PRACTICAL

ELECTRONICS

NOVEMBER 1973

20p

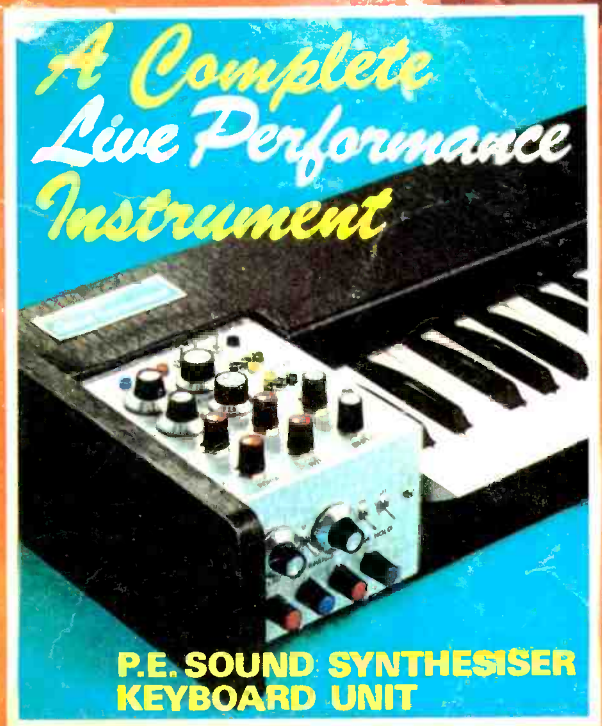
FREE INSIDE !

VEROBOARD

SUITABLE FOR THE CONSTRUCTION OF ANY OF THE 4 PROJECTS FEATURED IN OUR

8 PAGE SUPPLEMENT

- LIGHT-OPERATED DEVICE
- WAA WAA
- DIODE THERMOMETER
- TOUCH SWITCH



STAGE LIGHTING DIMMER

PRACTICAL
ELECTRONICS
VOLUME 9 No. 11 NOVEMBER 1973

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

SPECIAL SUPPLEMENT—*AUTUMN QUICKIES*

DIODE THERMOMETER—WAA WAA—OPTOELECTRONICS—TOUCH SWITCH

FREE INSIDE THIS ISSUE: *VEROBOARD PRINTED WIRING BOARD*

Our December issue will be published on Friday, November 9, 1973

Exciting...the Stereo 21!

Can you really get sound quality like this FOR LESS THAN £19? YES, YOU CAN! WITH THE NEW

STEREO 21

Until now, richly satisfying sound has always cost a richly satisfying price. *But not any more!* For an almost unbelievable **£18·45,** you can have Stereo 21—audio for the connoisseur! Whatever your taste in music, you can hear it on STEREO 21 the way its composers heard it in their dreams! Beethoven or Mahler . . . Ellington or Jellyroll Morton . . . Das Nibelung or Jesus Christ Superstar . . . Carols from King's College Chapel or the return of a Beatle . . . everything from a prettily fluting baroque organ to the newest pop group at full throttle—STEREO 21 does them all justice!

And have you ever seen a handsomer audio installation? Compact enough to go in a university student's bedroom-study, elegant enough for the suavest penthouse pad in Town, STEREO 21 offers you all the pride of possession as well as a thrilling musical experience!

Top-quality amplifier, BSR turntable, matching speakers. Deck and speaker cabinets you simply wrap round and glue to build. Screw in the amplifier and connect up (all push fit no soldering whatsoever), so simple literally anyone can do it. Except for glue and panel pins all parts supplied including full instructions—all for £18·45 (plus the cost of post and packing if you buy by mail), and—to round it all off—a money refund if not satisfied if your pleasure in STEREO 21 is not complete!

Personal shoppers and mail order price

£18·45 INCLUDING VAT plus £1·50 p. & p.

Diamond stylii, if required, £1·37 extra

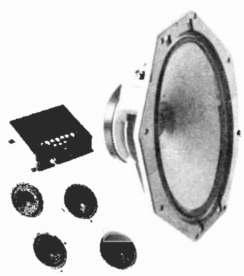
Suitable pair of stereo headphones with individual lever controls, if required £3·85.

Just think—in only a few days you could be giving your ears the treat of a lifetime—AND introducing your envious friends to STEREO 21!

EMI SPEAKERS AT UNBELIEVABLE PRICES

950 Kit. Five matched speakers and crossover unit for handling up to 45 watts, from 20 to 20,000 Hz. Huge–19in × 14in (approx.) high efficiency 16, 500-gauss bass unit built on a heavy diecast frame. The four 10,000 gauss tweeters, each 3¼in dia. approx., are fed by the crossover with a critically adjusted signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2in others 0·5in. Recommended list price £44.

OUR PRICE £25·00 + £1·50 p. & p



15in 14A/780. Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. Flux 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3in voice coil.

Recommended retail price £40·80.

OUR PRICE £18·70 + £1·50 p. & p.

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

Buy it on BARCLAYCARD Extended Credit PHONE YOUR ORDER

Access takes the waiting out of wanting

R T V C

RADIO AND TV COMPONENTS (ACTON) LTD, 21C HIGH STREET ACTON, LONDON W3 6NG · 323 EDGWARE ROAD, LONDON W2

Edgware: 9 a.m. to 5.30 p.m., half day Thurs.
Acton: 9.30 a.m. to 5 p.m. Closed all day Wed.; also see opposite.

Mail orders to Acton. Terms C.W.O. All enquiries Stamped Addressed Envelope. Goods not despatched outside U.K.

RTVC VISCOUNT III

a boost in the output.

VISCOUNT III now gives you an imposing 20 watts per channel—and the price quoted is actually INCLUSIVE OF VAT!

The money's important, of course, but not nearly so important as *value for money!* And that's something you get in abundance with VISCOUNT III. We design it . . . we make it . . . we sell it direct to you—passing on all the economies that come from cutting out middle-men! That's the only way you can get so much quality for so little money!

The unique VISCOUNT III amplifier, plus the Garrard SP25 Mk III deck, plus the magnificent Duo Type III matched speakers (or Duo Type II for a small room) give you an audio installation that will prove unbeatable for listening pleasure! On the brushed aluminium front panel of the amplifier you'll find all the facilities you need—volume, bass, treble and balance controls, plus switches for mono/stereo, on/off function and bass and treble filters. Plus headphone socket on the back. And the teak finish will harmonise and enhance virtually any style of interior decor!

The heart-stopping timbre of Tom Jones at his most virile . . . the last lingering harmonics of a solo performance by Heifetz or Menuhin . . . the pathos and the panache of Liza Minelli . . . the majestic sonorities of the brass band and the elfin subtleties of the virtuoso clavichordist—hear every nuance with a fidelity that you have *never* experienced before!

Come and hear VISCOUNT III! If it's inconvenient to travel, buy by post in the confidence that you won't be disappointed (and with a 24-carat Money-Back Guarantee to give you extra reassurance). Don't settle for second-best!

SPEAKERS: Duo Type II Size approx. 17in × 10¾in × 6¾in. Drive unit 13in × 8in with parasitic tweeter. Max. power 10 watts 8 ohms. Simulated Teak cabinet. **£14·00** a pair. £2·20 p. & p. Duo Type III Size approx. 23½in × 11½in × 9½in. Drive unit 13½in × 8½in with HF speaker. Max. power 20 watts. 8 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32·00** a pair + £3·30 p. & p.

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24·20	+ £1 p & p
2 Duo Type II speakers	£14·00	+ £2·20 p & p
Garrard SP25 Mk. III with MAG. cartridge plinth & cover	£18·00	+ £1·75 p & p
total	£56·20	

Available complete for only £49·00 + £3·50 p. & p.

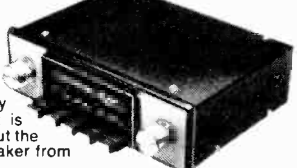
PRICES: SYSTEM 2

Viscount R 102 amplifier	£24·20	+ £1 p & p
2 Duo Type III speakers	£32·00	+ £3·30 p & p
Garrard SP25 Mk III with MAG. cartridge plinth & cover	£18·00	+ £1·75 p & p
total	£74·20	

Available complete for £65·00 + £4 p. & p.

STILL ONLY £49 COMPLETE

THE TOURIST PUSH-BUTTON CAR RADIO KIT £6·60



The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles it covers the full medium and long wave bands. It is permeability tuned and sturdily constructed. Output is a full 2·5 watts into an 8 ohms speaker. But the Tourist PB will operate into any loudspeaker from 8 to 15 ohms.

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

The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7in wide, 2in high and 4¾in deep.

* Circuit diagram and comprehensive instructions 55p free with parts.
* Fully retractable and lockable car aerial £1·37 post paid.

CAR RADIO KIT £6·60 p. & p. 55p
Speaker with baffle and fixing strips **£1·65**, 23p p. & p., post free if bought with the kit. Send stamped addressed envelope for leaflet.

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

RELIANT Mk IV £13·50

*5 Electrically Mixed inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.

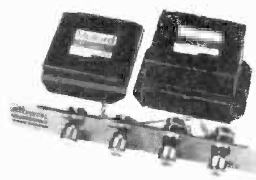
INPUTS 1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.). All 250mV sensitivity. Output 20 watts into 8 ohms (suitable for 15 ohms). Size approx. 12¼ × 6 × 3½ ins.

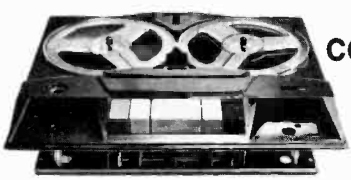
£13·50 p. & p. 60p.

UNISOUND MODULES

ONLY £7·64 + 55p p. & p.

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.





PE TAPE LINK CONSTRUCTORS

Suitable 3 speed tape deck, **less heads.** Caters up to 5¾ins. spools. 240V AC mains. Unused but store soiled hence no warranty. £1 p. & p. **£4·00**

IN-CAR ENTERTAINMENT AT HOME

With this elegant stereo 8 track add on unit, audio enthusiasts now have the opportunity to extend their systems to include the playing of 8 track cartridges. Simply select your channel, by push button, four digital lamps indicate channel selected. Mains operated.

The Viscount III, the fabulous Stereo 21 and the Unisound Modules will all accept this unit, simply connect up. **£10·60** p. & p. 80p

ALL PRICES INC. VAT

SEE OPPOSITE PAGE FOR ADDRESS DETAILS

Even Better All Round Sound Reproduction!

New, Improved BD2 Turntable By Connoisseur

Manufactured by:- A. R. Sugden & Co. (Engineers) Ltd.,
Atlas Mill Road, BRIGHOUSE, Yorkshire HD6 1ER.
Telephone: Brighouse (04847) 2142. Telegrams & Cables: Connoiseur, Brighouse.

Come and visit us at Stand No. F4 at the International Audio Festival

---

KEEP WARM AT A COOL PRICE.

Slash central heating costs with AMKIT.

If you can put in electric wiring, you can install Amkit. The unique nylon pipe hot water central heating system, that you install yourself in hours.

Look at these advantages:

No soldering
No 'T' junctions
No special equipment
No leaks, no lagging, no corrosion
No structural upheaval

Just reliable, effective central heating (Guaranteed 25 years) at a saving of between £150 & £250. This famous system has been successfully marketed since 1968.

Clip the coupon, and we'll tell you more.

To Autocon Manufacturing Co.
Spring House, 10, Spring Place, London, NW5, 3BH
Please send your brochure telling me all about Amkit.

Name..
Address..
....
.... PE3 AMC

or see for yourself at: THE AMKIT D.I.Y. CENTRE, 15, Procter St., London, W.C.1. (opp Holborn Undgnd).
Open Mon-Fri 9.30 am-5-30 pm. Sat 9 am-1 p.m.

SPECIAL 40 MHZ SCOPE—SOLARTRON CD1212 ONLY £50. Has to be a snag. There are no plug-in Y amps available.
TB—100 nanosecs per cm to 5 secs per cm in 24 calibrated ranges. 20 nanosecs per cm with times 5 expansion. 5in flat faced tube. Trace locator. 0·2 microsec signal delay. Built-in calibrator 1kHz square wave. 200 micro volts to 100 volts in 18 calibrated ranges. Tube sensitivity 3 V/cm. Main Frame Y Amp boosts this to better than 200 MV per cm at 40 MHz. 240V 50 Hz input. Complete with full manual including plug-in circuits. Come and see one working or Carriage £1·50.

MAKE YOUR SINGLE BEAM SCOPE INTO A DOUBLE WITH OUR NEW LOW PRICED SOLID STATE SWITCH. 2 Hz to 8 MHz. Hook up a 9 volt battery and connect to your scope and have two traces for ONLY £5·50. P. & P. 25p. (Not cased, not calibrated.)

NEW WIDE RANGE WOBBULATOR

5 MHz to 150 MHz up to 15 MHz sweep width. Only 3 controls, preset RF level, sweep width and frequency. Ideal for 10·7 or TV IF alignment, filters, receivers. Can be used with any general purpose scope. Full instructions supplied. Connect 6·3V A.C. and use within minutes of receiving. All this for ONLY £5·75p. P. & P. 25p. (Not cased, not calibrated.)

20 Hz to 200 kHz WB.

SINE and SQUARE GENERATOR. Four ranges. Independent amplitude controls, thermistor stabilised. Ready to use, 9V supply required. £7·85 each. P. & P. 25p (Not cased, not calibrated.)

GRATICULES. 12cm × 14cm high quality plastic 15p each. P. & P. 5p.

12" Long Persistance Crt, full spec. Price £12·50 to include V.A.T. & carr.

COMPONENT PACK consisting of 5 pots, various, brand new; 250 resistors ¼ and ½ watt, many high stabs, etc. Fine value at **50p.** P. & P. 17p.

P.C.B. PACKS S & D. Quantity 2sqft—no tiny pieces. **50p** plus P. & P. 20p.

FIBRE GLASS as above **£1** plus P. & P. 20p.

5 CRYSTALS 70 to 90kHz. Our choice, **25p.** P. & P. 15p.

5 MOVING COIL METERS various **£2.** P. & P. 37p.

CAPACITOR PACK—50 Brand new components only **50p.** P. & P. 17p.

POTS—10 different values. Brand new—**50p.** P. & P. 17p.

TRIMMER PACK. 2 Twin 50/200pF ceramic 2 Twin 10/60pF ceramic; 2 min. strip with 4 preset 5/20pF on each; 3 air spaced preset 30/100pF on ceramic base. ALL BRAND NEW, **25p** the lot. P. & P. 10p.

FLAT FACED 4" Twin Beam Tube, type CV2193. Green trace. Brand new **£4** each. P. & P. 37p.

LIGHT EMITTING DIODES (Red) from Hewlett-Packard. Brand New **38p** each. Holder **1p** each. Information 5p.

PHOTOCELL equ. OCP71, **13p** each.

PHOTO RESISTOR type Clare 703. Two for **50p.**

MODERN TELEPHONES type 706. Two-tone grey, **£3·75** each. The same but black, **£2·75** each. P. & P. 25p each.

Also **TOPAZ YELLOW £4·50** each. P. & P. 25p.

IDEAL EXTENSION Telephones with standard GPO type dial, bell and lead coding. **£1·75** each. P. & P. 25p.

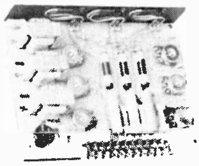
DELIVERED TO YOUR DOOR 1 cwt of Electronic Scrap chassis, boards, etc. No Rubbish. FOR ONLY **£3·50.**

PLEASE ADD 10% V.A.T.

OPEN 9 a.m. to 6.30 p.m. ANY DAY

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

Mk III Sound to Light Unit Chassis Version



The audio drive voltage is derived directly from the amplifier output or across the speaker load. The unit converts the audio-frequency signals into a three-coloured light display when used with coloured flood lamps or similar; the colour depending on the frequency of the signal and the intensity on the loudness of the audio source.
Max. power 1·5kW per channel at 240V a.c.
Complete assembly built and tested. Size: 9in × 7in × 3in. Price **£27·50.**

MN3 3 Channel I.C. Mixer Kit

Three channel I.C. audio mixer kit MN3 is specially designed for the home constructor or educational project. Suitable for use in domestic audio, discotheque and simple p.a. applications. The MN3 mixer kit has the following features: Advanced design using 5 ICs; Slider fader level controls mounted directly to p.c. board; Full range Bass and Treble controls; Uses top grade components with fibreglass ready-drilled and tinned printed circuit board and the unit may be operated from twin 9V batteries (PP3) if required.

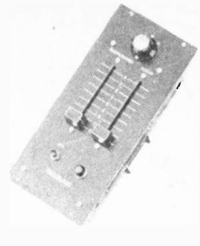
As optional extras, an attractive ready-punched facia panel and control knobs are available. The unit is available as a ready built mixer with facia.

Size: 9.5in × 4·8in × 1·5in (with facia).

Construction manual available separately at 25p.

