

PRACTICAL

ELECTRONICS

DECEMBER 1976

40p



RANDOM
NUMBER

GAMESMACHINE

INDEX
FOR VOL. 12

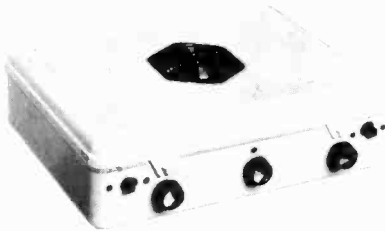
METAL PIPE OR
WIRING LOCATOR

RADIO EXCHANGE LTD.

**ALL PRICES
INCLUDE VAT**

NEW EDU-KIT MAJOR

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



- 4 Transistor Earpiece Radio
 - Signal Tracer
 - Signal Injector
 - Transistor Tester NPN - PNP
 - 4 Transistor Push Pull Amplifier
 - 5 Transistor Push Pull Amplifier
 - 7 Transistor Loudspeaker Radio MW/LW
 - 5 Transistor Short Wave Radio
 - Electronic Metronome
 - Electronic Noise Generator
 - Batteryless Crystal Radio
 - One Transistor Radio
 - 2 Transistor Regenerative Radio
 - 3 Transistor Regenerative Radio
 - Audible Continuity Tester
 - Sensitive Pre-Amplifier
 - Earpiece
 - Mica Baseboard
 - 1 Tuning Condenser
 - 3 Knobs
 - 24 Resistors
 - 21 Capacitors
 - 10 Transistors
 - 3 1/2 Loudspeaker
 - 3 1/2-way Connectors
 - 2 Volume Controls
 - 2 Slider Switches
 - 1 Tuning Condenser
 - 3 Knobs
 - Ready Wound MW/LW/SW Coils
 - Ferrite Rod
 - 6 1/2 yards of wire
 - 1 yard of sleeving, etc.
- Complete kit of parts including construction plans

Total building costs **£9.00** P.P. and Ins. 85p

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

£3.95 P.P. & Ins. 45p



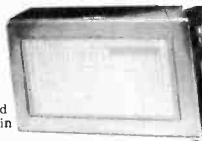
POCKET FIVE

Now with 3in Loudspeaker

3 tunable wavebands, MW, LW and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5 1/2in x 1 1/2in x 3 1/2in approx.

Complete kit of parts including construction plans.

Total Building Costs: **£3.60** P.P. and Ins. 60p



NEW ROAMER TEN MODEL R.K. 3

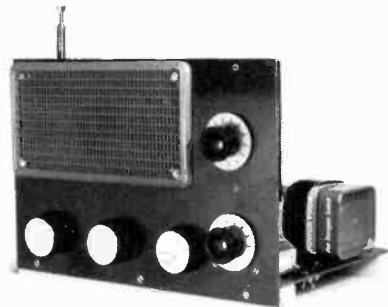
MULTIBAND V.H.F. AND A.M. RECEIVER.

13 TRANSISTORS AND FIVE DIODES. QUALITY 5" x 3" 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. Powered by P. P. 9.9 volt Battery.

Complete kit of parts including carrying strap, Building Instructions and operating Manuals. **£13.99** inc. P. & P.

Case enclosure kit (if required), **£1.80** inc. P. P. and Ins.



NEW Everyday Series

Build this exciting new series of designs.

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in. loudspeaker. Attractive case with red speaker grille. Size 9in. x 5 1/2in. x 2 1/2in. approx. All parts including Case and Plans.

Total Building costs **£4.30** P. & P. + Ins. 60p

E.V.6. Case and looks as above. 6 Transistors 3 diodes. Powered by 9V battery. Ferrite rod aerial. 3in. loudspeaker, etc. MW/LW coverage. Push/Pull output. All parts including Case and Plans.

Total Building costs **£4.95** P. & P. + Ins. 65p

E.V.7. Case and looks as above, 7 Transistors and 3 diodes. Six wavebands, MW/LW, Trawler Band SW1, SW2, SW3, powered by 9V battery. Push pull output. Telescopic aerial for short waves. 3in. Loudspeaker. All parts including Case and Plans.

Total Building Costs **£6.95** P. & P. + Ins. 70p

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, superb 9 section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit).

Complete kit of parts **£7.95** P.P. and Ins. 70p



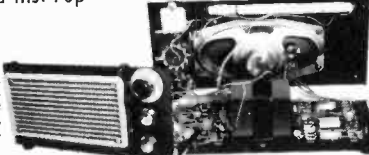
Including Construction Plans

E.C.K. 4

7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit.

With 5in x 3in loudspeakers. Push pull output stage, gain control, and rotary switch. 7 transistors and 4 diodes. 6 section chrome-plated telescopic aerial. 8in sensitive ready wound ferrite rod aerial, tuning capacitor, resistors, capacitors, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit).

Complete kit of parts **£7.25** P.P. and Ins. 70p



Including Construction Plans

Case enclosure kit (if required) **£1.50** inc. P.P. and Ins.

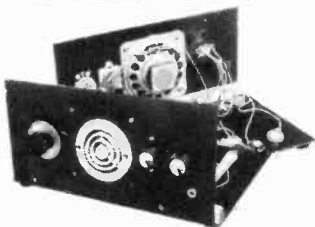
EDU-KIT JUNIOR

Completely Solderless Electronic Construction Kit. Build these projects without Soldering Iron or Solder.

- ★ Crystal Radio Medium Wave Coverage—No Battery necessary
- ★ One Transistor Radio
- ★ 2 Transistor Regenerative Radio
- ★ 3 Transistor Earpiece Radio Medium Wave Coverage
- ★ 4 Transistor Medium Wave Loudspeaker Radio
- ★ Electronic Noise Generator
- ★ Electronic Metronome
- ★ 4 Transistor Push/Pull Amplifier

All parts including loudspeaker, earpiece, MW ferrite rod aerial, capacitors, resistors, transistors, etc.

Complete kit of parts **£6.55** P. & P. including construction plans + 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 £..... for.....

Name

Address

PE12/76

PRACTICAL ELECTRONICS

VOLUME 12 No. 12 DECEMBER 1976

CONSTRUCTIONAL PROJECTS

- METAL PIPE OR WIRING LOCATOR** *by C. C. Whitehead* 952
A simple safety aid for the D.I.Y. man
- P.E. ORION TUNER—2** *by D. S. Gibbs & I. M. Shaw* 956
Construction, testing and final adjustments
- GAMES MACHINE** *by D. Burn* 969
A programmed random number generator
- BREAKDOWN TESTER** *by M. H. George* 977
Check Zener diode and transistor breakdown voltages with this mains-driven unit

GENERAL FEATURES

- GETTING TO GRIPS WITH MICROPROCESSORS** *by D. Brown* 963
Understanding and using these new devices
- SEMICONDUCTOR UPDATE** *by R. W. Coles* 976
A look at some recently released devices
- SOLID STATE TV CAMERAS** *by D. V. Eddolls* 980
A survey of developments
- INGENUITY UNLIMITED** 987
Car Lamp Monitor—Simple Timer—Model Train Controller—L.E.D. VU Meter—Quiz Monitor—
Simple Siren—"Preset-to-One" Counter—Variable Chance Ratio Device—Voltmeter
Impedance Multiplier—Tell Tale Alarm

NEWS AND COMMENT

- EDITORIAL—A Disingenuous Few** 951
- SERT SYMPOSIUM "MICROPROCESSORS AT WORK"** 965
An impression
- SPACEWATCH** *by Frank W. Hyde* 966
Space Shuttle—Mars—Soyuz 22
- NEWS BRIEFS** 984
TV Import Restrictions—Code of Practice—Overseas Symposium & Exhibition
- MARKET PLACE** 985
Interesting new products
- STRICTLY INSTRUMENTAL** *by K. Lenton-Smith* 986
Electronic music matters
- INDUSTRY NOTEBOOK** *by Nexus* 993
What's happening inside industry
- PATENTS REVIEW** 994
Thought-provoking ideas on file at the British Patents Office

INDEX FOR VOLUME 12

Our January issue will be on sale on Friday, December 10, 1976
(for details of contents see page 955)

© IPC Magazines Limited 1976. 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.

FROM THE BIGGEST RANGE OF GOOD QUALITY MULTIMETERS

CHINAGLIA

PRESENT THE

DOLOMITI

20k Ω /V a.c. and d.c.

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

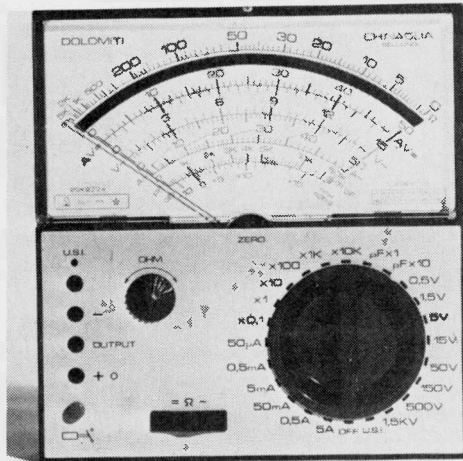
Accuracy: d.c. ranges, $\pm 2.0\%$, a.c. and Ω ranges $\pm 2.5\%$.
39 ranges: d.c. V. 0-150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V, 1.5kV.
 d.c. I. 0-50 μ A, 500 μ A, 5mA, 50mA, 500mA, 5A; a.c. V. 5V, 15V, 50V, 150V, 500V, 1.5kV, a.c. I. 5mA, 50mA, 500mA, 5A; dB -10 to +65 in 6 ranges; Ω 0-0.5k Ω , 5k Ω , 50k Ω , 500k Ω , 5M Ω , 50M Ω , pF50kPF, 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 650g with batteries. Supplied complete with carrying case, fused leads, hand-book and full 12-month guarantee. Optional 30kV d.c. probe available.

Meter £40.50 incl. VAT (£1 P. & P.)
 30kV Probe £12.85 incl. VAT

ALCON Instruments Ltd.

19 MULBERRY WALK · LONDON SW3 6DZ TEL. 01-352 1897



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.

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** EACH
 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
 (less lamps) Length 31 3/4
 BC Fitting **£15.60** EACH | ES Fitting **£17.00** EACH

100 WATT SPOT LAMPS
 RED, YELLOW, GREEN 3 lamps
 BLUE CLEAR **£1.18** each | **£3.54** each
 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

Send 20p for illustrated leaflet & price list

10,000 μ F 16VW ELECTROLYTICS. Size 3 3/4 x 1 1/4 in. at 15p, 4 for 50p.
 5MHz 10X CRYSTALS. At 50p each.
 POWER TRANSISTORS. MP8512 p.n.p. at 15p, MP8112 n.p.n. at 15p, R2008 at 50p, R2010 at 80p.
 600KHZ 1 OXAJ CRYSTALS. At 50p each.
 DUAL GATE MOS FETS LIKE 40673. At 33p, 4 for £1.10.
 TEXAS PNP POWER DARLINGTON TYPE TIL117. At 35p each.
 STC 12V DPTD RELAY. At 50p.
 GLASS WIRE ENDED 28KHz CRYSTALS at 50p.
 1 POLE 21 WAY ROTARY SWITCHES. At 65p.
 1,250 PIV 1A SILICON DIODES. BY294 at 12 for £1.
 BF177 100V NPN 600MW TRANSISTOR. 10p, 6 for 50p.
 COMPRESSION TRIMMERS. 10PF, 30PF, 50PF, 150PF, 750PF, 1,000PF. All at 6p each.
 B7G GLASS CRYSTALS. 324, 327, 333, 335-5, 338, 339, 341, 342, 345, 346, 348, 349, 350, 352, 354, 355, 359, 358, 370, 382, 386KHz. At 40p each.
 SILICON SOLAR CELLS. 0.5V 5MA at 35p each.
 800V 2A PLASTIC TO3 NPN POWER TRANSISTOR R2600A. At 50p.
 TEXAS PNP DARLINGTON POWER TRANSISTORS TIP117. At 35p.
 2,000 PIV 100MA WIRE ENDED SILICON DIODES. 7 for £1.
 VHF POWER TRANSISTORS. Unmarked 2N3866 at 40p, 3 for £1.
 PLASTIC SCR'S. 50 PIV 6A at 15p, 400PIV 6A at 40p.
 10A STUD MOUNTING SCR'S. 100PIV at 25p, 400PIV at 50p, 800PIV at 60p.
 1,000 μ F 40VW ELECTROLYTICS. Size 1 1/2 x 1/2 in. at 3 for 35p.
 SILICON BRIDGES. 100PIV 10A at 83p, 200PIV 2A at 30p, 400PIV 1A at 30p.
 TAG ENDED ELECTROLYTICS. Size 2 1/2 x 1 1/4 in. 3,300 μ F 64VW at 50p, 4,700 μ F 40VW at 45p.
 60 ASSORTED WIRE WOUND RESISTORS. 1 to 10W at 57p.
 200 CARBON FILM $\frac{1}{2}$ W RESISTORS. Assorted odd values at 75p.
 100 ASSORTED MIN. $\frac{1}{2}$ W RESISTORS. 17 different values at 57p.
 MULLARD 455KHz VERSION OF LP1175 FILTER with Data at 55p.
 TEXAS RF TRANSISTORS TYPE BF224. At 6 for 57p.
 80 METRE 10X CRYSTALS. 3545 at 40p each.
 50 AC128 TRANSISTORS. Branded but untested for 57p.
 10 μ F 300VW ELECTROLYTICS for 57p.

Please add 20p for post and packing on orders under £2. Overseas orders at cost.

J. BIRKETT

RADIO COMPONENT SUPPLIERS
 25 The Strait, Lincoln LN2 1JF
 Tel. 20767

CBM

SR7919D ● 8-digit or 5-digit + 2 Exp.
● Full trig and log functions ● Sq. root ● Reciprocals
Yx, X¹, π ● Register exchange
● Memory plus
● Store recall
● Sign change
● Algebraic logic.



£10.90*

4148R—10-digits, 2 exponents, Full log and trig functions. X¹, Reciprocal, 77, X root of Y, Polar rectangular co-ordinates. 2-store memory. Rechargeable. Mean and Standard deviation.

(R) £26.90

SR4190R—10-digit, 2 Exp. 90 function pre-programmed, metric conversions. Extra functions to the 4148R:—Perms and combinations. Gamma. Poisson and Binomial distributions, factorial, complex numbers, hyperbolic functions, linear regression and Integration of Y=f(x).

(R) £36.90

SR1800—Similar to the 4148R. Green display. Battery operated. £20.90*

SINCLAIR

CAMBRIDGE SCIENTIFIC

5-digit ● 2 Exp ● C & CE key ● sin ● cos ● tan ● arctan ● arcsin ● arccos ● arctan ● reciprocal ● E to the X ● natural log ● antilog ● memory + ● memory - ● memory exchange ● memory cancel ● EE exponent ● change notation ● PLUS a degree radian switch.



ONLY £10.90

OXFORD 300—

Larger version of above. £12.90*

A ZYCON EXCLUSIVE! ALARM WATCH

JUST ARRIVED and only available from us! This fantastic digital Alarm Watch shows Hrs, Mins, Secs, Mth, Date & Day! 5 Min advance bleep as a gentle reminder then, PULSATING BLEEP for 15 Secs unless stopped when it will bleep 5 Mins later as a further reminder. AM/PM feature. Simple to set. Alarm-set check. Single command button for all time functions. **NO MORE PARKING FINES and NEVER MISS APPOINTMENTS!** Solid Stainless Steel throughout with matching bracelet.



ONLY £98.90

+£1.50 Ins & P&P

TWO YES TWO SOLAR WATCHES JUST ONE IS EXCLUSIVE TO US: From £110 +£1.50 Ins & P&P. RING US NOW FOR FULL DETAILS!

ROCKWELL

44RD. 8-digit or 5-digit & 2 Exp. Green display. Store. Similar to the 63R less factorial

£18.90*

64RD. 12-digit or 8-digit + 2 Exp. Additional to 44RD. Polar rec., co-ordinates, log, rad or grad.

£23.90*

61R Green display. 8-digits. All trig and log functions. (R) £22.05



The ZYCON range of Quality Electronic Watches

L.C.D.

KLC3
L.C.D. Constant display Shows Hrs, Mins & pulsating secs. Chrome finish with Stainless Steel back and FREE Adjustable S/Steel bracelet. £24.50

Gold Plate £26.45

KLC5
Constantly shows hrs, mins & Pulsating secs. Press command button for mth & date, press again for mins & secs. May be set to alternate hr & mins to mth & date every 2 secs. resets to time. 4 yr cal. 'Nite Lite' £37.90

Gold Plate £42.40. FREE matching bracelets with each.

KLC2

U.S.A. MODULE Continuous hrs, mins & pulsating secs. Press command button for mth & date. Press again for secs readout. Setting for alternating hrs & mins to mth & date every 2 secs. Auto-time reset. 4 yr calendar. 'Nite-Lite' FREE matching S/Steel bracelet. £39.95

Heavy Gold Plate on S/Steel with matching G.P. Bracelet £44.95.

All come in FREE Presentation Box. All Zyon watches carry our 'NO QUIBBLE' 1 Year Guarantee



L.E.D.

KED5
5-Functs. Shows Hrs, Mins, Secs, Mth & Date. 4-Yr calendar. Beautifully finished with S/Steel back & FREE Leatherette Strap. £19.95

Gold Plate £22.95

KED6 A fantastic 6-Functions window display shows Hrs, Mins, Secs, Mth & Date. Day of week in letters. Single button. Auto-hold & Fade-out 4-Yr calendar. Case in Heavy Rhodium on Brass + S/Steel back. FREE matching S/Steel adjustable bracelet. £29.95 Gold Plate £33.90

KED6 PLUS

Month & Day of the Week in Letters! Shows Hrs, Mins, Secs, Date, Mth & Date, Day of Week, Auto 4-Yr calendar, A.M./P.M. Set/Indicate. One of the most sophisticated watches at this price. Accurate to within a few secs a year. Finished in Satin Stainless Steel with FREE matching Steel bracelet. Trimest watch in the world. £37.50 ONLY Gold Plate £40.50



4525—8-digit, 2 Exp. 100 step programmable. R.P.N. Full log, 4 trig functions, XY Exchange, exponent key, change sign, memory, 4 roll stack, skip, delete, accessible additional programmes within the 100 step.

(R) £34.90

4650. All trig & logs. 2-level paren. 8-dig + 2 exp. Algebraic logic. Full address logic. Deg rad. Rect/Polar co-ords (R) £29.60

4520—Non-programmable version of the 4525 incl. mem + x², deg. & Rad. (R) £ 22.90

4510—8-digits. 3 level stack. All trig and log functions. √, π, Reciprocal. Memory etc. £12.90*



NOVUS

NEW 4640. 10-digit, 2 Exponent 54 functions. RPN 4-level Roll Stack. 3, fully addressable memories. Logs Trigs, Stat & Metric Conversions etc.

(R) £42.90

4600—Same but Algebra IC (R) £47.10

(R) £31.90

4515—100-step programmable version. (R) £15.90*

6010—Metric £15.90*

6020—Financier. £15.90*

6025—Rechargeable. Financier 100-step programmable. (R) £34.90

6030—Statistician. £15.90*

6035—100-step programmable Statistician. Rechargeable. (R) £34.90

CASIO

NEW FX201P Green display. 127 steps, 11 memories, Conditional jumps, Sub-routine fractions. 8 + 2 exp. All logs & trigs. £49.95*

FX20 (Allus) logs, trigs etc. £15.65*

FX15. As above but larger and including a larger display.

x² key, π key. Reciprocal key. £13.95*

FX 101. De Luxe model with similar functions to the FX15 but 8-digits +2-exp. 10+⁹⁹ to 100⁻⁹⁹. £23.50*

FX19. Full Sci plus fractions, deg rad, algebraic, mem, exp, Std dev. £16.90*

FX102. 10-digit £19.95* version of FX19.

AL8. 8-digit fraction calc. £13.95*

AL10. 10-digit fraction calc. £15.95*



DECIMO DIGITAL CLOCK/RADIO

£33.95 OUR PRICE Incl. VAT plus £1 p&p

LARGE DIGITAL READOUT



This is the most unique clock/radio in the country today having a soft 1 1/2" high orange-glow digital readout which is completely silent and non-pulsating. In a beautiful teak style cabinet with up-to-date VHF/MW radio. You can awake to soft music or alarm—and if you want up to 10 minutes more—just press the 'Drowse' button. Automatic 80 minute 'sleep' button in case you drop off while the radio's on.

NEW! The Ideal Ladies Xmas Present!

An elegant 6-function watch which shows Hrs, Mins, Secs, Mth, Date, Day! She'll love this piece of miniaturised electronic wizardry! In GOLD PLATE with matching flexible, adjustable bracelet. Also available with stylised Chrome Bezel and Stainless Steel Bracelet. ONLY £39.95 S/Steel £39.95



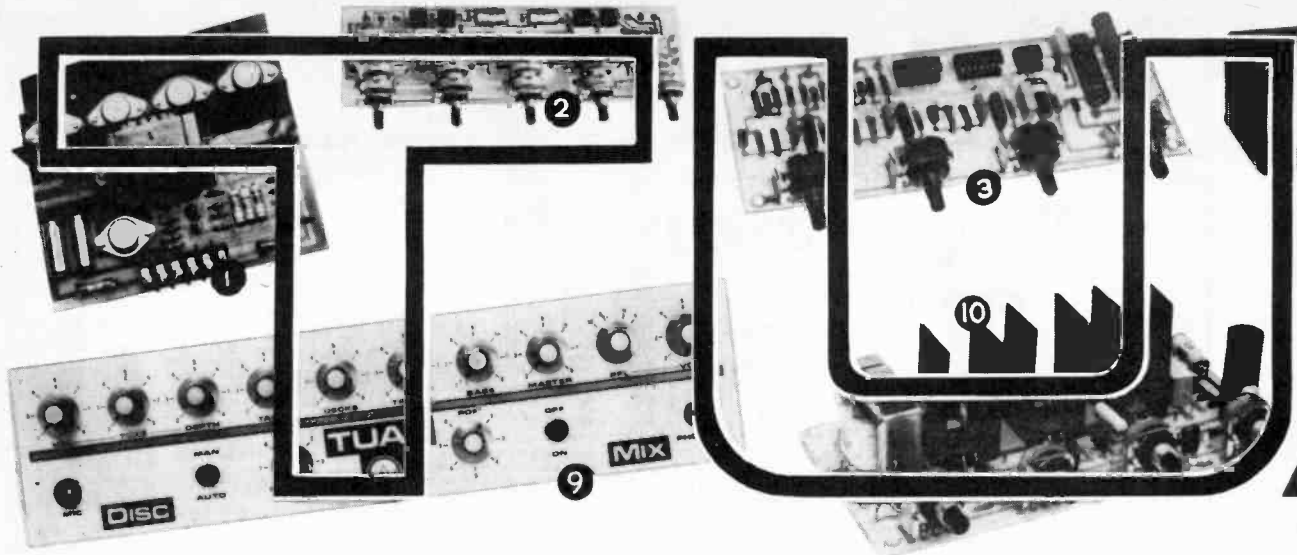
ORDER FORM

PHONE CALLS AND PERSONAL CALLERS WELCOME MONS TO THURS. BETWEEN 2 & 5 p.m. 01-456 4755. SUNDAYS 10 a.m. to 1 p.m. To: BARCLAY ELECTRONICS Dept. PE11, 1115 FINCHLEY ROAD, TEMPLE FORTUNE, LONDON N.W.11

Please send me.....
with/without optional mains adaptor. I enclose cheque/money order total value £..... Please add 55p to all items to cover p. & p.
NAME.....
ADDRESS.....

PHONE BARCLAYCARD OR ACCESS ORDERS.





TRANSISTOR UNIVERSAL AMPLIFICATION Co. Ltd.

PHONE 01-672 3137/672 9080

9 MONO DISCO MIXER WITH AUTO FADE

Designed for the discerning D. J. of professional standard. Offering a vast variety of functions. Controls: Mic Vol; Tone, over-ride depth, auto/manual sw; Tape Vol; L & R Deck Faders; Deck Volume; Treble and Bass; H. Phon Vol Selector; Master Vol On/Off sw. Max output 3V RMS. Specification: Deck inputs—50mV into 1M Ω ; Deck Tone Controls—treble total range 36dB at 15kHz—Bass total range 36dB at 50Hz. Mic input—200 ohms upwards 2mV into 22k. Mic Tone Control—Total range 40dB at 15kHz. Tape Input—100mV into 200 ohms. Power requirements 20–50 volts d.c. at 50mA. R.I.A.A. comp mag inputs available 75p extra. PANEL SIZE 18 x 4 $\frac{1}{2}$ in. DEPTH 3in.

£39.75

PRE AMPLIFIERS

VA08

Designed for use with TUAC power amplifier modules. Extensive research has gone into various wide range tone control circuits produces superb sound quality. Thousands are already in use in high quality professional amplification systems.

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.

£8.50

VA06 Vol. Treb. and Bass controls. Sensitivity 8mV. Treb. + 28 – 15dB at 12kHz. Bass \pm 18dB and 40Hz.

£7.50

2 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 – 15dB at 4kHz. Bass + 20 – 10dB at 40Hz. Plus Full Balance Control. Fully I/C operation supply voltage \pm 15VDC.

£15.00

THE PIEZO SUPER HORN

has all the features! ONLY £10.95

- NEEDS NO CROSS-OVER NETWORK
- FREQUENCY RESPONSE: 4,000–30,000Hz \pm 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—INCREASES OUTPUT
- POWER HANDLING CAPACITY 25 volts RMS—see chart
- COMPACT—3 $\frac{3}{8}$ x 3 $\frac{3}{8}$ x 2 $\frac{1}{2}$ in.



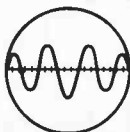
POWER HANDLING GUIDE

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

Suppliers to H.M. Govt. Depts. Manufactured and assembled in Gt. Britain, fully tested and guaranteed.

TO ORDER BY POST

Make cheques/P.O.s payable to TUAC LTD (PE/12) or quote Access/Barclaycard No. and post to TUAC LTD (PE/12), 119 Charlmont Road, London, SW17 9AB. We accept phone orders from Access/Barclaycard holders. Phone 01-672 3137, 9080.



AMPLIFIER MODULES

7 TL30 D.C. COUPLED POWER AMPLIFIER MODULE

- Output power 30 watt R.M.S. continuous sine wave into 8 Ohms
- T.H.D. at full power 0.5%
- Signal to noise ratio—85dB
- Input sensitivity 60mV into 50k ohms
- Frequency response 25Hz–50kHz
- 8 transistors 4 diodes

£12.50

11 TL60 5 x 5 x 3in

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

£16.75

11 TL100 5 x 5 x 3in

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

£18.75

1 TP125 7 x 6 $\frac{1}{2}$ x 3in

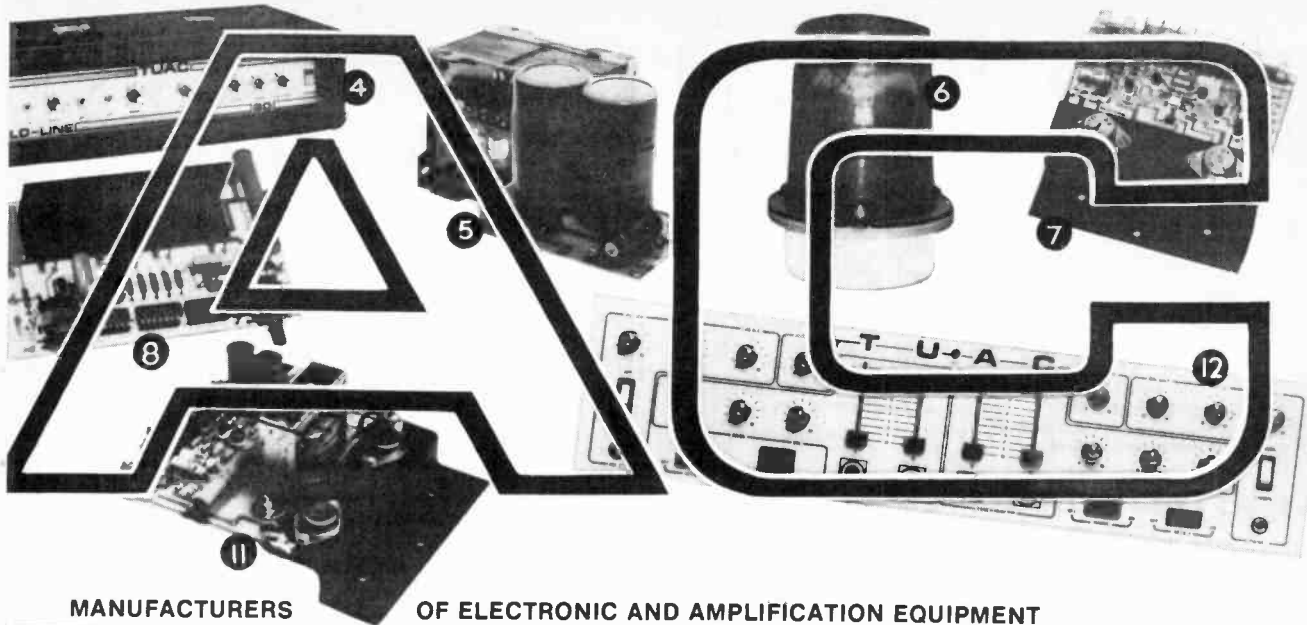
- 125 watt R.M.S. continuous sine wave output
- 4 R.C.A. 150 watt 15 amp output transistors

£23.25

Specification on power modules: ● Rugged layer wound driver transformer ● Short—Open—and Thermal overload protection ● Only 6 connections. All output power ratings \pm 0.5dB. Output impedance 8–15 ohms: THD at full power 2% typically 1%; Input sensitivity 60mV into 10k Ω ; Frequency response 20Hz–20kHz \pm 2dB. Hum and noise better than –70dB.

Send large stamped addressed envelope with all enquiries for fully illustrated 12 page catalogue

TRADE & EXPORT ENQUIRIES 01-672 9080



MANUFACTURERS OF ELECTRONIC AND AMPLIFICATION EQUIPMENT

5 POWER SUPPLIES

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

- PS250 for supplying 2 TP125s **£28.00**
- PS60/60 for supplying 2 TL60s **£25.50**
- PS125 ± 45 volts for TP125 **£16.75**
- PS100 ± 43 volts for TL100 **£15.50**
- PS60 ± 38 volts for TL60 **£14.50**
- PS30 ± 25 volts for TL30 **£9.75**
- PSU 2 for supplying disco mixer **£6.50**

4 CHANNEL SOUND TO LIGHT SEQUENCE CHASER—4LSM1 8

- 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
- Full wave control
- 13 easy connections

Patents applied for **£18.75**

Model 501 500W per channel as above without sound triggering **£12.25**

10 3 CHANNEL LIGHT MODULATOR

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

£18.00

(Single Channel Version 1500 Watts **£9.50**)

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

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

SEQUENCE DIMMER MODULE—3SDM1 **£13.00**

Factory reorganisation now completed. Assembly line capacity available for long and short runs to clients specification

All prices include VAT Postage and Packing

12 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 ± 1dB. 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

£115

FRONT PANEL FOR LIGHTING EFFECT MODULES

(complete with switches, neons and knobs) as illustrated



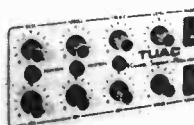
◀ For S1LMB

£6.50



▲ Size: 6 1/2" x 4 1/2"
For 4LSM1

£5.50



◀ For S1LMB combined with 3SDM1

£7.50

Size: 8" x 4 1/2"

Size 9" x 4 1/2"

6 FUZZ LIGHTS

RED GREEN BLUE AMBER
240 volt a.c.
Long Life
Candle Bulb,
Revolving
Reflector, adds a new dimension to disco lighting effects.

£21.50

TUAC AMPLIFICATION

- Loline 125 watt with sustain **£81**
- Loline Slave 125 watt **£70**
- Loline 60 watt with sustain **£65**
- Combo Twin 60 reverb **£140**
- Combo 30 **£75**

STOCKISTS—CALLERS ONLY

- Geo Mathews, 85/87 Hurst Street, Birmingham (Tel. 021-622 1941).
- Arthur Sallis Ltd., 28 Gardner Street (Tel. Brighton 65806).
- Bristol Disco Centre, 25 The Promenade, Gloucester Road (Tel. Bristol 41666).
- Soccod, 9 The Friars (Tel. Canterbury 60948).
- Cookies Disco Centre, 132 West Street (Tel. Crewe 4739).
- H.B. Electronics, 54 Montagu Street (Tel. Kettering 83922).
- Leighton Electronics Centre, 59 North Street (Tel. Leighton Buzzard 2316).
- Garland Bros. Ltd., Deptford Broadway, London (Tel. 01-692 4412).
- Damon Electronics, 99 Carrington Street (Tel. Nottingham 53880).
- 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. 01-872 3413).
- Mon-Sat. 9.30 a.m.—5.30 p.m., Half Day Wed. 9.30 a.m.—1 p.m.



"I MADE IT MYSELF"

Imagine the thrill you'll feel! Imagine how impressed people will be when they're hearing a programme on a modern radio you made yourself.

Now! Learn the secrets of radio and electronics by building your own modern transistor radio!

Practical lessons teach you sooner than you would dream possible.

What a wonderful way to learn—and pave the way to a new, better-paid career! No dreary ploughing through page after page of dull facts and figures. With this fascinating Technatron Course, you learn by building!

You build a modern Transistor Radio... a Burglar Alarm. You learn Radio and Electronics by doing actual projects you enjoy—making things with your own hands that you'll be proud to own! No wonder it's so fast and easy to learn this way. Because learning becomes a hobby! And what a profitable hobby. Because opportunities in the field of Radio and Electronics are growing faster than they can find people to fill the jobs!

No soldering—yet you learn faster than you ever dreamed possible.

Yes! Faster than you can imagine, you pick up the technical know how you need. Specially prepared step-by-step lessons show you how to: read circuits—assemble components—build things—experiment. You enjoy every minute of it!

You get everything you need. Tools. Components. Even a versatile Multimeter that we teach you how to use. All included in the course. **AT NO EXTRA CHARGE!** And this is a course anyone can afford. (You can even pay for it by easy instalments.)

So fast, so easy, this personalised course will teach you even if you don't know a thing today!

No matter how little you know now, no matter what your background or education, we'll teach you. Step by step, in simple easy-to-understand language, you pick up the secrets of radio and electronics.

You become a person who makes things, not just another of the millions, who don't understand. And you could pave the way to a great new career, to add to the thrill and pride you receive when you look at what you have achieved. Within weeks you could hold in your hand your own transistor radio. And after the course you can go on to acquire high-powered technical qualifications, because our famous courses go right up to City & Guilds levels.

Send now for FREE 44 page book—see how easy it is—read what others say!

Find out more now! This is the gateway to a thrilling new career, or a wonderful hobby you'll enjoy for years. Send the coupon now. There's no obligation.

POST TODAY FOR FREE BOOK

To: ALDERMASTON COLLEGE, DEPT. CPE12 READING RG7 4PF CPE12

Also at our London Advisory Office, 4 Fore Street Avenue, Moorgate, London EC2Y 5EJ. Tel: 01-628 2721

Yes, I'd like to know more about your course. Please send me free details—plus your big, 44-page book that tells about all your courses.

NAME

ADDRESS

POSTCODE



HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY



W:K:F ELECTRONICS



THE P.C.B. SPECIALISTS

PRACTICAL ELECTRONICS "PRINTED CIRCUIT BOARDS" NOW AVAILABLE

TYPE 'A': Made in 1.6mm Epoxy/Glass-fibre, supplied Roll-tinned & drilled.
TYPE 'B': Made in 1.6mm S.R.B.P., supplied Roll-tinned & drilled:

All units available Ex. Stock by return. All prices INCLUDE Post—Pack, and V.A.T. TERMS: Cash with order. Cheques & P.O.s payable to W.K.F. Electronics.

ISSUE	PROJECT	QTY OF P.C.B.s	TYPE 'A' PRICE	TYPE 'B' PRICE
Sept. 1976	Cross-Hatch Generator	1	3.75	—
Sept. 1976	Gas—Smoke Detector	1	2.25	1.65
Sept. 1974	Gas & Smoke Detector	1	—	1.75
JAN. 1975	ORION STEREO 20W AMPLIFIER	1	3.60	2.20
May 1975	I.C. Pulse Generator	1	—	1.40
DEC.—JAN 1976	50 + 50W GUITAR AMPLIFIER	3	3.25	2.00
JUNE 1976	DIGITAL FREQUENCY METER	4	4.25	3.50
June 1976	Audio Millivolt Meter	2	—	1.60
JUNE—AUG. 1976	RADIO CONTROL SYSTEM	8	5.70	4.30

PRODUCTION SPACE ALWAYS AVAILABLE FOR:

P.C.B. PRODUCTION—ELECTROPLATING—SCREEN PRINTING—TINNING
CONTRACT DRILLING—ANY PHOTOGRAPHIC ART PROCESS

SERVICE FOR:

P.C.B. MASTER PREPARATION + ANY GRAPHIC ARTS PROCESS

FROM:

ROUGH COPIES—EXISTING UNITS—CIRCUIT DIAGRAM
EVEN FELT TIP PEN ON OLD FISH & CHIP PAPER!!

QUOTATIONS FREE OF CHARGE BY RETURN

Large discounts given for long runs. Run-on's and repeat orders. Also call-off orders accepted

FOR OUTLINE QUOTATIONS PHONE:
WHITWELL (DERBY'S) 695 (STD 090974)

ALL ORDERS & MAIL TO:
W.K.F. Electronics,
Welbeck Street,
Whitwell, Near Worksop,
Notts.



Test Equipment

Multimeters



The Eagle range of multimeters covers every possible need of the electrical or electronic engineer. They cost from about £6 to £58 (inc V.A.T.). There's at least one which suits your job precisely.

We have a lot of other test equipment too. Send the coupon and we'll send you our complete catalogue.



Please send me details of all your test equipment.

NAME

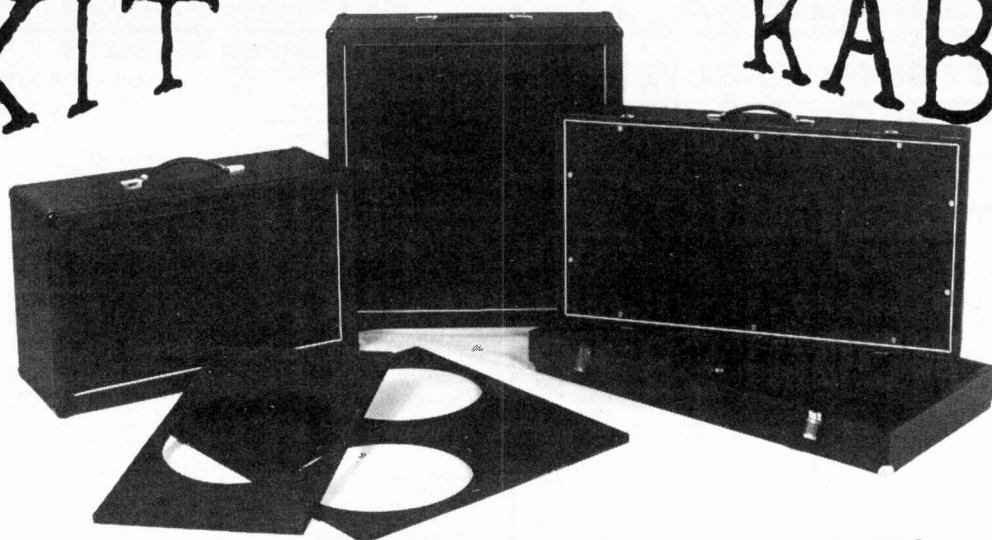
ADDRESS

Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU Tel: (01)-902 8832

Eagle

KIT

KABS



A RANGE OF STURDY, PRE-FABRICATED WOODEN CABINETS

All these cabinets are accurately machined, rebated and radiused, with all baffle holes cut out and fixing holes drilled. All the cabinet covering, fretcloth and fittings are included; along with detailed assembly instructions.

ALL YOU PROVIDE IS GLUE AND MANPOWER!

2 x 12" (or 1 x 15") Cabinet Kit—28" x 17½" x 11⅞"	£15.40	(¾" board)	} All prices inc. V.A.T. and carriage
4 x 12" (or 2 x 15") Cabinet Kit—29" x 28" x 11⅞"	£18.40	(¾" board)	
Disco Console Kit—36" x 19" x 9"	£17.40	(¾" and ½" board)	

Cheque or Postal Order to: KITKABS, P.O. Box 41, Stadium Works, Grainger Road, Southend-on-Sea, Essex

SEMICONDUCTOR DEVICES

by N. M. Morris Price £4.25

ELECTRONICS POCKET BOOK by P. J. McGoldrick. Price £4.25

PRACTICAL TRIAC/SCR PROJECTS FOR THE EXPERIMENTER by R. W. Fox. Price £2.10

SOLID STATE COLOUR T.V. CIRCUITS by G. R. Wilding. Price £6.25

ACTIVE-FILTER COOKBOOK by D. Lancaster. Price £9.60

PRACTICAL SOLID STATE D.C. SUPPLIES by T. D. Towers. Price £6.00

RAPID SERVICING OF TRANSISTOR EQUIPMENT by G. J. King. Price £2.75

COLOUR T.V. WITH PART REF. TO THE PAL SYSTEM by G. N. Patchett. Price £5.40

MAKING AND REPAIRING TRANSISTOR RADIOS by W. Oliver. Price £2.30

AMATEUR RADIO TECHNIQUES by P. Hawker. Price £2.50

M6800 MICROPROCESSOR APPLICATIONS MANUAL by Motorola. Price £8.00

★ PRICES INCLUDE POSTAGE ★

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKISTS
of British and American Technical Books

19-21 PRAED STREET
LONDON W2 1NP

Phone 01-723 4185
Closed Saturday 1 p.m.

P.E. JOANNA Electronic Piano



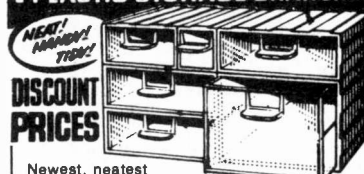
ALL PARTS CAN BE SUPPLIED

Keyboard, Keyswitch, P.C.B.s,
Hardware, Semiconductors,
Resistors, Capacitors, Cabinets
Complete kits or easy stages

Send S.A.E. for details

Clef Products
31 Mountfield Road, Bramhall
Stockport, Cheshire SK7 1LY

INTERLOCKING PLASTIC STORAGE DRAWERS



Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. 1D and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

As supplied to Post Office,
Industry and Government Depts.

SINGLE UNITS (1D) (5in x 2½in x 2½in).
£2.50 DOZEN.

DOUBLE UNITS (2D) (5in x 4½in x 2½in).
£4.40 DOZEN.

TREBLE (3D) £4.20 for 8.

DOUBLE TREBLE 2 drawers, in one outer case (6D2), £6.50 for 8.

EXTRA LARGE SIZE (6D1) £5.50 for 8.

PLUS QUANTITY DISCOUNTS

Orders over £20, less 5%.

Orders over £60, less 7½%.

PACKING/POSTAGE/CARRIAGE: Add 75p to all orders under £10. Orders £10 and over, please add 10% carriage.

QUOTATIONS FOR LARGER QUANTITIES

Please add 8% V.A.T. to total remittance

All prices correct at time of going to press

FLAIRLINE SUPPLIES

(Dept. PE12)

124 Cricklewood Broadway, London NW2
Tel. 01-450 4844

Stirling Sound

QV* MODULES FOR COST-CONSCIOUS CONSTRUCTORS

STIRLING SOUND policy is to ensure customer satisfaction by designing and making their products in their own factory in Essex and selling direct. Production control-checked throughout. All QV Modules are compatible within the range and with much other equipment.

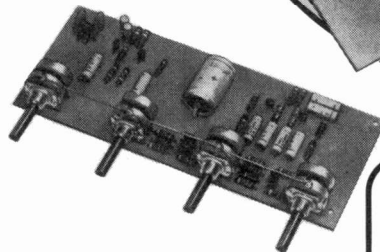
UNIT ONE PRE-AMP/CONTROL

Combined pre-amp with active tone-control circuits. ± 15 dB at 10kHz treble and 30Hz bass. Stereo. Vol./balance/treble/bass. 200mV out for 50mV in. Takes 10-16V £7.80

OTHER PRE-AMP AND CONTROL UNITS

SS100 Active tone control, stereo. ± 15 dB on bass and on treble £1.60

SS101 Pre-amp for ceramic cartridges, radio, tape. Stereo. Passive tone control circuit shown in data supplied £1.60



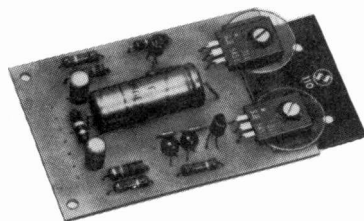
SS102 Stereo pre-amp for low output magnetic P.U.s R.I.A.A. corrected. Linear feedback facility £2.65



SS140

40 watts r.m.s. into 4 ohms using 45V supply such as SS345. Ideal for small speakers and P.A. 101 x 76 x 19mm (4 x 3 x 3/4in)

£3.95†



New style for power amps SS105, SS110 and SS120

POWER AMPLIFIERS FROM 3 TO 100 WATTS R.M.S.

The new **SS1100** Delivers 100 watts r.m.s. into 4 ohms using 70 volt supply. Heavy duty, ruggedly constructed module complete with output capacitor and heat-sink-type mounting bracket. Size approx. 140 x 76 x 32mm. Just the job for disco or P.A. use. £9.45†

Large Heatsink—£1.00†

SS103 3 watt r.m.s. mono I.C. with built-in current, short, and thermal protection £1.75

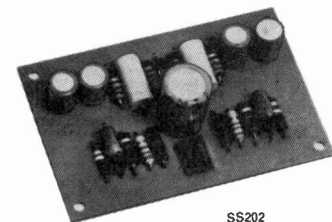
SS103-3 Stereo version of above £3.25

SS105 5 watts r.m.s. into 4 ohms, using 12V (SS312 for example) £2.25

SS110 10 watts r.m.s. using 24V and 4 ohm load. Use SS324 as the power supply. £2.75

SS120 20 watts r.m.s. into 4 ohms, using 34V. Use SS324 for your power supply. £3.00

The above all measure 89 x 50 x 19mm (3 1/2 x 2 1/4in). Suitable power supplies will be found in the accompanying range.



SS202 I.F. amp

FM TUNING MODULES

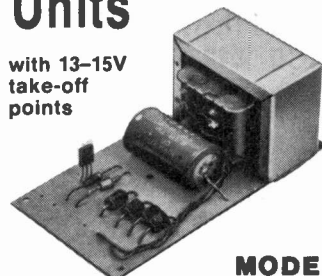
SS201 Front end tuner, slow geared drive, two gang. A.F.C. facility. Tunes 88-108MHz £5.00

SS202 I.F. amplifier. Metering and A.F.C. facilities £2.65

SS203 Stereo Decoder for use with the above or other FM mono tuners. A LED may be fitted £3.85

TODAY'S BEST VALUE IN Power Supply Units

with 13-15V take-off points



7 MODELS TO CHOOSE FROM

All the following are supplied assembled complete with mains transformers and low volt take-off points. Complete with mains transformers (except SS300). All at 8% VAT rate. Add 50p for p/p any model except SS300.

SS312 12V/1A £3.75†

SS318 18V/1A £4.15†

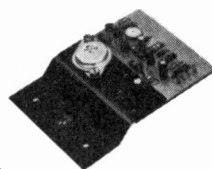
SS324 24V/1A £4.60†

SS334 34V/2A £5.20†

SS345 45V/2A £6.25†

SS350 50V/2A £6.65†

SS300 Power stabilising unit 10-50V adjustable for adding to unbalanced supplies. With built-in protection against shorting (p/p 35p) £3.25



SS310/50 Stabilised power supply with variable output from 10 to 50V/2A. With built-in protection against shorting £11.95†

*THE BUILT-IN QV FACTOR means Stirling Sound's guarantee of QUALITY AND VALUE to give you today's best value all round.

Stirling Sound

A member of the Bi-Pre-Pak group
220-224 WEST ROAD, WESTCLIFFE-ON-SEA, ESSEX SS0 9DF
Telephone Southend (0702) 46344
CALLERS WELCOME

WHEN ORDERING

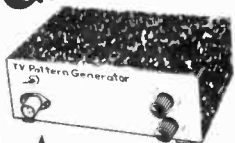
Add 35p for p/p unless stated otherwise. VAT add 12 1/2% to total value of order unless other price is shown † when the rate is 8%. Make cheques, etc., payable to Bi-Pre-Pak Ltd. Every effort is made to ensure correctness of information at time of going to press. Prices subject to alteration without notice.

FABULOUS NEW KITS EASY TO CONSTRUCT

DORAM KITS CONTAIN EVERYTHING DOWN TO THE LAST NUT!



TV PATTERN GENERATOR



£19.77 +S

Completely self contained unit. Output switchable for cross-hatch dots, black level or grey scale. Mains P.S.U. Has integral pulse generator and UHF modulator. Only requires connection to aerial socket and mains.

F.M. TUNER



£64.95 +H

★ 'Varicap' tuning. ★ Ultrasonic filter for pilot tone rejection to 65dB. ★ 'Mix' control. ★ Sensitivity 1.2 μ V for 26dB quieting. ★ 6 pre-set station selection.

TRANSISTOR TESTER



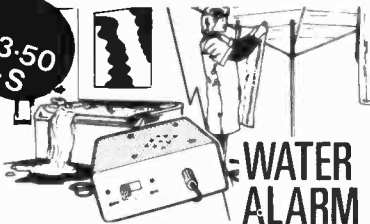
£9.95 +S

Measures hFE leakage for PNP, NPN, Silicon or germanium transistors. Includes battery check facility.

Available NOW!

NO MORE WET CLOTHES ON WASHDAY. NO MORE OVERFLOWING BATHS.

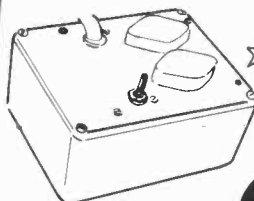
£3.50 +S



WATER ALARM

Ideal for mum on washdays this neat device emits an audible warning at the slightest sign of rain. ★ Very sensitive and easy to use.

ELECTRONIC CAR IGNITION



GIVE YOUR CAR NEW LIFE!

£9.95 +S

Will give your car greater performance and help to reduce fuel consumption. 12V Neg. operation. Includes many mechanical features.



- ★ New 16 page brochure contains complete details of kit range.
- ★ Big range of kits to interest Radio, Electronic and Hi-Fi enthusiasts.
- ★ Kits sent by return-of-post.
- ★ Each kit designed by specialists, only reliable and highest quality components included.

SEND FOR YOUR NEW KIT BROCHURE TODAY

Only **25p** inc. post and packaging.
S = 8%VAT; H = 12½%VAT.

DORAM

PE 12/76 PLEASE PRINT IN BLOCK CAPITALS

DORAM ELECTRONICS LTD
P.O.Box TR8,
Leeds LS12 2UF.

I enclose 25p please send me by return my new Doram Kit brochure. Overseas orders except N. Ireland please add 10p for post and packing, surface only. Customers purchasing the edition 3 Doram catalogue plus the Kit brochure can obtain the pair together for 70p, saving 15p, and receive two 25p vouchers free.

All products are offered for sale subject to the terms of business set out in our current catalogue.

Name _____

Address _____

Post Code _____

An Electrocomponents Group Company.

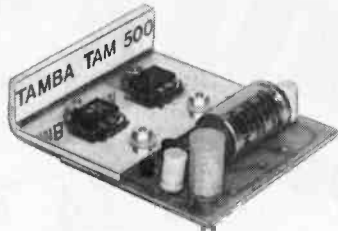
TAMBA ELECTRONICS

QUALITY PRODUCTS
FOR HI-FI, DISCO,
P.A. GROUP AND CLUB USE

A BRAND NEW RANGE OF AMPLIFIER MODULES 5 to 100 WATT/RMS

Choose the power you need from these five pure complementary amplifiers
Two-year guarantee

All amplifiers feature a pure complementary symmetry output stage for low distortion and high reliability—the highest grade components (by Mullard—Texas, Plelsey—RCA etc.) used throughout



TAM50 5W RMS 25V supply	£3.20
TAM100 10W RMS 35V supply	£3.75
TAM250 25W RMS 45V supply	£4.25
TAM500 50W RMS 45V supply	£6.95
TAM1000 100W RMS 65V supply	£9.80
(all modules carriage free)	

- Suits loads 4-16 ohms (optimum load 8 ohms, TAM50/100/250, 4 ohms TAM500/1000)
- Low distortion (0.1%)
- 20-20,000 Hz \pm 1dB
- Silicon circuitry throughout
- Inherently open circuit proof
- Four simple connections

- High sensitivity—100mV
- Low profile (1in high $3\frac{1}{2}$ in \times 3in)
- 75% efficient
- Glass fibre printed circuit board
- Accepts most mixers/pre-amplifiers

POWER SUPPLIES

For 1 or 2 TAM50/100	£4.25 (carr 50p)
For 1 or 2 TAM250/500	£6.95 (carr 50p)
For 1 or 2 TAM1000	£9.80 (carr 50p)

You may order as follows: C.W.O. (crossed cheques, P.O.s, M.O.s etc) C.O.D. (50p extra). We accept Access and Barclaycard—send or telephone your number—do not send your card. Add VAT at 8% to orders for 50-100W units and at 12½% for 5-25W units

Hours, 9.30a.m.—5p.m.
Mon.—Sat. Callers welcome.
Tel: (01) 684 0098

TAMBA ELECTRONICS

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

OVER 2,000 ELECTRONIC COMPONENTS IN A

BIG NEW FREE

100 PAGE CATALOGUE

YOURS BY POSTING TODAY

Please send me the 100 page Tandy catalogue

Name _____

Address _____

40 PAGES IN COLOUR

TANDY

Nationwide supermarket of sound!

Tandy Corporation (Branch UK), Bilston Road, Wednesbury, W. Midlands WS10 7JN

CJL

CJL LTD, P.O. BOX 34, CANTERBURY, CT1 1YT
ALL PRICES INCLUDE P&P AND V.A.T.

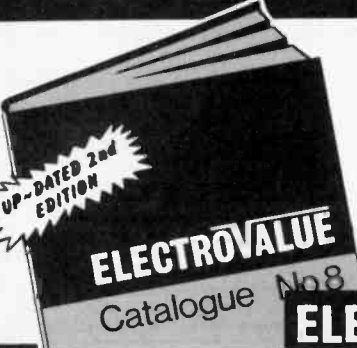
AUDIO MODULES (BI-PAK)

AMPLIFIERS	5W RMS £ 3.15	25W RMS £ 4.25
10W RMS	£3.50	125W RMS £16.00
35W RMS	£7.70	PA12 £ 7.50
PA12	£ 7.50	PA100 £13.30
S450	£18.75	SPM80 £ 3.55
T538	£ 3.20	BMT80 £ 3.50
EARPHONES/HEADPHONES		
Crystal £0.65,	Stethoscope £ 1.35	
2,000 Ω £3.85	Stereo £ 4.15	
INTERCOMS 2 station	£ 6.75	
MICROPHONES Dynamic	£ 2.15	
SPEAKERS 75mm dia. 8 Ω	£ 1.00	
TAPE HEAD DEMAGNETISERS	£ 3.65	
TEST CASSETTES	£ 2.30	
AERIALS Extend 15-120cm	£ 1.50	
FOOT SWITCHES Snap Action	£ 3.50	
KEYNECTORS	£ 3.95	
SIGNAL INJECTORS—AF/RF		
(Self contained)	£ 4.95	

SOLDERING IRONS (ANTEX)

15W "C" Miniature Irons	£ 3.20
15W "CCN" Low Leakage Irons	£ 3.45
18W "G" Miniature Irons	£ 3.25
25W "X25" Low Leakage Irons	£ 2.90
"SKT" Soldering Kits	£ 4.40
"MLX" 12V Kits	£ 4.10
Elements: "C" £1.50	"CCN" £ 1.85
"G" £1.85	"X25" £ 1.60
Bits: 3/32", 1/8", 3/16"	each £ 0.50
(N.B. state type of iron)	
"ST3" Stands—for all models	£ 1.45
SOLDER in handy dispenser	£ 0.45
"ESS" 25W De-Soldering Irons	£ 9.50
"GSS" 18W De-Soldering Irons	£ 9.50
Foot pump	£ 2.25
WIRE STRIPPERS / CUTTERS	£ 0.85
WELLER Dual Heat Solder Gun	
Kits—100/140W (Pistol grip with trigger control. Spotlight)	£10.55

THE OPEN DOOR TO QUALITY



This catalogue—Electrovalue Catalogue No. 8 (Issue 2, up-dated)—offers items from advanced opto-electronic components to humble (but essential) washers. Many things listed are very difficult to obtain elsewhere. The company's own computer is programmed to expedite delivery and maintain customer satisfaction. Attractive discounts are allowed on many purchases; Access and Barclaycard orders are accepted.

* FREE POSTAGE on all C.W.O. mail orders over £2 list value (excluding VAT) in U.K. If under, add 15p handling charge.

144 pages
post paid
40p
inc. refund
voucher
worth 40p

All communications to Head Office, Dept. PE12/2, 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB. Phone Egham 3603. Telex 284475. Hours 9-5.30 daily. 1 pm Sats.

NORTHERN BRANCH: 680 Burnage Lane, Burnage, Manchester M19 1NA. Phone 061-432 4945. Hours 9-5.30 pm. 1 pm Sats.

ELECTROVALUE LTD

The Experimenter

From Continental Specialities.

US Patent Design No 235554.

The Experimenter is not so much a new breadboard, practically a new way of life! Says Ronald J. Portugal (President, Continental Specialities Corporation.)



