversion. £48. H. GATEHOUSE, 5 Mountain Road, (aerphilly) CF8 1HG.

**WANTED**

**WANTED-NEW VALVES**, Transistors. Top Prices, popular types. KENINGTON SUPPLIES, (B) 367 Kensington Street, Bradford 8, Yorkshire.

**WANTED. £1-50** given for a January 1973 copy of Popular Electronics, condition not important but must be legible. Send to N. BINET, La Fontaine, St. Mary, Jersey, C.I.

**EDUCATIONAL**

**TELEVISION TRAINING**

**12 MONTHS'** full-time course in Radio and TV for beginners (GCE— or equivalent—in Maths and English).

**26 WEEKS'** full-time course in Mono and Colour TV (basic electronics knowledge essential).

**13 WEEKS'** full-time course in Colour TV (Mono TV knowledge essential).

These courses incorporate a high percentage of practical training.

Next session starts on January 3rd.

Prospectus from London Electronics College, Dept. All, 20 Penywern Road, London SW5 9SU. Telephone 01-373 8721

**COURSES—RADIO AMATEURS EXAMINATION.** City and Guilds. Pass this important examination, and obtain your G8 licence, with an RRC Home Study Course. For details of this, and other courses (GCE, Professional Examinations etc) write or phone THE RAPID RESULTS COLLEGE, Dept. J.S.1, Tuition House, London SW10 4DS. Tel. 01-947 7272 (Careers Advisory Service) or for a prospectus only ring 01-946 1102. (24hr recording service).

**TECHNICAL TRAINING**

Get the training you need to move up into a higher paid job. Take the first step now—write or phone ICS for details of ICS specialist homestudy courses on Radio, TV, Audio Eng. and Servicing, Electronics, Computers; also self-build radio kits. Full details from:

**ICS SCHOOL OF ELECTRONICS**  
Dept. 771N, Intertext House, London SW8 4UJ  
Tel. 01-622 9911 (all hours)

**CITY & GUILDS EXAMS**

Study for success with ICS. An ICS homestudy course will ensure that you pass your C. & G. exams. Special courses for: Telecoms. Technicians, Electrical Installations, Radio, TV & Electronics Technicians, Radio Amateurs. Full details from:

**ICS SCHOOL OF ELECTRONICS**  
Dept. 771N, Intertext House, London SW8 4UJ  
Tel. 01-622 9911 (all hours)

**COLOUR TV SERVICING**

Learn the techniques of servicing Colour TV sets through new homestudy course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Other courses for radio and audio servicing. Full details from:

**ICS SCHOOL OF ELECTRONICS**  
Dept. 771N, Intertext House, London SW8 4UJ  
Tel. 01-622 9911 (all hours)

**LADDERS**

**LADDERS.** Varnished 25ft extd. £30-41. Carr. £1-90. Leaflet. Immed. despatch. THE LADDER CENTRE (PEE3), Halesfield (1), Telford, Salop. Tel. 586644.

**COURSES**

**Department of Electrical and Electronic Engineering**

Lecturers in Newcastle Poly's Electrical and Electronic Engineering department are regular readers of

**Practical Electronics**

Not surprisingly, for they strongly approve of technological advances being made available rapidly to the experimenter. They also believe in keeping those who are interested in touch with opportunities in this area and are delighted to discuss courses and careers concerned with application of electronics.

The department specialises in digital engineering, computer applications and electronic communications, and possesses thirteen well-equipped laboratories plus a minicomputer. Full-time and part-time courses are offered.

Telephone (0632) 26002, ext 371 or write to L Barnes, Principal Lecturer in Charge at Ellison Place, Newcastle upon Tyne NE1 8ST.

**Newcastle upon Tyne Polytechnic**

**SERVICE SHEETS**

**BELL'S TELEVISION SERVICES** for Service Sheets on Radio, TV, etc. 70p plus S.A.E. Colour TV Service Manuals on request. S.A.E. with enquiries to B.T.S., 190 Kings Road, Harrogate, N. Yorkshire, Tel. (0423) 55885.

**SERVICE SHEETS** for Radio, Television, Tape Recorders, Stereo etc. With free Fault-finding guide, from 50p and S.A.E. Catalogue 25p and S.A.E. HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

**BUSINESS FOR SALE**

**SHREWSBURY.** Thriving electronics and electrical trade business. Excellent trading position in this busy market town. Previous experience in the trade not essential. Easily run by husband and wife. Premises to be let on lease. £11,000 for goodwill, fixtures and fittings. Full information from COOPER AND GREEN, 3 Barker Street, Shrewsbury. Tel. 50081

**BOOKS AND PUBLICATIONS**

**SIMPLIFIED TV Repairs.** Full repair instructions in individual British sets £4-50, request free circuit diagram. Stamp brings details unique. TV PUBLICATIONS (Ausepe), 76 Church Street, Larkhall, Lanarkshire.

**HOW TO START A BUSINESS.** By popular demand a fully illustrated manual has now been produced, showing, in easy, step by step stages, how to rewind Armatures and Field Coils as used in Vacuum Cleaners, Drills and Portable Tools. Chapters on taking data, materials required, test instruments required, rewind instructions, charts, etc. How to cost jobs and where to obtain work. No previous knowledge required. Complete instructions manual £4-00 plus 30p P. & P. CWO, COPPER SUPPLIES, 102 Parrswood Road, Withington, Manchester 20, Dept. PEA.

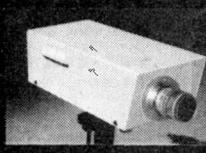
**ELECTRICAL**

**STYL, CARTRIDGES, AUDIO LEADS** etc. For keenest prices send S.A.E. for free list to: FELSTEAD ELECTRONICS (PE), Longley Lane, Gatley Cheshire, Cheshire, SK8 4EE.

**MISCELLANEOUS**

**QUALITY MW/LW/VHF PORTABLE RADIOS.** Limited stocks only. Be ready for changes in B.B.C. service frequencies when a three band set is preferred. Metal facia with twin speaker grill, telescopic aerial and dial illumination button. Only £15-50 complete with batteries, earphone and guarantee. ELECTRONIC SUPPLIES, Southview, Station Road, Bramley, Guildford, Surrey.

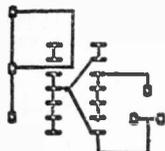
## BUILD YOUR OWN TV CAMERA



ONLY KNOWN HIGH PERFORMANCE SOLID STATE CAMERA IN KIT FORM. Also available factory assembled. Ideal for experimenters, industry security, education etc. \*Will work with most other CCTV equipment. \*Fully guaranteed. \*Completely self-contained. With our modulator will connect to any domestic TV set. Model C1 complete with Vidicon £99. Less Vidicon £82.35. (Lens available as optional extra). SAE for info or phone your order through your Barclay or Access Card.

**CROFTON ELECTRONICS LIMITED**  
35 Grosvenor Road, Twickenham, Middlesex. 01 - 891 1923

**OUTSTANDING HI-FI FM TUNER.** Comprises 7 transistors superb design with varicap tuning, AFC. Latest silicon circuitry, full coverage 88-102 MHz. Supplies built and tested with metal front panel and instruction sheet, only **£9.95 + 30p P. & P.** GREGG ELECTRONICS, 86-88 Parchmore Road, Thornton Heath, Surrey.