Kit Price **£11.**

STL/1 Single Channel Sound to Light Unit

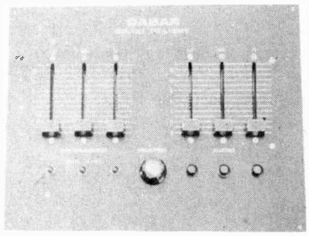


Single channel "Sound to Light" unit with 60mm slider fader controls for audio trigger level and background load dimmer.
This unit is switchable for response to High, Mid. and Low frequency audio signals, selected by facia control. A D.J. "pulse-flash" push button is fitted for manual flashing of the lamp load together with neon load indicator.
Maximum Load: 1kW at 240V a.c.
Size: 8in × 3·6in × 3in. Price **£14·30.**

Practical Electronics "Scorpio" Electronic Ignition System Kit

This Capacitor-Discharge Electronic Ignition system was described in the November and December issues of Practical Electronics. It is suitable for incorporating in any 12V ignition system in cars, boats, go-karts, etc.
Case size: 7·25in × 4·5in × 2in approx.
Complete assembly and wiring manual **25p.**
Price **£12·10.**

STL/3 Sound to Light Unit



The performance of this unit is similar to the Mk III chassis version above, but is provided with an attractive black anodised facia panel and designed to mount directly into equipment desks or cabinets. High, Mid. and Low frequency channel sensitivity controls employ 60mm slider faders for present-day attractive appearance and ease of use. Size: 11in × 8·5in × 4in. Price **£42·35.**

AUDIO EFFECTS

CREATE "PHASE" EFFECT ON YOUR RECORDS, TAPES, ETC., UNIQUE CIRCUITRY ENABLES YOU TO CREATE PHASE EFFECT AT THE TURN OF A KNOB. OPERATES FROM 9V BATTERY (not supplied). COMPLETE KIT OF COMPONENTS WITH PRINTED CIRCUIT BOARD AND FULL INSTRUCTIONS. KIT PRICE **£2·86.**

All prices quoted include postage and VAT.
S.A.E. for further details.

DABAR ELECTRONIC PRODUCTS
98 LICHFIELD STREET, WALSALL
STAFFS WS1 1UZ

become a RADIO-AMATEUR!

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

RAPY

free! Brochure, without obligation to:

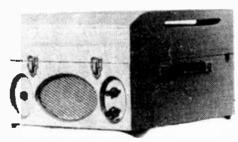
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL
P.O. BOX 156, JERSEY

NAME : ______________________

ADDRESS : ______________________ EB 113

______________________ BLOCK CAPS please

CASED AMPLIFIERS



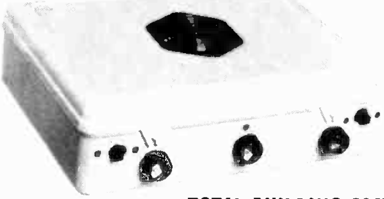
Polished wooden cabinet 14×13×9in with hinged lid containing a sensitive (20μV) 4 valve amplifier with tone and volume controls, giving about 3 watts output to the 7×4in 3Ω speaker. Also included is a non-standard single motor tape deck. Easily converted to record player, guitar practice, baby alarm, etc. Supplied in good working condition with circuit diagram. Mains operated. Only **£3** (£1 up to 200 miles, £1·20 over). Special cassettes, **£1** (25p). Spare heads, **40p.** Damaged machines from **£1·50** to callers only. Discounts on quantity. Amplifier chassis, 2× ECC83, EL84, EZ80, **£1·65** (35p).

7lb BARGAIN PARCELS

Hundreds of new components—capacitors, resistors, switches, crystals, pots, PC boards, etc., etc. Outstanding value, **£1·65** (37p).
COMPUTER PANELS: Type E: 4 OC29, 4 ACY19, 8 other transistors, 35 diodes, etc., **£1** (10p). Type H: 12 ASZ20+176 R's, C's & D's, **60p** (10p). Parcel of 12 top quality boards, inc. power transistors, trimpots, IC's, etc., **£2** (25p); 100 for **£15** (£1); 1,000 **£75** (£3); 3lb of lower quality, **£1** (25p); 7lbs, **£2** (40p); 56lbs, **£12** (c.pd.). Pack of boards containing at least 500 components including 50 transistors, **60p** (15p).
NEW COMPONENTS: 741C TO99 or 8 pin DIL, **32p**; BC107-9, **8p** or 14 for **£1**; 2N3055, **35p**; 10+, **32p**; 50+, **29p**. OC140 **25p**; OC170 **15p**; BFY18 **12p**; BCY72 **8p.**
PANEL METERS: Clearing 200 meters from **10p** each to callers only. Oscilloscopes available, also lots of odd units for spares. TF144G sig. gen. 85kHz-25MHz, from **£12-£22.** Oscilloscopes available: CD711S2 from **£35.** CD1212, etc. BFO No. 8 audio oscillator 50Hz-20kHz, **£10.** 10× crystals, 25 asstd., **75p** (25p); 4p8w switches, **40p** (10p); 2-8pF beehive trimmers, **5p**; 3×2½in **15A** thermocouple meters, **£1** (10p); delay line unit, operating around 1MHz with 7 transistor amplifier. Short delay, **40p**; long delay, **60p** (10p each). 1MΩ pots, 5p. 500 asstd. resistors **£1** (15p); 20,000 **£25** (£1); 100,000 **£80** (£2); 300 asstd. capacitors **£1** (25p).
Post in brackets, small parts 3p. **VAT NOT INCLUDED—ADD 10% TO TOTAL.** S.A.E. list, enquiries.

GREENWELD ELECTRONICS (PE5)

All mail to 24 Goodhart Way, West Wickham, Kent, BR4 0ES. Shop at 21 Deptford Broadway, SE8 (next to old cinema). Tel. 01-692 2009. Callers most welcome. Also 38 Lower Addiscombe Road, Croydon.



NEW EDU-KIT MAJOR

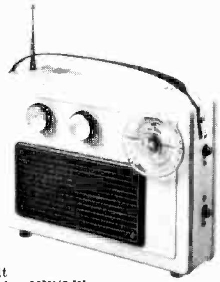
COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT
BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN—PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker Radio MW/LW.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- Batteryless Crystal Radio.
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier
- Parts price list and plans 40p (free with parts)

*10 Transistors
*3½" Loudspeaker

TOTAL BUILDING COSTS £7·23 (+10% VAT 72p) **P.P. & INS. 44p (Overseas P.P. £1·85p)**

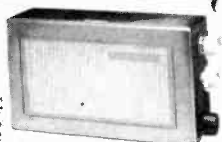
NEW ROAMER NINE WITH V.H.F. INCLUDING AIRCRAFT



Nine Transistors, 9 Tunable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with VHF section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange. Attractive all white case with red grille and carrying strap. Size 9¼in × 7in × 2¾in approx. Parts price list and plans 30p (FREE with parts).

TOTAL BUILDING COSTS £6·95 (+10% VAT 69p) **P.P. & INS. 44p (OVERSEAS P. & P. £1·85)**

POCKET FIVE



3 Tunable wavebands, MW/LW and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive Black and Gold Case. Size 5½in × 1¼in × 3½in approx. Plans and parts price list 15p (FREE with parts).

Total Building Costs £2·28 (+10% VAT 22p) **P.P. & Ins. 24p (Overseas P.P. £1.25)**

TRANSONA FIVE

Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and parts price list 15p (FREE with parts).

Total Building Costs £2·50 P.P. & Ins. 25p (+10% VAT 25p) **(Overseas P. & P. £1·25)**

NEW EVERYDAY SERIES

Build this exciting New series of designs

EV5 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9in × 5¼in × 2½in approx. Parts price list and plans 15p (FREE with parts).

TOTAL BUILDING COSTS £2·73 (+10% VAT 27p) **P.P. & INS. 30p (OVERSEAS P. & P. £1·25)**

EV6 Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt Battery. Ferrite rod aerial, loudspeaker, etc., MW/LW coverage. Push Pull Output. Parts price list and plans 15p (FREE with parts.)

TOTAL BUILDING COSTS £3·60 (+10% VAT 36p) **P.P. & INS. 30p (OVERSEAS P. & P. £1·25)**

EV7 Case and looks as above. 7 transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt Battery Push Pull Output. Telescopic Aerial for Short Waves. Parts price list and easy build plans 20p. Free with parts.

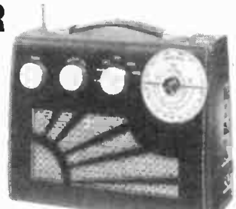
TOTAL BUILDING COSTS £4·08 (+10% VAT 40p) **P.P. & INS. 31p (OVERSEAS P. & P. £1·85p)**

ROAMER EIGHT Mk. I NOW WITH VARIABLE TONE CONTROL

7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Retractable chrome plated telescopic aerial for short waves. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

TOTAL BUILDING COSTS £6·98 (+10% VAT 69p) **P.P. & INS. 47p (OVERSEAS P. & P. £1·85)**

ROAMER TEN WITH VHF INCLUDING AIRCRAFT



10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS. ALSO AIRCRAFT BAND

Latest 4" 2 watt Ferrite Magnet Loudspeaker. Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Fine tone moving coil speaker. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in × 7in × 4in. Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

TOTAL BUILDING COSTS £8·50 (+10% VAT 85p) **P.P. & INS. 52p (OVERSEAS P. & P. £1·85)**

EDU-KIT

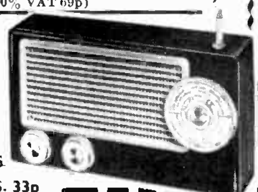
Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine tone moving coil Speaker: Terminal Strip: Ferrite Rod Aerial: 2 Plugs and Sockets: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¼in Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans 25p (FREE with parts).

TOTAL BUILDING COSTS £5·50 (+10% VAT 55p) **P.P. & INS. 33p (OVERSEAS P. & P. £1·85)**

TRANS EIGHT 8 TRANSISTORS AND 3 DIODES



6 TUNABLE WAVEBANDS, MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW. and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2½in approx. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 25p (FREE with parts).

TOTAL BUILDING COSTS £4·48 (+10% VAT 44p) **P.P. & INS. 33p (OVERSEAS P. & P. £1·25)**

ROAMER SIX 6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER BAND PLUS AN EXTRA MW BAND

FOR EASIER TUNING OF LUXEMBOURG, ETC. Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages—6 transistors and 2 diodes, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2½in approx. Plans and parts price list 25p (FREE with parts).

TOTAL BUILDING COSTS £3·98 (+10% VAT 39p) **P.P. & IN. 31p (OVERSEAS P. & P. £1·85)**

RADIO EXCHANGE LTD

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

To RADIO EXCHANGE CO., 61a HIGH STREET, BEDFORD MK40 1SA
Tel. 0234 52367 Reg. No. 788372

I enclose £ .... for ....

Name ....

Address ....

P.E.57

NEW VAT INCLUSIVE PRICES

OVERSEAS CUSTOMERS DEDUCT ONE ELEVENTH.

74 Series TTL

INTERNATIONALLY KNOWN BRANDS
1st. GRADE DEVICES AT NEW ROCK BOTTOM PRICES

SN7400	16p	SN7473	40p
SN7401	16p	SN7474	40p
SN7402	18p	SN7475	50p
SN7410	17p	SN7476	44p
SN7413	30p	SN7490	69p
SN7420	16p	SN7492	74p
SN7447	99p	SN7493	74p

This range will be increased continuously. Please enquire about any devices not listed.

PRICE BARRIER SLASHED

LED READOUTS

0·3in high characters

£1·99 + 20p VAT = £2·19

Veroboard

	Copperclad 0·1in	Plain 0·15in	0·15in	Extra P & P
2½in × 1in	6½p	6½p	—	—
2½in × 3¾in	22p	18p	11p	—
2½in × 5in	26½p	23p	13½p	—
3¾in × 3¾in	26½p	23p	—	—
3¾in × 5in	30p	30p	19p	—
17in × 2½in	74p	55p	41p	10p
17in × 3¾in	99p	77p	57½p	10p
17in × 5in	—	—	82½p	10p

DIP Breadboard, 4·15in × 6·15in, **110p.** Verostrip, 8·5in × 1·5in, **26½p.** Spot-Face Cutter, **40p**, Pin Injection tool (state 0·1in or 0·15in), **52p**, Terminal pins, **20p** (packs of 36)—state size.

I.C. SOCKETS

Dual-in-Line
8 pin **13½p** 16 pin **17½p** 36 pin **39½p**
14 pin **15½p** 24 pin **26½p** 40 pin **44p**
28 pin **30½p**

HEAT SINKS

TV2 for TO-66 15p. 5F for TO-5
TV3 for TO-3 16p. 18F for TO-18

5½p.

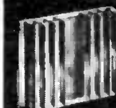
TV4 for TO-126
TV5 for TO-220

DIP10/2 for SL403D
DIP14/5 for EA1,000

14p

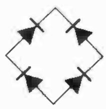
16p

10DN400 4" 4Y-1 4"



46p 35p

BRIDGE RECTIFIERS



P.I.V.	1 amp	R.M.S.	2 amp
100V	20p	50V	35p
200V	22p	100V	40p
600V	25p	200V	45p
1000V	38p	400V	50p

RECTIFIERS

P.I.V.	1 amp		3 amp	
50	1N4001	6½p	1N5400	15½p
100	1N4002	7½p	1N5401	16½p
200	1N4003	9p	1N5402	17½p
400	1N4004	9p	1N5404	22p
600	1N4005	11p	1N5406	26½p
800	1N4006	13½p	1N5407	30p
1000	1N4007	16½p	1N5408	33p

BY100	16½p	BY133	23p
BY103	22p	BY164	55p
BY105	16½p	BY176	£1·65
BY126	16p	BY182	£1·65
BY127	16½p	BY250	25½p

OR

FILAMENT INDICATOR MINITRON **3015F & G**

at **BREAKTHROUGH PRICE £1·49**

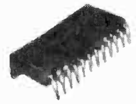
Cheapest Opto yet GaAsp LED's

RED
LED 2. 0·125" 26p
LED 3. 0·175" 17p

GREEN
LED 4. 0·125" 69p
LED 5. 0·175" 75p

Remember **Vat Inclusive Prices**

DIGITAL CLOCK on a chip



just imagine, one MOS LSI I.C. eliminating 15 MSI I.C.s and numerous other components. Either

12 or 24 hour. 4 or 6 digit
50 or 60Hz operation
leading zero supression
single voltage supply
similar to DIGITRONIC in P.W. March 1973.
Only £7·99

With 4 LED's £16·59
With 6 LED's £20·75

CHROMASONIC electronics

RESISTORS

Rating	Type	Tolerance		Range	Price Each
1/16 watt	Metal Glaze	±5%	E12 Series	51Ω to 100KΩ	5p
⅛ watt	Carbon Film	±5%	E24 Series	51Ω to 330KΩ	1½p
½ watt	Metal Oxide Film	±2%	E24 Series	10Ω to 1MΩ	4½p
½ watt	"Cermet" Thick Film	±2%	E12 Series	56Ω to 150KΩ	8p
½ watt	Carbon Film	±5%	E24 Series	10Ω to 10MΩ	1½p
½ watt	Carbon Composition	±0·5Ω	2·2Ω; 2·7Ω; 3·3Ω; 3·9Ω; 4·7Ω		4½p
1 watt	Carbon Composition		5·6Ω; 6·8Ω; 8·2Ω		5½p
1 watt	Carbon Film	±10%	E12 Series	10Ω to 10MΩ	3p
2 watt	Carbon Film	±5%	E12 Series	10Ω to 10MΩ	6p
2½ watt	Wire Wound	±5%	E12 Series	0·22Ω to 0·47Ω	10p
2½ watt	Wire Wound	±10%	E12 Series	1Ω to 270Ω	10p
5 watt	Wire Wound	±5%	E12 Series	0·5Ω to 8·2KΩ	10p
10 watt	Wire Wound			0·5Ω to 6·8KΩ	11p
10 watt	Wire Wound	±5%	10KΩ; 15KΩ; 20KΩ; 25KΩ		17p
15 watt	Wire Wound			10Ω to 6·8KΩ	13½p

DISCOUNTS: 10% on any 100 or more mixed value or wattage, 25% on any 100 or more same value and same wattage.