**No soldering.
No spoil devices.
No fuss.
No fiddling.
No wasted time.**
Now you can put circuits together as quickly as you think them up.
Just plug your devices in, pull them out, plug them in again, as many times as you want.

Two Versions.

Experimenter 600.

The world's first breadboard specially designed for 0.6 pitch devices. It gives you all the fan-out you need for complex MSIs, Micro-processors, Memories, Displays etc., (40 pins or more) with plenty of room for other components alongside.

Experimenter 300.

This one is designed to be ideal for 0.3 pitch DILs, any kind, from 6 pins up. Excellent fan-out. (You can also use it for 0.6 devices, though for these the 600 version is recommended.)

Apart from ICs, both versions take TO-5 transistors, diodes, LEDs, capacitors, resistors; any component with lead size between .015 and .032 inch diameter. And for interconnections you use standard solid hook-up wire.

Unique Construction.

Each version of the Experimenter gives you 94 five-contact terminals, arranged in two rows of 47, plus two integral bus-strips for Ground and Power, with 40 contacts on each.

That's 550 contacts in all! (See diagram).

All terminal strips are recessed into the bottom of the plastic body, and covered with a stick-on vinyl backing, so you have no insulation problems.

The contact rows are numbered 1-5-10 etc. and A-B-C--J lengthways, so each position is clearly defined. The bus-strips are labelled X-Y, each end.

The plastic body is rigid, strong and longlasting, with a recessed screw-hole at each corner, and all four edges have a special quick-locking lip so that you can build rigid arrays of two or more boards.

The Domino Theory.

See how the Experimenter boards fix together, side by side, end to end, or at right-angles, to give unlimited scope for circuit building, planning, extending, rearranging.

You can mix 0.3 and 0.6 DILs in any arrangement you like.

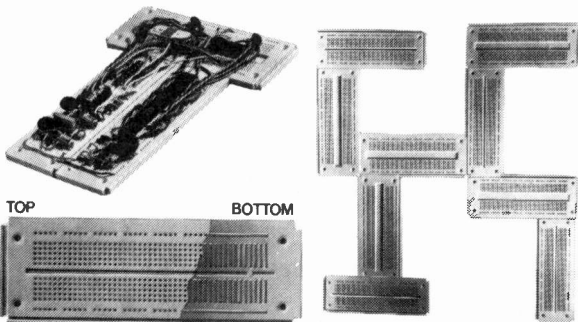
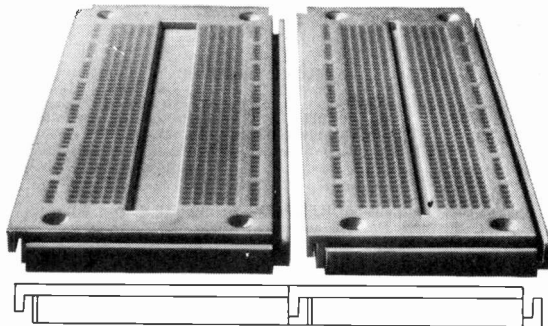
And all your displays can face the way you want them.

And look at these prices!

Experimenter 300, £6.85, Experimenter 600, £7.50. All made to top CSC professional quality, and every one is fully checked before dispatch.

Free Catalogue!

Page after page of fascinating CSC products. Just write and ask.



Easy to Buy.

There's no problem buying from USA.

Just send name, address (block letters please), quantity of each required, and a perfectly normal UK bank cheque, made out in Pounds Sterling, to Continental Specialities Corporation.

Or you can use an International Money Order, from any Post Office. We also accept your American Express Card or Access number.

Then we post by return airmail, and you should receive the goods within 2-3 weeks.

Dealer enquiries invited. Note that any UK taxes or duties chargeable are solely the responsibility of the buyer.



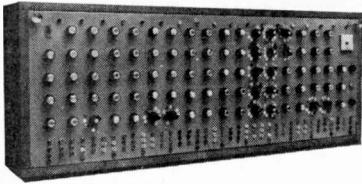
Continental Specialities Corporation, 44 Kendall St., PO Box 1942, New Haven, Conn. 06509 USA. Telephone: 203-624 3103.

Name.....
Address.....
.....
.....
Please send me.....(qty). Experimenter 300 @ £6.85 each,
and.....(qty). Experimenter 600 @ £7.50.
I enclose cheque/imo for £.....(total).
Amex/Access No

SYNTHESISERS, SOUND EFFECTS AND

PHONONICS

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



COMPONENTS SETS include all necessary resistors, capacitors, semi-conductors, 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 Phononics.

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

P.E. SYNTHESIZER

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

The well acclaimed and highly versatile large-scale mains-operated Sound Synthesiser complete with keyboard circuits. All function circuits may be used independently, or interconnected. The greater the number of circuits, the greater the versatility. Other circuits in our lists may be used with the Synthesiser to good advantage (notably P.E. Minisonic, Phasing Unit, Wind and Rain, Rhythm Generator, Sound Bender, Voltage Controlled Filter, Guitar Effects Pedal).

THE MAIN SYNTHESIZER

- Stabilised power supply £12-05
- Two Linear Voltage Controlled Oscillators and one Inverter—all 3 circuits £17-80
- PCB (2 are required) each £1-63
- Two Ramp Generators and Two Input Amplifiers £5-92
- all 4 circuits £1-51
- PCB (holds all 4 circuits) £7-95
- Sample-Hold and Noise Generator £1-87
- PCB (holds both circuits) £2-68
- Tone Control £2-88
- PCB £7-23
- Reverberation Amplifier £4-24
- Sprine Line unit for Reverb. Amp. Ring Modulator £1-50
- Peak Level Meter Circuit £4-99
- 100µA Panel Meter £2-14
- PCB to hold Reverb, Ring Mod and Meter Circuits £6-04
- Envelope Shaper £1-60
- PCB £8-69
- Voltage Controlled Amplifier and Differential Amplifier £1-45
- PCB (holds both circuits)

THE SYNTHESIZER KEYBOARD CIRCUITS

- (Can be used without the Main Synthesiser to make an independent musical instrument)
- Two Logarithmic Voltage Controlled Oscillators £15-28
 - Component set £2-86
 - PCB (holds both circuits)
 - Divider, 2 Hold Circuits, 2 Modulation Amplifiers, Mixer and 2 Envelope Shapers £21-88
 - PCB (holds the first 6 circuits) £1-98
 - PCB for both Envelope Shapers £1-70
 - Keyboard Stabilised Power Supply £7-61
 - Printed Circuit Board £1-04

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 £6-79
 - Alternative component set with panel mounting switches £4-90
 - 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) £7-24
Printed circuit board £1-74
- 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) £2-76

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) £2-85
- 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) £4-25

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 £3-20

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 £10-09
- Tone Generator and Top C Envelope Shaper £10-61
- PCB for Main PSU, Tone Gen & Top C.E.S. £2-31
- Envelope Shapers for all notes (except Top C) £37-68
- Set of PCBs for Envelope Shapers (except Top C) £11-88
- Voicing and Pre-Amp Circuits £10-53
- PCB for Voicing and Pre-amp £2-00
- Power Amplifier (incl. separate Power Supply) £15-86
- PCB for Power Amp and PSU 95p

RHYTHM GENERATOR (P.E. Mar./Apr. 74)

Programmable for 64,000 rhythm patterns from 8 effects circuits (high and low bongos, bass and snare drums, long and short brushes, blocks and soft cymbal), and with variable time signatures and rhythm rates. Really fascinating and useful.

- Tempo, Timing and Logic circuits £12-68
 - PCB for above circuits (double-sided) £3-24
 - Component set for all 8 effects circuits £12-72
 - PCB for all 8 effects £3-74
 - Simple mixer (our design) incl. PCB £3-95
 - Alternative mixer with external volume controls, incl. PCB £10-94
 - Power Supply for T, T and L, and Effects, incl. PCB £7-10
- (See our list for Power Supplies for Mixers)

REVERBERATION UNIT (P.W. Nov./Dec. 72)

A high quality unit having microphone and line input pre-amps, and providing full control over reverberation level.

- Component Set (excl. spring unit) £8-79
- Printed Circuit Board £1-93
- 9 in. Spring Unit £5-50
- Panel Meter (50µA) (optional) £4-99

WIND AND RAIN UNIT

A manually controlled unit for producing the above-named sounds.
Component set incl. PCB £3-37

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 £6-57
Component set using dual rotary pot £3-80
Printed circuit board £1-37

FUZZ UNIT

Simple Fuzz unit based upon P.E. 'Sound Design' circuit.
Component set incl. PCB £1-98

TREMOLO UNIT

Based upon P.E. 'Sound Design' circuit.
Component set incl. PCB £3-19

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

Gives a much shriller quality to audio signals fed through it. The depth of boost is manually adjustable.
Component Set incl. PCB £2-31

25 WATT MONO AMPLIFIER (P.E. Sept. 75)

A good general purpose integrated circuit power amplifier typically delivering 25 watts into 8 ohms. Power bandwidth 20Hz to 20kHz, 3dB, input impedance 20kΩ. Distortion 0.2%. Suitable for use with any of our sound producing kits.
Component Set incl. power supply £15-06
Printed Circuit Board 95p
For stereo use two sets and PCBs are required.

P.E. MINISONIC MK I

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

A portable, battery or mains operated, miniature sound synthesiser, with keyboard circuits. Although having slightly fewer facilities than the large P.E. Synthesiser, the functions offered by this design give it great scope and versatility. Like the large Synthesiser it too may be advantageously used with other circuits in our lists.

- Basic component set £41-58
 - Set of PCBs £7-71
- Full details in our list.

P.E. MINISONIC MK 2

More sophisticated version of the MK I.

- Basic component set from £52-15
 - Set of PCBs £9-10
- Full details in our list.

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 £19-43
Printed circuit board £2-85

ENVELOPE SHAPERS

Both of the kits below have manual control over their Attack, Decay, Sustain and Release functions. Both kits include PCB (VCA means Voltage Controlled Amplifier)
Envelope Shaper and VCA (P.E. Apr. 76) £6-50
Envelope Shaper (without VCA) (P.E. Oct. 75) £4-62

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 £3-74

VOLTAGE CONTROLLED FILTER (P.E. Oct. 74)

An independently designed VCF that can be used with the P.E. Synthesiser.
Component Set £3-67
Printed Circuit Board £1-38

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

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

- Main Component Set incl. PCB £14-77
- Power Supply set incl. PCB £6-95

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

An accented-beat electronic metronome, providing dupe, 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 £10-68
- Printed Circuit Board £1-70

PEAK LEVEL INDICATOR (P.E. Mar. 76)

A twin-channel visual display unit for monitoring the peak level of audio signals. Well suited for use when inter-coupling our many sound producing kits to help avoid signal over-loading.

- Component Set incl. PCB (as published) £3-84

POST AND HANDLING

U.K. orders—under £15 add 25p plus VAT, over £15 add 50p 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 for Europe send 20p, for other countries send 40p.

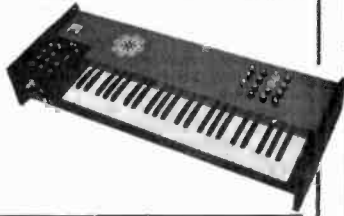
PHONONICS • DEPT. PE4D • 22 HIGH STREET • SIDCUP • KENT DA14 6EH MAIL ORDER AND C.W.O. ONLY SORRY BUT NO CALLERS PLEASE

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) £23.10. 4 Oct (49 notes) £27.45. 5 Oct (61 notes) £32.10. 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.

Contact	Each	3 Octave Set	4 Octave Set	5 Octave Set
SP	22p	£8.14	£10.78	£13.42
2P	25p	£9.25	£12.25	£15.25
4PS	50p	£18.50	£24.50	£30.50

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

SOUND-TO-LIGHT (P.E. Apr./Aug. 71)

The ever-popular **Aurora-4** or 8 channels each responding to a different sound frequency and controlling its own light. Can be used with most audio systems and lamp intensities. A hit LIST for any Disco, and a fascinating visual display for the home.

4 Channel Component Set (excl. thyristors)	£14.42
8 Channel Component Set (excl. thyristors)	£25.75
Power Supply Component Set	£5.35
PCB for 4 frequency channels	£3.65
PCB for power supply and 8 lamp drivers	£1.70
1A 400V thyristors (1 per chan. req.) each	75p
Panel meter (1µA) (optional)	£4.99

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	£11.18
-------------------------	--------

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	£4.11
Basic Output Circuits —combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lamp-driver circuits	£5.95
Audio Amplifier Module Type PC7	£6.75

TAPE NOISE LIMITER

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

Standard Tolerance Set of Components	£2.85
Superior Tolerance Set of Components	£3.30
Regulated Power Supply (will drive 2 sets)	£4.69

SINE AND SQUARE WAVE GENERATOR (P.E. July 75)

Suitable for audio, digital, or general purpose. Controllable through 4 decade ranges 10Hz to 100kHz, switched attenuation through 10 ranges from 10V to 1mV peak-to-peak.

Component Set. While stocks last	£9.83
PCB for above components	£1.76
Power Supply	£6.21
PCB for Power Supply	£1.06

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	£8.86
Panel meter (500µA)	£4.99

P.E. MINIMIX 6 (P.E. Nov./Dec. 75)

Each of the 6 input channels has its own gain, volume and panning controls. The volume of the twin channel outputs are fully manually controllable, as are the head-phone and pre-fade monitoring facilities. Twin VU meters provide visual display of channel audio levels. Ideal for use with effects and synthesiser kits. For details see our list. While stocks last.

8-INPUT MIXER

A simple mixer having 8 inputs each of which has a preset level control and which are combined into one output channel having a preset over-all level control and a master output volume control. Designed for inter-coupling our various sound effects and synthesiser kits.

Component set incl. PCB	£3.95
-------------------------	-------

TRANSISTORS

AC128	20p
AC176	20p
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	28p
BCY71	22p
BD131	44p
BD132	54p
BFY50	22p
BFY51	22p
BFY52	24p
BSY52A	22p
MJE2955	110p
OC28	60p
OC71	17p
OC72	25p
OC84	25p
ORP12	66p
ZTX107	12p
ZTX108	9p
ZTX501	13p
ZTX503	15p
ZTX531	23p
2N706	13p
2N914	22p
2N1304	22p
2N2219	27p
2N2905	35p
2N2905A	36p
2N2907	22p
2N3053	18p
2N3054	66p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N4871	36p
2N5245	51p
2N5777	45p

INTEGRATED CIRTS.

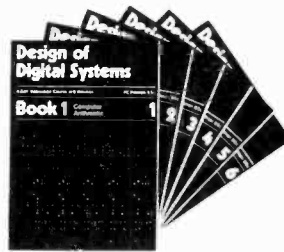
709 T05	40p
709 8-pin DIL	40p
723 T05	95p
741 8-pin DIL	32p
748 T05	63p
748 8-pin DIL	63p
µA7805 T0220	165p
µA7808 T0220	165p
µA7812 T0220	165p
µA7815 T0220	165p
µA7818 T0220	165p
AY-1-0212	62p
AY-1-6721/6	188p
CA3046	71p
MFC4000B	81p
SG3402N	220p

PHONOSONICS

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 11½" x 8½" 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.



£6.20

plus 80p packing and surface post anywhere in the world.

Payments may be made in foreign currencies.

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:

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

£4.20

plus 80p P. & P.

Offer Order both courses for the bargain price £9.70, plus 80p P. & P.

**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.

Guarantee—no risk to you

If you are not entirely satisfied with Design of Digital Systems or Digital Computer Logic and Electronics, you may return them to us and your money will be refunded in full, no questions asked.

To: Cambridge Learning Enterprises (Dept. ENG)
FREEPOST, St. Ives, Huntingdon, Cambs. PE17 4BR

*Please send me . . . set(s) of Design of Digital Systems at £7.00 each, p & p included

*or . . . set(s) of Digital Computer Logic and Electronics at £5.00 each, p & p included

*or . . . combined set(s) at £10.50 each, p & p included

Name

Address

*delete as applicable

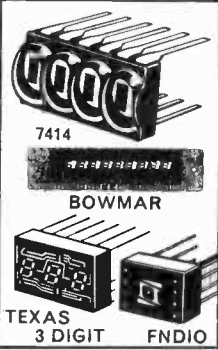
No need to use a stamp—just print FREEPOST on the envelope. PE12

CALCULATOR DISPLAYS

1/2" digit height, bright red LED 7 segment displays for calculators, digital watches, miniature clocks, DVMs, timers etc.

- * Fairchild FND-10, single digit common cathode £1.00 (+vat 8p) 6 for £5.00 (+vat 40p)
- * HP 7414 4 digit, common cathode 12 pin d.i.l. pin out 99p (+vat 8p) 6 for £5.00 (+vat 40p)
- * Bowmar 6 1/2 digit, common cathode with pc connector, and red bezel £1.85 (+vat 15p) 6 for £10 (+vat 80p)
- * Texas 3 digit common cathode 12 pin d.i.l. pin out 85p (+vat 7p) 6 for £4.00 (+vat 32p)
- * Texas 4+5 digit, common cathode 2x14 pin d.i.l. £1.85 pair (+vat 15p)
- * 30 pin termination board for all types except FND-10 20p (+vat 2p)

Texas calculator keyboards. 19 gold plated 'snap' type key contacts on gold plated pcb. 75p (+vat 6p) p & p on all the above 25p.



TAPE HEADS

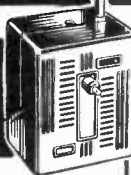
BX12E343 1/2 TRACK ERASE HEAD - £1.25 (+vat 15p)
 BX12RPG6 WITH BX12E343 - £2.95 (+vat 26p)
 STEREO CASSETTE R/RP HEAD (200 ohm) - £2.25 (+vat 28p)
 TWIN STAGGERED MARRIOTT HEADS R/RP1 - £1.50 (+vat 18p)
 MARRIOTT RECORD/REPLAY & ERASE HEAD - £1.75 (+vat 21p)
 MINIFLUX R9N ERASE - £2.25 (+vat 28p)
 GX11 E388 ERASE 675 ohms 2 mA - £0.88 (+vat 11p)
 GX12 E387 ERASE 90 ohms 2 mA - £0.88 (+vat 11p)
 GX20 E362 ERASE 90 ohms 90 mA - £0.88 (+vat 11p)
 R/RP1/3 TAPE HEAD 1/2 TRACK - £0.65 (+vat 8p)

MULLARD TUNER MODULES -

LP1171 combined AM/FM IF strip - £4.29 (+vat 53p) * LP1179 FM front end with AM tuning gang, used with LP1171 - £4.29 (+vat 53p) * LP1171 & 79 pair - £8.00 (+vat £1.00) * LP1157 complete AM strip - £2.05 (+vat 26p) * Ferrite Aerial - 95p (+vat 7p)
 p & p all modules 25p each

HR-RP TAPE HEAD SINGLE TRACK £0.55 (+vat 6p)
 XRPS17 1/2 TRACK - £3.25 (+vat 40p)
 XRPS18 1/2 TRACK RED - £3.25 (+vat 40p)
 XRPS36 1/2 TRACK - £8.75 (+vat 79p)
 XES11 1/2 TRACK ERASE - £1.25 (+vat 15p)
 BX/RP/63 1/2 TRACK - £2.25 (+vat 28p)

HENELEC RADIO CONTROL SYSTEM



* INCLUDING PROPORTIONALLY CONTROLLED SWITCH * FEATURING COSMOS DIGITAL LOGIC to minimise power consumption and extend battery life.

Specially designed to provide aircraft and boat modelmakers with a low-cost, easy-to-use radio control, the Henelec system gives you everything from single channel, up to sophisticated 7-channel Digital Proportional System! Buy the components you want. Ideal for any radio control application. * Simple transmitter - £2.95

(+vat 37p) * Single-ch. add-on for receiver - £11.75 (+vat £1.47p) * PC board for above - 75p (+vat 6p) * Case for transmitter - £1.25 (+vat 16p) * Basic receiver - £8.95 (+vat 87p). Send now for leaflet No. 8 (35p) for full details. Post etc., 50p each.

HENRY'S GREAT NEW CATALOGUE

For this latest edition, we have made hundreds of changes and additions. Containing virtually everything for amateurs and professionals, Henry's Radio Catalogue is also a "must" for manufacturers. Again, we have included a complete alphabetical index, as well as a sectional index, so that you'll have no trouble at all in finding what you need.

IT'S THE BEST EVER!

Henry's Radio 76 ONLY 85p PLUS 14p p&p

★ OVER 5,000 ITEMS
 ★ OVER 200 PAGES
 ★ DISCOUNT VOUCHERS
 ★ QUANTITY DISCOUNTS ON MOST ITEMS

FREE - to educational establishments and manufacturers when ordered on official headed notepaper.

BULK PURCHASE - EXCLUSIVE TO HENRY'S ALLOWS US TO SELL AT SUCH FANTASTIC PRICES!

QUALITY ITEMS
 Compare performance and specification with units costing 3 times as much!

DIGITAL 24 HOUR CLOCK

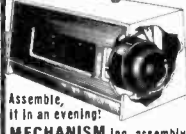
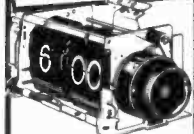


WITH BUILT-IN ALARM

AS USED IN BRAUN DIGITAL CLOCKS

NORMALLY £24 WITH CASE

● SILENT RUNNING ● LARGE ILLUMINATED NUMERALS ● AC MAINS ● SIZE 6 3/8 x 2 3/8 x 2 3/4



MECHANISM ONLY £6.00 +VAT 48p P&P 25p

MECHANISM AND CASE £7.99 +VAT 64p P&P 25p

COMPLETE UNIT £8.99 +VAT 72p P&P 25p

THREE FOR £16.50 +VAT £1.32 POST FREE

THREE FOR £22.00 +VAT £1.76 POST FREE

THREE FOR £25.00 +VAT £2.00 POST FREE

TEXAN AMPLIFIER

featured by PRACTICAL WIRELESS still the best selling amp in the UK.

Build it yourself £29.95 +VAT £3.74 P&P £1 Built £39.95 +VAT £4.93

Build the Texan stereo amplifier, and be doubly proud! You'll own a superb home entertainment unit. And the pleasure of doing it yourself. Look at the Texan specification Fully integrated stereo preamp and power amp, 6 IC's, 10 transistors, 6 rectifiers and zener diodes. Plus stabilised, protected circuitry, glass fibre pcb; Gardeners low-field low-line mains transformer; all facilities and controls. Slim design, chassis 14" x 6" x 2" overall. 20 watts per channel RMS.



The natural follow on!

TEXAN FM TUNER KIT £20.95 +VAT £2.62 Built and tested £25.95 +VAT £3.24

Build the matching Texan stereo tuner! Features advanced varicap tuning. Phase lock loop decoder. Professionally designed circuit. Everything you need is in the kit. From the glass fibre pcb to the cabinet itself. Excellent spec: 2.5 uV aerial sensitivity. 500 mV output (adjustable). Tuning range 87-102 MHz. Mains powered.

NEW HENELEC Mullard AM/FM TUNER MODULE £21.95 +VAT £2.74 p&p £1.00



MAY BE ASSEMBLED IN AN EVENING. FEATURES * Built-in AM Ferrite aerial * LW coverage 150KHz-250KHz * MW coverage 530KHz-1.6MHz * FM coverage 87-104MHz * 75Q aerial for FM * 150mV output * Size 8 1/2(L) x 6 1/2(W) x 2 1/4(H)

This new AM/FM tuner kit incorporates 2 Mullard modules. Supplied as a pre-aligned and tested printed circuit, the constructor only has to build the PCB into the chassis, connect the power, aerial and output loads. Styled to match the Texan amp, mains operated.

Easily adapted for stereo, using the Henelec IC stereo decoder kit, high performance modular design, phase lock loop principle. Low pass filters for optimum performance. Price £8.75 +VAT £1.02 p&p 50p.

We will be pleased to quote for parts for circuits in this magazine. Send your list for quotation in S.A.E. Ask for FREE leaflets and lists on our kits projects.

HENRY'S RADIO All mail to: Henry's Radio 303 Edgware Rd. London W2
 LONDON W2: 404/6 Edgware Road. Tel: 01-402 8381
 LONDON W1: 231 Tottenham Ct Rd. (lower sales floor) Tel: 01-636 6681

20x20 Watt STEREO AMPLIFIER

Superb Viscount IV unit in teak-finished cabinet. Black 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.



HOW YOU CAN SAVE

£29⁹⁰
+ p & p £2.10

SYSTEM 1B

For only £80, you get the 20+20 watt Viscount IV amplifier, a pair of our 12-watt-rms Duo Type IIb matched speakers; a BSR MP 60 type deck complete with magnetic cartridge, de luxe plinth and cover.

£80⁰⁰
+ p & p £6.50

SYSTEM 2

Comprising our 20+20 watt Viscount IV amplifier, a pair of our large Duo Type III matching speakers which handle 20 watts rms each; and a BSR MP 60 type deck with magnetic cartridge, de luxe plinth and cover.

£92⁰⁰
+ p & p £7.60

Carriage surcharge to Scotland: System 1b £2.50, System 2 £5

SPEAKERS Two models— Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/4" approx.

£34 + p & p £6.50
PER PAIR

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

£48 + p & p £7.50
PER PAIR



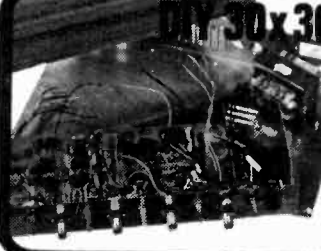
TURNTABLE Popular BSR MP 60 type, complete with magnetic cartridge, diamond stylus, and de luxe plinth and cover.

£24⁰⁰
+ p & p £3.50

VALUE



30x30 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. Black fascia and easy-to-handle aluminium knobs. Output 30+30 watts rms, 60+60 peak.

£29⁰⁰
+ p & p £2.10

STEREO CASSETTE DECK KIT

Again, this kit is specially designed for the experienced constructor — for mounting into his own cabinet. Features include solenoid-assisted AUTO-STOP, 3-digit counter, record/replay PC board, mains transformer and input and output controls. AC BIAS AND ERASE.

£32⁵⁰
+ p & p £1.50

DELUXE ACCESSORY KIT

Comprises of a matched pair of dynamic mics, and two replacement slider level controls.

£3.95 + p & p £1

P. & P. FREE WHEN PURCHASED TOGETHER WITH ITEM BELOW.



DIY STEREO SYSTEM

COMPLETE WITH SPEAKERS

Here's real value in DIY! Comprises ready-built amplifier module, 3-speed Garrard auto-return deck, and teak-veneered simulate cabinets with clear plastic top. Easily built by hobbyists.

£26⁹⁵
+ p & p £4.05



NEW SINCLAIR I.C. 20,20 WATTS STEREO AMPLIFIER KIT WITH PZ 20 POWER UNIT

FANTASTIC SAVING. A build-it-yourself stereo power amplifier with latest integrated circuitry, 10W RMS per channel output, full short-circuit and overheat protection.

LIST £14.50 OUR PRICE **£4.95** p+p £1.

TOURIST IV PUSH BUTTON CAR RADIO KIT

(Motor Top 10 Award)

Complete with speaker, baffle and fixing strips. 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 spun 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". Power Supply: Nominal 12 volts positive or negative earth (altered internally). Power Output: 4 watts into 4 ohms.

£10.50 + p & p £1.50



35-WATT DISCO AMP

Here's the mono unit you need to start off with. Gives you a good solid 35 watts rms, 70 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.

£27⁵⁰ + p & p £1.50

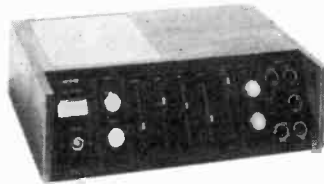
70 and 100 WATT DISCO AMPLIFIERS

Brilliantly styled for easy disco performance! Slipping fascia, so that you can use the controls without fuss or bother. Brushed aluminium fascia and rotary controls. Five smooth acting, vertically mounted style controls — master volume, tape level, mic level, track 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 it in. VU meter monitors output level. 70 watts rms, 140 watts peak output. All the big features as on the 70-watt disco amplifier, but with a massive 100 watts rms, 200 watts peak output power.

£49⁰⁰
+ p & p £3.00

£65⁰⁰
p & p £4.00



PORTABLE DISCO CONSOLE 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. Simply connects into your existing slave or external amplifier.

£55⁰⁰
+ p & p £6.50



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 3 1/2" (approx.) 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. Cabinet size 20" x 11" x 9 1/2" (approx.).

£25⁵⁰ + p & p £5.50
PER PAIR

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 above enclosures. Size 13" x 8" (approx.) EMI woofer, 3 1/2" (approx.) tweeter, and matching crossover. Power handling capacity 15 watts rms, 30 watts peak.

£7⁵⁰ + p & p PER SET

DECCA 20 WATTS STEREO SPEAKER

This matching loudspeaker system is hand-made, as only Decca know how, built to a specification, not down to a price. The kit comprises of two 8" diameter approx. base drive unit, with heavy die cast chassis laminated comes with rolled P.V.C. surrounds Two 3 1/2" diameter approx. domed tweeters complete with crossover networks.

Our price per stereo pair **£30.00** + £4.00 P & P

DIY SPEAKER KITS

'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 milled and professionally finished. Each cabinet measures 12" x 9" x 5" (approx.) deep, and is finished in simulated teak. Complete with two 8" (approx.) speakers for max. power handling of 7 watts.

£7⁵⁰
p & p £1.70 per pair

ELECTROLYTIC CAPACITORS AT BARGAIN PRICES

all brand new from reputable international manufacturers. PACK 1—Containing 30 mixed Electrolytics, values from 4.7mF to 47mF. Minimum 16 volt working. 55p + 20p p & p. PACK 2—Containing 17 mixed Electrolytic values from 100mF to 2200mF. Minimum 16 volt working. Majority 40 volt working. 75p + 20p p & p.

ALL PRICES INC. VAT AT CURRENT RATES

All items subject to availability. Prices correct at 1st October 1976 and subject to change without notice.

We are unable to show all our products, so please send S.A.E. for our fully descriptive catalogue and any further information.



212 HIGH STREET, ACTON, LONDON W3 8NG
323 EDGWARE ROAD, LONDON W2

Personal Shoppers EDGWARE ROAD. 9 a.m.—5.30 p.m.
Half day Thurs.
ACTON: 9.30a.m.—5p.m. Closed all day Wed.



Minimum order on Access and Barclaycards £15

DO NOT SEND CARD Just write your order giving your credit card number

SEMICONDUCTORS

TRANSISTORS

BRAND NEW FULLY GUARANTEED

Table with multiple columns listing transistor types (e.g., AC17K, AC126, BC169), prices, and descriptions. Includes a 'VAT CHAT' section with instructions: 'Please add 8% to prices marked *'.

THE FINEST VALUE IN UNTESTED SEMICONDUCTORS

Table listing semiconductor parts (e.g., U50, U51, U52), descriptions, and prices. Includes a note: 'Code numbers mentioned above are given as a guide to the type of device in the pak...'.

SIL.G.P. DIODES

300mW 40 PIV (min) SUB-MIN FULLY TESTED

Ideal for Organ builders 30 for *50p, 100 for *£1.50, 500 for *£5, 1,000 for *£9.

Table for TRIACS listing cases (Case TO5, TO6, TO48) and prices.

GP300

115 WATT SILICON TO3 METAL CASE Vceo 100V. Vceo 60V. IC 15A. Hfe. 20-100 suitable replacement for 2N3055, BDY11 or BDY20.

GP Switching Trans

TO18 SIM TO 2N706, 8 BSY27/28/55A All usable devices. No open and shorts. ALSO AVAILABLE IN PNP similar to 2N2906, BCY70. 20 for *50p, 50 for *£1, 100 for *£1.80, 500 for *£8, 1,000 for *£14.

WORLD SCOOP!!

JUMBO SEMICONDUCTOR PAK Transistors: Germ. and Silicon Rectifiers-Diodes, Triacs-Thyristors-I.C.s and Zeners. ALL NEW AND CODED Approx. 100 pieces only *£1.85p

ZENER DIODES

FULL RANGE IN STOCK. 2-33 Volts 400mW *8p 1.5W *17p 10W *30p

HANDBOOKS

- TRANSISTOR DATA BOOK DTE 1 151 Pages packed with information on European Transistors. Full specification including outlines. Price f£2.95 each
- TRANSISTOR EQUIVALENT BOOK BPE 75 256 Pages of cross references and equivalents for European, American and Japanese Transistors. This is the most comprehensive equivalents book on the market today and has an introduction in 13 languages. Price f£2.58 each
- DIODE EQUIVALENT BOOK DE 74 144 Pages of cross references and equivalents for European, American and Japanese diodes, Zeners, Thyristors, Triacs, Diacs and L.E.D.s. Price f£1.98 each

THE WORLD'S BROADCASTING STATIONS

WBS 75 An up to the minute guide for those interested in DX-ing. Contains all the world's broadcasters on SW, MW and LW, as well as European FM/TV stations. Price £3.58 each

TTL DATA BOOK

DIC 75 Now complete Data book of 74 series TTL (7400-74132) Covering 13 main manufacturers in the U.S.A. and Europe. This book gives full data as well as equivalents. Price f£3.74 each

A full range of technical books available on request.

Image of a P&P logo with text: 'Postage and Packing add 25p unless otherwise shown. Add extra for airmail. £1 minimum order.'

THYRISTORS

Table listing thyristor specifications (PIV, TO18, TO92, TO5, TO66, TO64, TO48, TO48, TO48, TO48) and prices.

SILICON RECTIFIERS

Table listing silicon rectifier specifications (300mA, 750mA, 1 Amp, 1.5 Amp, 3 Amp, 10 Amp, 30 Amp) and prices.

BI-PAK

P.O. BOX 6, WARE · HERTS

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. A mono kit of a stereo kit. The mono kit uses 13 semiconductors. The stereo kit uses 22 semiconductors with 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 100M.V. high imp. Size 9 1/2in x 3in x 2in.

Mono kit **£11.25** Stereo kit **£18.45p**

Easy to build. Full instructions supplied.



ELAC 10 inch

Dual cone plasticised roll surround. Large ceramic magnet. 30-16,000 c/s. Bass resonance 55 c/s. 8 ohm impedance. 9 x 5in. model **£3.25**. **£4.95**

MAINS TRANSFORMERS

ALL POST 50p each.

250-0-250V 70mA, 6-3, 2A **£2-95**
 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 **£6-50**
 300-0-300 120mA, 6-3V 4A C.T., 6-3V 2A **£7-00**
 220V 45mA, 6-3V 2A **£1-75p**
 HEATER TRANS. 6-3V 3A, **£1-45** 1 amp. 95p
 GENERAL PURPOSE LOW VOLTAGE.
 Tapped outputs at 2A 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V **£4-60**
 1A 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£4-00**
 2A, 6, 8, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£7-00**
 3A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£8-70**
 5A, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 **£11-25**
 5, 8, 10, 16V 1A **£2**. 6-0-6V 500mA **£1**. 9V 1A **£1**. 12V 300mA **£1**. 12V 500mA **£1**. 12V 750mA **£1**. 40V 2A **£2-50**. 30V 5A **£2-50**. 20V 3A **£2**. 40V 3A **£2-50**. 30V 5A **£2-50**. 20V 3A **£2**. 20-0-20V 1A **£2**. 30V 1A **£1-75**. 20V 1A **£1-80**. 60V, 40V, 20V or 20-0-20V, 1A **£3-50**.
 AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W **£5**; 250W **£8**; 400W **£7**; 600W **£8**.
 CHARGER TRANSFORMERS. Input 200/250V for 6 or 12V 1A **£2-75**; 4A **£4-60**.
 FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs 1A 40p; 2A 55p; 4A 85p.

R.C.S. STABILISED POWER PACK KIT

All parts including printed circuit and instructions to build this unit. Voltages available: 6V, 7.5V, 9V, 12V. Up to 100mA output. **£2.95** Post 45p. Please state voltage required.

R.C.S. STEREO FM TUNER



This completely cased mains powered Hi-Fi Tuner with brushed aluminium face is British made using the latest circuitry. Bargain. Post 45p Stereo Tuner/Amplifier Chassis. Brand new **£38-50**.

BARGAIN 3W AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£3-95**

WAFER HEATING ELEMENTS THIN

Size 10 1/2 x 8 1/2 x 1/4 in. 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. 1 1/2 x 8in SPEAKER SALE!

With tweeter. And crossover. 10W. State 3 or 8 ohm. As illustrated. Post 45p

15W model **£7-95** Post 50p
 8 or 15 ohms.

20W model **£8-95** Post 50p
 8 or 15 ohms.



BAKER MAJOR 12 £10-35

Post 50p



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 23W. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£13**

Please state 3 or 8 or 15 ohms. Post 80p

"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" **£8-95**
 12in 30W
 3, 8 or 15 ohms. Post 50p

GROUP "35" **£10-50**
 12in 40W
 3, 8 or 15 ohms. Post 50p

GROUP 50/12in **£14-50**
 60W 8 or 15 ohms with aluminium presence dome. Post 90p

GROUP "50" **£19-50**
 15in 75W
 8 or 15 ohms. Post 90p

Discos, Group + PA Cabinets in stock. Send for Leaflet. Cabinet Fittings, Handles, Corners, Feet, Covering Material all in stock.

BAKER 150 WATT ALL PURPOSE TRANSISTOR MIXER AMPLIFIER

Ideal for Groups, Disco, P.A. and Musical Instruments. 4 inputs speech and music. 4 way mixing. Output 4/8/15 ohm a.c. Mains Separate treble and bass controls. **£68** Carr. **£1-50** 50 watt model **£49**.

NEW 'DISCO 100 WATT' £52

ALL TRANSISTOR AMPLIFIER CHASSIS Carr. **£1**
 2 inputs. 4 outputs separate volume treble and bass controls. Ideal disco or slave amplifier chassis. BLACK CARRYING CABINET AVAILABLE **£9**.

PW SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three 1,000W channels. As featured in Practical Wireless. **£12-50** CABINET extra **£3**.

GOODMANS CONE TWEETER

18,000 c/s. 25W 8 ohm. Price **£3-25**
 8in Woofer **£8-75**.

R.C.S. 100 WATT VALVE AMPLIFIER CHASSIS



Professional model. Four inputs. Treble, Bass, Master Volume Controls. Ideal disco, P.A. or groups. **£85**
 S.A.E. for details. 5 speaker outputs. plus **£2-50** carr.
 3 or 8 or 15 ohm. 100V line to order. Suitable carrying case **£16-50**.

E.M.I. GRAM MOTOR **£1-25**
 120V or 240V a.c. 2,400 r.p.m. 2-pole 70mA. Size 2 1/2 x 2 1/2 in. Post 30p

E.M.I. TAPE MOTOR **£2-00**
 4 pole, 240V a.c. 185 mA 1,400 r.p.m. Spindle 3/4 in dia. 75V version 21. (Illustrated). Post 30p

COLLARO GRAM MOTOR 120V **75p**
 GEAR BOX 25:1 95p.

PHILIPS GRAM MOTOR 6 VOLT A.C. **£2-50**

NEW 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 1 1/2 x 1 1/2 in. Above motor board 3 1/2 in. Below motor board 2 1/2 in. With STEREO/MONO CARTRIDGE. **£11-95**



All Post 75p
 GARRARD AUTOCHANGER Model 6300 **£14-95**
 GARRARD MINICHANGER 12 x 8in **£8-95**

PORTABLE PLAYER CABINET £5-50

Post 50p
 Modern design. Size 16in x 15in x 7in. Covered. Large front grille. Hinged lid. Chrome fittings. Motor board cut for Garrard or BSR deck.



R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop, stereo/compat. cartridge. Baseplate. Size 1 1/2in x 8 1/2in. Turntable. Size 7in diameter. A.c. mains. 230/250V. 3 speeds plays all size records. **£6-95** Post 45p
 Two for **£13**. Post 75p.

HEAVY METAL PLINTHS

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Silver grey finish. Model "A". Size 12 1/2 x 14 1/2 x 7 1/2 in. Model "B". Size 16 x 13 1/2 x 7 1/2 in. **£5-95** Post 75p.
 Extra Large Plinth and Cover. Size 20 x 17 1/2 x 9 1/2 in. Callers only **£18-50**.

TINTED PLASTIC COVERS ONLY
 Sizes: 'A'—14 1/2in x 12 1/2in x 4 1/2in, **£2-50**. 'B'—20 1/2in x 12 1/2in x 4 1/2in, **£3**. 'C'—17 1/2in x 13 1/2in x 3 1/2in, **£2-25**. 'D'—16 1/2in x 14 1/2in x 4in, **£3-50**.
 Ideal for record decks, tape decks, etc. Post 75p.

BAKER HI-FI SPEAKERS HIGH QUALITY—BRITISH MADE SUPERB

12in 25 watts

A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in 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 15 ohms models. **£16-30** Post 80p.

AUDITORIUM 12in 35 watts

A full range reproducer for high power. Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Disco-theques. Bass Resonance 35 c/s Flux Density 15,000 gauss Useful response 25-16,000 c/s 8 or 15 ohms models. **£15-50** Post 80p.
 15in model 45 watts **£19-50**. Post 90p.

BLANK ALUMINIUM CHASSIS, 18 s.w.g. 9 1/2in sides, 6in x 4in, 70p; 8in x 6in, 90p; 10in x 7in, **£1-15**; 14in x 9in, **£1-60**; 16in x 6in, **£1-45**; 12in x 3in, **87p**; 16in x 10in, **£1-70**. 12in x 8in, **£1-35**.
 ALUMINIUM PANELS, 18 s.w.g. 6in x 4in, 15p; 8in x 6in, 25p; 10in x 7in, 30p; 12in x 5in, 30p; 12in x 8in, 40p; 16in x 6in, 45p; 14in x 9in, 50p; 12in x 12in, 55p; 16in x 10in, 75p.
 ALUMINIUM ANGLE BRACKET, 6in x 4in x 1in, 15p.
 ALUMINIUM BOXES MANY SIZES IN STOCK.

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON
 Open 9-6 Wed. 9-1 Sat. 9-5 (Closed for lunch 1.15-2.30)
 Minimum post 30p. Access and Barclaycard Welcome. Radio Books and Components Lists 10p. Rail Selhurst. Tel. 01-684 1665

A DISINGENUOUS FEW

ONE of the most interesting duties performed by the P.E. editorial staff is the examination of circuit ideas offered for publication by readers. It is an important and illuminating task. The ideas offered provide an insight into the multifarious activities of electronics enthusiasts and show how they have solved a problem or achieved some desired effect through their own ingenuity.

This brings us quite naturally to the question of originality. The purpose of Ingenuity Unlimited is to present circuits that are original, if not in whole, at least in significant part. Thus, certain modifications to existing designs can come within this definition. Electronics being what it is, the chances of anyone producing a circuit which in all respects is entirely original are rather remote. The important and essential point is that the individual submitting a design genuinely believes it to be original.

It is our task and responsibility to make judgement upon this point, and many submissions have to be rejected because the idea is already common knowledge. Yet we are not and cannot be infallible in this regard. It is impossible to have complete awareness of all published circuits, at home or elsewhere in the world. Thus it is always possible that an idea published in this magazine may exactly or closely resemble a circuit already published elsewhere. This is unfortunate. It certainly defeats the object of Ingenuity Unlimited, but if the contributor himself was unaware of the pre-existence of the design when submitting his own version, the spirit of Ingenuity Unlimited at least has not been consciously violated.

There is, sad to report, another possibility we must face up to. Evidence has been presented to us on a few occasions over the past years suggesting deliberate attempts to defraud. Certainly we have unwittingly published two circuits, at anyrate, that subsequently proved to be the direct copies of circuits previously published in other magazines. In both instances the evidence was irrefutable. Fortunately the deceptions were detected in time to withhold the customary payments.

One can only marvel at the kind of person who can derive any satisfaction from seeing his or her name appended as originator to a design which has been copied coolly and deliberately from someone else's published work.

Vigilant as we are, there is no guarantee that further abuse of our pages will not occur. But we know such dishonest persons are a tiny minority in the vast electronics fraternity. Ingenuity Unlimited is a continuing record of the undisputed creative abilities of genuine enthusiasts. Financial gain for them is but secondary to the reward of seeing something of their own creation in print. They are entitled to feel a little proud at this credit to their name, and at the realisation that perhaps hundreds or even thousands of their fellow enthusiasts will make some use of their brain child.

We will never knowingly permit these fine traditions to be besmirched by a few pirates and impostors whose actions are completely alien to the spirit of Ingenuity Unlimited.

F.E.B.

Editor
F. E. BENNETT

Editorial
G. C. ARNOLD *Assistant Editor*
D. BARRINGTON *Production Editor*
G. GOBOLD *Technical Editor*

Art Dept.
J. D. POUNTNEY *Art Editor*
D. J. GOODING
R. J. GOODMAN
K. A. WOODRUFF

Advertisement Manager
D. W. B. TILLEARD
Phone: 01-634 4504

P. J. MEW
Phone: 01-634 4181

C. R. BROWN *Classified*
Phone: 01-261 5762

Make-up and Copy Dept.
Phone: 01-634 4372

Editorial & Advertising Offices:
Fleetway House, Farrington St.
London EC4A 4AD
Phone: *Editorial* 01-634 4452
Advertisements 01-634 4504

WITH house electric wiring now invariably buried beneath the surface of the plaster on the walls, many forms of d.i.y. activity such as putting up shelves can become potentially dangerous. Even where installation plans are available, these seldom give any reliable indication of the positions of wiring runs. Since the required detection range is a couple of inches at maximum, a sensitive, sophisticated unit is not required, just something small, cheap, simple and handy.

The first design tried was a simple super-regenerative receiver with a pick-up coil a couple of inches square. It worked, but the indications were not sufficiently definite, as a change of two or three decibels in output level is the minimum that can be detected by most people. However, almost anyone (except the tone-deaf) can easily distinguish a change of pitch of a semitone in a clean note. So the solution to the difficulty was a heterodyne oscillator.

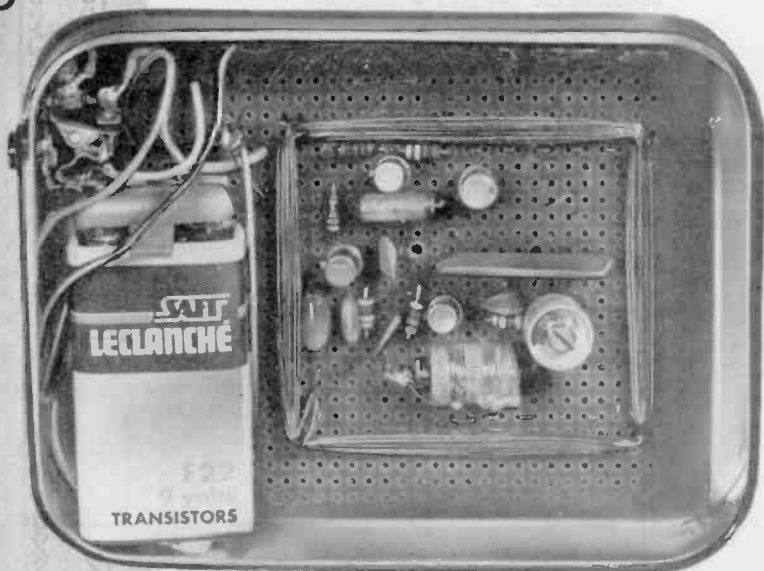
CIRCUIT

Basically the instrument (Fig. 1) consists of a reference oscillator (TR3, etc.), the magnetic field of which cannot couple with external metal, and a second oscillator (TR1, etc.) energising the search coil. The latter oscillator, which also acts as a detector, has an unusually low L/C ratio, so that only the magnetic field of the search coil is affected by the approach of metal: other materials therefore have very little effect. The frequencies used are low, about 110kHz, and are adjusted to give a beat note somewhere between 500 and 1,500Hz. Because of the low frequencies used, penetration through non-metallic materials is excellent.

The tone amplifier circuit based on TR2 is the simplest configuration possible. It was added simply to avoid the necessity for very sensitive headphones or earpiece, though sensitivity is not of great importance, since it is pitch, not level, that is the indication. The level varies only slightly and incidentally.

METAL PIPE OR WIRING LOCATOR

By C.C. WHITEHEAD



COMPONENTS

There is nothing critical about the components, operating frequencies or layout. Any transistors with characteristics approximating to the BC108 are suitable. The reference oscillator, whose coil is mounted so as to have minimum coupling with external objects, should preferably be higher in frequency than the search oscillator. The whole of the audible heterodyne range is then available when the frequency of the search oscillator is increased by the proximity of metal, causing the pitch of the beat note to fall, passing through zero to rise again when the instrument is very close to a large mass of metal. It is wise to avoid frequencies within 10kHz of 100 or 150kHz on account of the existence on these frequencies of powerful transmitters and their harmonics, though the instrument is adequately shielded and a very poor receiver in this respect.

The prototype instrument was built in a standard two-ounce tobacco tin, which is a convenient shape and size and will also house the required PP3 nine-volt battery. The bottom of the box is cut out and replaced by a piece of perforated board on which the components, including the search coil, are mounted. All components except the battery are within the area of the search coil, the wiring being done on the underneath of the board and covered with a layer of felt or velvet to avoid scratching any surface over which it is moved in close contact.

CONSTRUCTION

Cut out the bottom of the box, leaving a surround of about 6mm ($\frac{1}{4}$ in). Trim the perforated board as necessary to fit the box. When the board has been wired and tested, it will be fixed to the bottom of the box by means of a liberal application of Araldite.

All the wiring and coil-winding can be conveniently carried out with 36 s.w.g. enamelled wire, being careful to see that the insulation is not damaged where wires cross. Self-fluxing enamelled wire makes the job easier.

COMPONENTS . . .

Resistors

- R1 3.3k Ω
- R2 2.2k Ω
- R3 5.6k Ω
- R4 470k Ω
- R5 220k Ω
- R6 470k Ω
- All $\frac{1}{8}$ or $\frac{1}{4}$ W, 10%

Capacitors

- C1 5,000pF min ceramic
- C2 10 μ F 10V electrolytic
- C3 10 μ F 10V electrolytic
- C4 390pF silvered mica
- C5 5.5-65pF min preset, RS Components 125-660
- C6 1,500pF min ceramic
- C7 0.05 μ F min ceramic
- C8 5,000pF min ceramic
- C9 1,500pF min ceramic

Inductors

- L1 Search coil—see text
- L2 Wound onto L3
- L3 2mH r.f. choke, pie-wound

Transistors

- TR1-TR3 BC108 or any similar npn silicon

Miscellaneous

- S1 Min slide switch SPST. JK1 Min phone jack. Perforated board, 0.1in pitch, 108 \times 76mm approximately to suit case used (see text). 36 s.w.g. enamelled copper wire for coils and board wiring. Earphone, about 1k Ω impedance.

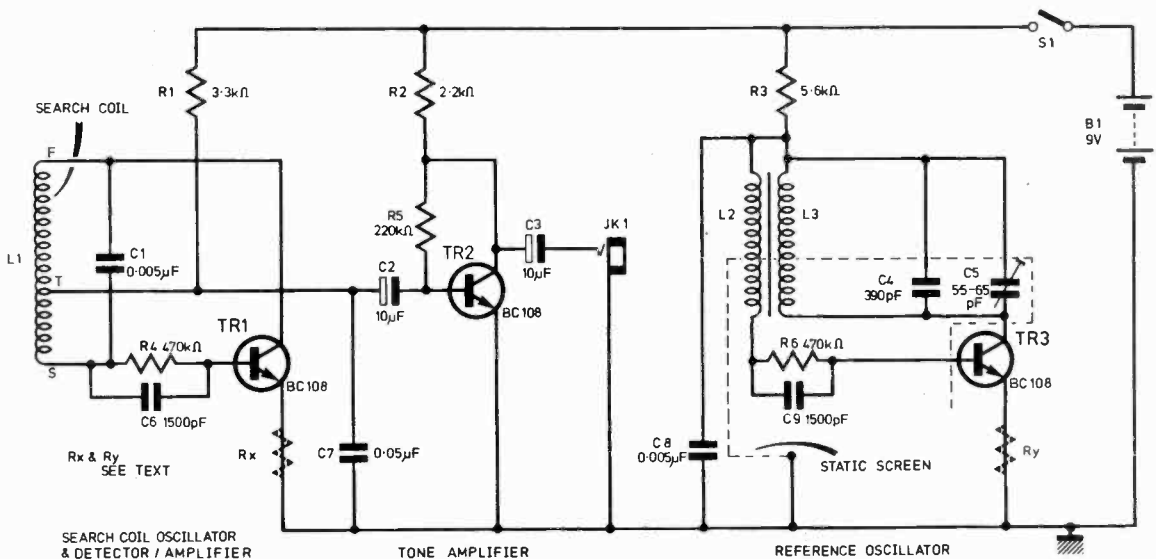


Fig. 1. Circuit diagram of the metal pipe and wiring locator

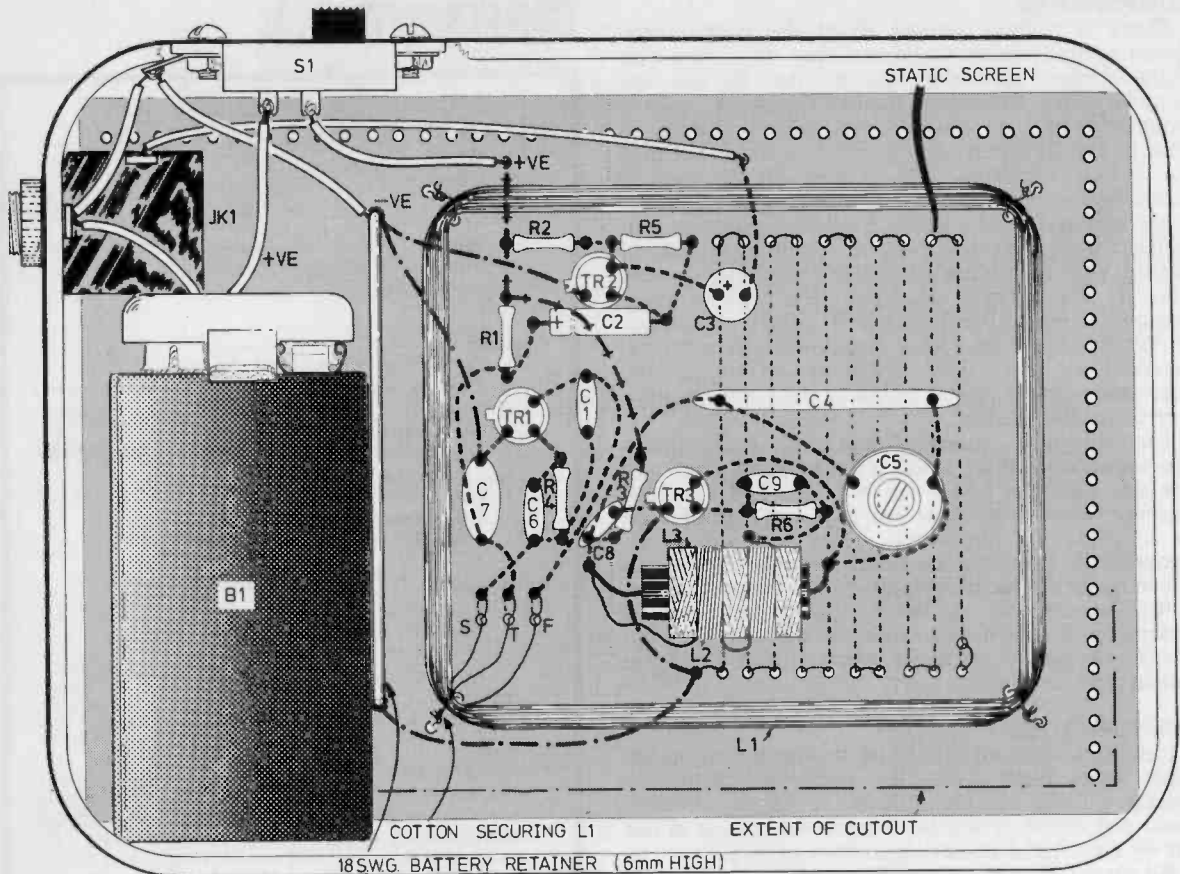


Fig. 2. Component layout and wiring details. All wiring shown in broken line is done on the underside of the board. The static screen is insulated from that wiring by a layer of Sellotape, etc. (see text)

The coils required are both "specials", the search coil being mounted directly on the circuit board, as already mentioned, and the reference oscillator coil being a modified r.f. choke. In the prototype, a Cambion 2mH choke was used, but any pie-wound component of about the same value should be satisfactory. Connect one end of the feedback winding L2 to the starting end of the choke and wind on a total of 78 turns in the spaces between the pies, divided more or less equally between them. Secure the end with a spot of adhesive. This added winding **must** be in the opposite sense to the choke winding. It is generally not

difficult to find the starting and finishing ends of the choke winding or the sense in which it is wound.

To locate the corners of the search coil, four pieces of 18 s.w.g. tinned copper wire about 10mm ($\frac{3}{8}$ in) long should be fitted to the board in the appropriate positions (see Fig. 2). Wind on 12 turns of wire, bring out the tap, then wind on another 48 turns, securing the ends as shown in the drawing. Dope the coil liberally with coil varnish and leave it to set. It should then be fairly securely attached to the board, but to make certain tie each corner to the board with a couple of turns of stout thread. The wire pins at the corners can then be carefully bent inwards and removed, to avoid any possibility of short-circuited turns.

LICENCE

We would like to warn constructors that a Home Office Pipe Finder licence is required for this device, which has been tested and approved for licensing in the United Kingdom. Licence application forms may be obtained on request to Radio Regulatory Department, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

(A licence for 5 years costs £1.20)

TESTING

If you have the means available, check the frequencies of the two oscillators. In any case, find out if it is possible, *with the lid on the box*, to cause them to beat over the whole of the audio frequency range by adjustment of C5. If not, the remedy is to change the value of C4 by a few picofarads. It is important that neither of the oscillators should show any tendency to "squeg". If such is the case, either choose transistors with lower gain or insert suitable resistors (R_x and/or R_y) in the emitter leads. In the prototype, these resistors were not necessary, and should not normally be required.