**MAKE YOUR OWN  
PRINTED CIRCUITS**  
Professional Finish

**RUB-ON TRANSFERS—STARTER PACK** £1.30 (5 sheets, lines, pads, i.c. pads), **SPARE SHEETS** 27p. **FERRIC CHLORIDE**—1lb bags 70p (P. & P. 30p)\*. **LOW-COST I.C. MOUNTING**—100 Soldercon sockets 69p. 7 or 8 hole plastic supports 6p pair. **TRANSISTOR TESTER**—Easy to use. Indicates gain. Identifies NPN or PNP. Cannot damage transistor **£7** (P. & P. 30p)\*. S.A.E. lists and samples (P. & P. 15p/order except\*).

**P.K.G. Electronics**

Oak Lodge, Tansley, Derbyshire DE4 5FE

**INVENTORS.** "Profit from Your Invention". Sources of Finance and other assistance. Details: Large S.A.E. DELTA (PE), 15 St. Mary Street, Southampton, Hants.

### GLASS FIBRE P.C.B.'s

From your own tape, film or ink master. Send S.A.E. for quotation.

**PRACTICAL ELECTRONICS P.C.B.'s** in glass fibre, tinned and drilled. June 76 Transmitter 98p, Coder 94p. July 76 Receiver 98p, Decoder 79p, Interface 58p. August 76 Servodrives 74p, Servo Amp 58p, Relay Drive 68p. Complete set of above boards £5.80. **Cross-Hatch Generator** £2.85. Dec. 76 Orion Tuner £2.48. April 77 Digital Volt Meter (GBCZW). Complete set of two boards (1304-3/4) £2.55. May 77 Burglar Alarm (1305-1) £1.68. June 77 Sports Centre (1306-1) and power supply p.c.b. £2.66. July 77 Digital Stopwatch (1307-1) £1. Oscilloscope trace doubler 95p. Earth Leakage C.B. (1307-2) £1.96. Aug. 77 C/R Meter (1308-1) 97p. Sept. 77 Freq. Counter Timer (1309-2/3) £3.98 set of 2 boards. Send S.A.E. for information on current boards and a full list. C.W.O. please.

### PROTO DESIGN

4 Highcliffe Way, Wickford, Essex SS11 8LA

**CLEARING LABORATORY.** Scopes, recorders, testmeters, bridges, audio, R.F. generators, turntables, tapeheads, stabilised P.S.U.s, sweep generators, test equipment, etc. Tel. Lower Beeding 236.

### H. M. ELECTRONICS

275a Fulwood Road, Broomhill, Sheffield S10 3BD



BEC CABINETS

Give your project that professional looking finish. Build it in a BEC. Dry transfer lettering now available . . .

ORION cabinet still available punched or unpunched. Send 15p (refundable) for leaflets.

**ELECTRONIC TIME DELAY KIT,** Mains, 1kW output, Mins/Secs/Hrs, many household uses, S.A.E. details. L. O. GREEN, 4 Gurney Road, Costessey, Norwich NR5 0HA.

### 100 Resistors 75p

±W 5% c/FILM 2-20-2.2MΩ (E12)  
10 each of any value. Send S.A.E. for free sample

**C90 CASSETTES 30p**  
**C90 CASSETTES 45p**

All prices include VAT.

Quantity Discounts

10 Units 5%

50 Units 7%

100 Units 10%

All Cassettes in Plastic Case with Index and Screwed Assembly

Add Postage 10p In £1

**SALOP ELECTRONICS**

23 WYLE COP

**BREWERY**

Tel. 53208

**STICKIES ARE NEW** High quality IC-size self-adhesive labels printed with pin-outs for the 61 most popular 16- and 14-pin 7400-series IC's. Each pin identified immediately. For design, construction and de-bugging. Also ideal for students. Introductory offer Set of 450 **£2.80** inclusive. **CONCEPT ELECTRONICS (A2)**, 8 Bayham Road, Sevenoaks, Kent.

### ARMATURE AND COIL WINDING

#### ENAMELLED COPPER WIRE

Only top quality materials supplied.

All orders despatched within 24 hours.

S.W.G.	1 lb reel	½ lb reel
10 to 19	£2.95	£1.60
20 to 29	£3.15	£1.80
30 to 34	£3.45	£1.90
35 to 40	£3.65	£2.10

All prices inclusive of P. & P. in U.K.

#### COPPER SUPPLIES

102 Parrswood Road, Wittington, Manchester 20 Telephone 061-445 8753

### NO LICENCE EXAMS NEEDED

To operate this miniature, solid-state Transmitter-Receiver Kit. Only **£9.75** plus 25p P. & P.

'Brain-Freeze' 'em with a **MINI-STROBE** Kit, pocket-sized 'lightning flashes', vari-speed, for discos and parties. A mere **£4.30** plus 20p P. & P. Experiment with a psychedelic **DREAM LAB**, or pick up faint speech/sounds with the **BIG EAR** sound-catcher; ready-made multi-function modules. **£5** each plus 20p P. & P.

**LOTS MORE!** Send 20p for lists. Prices include VAT. (Mail order U.K. only).

### BOFFIN PROJECTS

Cunliffe Road, Stoneleigh Ewell, Surrey (P.E.)

**BURGLAR ALARM** equipment, safes, trade supplies. **ASTRO-ALARMS**, 25 Stockton Rd., Sunderland. Tyne and Wear. Tel.: 77825. Free list S.A.B.

### NO MORE DING-DONG

Now get **MUSIC** from your **DOORBELL**—or your **CAR**. New programmable Chime announces you or your surprised guests. 50 easy-to-change tunes or **PROGRAM YOUR OWN**. Just needs speaker and existing bell transformer or 12V. All parts, instructions and programs, postage, money back assurance, send **£17.90** TODAY.

#### CAMBRIDGE KITS

45 (FY), Old School Lane, Milton, Cambridge

**100 WATT GUITAR/PA/Music Amplifier** superb treble bass overdrive slimline solidstate 12 months guarantee unbeatable offer at **£39**. Money returned if not absolutely delighted within 7 days. Send cheque or P.O. to: **WILLIAMSON AMPLIFICATION**, 62 Thorncliffe Avenue, Dukinfield, Cheshire.

#### ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
14-19	2.40	1.20	0.60	0.50
20-29	2.45	1.60	0.82	0.59
30-34	2.60	1.70	0.89	0.64
35-40	2.85	1.90	1.04	0.75

Inclusive of P. & P. and VAT. S.A.E. brings catalogue of copper and resistance wires in all coverings.

#### THE SCIENTIFIC WIRE COMPANY

P.O. Box 30, London, E4 9BW

Reg. Office: 22 Coningsby Gardens

**SUPERB INSTRUMENT CASES BY BAZELLI**, manufactured from P.V.C. faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low **90p**, chassis punching facilities at very competitive prices. 400 models to choose from, free literature (stamp would be appreciated). **BAZELLI**, Dept. No. 23, St. Wilfrid's, Foundry Lane, Halton, Lancaster LA2 6LT.

