PORTABLE GAS IGNITOR
FOR NATURAL, TOWN & BOTTLED GAS

Also... Guitar Effects Pedal
SINE/SQUARE WAVE SIGNAL GENERATOR
**NEW EDU-KIT MAJOR**

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

- 4 Transistor Earpiece Radio
- Radio Speaker
- Signal Injector
- Transistor Tester V/NP
- Transistor Push Pull Amplifier
- One Transistor Radio

Components include:
- 21 Resistors
- 10 Transistors
- 1 3 Transistor Radio
- 10 3 Transistor Radios
- 3 4 Transistor Radios
- 1 5 Transistor Radios
- 1 6 Transistor Radios
- 1 7 Transistor Radios
- 1 8 Transistor Radios
- 1 9 Transistor Radios
- 1 10 Transistor Radios

Total Building Costs
£7.00

---

**ROAMER TEN**

Mk. II

WITH VHF INCLUDING AIRCRAFT BAND

10 TRANSISTORS
3 TUNABLE WAVEBANDS
MW 1, MW 2, LW
SW 1, SW 2, SW 3
TRAWLER BAND
VHF AND LOCAL STATIONS
AIRCRAFT BAND

Plans and parts
5 tin x 1 tin x 3 tin
Black and Gold Case.

Rod Transistors
3 Tunable Wavebands.

LOUDSPEAKER
NOW WITH 3" (75MM)

COSTS
in black with silver blocking. Size 9in x 7in o
plus 3 diodes.

Car Aerial and tape record sockets.
Push-pull output rising 600nrave W transistors.

STEERED OUTPUT SWITCH
SW1, SW2, SW3, MW1, MW2, LW, SW1.

WAVEBANDS.
9 TUNABLE
10 TRANSISTORS.

AIRCRAFT Including MK II

TRAWLER BAND.

Total Building Costs
£6.98

---

**ROAMER EIGHT**

Mk. I

NOW WITH VARIABLE TONE CONTROL

7 TUNABLE WAVEBANDS:
MW 1, MW 2, LW 2, SW 1, SW 2, SW 3, TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Chrome plated telescopic aerial can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600W transistors. Car aerial and tape record sockets. Sensitivity 100 micro volts. Latest 4" 2 watt Ferrite Magnet loudspeaker. Air spaced tuning condenser. Volume control, tuning, wave change and tone controls. Attractive case in rich chestnut shade with polished metal knobs. Size 9in x 7in x 4in approx. Easy to follow instructions and diagrams. Parts price list and plans free with parts.

Total Building Costs
£6.98

---

**NEW EVERYDAY SERIES**

**EV6**

Attractive case in black with red grill, dial and black knobs with polished metal inserts. Size 9 x 7 x 2ins approx. Latest 4" 2 watt Ferrite Magnet loudspeaker. Attractive case in black with red grill, dial and black knobs with polished metal inserts. Size 9 x 7 x 2ins approx. Push-pull output. Parts price list and plans free with parts.

Total Building Costs
£3.98

---

**TRANS EIGHT**

8 TRANSISTORS
AND 3 DIODES

6 TUNABLE WAVEBANDS:
MW, LW, SW, SW 1, SW 2, SW 3, TRAWLER BAND. Sensitive ferrite rod aerial for MW and LW. Telescopic aerial for short waves. Latest 4" 2 watt Ferrite Magnet loudspeaker plus 3 diodes. Attractive case in black with red grill, dial and black knobs with polished metal inserts. Size 9 x 7 x 2ins approx. Push-pull output. Battery economizer switch for extended battery life. Amplified power to drive larger speaker. Parts price list and plans free with parts.

Total Building Costs
£4.78

---

**NEW JIFFY TESTER**

Easy to build and operate, fits in the pocket. A quick checker for continuity of resistors, diodes, transistors, circuit wiring and mains and loudspeakers. Also for checking short circuits of capacitors, tuning capacitors and many other uses not listed here.

Complete with earpiece, jack plug and socket, resistors, capacitors, components, parts price list and easy to follow instructions free with kit.

Total Building Costs
£2.95

---

**POCKET FIVE**

NOW WITH 3" LOUDSPEAKER
3 Tunable wavebands MW, LW, and SW, TRAWLER BAND. Sensitivity 100 micro volts. 4" 2 watt Ferrite Magnet loudspeaker. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 7 in x 4 in approx. Easy to follow instructions and diagrams. Parts price list and plans free with parts.

Total Building Costs
£2.50

---

**“Edu-Kit”**

Build Radios, Amplifiers, etc., from easy stage diagrams. Free units including master unit to construct.

Components include:
- 4 Transistor Earpiece Radio
- Radio Speaker
- Signal Injector
- Transistor Tester V/NP
- Transistor Push Pull Amplifier
- One Transistor Radio

Components include:
- 21 Resistors
- 10 Transistors
- 1 3 Transistor Radio
- 10 3 Transistor Radios
- 1 4 Transistor Radios
- 1 5 Transistor Radios
- 1 6 Transistor Radios
- 1 7 Transistor Radios
- 1 8 Transistor Radios
- 1 9 Transistor Radios
- 1 10 Transistor Radios

Total Building Costs
£5.50

---

**RADIO EXCHANGE LTD**

To RADIO EXCHANGE CO., Ltd.
61a HIGH STREET, BEDFORD MK40 1SA
Tel. 0234 529387 Reg. No. 788972

1 enclose £...for...

ROAMER TEN
ROAMER EIGHT
JIFFY TESTER
POCKET FIVE

Name...
Address...

---

£7.23

(Overseas Sealell P. & P. £3.40)

£9.50

(Overseas Sealell P. & P. £3.50)

£29.50

£4.78

(Overseas Sealell P. & P. £2.50)

£7.23

(Overseas Sealell P. & P. £3.40)

£6.98

(Overseas Sealell P. & P. £3.50)

£2.95

(Overseas Sealell P. & P. £3.50)

£2.50

£5.50

(Overseas Sealell P. & P. £3.75)

£2.25

(Overseas Sealell P. & P. £3.50)

£2.25

(Overseas Sealell P. & P. £3.50)
CONSTRUCTIONAL PROJECTS

P.E. PORTABLE GAS IGNITOR  by R. Bullen
Ignite town, bottle and natural gas with this simple project  552

GUITAR EFFECTS PEDAL  by R. Gwinn
Eight variable sound treatments in one unit  559

P.E. JOANNA—3  by A. J. Boothman
Envelope generation systems  572

SINE/SQUARE WAVE SIGNAL GENERATOR  by J. Smith
General purpose a.f. test instrument  582

GENERAL FEATURES

TRANSDUCERS—4  by P. R. Allcock
Concluding section on the inductive transformer  562

INGENUITY UNLIMITED
Tunnel Diode B.F.O./I.F. Marker—Adding Circuit—Random Number Generator—Desoldering Components  567

SYMBIOSIS—2  by M. Pointon
Concluding article on composing with the P.E. Minisonic  578

NEW DEVICES . . . APPLICATIONS
Solid-state power control  580

NEWS AND COMMENT

EDITORIAL—An Indiscriminate Tax  551

NEWS BRIEFS
Electronics For School Teachers—Queen’s Award  557

SPACEWATCH  by Frank W. Hyde
A new X-ray source  558

MARKET PLACE
Interesting new products and a V.A.T. announcement  571

POINTS ARISING
Ultrasonic Intruder Alarm—Light Pipe—Thermometer/Controller  576

INDUSTRY NOTEBOOK
A look at the American scene  589

PATENTS REVIEW
Thought provoking ideas on file at the British Patent Office  590

READOUT
A selection of readers’ letters  593

Our August issue will be published on Friday, July 11, 1975
Sound to Light Master Unit

600 watts per channel
Connects to your loudspeaker or loudspeaker socket. The unit can be connected to your existing spotlight fittings or to our type A or B fittings.

Special Introductory Price
Including channel output plugs and mains input socket.

Only £29.95 incl VAT plus p&p £1.00

Type B
3 BANK UNIT

£6.50 incl VAT plus p&p 40p each

Type A
(less lamp)

£1.60 incl VAT plus p&p 25p each.

Front

B.C. fitting
(less lamp)

B.C. fitting

TRAFAVGAR SUPPLIES
Dept. H.T., STANDISH STREET,
BURNLEY, LANCAS.

This helpful guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

ENGINEERS
FREE
YOURSELF FOR A BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New Opportunities shows you how to get them through a low-cost home study course. There are no books to buy and you can pay as you learn.

This 76 page FREE book shows how!

CUT OUT THIS COUPON

Post Now

CHOOSE A BRAND NEW FUTURE HERE!

Tick or state subject of interest. Post to the address below.

C. & G. L1 Installa.

C. A. G. L1 Installs and Writing

C. A. G. Electrical

Electrical Engineering

Society of Engineers

Engineering

Electrical Installations

C. A. G. Electrical Telecommunications

Engineers

Vacuum Clamp or screw-on base. They can be ROTATED, TIPPED, TILTED, ANGLED, ELEVATED, LOWERED.

The required work position is firmly secured with a patented ONE KNOB CONTROL, a unique feature of COLBERT POSITIONERS.

A series of special holders is available for various types of work. Full details available on request.

Distributors:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 PICCADILLY, LONDON, W1V 0HL Tel. 01-629 9556
Cables: SPECIPROD LONDON

 inout this coupon for a FREE book by:

ALDERMaston COLLEGE

81 PICCADILLY, LONDON, W1V 0HL

Distributors:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 PICCADILLY, LONDON, W1V 0HL Tel. 01-629 9556
Cables: SPECIPROD LONDON

/practical electronics july 1975

Colbert Pana-Vise WORK POSITIONERS - 300 SERIES

Colbert Pana-Vise Work Positioners are specially designed to quickly and easily achieve the most convenient, comfortable and time-saving work position.

Available with vacuum clamp or screw-on base. They can be rotated, tipped, tilted, angled, elevated, lowered.

The required work position is firmly secured with a patented one knob control, a unique feature of Colbert positioners.

A series of special holders is available for various types of work.

Full details available on request.

Distributors:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 PICCADILLY, LONDON, W1V 0HL Tel. 01-629 9556
Cables: SPECIPROD LONDON

Made in U.S.A.

Engineers

Free

Yourself for a better job with more pay!

Do you want promotion, a better job, higher pay? "New Opportunities shows you how to get them through a low-cost home study course. There are no books to buy and you can pay as you learn.

This helpful guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

Colbert Pana-Vise Work Positioners are specially designed to quickly and easily achieve the most convenient, comfortable and time-saving work position.

Available with vacuum clamp or screw-on base. They can be rotated, tipped, tilted, angled, elevated, lowered.

The required work position is firmly secured with a patented one knob control, a unique feature of Colbert positioners.

A series of special holders is available for various types of work.

Full details available on request.

Distributors:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 PICCADILLY, LONDON, W1V 0HL Tel. 01-629 9556
Cables: SPECIPROD LONDON

Made in U.S.A.
**Control Switch.**

spec.: 5 Section

CRESCENT RADIO LTD.

model single unit.

(Also) MINISTERS

This budget system compares very favourably with more sophisticated

commodities. This budget system compares very favourably with more sophisticated

**‘Crescent’ 100 Watt R.M.S.**

**ALL PURPOSE AMPLIFIER**

**Power Amp Module**

We supply the three modules for you to build this Diver-Group-P.A. amplifier into the cabinet of your choice. Complete with line input transformer, fuse,消费者, accurate, for further details on this or any other CRESCENT, contact us.

**12-18 500W/A**

240V primary transformer. Approx size: 860 x 860 x 860 mm. Fixing centres: 750mm. Our price £12.10.

**18-12 500W/A**

240V primary. Approx size: 860 x 860 x 860 mm. Fixing centres: 750mm. Our price 18.

**LOW NOISE, LOW PRICE Cassettes**

Cassette of this high quality well-made type cassette. Presented in single plastic cases.

**ABB PLASTIC BOXES**

Handy boxes for construction projects. Moulded extension rails for P.U. or chassis panels. Fitted with central panel. 100%, 100mm x 72mm x 45mm; 100%, 100mm x 72mm x 45mm; 100%. 100mm x 72mm x 45mm (sloping front) £6.

**RANGEFIND BOARDS**

Components gazette for the experimenter. Ex. Complete kits with resistors, capacitors and useful transistors—at least a transistors per board. Five boards £11.

2in. PANEL METERS

Variable Impedance

50mm x 50mm x 30mm

FRI 240V

Sec 2-0-10 100mA

Sec 0-0-5 100mA

Sec 0-0-10 100mA

Sec 0-0-12 100mA 0-20-10 100mA

£3 each. 10p. P. & P. + 10p.

**Crescent Bubble Light Show**

This budget system compares very favourably with more sophisticated and higher priced models. Specification:

**Power Supplies**

PP1: Switched-24 V-6-7/9 and 12V at 500mA.

PP2: Switched-6-7/9 Battery Eliminator. Approx. size 211 x (11 x 19). Ideal for radio receivers.

PP2: Car convertor. From 12V, or Neg. to 8-12V. SGT and transistor regulated, £3.00. + 10p.

**3 Kilowatts Psychiatric Light Control Unit**

Three Channel. Haan, Middle, Treble. Each channel has its own sensitivity control. Just connect the 2000 volt control unit to the line input terminals of an amplifier, and connect three 2000 volt control units to the output terminals of an amplifier, and you produce a fantastic sound-light display.

£18.00 plus 50p. P. & P. + 10p.

**Minid Spools for a CATALOGUE**

321-100-10m. Spool. 221-100m. Spool. Please include 50p. P. & P. on each L.H. + 10p.
Kit inspection

Dimensions
410 x 260 x 190mm

STUDIO ELECTRONICS EASIKIT

We invite your closest inspection of our loudspeaker kits. Here at last is a kit which doesn’t require you to be either an electronic genius or a master carpenter. The assembly is simplicity itself, taking barely 15 minutes and requiring only a soldering iron, screwdriver and our easy to follow instructions, the cabinet being already built. 4 drive units provide excellent reproduction free from colouration, cabinet resonance and listening fatigue. In teak or white. Based on an original design as also selected for the outstanding Practical Electronics Rondo Quadraphonic system.

SPECIFICATIONS
Impedance 4-8 ohms.
Power Handling 20W r.m.s.
Crossover Frequencies 250Hz, 5kHz.
Frequency response 30Hz to 20kHz ± 5dB.
4 Drive units, Bass (13cm dia.), Bass/Mid-range (13cm dia.), 2 Tweeters (6.5cm dia.).

£42.50 per pair. Post free. Plus VAT.

ready assembled £49.50 per pair. Post free.
Trade enquiries welcomed.
Demonstrations by telephone appointment.

SOUND SPHERES

The little speaker with the big sound! Only 4fin diameter and weighing 700 grams, it is capable of handling 10W. A very versatile little performer, ideally suited to rear channel systems, in the car: extension speakers, etc. The magnetic base enables them to be mounted virtually anywhere. Superbly finished in black, white or orange.

SPECIFICATIONS
Impedance 4-5 ohms.
Power Handling 10W.
Response 100Hz to 16kHz.

£19.95 per pair. Post free.

Please forward by return... I enclose cheque/PO/Cash
Barclaycard or Access cards welcome.

NAME
ADDRESS

Studio Electronics Ltd
LEVEL 16, TERMINUS HOUSE, HARLOW, ESSEX, CM18 6SH
Tel. Harlow 416771
BARGAINS FROM OUR FREE CATALOGUE

6th edition. 20 large pages filled with real bargains in transistors, IC's, components, etc. Send large S A E with 10p stamp for your FREE copy by return. Meanwhile, for prompt delivery order from our ad, this month now.

X-HATCH GENERATOR MK.2

Rotary selector switch provides choice of four patterns—essential for colour TV alignment. Featuring plug in IC's and a more sensitive sync pick-up circuit. The reinforced fibreglass case is virtually unbreakable—ideal for the engineer's toolbox—only measures 3in x 5 1/2in x 3in. Operates from three U-2-type batteries (extra).

£9.93 P & P, add 30p

£7.93 Complete unit only

PLASTIC POWER TRANSISTORS

40 WATT SILICON

Type No. Polarity Price

B151 15 NPN 25p

B152 15 PNP 35p

B153 15 Bi-Pol 45p

B154 15 NPN 25p

0.5 WATT SILICON

Type No. Polarity Price

6401 15 NPN 25p

6402 15 PNP 35p

6403 15 Bi-Pol 45p

40 & 45 PNP 35p

£7.93 Complete unit only

TRANSISTOR PACKS—ALL AT 50p EACH

TESTED AND GUARANTEED

B75 4 NPN075; Rec diodes 1.000 6 H8B 6 Integrated circuits & gates

B85 10 2N375; 1-in long Switch. 1/0.2 long Switch<br>

H25 100 Short lead Transistors NPN 35p<br>

H38 30 Short lead Transistors NPN 35p<br>

UNMARKED AND UTESTED

B1 50 Germanium Transistors NPN 15p<br>

B65 15 Georgia Diodes Min. NPN 1.7p<br>

844 100 Silicon Diodes 0.5 V.C. glass equiv. to 800. 800GC<br>

866 100 Si Diodes min. 190191 glass equiv. to 866144<br>

OVER A MILLION TRANSISTORS IN STOCK—All mass-assembled types Marked — TESTED — GUARANTEED—SEE CATALOGUE

TO BUY:

Hundreds of various portable transistor radio chassis and FM and AM. Ideal for experimenters. Components electronically sound chassis not all perfect. No instructions or tuning drives. A cheap way to make a radio set.

£1 Each

MAINS TRANSFORMERS

P. A. P. and 100p per unit

Type A—18V/1A (suit SS. 103) £1.10

Type B—25V/2A (suit SS. 110) £1.10

Type C—30V/3A (suit SS. 140) £1.25

Bridge Rectifiers: Type A 27p, Types B & C 3op

CAPACITOR DISCHARGE IGNITION KIT

Easy to assemble and fit to your car. 12V. With instructions. (P. & P. add 30p)

£7.50

TERMS OF BUSINESS

V. A. T. Prices shown do NOT include V. A. T. Please add 25% to total value of your order including postage for V. A. T. except for items marked 0 or (6) for which the V. A. T. rate is 6%. No V. A. T. on overseas orders.

Overseas—add £1, any difference being charged or refunded.

PAYMENT Cash with order. Cheque or money order. Minimum value—£1. You can also pay by ACCESS.

IMPORTANT—Every effort is made to ensure accuracy of prices and description at time of preparing this advertisement and going to press. Prices are subject to alteration without notice.

STIRLING SOUND DISCO MINOR

Twin turntable console with cross-fade mic (with over-ride) and headphone monitor jacks, etc. With unique "AMPOWER 40" speaker built in 40 watt R M S. power amp. You can add up to ten to give 400 watts! Portable console and one "AMPOWER 100" plus £5.50 can. U.K. plus VAT.

STIRLING SOUND AMPLIFIER KITS

Pre-amplifiers; tone control

SS. 100 10 watt pre-amp £5.00

SS. 101 15 watt pre-amp £6.00

£1.00 for V. A. T. on pre-amps.

POWER AMPLIFIERS

SS. 102-1 25 watt pre-amp £6.00

SS. 102-2 100 watt pre-amp £12.00

£2.25 for V. A. T. on power amps.

BUILD A STEREO F.M. TUNER!

SS. 201 Front-end with gained tuning and geared slow-motion drive in rugged housing. Excellent sensitivity. Tuning 88-108MHz. With A.F.C facility. Operates from 6-18V.

£6.25

SS. 202 I.F. stage (with I.C.). Tuned. A.F.C. connection. Operates from 4.5-14V.

£5.25

SS. 203 Stereo decoder. Designed essentially for use with SS. 201 and SS. 202. This module can also be used on most mono F.M. tuners. A.L.E. may be attached. Operating voltage 9-16V d.c.

£5.62

SPECIAL MONEY SAVING OFFER!

Save £5—buy all 3 units (SS. 201, SS. 202 and SS. 203) together for

£12.12

POWER SUPPLY STABILISER

SS. 300 Add this to an unstabilised supply (e.g. typically 45V output) to obtain a steady powerful working output adjustable from 12 to 60V. Essential for your audio and special systems. Money saving. very reliable and ideal for the workbench.

£3.25

To BI-PRE-PAK, 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX

SPECIAL OFFER!

Have you had your FREE CATALOGUE?

BI-PRE-PAK LTD

222 224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX SS0 9DF.

TELEPHONE: SOUTHBEND (0702) 46344.

WRITE ORDER SEPARATELY AND ATTACH COUPON IF NECESSARY

Practical Electronics July 1975 539
**VISCOUNT IV STEREO SYSTEM**

**System 1a. £69.00**

The new 20 x 20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with ersipled finish to harmonize with any decor. Polished trim and knobs.

The VISCOUNT IV has a comprehensive range of controls — volume, bass, treble, balance, mono/stereo, mode selector, and scratch filter. Front panel socket for stereo headphones. And a host of sockets at the rear — for left and right speakers, tape recorder, auxiliary, tuner, disc and microphone.

**SPECIFICATION:** 20 watts RMS per channel 40 watts peak. Suitable 8-15 ohms speakers. Total distortion < 0.02%. Six switched inputs: 1. Magnetic P.U. — 3 millivolts @ 60 K ohms. 2. Crystal/ceramic P.U. — 50 millivolts @ 50 K ohms (RIAA). 3, 4, 6. Tape Turret. — 140 millivolts @ 50 K ohms (flat frequency response). 5. Microphone — 3 millivolts @ 50 K ohms (flat frequency response).


The RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with ersipled finish to harmonize with any decor. Polished trim and knobs.

**System 2. £85.00**

VISCOUNT IV Stereo Amplifier (As System 1a) Garrard SP 25 deck (As System 1a) Two Duo Type III matched speakers — Enclosure size approx. 18" x 10" x 7" in simulated teak. Drive unit: 13" x 8" with 3" tweeter. 15 watts handling, 30 watts peak.

**Complete System with these speakers £98.00 + £6.50 p & p.**

---

**EMI SPEAKERS AT FANTASTIC REDUCTIONS**

**LE-4 SPEAKERS**

Superb performance and beautifully finished in selected teak veneers. A professional standard four-way speaker system giving 25 watts RMS power handling. Bass unit is 14" x 9" with 8" x 5" unit for mid-range and twin 3" (approx.) high frequency units to give monitor type quality and performance.

**Specification — Size 33" x 14" x 16" approx. Impedance 8 ohms. Power handling: 25W RMS. (Peak 50 watts.) Frequency range 35 Hz — 20 KHz.**

Our Price £34.00

**(normally £66.00) + £5.80 p & p.**

**EASY TO BUILD SPEAKER KITS**

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13" x 8" woofer, 3½" tweeter and matching crossover.

Easily put together with just a few basic tools.

**Specification (each speaker): Impedance 8 ohms. Power handling: 15 watts RMS (30 watts peak). Response 20—20,000Hz. Size 20" x 11" x 9½" approx. Comparable built units (EMI LES) sold elsewhere for over £45 pair.**

£22.00 pair complete

**£6.90 + £1.20 p & p.**

---

**EMI 350 KIT**

System consists of a 13" x 8" approx. woofer with a 3½" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)

**£6.50 + £1.20 p & p.**

**DECCA STEREO AMPLIFIER CHASSIS**

Specification: 4 x 4 watts into 8 ohms. Input Sensitivity 4mV into 47K (for magnetic cartridges). AC Mains only 240V Controls — volume, bass, treble, on/off, mains/ster. switch. Chassis size 11" x 5½" x 3½" approx.

£6.90 + £1.20 p & p.
PUSH BUTTON CAR RADIO KIT—THE TOURIST TT*

NO SOLDERING REQUIRED

NOW BUILD YOUR OWN
PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.

TECHNICAL SPECIFICATION: (1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) Integrated circuit output stage, pre-built three stage IF Module.

Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide x 2" high.

£9.50 +£1.05 p & p. Speaker including baffle and fixing strip £2.00 +45p & p. Car Aerial—Recommended—fully retractable £1.50 +45p & p.

The Tourist TT Kit for the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. Price £8.20 +£1.05 p & p.

*STEREO 21 QUALITY SOUND FOR LESS THAN £24.00

Stereo 21, easy to assemble audio system kit. No soldering required.

The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth. Includes — BSR 3 speed deck, automatic, manual facilities together with stereo cartridge.

Two speakers with cabinets. Amplifier module, fully built with control panel, speaker leads and full, easy to follow assembly instructions.

Specifications — For the technically minded:

- Input sensitivity 600mV Aux input sensitivity 120mV

- Power output 2.7 watts per channel. Output impedance 8 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs — radio, tape, etc., and outputs for paging tannings.

- Over-all Dimensions. Speakers approx 15" x 8" x 4" Complete deck and cover in closed position approx. 15" x 12" x 5"

Complete only £23.20 +£3.05 p & p.

Extra as required. Optional Diamond Stylus £1.60.

Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance £5.80.

*DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).


*Attractive styling.

INPUT SENSITIVITIES — Input: 1) Crystal mic. 2) Moving coil mic. 2 and 10mV. (Selector switch for desired sensitivity.) — Inputs 2), 3), 4)

Medium output equipment — ceramic cartridge, tuner, tape recorder, organs, etc. — all 250V sensitivity. AC Mains, 240V operation. Size approx: 12½" x 6" x 3½".

£20.00 +£1.35 p & p.

*8 TRACK HOME CARTRIDGE PLAYER

Elegant self selector push button player for use with your stereo system. Compatible with Viscount IV system, Unisound module and the Stereo 21.

Technical specification: Mains input, 240V, Output sensitivity 120mV. Comparable unit sold elsewhere at £24.00 approx. Yours for only £16.20 +£1.70 p & p.

BUILD YOUR OWN STEREO AMPLIFIER

For the man who wants to design his own stereo — here's your chance to start, with Unisound pre-amp, power amplifier and control panel. No soldering — just simply screw together 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V AC only.

Also available with 2 speakers (7" x 4") £10 +£1.75 p & p. £8.95 +£1.05 p & p.

PORTABLE DISCO CONSOLE*

INCORPORATES: Pre-amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control. Bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.

TECHNICAL SPECIFICATION:

Pre-amp — Output: 200mV Auxiliary inputs — 200mV and 750mV into 1 meg. Mic input — 6mV into 100k. 240 volt operation.

Turntable capacity — 7", 10" or 12" records. Rumble, wow and flutter Better than ±35dB. Rumble Better than 0.02%. Flutter Better than 0.05% (Gaumont Kalee meter).

Finish — Satin black mainplate with contrasting control panel. Matching control panel and 41" deep approx.

Console size — 17½" x 13½" x 4½" (top). Unit open — 35½" x 13½" x 24½" (top).

This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier. The unit is finished in black P.V.C. with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

Yours for only £57.00 +£6.50 p & p.

Mail orders to: RTV. Term C.W.O. All enquiries stamped addressed envelope. Goods not dispatched outside U.K.

Leaflets available for all items listed. Send stamped addressed envelope. All items subject to availability. Prices correct at 1st May 1975 and subject to change without notice. All prices include VAT at 25% rate.

Barclays Bank Card

DO NOT SEND CARD

Just write your order giving your credit card number

210 HIGH STREET, ACTON, LONDON W3 6NG

323 EDGWARE ROAD, LONDON W2

Personal Shoppers EDGWARE RD: 9 a.m. - 5.30 p.m. Half day Thurs.

ACTON: 9.30 a.m. -5 p.m. Closed all day Wed.

Practical Electronics July 1975

541
In ASTRO ELECTRONICS, 10A SPRINGBANK ROAD, CHESTERFIELD, DERBYS

SPECIAL RESISTOR KITS

RESISTORS

POLYSTYRENE CAPACITORS

B. H. COMPONENT FACTORS LTD.

MULLARD POLYESTER CAPACITORS C328 SERIES

400V. 0-001AF, 000 I 5µF, 00022µF, 00033µF, 0-0047AF, 3p.

22, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470,

500V. 0-001AF, 000 I 5µF, 00022µF, 00033µF, 0-0047AF, 3p.

470pF 10V

METALIZED PAPER CAPACITORS

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.

B. H. COMPONENT FACTORS LTD.
SUPERSOUND 13 HI-FI MONO AMPLIFIER

A superb solid state audio amplifier using high quality components throughout.
240V, 250VA, 25W into 8 ohms (15W into 4 ohms) at 0.2% distortion.
Full wave rectification.
Input impedance 10,000 ohms.

HARVERSON MAINS OPERATED SOLID STATE FM TUNER

Enjoy Fabulous Stereo Radio at this Low Introductory Price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the latest circuit techniques with high-gain, low noise IF stages, automatic frequency control, and switched 250VA power supply. Names include a nominal output of tuner 100mV. Approximate size 12" wide x 3" deep x 8" high. Only 90p to buy, fully assembled and perfectly tested and fully guaranteed (not available in kit form).

Price £7-50. Post and Packing £1-00.

STEREO-DECORDER SIZE 2 X 3

Fully built and tested for only £10-50.

HARVERSON SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages and the last channel reaching in turn lower gain levels with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Control. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridges—instructions included. Output stage for any speakers from 4 ohms to 150 ohms. Compact design, all parts supplied including wired metal work, high quality ready wired 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 the constructor to build a amplifier to be proud of. Brief specifications: Power output at 4 ohms 12 watts per channel rated. Frequency response ± 1dB 20-20,000Hz. Sensitivity 12μV at 300μA. 11 frequencies between 80Hz and 18,000Hz, base boost approx. to ±3dB. Treble roll-off approx. 12dB / Oct. Amplifier capable of withstanding over 1000W at 4 ohms with no damage. Fully detailed 7 page construction manual and parts list free with kit or send 25p extra for S.A.E.

AMPLIFIER KIT £15-00 P. & P. 50p.


(Postal free if all parts purchased at same time)

Also available ready built and tested £20-50. Post Free. Note: The above amplifier is suitable for feeding non-conversion systems (e.g. radio, video recorders, etc.) and will fully provide mixing and fading facilities for medium power Hi-Fi Distribution.

3-VALVE AUDIO AMPLIFIER HAS MK II

Designed as an immediate successor to MK I, the new MK II now available on order. Mains AC operated. Mono channel built on plated heavy gauge metal chassis. Size 17" x 9" x 3.5". Incorporates EBC5, 2110, 2110W, 6250W. Heavy duty, double wound mains transformer, output transistors mounted on board with parasitic tweeter 11000. £1.25. Suitable for use in cars. Loudspeaker Bargains

Loudspeaker BARGAINS

Jm. 3.0m £1-45, P. & P. 15p. Jm 7x 7.0m 3.5 in, £1-65, P. & P. 20p. Jm 10 x 2.0m, £3-00, P. & P. 30p. E.M.I. 3x 8 in, £2-40, P. & P. 40p. E.M.I. 5x 3.0m, £3-00, P. & P. 50p. E.M.I. 5x 3.5 in, £3-40, P. & P. 60p. E.M.I. 10x 3.0m, £6-90, P. & P. 75p.