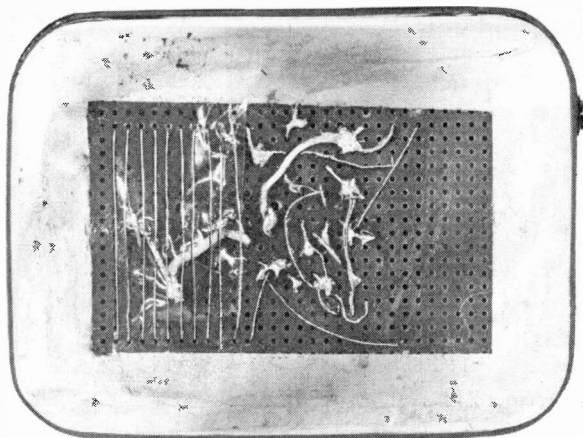


Fig. 3. Underside view of the prototype unit, showing the static screen laid across the board wiring and insulated from it

Once satisfactory results are achieved, the static screen can be added. A layer of insulation, such as p.v.c. tape or Sellotape, should be stuck over the board wiring over the area to be occupied by the screen (see Fig. 2), and a length of 36 s.w.g. enamelled copper wire "stitched" across it as shown, one end being soldered to the nearest convenient earthed point in the wiring. This screen cannot completely eliminate the capacitance effect of objects in contact with the working face, but it does reduce it. This effect is due to the rather high L/C ratio of the reference oscillator circuit. Finally attach the outer covering of felt or velvet, using Cow Gum, etc.

By means of C5, adjust the beat note to a tone somewhere between 500 and 1,000Hz. According to your hearing and the headphones or earpiece used, you may find a certain pitch that is easy to listen to and gives an apparently optimum sensitivity.

To test for sensitivity, the approach of a 10p coin within 50mm (2in) of the working face should result in a change in pitch of at least a semitone. Before trying to locate concealed wiring, leave the instrument on for a few minutes to let the beat note settle down to a reasonably steady value. Concealed metal will be located with certainty up to at least 50mm below the surface, and house wiring or pipes are not usually run at a deeper level. A run of several leads or conduits together can be detected at even greater depths. Latexal location of the wiring depends upon many things, but generally it is possible to fix a run fairly exactly by "straddling" it, judging where the pitch changes equally on either side of the run.

INTERFERENCE

The power of the oscillators, and the frequencies used are such that the instrument cannot possibly interfere with any normal radio equipment, or even be detected by anything other than a very sensitive receiver close by. Very powerful external signals may occasionally be heard faintly, but are unlikely to be mistaken for the normal indications of the instrument. The same applies to its use near unsuppressed electrical equipment.

The instrument's range is deliberately and necessarily limited, and though it will readily find a 50p piece lost beneath a carpet, it will be of no use in searching for Roman coins or World War II relics. ★

NEXT MONTH...

WIN A

MICROPROCESSOR KIT

FREE ENTRY COMPETITION

Full details and entry coupon in
NEXT MONTH'S ISSUE

MOTORING

Car Exhaust Monitor

Petrol prices up yet again? Keeping an eye on your driving technique with this unit can cut motoring costs.

RADIO CONTROL

4-Channel Coder/Decoder

A simple, low cost, four-channel tone coded system based on an NE555 coder and TTL decoder circuits.

AUDIO

Microphone Mixer

A versatile two-channel stereo/four-channel mono mixer with high and low impedance inputs available.

PRACTICAL

ELECTRONICS

JANUARY ISSUE ON SALE DECEMBER 10



F.M. STEREO TUNER

By D.S. GIBBS & I.M. SHAW

THIS final part deals with construction, testing and the simple adjustments required.

PUSH-BUTTON UNIT

The push-button selector mechanism used in the prototype was a type manufactured by Imperial Metal Industries and is available from Ambit International. A similar unit, but with six little plastic pointers to give an approximate indication of frequency, is manufactured by A. B. Metal Products Ltd., and is available from Integrex Ltd. However, both of these units are fairly expensive and many constructors will be able to find a suitable unit on the surplus market at much lower cost. The resistance of each potentiometer should be about 100 kilohm, i.e. 16 kilohm total resistance for a six-position switch.

Alternatively a suitable selector can be built up with a six-position rotary or push-button switch and 100 kilohm preset potentiometers.

No provision has been made for variable tuning as this is of very limited value with six stations to choose from, but it is a simple matter to add a 100 k Ω pot on the front panel.

PRINTED CIRCUIT BOARD

The copper pattern for the printed circuit board is shown in Fig. 2.1 and the component layout in Fig. 2.2. Wiring up the p.c.b. is straightforward and should not present any problems. It is probably best to start by soldering in all the resistors and capacitors, followed by the transistors, diodes and the coil L1, and then the two integrated circuits and the Tuner Head module can be soldered in place.

A socket can be used for the MC1310P (IC2) if desired but it is not advisable to use a socket for the SN76660N (IC1) as the extra lead length and stray capacitance may cause instability. It is not

necessary to use heat shunts when soldering any of the semiconductors provided the joints are made quickly with a clean, hot iron.

When all the components have been mounted, flying leads for the external connections can be soldered to the p.c.b. A short length of standard aerial coaxial cable should be used between the p.c.b. and the aerial socket and a piece of single screened (microphone) cable between the tuning voltage input on the p.c.b. and the push-button unit—as this point is rather sensitive to hum pick-up.

MECHANICAL WORK

The box used in the prototype unit was a type G.B.1 from H. M. Electronics, which was chosen to match the Orion Amplifier. But there is no reason why another type of box should not be used provided that the same layout is adhered to. A drilling diagram for the G.B.1. box is shown in Fig. 2.3, but note that some modifications will be necessary if an alternative push-button unit is used. The A. B. Metal Products unit mentioned earlier needs a small window for the six plastic pointers.

The G.B.1 box is supplied with a protective plastic film over the aluminium front panel. This can be used for marking out and should be left in place until all the drilling is complete—when it can be removed and the front panel lettered with Letraset or a similar product.

ASSEMBLY

The l.e.d. indicator lamps are supplied with plastic mounting clips, but these sometimes need a certain amount of persuasion to get them in place. Trimming the moulding “flash” from around the l.e.d. may help in stubborn cases. If desired, slide switches can be used instead of the miniature toggle switches shown, and are somewhat cheaper.

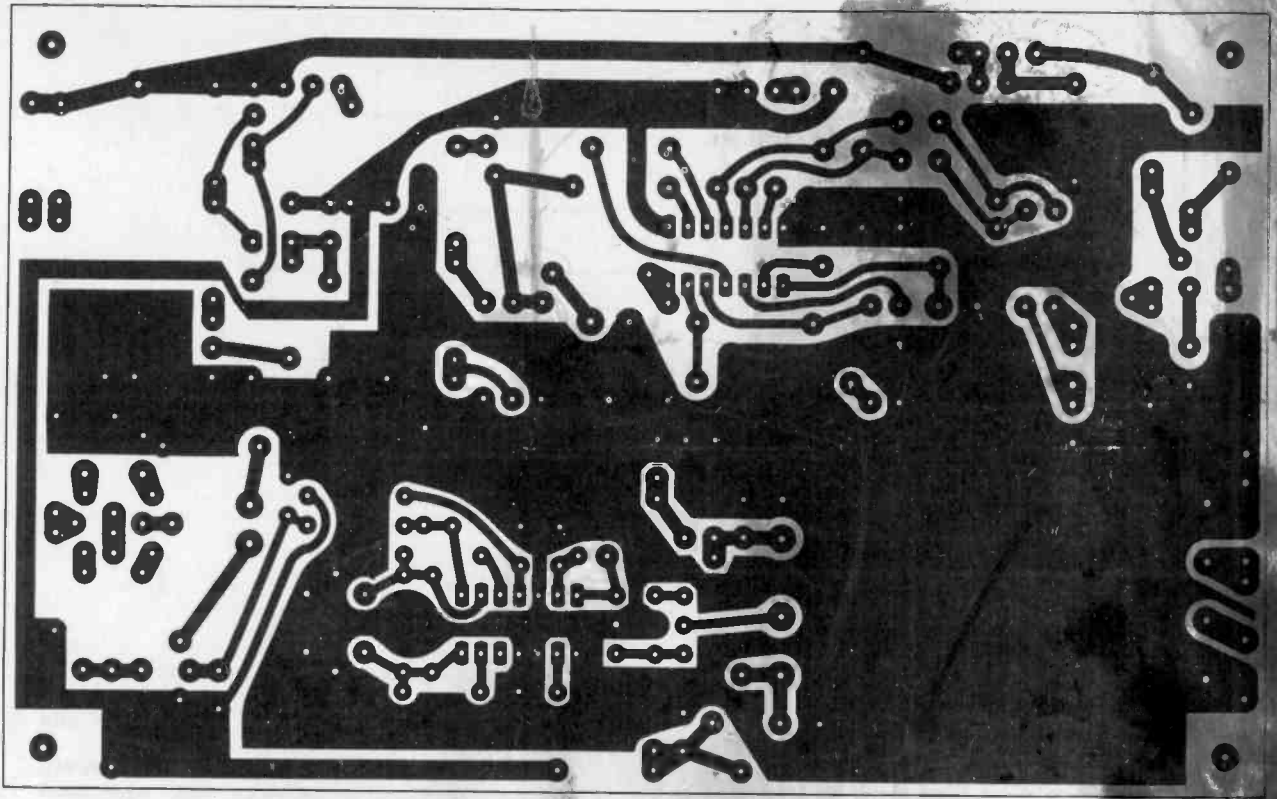


Fig. 2.1. Copper pattern for p.c.b.

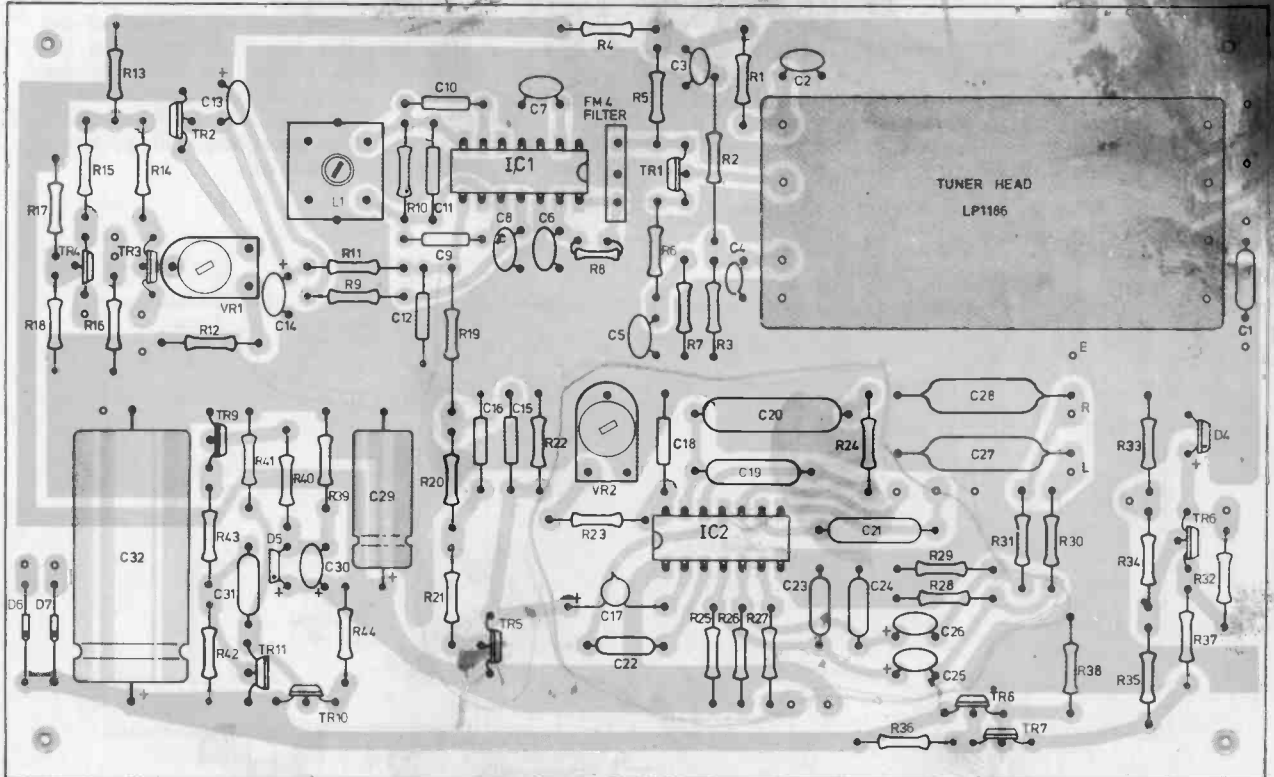


Fig. 2.2. Disposition of components on p.c.b.

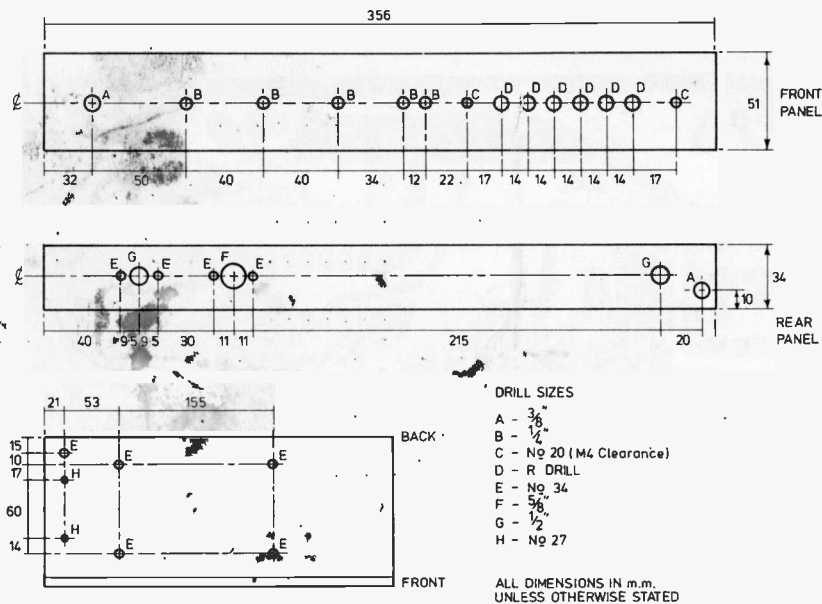


Fig. 2.3. Drilling details for the G.B.1 box

Mounting the other components on the chassis should not present any problems—but note that the aerial socket needs to be an insulated type (such as the Belling Lee L603/s) or an earth loop will be produced.

The printed circuit board should be fitted last and is mounted on $\frac{1}{4}$ in spacers (Fig. 2.4).

All wiring should be kept short and as neat as possible, and in particular wires from the mains transformer should be kept well away from the push-button unit or there will be an objectionable hum.

Before switching on, the wiring should be checked carefully for errors. In particular check that the two integrated circuits, all the transistors and diodes, and the electrolytic capacitors have been inserted the right way round—as these may be permanently damaged if they are wrongly connected.

TESTING

Switch on and check the voltage across C29. This should be between 11.0 and 12.5 volts. If the correct voltage is not obtained switch off immediately and check for errors.

The best way of aligning L1 is to use a sweep generator—and constructors with this equipment will need no further instructions—but it is possible to obtain adequate results with only a voltmeter or even with no instruments at all.

Connect an aerial and connect the output of the tuner to an amplifier. Put the a.f.c. switch to the 'off' position. Now tune across the band to see whether any stations can be received. It should be possible to pick up something, even with L1 badly off tune, but at this stage reception will probably be weak and somewhat distorted.

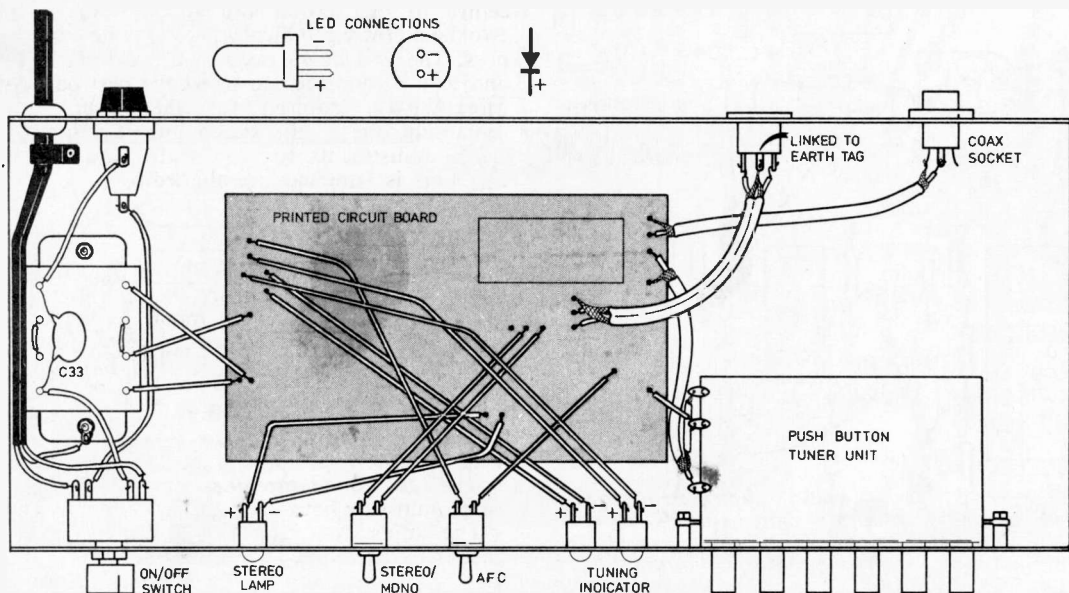


Fig. 2.4. External wiring to p.c.b.

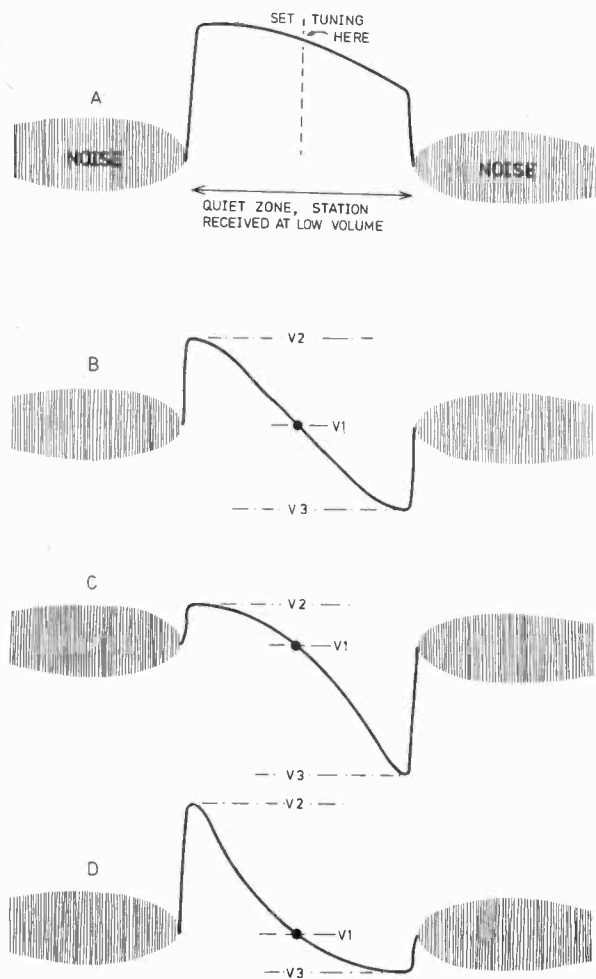
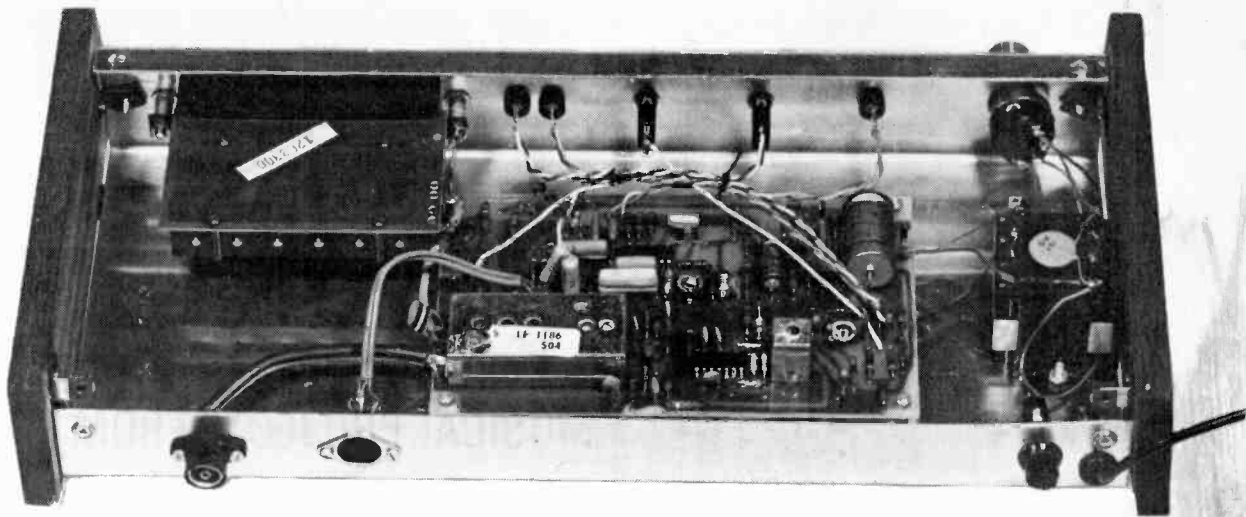


Fig. 2.5. At the start of the alignment procedure the tuner will probably behave as shown in (A) as it is tuned through a station. With L1 adjusted for maximum volume the discriminator curve should be as shown above (B) with V2 and V3 spaced equally about V1. If the adjustment of L1 is not quite correct the response will be as shown in (C) and (D)

Choose the strongest station and determine the two points on either side of the station where noise and obvious distortion appear. Then try to set the tuning accurately mid-way between these two points (see Fig. 2.5). Note that the mid-point may not coincide with maximum volume.

Then adjust the core of L1 for maximum volume. If you do not have a voltmeter you will have to adjust L1 for maximum volume by ear and leave it at the optimum point. It may be easier to do this on a steady tone—such as is transmitted on Radio 3 after the close-down of normal programmes at night.

If a voltmeter is available, check the voltage on the emitter of TR2 and make a note of the reading. Now tune off the station in both directions until noise and distortion are heard and make a note of the voltage readings at both points. These should be equally spaced above and below the first reading. If they are not equally spaced a further slight adjustment to L1 is necessary.

Once L1 has been correctly adjusted, tune to the centre of the station and adjust VR1 so that the two i.e.d. tuning indicators glow with equal brightness. The two i.e.d.s need to be reasonably matched and it is a good idea to select the best pair from the three i.e.d.s required for the tuner, using the remaining one as the stereo indicator lamp.

No adjustments to the LP1186 are necessary as this unit is supplied pre-aligned.

STEREO DECODER

Constructors with access to a digital frequency meter can simply connect it to pin 10 of the MC1310P, tune in to a mono transmission, and adjust VR2 until the frequency meter reads 19kHz. However, most constructors will have to use the following method.

Tune into a stereo transmission and adjust VR2 until the stereo indicator lamp comes on. Now turn VR2 in both directions noting the point at which the stereo indicator lamp goes out. VR2 should then be set mid-way between these two points.

The adjustment of VR2 is not very critical as once the oscillator is within the pull in range of the phase-lock loop its frequency is automatically corrected to the right value when the pilot tone appears.

VOLTAGE TABLE

Location	Voltage
Top of C2	8.3V
Emitter of TR2	6.0V*
Base of TR3	5.2V*
Base of TR4	5.2V
Bottom of R13	6.3V*
Top of R16	1.0V*
Anode of D1	1.5V*
Anode of D2	2.5V*
Emitter of TR5	6.0V*
Pin 2 of IC2	2.0V
Pin 4 of IC2	8.6V
Pin 5 of IC2	8.6V
Pin 6 of IC2	10.5V mono, 0.8V stereo
Collector of TR9	approx 12V
Top of C32	19.6V
Collector of TR7	13.5V
Emitter of TR6	6.0V
Push-button selector rail	13.2V
Top of C3	9.0V
H.T. rail	11.6V
Top of C4	2.2V
Top of C5	1.5V
Collector of TR1	7.5V
Pin 13 of IC1	2.0V
Pin 11 of IC1	11.4V

Voltages marked * vary with tuning.

PROBLEMS

The majority of problems with home built equipment are caused by simple wiring errors, so the first step should always be to carefully check the wiring. Then check that all components are the correct value and are inserted the right way round, and make sure that there are no obvious dry joints or bits of solder shorting out tracks on the p.c.b.

A table of voltages is given and this should be of some assistance in fault finding—but readings should be treated as approximate as component tolerances can cause slight variations from the values given. Readings were taken with an Avo Model 9.

It is difficult to give any specific advice for fault finding as anything could be at fault, and many faults would have the same general effect. However, the following general notes may be of some assistance.

1) If reception is noisy on stereo but all right on mono this indicates that the signal level is too low. The most likely cause is that the aerial is inadequate. A stereo signal needs to be some 26dB higher than a mono signal for the same signal/noise ratio due to the much greater bandwidth of the stereo transmission. If the aerial is all right then there may be a fault in the Tuner Head or i.f. amplifier causing low gain.

2) Severe distortion or a total lack of output probably indicates a fault in the Limiter/Discriminator section. Weak output but with no significant noise indicates that the quadrature detector is badly off tune—possibly due to a faulty capacitor.

3) Mono output from a stereo signal indicates a fault in the stereo decoder section—or that VR2 is badly off tune. ★

SOUND DESIGN

A PRACTICAL ELECTRONICS PUBLICATION

A SPECIAL SELECTION OF MUSICAL PROJECTS FROM PE

THE MINISONIC MK2 SOUND SYNTHESISER

An up-dated version of the published Mk 1, the Mk 2 has an integral keyboard, two 250 mW monitoring channels and loudspeakers, and facilities for amplitude, frequency and harmonic modulation.

THE JOANNA ELECTRONIC PIANO

has realistic piano effect with touch-sensitive keyboard and additional choice of harpsichord or honky-tonk voicing.

THE ORION STEREO AMPLIFIER

A hi-fi amplifier with output of over 20 + 20 watts. Compact and complete in one unit, it measures only 14" x 6" x 2".

PLUS

Some great sound effects units for guitars, keyboard instruments and general recording.

**Available
Now
£1.20**

POST PAID

(Please allow at least 2 weeks for delivery)

If you do not wish to mutilate your copy of the magazine, please send your order on a separate sheet.

To: Practical Electronics
IPC Magazines Ltd., Receiving Cashiers Dept.,
King's Reach Tower, Stamford Street, London SE1 9LS

Please send me.....copy(ies) of
"Sound Design". I enclose a Postal Order/Cheque
for £1.20 (post paid) or (state amount for
more than one copy)..... (£2.35 post paid
for 2 copies)

PLEASE WRITE IN BLOCK LETTERS

Name

Address

.....

..... Post code

Remittances with overseas orders must be sufficient to cover despatch by sea or air mail as required. Payable by International Money Order only.

PE 810

Company registered in England. Regd. No. 53626.
A subsidiary of Reed International Limited.

Semiconductors from LYNX ELECTRONICS

THYRISTORS

PIV	8A (TO92)	1A (TO5)	3A (C106)	4A (TO22)	6A (TO220)	8A (TO220)	10A (TO220)	15A (TO48)
50	0-20*	0-25	0-35	0-32	0-41	0-42	0-47	0-96
100	0-25*	0-25	0-40	0-37	0-47	0-48	0-54	1-02
200	0-27*	0-35	0-45	0-40	0-58	0-60	0-68	1-14
400	0-30*	0-40	0-50	0-45	0-67	0-68	1-40	1-40
600	—	0-65	0-70	—	1-09	1-19	1-26	1-80

TRIACS (PLASTIC TO—220 PKGE ISOLATED TAB)

	4A		6-5A		8-5A		10A		15A	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
100V	0-60	0-70	0-70	0-70	0-78	0-78	0-83	0-83	1-01	1-01
200V	0-64	0-64	0-75	0-75	0-87	0-87	0-87	0-87	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	0-87	1-01	1-21	1-26	1-42	1-50	2-11	2-17

N.B. Triacs without internal trigger diac are priced under column (a). Triacs with internal trigger diac are priced under column (b). When ordering please indicate clearly the type required.

LINEAR ICs

307	0.55*
380	0.90*
555	0.35
565	2.00*
566	1.50*
567	2.00*
709	0.35
741	0.28
748	0.70*
3901	0.85*
CA3045	0.85*
CA3046	0.50*
MC1304P	1.56
MC1307P	1.17*
MC1458P	0.77
TAA300	1.61
TAA310A	1.38
TAA550	0.45*
TAA611B12	1.25*
TBA530	1.85*
TBA570	0.98*
TCA270	1.95*



Special offer
Red LED
TIL209
10p

OPTOELECTRONICS

Displays	Discretes	
704	0-95	0-2 Red 0-13
707	0-95	0-2 Green 0-20
727	1-95	0-2 Yellow 0-14
728	1-95	0-2 Clear 0-14
747	1-80	
750	1-80	

NATIONAL CLOCK CHIPS

MMS314	£3.75
(Basic clock chip giving 6 digit display)	
Socket	0-45
MMS316	£5.25
(Sophisticated device including alarm)	
Socket for MMS316	0-80

SPECIAL OFFER—SG309K

1A TO3 5V 95p

REGULATORS

723	0-45	7818	1-50
1 amp Plastic		LM340-5	1-35
7805	1-50	LM340-12	1-35
7812	1-50	LM340-15	1-35
7815	1-50	LM340-18	1-35

IC SOCKETS

8 Pin	0-12	24 Pin	0-45
14 Pin	0-13	40 Pin	0-80
16 Pin	0-14		

TTL 74 Series Plastic

7400	0-16
7401	0-16
7402	0-16
7403	0-16
7404	0-18
7405	0-18
7406	0-51
7407	0-18
7408	0-18
7409	0-18
7410	0-16
7412	0-25
7413	0-25
7414	0-72
7416	0-43
7417	0-43
7420	0-16
7422	0-38
7423	0-40
7425	0-30
7427	0-48
7428	0-53
7430	0-16
7432	0-37
7433	0-49
4737	0-35
7438	0-35
7440	0-16
7441	0-76
7442	0-16
7445	1-50
7446	2-56
7447	0-81
7448	0-81
7450	0-85
7451	0-16
7453	0-18
7454	0-18
7460	0-18
7470	0-32
7472	0-26
7473	0-30
7474	0-32
7475	0-47
7476	0-36
7480	0-55
7481	1-26
7482	0-75
7483	1-12
7484	0-85

TO3 HARDWARE INC.

1 Mica—2 washers	
Solder TA6	
2 Nuts/Bolts Washers	
50 for 65p	

NPN TO-3 POWER TRANSISTORS

Fully tested but unmarked. Similar to 2N3055 except BVCEO = 50V +
HFE (gain) = 20 + at 3A.
VCE SAT < 1.3V at 3A.
Pack of 10 £1.80
Pack of 20 £3.40
Pack of 50 £7.50
Pack of 100 £13.00

Ideal for power supplies, audio output, etc.

TRANSISTORS, DIODES, RECTIFIERS

AC126	0-15	BC117	0-19*	BC301	0-32	BDY60	0-60	BT109	1-00	CRS3-10	0-45	TIP32A	0-64	2N3054	0-40
AC127	0-16	BC125	0-18*	BC323	0-60	BDY61	0-65	BT115	1-00	CRS3-20	0-50	TIP34	1-05	2N3055	0-50
AC128	0-13	BC126	0-20*	BC327	0-16*	BDY62	0-55	BU105	1-80	CRS3-60	0-85	TIP42A	0-72	2N3442	0-56
AC129K	0-25	BC141	0-28	BC328	0-16*	BF178	0-28	BU105.02	1-80*	MJ480	0-80	IN266P	0-14	2N3525	0-50
AC141	0-18	BC142	0-23	BC337	0-17*	BF179	0-30	BU204	1-60*	MJ481	1-05	IN2070	0-16	2N3570	0-80
AC141K	0-25	BC143	0-23	BC338	0-17*	BF194	0-10*	BU204	1-60*	MJ490	0-90	IN4001	0-04*	2N3702	0-10*
AC142	0-18	BC144	0-30	BCY30	0-55	BF195	0-10*	BU208	2-60*	MJ491	1-15	IN4002	0-05*	2N3703	0-10*
AC142K	0-28	BC147	0-09*	BCY31	0-55	BF196	0-12*	BY206	0-15	MJE340	0-40*	IN4003	0-06*	2N3704	0-10*
AC176	0-16	BC148	0-09*	BCY32	0-60	BF197	0-12*	BY207	0-20*	MJE371	0-60	IN4004	0-07*	2N3705	0-10*
AC176K	0-25	BC149	0-09*	BCY33	0-60	BF224J	0-18*	BYX36	300-0-12*	MJE521	0-55	IN4006	0-09*	2N3707	0-10*
AC187	0-18	BC152	0-25*	BCY34	0-55	BF244	0-17*		600-0-15*	OA5	0-50*	IN4007	0-10*	2N3714	1-05
AC187K	0-25	BC153	0-18*	BCY38	0-50	BF257	0-30*		900-0-18*	OA8	0-88	2N696	0-14	2N3715	1-15
AC188	0-18	BC157	0-09*	BCY39	1-15	BF258	0-35*		1200-0-21*	OA9	0-08	2N697	0-12	2N3716	1-25
AC188K	0-25	BC158	0-09*	BCY70	0-12	BF337	0-32*			OC41	0-15	2N706	0-10	2N3771	1-60
AD140	0-50	BC159	0-09*	BCY71	0-18	BFW60	0-17*	BYX38	300-0-50	OC42	0-15	2N709	0-14	2N3772	1-60
AD142	0-50	BC160	0-32	BCY72	0-12	BFX29	0-26		900-0-65	OC44	0-12	2N939	0-14	2N3773	2-10
AD143	0-46	BC161	0-38	BCY75	0-15	BFX30	0-30		900-0-60	OC45	0-10	2N1131	0-15	2N3779	0-28*
AD149	0-45	BC163B	0-09*	BD131	0-36	BFX84	0-23		1200-0-65	OC70	0-10	2N1132	0-16	2N3904	0-16*
AD161	0-35	BC182	0-11*	BD132	0-40	BFX85	0-25		1200-0-65	OC71	0-10	2N1394	0-20	2N3906	0-11*
AD162	0-35	BC182L	0-11*	BD135	0-36	BFX88	0-20	BZK61 Series	OC72	0-22	2N1335	0-20	2N4124	0-14	
AL102	0-95	BC183	0-10*	BD136	0-39	BPY50	0-20	Zeners	OC73	0-15	2N1335	0-20	2N4290	0-12	
AL103	0-93	BC183L	0-10*	BD137	0-40	BPY51	0-18	BZK68 Series	OC84	0-14	2N1711	0-18	2N4290	1-20	
AF114	0-20	BC184	0-11*	BD138	0-48*	BSX20	0-18	CRS105	0-25	SC45A	0-73	2N2102	0-44	2N4548	1-20
AF115	0-20	BC184L	0-11*	BD139	0-58*	BPY64	0-35	Zener	0-11	SC40B	0-81	2N2369	0-14	2N4870	0-35*
AF116	0-20	BC207B	0-12*	BD181	0-86	BPY90	0-55	CRS110	0-25	SC41F	0-80	2N2869	0-14	2N4871	0-35*
AF117	0-20	BC212	0-11*	BD182	0-92	BR100	0-20	CRS120	0-35	SC40F	0-65	2N2454	0-16	2N4919	0-70*
AF118	0-50	BC212L	0-11*	BD183	0-97	BFY39	0-40	C106D	0-50	SC41A	0-65	2N2646	0-16	2N4920	0-50*
AF139	0-35	BC213	0-12*	BD232	0-60*	BSX19	0-16	C106F	0-35	SC41B	0-70	2N2905	0-18	2N4922	0-58*
AF239	0-37	BC213L	0-12*	BD233	0-48*	BSX20	0-18	CRS105	0-25	SC41D	0-65	2N2805A	0-22	2N4923	0-46*
BC107	0-09	BC214	0-14*	BD237	0-55*	BSX21	0-20	CRS110	0-25	SC41F	0-80	2N2869	0-10*	2N5060	0-20*
BC107B	0-09	BC214L	0-14*	BD238	0-60*	BSY55A	0-12	CRS120	0-35	ST2	0-20	2N2860	0-09*	2N5061	0-25*
BC108	0-09	BC237	0-16*	BD184	1-20	BT106	1-00	CRS114	0-40	TIP29A	0-44	2N2926Y	0-09*	2N5062	0-27*
BC109	0-09	BC238	0-16*	BDY20	0-60	BT107	1-60	CRS160	0-65	TIP30A	0-52	2N2826G	0-10*	2N5496	0-65
BC109C	0-12	BC300	0-34	BDY38	0-60	BT108	1-60	CRS105	0-34	TIP31A	0-54	2N3053	0-15		

P & P 20p per order—overseas 80p. Matching 20p per pair.
VAT 8% except for items * which are 12%. No VAT on overseas.

LYNX ELECTRONICS (LONDON) LTD

Higham Mead, Chesham, Bucks

Telephone (02405) 75154. Telex 837571

GIRO NO 331 7056 Access and Barclay Card accepted
C W O only Terms of business as in our Catalogue
Export Order enquiries welcome (£5 min.)
Official Orders accepted from Educational and Government Departments
ALL PRICES include VAT and P & P.
SHOP HOURS 9.12.30.1.30.5.00.5 DAYS
CLOSED WEDNESDAY

1977 ISSUE 66 PAGES—3,000 ITEMS
FULLY ILLUSTRATED
*20p CREDIT
*VOUCHERS
*ALL NEW STOCK
*SATISFACTION GUARANTEED
*DISCOUNTS

25p plus 15p postage

Boxes — Cases —
Kits — PC Materials —
Tools — Resistors — Test
Meters — Capacitors —
Hardware — Semiconductors — Books — Pots — Coils
Audio Accessories — Screws
Connectors — Audio Modules
Veroboard — Transformers —
Knobs — Calculators — Audio Leads
Batteries — 5 dec Storage Units —
Heatsinks, etc., etc.

SPECIAL CAPACITOR KITS
C280 Kit—PC Mounting polyester 250V 5 of each value: 0.01, 0.022, 0.047, 0.1, 0.22uF, 2 of 0.47, 1uF, £1.81 net.
C296 Kit—Tubular polyester, 400V, 5 of each value: 0.01, 0.022, 0.047, 0.1, 0.22uF, 2 of 0.47uF, £2.43 net.
Ceramic Kit—square plaque, 50V 5 of each value: 22, 33, 47, 100, 220, 330, 470, 1000pF, 220, 4700pF, 0.01uF, £1.71 net.

SPECIAL RESISTOR KITS (CARBON FILM 5%) (Prices include post & packing) 10E12 4W or 1W KIT 10 of each E12 value, 22 ohms—1M, a total of 570 £5.04 net
25E12 4W or 1W KIT 25 of each E12 value, 22ohms—1M, a total of 1425 £11.70 net

B. H. COMPONENT FACTORS LTD.

MULTIMETER U4323
22 Ranges plus AF/IF Oscillator 20,000V/Volt
Vdc—0.5—1000V in 7 ranges
VAc—2.5—1000V in 6 ranges
Idc—0.05—500mA in 5 ranges
Resistance—5Ω—1MΩ in 4 ranges.
Accuracy—5% of F.S.D.
OSCILLATOR—1KHz and 465KHz (A.M.) at approx 1 Volt.
Size—160 x 97 x 40mm.
Supplied complete with carrying case, test leads and battery.
PRICE £10-95 net U4323

MULTIMETER U4324
34 Ranges. High sensitivity. 20,000Ω/Volt.
Vdc—0.6

GETTING TO GRIPS WITH MICROPROCESSORS

By D. BROWN*

A concise explanation of what a microprocessor is and what it does. A Development Kit incorporating a microprocessor provides a valuable tool for system design. The National SC/MP Development Kit, featured here, is ideally suited for private users and experimenters, as well as for professional users.

MICROPROCESSORS are already in use or under evaluation in a wide range of applications in industry, and are even finding their way into domestic appliances. On the other side of the Atlantic, hobbyists are beginning to experiment with these devices too.

What are the attractions of the microprocessor? Principally, its ability to replace complex electromechanical process timers or boards full of logic i.c.s, but with the added advantage that the control sequence can be modified in part or in whole merely by altering the program stored in the associated memory—no circuit changes are involved.

When using wired random logic, many gates are connected in series and/or parallel, to produce the desired relationship between inputs and outputs. When

using a microprocessor, one general purpose gate carries out all the operations, one after another. Clearly some sort of MEMORY is needed, to store the result of one operation while the microprocessor gets on with the next operation, or pauses for breath. The memory also contains a sequence of instructions which tell the microprocessor what to do. This sequence of instructions is called a PROGRAM.

Under control of the program, the microprocessor can perform LOGICAL or ARITHMETIC Functions on data (input or intermediate), or take decisions to JUMP to a different part of the program. For example, when performing division, a subtraction is repeated until

* Applications Engineer, National Semiconductor (U.K.) Ltd.

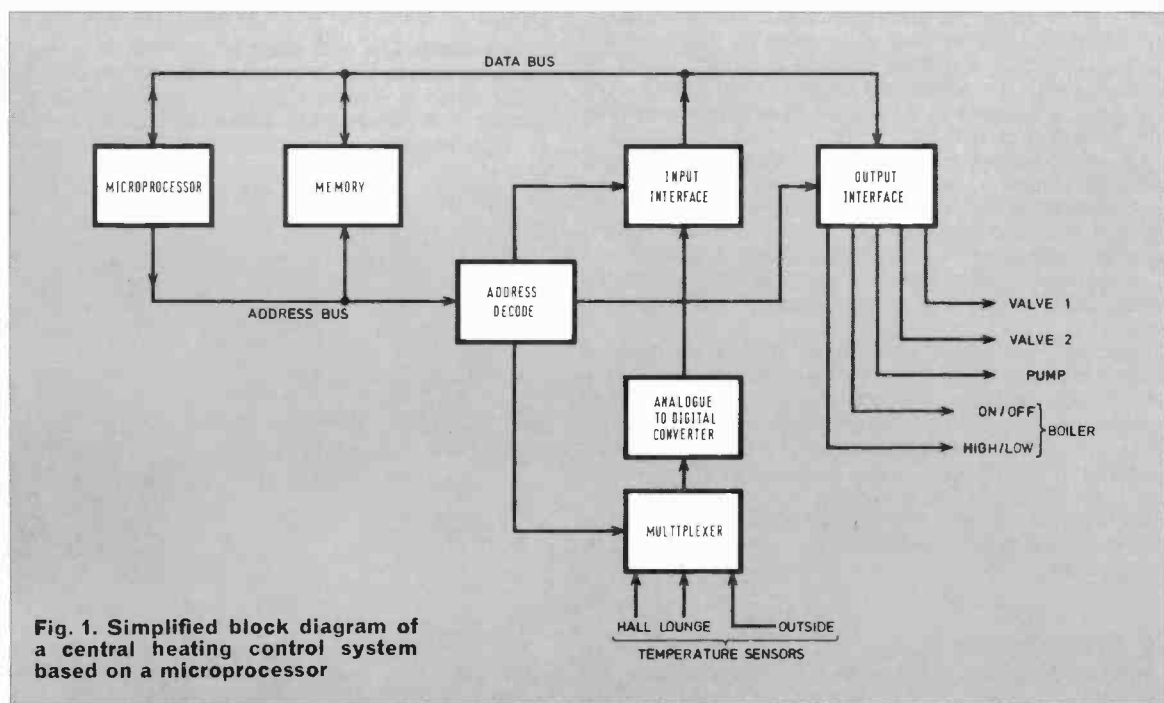


Fig. 1. Simplified block diagram of a central heating control system based on a microprocessor

there is no remainder, by repeating a few steps of the program in a LOOP. When the remainder is zero, or negative, the microprocessor jumps out of the loop, and carries on to the next instruction.

PROCESSOR CONNECTIONS

The microprocessor is connected to the memory by two sets of wires, the DATA BUS and the ADDRESS BUS. The instructions and data flow in on the data bus, and results flow out some time later. At each step of the address counter driving the address bus counts up by one. The memory is a matrix of storage elements. The

specification. For the sake of example we will consider a central heating controller, with temperature sensors in the lounge, hall and outside. The boiler system has two heat settings.

System definition:

1. If lounge temperature is less than 21°C, turn on boiler and pump, open valve 1.
2. If hall temperature is less than 18°C, turn on boiler and pump, open valve 2.
3. If outside temperature is less than 0°C, set boiler to high output if on, set boiler to low output if off.

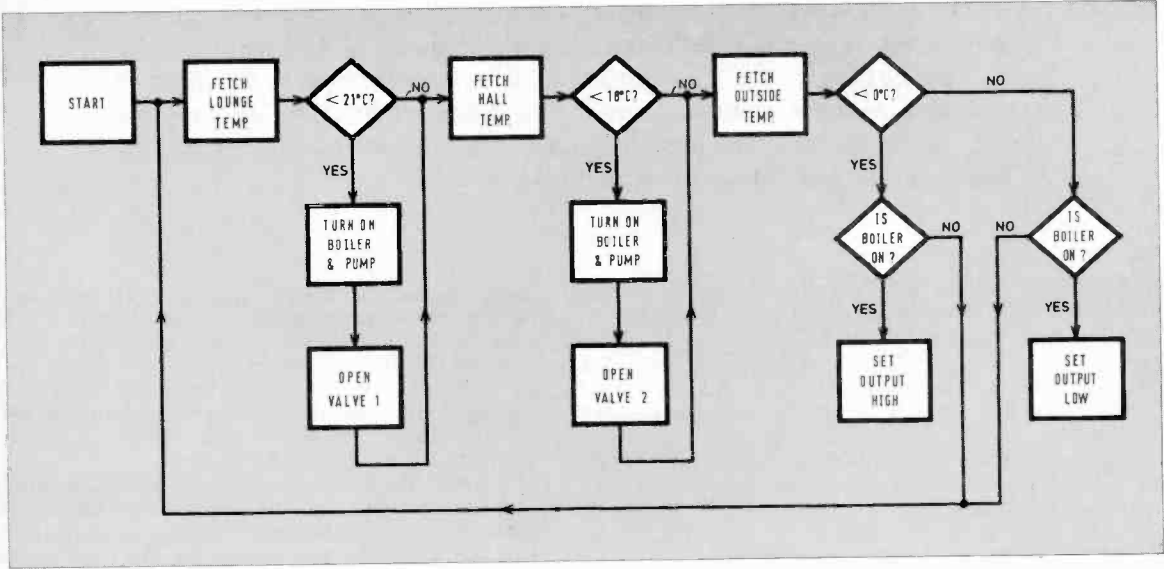


Fig. 2. Flow chart representing the sequence of decisions and commands required to control the central heating system

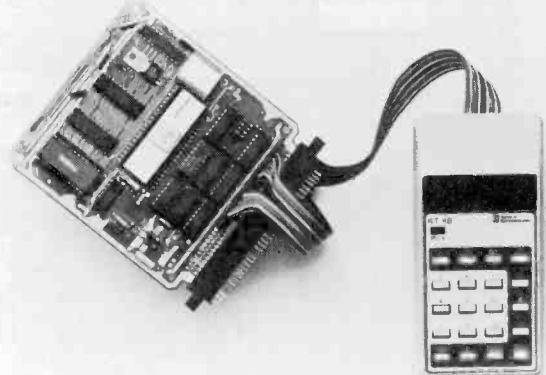
address bus determines which set of storage elements are connected to the data bus. READ ONLY MEMORY (programmed before use, and retains its data with the power off) and RANDOM ACCESS MEMORY (loses its contents with the power off) are both used. Any part of the program stored in RAM must be loaded every time the system is turned on.

A microprocessor connected to a memory is like a man looking at a "what the butler saw" machine. The eyepiece is the data bus, and instead of turning a handle to see the next picture, the microprocessor address counter advances by one. The analogy is incomplete because the microprocessor also sends data out on the data bus. Perhaps our voyeur could develop flashing eyes!

So far we have considered a system with a microprocessor and memory, but no inputs or outputs. A 16-bit address bus can address $2^{16} = 65,536$ locations. Practical systems usually use a much smaller memory. Several unused addresses are decoded with gates, and the results used to enable (i.e. allow) inputs onto the data bus, or load outputs from the data bus into latches. These addresses are called up by the program when the microprocessor needs to input or output data.

The hardware required to implement this system is shown in simplified block diagram form in Fig. 1.

Flow chart: The next stage is to construct a flow chart, such as that in Fig. 2, based on the system definition. A flow chart is simply a graphical representation of the series of decisions and commands required to make the system perform in accordance with that definition.



The SC/MP Introkit and its associated Keyboard Kit. The Introkit p.c.b. shown here is one for the U.S. market. The European version contains the same components but is a different shape

SYSTEM DESIGN

When designing a microprocessor based system, the starting point (as in all logic system design) is the system

Program: The last stage is write a program in machine code (the "language" which the microprocessor understands), but with comments in plain English for future reference! This program is then entered into RAM on a development system such as that described below. The input temperatures are simulated by putting numbers in the appropriate addresses.

When the program operates correctly, build up the hardware and try the two together. Next get your program put into PROM by your friendly PROM supplier, plug it in, and make sure it works.

In practice the microprocessor could easily do very much more. An input from the fuel tank of an oil-fired system would allow it to predict a run-out date, based on fuel consumption. Timing could also be built in.

The central heating controller is offered only as a simple example of how design is done, to show the procedures involved when developing a system.

NATIONAL SC/MP

So much for theory; what about practice? To start with you need a cheap microprocessor development system, like the SC/MP Introkit. This contains everything except power supply. A preprogrammed ROM contains "Kitbug", a program to allow you to enter a program into RAM in machine code from a Teletype, run the program, and print out the result on the Teletype. (No Teletype? Don't despair, read on!) The kit contains full paperwork, and some worked examples.

For those people wanting a cheap Teletype substitute, National Semiconductor have introduced Keyboard Kit. This kit consists of a cheap calculator, with the calculator chip removed. An umbilical cord connects it to the Introkit p.c.b., to which a handful of integrated circuits are added. All integrated circuits and sockets are included, also wire and a wire wrap tool. A new ROM, containing SCMPKB, is included. This new program contains all the routines necessary to interpret the key depressions and drive the 7-segment displays.

The comprehensive handbook gives step by step wiring instructions, and operating instructions for the completed kit. Using the keyboard, programs can be entered in hexadecimal (a shorthand form of machine code easier to use than binary). As well as the 16

hexadecimal keys (0-9 A. B. C. D. E. and F), there are 4 control keys, which allow the contents of any RAM address to be examined or modified.

In the following example, the addresses are in hexadecimal. Hex $200 = (2 \times 16^2) + (0 \times 16) + (0) = 2 \times 256 = 512$ in decimal. Address locations 0 to 1FF (511 in decimal) are occupied by SCMPKB in the ROM, 200 to 5FF are used by the keyboard and display so address location 600 is the first RAM address.

Address location	Enter data	Meaning of data
600	C4	Load immediately the next data word into the accumulator
601	03	The value to be loaded
602	EC	Decimal add immediately to the next data word
603	04	The value to be added
604	C8	Store instruction
605	05	Result of calculation stored 5 places on, i.e. 60A
606	C3	Finish, return to SCMPKB control
FF7	06	Enter start address in RAM location
FF8	00	Under SCMPKB control this value is put in the address counter before the programme is run

The result of the addition of 03 and 04 (07) is found in location 60A after the programme has been run by pressing the appropriate button.

To this simple system may be added some address decoding, tristate buffers (DM81LS95) and latches (DM74LS175), allowing real TTL inputs and outputs to connect to the system.

The Introkit at £62.37 + 8% VAT, the Keyboard kit at £59.85 + 8% VAT, and a pack of all relevant data (£1.50 or free with kits) are available ex stock from A. Marshall (London) Ltd., 42 Cricklewood Broadway, London NW2 3ET, distributors of National Semiconductor consumer products. ★

SERT Symposium "Microprocessors at Work"

THE interest in and importance of microprocessors in the future development of electronics is indicated by the attendance of over 200 delegates at the three-day residential symposium organised by the Society of Electronic and Radio Technicians at the University of Sussex in September. The symposium highlighted the tremendous potential of the microprocessor as part of a microcomputing system for control, display and calculation. The delegates were drawn mainly from technical management of research and development, but also included representatives from marketing, training and education, maintenance, test and production engineering.

A total of 23 papers were presented by authors drawn from microprocessor manufacturers, electronic equipment manufacturers and universities. The opening papers served as an introduction to microprocessors and their features. A survey of all the currently available processors followed, with some hints on selecting the right device for a particular application. The hardware papers concluded with descriptions of prototyping aids and various testing procedures.

Next it was the turn of programming and software, then on to what was for many delegates the real "meat" of the proceedings, the applications papers. These dealt with such

varied subjects as railways, remote graphics displays, instrumentation, lift controls, domestic cookers and industrial weighing systems.

The recurring message from authors throughout the symposium was that prospective users should "get their feet wet". Get hold of one of the development kits now available and gain some practical experience. Better by far than spending hours poring over literature from the various manufacturers, trying to make up your mind which is the best microprocessor for you.

The previously announced competition to find the best application of a microprocessor by a home constructor had unfortunately to be cancelled. Although about half a dozen constructors had expressed an interest, none of them was able to complete his project within the time available.

Symposium Papers

A volume containing reprints of all the papers presented at the symposium is available. This normally costs £7.50, but is available to PRACTICAL ELECTRONICS readers at the specially reduced price of £6.50 including postage and packing. Orders, with remittance, should be sent to the Secretary, MPU Symposium (Dept. PE), S.E.R.T., 8-10 Charing Cross Road, London WC2H 0HP.



SPACE SHUTTLE

Aptly named *The Enterprise* a black, white and grey spaceship made its first appearance to the public gaze in September this year. It is America's first Space Shuttle Orbiter. Its name is partly a recognition of the popular TV programme "Startrek".

This vehicle is a sort of aeroplane cum spaceship and is the next generation pioneer of the space age. It is designed for manned activities and near space missions in the 1980s. This is the simplifying generation which will bring space flight nearer to that of normal commercial travel.

In physical size the orbiter is about the size of a DC9 aircraft with swept wings. It is 122ft long and when launched it has two solid fuel detachable rocket boosters plus its own three engines. The boosters are jettisoned and later recovered for re-use. This procedure can be repeated many times before the boosters are scrapped.

Though launch will be vertical in the normal mode, the orbiter will cruise to a normal aircraft approach landing, or rather, like a glider landing for it will not be under power.

The orbiter has two main sections, a double decker flight deck and a rear cargo bay. This will provide room for satellites or space experiments. It also has room for other space experiments in the working quarters where the crew of seven can work.

All this is in addition to the 72 cubic metres of the two deck cabin. This area is for the equipment which controls and maintains the spacecraft. The lower deck is for the scientists and engineers as passengers who will work and sleep in the quarters provided.

The *Enterprise* will have multiple tasks to perform and its large cargo area will be able to carry satellites which can be placed in orbit and later

recovered for servicing or even repaired on site. A *Spacelab* will be carried and the first one, built by the European Space Agency, is scheduled for operation in 1980. The *Spacelab* can be instrumented for astronomy, high energy physics and astrophysics, solar research, together with biological, technological and Earth related studies.

Spacelab 1 will have a pressurised module for the experiments, but *Spacelab 2* will have instruments mounted on pallets and controlled from inside the flight deck. The pallets will be exposed directly in space. Canada is building a long arm manipulator for use with the pallet system as well as satellites.

TESTING

Tests of the orbiter will begin in January 1977 at the Dryden Spaceflight Centre. The orbiter will be placed on the back of a Boeing 747 and the first tests will be with unmanned conditions. The *Enterprise* will take off from the back of the 747 fly around and then land.

Fifteen such test flights will take between January and June. The shuttle pilots will then board the pick-a-back in late June and in July the first free flight will take place. For this test the orbiter will separate from the 747 at 28,000ft and the *Enterprise* will make a U-turn and land on the runway.

In March 1979 the second *Enterprise* will fly directly, manned, and after six test flights will be ready to go into scheduled operation in 1980.

The first pilots will be chosen from the *Apollo* astronauts. Although 28 men are attached to the Johnson Spaceflight Centre NASA is recruiting 15 pilots and 15 mission specialists. Applications by men or women will be open till June 30, 1977.

MARS

The vital experiments with regard to biological processes are not yet settled and a good deal of work is still to be done. Indeed, it may well be that until some of the Martian soil can be handled directly in Earth laboratories no final conclusion may be announced.

However, there are now indications that the surface of the planet is similar all over. The rocks appear to be the same and the manner of the debris that has been photographed confirms this. The fact that the two sites have similar signs in the soil, from the chemical point of view, all point to the view that the conditions are the same as the other planets, Earth, Venus and Mercury. Temperatures vary, atmospheres vary but the same basic materials are involved.

A new suggestion from the space centres now implies that the crust of Mars may be relatively thin. It is conceivable that there is water trapped as ice or in the form of permafrost not far below the surface. It is thought that this could be as much as a mile deep. Boreholes might well reveal this and

there would seem to be a case for a "mole" tunnelling device remotely controlled or at least a boring device when the first manned landing is made.