## BUILD THE TREASURE TRACER

### MK III Metal Locator



- Varicap tuning
- Britain's best selling metal locator kit
- Fitted with Faraday shield
- Speaker and earphone operation
- 4,000 already sold
- Prebuilt search coil assembly
- Five transistor circuit
- Thoroughly professional finish
- You only need soldering iron, screw-driver, pliers and snips
- As seen on BBC-1 and BBC-2 TV

Send stamped, addressed envelope for leaflet

Complete Kit **£15.95** Built and tested **£20.95**

Post £1.20 + £1.37 VAT Post £1.20 + £1.77 VAT

**MINIKITS ELECTRONICS**, 6g CLEVELAND ROAD LONDON E18 2AN (Mail Order Only)

### SINTEL FOR BOOKS, CMOS AND COMPONENTS

6800 Booklet 1-80, MOT CMOS Databk 3-50, 6800 Appl Man 12-95, 6800 Prog Man 5-35, SC/MP Introk Kit Man 0-75, NS TTL Databk 2-10, RCA CMOS Databk 5-45, 8085 User's Man 5-15, Z80 Ass Lang Prog Man 7-50, Z80-CPU Man 5-60, Z80-CTC Spec 0-80, Z80-PIO Man 3-30. Also a full range of **CMOS—send for free catalogue**. MPUs: MEK6800D2 190-00, MC6820 8-02, Z80 28-44, Z80A 36-98, Z80-CTC 12-80, Z80-PIO 12-80. Memories: 2102A-6 2-36, 2112A-4 2-90. Displays: FND500 1-30, TL1321 1-50, TL1322 1-49, 5LT01 4-90. Crystals: 32.768KHz 3-50, 5.12MHz 3-60. Clock ICs: AY51202 3-10, AY51224 3-50, MK50253 5-60. Soldercon Pins: 100 0-50, 1000 4-00, 3000 10-50. Free catalogue by return. All items CWO (Books-No VAT) add 8% VAT & 35p p&p. **SINTEL**, P.O. Box 75B, 209 Cowley Road, Oxford. Tel. (0865) 49791.

## BURGLAR ALARMS SUPPLIES AND EQUIPMENT



S.A.E. FOR FREE CATALOGUE

### ULTRASONIC DETECTORS

12V D.C. COMPLETE UNIT

ONLY £35.00 + VAT (12½%)

POST FREE

**BELLS SIRENS ALARM-UNITS CABLE BELL COVERS WINDOW FOIL VIBRATION CONTACTS ULTRASONIC AND INFRARED DETECTORS INERTIA SWITCHES.**

### A. D. ELECTRONICS

217 Warbreck Moor, Aintree

Liverpool L9 0HU. Tel. 051-525 3440

## CABINET FITTINGS

FOR

Stage Loudspeakers and Amplifier Cabs  
Fretcloths, Coverings, Recess Handles, Strap Handles  
Feet, Castors, Locks and Hinges, Corners, Trim,  
Speaker Bolts, etc., etc.

Send 2 x 9p Stamps for samples and list.

### ADAM HALL (P.E. SUPPLIES)

Unit Q, Starline Works, Grainger Road Southend-on-Sea, Essex.

## NOTICE TO READERS

*Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser both prices and availability of goods before ordering from non-current issues of the magazine.*

# CMOS COOKBOOK

by D. Lancaster Price £7.50

**OPTOELECTRONICS THEORY AND PRACTICE** by A. Chappell (Texas ins.) Price £8.00

**BEGINNER'S GUIDE TO INTEGRATED CIRCUITS** by I. R. Sinclair Price £3.20

**INTRODUCTION TO MICRO-PROCESSORS** by D. Aspinali Price £5.40

**PROBLEMS IN ELECTRONICS WITH SOLUTIONS** by F. A. Benson Price £4.50

**PRINCIPLES OF TRANSISTOR CIRCUITS** by S. W. Amos Price £4.50

**ELECTRONICS FAULT DIAGNOSIS** by I. R. Sinclair Price £3.00

**FOUNDATIONS OF WIRELESS AND ELECTRONICS** by M. G. Scroggie Price £4.25

**110 ELECTRONIC ALARM PROJECTS FOR THE HOME CONSTRUCTOR** by R. M. Marston Price £3.30

**NEWNES TAPE RECORDER SERVICING MANUAL VOL. I** by J. Gardner Price £8.40  
**VOL. II** Price £8.40

**TOWERS' INTERNATIONAL TRANSISTOR SELECTOR** by T. D. Towers Price £5.00

★ ALL PRICES INCLUDE POSTAGE ★

## 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.

## OSMABET LTD

We make transformers amongst other things

**LOW VOLTAGE TRANSFORMERS:** Prim 240V a.c.  
6-3V 1.5A £2; 3A £3; 6A CT £4.25; 12V 1.5A £2.50; 3A £4.25;  
6A CT £8; 18V 1.5A CT £4.25; 24V 1.5A CT £4.25; 3A CT £8;  
5A CT £10; 8A CT £15; 12A CT £21; 40V 3A CT £10; 50V 6A CT £21

**TWIN SEC TRANSFORMERS:** Prim 240V a.c.  
6V 0.6A + 6V 0.6A; 9V 0.4A + 9V 0.6A; 12V 0.25A + 12V 0.25A; 20V 0.15A + 12V 0.15A all at £2.65 each; 15V 0.75A + 15V 0.75A £4; 15V 1.5A + 15V 1.5A £5; 18V 1A + 18V 1A £4.50;  
18V 1.5A + 18V 1.5A £7; 20V 1.5A + 20V 1.5A £5.75;  
12V 4A + 12V 4A £7.50; 25V 2A + 25V 2A £7.50

**MIDGET RECTIFIER TRANSFORMERS:** Prim 240V a.c.  
9-0-9V 1.5A or 9-0-9V 1A £2.25 each; 12-0-12V 1A or 20-0-20V 0.75A £2.85 each; 9-0-9V 0.3A or 12-0-12V 0.25A or 20-0-20V 0.15A £2 each

**LT TRANSFORMERS TAPPED SEC:** Prim 240V a.c.  
0-10-12-14-16-18V 2A £4; 4A £5.25; 0-12-15-20-24-30V 2A £4.50;  
4A £7.50; 0-5-20-30-60V 1A £5.25; 2A £7.50; 0-40-50-60-80-100-110V 1A £7.50

**MAINS TRANSFORMERS:** Prim 240V a.c.  
250-0-250V 80mA 6.3V 1A £1.85 inc. P & P and VAT  
250V 100mA 6.3V 2A £2.50 inc. P & P and VAT  
23V 0.5A £1.50 inc. P & P and VAT  
110/240V a.c. Auto 20W £1.18 inc. P & P and VAT

**SPEAKER MATCHING AUTO TRANSFORMERS:** 12W, 3 to 8 or 15, up or down, £2.25 inc. P & P and VAT

**LOUDSPEAKERS:** 2 1/2in 8Ω, 2 1/2in 8 or 25Ω, 2 1/2in 8 or 80Ω; 3 1/2in 35Ω; 3 1/2in 3.16 or 80Ω; all at £1.50 each; 7 x 4ins 3.8, 16, 25 or 80Ω; £2 each; 8 x 5in 4, 8 or 25Ω; £2.70; 8ins 8Ω £2.70 inc. P & P and VAT

**"INSTANT" BULK CASSETTE TAPE ERASER:** Instant erasure of cassettes and tape pool, any diameter, demagnetises tape heads, 200/240V a.c. £6 inc. P & P and VAT

**POWER SUPPLY, TWIN OUTPUT:** Prim 240V a.c. New, ex British manufacture. Smoothed d.c. output 20V 1.5A, plus stabilised 15V 100mA, plus 12V a.c. 0.5A, with diagram. £4.75 inc. P & P and VAT

**CONDENSERS:** Electrolytic, W/E. 1000/50V 30p; 4700/40V 60p; Paper tubular, W/E. 47/600V, 2, 2/400V, 4, 7/160V all 25p each (£15 per 1000). Electrolytic screw terminal 120V 150p.