BRAND NEW WIRELESS LOUDSPEAKERS

These high performance loudspeakers are available in various models and are suitable for use in any room. The smallest model is suitable for use in bedrooms and living rooms, while the larger models are ideal for use in large rooms or halls. They feature advanced technology and are designed to provide high-fidelity sound quality. They also offer a wide frequency range and are compatible with most audio equipment. These speakers are perfect for music lovers who want to enjoy high-quality sound in their homes or offices. They come with a built-in subwoofer and a powerful amplifier for added bass. The speakers are made from high-quality materials and are designed to last a long time. They are easy to set up and use, and are supported by a comprehensive warranty. These speakers are an excellent choice for anyone looking to upgrade their audio system and enjoy high-fidelity sound quality. They are available for purchase now at a competitive price.
P.E. Portable gas ignitor kit for only £3.00

The Kit contains everything you need to make this electronic gas ignitor and includes an elegant transparent case moulded in high impact polycarbonate, ready wound coils and full assembly instruction.

- Uses a 1½ volt battery
- Provides a continuous stream of high voltage sparks
- Gives years of normal use

See through case shows your skill in action.

Please send S.A.E. for price list of individual components.

Elvins Electronic Musical Instruments
12 Brett Road, Hackney, London E8 1JP (Tel. 01-986 8455);
8 Putney Bridge Road, London SW18 1HU (Tel. 01-870 4949);
40a/42a Dalston Lane, Dalston Junction, London E8 (Tel 01-249 5824).

Business hours: Open 10 a.m. to 7 p.m. Monday to Saturday. Closed all day Thursday. Open 10 a.m. to 1 p.m. Sunday.

Vacancy for shop assistant with electronic knowledge
The Shop Window for the Very Best...

TOSHIBA VALVES

<table>
<thead>
<tr>
<th>Type</th>
<th>Price (p)</th>
<th>Type Each (p)</th>
<th>Type Each (p)</th>
<th>Type Each (p)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT88</td>
<td>30.0</td>
<td>AD161</td>
<td>38</td>
<td>BD124</td>
<td>75.0</td>
</tr>
<tr>
<td>DT180</td>
<td>23.0</td>
<td>AD162</td>
<td>38</td>
<td>BD131</td>
<td>45.0</td>
</tr>
<tr>
<td>E225</td>
<td>28.0</td>
<td>AD114</td>
<td>24</td>
<td>BD132</td>
<td>39.0</td>
</tr>
<tr>
<td>E194</td>
<td>34.0</td>
<td>AD115</td>
<td>21</td>
<td>BD160</td>
<td>1.20</td>
</tr>
<tr>
<td>E184</td>
<td>36.0</td>
<td>AD116</td>
<td>22</td>
<td>BD225</td>
<td>49.0</td>
</tr>
<tr>
<td>E182</td>
<td>35.0</td>
<td>AD117</td>
<td>20</td>
<td>BD160</td>
<td>1.20</td>
</tr>
<tr>
<td>PC500</td>
<td>24.5</td>
<td>A118</td>
<td>50</td>
<td>FD115</td>
<td>20.0</td>
</tr>
<tr>
<td>PC539</td>
<td>40.0</td>
<td>A119</td>
<td>50</td>
<td>FD116</td>
<td>1.00</td>
</tr>
<tr>
<td>PAC189</td>
<td>41.0</td>
<td>A117</td>
<td>45</td>
<td>FD167</td>
<td>1.00</td>
</tr>
<tr>
<td>PAC190</td>
<td>31.5</td>
<td>A118</td>
<td>45</td>
<td>FD173</td>
<td>20.0</td>
</tr>
<tr>
<td>PC198</td>
<td>39.0</td>
<td>A119</td>
<td>40</td>
<td>FD178</td>
<td>20.0</td>
</tr>
<tr>
<td>PC199</td>
<td>42.0</td>
<td>A240</td>
<td>10</td>
<td>FD181</td>
<td>32.0</td>
</tr>
<tr>
<td>PC128</td>
<td>39.0</td>
<td>B106</td>
<td>25</td>
<td>FD185</td>
<td>25.0</td>
</tr>
<tr>
<td>PC190</td>
<td>41.0</td>
<td>B107</td>
<td>25</td>
<td>FD185</td>
<td>25.0</td>
</tr>
<tr>
<td>PC185</td>
<td>44.5</td>
<td>B104</td>
<td>14</td>
<td>FD184</td>
<td>25.0</td>
</tr>
<tr>
<td>PC186</td>
<td>41.0</td>
<td>BC113</td>
<td>13</td>
<td>FK195</td>
<td>8.0</td>
</tr>
<tr>
<td>PC190</td>
<td>39.5</td>
<td>BC117</td>
<td>13</td>
<td>FK197</td>
<td>12.0</td>
</tr>
<tr>
<td>PC184</td>
<td>25.0</td>
<td>BC118</td>
<td>13</td>
<td>FK199</td>
<td>23.0</td>
</tr>
<tr>
<td>PC190</td>
<td>29.5</td>
<td>BC120</td>
<td>25</td>
<td>FK224</td>
<td>23.0</td>
</tr>
<tr>
<td>PC190</td>
<td>64.5</td>
<td>BC122</td>
<td>25</td>
<td>FK226</td>
<td>23.0</td>
</tr>
<tr>
<td>PC188</td>
<td>67.0</td>
<td>BC123</td>
<td>15</td>
<td>FK244</td>
<td>23.0</td>
</tr>
<tr>
<td>L519</td>
<td>1.90</td>
<td>BC125</td>
<td>15</td>
<td>FK244</td>
<td>23.0</td>
</tr>
<tr>
<td>PC188</td>
<td>38.5</td>
<td>BY106</td>
<td>10</td>
<td>FK258</td>
<td>36.0</td>
</tr>
<tr>
<td>PB40</td>
<td>33.0</td>
<td>BY108</td>
<td>10</td>
<td>FK258</td>
<td>36.0</td>
</tr>
<tr>
<td>PB500</td>
<td>85.0</td>
<td>BY123</td>
<td>23</td>
<td>FK338</td>
<td>28.0</td>
</tr>
<tr>
<td>PB500</td>
<td>55.5</td>
<td>BY131</td>
<td>23</td>
<td>FK338</td>
<td>28.0</td>
</tr>
<tr>
<td>PC36</td>
<td>25.0</td>
<td>BL106</td>
<td>14</td>
<td>FK338</td>
<td>28.0</td>
</tr>
<tr>
<td>PN64</td>
<td>64.5</td>
<td>BL108</td>
<td>14</td>
<td>FK338</td>
<td>28.0</td>
</tr>
<tr>
<td>PL58</td>
<td>67.0</td>
<td>BL120</td>
<td>15</td>
<td>FK218</td>
<td>30.0</td>
</tr>
<tr>
<td>PL519</td>
<td>1.90</td>
<td>BL123</td>
<td>13</td>
<td>FK224</td>
<td>23.0</td>
</tr>
<tr>
<td>PB87</td>
<td>38.5</td>
<td>BL125</td>
<td>15</td>
<td>FK244</td>
<td>23.0</td>
</tr>
<tr>
<td>PB501</td>
<td>33.0</td>
<td>BL127</td>
<td>15</td>
<td>FK258</td>
<td>36.0</td>
</tr>
</tbody>
</table>
| SEMI CONDUCTORS

<table>
<thead>
<tr>
<th>Type Each (p)</th>
<th>Price</th>
<th>Type Each (p)</th>
<th>Price</th>
<th>Type Each (p)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC172</td>
<td>12.0</td>
<td>AD149</td>
<td>10.0</td>
<td>BD173</td>
<td>20.0</td>
</tr>
<tr>
<td>AC128</td>
<td>13.0</td>
<td>AD153</td>
<td>15.0</td>
<td>BD532</td>
<td>25.0</td>
</tr>
<tr>
<td>AC14X</td>
<td>15.0</td>
<td>AD154</td>
<td>15.0</td>
<td>BD105</td>
<td>1.20</td>
</tr>
<tr>
<td>AC14X2</td>
<td>25.0</td>
<td>AD157</td>
<td>14.0</td>
<td>BU102/02</td>
<td>1.20</td>
</tr>
<tr>
<td>AC181</td>
<td>20.0</td>
<td>AD160</td>
<td>18.0</td>
<td>BU102/02</td>
<td>1.20</td>
</tr>
<tr>
<td>AC154</td>
<td>18.0</td>
<td>AD165</td>
<td>16.0</td>
<td>IN122</td>
<td>2.00</td>
</tr>
<tr>
<td>AC198</td>
<td>18.0</td>
<td>AD180</td>
<td>16.0</td>
<td>MJ2040</td>
<td>20.0</td>
</tr>
<tr>
<td>AC181X</td>
<td>22.0</td>
<td>BC132L</td>
<td>12.0</td>
<td>DC71</td>
<td>15.0</td>
</tr>
<tr>
<td>AC181X2</td>
<td>28.0</td>
<td>BC133L</td>
<td>18.0</td>
<td>DC71</td>
<td>15.0</td>
</tr>
<tr>
<td>AC187X</td>
<td>24.0</td>
<td>BC187</td>
<td>25.0</td>
<td>R2068</td>
<td>2.00</td>
</tr>
<tr>
<td>AC188X</td>
<td>17.0</td>
<td>BB208</td>
<td>15.0</td>
<td>R2068</td>
<td>2.00</td>
</tr>
<tr>
<td>AC188X2</td>
<td>28.0</td>
<td>BC328</td>
<td>28.0</td>
<td>RAC1534</td>
<td>80.0</td>
</tr>
<tr>
<td>AC142</td>
<td>45.0</td>
<td>BC357</td>
<td>19.0</td>
<td>RAC1535</td>
<td>80.0</td>
</tr>
</tbody>
</table>

P.E. "VARICAP" STEREO PUSH BUTTON F.M. TUNER

The P.E. "Varicap" Stereo Tuner uses the latest Mullard modules for R.F. and I.F. circuits—highly sensitive and pre-aligned for ease of construction.

This superb kit has everything to enable you to construct this highly sensitive F.M. Stereo Tuner, with instant push button station selection, self contained regulated power supply, stereo decoder, etc., etc. Easy to construct, highest quality reproduction.

Price only £44.50, including VAT and postage and packing. Please send stamped addressed envelope for our free leaflet on the Varicap, which gives performance figures, detailed description, etc., etc.

P.E. "GEMINI" STEREO AMPLIFIER

Output genuine 30W R.M.S. per channel!
Distortion 0.01% (maximum)!
Frequency response—3dB, 20Hz to 100kHz into 8 ohms!
Fully comprehensive inputs, disc, tape, MIC, etc., etc.

Yes, we are still supplying all components for this superb Stereo Amplifier, since we have not yet found a better one!

Fully comprehensive constructional booklet available, containing full specification, performance graphs, assembly instructions, photographs, fault finding guide, etc. etc. Price 55p plus 9p postage and packing.

For itemised price list only please forward stamped addressed envelope.

COMBINED PRECISION COMPONENTS
Department PE 194-200 North Rd.
PRESTON LTD
Tel: 55034

...In Prices, Quality and Service

Electro Spares, 288 Ecclesall Road, Sheffield S11 8PE
Please allow 14 days minimum for delivery, for postal delays, cheque clearance, etc.

546
Practical Electronics July 1975
SA35 £6.60
35W RMS 25-50V
7 transistors, 7 diodes

SA50 £8.50
50W RMS 25-65V
7 transistors, 7 diodes

SA100 £12.50
100W RMS 45-70V
10 transistors, 7 diodes

120 watt module complete with build-in supply—extra heavy duty £24.75 Carr.

Mk II STEREO DISCO MIXER £29.50
This well tried Pre-Amp mixes two decks, handles any ceramic cartridge, and features mic over-ride plus separate full range bass and treble controls on both mic and deck inputs. Ample headphone power is available for P.F.L. ... Mains. Size 17in x 3in x 4in deep.

DISCO MODULE £12.50 Carr.
Thousands sold of this extremely popular mono Pre-Amp. A mic input may be taken using the VA30 (see below). Low consumption from a 9V battery.

3-CHANNEL SOUND-LITE £24.75 Carr.
Features the same high standards of reproduction as the Stereo version. Controls: Mic vol, bass, treble. Left/Right fade, deck vol, bass, treble, high/phone select. Size 12in x 3in x 2.5in deep.

SAXON DISCO MODULE £12.50 Carr.
Add 8% VAT to all orders

MULTI-PURPOSE MIXERS

M4HL £25.00 Carr.
Featuring multiples of our VA30 module, the M4HL and M6HL fulfil the requirements of all clubs, groups, etc. where a high quality mixer is required. Each channel has one high and one low impedance input, plus volume, treble and bass controls. Input impedances may, if required, be easily changed. The M4HL has four channels, and one output, and the M6HL six channels (12 inputs) and a master control and two outputs. Either unit may be used free-standing or panel mounted. These mixers will feed all types of amplifier. Recommended for their versatility and high performance, and excellent value for money.

VA30 CHANNEL MODULE £3.90 Carr.
This is the basic channel module in the above mixers and may also be used for extra inputs on either the mono or stereo mixers. Fitted with volume, bass and treble controls, requires just a jack and supply (9-100V).

SAXON MULTIMIX 100 £57 Carr.
100W RMS SLIDER controls PLUS master slider. Wide range bass and treble controls—fantastic value. Ideal for complete Disco's, Groups, Clubs, etc.

SAXON MULTIMIX 50 EXACTLY AS ABOVE £45

CALLERS AND MAIL ORDER:
SAXON ENTERTAINMENTS LIMITED
329-333 WHITEHORSE ROAD • CROYDON CR0 2HS

(please quote magazine when ordering)

SHOP HOURS: 9 a.m. S p.m. LUNCH 12.30 1.30 p.m.
24-HOUR ANSWER SERVICE TEL: 01-684 6385. TECHNICAL ENQUIRIES 01-684 0098

SAXON Money saving high performance audio equipment
DIRECT FROM OUR OWN FACTORIES

GUARANTEED TESTED HIGH PERFORMANCE MODULES—now better value than ever

SA35 £6.60
35W RMS 25-50V
7 transistors, 7 diodes

SA50 £8.50
50W RMS 25-65V
7 transistors, 7 diodes

SA100 £12.50
100W RMS 45-70V
10 transistors, 7 diodes

120 watt module complete with build-in supply—extra heavy duty £24.75 Carr.

THE SA100 MODULE

POWER SUPPLIES

UNSTABILISED—READY WIRED AND FUSED
PU45 SUITS 2 SA35 or 1 SA50 (4 ohms) £6.50 Carr. free
PU70 SUITS 2 SA50 or 2 SA100 (8 ohms) £9.50 Carr. free

STABILISED
PS45 SUITS 2 SA35 or 2 SA50 (4 ohms) £5.50 Carr. free
MT45 Transformer for above £3.90 Carr. free
PS70 SUITS 2 SA100 £6.50 Carr. free
MT70 Transformer for above £5.50 Carr. free

N.B. PS70 is not suitable for the SA50

** Top-grade components
** Short and open circuit proof
** Continuously rated
** Simple wiring
** High sensitivity, compact, attractive vinyl case.
** Twin outputs. Wide range bass and treble controls—fantastic value. Ideal for complete Disco's, Groups, Clubs, etc.

SAXON MULTIMIX 100 £57 Carr.
100W RMS SLIDER controls PLUS master slider. Wide range bass and treble controls—fantastic value. Ideal for complete Disco's, Groups, Clubs, etc.

SAXON MULTIMIX 50 EXACTLY AS ABOVE £45

SEND 15p FOR OUR NEW 24-PAGE MANUAL—full circuits and details.

TELEPHONE BILLING: C.W.O., C.O.D. or ACCESS (must have card number). Send 21p for O.D.B.

Please include S.A.E. with all enquiries.

VAT at 8% must be added to all orders including carriage charges.

Practical Electronics July 1975
EX-COMPUTER STABILISED POWER MODULES

- Complete with circuit diagrams, etc.
- 99p each plus 2/6 post & P.
- LOW COST CAPACITORS

- 50p each plus 2/6 post & P.

- DECON-DALE 33PC Marker

- Insulated printed circuit marker pens
- 50p each.

- VEROBORDS

- Packs containing approx., 100g. In various sizes, 501-1 metre 35p.

- REPANO CHOKES & COILS

- BY Chokes

- CH1 3.5mH 30p
- CH2 3.0mH 30p
- CH3 4.0mH 30p
- CH4 3.0mH 30p
- CH5 4.0mH 30p
- QUICK-BLOQ 35p each.

- CAR AUDIO COMPONENTS OF FORMER.
-the lowest prices!

**BI-PAK QUALITY COMES TO AUDIO!**

**AL10/AL20/AL30 AUDIO AMPLIFIER MODULES**

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 18 watts R.M.S.

The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

**Parameter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AL10</th>
<th>AL20</th>
<th>AL30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Supply Voltage</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Power out for 3% T.H.D.</td>
<td>3 watts</td>
<td>5 watts</td>
<td>10 watts</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>Vm=20V, RS=10K</td>
<td>1KHz</td>
<td>75mV, RMS</td>
</tr>
<tr>
<td>Dimensions</td>
<td>3&quot; x 2&quot; x 1&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table relates to the AL10, AL20 and AL30 modules. The following tables outline the differences in their working conditions.

**HARMONIC DISTORTION**

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po = 3 WATTs</td>
<td>0-25%</td>
</tr>
<tr>
<td>f = 1KHz</td>
<td>0-16Ω</td>
</tr>
<tr>
<td>FREQUENCY RESPONSE</td>
<td>±14dB at 14KHz</td>
</tr>
<tr>
<td>SENSITIVITY FOR RATED D/P</td>
<td>300 mV</td>
</tr>
</tbody>
</table>

**PRE-AMPLIFIERS**

<table>
<thead>
<tr>
<th>Model</th>
<th>(Use with AL10, AL20, and AL30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA 10</td>
<td>£4.35</td>
</tr>
<tr>
<td>PA 100</td>
<td>£15.15</td>
</tr>
</tbody>
</table>

**POWER SUPPLIES**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL 12, (Use with AL10, AL20, AL30) 35</td>
<td>£2.80</td>
</tr>
<tr>
<td>BPM 50, (Use with AL60) 25</td>
<td>£2.85</td>
</tr>
<tr>
<td>FRONTPANELFP 12 with Knobs</td>
<td>£8.00</td>
</tr>
</tbody>
</table>

**POWER AMPLIFIERS**

<table>
<thead>
<tr>
<th>Model</th>
<th>(Use with AL30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA 11</td>
<td>£16.11</td>
</tr>
<tr>
<td>PA 14</td>
<td>£23.05</td>
</tr>
</tbody>
</table>

**TRANSFORMERS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>T661 (Use with AL10)</td>
<td>£4.20</td>
</tr>
<tr>
<td>T338 (Use with AL20, AL30) 22</td>
<td>£2.75</td>
</tr>
<tr>
<td>BPM 100, (Use with AL60) 25</td>
<td>£2.75</td>
</tr>
</tbody>
</table>

**STABILISED POWER MODULE SPM80**

SFM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (R.M.S.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Maine Transformer BPM780, the unit will provide outputs of up to 1.5 amps at 20 volts. Size: 63mm x 105mm x 35mm.

These units enable you to build a Hi-Fi System of the highest quality at a ubiquitous unobtainable price. Also ideal for many other applications including — Disco systems, Public Address, Intercom Units, etc. Handbook available 10p PRICE £3.25

**TRANSFORMER BPM 80**: £2.75 p. & p. 40p

**STEREO PRE-AMPLIFIER TYPE PA100**

Built to a specification and at a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of them being specially selected low noise 845 devices for use in the input stage.

Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which has a STABILISED/MONO switch, volume, balance and continuously variable bass and treble controls.

**SEMICONDUCTOR ADVERTISEMENTS in Practical Wireless - Wireless World - Radio Constructor**

**All Prices Include V.A.T.**

**The STEREOP**

The "Stereo 20" amplifier is designed, ready wired and tested in a one-piece chassis measuring 90 mm x 14 cm x 8 cm. This compact unit comes complete with on/off switch, volume control, balance and treble controls.

Transformer: Power supply and Power amp. Attractively printed front panel and matching control knobs. The "Stereo 20" has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w (R.M.S.) Input 1 (Cer.) 200V into 1K, Freq. Resp. 20Hz - 20KHz Input 2 (Al.) 40V into 10K. Harmonic distortion, bass control 5%, Treble control 2% typ. 0.25% at 1 watt, Treble control ± 12dB at 1KHz. £11.45 P & P 45p

**T2C20 TEAK VENEERED CABINET**

For Stereo 20 (front board unridged) Size 10" x 8" x 3", £8.95 plus 45p postage.

**SHP80 STEREO HEADPHONES**

3-16 ohms impedance. Frequency response 20 to 20,000Hz. Stereo/mono switch and volume controls. £4.95

**Now we give you**

50w PEAK (25w R.M.S.)

PLUS THERMAL PROTECTION!

The NEW AL60 Hi-Fi Audio Amplifier FOR ONLY £4.25

- Max Heat Sink temp 90°C.
- Frequency Response 20Hz to 100KHz.
- Distortion better than 0.1% at 1KHz.
- Signal to noise ratio 80dB.
- Power out 20w peak.
- Overall size 63mm x 105mm x 35mm.

- Thermal Feedback
- Latest Design Improvements
- Load — 3, 4, 8 or 16 ohms
- Supply voltage 15-50 volts

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

**Practice Electronics** July 1975

P.O. BOX 6, WARE - HERTS

Complete Price: £3.15 P & P 45p

**TEAK AUDIO KIT**

Comprising: 2 x AL10, 1 x BPM80, 1 x BTM80, 1 x PA 100, 1 front panel, 1 kit of parts to include on/off switch, neon Indicator, stereo headphone socket, plus instruction booklets. Complete Price: £8.75 plus 45p postage.

**Guaranteed Satisfaction or Money Back**
**SPECIAL OFFERS**

**MINIATURE MAINS TRANSFORMER, PRI**
- 240V SEC. 12V 10MA. Minchley. 
- Size 36 x 45 x 40cm F.C. 55mm. 
- Price includes VAT. 100-499p up. 100-499p up. 10,000-499p up.
- 3 CORE PVC INSULATED MAINS CABINETS, GREY M16050, 3 x 10mm. 
- Price 100-499p up. 100-499p up. 10,000-499p up.

**MINIATURE TRANSFORMER, PRI**
- 110V, 45VA, 1.5A. Minchley. 
- 240V A.C. SOLENOID. Reversible operation. 
- Twin coil. Size approx. 21 x 11 x 11cm. 
- Price 100-499p up. 100-499p up. 10,000-499p up.

**FERRITE CORE, Multik type FX2241. Price 50p each**

**MUFFLIER TUBULAR CERAMIC UNIPACK TRIMMERS (PROFESSIONAL)**
- Type 92W-0-6-2F2-2. Price 100p each.

**METAL BOXES**
- ALUMINIUM BOXES IDEAL FOR VERO-BOARD WITH BASE AND LID. Please ask for prices.

**T-VAL MILLIMETRE RESISTORS**
- 0.1, 1, 10m, 100m, 1k, 10k, 100k, 1M. Price 5p each.

**NEW IN**
- Now available at reduced prices.

**MICROPHONE DIODES**
- TOV VOLTAGE REGULATORS

**PERSONAL CALLERS**
- ALWAYS WELCOME

**ALSO STOCKED**
- Electronic Capacitors, Mullard, Sprague, Gernick, etc. Polystyrene, Polyethylene, Polyester, etc. Resistors ±10%Watt.

**Potentiometers**
- Linear or Log Single Double Rotary Switched 25p —

---

**DIGITAL INTEGRATED CIRCUITS**

**MULTICORE CABLE**
- 25-way, Individually screened. 14/0.075. £1.40 per yard. VAT. Postage by weight.

**PLASTIC SLEEVING**
- 1,000 PIECES OF 1in x 2mm at £1 + VAT of 8%.

**METAL OXIDE RESISTORS**
- All Values. I-off price 3p each. Discount on quantity.

---

**C.1. ELECTRONICS**

All mail order and enquiries to 270 Acton Lane, Chiswick W4 5DG. Tel. 01-994-6275

**SEMICONDUCTORS**

**DIGITAL INTEGRATED CIRCUITS**

**ALL MAIL ORDER BY RETURN. C.O.D. SERVICE WELCOME**

---

**VAT**
- Unless otherwise stated all prices are EXCEPTIVE of VAT. Please add 25% to all orders. Carriage: orders under 50p plus 35p. Over 50p post free.
AN INDISCRIMINATE TAX

The electronics constructor has suffered a substantial blow from the April Budget, since the new V.A.T. rate of 25 per cent applies to all electronic parts and accessories which can be used in or with radio, television, or audio equipment, electronic musical instruments, and a wide range of electrically operated domestic appliances. Very few circuit devices will escape this definition; though just how in practice the authorities will determine the finer points of distinction is currently a subject of much interest and speculation.

In fact, the whole scheme for a higher rate of V.A.T. effecting electronic components has been greeted with dismay by the manufacturers, distributors, and retailers alike. Confusion runs rife; already conflicting interpretations are reported from different tax offices up and down the country, and the Chancellor is under pressure from industrial and trade organisations to modify this unworkable and illogical scheme.

As it stands, in the original form, we must assume that very few components will be allowed to slip through at the lower rate of 8 per cent.

Hearing aids and electronic calculators are excluded from the higher rate. But what does the retailer charge for a resistor or semiconductor required to repair one of these instruments? Does he demand an affidavit that this component will not be used to build or service a radio set or amplifier?

Impending or future developments could very well embrace certain components which at this particular moment may not have any plausible connection with the classes of goods that are subject to the higher rate. In terms of technical feasibility there is scarcely anywhere where it is prudent to draw the line. Thus practically all active and passive components designed for use in the field of electronic engineering could conceivably be applied sensibly in electronic equipment suitable for domestic or recreational use, or in certain domestic appliances, (if not today, quite probably tomorrow).

This is not to argue a case on behalf of Customs and Excise for a blanket imposition of the higher rate of V.A.T. upon all electronic components. It is to illustrate the ludicrous situation brought about by those responsible for drafting the new Budget proposals. The authors seem to be oblivious of the fact that electronics is the common base of a multitude of products which may differ widely in all other respects. Complete equipments, sets, and machines can indeed be divided arbitrarily into classes as "luxury items" or otherwise, if so desired. But their component parts and related accessories cannot, for the greater part, be segregated in this same neat and tidy way.

We support all those who claim that the new system is unfair and largely unworkable. In particular we are concerned at the indiscriminate way in which this higher rate of tax, supposedly created in order to curb public spending on luxury goods, penalises the home constructor no matter what kind of project he happens to be building. Many home assembled units and equipments are clearly in the non-luxury class; others, due to some strange quirk of our legislators, have to be considered luxury items and they include the like of d.c. to a.c. converters, electronic power controllers, and control systems for central heating systems, for example. The very kind of equipments that should be welcomed and encouraged by the Government as valuable weapons in the battle against the waste of energy!

And just why have components been brought into this higher rate? It must be because, we presume, a few individuals will be tempted to build the so-called luxury goods themselves and thus cheat the Exchequer of a few paltry pounds.

All the indications are that the far reaching repercussions of this extra tax imposition upon (in effect) all electronic components were never foreseen by those responsible for compiling this part of the Budget proposals. This is a charitable interpretation, but it cannot give the taxpayer cause for confidence in those who originate new tax schemes.

(See Market Place for some further information on the new V.A.T. situation.)

F.E.B.
The first electronic spark gas ignitor powered by a 1.5V cell for the home constructor.

Simple circuitry provides a constant stream of sparks capable of lighting natural, town and bottled gas easily and swiftly.

Suitable to use in the home, caravan, boat or anywhere gas ignition is required.

PORTABLE GAS IGNITOR

By R. BULLEN

FOR THOUSANDS of years a spark has been the conventional means of obtaining ignition, and the conventional means of generating the spark has been a flint. However, attempting to ignite natural gas using a flint would have posed our ancestors with a rather tedious problem. Compared to even ordinary town gas, the energy required to ignite natural gas is considerably higher and the combustion limits of the gas/air mixture are considerably narrower, see Fig. 1.

Fortunately there is an effective electronic solution—the following design will provide a portable gas ignitor, which will light easily and effectively both natural, town and bottled gases.

The application of a high voltage across a pair of electrodes produces a field in the gas between them, this can lead to ionisation and breakdown of the gas and produce a spark across the gap. The ignitor featured here relies on this principle to produce a continuous stream of high voltage sparks from a 1.5V dry cell battery.

CIRCUIT CONSIDERATIONS

The method of achieving the spark from a low voltage source is outlined in Fig. 2. The power source feeds a d.c. to d.c. converter. When the switch shown in the central block is actuated, the stored energy is released into the primary winding of a step-up transformer and sufficient voltage is generated at the electrodes to cause air breakdown. The oscillation caused by the discharge of an associated capacitor is sufficient to maintain the breakdown for several tens of microseconds.

POWER AND D.C./D.C. CONVERSION

Power is supplied from 1.5V dry cell battery noted as B1 in Fig. 3 which shows the complete circuit of the ignitor. The oscillator circuit is a ringing choke type which utilises feedback between base (AB) and collector (CD) windings for its operation.

When the circuit is switched on by SI, most of the rail voltage will appear across CD as the collector current increases exponentially.

The base winding AB is wound in the opposite direction to the collector winding and so the inductive coupling from the collector winding tends to drive the base positive thus driving the transistor TR1 into saturation.

When the collector current reaches saturation the induced voltage in the base falls to zero causing a reduction in base current. This tends to reduce the collector current and induce a reverse voltage in the collector winding. The overall effect is to bring the transistor out of saturation.

The regenerative effect continues until the transistor enters the cut-off region. The discharge of winding capacitance is sufficient to generate a voltage across
the collector winding which causes the cycle to be repeated. Hence whilst the switch remains closed a series of pulses are generated at the collector. Figs. 4a and b show the collector current and voltage waveforms.