All things considered so far it would seem that the first colonies should be sited on Mars for even with present technology this is possible.

SOYUZ 22

A flash back to a unique spaceflight was called to mind when the name of Colonel Valery Bykovsky was announced recently as the commander of *Soyuz 22*. Indeed space history was made when Colonel Bykovsky and the only woman astronaut, so far, Valentina Tereshkova were partners in the flight of *Vostok 5*. This was in 1963 two years after Yuri Gagarin made his flight.

The sequel to the man and woman flight was that they were married. Much has happened since that time thirteen years ago, they now have two sons, Valery and Sergei, and Valentina is now chairman of the Soviet Women's Committee. Bykovsky has actively assisted in the training of Soviet space crews and the *Soyuz* flight missions.

The programme he now commands is a co-operative one by socialist countries. The main object is the improvement of scientific methods and the study from outer space of geological and geographical features of the Earth's surface.

The spacecraft carries multi-zonal photographic equipment developed by Germany and the USSR and manufactured by Zeiss. Medical and biological research is now a regular part of the *Soyuz* missions. The data from the spacecraft will be processed by the Soviet Flight Centre with the help of land based tracking stations and research ships in various parts of the world.

OZONE LAYER

Much confusion still exists regarding the ozone layer. A recent government report comes down in favour of a dangerous future if Freon is not banned from sale. At the same time another school of thought says that the activity of flights in the stratosphere by commercial aircraft may well inhibit the effects of contamination where the chlorofluoromethanes are concerned.

There seems to be some tendency to cry wolf in this area again and the fact should be recognised that wide ranging condemnations in these matters are based mainly on laboratory experiments. Just as the exact make up and "weather" changes in the upper atmosphere as a whole are still not extensively understood there has been too much conjecture as to the operation of the ozone layer. The fact that widely divergent percentages have been quoted (it could be as much as 7½ per cent or as little as 1 per cent) is too random to start a scare, often to little purpose or benefit to mankind.

For the first time in Britain!

PHILIPS MIXER AMPLIFIER KITS

- * Uniquely flexible – you build exactly what you need
- * Totally reliable – every component made to the highest Philips standards
- * Amazingly inexpensive * Available now from SST Distributors

Part of the overall range of Philips Electronic Kits, now available for the first time in Britain, Philips Mixer Amplifier Kits enable you to construct the kind of mixer amplifier you need – easily, confidently, to the highest professional standards.

Unusually flexible, the Philips range is built up in such a way that you can choose from a number of combinations certain that the end result will always be a complete unit – in function and appearance.

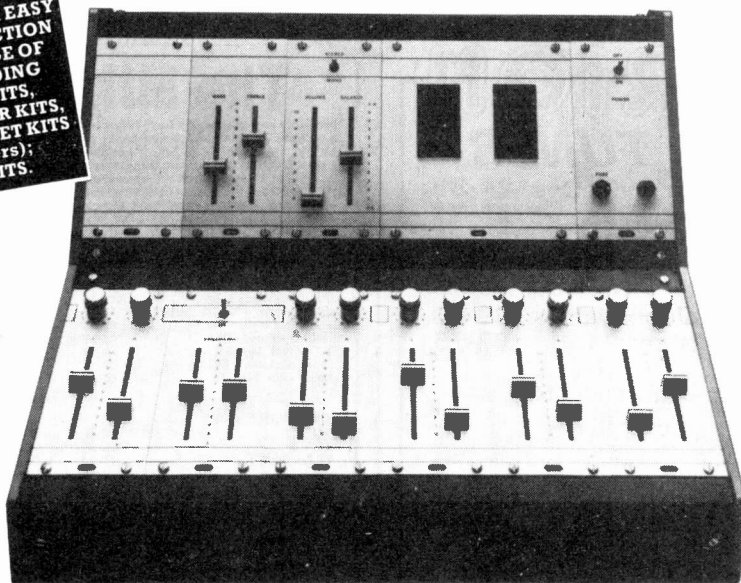
Individual Kits cover the following functions – mixer unit, separate input amplifiers (for microphone, record player, tape recorder or tuner), tone-control unit, level-meter unit with two VU-meters, and a feeder amplifier. In every case, the dimensions of the chassis and the front panel have been standardised to allow for smooth and

simple construction; moreover, the units can be easily interchanged.

The mixer amplifier illustrated is built up of eleven kits; the front panel contains 16 slide controls, 10 rotary controls and 2 large VU-meters. If a simple layout is required, one central tone control unit can be incorporated between the mixer and the feeder amplifier instead of three separate units. In any event, it is usually a good idea to block out your requirements initially in diagram form so that you can see how easily they can be engineered.

Whatever your choice, however, you can be assured that the complete mixer amplifier will amply exceed true hi-fi standards with distortion and signal-to-noise ratio on a professional level.

ALSO AVAILABLE FOR EASY AT-HOME CONSTRUCTION A COMPLETE RANGE OF HI-FI KITS, INCLUDING LOUDSPEAKER KITS, CROSS-OVER FILTER KITS, AUDIO KITS, CABINET KITS (for loudspeakers); AND HOBBY KITS.



Your skills. Philips quality. An unbeatable combination.

PHILIPS

Send today for fully illustrated catalogue and price list

To: SST Distributors
(Electronic Components) Ltd.
West Road, Tottenham,
London N17 0RN.

Name _____

Address _____

County/Postal Code _____

SST Distributors is a member of the Philips Group of Companies.

PE 10



SINTEL FOR KITS-CMOS-DISPLAYS-MEMORIES-BOOKS-MICROPROCESSORS

Components from leading manufacturers only

DATABOOKS and DATASHEETS (may be photocopies)

NEW 1976 RCA CMOS and Linear IC Combined Databook.....	£4-95
New 1976 RCA Databook on Power Transistors, SCR's, Thyristors, etc.....	£4-95
National Semiconductor 7400 Series TTL Databook, c. 200 pages.....	£3-45
T.I. Pin-Out Card Index. Set of cards with pin-outs (top and bottom views) of T.I. TTL range and many other T.I. IC's.....	£2-95
Intel Memory Design Handbook, c. 280 pages.....	£4-75
Intel 8086 Microcomputer Systems Users Manual, c. 220 pages.....	£4-85
Motorola CMOS Databook (Vol. 5 Series A) c. 500 pages.....	£2-77
Motorola M6800 Microprocessor Applications Manual, c. 650 pages.....	£12-45
Motorola M6800 Programming Manual, c. 200 pages.....	£8-85
Motorola Booklet Introducing Microprocessors.....	£1-50
National SC/MP Intronit Users Manual.....	£0-75
National SC/MP Programming and Assembly Manual.....	£6-30
National SC/MP Technical Description.....	£1-95
2650 Microprocessor Manual 220 pp.....	£24-50
DATASHEETS on Microprocessors (usually Xerox Copies)	
Interrail IM6100, 12 bit, CMOS.....	£0-75
National SC/MP, 8 bit, low cost.....	£0-75
Signetics 2650, 8 bit, low cost.....	£0-75
RCA CD1802, 8 bit, CMOS.....	£0-35
Zilog Z80 (Enhanced 8080).....	£0-75
Motorola MC6800.....	£0-75

FAST SERVICE

We guarantee that telephone orders for goods in stock, received by 4.15 p.m. Mon.-Fri. will be despatched the same day First Class Post (books and kits by parcel post), and our stocking is good. Private customers should telephone order quoting their Access or Barclaycard number, with a minimum order value of £5. Official orders no minimum.

CMOS from the top manufacturers, mainly RCA and MOTOROLA

CD4000	0-18	CD4028	0-99	CD4053	0-97	CD4096	0-74	CLOCK CHIPS	
CD4001	0-18	CD4029	1-16	CD4054	1-20	CD4089	2-81	75110J	2-88
CD4002	0-18	CD4030	0-56	CD4055	1-37	CD4093	0-89	75111D	3-04
CD4006	1-22	CD4031	2-24	CD4056	1-37	CD4094	1-84	751237J	1-72
CD4007	0-17	CD4032	1-11	CD4057	27-95	CD4095	1-99	751238D	2-15
CD4008	0-85	CD4033	1-45	CD4058	0-84	CD4096	1-96		
CD4009	0-56	CD4034	1-96	CD4060	1-18	CD4097	3-87		
CD4010	0-56	CD4035	1-22	CD4062	0-07	CD4099	1-90		
CD4011	0-17	CD4036	3-18	CD4063	1-14	CD4502	1-29		
CD4012	0-17	CD4037	0-99	CD4066	0-84	CD4510	1-41		
CD4013	0-56	CD4039	1-22	CD4067	3-87	CD4511	1-82		
CD4014	1-05	CD4039	3-09	CD4068	0-22	CD4514	2-25		
CD4015	1-05	CD4040	1-11	CD4069	0-22	CD4515	3-25		
CD4016	0-55	CD4041	0-87	CD4070	0-86	CD4516	1-41		
CD4017	0-99	CD4042	1-87	CD4071	0-22	CD4518	1-30		
CD4018	0-99	CD4043	1-05	CD4072	0-22	CD4520	1-30		
CD4019	0-56	CD4044	0-97	CD4073	0-22	CD4527	1-84		
CD4020	1-18	CD4045	1-45	CD4075	6-22	CD4532	1-50		
CD4021	1-05	CD4046	1-30	CD4076	1-81	CD4555	0-94		
CD4022	1-00	CD4047	0-94	CD4077	0-60	CD4556	0-94		
CD4023	1-17	CD4048	0-58	CD4078	0-22	MC14528	1-18		
CD4024	0-81	CD4049	0-55	CD4081	0-22	MC14553	5-24		
CD4025	0-17	CD4050	0-55	CD4082	0-22	IM6508	8-05		
CD4026	1-79	CD4051	0-87	CD4085	0-74				
CD4027	0-55	CD4052	0-97						

P. D. BOX 75B
OXFORD
Tel. 0865 49791



KITS

NEW



AUTOCLOCK
"AUT-CK"
£17-85

The SINTEL Autoclock is a four-digit car clock in an attractive mini white case. Features: large 0.5in red LED displays—High frequency quartz crystal timebase—an internal backup battery supplies power if the car battery voltage drops below nine volts when starting the engine, or if the clock is temporarily disconnected—only high quality components are used, Finer resistors, roller-tinned fiberglass PCB's, etc. Full instructions included. Simple but sophisticated circuitry gives you good performance at low cost. You benefit from our experience in clock design.

Complete kit/less battery—Order as 'AUT-CK'.....	£17-85
Also available less case—order as 'AUT-MODULE KIT'.....	£16-45
Other Kits: For details see previous ad or Catalogue.....	£26-80
'ACK' Advanced 8 digit alarm clock kit.....	£12-90
'GCK' 4 digit mini mantelclock (green displays).....	£8-28
'XTK' 50Hz crystal timebase kit.....	£19-85
'ACK + BBK + XTK'.....	£33-50
'GCK + GBBK + XTK'.....	£19-85

Send or phone for FREE CATALOGUE giving details of our complete range of Clock kits, LED displays, Cases, and other components

memory ic's and microprocessors

Please: Microprocessors should only be bought by experienced constructors. Sorry, we cannot answer technical queries or supply data other than from our data selection.

IM6100CCDL.....	£58-00	MPU s	6820	£17-67
8080A (2uS).....	£43-65		6850	£17-67
6800.....	£33-87		8224	£9-76
ISPA500 (SC/MP).....	£18-75		8228	£12-16
2650.....	£27-90		8251	£17-67
			8255	£17-67

MEMORY IC's				
Intel 2102-4 (New version of 2102-2, 16 pin IC, TTL compatible, Single +5V supply, 650nsec., 1024 x 1 bit Static NMOS RAM.....)				£3-35
Intel 2112-2 650nsec. 256 x 4 bit Static NMOS RAM.....				£4-78
Interrail IM598C CMOS 1024 x 1 bit Static RAM.....				£8-05

SINTEL

Add 8% VAT + 25p P. & P. on all orders. Phone orders see 'Fast service' for details. Export orders welcome, but you must contact us first for special order form and postage rates. OFFICIAL ORDERS WELCOME.

PE ORION

STEREO TUNER

Complete set of semiconductors £4-99
Mullard LP1186 tuner head £7-75
High quality glass fibre P.C.B. £2-45

STEREO AMPLIFIER

Complete set of semiconductors £9-40
High quality glass fibre P.C.B. £2-75

FERRANTI semiconductors

BC107P	11p	ZTX108	9p	ZTX330	17p	ZTX530	18p	ZS176	33p
BC108P	9p	ZTX109	11p	ZTX331	18p	ZTX531	19p	ZS178	54p
BC109P	11p	ZTX212	15p	ZTX382	16p	ZTX550	16p	ZS270*	14p
BC415P	17p	ZTX213	15p	ZTX383	15p	ZTX551	17p	ZS271*	23p
BF559	14p	ZTX214	17p	ZTX384	17p	2N3055*	70p	ZS272*	24p
BF560	15p	ZTX239	10p	ZTX450	16p			ZS274*	29p
BF561	15p	ZTX300	12p	ZTX451	16p			ZS276*	36p
BF596	14p	ZTX301	16p	ZTX500	13p	DIODES		ZS278*	57p
BF597	15p	ZTX302	15p	ZTX501	14p	ZS142	38p		
BF598	16p	ZTX303	18p	ZTX502	16p	ZS170	13p		
ZXA20	10p	ZTX304	19p	ZTX503	17p	ZS171	16p	ZENERS	
ZX107	11p	ZTX300	16p	ZTX504	20p	ZS174	25p	BZV19 series	
								4.7 to 47V	10p

FERRANTI CDI INTEGRATED CIRCUITS. All with circuits and data.
ZN414 radio microcircuit £1.00, ZN424E low noise audio i.c. £1.00
ZN425E* D to A converter £3.50, ZN1034E* precision timer i.c. £1.80
ZN1040E* universal Count/display i.c. £7.50

PE TV SOUND SEPARATOR

Complete kit of semiconductors £2.30, High quality glass fibre p.c.b. £1.00
Murata ceramic filters—SFE6.0MA 35p, CDA6.0MC 35p each.

PHASE LOCKED STEREO DECODER

To Motorola specification, COMPLETE KIT ONLY £3.50, including MC1310P, glass fibre p.c.b., all resistors & capacitors, LED indicator and full instructions

MOTOROLA: MC1357PQ £1.65, MC1310P £1.80, BD699* £1.14, BD700* £1.28, M34032* £5.17, M34035* £4.95

PE OPTO REV. COUNTER, MS44 photocell, £1.35
PE JOANNA: 771X108 for £5.00, 183ZS170 diodes for £15.00.

POSTAGE AND PACKING: 15p per order. Orders over £5.00 post free. All devices top grade, brand new and to full manufacturers spec. We do not sell seconds or rejects. Send SAE for our data sheet and price list. We can supply any Ferranti semiconductor device to order.

PRICES DO NOT INCLUDE VAT—ADD 8% TO ITEMS MARKED * AND 12% TO ALL OTHERS.

DAVIN ELECTRONICS

PO BOX 38 OLDHAM LANCS. OL2 6XJ

The MINISONIC 2

probably represents the best value for money in electronic music today. Kits are available for complete instruments or individual sections, or for the conversion of Mk. 1 Minisonics to Mk. 2 specification. (Conversion details apply to Eaton Audio P.C.B.s, but may be adapted to suit others.)

In order to ensure that the appearance of the complete instrument enhances its performance, a complete cabinet kit is available, incorporating a fully finished black enamelled, silk-screened front panel, with matching back and base, and solid Afrormosia end-cheeks. This kit also includes all switches, knobs, sockets, screws and panel indicators. Suitable keyboards and contact assemblies are also in stock.

Kbd. Control MS2/3	£9-54	Output Amps. MS2/11	£7-52
V.C.O. (single) MS2/4	£18-66	Inverter MS2/12	£0-90
Env. Shaper + V.C.A. MS2/5	£7-57	Power Supply MS2/13	£9-90
H.F. Osc. + Det. MS2/6	£2-13	Conversion Kits	
Hold Isolator MS2/7	£3-56	V.C.O. (single) MS2/15C	£12-15
V.C. Filter MS2/8	£8-29	Ancillary Functions MS2/14C	£12-84
Ring Modulator MS2/9	£4-13	Main P.C.B. EA0014	£4-20
Noise Gen. MS2/10	£2-80	P.S.U. P.C.B. EA0015	£2-05

COMPONENTS

741	£0-27	MFC 4000B	£0-70
LM318	£2-86	CA 3046	£0-60
FET-MOPA	£3-63	MD 8001	£1-56
ZN 424E	£0-70	2N 5459	£0-54
MC 1306P	£0-53		

LAST FEW TO CLEAR

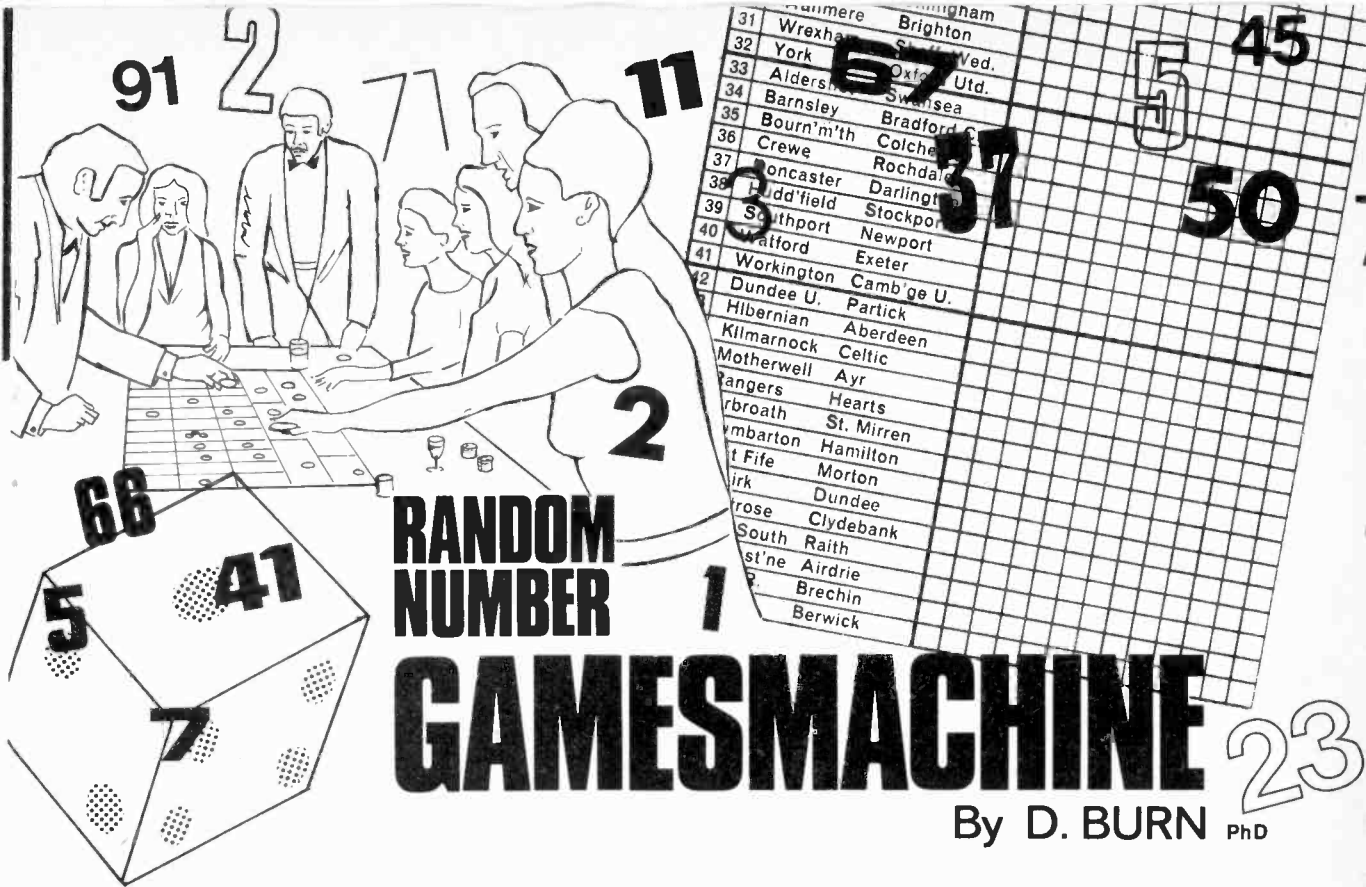
Minimix-6 4 in 1 composite P.C.B. £1-00
Minimix-6 screened, black front panel £2-00
Stereo Jack Plugs (chromed brass) £0-35
Stereo Jack Socket £0-20
Pair—Plug and Socket as above £0-55

We also stock E24 Series Resistors in metal oxide and carbon film, all types of capacitors, pots, hardware, etc., all available off the shelf at very reasonable prices. Please send S.A.E. with 'Wants' list, and solve your supply problems.

EATON AUDIO

DEPT PE, P.O. BOX 3
ST. NEOTS, CAMBS
PE19 3JB

TERMS: MAIL ORDER ONLY. C.W.O. MINIMUM ORDER £1. VAT: Please add 12½% 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.



RANDOM NUMBER

GAMESMACHINE

By D. BURN PhD

A CHANCE remark, in humorous vein, by a neighbour sparked off the train of thought that led finally to a versatile random number generator. "Can't you," he asked, "make a gadget that will win the 'pools' for me?" I explained that I didn't think that I could do an H. G. Wells and produce a time machine, and that perhaps some sort of random number device was the most likely alternative. At least, the chances should be about the same as with "Ernie" and a Premium Bond.

As the idea took shape, it became clear that any such device need not be limited to the football pools, and so the final design incorporates switching for four modes of operation: a random number generator up to a maximum of 99, a pools game selector limited to 59, a roulette wheel counting up to 36, and a dice simulator in which each digit has a maximum value of 6.

PRINCIPLE

In order that the circuit shall be as free as possible from external influences, two essentially random events are employed in selecting a number. First, a white noise generator produces a sequence of pulses which are quite random with respect to time and second, these pulses are counted for a relatively long and indeterminate length of time. A block diagram which demonstrates this principle is shown in Fig. 1.

Operation of the "play" switch sets the bistable which enables the gate so that the stream of very high speed pulses from the noise generator is passed into the counting circuit. When this happens, the free-running clock circuit will be at some unknown point in its operating cycle, so that a short and indeterminate time later its next output will reset the bistable, stopping the count and displaying the result on the two seven-segment displays. During this period, the

counters will have cycled through their count sequences a very large number of times, and it has been so arranged that the displays are blanked during counting so that there can be no possible indication of the final result until the number has been selected and displayed.

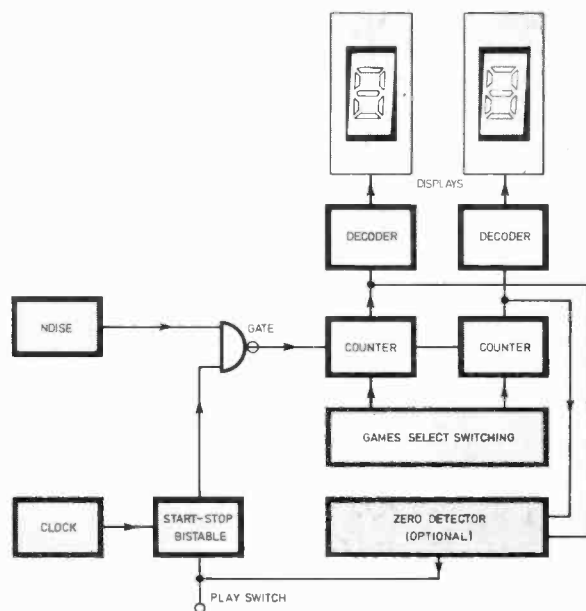


Fig. 1. Block diagram of unit

CIRCUIT

The major part of the circuit is shown in Fig. 2. The noise signal is derived from the base-emitter diode of transistor TR1 and is further amplified by TR2 and TR3; the resulting signal is squared and limited by IC1a, which is one half of a dual TTL Schmitt trigger, type 7413, which also doubles as the signal gate. The clock pulse is produced by the very simple unijunction oscillator TR4, which has a period of about 3-4 seconds; its output is also squared, in the second half of

the Schmitt IC1b. The bistable IC2 is a TTL type 7472 J-K flip-flop, whose J inputs are permanently at a logic "0" level and K inputs are permanently "1". Thus the clock pulses will keep it in the "reset" state in which the Q output is "0" (pin 8) which inhibits the signal gate IC1a.

Pressing S1 places a "0" on the "set" input of the bistable which overrides all other inputs and causes a "1" to appear at the Q output, so enabling the signal gate. At the same time, the "0" at the Q output (pin 6)

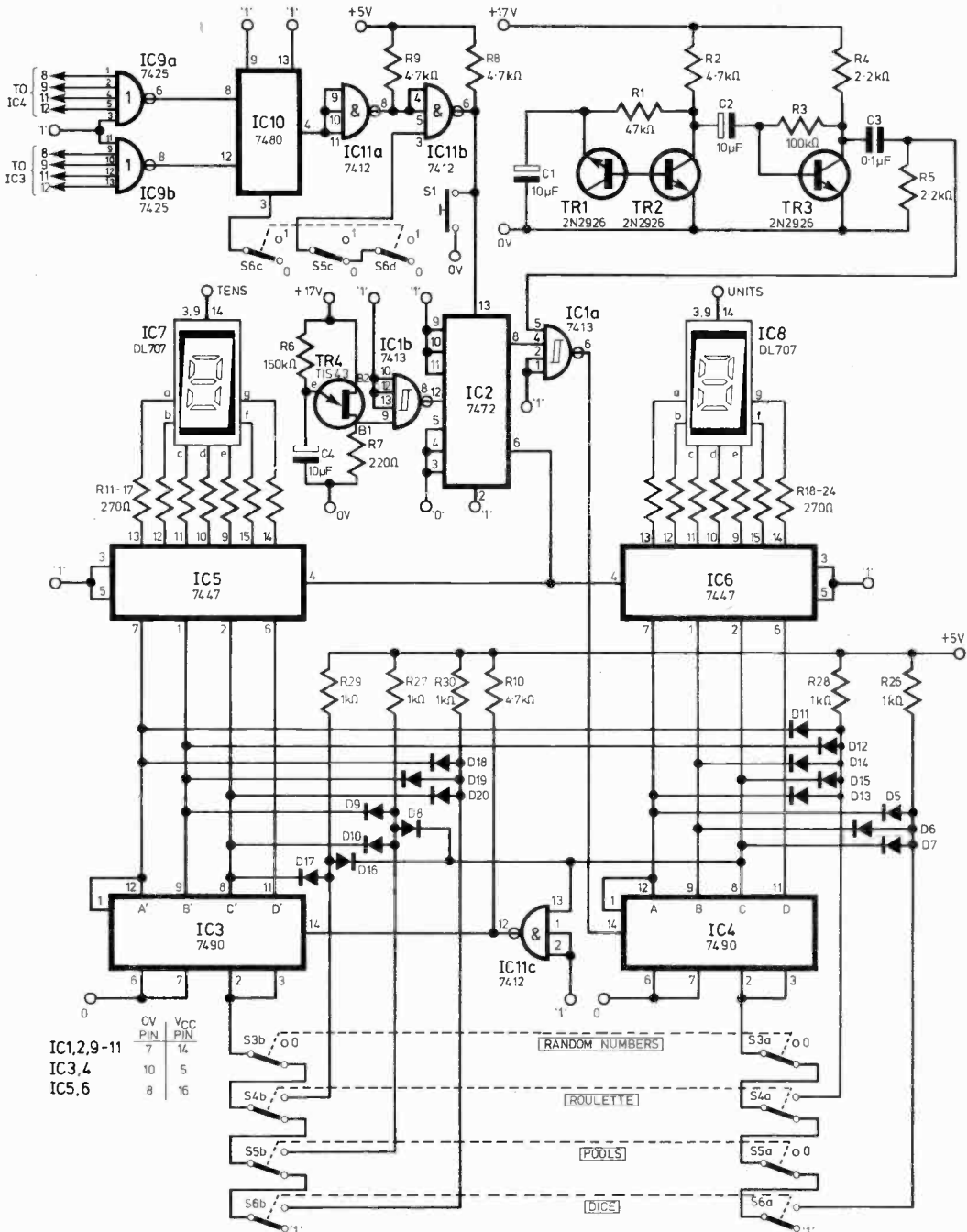


Fig. 2. Pulse circuitry for the Games Machine

is applied to the blanking inputs of the decoders IC5 and IC6, so blanking the displays while the count is in progress. The next clock pulse to arrive at the bistable after the "play" button is released resets it, stopping the count and enabling the displays. The counting chain consists of the two 7490 decade counters IC3 and IC4, the decoders IC5 and IC6, and the DL707 displays IC7 and IC8.

In a chain of counters, it is normal practice to drive each decade from the D output of the preceding decade, but in the present application this method will not work. Consider, for example, the dice option. The "units" counter cycles up to 6 and then resets, so that the D output never changes state, and cannot possibly provide the carry pulse for the "tens" counter. However, inspection of the truth table of the 7490 counter shows that the C output also changes state once per decade, and can therefore provide the necessary carry pulse. Unfortunately, the required "1" to "0" transition occurs on the count of 8, and this gives rise to some further problems in the roulette option. Inverting the C output produces the required transition on the count of 4, and it turns out that this is perfectly suitable for all the options that are to be provided. Of course, it does give rise to a most peculiar count sequence, since the "tens" counter will now increment each time the "units" counter reaches 4. While this may appear very odd, no numbers are missed, and the actual sequence is quite irrelevant in this application.

MAINS POWER UNIT

Power for the circuit is applied by a simple mains power unit (Fig. 3) based on an integrated voltage regulator IC12 which provides a stabilised 5 volt output; the noise and clock generators require a higher voltage and so their supply is taken from the bridge output of about 17 volts. In the prototype, the seven-segment displays are also powered from the output of the i.c. regulator and the current limiting resistors R11-R24 were chosen accordingly to be 270 Ω . However, the current drain is such that the regulator is running close to its maximum dissipation and it does get rather hot. While a small heat sink is shown in the constructional details, a better solution would perhaps be to run the displays from the un-stabilised 17 volt line, and increase the limiting resistors to about 820-1,000 Ω ; although this has not been tried out, it is standard practice and should not give any trouble.



GAMES SWITCHING

Without further modification, the circuit so far described will count from 00 to 99 and continuously recycle. This is fine for the random number option, but for the other options it is necessary to limit the count cycles. To do this, use is made of the reset-to-zero facility of the 7490 counter; in order to count, this input must be held at the logic "0" level. A "1" at this input will immediately reset the counter to zero and inhibit further counting until the "0" level is restored. In principle therefore, it is simply necessary to detect the required maximum count and to cause a "1" to momentarily appear at the reset-to-zero input. In practice, it is rather more complicated because several different counting cycles are required.

The switches which carry out this selection are S3/S6, linked so that depressing one switch releases the others. They are all shown in the released position, so that there is a connection through all four switches from the reset-to-zero input to a logic "1" level. Thus any attempt to operate the device without one of the games being correctly selected will cause the displays to permanently show zeros.

The required maximum count is detected by decoding its binary equivalent in the diode-resistor gates; at this time, all the inputs to the selected gate will be at a "1" level, so that its output will also go to "1". This "1" level is then routed to the reset-to-zero input of the appropriate counter by one of the switches.

Switch S3 selects the random number option. Hence operation of S3 applies a logic "0" to counter IC4 via S3a, and to counter IC3 via S3b; both counters are therefore permanently enabled and cycle through the full 00-99 count as required.

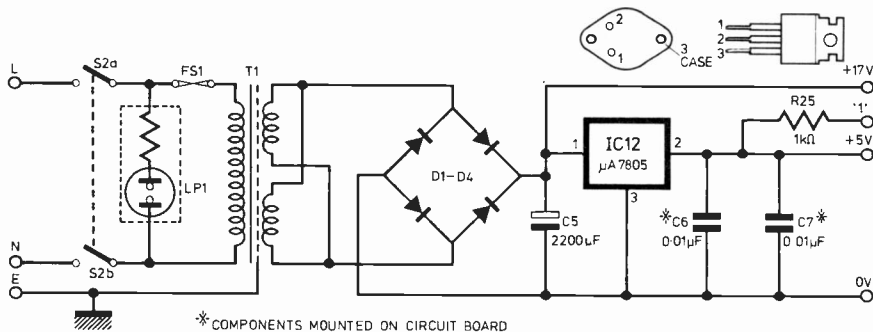


Fig. 3. Mains power unit

Switch S4 selects the roulette option, in which the maximum count will be 36; the counters must therefore be reset as soon as the count of 37 is reached. Examination of the count sequence around this number reveals that two resetting operations will be necessary. First, 37 is detected by the gate D11, D12, D13, D14, D15 and R28 and the reset signal is applied, via S4a, to the units counter only. This ensures that the counts of 30-33, which would have been lost if both counters had been reset to zero, do in fact appear. Next, the count of 44 is detected by gate D16, D17 and R29 and the reset signal is applied, via S4b, to the tens counter; if the full sequence is written out, it will be seen that no numbers are lost. The maximum number of matches on a football coupon never exceeds 60, and so for the pools option the count is limited to this number. Looking once again at the counting sequence around 60, we find that the first number that appears in the sixties is in fact 64:

... 57 58 59 50 51 52 53 64 65 66 ...

so this is detected by the gate D8, D9, D10 and R27 and applied to the reset-to zero of the "tens" counter only; the modified count is then: 52 53 64 4 5. Switch S5b is used for this reset signal; S5a applies a "0" to the reset of the units counter so that the full 0-9 range is covered.

Finally, the much simpler dice option. Each counter is required to cycle up to 6, so that 7 has to be detected individually for each counter and used to reset it. D5, D6, D7, R26 and S6a carry out this operation for the "units" counter, while D18, D19, D20, R30 and S6b do the same for the "tens" counter.

ZERO DETECTOR

The circuit that has so far been described may be built without further elaboration and will operate exactly as planned but, there is a small snag. We have so far been very concerned with the various maxima that are required for the different games, but the corresponding minima have been ignored. This is fine as far as random numbers and roulette are concerned, for a selection of 00 is perfectly acceptable. However, there is no match number 0 on a pools coupon, neither do dice have zero on any face.

An optional extra to the circuit is therefore some additional logic which will prevent these forbidden scores being selected. What then are the requirements for such a circuit? It must of course know which game has been selected so that it will know when and how to operate; clearly, some additional switching will be necessary. It must be able to detect the zeros, and determine whether a single zero is permissible (for example, 04 or 20) as for the pools, or whether neither digit is allowed (dice); should either of the forbidden states be selected, the circuit should initiate a new count, and continue to do so until an allowed selection is made.

The counter outputs are wired to two 4-input NOR gates IC9a and IC9b (7425), each of whose outputs will be a "1" when, and only when, all its inputs are "0". Next, these "1"s must be combined in a circuit that will distinguish between the "either" and "both" requirements, that is, it will perform the logical AND and OR functions at will.

Whilst there are several ways in which this may be implemented, a particularly simple way in practice is to use an i.c. full adder; the truth table for the 7480 one-bit adder shows that when the "carry" input is at a logic "0", the "carry" output performs the NAND

COMPONENTS . . .

Resistors

R1	47k Ω
R2	4.7k Ω
R3	100k Ω
R4	2.2k Ω
R5	2.2k Ω
R6	150k Ω
R7	220 Ω
R8	4.7k Ω
R9	4.7k Ω
R10	4.7k Ω
R11-R24	270 Ω
R25-R30	1k Ω
All	$\frac{1}{2}$ W carbon

Capacitors

C1	10 μ F, 16V, tantalum
C2	10 μ F, 16V, tantalum
C3	0.1 μ F
C4	10 μ F, 16V, tantalum
C5	2,200 μ F 25V electrolytic
C6	0.01 μ F
C7	0.01 μ F

Semiconductors

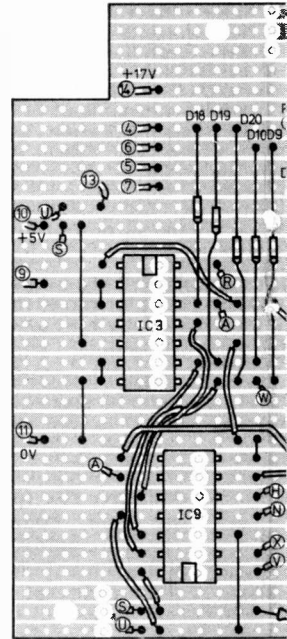
TR1	2N2926
TR2	2N2926
TR3	2N2926
TR4	1N543 or 2N2646
IC1	7413
IC2	7472
IC3	7490
IC4	7490
IC5	7447
IC6	7447
IC7	DL707
IC8	DL707
IC9	7425
IC10	7480
IC11	7412
IC12	μ A7805 or similar 5 volt regulator
D1-D4	1N4001 or 50 volt, 1 amp bridge
D5-D20	1N914 or similar general purpose silicon diode.

Switches

Push-button switches with 8-switch mounting frame including latching bar and return spring (Doram), and 6 buttons (square opaque)	
S1	2-pole changeover
S2	2-pole mains
S3	2-pole changeover
S4	2-pole changeover
S5	2-pole or 4-pole changeover according to version built
S6	2-pole or 4-pole changeover according to version built

Miscellaneous

Two-tone polystyrene case, size 188 \times 110 \times 60mm (Doram type 509-585)	
Transformer miniature 6VA, 0-12V, 0-12V secondaries (Doram)	
Miniature group panel	
"Soldercon" pins	
Veroboard, 0.1in matrix, 86 \times 180mm	
6BA threaded rod, sundry nuts and bolts	
Small pieces of celluloid and 18swg aluminium	
Lightweight, colour coded, single core and stranded hook-up wire	



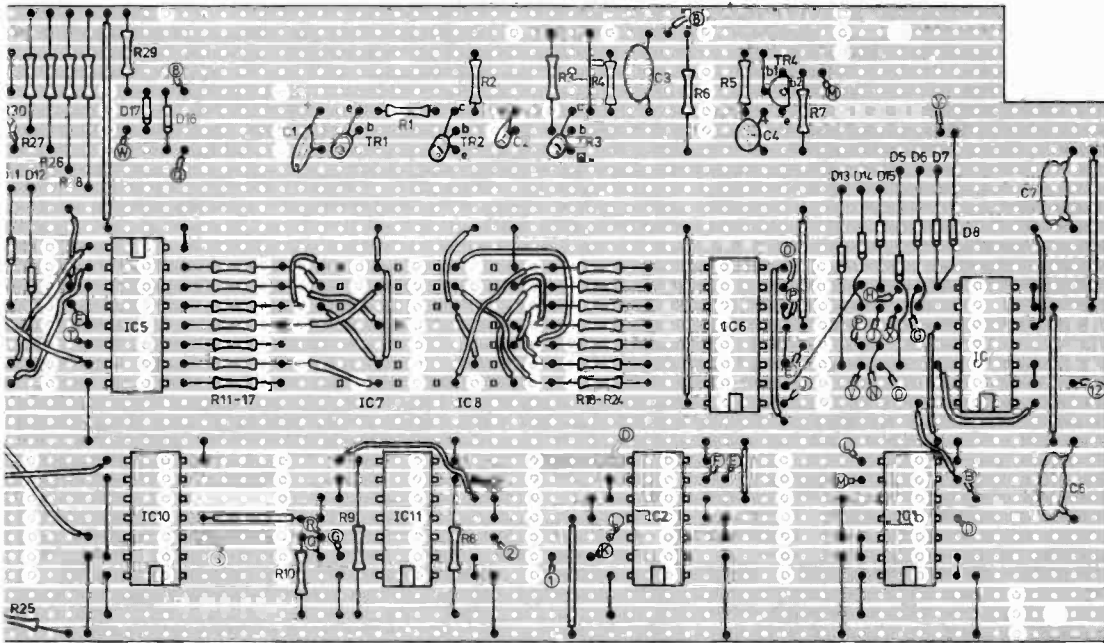


Fig. 4. Main board wiring and assembly

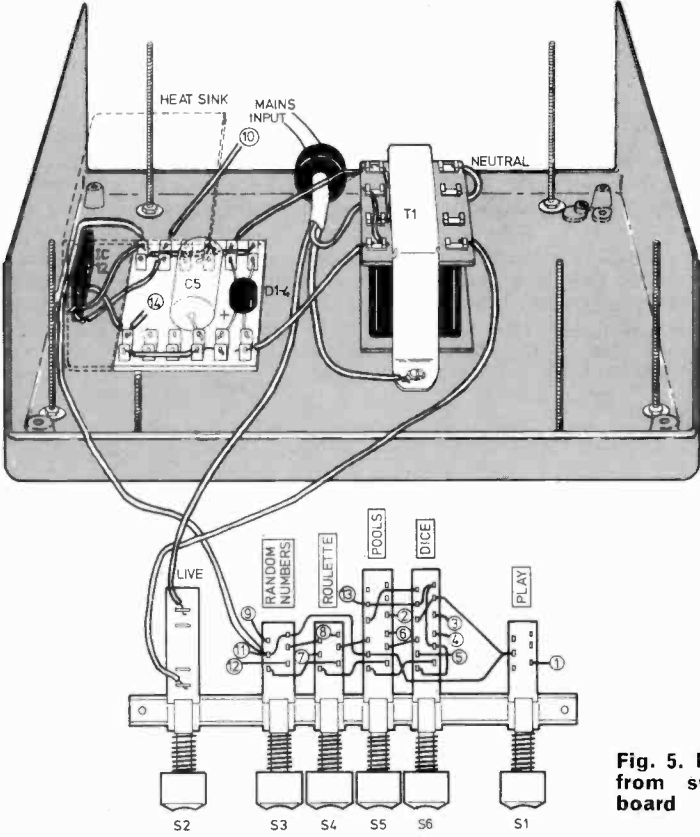
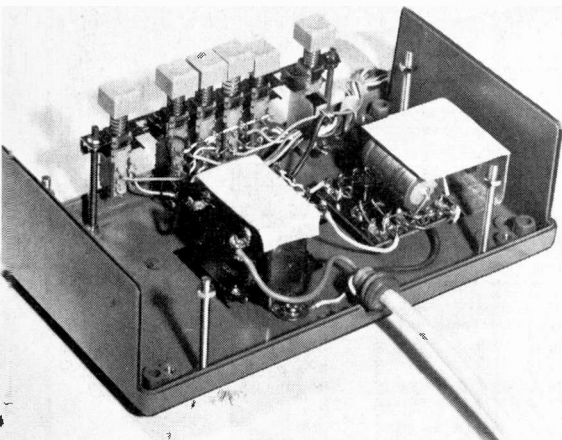


Fig. 5. P.s.u. assembly and wiring from switch assembly to main board



The unit with the main board removed showing the p.s.u. Note the angled heat sink for IC12

operation on the inputs A and B, while a logic "1" on the "carry" input produces the NOR function:

A	B	Carry in	Carry out	
0	0	0	1	} NAND
0	1	0	1	
1	0	0	1	
1	1	0	0	
0	0	1	1	} NOR
0	1	1	0	
1	0	1	0	
1	1	1	0	

Thus, by inverting the "carry" output of the adder, the desired AND and OR functions are obtained. The "carry" input is used as a control and is supplied by a further pole on the dice switch, S6c (Fig. 2), so that when dice is selected, a "1" is applied and the OR operation is carried out; for all other options, the AND function results.

However, this circuit is only required to operate on the dice and pools options, so a second gate IC11b is enabled by application of a "1" to one of its inputs by S5c or S6d when these games are selected; selection of the other alternatives disables this gate so that its

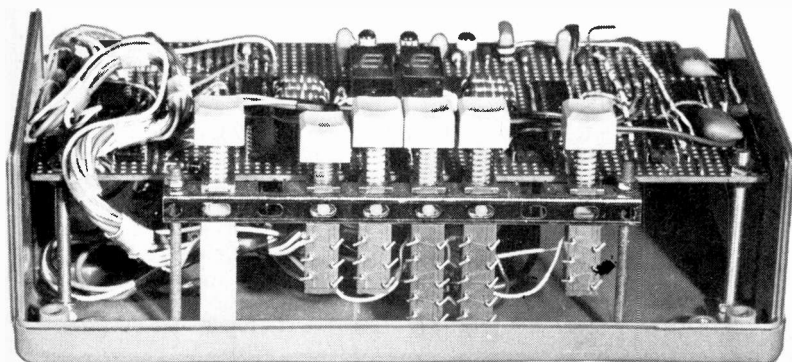
output is permanently "1". So now we have the result that whenever a forbidden selection is made, as determined by the extra switching, the output of the gate IC11b goes to a logic "0" level, and this is precisely what is required to set bistable IC2 and restart the count; it will be recalled that the "set" input of the J-K flip-flop overrides all others so that correct operation is assured. Because the restart signal has to be combined with the "play" signal from S1, it is necessary to use an open-collector gate for IC11b so that the "wired-or" connection can be utilised; IC11a, b and c are therefore the three open-collector gates of the 7412 package, and each requires a pull-up resistor R8, R9, and R10.

CONSTRUCTION

Most of the components, and all of the i.c.s, are mounted on a single piece of 0.1in matrix Veroboard approximately 86 x 180mm; the length in particular should be trimmed so that the board is a snug fit in the case. Note the two cut-outs to clear the fixing pillars which are moulded into the case.

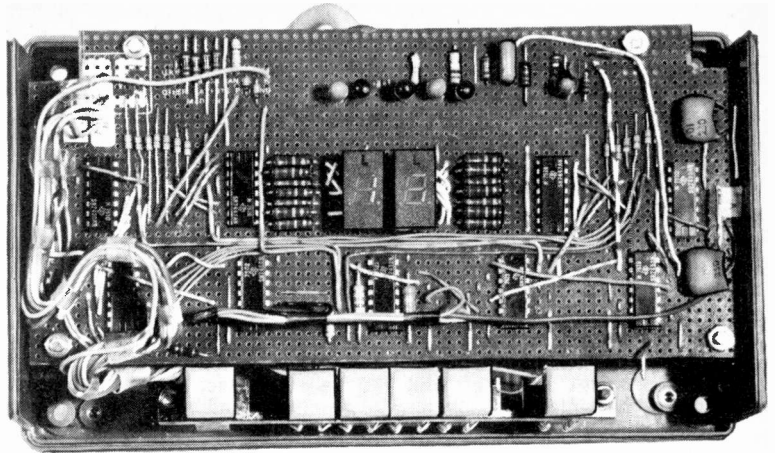
As may be seen from Fig. 4, the l.e.d. displays are set roughly centrally on the board, which is held in place just below the top of the case by four pillars cut from 6BA threaded rod. Along the long side of the board is mounted the assembly of pushbutton switches, also on 6BA pillars, and underneath it is the mains transformer and the power unit.

The circuit board itself is fairly complex, and it is recommended that the following system is adopted in its assembly. First the i.c.s are mounted in position and then used as reference points to identify the breaks in the copper strips; it is vital that none of these are missed. Note that all the i.c.s with the exception of the displays are mounted directly on to the board. These latter are set in holders of Soldercon pins which, together with their extra long leads, ensures that they are higher off the board than any other component; it also conveniently allows some of the wiring to pass between the package and the board. Next, the connection of each individual i.c. to the supply strips, together with any connections to logic "1" and "0" levels, is tackled, using a lightweight, single-core insulated wire. Finally, the interconnections between the i.c.s are completed.



Showing how the Doram push-button switches are mounted on the eight switch mounting frame. For wiring details see Fig. 5

The majority of the flying leads to the main board are made up as a loom and numbered as shown in Fig. 4. Lead interconnections on the board, however, are shown lettered



The switch assembly is constructed from Doram pushbutton switches; although only six switches are used, they are mounted on an eight-switch mounting frame, with spaces between the first and last switch (on/off and "play") and the central group of four game selector switches. Assembly details should follow the instructions in the Doram catalogue, the following points being noted:

The on/off switch is of the push-on/push-off type and is used as supplied.

The "play" switch is push-on/release-off so that the action link should be removed.

The four selector switches are used in a latched mode. They are linked so that pushing one releases all the others. The action links are removed from all four and the latching bar, which must be cut down from the eight-switch length supplied to a four-switch length, should be fitted as per instructions; the latching return spring is fitted to the right hand switch.

The complete assembly is again mounted on long pillars cut from 6BA threaded rod so that the four-pole switches just touch the bottom of the case; the buttons will then be found to project through the top of the case by just the correct amount. There are several choices for the style and colour of these buttons; possibly the square, grey type best match the case and the dimensions given later are for this type.

The wiring of the switches is shown separately in Fig. 5.

TESTING

By its very nature, it is impossible to tell whether the completed unit is operating correctly. A test procedure must therefore be adopted, and this requires a few temporary modifications to the circuit. First, the noise and clock generators are disconnected from the remainder of the logic. The rather slow pulses from the unijunction oscillator may easily be seen by monitoring the voltage across R7 with a multimeter; the noise generator can only really be checked with an oscilloscope—which incidentally will confirm the random nature of its output as it will be found impossible to synchronise the time-base to noise waveform. A push-on/release-off switch should be

connected between IC1, pin 9 and the 0 volt line, and the blanking inputs of the decoders IC3 and IC4, pin 4, should be wired to the logic "1" line so that the displays remain on. Finally, a slow pulse wave at, say, 1–2Hz should be fed into the signal gate IC1, pin 5; in the absence of a pulse generator, a simple unijunction oscillator such as that shown in Fig. 2, but with C4 reduced to 2 μ F, will suffice.

It is now possible to start and stop the logic circuit at will, and to observe the count sequences whilst it is running. The following checks are carried out:

1. With no game selected, that is, with all the switches out—which can occur if the switches are not fully depressed, the display will show 00 and will not count when the "Start" switch is pressed.
2. Random numbers selected: on pressing the "Start" button, the display will cycle from 00 to 99 in the rather curious sequence already described; it can be stopped—with the temporary "stop" switch—at any count, including 00.
3. Roulette: the count will reach 33, via 36 30 31 32, reset to 04, and continue 05 06 07 . . . ; the count can again be stopped at 00.
4. Pools: the count will follow the sequence . . . 58 59 50 51 52 53 04 05 . . . It can be stopped if a single zero is displayed, e.g. 03, 40, but if two zeros are shown, the stop signal will be ignored and counting will continue.
5. Dice: neither display will show a number greater than 6, and the count cannot be stopped if either or both displays show a zero.

Providing that all these responses are correct, the temporary connection between the decoder blanking inputs and "1" should be removed and these inputs should be reconnected to the Q output of the bistable (IC2, pin 6). Now when the "Start" button is pressed, the display will blank out and will remain blanked until the "Stop" button is pressed, when the selected number will be displayed. If this also checks out, all the remaining temporary connections should be removed and the circuit completed. ★

SEMICONDUCTOR UPDATE

By R.W. COLES

RC4194
DF215
ZN423T

PERSONAL AWARD

As regular readers of this column will be aware, I am eternally grateful for the way that integrated circuit technology continues to solve all those little housekeeping problems which crop up in all the circuits I put together. You know the sort of thing, when you are building a circuit with a sprinkling of 741 op-amps and a few CMOS gates which will perform (you hope!) the most amazing electronic miracles, you really don't want to have to spend nail biting hours inventing a power supply regulator to provide the necessary milliamps. No, what you want is a ready-made, off-the-shelf solution so that you can concentrate on the creation of those electronic miracles, and these days, thanks to the variety of regulator chips available, to a large extent your needs (and mine) have been satisfied.

Any addition to this existing pool of labour-saving goodies is always welcome, and a new device from Raytheon, the **RC4194** dual tracking voltage regulator, has just been awarded my own personal "Good-Housekeeping Award" for services to overworked designers.

The two outputs of the regulator track to within 2 per cent and their magnitude can be set with a single resistor to any voltage between the limits $\pm 50\text{mV}$ and $\pm 42\text{V}$. Output current from each rail is a creditable 200mA, although, of course, due attention must be paid to the power dissipation rating of the device in individual applications.

To give flexibility in power dissipation the RC4194 is available in two package styles, the suffix D 14-pin d.i.l. which will handle 900mW, and the suffix TK 9-pin TO66 which can handle 3W.

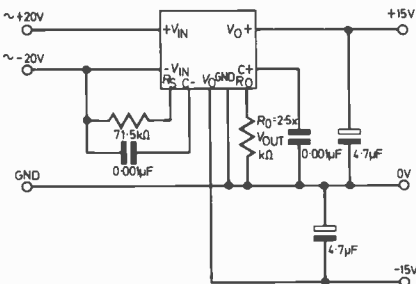


Fig. 1. The RC4194 used for an op amp supply

POINT-TO-POINT

My next offering is something of a challenge, because what I want to describe is an all-singing, all-dancing new device, which I could ramble on about for at least a couple of pages, if space permitted!

The **DF215** is described by its manufacturer, Siliconix, as a Dual Set Point Timer/Counter, for automatic control interval timing, but its true usefulness and originality can only be appreciated after an extended perusal of the bulging data-sheet. The DF215 is an MOS l.s.i. circuit in a 28-pin plastic package which will run happily on supplies between 8 and 20V, and which offers a multitude of different timing, counting, and control functions.

The logic of the chip breaks up into three basic building blocks. A versatile counter which can count events or act as an accurate timebase when driven by 50Hz mains frequency. A double comparator which can continuously compare the four most significant digits of the counter with the inputs from two banks of four digit thumbwheel switches, and a display driver which provides synchronised outputs to display the current contents of the counter in seven-segment decimal form.

Flexibility of the chip is ensured by four control inputs which configure the internal circuit blocks in a variety of different ways, making this much more than just another clock chip. With appropriate control functions switched (or wired) in, counting can be from 50 or 60Hz mains frequency or from an asynchronous pulse (event) input. Counter range can be 0 to 999.9 seconds, 0 to 99 minutes 59 seconds, 0 to 999.9 minutes or 0 to 99 hours 59 minutes. Using the

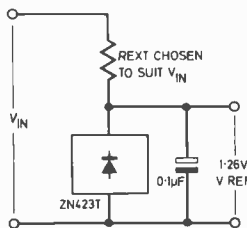


Fig. 2. The ZN423T as an accurate voltage reference

event input as a count source, 0 to 9999 events can be totalised.

The chip serialises the BCD data from the two four digit thumbwheel switch banks (set points A and B), and compares their setting with the counter. When either comparison is valid, a control output is produced providing accurately controlled intervals of 0 to set point A, and set point A to set point B, when a 50Hz clock is used.

Inputs are provided to start the cycle or to reset it part way through if necessary, and by connecting the set point B output back to the start input, a continuous operating cycle can be maintained—Phew!

REFERENCE ONLY

I recently described the National LM399 voltage reference integrated circuit which had a temperature controlled heater as part of the chip in order to realise an extremely low apparent temperature coefficient. This novel idea yielded a high precision reference source, but there are other ways of realising a low temperature coefficient which are potentially cheaper to produce and which devour less current, if a small relaxation of specification is possible.

By clever design it is possible to produce a self-compensating reference such that a positive temperature coefficient in one part of a circuit is cancelled by a negative coefficient in another.

Past masters at ingenious chip design are Ferranti, and their new **ZN423T** device uses the self-compensation principle to yield an accurate, low voltage (1.26V) reference with a temperature coefficient of just 0.01 per cent per degree C. The reference elements of the ZN423T do not employ the Zener or Avalanche breakdown principles but in fact depend on the energy band gap of transistor base-emitter junctions.

The low voltage reference which results can be a positive advantage in low voltage circuits where previously it was necessary to step down the 6 volts or so from a standard low T.C. Zener type reference. The use of the band-gap principle also removes the noise source inherently present with the alternative breakdown mechanisms, making this new device attractive on several counts.

Breakdown TESTER

By M.H. GEORGE



THE unit to be described allows the testing of the voltage breakdown characteristics of electronic devices. This is particularly appropriate for checking the voltage ratings of transistors, rectifiers, Zener diodes, neon lamps, etc.

DEVICE CHARACTERISTICS

A voltage breakdown region is that area of the device characteristic where a large increase in current through the device results in only a small increase in voltage across it. A typical characteristic is shown in Fig. 1. This might represent current against voltage in a Zener diode, or the collector/emitter characteristic of a transistor with the base connection open-circuited.

Obviously if the current is allowed to increase too far, the power dissipated will eventually cause destruction of the device. If, however, the current is limited to a safe value, the breakdown may be observed non-destructively.

CONSTANT CURRENT GENERATOR

The ideal constant current generator is a power source which allows the voltage across any circuitry connected to it to rise until a set value of current flows in the network. This current is the same value, whatever the network connected. A generator of this type connected to a device having a voltage/current characteristic like that in Fig. 1 will cause the breakdown voltage to appear across the device, provided that the current generated exceeds the leakage current.

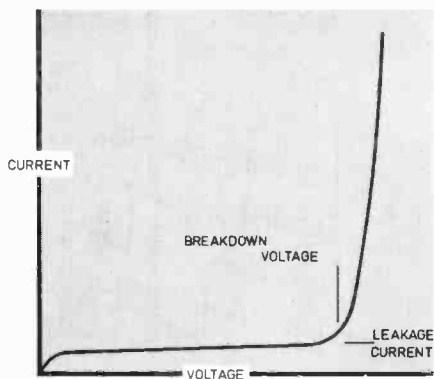


Fig. 1. Typical breakdown characteristic of a semiconductor junction

COMPONENTS . . .