TRANSISTORS and DIODES

AC107	16p	AF179	71½p	BC214L	11p	BF177	28p	BSX20	18p	TIC44	46p								
AC126	13p	AF239	41p	BC268	15p	BF178	29p	BSX21	22p	TIC226D	£1·97								
AC127	13p	ASY26	33p	BC327	28½p	BF179	33p	BSY9SA	13p	TIP41A	81p								
AC128	13p	BC107	10p	BC328	24½p	BF180	33p	BU105	£1·75	TIP42A	99p								
AC176	15p	BC108	10p	BCY70	17p	BF181	35½p	BU105/02	£1·92	TIS43	36½p	2N3054	55p	2N4289	16½p	AAZ13	11p	BAX13	9p
AC187	22p	BC109	10p	BCY72	17p	BF184	27½p	D13V	53p	TIS73	£2·10	2N3055	52p	2N4441	87p	BA100	10p	BAX16	10p
AC187K	20p	BC114	15½p	BCZ10	28p	BF185	27½p	MJ4000	£1·49	TIS91	33p	2N3391A	29p	2N4442	£1·06	BA102	27½p	BAY38	41p
AC188	22p	BC117	22p	BCZ11	28p	BF194	15p	MJ4010	£1·49	2N697	16½p	2N3566	18p	2N4443	£1·45	BA110	45p	BB105	42p
AC188K	20p	BC147	9p	BD115	74p	BF195	17p	MJE340	52p	2N706	13p	2N3638	20p	2N4444	£2·09	BA111	55p	BB141	99p
ACY17	24p	BC148	9p	BD124	82p	BF196	16½p	MJE2955	£1·82	2N708	16½p	2N3702	11p	2N4871	60p	BA112	99p	BB142	82p
ACY18	21p	BC149	9p	BD131	68p	BF197	16½p	MJE3055	92p	2N914	24½p	2N3703	10p	2N5129	16½p	BA114	9p	OA5	99p
ACY19	25p	BC157	13p	BD132	83p	BF200	35½p	MPF102	27½p	2N1302	20p	2N3704	11p	2N5172	9p	BA115	19p	OA10	94p
ACY20	22p	BC158	12p	BD131/2 PR	£1·49	BF220	27½p	MPF103	41p	2N1303	24p	2N3705	10p	2N5459	36½p	BA116	9p	OA47	11p
AD140	40p	BC159	14p	BD133	83p	BF244B	27p	MPF104	45p	2N1304	24p	2N3706	10p	2N5777	47p	BA128	11p	OA79	10p
AD149	38p	BC168B	11p	BD135	42p	BF262	25p	MPF105	45p	2N1305	24p	2N3707	12p	2N6076	14p	BA129	23p	OA81	8p
AD161	29p	BC169	12p	BD136	50p	BF263	25p	MPF106	49½p	2N1306	24p	2N3708	9p	3N140	£1·01	BA143U	75p	OA85	10p
AD162	29p	BC171	20p	BD137	57½p	BF272	£1·21	OC28	33p	2N1307	27½p	2N3709	10p	3N141	89p	BA143V	67p	OA90	8p
AD161/2 PR	59p	BC172	17½p	BD138	74½p	BF390	37p	OC35	38p	2N1308	27½p	2N3710	11p	3N152	101p	BA144	20p	OA91	8p
AF114	14p	BC174B	35p	BD139	78p	BFS28	£1·01	OC36	38p	2N1309	27½p	2N3711	11p	3N153	89p	BA145	22p	OA95	9p
AF115	14p	BC177	22p	BD140	91½p	BFW10	67p	OC44	13½p	2N1613	22p	2N3771	£1·82	40360	51p	BA148	22p	OA200	11p
AF116	14p	BC178	22p	BD201	£1·55	BFW11	67p	OC45	13½p	2N1711	26p	2N3772	£2·75	40361	50p	BA154	20p	OA202	12p
AF117	14p	BC179	24p	BD202	£1·37	BFW87	38p	OC71	13½p	2N1893	52½p	2N3773	£2·20	40362	50p	BA155	15½p	OA210	19½p
AF118	92p	BC182L	9p	BD203	£1·55	BFX29	43p	OC72	13½p	2N2160	£1·54	2N3819	28p	40408	55p	BA156	16½p	OA211	30p
AF124	24p	BC183L	9p	BD204	£1·37	BFX30	37½p	OC75	15p	2N2219	41p	2N3823	99p	40430	£1·39	BA182	26½p	IN914	8p
AF125	22p	BC184	9p	BF109	75p	BFX88	26p	OC81	13½p	2N2646	55p	2N3903	16½p	40432	£2·17	BA220	7p	IN916	10p
AF126	22p	BC184L	9p	BF115	25p	BFY50	16½p	OC83	22p	2N2905	46p	2N3904	19p	40673	55p	BA221	7p	IN4148	5½p
AF127	22p	BC187	27½p	BF160	25½p	BFY51	16½p	OC140	22p	2N2924	18p	2N3905	23p	AA119	10p	BA222	7½p		
AF139	35p	BC212L	11p	BF167	27½p	BR100	43p	OC170	27½p	2N2926 all	10p	2N3906	25p	AA120	10p	BAV10	11p		
AF172	25p	BC213L	11p	BF173	22p	BRY39	44p	OC171	33p	2N3053	22p	2N4058	13½p	AA129	10p	BAW62	10p		

CAPACITORS

MULLARD C333, 629 and 630 series—Ceramic Plate. E12 series from 1·8pF to 0·022μF. **5½p.**

CERAMIC DISC—LOW VOLTAGE—0·01μF, 0·022μF, 0·047μF, **5½p;** 0·1μF, 0·22μF, 0·47μF, **6½p.**

POLYSTYRENE (160V)—From 10pF to 0·01μF in multiples of 10pF: 15pF; 22pF; 33pF; 47pF and 68pF **3½p.**

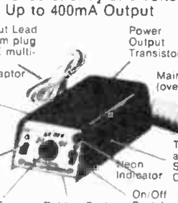
MYLAR PLATE (100V)—1000 pF, 2000pF, 5000pF, **2½p**, 0·01μF, 0·02μF, 0·04μF, 0·05μF, **3½p;** 0·068μF, 0·1μF, **5p;** 0·2μF, **6½p.**

MULLARD C280 (250V POLYESTER)—0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, **3½p;** 0·068μF, **4p;** 0·1μF, 0·15μF, **4½p;** 0·22μF, **5½p;** 0·33μF, **7p;** 0·47μF, **9p;** 0·68μF, **12p;** 1·0μF, **14½p;** 1·5μF, **22p;** 2·2μF, **26½p.**

new stabilised

POWER PACK/CONVERTER

Switched 3, 6, 7½ or 9 volts.
Up to 400mA Output



Our Price £3·99 + P. & P. 16p.

Unstabilised Version of above	£2·99
Other Eliminators (unstabilised)*	
6 volts at up to 50mA	£1·65
9 volts at up to 50mA	£1·65
9 volts (miniature) up to 50mA	£2·09
6 + 6 volts at up to 50mA	£2·75
9 + 9 volts at up to 50mA	£2·75
7½ volts for Cassette Players (small)	£2·20
3, 4½, 6, 7½, 9, 12 volts up to ½A	£3·75
Fully Stabilised* Car Battery Converter, giving switched outputs of 6, 7½ or 9 volts	£5·49

P. & P. on all models 16p.

ZENERS

All 5% tolerance

BZY88, 400mW, 3·3V to 33V	11p
1ZS, 1W, 3·3V to 100V	18p
BZX70, 2·5W, 7·5V to 75V	27p

YES, "YOU'VE GOT THE WHOLE WIDE WORLD IN YOUR HANDS"! ALMOST UNBELIEVABLE! Think of the year 1984 and what might be produced then—now get the fantastic ASTRAD 17 and SEE for yourself that the incredible Russians have done it all NOW! It's the radio perfectionist's dream come true! THIS ONE SUPERSEDES ALL EARLIER MODELS! It will probably make your present radio seem like a "crystal set"! Complete with optional battery eliminator for both battery and mains use! We're almost giving them away at only £18·50—a mere fraction of even today's Russian miracle price! We challenge you to compare performance and value with £80 radios! *Send quickly, from receipt of goods test on mail order 7 day approval, refund if not delighted. Or call. Volume controlled from a whisper to a roar that would fill a hall! Much wider band spread, for absolute "pin-point" station selection! Plus "MAGIC EYE" tuning level indicator for ultra perfect tuning sensitivity! Yes, the Russians have surpassed themselves, proving again their fantastic ability in the field of electronics and brilliantly reflecting their advanced micro-circuitry techniques in the field of space-ship and satellite communications. Yes, EVERY WAVEBAND instantly at your fingertips including Standard Long, Medium, Short and Ultra Short Waves to cover the four corners of the earth during 24 hours a day including all normal transmissions. VHF, FM/USW, AM:LW, MW, SW, gets, locally, local & new stations not yet operational, and messages from all over the world! Expensive TURRET TUNER side control waveband selection unit (as used on expensive T.V.'s!). Every waveband clicks into position giving incredible ease of station tuning! Genuine push-pull output! ON/OFF volume and separate Treble and Bass tone controls for utter perfection of reproduction and tone! Press-button dial illumination! Take it anywhere—runs economically on standard batteries (obtainable everywhere) or direct through battery eliminator from 220/240V AC mains supply. Internal ferrite rod aerial plus built-in "rotatable" telescopic aerial extending to 39in approx. It's also a fabulous CAR RADIO. Can also be used through extension amplifier, tape recorder or public address system. SIZE 13in × 10in × 4½in overall approx. Magnificently designed, in highly polished cases. Made to give years of perfect service. Purer & sweeter tone than ever. (U.K. service facilities & spares available for years & years to come, if ever necessary!). With WRITTEN GUARANTEE, manual with simple operating instructions & circuit diagram. PLUS ultra sensitive earphone for personal listening. ONLY £18·50 (with mains/battery eliminator £2·25 extra) BOX, POST, ETC. 45p. NO MORE TO PAY! *BUT WAIT, for only 75p extra you get the sensational "COMPUTERISED" WORLD TUNING GUIDE (it enables you to zone and time in a flash for transmissions the whole world over—even a child can do it in a flash—it even lets you know when to tune into the U.K. when abroad. NO GUESSING! NO MESSING!) PLUS Standard 'longlife' batteries and Converter Plug. (Sorry—We cannot change these new radios for any earlier model purchased.) Send quickly to Uxbridge Road address, or call at either Store. But HURRY! SHOPERTUNITIES SAVE YOU £££'s.

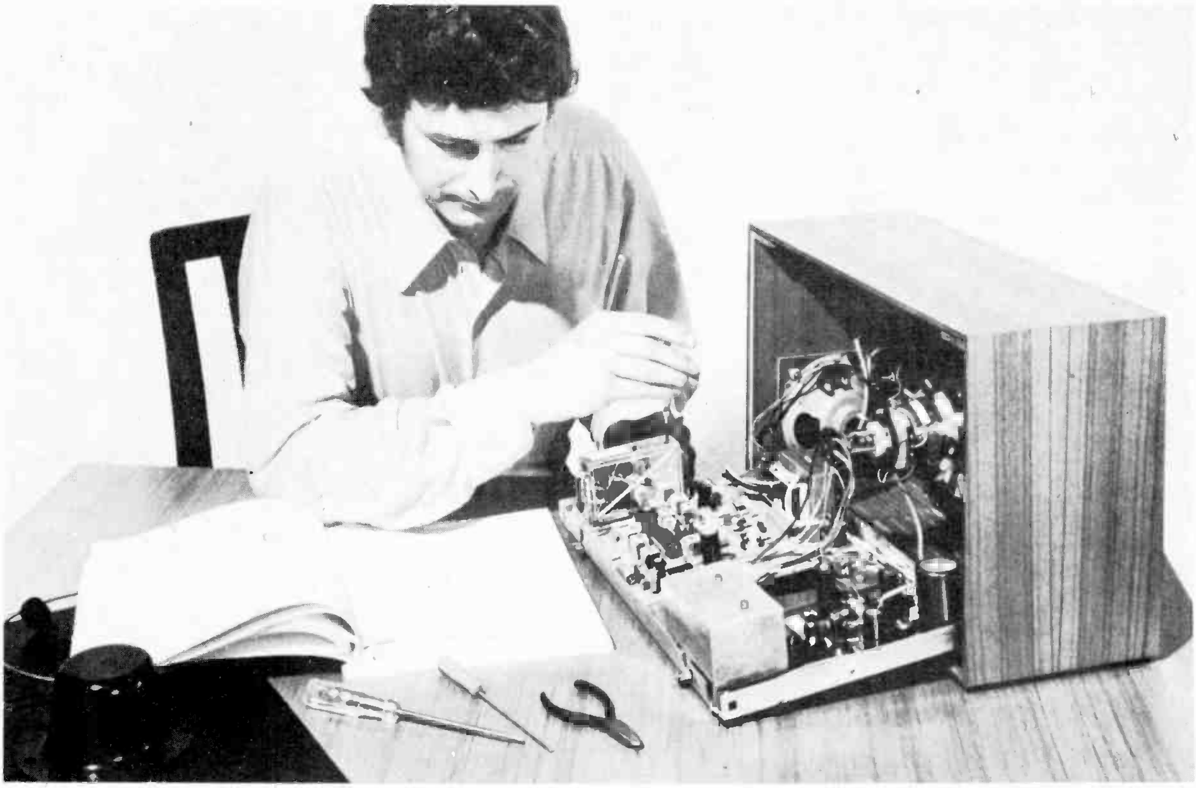
Shopertunities "thunder" ahead with an offer that's FANTASTIC (even by our standards!). We've snapped up 500 magnificent machines. Latest sensation in the world of-sound! First-class makers! Fabulous VHF, AM/FM Radio AND Cassette Tape Recorder & Player combined & it also runs off standard batteries or mains. (Simply plug in the 220/240V AC line cord). Record and play back anything, anywhere! IMPORTERS RECOMMENDED RETAIL PRICE £44! WE OFFER AT UNDER HALF PRICE! Wonderful features: ★ Press-button Keyboard Control Panel or latest MASTER SWITCH CONTROL! ★ "MAGIC EYE" Visual Battery check/recording level indicator or built-in automatic Leveller! ★ Separate ON/OFF and HI-LO volume controls! ★ Heavy duty built-in speaker! ★ Earphone (for personal listening or 'monitoring") and extension speaker sockets! ★ Remote control microphone! ★ Built-in swivel telescopic extension aerial (24in approx.)! Magnificently made case with carry handle. (DESIGNS VARY SLIGHTLY.) Takes standard 30, 60, 90 or 120-minute Cassette Tapes, obtainable everywhere. AND the amazing built-in full circuit VHF, AM/FM Radio gives you superb clarity of tone, incredible station selection. Unique rotating Station Selector Dial—gets, locally, local city and regional stations in every part of the country, plus B.B.C. National, VHF. Picks up dozens of foreign stations. Fabulous in your car! You could pay £££'s more for a Car Radio or Car Cassette player ALONE! £20·97, carr. etc., 50p—NO MORE TO PAY! Complete with simple instructions, remote control microphone with on/off switch and microphone stand. WITH WRITTEN GUARANTEE. Send quickly, test on mail order 7 day approval from receipt of goods, refund if not delighted. Or call.
BONUS OFFER: Batteries and Cassette Tape 28p extra if required.
Callers: ACCESS & BARCLAY CARDS ACCEPTED AT BOTH STORES

THE ONE STEP FORWARD EVERYONE HAS WAITED FOR! NOW a superb de luxe portable BATTERY/MAINS tape recorder and player—and incredible Shopertunities bring it to you for ONLY £10·95. Due to our cut price we cannot name first-class makers—but rest assured you're getting one of the BEST! Expensive "PIANO KEYBOARD" CONTROL PANEL (or latest MASTER SWITCH control) AND AUTOMATIC LEVEL CONTROL. No fiddling with awkward tape and reels, just "slap-in" a cassette and off you go! (Takes 30, 60, or 90 minute standard cassette tapes obtainable everywhere.) Amazing performance ensures perfect tapings and superb reproduction! Remote control microphone. Rapid Rewind! Fast forward! Beautiful tone from a whisper to a roar! Complete—record anywhere, indoors or out! Runs on standard batteries AND 220/240V AC mains. Separate jacks for remote control microphone, etc. Size 9½in × 5in × 2½in approx. Design can vary slightly. With carry handle. WRITTEN GUARANTEE and full instructions. Importers (Recommended selling price £26·97!) OUR PRICE ONLY £10·95, post, etc. 50p. NO MORE TO PAY! *Send quickly, from receipt of goods test on mail order 7 day approval—refund if not delighted. Or call at either of our stores. BONUS OFFER—Cassette tape, Standard batteries AND microphone stand 55p extra if required.

Order by post to Uxbridge Road address or call at either store.
Bargains galore at both stores.—(COMMERCIAL TRAVELLERS PLEASE NOTE: Merchandising office at Holborn Store.)

SHOPERTUNITIES LTD.

Dept. PE/NC/32, 164 UXBRIDGE RD. (facing Shepherds Bush Green), LONDON W12 8AQ. (Thurs. 1, Fri. 7). Also at 37/39 HIGH HOLBORN (opposite Chancery Lane), LONDON, W.C.1. (Thurs. 7 p.m.) BOTH OPEN MON. TO SAT. 9 A.M. TILL 6 P.M.



LEARN about MODERN TV Design by building this Heathkit 12" B/W Portable

on the new Heathkit GR-9900 portable 12" UHF Monochrome Television kit. A unique chance to double the pleasure available from any other television set — because you build this yourself.

We've used the latest modular construction and advanced design concepts to produce an outstandingly high performance TV worthy of the Heathkit name. All the main electronics are mounted on two easy-to-assemble printed circuit boards—this plus the use of no less than four integrated circuits perform the complex function of IF, video, sound, line frame and scan. Factory pre-aligned coils make alignment very easy and there are four presetable pushbutton controls for channel tuning—a luxury found in very few other models. The quality and fidelity is therefore excellent, and of a far higher standard than most ready-built televisions in the shops.

The GR-9900 is portable too—equally at home on the mains or off your 12 volt battery for car, boat or caravan use. Add to this Heath's world renowned experience in the design of equipment for first-time kit builders, and you will be impressed on all counts of engineering, styling, and performance.

The instruction manual is surprisingly simple with big, clear illustrations to map out your way. Would-be TV engineer? Here's your chance to learn—by actually building a television yourself. The manual not only shows you how to get 100% personalised quality control on your own; in the event of anything going wrong, a Trouble-Shooting section enables you to find the fault—and, in most cases, to put it right unaided.

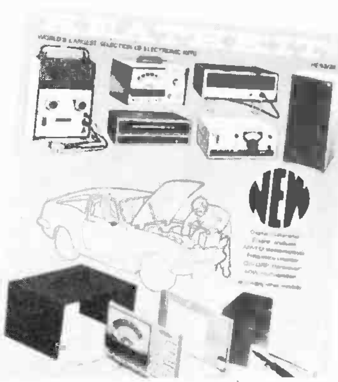
The GR-9900 is a kit you'll be proud to build and own. You have a choice of fully finished cabinets in teak or modern white and the kit price, £62.70 (carriage extra), includes a FREE high performance indoor aerial.

FREE Heathkit Catalogue

Contains something for everyone: Hi-Fi Stereo, Testers & Instruments, SWL, Metal Detectors . . . even a Battery charger Kit.
Mail the coupon . . . Today!

Heath (Gloucester) Limited, Gloucester GL2 6EE.