A tertiary winding EF, wound in phase with the collector winding, steps up the voltage appearing across CD to a level of approximately 600V. The resulting pulses are used to charge C1.

The transistor used should have a low $V_{ce}$ (sat) to minimise the energy loss and also have a good collector-to-base breakdown voltage.

**WINDINGS**

The design of windings is related to the transistor used. The base and collector windings should be optimised to achieve maximum output without drawing too large a collector current. For this design, using a Microelectronics type ME 8001 transistor or its equivalent (BFY 50, 2N2297), a base winding of 12 turns of 37 s.w.g. and a collector winding of 18 turns of 33 s.w.g. will be found suitable.

The collector voltage should be approximately 28V, choice of 600 turns of 44 s.w.g. for the secondary provides the requisite intermediate voltage.

The oscillator windings are housed in a 14mm pot core. The main requirement for the ferrite material is that the saturation level is not too low.

**SWITCHING AND DISCHARGE CIRCUIT**

Charging the capacitor is achieved through a rectifying diode D1 which should be an 800V type. The diode should also have a fast switch-off time to minimise leakage from the capacitor. A BA157 is chosen as a suitable component.

The main discharge capacitor is a 250V type the capacitance of which is governed by the energy requirements of the spark. Generally a 0.47µF is suitable for the application. The I.T.T. range of PMT capacitors is recommended as they appear to withstand the high current discharges which occur during the oscillation.

**THE SWITCH**

The switch used is a device known as a surge voltage protector. This component originated as a protection for equipment which was liable to high voltage spikes. The device is similar to a neon in that a pair of electrodes are contained in a glass envelope which is filled with an inert gas.

When sufficient electrical stress appears across the electrodes breakdown will occur and current of up to several tens of amps will be allowed to pass under pulse conditions. Subsequent to breakdown a voltage of about 25V exists across the device. The type used in this case has a breakdown of about 220V, thus the capacitor charges to 220V, the protector flashes over and the resulting oscillation generates the high voltage for the spark.

**TRANSFORMER DESIGN**

The number of primary turns required may be estimated on the basis of impedance matching and energy input to the transformer. From this the secondary turns may be estimated from simple transformer theory. For the size of electrode gap used here an output of 8kV will be required.

A primary of 40 turns of 30 s.w.g. and a secondary of 3000 turns of 40 s.w.g. will be found suitable. The
**MATRIX BOARD VERSION**

**Fig. 5.** Constructional details of the output transformer T2

**Fig. 6.** Details of the oscillator transformer T1

**Fig. 7.** Construction and component layout for the matrix board and case, together with details of the electrode tube

*icy Practical Electronics  July 1975*
COMPONENTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistor</td>
<td>R1 15Ω, 1W carbon</td>
</tr>
<tr>
<td>Capacitor</td>
<td>C1 0.47µF, 750VW, d.c.</td>
</tr>
<tr>
<td>Transistor</td>
<td>TR1 ME8001</td>
</tr>
<tr>
<td>Diode</td>
<td>D1 BA157</td>
</tr>
<tr>
<td>Coils</td>
<td>Oscillator coil: Single section 14mm bobbin, 14mm ferrite core, FX 3594, 1g of 44 s.w.g. enameled copper wire, 0.1g of 37 s.w.g. and 0.3g of 33 s.w.g., tape to suit. Output transformer: Ferrite rod, 27mm by 8mm; bobbin, see text; 1g 30 s.w.g. enameled copper wire, 1g 44 s.w.g.; tape to suit. Electrode tube: Brass or copper tube, 9mm o.d., 0.5 to 1mm wall thickness, 150mm; 20 s.w.g. tinned copper wire insulated with 1mm wall-thickness silicone rubber tube or equiv.; epoxy putty, fire clay etc. as needed.</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Matrix board, 0.1 or 0.15in. hole spacing; S1, push-to-make switch; Voltage protector, Siemens KASO2; plastic box ref. 1005; solder, wire etc. as required. For the fully described version the plastic case can be obtained from Crescent Radio Ltd., 11 Mayes Road, London, N.22. The case and a complete kit for the second proprietary version can be obtained from Greenweld, 51 Shirley Park Road, Southampton, SO1 4FX, Tel. 772501. The Siemens voltage protector can be obtained from Jermy Distribution, Vestry Way, Sevenoaks, Kent.</td>
</tr>
</tbody>
</table>
Fig. 8. General layout, component details and p.c.b. master for the printed circuit version
ELECTRODE TUBE ASSEMBLY

Since it is the function of this unit to ignite gas virtually instantly, this part should be constructed in such a way that the best possible spark gap is produced and that gas is able to surround the electrode easily. Materials should be heat resistant, the tube being conductive and preferably solderable. For this purpose brass or copper are recommended.

Basically the assembly consists of a well insulated wire, the end of which is bared to discharge the spark across an air gap of 3 to 4mm to the outer tube. An essential part of the structure is a heat resistant inner insulating tube which positions longitudinally and centralises the electrode wire.

For the model this part was constructed from a 2-part epoxy putty which cures hard, resists heat and adheres to the inside of the tube. This part could equally well be produced from clay or fabricated from fire brick, etc. and secured in position with an epoxy adhesive or the like.

Fig. 7 shows the electrode tube assembly.

ASSEMBLY AND MOUNTING

The first stage is to cut a 100 x 37mm section of matrix board to size, drill additional holes and fit the spring battery connection (28 s.w.g. brass or similar) as shown in Fig. 7. The components are mounted as shown, securing the oscillator ferrite core halves together and to the board with a 6 B.A. brass screw. The output transformer was fixed in position with two layers of double-sided adhesive tape although a suitable adhesive would have been quite adequate.

Next the board assembly is slid into a plastic box in which two holes have been drilled as shown and the electrode tube positioned through one hole before soldering it to the double bar of 16 s.w.g. tinned copper wire for retention and connection. The output wire is soldered to the electrode from J on the output winding and the joint well insulated. The switch is fitted and connections made to the board and the second battery spring which is bent to engage a pillar in the box chosen.

The battery is located between the two springs as shown in the accompanying photographs noting the polarity.

APPLICATION

Ignition is normally best obtained by touching the tip of the electrode tube against the gas burner and allowing 1 or 2 seconds after opening the burner before operating the igniter.

It has been suggested that in the absence of ignition after a few sparks, turn the gas off and blow away the surplus before trying again. Some experiment may be required before the best spark-to-burner distance is accurately achieved.

You will find this igniter ideal for camping, boating, caravanning as well as for use in the kitchen. It will provide you with many years of normal use.

PRINTED CIRCUIT VERSION

For those who wish, a second version of the ignitor is proposed here using a printed circuit board, a diagram of which appears in Fig. 8. This version makes use of a proprietary clear plastic case with self-contained “trigger” switch, battery retaining members, ignitor tube and even a spring clip with which the ignitor can be hung up on a hook.

Of course, there is nothing to stop anyone from using p.c.b. techniques in the manufacture of the first version or, for that matter, Veroboard techniques.

The clear plastic case version makes use of a complex moulding which holds the trigger tube in place with snap-action clips. The tube holds the p.c.b. in place using two metal clips which engage through the board, and the whole is held in place finally with a moulded plastic element which acts as an end plate against which the battery is pressed or the case.

The moulding includes an access through which a trigger passes to engage with a spring and suitable contacts on the end plate. The mouldings and various parts are available from Greenweld.

NEWS BRIEFS

Electronics For School Teachers

The University of Essex is holding its fourth Electronics Summer School for teachers from July 7-11. This will take the form of two courses which will be run simultaneously.

The first course, ESS 8—Linear Circuit Design—is concerned with the use of transistors and operational amplifiers in linear applications such as amplifiers, filters and power supplies. The second course, ESS 9—Digital Circuit Design—concentrates on the use of the transistor as a switch and develops design using integrated logic circuits.

A full laboratory programme backs up the topics covered in the lectures, and tutorials are held to discuss the design for the practical sessions.

Further details can be obtained by writing to Bob Mack at The Department of Electrical Engineering Science, University of Essex, Wivenhoe Park, Colchester, Essex, CO4 3SQ.

Queen's Award

The Queen's Award to Industry, 1975 in recognition of its export achievement and for technological innovation in scientific electronic calculators has been awarded to Sinclair Radionics for their “Sinclair Scientific”.

During a three year period ending in April 1974 the company, which is claimed to be Europe's largest manufacturer of electronic calculators, increased its exports tenfold to £2,232,040 p.a. or 56 per cent of turnover.

Sinclair is one of only two companies that have won the award in both categories this year. In the previous three years only three companies have been successful in both categories.

JUST THE IDEA!

VALUABLE PRIZES TO BE WON

A competition for the most novel ideas for practical applications of a particular circuit in this issue.

Details Next Month.
CHRISTMAS PRESENT

The name of Jocelyn Bell became recognised by the scientific world when her observations of the first pulsar were announced. Since then she has changed both her location and her name. Her new location is the Mullard Space Science Laboratory at Dorking and her new name is Jocelyn Bell Burnell.

With the team at Dorking, John Ives, Peter Sanford, Jocelyn Bell Burnell is engaged on carrying out the task of reducing data from Ariel 5, the United Kingdom's first X-ray Satellite. The whole of the programme of this satellite is devoted to observations of existing X-ray sources and the search for new ones.

One new star which flared up at Christmas was named, by Jocelyn Bell Burnell, Cen-Xmas. It was observed from December 19 to January 27. This star may well supply the clue to a class of X-ray sources not previously known.

Cen-Xmas was discovered in the constellation of Centaurus near to an already known source Cen X-3. Cen-Xmas flared up on Christmas day and showed a light curve much like that which appears at optical wavelengths by fast moving Novae.

The team observed that there was a regular rising and falling of intensity every 6-755 minutes. This was a point of great interest since the usual periods of variation for X-ray binary systems is hours or even days and the periods for pulsars a few seconds or less. It does not seem likely that it was a slowly rotating neutron star.

OPINION

The team are of the opinion that the source may be a binary system of two collapsed objects. These could be perhaps a white dwarf and a neutron star. Another possibility has been put forward and that is the objects could be a white dwarf and a black hole. Clearly the object is unusual in the present catalogue. The official catalogue number is Ariel 1118-61.

A search is now being made in the data of the Copernicus satellite to see whether there have been earlier bursts. A request has been made that Copernicus, which has better pointing facilities than Ariel, should specially observe this area of the sky.

Satellite Ariel 5 has more than justified its launch in this valuable study of X-ray sources.

ANOTHER DISCOVERY

A second bonus is the discovery of a very bright source near the galactic centre. This, according to Professor K. A. Pounds of Leicester, a pioneer in these observations, was not visible in November when that area was studied. The new source is second only in brightness to a source called Sco X-1.

This new source as yet unnamed is at such a vast distance that its intensity must be at the upper limit for normal galactic X-ray sources. Both Cambridge and the Jodrell Bank teams have been asked to watch the area in case the X-ray flare up should be followed by radio bursts.

FURTHER EXPERIMENT

Another experiment aboard the satellite also controlled by Leicester, with the team led by Professor Pounds has indicated that an excess of heavy elements such as iron have been found in the super nova remnants of Tycho and Cassiopeia A. As this is the first report of the X-ray detection of spectral lines from a cosmic source it adds weight to the growing feeling that the heavy elements in the universe may be produced at the time of the explosions associated with supernovae.

It would seem that the fluctuating nature of X-ray sources is a common factor. Professor Pounds thinks that they may account for 30 per cent of the known sources. There are now more than two hundred recorded.

FADE-OUT!

A notable feature, derived from data received from Ariel, is the number of sources that do not last all the time. During the present period of observation some 16 sources have disappeared from the areas. This may be because they are now out of the limits of detection or that there has been a change of such a nature that there are no longer X-ray types of emmission. The sixteen sources that have disappeared were originally detected by the Uhuru satellite.

It is expected that Ariel 5 will be able to continue operations for a year with the gas available on board. Thereafter it will be a waiting period till the next British X-ray satellite is launched in 1977.

SATELLITE DETAILS

The data handling system of the Ariel 5 satellite is effectively a fixed programme computer with two core stores. This enables the integration of experimental data so that the best may be made of the low data rate of transmission from the spacecraft. Only by keeping the data rate low is it possible to utilise long ground data-links.

The details of the satellite are:

- Dimensions: Diameter 38 in, length 34 in, weight 298 lbs
- Stabilisation: Spin 10 ± 2 r.p.m.
- Attitude control: Propane gas jets
- Power supply: Solar array 35W
- Telemetry: Frequency 137-68 MHz
- Real time rate: Real time power 85mW
- Playback rate: 2048 bits/second
- Playback power: 80W
- Stations: Quito and Ascension (Nasa stations)
- Telecommand: Digital tone
- Frequency: 148-25 MHz

NEWS FROM RUSSIA

India's first satellite is being prepared for launching from a Soviet site. Academician Boris Petrov, chairman of the Intercosmos council, said that the joint work of the Soviet scientists and experts had produced an elaborate spacecraft for experiments connected with research in the short wave radiation of celestial bodies, together with studies of the ionosphere.

Launched on March 27, Intercosmos 13 is a joint socialist countries enterprise. The main aim is to study dynamic processes in the magnetosphere and the polar ionosphere. Research is also directed to low frequency electromagnetic waves.

The satellite carries instrumentation from the Soviet Union and Czechoslovakia. The participating observation points are in Bulgaria, the German Democratic Republic, the Soviet Union and Czechoslovakia.
There are numerous guitar effects pedals available today, but there are still many areas of sound treatment in which it is possible for the amateur to produce something which is not just a copy of a commercial effect.

The pedal to be described makes use of voltage control techniques. There are two treatments, a voltage controlled amplifier and a voltage controlled filter; either of which can be selected by a switch. These are controlled by an oscillator which produces triangle, square and rising and falling ramps at controllable frequency and amplitude. The combination of four waveforms and two treatments gives eight basic effects, all of which can be considerably modified by adjustment of the controls.

**WAVEFORM GENERATOR**

The basic rising ramp wave is generated by IC1 and 2 (see Fig. 1). Integrator IC1 ramps upwards at a rate set by the speed control until it exceeds a limit set by comparator IC2. Then, a large reset current flows through D1 and R2 until the integrator is back to its starting point.

When the waveform switch is in the falling ramp position, IC3 acts as a unity gain inverter to give the required waveform.

In the square position, IC3 acts as a comparator. This gives a square wave of ±8V at the i.c. output, which is reduced by R14 to the same level as the other waveforms.

The triangle wave is shaped from the ramp wave by TR1. When out of saturation, this has a gain of -1. It is biased by VR2 so that for half the cycle it is saturated, when it has a gain of +1. The triangular wave at the collector of TR1 is amplified by IC3. VR3 is adjusted to offset the d.c. introduced by TR1 and its associated components.

**VOLTAGE CONTROLLED FILTER**

When S2 is in the filter position, IC5 has multipath feedback with a minimum at a single frequency. The overall response is then bandpass peaking at that frequency, which can be changed by changing the voltage on the gate of the f.e.t.

**VOLTAGE CONTROLLED AMPLIFIER**

R22 and TR2 form an attenuator, and since the effective resistance of the f.e.t. can be varied by changing the gate voltage, the degree of attenuation can be changed. IC5 becomes an amplifier with a gain of 10 with S2 in the envelope position; this amplifies the previously attenuated signal.

In both the v.c.a. and the v.c.f. the f.e.t. is being used as a voltage controlled resistor. The effective resistance between the drain and source depends on the amount of negative bias on the gate. As the amount required varies from transistor to transistor, preset VR5 is included.

The control voltage from VR4 is also fed to the gate via a low-pass filter R15, R16, C5 and C6. This removes the sharp edges from the signal and so reduces the breakthrough of the control into the output.

**BATTERY SWITCHING**

There are two batteries to be switched on by the insertion of a jack plug to SK1. It is possible to get sockets which have a single make connection, which is used to turn on the positive supply. This turns on TR3, which then turns on the negative rail. The leakage through TR3 when it is off is negligible.
CONSTRUCTION

Most of the components are mounted on a piece of Veroboard 67mm x 112mm (Fig. 2). These are rather tightly packed as there is a lot to be fitted on. The board is screwed into a plastic bracket to hold it in place.

The unit can be housed in any convenient case, which should be earthed to prevent hum. This could be done by soldering onto the back of a pot.

The batteries are prevented from moving with a sheet of foam rubber.

SETTING UP

Turn all presets to mid-positions. While monitoring the waveform at the output of IC3, with the waveform switch set to “triangle”, adjust VR2 for the best triangle wave shape. A scope is useful for this. Now set VR3 for 0V d.c. at IC3 output.

Set S2 to “filter”. With the depth control at maximum, adjust VR5 for the best sound—a smooth change in filter frequency without it breaking into oscillation.

Finally set VR6 so that the volume of the treated signal is the same as in the straight through position.

PLAYING TECHNIQUE

All the effects are repetitive, so it is best used on sustained chords or single notes. Apart from that, there are no set rules to stick to.

It will be noticed that rising and falling ramps have opposite effects on the two treatments; this is so that subjectively more interesting changes can be made simply by switching effects with one’s feet. Thus a rising ramp selected on the switch will produce a decaying sound on the v.c.a.

A fast decaying ramp on the v.c.a. produces a sound like a mandolin; the same control into the filter gives a bubbling, which slows down into a repeated “Waa-Waa”. A very slow triangle into the filter can be applied to any playing including fast runs.

The unit can of course be used to treat any instrument, with due attention to the matching of signal levels.

Fig. 1. Circuit of the Effects Pedal

Fig. 2. Component layout and track cuts
Fig. 3. Control panel wiring details

**COMPONENTS . . .**

**Resistors**
- R1 56kΩ
- R2 470kΩ
- R3 10kΩ
- R4 47kΩ
- R5 47kΩ
- R6 10kΩ
- R7 18kΩ
- R8 27kΩ
- R9 180kΩ
- R10 47kΩ
- R11 47kΩ
- R12 47kΩ
- R13 180kΩ

All ½ watt 10% carbon

**Potentiometers**
- VR1 10kΩ log
- VR2 100kΩ linear
- VR3 100kΩ linear
- VR4 10kΩ linear
- VR5 100kΩ linear
- VR6 100kΩ linear

**Capacitors**
- C1 0.47µF
- C2 2.2nF
- C3–C4 100µF elect. 25V (2 off)
- C5 0.01µF
- C6 0.1µF
- C7 0.1µF
- C8–C9 6.8nF (2 off)

**Semiconductors**
- IC1–IC5 741 (6 off)
- TR1 BC187
- TR2 2N3819
- TR3 BC108
- D1–D2 OA47 (2 off)

**Miscellaneous**
- B1–B2 9V PP3 (2 off), S1—2 pole, 4 way switch, S2—2 pole, 2 way switch, S3—single pole change-over, SK1—jacket socket with make contacts, SK2—standard jack socket.
The second section on inductive devices is concerned mainly with synchronous and stepping transducers.

**SYNCHRO TRANSFORMERS**

This group includes a wide variety of devices such as torque-producing synchros, control synchros, resolvers and related devices. These devices are widely used in systems involving angular displacement and angular position control and are similar in construction to small three phase alternators of fractional horse power rating.

They are often classified according to their intended application, construction or manufacturers' trade names.

The form of the rotor and the arrangement of the rotor winding identify the type of synchro and its function. Generally the synchro stator is a cylindrical slotted structure made up of laminations and having three separate windings arranged in slots which are displaced, spatially, by 120° from each other.

The slots are often skewed one slot pitch to avoid any tendency for slot locking and the resulting angular displacement error. Sometimes the stator slots are parallel to the rotor axis in which case the rotor laminations are normally skewed for the above reasons. Unlike the usual three phase system the voltages associated with the three stator windings are all in step or phase with each other as far as their voltage-time variation is concerned.

The rotor of a control or torque synchro usually carries a single winding and often has a salient-pole form, the coil connections being made available via slip rings. Resolvers on the other hand usually have two rotor and stator coils.

**PRINCIPLE**

The synchro principle is illustrated in Fig. 4.1. The magnitude of the voltages induced into the three stator coils depends on the rotor position and varies sinusoidally with shaft displacement from some reference position. The system is essentially a transformer with three output coils in which the degree of coupling to the primary rotor coil varies with rotor position.

There is always an output from the system whether the rotor is in motion or not—consequently slowly varying or static angular displacement can be determined.

The resolver usually operates as a two phase system as illustrated at Fig. 4.1b. The rotor coils provide output voltages which vary as the cosine and sine of the angular displacement, by virtue of the variation of coupling and the relative coil displacements. When output from coil O1 is maximum, that from coil O2 will be zero. A rotation of 90° will cause the output of coil O1 to be zero whilst that of coil O2 reaches its maximum.

In some applications only one coil may be used in which case the unused coil is normally short circuited. With two primary and two secondary coils four vector combinations are possible for both coil sets according to the sense of the coils.

Synchros and resolvers are usually designed to operate at 50, 60 or 400Hz, often at specified voltage levels and in all cases it is essential to follow the manufacturers' advice and ratings if the best accuracy is to be achieved. For further details the reader should consult the references listed, together with manufacturers' data/application sheets.

* North Staffordshire Polytechnic
**Fig. 4.2.** The stepper motor concept in diagrammatic form

**Fig. 4.3.** The motor of Fig. 4.2 opened out to show the coil and pole orientation

**Fig. 4.4.** Three versions of the electromagnetic tachometer principle, the d.c. generator, a.c. generator and toothed rotor

**Fig. 4.5.** Principle of operation of a Hall Effect probe
STEPPER MOTORS

Several devices have been invented for imparting a given amount of angular movement to a shaft, in response to an electrical input. Two common examples are the stepping uniselector mechanism and the Ledex solenoid system, both of which involve a form of ratchet action. The stepper motor, however, does not use a mechanical ratchet but achieves its position latching feature by virtue of its special magnetic system.

Two main types exist, those using permanent magnet rotors and those using variable reluctance techniques. The variable reluctance group can be further subdivided into vernier and non vernier types. (vernier motors achieve more steps per revolution than might be indicated by the number of teeth on the rotor or stator.)

Stepper motors do not have brushes or slip rings and are consequently robust and reliable with a low maintenance requirement. The electrical excitation is provided by a two, three or four phase coil system on the stator portion of the motor.

Fig. 4.2 illustrates the operation of a permanent magnet rotor, three phase stator, type of construction. The rotor only has two poles and with the stator un-energised, the motor has 12 magnetic “detent” positions as illustrated where the rotor is aligned on an axis midway between adjacent pairs of stator poles.

If the shaft of such a motor is rotated by hand these detent positions can easily be felt since the rotor tends to pull into the nearest available detent position as the shaft turns.

To illustrate the stepping action under drive conditions the motor stator is shown opened out into a straight line in Fig. 4.3. Each of the three separate stator coil sets is made up of four coils in series such as A1, A2, A3, A4 for the “A” phase. The sense of the currents that flow in these four coils is shown by arrows and it can be seen that coils A1, A2 produce four south poles whilst coils A3, A4 produce four north poles.

The flux of the innermost two poles in each group of four is greater than that of the outermost poles since two aiding coils encircle the inner poles but only one coil encircles each of the outermost poles. The rotor thus aligns itself as illustrated in Fig. 4.3 if only the A phase is energised.

The B and C phases also employ four coils each, in exactly the same pattern as for phase A. However, the slots used are displaced by 120° in each case. Thus coil A1 is displaced 120° from B1 which in turn is displaced 120° from C1. Likewise coils A2, B2, C2 are displaced 120° apart and so on. The effect of this is that each of the 12 coil slots in the stator carries two coils from different phase coil groups.

STEPPING ACTION

The stepping action is determined, for a given construction and coil system, by the manner in which the various phases are energised. If the phases are energised singly in the sequence A, B, C the rotor will take three steps to complete one complete revolution of 360°. Energising the A phase brings the rotor north pole to midway between poles 1 and 2. Subsequent energisation of the B phase pulls the rotor north pole to an equivalent position with regard to coils B1, B2 which gives an axis midway between poles 5 and 6, a rotation of four poles or 120°.

Subsequent energisation of the C phase gives a rotor axis midway between poles 9 and 10.

Smaller angular steps can be achieved by controlling the phases in the sequence A only; A and B, B only, B and C, C only, C and A, etc. This gives six steps of 60° each.

ELECTROMAGNETIC TACHOMETERS

The most common tachometer arrangements are illustrated in Fig. 4.4. The d.c. tachometer uses a permanent magnet stator in conjunction with a rotor coil and commutator. The connections to the coil are made via the commutator and associated brushes and the output voltage is proportional to the angular velocity. Reversing the direction of rotation reverses the output voltage polarity and this is a useful characteristic in some applications. The brush commutator arrangement requires periodic maintenance if reliable operation is to be obtained.

The a.c. tachometer uses a rotating magnet and fixed stator coil thus avoiding the need for brushes and commutator. Both the amplitude and frequency of the output depend on angular velocity and in modern systems an electronic frequency meter is usually employed to give the shaft speed directly, in, say, rev/min, as this avoids the inaccuracies associated with measurement of voltage.

Variable-reluctance pulse generating systems are also widely used due to their simplicity and reliability, the number of output pulses per revolution in this case depends on the number of teeth on the rotor wheel or disc.

INTERFERENCE

All magnetic devices can be influenced to some extent by external magnetic fields due to solenoids operating, mains wiring and stray fields of transformers and motors. In some instances the interfering field cannot be removed and the only course of action is to employ magnetic screening and select the best orientation of the transducer to minimise the unwanted coupling. In some situations hum-cancellation coils can be fitted to introduce an opposing interfering voltage into the output circuit. Connecting leads from low-output devices should be tightly twisted and screened to minimise the effective loop area available for flux linkage with the stray field.

HALL EFFECT DEVICES

When a conductor carries a current at right angles to a magnetic field a charge difference is set up on the surface of the conductor in a direction which is mutually perpendicular to both the magnetic field and the current. Modern high mobility semiconducting materials such as Indium Arsenide and Indium Antimonide have made the Hall Effect a useful practical phenomenon due to the magnitude of the voltage available with reasonable levels of magnetic flux density and current. Fig. 4.5 illustrates the basic principles which can be incorporated into a transducer in various ways.

Either the current or magnetic field can be varied to give a change in the output voltage and Hall Effect plates, together with varying magnetic fields, have been used in flowmeters, tachometers, wattmeters, accelerometers and displacement transducers.

Next month: Piezoelectric devices.
This could lead to something big.

A soldering iron and a screwdriver. If you know how to use them, or at least know one end from the other, you know enough to enrol in our unique home electronics course.

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

You build, see and learn as, step by step, we take you through all the fundamentals of electronics and show you how easily the subject can be mastered and add a new dimension not only to your hobby but also to your earning capacity.

This course is accepted by and used in a large number of schools and colleges and forms an invaluable grounding for professional training in the subject. All the training is planned to be carried out in the comfort of your own home and work in your own time. You send them in when you are ready and not before. These culminate in a final test and a certificate of success.

**PLUS**

FREE GIFT

ALL STUDENTS ENROLLING IN OUR COURSES RECEIVE A FREE CIRCUIT BOARD ORIGINATING FROM A COMPUTER AND CONTAINING MANY DIFFERENT COMPONENTS THAT CAN BE USED IN EXPERIMENTS AND PROVIDE AN EXCELLENT EXAMPLE OF CURRENT ELECTRONIC PRACTICE.
### Top 500 Semiconductors From the Largest Range in the UK.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N4141</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4142</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4143</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4144</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4145</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4146</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4147</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4148</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4149</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
<tr>
<td>1N4150</td>
<td>N-Channel JFETs</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Everything you need is in our New 1975 Catalogue

Available now price 25p

100 pages of prices and data.

Call in and see us - 9.30 Mon-Fri
9.00 Sat
Trade and export enquiries welcome.

---

### TTL Integrated Circuits—Quality and Prices You Can't Beat

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN7400</td>
<td>10-Input 2-Input OR Gate</td>
<td>1000</td>
</tr>
<tr>
<td>SN7401</td>
<td>1-Input 2-Input OR Gate</td>
<td>1000</td>
</tr>
<tr>
<td>SN7402</td>
<td>2-Input 2-Input OR Gate</td>
<td>1000</td>
</tr>
<tr>
<td>SN7403</td>
<td>3-Input 2-Input OR Gate</td>
<td>1000</td>
</tr>
<tr>
<td>SN7404</td>
<td>4-Input 2-Input OR Gate</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Diodes and Rectifiers—A Selection from our Range

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN34A</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34B</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34C</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34D</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34E</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34F</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34G</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34H</td>
<td>2N34</td>
<td>1000</td>
</tr>
<tr>
<td>IN34I</td>
<td>2N34</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Diodes and Rectifiers—A Selection from our Range

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N5407</td>
<td>1N5407</td>
<td>1000</td>
</tr>
<tr>
<td>1N5408</td>
<td>1N5408</td>
<td>1000</td>
</tr>
<tr>
<td>1N5409</td>
<td>1N5409</td>
<td>1000</td>
</tr>
<tr>
<td>1N5410</td>
<td>1N5410</td>
<td>1000</td>
</tr>
<tr>
<td>1N5411</td>
<td>1N5411</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Bridges and SCRs

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCRs</td>
<td>1000 V</td>
<td>1000</td>
</tr>
<tr>
<td>SCRs</td>
<td>200 V</td>
<td>1000</td>
</tr>
<tr>
<td>SCRs</td>
<td>400 V</td>
<td>1000</td>
</tr>
</tbody>
</table>

---

### PW TELETENNIS KIT

Available now price 25p

100 pages of prices and data.