**EDGWISE LEVEL MESH FSD 200A:** Size, 19 x 18 x 20mm, 800, £1.35 inc. P & P and VAT

**PRINTED CIRCUITS ETCHING KIT:** Make your own PC Boards. Comprehensive commercial kit, instructions, £4 inc. P & P and VAT

**MULTI WAY CABLE, SCREENED PVC COVERED:** 36 way £1; 25 way 75p; 14 way 50p; 6 way 25p; 4 way 20p; 2 way 10p; 1 way 8p per metre. Fig. 8 stereo twin. £1.25 15 metres.

**MINI 3-CORE CABLE, 19/10, 10mm:** Ideal for speakers, intercoms, etc. £4.85 inc. P & P and VAT

**TWIN FIG. 8 CABLE:** Polarised, 100m £5.00 inc. P & P and VAT

All types domestic and commercial cables. Enquiries invited.

Carriage and VAT on all orders except where otherwise stated.

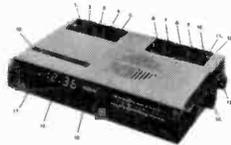
Callers by appointment only S.A.E. Enquiries, Hsts.

46 Kenilworth Road, Edgware, Middx HA8 8YG Tel. 01-958 9314

# Our finger is right on the button when it comes to SCIENTIFIC PRODUCTS at the right price



The New 36 Step Scientific Programmable from Sinclair Algebraic logic has all scientific functions log., trig., sin., tan., cos., rad./degree, exp., etc. plus a programme calculator with conditional and unconditional branch instructions. Our price only £14.95. Set of 4 programme books giving 294 programmes £4-95. Mains adaptor £2-95.



### THE NEW LIGHT SENSOR CLOCK RADIO

This ultimate fully solid state a.m./f.m. clock radio has everything you need, a high Green display that automatically dims when the lights are on to an unobtrusive glow. Wake to music or bleep alarm, or at the slightest touch on the snooze plate have 9 min. more or more, etc., or fall asleep to music. It automatically switches off 1-59 min. Push button controls, volume control. Excellent a.m./f.m. radio ear socket. Only £49.95. Similar clock radio but with switch to dim and button for snooze red display £39.95. Stereo £59.95. Add £1 to any one for P. & P.

### L.E.D. NEW RANGE L.C.D.



**2AED Gents Hr. Min. sec. Month:** Date Day £3.95  
**3AED luxury finish gents Hr. Min. Sec. Month Date Day** £14.95  
**3LAD Ladies Hr. Min. Sec. Month Date Day** £12.95  
**3LAD Ladies Dress Bark finish Hr. Min. Sec. Month Date Day** £16.95  
**1UD unisex Hr. Min. Sec. Month Date Day** £14.95  
**QUARTZ, ANALOG, The Familiar Face.** But with the Quartz accuracy, 3 year. Bat. Life. Stainless Steel, Date, Second hand £48.95  
All prices quoted are for stainless steel with adjustable matching bracelets. For gold plate add £11.50 to price.  
All our watches have manufacturer's back-up service and full guarantee for 12 months.

**2LC Gents (Hr. Min.) back lite. Sec. Date Month** £17.95  
**3LC Gents (Hr. Min. Sec.) B.lite. Month Date** £28.95  
**4LC Gents (Hr. Min. Sec.) B.lite. Month Date Day Stop watch 10/100m sec.** £37.95  
**5LC Gents World time (Hr. Min. Sec. Day) Date, Month. Blime zones stop watch Counter** £45.50  
**6LC Gents Chronograph (Hr. Min. Sec.) or date, Date Day of week, B.lite. 12 chronograph functions stop watch acc. time etc.** £49.90  
**8LC Ladies (Hr. Min.) B.lite. Sec. Month Date** £39.50  
**SOLAR WATCH (Hr. Min. Sec.) B.lite. Month Date** £58.95  
(Functions in brackets are continuously on display.)

### RADIO TV CASSETTE

This wonderful portable machine has everything you want for your personal pleasure on holiday abroad, anywhere in the world. TV as well 3in TV, V.H.F. and U.H.F. Radio M.W.F.M. and Short wave Radio. Cassette tape recorder output 3 watts. Bass, Treble, tone controls mixing facilities beat cut switch review pause. Auto stop record facilities Bat Mains car. Our price only £198.95. Add £1.50 for P. & P.



### TV GAMES—LATEST IN HOME ENTERTAINMENT

SETS  
**MARK 1—Football Tennis Squash** 19.95  
**MARK 2—De Luxe Football Tennis Squash Solo/Practice** £27.50  
**MARK 2 "C"—As Mark 2 in colour** £38.50  
**MARK 3—De Luxe Football Tennis Squash Solo/Practice** £47.50  
**GUN for target and Skit Shooting** £54.95  
**MARK 3C—As Mark 3 in colour** £54.95  
All games have auto service auto scoring on screen selectable bat sizes and ball speeds realistic noises and fits all TV. Add £1 for P. & P.

We are major suppliers to government depts., large companies, schools, etc. All products are guaranteed for 12 months. Send your order with Cheque/Barclaycard/Cash to Dept. ET. All prices include VAT. Add 65p for P. & P. unless otherwise stated. Open. Mon.—Thur. 9.30-5.30. Fri.—Sun. 10-1pm.



**Texas**  
58 480 program steps up to 60 memories our price £78.95  
59 Card programmable 960 steps 100 memories £208.95  
57 50 step programmable £42.95  
PC100A Print cradle for use with 59, 52, 56, 58 £175.95  
51  $\mu$  fully sci 3 mem £33.95  
41 Financial £27.95  
5200 Desk top £42.95

**CBM**  
pr100 72 steps programmable £37.95  
N60 Navigator £69.95  
SR61 Statistician £89.95  
4/519R 92 steps Pre programmable sci £24.95  
4148 Full sci. £19.95

**Sinclair**  
New Cambridge programmable £14.95  
Set of 4 libraries £4.95  
Micro Quartz Car Clock £16.95

**Hewlett Packard**  
HP-25, HP67, HP23, HP91, HP97, HP11, etc. Prices on application.

**Sharp**  
E18120 LCD recharge % V Mem £20.95  
Lc 8029 LCD Folding pen £23.95

**Casio**  
CQ1 Time, stop watch, calc., Alarm set alarm 4 diff. times £29.95  
and 4 diff. tones £30.90  
MQ1 New LCD, Calculator Clock, Stopwatch £49.95  
S11 Mem. calc., time measurement, Net, Time, Lap, & split time £26.95  
Pro FX1 Card programmable £129.95  
FX201 Programmable £49.95  
FX202 Prog. with Facility for keep prog. when off £67.95  
FX200 LCD Sci £24.95  
FX110 Full Sci £17.95  
Lc820 Lcd in Wallet £17.95  
Rechargeable free.