LONDON showroom
233 Tottenham Court Road
Tel 636 7349



Choose cash or Heath Monthly Budget Plan

(Mail order prices and specifications subject to change without notice)

Please send me a FREE Heathkit catalogue

Name ______________________

Address ______________________

____

____

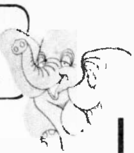
HEATH
Schlumberger

Heath (Gloucester) Limited, Dept. PE/11/73
Gloucester GL2 6EE. Telephone 0452 29451

Henry's

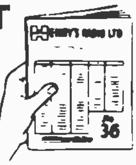
UK'S LARGEST RANGE OF TRANSISTORS, IC'S RECTIFIERS, ALL SEMICONDUCTOR DEVICES

BEST PRICES · RETAIL · TRADE · EXPORT & INDUSTRIAL



FREE BOOKLET

All types of
TRANSISTORS • RECTIFIERS
BRIDGES • SCR's • TRIACS
INTEGRATED CIRCUITS
F.E.T. • LIGHT DEVICES
OVER **1500** DIFFERENT DEVICES

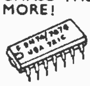


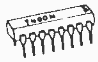
MORE DEVICES
NEW PRICES
NEW RANGES
THIS IS A MUST
FOR ALL
SEMI-CONDUCTOR
USERS!

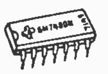
ENTIRELY NEW 1973 EDITION (ask for Booklet No. 36)

SEND FOR YOUR FREE COPY TODAY!

INTEGRATED CIRCUITS. VERY IMPORTANT—**ONLY** BRANDED I.C's ARE TO THE **FULL** MANUFACTURERS' SPECIFICATIONS. **ALL** OTHERS ARE NOT. HENRY'S SELL *ONLY* BRANDED INTEGRATED CIRCUITS . . . FROM **TEXAS . . . I.T.T. . . . FAIRCHILD . . . SIGNETICS** . . . SO WHY BUY ALTERNATIVES OR UNDER SPEC. DEVICES WHEN YOU CAN PURCHASE THE GENUINE ARTICLE FROM US EX STOCK . . . NEED WE SAY MORE!







Type	1–11 £p	12–29 £p	30–99 £p	Type	1–11 £p	12–29 £p	30–99 £p
SN7400N	20	18	16	SN7446N	2·16	2·16	1·89
SN7401N	20	18	16	SN7447AN	1·80	1·80	1·57
SN7401AN	38	38	33	SN7448N	1·50	1·27	1·13
SN7402N	20	18	16	SN7450N	20	18	16
SN7403N	20	18	16	SN7451N	20	18	16
SN7403AN	38	38	33	SN7453N	20	18	16
SN7404N	24	21	18	SN7454N	20	18	16
SN7405N	20	18	16	SN7460N	20	18	16
SN7405AN	44	44	38	SN7470N	33	30	27
SN7406N	40	38	35	SN7472N	38	38	34
SN7407N	40	38	35	SN7473N	44	41	37
SN7408N	25	22	19	SN7474N	48	48	42
SN7409N	33	33	28	SN7475N	59	55	51
SN7409AN	44	44	38	SN7476N	45	36	32
SN7410N	20	18	16	SN7480N	80	70	50
SN7411N	25	23	21	SN7481N	1·25	1·10	95
SN7412N	28	28	25	SN7482N	87	80	72
SN7412AN	38	38	33	SN7483N	1·20	1·10	1·00
SN7413N	30	27	25	SN7485N	1·87	1·87	1·63
SN7414N	72	72	63	SN7486N	50	50	44
SN7416N	30	27	25	SN7489N	4·32	4·32	3·78
SN7417N	30	27	25	SN7490N	75	70	63
SN7420N	20	18	16	SN7491AN	1·10	1·00	90
SN7422N	28	28	25	SN7492N	75	70	63
SN7422AN	38	38	33	SN7493N	75	70	63
SN7423N	37	34	32	SN7494N	85	80	75
SN7425N	37	37	32	SN7495N	85	80	75
SN7427N	37	37	32	SN7496N	1·00	90	83
SN7428N	43	43	37	SN74100N	2·16	1·89	1·89
SN7430N	20	18	16	SN74104N	60	53	45
SN7432N	37	37	32	SN74105N	60	53	45
SN7433N	43	43	38	SN74107N	51	51	45
SN7433AN	57	57	50	SN74110N	57	57	50
SN7437N	43	43	37	SN74111N	86	86	75
SN7438N	43	43	37	SN74116N	2·16	2·16	1·89
SN7438AN	57	57	50	SN74118N	1·00	90	83
SN7440N	20	18	16	SN74119N	1·92	1·92	1·68
SN7441AN	85	79	73	SN74120N	1·05	1·05	92
SN7442N	85	79	73	SN74121N	57	57	50
SN7443N	1·50	1·27	1·13	SN74122N	80	80	70
SN7444N	1·50	1·27	1·13	SN74123N	1·44	1·44	1·26
SN7445N	2·16	2·16	1·89	SN74125N	69	69	60

Type	1–11 £p	12–29 £p	30–99 £p
SN74126N	69	69	60
SN74132N	72	72	63
SN74136N	63	63	55
SN74141N	1·00	90	80
SN74142N	2·88	2·88	2·52
SN74145N	1·44	1·44	1·26
SN74147N	2·30	2·30	1·83
SN74148N	2·01	2·01	1·63
SN74150N	2·30	2·30	2·01
SN74151N	1·15	1·15	1·00
SN74153N	1·09	1·09	95
SN74154N	2·30	2·30	2·01
SN74155N	1·55	1·55	1·00
SN74156N	1·09	1·09	1·00
SN74157N	1·09	1·09	95
SN74159N	2·44	2·44	2·14
SN74160N	1·58	1·58	1·38
SN74161N	1·58	1·58	1·38
SN74162N	1·58	1·58	1·38
SN74163N	1·58	1·58	1·38
SN74164N	2·01	2·01	1·76
SN74165N	2·01	2·01	1·76
SN74166N	2·16	2·16	1·89
SN74167N	4·10	4·10	3·59
SN74170N	2·88	2·88	2·52
SN74172N	5·76	5·76	5·04
SN74173N	1·66	1·66	1·45
SN74174N	1·80	1·80	1·57
SN74175N	1·29	1·29	1·13
SN74176N	1·44	1·44	1·26
SN74177N	1·44	1·44	1·26
SN74180N	1·44	1·44	1·26
SN74181N	5·18	5·18	4·53
SN74182N	1·44	1·44	1·26
SN74184N	2·16	2·16	1·89
SN74185AN	2·16	2·16	1·89
SN74188N	6·48	6·48	5·67
SN74190N	2·30	2·30	2·01
SN74191N	2·30	2·30	2·01
SN74192N	2·30	2·30	2·01
SN74193N	2·30	2·30	2·01
SN74194N	1·72	1·72	1·51
SN74195N	1·44	1·44	1·26
SN74196N	1·58	1·58	1·38
SN74197N	1·58	1·58	1·38
SN74198N	3·16	3·16	2·77
SN74199N	2·88	2·88	2·52

PRICING OF SN7400 SERIES IS CALCULATED ON THE TOTAL NUMBER ORDERED REGARDLESS OF MIX

SN74 (HIGH POWER), SN74 (LOW POWER) series in stock. Send for List 36 free on request. Low Profile Sockets, 14 pin, 15p, 16 pin, 17p, 8 pin, 14p.

TRANSISTORS—A selection

For *full* list send for booklet 36 today

Type	£p	Type	£p	Type	£p	Type	£p	Type	£p	Type	£p
AAZ13	10	BC169C	14	BY100	15	OC36	65	V405A	25	2N3614	59
AC107	35	BC182	12	BY127	15	OC44	18	ZTX108	10	2N3702	11
AC128	20	BCY32	85	BYZ13	35	OC45	18	ZTX300	14	2N3714	1·60
AC187	20	BCY39	1·00	C106D	55	OC71	15	ZTX302	18	2N3771	1·75
ACY17	35	BCY55	2·50	GET111	55	OC72	25	ZTX500	15	2N3773	2·25
ACY39	65	BCY70	15	GET115	75	OC77	55	2G301	40	2N3790	2·25
AD149	50	BCY71	20	GET880	55	OC81	28	2N697	15	2N3819	35
AD161	39	BCY72	13	LM309K	1·87	OC83	25	2N706	10	2N3866	75
AD162	39	BD124	80	MAT121	25	OC140	65	2N930	20	2N3903	15
AF117	20	BD131	50	MJE340	50	OC170	25	2N987	45	2N4062	14
AF118	50	BF115	22	MJE520	65	OC200	55	2N1132	25	2N4126	15
AF139	33	BF180	33	MJE305S	75	OC202	90	2N1304	22	2N4871	35
AF186	40	BF194	13	MPF105	46	OCP71	1·00	2N1613	20	2N5457	36
AF239	44	BFX13	25	NKT217	45	ORP12	55	2N1671	1·00	2S001	3·00
ASY27	30	BFX34	55	NKT404	60	ORP60	45	2N2147	75	2S026	8·90
BA115	10	BFX88	22	OAS	60	P346A	20	2N2160	69	2S303	70
BAX13	5	BFY50	20	OA81	10	TIL209	25	2N2926	10	40250	45
BC107	12	BFY51	20	OA200	8	TIP29A	49	2N3053	20	40361	45
BC108	12	BFY64	45	OA202	10	TIP30A	58	2N3054	45	40362	40
BC109	12	BFY90	75	OC16	85	TIP31A	61	2N3055	45	40408	50
BC109C	14	BLY36	6·25	OC20	1·25	TIP41A	74	2N3440	50	40486	75
BC113	16	BSX20	15	OC28	65	TIP42A	90	2N3442	1·10	40636	1·00
BC147	12	BU105	2·20	OC35	55	TIS43	26	2N3525	80	40430	85

TBA 800 5 WATT I.C.

Suitable alternative to SL403D, 5/30 volt operated. 8/16 ohm 5 watt output.
With circuits and data £1·50.

SINCLAIR IC12

With circuits and data, 6 W IC with printed circuit board 28V operated, £1·80.

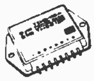
ZN414 IC

Integrated circuit radio as featured by many magazines. (PW Jan. 73 Reprint Ref. No. 19 for 10p), £1·20.

TOSHIBA POWER AND PREAMPLIFIER MODULES

TH9013P 20W power amplifier 22–0–22 or single 45V operated, £4·57.

TG9014P Stereo on two channel preamplifier, £1·50.
(Circuit book No. 42 price 10p).



ULTRASONIC TRANSDUCERS

Operate at 40kHz up to 100 yds. Ideal remote switching and signalling, complete with data transmitter and receiver, new I.C. circuits. Per pair, £5·90.

TA 960 I.C. with socket £1·80.

3015F 7 SEC.

IC size complete with data price £2 each or 4 for £7. (Digital clock circuits Ref. No. 31, 15p).

TRANSISTORS—SPECIAL OFFERS

2N3055

25	47p each
100	42p each
500	39p each
1000	34p each

BY127

25	12p each
100	10p each
500	9p each
1000	8p each

AF117

25	15p each
100	13p each
500	12p each
1000	10p each

OC35

25	46p each
100	42p each
500	38p each
1000	34p each

ZENER DIODES

400m/w BZY88/BZX83. From 3·3V—33V, 10p each.
1·3W 5% Miniature Tubulars IN4700 series. From 3·3V—33V, 18p each.
10W. Stnd. Mounting ZS series 6·8V—100V 5%, 40p each.

LINEAR I.C.

Type	£ p
702C (T05)	75
709C (T05)	39
709C (DIL)	39
723C (T099)	90
723C (DIL)	90
728C (DIL)	45
728C (T099)	45
741C (T05)	50
741C (DIL)	50
747C (T099)	1·00
747C (DIL)	1·00
748C (DIL)	61

SILICON RECTIFIERS

1 amp series. IN4001 to IN4007. From 6p each.
1·5 amp. PL4001 to PL4007. From 8p each.
3 amp. PL7001/IN5400. From 14p each.
Send for full list 36.

SEMI-CONDUCTOR QUANTITY DISCOUNTS

10% 12+, 15% 25+, 20% 100+
All one type except where quantity discounts shown.
Min. order £1·00 please.

MORE OF EVERYTHING AT HENRY'S

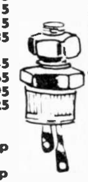
See pages 935, 936, and Back Cover of this magazine.

BEST VALUE

10% VAT

TO BE ADDED TO ALL ORDERS

TRIACS—Stud Mounting with accessories

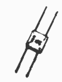


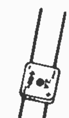
Type	P.I.V.	Price ea. 1–11
3 AMP RANGE		
SC35A	100V	80p
SC35B	200V	85p
SC35D	400V	90p
SC35E	500V	£1·20
6 AMP RANGE		
SC40A	100V	90p
SC40B	200V	95p
SC40D	400V	£1·20
SC40E	500V	£1·50
10 AMP RANGE		
SC45A	100V	£1·05
SC45B	200V	£1·15
SC45D	400V	£1·45
SC45E	500V	£1·85
15 AMP RANGE		
SC50A	100V	£1·45
SC50B	200V	£1·65
SC50D	400V	£1·95
SC50E	500V	£2·25

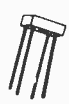
TRIACS—Additional Types
40430 TRIAC (T066) 85p
40669 TRIAC (Plastic) 90p
40486 TRIAC (T05) 75p

NEW RANGES BRIDGE RECTIFIERS

FEATURES SMALL SIZE & LOW COST







250 M/A ¼ AMP P.I.V.

Type	P.I.V.	Price
B025/05	50	16p
B025/10	100	18p

¼ × ¼ × ⅛in dia.

½ AMP 1–11

Type	P.I.V.	Price ea.
B05/05	50V	20p
B05/10	100V	22p
B05/20	200V	23p
B05/40	400V	25p
B05/60	600V	27p

½H × ½L × 3/16in. dia.

1 AMP

Type	P.I.V.	Price
B1/05	50V	25p
B1/10	100V	25p
B1/20	200V	28p
B1/60	600V	30p

½H × ½L × 3/16in. dia.

1 AMP

Type	P.I.V.	Price
W005	50V	29p
W01	100V	30p
W02	200V	32p
W06	600V	35p

⅜ × ½in. tubular

2 AMPS

Type	P.I.V.	Price
B2/05	50V	35p
B2/10	100V	40p
B2/20	200V	45p
B2/60	600V	50p
B2/100	1000V	55p

½H × ½L × 3/16in. dia.

4 AMPS

Type	P.I.V.	Price
B4/100	100V	55p
B4/200	200V	59p
B4/400	400V	65p
B4/600	600V	75p
B4/800	800V	£1·00

½H × ½L × 3/16in. dia.

6 AMPS

Type	P.I.V.	Price
B6/05	50V	65p
B6/10	100V	70p
B6/20	200V	80p
B6/40	400V	90p
B6/60	600V	£1·00

½H × ½L × 3/16in. dia.

SILICON CONTROLLED RECTIFIERS

Type	P.I.V.	1–11
1 AMP (TO5)		
CRS 1/05AF	50V	30p
CRS 1/10AF	100V	30p
CRS 1/20AF	200V	35p
CRS 1/40AF	400V	45p
CRS 1/60AF	600V	55p
3 AMP (TO48)		
CRS 3/05AF	50V	40p
CRS 3/10AF	100V	40p
CRS 3/20AF	200V	45p
CRS 3/40AF	400V	55p
CRS 3/60AF	600V	65p
5 AMP	400V	60p
CRS	5/400V	60p
7 AMP (TO48)		
CRS 7/100	100V	60p
CRS 7/200	200V	67p
CRS 7/400	400V	85p
CRS 7/600	600V	95p

All types offered subject to availability. Prices correct at time of press. E. & O.E. U.K. post, etc. 15p per order.

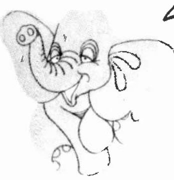
Henry's RADIO LIMITED
EDGWARE ROAD, W2

404-406 Electronic Components and Equipment 01-402 8381
354-356 High Fidelity and Tape Equipment 01-402 5854/4736
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road, London W2 1BW

Open:- 9 am-6 pm 6 days a week All stores open all day Saturday

Henry's

PANEL METERS · TRANSFORMERS · CONTROLS · RELAYS
IRONS · TOOLS · VALVES · POT CORES MOST TYPES OF COMPONENTS
You need a catalogue! 55p post paid complete with Discount Vouchers



UK's LARGEST RANGE OF KITS & GADGETS

TEST EQUIPMENT

MULTIMETERS

(carr., etc. 30p)

200H (M210) 20k/V Slimline with case, **£4·95**
THL33D 2k/V Robust with case, **£4·95**
U437 10k/V Steel case. A.C. up to 40kHz, **£4·95**
U4324 20k/V with A.C. current ranges, **£8·00**
AF105 50k/V with leather case, **£9·50**
U4313 20k/V A.C. current. Steel case, **£10·50**
U4341 Plus built in transistor tester, **£10·50**
Model 500 30k/V, **£9·95**

OTHER EQUIPMENT

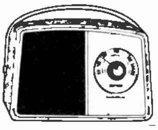
SE250B Pocket Signal Injector, **£1·90.** Carr. 15p
SE500 Pocket Signal Tracer, **£1·50.** Carr. 15p
TE15 Grid Dip Meter 440kHz—280MHz, **£13·45.** Carr. 30p
TE40 A.C. Millivoltmeter 1·2MHz, **£18·75.** Carr. 35p
TE65 28 Range Valve Voltmeter, **£19·25.** Carr. 40p
TE20D 120kHz—500MHz RF Generator, **£16·95.** Carr. 40p
TE22D 20Hz—200kHz Audio Generator, **£18·75.** Carr. 40p
SE350A Deluxe Signal Tracer, **£9·95.** Carr. 20p
SE400 Volts/ohms/R-C sub./RF field/RF gen., **£11·25.** Carr. 20p

A SELECTION OF INTERESTING ITEMS

C3025 Compact transistor tester, **£5·50.** P. & P. 15p
E1300 Mono mag cart preamp, **£1·95.** P. & P. 15p
E1310 Stereo mag cart preamp, **£4·95.** P. & P. 25p
Easiphone telephone amplifier, **£6·15.** P. & P. 25p
D1203 Teleamp with PU coil, **£3·60.** P. & P. 20p
LL1 Door Intercomm. and chime, **£11·95.** P. & P. 25p
Chattalite (lights as you talk), **£13·90.** P. & P. 20p
1kW Dimmer/controller, **£3·00.** P. & P. 10p
9in Twin spring unit, for Reverbs, **£2·75.** P. & P. 15p
16in Twin spring unit, for Reverbs, **£6·50.** P. & P. 25p
Car Tachometer Electronic, **£7·50.** P. & P. 15p

VHF 205 Marine band converter, **£3·95.** P. & P. 15p
B2005 4 Ch. mic. mixer, **£2·95.** P. & P. 15p
B2004 2 Ch. stereo mixer, **£4·75.** P. & P. 15p

BUILD THIS RADIO



PORTABLE MW/LW RADIO KIT using Mullard RF/IF module. Features MW—bandspread for extra selectivity. Slow motion tuning. Fibre glass PVC cabinet. 600MW output. All parts **£7·98** (battery 22p). Carr. etc. 32p.

EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO + or — earth with speaker and fixings. **£6·50** carr/packg. 30p.

8 TRACK CAR STEREO (— earth) with speakers, in pods and fixings. **£12·50** carr/packg. 40p.

HANIMAX HC1000 battery cassette recorder. **£10·50** carr/packg. 25p.

HANIMAX HC2000 battery/mains cassette recorder. **£13·50** carr/packg. 30p.

AKAI GXC40 stereo cassette recorder, **£59·95** carr/packg. 50p

Pair Akai ADM microphones. **£6·95** carr/packg. 20p.

5 WAVEBAND PORTABLE TWIN SPEAKER RADIO FM/MW/SW/ AIRCRAFT — PUBLIC SERVICES. **£10·45** carr/packg. 30p.

PORTABLE CASSETTE TAPE PLAYER — for car or carry around. **£7·25** carr/packg. 20p.

HANIMAX POCKET CALCULATOR with % key. **£33·50.**

SPECIAL PURCHASES

AVOMETER MOVEMENTS

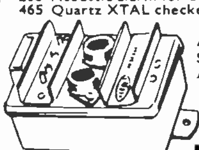
AVO 8 or 9 50mA MOVEMENTS. Ex Brand New AVO's. **£3·50.** Post 20p.

UFH TV TUNERS CHANNELS 21 to 64

Brand new transistorised geared tuners for 625 Line Receiver IF output. **£2·50.** Post 20p.

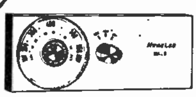
EASY TO BUILD KITS BY AMTRON—EVERYTHING SUPPLIED

Model No.		£
310	Radio control receiver	3·00
300	4-channel R/C transmitter	5·75
345	Superhet R/C receiver	5·08
450	TV sweep generator	10·24
455	AM signal generator	9·25
460	FM signal generator	9·91
65	Simple transistor tester	1·18
115	8W amplifier	2·87
120	12W amplifier	3·88
125	Stereo control unit	4·20
130	Mono control unit	3·52
605	Power supply for 115	3·88
610	Power supply for 120	4·08
615	Power supply for 2 × 120	4·85
230	AM/FM aerial amplifier	2·79
240	Auto packing light	5·18
275	Mic. preamplifier	5·83
480	Electronic voltmeter	17·51
485	0–12V 300mA STAB. supply	9·68
570	LF generator 10Hz—1mHz	12·60
575	Sq. wave generator 20Hz–20kHz	12·87
590	SWR meter	10·24
620	Ni–CAD Charger 1·2–12V	7·47
630	STAB. Power supply 6–12V 0·25–0–1A	7·65
690	D.C. motor speed Gov.	2·63
700	Electronic Chaffinch	5·96
705	Windscreen wiper timer	5·56
760	Acoustic switch	8·87
780	Metal Detector (electronics only)	7·27
790	Capacitive burglar alarm	6·16
810	Dynamic Compressor	6·79
835	Guitar preamp	3·75
840	Delay car alarm	5·20
875	CAP. Discharge ignition for car engine (–Ve Earth)	10·68
80	Scope calibrator	1·98
255	Level indicator	5·50
430	3mHz Millivoltmeter	18·23
525	120—160mHz VHF timer	9·33
715	Photo cell switch	6·93
795	Electronic continuity tester	3·88
860	Photo timer	12·04
871	Slide projector auto feed control	8·72
235	Acoustic alarm for driver	6·96
465	Quartz XTAL checker	7·89



ALL KITS OFFERED SUBJECT TO STOCK AVAILABILITY

BUILD THIS TUNER



MW/LW Radio tuner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built-in battery. Excellent results. Size: 7in × 2¼in × 3¾in. All parts **£4·85.** Carr. 15p.

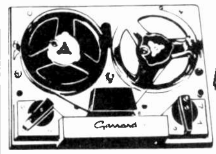
MULTI-USE AND RADIONIC KITS

		£
10–1	10 Projects	3·60
50–1	50 Projects	8·00
150–1	150 Projects	13·20
Telephone Communicator		7·20
X20	20 (Elec) } Projects	4·95
X40	40 (radio) } Projects	9·45

(Carr./Packing 40p)

ALL TRANSISTOR CIRCUITS WITH HANDBOOKS

All types offered subject to availability. Prices correct at time of press E & OE. 10% VAT TO BE ADDED TO ALL ORDERS. UK post, etc. 15p per order unless stated.



GARRARD BATTERY TAPE DECK

GARRARD 2 speed 9 volt tape decks. Fitted record/play and oscillator/erase heads. Wind and rewind controls. Takes up to 4in spools. Brand new complete with head circuits. **£9·50.** Carr. 30p.

TOP QUALITY SLIDER CONTROLS

60mm stroke high quality controls complete with knobs (post, etc. 15p any quantity).

Singles Log and Lin
5kΩ, 10kΩ, 22kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1 Meg. **45p each.**

Ganged Log and Lin
10kΩ, 22kΩ, 50kΩ, 100kΩ, 250kΩ. **65p each.** (Quantity discounts available). Complete with knobs.

MARRIOT TAPE HEADS

4 TRACK MONO or 2 TRACK STEREO

'17' High Impedance, **£2·00**; '18' Med. Impedance, **£2·00**; Erase Heads for '17' and '18', **75p**; '63' 2 track mono-Hi imp., **£1·75**; '43' Erase Head for '63', **75p.** (Post, etc. 15p any quantity).

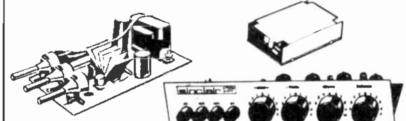
R730/E73 2 Track Mono Record Erase Low Imp., **75p** pair.

S!NCLAIR AND MINIATURE AMPLIFIERS

AMPLIFIERS (Carr. etc. 20p).		£
4–300	0·3 watt 9 volt	1·75
104	1 watt 9 volt	2·20
304	3 watt 9 volt	2·50
555	3 watt 12 volt	2·85
E1208	5 watt 12 volt	4·50
608	10 watt 24 volt	4·10
410	10 watt 28 volt	4·95
Z30	15 watt 30 volt	3·57
E1206	30 watt 45 volt	9·75
Z50	30 watt 50 volt	4·37
E1210	2½ + 2½ watts 12 volt	5·25
RE500	5 watt IC mains operated Amplifier with controls	6·30
SAC14	7 + 7 watt Stereo with controls	8·00
SAC30	15 + 15 watt Stereo with controls	11·00

SINCLAIR UNITS (Carr. 20p)	£
Z30 3·57 .. Z50	4·37
Stereo 60 Preamplifier	7·97
PZ5	3·97
PZ6	6·37
PZ8 (for Z50)	4·77
TRANS.	2·95
AFU	4·45

SINCLAIR PACKAGE DEALS. Post 25p	£
2 × Z30, Stereo 60, PZ5	15·95
2 × Z30, Stereo 60, PZ6	18·00
2 × Z50, Stereo 60, PZ8	20·25
Transformer for PZ8	2·95
PROJECT 605 KIT	19·95



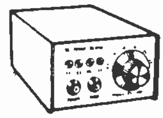
POWER SUPPLIES FOR EVERY PURPOSE

(All cased unless stated chassis)

470C 6/7½/9V 300mA, (Includes Multi-Adaptor for Tape Recorders etc.), **£1·95.** Post 20p
Car Lighter Voltage Adaptors 300mA (State Voltage 6V, 7½V, 9V), **£1·95** each. Post 25p
SC202 3/6/7½/9V 400mA, **£3·25.** Carr. 30p
HC244R Stabilised version, **£4·25.** Carr. 30p
P500 9V 500mA, **£2·80.** Post 20p
P11 24V 500mA (chassis), **£2·80.** Post 20p
P15 26/28V 1 amp (chassis), **£2·70.** Post 20p
P1080 12V 1 amp (chassis), **£3·25.** Post 20p
P1081 45V 0·9 amp (chassis), **£4·40.** Post 20p
P12 4½—12V 0·4—1 amp, **£6·75.** Post 30p
SE101A 3/6/9/12V 1 amp (Stab.), **£9·15.** Post 25p
RP164 6/7½/9/12 1 amp (Stab.), **£9·95.** Post 30p

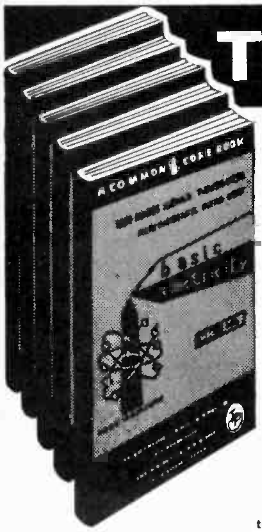
FIBRE OPTICS

0·01 dia. Mono Filament, **£1·50** per 25 metre reel. 0·13 dia. 64 Fibres Sheathed, **£1·00** per metre. SPRAYS 15mm dia. Mares Tails, **£9·50.**



Henry's RADIO LIMITED
EDGWARE ROAD, W2

SEE FACING PAGE FOR ADDRESSES



ALL OUR PRICES INCLUDE V.A.T.

BSR LATEST SUPERSLIM STEREO & MONO

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250V. Size 18¾ × 11¼in. Above motor board 3¼in. Below motor board 2¼in.

with STEREO and MONO XTAL **£8·25** Post 25p.

PORTABLE PLAYER CABINET

Modern design. Black rexine covered. Silver front grille. Padded Lid. Chrome fittings.

Motor board cut for BSR deck **£4·50** Post 25p

4 Transistor Mono Amplifier

Powerful 3 watt output. 15 ohm. AC mains operated with transformer. 3-Controls, volume, treble, bass and On/Off switch with knobs. Ready made on printed circuit board. Fused inputs and outputs. Famous make. Size 8in wide × 4in deep × 3in high.

Suitable 7in × 4in speaker, £1. **PRICE £5·95** Post 25p

BSR JUNIOR SINGLE PLAYER

Heavy duty 4-speed motor with separate pick-up arm fitted LP/78 turnover mono compatable cartridge. **£4·95**

GARRARD DECCA HI-FI DECK

Single play Stereo/Mono Deram transcription head and arm. Four speeds. 10½in turntable. Anti-rumble filter. Bias compensation. Laboratory motor.

SPECIAL PRICE **£18·50** Post 25p Ideal for Disco Decks

METAL PLINTH AND PLASTIC COVER

Cut out for most Garrard or B.S.R. Most will play with cover in position. 12¾ × 14¾ × 7½in. Covered in black leatherette. **£4·95** Post 35p

ALSO AVAILABLE IN SOLID NATURAL MAHOGANY WAX POLISHED FINISH—AT SAME PRICE

COMPACT PORTABLE STEREO HI-FI

Two full size loudspeakers 13¾ × 10 × 3½in. Player unit clips to loudspeakers making it extremely compact, overall size only 13¾ × 10 × 8½in., 3 watts per channel, plays all records 33 r.p.m., 45 r.p.m. Separate volume and tone controls. 240V AC Mains.

Attractive Teak finish Weight 13 lb.

Bargain Price **£25** 85p Carriage

SPECIAL OFFER! SMITH'S CLOCKWORK 15 AMP TIME SWITCH

Single pole two-way Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights etc. Variable knob. Turn on or off at full or intermediate settings. Two types available type A 0 to 60 minutes or type B 0 to 6 hours. Fully insulated. Makers last list price £4·50. Brand new and fully guaranteed.

OUR PRICE **£1·65** P. & P. 15p or £3 pair

(STATE TYPE A OR B WITH ORDER.)

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in sides 6 × 4in 45p; 8 × 6in 53p; 10 × 7in 65p; 12 × 8in 85p; 14 × 9in 90p; 16 × 6in 90p; 12 × 3in 50p; 16 × 10in £1.
ALUMINIUM BOXES 3 × 3 × 3in 60p; 4 × 4 × 4in 70p; 6 × 4 × 4in 80p; 9 × 4 × 4in £1; 12 × 4 × 4in £1·30.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in 9p; 8 × 6in 15p; 14 × 3in 16p; 10 × 7in 19p; 12 × 5in 20p; 12 × 8in 28p; 16 × 6in 28p; 14 × 9in 34p; 12 × 12in 40p; 16 × 10in 50p.
PAXOLIN PANEL 10 × 8in 15p.
1¼ inch DIAMETER WAVECHANGE SWITCHES, 25p.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way, 25p each.
1 p.l. 2-way, or 4 p. 2-way, or 4 p. 3-way, 25p.
TOGGLE SWITCHES, sp. 14p; dp. 22p; dp. dt. 22p.
Sub-miniature, sp. 30p; dp. 37p; dp. dt. 45p.

BRITISH FM/VHF TUNING HEART

88 to 108 Mc/s British made. 2 Transistors ready aligned —requires 10·7 Mc/s I.F. Complete with tuning gang. Connections supplied but some technical experience essential. **Our price £3·95** Post 20p

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. Size 3½ × 1¼ × 1¼in. **£2·20** Post 20p

R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12V or H.T. line 200-300V d.c. operation. Size: 1¾ x 1¼ x ¾ in. Response 25 c/s to 25 kc/s, 26 dB gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **99p** Post 20p

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	50+50/300V	50p
4/350V	14p	500/25V	20p	60+100/350V	85p
8/450V	18p	1000/25V	35p	32+32/250V	20p
16/450V	22p	1000/50V	47p	32+32/450V	45p
32/500V	50p	8+8/450V	22p	350 · 50/325V	55p
25/25V	10p	8+16/450V	25p	32+32+32/350V	55p
50/50V	10p	16+16/450V	40p	100+50 – 50/350V	55p
100/25V	10p	32+32/350V	40p		

LOW VOLTAGE ELECTROLYTICS.
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.
500mF 12V 15p; 25V 20p; 50V 30p.
1000mF 12V 20p; 25V 35p; 50V 47p; 100V 70p.
2000mF 6V 25p; 25V 42p; 50V 57p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.
CERAMIC 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 4p; 0·5 13p; 1mF 15p; 2mF 150V 15p.
500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p.
SILVER MICA. Close tolerance 1%. 2·2-500pF 8p; 560-2,200pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p each.
TWIN GANG. "0-0" 208pF : 176pF, 65p.
Slow motion drive 365pF + 365pF with 25pF + 25pF, 50p; 500pF standard 65p; small 3-gang 500pF £1·60.
SHORT WAVE SINGLE. 10pF, 30p; 25pF, 55p; 50pF, 55p.

SHORT WAVE SINGLE GANG. Precision Silver Plated Gangable Tuning Condensers. Values up to 100pF. **50p** each
Section Couplers supplied FREE with two or more gangs.

NEON PANEL INDICATORS 250V AC/DC. Amber 20p.
RESISTORS. ¼W. ½W. 1W. 20% 1p; 2W, 5p. 10Ω to 10M.
HIGH STABILITY. ½W 2%, 10 ohms to 6 meg., 10p.
Ditto 5%. Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each; 0·5 ohm to 8·2 ohms 10p.
TAPE OSCILLATOR COIL Valve type 35p.
FERRITE ROD 8 × ⅜in 20p; 6 × ¼in 20p; 3 × ⅜in 10p.

MAINS TRANSFORMERS

ALL POST 25p each

Eagle MT12 12-0-12V 50mA	90p
250-0-250 80 mA. 6·3V 3·5A 6·3V 1A or 5V 2A	£2·50
350-0-350 80 mA 6·3V 3·5A, 6·3V 1A or 5V 2A	£3·00
300-0-300V 120mA, 6·3V 4A C.T.; 6·3V 2A	£3·25
MINIATURE 200V 20mA, 6·3V 1A 2½ × 2½ × 2in	75p
MIDGET 220V 45mA, 6·3V 2A 2¼ × 2¼ × 2in	90p
HEATER TRANS. 6·3V 3A	60p

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V £2·80
1 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £2·25
2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £3·80
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £8·75
3 amp, 5, 8 and 13V £1·00; Ditto 5 amp £1·20. 3 amp, 3, 5, 8, 10, 13 and 5-0-5V £1·30, Ditto 5 amp. £1·50; 6-0-6V 500mA 90p 9V 1 amp 95p 12V 300mA 75p 12V 500mA 85p 12V 750mA 95p. 40V 1 amp £1·75.
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £2·25; 500W £6·25; 750W £10; 1000W £15
CHARGER TRANSFORMERS. Input 200/250V. for 6 or 12V, 1½ amp £1·50; 2 amp £1·80; 4 amp £2·50
BATTERY CHARGERS. Ready built with leads and clips 1½ amp £2; 4 amp £4; 5 amp. £4·50.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs. 1½ amp 40p; 2 amp 55p; 4 amp 85p.