Resistors

R1	220k Ω 1W carbon film
R2	25k Ω 10W wirewound
R3	330 Ω 2.5W wirewound
*R4	1.5k Ω 5W wirewound
R5	220 Ω 1W carbon film
R6	100 Ω
R7	56k Ω
R8	33k Ω
R9	910k Ω
R10-R13	1M Ω (4 off)
R14	10k Ω
(R6-R14 all 2% metal oxide)	

Potentiometers

VR1 10k Ω wirewound. At least 1W rating

Capacitors

C1 32 μ F 450V working electrolytic

Semiconductors

*TR1	2N5657 or MJE340
D1-D4	1N4007 (4 off)
D5	BZX61 C10 10V 1W Zener
D6	OA91 or any small germanium diode
D7	BZY88 C5V6 5.6V 400mW Zener

Miscellaneous

M1	50 μ A f.s.d. Coil resistance 1k Ω
T1	Pri: 240V. Sec: 200V 50mA approx. (e.g. Belclere MS3173)
S1	DPST mains toggle switch
S2	Press to changeover, momentary action microswitch
S3	2P 4W rotary switch
FS1	300mA A/S fuse and holder
LP1	Mains neon indicator

Heatsink and insulating kit for TR1

Instrument case. Red and Black 4mm terminals.

* See text

Note—If an external multimeter is to be used, R6-R14, D7, M1 and S3 are not required.

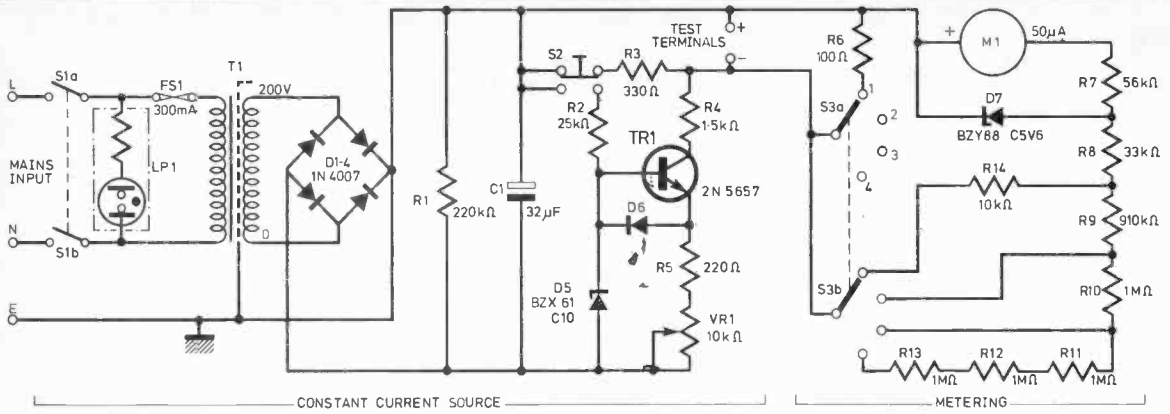


Fig. 2

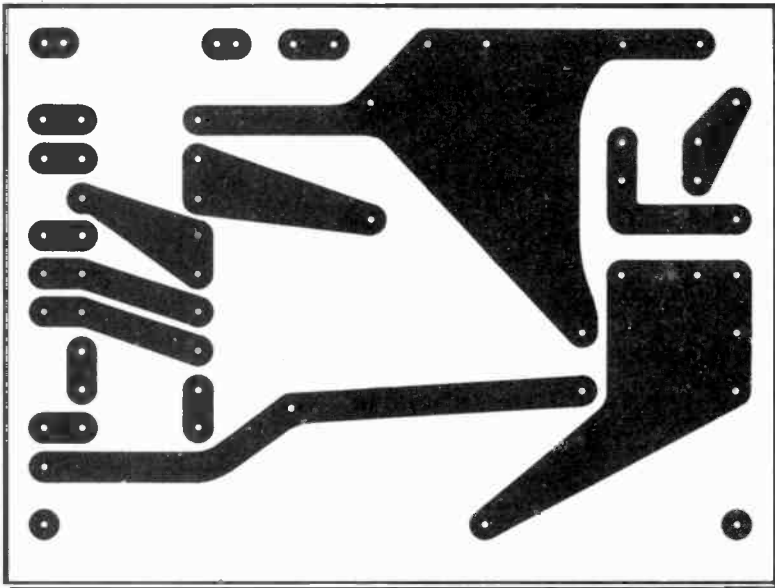
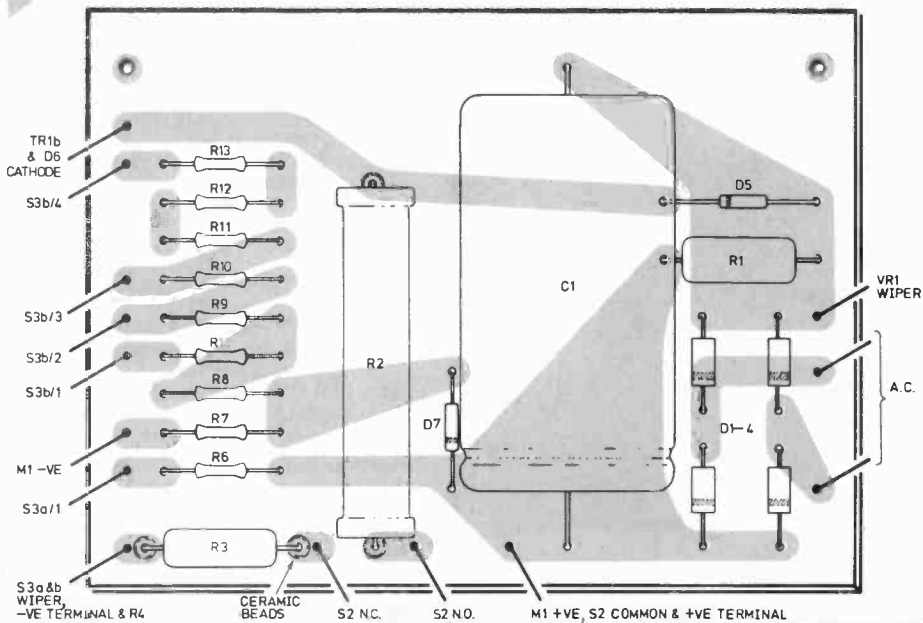


Fig. 3



PRACTICAL CIRCUIT

The circuit diagram of the complete unit is given in Fig. 2. Transformer T1 provides isolation from the mains, and the associated rectifying and smoothing components develop about 250 volts d.c. across C1. When S2 is depressed, about 8mA passes through R2 and D5, providing a 10 volt reference at the top of D5. This voltage, minus the V_{BE} drop in TR1, appears across R5 and VR1, so that a constant current of about

$$\frac{9.3}{R5 + VR1} \text{ amps}$$

flows in the emitter circuit of TR1. By transistor action, a fraction α (equal to the common base current gain—about 0.96 in the MJE340) of this current flows in the collector circuit, through R4 and the device connected to the test terminals. Thus VR1 varies the collector current, which is independent of the collector load until the transistor saturates. This occurs when the voltage drop across R4, R5, VR1 and the device under test approaches the voltage available across C1.

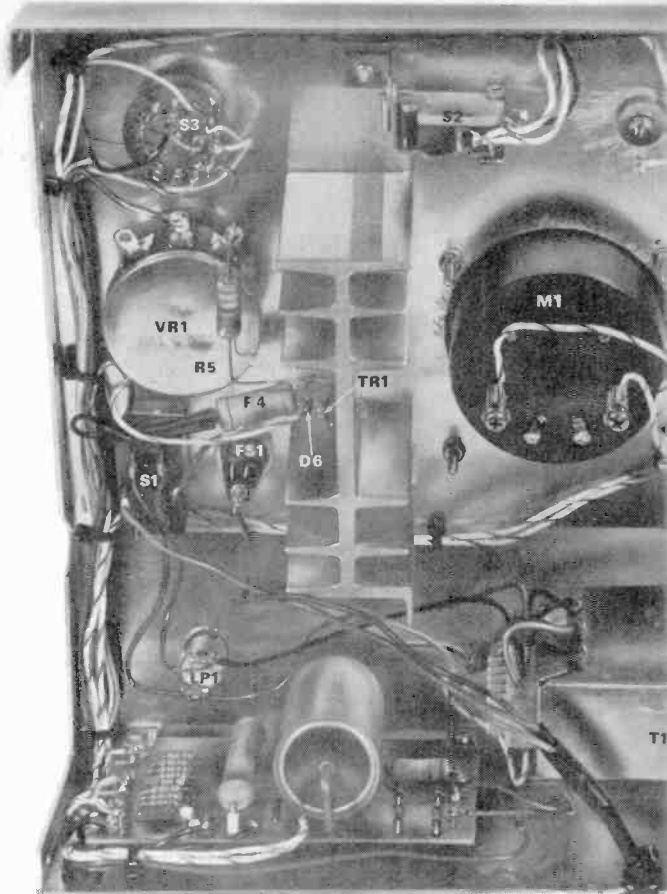
The meter circuit measures the voltage appearing across the test terminals, and thus across the device. Three ranges are provided, of 50V, 100V and 250V f.s.d. With S3 in position 1, the meter is connected as a milliammeter of 50mA f.s.d., and is used to set the test current.

The meter circuit is entirely optional, and a multimeter connected across the test terminals would be an acceptable alternative, especially where only occasional use is to be made of the unit. The "Set current" measurements may then be made straight through the multimeter on a suitable current range.

CONSTRUCTION

Most of the components are mounted on a printed circuit board (Fig. 3), which should be of glass fibre for preference because of the high voltages on some of the tracks. The wirewound resistors should be spaced about 6mm (0.25in) off the board.

Requirements for TR1 and R4 depend to some extent on the transformer secondary voltage. If this is rated at 200 volts r.m.s. or more, use a 2N5657 for TR1 and 1.5k Ω for R4. For 180 volts r.m.s. or less, a



MJE340 is suitable, and R4 (which merely protects TR1 and D5 in the event of collector/base breakdown) may be reduced to $\approx 20\Omega$ or 1k Ω .

For TR1, a heatsink such as that employed in the prototype is hardly necessary unless prolonged operation into near-short-circuit loads is anticipated. In most cases it will be sufficient to bolt the transistor to the metal case, making sure that the two are electrically isolated.

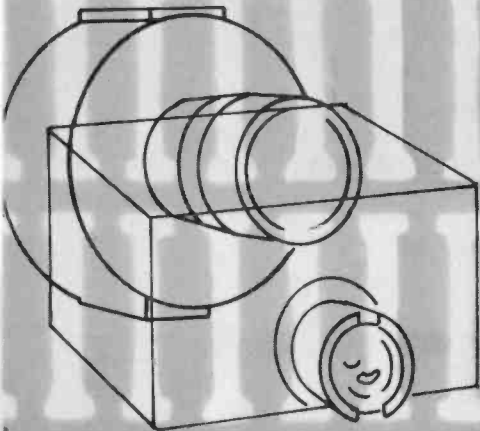
OPERATION

Before connecting the device to be tested, set the meter range switch to SET CURRENT, depress the TEST switch and adjust VR1 for the desired test current. Release the TEST switch.

Connect the device to be tested to the test terminals (red positive). Set the range switch to 250 volts. Depress the TEST switch and read the breakdown voltage on the meter, adjusting the range switch for optimum meter deflection.

The principal use for this unit will probably be for testing the collector/emitter breakdown voltages of transistors. It should be borne in mind that the collector/emitter leakage of some power transistors, particularly germanium, may be of the order of a few milliamps. A quick check on a multimeter set to the ohms range will reveal this. Also bear in mind that at maximum current, the device connected may dissipate up to 10 watts (250V \times 40mA)—easily enough to destroy a small high voltage transistor carelessly connected; also that 250 volts can give quite a nasty shock. ★





SOLID STATE TV CAMERAS

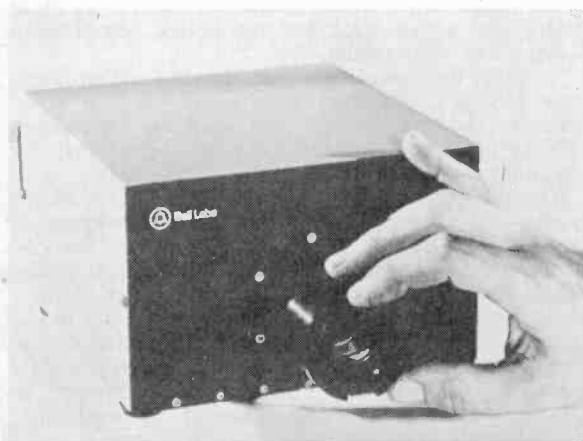
By D.V. EDDOLLS

CONVENTIONAL television cameras convert light to an electric charge pattern on a target in a vacuum tube. An electron beam scans the target producing a voltage waveform or video signal which is transmitted to the television receiver. However, these camera tubes are bulky, fragile and need a high voltage power supply.

Many military, industrial and commercial applications require compact, lightweight imaging systems. This need, combined with rapid advances in silicon technology, has resulted in all-solid state television cameras becoming commercially available. This article traces their development from relatively insensitive systems tested in the early sixties to present day cameras able to work at very low light levels.

INTEGRATED ARRAYS

In solid state imaging an array of light sensitive elements, such as photodiodes, replaces the continuous target of the conventional camera. The scanning electron beam is replaced by an electronic circuit which connects the output of each element in turn to the video amplifier.



Solid state colour TV camera (courtesy Bell Laboratories)

Integrated arrays of diodes are made by coating the semiconductor slice with a photosensitive resist, a solution of resins in organic solvents. This is exposed to ultra-violet light through a glass plate carrying an opaque pattern identical to the diode array.

The photoresist areas protected by the opaque pattern are dissolved away leaving a chemically resistant masking layer. The slice with its protective layer is then exposed to an *n* or *p*-type impurity under carefully controlled conditions. The impurity diffuses into the unprotected parts of the semiconductor to form diodes. Finally, the photoresist masking layer is removed.

Phototransistor arrays and integrated scanning circuits are made by the same technique. However, several stages of masking and diffusion are necessary.

PHOTODIODES AND PHOTOTRANSISTORS

When a semiconductor diode is used as a photo-detector it is usually operated in reverse bias. Under this condition negligible current flows in the diode unless light falls on it.

Light shining on the diode raises electrons to higher energy levels allowing them to cross the potential barrier at the *p-n* junction. This produces a current in the external circuit if its resistance is low compared with the junction resistance. If the circuit resistance is high a voltage is generated.

One of the earliest solid state imaging systems was developed by the IBM Corporation in America. The imaging array consisted of a line of 75 diodes, each 0.075mm by 0.25mm, in a silicon slice 1.27mm wide and 9.5mm long. In operation the diodes were normally biased in the forward direction. By scanning the array with a ramp voltage each diode in turn was switched into reverse bias producing an output current pulse proportional to the incident light.

The array was used in a facsimile system by mounting the document on a rotating drum and focusing its image onto the array. A line of type was scanned vertically by electronically scanning the array and horizontally by rotating the drum.

This technique, called linescan, in which movement of the object or the imager provides one

direction of scan, is widely used to provide a two dimensional image with a linear array. Examples include airborne surveillance and the monitoring of continuous industrial processes.

The disadvantage of the IBM approach was that each diode only detected while it was generating a video signal. In an array of a hundred by a hundred diodes only one ten thousandth of the light incident on each device would contribute to the output.

This problem was solved independently by the Plessey Company in England and the Fairchild Corporation in America. They used the incident light to discharge the capacitance which is always associated with a $p-n$ junction. For a given semiconductor material this capacitance depends on the junction area, electron concentration and bias.

The capacitance is charged by connecting the diode to a voltage supply once in each frame period. With no incident light this voltage decreases slowly due to the very low leakage current which is always present. Light shining on the diode increases this current and the voltage decays more rapidly.

A video signal is generated once in each frame period by monitoring the discharge of the diode capacitance. This is done by measuring either the voltage remaining on the capacitance or the current needed to recharge it to its original value.

Whichever technique is used, light falling on the detector during the entire frame period contributes to the video signal. Imaging arrays using this approach, which is called light integration, have a frame storage sensitivity similar to that of a vidicon and are sensitive to much lower light levels than the IBM system.

The resolution of a vidicon is determined by the diameter of the scanning beam. The maximum value for an integrated array depends on the number of imaging elements. However, this resolution is degraded because part of each element is employed as a contact or to provide isolation from adjacent elements and does not detect light from the scene. Obviously this dead space must be kept to a minimum.

In addition to diodes, transistors can also be used as photodetectors. They operate with the base open circuit and light incident on the base-collector junction. A phototransistor operates in a similar way to a photodiode but also provides current gain.

Phototransistors were used in an imaging system developed for NASA by the Westinghouse Electric Corporation. By 1967 they had produced a complete television camera 254mm long and 216mm square. The image was detected by a matrix of 100×128 phototransistors, each one 0.1mm by 0.125mm, on a 12.7mm square silicon substrate.

In each of the 100 rows the collectors were common and in each of the 128 columns the emitters were connected by aluminium strips. Readout of a phototransistor MN was achieved by simultaneously applying voltage pulses to collector row M and to the transistor switch connecting column N to the video amplifier.

The camera, which used a 6 volt supply, was capable of producing seven grey tones and working at up to 60 frames per second. Since it used silicon photodetectors it was sensitive over the visible spectrum and into the near infra-red.

A disadvantage was that the imaging array and scanning circuits were on separate substrates

mounted on integrated circuit logic cards. Thus it was necessary to make separate interconnections to each of the 100 rows and 128 columns. Another problem was the variation in gain between transistors. This meant that even with uniform illumination the response varied across the array.

Because of this variation in gain, diodes were generally preferred to transistors in later development work. By the early seventies completely integrated arrays with imaging and scanning circuits on a single silicon slice were available.

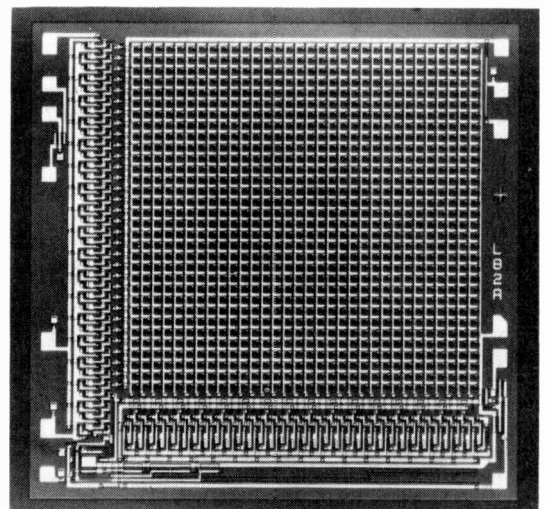
The Plessey array shown in the photograph is an example of this technology. The elements are on a 0.06mm pitch and each consists of a photodiode and transistor switch. In America, integrated arrays of up to 2,500 diodes are marketed by the Reticon Corporation. The largest of these is on a 6.35mm square slice mounted on a 16-pin dual in line package.

PHOTOCONDUCTORS

The imaging systems described so far used integrated arrays of silicon devices. All the diodes or transistors were made in a single silicon slice by carefully controlled diffusion of n or p -type impurities.

However, the difficulties encountered in producing very large numbers of close spaced devices by this technology led workers at RCA Laboratories to try a different approach. They evaporated a continuous photoconductive film and used conventional photoresist processing techniques to define an array of isolated photoconductors.

A photoconductor is made from a semiconducting material, in this case a mixture of cadmium sulphide and cadmium selenide, and has no $p-n$ junction. Incident light releases electrons normally bound to atoms and decreases the material's resistance. The RCA photoconductor arrays were able to store this photo-excited charge for a frame period, making them suitable for imaging.



Self-scanned imaging array. Each element consists of a photodiode and an MOS transistor switch (courtesy Plessey)

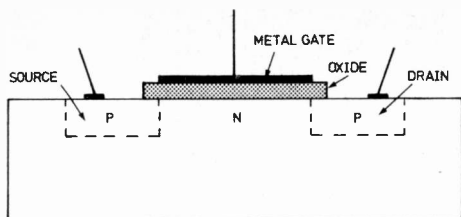


Fig. 1a. Construction of a MOS transistor

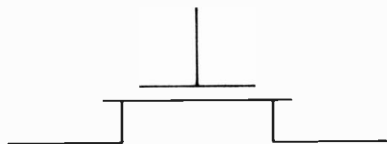


Fig. 1b. Circuit symbol for a MOS transistor

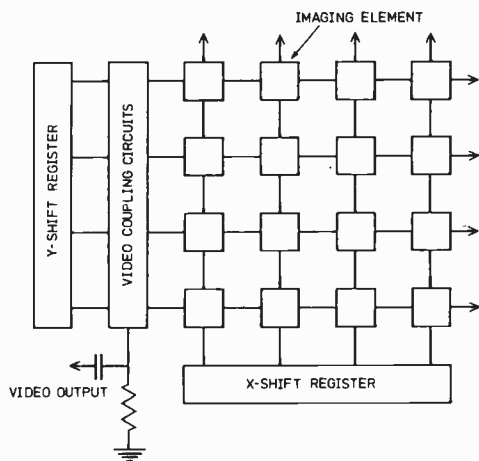


Fig. 2. Block diagram of self-scanned imaging array

Each photoconductor had one ohmic indium contact. The second contact, tellurium, was rectifying and normally high resistance preventing current flow through the photoconductor. Once in each frame period the tellurium contact was biased positively, making it low resistance, and the stored charge read out.

The imaging array, X and Y scanning circuits and the video coupling transistors were on separate 25mm square glass substrates. These were cemented together and mounted on a printed circuit card. Interconnections between the circuits were made by conducting strips evaporated through a mask.

In 1967 RCA delivered a solid state camera to the American Air Force in which the imaging array consisted of 180×180 (32,400) photoconductors on 0.05mm centres. This camera was about the same size as a 35mm camera and was powered by a self-contained 14 volt battery. It was connected to the receiver by a u.h.f. link. By 1969 RCA had built a camera with 65,000 imaging elements. However, processing techniques were still at the research stage and the devices were unstable.

SCANNING THE ARRAY

Whether the imaging elements are photoconductors or silicon junction devices a switch is needed to connect them to the video amplifier once in each

frame period. The junction capacitance of a diode or transistor is simultaneously recharged.

One approach is to make each element in the array two back to back diodes. One diode is the photodetector and the other is the switch. When voltage pulses are applied to the element the diode switch is forward biased and of low resistance, allowing the junction capacitance of the reverse biased diode to recharge.

Two back to back diodes are equivalent to a transistor with its base open circuit, and transistors have been used in the dual role of detector and switch. The collector-base junction acts as the light detector and the emitter-base junction as the switch.

An alternative switch is the metal-oxide-semiconductor (MOS) transistor (Fig. 1). This is a high resistivity silicon substrate into which two p-type diffusions have been made. These are called the source and drain and are separated by a channel which is covered with an insulator, silicon dioxide, and a metal electrode called the gate.

With no voltage applied to the gate, negligible current flows between the source and drain. When a negative voltage is applied, positive current carriers or holes are drawn into the channel increasing its conductance and allowing current to flow.

Whether the switch is a diode or MOS transistor a shift register provides the scanning voltage pulse. For a two dimensional array, pulses from X and Y registers coincide at each element in turn to connect it to the video amplifier (Fig. 2).

Each stage of the shift register consists of two dynamic inverters. A voltage pulse injected at the first stage will progress through the register as clocking pulses are applied alternately to each inverter. The outputs are taken from alternate inverter stages in the register. The clock pulses are obtained from a master pulse generator which is either on the same chip as the scanning circuit or external to it.

When one voltage pulse is moving through the shift register it is essential that it should reach the last stage before another is injected. This is achieved by feeding back the output from each stage except the last through a logic circuit called a NOR gate. This only allows a new pulse to be injected when no feedback pulse is obtained.

DISADVANTAGES

Imaging arrays for commercial broadcasting would need 250,000 close-spaced elements to give acceptable picture quality. By the early seventies integrated arrays of up to 10,000 silicon photodiodes with vertical and horizontal scanning circuits could be made. The main limitations were the size of the slice that could be produced with acceptable yield, and the processing technology.

There is also a fundamental noise problem with these systems. When each element is connected to the video amplifier, noise spikes are produced by the voltage pulses from the scanning circuits.

CHARGE-COUPLED DEVICES

A significant advance was made in 1970 with the invention of the silicon charge-coupled device (CCD) at Bell Telephone Laboratories. These devices use conventional silicon technology but are simpler to make than diode or transistor arrays. This allows

smaller elements with closer spacing to be made. In addition coupling between the scanning circuit and the video amplifier can be completely eliminated.

A two dimensional array of CCDs is shown in Fig. 3. It consists of a slice of *p*-type silicon with a silicon dioxide insulating layer covering the whole surface. On top of the oxide a two dimensional pattern of metal electrodes is deposited.

Each element in the array consists of three adjacent electrodes in each vertical column. A positive voltage of about 10 volts is normally applied to the centre electrode (P2) of each element, and 1 volt to the electrode above and below. The array is divided into an imaging area and a storage area.

When light is incident on the imaging area, photo-excited electrons will accumulate under the P2 electrode of each element because of its higher positive voltage. Once in each frame period this accumulated charge is transferred to the storage area (Fig. 4).

This is done by raising the P3 electrode in each group to 10 volts and gradually reducing the P2 electrode to 1 volt. All the stored electrons move down one row to the more positive P3 electrodes.

Next the P1 electrodes are raised to 10 volts and the P3 electrodes gradually reduced to 1 volt. The stored electrons again move down one row. This process is repeated until all the charge reaches the storage area. From here it is moved line by line into the serial readout section and transferred to the video output. Coupling between the scanning circuits and the video output is prevented by a positively biased gate after the last stage of the serial readout.

INTERLACING

Conventional television cameras use a picture scanning technique called interlacing to reduce flicker. The focused image of the scene is scanned in a series of horizontal sweeps every twenty-fifth of a second.

If the horizontal sweeps are numbered from top to bottom the odd numbered sweeps are made in the first fiftieth of a second and the even numbered sweeps in the second fiftieth of a second.

Interlacing is achieved with CCD arrays in the following way. In the first fiftieth of a second, charge is accumulated under the P2 electrode and then transferred to the storage area and the video output as described above. In the second fiftieth of a second, charge is accumulated simultaneously under the P3 and P1 electrodes and transferred to the storage area and output.

Accumulating charge under the P3 and P1 electrodes is equivalent to scanning along a line midway between them. Since this line is also midway between the P2 electrodes the desired interlacing effect is achieved.

CCD CAMERAS

Bell Telephone Laboratories have demonstrated both monochrome and colour transmission with CCD cameras. However, only monochrome cameras are commercially available.

In 1974 Fairchild became the first company to market CCD cameras. The model shown in the photograph is 76mm diameter, 48mm long and weighs 11 ounces. The light sensitive area is a 100 × 100 array with each element 0.03mm by 0.02mm on 0.03mm vertical and 0.04mm horizontal centres.

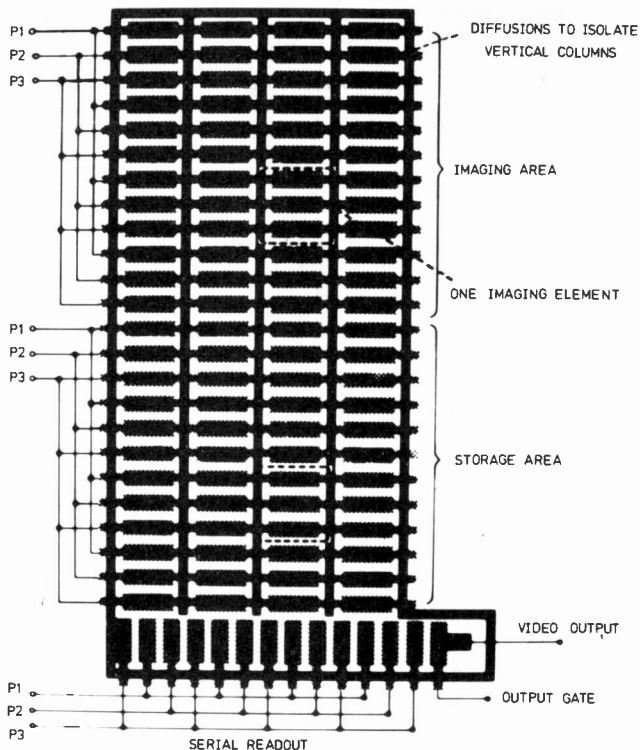


Fig. 3. Layout of charge-coupled imaging array

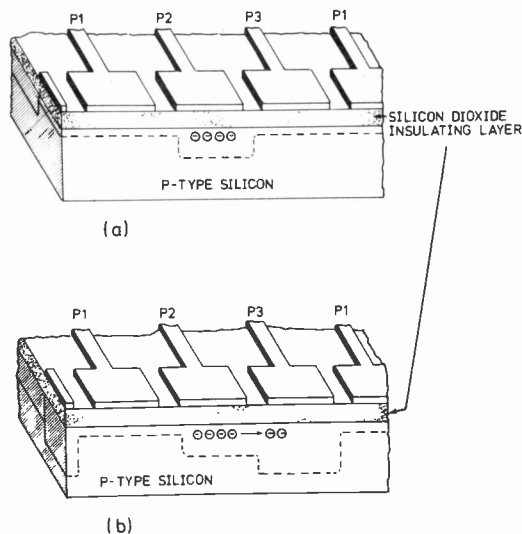


Fig. 4. (a) When light is incident on a CCD imaging array photo-excited electrons are accumulated under the centre electrode in each element because of its higher positive voltage. (b) Once in each frame period the accumulated charge is transferred to the storage area by sequentially adjusting the positive voltage on each electrode



The Fairchild TV camera using a charge-coupled imaging array (courtesy Fairchild Corporation)

The array is mounted on a 24-pin dual in line package with an optical glass window.

The camera uses interlaced scanning, produces nine grey tones and, since the imaging array is silicon, is sensitive into the near infra-red. The power consumption is 1.5 watts with all operating potentials less than 20 volts.

RCA are now marketing a CCD camera with a resolution comparable with a 3in vidicon and capable of producing a usable picture with one third the scene illumination required by the vidicon. The imaging array contains 320 vertical columns each with 256 sensing elements 0.03mm square. The effective number of vertical resolution elements is increased to 512 by interlacing.

As with the Fairchild camera the silicon imaging array is mounted on a hermetically sealed 24-pin dual in line package with an optical glass window. The camera weighs 2.5lbs and the power requirement is 4 watts at 12 volts.

APPLICATIONS

Since these cameras can work with low levels of illumination they are suitable for security surveillance in commerce and industry. In industry they can be used to monitor processes in hostile environments, for example where high pressures or poisonous gases are involved.

Solid state imaging systems are already being used to transfer data into computers. In some American cities they are used to sort mail since they are faster and more accurate than manual sorting. The performance of available systems is also adequate for page and document reading.

Transmitting images of documents and drawings is one of the aims of the Picturephone system being developed at Bell Telephone Laboratories. By using a miniature camera and television display the Picturephone allows subscribers to both see and hear one another.

In the immediate future solid state imaging systems will only reach a specialist market. However, as advances in technology and increased demand reduce prices, hand-held TV cameras may become as widely used in the 1980s as photographic cameras are today. ★

NEWS BRIEFS

TV Import Restrictions

FOLLOWING strong representations from British set makers, the government has decided to restrict imports of portable monochrome TV sets from Taiwan to a level of 70,000 sets during a 15 month period, commencing from October 1, 1976. This restriction applies to sets with cathode-ray tubes having a bulb diagonal measurement of 39cm or less.

Transistorised television receivers originating in or consigned to the United Kingdom from the Eastern Area (which comprises Albania, Bulgaria, Czechoslovakia, The German Democratic Republic and Berlin (East), Hungary, North Korea, North Vietnam, The People's Republic of China, The People's Republic of Mongolia, Poland, Romania and The Union of Soviet Socialist Republics) are already subject to quota licensing arrangements which are unaffected by the new restrictions.

Code of Practice

GOOD news for the consumer is the setting up and publication of a "Code of Practice" by the Radio, Electrical and Television Retailers' Association (RETRA). Contained in a 12-page booklet, the Code was drawn up in consultation with the Office of Fair Trading and other professional bodies. The Code will be operated by over 4,000 member outlets, from the one man business to the larger independent High Street retailer and multiple companies.

Some of the subjects covered in the Code are pricing, refunds, deposits, retailer's guarantee, repairs and servicing, and guarantee of repairs.

On the touchy subject of repairs, the Code stipulates specific time limits within which retailers must complete repairs. It is claimed that 80 per cent of repairs undertaken in the workshop will be completed within five working days.

Many dealers will be able to finish repairs undertaken in the home on the same day but if this proves to be impossible, then 15 working days is laid down as the maximum time to effect a repair under normal working conditions. All repairs will be guaranteed for a minimum of three months for parts fitted and workmanship.

If there is any delay, or a repair cannot be made, the retailer will ensure that his customer is kept fully informed of the reason.

Copies of the "Code of Practice" have been distributed to such bodies as the Citizens Advice Bureau, Local Authorities, Chief Trading Standards and County Consumer Protection Officers. Also, copies can be obtained from any RETRA dealer or direct from The Secretary, Radio, Electrical and Television Retailer's Association (RETRA) Ltd., 100 St Martin's Lane, London, WC2N 4BD. (s.a.e.)

Overseas Symposium & Exhibition

THE 2nd Electromagnetic Compatibility Symposium and Exhibition will be held from June 28 to 30, 1977 at Montreux, Switzerland.

The forthcoming conference will again be aimed at the problems of interaction of r.f. energy with electrical and biological systems, spectrum pollution and system immunity or, "protection of the electromagnetic environment".

Papers (in English) covering the above fields of research should be sent to Prof. Dr. F. L. Stumpers, Elzentlaan 11, Eindhoven, Netherlands. The last date for papers is October 30, 1976.

Further details of the exhibition can be obtained from the Secretary General, T. Dvorak, EMC Symposium & Exhibition, Montreux, Switzerland.

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.

MICROPROCESSOR KITS

Elsewhere in this issue we are printing a special article on "Getting to Grips with Microprocessors" and a review of a recent "Microprocessor Symposium". In one of the articles it recommends that readers should "get their feet wet" as practical experience is far more informative than becoming too immersed in the theory.

This comment has been taken up by **A. Marshall (London) Ltd.**, who are stocking the SC/MP microprocessor kit discussed in the article, and **Limrose Electronics**.

The Marshall's SC/MP kit will sell for £122.22, plus 8% VAT. The kit consists of the Introkit (£62.37, plus 8% VAT) and the Keyboard kit which will retail for £59.85, plus 8% VAT. For further details readers should write to **A. Marshall (London) Ltd. (Dept. P.E.), 42 Cricklewood Broadway, NW2 3ET.**

A fast and an inexpensive way to develop a fundamental understanding of microprocessors is claimed for the **Microtutor 8080** from **Limrose Electronics**.

The claim is that the 8080 gives you "hands on" experience necessary to master microprocessors. However, it is not just a learning module, it is a full 8-bit microcomputer with an 8080 CPU, 1k x 8-bit Random Access Memory, an input port, an output port, an interrupt instruction port and a status port.

Also, with facilities for manual loading of the memory and for single stepping, the processor can be used as a prototyping computer for development of applications software and can be expanded with additional memory and a Teletype interface, using plug-in cards for more advanced work.

All important signals, data bits and addresses are continuously displayed using over 40 l.e.d. indicators. Inputs are provided on several switch registers and pushbutton switches. The data paths, and how they relate to various registers, are clearly shown on the front panel of the unit.

By following the instruction book provided with the **Microtutor**, it is claimed, a person with limited technical knowledge can rapidly learn how

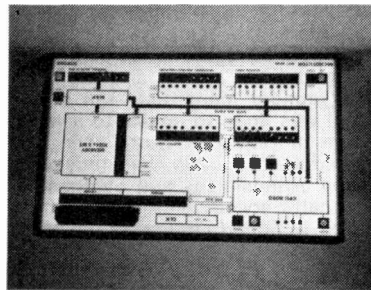
microprocessors work. Trained electronics engineers can quickly bridge the gap between conventional hardware and microprocessor software by making a step-by-step progression from developing simple algorithms to complex programmes.

The **Microtutor 8080** is available fully tested and assembled for £249, single units. Further information can be obtained from **Limrose Electronics Ltd. (Dept. P.E.), 241-243 Manchester Road, Northwich, Cheshire.**

LEARNING AID

As a Christmas present with a difference we suggest the "Little Professor", a calculator-based learning aid with preprogrammed basic math problems for children (age group 6 to 9) now being marketed by **Texas Instruments**. This 16-key machine has addition, subtraction, multiplication and division sequences in variable degrees of difficulty.

Problems can be selected according to degree of difficulty by the user. Once the type of problem and degree of difficulty is selected, the machine presents the problem (with function



The **Microtutor 8080** from **Limrose**



Texas "Little Professor"



AM/FM Stereo Tuner from **Eagle**

and equal sign) in the large v.l.e.d. display. The user keys in an answer, if correct the complete equation appears for one second and then the next problem in sequence is displayed. If incorrect the problem reappears.

If a wrong answer is entered three times, the "Prof" automatically displays the correct answer. The answer remains in the display until the user presses the "go" key. If the next problem is also answered incorrectly three times, the correct answer would again be displayed.

The machine will, after ten problems, display a score out of ten. This "score" display would be followed by the next set of problems in sequence.

Addresses of nearest stockists and price of the Texas "Little Professor" can be obtained from **Texas Instruments Ltd., Calculator Division (Dept. P.E.), Block C, Manton Centre, Manton Lane, Bedford, MK41 7PU.**

AM/FM STEREO TUNER

The new a.m./f.m. stereo tuner now being marketed by **Eagle International** is a low cost unit which is claimed to match virtually any amplifier. The AA102 is based on Eagle's TST152 and retains a number of features including wide range, switchable a.f.c., stereo indicator beacon, noise filter and variable output to avoid mismatch.

The AA102 has a frequency response of 25Hz to 14kHz \pm 2dB. The sensitivity for 30dB quieting is better than 7 μ V and total harmonic distortion is less than 0.8 per cent. The signal to noise ratio is better than 54dB.

Backed by Eagle's two year guarantee and complete after sales service the AA102 recommended retail price is £52, plus VAT.

CATALOGUE

A new catalogue from **General Instrument Microelectronics** gives comprehensive details of their current range of over 200 MOS/LSI microcircuits. Applications covered are calculators, clocks, radio, television, TV games, electronic organs, appliance timers, telecommunications, data communications, counters and digital meters, microprocessors, RAMs, EAROMs, ROMs, and keyboard encoders and character generators.

Entitled **MOS Data 1976** and priced £1.50, the catalogue is available from GIM distributors (including **SDS Components Ltd., Hilsa Industrial Estate, Portsmouth, Hants. PO3 5JW.**)

In our October issue we mentioned the excellent catalogue from **Marshall's** and the fact that an error had crept into the case outline drawings. This has now been corrected and **Marshall's** are now issuing a "stick-in" amendment page.

Copies of the amendment page can be obtained from **A. Marshall (London) Ltd., 42, Cricklewood Broadway, NW2 3ET.**

Strictly Instrumental

by K. Lenton-Smith

LAST August's British Musical Instruments Trade Fair—surely International rather than British—offered a number of new models, though the mixture was largely as before. Indeed, the common denominator is now so strong that it is difficult to differentiate between one organ and another once reverberation and the inevitable Leslie have been switched in.

SHARP'S THE WORD

I was highly tempted by the large Kawai organ being demonstrated by Brian Sharp. He was showing his audience how to cope with three manuals with only two hands—by playing the synthesiser with his nose. Fortunately, Brian's nose lives up to his name! The idea of inscribing the waveform on controls seems eminently sensible where electronic music is deviating increasingly from the conventional.

Wurlitzer were showing an unusual electric piano, where the cabinet was arranged as a miniature baby-grand containing the electro-mechanical and speaker systems. The sound was good but the selling point in the U.S. is equally its attraction as a fine piece of furniture.

The Hammond Aurora is a very pleasant instrument to play, with an excellent poly-synthesised percussion piano sound. The Auto-Vari Rhythm Unit, which I referred to in the April issue, is fitted to this model. Despite the multiple-derivative-divider used in this series of Hammonds, voicing closely approaches the older tone-wheel instruments. But I find that the drawbar settings have to be slightly different with m.d.d. models.

The Japanese-made Hammond X-5, though falling short of the U.S. manufactured organs tonally, represents good value and is suited particularly to the combo player on grounds of portability. The highest compliment to Hammond is the use of their drawbar system by other manufacturers. On this stand, the "Old Organ Grinder" Robin Richmond was seen taking an active interest in

the Aurora: it is incredible to me how Robin's voice belies his age and experience in the organ field!

SOUND DESIGN

I suspect that a number of readers have still not seen the very useful P.E. publication *Sound Design*. Although convenient to have complete projects in one volume—to save thumbing through the series in back copies—the more important fact is that there has been up-dating, particularly with regard to the Minisonic. Douglas Shaw's original design had the younger constructor in mind, but it was soon to appeal to a wider range of readers. Since then, the Minisonic has been the study of a group of musicians and Synthesiser Musical Services and also republished in *Sound Design* as the Minisonic Mk. II.

MINISONIC

Ignoring the other projects in this book, the major changes to the Minisonic should be mentioned. The v.c.o.s have been greatly improved and phase-locking added: the phase lock helps enormously when using the Ring Modulator, of course, making for accurate tracking with a fixed interval between v.c.o.s. The Hold circuit of the original version was somewhat unstable and has been improved in the Mk. II by using a FETMOPA and a reed relay to reduce loading on the Hold capacitor. Modification of the Envelope Shapers includes visual indication of the envelopes by means of i.e.d.s. The $\pm 6V$ supplies are now derived from the power pack through separate transistors, minor changes being made to the Ring Modulator, Noise Generator and Keyboard Controller.

From the playing aspect, inconvenient patch cords (which get tangled with fingers and playing keys at the wrong moment) have been replaced by press-button switches. *Sound Design* gives modification data for original owners, the Mk. II

version adding up to a reliable and useful small synthesiser. With printed circuit boards readily available for the Mk. II Minisonic, I suggest readers send for their copy of *Sound Design* before it goes out of print: this is available for £1.20, post paid, from Practical Electronics, IPC Magazines Ltd., Receiving Cashiers Dept., Kings Reach Tower, Stamford Street, London SE1 9LS.

THE ALLEN ORGAN

We must now differentiate between Allen organs, for this time the reference is to Model MES 53, designed by Roger Allen of Maplin Electronic Supplies and frequently mentioned on the back page of this magazine. The MES 53 was recently demonstrated to the London meeting of the Electronic Organ Constructors Society with great success: a full scale account of this organ by Alan Douglas will appear in P.E. shortly.

EOCS members were most impressed by this instrument. Minor criticisms were on layout of the controls only, a point totally at the constructor's discretion. This instrument has drawbars and rocker tabs, with attack/decay and seven keyed pitches on each manual. Individual voices were up to professional standards, whilst the total lack of "beehive" effect was considerably better than most commercial instruments. The Society's demonstrators put the MES 53 through its paces, to the delight of members, and summed it up as a very good organ indeed. Roger Allen is to be congratulated on his excellent circuitry, and Maplin on the price of the kit for such a comprehensive instrument. Readers further interested should write to Maplin Electronic Supplies for their leaflet MES 53.

GENERATION GAME

Mr. Francis T. Chambers of Ballycroy, Co. Mayo has written to me to describe his multi-recording technique, using a four-channel recorder, for synthesiser build-up. His machine has four sets of record, play and erase heads and by using the low quality 'playback' signal from an unused record head he can obtain synchronous monitoring. He uses a carefully planned sequence of mixing and recording and believes that ten good quality voices are obtainable.

Four of these are reserved for the more important voices and are first generation (i.e., direct) recordings, the remaining six being second generation (re-recordings). Space does not allow publication of his sequence chart, but a recording plan that minimises re-recording is always well worth while if a multi-channel machine is available.

INGENUITY UNLIMITED



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.

however, and is lit to show that the lamp is healthy.

If the lamp filament goes open circuit, TR1 conducts and D1 is lit to show that the bulb has failed. The potential at point A is approximately 0.7 volts ($V_{ce} + V_d$), and D2 is therefore extinguished.

Two components have been included to allow the circuit to continue to function when the lamp is switched on. These are RLA, comprising a normally-open reed switch and a specially wound operating coil, and the germanium diode D3. The latter prevents the lamp supply being applied to the base of TR1. The lamp operating current flows through the coil of RLA, the contacts of which ground the base of TR1 provided the lamp is intact.

The reed switch requires approximately 40–50 ampere turns to operate, therefore the operating coil should be wound with 20 turns of 18 s.w.g. for headlamps, and with 40–80 turns of 22 s.w.g. for other lamps, depending on their power. The total current consumption of the unit is less than 12mA.

T. H. Gibson,
Barnsley.

CAR LAMP FILAMENT MONITOR



THIS simple design (Fig. 1) gives a constant indication of the condition of a car lamp filament, regardless of whether it is switched on or off. Now that the law requires the obligatory car lamps to be in good order, day or night, this is a useful safeguard.

Transistor TR1 is used as an electronic switch. Taking first the case where the lamp is switched off; if the filament is intact, the base of TR1 is grounded and the transistor cut off. This means that point A is approximately at the potential of the positive supply rail, and the red l.e.d. D1 is "off". The green l.e.d. D2 conducts,

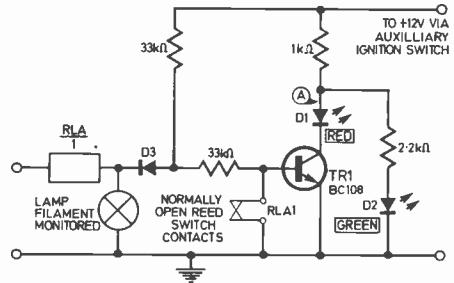
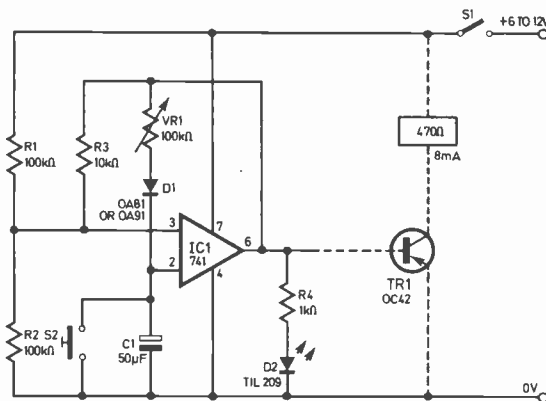


Fig. 1

SIMPLE TIMER

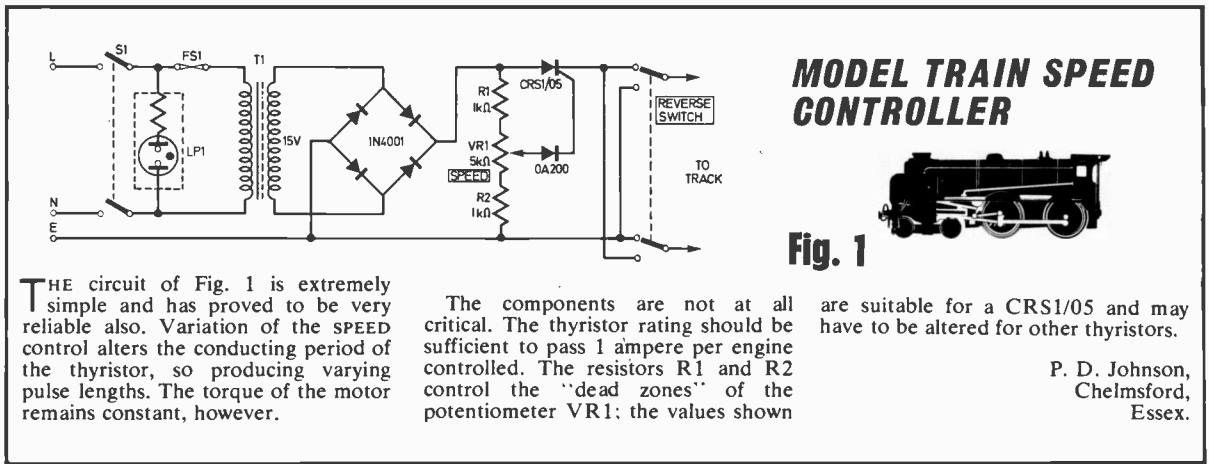


THIS timer will drive a light emitting diode direct from the output of IC1 via a 1kΩ limiting resistor, or it will operate a relay with the addition of a suitable transistor.

The 741 i.c. acts as a multi-vibrator, the timing interval being determined by the variable resistor VR1, C1 and D1. The diode is necessary to prevent the multi-vibrator running continuously. With the component values shown, the timing interval is variable over the range from about one second to 75 seconds. Maximum current consumption is 15mA.

M. P. Wilson,
Oswestry,
Salop.

Fig. 1



L.E.D. VU METER



THE basis of this circuit (Fig. 1) is a Hex Schmitt trigger i.c. the SN7414. The unit is connected to the loudspeaker terminals of an amplifier and requires a minimum of 16V peak signal. If the unit is required to monitor lower signal levels a simple voltage amplifier using an op. amp could be used to boost the signal up to this level.

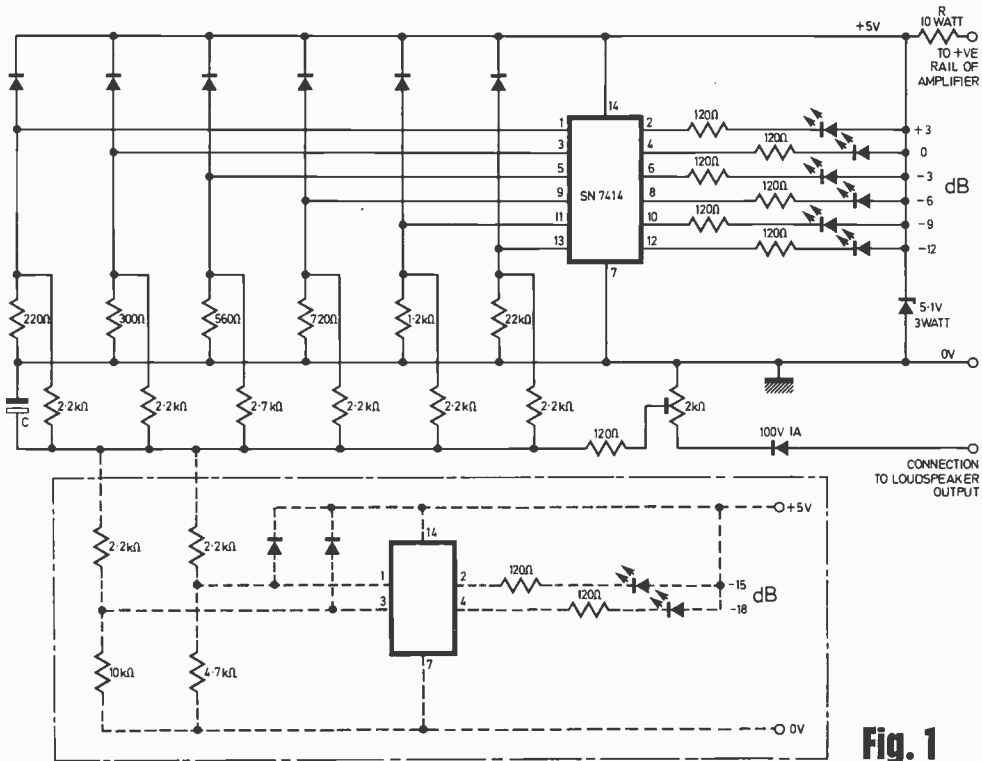
The main advantages of the l.e.d. VU meter are its ease of reading, fast response without overshoot and in this case, cheapness.

The loudspeaker voltage is first rectified and then divided down by the preset. The resistor divider networks are so calculated that for 3dB increase in power the threshold of another Schmitt is reached.

Calibration is done by driving the amplifier to clipping and adjusting the preset until all the l.e.d.s just come on. The +3dB light then corresponds to full power, the 0dB to half power, the -3dB to quarter power etc. The unit can be extended to -18dB by using an extra i.c. and the components

shown in the box. For a little extra cost different coloured l.e.d.s can be used (green, orange etc.). The value of R is given by (the +ve rail voltage \times 10) Ω . The value of C is chosen to suit the attack and decay time desired and can be between 0 and 100 μ F.

J. S. Broadhurst,
Northwich.





QUIZ MONITOR

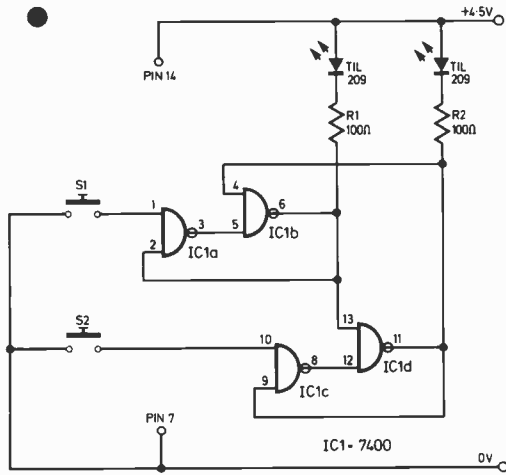


Fig. 1

THE circuit in Fig. 1 is of a two station latching quiz monitor, with l.e.d. indication.

The circuit is built around a 7400 quad two input NAND gate. Two gates are used to make each latch. When one of the buttons S1 or S2 is pressed its corresponding latch will latch. The output drives an l.e.d. via a current limiting resistor (R1 or R2) and is also fed to the reset input of the other latch. This arrangement ensures that the first person to press their button is indicated, and the second is eliminated.

The circuit can be increased to as many stations as required. For more stations use a gate with the required amount of inputs for the l.e.d. driver gates, and a two input gate for the other gate in each latch.

C. F. Shorto,
Weymouth.

CAR SIREN



THE circuit shown in Fig. 1 is for an electronic siren; it was designed for use in a car burglar alarm. As a car horn is a commonplace sound, I thought that a siren was a good way of making a distinctive noise.

The unijunction transistor 2N2646 is employed as a relaxation oscillator R2 and C1 determining the tone. The IC is a 555 timer, and here it is employed in an astable mode, the output pulses being fed to the oscillator from pin three via R1.

Using the values given for R3 and C3, a pulse is given out about every half second, giving the siren its wailing sound. If the output is fed into a 5 watt amplifier driving a re-entrant

horn speaker it can be heard several streets away, and is sure to give the would-be burglar second thoughts.

P. Jones,
Gower.

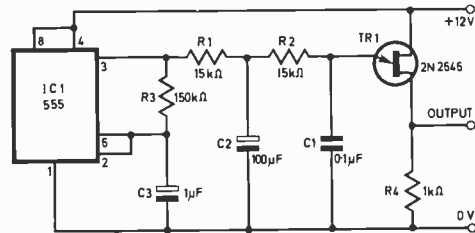


Fig. 1

"PRESET-TO-ONE" COUNTER

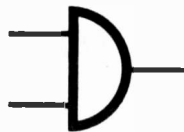
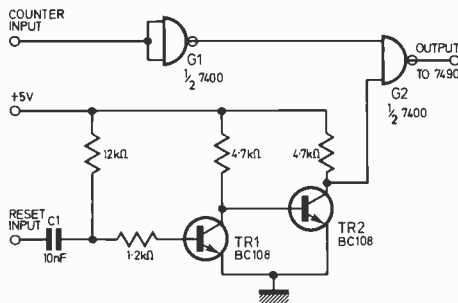


Fig. 1

counters such as the 74163 are normally used. Fig. 1 shows a circuit which uses a 7490 in a "preset-to-one" mode, and is suitable for low-speed counting uses.

The reset input is connected to an output of the counter which before reset is at logic 1, and after reset is at logic 0. This output must only go high once during the count cycle. An example is the tens of months output of a calendar, which is high only for months 10, 11 and 12 in each year. When the reset input goes low, G2 receives a short negative-going pulse from the collector of TR2. The counter input is low after reset, so the output of G1 and the input of G2 are high. The negative pulse at G2 therefore causes a positive pulse at the output. This advances the count on the decade counter from zero to one.

John Cowking,
Ambleside,
Cumbria.

IN certain counting operations it is necessary to have a counter which, on reset, starts counting from one rather than the more normal zero. A common example occurs in calendars, where both the day and month counts

must be reset to one at the end of the month or year. The hour counter in twelve hour digital clocks must also reset to one. As simple decade counters such as the 7490 reset to zero, the more expensive presettable

THE circuit (Fig. 1) consists of an astable producing a square wave, which, when the spin button is depressed, is fed into a bistable. The l.e.d.s will indicate heads or tails depending on the state of the bistable when the button is released.

The circuit was originally developed for use as an electronic coin tosser, however, by varying the value of one of the timing resistors the mark/space ratio of the square wave can be altered thereby changing the chance ratio. In the original device the 10kΩ resistor was a preset so an accurate ratio could be set and left unaltered, however, it could take the form of a panel mounted control. Ratios of between 1:1 and 1:4 can be obtained. When setting or calibrating the resistor the spin button should be depressed as resistances in the bistable will also affect the mark/space ratio and should be compensated for.

N. H. Quick,
Bristol.

VARIABLE CHANCE RATIO DEVICE

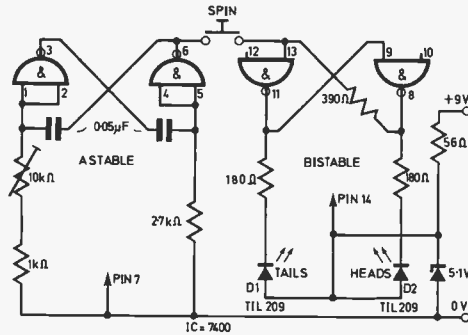


Fig. 1

VOLTMETER IMPEDANCE MULTIPLIER



It is often necessary to take voltage readings around transistor circuits, for example when fault finding, where an ordinary voltmeter is not suitable due to its low resistance. A "front end" which effectively increases the input impedance of the meter is desirable, and the arrangement of Fig. 1 was evolved for this purpose.

The circuit is simply a voltage follower using a 741 operational amplifier, producing an input impedance of the order of 2 megohms. With the input lead floating, the output took up a potential of about -6.5V.