### NEW PHONE



The Phone that you don't have to get out of bed in order to dial. All is contained in the hand piece. Not GPO approved but everybody else approves. Just plug in to ordinary GPO extension socket, fully guaranteed. White, red, ivory, pastel blue and green. £55. Ordinary push button for those who don't like to work their fingers too hard £149.95.

### WIRELESS INTERCOM



Just plug each unit into house mains up to 1 mile distance depending on conditions, no other wires or batteries needed, excellent for offices, warehouses, homes, etc. Identical units. Volume control, on/off switch, pilot light. Talk and lock buttons. £33.95 P. & P. 95p. £149.95.

### VINTAGE CAR RADIOS



1931 ROLLS ROYCE  
Replica models beautifully finished. Makes a lovely present £13.75.

1928 LINCOLN (illustrated)

## Superb 2-Way Walkie Talkies

HVI only £37.95 per pair range up to 3km approx. 100mW call buzzer compact strap volume control  
HV 100 only £85.50 per pair range up to 8km approx. 1 watt 3 channel int. circuit FET V. control call buzzer car. case earphone  
HV 2500 only £165.00 per pair range 12km approx. 2.5 watt 2 channel super-hot squelch V. control call buzzer car. case earphone all sets 30% longer range at sea. These sets are solidly made to the highest standard. For export and Yachtsmen.



All our goods are fully guaranteed for 12 months. We also stock a range of desk, print outs, ordinary calcs, Specialist calcs. Cassette, Cassette radios Stereo, etc. Tell us your requirements and we will supply. If you are not fully satisfied please return goods to us in proper condition within 10 days and we will send you a refund.

1115 FINCHLEY RD  
TEMPLE FORTUNE TEL: 01-  
LONDON NW11. 458 4755

# barclay ELECTRONICS

TTLs by TEXAS		CMOS I.C.s.	OP. AMPS.	NE531V	MEMORY I.C.s.	MJ2955	DIODES	BRIDGE RECTIFIERS
7400	14p	74112	96p	108p	148p	130p	2N2928RB	9p
7401	14p	74113	216p	70p	150p	130p	2N2929CG	11p
7402	18p	74118	160p	120p	150p	250p	2N2930	22p
7403	18p	74119	225p	120p	25p	550p	2N3054	65p
7404	24p	74120	130p	40p	75p	800p	2N3055	65p
7405	25p	74121	320p	75p	80p	800p	2N3056	65p
7406	43p	74122	225p	175p	40p	800p	2N3057	65p
7407	43p	74123	75p	300p	216p	800p	2N3058	65p
7408	22p	74125	70p	75p	70p	800p	2N3059	65p
7409	22p	74126	85p	75p	70p	800p	2N3060	65p
7410	18p	74128	82p	40p	40p	800p	2N3061	65p
7411	26p	74132	81p	4011	21p	800p	2N3062	65p
7412	25p	74136	81p	4012	23p	800p	2N3063	65p
7413	46p	74141	85p	4013	85p	800p	2N3064	65p
7414	85p	74142	300p	4014	90p	800p	2N3065	65p
7416	40p	74145	95p	4015	90p	800p	2N3066	65p
7417	40p	74147	205p	4016	94p	800p	2N3067	65p
7420	18p	74150	130p	4018	110p	800p	2N3068	65p
7421	42p	74151	81p	4019	87p	800p	2N3069	65p
7422	28p	74154	100p	4021	140p	800p	2N3070	65p
7423	36p	74155	81p	4020	140p	800p	2N3071	65p
7425	33p	74155	87p	4022	140p	800p	2N3072	65p
7426	42p	74156	97p	4023	28p	800p	2N3073	65p
7427	40p	74157	97p	4024	94p	800p	2N3074	65p
7428	40p	74158	95p	4025	23p	800p	2N3075	65p
7430	18p	74160	90p	4026	200p	800p	2N3076	65p
7432	37p	74161	130p	4027	64p	800p	2N3077	65p
7433	43p	74162	130p	4028	110p	800p	2N3078	65p
7437	37p	74164	120p	4029	120p	800p	2N3079	65p
7438	37p	74164	120p	4030	87p	800p	2N3080	65p
7440	18p	74165	150p	4040	150p	800p	2N3081	65p
7441	85p	74166	180p	4042	87p	800p	2N3082	65p
7442	75p	74167	320p	4043	100p	800p	2N3083	65p
7443	120p	74170	260p	4046	120p	800p	2N3084	65p
7444	120p	74172	750p	4047	120p	800p	2N3085	65p
7445	108p	74173	190p	4049	84p	800p	2N3086	65p
7446	108p	74174	130p	4050	58p	800p	2N3087	65p
7447	75p	74175	87p	4054	120p	800p	2N3088	65p
7448	85p	74176	130p	4055	140p	800p	2N3089	65p
7450	18p	74177	100p	4056	145p	800p	2N3090	65p
7451	18p	74180	160p	4060	130p	800p	2N3091	65p
7453	18p	74181	160p	4061	30p	800p	2N3092	65p
7454	18p	74182	150p	4069	30p	800p	2N3093	65p
7460	18p	74184	250p	4071	30p	800p	2N3094	65p
7470	36p	74185	190p	4072	30p	800p	2N3095	65p
7472	32p	74186	190p	4073	45p	800p	2N3096	65p
7473	36p	74190	140p	4078	30p	800p	2N3097	65p
7474	37p	74191	140p	4081	30p	800p	2N3098	65p
7475	43p	74192	220p	4082	30p	800p	2N3099	65p
7476	37p	74193	130p	4083	100p	800p	2N3100	65p
7480	54p	74194	100p	4510	140p	800p	2N3101	65p
7481	108p	74195	110p	4511	140p	800p	2N3102	65p
7482	96p	74196	130p	4516	130p	800p	2N3103	65p
7483	96p	74197	130p	4518	140p	800p	2N3104	65p
7484	108p	74198	270p	4528	140p	800p	2N3105	65p
7485	108p	74199	210p	4530	140p	800p	2N3106	65p
7486	36p	74221	175p	14533	94p	800p	2N3107	65p
7489	340p	74231	320p	14583	150p	800p	2N3108	65p
7490	36p	74265	87p			800p	2N3109	65p
7491	90p	74278	320p			800p	2N3110	65p
7492	54p	74279	130p			800p	2N3111	65p
7493	36p	74283	175p			800p	2N3112	65p
7494	90p	74284	475p			800p	2N3113	65p
7495	75p	74285	475p			800p	2N3114	65p
7496	90p	74290	180p			800p	2N3115	65p
7497	290p	74291	320p			800p	2N3116	65p
74100	140p	74298	220p			800p	2N3117	65p
74104	75p	74365	180p			800p	2N3118	65p
74105	75p	74366	180p			800p	2N3119	65p
74107	36p	74367	130p			800p	2N3120	65p
74109	60p	74390	220p			800p	2N3121	65p
74110	90p	74393	245p			800p	2N3122	65p
74111	75p	74490	250p			800p	2N3123	65p