---

### Cmos Circuits (CD Range)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>4000</td>
<td>1000</td>
</tr>
<tr>
<td>4001</td>
<td>4001</td>
<td>1000</td>
</tr>
<tr>
<td>4002</td>
<td>4002</td>
<td>1000</td>
</tr>
<tr>
<td>4003</td>
<td>4003</td>
<td>1000</td>
</tr>
</tbody>
</table>

### P.C. Marker Pen Daco 35PC £0.15

Zamak 0.04 0.15 0.25 0.50 1.00 2.00 5.00 10.00 12.00

---

### Veroboard

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>1000</td>
</tr>
<tr>
<td>Red</td>
<td>1000</td>
</tr>
<tr>
<td>Green</td>
<td>1000</td>
</tr>
</tbody>
</table>

---

### Potentiometers

<table>
<thead>
<tr>
<th>Linear or Log</th>
<th>Single Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary Pot</td>
<td>10p 15p</td>
</tr>
<tr>
<td>Potentiometer</td>
<td>50p 10p</td>
</tr>
</tbody>
</table>

---

### Full range of capacitors

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minitron</td>
<td>1000</td>
</tr>
<tr>
<td>Minitron</td>
<td>1000</td>
</tr>
<tr>
<td>Minitron</td>
<td>1000</td>
</tr>
</tbody>
</table>

---

### Construction Kits

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-amp Amps</td>
<td>20p 50p</td>
</tr>
<tr>
<td>LM308 Transistor</td>
<td>10p 20p</td>
</tr>
<tr>
<td>MRE7 Receiver</td>
<td>10p 20p</td>
</tr>
<tr>
<td>Ew18 Electronics</td>
<td>10p 20p</td>
</tr>
</tbody>
</table>

---

### Mall Order

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAT All prices exclusive P &amp; P 25p</td>
<td></td>
</tr>
</tbody>
</table>

---

### Try our New Glashow Shop

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-amp Amps</td>
<td>20p 50p</td>
</tr>
</tbody>
</table>

---

### Practical Electronics

July 1975
A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought. Any idea published will be awarded payment according to its merits. Why not submit YOUR IDEA?

TUNNEL DIODE B.F.O. I.F. MARKER

Circuit 1 shows a tunnel diode beat frequency oscillator, which was designed for reception of s.s.b. and c.w. in conjunction with a short-wave a.m. receiver. It also served as an i.f. marker by f.m. modulating the anode of the tunnel diode via a coupling capacitor.

By setting up a potential divider (R1/R2) across the main d.c. supply rail, a low impedance voltage of around 150mV can be supplied to the tunnel diode which will oscillate when the current rises to about 5mA. The frequency of oscillation is determined by the i.f. transformer which is chosen to suit the receiver i.f.

When the 7490 outputs and the control inputs are equal the 4-input NOR gate gives a pulse which clears the 7473 and the 7490. When the 7473 output goes low the NAND gate cuts off the clock pulses to the 7490 and the output.

To obtain a fine beat-frequency control a 10pF air spaced variable capacitor can be connected across the i.f.t. primary. Beat frequency may also be adjusted by varying the bias voltage on the tunnel diode, this can be achieved by substituting R1 for a linear pot and a fixed resistor in series.

If no centre tap primary is available on the transformer the diode may be connected to one end of the primary, the other end being grounded.

The output of the b.f.o. can be taken from the i.f.t. secondary via a small ceramic capacitor to the last i.f.t. of the a.m. receiver.

Component values would have to be selected individually, but about 10mA should be allowed through R1. R2 should be no greater than the negative resistance of the tunnel diode. Typical values for a 6V rail, being R1 approximately 600R and R2, 15R where R is the negative resistance of the diode.

The tunnel diode can be any general purpose 5mA germanium device.

A. Morter, Norwich

Fig. 1

ADDING CIRCUIT

The adding circuit of Fig. 1 outputs a number of pulses equal to the binary number set up at the control inputs. If the output is connected to a conventional decimal counter with decoder and display a simple adding circuit can be constructed giving the sum of the binary numbers set up on the inputs.

The first binary number is set up on the control inputs and entered by pulsing the 7473 J-K flip-flop once with a bounce-free pulse. The next number can then be set up on the input, the 7473 pulsed and the sum will appear on the display of the associated counter.

The 7490 b.c.d. counter outputs are compared with the binary input numbers by the EXCLUSIVE OR gates G3 to G6 and the outputs of the latter are connected to a 4-input NOR gate made up from three 2-input NOR gates G7, G9 and G11 and two inverters G8 and G10.

When the 7490 outputs and the control inputs are equal the 4-input NOR gate gives a pulse which clears the 7473 and the 7490. When the 7473 output goes low the NAND gate cuts off the clock pulses to the 7490 and the output.

A 7400 can be used for the NAND gate G1 and the inverters G8, G10 and G2. A 7402 can be used for the NOR gates G7, G9 and G11 and a 7486 for the EXCLUSIVE OR gates G3 to G6.

G. W. J. van der Berg, Pretoria, South Africa.

Fig. 1
A SIMPLE random number generator using TTL is shown in Fig. 1. This may be of interest to anyone experimenting in “psychokinesis” and associated e.s.p. phenomena.

A telephone dial is used to generate pulses which are fed to the A input of an SN7490 decade counter. This counts round from 0 to 9 and gives an output in b.c.d. which is fed to an SN7447 b.c.d.-to-segment decoder-driver. The latter drives a Mintron 3015F indicator.

Dial switch contact bounce ensures that the number of pulses counted by the circuit is always greater than the number dialled and completely random. Thus if a 10 is dialled something like 20 to 30 pulses are applied to the counter which cycles and finally comes to rest on an effectively random figure.

If required, a pair of the normally open contacts in the dial can be used to blank the display whilst dialling. An “0” is applied to the blanking input of the SN7447 whilst the dial is moving. In addition, the ability to reset to “0” and “9” is useful in experimental work.

The circuit may be used as a “wide-range” dice, operated by dialling 10.

If it is required to generate a specific number of pulses then the insertion of a large capacitor, about 125μF, across the pulsing switch, should dispose of the effects of switch bounce and convert the circuit to normal counting.

N. J. C. Ray, Northampton.

**ASTOUNDING OFFER**

We are offering you the choice of two superb scientific pocket slim calculators (size 13.5cm x 6.75cm x 1.75cm) at a fantastic price.

**DECIMO 2001**

In addition to common functions it registers all functions appertaining to natural logs,

<table>
<thead>
<tr>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 figure Mantissa</td>
</tr>
<tr>
<td>Common Logs</td>
</tr>
<tr>
<td>Natural Logs</td>
</tr>
<tr>
<td>Trig. functions</td>
</tr>
<tr>
<td>Memory</td>
</tr>
<tr>
<td>Memory +</td>
</tr>
<tr>
<td>Memory Exchange</td>
</tr>
<tr>
<td>Sign Change</td>
</tr>
<tr>
<td>Reciprocals</td>
</tr>
<tr>
<td>Square Roots</td>
</tr>
<tr>
<td>Radicals/Degrees</td>
</tr>
<tr>
<td>Register Exchange</td>
</tr>
<tr>
<td>π</td>
</tr>
<tr>
<td>Algebraic Logic</td>
</tr>
<tr>
<td>Floating point</td>
</tr>
<tr>
<td>Positive feel</td>
</tr>
<tr>
<td>25hr battery time</td>
</tr>
</tbody>
</table>

£29.95 + P. & P. + 8% VAT
including carry case

**DECIMO 2001E**

In addition to all the above features it has a 10 digit mantissa with 2 figure exponent, 2 figure display hyperbolics and functions on separate keys.

<table>
<thead>
<tr>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 figure Mantissa</td>
</tr>
<tr>
<td>2 figure Exponents</td>
</tr>
<tr>
<td>2 sign display</td>
</tr>
<tr>
<td>Common Logs</td>
</tr>
<tr>
<td>Natural Logs</td>
</tr>
<tr>
<td>Trig. Functions</td>
</tr>
<tr>
<td>Memory</td>
</tr>
<tr>
<td>Memory +</td>
</tr>
<tr>
<td>Memory Exchange</td>
</tr>
<tr>
<td>Radians/Degrees</td>
</tr>
<tr>
<td>Grads.</td>
</tr>
<tr>
<td>Hyperbolics</td>
</tr>
<tr>
<td>Register Exchange</td>
</tr>
<tr>
<td>π</td>
</tr>
<tr>
<td>Algebraic Logic</td>
</tr>
<tr>
<td>Floating point</td>
</tr>
<tr>
<td>Positive feel</td>
</tr>
<tr>
<td>25hr Battery time</td>
</tr>
</tbody>
</table>

£37.46 + P. & P. + 8% VAT
including carry case

**DEMODERATING COMPONENTS**

Many constructors are faced with the problem of removing Perspex strips from circuit boards for various reasons without doing damage to the associated printed circuit track and, of course, the component itself.

The following method has been used for some time to save the outlay on special desoldering tools.

Strip the end of a length of scrap p.v.c. wire and dip it in Fry’s Fluxite soldering paste (available in most hardware stores). Apply the wire and a hot iron to the joint to be cleaned and the solder will be drawn up the wire by capillary action. With large blobs of solder it may require more than one application of clear wire and of course care should be exercised over the amount of heat applied to the joint.

After removal of the bulk of the solder the component may be lifted without undue physical strain to the leads or thermal strain to the I.C.

Any residual flux should be removed from the component and the board to avoid corrosion problems.

J. Barvie-Smith, Fareham, Hants.
In October of last year we ran several ads announcing a brand-new service for amateur electronics enthusiasts.

The new service was called Doram.

And it promised the first-ever professional electronics service for amateurs.

We said that if you didn’t get your order within seven days we’d refund your money. So you’d have no long wait.

We said that we’d only give you top quality, big-name components.

We said that we’d give you a no-quibble guarantee and replace any component which arrived faulty.

And finally we said that we’d offer you a choice of millions of components on over 4,000 product lines.

Buy the Doram catalogue for 25p, we said, and you’ll get a fantastic electronic component mail order service.

We were as good as our word. And your letters of thanks flooded in. Thousands tried our service. Hundreds went out of their way to write congratulating us.

‘Your storeman must be power assisted’, you said.

‘I think you are a good firm and live up to your advertisement well’, you said.

‘How nice to find a firm which actually stocks all the items in its catalogue, you said.

And an awful lot more we’d blush to admit.

The Doram catalogue is still available, price 25p.

To encourage you to try us we’ll give a £10 voucher to the first catalogue buyer out of the post bag on 30th June. And a £5 voucher to the next 19 new buyers.

Similarly, on 31st July, we’ll give a £10 voucher to the first new catalogue buyer. And a £5 voucher to the next 19 new buyers.

Use the coupon now while the offer lasts. Only these coupons are eligible, and all unsuccessful coupons from the June draw will also be entered for the July draw.
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.

ELECTRONIC IGNITION

Well-known for their "Sparkrite" capacitive discharge ignition systems, Electronics Design Associates, of Walsall, have extended the range recently by the addition of two new models, the Sparkrite G.T. (12V -ve and +ve earth) and the Sparkrite G.T.3 (12V -ve earth only).

Both these new models, which are a development of the Sparkrite Mk 2, incorporate a high voltage a.c. accessory outlet socket into which can be plugged the Sparkrite G.T. Fluorescent Inspection Light (extremely useful for emergency repairs at night) and the Sparkrite G.T. Xenon Dynamic Timing Light for those who wish to accurately "time" the engine to help obtain the best fuel consumption and performance. Also, both models can be used with all types of tachometer.

The G.T.3 version has two indicator lamps, one to tell you the system is wired in correctly and the other a static timing light which only lights if the unit is wired in correctly with the points open. Full details of the use of the latter are included with the comprehensive instructions accompanying each unit.

One other feature on the G.T.3 version is the inclusion of an automatic contact breaker cleaning circuit which burns oil and dirt from the surfaces of the points. Thus the life of the points is increased, pitting and burning being virtually eliminated.

The G.T.3, which is suitable for all vehicles with conventional coil/ contact breaker ignition up to eight cylinders, was fitted to an Audi 100LS in need of an engine tune. Also the car battery was in a poor condition and there was a bad connection to one of the sparking plugs. Before fitting the unit, starting virtually in the early morning was, needless to say, difficult, and occasionally needed a bump start. After starting, it was not unusual for the spark plug with the faulty lead to foul up for a while.

After fitting the unit, which took about half an hour, the difference was incredible. The car did not start first time, but when it did, at the third attempt, it was running smooth and quiet and purred like a tiger. Response to the accelerator was instant. The car was immediately taken for a trial run and found to have a lively response to accelerator demands with greatly increased acceleration. If it can transform a neglected engine into a lively powerful vehicle, just think what it can do for a tuned engine!

The device has been fitted to the car for about 1,000 miles. No precise quantitative measurements have been recorded during this period as far as fuel consumption is concerned, but it has been noticed that the number of visits to the garage for petrol has decreased. Since fitting the G.T.3 no plug foul up has occurred and the car has always started at the first or second attempt.

For further details and price of the Sparkrite range of ignition systems and accessories, contact Electronics Design Associates, 82 Bath Street, Walsall, WS1 3DE.

LOUDSPEAKER KIT

You don't have to be a good carpenter to build the Easikit loudspeaker kits from Studio Electronics. The teak veneer or white cabinets are ready built and the kit consists of 4 drive units, 4 tweeters, 2 Declon foam fronts, cabinet wadding and sealant, and a p.c.b. crossover pack.

Capable of handling up to 20W, the frequency response of the enclosure is 30Hz to 20kHz ±5dB.

Full details and price list of the Easikit enclosures can be obtained from Studio Electronics Ltd., P.O. Box 18, Harlow, Essex, CM18 6SH.

COMPONENTS AND V.A.T.

How, precisely, the new V.A.T. rules will be interpreted is far from clear at the time of writing. But one thing is sure. Suppliers of components are in the front line and they have our sympathy. They face the wrath or indignation of their customers when they apply the higher rate of V.A.T. to all components (with perhaps those few unarguable exceptions). The suppliers are, of course, accountable to the tax authorities, so they cannot take chances. In short, when in doubt, the higher rate of 25 per cent is bound to be applied.

The individual customer has no option but to accept the increased price, though if he does feel there is a particular case for exemption from the higher rate he can take the matter up with his local V.A.T. office. This is the only advice we can offer our readers at this time. Some clarification of the situation must emerge but not long, though it is doubtful whether much or any relief will be forthcoming.

Soldering irons (and other tools) remain at 8 per cent, so do electronic calculators and hearing aids. Multi-meters should be handled by our reckoning also remain as before, but any meter movement capable of being incorporated in radio or audio equipment is subject to the higher rate.

There are many other questionable items . . .

G.T.3 Ignition from Electronics Design Associates

MODEL RAILWAY CONTROLLER

For those of our readers who are keen model railway enthusiasts, Routier (Electronic Engineers) Ltd., are producing a new power unit and controllers for gauge 00 and gauge N tracks.

Called the Brakeman Power-Pak and Brakeman Controllers, the units are of modular design, the controllers plugging into the sides of the power units. A power unit can be used alone, with one or two controllers for gauge 00 or with up to six controllers for N gauge tracks.

Each controller has a forward, reverse and central off slide-lever control which governs the motion of one locomotive.

The Power-Pak is fitted with a double insulated transformer (no earth lead required) and an automatic resetting cut-out gives overload protection for all outputs. Two independent isolated output windings of 12V d.c. provide 1A on either side in addition to which a 16V a.c. output with two wander plugs is located at the front panel to provide power for points, motors, signals, etc.

Further information and prices for the Power-Pak and Controller can be obtained from Routier (Electronic Engineers) Ltd., Ion House, Sheep Lane, London, E8 4QS.
In order to achieve independent operation for each note in the Piano it is necessary to provide a complete envelope generation system linked to each key on the keyboard. Each envelope shaper consists of a Touch Sensitive circuit followed by a Decay circuit. The latter is also designed to mix in the required pitch and to simulate the sustain pedal and damper action of a conventional piano.

Touch Sensitivity

The touch characteristics are shown in Fig. 3.1, together with the circuitry used to achieve the effect. The keyswitch is normally at ground potential until a note is played, such that the voltage across capacitor $C_T$ is zero. On depression of a key, the switch leaves the ground busbar and starts to travel towards the rail (19 volts) busbar. This allows capacitor $C_T$ to charge through the resistor $R_T$, such that the voltage on the positive plate of $C_T$ follows curve A, according to the time constant $R_T \cdot C_T$ to the final touch level voltage on $R_T$ of approximately 17 volts.

When the key completes its travel a 19 volt pulse is applied to $C_T$, which for a very short time raises the voltage at the junction of $C_T$ and $R_P$ by an amount equal to 19 volts minus the voltage across $C_T$ at that time. This results in an output which follows curve B, over the range of normal key-travel times of between 40 ms and 2 ms, offering a variable attack voltage which is passed on to the Decay circuitry.

A closer investigation of the attack pulse shows that two pulses do in fact occur. The first pulse is very small, and occurs at the moment when the keyswitch leaves the ground busbar, and is kept to a minimum by the choice of a high ratio for $R_T : R_I$. Later components in the Decay circuit ensure that this pulse does not get through to the preamplifiers. The values established for $R_T$ are critical in obtaining maximum touch feel, and since they obviously take a fairly high current drain in the rest position, consumption has been minimised by the use of slightly higher values than optimum at the extreme ends of the keyboard. The attack trigger decays very quickly ($C_T R_I$) due to the necessarily low value of $R_I$. The attack level is proportional to the average speed of depression of the key over the full travel, which is a very similar situation to the final key velocity characteristic of a conventional piano since the latter is normally achieved by an even application of energy.

PE JOANNA

PART 3

By A.J. BOOTHMAN B.Sc.
DEcAY CHARACTERISTIC

The Decay circuitry is shown in Fig. 3.2 together with the resulting characteristics in the various modes of operation. The circuit consists of a capacitor $C_s$, which stores the energy passed to it from the attack pulse, a Damper and Early Decay circuit, and a chopper circuit via which the envelope is modulated to introduce the pitch.

At the moment when the keyswitch reaches the rail busbar, as described in the previous section, the rail voltage is applied to the Damper circuit and the attack pulse appears at the isolating diode $D_I$ in Fig. 3.2. Damper diode $D_D$ normally holds the voltage across capacitor $C_s$ to nearly zero via the damper resistor $R_D$, but the application of the rail voltage lifts the voltage on the cathode of $D_D$ to approximately three volts. Thus as the attack pulse is applied to $C_s$ through diode $D_I$ the capacitor is allowed to charge to a voltage determined by the ratio of $C_s$ to $C_T$, followed by a quick decay to a level of three volts plus the forward volt drop of diode $D_D$. This action is termed the “early decay”; and whilst it is fast compared with the final decay action, it is long compared with the collapse of the attack pulse ($C_T R_I$), such that it is not influenced by the touch portion of the circuit which is isolated by diode $D_I$ immediately after the attack voltage has appeared. The early decay characteristic emphasises the percussive nature of the instrument.

Assuming the key remains depressed the voltage across $C_s$ will continue to decay, but at the much slower rate defined by resistors $R_A$ and $R_B$. It will be shown later that the chopper transistor works on a $1:3$ mark space ratio, such that for three quarters of the period the decay time is determined by $R_A$, and for the remaining quarter of the period it is defined by the sum of $R_A$ and $R_B$. Different values of $R_A$ and $R_B$ are used for each octave to give a variation in decay time of from approximately 6 seconds to 3 seconds across the compass.

If the key is released before the voltage has fully decayed, the damper resistor $R_D$ will determine the rate of final decay. This action will however be overridden if the sustain pedal is used since the voltage on the cathode of $D_D$ is pulled up by the sustain voltage in a similar manner to the damper release action described above. Release of the sustain pedal brings back the $C_s R_D$ decay as before.

Fig. 3.2. Basic Decay circuit and curve
Fig. 3.3. Complete Envelope circuit

Fig. 3.4. Harmonic spectrum of basic waveform is shown on right

Fig. 3.5. Circuit of an Envelope Board
Fig. 3.6. Component layout and etching details for one Envelope Board
together into the circuit shown in Fig. 3.5. The input frequency is obtained from the gate outputs on the Tone Generator Board, described earlier, and is divided by sixteen (D) of the input frequency.

Four outputs at half (A), one quarter (B), one eighth (C), and one sixteenth (D) of the input frequency are produced by a divide-by-sixteen counter, which has four inputs at half (A), one quarter (B), one eighth (C), and one sixteenth (D) of the input frequency. The divider input is fed into the circuit shown in Fig. 3.4, together with its harmonic spectrum. This is a relatively easy waveform to handle in circuits which are inherently non-linear and contain five key inputs, one sustain input, and one pitch input. The outputs are grouped to cover the bottom two octaves, the middle two octaves, and the top octave, at separate output terminals. The board requires only one 5 volt supply, to power the divider.

ENVELOPE BOARD CONSTRUCTION

Each group of Envelope circuits is constructed on a printed circuit board 203 x 76mm, the etching and drilling details for which are given in Fig. 3.6 together with component details.

To assemble the board the terminal pins should be fitted, followed by resistors, capacitors, diodes, transistors and integrated circuit. It is important that both the transistors and the integrated circuit should be inserted with the correct orientation.

DIODES

The author has used diodes in the prototype which can be described loosely as manufacturer's rejects, of silicon planar type in DO-7 encapsulation. To test the diodes a multimeter was used with 20kΩ/volt sensitivity (1kΩ range). Diodes were rejected where a movement of the needle was observed in the reverse polarity position, whilst the forward resistance was generally of the order of 12kΩ, although no specification was applied to this parameter. Occasionally a diode selected in this way gave some trouble if used in the output position (breakthrough) but the success rate was very high, after the diodes had passed the test. The forward resistance is measured when the negative lead of the multimeter is connected to the anode, and the positive lead to the cathode of the diode.

TESTING THE ENVELOPE BOARDS

The Envelope Boards can be tested one at a time using the jig described in earlier articles. Since the power supplies are unregulated (apart from the 5 volt logic supply) the warning is repeated to keep a check on the supply levels, particularly to the Tone Generator Board, whilst performing any partial check-out experiments.

NOTE: In Fig. 2.3 the 9V and 17V legends should be reversed.

Next month: Voice Filters and final circuitry

POINTS ARISING

ULTRASONIC DOPPLER SHIFT INTRUDER ALARM (March 1975)

The battery and S1 connections as shown in Fig. 5, page 208, should be reversed to agree with the circuit diagram of Fig. 2.

LIGHT PIPE (January 1975)

Parts list, page 31, Veroboard dimensions should be 24 strips by 37 holes.

THERMOMETER/CONTROLLER (December 1974)

In the component layout of Fig. 2 the circuit points 1 and 8 should be reversed together with their polarities. In the Veroboard cutting details there is no need for a cut at B5, Fig. 2. In Fig. 3, the switch positions 3 and 4 should be identified 0 to -100°C and 0 to +100°C respectively.
IN NEXT MONTH'S ISSUE...

T.V. SOUND UNIT
A sound unit designed to detect the 6MHz radiation from a t.v. set i.f. strip and convert this into quality sound output suited to processing in the normal domestic hi-fi equipment, thus avoiding the hum and narrow bandwidth problems normally associated with t.v. sets.

8-Channel Logic Trace Multiplier
Converts normal single-beam oscilloscope into an 8-channel unit for logic waveform examination; or a double-beam unit into a 9-beam instrument capable of displaying one channel of analogue data and eight of logic.

DIGITAL CLOCK
An electronic clock using proprietary components to achieve a simple and sensible design suited to use on 50 or 60Hz mains as either a 12 or a 24-hour unit with equal facility.

PRACTICAL ELECTRONICS
AUGUST ISSUE ON SALE JULY 17, 1975—PRICE 30p
PLACE A FIRM ORDER WITH YOUR NEWSAGENT TO AVOID DISAPPOINTMENT
This is the second and final part for setting up the Minisonic for performing the specially prepared composition “Symbiosis”.

**SEQUENCE I TO O**

This is the central section of the piece and the one requiring the most careful setting up. The pitches (which appear on the score as thick horizontal lines tapered at the end) are crucial to the effect produced.

Firstly the keyboard must have its Span set to give an equal-tempered scale (i.e. 12 equal divisions of pitch from one note to its counterpart an octave higher). Set KBD CON Span to 5, adjust KBD CON Tune to a comfortable mid-range level (about 6 with VCO2 Freq at 62). Set the note a at Concert A pitch (440Hz) using some external musical instrument. When you have this, insert a spare 3.5mm jack into the keyboard over-ride plug of VCO1. Now tune VCO1 to an octave below the note on VCO2. This is now your standard reference frequency. By gradually adjusting KBD CON Tune and Span you will eventually reach a perfect octave span. This will take quite a long time to achieve, so do not be dismayed if things do not go well right away. Once the Span is fixed the niggling problems are over. Make quite sure that you do not accidentally move KBD CON Span whilst working on this sequence or all the blood, sweat and tears will have to be re-lived.

Remove the jack plug from VCO1 keyboard over-ride and re-tune the oscillator to an octave below VCO2. The two v.c.o.s will track each other quite faithfully over a large part of the keyboard’s range. The rest of the settings can now be made quite quickly.

For controls:

- **VCA1 and 2**
  - Level 11
  - Attack 2
  - Decay 3-8

- **ES1**
  - Attack 1
  - Decay 4

- **ES2**
  - Level 11
  - Q 9
  - Freq 7-5
  - Fully clockwise

- **VCF**
  - Level 11
  - Q 11
  - Freq 6-8

- **CE**
  - Fully Clockwise

- **VCOs, KBD CON**
  - as above

For patch-cords:

- 3D to 5C; 3C to 3F

As you will see from the score there are 15 repetitions, lasting eight seconds each, of a simple two-note figure along the bottom line. The first (A) lasts for two seconds, the second (A#) lasts for six seconds. As you play these two notes, touch the keyboard for only about half a second to allow the resultant harmonics to sing through. With the control settings given the A# will last about nine seconds, so the continuity of line is built in.

**ADDING REVERBERATION**

The last refinement concerns the tape machine. Arrange your input and output levels on both the mixer and the stereo machine (track one) so that a small touch of tape reverberation is added to the sound. Too much will muddy the signal, too little will take away its resonance. Make two separate recordings of this sequence of events; the second one will be used again towards the end of the piece.

At letter L you are free to choose which notes you play provided: (a) they begin at about one per second and accelerate to no more than three per second, and (b) they do not wander very far in pitch from the four or five notes immediately above A#. At letter M you increase the amount of tape feedback until the sounds you are making distort into a general mess of reverberant tape noise; this reaches its peak after four seconds, and over the next ten seconds ease the feedback down to a level where the sound dies away of its own accord.

Having laid down one line on track one, change over to record on track two and set up the synthesiser for the line of thick horizontal strokes and the wedge-shapes above them. This musical line is dealt with in a similar way to the material just completed, although the control settings and patches are different—except, of course, for KBD CON Span and VCO2.

For controls:

- **VCA1**
  - Level 11

- **VCA2**
  - Level 1

- **ES1**
  - Attack 1; Decay 3-2

- **ES2**
  - Attack 1; Decay 1

- **VCO1**
  - Level 1

- **VCF**
  - Level 11
  - Q 11
  - Freq 6-8

- **CE**
  - Fully Clockwise

- **N**
  - Level 3

For patch-cords:

- 3C to 3F; 3A to 3E; 3D to 1A

Set the previously recorded channel running. As soon as you have heard the first two notes of the
recorded sequence, add the next two notes (c' and c#) in equal time—i.e. two seconds after the prerecorded second note and lasting two and six seconds respectively, meanwhile increasing the level on the mixer from silence to a comfortable maximum over 24 seconds. When you arrive at letter L try to follow the speed of the notes in the recorded channel without wandering too far in pitch from c# and again, at M increase the reverberation as before until it overwhelms the system and then is allowed to die away.

The final overlay does not require tape reverberation, so feed both the recorded channels through the mixer into the second tape machine.

**IMPROVISATION**

The score at this point allows for some freedom of melodic line; for 40 seconds you improvise on the notes f, a, f#, c#, and d#, and for 48 further seconds the notes f#, a, f, and g. At letter L you stop playing until letter N where two slow notes appear amidst the aftermath of the tape reverberation—g following by f. The settings for this line of music are:

- **VCO1 and 2**: As previous setting
- **KBD CON**: Ditto
- **ESI**: Attack 2.5; Delay 4.5
- **CE**: Fully clockwise
- **VCF**: Level 11; Q 11; Freq 3.5

For patch-cords: 3D to 1A; 3C to 3F; 5D to 3E.  
At letter O the tape is cut.

The final triangular block in this sequence is a cataclysmic slam of white noise which is tape reverberated and allowed to die at its own rate, recorded separately and spliced on to the previous recording. The control setting is:

- **VCA1**: Level 11
- **VCO1**: Level 1
- **ESI**: Attack 4
- **N**: Level 10

For patch-cord: 3A to 1A.

**FINAL SEQUENCE: P TO END**

Between P and R three separate kinds of sounds are heard in counterpoint. The first to appear (small black arrowheads in the score) is a sequence of band-pass filtered white noise; the second (shown as a wavy line) is a modulated and filtered VCO signal; the third (small egg shapes) is a short-lived "Wah-Wah" sound.

The recording procedure is identical to that used in Sequence D to I but, of course, this time you need to make three separate control settings and patches. If you are to save time in producing this Sequence then pretty precise timing will be required between P and S; the arrowhead sign appears consistently between P and Q, once only between Q and R, and very exposed between R and S—and all this over almost two minutes' duration. Similarly the occurrence of the other two symbols which appear at various times after Q.

The KBD CON Span is not critical in this Sequence since the randomness works much in the same way as the counterpoint beginning at D. However, the egg-shaped symbols must be kept around mid-range and the overall speed of events is slower than before.

Begin by recording, with the aid of a watch with a seconds hand, the arrowheads at a fairly high dynamic level throughout; the lowering of dynamic at Q et seq. can be effected on the final dub using a mixer control. The single arrowhead between Q and R will appear at approximately 71 seconds from the beginning. Record the whole of this line of music on your second tape machine. "Arrowhead" control settings are:

- **VCA1**: Level 11
- **ESI**: Attack 1; Decay 2.5
- **VCO1 and 2**: Level 1
- **N**: Level 9
- **VCF**: Level 11
- **Q**: Level 11
- **FREQ**: 7
- **VCO1**: Level 10
- **Q**: Level 11
- **FREQ**: 6-5

For patch-cords:

- **3D to 1A; 3A to 3E; 2E to 3F**

Next play back the recording from the second tape machine through the mixer onto track one of the stereo tape machine along with the egg-shaped symbols. Again you will need to "watch the clock". Do not forget to let the tape run well over the 113 seconds required before switching off otherwise unwanted clicks will occur in the finished sequence.