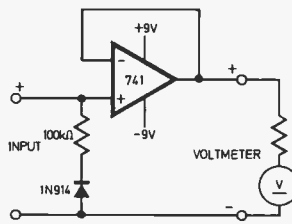


Fig. 1

This problem was overcome by providing a high resistance return path to ground for the input, and this is the function of the 1N914 diode which should have very low leakage.

With ±9 volt supplies, the linear range should extend to about 7.5 volts. With ±15 volt supplies this should go up to about 12 volts. Input overload protection can be incorporated by connecting two Zener diodes back to back in series across the input terminals.

T. K. Wong,
Plymouth.

TELL-TALE ALARM



THIS circuit (Fig. 1) is intended to operate a warning light or bell if someone such as a burglar enters a darkened room using a torch. When light from the torch falls on the light dependent resistor, R1, its resistance decreases, reducing the forward bias on the base of TR1. The rise in voltage at TR1 collector then turns on TR2, lighting the warning lamp LP1.

Once the circuit has been actuated, it will remain in the "alarm" state until the RESET button, S1, is pressed. The level of light at which the circuit operates can be set by means of VR1.

T. Robinson,
Malton,
Yorks.

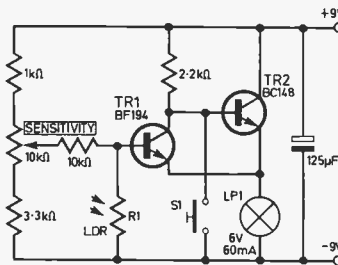


Fig. 1

NEWS FROM JOSTY KIT

JOSTYKIT

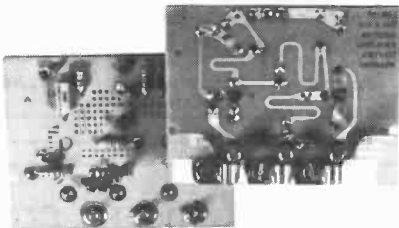
AF 300 3 WATT AUDIO AMPLIFIER



This is a 3 W complementary output stage, general purpose amplifier. Use it to boost the output from your record player, cassette recorder, transistor radio or drive it from one of the HF range of JOSTYKIT receivers. Try it with the HF 310 FM receiver in your car or boat. **£ 6.10**

JOSTYKIT

HF 385 VHF/UHF AERIAL AMPLIFIER



A quality, printed circuit, no trimming, aerial amplifier. Fantastic frequency range due to use of printed coils, 21 dB amplification at 400 MHz. Two separate inputs for UHF and VHF. No loss of signal or intercommunication problems. **£ 5.80**

JOSTYKIT

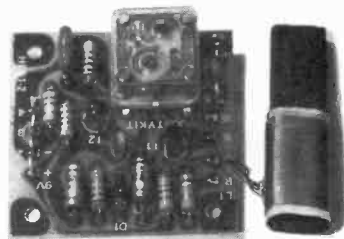
AT 365 3-CHANNEL DISCO LIGHT



A new concept in psychedelic lighting. Uses built-in microphone. Avoids awkward connections to amplifiers. Position light-show to best advantage without long trailing leads - just plug in to nearest power point. Circuit combines latest integrated circuit techniques with solid-state power control. Quad op. amp. makes selection of bass, midrange and treble frequencies easy. Three thyristors (SCRs) control three separate lampbanks. Kit includes fused dc power supply and FET zero light adjustment. **WARNING.** Only experienced persons should attempt the interconnection of mains equipment. **£ 17.00**

JOSTYKIT

HF 61 DIODE MEDIUMWAVE RECEIVER

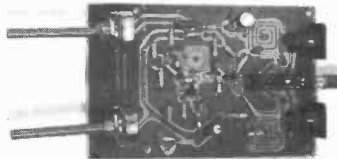


HF 61 is an extended diode receiver for mediumwave-reception. By means of a very simple technique a reasonable reception even from foreign medium stations is attained.

HF 61 is built on a small circuit board of the same size as the general purpose amplifier AF 380. The two assemblies should be connected to produce power for a loudspeaker. HF 61 is especially useful for beginners, who have not tried to assemble electronic kits before. **£ 4.30**

JOSTYKIT

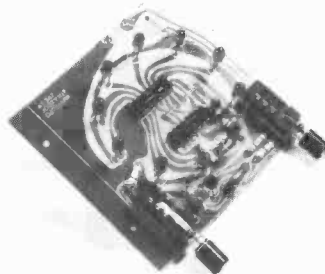
HF 305 VHF RADIO-CONVERTER



Extend the range of your transistor radio. Listen to Amateurs (2 metre band), Aircraft, Trawlers etc. Two transistor circuit with printed circuit coils, varactor diodes and superior circuit design. Converts radio signals in the 100 - 200 MHz range to output signal at 100 MHz. Pipe this into your VHF receiver and you're in a new dimension. **£ 6.70**

JOSTYKIT

AT 347 ELECTRONIC ROULETTE



A set of exciting games for family and friends. In the home or in the pub they'll envy your electronics wizardry. Two integrated circuits provide a random number system. A 7490 counts the pulses and a 7442 decodes. The decoded outputs turn on a sequentially rotating L.E.D. light display. Your chance to try hand with TTL digital electronics. Supplied with six colourful game indicators. **£ 8.75**

JOSTY KIT (U.K.) LTD

MAIL ORDER DIVISION
P.O. BOX 68, Middlesbrough, Cleveland, TS1 5DQ, England
Send for our 1966/7 Free Catalogue

TRAIN FOR SUCCESS

in Radio, Television & Electronics

ICS have helped thousands of ambitious people to move up into higher paid more secure jobs in the field of electronics - now it can be your turn. Whether you are a newcomer to the field or already working in the industry, ICS can provide you with the specialised training so essential to success.

Personal Tuition and Guaranteed Success

The expert and personal guidance by fully qualified tutors, backed by the ICS guarantee of tuition until successful, is the key to our outstanding record in the technical training field. You study at the time and pace that suits you best and in your own home. In the words of one of our many successful students: "Since starting my course, my salary has trebled and I am expecting a further increase when my course is completed."

City and Guilds Certificates

Excellent job prospects await those who hold one of these recognised certificates. ICS can coach you for:

- Telecommunications Technicians
- Radio, T.V. Electronics Technicians
- Technical Communications
- Radio Servicing Theory
- Radio Amateurs
- Electrical Installation Work
- Also MPT Radio Communications Certificate

Diploma Courses

Colour T.V. Servicing
Electronic Engineering & Maintenance
Computer Engineering and Programming
Radio, T.V. and Audio, Engineering & Servicing
Electrical Engineering, Installations & Contracting

Other Career Courses

A wide range of other technical and professional courses are available including GCE.

Post this coupon or 'phone today for free ICS careers guide.

Name _____

Address _____

Age _____

ICS

To ICS, Dept. 772N, Intertext House,
London SW8 4UJ
or telephone 01-622 9911 (all hours).

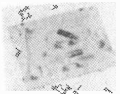
SOLDERLESS BREADBOARDING — DECS

The famous DEC System of Solderless Breadboarding is ideal for both the young and more mature students of Electronic Engineering as it enables circuits to be tried and tested without the use of soldering and because of the specially designed contacts allows components to be used over and over again. It is also extremely useful for the Circuit Designer who wishes to experiment with and perfect his circuit quickly yet economically.

S-DEC (Model PB11)

This, the most popular Board, is designed solely for the use of discrete components and is particularly useful for basic educational purposes.
(No. of Contacts: 70)

1 off £1-98
5 off £1-78



T-DEC (Model PB21)

This Board allows 2 TO5 or 1 DIL IC Station to be used and so is primarily intended for discrete work or for linear IC application where considerable numbers of discrete components may be required.
(No. of Contacts: 208)

1 off £3-82
5 off £3-21



μ-DEC 'A' (Model PB31)

The μ-DEC 'A' is specially designed for ease of use with IC's and allows 2 DIL or 4 TO5 stations to be used but will accommodate discrete components with equal facility.
(No. of Contacts: 208)

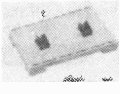
1 off £3-87
5 off £3-53



μ-DEC 'B' (Model PB41)

The μ-DEC 'B' is for similar uses as μ-DEC 'A', but has two 16 lead IC sockets as part of the Board.
(No. of Contacts: 208)

1 off £3-97
5 off £3-19



DEC ACCESSORIES

16 DIL adaptor (with socket) PB062	£1-92
10 TO5 adaptor (with socket) PB072	£1-80
Single ended leads (set of ten) PB101	£3-90
Double ended leads (set of ten) PB102	£2-99
1mm plugs (set of ten) PB103	£2-45
All prices include 8% VAT. P. & P. 25p.	

Our retail counter is now open, stocking a large variety of audio and electronic parts and accessories, branded and surplus.

WE ARE SITUATED 2 MIN. WATFORD JUNCTION STATION

THE COMPONENTS CENTRE

7 Langley Road, Watford, Herts., WD1 3PS.
Tel.: Watford 45335

complete DIGITAL CLOCK KITS TEAK CASES

prompt order despatch

NON-ALARM

£10-65

+ 85p VAT

ALARM

£13-43

+ £1-07 VAT

(Prices include P. & P.)



"DELTA"

GENUINE TEAK OR PERSPEX CASE

DELTA DATA: 4 Radiant Red 7in high LEDs. 12hr display with a.m./p.m. indication. Beautiful Burma Teak Case or Pretty Perspex in white, black, blue, red, green. Power failure is indicated by flashing display.

MODULES: Kits can be bought without case—Non-Alarm £9; Alarm £12-50 inclusive.

READY BUILT: Buy a working tested module and fit your own case—Non-Alarm £9-50; Alarm £13; or put it with our case parts (£4-32) and save on complete clock price. Complete clock ready built. 2yr guarantee—Non-Alarm £13-50; Alarm £18-50.

ALARM FEATURES: Pulsed tone. Tilt operated 10 minute "Snooze" period. Single switch setting. Optional extra mercury switch (45p) allows alarm reset by tilting clock. Digit brightness is automatically controlled to suit lighting level.

"ALPHA" CHRISTMAS OFFER 4 Glowing Green 7in high digits 12 or 24 hour. Non-Alarm Built and Tested Module plus Perspex Case Incl. £11

NOVUS CALCULATORS

650 £5-40 4510 £16-20
850 £8-75 6030 £21-60



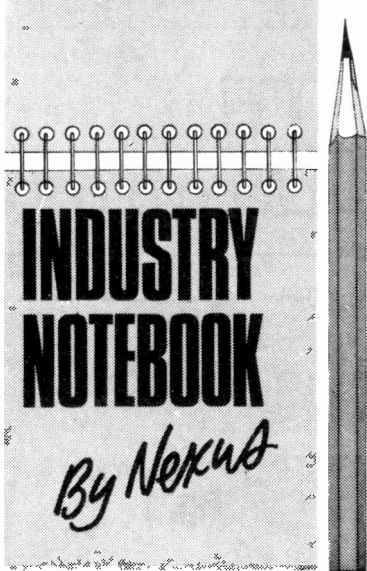
Send payment with order. S.A.E. for complete range of clocks, calculators and components



Pulse Electronics Ltd

Dept. PE5, 202 Shefford Road,
Clifton Shefford, Beds.

Telephone: Hitchin (0462) 814477



INDUSTRY NOTEBOOK

By Nexus

COST OF TRAVEL

Getting my bags packed in readiness to attend yet another international conference I came across some interesting statistics on the conference business—said to be the fastest growing sector of international travel.

As a patriot I was pleased to discover that the United Kingdom is Number One conference country in Europe, with Europe itself being the leading continent with (in 1974) 70% of all the world's conferences. North America is second with only 15%.

Another interesting fact was that the average delegate, excluding travel and registration fees spends, and I quote the figure for London, £26 per day. Although it has always been a puzzle to me on how my cash disappears at these functions I'm glad to report that I must be a model of economy or just plain mean, because even my most reckless days are generally below the average.

The growth rate in conferences is such that for London alone the forecast for 1980 is that they will attract a million people who will spend some £140 million. On a world scale the projection is that 15,500 international conventions and conferences will be held in 1980 and attended by 10.5 million people.

But sending delegates to business, scientific or engineering conferences is only a small part of a company's travel budget. Most are big spenders and the biggest of all are multinationals with executives thinking nothing of several transatlantic trips a year. On high density routes like London-Brussels or the internal London-Edinburgh flights it's hard to travel without meeting someone you know

in the electronics business. All of it seemingly essential, even at over £40 return to Edinburgh, over £70 return to Brussels plus hotels, meals and getting to and from the airport.

Are their journeys really necessary? Perhaps not all, but how do you measure the pay-off? Rcal Electronics Group with a world wide business in over 130 countries makes no secret of spending over £1 million a year on travel and expenses of sales engineers.

SELLING TIME

The high cost of travel is one of the factors that is changing business methods. If you're in the big league then you may well be able to absorb all the costs of sending your own people into the world. For smaller businesses it can be a crippling expense. Hence the increasing use of agents overseas who do the selling for you and of wholesalers or distributors at home, some of whom have become highly specialised.

One such specialist is Electroplan, distributing electronic instruments and accessories. It is part of the Electrocomponents Group which, before it went public, was universally known as Radiospares with that part of the business still flourishing today under the name RS Components Ltd. Electroplan, formed four years ago, acquired Dave Hall as managing director a year ago, and he has just completed a re-organisation of the product line.

The whole of the Electroplan business is based on the cost of selling and today this is as much the cost of travel as the cost of the salesman himself. To put a good person on the road with a car and expenses now costs between £10,000 and £15,000 a year and taking out non-productive travel and administration time there are about 1,000 hours of actual selling time available in a year at a cost price of £10-15 an hour.

The sales people have to support not only themselves but a whole series of operations behind them such as warehousing, accounts department, test laboratory, after-sales service, and to make a profit Hall says each of the sales force needs to generate business at the rate of £200 per selling hour minimum.

Looked at in this light, what chance has the small man?

ENG (or EJ)

ENG, sometimes called EJ is now the rage among t.v. professionals. The initials stand for Electronic News Gathering and Electronic Journalism through the use of lightweight t.v. cameras. Spaceflight t.v. led the way to small is beautiful, and now every

major company is in on the act on pedestrian-portable systems, electronics now supplanting the long-established cine camera with all its delay in film processing before the picture could be transmitted.

Probably the smallest and lightest portable colour camera is the Thomson-CSF Microcam with a camera package weighing only eight pounds plus an electronics package which can be slung at waist level weighing another three pounds. With a power consumption of only 20W, the system can be operated in an emergency from flash light cells. The camera can be used for news-casting in real time or even if the event is taped, no re-processing is necessary at the studio.

Exploiting every promotional aspect, Thomson-CSF suggests that the Microcam may well broaden opportunities for women in t.v. journalism, clearly regarding the girls, even in the lib age, as being by far the frailer sex.

But even with heavier models you don't need to be a professional weight lifter to shoot pictures. RCA's TK-76 candid camera weighs 19lb, all in one package without a back-pack. But the Ampex AVR-3 one-man t.v. news system weighs nearly 50lb.

Britain's native contribution to ENG is the Marconi Mk VIII P which is the lightweight portable version of the outstandingly successful Mk VIII "hands-off" automatic studio camera. It weighs 17lb and is thus very manageable on a shoulder mount. After only a year since its introduction to the market it is already in use in the Soviet Union, Yugoslavia, the United States, Australia and Qatar.

Cashing in on the new craze for mobility, Marconi has just designed a "mini" OB vehicle which can shoot on the move, be used as a stationary base for pedestrian news gathering, or as a platform for roof-mounted cameras on tripods. Video and audio mixers, sync generators, colour monitors, waveform monitors are all in the small vehicle and powered from an on-board generator.

While the domestic market for t.v. receivers remains flat, the professional broadcasting side of the business seems to be experiencing a boom. There are still plenty of countries with no t.v. service at all.

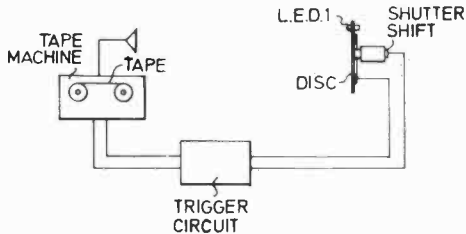
Even in recession-ridden Britain, 200 new t.v. relay stations have been introduced by the IBA in the past four years, bringing the total of IBA radio and t.v. stations to 300. Low power relay stations are still opening at the rate of one every week. Nice work for the manufacturers but no extra employment for IBA engineers, whose numbers are no greater today than in 1969 when there were under 50 stations. Nearly all the new stations are unattended, including many high-powered ones.

PATENTS REVIEW...

SOUND/SYNC

The name of Alan Sidi, of Leeds, is well known in home movie circles, and in BP 1 418 776 he describes one of his sound-sync inventions. A sound recording to be synchronised is made on one track of the tape with a conventional pulse track applied during filming on an adjacent track.

The pulses (usually one per film frame) and the sound signals are read by adjacent playback heads of the tape machine (Fig. 1) and the sound signals conventionally reproduced. The pulses are fed to a transistor triggering circuit, which feeds a corresponding train of voltage pulses to a rotating light emitting diode or neon, via slip rings. The neon or l.e.d. 1 is carried by a rotary disc, either mounted on the projector shutter shaft or driven via a Bowden cable link.



BP 1 418 776

Fig. 1

When the frequency of the pulses from the tape exactly equals the frequency of rotation of the disc (which is directly proportional to the speed at which the film is passing through the projector) the spot of light will appear stationary relative to a stationary pointer outside the circumference of the disc.

If either the projector or the tape recorder is rotating too fast or too slowly the spot of light will appear to "creep" forwards or backwards with respect to the pointer in the manner of a stroboscopic display. Such movement is halted by adjustment of the tape recorder or (preferably) the projector speed, until the light again appears stationary.

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent Price 75p each

GOOD NEWS FROM

Connoisseur THE NEW BD2/A



Based on the popular BD2, the new BD2/A offers the hi-fi enthusiast all the features usually associated with Connoisseur turntables, such as low rumble, wow and flutter, plus the addition of an automatic pick-up arm lift-off at the end of the record. This is achieved by an ingenious, though simple, electromagnetic system, which avoids having any physical contact with the pick-up arm. It is possible, therefore, to use top quality cartridges, tracking at less than one gram, without putting any extra side pressure on the stylus.

The BD2/A comes either as a chassis model, or mounted on a slimline plinth, standing on rubber anti-vibration feet, finished in genuine American walnut, and fitted with a bronze, hinged dust cover. For those with restricted space, a compact plinth measuring only 13½" x 15½" x 5½" is still available.

Specification

Rumble - 65dB when measured in accordance with DIN 45539 using weighting network, referred to 7cm/sec. at 330Hz.

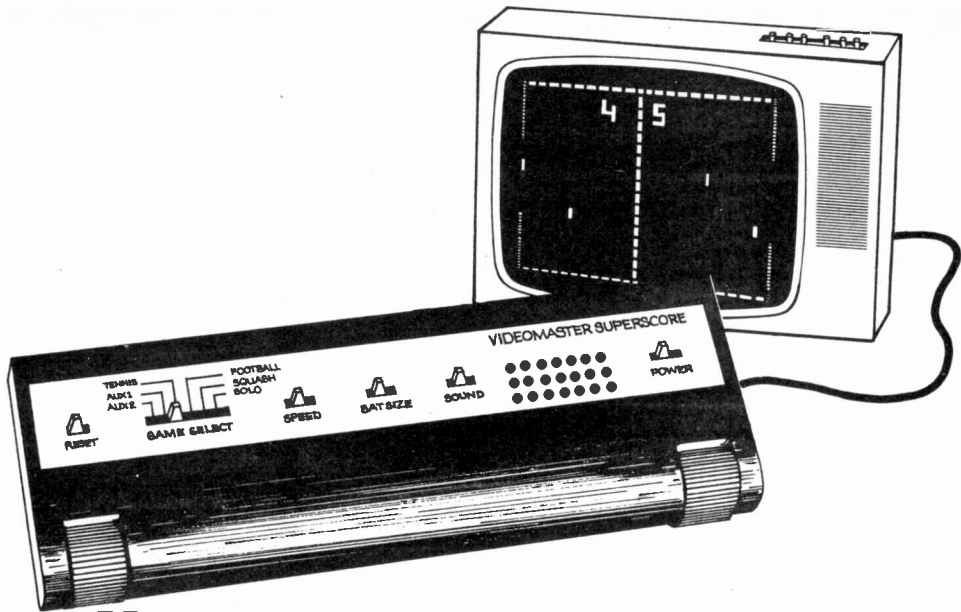
Wow and flutter Less than 0.1%.

Hum level - 80dB.

The BD2/A sells for a recommended price of only £55.00 + VAT. Ask your local hi-fi dealer, or write to the factory, for further details.

Connoisseur

Manufactured by:- A. R. Sugden & Co (Engineers) Ltd., Atlas Mill Road, Brighouse, West Yorkshire, HD6 1ES.
Telephone: Brighouse (04847) 2142. Telegrams & Cables: Connoisseur, Brighouse.



Here's the remarkable new **VIDEOMASTERTM** Superscore Home TV Game Get it together for only £24.95

Available to you in kit form at the same moment as its national launch, the brilliant new Videomaster Superscore contains the latest product of MOS technology: a TV game chip.

The logic contained in it had previously to be generated by 100 TTL devices. Now it is condensed into one 28-pin chip.

This all-new Videomaster plugs into your 625-line UHF TV set (for overseas customers having VHF sets we can supply the necessary VHF modulator) to give you four exciting games (including tennis and football) and two future game options. It features on-screen digital scoring, realistic hit sounds, two bat sizes, two

ball speeds, automatic serving and much more. It runs on six 1½ volt SP11 type batteries (not supplied).

The Videomaster Superscore kit costs only £24.95 including VAT (recommended retail price of the ready built model is over £40.00) and comes complete with ready-tuned UHF or VHF modulator, circuit board with printed legend, all resistors, transistors and diodes, built-in loudspeaker, socket for mains adaptor, and, of course, the TV game chip itself.

Easy to put together the Superscore has full assembly instructions, circuit diagram and circuit description. Don't miss this chance to own the newest electronic game at such low cost.

POST TODAY TO:

Videomaster Ltd 14/20 Headfort Place, London SW1X 7HN



Please send me (insert No. requ'd).....Videomaster Superscore Kits at £24.95 (inc. VAT & P&P in UK) or £23.10+£4.00 for P&P overseas)

I enclose my cheque/money order* for £.....

VHF modulator required YES/NO*

PE79

NAME _____

ADDRESS _____

ALLOW 21 DAYS FOR DELIVERY

* delete as necessary

PRINTED CIRCUIT KIT £3-95*

Make your own printed circuits. Contains etching dish, 100sq.in of pc board, 1lb ferric chloride, dalo pen, drill bit, laminate cutter.

JC12 AMPLIFIER

6W IC audio amp with free data and printed circuit. £2-25*



DELUXE KIT FOR JC12

Contains extra parts except JC12 needed to complete the amp including balance, volume, bass and treble controls. Mono £2-33. Stereo £4-95.

JC12 POWER KIT

Supplies 25V 1A £3-55.

JC12 PREAMP KITS

Type 1 for magnetic pickups, mics and tuners. Mono £1-50. Stereo £3. Type 2 for ceramic or crystal pickups. Mono £8p. Stereo £1-78.

SINCLAIR IC20

IC20 10W + 10W stereo integrated circuit amplifier kit with free printed circuit + data £4-95. PZ20 Power supply kit for above £3-95. VP20 Volume, tone-control and preamp kit £7-95.

JC40 AMPLIFIER

New integrated circuit 20W amplifier kit complete with chip, printed circuit and data £4-45.

FERRANTI ZN414

IC radio chip £1-44. Extra parts and pcb for radio £3-85. Case 90p. Send S.A.E. for free data.

BATTERY ELIMINATOR BARGAINS

STABILIZED POWER UNITS*

Millenia series. Switched 1 to 30V in 0-1V steps. 1A: Kit £11-95. Kit + case £14-90. Built £23. 2A: Kit £14-45. Kit + case £17-40. Built £28.

6-WAY SPECIAL £5-20

Switched output of 3/4/6/7/9/12V at 500mA



3-WAY MODELS*

With switched output and 4-way multi-jack connector. Type 1: 3/4/6V at 100mA £2-94. Type 2: 6/7/9V at 250mA £3-16.

RADIO MODELS

50mA with press-stud battery connectors. 9V £3-25. 6V £3-45. 9V + 9V £5-45. 6V + 6V £5-45. 4V + 4V £5-45. Also 9V 300mA £3-95. 6V 400mA £3-95.

CASSETTE MAINS UNITS

7½V with 5 pin din plug. 50mA £3-45. 300mA £3-95.

CAR CONVERTERS £5-10*

Input 12V d.c. Output 6/7/9V d.c. 1A stabilized.

BATTERY ELIMINATOR KITS

Send S.A.E. for free leaflet on range.

100mA radio types with press-stud battery terminals. 4V £1-95. 6V £1-95. 9V £1-95. 4V + 4V £2-60. 6V + 6V £2-60. 9V + 9V £2-60.

100mA cassette type 7½V with 5 pin din plug £1-95. Transistor stabilized 8-way type for low hum. 3/4/6/7/9/12/15/18V. 50mA £3-15. 1A £5-50.

Heavy duty 13-way types 4/6/7/8/11/13/14/17/21/25/28/34/42V. 1A model £4-95. 2A model £7-55. Car converter kit input 12V d.c. Output 6/7/9V d.c. 1A transistor stabilized £1-95.

MAINS TRANSFORMERS

6-0-6 100mA £1. 9-0-9V 100mA £1. 18V 1A £1-95. 0/12/15/20/24/30V 1A £4-30. 12-0-12V 50mA £1. 0/12/15/20/24/30V 2A £5-95. 20V 2A £2-85. 6-0-6V 1½A £2-85. 9-0-9V 1A £2-45. 12-0-12V 1A £2-95. 15-0-15V 1A £3-20. 30-0-30V 1A £4-10. 6-3V 1½A £1-95.

S-DECS AND T-DECS*

S-Dec £2-24.

T-Dec £4-95.

µ-DecA £4-45.

µ-DecB £7-85.

IC carriers

with sockets: 16 dii £2-05. 10T05 £1-95.



SINCLAIR CALCULATORS AND WATCHES*

Cambridge Universal £8-80. Cambridge Scientific £8-95. Oxford 300 £13-30. Programmable Scientific with free mains unit £24-95. Mains adaptors for other models (state type) £3-20. Assembled Grey Watch with free stainless steel bracelet £16-45.

SINCLAIR PROJECT 80 AUDIO MODULES

PZ5 £4-95. PZ6 £8-70. Z40 £5-75. Project 805Q £8-95.

BI-PAK AUDIO MODULES

S450 tuner £18-95. AL60 £4-33. PA100 £13-45. MK60 audio kit £27-20. Teak 60 £10-95. Stereo 30 £15-95. TC30 £4-80. AL250 £16-15. Send S.A.E. for free data.

SWANLEY ELECTRONICS

Dept. PE, PO BOX 68, Swanley, Kent

Send S.A.E. for free leaflets on all kits. Post 30p on orders under £2-23, otherwise free. Prices include VAT (Overseas customers deduct 7% on items marked *, otherwise 11%). Official orders welcome.

PRECISION PETITE LTD.

119a High Street, Teddington, Middlesex TW11 8HG

Tel. 01-977 0878 (24 hr. telephone answering service)

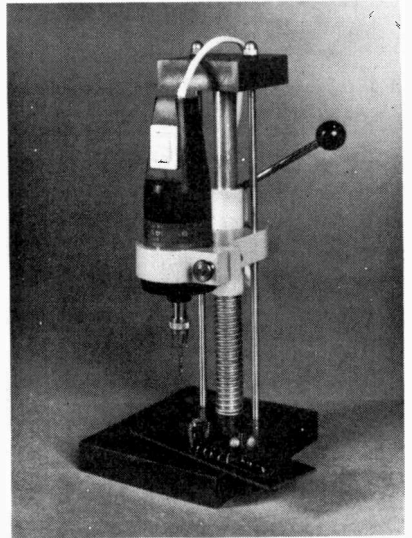
S.A.E. please for leaflet and order form

- Super 30 Kit (30 Tools) (incl. drill without stand) £17-62 plus P. & P. 85p
- Super 10 Kit (10 Tools) (incl. drill without stand) £13-74 plus P. & P. 65p
- Mk. II Drill Stand £4-40 plus P. & P. 35p
- Mk. II Drill only £8-79 plus P. & P. 35p
- Flexible Drive Shaft £5-46 plus P. & P. 25p
- Transformer 240V a.c./12V d.c. £6 plus P. & P. 70p

Replacement drills, stones, burrs, etc. 40p each. Circular saw blades 50p each. £2 per set of 4 sizes. P. & P. any quantity 20p.

All VAT inclusive

SEE OUR STAND AT MODEL ENGINEERING EXHIBITION, WEMBLEY, JAN. 4th-11th.



AN L.C.D. FOR UNDER £22!

Our introductory offer INSTAR 103P L.C.D.



INSTAR

Continuous readout of hrs, mins, and pulsating secs. Gold-plated case with a/s back and matching bracelet. Presentation box. Limited availability. £21-50.

Special offer—new from U.S.A. FAIRCHILD TIMEBAND L.C.D.s

5 + 4 functions: constant readout of hrs., mins. and pulsating secs. Single command button push once for month/day/date (auto return), twice for cont. secs. readout. PLUS Auto 4 yr. calendar adjust; backlight a.m. p.m. setting indicator; optional cont. alt. time-date display.

TC411 chrome finish £29-50

TC410 gold plated £32-50

With leather strap and presentation box.



TC413 chrome finish £34-50

TC412 gold plated £37-50

With matching bracelet and presentation box. These are beautiful watches.

VERY SPECIAL L.E.D. OFFER GALA



GALA

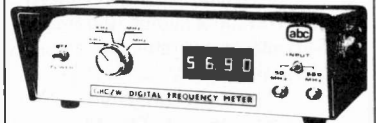
5 + 3 functions: hrs., mins., secs., alpha day, date and month. PLUS auto 4 yr. calendar adjust; a.m.-p.m. setting indicator; auto hold and fade out. Available in a/s or gold plated with a/s back and matching bracelet. Sold elsewhere at £22-95. OUR SPECIAL PRICE £14-95.

No quibble 1 Year Guarantee. Prices include VAT and P. & P. Free battery(s). Compare our prices and specifications. Send cheque/money order to:

TEMPUS

Dept. P.E., 5-7 Norfolk Street Cambridge CB1 2LD. Tel. 55094

G8CZW DIGITAL FREQUENCY METER



COMPLETE 50MHz KIT £54 inc. VAT and Post (U.K.)

Component	Price
ZN 1040E Count/Display I.C.	8-90
Integrated Circuit Pack	9-25
Displays and Filter	7-28
Semiconductor and Diode Pack	2-38
Resistor and Capacitor Pack	2-98
Logic and Display P.C.B.'s	4-84
Buffer (includes PCB)	3-45
5 MHz Crystal	2-48
Transformer 0-0-8V (+ 60p P. & P.)	2-48
I.C. Sockets Pack	2-30
Switches, Knob, BNC Sockets, etc.	4-15
Hardware and Wire Pack	1-45
Case—Two-tone PVC-faced steel punched and lettered (+ 75p P. & P.)	5-75
Spare min. BNC Sockets (50 ohm)	0-70
Spare min. BNC Plugs (50 ohm)	0-70
Complete kit of parts for High Impedance Buffer (includes PCB)	3-82
High Impedance Buffer P.C.B. only	0-80
Complete kit for VHF Pre-scaler (includes PCB but less I.C.)	1-78
VHF Pre-scaler printed circuit board only	0-80
SP8631B 500MHz Pre-scaler I.C.	8-96
ZN1034E Precision Timer I.C.	2-97
ZNA116E 3½ digit digi-voltmeter I.C.	6-48
Digital Voltmeter P.C.B.'s and Circuits	3-78
NE592 Wideband video amplifier I.C.	1-43
Reprint of full G8CZW article (post free)	0-50

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.

abc ELECTRONICS (OLDHAM) LTD.

83 Lees Road, Oldham OL4 1JW
Tel. 061-624 8812

Sparkrite mk2

Capacitive discharge
electronic ignition kit

VOTED BEST
OF 8 SYSTEMS
TESTED BY
'POPULAR
MOTORING'
MAGAZINE



- * Smoother running
- * Instant all-weather starting
- * Continual peak performance
- * Longer coil/battery/plug life
- * Improved acceleration/top speeds
- * Up to 20% better 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

POST TODAY!

Quick installation
No engine modification
required

Electronics Design Associates, Dept. PE12
82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 33652

Name
Address

Mk. 2 DIY Ass. Kit @ £11.80	QUANTITY REQ'D.	I enclose cheque/PO's for £
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		

Your free start to a rewarding new hobby.



Heathkit make the world's largest range of electronic kits.

Including hi-fi, amateur radio, test equipment and general interest kits.

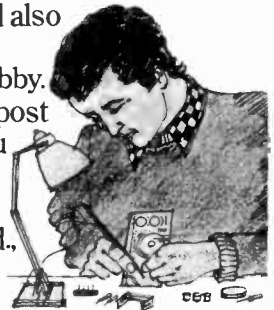
Every one of which comes to you absolutely complete—right down to the last nut and bolt.

You'll also get a very easy to understand instruction manual that takes you step by step through the assembly.

So, besides making an attractive, useful piece of equipment, you'll also have the makings of a satisfying, rewarding hobby.

To find out more, post the coupon we'll send you our latest catalogue.

Heath (Gloucester) Ltd.,
Dept. PE -126, Bristol Rd.,
Gloucester, GL2 6EE.
Tel: Glos (0452) 29451.



HEATHKIT

BETTER BUILT BECAUSE YOU BUILD IT YOURSELF

The new Heathkit catalogue. Out now. FREE.

To: Heath (Gloucester) Ltd., Dept. PE-126, Gloucester, GL2 6EE. Please send me my Heathkit catalogue.

I enclose an 11p stamp for postage.

Name

HEATH
Schlumberger

Address

Postcode

FREE
SOLDERING IRON
with your first order
(over £30)

EASY TERMS AVAILABLE
WITH HEATHKIT MONTHLY
BUDGET PLAN

Showrooms at 233 Tottenham Court Road,
London and Bristol Road, Gloucester.

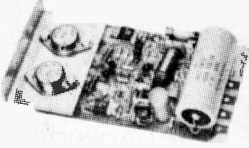
SAXON ENTERTAINMENTS LTD

A FULL RANGE OF PRINTED CIRCUIT
MODULES FOR ALL P.A. & DISCO &
GROUP APPLICATIONS

SYSTEM 7000 HAS IT!

A COMPLETE SELECTION OF READY
TO USE PROFESSIONAL QUALITY
AUDIO & LIGHTING EQUIPMENT

POWER AMPLIFIER MODULES 30—240 WATTS



- Fully tested & guaranteed.
- Full RMS Sine Wave output.
- Distortion typically 0-2%
- 10 Transistors, 4 Diodes.
- Response 30HZ-30KHZ
- Fully short & open circuit proof
- Sensitivity suits most mixers.
- Built-in surge suppression & compensation
- Twin D.C. & 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 £15-00
			SA2404 240W rms/ 4 ohms £25-50

POWER SUPPLIES FOR THE ABOVE MODULES—READY WIRED & FUSED ON
GLASS FIBRE PCB

PM301 For 1/2 SA308 £9-90	PM601/4 For 1/2 SA604 £12-50	PM601/8 For 1/2 SA608 £12-50	PM1201/4 For 1 SA1204 £12-50	PM1201/8 For 1 SA1208 £12-50	PM1202/4 For 2 SA1204 £19-50	PM1202/8 For 2 SA1208 £19-50	PM2404/1 For 1 SA2404 £19-50
------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------

DISCO MIXER MODULES Mono or Stereo (with Auto Fade)



Printed circuit module assembled &
tested with all components ready
mounted.

Mono **£19-50** Stereo **£29-50**

* Front panel to suit £3-50

- Mixes two decks, tape and mic.
- Wide-range bass & treble controls on mic. & music channels.
- Variable autofade (mic. override)
- Ample headphone power.
- Needs only front panel* knobs and selector switch.
- Push-pull monitor circuit.
- 20HZ-20KHZ—Noise -77dB
- Comprehensive wiring details provided
- Perfect for incorporation in your system

ALL PURPOSE CUSTOM—MIXER MODULES (Mono or Stereo)



- Using these modules, mixers may be built to your specification up to 20 Channels, mono or stereo, or a combination of both. System 7000 custom-mixer modules have monitoring facilities too!

INPUT MODULES

- Accept low/high 2 mics, ceramic & magnetic cartridges, all musical instruments & line signals
 - Low-noise circuitry—high grade components
 - Wide-range bass & treble controls (23dB)
 - 20HZ-30KHZ Noise -80dB
 - Echo sound/return etc easily fitted
- Mono—IM7001M **£5-50**
Stereo—IM7001S

Power supply for up to 20 modules—PPM18 £8-50

MIXING MODULES

- Only one required per mixer track whether mono or stereo
 - Feeds up to ten power modules
 - Complete with $\frac{1}{2}$ W monitor amplifier
 - Accepts up to 20 input modules
 - Will match any other make of amplifier
- Mono—IM7002M **£9-00**
Stereo—IM7002S

QUADRAFECT FOUR CHANNEL 4KW SEQUENCER WITH DIMMERS

A COMPLETE
LIGHT
SHOW!!



£29-50

* PANEL £2-50

THE ONLY MODULAR
SOUND TO LIGHT UNIT WITH:

- * Four Integral dimmers.
- * Two + Two sequencer
- * Automatic audio level

- RCA 8A Triacs
- Sequence 0-5-20HZ
- I.C. circuitry
- Needs only front panel*

- Audio trigger 1-240W
- Fully suppressed
- Individual fuses
- Complete with speed Slider control

THREE CHANNEL 3KW SOUND/LITE—Low Cost— Superb Value



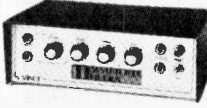
£16-50

* Panel £2-50

- Long-established Saxon design
- Individual level controls + master
- RCA 8A Triacs
- 1W-240W input
- Individual channel fuses
- Needs only front panel*

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 \pm 2dB
 - 23dB bass/treble
- A four input, high power amplifier which will deliver up to 150 watts output. An absolute must where multiple mixing & power are required
- 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, disco's & clubs

- Vynlide covered case
- Fully short proof
- Superb value for money

£49-50



SAXON 150 HEAVY DUTY AMPLIFIER £59-00

SYSTEM 7000

COMPLETE DISCO MIXERS (with Auto Fade)



The choice of the professional D.J.

Controls: Mic. volume, bass, treble, A/fade depth, tape, L/deck, r/deck vols., treble, bass, master, headphones vol., selector, left/right fader.

MONO 18V **£37-50** MONO MAINS **£43-50**

*Ready to plug in & use
* Mono or Stereo

- Automatic mic. override
- Mixes two decks, tape & mic
- Facilities as for modular version opposite
- Mute positions on headphone selector for ease of monitoring
- Two tone stainless steel panel
- Sockets on front & rear panels
- Left/right deck fader
- May be operated from any power supply or from mains

Stereo 18V **£53-50**
Stereo Mains **£59-50**

SYSTEM 7000 COMPLETE CUSTOM MIXERS (Mono or Stereo)



- Similar to the modules opposite these mixing modules are complete with front panels, sockets, knobs, monitor switch etc. Up to 20 channels (mono or stereo) may be incorporated in one system with any number of output tracks.

Ideal for the economical & quick assembly of a purpose built mixer with individual channel monitoring, and optional extra facilities—consult our technical dept. to discuss your needs.

- Stainless steel panels
 - Built-in monitoring
 - Will feed all amplifiers
 - Professional appearance
 - Accepts all types of signals
 - Infinitely adaptable
- Mono Input module **£8-50**
Stereo Input module **£12-00**
Mono mixing module **£8-50**
Stereo mixing module **£12-00**
Power supply **£8-50**

SYSTEM 7000 LIGHTING CONTROL MK II



HAS YOUR SOUND TO
LIGHT CONVERTER GOT:

- 4000W Handling
- Integral Individual dimmers
- Automatic audio level control
- Two + Two sequence facility

OURS HAS! — PLUS:

- Stainless steel panel
- Heavy duty terminations

ALL YOUR ELECTRONIC
LIGHTING NEEDS IN ONE
SUPERBLY DESIGNED
UNIT.

£42-50

SAXON SOUND-LITE—An old design with improved appearance

- Scintillating performance
- Similar to Mk II lighting control in appearance
- 3KW power handling
- Individual bass, treble, middle & master controls
- 1-240W input
- Fully fused & isolated

Complete with heavy
duty terminations

£24-75

EXPORTERS TO 17 COUNTRIES — ENQUIRIES WELCOMED — NATIONWIDE DISTRIBUTION BY NORMAN

BRANCHES AT CROYDON & WALLINGFORD

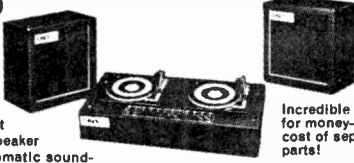
CUSTOMERS INCLUDE BBC, LONDON WEEKEND TV, SCOTTISH TELEVISION, NATIONAL TYRES, POST OFFICE, GOVT. DEPTS.

A READY-TO-USE 100W STEREO DISCO WITH BUILT-IN SOUND/LITE SEQUENCER AND LIGHTS FOR ONLY £199

THE CENTAUR

(Carr free in U.K.)

- 100W rms stereo output
- Twin heavy duty loudspeaker
- Four channel fully automatic sound-lite with variable speed sequence
- I.C. pre-amp with tape input & X fade
- Separate mic. & music treble and bass controls
- Attractive Vynide cabinets
- Twin BSR decks with autostop & lift arm
- All connecting leads supplied—ready to plug in
- Loudspeakers have kick-proof grills
- Four colour built-in light display gives ever changing pattern with or without music



Incredible value for money—2/3 cost of separate parts!

A READY-TO-USE 50W MONO DISCO COMPLETE WITH TWIN HEAVY DUTY LOUSPEAKERS FOR ONLY

£89.90

- 50W rms output
- Twin heavy duty loudspeakers
- Separate mic. input
- Wide range bass & treble controls
- Smart Vynide cases—clip together to form one neat package
- Twin BSR decks with lift & autostop
- Tremendous value—price includes leads just plug in & go!



Accessories for complete discos & other systems

- Electret Condenser Mic ECM31 C/W windshield & clip £12.00
- ECM78—as above but dual impedance with removable lead £13.00
- Crown Stereo Headphones £6.75
- Heavy duty boom mic. stand £12.50

CUSTOM BUILT DISCOS

A full range of custom consoles are available using System 7000, from 50W mono to 500W stereo. Ask for our price list.



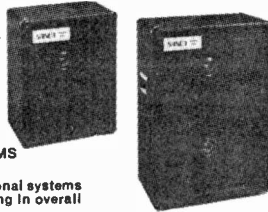
LOUDSPEAKER CABINETS

- Kick proof grills.
- Jointed construction
- Protective corners
- Smart & professional
- Heavy duty units.
- Black Vynide
- finished.

Single Twelve: Empty £14
With 60W unit £33.00
Twin Twelve: Empty £24
With units from £59.00
Folded Horn—Full range P.A. Bin 100W RMS £120.00

This cabinet is 3-4 times as loud as conventional systems for a given input power—thus there is a saving in overall size & cost.

Many other cabinets available—ask for details.



EMPTY DISCO CONSOLES

- £19 with plain motorboard. £21 with cutouts.
- Black Vynide finish
- Protective corners
- With your choice of cutouts

STROBES & PROJECTORS (We stock the full Pluto range) Send for details

SUPERSTROBE £19.75

- 2-3 Joules
- 80W Tube for long life
- Compact 4" x 4" x 4"

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 & motor plate
- Sturdy steel construction
- Remarkable value—Sold elsewhere at £39.50. Our price is only: £31.50

Please add 8% VAT to all orders (12 1/2% for SA308/PM301)
We accept Access & Barclaycard—simply telephone or send your card number—Do not send your card.

You may pay by cheque, crossed postal orders, cash (registered) or bank draft

To order—or for advice phone (01) 684 6385 or (01) 684 0098
Mail orders to: 327-333 Whitehorse Rd., Croydon, Surrey CR0 2HS
Shop open 9am-5pm Mon.—Sat. Mail order desk 10am-3pm Mon.—Fri.

Wallingford Branch: Filnt House, High St., Wallingford, Oxon
(Callers only)
9am-5pm Mon.—Sat. Telephone (0491) 35529

ROSE ELECTRICAL TO BONA FIDE TRADE CUSTOMERS

GREENWELD

443 Millbrook Road Southampton
SO1 0HX Tel: (0703) 772501

All mail orders and callers to this address please—callers only to 21 Deptford Broadway, SE8 (Tel. 01-692 2009) and 38 Lower Addiscombe Road, Croydon

44 PAGE CATALOGUE 10P + LARGE S.A.E. Free with orders over £2

DIGITAL I.C.s

7400 12p	7450 15p	7485 75p
7401 14p	7451 14p	7486 85p
7402 14p	7453 14p	7407 37p
7404 17p	7454 14p	7421 36p
7405 23p	7460 14p	7422 51p
7406 28p	7472 29p	7423 64p
7408 14p	7473 29p	7432 56p
7410 13p	7474 29p	7435 173p
7413 29p	7475 51p	7434 144p
7414 62p	7476 29p	7455 73p
7420 14p	7483 91p	7457 66p
7430 14p	7486 40p	7459 200p
7432 18p	7490 40p	7474 110p
7437 18p	7491 75p	7479 120p
7447 84p	7492 52p	7480 120p
	7493 52p	7487 120p

DIL Sockets—8 pin 12p; 14 pin 13p;
16 pin 14p. 100+ less 25%.

LINEAR I.C.s

741 25p; 555 40p; 723 (TO99) 50p
Plastic Voltage Regulators:
TO126 case 5V 600mA 80p, 12V 500mA 90p

TRANSISTORS

AC127 15p	BC183 12p	2N2646 42p
AC128 15p	BC184 12p	2N2656 12p
AC176 16p	BC212 14p	2N3053 18p
AC187 18p	BC213 14p	2N3054 48p
AC188 18p	BC214 14p	2N3055 38p
AD161 35p	BCY70 15p	2N3440 54p
AD162 35p	BCY71 15p	2N3442 £1.20
BC107 10p	BCY72 15p	2N3702 10p
BC108 10p	BD131 38p	2N3704 10p
BC109 10p	BD132 40p	2N3705 10p
BC108C 15p	BFY50 15p	2N3705 10p
BC147 10p	BFY51 15p	2N3708 10p
BC148 10p	BFY52 15p	2N3819 22p
BC149 10p	TIP41A 60p	2N4059 10p
BC157 10p	TIP42A 75p	2N4418 10p
BC158 10p	TIP2955 36p	2N5294 30p
BC159 10p	TIP3055 42p	40673 50p
BC161 18p	2N2219 28p	
BC182 12p	2N2369 22p	

VEROBOARD

Good size offcuts; all packs contain 100 sq. in. (About 6 pieces). All packs £1.20.
Pack A, all 0.1in pitch;
Pack B, all 0.15in pitch;
Pack C, mixed 0.1 and 0.15;
Pack D, all 0.1in plain.
Also available by weight: 1lb £3.45; 10lbs £30.
17 x 3 1/2 x 0.1in sheets £1.90;
0.1in or 0.15in pins, single or double sized 35p/100.

DIODES AND LEDs AND SCR's

500V 5A SCR 45p; 400V 2A Triac 80p;
Diac BR100 25p; 400V 15A Triac £1.50;
ORP12 45p; MRD450 40p; TIL209 Red LED 15p; 0.2in LED Red 23p; green, Yellow or amber 24p
1N4002 5p; 1N4004 6p; 1N4007 9p;
1N4148 4p; BY127 12p; 100V 3A 12p;
400V 3A 15p; OA81 5p; OA91 5p
50V 1A bridge 22p; 800V 1A 40p;
250V 2 1/2A 40p; 200V 5A 70p; 500V 6A £1.80.
50V 30A rect. + or - stud 40p
Zeners—400mW BZY88. All voltages from 3V to 30V 10p
1.3W plastic from 3V to 200V 20p

RESISTORS

Carbon film 5% 1/4W miniature. All values in E12 series from 1Ω to 10MΩ (over 1MΩ 10%) 1 1/2p each.
Metal Film 5% 1W. All values in E12 series from 27Ω to 10MΩ 2 1/2p.
Sub-mini. presets: vert. or horiz. all values from 20Ω to 4MΩ, 7p.
Standard pots, lin or log, 22p.
Wirewound 2 1/2W 0.25, 0.33, 0.47 1Ω 9p.
Wirewound 5W all values from 1Ω to 47k 10p each.

TRANSFORMERS

6-0-6V 100mA 90p; 9-0-9V 100mA 95p;
12-0-12V 50mA 90p; 12-0-12V 100mA £1;
12-0-12V 1A £2.80; 20V 55mA 90p;
22V 100mA £1; 29V 50mA 85p; 6.3V 1 1/2A £1.95; 6-0-6V 1 1/2A £2.30; 12V 150mA 80p; 17V 1A £1.90; 25V 1 1/2A £2.30; 30-0-30V 1A £3.70.

REEDS

1in inserts. 5p; 10/40p; 100/£3.50. DIL relays. 3-7-10V. £2.20.

WIRE

Enamelled copper wire on 2oz reels
SWG/price: 16/32p, 18/34p, 20/36p, 22/38p, 24/40p, 26/42p, 28/44p, 30/46p, 32/48p, 34/50p, 36/52p, 38/54p, 40/56p.

RF CHOKES

0.75, 2.95, 6.8, 10, 22, 47μH, all 10p each; 1.5, 2.5, 5.0, 7.5, 10mH, all 30p each

CAPACITORS

Ceramic plate, 22pF to 1.000pF 2p; polyester 1.000 to 5.000pF 5p; 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1mF 4p; 0.15, 0.22mF 5p; 0.33 6p; 0.47 6p; 0.68 10p; 1mF 12p; 2.2mF 18p; 3.3mF 24p. 1.000pF feedthrough 5p.
1%, 1.000pF, 10.000pF 15p; 0.1μF, 0.2μF, 0.25μF 30p; 2.2μF 35p.
Polystyrene 10pF to 1.000pF 4p; 1.200pF to 10.000pF 8p. All 2 1/2%.

Electrolytics:

All 25V: 0.47, 1, 2.2, 4.7, 10, 22, 47mF 6p; 100mF 7p; 220mF 9p; 470mF 11p; 1.000mF 16p; 2.200mF 27p; 40V: 47mF 7p; 100mF 8p; 220mF 10p; 470mF 16p; 1.000mF 32p; 2.200mF 48p.
Tantalum bead, mF/V: 0.1/35; 0.22/35; 0.33/35; 0.47/35; 1/35; 1.5/35; 10/16; 10/25; 15/10; 22/6; 3; 22/10; 22/16; 33/10; 47/6; 3; 100/3, 12p each.

BREADBOARDS

S-DEC Breadboard £2.10;
T-DEC Breadboard £3.75.
Special price to colleges etc. for quantities—ring for quote.

ALUMINIUM BOXES

Complete with base and PK Screws.
AB7 133 x 70 x 38mm 50p
AB8 102 x 102 x 38mm 50p
AB9 102 x 70 x 38mm 47p
AB10 102 x 133 x 38mm 50p
AB11 102 x 64 x 51mm 47p
AB12 76 x 51 x 25mm 44p
AB13 152 x 102 x 51mm 65p
AB14 178 x 127 x 64mm 85p
AB15 203 x 152 x 76mm £1.50
AB16 254 x 178 x 76mm £1.80
AB17 254 x 114 x 76mm £1.50
AB18 307 x 128 x 76mm £1.75
AB19 307 x 203 x 76mm £2.00
AB20 102 x 102 x 64mm 80p
AB24 133 x 102 x 64mm 90p
AB25 152 x 102 x 76mm £1.00

VEROBONES AND CASES

Professional 2 part boxes made of dark and light grey high impact polystyrene.
2518 120 x 65 x 40mm £1.90
2520 150 x 80 x 50mm £2.15
2522 188 x 110 x 60mm £2.85

Sloping front version, ideal for mixers
2523 220 x 174 x 100/52mm £4.95
Cases, white plastic top and bottom, front and back aluminium panels that slot in. Type;

1410 205 x 140 x 40mm £2.90
1411 205 x 140 x 75mm £3.25
1412 205 x 140 x 110mm £4.20
1237 154 x 85 x 40mm £1.80
1238 154 x 85 x 60mm £2.25
1239 154 x 85 x 80mm £2.75
Small general purpose plastic boxes:
1413 7 1/2 x 40 x 24mm 32p
PB1 115 x 75 x 36mm 42p

DEVELOPMENT PACKS

Save ££££ by buying a full range of components at one go! All full spec. marked devices, no rejects or old stock.
50V ceramic plate capacitors 5% 10 of each value, 22pF to 1.000pF. Total 210 capacitors £2.20.
CR25 carbon film resistors, 1/4 watt 5% 10 of each value 10Ω to 1MΩ. total 610 68.00.

Extended range 1 ohm to 10M 850 resistors £8.30.

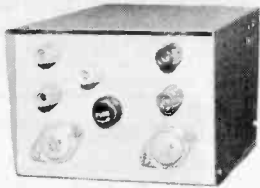
Electrolytics, wire ended 25V working 10 each of: 1, 2.2, 4.7, 10, 22, 47 and 100mF 70 capacitors for £3.20.

Zeners, 400mW 5% BZY88, 10 each 3V to 30V total 260 £14.00.

1 1/2 pack, 5 of each value £8.20.
Tantalum Bead caps, 14 values from 0.1/35 to 100/3, 10 of each total 140 caps £12.90.

See Practical Wireless for details of packs of components, surplus, goods, etc. All prices quoted include VAT. Add 20p postage on orders under £2. Most orders despatched on day of receipt. SAE with enquiries. Send 10p for Multimeter catalogue—free on request on orders over £3. Official Orders accepted from Schools, etc. Export/wholesale enquiries welcome. Surplus components always wanted.

INVERTORS



240v-50Hz from your 12v car battery.

25 watt—£4.75	300 watt (24v)—£26.45
40 watt—£8.27	400 watt (12v)—£39.05
75 watt—£12.03	500 watt (24v)—£48.18
150 watt—£21.27	1kW (50v)—£127.00
300 watt (12v)—£33.03	1.5kW (110v)—£140.80

All above invertors are in kit form but may be purchased built up in metal case & ready for use. Price list sent on receipt of s.a.e. Prices include post & packing.

P.W. AUTOMATIC EMERGENCY SUPPLY

240v-50Hz-150 watt inverter with built in battery charger. In event of power failure switches over automatically from battery charging to inverter operation. Cct. as appeared in Dec. 72 P.W. Complete kit of parts (excluding meter) £24.50 + £1.70p. & p.

DIGITAL WATCH

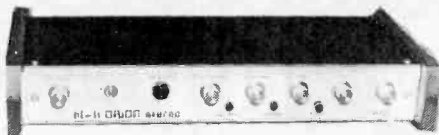
L.E.D. display giving hours, minutes, seconds and date. Design based on American technology, and fantastic value at £16 + 30p p. & p. One year guarantee.

TRANSFORMERS & COILS

Both high volume & small order capacity available. Special offer. Miniature mains transformer 6-0-6v-6V. A.—85p plus 10p p. & p.

TRADE & EXPORT ENQUIRIES WELCOMED

P.E. ORION STEREO AMPLIFIER



20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0.01% 100Hz-10kHz. Frequency response ± 1 dB 20 Hz to 20 kHz. 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.

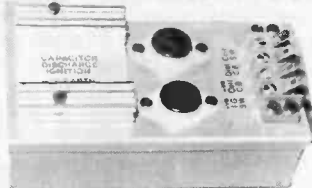
Complete kit of parts including slim line bookend case, silk screened front panel & knobs. £47.30 incl. VAT & p. & p.

The bookend case, I.C.s & semiconductors, P.C. board, Transformer, etc. may be purchased separately if desired. Send S.A.E. for further information

P.E. ORION TUNER

Full kit of parts for this superb tuner unit to complement the now well established amplifier. Parts may also be purchased separately. Send S.A.E.

ASTRO IGNITION

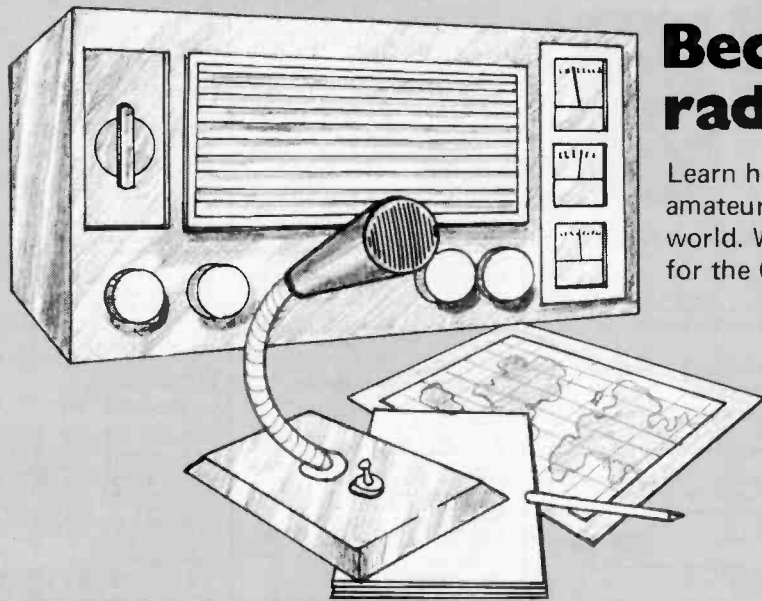


ASTRO IGNITION SYSTEM

Complete kit of parts for this proven and tested system £10.45 incl. VAT. Ready built with only two connections to alter £13.75 incl. VAT. Thousands have used this system both home and abroad. Consider these *advantages* more power, faster acceleration, fuel economy, excellent cold starting, smoother running, no contact breaker burning. Also because of the high energy spark, the fuel mixture can be made weaker giving further economy and fewer plug problems. Fitting time when built 5 minutes approx. Please state whether positive or negative earth. Trade and export enquiries welcomed.