**LINEAR I.C.s.**

AY-1-0212	650p	NE540L	225p
AY-3-8500	775p	NE555	36p
CA3028A	112p	NE561B	97p
CA3046	100p	NE562B	460p
CA3048	85p	NE565	200p
CA3053	250p	NE568	140p
CA3065	75p	RC4151N	432p
CA3080E	200p	SN72710N	54p
CA3085E	97p	SN76003N	275p
CA3090AQ	250p	SN76013N	260p
ICL3083CC	400p	SN76013ND	280p
LM339N	175p	SN76018	200p
LM337N	200p	SN76022N	175p
LM380N	112p	SN76023ND	160p
LM381N	190p	TAA821A	310p
LM389N	160p	TAA861A	300p
LM496L	850p	TBA120	87p
MC1310P	100p	TBA614B	130p
MC1351P	110p	TBA651	225p
MC1495L	490p	TBA800	112p
MC1495L	112p	TBA810	125p
MC3340P	180p	TBA820	108p
MC380P	100p	TDA2020	140p
MFG400B	120p	ZN414	140p

**VOLTAGE REGULATORS—Fixed**

LM309K TO3	150p	LM468	DIL	300p
LM317	70p	TBA825B	TO5	120p
LM327N	DIL	7805K	TO3	150p
LM337N	DIL	7805	TO3	150p
LM339N	DIL	7805	TO3	150p
LM350	DIL	7805	TO3	150p
LM358	DIL	7805	TO3	150p
LM359	DIL	7805	TO3	150p
LM360	DIL	7805	TO3	150p
LM361	DIL	7805	TO3	150p
LM362	DIL	7805	TO3	150p
LM363	DIL	7805	TO3	150p
LM364	DIL	7805	TO3	150p
LM365	DIL	7805	TO3	150p
LM366	DIL	7805	TO3	150p
LM367	DIL	7805	TO3	150p
LM368	DIL	7805	TO3	150p
LM369	DIL	7805	TO3	150p
LM370	DIL	7805	TO3	150p
LM371	DIL	7805	TO3	150p
LM372	DIL	7805	TO3	150p
LM373	DIL	7805	TO3	150p
LM374	DIL	7805	TO3	150p
LM375	DIL	7805	TO3	150p
LM376	DIL	7805	TO3	150p
LM377	DIL	7805	TO3	150p
LM378	DIL	7805	TO3	150p
LM379	DIL	7805	TO3	150p
LM380	DIL	7805	TO3	150p
LM381	DIL	7805	TO3	150p
LM382	DIL	7805	TO3	150p
LM383	DIL	7805	TO3	150p
LM384	DIL	7805	TO3	150p
LM385	DIL	7805	TO3	150p
LM386	DIL	7805	TO3	150p
LM387	DIL	7805	TO3	150p
LM388	DIL	7805	TO3	150p
LM389	DIL	7805	TO3	150p
LM390	DIL	7805	TO3	150p
LM391	DIL	7805	TO3	150p
LM392	DIL	7805	TO3	150p
LM393	DIL	7805	TO3	150p
LM394	DIL	7805	TO3	150p
LM395	DIL	7805	TO3	150p
LM396	DIL	7805	TO3	150p
LM397	DIL	7805	TO3	150p
LM398	DIL	7805	TO3	150p
LM399	DIL	7805	TO3	150p
LM400	DIL	7805	TO3	150p

**OPTO-ELECTRONICS**

OCF71	30p	LEDs	14p	
ORP12	30p	TL209	Red	14p
ORP13	30p	TL32	Green	22p
ORP14	30p	TL32	Infrared	81p
ORP15	30p	TL32	Red	19p
ORP16	30p	TL32	Green	28p
ORP17	30p	TL32	Amber	36p
ORP18	30p	TL32	Amber	36p
ORP19	30p	TL32	Amber	36p
ORP20	30p	TL32	Amber	36p
ORP21	30p	TL32	Amber	36p
ORP22	30p	TL32	Amber	36p
ORP23	30p	TL32	Amber	36p
ORP24	30p	TL32	Amber	36p
ORP25	30p	TL32	Amber	36p
ORP26	30p	TL32	Amber	36p
ORP27	30p	TL32	Amber	36p
ORP28	30p	TL32	Amber	36p
ORP29	30p	TL32	Amber	36p
ORP30	30p	TL32	Amber	36p
ORP31	30p	TL32	Amber	36p
ORP32	30p	TL32	Amber	36p
ORP33	30p	TL32	Amber	36p
ORP34	30p	TL32	Amber	36p
ORP35	30p	TL32	Amber	36p
ORP36	30p	TL32	Amber	36p
ORP37	30p	TL32	Amber	36p
ORP38	30p	TL32	Amber	36p
ORP39	30p	TL32	Amber	36p
ORP40	30p	TL32	Amber	36p
ORP41	30p	TL32	Amber	36p
ORP42	30p	TL32	Amber	36p
ORP43	30p	TL32	Amber	36p
ORP44	30p	TL32	Amber	36p
ORP45	30p	TL32	Amber	36p
ORP46	30p	TL32	Amber	36p
ORP47	30p	TL32	Amber	36p
ORP48	30p	TL32	Amber	36p
ORP49	30p	TL32	Amber	36p
ORP50	30p	TL32	Amber	36p

**LOW PROFILE DIL SOCKETS BY TEXAS**

8 pin	12p	22 pin	36p
-------	-----	--------	-----

## RELAYS SIEMENS, PLESSEY, etc. MINIATURE RELAYS

RELAYS. WIDE RANGE OF A.C. and D.C. RELAYS AVAILABLE from stock, phone or write in your enquiries.

### FT3 NEON FLASH TUBE

High intensity multi turn, high voltage, neon glow, discharge flash tube. Design for ignition timing, etc. £1.50, P. & P. 25p (£1.89 inc. VAT). 3 for £3. P. & P. 50p (£3.78 inc. VAT & P.).



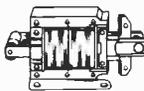
### NI-CAD BATTERIES

	Height (mm)	Width (mm)	Length (mm)
23AH 1.2V Plastic Case £4.86	214	79	27
35AH 1.2V Metal £7.56	219	75	29
40AH 1.2V Plastic Case £9.18	275	80	35

Post 50p per unit

**21 WAY SELECTOR SWITCH WITH RESET COIL.** The ingenious electro mechanical device can be switched up to 21 positions and can be reset from any position by energising the reset coil. 230/240V a.c. operation. Unit is mounted on strong chassis, complete with cover. Price £7. P. & P. 75p (£8.37 inc. VAT & P.). Similar to above approx. 10lb pull £3.50 P. & P. 60p (£4.43 inc. VAT & P.).

**NEW HEAVY DUTY SOLENOID.** mfg. by Magnetic Devices. 240V a.c. operation approx. 20lb pull at 1.25in. Price £7. P. & P. 75p. Similar to above approx. 10lb pull £3.50. P. & P. 60p. 230-250V a.c. Solenoid. Similar in appearance to illustration. Approx. 1 1/2lb pull. Size of feet 1 1/2 x 1/2in. Price £1. P. & P. 25p.



### UNISELECTOR SWITCHES

4 bank, 25 way 75 ohm. Coil. 36-48V d.c. operation. Ex. Heavy equipment £4.25. P. & P. 75p. Total price inc. VAT £5.40.



### MINIATURE UNISELECTOR

12 volt 11-way, 4 bank (3 non-bridging, 1 homing). £2.50. P. & P. 35p (£3.08 inc. VAT & P.).

### RODENE UNISET TYPE 71 TIMER

0-60 sec. 230V a.c. operation. Incorporating a lapsed time indicator and repeat facilities. A precision motor timer ideal for process timing, photography, welding, mixing, etc. Price £6. P. & P. 60p (£7.13 inc. VAT & P.).