MAINS ISOLATING TRANSFORMER

Primary 0-110-240V. Secondary 0-240V 3 amps 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make (Value £19) OUR PRICE **£10** Carr. 50p
Can be used as 800 watt auto transformers 240-110V.

SET OF 3 MOTORS FOR COLLARO STUDIO TAPE DECK

£2·50 Post 50p

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge5K. S.P. Transistor 25

80 Ohm Coax 4p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd £1·40; 60 yd £2. FRINGE LOW LOSS Ideal 625 and colour. **10** p per yd

Wire Wound controls 1¼in diam. 3 Watts. 10 ohms to 100K British Made with long ¼in spindles ¼in dia. 45p each.
HELICAL POT 10K LIN. List £3. Bargain 75p.
DUAL CONCENTRIC POT 500K LOG AND 500K LIN D.P. switch. Inner spindle 3¼in; outer spindle 2¼in 75p.

E.M.I. 13½ × 8in. SPEAKER SALE!

With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4·50** Post 25p

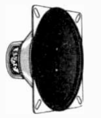
With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 c/s. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·75** Post 25p

Bookshelf Cabinet 16 × 10 × 9in. Teak finish **£5·50** Post 25p

GOODMANS 6½in. HI-FI WOOFER

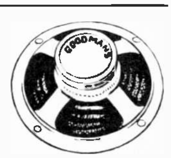
8 ohm. 10W. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 c/s. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**
Suitable Cabinet 12 × 8 × 6 £4 Suitable Tweeter £2

ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3¼ × 3¼ × 2in deep. Rating 10W, 3 ohm or 15 ohm models. Crossover 95p **£1·90** Post 20p.

GOODMANS 8in. WOOFER



8 ohm 12 watt. Deep cone. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps. Ideal bass unit for Hi-Fi system. **£3·75**

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in £1·25; 6½in £1·50; 8 × 5in £1·60; 8in £1·75; 10 × 6in £1·90; 10in £2·00.
SPECIAL OFFER! 80 ohm, 2¾in 2¾in 35 ohm, 2in.; 3in; 5in 25 ohm, 2½in dia; 3in. dia; 15 ohm. 3½in dia; 5in./6 × 4in; 7 × 4in; 8 × 5in **£1** EACH TYPE
3 ohm, 2½in, 2¾in, 3½in, 5in dia (6 × 4in, 8 ohm, £1·50).
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in diameter 4W £2·50, 10 in diameter 5W £2·50; Post 25p. 12in diameter, 6W, £2·95; 3 or 8 or 15 ohm models.
SPEAKER COVERING MATERIALS. Samples Large S.A.E
Horn Tweeters 2-16Kc/s. 8W 8 ohm or 15 ohm £1·95
De Luxe Horn Tweeters 2-18Kc/s, 15W, 15 ohm £3·50
TWO-WAY 3,000 c.p.s. CROSSOVERS 3, 8 or 15 ohm 95p

TWO-WAY CROSSOVER NETWORK 3,000 c/s

With variable tweeter attenuator giving accurate high/low frequency balance. Mounted on panel 5½in × 4in with control knob, tweeter and woofer leads and input terminals. Suitable for 3 to 8 ohm impedance. **£2·20** Post 15p

VALVE OUTPUT TRANSFORMER 25p.
MIKE TRANSFORMER MU metal 100-1 £1·25.
5 WATT MULTI RATIO. 3, 8 and 15 ohms, 80p.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt .... £11·50 100 watt .... £14·00

ELECTRO MAGNETIC PENDULUM MECHANISM

1·5V d.c. operation over 100 hours continuous on SP2 battery, fully adjustable swing and speed. Ideal displays, teaching electro magnetism or for metronome, strobe, etc. **95p** Post 20p

BRITISH MADE STEREO MULTIPLEX DECODER

Brand New. 7 transistors plus integrated circuit. Fibre glass printed circuit board. Size 2¼ × 6¼ × ¾in. Pre-aligned. Complete with stereo beacon indicator. 12V d.c. operation. 400mV output for 100mV input. Full instructions for any FM Tuner. Some technical experience essential. **£6·50** Post 15p

DIPOLE LOFT AERIAL £1·50.
80 OHM CABLE 4p yard.
300 OHM CABLE 5p yard.

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p
OUTLET BOXES, SURFACE MOUNTING 25p.
BALANCED TWIN RIBBON FEEDER 300 ohms, 5p yd.
JACK SOCKET Std. open-circuit 14p. closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p
JACK PLUGS Std. Chrome 15p; 3·5mm Chrome 12p DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p DIN SOCKETS Lead 3-pin 18p; 5-pin 15p. DIN PLUGS 3-pin 18p; 5-pin 25p.
VALVE HOLDERS 5p; CERAMIC 8p; CANS 5p.

ALL PRICES INCLUDE VAT MINIMUM POST AND PACKING

RADIO COMPONENT

Illustrated Colour Brochure, Radio Books & Components Lists 10p Written guarantee.

ALL OUR PRICES INCLUDE V.A.T.

E.M.I. WOOFER AND TWEETER KIT

£5·75 THE PAIR, Post 25p. (Available separately. Woofer £4·25; Tweeter £1·90)

Comprising a fine example of a Woofer 10¾ × 6¼in with a massive Ceramic Magnet, 44oz Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3¾in square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

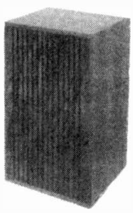
Impedance Standard 8 ohms
Maximum power 12 watts
Useful Response 35 to 18,000 cps
Bass Resonance 45 cps

SUITABLE ENCLOSURE 20 × 13 × 9in. MODERN DESIGN. TEAK WOOD FINISH. **£9·90** Post 25p

8in. or 10in. ELAC HI-FI SPEAKER

Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts, 10in. 12 watts. **£3·75**

TEAK VENEER HI-FI SPEAKER CABINETS
Fluted Wood Fronts



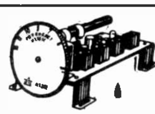
MODEL "A". 20 × 13 × 9in For 12 in. dia. or 10in speaker. **£9·90** Post 25p

MODEL "B". 16 × 10 × 9in For 13 × 8in. or 8 in. speaker **£5·50** Post 25p
MODEL "B" 2 ditto. Triangular Corner Version.

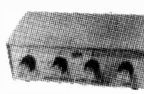
MODEL "C". 16 × 8 × 6in. For 8 × 5in. speaker **£4.40** Post 25p

LOUDSPEAKER CABINET WADDING 18in wide, 15p ft.

BARGAIN AM TUNER. Medium Wave. Transistor Superhet Ferrite aerial. 9 volt. **£4·95**



BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£3·95**



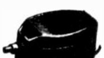
STEREO VERSION OF ABOVE £5·95

BARGAIN FM TUNER. 88-108 Mc/s Six Transistor. 9 volt. Printed circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4in. **£12·85**

BARGAIN FM TUNER. As above less cabinet. **£8·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£4·50**

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£2·50** Post 15p



WAFER THIN HEATING ELEMENTS

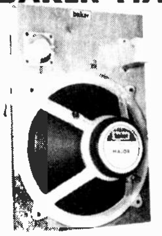
OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10¾ × 8¼ × $\frac{1}{16}$in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photo-copiers and print drying equipment.

Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

BAKER MAJOR 12" £9·90



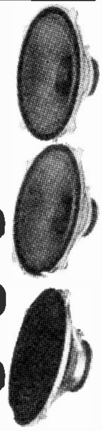
Post Free

30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. Post Free **£12·50**

Please state 3 or 8 or 15 ohms. Post 25p

BAKER "BIG SOUND" SPEAKERS



Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass Resonance 55 cps.

GROUP "25" 12in 25 watt 3, 8 or 15 ohms. **£8·80** Post Free

GROUP "35" 12in 35 watt 3, 8 or 15 ohms. **£9·90** Post Free

GROUP "50" 15in. 50 watt 8 or 15 ohms. **£22·00**

NEW 12in VERSION £17·60

MAJOR 100 WATT ALL PURPOSE 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. Separate treble and bass controls. Guaranteed. Details S.A.E. **£49** Carr. £1·00

CALLERS ONLY! DE-LUXE 100 WATT AMPLIFIER CHASSIS. 7 Valve version, 4 inputs, 10 wide range controls. For Mikes, Discos, Organs, Guitars, etc. 4, 8 and 15 ohm Loudspeaker matching. **£59**

Q MAX CHASSIS CUTTERS
A die, punch and Allen Screw

Sizes ⅜"	74p	Sizes 1⅜"	£1·70
$\frac{7}{16}$"	83p	Key "B" for above	10p
Key "T" for above 6p		2"	£2·25
½", $\frac{9}{16}$", ⅝"	90p	2 3/32"	£2·50
$\frac{11}{16}$", ¾"	92p	2½"	£3·30
$\frac{13}{16}$", ⅞"	99p	Key "C" for above	13p
Key "A" for above 6p		2⅝"	£4·50
$\frac{15}{16}$", 1", 1$\frac{1}{16}$", 1⅛"	£1·00	2¾"	£5·75
$\frac{15}{16}$", 1 7/32", 1¼"	£1·15	3"	£9·00
1$\frac{5}{16}$", 1⅜"	£1·20	Key "E" for above	20p
1½"	£1·35	1" Square, with key	£2·10
1⅝"	£1·55		

SLIDER VOLUME CONTROLS

Available in both LOG and LINEAR type. Size 3$\frac{5}{16}$ × ⅜ × $\frac{5}{16}$in. with knobs. 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1 MEG, 2 MEG. **65p** EACH

DELUXE 4 POLE MOTOR

1,400 r.p.m. reversible 42 Watt, spindle 1¼in × 7/32in, size 3½in × 3in. As illustrated. 240V a.c. mains. **£1·95** Post 25p

E.M.I. GRAM MOTOR

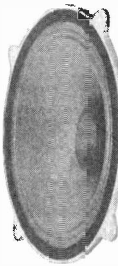
120V or 240V a.c. 2,400 rpm. 2-pole 70mA. Size 2¾ × 2¼ × 2¼in. **£1·00** Post 25p

ONE RPM GEARED MOTOR

240V a.c. mains. Ideal for displays/disco lightwheels. **£1·25** Post 25p

BAKER HI-FI SPEAKERS
HIGH QUALITY—BRITISH MADE

REGENT
12in. 15 watts

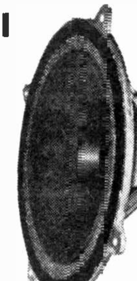


An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.

Bass Resonance 45cps
Flux Density 12,000 gauss
Useful response 45-13,000cps
3 or 8 or 15 ohm models.

£8·80 Post Free

DE-LUXE Mk II
12in. 15 watts

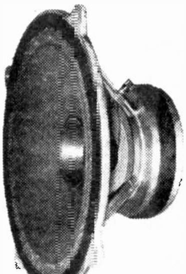


Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.

Bass Resonance 30cps
Flux Density 14,000 gauss
Useful response 25-16,000cps
8 or 15 ohms models.

£11 Post Free

SUPERB
12in. 20 watts

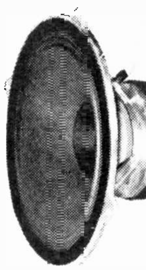


A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.

Bass Resonance 25cps
Flux Density 16,500 gauss
Useful response 20-17,000cps
8 or 15 ohms models.

£16·50 Post Free

AUDITORIUM
12in. 25 watts

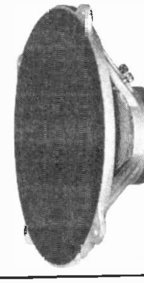


A full range reproducer for high power, Electric Guitars, public address, multi-speaker systems, electric organs, Ideal for Hi-Fi and Discotheques.

Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 25-16,000cps
8 or 15 ohms models.

£15·40 Post Free

AUDITORIUM
15in 35 watts



A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home.

Bass Resonance 35cps
Flux Density 15,000 gauss
Useful response 20-14,000cps
8 or 15 ohms models.

£22 Post Free

Hi-Fi Enclosure Manual containing 20 plans, designs, crossover data and cubic tables. 42p. Post Free.

CALLERS WELCOME ● 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 337 WHITEHORSE ROAD · CROYDON

(Export: Remit cash and extra postage.) *Buses 50, 68, 159. Rail Selhurst* Telephone 01-684-1665

The largest selection

EX COMPUTER BOARDS
Packed with transistors, diodes, capacitors and resistors—COMPONENT VALUE £1·50. 3 for ONLY 55p + p & p 30p
SPECIAL. As above PLUS Power Transistors ONLY 55p each + p & p 15p
STABILISED POWER MODULES Complete with circuit diagrams, etc. 99p each + p & p 15p
PAXOLINE BOARDS 7½ × 9" approx. 4 for 30p + p & p 20p.

FIBRE-GLASS PRINTED CIRCUIT BOARDS
16½ × 4" approx. 2 for 55p

DECON-DALO 33pC Marker
Etch resistant printed circuit marker pen 90p each

VEROBOARDS
Packs containing approx., 50sq. ins. various sizes, all 0·1 matric 55p

REPANCO CHOKES & COILS
RF Chokes
CH1. 2·5mH 25p CH2. 5·0mH 25p
CH3. 7·5mH 25p CH4. 10mH 25p
CH5. 1·5mH 25p
COILS
DRX1 Crystal set 56p DRR2 Dual range 45p

COIL FORMERS & CORES
NORMAN ¼" Cores & Formers 7p
⅜" Cores & Formers 8p

SWITCHES
DP/DT Toggle 25p SP/ST Toggle 18p

FUSES
1¼" and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A
QUICK-BLOW 4p ea. ANTI-SURGE 5p ea.

EARPHONES
Crystal 2·5mm plug 33p
Crystal 3·5mm plug 33p
8 ohms 2·5mm plug 22p
8 ohms 3·5mm plug 22p

DYNAMIC MICROPHONES
B1223. 200 ohms plus on/off switch and 2·5mm and 3·5mm plugs £1·60

3-WAY STEREO HEADPHONE JUNCTION BOX
H1012 £1·87

2-WAY CROSSOVER NETWORK
K4007. 80 ohms Imp. Insertion loss 3dB £1·21

SELECTED RESISTORS
R1. Our mix, ¼ watt carbon—50 for 55p

CAR STEREO SPEAKERS
(Angled) £3·85 per pair.

BI-PAK
CATALOGUE AND LISTS
Send S.A.E. and 10p.

INSTRUMENT CASES

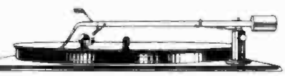
(Black Vinyl covered)

No.	Length	Width	Height	Price
BV1	8"	× 5½"	× 2"	90p
BV2	11"	× 6"	× 3"	£1·20

ALUMINIUM BOXES

BA1	5¼"	× 2¼"	× 1½"	42p
BA2	4"	× 4"	× 1½"	41p
BA3	4"	× 2¼"	× 1½"	41p
BA4	5¼"	× 4"	× 1½"	47p
BA5	4"	× 2½"	× 2"	41p
BA6	3"	× 2"	× 1"	34p
BA7	7"	× 5"	× 2½"	66p
BA8	8"	× 6"	× 3"	84p
BA9	6"	× 4"	× 2"	54p

BIB HI-FI ACCESSORIES
De Luxe Groov-Kleen
Model 42 £1·84
Chrome Finish Model 60 £1·50



Ref. 36A. Record/Stylus Cleaning Kit 28p
Ref. 43. Record Care Kit £2·35
Ref. 31. Cassette Head Cleaner 54p
Ref. 32. Tape editing Kit £1·54
Model 9. Wire Stripper/Cutter 83p
Ref. P. Hi-Fi Cleaner 31p
Ref. 32A. Stylus Balance £1·36
Ref. J. Tape Head Cleaning Kit 51p
Ref. 34. Cassette Case £1·27
Ref. 56. Hi-Fi Stereo Hints & Tips 32p

ANTEX SOLDERING IRONS
X25. 25 watt £1·93
CCN 240. 15 watt £2·15
Model G. 18 watt £2·15
SK2. Soldering Kit £2·86
STANDS: ST1 £1·21. ST2 77p
SOLDER: 18SWG Multicore 7oz 82p
22SWG 7oz 82p. 18SWG 22ft 28p
22SWG Tube 22p

ANTEX BITS and ELEMENTS

Bits No.		
102	For model CN240 3/32"	28p
102	For model CN240 ⅛"	28p
1100	For model CCN240 3/32"	28p
1101	For model CCN240 ⅛"	28p
1102	For model CCN240 ¼"	28p
1020	For model G240 3/32"	28p
1021	For model G240 ⅛"	28p
1022	For model G240 3/16"	28p
50	For model X25 3/32"	37p
51	For model X25 ⅛"	37p
52	For model X25 3/16"	37p