"Egg-shaped" control settings:

- **VCA1 and 2**: Level 1
- **ESI**: Attack 2; Decay 2.5
- **VCO1**: Level 10; Freq 7
- **VCO2**: Level 10; Freq 6.5
- **VCF**: Level 11
- **Q**: Level 11
- **FREQ**: 4
- **CE**: Fully clockwise
- **KBD CON**: Tune 4; Span 5

For patch-cords:

- **3D to 1C; 1D to 3E to 5D; 3F to 3C**

The next overlay will be recorded on to track two of the stereo tape machine. Your second tape machine has the tape made earlier of the eight-second note patterns in Sequence I to P. This will be fed in at R, rather quietly, just after you have finished your last bit of stylus work on the wavy line. For "Wavy Line" controls:

- **VCA1 and 2**: Level 1
- **ESI**: Attack 1; Decay 2.5
- **VCO1**: Level 11; Freq 4.5
- **VCO2**: Level 11; Freq 7
- **VCF**: Level 11
- **Q**: Level 11
- **FREQ**: 4
- **CE**: Fully clockwise
- **RMOD**: Level 10
- **KBD CON**: Tune 6-5; Span 11

Patch-cords:

- **F1 (over-ride plug); 3E to 4D; 3C to 3F; 4E to 5D; 3D to 1C**

VCO1 frequency may need slight adjustment in order to give this sound a distinctive stuttering effect.

The last three surges of white noise are dealt with manually by means of the VCF frequency control and then spliced on to the rest of the work. For white sound controls:

- **N**: Level 9
- **VCF**: Level 11
- **Q**: Freq as required.

All other units level 1.

Patch-cords:

- **3D to 1C; 3A to 3E**

And that completes "Symbiosis".

© Practical Electronics 1975

July 1975 579
SOLID-STATE POWER CONTROL

THE CONTROL of power to fairly large unity power factor loads, that is loads which do not normally include inductive and capacitive items, such as electrode water heaters and radiant heating processes, has always been difficult for two basic reasons.

The already well-known phase control technique which is used for power control in resistive loads, as shown in Fig. 1, is just out of the question since it causes disturbances in the supply waveform as in Fig. 2.

Such disturbances can be avoided by using zero-crossover switching, Fig. 3, when the power is controlled by allowing more or less cycles of the supply to pass to the load. Switching of the selected cycles occurs as the voltage (or current) passes through the zero condition, thus avoiding r.f.i. problems.

However, if a wide area of control is to be achieved as from zero to 100 per cent with a three-phase supply, then a new problem appears; lamp flicker can be induced because of subharmonics met in the various combinations of switching. Equally, conduction sequences can introduce periods of d.c. in the load which, for electrode water heaters, would cause electrolysis.

Two workers at the University of Nottingham, R. M. Davis and B. R. Downing, have developed a solid state system for control of power under such circumstances which avoids the problems.

SWITCHING SEQUENCE

Taking the case of three phase resistive loads and in particular an electrode water heater as an example, their method can be described with reference to Figs. 4 and 5. With the load in a star-delta configuration and the constraint that the triacs be switched only at zero crossing, a switching sequence was developed.

With a switching sequence which repeated itself every three cycles the number of different permutations in which the three triacs could be switched can be shown to be in excess of $2 \times 10^6$ but this number includes many identical power levels and many sequences which would produce a d.c. component.

A computer selection programme was utilised to remove these problem sources altogether, together with those other sequences which might produce 16Hz or 25Hz lamp flicker, and a final set of 24 acceptable power levels were produced.
for channel changing, and analogue (gradual) adjustments to such parameters as volume, colour and brilliance.

The new devices use discrete frequency steps in the 30kHz to 45kHz band and these are crystal-controlled at both transmitter and receiver to avoid incorrect triggering. Cost is envisaged to be in the region of £10/pair for 15 channels and £15/pair for the 30 channel. The final cost to the set user would of course be more.

Further details from ITT Semiconductors, Footscray, Sidcup, Kent.

SINGLE IC TV SOUND CHANNEL

The TDA 1190 is a new integrated circuit from SGS-ATES which, with the addition of a few external components, forms a complete TV sound channel taking the sound i.f. from the tuner and producing up to 4.2W into a 16 ohm load.

The input limiting voltage of the i.f. section is only 30μV and the electrical characteristics remain constant over the range 4.5 to 6MHz making the i.c. suitable for use with all television standards.

A single resistor is used to set the a.f. amplifier gain and a single capacitor sets the upper cut-off frequency. There is d.c. volume control which can be achieved by connecting a variable resistor between an i.c. pin and earth. This gives a control range of typically 90dB.

Supply voltage can be anywhere between 9 and 28V.

Further details from SGS-ATES, Planar House, Walton Street, Aylesbury, Bucks.

QUAD 80-BIT STATIC SHIFT REGISTER

Another new i.c. from SGS-ATES is the M142, a quad, 80-bit static shift register. Most semiconductor manufacturers produce quad 80-bit MOS devices, but the M142 is unusual in that it only requires a single 5V supply line. This completely eliminates the need for interface circuits when using the device with TTL.

Each of the four 80-bit shift registers has an independent input, output and recirculate control, though the single clock line is common to all four registers.

The data can be shifted into or out of the registers at anything up to 3MHz. Total power dissipation is a mere 125mW.

ULTRASONIC I.C.

Remote control of T.V. sets, particularly colour sets, is a subject which has gained particular interest in manufacturing circles for some time now. Various methods of linking the hand-held control unit to the set have been proposed ranging from the obvious hard-wired style through to infra-red and ultrasonic linking.

Each method has associated advantages and disadvantages but obviously any solution using hard wiring is out. Of the others, a great deal depends on the sound or light characteristics of the domestic environ.

After much deliberation and research, ITT Semiconductors have come up with an integrated circuit ultrasonic solution to the problem using two basic chips, a transmitter and a receiver. These are available in 15-channel and a 30-channel form as pairs and can be used to effect both discrete switching functions...
A GENERAL purpose oscillator is a useful item of test gear in any electronic workshop. The instrument described in this article is intended for audio, digital and general purpose use. The design employs simple components which are readily available from component suppliers. Output frequency is continuously variable over four decade ranges from 10Hz to 100kHz and the output signal, which is 10V peak-to-peak, can be attenuated with a switched attenuator down to 1mV.

The output will drive loads down to 600Ω on the 1 to 10mV ranges and 100kΩ on the ranges above 20mV.

The oscillator requires a positive and a negative 15V supply. Readers having suitable external power supplies can economise by using such a source. However, the full design incorporates a suitable power supply since we believe that most people will prefer a compact, self-contained instrument.

OSCILLATOR

Fig. 1 shows the sine oscillator circuit. In this circuit an SN 72709 integrated circuit IC1 is wired as a thermistor-stabilised Wein Bridge oscillator, the main requirements of which are to produce positive feedback with unity gain. In this instance the Wein Bridge supplies the positive feedback required, but in doing so attenuates by 1/3. Therefore, to sustain oscillation the resistor ratio R5 to R3 achieves the required gain of

By J. SMITH

Fig. 1. Circuit diagram of the sinewave generator and output amplifier/attenuator
Fig. 2. Double-rail power supply for the complete generator

3; here R5 is a thermistor. The circuit incorporates frequency compensating components C7, C6 and R4 to form a basic stable amplifier.

The stabilisation thermistor, R5, controls the output voltage level: an increase in voltage will heat up the thermistor, so decreasing its resistance, and reducing the gain. Conversely, a fall in output voltage reduces the power dissipated in R5, so it cools down, and its resistance increases. This arrangement stabilises the output level of the oscillator. This output feeds the positive feedback loop via the frequency selective components C8 to C11 and VR2 to pin 5 of IC1.

The product of capacitance C and resistance R determines the frequency of oscillator output according to the formula:

\[
\text{Frequency} = \frac{1}{2\pi CR}
\]

Since in this oscillator both the series resistance R7 and the variable resistance VR2 affect the frequency, we must substitute \((VR2 + R7)\) for \(R\) in the formula, so that in this instance:

\[
\text{Frequency} = \frac{1}{2\pi C (VR2 + R7)}
\]

Because of its limited slew rate the 72709 operational amplifier IC1 will produce a distorted large signal output at high frequencies, so the output swing is limited to a few volts. The Zener chain, R1, D1, ensures that the swing is either side of earth potential.

Coupling the limited output from IC1 to a transistor amplifier TR1 through capacitor C12 produces a high signal level. The amplified oscillator signal appears across R10, the collector load of TR1. This signal feeds the amplifier via switch S2 and C13 to the output driver circuit TR2/TR3.

OUTPUT ATTENUATION

The square wave generator is an add-on circuit which one can omit readily by coupling directly through C13, so leaving out the sine/square switch S2. TR2 and TR3 feed the output signal to a simple attenuator circuit, which gives off-load peak voltages from 10V down to 1mV in a 10, 2, 1 sequence.

Loads down to 600Ω on the 1 to 10mV ranges and loads of 100kΩ or more on the 20mV to 10V ranges will have little effect on these output voltages.

Readers who have suitably stable power supplies to attach to it will find that the circuit shown in Fig. 1 makes an extremely simple and useful instrument in its own right. Anyone requiring more accurate control of the output voltage can easily fit a meter circuit measuring the 10V peak across R17. In such an arrangement varying R10 or R11 by a small amount before making each measurement will adjust the output voltage to a pre-set level. We have not included such an arrangement since the instrument is stable enough for the majority of applications.

POWER SUPPLY

As many readers who decide to construct this instrument will require a self-contained unit, a suitable stable power supply is given. Fig. 2 shows the circuit diagram for this supply.

In this circuit 40V output transformer T1 together with diode bridge D1–D4 and the smoothing capacitor C1 provide a roughly smoothed output of 55V. This voltage feeds the Zener chain D5 to D8 through resistor R1 to provide the reference voltages shown on the circuit diagram.

The roughly smoothed d.c. also passes to a series regulator TR2. Primarily this section of the instrument provides a 30V stabilised supply. IC2 samples the output voltage through R2 and compares it with a reference voltage of 30V developed at the junction of D5 and D6. The error signal passes via R3 to amplifier TR1 which drives the series regulator TR2, thus forming a conventional 30V stabilised supply. IC2 changes the 30V supply into the ±15V supply required to drive the oscillator.

Because IC3 will only function correctly with the balanced load of the oscillator, this arrangement is quite unsuitable as a general purpose power supply and on no account should be used as such.

The two circuits shown in Figs. 1 and 2 together make a very compact instrument for constructors, who do not wish to incorporate the square wave circuits.
SQUARE WAVE GENERATION

The sine wave oscillator is designed so that the square wave circuit is add-on, as it were. This enables users not immediately interested in square waves to use the signal generator and to add the squaring facility later. Fig. 3 shows the circuit diagram of the square wave generator with details of S2, Fig. 1, included.

When S2 is switched to square-wave, the sine wave signal passes to a Schmitt trigger circuit consisting of TR1 and TR2. In this trigger circuit TR1 is normally off and TR2 is fully conducting since its base is driven from the $-15V$ line via R4 and R6; the circuit remains in this condition as long as a positive half-cycle is applied to TR1 via R1.

When the sine wave input falls through zero to a negative potential, TR1 starts to conduct and the potential at its collector starts to fall, so reducing the current through R5. This change in current is transferred via the emitter of TR2 to the emitter of TR1 and encourages TR1 to “switch on” even faster, so the circuit “changes over” regeneratively.

A similar regenerative action occurs as the sine wave passes from negative to positive. The collectors of both TR1 and TR2 show a square wave signal and that from TR2 passes to amplifier TR3 which ensures that the output signal switches between $\pm 10V$.

**Fig. 3. The squarewave generator section circuit**

**Fig. 4. General arrangement of the circuit boards and main components on the front and back panels**

**COMPONENTS . . .**

<table>
<thead>
<tr>
<th>Resistors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>1kΩ</td>
</tr>
<tr>
<td>R2</td>
<td>150kΩ</td>
</tr>
<tr>
<td>R3</td>
<td>2.2kΩ</td>
</tr>
<tr>
<td>R4</td>
<td>2.7Ω</td>
</tr>
<tr>
<td>R5</td>
<td>2.7kΩ</td>
</tr>
<tr>
<td>R6</td>
<td>10kΩ</td>
</tr>
<tr>
<td>R7</td>
<td>10kΩ</td>
</tr>
<tr>
<td>R8</td>
<td>3kΩ</td>
</tr>
<tr>
<td>R9</td>
<td>4.3kΩ</td>
</tr>
<tr>
<td>R10</td>
<td>22kΩ</td>
</tr>
<tr>
<td>R11</td>
<td>75kΩ</td>
</tr>
<tr>
<td>R12</td>
<td>1.8kΩ</td>
</tr>
<tr>
<td>R13</td>
<td>6.8kΩ</td>
</tr>
<tr>
<td>R14</td>
<td>7.5kΩ</td>
</tr>
</tbody>
</table>

All 5% $\frac{1}{2}$W carbon

<table>
<thead>
<tr>
<th>Capacitors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>300pF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semiconductors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TR1/TR2</td>
<td>BC212, 2-off</td>
</tr>
<tr>
<td>TR3</td>
<td>BC182</td>
</tr>
</tbody>
</table>

TR1 and TR2. In this trigger circuit TR1 is normally off and TR2 is fully conducting since its base is driven from the $-15V$ line via R4 and R6; the circuit remains in this condition as long as a positive half-cycle is applied to TR1 via R1.

When the sine wave input falls through zero to a negative potential, TR1 starts to conduct and the potential at its collector starts to fall, so reducing the current through R5. This change in current is transferred via the emitter of TR2 to the emitter of TR1 and encourages TR1 to “switch on” even faster, so the circuit “changes over” regeneratively.

A similar regenerative action occurs as the sine wave passes from negative to positive. The collectors of both TR1 and TR2 show a square wave signal and that from TR2 passes to amplifier TR3 which ensures that the output signal switches between $\pm 10V$. 

**Fig. 3. The squarewave generator section circuit**

**Fig. 4. General arrangement of the circuit boards and main components on the front and back panels**
COMPONENTS

POWER SUPPLY

Resistors
- R1 1kΩ
- R2 10kΩ
- R3 10kΩ
- R4 10kΩ
- R5 240Ω
All 5% + W carbon

Capacitors
- C1 2,500μF, 64V
- C2 2.2μF
- C3 100μF, 50V

Semiconductors
- ICI/IC2 SN72741, 2-off
- TR1 ZN3053, 2N3053
- TR2 ZN3055, 2N3055
- D1, 2, 3, 4 100 V p.i.v. bridge, 40mA (96A, ITT)
- D5 BZY88 C10
- D6 BZY88 C15
- D7 BZY88 CV51
- D8 BZY88 C10

Miscellaneous
- S1 2 -pole mains on/off
- FS1 1A cartridge fuse and holder
- LP1 Neon indicator unit
- TR1 Mains (240) to 40V (20-0-20), 40mA transformer

Fig. 5 (top). Component layout for the power supply board
Fig. 6 (bottom). Wiring details for the layout of Fig. 5

CONSTRUCTION

A standard instrument case measuring 8\(\frac{1}{4}\) x 5\(\frac{1}{2}\) x 5\(\frac{1}{2}\)in (216 x 140 x 140mm), provides a suitable unit in which to house the generator. The photograph of Fig. 4 shows the general arrangement of the three main sections, front panel, main board, and back panel.

First the power supply components are mounted as shown in Figs. 5 and 6, with the exception of the capacitor C1 and mains transformer, on a 55 x 95mm, 0.1in matrix board. The matrix is mounted on the back panel using 4BA spacers to provide the required board clearance. Next mount the transformer and capacitor directly on to the back panel using a “P” clip to fasten the capacitor as in Fig. 4. FS1 and LP1 are omitted in the prototype.

The oscillator assembly is made up on a 175 x 95mm matrix board as in Figs. 7 and 8. This assembly includes the components which comprise the oscillator and square wave generator. The board is mounted on the bottom of the unit, again using 4BA spacers to provide the required board clearance.

Fig. 1 shows the oscillator as two distinct sections, oscillator and output amplifier, and the square wave generator. The recommended layout shown in Figs. 7 and 8 preserves these distinctions.

Board wiring is not critical providing one adopts a sensible approach. Mount all other components having control functions on the front panel, for example the attenuator output switch, S3, with the resistors R18 to R26 mounted on the switch itself.

Finally, attach the flexible interconnecting leads to the oscillator board, power supply and front panel.

Keep the transformer wiring separate and connect it directly to the mains switch S1 and bridge rectifier connections. Make the main earth connection to the chassis. Run the two wires from the output terminals directly to the output switch S3 pins 1 and 11.

The remaining interconnecting wiring in the prototype was divided into three distinct looms, wire idents providing individual wire identification. The first loom consisted of three power supply wires, the second of the wiring concerned with the sine-square switch S2, and the third included the Wein bridge potentiometer wires and the output wiring to the attenuator switch S3. These wires must be screened and the screens connected to the chassis via a tag on the front panel. Keep wire lengths to a minimum, but long enough to enable back and front panels to be laid flat for wiring and test purposes.

COMPONENTS

Close tolerance capacitors in the timing circuits will yield the best results; silver mica capacitors are particularly suitable. Also the twin ganged potentiometer VR1, VR2 needs to be of good quality. Because single screened wire has an inherent capacitance, this affects the frequency output in the 100kHz range, and to compensate for the value of the capacitor, C8 is varied from that determined by the formula. Readers who do not have accurate resistance or frequency measuring test gear should obtain the best possible twin potentiometers they can afford, together with 1 or 2 per cent capacitors in the timing circuits. This helps to increase the accuracy of calibration.
COMPONENTS

Resistors
- R1 2kΩ 5%
- R2 2.2kΩ 2%
- R3 51Ω 2%
- R4 1.5kΩ 5%
- R5 STC Thermistor, R53
- R6 51Ω 5%
- R7 2.2kΩ 2%
- R8 30kΩ 5%
- R9 2kΩ 5%
- R10 11kΩ 5%
- R11 1kΩ 5%
- R12 150kΩ 5%
- R13 30kΩ 5%

Potentiometers
- VR1/2 2-gang linear 20kΩ pot., ±10% tol., ±1% linearity

Capacitors
- C1 500pF 1%
- C2 6,800pF 1%
- C3 0.068µF 5%
- C4 0.68µF 5%
- C5 250µF, 25V
- C6 20µF
- C7 5,000pF
- C8 500pF 1%
- C9 6,800pF 1%
- C10 0.068µF 5%
- C11 0.68µF 5%
- C12 100µF, 50V
- C13 100µF, 50V
- C14 100µF, 5V

Semiconductors
- TR1/2 BC182, 2-off
- TR3 BC212
- D1 BZY88 C15
- IC1 SN72709

Switches
- S1 2-pole, 4-way
- S2 2-pole changeover
- S3 1-pole, 9-way

Miscellaneous
- Matrix board, 175 x 95mm.
- Suitable case, wire, solder

**Fig. 7. Component layout for the oscillator board**

**Fig. 8. Wiring details for the layout of Fig. 7**
CALIBRATION

The dial showing frequency settings may be a simple dial, knob and pointer, or an elaborate linear dial as used on a receiver. But whichever dial one uses, one must calibrate it. To allow for the various types of dial and potentiometer available, the calibration data is tabulated in Table 1. The best way of calibrating the instrument is to measure the frequency and to mark the dial accordingly; the next best method is to measure resistance.

However, if one does not have suitable measuring facilities one can still obtain quite good results by measuring dial positions with a protractor or ruler and using the data given in Table 1. Because the instrument has decade ranges, one needs only to plot one range of frequency.

If the instrument incorporates a linear dial, mark the two end stops to give 1.05kHz and 10.6kHz and use a rule to measure the distance between these two stops.

If it incorporates a rotary dial, mark the end stops to give 1.05kHz and 10.6kHz and use a protractor to measure the angle (in degrees) between them.

Table 1 shows corresponding values of frequency measured directly with frequency measuring equipment, resistance measured with resistance measuring equipment, and the multiplying factor for determining the dial setting.

To calculate the dial setting corresponding to the required frequency, multiply the factor given in column 3 of Table 1 by the angle or distance measured between the two end stops. The result is the angle or distance from the 10.6kHz marker which one should mark on the dial. To illustrate how multiplying the total angle by the factor gives the calibration angle required, column 4 gives the angles calculated for the prototype instrument.

Because frequency is proportional to the reciprocal of resistance, the frequency scale marked on the dial will not be linear.

SQUARE WAVE TESTING

Using a square wave source for testing digital circuits such as counters and frequency meters is a fairly obvious application for these units. In contrast many enthusiasts are not aware of the value of square wave testing of high-fidelity amplifiers.

Gain frequency plots of amplifiers tell us a little about their characteristics, but such a plot does not indicate how the amplifier responds to transient signals. Plotting may miss small changes in level at different frequencies which can contribute to a reduced performance under transient conditions.

A good-shaped square wave signal consists of the fundamental frequency plus a large number of harmonics, which are necessary to form a precise square wave signal. Therefore, when one applies a square wave to an amplifier one is, in effect, sweeping a whole band of frequencies. This means that when one views the square wave signal output with an oscilloscope, one sees the effect of the overall response of the amplifier.

One can investigate the principal characteristics of square wave testing by connecting an audio amplifier to a resistive load and applying a low frequency, low amplitude square wave to the input. This gives rise to the three basic output waveforms shown in Fig. 9b, c and d. Fig. 9a represents the input square wave and also the output waveform which one might expect from a perfectly flat response amplifier.

The curve at b represents the output to be expected from a capacitively coupled amplifier. Here the pulse droops with an amount related to the low frequency characteristics of the amplifier.

Strictly speaking it is difficult to relate droop to the 3dB point in an amplifier, because the rate at which the amplifier falls towards cut-off influences the droop. However, many people assume that a single time constant operates (6dB per octave) and estimate the 3dB point from the droop which this single time constant causes. These estimates are quite accurate enough for most applications. Droop is also caused by the bass cut control of the amplifier, so we can use a square wave source for evaluating the operation of the tone circuits as well.

Table 1: Calibration

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>Potentiometer Resistance kΩ</th>
<th>Multiplying Factor Angle or Distance</th>
<th>Typical Dial Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-05</td>
<td>20-1</td>
<td>1-0</td>
<td>285°</td>
</tr>
<tr>
<td>1-5</td>
<td>13-40</td>
<td>0-652</td>
<td>190°</td>
</tr>
<tr>
<td>2-0</td>
<td>9-05</td>
<td>0-475</td>
<td>135°</td>
</tr>
<tr>
<td>2-5</td>
<td>7-16</td>
<td>0-358</td>
<td>102°</td>
</tr>
<tr>
<td>3-0</td>
<td>5-60</td>
<td>0-28</td>
<td>78-8</td>
</tr>
<tr>
<td>3-5</td>
<td>4-49</td>
<td>0-224</td>
<td>64°</td>
</tr>
<tr>
<td>4-0</td>
<td>3-65</td>
<td>0-182</td>
<td>52°</td>
</tr>
<tr>
<td>4-5</td>
<td>3-00</td>
<td>0-15</td>
<td>43°</td>
</tr>
<tr>
<td>5-0</td>
<td>2-48</td>
<td>0-124</td>
<td>35°</td>
</tr>
<tr>
<td>5-5</td>
<td>2-05</td>
<td>0-10</td>
<td>28-5</td>
</tr>
<tr>
<td>6-0</td>
<td>1-70</td>
<td>0-085</td>
<td>24°</td>
</tr>
<tr>
<td>6-5</td>
<td>1-40</td>
<td>0-07</td>
<td>20°</td>
</tr>
<tr>
<td>7-0</td>
<td>1-14</td>
<td>0-057</td>
<td>16°</td>
</tr>
<tr>
<td>7-5</td>
<td>0-92</td>
<td>0-046</td>
<td>12-8</td>
</tr>
<tr>
<td>8-0</td>
<td>0-72</td>
<td>0-036</td>
<td>10-2</td>
</tr>
<tr>
<td>8-5</td>
<td>0-55</td>
<td>0-028</td>
<td>7-9</td>
</tr>
<tr>
<td>9-0</td>
<td>0-40</td>
<td>0-02</td>
<td>5-7</td>
</tr>
<tr>
<td>9-5</td>
<td>0-26</td>
<td>0-013</td>
<td>3-7</td>
</tr>
<tr>
<td>10-0</td>
<td>0-14</td>
<td>0-007</td>
<td>1-9</td>
</tr>
<tr>
<td>10-6</td>
<td>0-01</td>
<td>0-00</td>
<td>0°</td>
</tr>
</tbody>
</table>
Fig. 9. Squarewave testing waveforms

Fig. 10. High frequency waveforms

LOW FREQUENCY RESPONSE

Fig. 9c shows the characteristic effect of a rising high frequency response. The leading edge of a pulse contains the majority of the high frequencies, so when one increases the treble boost control, the pulse acquires leading-edge spikes. Adjusting the “treble cut” will remove high frequencies from the pulse as shown in Fig. 9d. These tests are normally carried out with square wave frequencies below 500Hz. The low frequency droop characteristics show up even better on lower frequencies, such as 50 to 100Hz, while the high frequency effects are more apparent at the higher frequencies.

HIGH FREQUENCY RESPONSE

At much higher frequencies square wave testing has several useful applications. Fig. 10 shows examples of high frequency waveforms. At 10a, the response of a good amplifier to a well-shaped square wave is shown. This waveform has sloping sides caused by the fall off in high frequency response of the amplifier. Specifications often quote rise times for amplifiers, especially oscilloscope amplifiers. The rise time is the time the pulse takes to grow from 10 per cent of its final amplitude to 90 per cent of its final amplitude, hence the expression “the 10 to 90 per cent rise time t”.

As with low frequency and droop, rise time may be related to the high frequency 3dB point in the amplifier, if one assumes a single time constant cut-off. Since one may measure the 3dB point directly using the sine generator, it is not worth making either of the latter calculations.

H.F. OSCILLATIONS

Waveform 10b represents a more important aspect of square wave testing in which the pulse causes some high frequency oscillation. Oscillations of this type are caused by stray capacity giving positive feedback and instability which shows up on transient signals. The source of such oscillations must be located and stopped.

The waveform of 10c shows a typical underdamped response which one would expect from many electromechanical systems. A transformer coupled circuit, for example, would often exhibit this type of characteristic. After finding a response of this type one would seek out the source of underdamped responses and in an effort to improve performance increase the damping to give a response as near as possible to Fig. 10a.

The frequency at which one should test amplifiers depends upon the high frequency 3dB point f/3dB. One should examine frequencies in the range f/3dB/10 to f/3dB/2 as different effects show up at various frequencies, for example a frequency of f/3dB/4 e.g. 25kHz for a 100kHz amplifier might produce the waveform depicted in Fig. 10a.

ENCLOSURE TESTING

The testing of loudspeaker enclosure damping will also interest the hi-fi enthusiast. In this test the square wave generator must drive a powerful amplifier coupled to the loudspeaker through a high impedance. An impedance some ten times that of the loudspeaker will be necessary using an amplifier which is capable of operating without the loudspeaker load. Few valve amplifiers can be used for this test. The amplifier must also be capable of amplifying at frequencies below that of the speaker resonance under test, and producing satisfactory square waves at 20Hz or less.

Fig. 11 shows the test circuit arrangement. One needs a high gain oscilloscope to see the effects shown in Fig. 12a and b. Waveform 12a is the type of response one should try to achieve while 12b shows an underdamped system. This method provides a means of investigating the effect of various cavities and baffles using a variety of loudspeakers.

Square wave frequencies of the order 20 to 30Hz are necessary for these tests. Removing or omitting the high impedance will cause the amplifier to damp the loudspeaker system (a highly desirable characteristic in practice), but will mask out the effects of the acoustic damping system, which is being investigated.

In square wave testing one must be absolutely sure that the circuits are not being overdriven as this will remove any ringing or oscillatory responses one is investigating, so it is better to start off with a very small amplitude and increase it to the desired level.
THE US SCENE

Arriving in New York for the IEEE electronics show, one expected to find signs of recession and first impressions confirmed all expectations. Unemployment almost 9 per cent which meant 8 million workless citizens. Worse still, a survey showed that of those, over a million had given up all hope of finding a job and were not even bothering to try any more. The city itself is bankrupt—not enough income from rates and taxes to meet its bills. In foreign affairs there was the added depression of the collapse of American policy in South East Asia and little comfort to be had from the Middle East where the Kissinger initiative had failed—at least for the time being.

Enough to give anyone the shivers and suddenly the European situation didn't look so bad after all. But strangely, when the show opened things seemed not nearly so desperate. True, Senator Barry Goldwater in the opening speech of the technical congress said the chips were down, the USA was running into bankruptcy, losing credibility in the world, but his was a political rather than a business speech.

At the New York Coliseum, where nearly 400 companies were exhibiting and attracting 22,000 visitors in three days, there was an optimistic outlook. Were these exhibitors and buyers just whistling in the dark to keep up their courage? This was not my impression. The consensus was that the recession was about to bottom out, perhaps had already done so. Another three months, perhaps, and things would be taking off. In twelve months the overall outlook would really be bright. Old hands in the game remembered being caught unprepared in former trade cycles. They had cut back in times of recession and missed out on market shares when the upturn came. This time they wouldn't be caught with their pants down.

The results were quite contrary to expectations. This was the busiest show I had seen in years and among the least gloomy. It demonstrated that whatsoever the shortcomings of Government—the Americans are still in a state of shock from Watergate and have little confidence in the present administration—the hard core of the US electronics industry is showing resilience and enterprise.

The United States, recession or not, remains more than 50 per cent of the world's total electronics market and should not be neglected. In Europe, and especially in Britain, we are so mesmerised by the new affluence in the States that all eyes are looking East. Those British companies who exhibited in New York were not disappointed.

Companies already established in the US market like Marconi Instruments, Plessey and Ferranti, widened their business base this year. Newcomers like Brandenberg, Mirvalle and the still tiny Linton Laboratories found new markets, new opportunities. And did you know that American semi-conductor manufacturers send wafers to Harwell for ion implantation? Well, Harwell Industrial Research, who offer this specialised service, also did good business.

Ten British companies exhibited. There should have been a hundred. British technology is highly respected in the USA and is in demand provided, of course, the price is right. Our problem is inflation, not technology.

HOT MARKETS

The two hottest and toughest markets in the United States are calculators and watches. The British Sinclair-made model designed for Gillette was tested marketed in San Francisco and St. Louis and, according to reports, exceeded all expectations. It was planned to sell the 4-function, 8-digit model at 30 dollars (£12-50) but the week before the test marketings came out with a competitive unit at 20 dollars so Gillette dropped the price to 25 dollars.

Although the operation was a success, Gillette has now pulled out of this business, blaming unstable pricing. Gillette was reported to have ordered 100,000 calculators for the test-marketing. It was good business for Sinclair because the British company is left with world marketing rights and those machines designed for Gillette have now appeared as the Sinclair Oxford range.

The 5-function 8-digit calculator from Texas Instruments had a retail price of 25 dollars (a little over £10) as I left for home, but even lower prices could be negotiated by individuals at the point of sale in many New York stores. One wag suggested to me that the way things are going the batteries will soon cost more than the calculators. He could be right.