ASTRO ELECTRONICS

Spring Bank Road, West Park
Chesterfield.



Become a radio amateur.

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

Free!

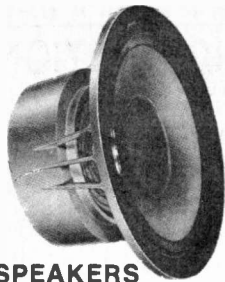
Brochure, without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL,
P.O. Box 156, Jersey, Channel Islands.

NAME _____

ADDRESS _____

Block caps please

PEE 126



WILMSLOW AUDIO

THE Firm for speakers!

SPEAKERS

Baker Group 25, 3, 8 or 15 ohm	£9.00
Baker Group 35, 3, 8 or 15 ohm	£10.75
Baker Group 50/12 8 or 15 ohm	£14.00
Baker Group 50/15 8 or 15 ohm	£18.62
Baker Deluxe 124, 8 or 15 ohm	£13.38
Baker Major 3, 8 or 15 ohm	£10.69
Baker Superb 8 or 15 ohm	£16.31
Baker Regent 12in 8 or 15 ohm	£9.00
Baker Auditorium 12in 8 or 15 ohm	£14.85
Baker Auditorium 15in 8 or 15 ohm	£19.41
Castle 8RS/DD 4 or 8 ohm	£9.28
Celestion G12M 8 or 15 ohm	£13.50
Celestion G12H 8 or 15 ohm	£18.75
Celestion G12/50 8 or 15 ohm	£16.50
Celestion G12/50TC 8 or 15 ohm	£20.00
Celestion G12/50 2236 s/cone	£18.00
Celestion G12/50 2239 s/cone, alum, dome	£18.50
Celestion G15C 8 or 15 ohm	£26.95
Celestion G18C 8 or 15 ohm	£39.95
Celestion HF1300 8 or 15 ohm	£6.98
Celestion HF2000 8 ohm	£8.55
Celestion MH1000 8 or 15 ohm	£13.50
Celestion C03K	£4.46
Coles 4001G	£5.90
Coles 4001K	£5.90
Decca London ribbon horn	£29.95
Decca London CO/1000/8 crossover	£6.95
Decca DK30 ribbon horn	£19.95
Decca CO/1/8 crossover (DK30)	£4.75
EMI 150 13 x 8in d/cone 8 ohm	£2.94
EMI 13 x 8in 20W bass 8 ohm	£9.00
EMI 14 x 9in bass 8 ohms, 14A770	£11.92
EMI 8 x 5in, 10W, d/cone, roll surr.	£3.75
EMI 6in d/cone, roll surr., 8 ohm	£3.93
EMI 8in roll surr. bass	£5.73
EMI 5in mid range	£3.50
Etac 59RM 109 (15 ohm), 59RM114 (8 ohm)	£3.38
Etac 6in d/cone, roll surr., 8 ohm	£3.95
Etac 10in 10RM239, 8 ohm	£3.95
Eagle Crossover 3000Hz 3, 8 or 15 ohm	£1.57
Eagle FR4	£5.51
Eagle FR65	£8.95
Eagle FR8	£11.95
Eagle FR10	£14.06
Eagle HT15	£3.96
Eagle HT15	£4.95
Eagle HT21	£4.00
Eagle MHT10	£5.95
Eagle FF28 Multicell. horn	£5.50
Fane Pop 15, 8 or 16 ohm	£9.75
Fane Pop 33T, 8 or 16 ohm	£12.50
Fane Pop 50, 8 or 16 ohm	£16.75
Fane Pop 55, 8 or 16 ohm	£19.95
Fane Pop 60, 8 or 16 ohm	£21.75
Fane Pop 70, 8 or 16 ohm	£33.95
Fane Pop 100, 8 or 16 ohm	£42.95
Fane Crescendo 12, 8 or 16 ohm	£44.95
Fane Crescendo 12BL, 8 or 16 ohm	£54.95
Fane Crescendo 15/100A, 8 or 16 ohm	£64.95
Fane Crescendo 15/125, 8 or 16 ohm	

SPEAKERS

Fane Crescendo 18, 8 or 16 ohm	£75.95
Fane 910 Mk II horn	£15.75
Fane 920 Mk II horn	£45.95
Fane HPX1 crossover 200W	£2.50
Fane 13 x 8in, 15W dual cone	£5.50
Fane 801T 8in d/c, roll surr.	£8.96
Gauss 12in	£95.00
Gauss 15in	£110.00
Gauss 18in	£121.00
Goodmans Axent 100	£8.50
Goodmans Audiom 200 8 ohm	£14.95
Goodmans Axiom 402 8 or 15 ohm	£22.00
Goodmans Twinaxiom 8, 8 or 15 ohm	£10.80
Goodmans Twinaxiom 10, 8 or 15 ohm	£10.95
Goodmans 8P 8 or 15 ohm	£6.20
Goodmans 10P 8 or 15 ohm	£6.95
Goodmans 12P 8 or 15 ohm	£16.50
Goodmans 12PG 8 or 15 ohm	£17.75
Goodmans 12PD 8 or 15 ohm	£18.75
Goodmans 12AX 8 or 15 ohm	£44.00
Goodmans 12AX 8 or 15 ohm	£49.00
Goodmans 15AX 8 or 15 ohm	£24.00
Goodmans 15P 8 or 15 ohm	£39.95
Goodmans 18P 8 or 15 ohm	£16.00
Goodmans Hifax 750P	£4.05
Goodmans Sin midrange 8 ohm	£15.36
Jordan Watts Module, 4, 8 or 15 ohm	£5.18
Kef T27	£10.75
Kef T15	£6.95
Kef B110	£6.75
Kef B200	£7.85
Kef B139	£16.50
Kef DN8	£2.08
Kef DN12	£5.39
Kef DN13 SP1015 or SP1017	£4.05
Lowther PM6	£32.00
Lowther PM6 Mk 1	£35.00
Lowther PM7	£48.00
Peerless KO10DT 4 or 8 ohm	£8.25
Peerless DT10HFC 8 ohm	£9.50
Peerless KO40MRF 8 ohm	£9.95
Peerless MT225HCF 8 ohm	£3.40
Richard Allan CA12 12in bass	£19.80
Richard Allan HP8B	£12.50
Richard Allan LP8B	£8.50
Richard Allan DT20	£6.25
Richard Allan CN8280	£16.95
Richard Allan CN820	£3.15
Richard Allan Super Disco 60W 12in	£16.95
Richard Allan CG15 15in bass	£27.45
Richard Allan Super Disco 12in 60 watt	£16.95
Richard Allan Super Disco 10in 50 watt	£13.25
Richard Allan Super Disco 8in 50 watt	£12.95
Radford BD25	£23.20
Radford MD9	£11.50
Radford MD6	£15.75
Radford TD3	£8.25
Radford Cross Over Network	£14.75
Coles 4001 G & K	£5.90
Tannoy 10in Monitor HPD	£78.00
Tannoy 12in Monitor HPD	£86.00

Tannoy 15in Monitor HPD	£99.95
Wharfedale Super 10 RS/DD 8 ohm	£13.50

SPEAKER KITS

Baker Major Module 3, 8 or 15 ohm	each	£13.28
Fane Mode One Mk II 15W	each	£10.35
Fane D40 Disco Kit	each	£19.95
Goodmans DIN 20 4 or 8 ohm	each	£15.75
Goodmans Mezzo Twin Kit	pair	£51.95
Heime XLK 30	pair	£21.95
Heime XLK 35	pair	£26.75
Heime XLK 40.	pair	£38.50
Kefkit 1	pair	£51.00
Kefkit III	each	£46.00
Peerless 1060	pair	£54.00
Peerless 1070	each	£46.00
Peerless 1120	each	£54.00
Peerless 2050	pair	£39.50
Peerless 2060	pair	£53.00
Richard Allan Twin assembly	each	£13.95
Richard Allan Triple 8	each	£20.75
Richard Allan Triple 12	each	£25.95
Richard Allan Super Triple	each	£29.50
Richard Allan RA8 Kit	pair	£37.80
Richard Allan RA82 Kit	pair	£59.40
Richard Allan RA82L Kit	pair	£65.70
Wharfedale Linton II kit	pair	£21.50
Wharfedale Glendale 3XP kit	pair	£47.70
Wharfedale Dovedale III kit	pair	£59.40
Wharfedale Denton 2XP kit	pair	£23.25
Wharfedale Linton 3XP kit	pair	£34.25

HI-FI ON DEMONSTRATION in our showrooms:

Akai, Armstrong, Bowers & Wilkins, Castle, Celestion, Dual, Goodmans, Kef, Leak, Pioneer, Radford, Richard Allan, Rotel, Tandberg, Trio, Videotone, Wharfedale, etc.—ask for our Hi-Fi discount price list.

THIS MONTH'S SPECIALS! (Carr. £2.50)

Rotel RA412	£77.95
Rotel RX202 Mk. II	£97.50
Videotone Minimax II	£43.00
Videotone Saphir II	£49.00
Pioneer SX450	£116.00
Sansui SC2000/2002	£149.70
We stock the complete Radford range of amplifiers, preamplifiers, power amplifiers, tuners, etc., and also Radford Audio Laboratory equipment, low distortion oscillator, distortion measuring set, audio noise meter, etc.	

ALL PRICES INCLUDE VAT
(PRICES CORRECT AT 6/10/76)

Send stamp for free 38 page booklet "Choosing a Speaker"

ALL UNITS GUARANTEED NEW AND PERFECT
Carriage and insurance: Speakers up to 12in 60p; 12in £1; 15in £1.75; 18in £2.50. Kits £1 each (£2 per pair). Tweeters and Crossovers 33p each.

WILMSLOW AUDIO

Dept PE

Loudspeakers, mail order and export:
Swan Works, Bank Square, Wilmslow.

Hi-Fi, Radio and TV: Swift of Wilmslow,
5 Swan Street, Wilmslow, Cheshire.

PA, Hi-Fi and Accessories: Wilmslow
Audio, 10 Swan Street, Wilmslow,
Cheshire.

Telephone: Loudspeakers, mail order and
export—Wilmslow 29599; Hi-Fi, Radio,
etc.—Wilmslow 26213.

Access and Barclaycard orders accepted by phone

Complete kits in stock for Radford Studio 90, Radford Monitor 180, Radford Studio 270, Radford Studio 360, Hi-Fi Answers Monitor (Rogers), Hi-Fi News No Compromise (Frisby), Hi-Fi News State of the Art, Wireless World Transmission Line (Bailey), Practical Hi-Fi and Audio Monitor (Giles), Practical Hi-Fi and Audio Triangle (Giles), Popular Hi-Fi (Colloms), etc.

On dem. Answers Monitor, State of Art, etc.

Construction leaflets for Radford, Kef, Jordan Watts, Tannoy, Hi-Fi Answers Monitor, free on request.

P.A. amplifiers, microphones, etc., by Shure, Linear, Eagle, Beyer, AKG, etc.

FREE with orders over £10—"Hi-Fi Loudspeaker Enclosures" book.



Build yourself this high quality touch-sensitive piano. The design also features the new transpose control which is an external tuning control—this tunes the entire keyboard higher or lower than the concert pitch by one whole octave. Two models are available: TS50 which is a straight piano and TS53 has piano, honky tonk, harpsichord, and fast and slow tremolo effects. These professional pianos can be built in just 12 hours.

Parts List

Constructional details are available with complete kit

ESU/5 Divider and Touch-Sensitive Keyer Unit

1 x AY-1-5051 i.c. divider	£1.20
25 x diodes low noise high resistance (5p each)	£1.25
5 x transistors 2N3703 (12p each)	60p
10 x elect. caps 3-3µF 25V (5p each)	50p
48 x resistors watt 5% (1p each)	48p
12 x terminal pins (½p each)	6p
1 x p.c. board, drilled	£1.00
2 x 0-01 (4p each)	8p
3 x 0-02 (4p each)	12p
Total Price per unit (11 units required)	£5.29

ESU/6 Divider and Touch-Sensitive Keyer Unit

1 x AY-1-6721/5	£1.30
30 x diodes low noise high resistance (5p each)	£1.50
6 x transistors 2N3703 (12p each)	72p
12 x elect. caps 3-3µF 25V (5p each)	60p
58 x resistors watt 5% (1p each)	58p
14 x terminal pins (½p each)	7p
1 x P.C. board, drilled	£1.00
2 x 0-01 (4p each)	8p
4 x 0-02 (4p each)	12p
Total Price (only 1 unit required)	£6.01

Power Supply

3 x yards main cable (10p yard)	30p
1 x mains transformer 20-0-20 1A	£2.45
1 x mains plug and socket	76p
2 x fuse holders (20p each)	40p
2 x fuses 1A (6p each)	12p
4 x rectifier diodes (5p each)	20p
2 x elect. caps 2,200µF 40V (95p each)	£1.90
1 x elect. caps 1,000µF 35V	40p
2 x resistors 5W (12p each)	24p
1 x neon lamp	25p
1 x pot with switch	54p
1 x metal knob	55p
2 x capacitor clamps (5p each)	10p
1 x chassis	60p
Total Price (only 1 unit required)	£8.81

1 x voltage regulator	£1.75
1 x 5-octave keyboard C-C or F-F	£22.00
1 x cabinet, front plate and fittings	£26.00
1 x jack socket	15p
1 x switched jack socket	50p
1 x stereo jack socket	25p
1 x stereo jack plug	25p
4 x rocker switches (29p each)	£1.16
1 x headphone amp. built and tested	£2.89
1 x loud and soft pedal	£6.00
1 x tremolo unit for TS53 only	£3.68
1 x toneforming unit for TS53 only	£5.50
1 x variable capacitor, 10 turns	£3.72
1 x GU500 built and tested, M.T.G.	£14.05
3 x yards gold wire (59p yard)	£1.77
2 x yards rhodium bar (£1.50 yard)	£3.00
3 x yards 25 core cable (58p yard)	£1.74
61 x terminal pins (½p each)	30½p
1 x pre amp for TS50 only	£1.95

TS50 Complete Kit £168.81 + £21.10 VAT

TS53 Complete Kit £172.72 + £21.59 VAT

Carriage on Complete Kit £6 (U.K. only).

Wide range of Electronic Organ Kits available, i.e. Mayfair Mk. II Portable Organ—4 octave keyboard, 4 pitches, 10 voices, sustain, vibrato, split keyboard, transpose control. Price £166 inc. VAT, carriage £6 (U.K. only). Overseas customers C.I.F. at cost.

Also available from stock, a huge quantity of specialised I.C.s and components. Send 60p for catalogue. Data Sheets for organics 25p.



Electronic Musical Instruments

Showroom: 12 Brett Road, Hackney, London E8 1JP. Tel. 01-986 8455

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

Make light work
of wiring

with the **NEW**
SELF ADHESIVE
WIRE STAPLES

Countless uses in industry and offices

*QUICK AND EASY TO APPLY —
EVEN IN AWKWARD PLACES

*SAVES DAMAGE TO WOOD AND PAINTWORK

*STICKS ON INSTANTLY: HOLDS WIRE FIRMLY

You'll save enormous time and trouble with the new Brandauer adhesive staple. Just peel off the backing strip and press staple into place. Then bend clips over to hold wire firmly in position. No messing with pins, tacks, soldering or drilling. No damage to woodwork, e.g. skirting boards. Use the Brandauer Staple for any wall, frame or cabinet wiring jobs — it's wonderfully easy for fitting in those awkward corners.

Send now for details to:

SPECIAL PRODUCTS DISTRIBUTORS LTD.

81 Piccadilly, London W1V 0HL. Tel: 01-629 9556.

CMOS WITH DISCOUNTS!

Any mix: Discount 10% for 25+, 25% for 100+, 33% for 1,000+



C
4
US
CMOS!

4000	0-20	4037	1-00	4075	0-24	14175	1-84	14528	1-22	'E' LED DISPLAYS	
4001	0-20	4038	1-20	4076	1-71	14194	1-17	14529	1-72	DL-704E 0-3"	79p
4002	0-20	4039	3-19	4077	0-85	14410	5-78	14530	0-85	DL-707E 0-3"	79p
4006	0-31	4040	1-18	4078	0-24	14411	0-54	14531	1-74	DL-728E 2 x 0-5"	£1.90
4007	0-20	4041	0-83	4081	0-24	14412	17-07	14532	1-39	DL-727E 2 x 0-5"	£1.80
4008	1-07	4042	0-83	4082	0-24	14415	7-35	14534	0-15	DL-750E 0-6"	£1.90
4009	0-60	4043	1-12	4085	0-00	14413	2-87	14536	0-00	DL-747E 0-6"	£1.90
4010	0-00	4044	1-84	4086	0-80	14422	4-80	14537	13-17		
4011	0-20	4045	1-50	4089	1-74	14435	7-83	14539	1-24	RED LEDS	
4012	0-20	4046	1-40	4093	0-09	14440	11-50	14541	1-82	0-1"	15p
4013	0-60	4047	1-31	4094	2-08	14450	2-87	14543	1-82	0-2"	15p
4014	1-12	4048	0-80	4095	1-10	14451	2-87	14549	4-10		
4015	1-12	4049	0-80	4096	1-10	14490	0-81	14552	10-50	CLOCK CHIPS	
4016	0-80	4050	0-80	4097	4-13	14501	0-20	14553	4-86	AY-5-1224A	£3.50
4017	1-12	4051	1-84	4098	1-22	14502	1-38	14554	1-87	MK 5025S	£3.90
4018	1-12	4052	1-04	4099	2-03	14503	0-75	14555	1-01		
4019	0-80	4053	1-04	40101	1-78	14505	4-38	14556	1-01	BOLDERCON PINS	
4020	1-24	4054	1-29	40102	2-18	14508	0-37	14557	4-85	100	84p
4021	1-12	4055	1-48	40103	2-18	14507	0-80	14558	1-80	157 x 92 x 3mm	£4.00
4022	1-07	4056	1-48	40104	2-00	14508	1-30	14559	4-10	2500	£8.75
4023	0-20	4057	28-81	40107	0-00	14510	1-51	14580	2-17		
4024	0-87	4059	0-20	40108	1-18	14511	1-74	14581	0-76	DIL SOCKETS 14/16 PIN	15p
4025	0-20	4080	1-24	40109	2-21	14512	1-03	14582	3-50		
4026	1-82	4081	25-80	40112	1-70	14514	3-47	14586	1-87	RED ACRYLIC FILTER	
4027	0-80	4082	10-10	40182	1-73	14515	3-47	14588	3-15	For L.E.D. displays	
4028	1-00	4083	1-22	40194	2-28	14516	1-51	14589	3-72	157 x 92 x 3mm	75p
4029	1-27	4086	0-89	40257	2-28	14517	4-92	14572	0-27		
4030	0-80	4087	4-18	4700	1-18	14518	1-30	14580	0-28	PUSH SWITCHES	
4031	2-46	4088	0-24	7483	4-25	14519	0-37	14581	4-30	Type SW9	15p
4032	1-19	4089	0-24	14180	1-18	14520	1-20	14582	1-84		
4033	1-86	4070	0-83	14161	1-18	14521	2-77	14583	0-84	OP-AMPS	
4034	2-11	4071	0-24	14162	1-18	14522	2-15	14585	1-19	CA 3130 (COSIMOS)	£1.00
4035	1-21	4072	0-24	14163	1-18	14526	2-16			CA 3140 (BIMOS)	95p
4036	3-08	4073	0-24	14174	1-08	14527	1-78			741 Minsid	25p

Terms: C.W.O. Add VAT to all prices at 8%. Post, etc. U.K. 25p (+ 2p - 27p) per order. All orders processed same day. Official Govt., Variety, Poly., etc. orders (written or telephoned) welcome.

GREENBANK ELECTRONICS (Dept. E12P)

94 New Chester Road, New Ferry, Wirral, Merseyside, L62 5AG, England.
Tel: 051-645 3391

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.

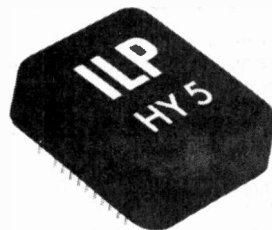
FEATURES: complete pre-amplifier in single pack; multi-function equalisation; low noise; low distortion; high overload; two simply combined for stereo.

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 Ω 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 18-50V.

Price \pounds 4.75 + 59p VAT. P. & P. free

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



HY30 15W into 8 Ω

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 Ω . Distortion—0-1% at 15W. Input Sensitivity—500mV. Frequency Response—10Hz-16kHz -3dB.

Price \pounds 4.75 + 59p VAT. P. & P. free

HY50 25W into 8 Ω

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 Ω . Load Impedance—4-16 Ω . 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 6.20 + 77p VAT. P. & P. free

HY120 60W into 8 Ω

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 Ω . Load Impedance—4-16 Ω . 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 14.40 + \pounds 1.16 VAT. P. & P. free

HY200 120W into 8 Ω

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 Ω . Load Impedance—4-16 Ω . Distortion—0-05% at 100W at 1kHz. Signal/Noise Ratio—96dB. Frequency Response—10Hz-45kHz -3dB. Supply Voltage— \pm 45V. Size—114 x 100 x 85mm

Price \pounds 21.25 + \pounds 1.70 VAT. P. & P. free

HY400 240W into 4 Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 Ω ! 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.

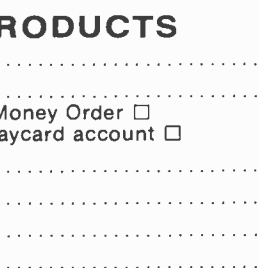
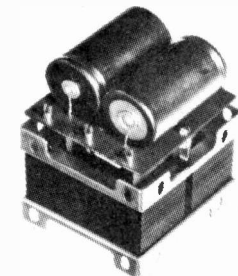
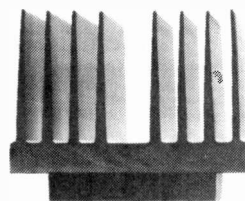
FEATURES: thermal shutdown; very low distortion; load line protection; no external components.

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

SPECIFICATION: Output Power—240W R.M.S. into 4 Ω . Load Impedance—4-16 Ω . 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 29.25 + \pounds 2.34 VAT. P. & P. free

**AVAILABLE
EX STOCK**



POWER SUPPLIES: PSU36—suitable for two HY30s \pounds 4.75 + 59p VAT. P. & P. free. PSU50—suitable for two HY50s \pounds 6.20 + 77p VAT. P. & P. free. PSU70—suitable for two HY120s \pounds 12.50 + \pounds 1.00 VAT. P. & P. free. PSU90—suitable for one HY200 \pounds 11.50 + 92p VAT. P. & P. free. PSU100—suitable for two HY200s or one HY400 \pounds 21 + \pounds 1.68 VAT. P. & P. free.

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

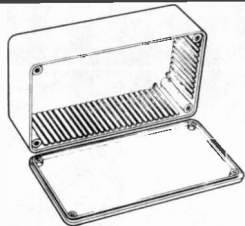
Please debit my Access account Barclaycard account

Account number

Name and Address

Signature

Registered office No. 1032630



PLASTIC BOXES IN 5 SIZES

Easily drilled or punched, grey ABS boxes incorporate slots for 1.5mm pcb's with lid fixing screws running into integral brass bushes

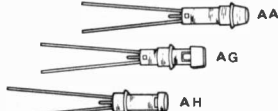
100x50x25mm 51p (1-9) 49p (10+)
 112x62x31mm 59p (1-9) 52p (10+)
 120x65x40mm 68p (1-9) 62p (10+)
 150x80x50mm 77p (1-9) 74p (10+)
 190x110x60mm £1.33 (1-9) £1.30 (10+)

Polystyrene version

Plain inside, no integral bushes
 112x61x31mm 35p (1-9) 32p (10+)
 Add 25p per £1 order value for Post & Packing

TYPE A NEON INDICATORS

Held in 8mm hole by plastic bezel
 150mm wire leads



Red, Amber, Clear, Opal 19p each
 Green 28p each

TYPE MP NEON INDICATOR

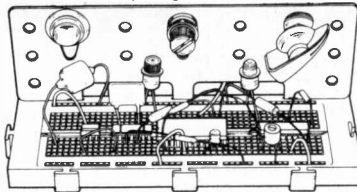
150mm leads, held in 6.4mm hole by nut



Red, Amber, Clear, Opal 20p each

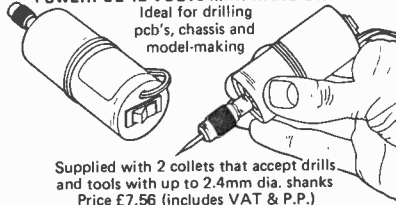
On all orders quote reference PE/12/76

Stop wasting time soldering
The NEW MW BREADBOARD accepts
 Transistors, LED's, Diodes, Resistors, Capacitors
 and all DIL packages with 6 to 40 pins



Includes slot-in Component Support Bracket and has over 400 individual sockets, plus Vcc & Ground Bus Strips
 Price £9.72 (includes VAT & P.P.)

POWERFUL 12 VOLTS MINI HAND DRILL



Ideal for drilling
 pcb's, chassis and
 model-making

Supplied with 2 collets that accept drills
 and tools with up to 2.4mm dia. shanks
 Price £7.56 (includes VAT & P.P.)

SEVEN SEGMENT DISPLAYS

Economy Quality - Only 66p
 0.3" - Red
 Common Anode - Left Decimal

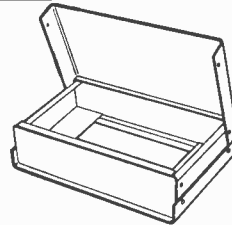


Full specification displays also available
 Red, Green and Yellow
 £1.35 each inc. data

P.P. Note. Unless included in price add 25p post & packing for orders totalling under £10 Prices include VAT and are valid in UK only for 2 months from journal issue date.

Michael Williams Electronics

47 Vicarage Av., Cheadle Hulme, Cheshire SK8 6JP



EYE CATCHING INSTRUMENT CASE

Removable Red, Orange or Grey covers
 Black chassis with support brackets
 Overall size 250x167x68mm
 Price £11.86 (includes VAT & P.P.)

ECONOMY QUALITY LED's

50 for only £5
 100 for only £9

Mixed bags, all sizes, various colours



FULL SPEC. INDIVIDUAL LED's

Red (any size) £0.75/pack
 Green, Yellow, Orange (any size) £1.20/pack
 Packs contain 5 LED's, clips and data



OH LAMPHOLDER

For LES or Midget flange lamps
 13mm hole fixing, lamp not included
 Red, Blue, Green, Amber, Clear, Opal, Orange
 Price 25p each (See P.P. Note below)

Quantity quotations on request.

LEKTROPACKS

17 Turnham Green Terrace, Chiswick, London, W.4. Tel: 01-994 2784

* NEW * FULLY GUARANTEED COMPONENT PACKS * FULL SPEC. SEMI-CONDUCTORS * AVAILABLE IN LOW COST PACKS OF TEN * ALL PRICES INCLUDE VAT AND U.K. POSTAGE * NO HIDDEN EXTRAS * TEN PACKS LESS 15%.

Price per 10	Price per 10	Price per 10	Price per 10
AC126 £1-50	BFY52 £2-80	TIP31A £3-50	1N4006 £9-90
AC128 £1-20	BFY50 £10-00	TIP31B £8-90	1N4148 £0-70
AC176 £1-20	BFX29 £2-80	TIP31C £7-80	2N706 £1-20
BC107 £1-00	BFX84 £3-00	TIP32A £8-80	2N708 £1-50
BC106 £	BFX87 £3-00	TIP32B £8-50	2N850 £2-90
BC114 £1-00	BFX88 £2-50	TIP32C £9-00	2N2219 £2-20
BC126 £1-00	BY127 £1-20	TIP33A £9-00	2N2904 £2-80
BC147 £1-20	BZY59 £1-00	TIP33B £11-90	2N2906 £2-50
BC148 £1-20	C106B £3-00	TIP33C £13-90	2N2907 £2-80
BC168 £1-20	D30 Diac £1-50	TIP34A £13-50	2N2926 £1-20
BC182 £1-20	MFC4000 £8-00	TIP34B £14-00	2N3053 £2-20
BC183 £1-20	MPF103 £3-80	TIP34C £15-30	2N3054 £4-50
BC184 £1-20	MPF104 £3-80	TIP35A £13-50	2N3055 £5-00
BC212 £1-20	NK1135 £2-00	TIP35B £14-50	2N3643 £2-80
BC213 £1-20	OA10 £2-00	TIP35C £15-30	2N3702 £1-50
BC214 £1-20	OA200 £0-80	TIP36A £30-00	2N3703 £1-40
BC237 £1-20	OA202 £0-80	TIP36B £32-00	2N3706 £1-20
BCY38 £10-00	OA211 £2-50	TIP36C £30-00	2N3707 £1-50
BCY70 £2-00	OC71 £1-00	TIP41A £8-30	2N3819 £2-20
BCY71 £2-00	TIP29A £4-50	TIP42A £8-10	2N3820 £2-50
BCY72 £2-00	TIP29B £3-50	TXAL228B 3A £4-50	2N3904 £1-80
BD131 £3-00	TIP29C £8-90	400V Triac £8-50	2N3905 £1-80
BD132 £3-50	TIP30A £5-40	1N614 £0-80	2N3906 £2-00
BF194 £1-00	TIP30B £8-90	1N4003 £0-80	40360 £4-00
BF195 £1-80	TIP30C £7-80	1N4004 £0-70	40361 £4-00
BFY50 £2-20		1N4005 £0-75	40362 £4-00

THERMAL GAS SENSOR. Figaro TGS105 £2-25 each. As used in Sept. '76 P.E. Gas/Smoke Detector.

Organ Constructors
13-NOTE BASS PEDAL BOARD
 Hard wearing plastic covered steel levers. Change-over contacts on each note. Slightly shop-soiled therefore less than half price. £12-50 each

Miniature Mains Transformers. Pri. 240V a.c. Sec. 12V 150mA. 10 for £5-75.

SPECIAL REDUCTIONS OF EAGLE INTERNATIONAL PRODUCTS

White Stocks Last	RRP	Reduced to
TPA160 P.A. Amplifier 240V a.c.	£149-00	£99-00
TPA40 P.A. Amplifier 240V a.c./12V d.c.	£61-00	£39-50
AG71 Audio Signal Generator	£61-00	£39-50
SG70 R.F. Signal Generator	£54-00	£35-00
SAC14 7 + 7W Stereo Amp. Module	£9-50	£7-50
SAC30 15 + 15W Stereo Amp. Module	£14-50	£10-95

All prices include VAT and U.K. Postage. Callers welcome. Also in stock a large selection of second-hand records—callers only.



THE "Manta" Capacitive Discharge Electronic Ignition Unit

IMPORTANT NEWS:

We are pleased to announce that the "Manta"—one of the highest quality ignition units available—is now supplied in Kit Form.

Construct this top performance electronic ignition unit and benefit from improved petrol consumption, smoother running and instant starting for your vehicle. **ONLY £16.50**
 Kit price (including postage and packing, VAT, full assembly and installation instructions):
 (Ready-made unit available at £19.85, including VAT, postage and packing)

Please send S.A.E. today for full details of this top quality unit and our illustrated brochure "Electronic Ignition—How it Works"

ELECTRO SPARES

Dept. P.E., 187a Sheffield Road, Chesterfield, Derbyshire
 S41 7JQ. Tel. (0246) 36638

New to the UK from PRONTO

Battery operated LCD read out
CALENDAR CLOCK KIT—crystal accuracy—
Bold Digits—runs on two Penlight Cells.

Now is the time for the hobbyist to move into Advanced Technology with Pronto!
PRONTO MODEL 301 — The first completely portable liquid crystal display, digital CALENDAR CLOCK KIT offered in the United Kingdom.

- * Battery operation — two small alkaline cells give a minimum life of 12 months.
- * Superb accuracy through crystal control — of 3 minutes a year
- * Wide angle display with $\frac{1}{2}$ inch digits
- * Push Buttons give choice of 3 display modes — hours minutes on 12 hour display with flashing colon, or seconds, or date.
- * PRONTO 301 comes complete with easy to follow

instructions AT **£29.50** including V.A.T. You save Pounds off the recommended retail price of a comparable made up clock.

TERMS: Cash with order — make a cheque and/or postal order payable to PRONTO ELECTRONIC SYSTEMS LIMITED.
 (P & P — U.K. £0.45 Overseas £1.50)



PRONTO Fluorescent Display Alarm Clock KIT

Wake up to the electronic age with the new PRONTO 304 Alarm Clock

- * Large Bright Green Display
- * Alarm with 10 minute 'snooze' feature
- * AM/PM indication and simple setting
- * Automatic brightness control on digits governed by room lighting

- * Ingenious gravity alarm — time setting mode switch * Full assembly instructions

AT **£15.50** including V.A.T.
 With all PRONTO products — enquiries from the Trade, as well as the Hobbyist, are welcome, and you can also buy individual components!
PRONTO CONSTRUCTOR'S CLUB
 When you buy your first Pronto kit you're automatically a Member of the PRONTO CONSTRUCTOR'S CLUB. It will not only keep you in the picture on new ideas and kits . . . but gives you **FREE a £2 Voucher** against the purchase of your next kit!
 Isn't it time you joined the Club?



Please send me —

- PRONTO 301 KIT/S AT £29.50 EACH (Plus P & P)
- PRONTO 304 KIT/S AT £15.50 EACH (Plus P & P)

My cheque/P.O. for _____ is enclosed

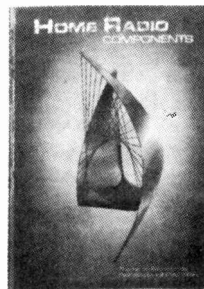
NAME _____

ADDRESS _____

Pronto Electronic Systems Ltd.
 645/647 High Rd., Seven Kings,
 Essex IG3 8RA. 01-599 3041
 Reg. office No 1081707



Are you only
HALF
 a Constructor?



For a year or two I was only half a constructor—struggling along trying to find the right components by tramping from shop to shop. Then I discovered Home Radio and their marvellous Components Catalogue! It's made life so much simpler for me—I can soon locate just what I need and then order by phone. I really feel that now I can claim to be a *complete* constructor.

The Home Radio Components Catalogue consists of 200 pages containing some 5,000 items, nearly 2,000 of them illustrated. Everything is set out so clearly the catalogue is a pleasure to use. When you buy one you also receive *free* a mini catalogue filled with super bargains. The saving on some of your purchases from this bargain list alone can more than pay for your catalogue. The catalogue costs £1 plus 40p for postage and packing. Why hesitate? Send off your cheque or P.O. for £1.40 now, and discover the satisfaction of being a *complete* constructor!

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 91266 London



POST THIS COUPON
 with cheque or p.o. for
£1.40

HOME RADIO (Components) LTD. Dept. PE 234-240 London Road, Mitcham, CR4 3HD Phone 01-648 8422

One of these could make a new man of you

Take a look at the labels. Each one a formula for making you forget the stresses and strains of modern living.

The message of each name is: make something. Make a digital clock . . . make a coffee table . . . make some new sounds. The sheer concentration involved in constructional projects like these smoothes away the tensions.

Any one of these "Practical" magazines packs so many hours of creative satisfaction that it could make a new man of you.

TELEVISION

December issue
The art of alignment, audio circuits for the constructor and servicing the Philips G8 Colour Chassis and the Philips 320.
OUT NOVEMBER 15

PRACTICAL ELECTRONICS

December issue
Projects for constructing a Gamesmachine that produces random numbers for Dice, Roulette and the Pools and a Metal Locator that is ideal for the home improvement enthusiast.
OUT NOVEMBER 12

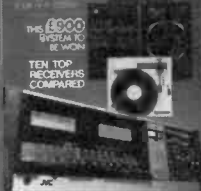
PRACTICAL WIRELESS

December issue
How to make a Chromachaser for flashing lights at discos, a VHF Converter
Start of a new 'S Deck Projects' series.
OUT NOVEMBER 5

FOR HI-FI ENTHUSIASTS

PRACTICAL HI-FI & AUDIO

Special 12 page beginners' guide



PRACTICAL HI-FI & AUDIO

December issue
Ten loudspeakers undergo the ultimate test - live versus reproduction. A buyers' guide to music centres and complete audio systems. A new series starting on choosing a hi-fi system.
OUT NOVEMBER 12

PRACTICAL WOODWORKING

December issue
Contents include a variety of Christmas gifts to make, a toy farm and a timber wagon for modelers, a stereo storage stand to build and a carving project.
OUT NOVEMBER 19

EVERYDAY ELECTRONICS

December issue
Two big projects: how to make a Mini Organ and a 'Scrabble' Timer. Start of a new series explaining the mathematics used in electronics.
OUT NOVEMBER 19

FOR BEGINNERS

everyday electronics



FOR HANDYMEN

WOOD WORKING



Pick up a 'Practical' and be a new man

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: PE
40/42 Cricklewood Broadway London NW2 3ET
Tel: 01-452 0161/2 Telex: 21492
& 85 West Regent St Glasgow G2 2QD
Tel: 041-332 4133
& 1 Straits Parade Fishponds Bristol BS16 2LX
Tel: 0272-654201/2
& 27 Rue Danton Issy Les Moulineaux Paris 92
160-page Catalogue full of new products,
data, Jap equivalents, etc., 40p
(30p to callers)

TOP 500 SEMICONDUCTORS FROM THE LARGEST RANGE IN THE U.K.

All devices manufacturer's branded stock

2N456	1-40	2N2926	0-13	2N4922	0-65	AD161	PR	BC183	0-11	BF152	0-25	CA3130	0-88	NE561	4-48
2N456A	1-54	Green	0-13	2N4923	0-70	AD162	1-70	BC183L	0-14	BF153	0-25	LM301A	0-47	NE565A	1-30
2N457A	1-70	Yellow	0-13	2N5190	0-70	AF106	0-45	BC184	0-12	BF154	0-25	LM309K	1-32	OC28	2-50
2N490	4-60	Orange	0-13	2N5191	0-80	AF114	0-65	BC184L	0-14	BF159	0-35	LM380	0-98	OC32	1-50
2N492	5-75		0-25	2N5192	1-00	AF115	0-65	BC207	0-11	BF160	0-30	LM381AN	2-07	OC72	0-45
2N493	5-75		0-25	2N5198	1-10	AF116	0-65	BC212	0-14	BF166	0-40	LM702C	0-75	OC81	0-75
2N495	5-75		0-25	2N5245	2-00	AF117	0-65	BC214L	0-17	BF173	0-33	DM709	0-40	OC83	0-50
2N696	0-25	2N3390	0-37	2N5294	0-35	AF118	0-65	BC237	0-17	BF177	0-38	TO99	0-40	OC91	1-70
2N697	0-16	2N3391	0-34	2N5295	0-40	AF124	0-65	BC238	0-12	BF178	0-45	LM710	0-45	OC92	1-70
2N698	0-82	2N3392	0-14	2N5296	0-36	AF125	0-65	BC239	0-16	BF179	0-48	LM723C	0-60	OC93	1-70
2N699	0-55	2N3393	0-15	2N5298	0-40	AF126	0-65	BC251	0-15	BF180	0-45	LM741	0-45	OC94	1-70
2N706	0-12	2N3394	0-15	2N5457	0-29	AF127	0-65	BC253	0-22	BF181	0-45	TO99	0-40	OC95	1-70
2N706A	0-12	2N3402	0-30	2N5458	0-26	AF129	0-65	BC257	0-17	BF182	0-45	BO1L	0-35	OC96	1-70
2N708	0-20	2N3414	0-15	2N5459	0-29	AF186	0-50	BC258	0-17	BF183	0-45	14D1L	0-40	OC97	1-70
2N709	0-50	2N3415	0-17	2N5492	0-42	AF200	0-70	BC259	0-18	BF184	0-35	LM747CN	0-78	OC98	1-70
2N711	0-55	2N3416	0-23	2N5494	0-45	AF239	0-74	BC261	0-21	BF185	0-30	LM748	0-44	OC99	1-70
2N718	0-22	2N3418	0-27	2N5496	0-50	AF240	0-90	BC262	0-19	BF194	0-12	8D1L	0-44	OC100	1-70
2N718A	0-40	2N3440	0-57	2N5497	0-45	AF279	0-80	BC263	0-30	BF195	0-11	14D1L	0-41	OC101	1-70
2N720	0-69	2N3441	0-78	2N6027	0-45	AF280	0-80	BC109	0-15	BC308	0-18	SN7603N	1-50	OC102	1-70
2N914	0-22	2N3442	1-20	3N128	0-80	AL102	1-50	BC301	0-45	BF197	0-14	LM7805P	1-45	OC103	1-70
2N916	0-43	2N3638	0-18	3N139	1-45	AL103	1-50	BC302	0-40	BF198	0-15	LM7812P	1-39	OC104	1-70
2N918	0-34	2N3638A	0-18	3N140	1-40	BC107	0-14	BC303	0-60	BF200	0-31	LM7815P	1-39	OC105	1-70
2N929	0-25	2N3639	0-30	3N141	0-85	BC108	0-12	BC307	0-20	BF225J	0-25	LM7824P	1-39	OC106	1-70
2N930	0-26	2N3641	0-20	3N200	2-80	BC109	0-15	BC308	0-18	BF244	0-35	LOOST1	1-60	OC107	1-70
2N1302	0-37	2N3702	0-17	40361	0-45	BC113	0-17	BC309C	0-25	BF245	0-34	MC1303	1-47	OC108	1-70
2N1303	0-37	2N3703	0-15	40362	0-48	BC115	0-18	BC317	0-14	BF246	0-34	MC1310	1-98	OC109	1-70
2N1304	0-40	2N3704	0-15	40363	1-00	BC116	0-19	BC318	0-13	BF254	0-20	MC1330P	0-75	OC110	1-70
2N1305	0-40	2N3705	0-15	40389	0-80	BC116A	0-20	BC337	0-19	BF255	0-20	MC1351P	0-87	OC111	1-70
2N1306	0-45	2N3706	0-14	40394	0-60	BC117	0-22	BC338	0-21	BF257	0-37	MC1352P	0-87	OC112	1-70
2N1307	0-45	2N3707	0-18	40395	1-20	BC118	0-16	BC347	0-12	BF258	0-49	MC1466L	3-95	OC113	1-70
2N1308	0-60	2N3708	0-14	40406	0-48	BC119	0-30	BC348	0-10	BF259	0-49	MC1469R	2-50	OC114	1-70
2N1309	0-60	2N3709	0-14	40407	0-38	BC121	0-45	BC349	0-13	BF259	0-24	ME0402	2-20	OC115	1-70
2N1671	1-80	2N3710	0-14	40408	0-58	BC125	0-18	BC330	0-03	BF279	0-03	ME0404	1-15	OC116	1-70
2N1671A	1-92	2N3711	0-15	40409	0-55	BC126	0-25	BCY31	1-06	BF281A	2-60	ME0412	0-20	OC117	1-70
2N1671B	1-92	2N3712	1-20	40410	0-55	BC132	0-30	BCY32	1-18	BF282	2-04	ME4102	0-10	OC118	1-70
2N1701	0-27	2N3713	2-30	40411	2-30	BC134	0-15	BCY33	0-90	BF281	0-30	ME4104	0-10	OC119	1-70
2N1717	5-50	2N3714	2-45	40594	0-75	BC135	0-15	BCY34	0-98	BF289	0-27	MJ480	1-05	OC120	1-70
2N1719	0-60	2N3715	2-45	40595	0-85	BC136	0-19	BCY38	2-00	BF289	0-36	MJ481	1-30	OC121	1-70
2N2147	1-40	2N3716	6-60	40596	1-10	BC137	0-14	BCY42	0-60	BF290	0-36	MJ490	1-05	OC122	1-70
2N2148	1-65	2N3717	1-60	40602	0-50	BC140	0-60	BCY58	5-00	BF284	0-38	MJ491	1-55	OC123	1-70
2N2160	1-10	2N3722	1-70	40603	0-60	BC141	0-65	BCY59	3-32	BF285	0-41	MJ2955	1-21	OC124	1-70
2N2218A	0-47	2N3723	2-65	40604	0-60	BC142	0-30	BCY70	2-25	BF287	0-35	MJE340	0-58	OC125	1-70
2N2219	0-42	2N3789	2-60	40636	1-15	BC143	0-30	BCY71	2-26	BF288	0-32	MJE2955	1-25	OC126	1-70
2N2219A	0-52	2N3790	2-75	40673	0-73	BC147	0-10	BCY72	2-24	BF289	0-95	MJE3055	0-75	OC127	1-70
2N2220	0-35	2N3791	2-75	40674	0-37	BC148	0-10	BD115	1-20	BFY50	0-30	MJE370	0-68	OC128	1-70
2N2221	0-22	2N3792	2-90	40675	0-44	BC149	0-13	BD116	1-20	BFY51	0-38	MJE371	0-81	OC129	1-70
2N2221A	0-26	2N3794	2-00	AC128	0-77	BC153	0-27	BD121	2-00	BFY52	0-36	MJE520	0-65	OC130	1-70
2N2222	0-25	2N3819	0-36	AC151V	0-35	BC154	0-27	BD123	2-00	BFY53	0-34	MJE521	0-75	OC131	1-70
2N2222A	0-25	2N3820	0-29	AC152V	0-50	BC157	0-12	BD124	2-00	BFY59	1-27	MPB111	0-35	OC132	1-70
2N2368	0-17	2N3823	0-61	AC153	0-40	BC158	0-11	BD131	0-51	BRV39	0-50	MPB112	0-40	OC133	1-70
2N2369	0-25	2N3824	0-21	AC158K	0-42	BC160	0-42	BD135	0-71	BSX21	0-31	MPB113	0-45	OC134	1-70
2N2369A	0-25	2N3906	0-22	AC154	0-45	BC167	0-12	BD135	0-52	BSX21	0-32	MPF102	0-30	OC135	1-70
2N2646	0-55	2N4036	0-67	AC176	0-40	BC168	0-12	BD136	0-42	BU105	3-05	MPSA05	0-20	OC136	1-70
2N2647	1-10	2N4037	0-55	AC176K	0-45	BC168	0-12	BD137	0-45	BU205	2-40	MPSA06	0-20	OC137	1-70
2N2904	0-38	2N4058	0-20	AC187K	0-46	BC169	0-12	BD138	0-48	CI06D	0-65	MPSA12	0-35	OC138	1-70
2N2904A	0-38	2N4059	0-15	AC188K	0-45	BC169	0-12	BD139	0-50	CA3020A	1-50	MPSA55	0-20	OC139	1-70
2N2905	0-37	2N4060	0-25	AC189	0-45	BC170	0-12	BD140	0-65	CA3020B	1-50	MPSA56	0-20	OC140	1-70
2N2905A	0-38	2N4061	0-17	AC188	0-42	BC171	0-14	BD529	0-35	CA3036	0-73	MPSU06	0-40	OC141	1-70
2N2906	0-28	2N4062	0-18	AD142	0-65	BC172	0-12	BD530	0-38	CA3046	0-73	MPSU06	0-40	OC142	1-70
2N2906A	0-25	2N4126	0-17	AD143	0-75	BC177	0-19	BDY20	1-13	CA3048	2-15	MPSU55	0-45	OC143	1-70
2N2907	0-21	2N4289	0-30	AD149	0-74	BC178	0-18	BF115	0-36	CA3052	1-62	MPSU56	0-45	OC144	1-70
2N2907A	0-22	2N4819	0-85	AD150	1-20	BC179	0-21	BF117	0-70	CA3080A	1-10	NE555V	0-48	OC145	1-70
2N2924	0-15	2N4920	0-90	AD161	0-75	BC182	0-11	BF121	0-55	CA3089E	2-00	NE556	1-30	OC146	1-70
2N2925	0-18	2N4921	0-60	AD162	0-75	BC182L	0-14	BF123	0-55	CA309AQ	4-25	NE560D	4-48	OC147	1-70

NEW RANGE TOOLS—HIGH QUALITY MINIATURE ELECTRONIC PLIERS AND CUTTERS INSULATED HANDLES
Round nose box joint 4in long £2.50
Diagonal cutters box joint 4in long £2.80
Flat nose box joint 4in long £2.40
Snipe nose box joint 4in long £2.40

DESOLDERING TOOL £5.00
P.C. MARKER PEN DALO 33PC. 8tp.
ZENER DIODES 400MW 11p, 1W 17p, 2.5W 35p.
IC SOCKETS 8 DIL 14p, 14 DIL 15p, 16 DIL 16p.
RESISTORS 1/2W 2p (100 per value £1.30) 1/4W 3p (100 per value £2.00)
SCORPIO CAR IGNITION KIT £12.95
JUMBO 7 SEGMENT DISPLAYS £2.16
DL 707 £1.60
MINITRON £1.50
LEDs Red, green and yellow, 0.2in or 0.16in dia. 24p.

SEE MARSHALL'S FOR CMOS

CD4000	0-20	CD4018	0-01	CD4043	0-83
CD4001	0-20	CD4019	1-10	CD4044	0-00
CD4002	0-20	CD4020	1-12	CD4045	1-43
CD4006	1-18	CD4021	0-01	CD4046	1-32
CD4007	0-20	CD4022	0-97	CD4047	1-15
CD4008	0-87	CD4023	0-20	CD4048	0-96
CD4009	0-57	CD4024	0-78	CD4049	0-96
CD4010	0-57	CD4025	0-20	CD4050	0-96
CD4011	0-20	CD4027	0-86	CD4051	1-54
CD4012	0-20	CD4028	0-61	CD4052	1-40
CD4013	0-57	CD4029	1-17	CD4053	1-54
CD4014	1-01	CD4030	0-57	CD4054	1-25
CD4015	1-01	CD4031	2-28	CD4055	1-25
CD4016	5-46	CD4032	0-87	CD4056	4-07
CD4017	1-01	CD4041	0-83		

Please enquire about CMOS not listed

MICROPROCESSORS FROM MARSHALL'S

Read the article, buy the kits!
SCAMP INTRIC KIT £62.37
KEYBOARD KIT £59.85
Contact Marshall's for RAM's, ROM's and PROM's
Full range of Low Power Schottky and Octal Tristate Buffers.

TTL FROM NATIONAL, ITT, TEXAS, SIGNETICS, ETC.

SN7400	0-16	SN7412	0-25	SN7438
--------	------	--------	------	--------

SMALL ADS

The prepaid rate for classified advertisements is 15 pence per word (minimum 12 words), box number 40p extra. Semi-display setting £12.00 per single column inch (2.5cm). 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 5918).

RECEIVERS AND COMPONENTS

ZN7447 BCD-7 segment decoder driver	80p
DL707 common audio 7 seg. display	£1.20
ZNA116E 3½ digit DVM IC inc. data	£5.90
ZN1040E 4 digit Count/Display IC	£7.00
1040E (R) unmarked reject of above	£3.00
count/display assets O.K.	
ZN1034E precision timer 50MS-2 weeks	£2.50
ZN425E 8 bit D-A/A-D converter	£3.90
ZN424P linear/gated/low noise amp.	£1.00
ZN423T precision 1.26V ref. source	£1.08
ZN414 radio microcircuit	£1.35
7489 fully functional 64 bit read/write	
memory-speed failures	£0.70
P. & P. 20p. Data sheets 10p each. (Mail Order).	

GJD ELECTRONICS

105 Harper Fold Road, Radcliffe, Manchester, M26 0RQ

LED S		0-125	0-2	INFRA RED
	RED	15p	18p	550uW
	G/Y	27p	33p	Axial lead 40p
panel clip 1p	OR	27p	33p	6mW £1.95
				OPTO Data free
				ORP12 55p
OPTO-ISOLATORS				
TL111 1-SkV, 150kHz	£1.25	SCR's 50V	100V 400V Diac	
4350 2-SkV, 5MHz	£2.25	T05 1A 25p	27p 40p BR100	
Avdelbond 2gm	85p	T068 3A 27p	35p 50p 21p	
		400V TRIACS 2A	60V 10A £1.50	
VOLTAGEREGS				
AC125/8/7/8	15p	2N2926(G)	12p	5V 7805 Plastic
AD151/162	40p	2N3055	15p	12V 7812 1 Amp
AF117	20p	2N3055	45p	15V 7815 all
AF124/5/8/7	34p	2N3055	41p	18V 7818 £1.50
BC107/8/9	9p	2N3702/3/4	12p	723 DIP14 50p
BC109C	12p	2N3903/4/5/6	16p	
BC147/8/9	10p	2N2646	35p	
BC157/8/9	11p	TIS43	25p	
BC167/8/9	11p	MP1202	46p	
BC169C	12p	2N3819	25p	
BC177/8/9	17p	2N3823	30p	
BC182/3/4/11	11p	IN914	3p	
BC182/7	30p	IN4001	5p	
SC121/3/4/12	13p	IN4002/3	6p	
BC707/1/12	13p	IN4004/5	7p	
BF194/5	14p	IN4006/7	8p	
BFX50/51	16p	IN4148	46p	
9FX29	30p	BA100	9p	
9FX74	24p	BY127	16p	
9FX81	18p	OA47	6p	
ESK18/20	16p	OA70 OA79	6p	
OC78	10p	OA81 OA90	7p	
2N1711	20p	OA91 OA95	6p	
2N2219	20p	OA202	7p	
2N2904/5/6/7	16p	ZENER'S 2-7-33V	5p	
2N2904/5/6/8	16p	BZ88 or sim 9p	7p	
2N2925(R)	7p			
PRICES INCLUSIVE + 15p P. & P. (1st class)				
ISLAND DEVICES, P.O. Box 11, Margate, Kent				

CARBON FILM RESISTORS. 5% E12 Series, 1/8W, 1/4W, 1/2W. Mixed to your choice, 100 for 90p. Electrolytics 50/15V, 7p. Microprocessors SC/MP, £18. MM6800, £33. P. & P. 15p—CANDAR, Freepost, Reading RG1 1BR.

PANEL WITH 10 SCRS 200V 1A, 12 Trans, 12 Ferrite Cores etc. £1 (25p). T.V. CONVERTER. GENE PANELS AC 128, 3 Slugged Coils, 3 Slide Switches, 11 W.W. Pots, 3 Carbon Presets, 2 Ferrite Chokes, etc. £1 (50p.). 5 FIGURE RESETTABLE COUNTER 18/22 V. works on 12 V. £2.50 (50p). COPPER CLAD PAX. PANELS 17 1/2" x 9 1/2" 90p, 5 1/2" x 5 1/2" 6 for 85p, 12 1/2" x 9 1/2" 60p. FIBRE GLASS 13 1/2" x 5 1/2" 80p, 13 1/2" x 11 1/2" £1.50. D.S. + 10%. All C.P. List 15p. Refund on purchase. 71b Assorted Components £2.60 C.P.

J. W. B. RADIO

2 Barnfield Crescent, Sale, Cheshire M33 1NL Postage In Brackets Mail Order Only

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.

R. T. SERVICES

(MAIL ORDER ONLY)

75 Hayfield Road, Salford 6 Lancs.

FM TUNER with R.F. Stage and A.G.C. 3 transistors, neg. earth 2 1/2 x 2 x 1 1/2 in with circuit, £1.75.

MAINS INPUT TRANSFORMERS 20V-0-20V at 2 amp, £3.95. New. 6V at 1 amp, £1.45. New. 12V at 1 amp, £1.45. New.

Mixed Pack of C280 series Mullard capacitors, 100 for £1.15 inc. P. & P. Send S.A.E. for our list prices.

Tel. 061-236 1541

All prices include VAT and P. & P.

TURN YOUR SURPLUS capacitors, transistors, etc., into cash. Contact COLES-HARDING & CO., P.O. Box 5, Frome, Somerset. Immediate cash settlement.

Precision Polycarbonate Capacitors

All High Stability—extremely Low Leakage			63V D.C. RANGE			
440 V A.C. RANGE	Price	±2%	±5%	Value	±2%	±5%
Value Dimen- Price	µF	mm	each	µF	mm	each
0-1 27	12-7	68p	0-01-0-2	£1.28	75p	50p
0-16 27	12-7	80p	0-22-0-47	£1.88	77p	51p
0-22 33	16	86p	0-68	£1.44	84p	56p
0-26 33	16	92p	1-5	£1.56	91p	60p
0-33 33	16	99p	2-5	£1.98	£1.88	79p
0-47 33	16	1-13	3-3	£2.40	£1.10	99p
0-5 33	19	£1.16	6-7	£2.88	£1.88	£1.88
0-68 60-8	19	£1.25	6-8	£3.48	£2.88	£2.81
1-0 60-8	19	£1.87	10	£4.98	£3.88	£2.01
1-5 60-8	25-4	£1.64	15	£7.14	£4.78	£2.88
2-0 60-8	25-4	£1.95	22	£9.66	£6.44	£2.90

TANTALUM BEAD CAPACITORS—Value available: 0.1, 0.22, 0.33, 0.47, 0.68, 1.0, 1.5, 2.2, 3.3, 4.7, 6.8µF at 15V/25V or 35V; 10-40µF at 16V/20V or 25V; 22-40µF at 6V/10V or 16V; 33-40µF at 6V or 10V; 47-40µF at 8V or 6V; 100-40µF at 3V. All at 12p each, 10 for £1.10*, 50 for 85p, 100 for 80p.*

TRANSISTORS & I.C.'s

BC107/8/9	9p	*BC212/212L	12p	2N3055	50p
*BC114	12p	*BC213/313L	11p	OC712	80p
*BC147/8/9	10p	*BC214/214L	11p	*NE666Timer	81p
*BC157	16p	*BF194/5	18p	*741C 8pin DIL	
*BC164/7/8/9	12p	BFY50/1/2	20p		
*BC182/182L	11p	AF178	40p	ZN414	£1.15
*BC183/183L	11p	AF239	38p	BN76013ND	
*BC184/184L	11p	*2N3702/4	11p		

POPULAR DIODES—1N914 6p, 8 for 45p, 18 for 80p; 1N916 8p, 8 for 45p, 14 for 80p; 1S44 5p, 11 for 50p, 26 for £1.00, 1N4148 5p, 6 for 27p, 12 for 48p; 1N4001 5p; 002 6p; 003 6p; 004 7p; 005 7p; 006 8p; 007 8p.