ELEMENTS
ECN 240 £1·16 ECCN 240 £1·16
EG 240 £1·16 EX 25 £1·16

ANTEX HEAT SINKS 10p

V A T included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C1	250	Resistors mixed values approx. count by weight	0·55
C2	200	Capacitors mixed values approx. count by weight	0·55
C3	50	Precision Resistors 0·1%, 0·01% mixed values	0·55
C4	75	⅛th W Resistors mixed preferred values	0·55
C5	5	Pieces assorted Ferrite Rods	0·55
C6	2	Tuning Gangs, MW/LW VHF	0·55
C7	7	Pack Wire 50 metres assorted colours	0·55
C8	10	Reed Switches	0·55
C9	3	Micro Switches	0·55
C10	15	Assorted Pots & Pre-Sets	0·55
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Type	0·55
C12	40	Paper Condensers preferred types mixed values	0·55
C13	20	Electrolytics Trans. types	0·55
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·55
C15	4	Mains Toggle Switches, 2 Amp D/P	0·55
C16	20	Assorted Tag Strips & Panels	0·55
C17	10	Assorted Control Knobs	0·55
C18	4	Rotary Wave Change Switches	0·55
C19	3	Relays 6—24V Operating	0·55
C20	4	Sheets Copper Laminate approx. 10" × 7"	0·55

PLUGS AND SOCKETS
SOCKETS

PS 35 DIN	2 Pin (Speaker)	0·06
PS 36 DIN	3 Pin	0·10
PS 37 DIN	5 Pin 180°	0·10
PS 38 DIN	5 Pin 240°	0·10
PS 39	Jack 2·5mm Switched	0·09
PS 40	Jack 3·5mm Switched	0·10
PS 41	Jack ¼" Switched	0·17
PS 42	Jack Stereo Switched	0·26
PS 43	Phono Single	0·06
PS 44	Phono Double	0·10
PS 45	Car Aerial	0·09
PS 46	Co-Axial Surface	0·09
PS 47	Co-Axial Flush	0·14

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0·13
PS 22	D.I.N. 3 Pin	0·17
PS 23	D.I.N. 5 Pin 180°	0·17
PS 24	D.I.N. 5 Pin 240°	0·17
PS 25	Jack 2·5mm Plastic	0·10
PS 26	Jack 3·5mm Plastic	0·12
PS 27	Jack ¼" Plastic	0·24
PS 28	Jack ¼" Screened	0·28
PS 29	Jack Stereo Plastic	0·22
PS 30	Jack Stereo Screened	0·32
PS 31	Phono Screened	0·14
PS 32	Car Aerial	0·15
PS 33	Co-Axial	0·17

PLUGS

PS 1	D.I.N. 2 Pin (Speaker)	0·11
PS 2	D.I.N. 3 Pin	0·12
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·14
PS 5	D.I.N. 5 Pin 240°	0·15
PS 6	D.I.N. 6 Pin	0·15
PS 7	D.I.N. 7 Pin	0·15
PS 8	Jack 2·5mm Screened	0·10
PS 9	Jack 3·5mm Plastic	0·09
PS 10	Jack 3·5mm Screened	0·12
PS 11	Jack ¼" Plastic	0·13
PS 12	Jack ¼" Screened	0·16
PS 13	Jack Stereo Screened	0·29
PS 14	Phono	0·06
PS 15	Car Aerial	0·15
PS 16	Co-Axial	0·10

CABLES

CP 1	Single Lapped Screen	0·06
CP 2	Twin Common Screen	0·08
CP 3	Stereo Screened	0·08
CP 4	Four Core Common Screen	0·23
PC 5	Four Core Individually Screened	0·30
CP 6	Microphone Fully Braided Cable	0·10
CP 7	Three Core Mains Cable	0·07
CP 8	Twin Oval Mains Cable	0·06
CP 9	Speaker Cable	0·04
CP 10	Low Loss Co-Axial	0·10

CARBON POTENTIOMETERS
Log and Lin
4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M

VC 1	Single Less Switch	0·14
VC 2	Single D.P. Switch	0·26
VC 3	Tandem Less Switch	0·44
VC 4	1K Lin Less Switch	0·14
VC 5	100K Log anti-Log	0·14

HORIZONTAL CARBON PRESETS
0·1 watt 0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4·7M

BOOK BARGAIN BUNDLE
8 Books comprising
2 Transistor Equivalent Books
1 Radio and Electronic Colour Code and Data Chart
1 Radio Valve Guide PLUS
3 other Constructional books on Receivers, FM Tuners, etc.
Also 1 General Constructional book
Value £3 Our Price £2 10p p & p

BP1	Handbook of Transistor Equivalents and Substitutes	40p
BP2	Handbook of Radio, T.V. and Industrial Tube & Valve Equiv.	40p
BP3	Handbook of Tested Transistor Circuits	40p
BP4	International Handbook of the World's Short Wave, Medium and Long Wave Radio Stations and FM/TV Listings	35p
BP5	Handbook of Simple Transistor Circuits	35p
BP7	Radio & Electronic Colour Codes and Data Chart	15p
BP8	Sound and Loudspeaker Manual	50p
BP9	38 Practical Tested Diode Circuits for the Home Constructor	35p
BP11	Practical Transistor Novelty Circuits	40p
129	Universal Gram-Motor Speed Indicator	8p
138	How to make FM & TV Aerials, Bands 1, 2 and 3	18p
141	Radio Servicing for Amateurs	20p
146	High Fidelity Loudspeaker Enclosures	37p
156	Transistor Circuits Manual No. 1	15p
160	Coil Design & Constructional Manual	30p
161	Radio, TV and Electronics Data Book	25p
170	Transistor Circuits for Radio Controlled Models	40p
174	Transistor Subminiature Receivers	32p
175	Transistor Test Equipment and Servicing Manual	25p
176	Transistor Audio Amplifier Manual	40p
177	Modern Transistor Circuits for Beginners	40p
178	A Comprehensive Radio Valve Guide, Book 5	30p
183	How to Receive Foreign TV Programmes on your set by simple modifications	32p
185	Tested Shortwave Receiver Circuits using MAT's	30p
187	The TSL Mark '4' Valved FM Tuner and its construction	20p
196	Reactance-Frequency Chart for Audio & RF use	15p
	Resistor Colour Code Disc Calculator	10p

CARTRIDGES

ACOS GP91-1SC. 200mV at 1·2cms/sec	£1·16
ACOS GP93-1. 280mV at 1cm/sec	£1·65
ACOS GP96-1. 100mV at 1cm/sec	£2·65
TTC J-2005. Crystal/Hi Output	95p
TTC J-20 10C Crystal/Hi Output Compatible	£1·10
TTC J-200 CS Stereo/Hi Output	£1·60
TTC J-2105 Ceramic/Med. Output	£1·64

CARBON FILM RESISTORS
The E12 Range of Carbon Film Resistors, ⅓ watt available in PAKS of 50 pieces, assorted into the following groups:—

R1	50 Mixed 100 ohms-820 ohms	40p
R2	50 Mixed 1K ohms-8·2K ohms	40p
R3	50 Mixed 10K ohms-82K ohms	40p
R4	50 Mixed 100K ohms-1 Meg. ohms	40p

THESE ARE UNBEATABLE PRICES—LESS THAN 1p EACH INCL. V.A.T.

BI-PAK SUPERIOR QUALITY LOW-NOISE CASSETTES
C60, 32p; C90, 41p; C120, 52p

VISIT OUR COMPONENT SHOP
18 BALDOCK ST., WARE, Herts. (A10)
Open Mon.-Thurs. 9.15-6 p.m. Sat. 9.15-5.30. Late Night Shopping until 7 Fri. Tel. 61593

HOME RADIO (Components) LTD. Dept. PE, 234-240 London Road, Mitcham CR4 3HD Phone 01-648 8422

The Catalogue you MUST have!

250 pages 11¾" x 8¼"

6,785 electronic components clearly listed and indexed

1,750 pictures

10 free Vouchers each worth 5p.

Price list regularly updated

Bookmark with useful list of technical abbreviations

Details of our popular Credit Account Service and our Easy Ordering System are included in the catalogue.

Only 55p. plus 22p POST AND PACKING

POST THIS COUPON
with cheque or P.O. for 77p.

The price of 77p applies only to customers in the U.K. and to BFPO addresses.

Name ____________________

Address ____________________

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

PE

TAKE YOUR PICK

THE tendency towards larger and more ambitious projects is a perfectly natural development in the wake of technological advancement. Not everyone wants to become involved in building the more complex project, that is true. But this expansive side of home construction should be welcomed by all the genuine enthusiasts, since it provides an opportunity for amateurs to keep up to date with the latest developments and techniques and to make practical use of them as and when they feel so inclined.

It is worth considering, also, the beneficial effect on the retail components market arising from the demand generated by some larger projects. Such demands encourage suppliers to hold a wide variety of stocks and to seek out lines in components they might not otherwise contemplate handling. A healthy and venturesome retail trade is to the advantage of everyone who purchases components, whether in large or small quantities.

The needs and interests of constructors vary widely, but so far as generalisation can go, it seems reasonable to suppose that out of the whole, a majority of constructors confine their activities to the more simple kind of project. Newcomers undoubtedly start this way too, although many will in due course feel the compulsion to pursue their hobby to greater heights. Our recognition of the need for small simple designs is reflected in this month's special supplement. This contains details of four uncomplicated but useful and highly adaptable circuits, any of which can be assembled on the piece of printed wiring board presented free with this issue of Practical Electronics.

Returning now to larger projects, it may be recalled that the virtues of modular construction were discussed here last February when the P.E. Sound Synthesiser made its debut. With the synthesiser main unit now completed, this month's article in the series introduces the complementary keyboard unit.

It will interest many readers to learn that over the past 12 months the complete synthesiser has been handled by a number of professional musicians, and its unique creative possibilities—both as a composing machine and as a live performance instrument—have been established and enthused upon. Moreover, it has been confirmed that the keyboard unit on its own does constitute a valuable and versatile instrument for live performance. For example, it will meet the needs of many musical groups, being able to provide novel avant-garde accompaniment.

This feasibility is another bonus or "spin off" from the modular approach. It confirms the importance of considering both the *whole* and the *parts*, where many large and ambitious projects are concerned.

F.E.B.

Editor
F. E. BENNETT

Editorial
R. D. RAILTON *Assistant Editor*
D. BARRINGTON *Production Editor*
G. GODBOLD *Technical Editor*
S. R. LEWIS B.Sc.

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

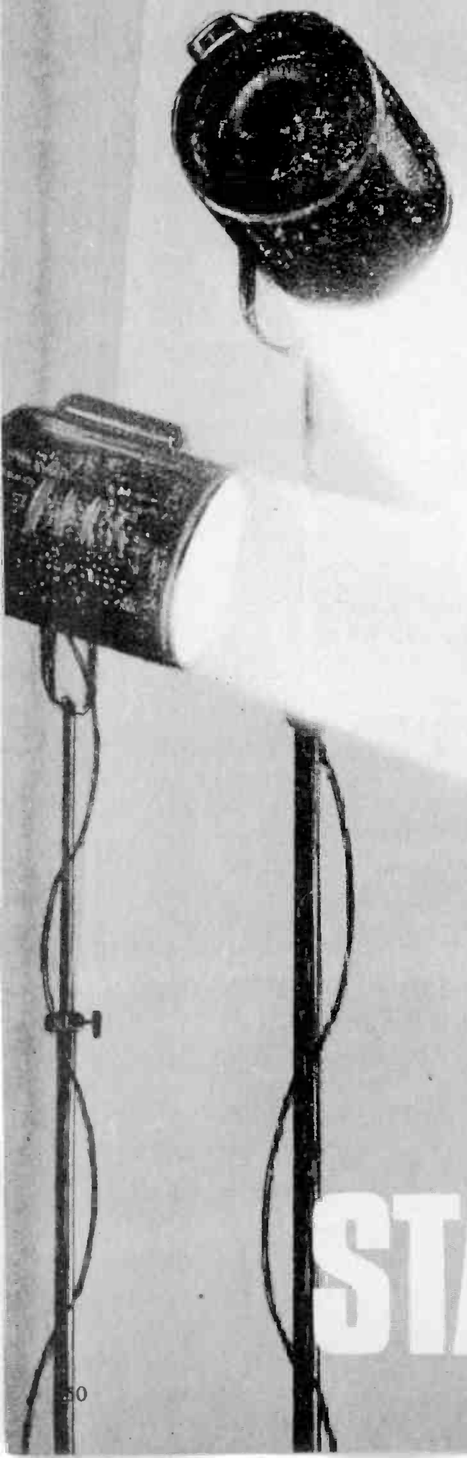
Advertisement Manager
D. W. B. TILLEARD
Phone: 01-634 4202

P. J. MEW
Phone: 01-634 4210

C. R. BROWN, *Classified*
Phone: 01-634 4301

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

FOUR CHANNELS OF INDEPENDENT CONTROL . . .



THIS Stage Lighting Dimmer was built to the specific requirements of an amateur revue company. It consists of four independent channels each capable of dimming 13 amps (3250 watts) of incandescent (not fluorescent) lighting. The number of channels may be increased as necessary providing the current capability of the input is uprated.

SYSTEM DESCRIPTION

Each of the four dimmable channels is controlled by a linear slider fader. Any channel can be switched to a Master Fader which is a double unit made up of two stereo slider potentiometers. The Master has control over all channels simultaneously when required.

Each channel has a mimic light next to the fader control which gives a visible representation of the relative brilliance of the lights plugged into that channel.

A preset potentiometer in each channel allows the cutoff point of each channel to be adjusted for different wattage lamps with differing thermal capacities.

Interference suppression is included and the dimmers are mounted in an earthed box to reduce radiation.

The output to each channel is fed *via* a 13 amp switched socket and input from the mains is taken *via* a 60 amp fused switch which can act as a "Master Blackout" control when it is necessary to cut out all the lamps in the fastest possible time.

CIRCUIT OPERATION

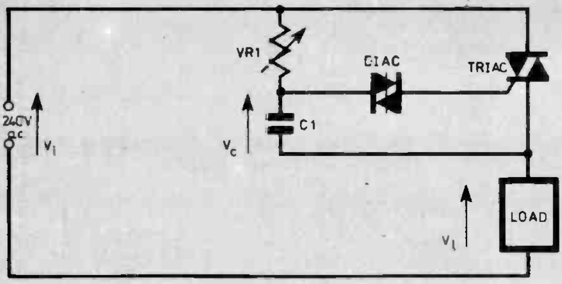
Each of the four channels uses an identical circuit which uses a triac to control the current through the lamps. The basis of this circuit is shown in Fig. 1.

A triac is a four layer semiconductor device with three terminals. It will only conduct when a voltage is applied to the gate (g) terminal and will then continue conducting in either direction even when the gate voltage is removed. It will cease to conduct when the current through it drops below a threshold level known as the holding current.

The circuit shown in Fig. 1 varies the average current through the lamps by controlling the point in the mains cycle at which the triac is triggered into conduction. This method of control is known as phase control.

STAGE LIGHTING

EACH CAPABLE OF DIMMING 3¼ kW OF LIGHTING



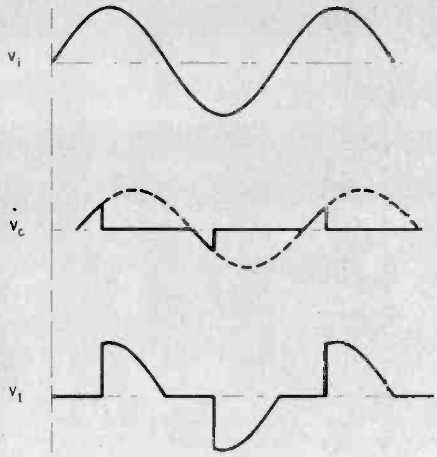


Fig. 1. The basic phase control triac circuit. The waveforms in different parts of the circuit are shown right

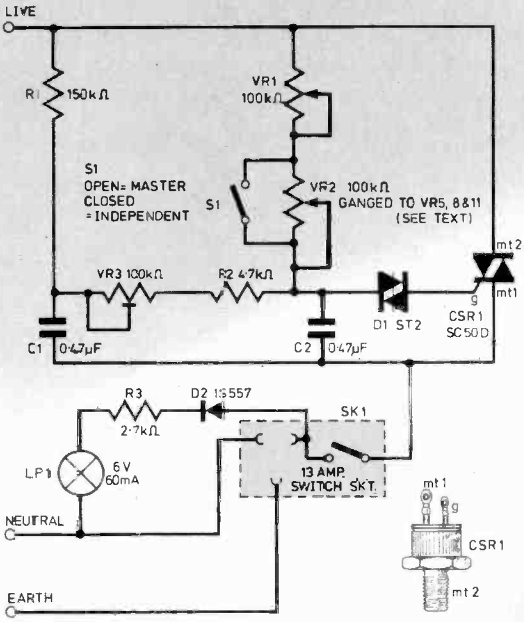


Fig. 2. The circuit of one of the control channels of the Stage Lighting Dimmer. Four identical channels are used in the unit

Referring to Fig. 1, capacitor C1 and variable resistor VR1 form a phase shift circuit which alters the phase of the signal at their junction with respect to the applied mains voltage.

The diac in series with the triac gate is a four-layer device which presents a high impedance until the voltage across it exceeds a value known as the breakdown voltage (about 30 volts) when it presents a low impedance. When the breakdown voltage is reached the capacitor C1 discharges into the gate of the triac causing it to conduct. Typical waveforms are also shown in Fig. 1.

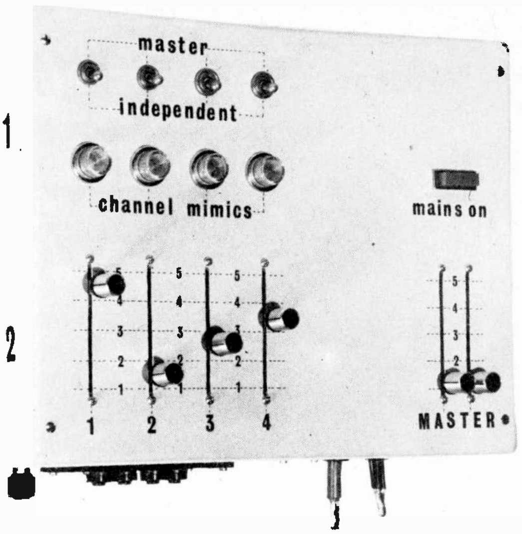
COMPLETE CIRCUIT

In the actual circuit used, shown in Fig. 2, VR1 is the Channel Fader and VR2 is one section of the Master Fader which can be over-ridden by S1 to give independent control. VR1 and C2 form the phase control network and R1 and C1 are additions to provide smooth control at low light levels.