Innovators are already working on getting some added value into calculators by making them part of a larger assembly. For example, by building a calculator into a notebook and daily diary. This model sells for 35 dollars and makes a nice present in a new market dubbed locally as "Gimmick Calculators".

PACSETTERS

Electronic watches are going the same way. If you are a watch manufacturer you can buy the complete i.e.d. electronics kit from Fairchild for a reported 10 dollars (just over £4) in 1,000 lots. This market is somewhat different because a lot of the value of a watch is not so much in the "movement" but in the case.

It is still not clear how many semi-conductor manufacturers will go directly into the manufacture of complete watches but a number have already done so, two of them having already reached the low retail price level of 50 dollars (£25). It's hard to find any other product going up in price but electronics goods still fall in price—Amazing!

Nobody's yet done it but the next step, believe it or not, is the combined wristwatch and calculator in a single case. An enterprising plastics manufacturer has already produced a prototype case which can be plated to look like metal. There are 18 tiny dimpled calculator keys which can be depressed with the tip of a pen or pencil.

Expected to be a popular new line in the States is a calculator variant which caters for the individual (actually, nearly everybody) who runs his bank account perilously near the red. It's called the CheckMaster. You enter in your bank balance and every time you pay by check (we spell it cheque) you key in the amount and it gives you your new balance. If your balance drops below the pre-set level, the alarm goes off. Snapping the lid shut switches the CheckMaster off but the balance remains stored in the memory and shows up again next time you use the machine.

A curvilinear lens on the i.e.d. display gives a very narrow angle of view so that Peeping Toms can't see how hard up you are.
PAGING BY PHONE

Radio paging systems often use a radio frequency carrier, modulated by a sub-audio tone signal to alert the attention of someone carrying the necessary receiver. But usually the centre of paging operations is remote from the transmitter and connection must be via standard telephone lines and these attenuate all signals below 300Hz. Thus to transmit a sub-audio tone from a remote point involves the expense of hiring special phone line connections.

In BP 1 373 748, Motorola Inc. provide a simple answer which could have wider uses in the art of remote control over phone lines. As shown in the block schematic diagram (Fig. 1) an encoder at the centre of operations incorporates a bank of oscillators which develop audio tone signals. These signals, in the range from 300-3,000Hz, can be transmitted without attenuation over the phone line to the transmitter station.

The audio tones produced are exact harmonics of the sub-audible tones which are needed to actuate a paging receiver. In the example given two sequentially received sub-audio tones are needed to actuate the paging receiver and the encoder sequentially develops two corresponding audible tones.

D.C. signals are also sent down the line for transmitter switching, and at the transmitter station the d.c. separator directs these to the transmitter and directs the audio tone signals to an amplifier and bistable clipper.

The square wave signal at the output of the amp and clipper have the same frequency as the tones sent down the phone line. A divider network separates these square wave signals by the requisite number, to produce a second spectrum of square wave signals of the required sub-audio frequencies. For example, 1,800Hz square waves coupled to the divider will be divided by eight to develop 225Hz square wave signals. The latter are coupled to the frequency selector which routes all signals with a frequency in excess of 125Hz to filter 1 and all signals below 125Hz to filter 2.

Filter 1 has low pass characteristics to remove all harmonics above 250Hz and prevent intermodulation products. Filter 2 functions similarly on all frequencies above 125Hz. An automatic gain control circuit (a.g.c.) compensates for filter variation, provides a constant amplitude output signal for all sub-audio tones in the range 65-225Hz and passes them to the transmitter for transmission and reception in conventional manner.

The patent contains detailed descriptions of suitable circuitry for realising the schematic.

**WORLD PATENT INDEX**

Patents reported here are almost exclusively British issues and represent only a few culled monthly, on a purely arbitrary basis, from the vast number (around 50,000) published every year by the British Patent Office. Even more daunting to anyone interested in keeping a close watch on patents for inventions in their own particular field, is the fact that comparable numbers of patents are continually being published in every other civilised country in the world.

The Derwent World Patents Index (WPI) is a weekly publication which seeks to give an early warning of important patents by listing 12,000 per week from 24 countries. The aim is to break through the language barrier and provide a summarised and indexed world-wide surveillance for researchers.

The Foreign Patents Section of the Science Reference Library, just over the road from the British Patent Office, in Southampton Buildings, Chancery Lane, has the WPI material available for the public’s use free of charge.

Part of the Derwent scheme is to identify “basic” and “equivalent” patents as such. As the terms imply, basic patents are concerned with initial protection for new inventions, and equivalents relate to further protection elsewhere. The WPI material, at least initially, is somewhat off putting. A researcher will need time and patience to accustom himself to the terminology and symbols used. American and British patents are logically listed as US and GB, but their normal seven-digit numbers are broken up with hyphens in a manner which may confuse workers used to working with conventional patent numbers.

The Foreign Patents Section enquiry desk has a guide hand-book available to help readers who wish to use the index and need to familiarise themselves with the system. In fields such as electronics, where new developments are continually emerging and there is a real risk of laboratories wasting time by duplicating work already done by others, it could be of value for small or medium-sized firms to form a consortium and use the WPI together.
PHONOSONICS

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

BIOMEDICAL AMPLIFIER (P.E. Jan./Feb. '73)
Multi-function circuits that, with the use of other equipment, can serve as life detector, alarmphone, cardiograph, etc.
Component set and PCB £3.40

PHOTOPRINT PROCESS CONTROL (P.E. Jan./Feb. '73)
For colour and B & W, an indispensable dark-room unit for finding exposure, controlling enlarger timing, and stabilising mains voltage.
Component set (excl. meter) £8.85
Pre-amp circuit board £2.30
Panel meter (1mA) £3.50

ENLARGER EXPOSURE METER AND THERMOMETER (P.E. Sept. '73)
A dual-purpose dark-room unit with good accuracy.
Component set with PCB but excl. meter £4.90
Panel meter (100mA) £3.50

P.E. MINISONIC
A portable, battery or mains operated, miniature sound synthesiser, with keyboard circuitry. Although having slightly fewer facilities than the P.E. Synthesiser, the functions offered by this design give it a greater scope and versatility.
Full details of complete printed circuit boards and discount facilities are in our list. Send S.A.E.

REVERBERATION UNIT (P.E. 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) £8.82
Printed circuit board £2.25
9 inch spring unit £9.45
Panel meter (500mA) (optional) £3.50

ULTRASONIC TRANSMITTER-RECEIVER (P.E. Sept. '73)
A highly sensitive, tight-beam, long-range, "invisible beam" detection circuit with numerous applications.
Component set with PCBs but excluding transducers £4.40

SEMICONDUCTOR TESTER (P.E. Oct. '73)
Essential test equipment for the enterprising home experimenter.
Set of resistors, capacitors, semiconductors, mercury switches and PCBs £8.58
Panel meter (500mA) £3.50

PCB LAYOUT-AND COMPONENT IDENTIFICATION
COLOUR CODE IDENTIFICATION
SUPPLIED WITH ALL PCB DESIGNS BY PHONOSONICS

LIST
ALL PCBs ARE FIBRE-GLASS, DRILLED AND TINNED

POST AND HANDLING
Optional: Fee for compensation against loss or damage of post (U.K., Eire & C.I. only) 35p.
Overseas—will be charged extra, minimum charge 70p. Details of weights, and postage rates will be sent with Eire and Channel Isles classified as overseas for postage purposes.

VAT
Add 25% (or current rate if different) to full total of goods, post and handling.
Overseas—VAT does not currently apply.

PHONOSONICS, DEPT. PE37, 25 KENTISH ROAD, BELVEDERE, KENT DA17 5BW
MAIL ORDER AND C.W.O. ONLY
DON'T FORGET VAT!

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 MUST for any Disco, and a fascinating visual display for the home.

4 channel component set (excl. thyatrons) £1.49
8 channel component set (excl. thyatrons) £2.49
Power supply component set £4.78
PCB for supply power and 8 lamp drivers £1.25
1 A-thyratron thyatron (1 per channel, each) £1.50
Panel meter (1mA) optional £3.50

VOICE OPERATED FADER (P.E. Dec. '73)
For automatically reducing music volume during "Talk-over"—a most useful for Disco work or home-movie shows.
Component set incl. PCB £2.95

TAPE-NOISE LIMITER
Very effective circuit for reducing the hiss found in most tape recordings.
Component set (incl. PCB) £3.30
Regulated power supply (incl. PCB) £3.71

P.E. SYNTHESISER
The well-accepted and versatile large-scale miniaturised Sound Synthesiser complete with keyboard circuits, and having a wider range of facilities than the P.E. Minisonic, although the two may be used in conjunction with each other to great advantage. Published in P.E. Feb. 1973 to Feb. 1974.
Full details of complete sets, printed circuit boards and discount facilities are in our list. Send S.A.E.

HI-FI TAPE-LINK (P.E. Mar./Apr. ’73)
Designed for use with reasonably quiet tape-decks, this high performance pre-amp includes record, playback and metering circuits.
Stereo component set (excl. panel meter) £2.95
Mono component set (excl. panel meter) £1.33
Power supply component set £1.72
Stereo main PCB £2.50
Stereo sub-assembly PCB £6.8p

P.E. GEMINI 25W STEREO AMPLIFIER
An exceptionally high quality Stereo Amplifier system, specifications for which are shown in detail in our list, together with semiconductor requirements.
While stocks last!
Main Amplifier:
Set of resistors, capacitors and preset £5.84
Stereo printed circuit board £1.28
Pre-Amp:
Set of resistors, capacitors, potentiometers and switches £6.57
Stereo main PCB £1.28
Superior tolerance set £1.29
Printed circuit board £4.86
Regulated power supply (as published) £2.84
Set of resistors, capacitors and preset £4.58
Printed circuit board £7.20

WIND AND RAIN UNIT
A manually controlled unit for producing the above-named sounds.
Component set incl. PCB £2.40

P.E. JOANNA
Component set (excl. PCB) £11.11
Component set (incl. PCB) £11.49

Other PCBs (all "as published") While stocks last!

Component set (excl. meter) £8.95
Bench Power Supply (P.E. Aug. '74) £0.60
Digital Power Supply (P.E. Aug. '72) £5.00
Electronic Power Supply (P.E. Nov./Dec. '72) £11.50
SEMICONDUCTOR POWER Supply (P.E. July '72) £5.00
Gemin Stereo Tuner (P.E. June '72) £5.00
Power Stabiliser modules (P.E. Sept. '74) £1.00
Panel meter (100mA) £3.50
Panel meter (500mA) £3.50
Component set (excl. PCB) £8.58
Component set (incl. PCB) £9.00
Component set (incl. PCB) £9.30
Printed circuit board £7.80

ULTRASONIC TRANSMITTER-RECEIVER
A highly sensitive, tight-beam, long-range, "invisible beam" detection circuit with numerous applications.
Component set with PCBs but excluding transducers £4.40

SEMICONDUCTOR TESTER (P.E. Oct. '73)
Essential test equipment for the enterprising home experimenter.
Set of resistors, capacitors, semiconductors, mercury switches and PCBs £8.58
Panel meter (500mA) £3.50

PCB LAYOUT-AND COMPONENT IDENTIFICATION
COLOUR CODE IDENTIFICATION
SUPPLIED WITH ALL PCB DESIGNS BY PHONOSONICS

LIST
ALL PCBs ARE FIBRE-GLASS, DRILLED AND TINNED

POST AND HANDLING
Optional: Fee for compensation against loss or damage of post (U.K., Eire & C.I. only) 35p.
Overseas—will be charged extra, minimum charge 70p. Details of weights, and postage rates will be sent with Eire and Channel Isles classified as overseas for postage purposes.

VAT
Add 25% (or current rate if different) to full total of goods, post and handling.
Overseas—VAT does not currently apply.
**CATALOGUE**

Don't miss your copy of HENRY'S NEW 1975 CATALOGUE

* OVER 5,000 ITEMS — LARGEST UK range of electronic components for home constructors.

* 200 PAGES — Every aspect of electronics and components for amateurs and hobbyists - kits, projects, test gear.

* DOZENS of new lines and new ranges.

* MANY price reductions throughout the new Catalogue.

* A Discount Voucher with every copy, worth 50p.

**FREE TO EDUCATIONAL ESTABLISHMENTS** when ordered on official notepaper.

Write now for your copy, enclosing 65p remittance.

NOW OPEN SUPERMARKET, BROWSE ROUND THE NEW SUPERMARKET AT 404 EDGWARE ROAD.

PC ETCHING KIT
Contains 1lb ferric chloride, 100oa in copper-etching board, D.OX-electro-pon, abrasive cleaner, etching dish and instructions £3.99.

FERRIC CHLORIDE
Anodizing technique using in lbd double sealed packs. 1lb 50p; 3lb £1.90; 10lb £6.40; 100lb £32.

COMPUTER PACKS
Large quantity sheets available, 3lb assorted £1.60; 7lb £2.85; 56lb £13. Pack with about 500 components inc. at least 50 transistors £1. Pack with 100 20V 1A 50V 1W resistors, 100 other parts £1. Pack with 2x1B 2N3969 etc. 50p.

7lb BARGAIN PARCELS
Hundreds of new components — resistors, capacitors, pots, switches. 32 packs with transistors and diodes, also loads of odds and ends. Contents always changing £3.

POWER SUPPLY UNIT
G101. Mains transformer, 2A thermal cut-out. Bridge rect. will give 1.7 to 10.5 V output with 2 x capacitors (provided). With data £1.99.

TRANSISTOR PACKS
Large quantity of mostly unmarked transistors just arrived — samples tested show 75% O.K. All types included — pnp, n-p-n, rf, af, small signal and power. At least 200 for £1.50; 500 £3; 1,000 £5.60.

All prices quoted include UK post and VAT at 8% or 25% as appropriate. Suitable for constructors, kits and equipment wanted for cash S.A.E for list or enquiries.

GREENWELD (PE7)
51 Shirley Park Road, Southamp-

ton, SO1 4FX. Tel (0703) 775391.
Also callers at 21 Depopt Broad-

day, SEB Tel 01-688 2950, and
38 Lower Addison Road, Croydon. Tel. 01-688 2950.

ELECTRONIC FOOTBALL AND TENNIS WITH THE FABULOUS VIDEO SPORT
ON YOUR OWN TV Play three exciting electronie ball games. FOOTBALL, TENNIS, HOLE IN THE WALL on your own TV set. (Postcard 25p each.) Plug Video Sport into your own TV and away you go. Completely safe for your children. And your TV. Maints operated. Our incredible price £3.50 Demonstrations now in all Hi-Fi CENTRES.

**AM/FM MODULES**

LP1175 LP1171 Combined A/F module, together with a small number of P C A Ferrite Array., make up a sensitive FM/AM LW tuner. 6 V battery supply. supplied with data and circuit sheets.

**HVF TV TUNERS**

0.51 Fine-tuning Univ transistor/dual-tuner U.C. output with 2 extra capacitors (provided) £1.20. +37. TYPE B — four-bolt push button (adjustable) £2.50. Duty push tuner £2.50.

**SCREWS**

WASHERS, NUTS, ETC.

BARGAIN PACK FOR HOME CONSTRUCTOR

100 assorted stainless steel screws, nuts and washers — various BA sizes and lengths — all graded for rust prevention £1.50 or 10 bargain packs for £13.50. 100 assorted steel screws, nuts and washers — various BA sizes and lengths — all branded £1.50 or 10 bargain packs for £13.50.

**INSTRUMENT ENGINEERING**

High Street, Riskeley, Bedford, MK44 1DX

NEW! V.H.F. FRONT END/CONVERTOR

- • ADVANCED DESIGN
- • DUAL-GATE MOSFET FIRST STAGE
- • COVERS: AIRCRAFT WEATHER SATELLITES AMATEURS
- • VARICAP TUNED, INPUT 118-150 MHz
- • 1.5 OUTPUT to 7 MHz

A high performance front-end combining high gain with low noise factor (8dB Typ.)
Each unit is fully tested and aligned before leaving the factory
Price £10.90 (includes VAT and P & P.)
Sole Agents: REEDHAMPTON LTD, 192-194 Addison Road, Sealdon, Surrey, CR2 8LB

**FEATURES**

Features glass fibre PCB board. Low noise field transistors, S. I. C. Integrated transistors plus diodes. Designed by Texas Instruments engineers for Henry's and tested & IR. Oversize case £5.75 x 3,6 x 10. Manu factured. Free trial units with every order:

£38.75 (carriage 50p)
£26.25 (carriage 50p)

FREE Send now for our free list No. 36 for our complete range of over 10,000 semiconductor devices at new low prices.

**EXTRA DISCOUNTS**

Semiconductors: Any one type or mixed SI 74 Series ICs — 12% extra 10% -extra 20%.

**TRANSISTORS AND INTEGRATED C. I. S**

TYL 7400 series 1 O from each. Cosmos 4050 1 £1.20 and each. Signet phase locks 1 £1.20. (C. 1. C.) 1.0A power transistors £1.0. 300-10 and 90- range from 1st each. Range of OD types 1 £1.00. Plastic power devices. Rectifiers, etc. £1.00 each and up to £1.20.

**ALL PRICES INCLUSIVE OF VAT**

Electronic Centres
404 406 Electronic Components & Equipment 01-402 3381
309/PA Dasio Lighting High Power Sound 01-723 5663
310 Special offers and bargains store
All mail to 303 dymore Road, London W10 1GW

Prices correct at time of preparation. Subject to change without notice. £5 0 0.

**EXTRA DISCOUNTS**

Semiconductors: Any one type or mixed SI 74 Series ICs — 12% extra 10% -extra 20%.

**TRANSISTORS AND INTEGRATED C. I. S**

TYL 7400 series 1 O from each. Cosmos 4050 1 £1.20 and each. Signet phase locks 1 £1.20. (C. 1. C.) 1.0A power transistors £1.0. 300-10 and 90- range from 1st each. Range of OD types 1 £1.00. Plastic power devices. Rectifiers, etc. £1.00 each and up to £1.20.

**ALL PRICES INCLUSIVE OF VAT**

Electronic Centres
404 406 Electronic Components & Equipment 01-402 3381
309/PA Dasio Lighting High Power Sound 01-723 5663
310 Special offers and bargains store
All mail to 303 dymore Road, London W10 1GW

Prices correct at time of preparation. Subject to change without notice. £5 0 0.

**EXTRA DISCOUNTS**

Semiconductors: Any one type or mixed SI 74 Series ICs — 12% extra 10% -extra 20%.

**TRANSISTORS AND INTEGRATED C. I. S**

TYL 7400 series 1 O from each. Cosmos 4050 1 £1.20 and each. Signet phase locks 1 £1.20. (C. 1. C.) 1.0A power transistors £1.0. 300-10 and 90- range from 1st each. Range of OD types 1 £1.00. Plastic power devices. Rectifiers, etc. £1.00 each and up to £1.20.

**ALL PRICES INCLUSIVE OF VAT**

Electronic Centres
404 406 Electronic Components & Equipment 01-402 3381
309/PA Dasio Lighting High Power Sound 01-723 5663
310 Special offers and bargains store
All mail to 303 dymore Road, London W10 1GW

Prices correct at time of preparation. Subject to change without notice. £5 0 0.

**EXTRA DISCOUNTS**

Semiconductors: Any one type or mixed SI 74 Series ICs — 12% extra 10% -extra 20%.

**TRANSISTORS AND INTEGRATED C. I. S**

TYL 7400 series 1 O from each. Cosmos 4050 1 £1.20 and each. Signet phase locks 1 £1.20. (C. 1. C.) 1.0A power transistors £1.0. 300-10 and 90- range from 1st each. Range of OD types 1 £1.00. Plastic power devices. Rectifiers, etc. £1.00 each and up to £1.20.

**ALL PRICES INCLUSIVE OF VAT**

Electronic Centres
404 406 Electronic Components & Equipment 01-402 3381
309/PA Dasio Lighting High Power Sound 01-723 5663
310 Special offers and bargains store
All mail to 303 dymore Road, London W10 1GW

Prices correct at time of preparation. Subject to change without notice. £5 0 0.
**Voice control**

Sir.—I recently built the "Voice operated Fader" described in your December 1973 issue of PRACTICAL ELECTRONICS. The fader worked quite well apart from one disadvantage. This was that when the unit operated, the signal from the deck was attenuated too much causing an unacceptable interruption in the music.

What was needed was some form of control over the level to which the music was attenuated. My first attempt at providing this is shown in Fig. 1. Although this enabled the final voltage level to which C5 was charged and thus the level of attenuation, to be set, the rate of attenuation was markedly reduced. This was due to the operating point being at the top of the charging curve to C5.

After some thought the circuit shown in Fig. 2 was evolved. This operates as follows: Suppose VR2 is set so that its slider is at 2V and TR4 collector will be at 0.8V and diode D1 reversed biased. Hence, IC1 pin 2 will also be at approximately 0.8V. When TR4 turns off, capacitor C5 charges through R7. When the voltage across C5 reaches 0.6V greater than VR2 slider, D1 begins to conduct. Further increase of the voltage across C5 has little effect on VR2 slider voltage due to its relatively lower impedance than R7 and R10 and therefore IC1 pin 2 remains substantially at 2.6V.

The circuit effectively clamps the rising voltage on IC1 pin 2 (attenuation control input) at any level 0.6V higher than that set by VR2 slider without affecting the rate of rise and hence the rate of attenuation.

Because of the increase in current due to R11 and VR2, R9 will need to be re-calculated to maintain the 9V supply rail.

J. H. Taylor, Sunderland, Tyne & Wear.

**So what!**

Sir.—As a relative newcomer to P.E., I am amazed at some of the comments given with regard to electronically produced or synthesised music. I agree that some of the results are fairly hideous but I feel that some people allow their musical appreciation and technical ability to run away with common reasoning.

I speak as a fairly experienced D.J., also as a fairly experienced technician dealing with radio/radar and so on in the aircraft industry. So what, if a machine is capable of producing over n thousand combinations of notes, etc. and only 100 of them are being used? So what, if a group chooses to use a simple application of £10,000 worth of electronic noise producing equipment? Surely, the general public have a say in the music that gets thrown at them. If they like a particular sound the record sales will reflect this; if it's not liked then it's tough luck on all concerned.

I suggest that if some of your readers are not satisfied with electronic music as it is now, they should make their own recordings, but I, as a D.J. do not relish the thought of playing "Handels Second Logical Computation" performed on an OC21! No sir, the proof of music is in its adaptation, not its rigid application.

M. D. Wells, Hayling Island.

**Borus-calculatii**

Sir.—With reference to the article Mild & Bitter—"The Pocket Calculator Bore" by A.P.S. in your May issue, may I shine a ray of hope by offering a partial solution to the problem.

Recent research in the north-west shows that there exists a mutation of Borus-calculatii-simplex, known as Borus-calculatii-simplex-erroneous, a particularly virulent strain of which appears to originate from the Oxbridge area. As far as can be ascertained, the mutation arose through no fault of the Fish Fryer's Association—from the consumption of questionable chips.

The strain can be readily discerned. On being approached the challenge "0-3.5 = K3+" is given. If the reply "-2.857143" is obtained, then the menace is of the normal strain. If however, the reply is "0.6530612" then the mutant strain has been identified and isolated.

Now for the annihilation of the pest. Leaving the constant of -3.5 still set, ask the menace to perform 80/\(\text{\(\text{\(\div\)}\)}\) 9+ and 90\(\text{\(\text{\(\div\)}\)}\) 9 closely observe his face. There should be some reddening accompanied by bulging of the eyes and general emission of steam. It is of the essence to move quickly at this stage before the blood pressure has a chance to subside.

The next step is to present the sequence "0-3.5 = K36998784" which will give "26972112" instead of "-8990704". Tension will be mounting at this point so step back two paces and ask that 10\(^{-12}\) should be added to, or subtracted from, 10. This final operation will almost certainly give simultaneous bursting of several major blood vessels, which, according to my calculator, should leave the world one (or is it minus six) Borus-calculatii-simplex-erroneous fewer.

R. Lane, Glossop, Derbyshire.

**Moving speech**

Sir.—In your article "Loudspeaker Breakthrough", published in the May edition, the author comments that C. W. Rice and E. W. Kellogg invented what is now known as the "moving-coil" or dynamic speaker "almost forty years ago".

It was in fact ten years earlier—nearly Half A Century ago—in the mid-twenties (not the thirties), when the R.K. was offered to the public. The original production models were all energised from a low-voltage source (a car accumulator!), and in a 1929 wireless catalogue now in our archives, they are advertised side by side with balanced-armature cone units, and even horn-speakers!

Douglas Byrne, G3KPO, The Wireless Museum, Shanklin, I.O.W.
Sixth Sense, or Nonsense

Sir—Experiments with plants were reported by Mr Patrovsky (Readout, January 1975), in which he was able to speed germination and growth rate using either a magnetic field, hand movements of water acted upon by a magnetic field. He felt that the mechanism concerned was "polarisation" of water.

There have been many experiments over the years around the world and some have yielded inexplicable results. A non-technical account of the whole subject can be found in "The Secret Life of Plants" by Peter Tomkins and Christopher Bird; a fascinating book.

One such experiment involved irradiating vermiculite using some kind of electronic apparatus. The vermiculite, which is an entirely inanimate substance, was mixed with the earth in which plants were grown, and resulted in some 186 percent increase in weight of those with irradiated vermiculite over the rest. The whole system was handed over to a commercial firm which tried it out and achieved no increased weight in their plants whatever.

Later the original experimenters themselves (the De La Warrs) repeated the firm's trials at their nursery and again showed increased growth. Finally, they supplied interested nurserymen with two lots of vermiculite. One was irradiated, and so labelled, and the other not. Again, increased growth was found in the plants grown with the irradiated vermiculite. The interesting part of this last experiment was that the De La Warrs in fact did nothing at all to either lot of vermiculite.

Mr Patrovsky was to repeat his experiments by getting some other person to do them, and supplied him with two lots of water, one "polarised" and the other plain, and so labelled, the same increase in growth would most probably be observed even if nothing at all had been done to either supply of water.

The mechanism of this form of communication with plants is entirely unknown and it does the advancement of knowledge in this sphere a disservice by trying to tie it to magnetism, polarisation, radiation or any other well established physical process. Anyone doing so would be inviting scurrility to be either a charlatan or a fool.

That plants take heed of some as yet inexplicable message delivered to them can also be shown by a change in electrical resistance between two say, on a leaf, and lie detectors have been used to show it. This involves passing a current through the leaf and is therefore suspect. Similar results have been obtained, however, using an electrocardiograph, which is a recording instrument susceptible of showing changes of a millivolt or two. Mr Baily reported the same kind of result in "ESP" (April 1974) using a voltage controlled oscillator as an indicator.

When life first started on this planet there must have been a time when there was a little chunk of something different from every other little chunk because it was living. It absorbed energy and nourishment from its surroundings and became larger. At time came when its bulk, and therefore the ratio between mass and surface area, became too large, so it divided into two smaller chunks, to be able to absorb essential nourishment more easily, as did two from a vegetable, that had remained in contact. The process must have repeated itself countless times with the formation later of separate chunks of living matter. It was with obvious advantage for each chunk to maintain some kind of communication with its neighbours, and it is reasonable to assume that such communication existed, and that every chunk of life in a group communicated with every other chunk. As the number of living organisms increased and different types started to appear, such universal communication would have become too complex and so longer advantageous. So presumably links between separate organisms grew less generalised. Links between parts of the same organism became highly specialised and ultimately in animals, for example, the nervous system.

If human imagination can accept the possibility of a perhaps fortuitous grouping of atoms into molecules of some primitive form of protein or all have developed, it should not stretch that imagination beyond its limit to accept as possible that the remnants of this primitive form of communication exist still between humans and plants, and that it can be demonstrated by those with green fingers and possibly by all of us to some extent. If between humans and plants, then it would seem even more likely that it still exists between humans and man.

Telepathists and jibby witch doctors at least, would agree.

Mr Baily (ESP, June 1974) has described experiments where efforts have been made by thought alone to influence a detector producing random readings. If the communication system, whatever its mechanism, depends upon there being living tissue at both the sending and receiving ends, then such experiments are bound to fail. This may not be so, in which case there is presumably another system or sense and the astonishing feats of Uri Geller suggest that living tissue can have some kind of influence on inanimate material.

As an expert and try to probe this almost entirely unexplained region should be as simple as possible. In Mr Russell's "Probability Anomaly Detector" (PE, Feb. 1975), supposing someone is found who can influence it, and then reasonable effects like hand capacity, static charge and so on can be eliminated, as well of course as chicanery, then one would still not be able to tell which part of it was being influenced.

A simpler system is needed. Such a system exists in the form of crystal growth, which some of us will remember from early chemistry days. A crystal of copper sulphate suspended by a strand of glass fibre in a saturated copper sulphate solution gradually grows larger as the water evaporates. It would be a simple matter to set up two equal crystals under identical conditions and try by will alone to influence the growth of one at a time. Nothing could be more inanimate than copper sulphate. Perhaps something involved in animal metabolism would be more likely to be influenced. Glucose, urea or even common salt are possibilities.

This will not appeal to those who feel that electronics ought to be somehow involved. It may not perhaps be generally known that a neon lamp supplied with a voltage on the verge of its striking voltage can be triggered on by light, X-rays, cosmic rays and, who knows, Uri Geller and some of you, the readers—always assuming you have read this far. A possible device consists of a lamp of 180 volts with a 50 kilohm potentiometer across it. The voltage between the slider and one end is applied via a 0.25-0.5 megohm resistor to a 0.1 mF capacitor. The neon lamp, an Osram Osglim, is connected across the capacitor via a pair of headphones. The neon lamp is enclosed in a tin to avoid the effects of light and the potentiometer adjusted so that a few clicks are heard per minute in the headphones. These clicks are due to natural radiation.

A simple experiment might consist of setting the device to give an occasional click and at the start to press simultaneously a typewriter key and the start button of a stop-watch. At each click a letter would be typed and when the bell rang at the end of the line the watch would be stopped. If by willing the right rather than the other pressure line and decrease line by line alternately, a significant difference in time for alternate lines typed could be shown—then such a result would be utterly inexplicable but a basis for further experiment.

R. Parfitt, Croydon.
**NEW! SPACE AGE KITS**

**PRESENTING**

**THE WORLD’S FIRST LED DIGITAL WRIST WATCH KIT**

**SINGLE I.C. WATCH PROVIDES HOURS/ MINUTES/ SECONDS/ DATE ON DEMAND—SAVES BATTERY POWER**

**ONLY £36.50 Complete kit less band**

+ £1.25 Airmail postage, insurance, etc.