### MICRO SWITCHES

As illustrated but fitted with 1in lever, 10 for £2. P. & P. 30p (£2.46 inc. VAT & P.). Sub-miniature Burgess type v 41-1; 10 for £2.50. P. & P. 30p (£3.02 inc. VAT & P.). 50 for £10, post paid (£10.80 inc. VAT & P.). Sub min Honeywell roller m/s type 3115m 9061, 10 for £2.50 post paid. BF LEVER OPERATED 20 amp. C/O. Mfg. by Unimax USA. 10 for £4. P. & P. 50p (min. order 10).



### 24 VOLT DC SOLENOIDS

UNIT containing 1 heavy duty solenoid approx. 25lb pull 1 in travel. Two x approx. 1lb pull 1/2 in travel. 6 x approx. 4oz pull 1/2 in travel. BF LEVER OPERATED 20 amp. C/O. Mfg. by Unimax USA. 10 for £4. P. & P. 50p (min. order 10).

### VORTEX BLOWER AND VACUUM UNIT

Dynamically balanced totally enclosed 9in rotor with max. air delivery of 1.5 cubic metres per min. Max. static pressure 600mm W.G. Suction or blow from 2 side-by-side 37mm 1/2 circular apertures fitted to base of unit. Powerful continuously rated 115V a.c. motor mounted on alloy base with fixing facilities. Dimensions: length 22cm x width 25cm x height 25cm. These units are ex equipment but have had minimum use. Fully tested prior to despatch. Price £12 + £1.50 P. & P. (£14.58 inc. VAT & P.). Suitable transformer for 230/240V a.c. £6 + £1 P. & P. (£7.56 inc. VAT & P.).



### CENTRIFUGAL BLOWER

Mfg. by Smiths Industries 230/240V a.c. Miniature model. Series SE/200. size 95mm x 82mm x 82mm. Aperture 38mm x 31mm. 12 c.f.m. Price £2.75, post 50p (£3.51 inc. VAT & P.). Other types available—please phone for details.



### INSULATION TESTERS NEW!

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in. W.4in. H.6in. weight 6lb. 500V, 500 megohms. £40. Post 80p (£44.06 inc. VAT & P.). 1,000V, 1,000MΩ, £46. Post 80p (£50.54 inc. VAT & P.). SAE for leaflet.



All Mail Orders—Callers—Ample Parking

Dept. PE11, 57 BRIDGMAN ROAD  
CHISWICK, LONDON W4 5BB  
Phone 01-995 1560

Showroom open Mon.-Fri.

## VARIABLE VOLTAGE TRANSFORMERS

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

200 watt (1 amp) inc. a.c. voltmeter	£12.50
0.5 KVA (2 1/2 amp) (MAX)	£15.00
1 KVA (5 amp) (MAX)	£19.50
2 KVA (10 amp) (MAX)	£32.00
3 KVA (15 amp) (MAX)	£39.50
4 KVA (20 amp) (MAX)	£60.00

CARRIAGE AND PACKING EXTRA



### L.T. TRANSFORMERS

0-12V/24V at 1 amp, £2.50. P. & P. 50p (£3.24 inc. VAT & P.).  
0-15V at 1 amp - 0-15V at 1 amp (30V 1 amp), £2.50. P. & P. 50p (£3.24 inc. VAT & P.).  
25-0-25V at 2 1/2 amp, £4.50. P. & P. 75p (£5.67 inc. VAT & P.).  
0-12V/24V 10 amp, £12.35. P. & P. £1 50 (£14.96 inc. VAT & P.).  
0-4V/6V/24V/32V at 12 amp, £13. P. & P. £1 50 (£15.66 inc. VAT & P.).  
0-12V at 20 amp or 0-24V at 10 amp, £12.00. P. & P. £1 50 (£15.01 inc. VAT & P.).  
0-6V/12V/18V/20V at 20 amp, £14. P. & P. £1 50 (£16.74 inc. VAT & P.).  
0-6V/12V at 20 amp, £11.85. P. & P. £1 (£13.88 inc. VAT & P.).  
Other types in stock—phone your enquiries.

## STROBE! STROBE! STROBE!

### HY-LIGHT STROBE KIT MK IV

Latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/240V a.c. operation. Designed for larger rooms, halls, etc. Speed adjustable 1-20 f.l.s. Light output greater than many (so called 4 Joule) strobes. Price £18. Post £1 (£20.56 inc. VAT & P.). Specially designed case and reflector for Hy-Light £8.25. Post £1 (£9.99 inc. VAT & P.).

### XENON FLASHGUN TUBES

Range available from stock S.A.E. for details.



### ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft 40 watt, £7.75 (callers only).  
2ft 20 watt, £5.50. Post 60p. (For use in standard bi-pin). MINI. 12in 8 watt, £1.75. Post 25p (£2.16 inc. VAT & P.). 9in 6 watt, £1.40. Post 25p (£1.78 inc. VAT & P.). 6in 4 watt, £1.40. Post 25p (£1.78 inc. VAT & P.). Complete ballast unit and holders for 6in, 9in and 12in tube, £3.50 plus P. & P. 40p (£4.21 inc. VAT & P.). Also available for 12V d.c. operation, £3.50 plus P. & P. 40p (£4.21 inc. VAT & P.).

### GALVANOMETER

50 micro mirror galvo. Calibrated 50-0-50 and 0-100 Mfg. by Griffin & George Ltd. Offered at a fraction of maker's price, in original ministry packing. £12. P. & P. 60p (£13.60 inc. VAT & P.).



### WIDE RANGE OF DISCO LIGHTING EQUIPMENT

S.A.E. (foolscap) for details.

### CONTACTOR

Mfg. by Hendrey Relays type C2839 220/250 a.c. ops. Contact 4C/O at 20 amp at 440V a.c. Price £6. P. & P. 75p.



### RESET COUNTER

230V a.c., 3 digits mfg. Veeder Root type LL/1441 £1.75. P. & P. 25p (£2.16 inc. VAT & P.). 7 Fg. 24V d.c. non set £1.50. P. & P. 25p (£1.89 inc. VAT & P.). 230V a.c. Fan Assembly. Powerful continuously rated a.c. motor complete with 5 blade 6in Aluminium fan. Price £3.95. P. & P. 65p. 6 fig. 24V d.c. resettable £3. P. & P. 25p (£3.51 inc. VAT & P.).



### BIG INCH

Tiny precision built 3RPM U.S.A. motor size only 1 x 1 1/16" a.c. op. supplied with resistor for 230V a.c. Price £2. P. & P. 20p (£2.37 inc. VAT & P.). 4 for £5 post paid (£5.40 inc. VAT & P.).



## VAT

AT CURRENT RATE MUST BE ADDED TO ALL ORDERS FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE UNLESS OTHERWISE STATED

# SERVICE TRADING CO.

## GEARED MOTORS

100 r.p.m. 115lb.in. 110V. 50Hz. 2.8A. single phase split capacitor motor. Immense power. Continuously rated. Totally enclosed. Fan cooled in-line gearbox. Length 250mm. Dia. 135mm. Spindle dia. 15.5mm. Length 145mm. Ex-equipment tested £12. Post £1.50 (£14.58 inc. VAT & P.). Suitable transformer 230/240V operation £8. Post 75p (£9.45 inc. VAT & P.).