LOW PRICE ZENER DIODES—400mW. Tol. ±6% at 5mA. 3V; 3V3; 3V6; 4V7; 5V1; 5V6; 6V2; 6V8; 7V6; 8V2; 9V1; 10V; 11V; 12V; 13V; 13.5V; 15V; 16V; 18V; 20V; 22V; 24V; 27V; 30V; 33V. All at 7p each, 6 for 85p, 10 for 65p, 50 for 48p. SPECIAL OFFER: 100 Zeners (may be mixed) for £8.00.

RESISTORS—High stability, low noise carbon film 5% 1/4W at 40°C, 1/2W at 70°C. E12 series only—from 2.0Ω to 2.2MΩ. ALL at 1p each, 8p* for 10 of any one value, 70p* for 100 of any one value. SPECIAL PACK: 10 of each value 2.2Ω to 2.2MΩ (730 resistors) 25p.*

SILICON PLASTIC RECTIFIERS—1.5 amp, wire-ended D027; 100 P.I.V. 7p (4 for 28p); 400 P.I.V. 8p (4 for 30p).

BRIDGE RECTIFIERS—2 1/2 amp: 200V 40p; 350V 45p; 600V 65p.

SUBMINUTE VERTICAL PRESETS—0.1W only: All at 5p each: 50; 100; 220; 470; 680 ohm; 1k; 2k2; 4k7; 6k8; 10k; 15k; 22k; 47k; 100k; 320k; 680k; 1M; 2M5; 5M.

PLEASE ADD 20p POST AND PACKING ON ALL ORDERS. EXPORT—ADD COST OF SEA/AIRMAIL. Add 8% VAT to all items except those marked with * which are 12 1/2%.

Send S.A.E. for additional stock lists. Wholesale price lists available to bona fide companies.

MARCO TRADING (Dept. P.3)

The Old School, Edglaston, Wem, Shropshire
Tel: Whixall 464/465 (STD 094 872)
(Proprs. Minicost Trading Ltd.)

TTL SPECTACULAR!

(All famous makes. Prices include VAT)

7400	12p	7447	80p	74107	29p
7401	13p	7448	82p	74109	54p
7402	13p	7450	13p	74121	31p
7403	13p	7451	13p	74122	30p
7404	13p	7453	13p	74123	59p
7405	15p	7454	13p	74141	74p
7406	27p	7460	13p	74145	78p
7408	15p	7472	22p	74150	£1.05
7410	13p	7473	27p	74151	69p
7411	20p	7474	28p	74153	65p
7412	16p	7475	47p	74154	£1.35
7413	33p	7476	23p	74155	74p
7414	65p	7480	60p	74157	86p
7417	26p	7483	76p	74160	£1.10
7420	13p	7484	97p	74164	£1.35
7422	20p	7485	£1.03	74174	£1.10
7425	26p	7486	29p	74175	92p
7427	26p	7489	£2.50	74181	£2.19
7430	13p	7490	43p	74190	£1.25
7432	25p	7491	60p	74191	£1.25
7437	29p	7492	46p	74192	£1.08
7440	13p	7493	46p	74193	£1.08
7441	69p	7495	60p	74195	90p
7442	63p	7496	69p	74196	£1.19
7445	80p	74100	97p	1N4148	2p
ZTX108	7p	ZTX300	12p	1N4003	4p

Intel 2102 1K Memory £3

DL707E 0.3in. Display 69p

Min. order £2. P. & P. 20p (1st class) C.W.O.

Send S.A.E. for full list

J. C. JONES (Dept. PE21)

46 Burstallars, St. Ives, Cambs.

PE17 4XX

(Mail Order only)

BRAND NEW COMPONENTS BY RETURN

Electrolytic Capacitors 16V, 25V, 50V—0.47, 1.0, 2.2, 4.7 and 10mF 5p; 22, 47 8p (60V 8p); 100 7p (60V 8p); 220 8p (50V 10p); 500 11p (50V 10p); 1,000 (16V) 16p, 1,000 (25V) 18p, 1,000 (50V) 82p. Subminiature Tantalum Bead Electrolytics—0.1, 0.22, 0.47, 1.0, 2.2, 3.5V, 4.7/25V 11p; 10/25V, 22/16V, 47/6V and 100/3V 12p.

Mullard Min. Ceramic E12 Series 63V 2%—10-47P 8p; 56-330P 4p. Ceramic plate 50V E12 series 22-1,000P F and E6 series 1,600-47,000P F 8p.

Polystyrene E12 Series 63V Horizontal Mounting—10-1,000P F 8p; 1,200-10,000 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; 1.5 80p; 2.2 82p.

Mylar (Polyester) Film 100V Vertical Mounting—0.001, 0.002, 0.005 8p; 0.01, 0.02 3p; 0.04, 0.06 4p.

Miniature Resistors Highalt. E12 Series 5%—Carbon Film 1/4W 0.1-10MΩ 4p, 1M up 1p; Metal Film 1/4W 0.1-2MΩ 1.5p; Metal Film 1/2W 10Ω-2MΩ 1.5p; Metal Film 1W 27Ω-10MΩ 1.75p.

1N4148 8p; 1N4002 5p; 1N4006 7p; 1N4007 8p; BC107/8/9, 147/8/9, 157/8/9, BF194/7 9p.

Fuses 20mm glass, 1 1/2in glass, 1in ceramic 2p.

Post 10p (free over 24). Prices inclusive of VAT.

THE C.R. SUPPLY CO.

127 Chesterfield Road, Sheffield S8 0RN

Mullard Components

Polyester Capacitors. C280 Series. 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1, 0.15, 0.22, 0.33, 0.33, 6p; 0.47, 7p; 0.68, 10p; 1-0, 12p; 1.5, 18p; 2.2µF, 21p.

Carbon Film Resistors. 0.33W 5% Hi-stability E12 series 47-1M. Your selection 1p each, 0.9p 10+. 0.85p 100+.

Return of post service. Prices include 12 1/2% VAT. Allow 15p for carriage. Mail order only. All components brand new.

C. N. Stevenson (PE)

304 Avery Hill Road, London SE21 2JN

Mylar Low Cost Quartz Crystal Oscillators

TTL compatible.

Two plastic encapsulated styles give high accuracy and stability.

A.D.I.L. package 12.5 x 20 x 10 mm (QC1313) 5-25MHz priced from £7, and a 2 x D.I.L. spacing, 20 x 26 x 12.7 mm (QC1453) for 1-4MHz from £8, or for 5-10MHz from £6.

Prices apply for production quantities.

For full specification write or phone

ANN OPENSHAW

OR

ALAN PEARSON

on Heywood 69911

Illuminated thumbwheel switches, decimal output 50p each. End cheeks 25p per pair. Sub min. 1 c/o toggle switch, very high Q, 50p each. Sub min. 1 c/o toggle switch, non locking 50p each. Relay 3 c/o mains coils round 11 pin base 1 each. P.C. or solder tag socket for relay 25p each. 19mm PVC adhesive tape. 33 metre rolls 50p per roll. Vero board 0.2in pitch 4in x 3in (approx.) 10p each. 4-core common screened cable 10p per metre. Still some P.C. boards left as advertised in "Practical Electronics", June and August £1.33 each.

All prices include VAT and P. & P.
Minimum order £1.

Free set of four plastic clip on P.C. board supports for every full £1 spent.
Many other switches, relays and other components on special offer.

Free list sent with every order.

PAYLOR CONTROLS LTD.
1 WELLINGTON GARDENS
BURY, LANCS. BL8 2PQ

VALVES, RADIO, TV, TRANSMITTING, INDUSTRIAL. 1930 to 1975. 2,200 types in stock, many obsolete. List 20p. Quotation S.A.E. Postal export service. We wish to purchase new and boxed valves. Dealers, wholesalers, etc., stocks purchased. COX RADIO (SUSSEX) LTD., The Parade, East Wittering, Sussex. Tel. West Wittering 2023.

FOR SALE

DOUBLE BEAM OSCILLOSCOPE. Separate y-amps, accessories, manual, as new, carriage paid £70. Mr. MARSHALL, 4 Hall Place, Harbledown, Canterbury, Kent, CT2 9AF.

DISCOLIGHTS: 3-chan soundlights £17.50! Strobes £22! Full catalogue from—AARVAK ELECTRONICS, 12a (L) Bruce Grove, London N17. (01-808 8923).

PATCHBOARD and 9 unused Dewtron Synthesiser Modules, half price, S.A.E. for details—STEELE, 42 Quarry Road, Ryde, Isle of Wight.

EDUCATIONAL

UNIVERSITY OF ST. ANDREWS PHYSICS AND ELECTRONICS

A new Joint Honours BSc Degree course in Physics and Electronics (UCCA course No. 3350). Scotland's oldest University offers the opportunity to study this interesting combination of subjects. Details from Physics Department, North Haugh, St. Andrews, Fife, KY16 9SS.

SITUATIONS VACANT

RADIO TECHNICIANS

Government Communications Headquarters has vacancies for Radio Technicians. Applicants should be 19 or over.

Standards required call for a sound knowledge of the principles of electricity and radio, together with 2 years experience of using and maintaining radio and electronic test gear.

Duties cover highly skilled telecommunications/electronic work, including the construction, installation, maintenance and testing of radio and radar telecommunications equipment and advanced computer and analytic machinery.

Qualifications: Candidates must hold either the City and Guilds Telecommunications Part I (Intermediate) Certificate or equivalent HM Forces qualifications.

Salary scale from £2,230 at 19 to £2,905 at 25 (highest pay on entry) rising to £3,385 with opportunity for advancement to higher grades up to £3,780 with a few posts carrying still higher salaries. Pay supplement of £313.20 per annum.

Annual leave allowance is 4 weeks rising to 6 weeks after 27 years service. **Opportunities** for service overseas.

Candidates must be UK residents.

Further particulars and application forms available from:

Recruitment Officer, Government Communications Headquarters
Oakley, Priors Road, Cheltenham, Glos. GL52 5AJ
Tel.: Cheltenham (0242) 21491 (Ext. 2270)

BOOKS AND PUBLICATIONS

START YOUR OWN BUSINESS REWINDING ELECTRIC MOTORS

This unique instruction manual shows step by step how to rewind motors, working part or full time, without previous experience. Everything you need to know easily explained, including where to obtain materials, how to get all the work you need, etc., etc. A goldmine of information and knowledge. Only £3.90 plus 26p P. & P. From:

MAGNUM PUBLICATIONS, Dept. PES
Brinkway Trading Estate, Brinkway
Stockport SK3 0BZ
Overseas Distributors wanted.

Theory and practice of
MODEL RADIO CONTROL
2nd edition with latest circuitry
Development of proportional digital systems explained. Gives practical examples of a modern digital system transmitter-receiver-decoder and servo's.

£2.25 plus 35p P. & P. C.W.O.
SAE for lists to:

D. J. & D. MODEL GEAR
58 Lowther Grove, Garforth,
Leeds LS25 1EN

WANTED

"GLENN MILLER"

Collector requires recordings taken from BBC broadcasts during 1944-5 of the American Band of the A.E.F., under the headings "A.E.F. Band", "Swing Shift", "Uptown Hall", "Johnny Desmond Sings", "Strings with Wings", etc. Condition not important; tape copies acceptable; good price paid or will exchange from my unique collection. A. HIBBERD, 59 Waverley Road, Rugby, Warks. Or phone: Day 76473, Evening 71066.

WANTED, NEW VALVES, TRANSISTORS, top prices, popular types—KENSINGTON SUPPLIES (B), 367 Kensington Street, Bradford 8, Yorkshire.

ELECTRICAL

STYL, CARTRIDGES AND AUDIO LEADS, etc. For the best at keenest prices send S.A.E. for free illustrated list to: FELSTEAD ELECTRONICS (PE), Longley Lane, Gatley, Cheshire, Cheshire, SK8 4EE.

SERVICE SHEETS

SERVICE SHEETS, Radio, TV, etc., 50p and S.A.E. Catalogue 20p and S.A.E. HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

BELL'S TELEVISION SERVICES for service sheets on radio, TV, etc., 75p 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, radio, TV, etc. 10,000 models. Catalogue 24p plus S.A.E. with orders-enquiries. TELRAY, 154 Brook Street, Preston, PR1 7HP.

PROFESSIONAL SERVICES

PATENTS AND TRADE MARKS. KINGS PATENT AGENCY LIMITED (Est. 1886), B. T. King, Director, M.I.Mech.E., Registered Patent Agent, 146a, Queen Victoria Street, London, EC4V 5AT. Booklet on request. Tel. 01-248 6161. Telex 883805.

LADDERS

LADDERS. Varnished, 20ft. 9in. extd. £23.03. Carr. £1.80. Leaflet. Alloy ext. and Loft ladders. Immed. despatch. THE LADDER CENTRE (PEE), Halesfield (1), Telford, Salop. Tel.: 586644. Order C.O.D.

MISCELLANEOUS

NO LICENSE EXAMS NEEDED

To operate this miniature, solid-state **TRANSMITTER RECEIVER** kit. Only £8.25 plus 20p P. & P.

'Brain-freeze' 'em with a **MINI-STROBE** kit, pocket-sized 'lightning flashes', variable, for disco's and parties. A mere £3.80 plus 20p P. & P.

Experiment with a psychedelic **DREAM LAB**, or pick up faint speech/sounds with the **BIG EAR** sound-catcher: ready-made modules. £4.75 plus 20p P. & P. LOTS MORE! Send 20p for lists.

(Prices include VAT).
(Mail Order U.K. only).

BOFFIN PROJECTS

4 Cunliffe Road
Stoneleigh, Ewell, Surrey (P.E.)

CINE/TAPE SYNCHRONISATION (STEREO TOO). Our kit converts Philips mono cassette recorders to variable speed with spare track for sync pulse recording or stereo. Ideal for the PE synchroniser. Only £9.95 (P. & P. 30p). A.M.P.C., 115 York Street, Cambridge.

BUILD THE TREASURE TRACER

MK III Metal Locator



- Variable tuning
- Britain's best selling metal locator kit
- Fitted with Faraday shield
- Speaker and telephone 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
Post £1 + £1.18 VAT

£14.75

Built and tested
Post £1 + £1.58 VAT

£19.75

MINIKITS ELECTRONICS, 66 CLEVELAND ROAD
LONDON E18 2AN (Mail Order Only)

GLEARING LABORATORY, scopes, recorders, testmeters, bridges, audio, R.F. generators, turntables, tapeheads, stabilised P.S.U.s, sweep generators, test equipment, etc. Lower Beeding 236.

SUPERB INSTRUMENT CASES by Bazelli, manufactured from heavy-duty pvc faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low 82p. Examples: width, depth, height, 8in. x 5in x 3in, #1-70; 10in x 6in x 3in, #2-42; 10in x 8in x 3in, #3-02; 12in x 10in x 3in, #3-06; 8in x 4in x 4in, #1-98; 10in x 6in x 4in, #2-97; 12in x 8in x 4in, #3-06; 7in x 7in x 5in, #2-91; 8in x 10in x 6in, #3-06; 12in x 8in x 7in, #4-40; 12in x 12in x 7in, #4-84. Plus 85p carriage and 8% VAT. Over 400 models to choose from. Prompt despatch. Free literature (stamp would be appreciated): BAZELLI, Dept. No. 23, St. Wilfrid's, Foundry Lane, Halton, Lancaster LA2 6LT.

ENAMELLED COPPER WIRE

S.W.G.	1lb reel	1/2lb 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 the above prices are inclusive of postage and packing in the U.K.

COPPER SUPPLIES
102 Parrwood Road, Withington,
Manchester 20
Telephone 061-445 8753

PRINTED CIRCUIT DESIGN SERVICE. Competitive prices. Send S.A.E. with circuit diagram and specifications for return of post estimate. G. GLOVER, 90 Ashridge Drive, S. Oxhey, Herts.

**LOW COST — HIGH EFFICIENCY
AUDIO TEST OSCILLATOR £20**



RANGE: 10Hz to 100kHz. OUTPUT: 1V, sine/sq. DISTORTION: less than 0.02%. 9V battery. Also available in Kit form at £16.50. Add 8% VAT. P. & P. and ins. 75p. Leaflet available. Also F.M. Signal Generator, Millivoltmeter, freq. meter, THD analyser, P.S. Units and high quality amplifiers.

TELERADIO ELECTRONICS
325 Fore Street, London, N9 0PE
Tel. 01-807 3719

DO-IT-YOURSELF LOUDSPEAKERS for hi-fi are our speciality. Full range of components and accessories including chassis speakers, cross-overs, sound absorbent, grille fabrics, etc., always available. We stock the fabulous value Hemie speaker kits (complete with full and easy instructions), also Peerless and Wharfedale kits. Just about the lowest prices anywhere! Send 81p. stamp for bargain list to: AUDIOSCAN, Dept. PE-1276, 4 Princes Square, Harrogate, North Yorkshire.

GLASS FIBRE P.C.B.'s

From your own tape, film or ink master. Send S.A.E. for quotation. PRACTICAL ELECTRONICS printed circuit boards in glass fibre, drilled and tinned. July 76 Transmitter 93p, Coder 84p. July 76 Receiver 90p, Decoder 73p. Interface 56p. August 76 Servo Drive 69p. Servo Amp 54p, Relay Driver 62p. Complete set of above boards £5.30. Sept. 76 Tone Generator 66p, Tone Decoder 72p. May-June 76 Digital Frequency Meter. Complete set of 4 boards £4.20. Sept. 76 Cross-Hatch Generator £2.85. Send S.A.E. for information on current boards. C.W.O. please.

PROTO DESIGN

4 Highlife Way, Wickford, Essex SS11 8LA

LIGHTING CONTROL UNITS

Sound to Light. Quality 3 channel display control (1.5kW per channel) is designed for ruggedness, safety and simplicity of construction. The kit includes individual sensitivity controls and the unique 1/2 intensity dimming control. KIT PRICE £13.90 (incl.). Bypass switches, 25p each (3 required). Strobe/Flasher Control Unit. KIT £7.50. Pre-built £9.50. Flash rate. 20 ft./sec. to 2 ft./min. Flash on time variable. Other kits and modules for discos, shops & theatres available. Order or write for details from: SELEKTRON, 21 Priors Rd., Windsor, Berks. SL4 4PD

CHROMASONIC Electronics

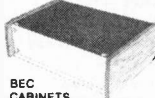
From Denco Coils, through TTL, C'Mos, Quarts Crystals, Vero, DVM Chips, Clock Chips, LED's; LCD's; Displays, Transformers, Boxes, Cases, Knobs and millions of R's and C's, Transistors and Diodes.

It's all in our **BRAND NEW** illustrated CATALOGUE. FREE with every copy are 36p worth of vouchers. Send 35p, incl. Free p & p to:

Dept. 2, Chromasonic Electronics, 56 Fortis Green Road, London N10 3HN

H.M. ELECTRONICS

275a Fulwood Road, Broomhill, Sheffield S10 3BD



BEC CABINETS

ORION cabinet still available punched or unpunched. Send 15p (refundable) for leaflets.

Give your project that professional looking finish. Build it in a BEC. Dry transfer lettering now available...

Musical Miracles!

by **Dewtron**®

Build your own synthesiser or musical effects using some of the huge range of DEWTRON modules. Or, build fuzz or waa-waa at budget prices using special kits.

Send 20p for Catalogue from:

D.E.W. Ltd., 254 Ringwood Road, Ferndown, Dorset BH22 0AR.

RECHARGEABLE NICAD BATTERIES. "AA" (HP7) 98p. "Sub C" \$1-18. "C" (HP11) \$1-92. "D" (HP2) \$2-50. "PP3" \$2-48. Matching chargers respectively, \$4-48, \$4-48, \$4-88, \$3-98. All prices include VAT. Please add 10% post and package. S.A.E. for full price list + 30p for information booklet if required. SANDWELL PLANT LTD., 1 Denholm Road, Sutton Coldfield, West Midlands. Tel. 021-854 9764.

CABINET FITTINGS

FOR

Stage Loudspeakers and Amplifier Cabs
Fretcloths, Coverings, Recess Handles, Strap Handles, Feet, Castors, Locks and Hinges, Corners, Trims, Speaker Bolts, etc., etc.
Send 2 x 81p Stamps for samples and list.

ADAM HALL (P.E. SUPPLIES)

Unit Q, Starline Works, Grainger Road Southend-on-Sea, Essex.

LOW COST I.C. MOUNTING for any size DIL package. 100 Soldercon sockets 65p. 7 and 8 hole plastic supports 5p/pair. Quantity rates. S.A.E. details and sample. Trial pack 65p (P. & P. 10p/order). PKG ELECTRONICS, Oak Lodge, Tansley, Derbyshire, DE4 5FE.

12 VOLT FLUORESCENTS

35% OFF
RRP

MADE BY THORN LIGHTING. Ideal for Caravan, Boat, Tent, Emergency Lighting etc. All lamps guaranteed for 12 months.

21 ins 13 watt
£4.90



12 ins 8 watt
£4.00

All lamps have On/Off Switch. Wrong Polarity Protection Device and Diffuser.

C60 CASSETTES 32p
C90 CASSETTES 45p

All Cassettes in Plastic Case with Index and Screwed Assembly.

All prices include VAT. Add Postage 5p in £1.
Quantity Discounts.
10 Units 5%
50 Units 7%
100 Units 10%
SALOP ELECTRONICS
23 WYLE COP
SHREWSBURY
Tel. 53206

PRINTED CIRCUITS and HARDWARE

Readily available supplies of Constructors' hardware, Aluminium sheet and sections. Printed circuit boards, top quality for individual or published designs.

Prompt service.

Send 15p for catalogue.

RAMAR CONSTRUCTOR SERVICES
Masons Road, Stratford on Avon
Warwicks. Tel. 4879

WIND GENERATORS, solar electricity generators, inverters, etc. S.A.E. lists. **COMMERCIAL RADIO SERVICES**, 125 Hazlebury Road, Fulham, London, SW6 2LX.

ENAMELLED COPPER WIRE

SWG	1 lb	4 oz	2 oz
14-19	2-40	0-60	0-50
20-29	2-45	0-82	0-59
30-34	2-60	0-99	0-64
35-40	2-85	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

COLCHESTER'S COMPONENT SHOP open Sunday-Friday, 12-6 p.m. J. K. ELECTRONICS, 11 Mersea Road. Tel. 64433.

SURPLUS TO INDUSTRIAL REQUIREMENTS

- 25 assorted spindle potentiometers.
- 25 assorted electrolytics, axle wire ended.
- 25 assorted 7R, 10R and 20R wire-wound presets.
- 4 single pole 100V d.c. relays.
- 20 neons (10 clear, 10 amber).
- 5 miscellaneous lever key switches.
- 6 miscellaneous dual potentiometers.

£1-25 inc. VAT + 20p P. & P. — any selected pack C.W.O. to:

BLORE-BARTON LTD.
Reedham House, Burnham, Bucks.

VERO BOXES/CASES, e.g. 65-2520J £2-12 VAT/Postage inclusive. Send S.A.E. for list. CAVERN ELECTRONICS, 94 Stratford Road, Wolverton, Milton Keynes, MK12 5LU.

I.C. EXPERIMENTER'S KITS

Learn about modern electronics with our new series of Kits on digital logic techniques. Each Kit contains specially selected I.C.s, Holders, Veroboard, L.E.D.s, and Instructions. Available at £4.90 each (including P. & P.)
Kit One—Gates Kit Two—Flip-Flops
Kit Three—Shift Registers
Kit Four—Counters Kit Five—Displays
S.A.E. for further details to:
AUTOMATED HOMES
69 High Street, Ryton, Coventry CV8 3FJ
(Mail Order Only)

Dimmit

range of light dimmers and lighting control systems

Illustrated is the popular PMSD1000 module. A 1kW slider control dimmer, interference suppressed, 60mm slider range size $4\frac{1}{2} \times 2 \times 1\frac{1}{2}$ in. Ideal for low cost stage and disco lighting. Used by schools, theatres, studios, etc. Complete with scale plate, fixing screws and full instructions. £9.06 inc. VAT and postage and packing.

Complete compact light dimmer systems for stage, club and disco lighting, etc.

DD61M (illustrated). Six 1kW channels, six outlet sockets, master control, mains on/off switch, size $23 \times 8\frac{1}{2} \times 5$ in. Price £140.40 inc. VAT.

DD61-B. Six 1kW channels, using module PMSD1000, lowest cost system. Size $16\frac{1}{2} \times 8 \times 5$ in. Price £64.50 inc. VAT.

DD62M. As DD61M but with six 2kW channels, size $25 \times 10\frac{1}{2} \times 6$ in. Price £205.20 inc. VAT.

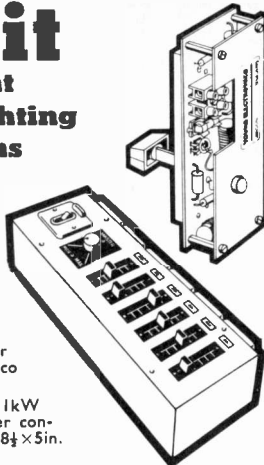
Add £2.20 postage and packing for all systems.

The Dimmit range includes rotary and slider control dimmers and sound to light converters for home, entertainment and professional applications. Ratings 1kW, 2kW, 3kW.

All products are guaranteed and are supplied with full instructions and applications. Full after-sales service. Technical advice given.

For full information on all modules and lighting control systems send for our FREE illustrated catalogue and price list. Callers welcome, visit our showroom for a demonstration of any of the modules or systems. Mon.-Fri. 9.30 to 6.0 p.m. Sat. by arrangement.

YOUNG ELECTRONICS LTD.
184 Royal College Street, London NW1 9NN Tel. 01-267 0201



YES SIR 1st class post TONIGHT!
We specialise in high spec components with express service for phone customers



HIGH SPEC components FAST!

Agents for VERO - ANTEX -
BIB MULTICORE SOLDER

- OPEN 9am-5pm, 6 days—Phone orders 9am-4pm.
- S.A.E. for stock list including pots, presets, I.C.'s 7400 & CMOS, capacitors, plugs, sockets, switches, cable, etc.
- Post free catalogue included for your next order.
- SUPER EXPRESS phone service—ask for details.
- Shop at keen prices 6 days per week, Late night—Fri. 7-10pm.

TRANSISTORS + 200 OTHER TYPES IN STOCK

AC125 24p	BC109 11p	BC262A 15p	BFX29 26p	TIP41A 67p
126 20p	109B 12p	287 20p	84 22p	42A 80p
127 20p	109C 13p	300 35p	88 22p	TIS43 35p
128 20p	117 18p*	301 34p	BFY50 17p	ZTX300 13p*
151 35p	142 22p	303 35p*	51 16p	302 18p*
153 35p	143 24p	338 16p*	72 18p	500 15p*
176 20p	147A 9p*	351 16p*	BY164 40p	502 18p*
187 20p	147B 10p*	BCY71 18p*	ME0401 18p*	1N914 5p
188 20p	148 9p*	72 14p	0411 18p*	4001 5p
AD149 68p	148B 10p*	BD123 90p	4001 10p*	4002 6p
161 42p	149B 11p*	124 68p	4101 11p*	4005 9p
162 42p	149C 11p*	131 36p	MPF102 32p*	4006 10p
MCH/PR	154 18p*	132 38p	OA47 8p	4148 5p
	157B 12p*	137 54p*	9A7 25p	2N2219 20p
	157C 14p*	154 18p*	91 4p	2E646 40p
AF116 24p	177 17p	155 75p*	200 6p	2926G 13p*
117 24p	178B 18p	BF158 20p*	29 58p	3053 18p
124 30p	179B 19p	184 25p	OC28 90p	2926G 15p*
239 48p	184B 12p*	185 28p	29 58p	3053 18p
BU113 1.50*	184L 11p*	194 10p*	35 80p	3055 60p
AC107 11p	187 28p	196 12p*	44 38p	3702 11p*
108 10p	212A 12p*	197 12p*	9A7 25p	3703 18p*
108 10p	212L 15p*	199 15p*	ORP12 85p	3704 13p*
CIL108 6p	213B 12p*	200 33p	TIP29A 47p*	3705 19p*
BC108B 11p	214 15p*	338 34p	30A 56p*	3707 12p*
108C 12p	214L 17p*	BFW11 64p	31A 57p*	3819E 25p*

DIODES	BRIDGES	RESISTORS 1p each	LINEAR I/C's
50V 3A 13p	100V 1A 24p	WATT E12 (5%)	LM380 SL60745 1.25*
100V 3A 15p	200V 1A 25p	1 ohm - 10m ohm	LM3900N 68p
200V 3A 18p	400V 1A 26p	ZENERS (400mw) BZX 83	NE555 33p
400V 3A 21p		3V, 3V3, 5V1, 5V6, 7V5, 9V1, 10V, 12V, 18V, 22V, 30V. All at 12p each.	SN7613ND 1.60*
			SN7613N 1.75*
			SN7613D 1.75*
			TBA800 1.35*
			TBA810S 1.48*
			TBA820 1.35*
			ZN414 1.20*

Post & Packing 25p per order. VAT please add to total * 12½% rest 8%
ORCHARD ELECTRONICS
FLINT HOUSE, HIGH STREET, WALLINGFORD, OXON, OX10 8DE
Telephone 0491 35529.

ELECTRONI-KIT

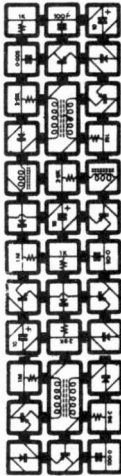
Build, Dismantle and Rebuild
Over 100 Different Projects
and Design New Circuits too

Radio Receivers and Transmitters, Telephone Amplifiers, Time Buzzers, Battery Checkers, Computer Circuits, Amplifiers, Directional Transmitters, Metal Detectors, Continuity Testers, Electronics Birds, Guns, Metronomes, Sirens, Roulette, etc. All in one kit

"... educational kits of exceptional quality" (Audio mag.)
"... worthwhile ... good value for money" (Everyday Electronics mag.)

Educational manuals included with each kit. No previous experience required. Suitable for beginners and experts too.

- 100 project kit £19.60
 - 45 project kit £15.60
 - 25 project kit £12.10
- (Add-on kits available too)
- Prices include manuals, batteries, VAT and P. & P.



Cheque/P.O. (or 11p for illustrated literature) to Dept. PE

Satisfaction guaranteed

ELECTRONI-KIT LTD. 408 St. John's Street, London, E.C.1. (01-278 4579)

OSMABET LTD

We make transformers amongst other things

LOW VOLTAGE TRANSFORMERS
Prim. 200/240V a.c., 5V 1A 60p; 6.3V 1.5A £1.65; 3A £2.10; 6A CT £3.75; 12V 1.5A £2.10; 3A £3.75; 6A CT £5.25; 18V 1.5A CT £3.45; 24V 1.5A CT £3.75; 3A CT £5.25; 5A £8; 8A £11.25; 12A £16.50; 40V 3A CT £7.50; 50V 6A CT £18.75; 25V 2A + 25V 2A £7; 12V 4A + 12V 4A £7.

LT TRANSFORMERS TAPPED SEC. Prim 200/240V 0-10-12-14-16-18V 2A, £4; 4A, £5.25, 0-12-15-20-24-30V 2A, £4.50; 4A, £8.75, 0-5-20-30-40-60V 1A, £4.85; 2A, £8.75, 0-40-50-60-80-100-110V 1A, £7.

MIDGEE RECTIFIER TRANSFORMERS
For FW rect. 200/240V a.c., 6.0-6V 1.5A or 9.0-9V 1A £1.80 each; 12.0-12V 1A, or 20.0-20V 0.75A, or 9.0-9V 0.3A, or 12.0-12V 0.25A, or 20.0-20V 0.15A, or 6.0V 0.5A + 6V 0.5A, or 9V 0.35A + 9V 0.35A, or 12V 0.25A + 12V 0.25A, or 20V 0.15A + 20V 0.15A, all at £2 each.

LOUDSPEAKERS
2½in 8 or 75Ω, 2½in 8 or 25Ω, 3in 3, 8 or 35Ω, 3½in 15Ω, £1 each; 8 x 5in 3, 8 or 25Ω, £1.75; Goodmans 6½in twin cone, hi-fi, 4Ω, £2.50; 7 x 4in, 3-8, 15 or 25Ω, £1.50.

"INSTANT" BULK TAPE/CASSETTE ERASER
Instant erasure any diameter tape spool or cassette, demagnetises tape heads, 200/240V a.c., £3.75.

SYNCHRONOUS GEARED MOTORS 200/240V a.c.
Brand new Smiths, built in gearbox, 6 r.p.m., £1.25 each.

PAPER TUBULAR CONDENSERS
4.7mF, 160V, 30 x 20mm, 20p (100 for £10).

SPEAKER MATCHING AUTO TRANSFORMER
12W, 3 to 8 or 15Ω, up or down, £1.85.

G.E.C. MANUAL OF POWER AMPLIFIER COVERING VALVE AMPLIFIERS OF 30W TO 400W-35p.

CABLES — CABLES — CABLES

MICROPHONE TWIN H/DUTY, BRAIDED SCREEN
Professional cable for stage, studio, outdoor, PVC covered, grey, 20p per metre. Grey.

MULTI WAY SCREENED, PVC COVERED
38 way £1; 25 way 75p; 14 way 60p; 6 way 25p; 4 way 20p; 2 way 10p; 1 way 6p per metre.

LOW LOSS CO-AXIAL CABLE 75Ω
UHF, white, 16p per metre; VHF, white, 9p per metre.

BALANCED TWIN FLAT FEEDER 300Ω
40p per 10 metres.

FLEXIBLE PVC MINI 3-CORE CABLE, 19/0-10MM
100 metres £3.50. Ideal for speakers, intercoms, etc.

TWIN FIG. 8 CABLE
Polarised, £2/100m. Screened stereo £1/15m. ALL TYPES DOMESTIC AND COMMERCIAL CABLES. ALL SIZES AND COLOURS CONNECTING WIRES. MULTI SCREENED AND UNSCREENED CABLE.

TRADE ENQUIRIES INVITED
Carriage and VAT extra on all orders
S.A.E. ENQUIRIES. LISTS. MAIL ORDER ONLY
46 Kenilworth Road, Edgware, Middx. HA8 8YG
Tel. 01-858 9314

Still some of the following Low Cost Items available:

- MARCONI OSCILLATOR TF885A/1 in superb condition covering 25Hz to 12MHz sine wave in 3 ranges and 50 Hz to 150KHz square wave. High output 31-6V. Meter scaled in volts and dB.
- MARCONI TF675F WIDE RANGE PULSE GENERATOR—± variable outputs up to 50V. Optional delay, small compact unit.
- AVO VALVE TESTER CT160—"The Suitcase". Size approx 15in. wide x 10in. high x 11in. deep.
- FURZEHILL VALVE VOLTMETER V200A Audio to 10MHz with probe 1mV FSD. Fine condition.
- MARCONI TF1106 NOISE GENERATOR—4 ranges 0-5; 0-10; 0-15; 0-30.
- ALL ITEMS £22.50 each or ANY THREE ITEMS FOR £60. Carriage £2.50 each or £5 for 3.

COME AND LOOK ON OUR SHELVES—HUNDREDS OF OTHER ITEMS TO INTEREST YOU. TOO FAR AWAY—THEN SEND FOR LISTS.

- Low cost peripherals
- 5 Level Printers, Punches, Readers, ASCII interface available.
- 8 Level items also available at higher cost. Various KEYBOARDS available.

CHILTMEAD LTD

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

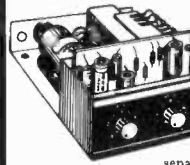


TTLS by TEXAS		C-MOS ICs		OP AMPS		AC125		BF196/7		TIS43		2N3906		VOLTAGE REGULATORS (Plastic) Fixed	
7400	18p	7494	90p	4000	18p	1458	75p	AC125	18p	BF196/7	18p	TIS43	40p	2N3906	16p
7400	30p	7495	75p	4001	18p	301A	40p	AC126/17	18p	BF200	40p	TIS93	30p	2N4060	16p
74100	32p	7496	84p	4002	18p	3130	40p	AC128	16p	BF244/B	40p	ZTX108	12p	2N4123/4	22p
74500	40p	7497	295p	4006	110p	3900	60p	AC141/2	20p	BF257/B	30p	ZTX300	18p	2N4125/6	32p
7401	18p	74100	116p	4007	18p	536T	30p	AC176	18p	BFR39/40	34p	ZTX500	20p	2N4401/3	24p
7402	18p	74104	90p	4008	87p	741	25p	AC187/8	20p	BFR79/B0	34p	2N697	25p	2N4442	97p
7403	18p	74105	90p	4011	18p	747	70p	AC187K	25p	BFR88	40p	2N698	34p	2N4871	40p
7404	24p	74107	36p	4012	18p	747	25p	AC188K	25p	BFX29/30	34p	2N706/8	22p	2N5296	85p
74H04	40p	74109	70p	4013	55p	748	40p	AD149	46p	BFX84/85	30p	2N918	43p	2N5457/8	40p
7405	25p	74110	55p	4014	110p	776	155p	AD161/2	30p	BFX88/7/8	30p	2N930	19p	2N5459	40p
7406	45p	74111	90p	4015	120p	Linear ICs		AF114/5	20p	BFY50	18p	2N1131/2	25p	2N6207	60p
7407	30p	74112	220p	4016	54p	CA3028A	112p	AF116/7	20p	BFY51	18p	2N1304/5	40p	2N6107	70p
7408	22p	74120	85p	4018	120p	CA3046	70p	AF124	27p	BFY52	18p	2N1306/7	40p	2N6247	200p
7410	18p	74121	32p	4019	54p	CA3046	250p	AF127	27p	BRY39	45p	2N1613	22p	2N6254	140p
74H10	30p	74122	80p	4020	120p	CA3053	70p	AF136	43p	BSX19/20	20p	2N1711	22p	2N6292	70p
7411	20p	74123	75p	4022	100p	CA3080	87p	AF139	43p	BU105	175p	2N1893	32p	3N128	81p
7412	20p	74125	70p	4023	18p	CA3089E	87p	AF139	43p	BU108	315p	2N2160	90p	3N140	92p
7413	30p	74126	78p	4024	75p	CA3090AG	50p	AF239	46p	BU2955	120p	2N2219	22p	3N141	81p
7414	35p	74128	90p	4025	19p	ICL8038C	370p	BC108/B	108p	MJE340	45p	2N2222	22p	3N187	200p
7416	35p	74132	76p	4026	200p	ICL8039E	600p	BC109/C	10p	MJE345	85p	2N2268	15p	40361/2	45p
7417	30p	74136	81p	4027	81p	LM380	108p	BC147/B	8p	MJE2955	120p	2N2484	32p	40409/10	65p
7420	18p	74141	85p	4028	152p	LM381	180p	BC149/C	10p	MJE3055	85p	2N2648	48p	40411	275p
7421	43p	74142	300p	4029	120p	M252	85p	BC157	11p	MPE102/3	40p	2N2904/A	22p	40454	85p
7422	30p	74145	90p	4030	50p	MC1310P	190p	BC158/9	12p	MPE104/5	40p	2N2905/A	22p	40585	97p
7423	30p	74148	170p	4042	90p	MC1351P	104p	BC169C	16p	MPSA06	67p	2N2906/A	24p	40673	63p
7425	33p	74150	135p	4043	100p	MC1485	370p	BC172/B	32p	MPSA12	31p	2N2926RB	8p	TRIACS	
7427	40p	74151	77p	4046	150p	MC1496	115p	BC177/B	20p	MPSA12	31p	2N2926OYG	11p	Amp Volts	
7430	18p	74153	82p	4047	110p	MC3340P	180p	BC179	20p	MPSU06	78p	2N3053	20p	3 400	130p
7432	30p	74154	184p	4049	80p	MFC4000B	75p	BC182/3	12p	MPSU06	94p	2N3054	54p	6 400	162p
7437	32p	74155	87p	4050	54p	NE540L	140p	BC184	14p	OC28	78p	2N3055	54p	6 500	194p
7438	32p	74156	87p	4054	120p	NE555	40p	BC187	32p	OC35/36	78p	2N3442	151p	10 400	200p
7440	18p	74157	90p	4055	120p	NE561	425p	BC212	14p	OC71	25p	2N3702/3	14p	10 500	270p
7441	35p	74158	160p	4056	145p	NE562	425p	BC213	12p	TIP29A	50p	2N3704/5	14p	15 400	300p
7442	75p	74159	220p	4060	120p	NE565	290p	BC214	18p	TIP29C	62p	2N3708/9	14p	15 500	340p
7443	130p	74160	108p	4069	40p	NE566	290p	BC217	12p	TIP30C	72p	2N3773	320p	40430	108p
7444	130p	74161	108p	4071	29p	NE567	290p	BC218	18p	TIP31A	56p	2N3819	27p	40659	108p
7445	105p	74162	168p	4071	29p	NE567	290p	BC219	18p	TIP31C	68p	2N3823	54p	DIAC	
7446	108p	74163	180p	4081	12p	2567	400p	BC272	20p	TIP32C	83p	2N3866	95p	BR100	32p
7447	81p	74164	130p	4082	29p	SN72110N	45p	BC312	12p	TIP33A	83p	2N3904/5	18p	VAT INCLUSIVE PRICES	
7448	90p	74165	150p	4510	142p	SN72733N	150p	BC313	12p	TIP34A	124p	MAIL ORDER ONLY		Add 20p P. & P.	
7450	18p	74166	130p	4511	180p	SN75003N	275p	BC314	18p	TIP34B	124p	Govt., Colleges orders accepted		TECHNOMATIC LIMITED	
7451	18p	74167	340p	4516	140p	SN76008	275p	BC378	32p	TIP35A	240p	54 Sandhurst Road, London NW9.		Tel. 01-204 4333	
7453	18p	74173	180p	4518	130p	SN78013N	275p	BC478	32p	TIP35C	290p	922800		Telex: 922800	
7454	18p	74174	130p	4528	130p	SN78018	275p	BC478	32p	TIP35C	290p				
7455	18p	74175	82p			SN78023N	275p	BCY71	24p	TIP36A	297p				
7460	20p	74176	130p			SN78033N	275p	BCY72	20p	TIP41C	84p				
7470	32p	74177	130p			SN78060N	85p	BD131	49p	TIP42A	78p				
7472	32p	74178	118p			TA6A21A	275p	BD132	43p	TIP42C	94p				
7473	30p	74180	130p			TA6A61B	150p	BD135	54p	TIP42A	78p				
7474	37p	74181	130p			TBA120	75p	BD136	55p	TIP42C	94p				
7475	48p	74182	84p			TBA641B	300p	BD139	50p	TIP42A	78p				
7476	37p	74185	144p			TBA651	275p	BD140	60p	TIP2955	75p				
7480	54p	74186	90p			TBA810	125p	BD140	60p	TIP2955	75p				
7481	105p	74190	150p			TBA820	100p	BDY56	175p	TIP36A	297p				
7482	85p	74191	180p			TBA820	100p	BF115	24p	TIP36C	380p				
7483	85p	74192	130p			TDAC020	400p	BF167	35p	TIP41A	70p				
7484	103p	74193	130p			ZN414	140p	BF178	40p	TIP41C	84p				
7485	130p	74194	130p					BF180	40p	TIP42A	78p				
7486	30p	74195	104p					BF184	30p	TIP42C	94p				
7489	281p	74196	130p					BF194/5	12p	TIP2955	75p				
7490	43p	74197	130p												
7491	90p	74198	130p												
7492	56p	74199	214p												
7493	43p														

INDEX TO ADVERTISERS

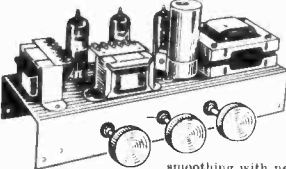
A. B. C. Electronics (Oldham) Limited	996	Electrospace	1008	Paylor Controls	1013
Adam/Hall (P.E. Supplies)	1014	Electrovalue	940	Philips	967
Alben Engineering	930	Elvins Electronics	1006	Phonosonics	942, 943
Alcon Engineering	930	Flairline Supplies	936	Precision Petite	996
Astro Electronics	1004	G. I. D. Electronics	1012	Pronto Electronics	1009
Automated Homes	1014	Government Communications		Proto Electronics	1014
Bamber, B. Electronics	944	Headquarters	1013	Pulse Electronics	992
Barclay Electronics	931	Greenbank Electronics	1006	Radio Components Specialists	950
Barrie Electronics	944	Greenweld Electronics	1003	Radio Exchange	cover ii
B. H. Components	962	Harverson's Surplus	cover iii	Raffe, P. F.	946
Bi-Pak	948, 949	Heathkil	1001	Ramar Constructor Services	1014
Bi-Pre-Pack	937	Henry's Radio	945	RST Valve Mail Order Co.	946
Birkett, J.	930	Hibbard A.	1013	R. T. Services	1012
Blore Barton Ltd.	1014	H. M. Electronics	1014	R & T Components	947
Boffin Projects	1013	Home Radio	1009	Salford Electronics	1012
British Institute of Engineering		I. L. P. Electronics Ltd.	1007	Salop Electronics	1014
Technology	934	International Electronics Limited	935	Saxon Entertainments Ltd.	1002, 1003
British National Radio & Electronics		Intertext ICS	992	Scientific Wire Selektion Co.	1014
School	961, 1004	Island Devices	1012	Selektion	1014
Cambridge Learning	943	Jones, J. C.	1012	Sintel	968
Chillmead Limited	1015	Josty Kit (U.K.) Ltd.	991	Specials Products Ltd.	1006
Chromasonic Electronics	1014	J. W. B. Radio	1012	Stevenson, C. N.	1012
C.J.L. Ltd.	940	Kit Cabs	936	Sugden, A. R.	994
Clef Products	936	Lektropacks	1008	Swanley Electronics	996
Cliffpalm	938	Lynx Electronics	962	Tamba	940
Components Centre, The	992	Magnum Publications	1013	Tandy Corp. (U.K.)	940
Continental Supplies	941	Maplin Electronic Supplies	cover iv	Technomatic Ltd.	1016
Copper Supplies	1014	Marco Trading	1012	Teleradio Electronics	1014
Crescent Radio Ltd.	938	Marshall, A., & Sons	1011	Tempus	996
Crofton Electronics	946	Minikits Electronics	1013	Trampus Electronics	938
C.R. Supply Co.	1012	Modern Book Co.	936	T.U.A.C.	932, 933
Davian	968	Orchard Electronics	1015	University of St. Andrews	1013
D.E.W. Ltd.	1014	Osmabet	1015	Videomaster (Sales Team)	995
D.J. & D. Model Gear	1013			Williams, Michael	1008
Doram	939			Willslow Audio	1005
Eagle International	934			W.K.F. Electronics	934
Eaton Audio	968			Young Electronics	1015
Electronic Design Assoc.	1001				
Elektronik	1015				

SUPERSOUND 13 HI-FI MONO AMPLIFIER



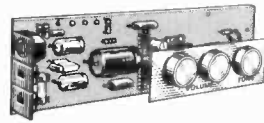
A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 18 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz \pm 3db. Fully integrated pre-amplifier stage with separate Volume, 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 8" high x 6" wide x 7 1/2" deep. AC 200/250V. PRICE £13.75. P. & £1.00.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated transformer with full wave rectification giving adequate smoothing with negligible hum. 15 diode rectifier. Two dual potentiometers are used for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 8 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" w x 4" d. Overall height including valves 5". Ready built and tested to a high standard. £12.40. P. & £1.30.

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 diode speaker sockets and 5 pin i/c tape rec. play socket are mounted on the printed circuit board. Panel size approx. 9 1/2" x 2 1/2" x 1" deep. 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 £7.50 plus 60p P. & P. Mains transformer with an output of 17V a/c at 500 ma. can be supplied at £1.50 plus 40p P. & P. if required. Full connection details supplied.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 15 alternatives. Primary 0-210-240V. Secondary combinations 0-5-10-15-20-25-30-35-40-50V. Half wave at 1 amp, or 10-0-10-20-0-20-30-0-30V, at 2 amps full wave. Size 3in. long x 3 1/2in. wide x 3in. deep. Price £2.90. P. & P. 90p.

MAINS TRANSFORMER. For power supplies. Pri. 200/240V. Sec. 9-0-9 at 500 mA. £1.50. P. & P. 60p. Pri. 200/240V. Sec. 12-0-12 at 1 amp. £1.85. P. & P. 60p. Pri. 200/240V. Sec. 10-0-10 at 2 amp. £2.35. P. & P. 90p. Pri. 200/240V. Sec. 25v. at 1.5 amp. 6v. at 6 amp. 8v. at 50 mA. £2.00 + 60p P. & P.

ALL PURPOSE POWER SUPPLY UNIT 200/240V. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" x 3 1/2" x 2 1/2". Ready built and tested. Price £5.75. P. & P. 85p.

STEREO-DECODER SIZE 2" x 3" x 1 1/2"

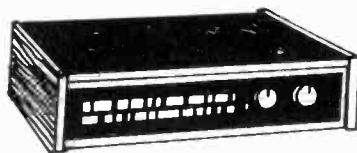
Ready built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £5.62 plus 20p P. & P. Stereo beacon light if required 40p extra.



QUALITY RECORD PLAYER AMPLIFIER MK II A top quality record player amplifier employing heavy duty double wound mains transformer. ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in wide x 3in deep x 6in high. Ready built and tested. PRICE £6.20. P. & P. 90p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £7.30. P. & P. £1.00.

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.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER



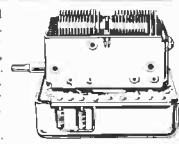
Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-grain, low noise IF stages. Automatic frequency control to 'lock on' station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo balance indicator. Nominal output of tuner 100mV. Approximate size 12 1/2in wide x 8in deep by 2 1/2in high. Supplied ready built, fully tested and fully guaranteed. AC mains 200/240V (not available in kit form).

Special Offer £22.50 + £1.40 P. & P.

SPECIAL OFFERS

Mullard LP1159 RF-IF (Double Tuned Amplifier Module for nominal 470kHz. Size approx. 2 1/2" x 1 1/2" x 1 1/2" high. Brand new pre-aligned. Full specification and connection details supplied. £2.25 + P. & P. 12p.

Pye VHF/FM Tuner Head covering 88-108MHz. 10.7MHz IF output 7.8V \pm earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-ganged FM Gang and 323 P1 + 323 P1 AM Tuning Gang only £3.15 + P. & P. 35p.



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 5" x 2 1/2" x 1". Supplied complete with chrome finished switch buttons 2 for £1.50 + 20p. P. & P.

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made simulated teak finish enclosure now with most attractive slatted front. Size 16 1/2" high x 10 1/2" wide x 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, H.F. tweeter unit and crossover. AVAILABLE IN NOMINAL 4 ohm, 8 ohm or 16 ohm impedance (state which).

OUR PRICE £12.00 each. Carr. £1.90

Cabinet Available Separately £7.25. Carr. £1.40. Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter £10.25. Carr. £1.90

LOUDSPEAKER BARGAINS

5in. 3 ohm £1.45. P. & P. 35p. 7 x 4in. 3 ohm £1.80. P. & P. 48p. 10 x 6in. 3 or 15 ohm £2.50. P. & P. 75p. E.M.I. 8 x 6in. 3 ohm with high flux magnet £2.06. P. & P. 50p. E.M.I. tweeter. Approx. 3". Available 3 or 8 or 15 ohms, £2.00 + 25p. P. & P.

VYNAT & REXINE SPEAKERS & CABINET FABRICS ap. 54 in. wide. Our price £1.50 yd. length. P. & P. 60p per yd. (min. 1 yd.). S.A.E. for samples.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11" x 14 1/2" x 1 1/2" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20KHz. Can be mounted on ceilings, walls, etc. and used with or without baffle. Send S.A.E. for details. Only £8.40 each. P. & P. 75p for one, 90p for two.

Now also available 8" x 8 ohm, 10 watts r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1 1/2". Ideal for Hi-Fi or for use in cars. £5.10 + P. & P. (one 35p, two 65p).

SPECIAL LINES OFFERED SUBJECT TO STOCK AVAILABILITY

Hi-Fidelity stereo cassette tape deck transport mechanism as used in Hi-Fi Music Centers. Electronically speed controlled motor, belt-driven flywheel capstan, three digit re-settable counter. Record/Play pre-amps. Bias oscillator. Record/Play and erase heads, etc. Power supply required 2V D.C. Circuit diagrams, etc. supplied. These units are brand new, but un-tested and are only offered to the more advanced constructor enthusiast. PRICE £16.87 + £1.25 P. & P.

WE REGRET THAT WE ARE UNABLE TO ENTER INTO CORRESPONDENCE ON THESE UNITS.

OUR PRICES INCLUDE VAT AT CURRENT RATES

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



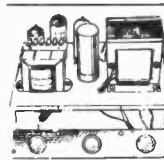
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality reily drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response \pm 3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω . Full power bandwidth: \pm 3dB 12-15,000 Hz. Bass, boost approx. to \pm 12dB. Treble cut approx. to \pm 10dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall size 12" w x 8" d x 2 1/2" h.

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. 65p (Magnetic input components 33p extra)
POWER PACK KIT £4.85 P. & P. 85p
CABINET £4.85 P. & P. 80p

Special offer—only £22.50 if all 3 units ordered at one time plus £1.00 P. & P.

Full after sales service. Also available ready built and tested £29.25. P. & P. £1.00.



3-VALVE AUDIO AMPLIFIER HA34 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2" w x 4" d. x 4 1/2" h. Incorporates ECC83, EL84, E280 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £7.80. P. & P. £1.00.



10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and E280 rectifier. Simple instruction booklet 25p x SAE (Free with parts). All parts sold separately. ONLY £11.25. P. & P. £1.35. Also available ready built and tested £15.20. P. & P. £1.30.

SPECIAL OFFER

Latest model Garrard 6300 Auto/Manual changer de luxe with cueing lever, bias compensator, counter-balanced low resonance arm and fitted with Acos 104 diamond ceramic stereo cartridge. PRICE ONLY £14.50 + £1.00 P. & P.

Limited number of the latest BSR C141R Auto/Manual changer de-luxe. Lightweight tubular arm cueing lever, bias compensator. PRICE £12.60 + £1.40 P. & P.

Also similar but without cueing lever or bias compensator. ONLY £11.00 + £1.40 P. & P.

New but very slightly marked 'GLENBURN' BSR automatic record changer decks fitted with cueing lever, lightweight arm and ceramic Hi-Fi stereo/compatible cartridge. Can be used for automatic or manual play. PRICE £9.58 + £1.20 P. & P.

(Please write clearly)

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

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
SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

The new Maplin Catalogue is no ordinary catalogue...

Hundreds of fascinating new lines.

Several major new projects to build

MAPLIN ELECTRONIC SUPPLIES



SUPERSONIC SAME DAY SERVICE!

QUALITY COMPONENTS FAST!



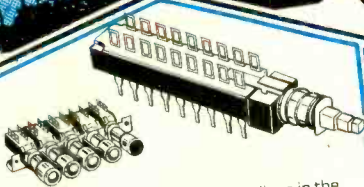
Test Gear Section includes superior quality single-beam and dual beam OSCILLOSCOPES at remarkably low prices. These superb SCOPEX scopes are, undoubtedly the best value for money around.

MULTI-CHANNEL MIXER

Projects section includes complete construction details of a professional quality MULTI-CHANNEL MIXER with modular sections for complete flexibility. Extremely low noise and distortion AND low cost.

Super Discount Scheme - saves you pounds!

Hundreds of photos and illustrations



Just one of the hundreds of new lines in the component section. A new range of FULLY INTERLOCKING PUSH BUTTON SWITCHES - high quality - low price - large range.

Catalogue includes a very wide range of components: hundreds of different capacitors; resistors; transistors; I.C.'s; diodes; wires and cables; discotheque equipment; organ components; musical effects units; microphones; turntables; cartridges; styli; test equipment; boxes and instrument cases; knobs, plugs and sockets; audio leads; switches; loudspeakers; books; tools - AND MANY MANY MORE.



* Our bi-monthly newsletter keeps you up to date with latest guaranteed prices - our latest special offers (they save you pounds) - details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).

SEND THIS COUPON FOR YOUR COPY OF OUR CATALOGUE ON APPROVAL! Price 50p - SEND NO MONEY NOW. Please rush me a copy of your brand new 1977/78 catalogue that is instant it is published. Only if I am completely satisfied that it is worth every penny, will I send 50p within 14 days of receipt. If I am not satisfied, I may return the catalogue to you within 14 days without obligation. I understand that I need not purchase anything from your catalogue should I choose to keep it.

NAME _____

ADDRESS _____

PE 12

Maplin Electronic Supplies P.O. Box 3, Rayleigh, Essex, SS6 8LR

Owing to delay in completion of larger warehouse, catalogue will be delayed by up to four weeks - so there's still time to order before publication and get your pack of ten super special offer coupons, giving big discounts on ten different popular items. YOU COULD SAVE POUNDS! - SO DON'T DELAY - FILL IN AND POST COUPON NOW!

MAPLIN

ELECTRONIC SUPPLIES
P.O. BOX 3, RAYLEIGH, ESSEX SS6 8LR

Shop: 284, London Road, Westcliff-on-Sea, Essex
(Closed on Monday) Telephone: Southend (0702) 44101