**THE LOWEST PRICE ANYWHERE**

**LOOK AT THESE AMAZING FEATURES!**

- Easy 3 button operation.
- Easy to read LED display with anti-glare filter.
- Display hours, minutes, seconds and date on demand.
- Crystal controlled accuracy, adjustable to 2 seconds or better per month.
- Incorporates the latest in solid state technology.
- Quality nickel-silver case included.
- Detailed pictorial instructions supplied with every kit.
- All parts included, except band.
- Batteries included at no extra cost.
- Batteries last up to one full year.

This kit not recommended for beginners.

NOW YOU CAN BUY THE SPACE AGE WATCH OF TOMORROW—TODAY! You don't have to pay £150 for this amazing technological miracle. Order yours direct from the exporter and SAVE up to £112! NO MOVING PARTS: NOTHING TO WEAR OUT! Batteries last up to one full year and are widely available. SILENT OPERATION! BRIGHT LED DISPLAY visible in any light. Readout is on demand only. Batteries last up to one full year. Save over 2112%!

**DIRECT FROM THE U.S.**

**NEW**

**LOW COST DIGITAL MULTIMETER KIT**

with features found only on more expensive types

**NEW BRIGHT YELLOW 0-27m HIGH LED DISPLAY**

**EASY TO READ**

**BATTERY OPERATED - AUTO POLARITY - AUTO ZERO**

- Automatic polarity automatic ranging.
- Measures d.c. and a.c. volts and a.c. current.
- Overrange indicated by blinking display.
- Easy to read 0-27m high yellow LED display.
- Anti-glare display filter.
- High-impact CYCLOLAC case.
- High-Z input assures greater accuracy.
- Batteries operated: 6 x 9V (not included).
- Guarantee: Limited warranty against breakdown within 1 year.
- Complete easy to assemble kit (except batteries and test leads)
- Detailed illustrated instructions supplied with each kit.

Send payment with order (U.S. FUNDS only): BANK DRAFT or INTER-NATIONAL MONEY ORDER (include receipt with order). Shipment made via first-class airmail parcel within five days after receipt of order. Sorry no C.O.D.

**NATIONAL**

**£553 £50 post paid**

**OTHER COUNTRIES**

**U.S. $90.00 postage and insurance paid.**

Sorry no C.O.D.

**EURAY TRADING, INC.**

5531 Dyer Street, Dallas, TEXAS 75206, U.S.A.

Phone: 369 7309 Area Code (214)

**TRADE ENQUIRIES WELCOMED - ALL COUNTRIES**

**Distributed for export exclusively by**

**Cambs. CB4 1NH**

**Church End, Over Church Farm House**

**595**

---

**New calculator ICs/lower prices from Thurlby**

Increasing demand for the XE series high performance calculator chips has resulted in increases in scale allowing us to offer even better value for money.

Thurlby Electronics offer you the opportunity to build yourself an advanced electronic calculator at amazingly low cost using one of the XE series MOS single chip calculator IC's.

Every IC is brand new, tested and guaranteed. It comes complete with full data, circuit diagrams and wiring details covering the use of different types of displays, describing how to construct both very simple and more elaborate keyboards, and explaining the operation of the calculator — both in normal calculations and in more complex operations.

Full money back refund. Cash with order. Postage and packing 25p per order. Please add 8% VAT to total order value.

**XE303 Calculator IC**

New XE303 series with memory and %

- 5 functions, +, -, x, ÷ with automatic constant facility on all 4 plus live % key.
- Full performance memory, store-recall-exchange, or automatic accumulating.
- Full 8 digits with floating decimal point and algebraic logic.
- Built-in clock generator, single power supply.
- Direct segment drive, suppression of non-significant zeros.

**£3.25 + VAT**

**XE202 Calculator IC**

XE202 series 4 function and constant

- Full 8 digits with floating decimal point and algebraic logic.
- Powerful keyed constant facility on all 4 functions.
- Enormous exponent range: 10^19 to 10^-19.
- Single strobe line facilitates very simple keyboard construction.
- Direct segment drive, suppression of non-significant zeros.

**£2.25 + VAT**

**Display driving interface chips**

- TK9 9 digit driver IC suitable for use with XE303 series.
- 75p + VAT
- 7105 8 digit driver IC suitable for use with XE202 series.
- 75p + VAT

**Special magnified LED displays**

9 digit suitable for use with XE303 series.

**£3.75 + VAT**

8 digit suitable for use with XE202 series.

**£3.25 + VAT**

To Thurlby Electronics
Church Farm House
Church End, Over
Cambs. CB4 SNH

Please supply for which I enclose cash/cheque/PO for £ including VAT & postage.

Name

Address
BSR HI-FI AUTOCHANGER STEREO & MONO


PORTABLE PLAYER CABINET


BSR JUNIOR SINGLE PLAYER

Massy duty kapex motor with separate pick-up and fitted 12/76 transformer motor board. £4.95 post 5p.

R.C.S. DISCO DECK SINGLE RECORD PLAYER


SOLID MAHOGANY PLINTH Post 75p

With P.V.C. Cover. Cut out for most record changers. Size 18 x 14 x 7½ in.

COMPLETE STEREO HI-FI SYSTEM

Two full size loudspeakers 12½ x 10 x 8½. Player unit to loudspeakers makes it extremely compact. Overall unit only 12½ x 10 x 8 inches. 3 watts each channel, plays all records 33 1/3 r.p.m., 45 r.p.m. Separate volume and tone controls.

240V AC Mains

Attractive Turntable

Weight 1 lb.

Bar Price £29

£25 Carriage

SPECIAL OFFER! SMITH'S CLOCKSLOCK IS AMP TIME SWITCH 0 TO 60 MINUTES


Our price £2.50 Post 10p.

BLANK ALUMINIUM CHASSEIS. 18 s.w.g. 3 1½ in sides 6 x 6 in 40p; 8 x 6 in 60p; 10 x 7½ in 65p; 12 x 8 in 85p; 14 x 9 in 50p; 16 x 10 in 70p; 18 x 12 in 95p; 20 x 15 in 130p; 1 inch diameter WAVEMATCH CHANGERS, 45s ca.

2, 3, 5, 8, 10, 15, 20, 25, 30, 45, 50, 60, 100, 150, 200, 300, 500, 1000 pבע. Size, 2½ x 1½ x 1¼ in. All sizes at 50p extra.

TOGGLE SWITCHES, sp. 20p; dp. 25p; dp. dt. 30p. Below motor board 3in.


R.C.S. STEREO FM TUNER BRITISH MADE

This completely tested mains powered Hi-Fi Tuner with both European and I.C.A. is British made using the latest circuitry. Post 45p.

R.C.S. GENERAL PURPOSE TRANSISTOR PRINTER MACHINE MADE

Ideal for Mike, Tape, P.U., Guitars etc. with Battery 9-12V or H.T. line 200-300V etc. operation. Size: 11 x 11 x 9 in. Response 85 c/s to 19 kcs, 50 db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. £1.45 Post 10p.

R.C.S. POWER PACK KIT

15 Volt, 750mA Kit £3.25 Post 10p. 15 Volt 1 Amp Kit £5.25 Post 10p.

TUBULAR ELECTROLYTICS (Can Type)

700µF 10V 30p; 500µF 15V 40p; 500µF 25V 41p; 200µF 35V 50p; 100µF 100V 51p; 50µF 300V 15p.

LOW VOLTAGE ELECTROLYTICS

1. 2, 4. 5. 6, 7, 8, 9, 10, 20, 30, 100, 250µF 1.5V 10p.

FERRITE ROD 8 x tin 20p; 8 x tin 20p; 3 x tin 109.

RESISTORS. 1W, 2W. 1W. 20% 1p; 2W, 1W 10p.

100/25V

32/500V

16/350V

459

500V-0.001 to 0.005 4p; 0.110p; 0.25 8p; 0.47 25p.

50/50V

25/25V

2/350V

12 VOLT, 750mA.

Full instructionssupplied.

Battery 9-12V or H.T. line 200-300V d.c. operation.

R.C.S. STEREO FM TUNER

£2.50 Post 15p.

E.M.I. 13x x 8in. SPEAKER SALE!

With tweeter and crossover. 10 watt. State 3 or 8 or 12 ohm. As illustrated. Post 35p


State 3 or 8 or 12 ohm. Post 35p

18 ½ in Base until 80 watter cone surround 86-80

LOUDSPEAKER FRONT GRILLES

Textured strips wrapped in cloth backing. Easily glued on to moderate finishes.

Size 18½ x 10½ in. £7.50

Or size 10½ x 7½ in. £4.50

E.M.I. 6¼in. HI-FI WOOFER

8 in. 120W. Large ceramic magnet. Special Rubber cone surround. Frequency response 50-15,000. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc.

£9.60

ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern in the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Price £3.85. £3.50. B.S.R. £2.65. £2.25. 120W £4.60

GOODMANS 8in. WOOFER

8in. 120W. Large ceramic magnet. £3.50. £2.80. £2.60. £1.95

SPECIAL OFFER LOUDSPEAKERS

3 ohm, 11½ in; 3½ in; 6½ in; 7 x 4½ in; 8½ in; 120W. £3.50. £2.80. £2.00. £1.30

RICHARD ALLANpunk CROSSOVER LOUDSPEAKERS. Hi-fi speaker 8W or 12W, 10 in diameter £8.95. £6.95. £5.50. £3.85. £2.60. £1.50. £1.00. £8.95

CABINETTE MACHINE MOTOR. 6 Volt.

Will replace many types £1.00.

R.C.S. 3 WAY CROSSOVER

Complete with 12½ in lead wired with diam speaker plug. Ready assembled with leads for speakers, bass, mid and treble. Crossover frequencies—600 c/s and £2.25.

VALVE OUTPUT TRANSFORMER 50p.

MICRO TRANSFORMER M.U. metal 10-1. £1.40

POW. FULL-BOUNDED TRANSFORMERS

50 watt... £1.60

100 watt... £2.20

ELECTRO MAGNETIC PENDULUM MECHANISM

1½V Operation over 200 hours continuous on 6V battery, fully adjustable wind speed. Ideal displays, teaching electromagnetism or for metronome, 9c., Post 12p.

R.C.S. RECORD PLAYER AMPLIFIER

2 stage triode pentode valve. 3 watts outputs. Volume on/off and tone controls. Printied circuit £7.50 Complete and tested. £4.50 Phone or write.


BALANCED TWIN BROWSER PEDDLER 5000, 7m, 7.5m. JACK SOCKET Std. open-circuit 7p, closed circuit 9p; Chrome Lock 3p; Lock 7p. Phone Socket 7p.

JACK Plug Std. Chrome 3p; 2-8mm Chrome 3p; DIN SOCKETS 8mm 3p, £3.75. 3 pin DIN Lead 3 pin 9p, 5 pin 5p. DIN PLUGS 8 pin £2.25.

VALVE HOLDERS 5p; CERAMIC 100; CANS 5½ 7½ 11½ 15½ 20½ 25½ 30½ 35½ 40½ 45½ 50½ 55½ 60½ 65½ 70½ 75½ 80½ 85½

HALFE 10p

£2.25

Meet 3 or 8 or 12 ohm. £1.30

Famous make (Value £9) O/U Price £3.50

Can be used on 500 watt auto transformers 250-110V.

VOLUME CONTROLS

80 ohm Coax 5x 5p.

BRITISH EM/FM/TUNING HEART

6½ to 10½ kHz British made. 2 Transistor ready aligned requires 10-7 Mf.s. Complete with tuning capacitors and special experience essential.

Our price £3.50 Post 10p.


DECLASSER 99p.

------------------------------

30% minimum Post and Packing • Callers Welcome

RADIO COMPONENT


596

Practical Electronics July 1975
CUSTOMERS FREE CAR PARK

ALL OUR PRICES INCLUDE V.A.T.

E.M.I. WOOFER AND TWEETER KIT
THE PAIR. Post 40p.
(Available separately. Order 24-25; Tweeter £1.25)
Comprising a full line example of a Woofer 101 x 8in with a massive Ceramic Magnet. 660 Gauss 12,000 lines. Alnico 5 magnet for excellent middle and top response. Also the E.M.I. Tweeter, 5 inch, a brand new item. Perfect lightweight paper cone and magnet disc 10,000 Lines. Strung braces, 3 Yards. Complete with instructions, 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 146,000 Maxwells. Base resonance 40 c/s. Raised 20 volts. NOTE: 2 or 15 or 18 ohms must be stated.

Module kit, 33-17,000 c/s with tweeter, crossover, baffle and instructions. £14-50

Please state 3 or 8 or 15 ohms.

BAKER MAJOR 12" £11-50

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 146,000 Maxwells. Base resonance 40 c/s. Raised 20 volts. NOTE: 2 or 15 or 18 ohms must be stated.

Module kit, 33-17,000 c/s with tweeter, crossover, baffle and instructions. £14-50

BAKER SPEAKERS "BIG SOUND"
Robustly constructed to stand up to long periods of electronic power. As used by leading groups. £9.50 Post 40p

GROUP "25"
12in 85 watt 3, 8 or 15 ohms.
£9.50 Post 40p

GROUP "35"
12in 125 watt 3, 8 or 15 ohms.
£11.50 Post 40p

GROUP "50"
12in 50 watt professional model. 3 ohms or 15 ohms
£22 Post 40p

GROUP "60/12"
12in 80 watt professional model. 8 or 15 ohms
£16

MAJOR 100 WATT TRANSISTOR AMPLIFIER
All purpose transistorised, Ideal for Groups, Disco and P.A. 4 inputs, speech and music, 4 way mixing, Output 8/15 ohm a.c. mains. Separated treble and base controls. Guaranteed, 100 watt, £59 Cash £60 Post 40p

NEW MODEL MAJOR 50 WATT
4 inputs, 2 way mixing, 695-95. Carr. £1. Ideal disco amp.
QUALITY LOUDSPEAKER ENCLOSURE
Tweeter crossed 1in thin wood cabinet. Size 18in x 18in x 8in. Weight 26 lb. This cabinet features a wide mesh Silver Grill covering a separate bass unit, 1-5in. mid range. 1-3in. bass. Resonance 18,000. Ideal for Quad, etc. £4.50

DE-LUXE MODEL IN WOOD CABINET. BLACK. £69.

SUPERB hi-fi speakers
A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Base Resonance 25,000 gauss
Price £15.50

AUDITORIUM
12in. 25 watts
A full range reproducer for high power, Electric Guitars, Public Address, multi-channel systems, electric organs, Ideal for Hi-Fi and Discotheques. Rated 20-14,000 cps
£16 Post 50p

AUDITORIUM
15in. 35 watts
A high wattage loudspeaker of exceptional quality with a level response to 5000 c/s. Ideal for Public Address, Discotheques, Electric organs and all forms of stereo equipment. £22 Post 50p

WAFER HEATING ELEMENTS
OFFERING 1001 Uses for every type of heating and drying applications in the home, garage, greenhouse, workshop, etc. (Available in manufacturing quantities) Approximate size 10x 8 x 1/2in. Loading voltage 220V/250V. 9W. These elements are printed circuit element enclosed in asbestos filled with connecting wires. Completely flexible providing vital heat for photography, etc. Printed circuit elements are made for use in photo-copying and print drying equipment.

WAFER HEATING ELEMENTS Thin £4.35 Post 50p

SPECIAL OFFER
100 Ohm 80 watt Rheostat 2in dia. Ceramic Former. Screw Terminals 2in dia. spindles.

R.C.S. STEREO DECODER
British made. Ready aligned and tested. Complete with instructions. Bass 8 in. x 8 in.

WEYRAUD COILS

DE-LUXE 4 POLE MOTOR
1,400 r.p.m. reversible 48 Volt, spindles 1 in x 1/2in, size £1.25 Post 50p

E.M.I. GRAM MOTOR
120V or 240V 50/60Hz, 4 Pole 700A. Size 2 in x 1/2in.

Special Offer £1.25 Post 50p

CREATIVE WADDELS 18in wide, 30p.

DE-LUXE SPEAKERS
ELAC 9 SQUARE 3:1 $4.50

E.11/1I L760 13,000 lines. Crossover condenser and E.M.I. Specialists 20-17,000 cps

Sherman REELS 50p

Simplex, Double Stack, etc.

WADDELS 18in wide, 30p.

DE-LUXE CABINET WADDELS 18 in wide, 35p.

GOODMANS CONE TWEETER
8in, dia. 18.000 C.P.S. 35 WATTS 8 0hm.

BARGAIN CABLE THERMO TRANSISTOR MIXER
Add musical highlights and sound effects to recordings. Will mix Microphones, tape and center with separate controls into single output. 9 volt battery.

STEREO MODELS OF ABOVE 60-90.

DE-LUXE TWIN GANG £1.20

EATON ERASER & HEAD D:EMAGNETISER
Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V.

WEYRAUD Coils
P0/00C 60p P0/LAC 60p P0/LOC 60p P0/0AC 60p P0/1AC 65p P0/10C 35p PC1 80p Twin Gang £1-20

SPECIAL OFFER
100 Ohm 80 watt Rheostat 2in dia. Ceramic Former. Screw Terminals 2in dia. spindles.

R.C.S. STEREO DECODER

WEYRAUD COILS

DE-LUXE 4 POLE MOTOR
1,400 r.p.m. reversible 48 Volt, spindles 1 in x 1/2in, size £1.25 Post 50p

E.M.I. GRAM MOTOR
120V or 240V 50/60Hz, 4 Pole 700A. Size 2 in x 1/2in.

Special Offer £1.25 Post 50p

Hi-Fi Enclosure Making plans, designs, crossovers data and cubic tables.

CUSTOMERS FREE CAR PARK

OPEN 9-6 p.m. WEDNESDAYS 9.1 p.m., SATURDAYS 9.5 p.m. (Closed for Lunch 1.15-2.30)

SPECIALISTS
357 WHITEHORSE ROAD - CROYDON
(Export: Remit cash and extra postage.)
Practical Electronics July 1975

Buses 50, 68, 139, Rail Selhurst
Telephone 01-684-1665

597
SPAKER BARGAINS

- Type 350, 8 ohm, 20W
- EMI 13in x 9in 3 or 8 ohm

P. & P. 40p per speaker.

CARTRIDGE AND STYLII

- OKI Kit (1 watt iron, 2
- SOLDERING IRONS

1'0147 1'0130 50K/600 ohm. uni-dir.
- '5170 Planet stick metal.
- 17in x 10in x gin with gin X fin or
- VENEER. 12in x 11in x Gin with Gin,
- Tweeter 8 ohm, 30W
- The following, P. & P. 15p per

COMPONENT PACKS

- OKEYNECTOR, rapid connect to mains — single/multiple
- OD .1. L. SOCKETS (Pk of 3)£0.50
- CIF.M. STEREO DECODER (Motorola)
- 5 Audio Power amplifier (National) LM380
- 0 VOLTAGE REGULATOR (Signetics)
- 0 LockFLEX RULE, (Rabone Chesterman), 3'10ft
- SOLDERING IRON, 25 W, (Antext), X25, 240V
- SIGNAL INJECTOR, audio through video signals,
- SOLDING IRONS
- SOLDERING KIT, (pr.)
- ADASTRA 10in, 8 or 15 ohm,
- ELAC 10in 8 ohm Dual cone
- ELAC 61in 8 ohm Dual cone
- Wharfedale SPEAKER
- Baker Group 25
- Adastra 10in. 8 or 15 ohm,
- Emeraude 10in, 8 or 15 ohm,
- COMPONENT PACKS
- BIB ACCESSORIES
- Tape Recording Kit, Ref. 23
- Panasonic Tape, Edging, Ref. 24
- Cassette Tape, Ref. 26
- Cassette Salvage Kit, Ref. 29
- Mylar Halves, Ref. 2A
- Spirit Level, Ref. 46
- Hi-Fi Stereo Test Cassette
- Groove-Kleen Record Cleaner

VAT AT THE CURRENT RATE MUST BE ADDED TO ALL ORDERS

Send 50p for COMPLETE CATALOGUE, refundable upon first order.
ALL OUR MERCHANDISE IS FULLY GUARANTEED
Subject to manufacurers' increase and availability

Riverside Electronics

P.O. Box 470, Manchester M60 4BU

July 1975

Digital Clock Kits Special Offer
£2 OFF

Usual Price (Complete Kit) Exclusive to P.E. Readers
Quick to Build—No Knowledge of Electronics Required

Latest 1975 Design—Only £14
(including P. & P. VAT, Circuit)

Compare our prices

CJL Prices Include P&P and V.A.T.

Audio Hi-Fi Accessories
- Cassette Tape Recorder Kit
- Cassette Splicing and Editing Kit
- Hi-Fi Stereophonic Test Cassette
- Tape Editing Kit
- Groove-Kleen Record Cleaner

Capacitors—Electrolytic-Submin—Mixted £0.50
- Capacitors—P.C.B, Polyester—Mixted Preferred £0.50
- Resistors—Carbon Film—Mixted Preferred £0.50
- Potentiometers—Midget Carbon Track—Mixted £0.50
- Earphone, alesstoscope style, 8 ohm dynamic £1.00
- Hand Drill, (Leysol), compact precision drill, 5/16'' chuck, Gears totally enclosed, S/L bearings £2.99

Integrated Circuits
- Audio Power Amplifier (National) LM380 £1.00
- A.M. Radio Receiver (RCA) CAS132E £1.40
- F.M. Stereo Decoder (Motorola) MC1215P £2.80
- Timer (Signetics) NE555V £0.78
- Voltage Regulator (Fairchild) u7405 £1.70
- Voltage Regulator (Signetics) NE550A £0.80
- D.A.L. SOCKETS (Pk of 3) 8 or 16 pin £0.50

Keylector, rapid connect to mains—single/multiple
leads. Built-in plastic switches, ronw & 13A fuse £3.20

LockFlex Rule, (Rabone Chesterman), 3'10ft

Soldering Iron, 25 W, (Antext), X25, 240V

Very low leakage, 1/8''long/1/16''bit (interchangeable) £2.05

3/32''bit £0.47 3/16''bit £0.47 £1 Element £1.10

Stand, ST3, High grade base, chrome plated

£1.00

Digital Clock Kits

£2 OFF

Usual Price (Complete Kit) Exclusive to P.E. Readers
Quick to Build—No Knowledge of Electronics Required

Latest 1975 Design—Only £14
(including P. & P., VAT, Circuit)

Compare our prices

1. MOS Clock Chip 12—24 hr option £4.00
2. 0 63'' LED Displays (latest Hi BRI Type) £5.00
3. Segment Driver Chip £0.30
4. Pack Resistors, Caps., Transistors, Switch, etc. £1.20
5. Double Sided Glass Fibre P.C. Board £1.00
6. Double-wound Mains Transformer £1.00
7. Circuit Assembly Manual £0.50
8. Stylistically-styled Case (state colour)—Yellow, Orange, Red, Black, White, Mauve, Green, Blue £3.00

C.W.O. to:

Pulse Electronics Ltd

Dept. PE1, 202 Shefford Road, Clifton, Beds.
Tel. Hitchin (0462) 812453
**RELAYS**

PRACTICAL ELECTRONICS

**VARIABLE VOLTAGE TRANSFORMERS**

**INPUT 230/240V a.c. 50/60 OUTPUT 2/3/4 50/60 50/60**

- **SHROUDED TYPE**
  - 200 watt (1) 50/60 c.a.m. £12.00
  - 0.5 KVA (2) a.m. £45.00
  - 2 KVA (10) a.m. £30.00
- **Type for C.V. use £55.00**
- **275 a.m. (6) £105.00**

- **CARRIAGE & VALVE TYPE**
  - OPEN TYPE 1 a.m. (panel mount) £10.00

**L.T. TRANSFORMERS**

**Step up step down**

- 0/1-250 12 volt 2.5 watt £1.75, Post 50p.
- 0/1, 17, 18 volt at 10 a.m. £7.95, Post 70p.
- 0, 6, 7, 8 volt at 20 a.m. £9.90, Post 70p.
- 0, 12, 20 volt at 20 a.m. £10.35, Post 70p.

**RELAY 3-9V d.c. 250 ohm Coil**

- **GEARED RELAY**
  - 50 cycle 115V A.C. £9.12
  - 50 cycle 24 volt £2.75
  - 24 volt 0.5 amp £2.75

**REVERSOVERTIME**

A.E.I. & h.p. reversible motor 100, 120 volt A.C. £19.35

**PROGRAMME TIMERS**

- **A.G. MAINS TIMER UNIT**
  - £12.00

- **STC 6" RED ALARM BELL**
  - £1.35

- **NICKEL CADMIUM BATTERY**
  - 1.5V, 15Ah 12 volt £30.00

<table>
<thead>
<tr>
<th>METERS NEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>90mm diameter</td>
</tr>
</tbody>
</table>

**ROTARY VACUUM AIR PUMP AND COMRESSOR**

**STREET LIGHTING**

**NICKEL CADMIUM BATTERY**

- 1.5V, 1SA battery 12 volt £15.00

**INSULATION TESTERS**

- 500 V a.c.

**CENTRIFUGAL BLOWER**

- 240/230V a.c. 50/60 1/2 hp £15.00

**POWER RHEOSTATS!!**

- **Superior Quality Precision Made NEW POWER RHEOSTATS**
  - New ceramic construction, wire wound, enamel bound, heavy duty, brush assembly, continuous duty rated.
  - 25 WATT 10/25/50/100/150/250/500/1K/5V/2.5K ohm £7.10
  - 50 WATT 1/5/10/25/50/100/250/500/1K/5V/2.5K ohm £12.10
  - 100 WATT 1/25/50/100/250/500/1K/5V/2.5K ohm £18.10

**VAT**

VAT AT THE APPROPRIATE RATE FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE

**SERVICE TRADING CO.**

All Mail Orders—Callers—Ample Parking

DUDLEYET3 BRIDGAM ROAD

CHISWICK, LONDON W4 SBB

Phone 01-995 1560

Showroom open Mon.—Fri.
**BYWOOD ELECTRONICS**

181 Ebbers Road, Hemel Hempstead, Herts. HP3 9RD.

Terms, C.W.O., Access, Barclaycard (quote card No.). All prices on this advert exclude VAT. Tel. 0442 82757

**MINISONIC COMPONENT KITS—PRICES ARE DOWN**

**MINISONIC:**

- **P.C.B. S**
- **EA008a (Main Board),** £3.35. Post free.
- **EA008b (Power supply and Temp. Stabilisation)**, £1.96. Post free.

**CASSETTES**

- **NEW!!!**
- **"SYMBOLIC"**

- Each tape £1.06. U.K. post free.

**POTS GALORE**

24mm Carbon without switch. All values log or lin.

- 5KΩ to 1MΩ: 25p each
- Wirewound 1W semi-precision. All values 10Ω to 25Ω: 82p each
- Min. horiz. carbon presets, 100Ω to 2MΩ: 18p each
- Ceramic presets, horiz. min. 100Ω to 1MΩ: 45p each
- Helical 10 turn W.W. 1KΩ, 5KΩ, 10KΩ £1.10 each

**OTHER ITEMS**

- **ADDED TO FINAL TOTAL OF ORDER**

**TERMS: MAIL ORDER ONLY.**

C.W.O.

Cheques or P.O.s payable to Eaton Audio. Orders over £5 free of P. & P. Otherwise please add 10p in the £.

**FABULOUS—FANTASTIC**

**P.E. ORION**

**ASTRO IGNITION SYSTEM**

Complete Kit of Parts for this well proven Transistorised Ignition System. £3.50

- Ready-built with only 2 connections to alter. £3.50
- Thousands of these units are in use today and have been proven to give the following advantages; fueleconomy, faster acceleration, smoother running, no contact-breaker burning and many more.

**MONEY BACK GUARANTEE**If you are not satisfied. Please state whether positive or negative earth.

- Postage included in above prices but add VAT at 8%

**ASTRO ELECTRONICS**

Spring Bank Road, West Park, Chesterfield, Derbyshire

**SPECIAL OFFER**

Ferranti ZN414 Radio I.C. £1.06

**NEW PRECISION TIMER I.C.**

Ferranti ZN1034E £2.90

Ferranti Applications Booklet for ZN414, 25p includes circuits for earpiece radios, loudspeaker radios, crystal controlled receiver and frequency standard receiver.

**RADNAGE RADIO & ELECTRONICS**

2 Bottom Road, Radnagor, High Wycombe, Bucks.

Prices inclusive plus 15p Post and Packing

Mail order only
WILMSLOW AUDIO

THE Firm for speakers!

SPKERS

Baker Group 255 8 or 15 ohm £8.64
Baker Group 253 8 or 15 ohm £10.25
Baker Group 50/72 8 or 15 ohm £14.00
Baker Deluxe 12in d cone £13.75
Baker Major 15in d cone £11.87
Baker Regent £10.00
Baker Superto £16.12
Baker Auditorium 12 £16.25
Celestion MT1000 8 or 15 ohm £16.95
Celestion PS8 for Unites £22.75
Celestion G10RM8 8 or 15 ohm £22.00
Celestion G12H 8 or 15 ohm £15.00
Celestion G12N 8 or 15 ohm £20.00
Celestion G12C 8 or 15 ohm £23.00
EM 13in x 8in 150 d c ohm £2.94
EM 13in x 8in type 890 8 or 15 ohm £3.56
EM 15in x 8in 20W Base £7.69
EM 9in 9430 6 or 8 ohm £2.90
EM 5in 14A3000 mid range 8 ohm £3.50
EM 21in tweeter 971/25AT £0.77
Eagle DT33 30W tweeter £9.80
Eagle HT15 horn tweeter £4.40
Eagle HT15 cone tweeter £2.06
Eagle CT10 tweeter 8 or 16 ohm £3.00
Eagle MHT15 horn tweeter £4.44
Eagle crossover CN23, CN28, CN218 £1.75
Eagle FR £6.12
Eagle FR05 £9.62
Eagle FR8 £12.31
Eagle FR10 £17.89
Eagle FR15 £23.44
Eagle FR25 £38.97
Fane Pop 10X10 £5.25
Fane Pop 20T20 12in £7.50
Fane Pop 20W10 £12.09
Fane Pop 505 60W 12in £12.75
Fane Pop 60W 15in £13.75
Fane Crescendo 12A 100W 12in £34.50
Fane Crescendo 12B bass £34.50
Fane Crescendo 15W10 £47.50
Fane Crescendo 15W12 £47.50
Fane 801T 8in d c roll surre £6.12
Fane 801T 8in d c roll surre £4.42
Fane DBT 8in d c £4.50
Fane 15in d ribbon horn £14.95
Fane 210 horn £23.50
Goodmans 8P 8in 8 or 15 ohm £5.50
Goodmans 15P 8 or 15 ohm £13.95

FREE with Speaker Orders over £7

Hi-Fi Loudspeaker Enclosures book.
All units guaranteed new and perfect. Prompt dispatch. Cartidge and packing speakers 36p each. 12in and up 50p each, speaker kits 75p each (21, 50 pair), tweeters and crossovers 25p.
Send stamp for free booklet. Choosing a Speaker - including VAT 25% on Hi-Fi, 15% on PA

WILMSLOW AUDIO (Dept. PE)

Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire, SK9 1HF. Discount Radio, PA. Hi-Fi: 10 Swan Street, Wilmslow.