## CITENCO

FHP motor type C 7333/15 220/240V a.c. 19 r.p.m. reversible motor, torque 14.5 kg, gear ratio 144-1. Brand new incl. capacitors, our price £14.25. P. & P. £1 25 (£16.20 inc. VAT & P.).



## BODINE TYPE N.C.I.

### GEARED MOTOR

(Type J) 71 r.p.m. torque 10lb.in. Reversible 1/70th h.p. 50Hz. The above precision made U.S.A. motor is offered in 'as new' condition. Input voltage of motor 115V a.c. Supplied complete with transformer for 230/240V a.c. Input. Price, either type £6.25. Post 75p (£7.56 inc. VAT & P.) or less transformer £3.75. Post 65p (£4.75 inc. VAT & P.). (Type 3) 71 r.p.m. 4 lb.in. 230V a.c. Continuously rated. Reversible. £6.50. Post 75p (£7.83 inc. VAT & P.).



## 15 R.P.M.

Type SD48 80lb.in. Input 100/110V AC. Length incl. gearbox 270mm. Height 135mm. Width 150mm. Drive shaft 16mm. Weight 8.5 kg. BRAND NEW. Price £10. Carr. £1 (£11.88 inc. VAT & P.). Suitable transformer for use on 220/240V a.c. £6. Post 50p (£7.02 inc. VAT & P.).

## A.E.G. WATER PUMP

200/240V a.c. motor. 2.850 r.p.m. 480W approx 1/2 h.p. Driving a centrifugal pump with 1 1/2 in inlet and outlet delivering approx 40 gallons per min. at 10ft head. Ideal for pumping or circulating any non-corrosive light viscosity liquid. Dozens of uses in industrial labs, etc. Note this pump is not self priming. Price £15. Post 75p (£17.01 inc. VAT & P.).



## PROGRAMME TIMERS

12 cam model £8.74. Post 60p. Also available for 50V operation. Price as above.



## METERS NEW—90mm Diameter

Type: 65C5 d.c. Mc. 0-2, 0-5, 0-20, 0-50, 0-100 amp. 0-15V d.c. 0-30V d.c. Type: 62T2 a.c. M/1-0V, 0-50 amp, 0-15V, 0-30V. Type 65L5 R/mc. 0-30V a.c. All at £3.50 each. P. & P. 50p (£4.32 each inc. VAT & P.).



## WHY PAY MORE?

MULTI RANGE METER. Type MF15A a.c./d.c. volts 10-50, 250, 500, 1000, Ma 0-5, 0-10, 0-100. Sensitivity 2000V. 24 range, diameter 133 by 93 by 46mm. Price £6.50 plus 50p P. & P. (£7.56 inc. VAT & P.).



## TIME SWITCH

'Horstmann' type V Mk. II Time switch. 200/250V a.c. Two on/two off every 24 hours, at any manually preset time. 30 amp contacts. 36 hour spring reserve. Day omitting device. Built to highest Electricity Board Spec. Individually tested. Price £7.75. Post 50p. (Total inc. VAT £8.91).



SANGAMO WESTON type S251 200/250V a.c. two on/two off every 24 hours. 20 amp contacts with over ride switch, dia. 4in x 3in. Price £6. P. & P. 50p (£7.02 inc. VAT & P.) also available with Solar dial.

## 600 WATT DIMMER SWITCH

Easily fitted. Fully guaranteed by makers. Will control up to 600W of lighting except fluorescent at mains voltage. Complete with simple instructions £3.95, post 25p (£4.53 inc. VAT & P.). 1,000 watt model £5.80, post 25p (£6.32 inc. VAT & P.). 2,000 watt model £9.75, post 40p (£10.96 inc. VAT & P.).

## Superior Quality Precision Made NEW POWER RHEOSTATS

New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.  
25 WATT 10/25/50/100/150/250/500/1kΩ/1.5kΩ. £2.40. Post 20p (£2.81 inc. VAT & P.).  
50 WATT 100/250/500/1kΩ. £2.90. Post 25p (£3.40 inc. VAT & P.).  
100 WATT 1/5/10/25/50/100/250/500/1kΩ/1.5kΩ/2.5kΩ/3.5kΩ. £4.90. Post 35p (£5.67 inc. VAT & P.).  
Black Silver, Skirted knob calibrated in Nos. 1-9 1/2 in. dia. brass bush. Ideal for above Rheostats 24p each.



Personal callers only. Open Sat.

9 LITTLE NEWPORT STREET  
LONDON WC2H 7JJ  
Phone 01-437 0576

# MAPLIN

in a modern world of electronics

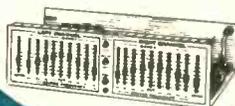
## AUDIO MIXER

A superb stereo audio mixer. It can be equipped with up to 16 input modules of your choice and its performance matches that of the very best tape recorders and hi-fi equipment. It meets the requirements of professional recording studios, FM radio stations, concert halls and theatres. Full construction details in our catalogue. A component schedule is available on request



## 10 CHANNEL STEREO GRAPHIC EQUALISER

A new design with no difficult coils to wind, but a specification that puts it in the top flight hi-fi class. All this for less than £70 including fully punched and printed metalwork and woodwork. Send for our component schedule now. Full construction details price 40p.



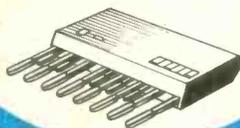
## INTEGRATED CIRCUITS

Over 35 pages in our catalogue devoted to hundreds of useful I.C.s. All with data, pin connections and many with applications circuits and projects to build. Post the coupon now!



## PEDAL UNIT

A completely self-contained pedal unit. 13-note, 2-Octave range. 4 organ stops. It can be added to any organ. A really unusual extra is the bass guitar stop which uses four envelope shapers to give a real bass guitar sound. A must for the solo guitarist. Full construction details in our catalogue—post the coupon below now!



## SYNTHESISER

The International 4600 Synthesiser. A very comprehensive unit. Over 400 sold. We stock all the parts costing less than £500 including fully punched and printed metalwork and a smart teak cabinet. Far less than half what you'd pay for a ready made synthesiser of equal quality. Specification on request, full construction details in our construction book £1.50.



Who says the Maplin Catalogue's worth having?

"in our 'musts' for readers-to-collect list". —P.E.

"contains . . . just about everything the DIY electronic enthusiast requires"—P.W.

"probably the most comprehensive catalogue we have ever come across"—E.E.

"has been carefully prepared and is very well presented"—R.E.C.

"makes the job of ordering components an easy, accurate and enjoyable pastime"—P.W.

"Only one word describes the publication—superb!"—E.T.I.

OVER 60,000 COPIES SOLD. DON'T MISS OUT!  
SEND 60p NOW

## MAPLIN ELECTRONIC SUPPLIES

P.O. Box 3, Rayleigh, Essex SS6 8LR  
Telephone: Southend (0702) 715155  
Shop: 284 London Road, Westcliff-on-Sea,  
Essex. (Closed on Monday). Telephone: Southend (0702) 715157.

Our bi-Monthly newsletter keeps you up to date with latest guaranteed prices—our latest special offers—details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).

POST THIS COUPON  
NOW FOR YOUR COPY OF  
OUR CATALOGUE PRICE 60p

Please rush me a copy of your 216 page catalogue. I enclose 60p, but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 60p refunded immediately.

Name \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