P.E. JOANNA

Electronic Piano

ALL PARTS WILL BE AVAILABLE

Keyboard, Keyswitch, P.C.B.s, Hardware, Semiconductors, Resistors, Capacitors

Complete kits or easy stages
Send 5sp stamp for details

Clef Products

31 Mountfield Road, Bramhall
Stockport, Cheshire SK7 1LY

£16-15

Save your communications problems with 4-Station Transistor Intercom system (1 master and 3 subs), in robust plastic cabinets for desk or wall mounting. Call/Call/Slave from Master to Subs and Subs to Master... idealtly suitable for Business, Nursing, Schools, Hospitals, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 60ft and other accecssories. £1.65pa.

4-STATION INTERCOM

ROSS TAP

Send 5sp stamp for details

WILMSLOW AUDIO (DEPT. PE)

WILMSLOW (DEPT. PE)

The best buy!

AGFA Low Noise Cassettes 
AT LESS THAN HALF PRICE!

AGFA HIGHDYNAMIC SUPER

AGFA STEREO-CHROMIUM CHROMIUM DIOXIDE

Cut-price prerecorded cassettes—send stamp for list

WILMSLOW AUDIO

(DEPT. PE)

10 SWAN STREET, WILMSLOW,
CHESTRE, SK9 1HF

The best buy!

Agfa Low Noise Cassettes 
AT LESS THAN HALF PRICE!

AGFA HIGHDYNAMIC SUPER

AGFA STEREO-CHROMIUM CHROMIUM DIOXIDE

SAME DAY DESPATCH. P. & P. 15p per order

WILMSLOW AUDIO

(DePT. PE)

10 SWAN STREET, WILMSLOW,
CHESTRE, SK9 1HF

Cut-price prerecorded cassettes—send stamp for list

Practical Electronics July 1975
Here's a book of very special appeal to all concerned with designing, using or understanding electronic circuits. It comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regulary published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs. Each of the ten sets – including 29 additional circuits – in this magazine size hard cover book comprises information previously included in the first ten sets of Wireless World's highly successful Circards – regularly published cards giving selected and tested circuits, descriptions of circuit operation, component values and ranges, circuit limitations, modifications, performance data and graphs.
The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

**TECHNICAL SPECIFICATION**

- **Inputs**: Magnetic Pick-up 3mV RIAA; Ceramic Pick-up 30mV; Microphone 1mV; Tuner 100mV; Auxiliary 3-100mV; Tuner 100mV; Main output 2db (0.775V RMS). Active Tone Controls: Treble + 12db at 10kHz; Bass - 12db at 100Hz. Distortion: 0.5% at 1kHz. Signal/Noise Ratio: 68db. Overload Capability: 40db on most sensitive input. Supply Voltage: ±15-25V.

**PRICE £4.75 + £1.19 VAT P. & P. free**

**TWO YEARS’ GUARANTEE ON ALL OUR PRODUCTS**

---

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided, input, output, power lines and earth.

**TECHNICAL SPECIFICATION**

- **Output Power**: 25W RMS into 8Ω. Load Impedance: 4-16Ω. Input Impedance: 4-16Ω. Input Sensitivity: 0db (0.775V RMS). Input Impedance: 4-16Ω. Distortion: Less than 0.1% at 25W, typically 0.05%. Signal/Noise Ratio: Better than 75db. Frequency Response: 10Hz-50kHz ± 3db. Supply Voltage: ±25V. Size: 105 x 90 x 25mm.

**PRICE £6.20 + £1.55 VAT P. & P. free**

---

The PSU50 incorporates a specially designed transformer and can be used for either mono or stereo systems.

**TECHNICAL SPECIFICATIONS**

- **Output Voltage**: ±25V. Input voltage: 210-240V. Size: L70 x W30 x H60mm.

**PRICE £6.25 + £1.56 VAT P. & P. free**

---

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
**Digital Displays**

**LEDs red 13P**

LEDS 200 STYLE. ONLY 13p ea. TLL 200 with CLIP RED 15p ea. TLL 211 & CLIP GREEN 29p ea. LARGE 0.2" & CLIP RED 17p ea. LARGE 0.2" CLIP GREEN 30p ea. 209 STYLE OR 2. ORANGE 29p ea. INFRARED LED (1) £3.50/777 33p.

**Photo IC 81P**

TEC1 PHOTO ADDITION DRVR or LED TTL INTERFACE 81p.

**Integrated Circuits**


**Transistors**


**Electronics design associates of Walsall**

**Fluorescent Light Boxes**

You can build your own personal 110V fluorescent light. Everything needed is supplied: white fluorescent tube, brass fittings, end caps, end cap screws, and circuit board. High quality components and transformer, and cage, cable, etc. Thank you for your support. We supply fluorescent tube, hardware assembly and components incorporated. We have the latest range of new and improved parts for fluorescent light. Please, assembly set for £2.18 net. Kit post and pack. Ready built £14.18 inc. VAT post and pack. Remember the date for 31st March each year. If you ever need a fluorescent light or fluorescent tube, please contact us.

**Capacitive Discharge Electronic Ignition Kit**

"Spark MEK 2" is a high performance, high quality, capacitive discharge electronic ignition system. Spark MEK completely eliminates the contact breaker: where due to contact breaker failure, the motor cannot be started. The Cap MEK completely eliminates the contact breaker. No repairs, maintenance, or age of the distributor is necessary. The Cap MEK makes the engine run smoothly, continuously and fast performance. The kit comprises everything needed: mainly, insert prestressed steel case caused in real track spares nearest, ready fitted base and heads, so top quality. We guarantee transformer and circuit board. We have already fitted thousands of motors over the years. We say it is the best system at any price. Voted best of 8 ignition systems tested by a leading motoring magazine.

**Order Now**

To Electronics Design Associates, Dept. P.M.T. 8 Station Road, Walsall, W.S.T. 1DF. Telephone 3509285

**Quantity**

- Spark MEK 2: D.I.Y. Assembly kit at £15.45
- Spark MEK 2. Ready Built Magnetron earth at £10.36
- Spark MEK 2. Ready Built Magnetic earth at £10.36

**Electronic Ignition Switches**

- IGNITION CHANGE SWITCHES AT £3.79
- Ignition change switches in the above units at £3.79

**Fluorescent Light Components**

- Fluorescent light components at £1.66
- Fluorescent light built units at £1.66

Please, allow 14 days for delivery. Thank you for your support.
Enough books are written about crime, this one stops it.


A complete kit that can be assembled in only a few enjoyable hours, with the help of a very easy to follow instruction manual.

The GD-39 works by transmitting a silent, ultrasonic signal throughout the room. And continuously monitoring any movement made by an intruder in the room will then automatically produce a change in the signal.

Which triggers off a lamp and, thirty seconds later, a remote buzzer, that just you hear, or a loud bell.

Enough to scare the living daylights out of a burglar. For more details, and a bookful of other ideas, just post the coupon now for your free Heathkit catalogue.

Or, if you're in London or Gloucester, call in and see us. The London Heathkit Centre is at 233 Tottenham Court Road. The Gloucester showroom is next to our factory in Bristol Road.

Heath (Gloucester) Limited.
Dept. PE75. Bristol Road,
Gloucester GL2 6EE.
Tel: (0452) 29451.

The GD-39

Ultrasonic Burglar Alarm

To: Heath (Gloucester) Limited, Dept. PE75. Gloucester GL2 6EE. Please send me a free Heathkit catalogue.

Name

Address

Postcode

Remember easy terms are available with the Heathkit Monthly Budget Plan.

ELECTROVALUE

The best of all!

CATALOGUE 7 ISSUE 3

With 25p refund voucher

Up-dated Price and Product Information

All communications to Section 0/5, 20, St. JUDES ROAD, EGGLEFIELD GREEN, EGMH, SURRY TW20 9NH. Telephone Egham 3603, Telex 264475. Shop hours: 9-5.30 daily, 9-1 pm Sat.

NORTHERN BRANCH: 886, Burnage Lane, Burnage, Manchester M19 1NA. Telephone (061) 432 4945. Shop hours: Daily 9-5.30 pm, 9-1 pm Sat.

12in LONG PERSISTENCE CRT. Full spec. Price £6.50 to include VAT & Carriage

MAKE YOUR SINGLE BEAM SCOPE INTO A DOUBLE WITH OUR NEW LOW PRICED SOLID STATE SWITCH. 2Hz to 6MHz. Hook up to a 9 volt battery and connect to your scope and have two traces for ONLY £5.95, P. & P. 25p. (Not case, not calibrated).

WIDE RANGE WOBBLULATOR. 5MHz to 150MHz up to 15MHz sweep width. Only 3 controls: preset RF level, sweep width and frequency ideal for 10 or TV IF alignment. Many uses. Card has been designed to suit any general purpose scope. Full instructions supplied. Connect 6.3V A.C. and use within minutes of receiving. All this for ONLY £5.75, P. & P. 35p. (Not case, not calibrated)

20Hz to 200kHz WB, SINE and SQUARE GENERATOR. Four ranges Independent amplitude controls on each channel. Ready to use A.C. supplied. £8.85 each. P. & P. 35p. (Not case, not calibrated)

GRAVITIES—12cm x 14cm high quality plastic 15p each. P. & P. 10p

Large quantity of good quality components—NO PASSING TRADE—so we offer 3ib of ELECTRONIC GOODS FOR £1.75. Post paid.

ROTARY SWITCH PACK—6 brand new switches (1 ceramic. 1 off f01.02. 2 way. etc.: 1.5p, P. & P. 37p

P.C.B. PACKS, 5 & 6. Quantity 2 sq. ft—no tiny pieces. 50p, P. & P. 37p

CAPACITOR PACK—50 brand new components, only 85p. P. & P. 37p

PLEASE ADD VAT AT 8% OPEN 9 a.m. to 6.30 p.m. any day

RANKCUMBER LTD

CHILMTREAD LTD

78 ARTHUR ROAD, READING, BERKS.

PTC Tech. College. Tel. Reading 520505/5916
B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)

B. BAMBER ELECTRONICS
5 STATION ROAD, LITTLEPORT, CAMBS, CB6 1QE
Telephone: ELY (0353) 866 182 (Tuesdays 2-5pm)
Special Features this month:

**LARGE SCREEN TV OSCILLOSCOPE**
How a large-screen monochrome receiver can be converted for displaying television waveforms.

**CEEFAX/ORACLE RECEPTION**
Start of a new series explaining the principles and the practical techniques used for teletext news displays.

**LATEST COLOUR RECEIVER CIRCUITRY**
An account of the many novel circuit techniques used in the latest Rank colour chassis.

**VIDEO SIGNAL EXTRACTION**
Many VCRs require a v.f. input. K. Cummins presents a suitable circuit for extracting the video signal from a domestic TV set.

**COLOUR RECEIVER SERVICING**
Les Lawry-Johns deals with faults experienced on the Philips G6 colour chassis.

**PLUS ALL THE REGULAR FEATURES**

**JULY ISSUE OUT MONDAY 16th JUNE, PRICE 40p**
TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio and TV Servicing (Mono and Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on September 15th.

Prospectus from London Electronics College, Dept. A7, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

COLOUR TV SERVICING.

Learn the techniques of servicing Colour TV sets through a new homework course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Offers courses for radio and audio servicing. Full details from: ICS SCHOOL OF ELECTRONICS, Dept. 314, Intertext House, London, SW8 4UJ. Tel. 01-622 9911 (all hours).

LADDERS

LADDERS, timber and aluminium. Tel. Telford 586644 for brochure.

SERVICE SCHOOLS

COUNTY TRAINING COUNCILS

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio and TV Servicing (Mono and Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on September 15th.

Prospectus from London Electronics College, Dept. A7, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

COLOUR TV SERVICING.

Learn the techniques of servicing Colour TV sets through a new homework course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Offers courses for radio and audio servicing. Full details from: ICS SCHOOL OF ELECTRONICS, Dept. 314, Intertext House, London, SW8 4UJ. Tel. 01-622 9911 (all hours).

LADDERS

LADDERS, timber and aluminium. Tel. Telford 586644 for brochure.

SERVICE SCHOOLS

COUNTY TRAINING COUNCILS

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio and TV Servicing (Mono and Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on September 15th.

Prospectus from London Electronics College, Dept. A7, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

COLOUR TV SERVICING.

Learn the techniques of servicing Colour TV sets through a new homework course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Offers courses for radio and audio servicing. Full details from: ICS SCHOOL OF ELECTRONICS, Dept. 314, Intertext House, London, SW8 4UJ. Tel. 01-622 9911 (all hours).

LADDERS

LADDERS, timber and aluminium. Tel. Telford 586644 for brochure.

SERVICE SCHOOLS

COUNTY TRAINING COUNCILS

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio and TV Servicing (Mono and Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on September 15th.

Prospectus from London Electronics College, Dept. A7, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

COLOUR TV SERVICING.

Learn the techniques of servicing Colour TV sets through a new homework course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Offers courses for radio and audio servicing. Full details from: ICS SCHOOL OF ELECTRONICS, Dept. 314, Intertext House, London, SW8 4UJ. Tel. 01-622 9911 (all hours).

LADDERS

LADDERS, timber and aluminium. Tel. Telford 586644 for brochure.

SERVICE SCHOOLS

COUNTY TRAINING COUNCILS

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio and TV Servicing (Mono and Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on September 15th.

Prospectus from London Electronics College, Dept. A7, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

COLOUR TV SERVICING.

Learn the techniques of servicing Colour TV sets through a new homework course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Offers courses for radio and audio servicing. Full details from: ICS SCHOOL OF ELECTRONICS, Dept. 314, Intertext House, London, SW8 4UJ. Tel. 01-622 9911 (all hours).

LADDERS

LADDERS, timber and aluminium. Tel. Telford 586644 for brochure.
DIFFICULT TO GET AT? Hold that screw with a Non Trip Screwdriver and the Split Blade holds screw firmly. Screw can be driven home with same force as standard screwdriver.

High quality, 10 invar wire, wide 6½ for M3-M4 screws. £1.70 plus 10p P. & P. E. E. S., Cranbrook, Lavenham Park, Salis-

bury, Wilt.

**fi bre optical suppliers**

MARE'S TAILS. Build a decorative display with this professionally finished unit, 22in diameter with 7000+ fibre optic suppliers, London, SE8 4I'H.

over 10 items P. & P. 27p.

1 1A bridge rectifier, 8 LA diodes and 7 other wires. PRICES which begin at a low 75p. Practical Electronics, March 1975

VERSUS LIGHT. Some saucy names for your LAB, but the plumber is not very flexible! Important: New 76p, P. & P. 27p. P. & P. 7p.

7p.

95p, P. & P. 7p.

TH YR MORS gold bonded BT119 96p, P. & P.

FIBRE OPTIC SUPPLIERS

MINIKITS ELECTRONICS, 6g CLEVELAND ROAD

BUILD THE TREASURE TRACER MK III Metal Locator

**HOME SCIENTISTS**

Get the key to a FANTASTIC WORLD of DO-IT-YOURSELF PROJECTS! A NEW Boffin catalogue lists LOTS of ideas with LOW-COST BAN-

GAINS, READY-BUILT MODULES.

Here are just a few examples, there are stocks more:

Dazzling MINI-STROBE (pocket size) £1.90

Big-Ear SOUND-CATCHER £3.20

Mini DREAM LABORATORY £1.90

Don't wait, act now! PROFIT from LOW-COST LIGHT. GET A COPY AND SEE SEND ONLY 20p and we'll rush YOU YOUR COPY. YOU CAN'T GET THE 'GOODIES' JUST AS QUICKLY TOO!

BOFFIN PROJECTS

4 Custhills Road, Stonelagh

Ewell, Surrey

(Mail Order U.K. only)

S M A R T S T O N E L A B I R A N C H

35 market place

Bestwick Park, Blackburn

{Staffordshire, WA4 5AD}

SUREB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

NUMERICAL read out tubes type GN4A

PRICE £2.50

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

your VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.

enthusiasts and Industrial users are choosing

SUPERB INSTRUMENT CASE

Width, Depth, Height, 7" / 7"

YOUR VAT go further with our competitive

prices which begin at a low 75p.
**FANTASTIC NEW MICROTEST 80**

**MEASURES ONLY**

90 x 70 x 18mm

**ELECTRONIC ZERO**

**PRINTED CIRCUIT BOARD IS REMOVABLE WITHOUT SOLDERING**

**Voltage d.c. ranges:** 100mV, 2V, 15V, 50V, 200V, 1.000V (200mA), 2% precision on d.c. and a.c.

**Voltage a.c. ranges:** 5 V, 16V, 50V, 200V, 1.000V (dc / V).

**Amp. d.c. & a.c. ranges:** 50μA, 500μA, 5mA, 50mA, 500mA, 5A.

**Amp. d.c. & a.c. range:** 250μA, 2.5mA, 25mA, 250mA, 2.5A.

**Ohms ranges:** Low (1, 10, 100, 1000, 10kΩ), 1MΩ.

**V Output ranges:** 5 V, 10V, 50V, 200V, 1.000V (5MHz).

**Accuracy** ± 1% of full scale, ± 2% of 0-5V.

**Price** £18.50

**Accessories Extra**

* £18.50

**MORE RANGES FOR LESS MONEY!**

**AC/DC Multimeter type U4324**

- A-D C 0-50-3 A ranges (0.001-0.002-0.005% accuracy, 0.1% 30%)

- V-D C 0-6-1.000 V ranges (0.05-0.1-0.15% accuracy, 0.1% 30%)

- I-AC 0-100-5-5-1-0.05% accuracy, 0.1% 30%

**Frequency range:** 0.001-100kHz, 0.001-100mHz, 0.001-100kHz

**DC volts:** 0-100-500-1000V

**AC volts:** 0-100-500-1000V

**Capacitance:** 0-100-1000nF, 0-100-1000μF, 0-100-1000μF

**Frequency:** 0-100kHz, 0-100mHz, 0-100kHz

**Accuracy:** ± 1% of full scale, ± 2% of 0-5V

**Price** £25.00

**ALPHANUMERIC NIXIE TUBES B7971**

The alphanumeric NIXIE tube has the ability to display all the letters of the alphabet and 10 digits in a single tube. From the standpoint of both reliability and electrical efficiency, the Alpha-Numeric NIXIE tube provides many unique benefits including: 170V/21mA output, a.c. operation, uniform brightness of each character, memory with simple solid state drive circuits, readability in high ambient light, 200° fanfilament brightness, long life with no loss of brightness, Character height 5mm. Bases for 300V each plus £1.50.

**Price** only 99p each plus £1.50 P.P.

**JUST ARRIVED! NUMERIC INDICATOR TUBES**

Ultra-long life, high quality, 0-8 and 2 independent decimal points. Supply 250V d.c. Voltage 0-250V d.c. Current 14mA Pulse duration 100μs. Character height 0.51, overall size 1 4.

**Price** £1 00, 25 00, 100 00, 800 00, 1000 00 plus application.

**ADD 8% VAT to all items.**

**GIVE YOUR INSTRUMENTS QUALITY AT LOW COST**

**METAC**

Cross Lane, Braunton

Daventry, Northants.

---

**DIGITAL CLOCK CHIP, AV-5-1224,**

**21 Prior's Road,**

**Windsor, Berks. SL4 IPD**

**P. & P. only to mail order or written enquiries only to control units available on request.**

Details of dimmers, sequencers and other lighting extra.

**SELEKTRON**

21-25 Hart Road, Benfleet, Essex.

**BUDGET MINI AUDIO MIXERS**

With Professional Facilities, Slider Faders. Tone Controls. Monitoring V U Meter. Mono or Stereo. Ready to use or kit or ready built form and features individual sensitivity controls. Sensitivity range switch 3 x 11kW per channel.

**SOUND TO LIGHT CONVERTER USING**

**BUDGET MINI AUDIO MIXERS**

**7 Nursery Road**

**Write for details:**

**CASES & HOUSINGS**

**HIGH QUALITY INSTRUMENT CASES**

Size: 7x4 x 2in

**MODERN STYLE PANEL METERS**

100μA

**Price** £1.98

**Price** Plus 16p VAT

**Price** Plus 36p VAT

**P. & P. 20p.**

**GIVE YOUR INSTRUMENTS QUALITY AT LOW COST**

**METAC**

Cross Lane, Braunston

Daventry, Northants.

---

**ARROW ELECTRONICS LTD.**

**DEPT. PE13**

**7 COPTFOLD ROAD,**

**BRENTWOOD, ESSEX**

**ULTRASONICS**

40kHz transducers at low price as used in many magazine articles. Price includes suggested circuits, order as type RL400PP per pair £2.35 VAT inclusive.

**CA3035—I.C.**


**COS—MOS LOGIC**

**NEW LOW PRICES**

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD4000AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4001AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4002AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4003AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4004AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4005AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4006AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4007AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4008AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4009AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4010AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4011AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4012AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4013AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4014AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4015AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4016AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4017AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4018AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4019AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4020AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4021AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4022AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4023AE</td>
<td>0.27</td>
</tr>
<tr>
<td>CD4024AE</td>
<td>0.27</td>
</tr>
</tbody>
</table>

**ALSO**

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC128</td>
<td>0.22</td>
</tr>
<tr>
<td>AC176</td>
<td>0.26</td>
</tr>
<tr>
<td>AD161</td>
<td>0.51</td>
</tr>
<tr>
<td>AD165</td>
<td>0.48</td>
</tr>
<tr>
<td>BC107</td>
<td>0.12</td>
</tr>
<tr>
<td>BC108</td>
<td>0.12</td>
</tr>
<tr>
<td>BC109</td>
<td>0.12</td>
</tr>
<tr>
<td>BC109C</td>
<td>0.12</td>
</tr>
<tr>
<td>BC182</td>
<td>0.14</td>
</tr>
<tr>
<td>BC212</td>
<td>0.17</td>
</tr>
<tr>
<td>BF51</td>
<td>0.28</td>
</tr>
<tr>
<td>BCY88</td>
<td>0.11</td>
</tr>
</tbody>
</table>

**IMPORTANT.** All prices include VAT. No hidden extras.

**ARROW SERVICE PLUS COMPREHENSIVE LIST NO HIDDEN EXTRAS. TOP QUALITY PRODUCTS BY RETURN.**

**1 enclose PO/Cheque for 20p**

**Name**

**Address**

**Arrow Electronics Limited**

**Dept. PE13**

**7 Coptfold Road, Brentwood, Essex.**
SYNTHESIZER Modules by Dewtron®

The synthesizer illustrated was built using Dewtron modules, as sold to constructors for some years now. With over 10 years’ experience in mail-order, we have supplied many famous people and groups. Over 30 types of synthesis modules, some of extremely precision design, e.g. VCO-2 log-linear oscillator, 3-wave sample-hold envelope module, pitch-to-voltage module allowing a whole equipment to “play itself” in unison/harmony with any solo input or voice. Modules for sequencer construction, too. Famous “Modulatron” patching system makes other patching a thing of the past! Send just 20p for full catalogue to:

D.E.W. LTD.
254 Ringwood Road, Ferndown
Dorset BH22 9AR

Scott Electronics
ESTCOURT HOUSE, ESTCOURT ROAD
GREAT YARMOUTH, NORFOLK
Tel. Great Yarmouth 57066

5W Chassis Stereo Amplifier (2 5W/CH). Power requirements 12v d.c. Output: 2 5W/CH into 8 ohms. Two inputs: tape head (50mV) and 100mV mic. (P. Li 100mV mic. and 100mV line). Controls: volume, balance and tone (slider controls). Directly coupled PA. £15.00 inc. VAT.

5W Swingout PA Amplifier. Separate line and mic inputs. Line 0-2.5V or 0-5V mic. (P. Li 0-5V mic.). Controls: volume (tubes). £20.00 inc. VAT.

Tuba Sampler. 9s. £20.00 inc. VAT.

7W Mono PA Amplifier. Line 0-5V mic. (P. Li 0-5V mic.). Controls: volume (tubes). £25.00 inc. VAT.

8W Stereo PA Amplifier. 0-5V mic. (P. Li 0-5V mic.). Controls: volume (tubes). £30.00 inc. VAT.

Tuba Sampler. £40.00 inc. VAT.

Transistor Power Amplifiers. £10.00 inc. VAT.

PUA 150W 0.5% Excursion. £120.00 inc. VAT.

120W Mono Special. £50.00 inc. VAT.

60W Stereo Special. £70.00 inc. VAT.

20W Stereo Special. £90.00 inc. VAT.

12W Mono Special. £30.00 inc. VAT.

6W Mono Special. £20.00 inc. VAT.

Additional sets of speakers are £10.00 inc. VAT.

Considerable savings may be made on orders over £100 inc. VAT.

TECHNOMATIC LTD
54 Sandhurst Road, London NW9. Tel. 01-204 4333

TUAC Important Announcement

Prices quoted in our June advertisement included 25% V.A.T. V.A.T. will be charged. When ordering, the following prices apply: Disco Mix £31.50; 3 Channel Light Modulator £15.50, Single Channel version £7.25; Power Modules—TP125 £19.50, TL30 £7.90, TL60 £12.50, TL100 £15.00; Preamplifiers—VA08 £5.75, VA06 £5.00, SVAO1 £10.00; PS125 £12.25, PS100 £11.25, PS60 £10.00, PS30 £5.95, PS10 £4.75.

TUAC
163 Mitcham Road, London SW17 9PG
01-872 3137/9080

Scott Electronic ESTCOURT HOUSE, ESTCOURT ROAD GREAT YARMOUTH, NORFOLK Tel. Great Yarmouth 57066
Practical Radio & Electronics Certificate course includes a learn while you build 3 transistor radio kit. Everything you need to know about Radio & Electronics maintenance and repairs for a spare time income and a career for a better future.

Cut out this coupon
Tick or state subject of interest.
Post to address below.

To Aldermaston College, TPE07
Dept. TPE07, Reading RG7 4PF
Also at our London Advisory Office, 4 Fore St Avenue, Moorgate, London EC2V 7ED Tel. 01-6213 2721

Others have done it, so can you
"Yesterday I received a letter from the Institution informing me that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained. a view echoed by two colleagues who recently commenced the course." — Student D. J. H., Yorks.
"Completing your course meant going from a job I detested to a job that I love, with unlimited prospects." — Student J. A. O., Dublin.
"My training quickly changed my earning capacity and, in the next few years, my earnings increased fourfold." — Student C. C. P., Bucks.

Find out for yourself
These letters, and there are many more on file at Aldermaston College, speak of the rewards that come in just 2 minutes to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help you. Write to:

Aldermaston College
Dept. TPE07. Reading RG7 4PF


Publisher's subscription rate including postage for one year: Inland 4/0; overseas (5/0); U.S.A. & Canada 5/3. 50.

International price: Eire 4/0. Please state reason for payment, unless to spare.

Practical Electronics is sold subject to the following conditions: namely, that it shall not, without the written consent of the Publishers, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Fire where the selling price is subject to V.A.T., and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication, advertisement, literary or pictorial matter whatsoever.
More than just a catalogue

Projects for you to build.

4-digit clock, 6-digit clock, 10W high quality power amp., High quality stereo pre-amp., Stereo Tuner, F.M. Stereo decoder, etc., etc.

CIRCUITS: Frequency Doublers, Oscillators, Timers, Voltmeters, Power Supplies, Amplifiers, Capacitance Multipliers, etc., etc.

Full details and pictures of our wide range of components, e.g. capacitors, cases, knobs, vero-boards, edge connectors, plugs and sockets, lamps and lampholders, audio leads, adaptors, rotary and slide potentiometers, presets, relays, resistors (even 1% types!), switches, interlocking pushbutton switches, pot cores, transformers, cable and wire, panel meters, nuts and bolts, tools, organ components, keyboards, L.E.D.'s, 7-segment displays, heatsinks, transistors, diodes, integrated circuits, etc., etc., etc.

REALLY GOOD VALUE FOR MONEY AT JUST 40p.

ELECTRONIC ORGAN

Build yourself an exciting Electronic Organ. Our leaflet MESS1, price 15p, deals with the basic theory of electronic organs and describes the construction of a simple 49-note instrument with a single keyboard and a limited number of stops.

Leaflet MESS2, price 15p, describes the extension of the organ to two keyboards each with five voices and the extension by an octave of the organ’s range.

Solid-state switching and new footages along with a pedal board and a further extension of the organ’s range are shown in leaflet MESS3, also priced at 15p.

No more doubts about prices

Now our prices are GUARANTEED (changes in VAT excluded) for two month periods—and we’ll tell you about price changes in advance for just 30p a year (refunded on purchases). If you already have our catalogue send us an S.A.E. and we’ll send you our latest list of GUARANTEED prices. Send us 30p and we’ll put you on our mailing list—you’ll receive immediately our latest price list then every two months from the starting date shown on that list you’ll receive details of our prices for the next GUARANTEED period before the prices are implemented—plus details of any new lines, special offers, interesting projects and clip-off coupons to spend on components to repay your 30p when used as directed.

NOTE: The price list is based on the Order Codes shown in our catalogue so an investment in our super catalogue is an essential first step.

SYNTHESISER

A reprint of the complete article giving full construction details published by Electronics Today International between January-September ’74 of the International Voltage Controlled Synthesiser, developed as a "state of the art", will be available shortly, price £1.50. S.A.E. please for detailed price list.

GRAPHIC EQUALISER

A really superior high quality stereo graphic equaliser as described in the January edition of Electronics Today International. We stock all the parts (except woodwork) including the metalwork drilled and printed, 15p brings you a reprint of the article or a S.A.E. please for our detailed price list.

MAPLIN ELECTRONIC SUPPLIES

P.O. Box 3 Rayleigh Essex SS6 8LR.
Telephone: Southend-on-Sea (0702) 44101