The current supplied by R1 and C1 is determined by VR3 in series with R2. VR3 can be used to

DIMMER

By R. Liffen



Photograph showing the layout of the components on the front panel and the output sockets mounted on the side of the case. Another two sockets are similarly fixed the other side

preset the extinguishing point of the lamp when the Channel Fader is fully down. There are two modes of use for VR3: it may be used to fully extinguish a lamp which would otherwise "sing" (due to the filament vibrating in the presence of small residual spiky current; alternatively it may be set so that the filament glows dull red, which enables a big lamp to be taken to full brightness quickly.

MIMIC CIRCUIT

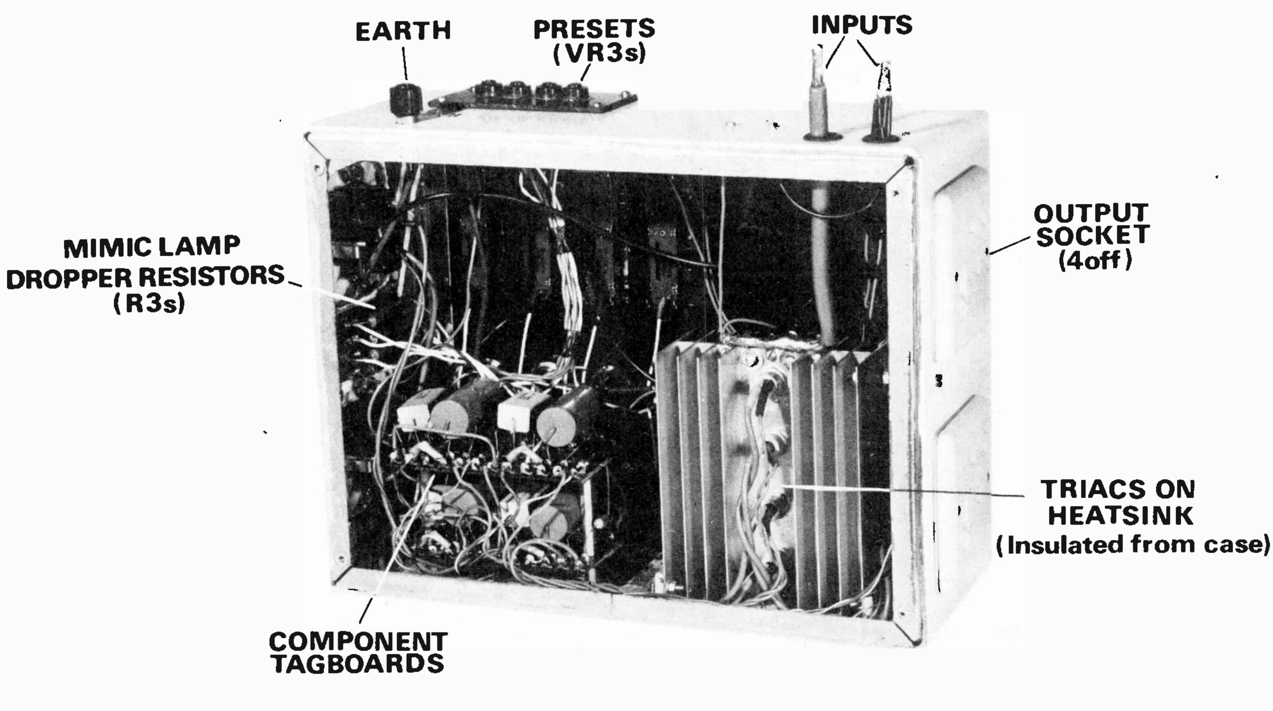
Components D2, R3 and LP1 form a "mimic" circuit to give a visual indication of the lamp brightness. D2 and R3 simply reduce the mains voltage down to six volts. The four resistors (R3 and its counterparts) dissipate nearly 10 watts each and must be placed in a well ventilated position.

Note the special connection between the switchboard 13 amp socket and D2. This is necessary because with no lighting load plugged in, the leakage through the triac will give a glow in the mimic lamp which can be disturbing to the lighting operator. With no lamp plugged in, the channel should be switched off at the socket.

The point to connect D2 will be found as a copper rivet head on the rear of the socket and should be verified with an ohmmeter.

LOAD CONNECTION

The load is connected on the neutral side of the triac. This reduces the risk of electric shock from



Photograph showing the arrangement of the triac heatsink, the presets, the tagboards and the input connections within the case. ***The heatsink must not touch the earthed case***

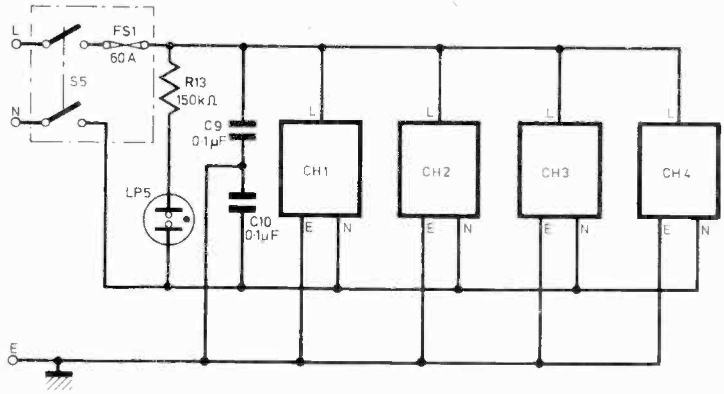


Fig. 3. Block diagram showing the four circuits of Fig. 2 interconnected and the extra components needed to complete the unit

defective lamps, since the lamp is at neutral rather than live when faded down. It also enables all the triacs to be mounted on a heatsink without insulating washers although this has the disadvantage that the heatsink is live and must therefore be insulated from the case.

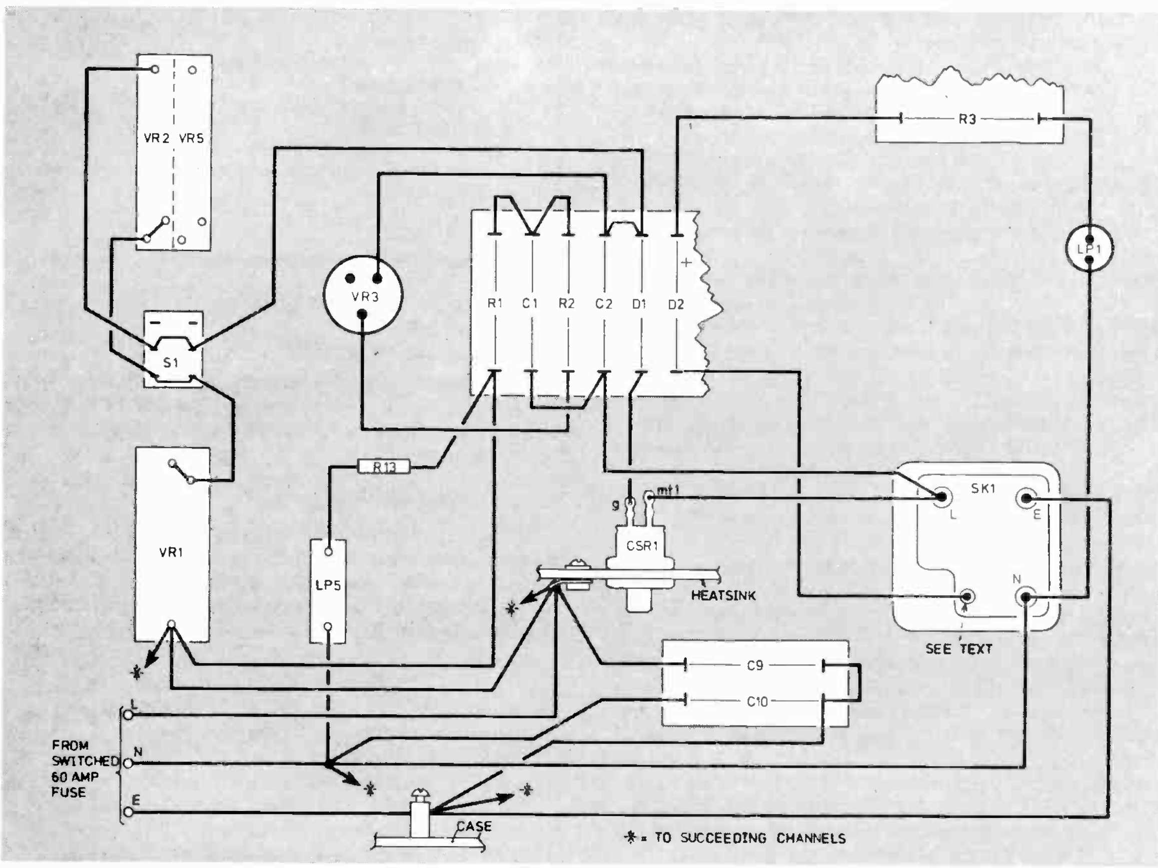
The triac, though a bi-directional device, operates best with the main terminal 2 (mt2) live with respect to mtl. For the SC50D mt2 is the threaded stud.

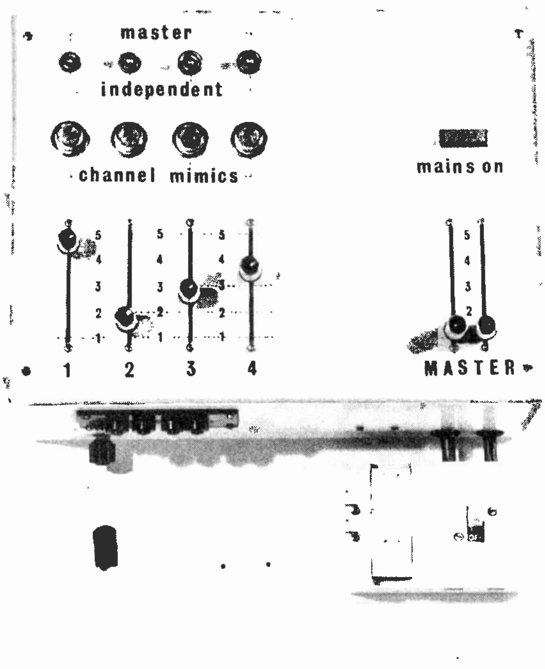
Interference suppression is obtained using two capacitors (C9 and C10) connected between the supply lines as shown in Fig. 3. Also seen on Fig. 3 is the mains indicator neon and the 60 amp fused switch.

CONSTRUCTION

The dimmer was designed to be mounted on a wall so the control box and the switched fuse were

Fig. 4. Layout of the components on the tagboard and interwiring for one of the four channels. Components should be mounted on the front panel, the case and the tagboards, and then interwiring should be done using this diagram and Fig. 3 as a guide. Wires which carry the current to the lamps should be heavy duty to reduce heating effects.





Photograph showing the completed unit and 60 amp switched fuse mounted on the backing board

fitted on a wooden panel fitted with mounting brackets (see photograph). The metal box used for the prototype is not generally available but any aluminium or steel box of sufficient size (13in × 10in × 5in) can be used.

The four triacs are mounted on a large heatsink which is connected to the live input via the switched fuse. A smear of heat-conducting grease should be applied before the triacs are bolted in position.

All the small components are mounted on two tagboards as shown in Fig. 4. The only exceptions are the four mimic lamp resistors (R3 etc.) which are mounted on a separate tagboard in a ventilated position.

The m.e.s. lampholders must be of the type which have both lamp terminals insulated from the case as neither must touch the case which is earthed.

The four preset potentiometers (VR3 etc.) are mounted on the outside of the case so that they are easily adjusted.

The output sockets are mounted two on either side of the case. The tagboards are mounted on pillars.

Plastic brackets are used to support the heatsink without it touching the case. Make sure that the lid of the case does not touch it when fitted.

Vents must be cut in the case to allow air to circulate if none are present.

Front panel layout is not critical, the photographs showing the prototype layout. Note that the two stereo sliders which form the Master Fader should be mounted as close as possible to each other so that they may be moved together. They may be physically joined with a metal bracket if this is desired.

Cables capable of carrying the 60 amp input current must be used for connection to the unit. A heavy duty earth cable should be connected to the case using a screw terminal.

COMPONENTS . . .

Resistors
R1 150kΩ } ½ watt carbon
R2 4·7kΩ }
R3 2·7kΩ 10W wirewound

Potentiometers
VR1 100kΩ linear slider
VR2 100kΩ + 100kΩ linear stereo slider (each channel uses half of one)

Capacitors
C1, C2 0·47μF 400V (2 off)

Semiconductors
D1 Diac type ST2 (Henry's Radio)
D2 1S557, BY100 or any 400V 1A diode
CSR1 SC50D 400V 15A Triac (Henry's)

Miscellaneous
LP1 6V 60mA m.e.s. lamp and holder
SK1 13A switched mains socket (MK2957) + mounting plate MK2200 21L
S1 Mains on/off switch
The components above are required for each of the four channels, i.e. four of each (except VR2) are required. The components below are required to complete the unit

Resistor
R13 150kΩ (not needed if included with neon)

Capacitors
C9, C10 0·1μF 1000V (2 off)

Miscellaneous
LP5 Mains neon indicator
S5 M.E.M. 60A switch/fuse
12 way tagboards (2 off)
4 way tagboard
Screw terminal, 6in × 6in × 2in finned heatsink, plastic brackets, 16mm copper double insulated (p.v.c./p.v.c.)

PRACTICAL POINTS

To reduce the interference effects of the unit it should be used on a supply separate from that being used by any microphone or musical instrument amplifiers, i.e. the 60 amp cables to the input should be taken to the nearest low impedance mains supply, the local "main feeder."

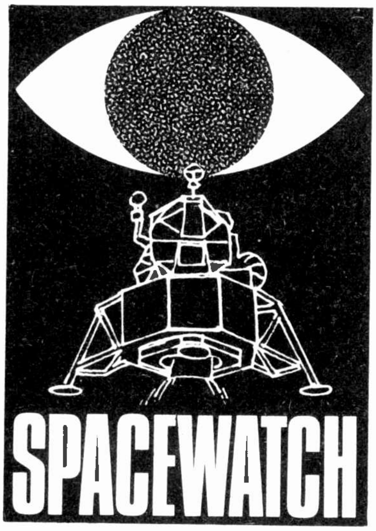
Ordinary household ring main circuits will not handle the unit on full load. In the case of a house or small hall the connections should be made direct to the fuse box, having first checked that the incoming mains can supply 13kW.

Footlights present a special problem since they are often close to stage microphone cables. If possible use footlight feeder cable which has an earth screen totally enclosing the conductors.

The slots in the box for the faders was made using a Monodex metal cutter.

A heavy duty soldering iron is necessary for soldering the 60 amp cables.

Total cost of the unit was approximately £35. ★



BY FRANK W. HYDE

BLACK HOLES

There are many enquiries about "black holes" and not surprisingly they are mostly of the form "What is a black hole?"

The term "hole" is the main difficulty, just as it was with solid state devices. Perhaps this is because usually a hole is some space which is at an angle to a surface.

Since the situation is one of concentration of matter and energy it is better to use the word concentration. The new name then is a "black concentration" and in this case it means that energy and matter is not radiating outwards but is concentrated away from the observer. It is, therefore, a black condition.

Proceeding from there, imagine that the Sun in following its life course goes through the process of normal star evolution and death. It will expand to many times its present size to become a Red Giant. In expanding it will cool down and as the fuel of it becomes consumed the gravitational forces will cause it to contract to about one per cent of its volume. This will mean that it will become very hot again. It will then acquire a new name, that of White Dwarf. Its brightness will have increased and so will its density so that a cubic inch would weigh many tons.

However, by the nature of the process there is a limit to the compression and in the case of the Sun it will probably remain as a White Dwarf, gradually cooling down.

GRAVITATIONAL COLLAPSE

In the case of stars more massive than the Sun the energy produced during the life cycle may be such as to make the stage from Red Giant to White Dwarf much more concentrated. In this case a state of gravitational collapse may occur and a "black concentration" will take place.

Not only does this effect apply to the star itself but also to the surrounding media. In this condition it is possible that other concentrations of matter nearby are sucked into the area.

The advent of gravitational collapse is likely to arise after the transition from Red Giant to White Dwarf. This could be because the White Dwarf stage is not a halting point as it were, and the energy of the shrinking from Red Giant may over-run the White Dwarf point. In this case the enormous energies will build up to a catastrophic explosion and a supernova would be the result. This will appear as an extremely bright object and parts of the original star will be flung out at fantastic speeds of the order of hundreds of miles a second. There will be left a small highly concentrated mass, the neutron star. This is the Pulsar according to the accepted current theory.

Sometimes the energy is so great that the situation is not ended at this point and the collapse goes beyond the neutron star point. It is here that the condition of the "black hole" is reached.

It is not easy to accept the implications of this manner of events. It would mean that no light or radiation of any kind comes out of this concentration.

The gravitational field is so great that in the comparatively short distance involved (if the Sun became a "black hole" it would be only two miles in diameter) matter in moving inwards from the "surface" would stretch out from the observer. In fact, there would persist for some time an image of the original matter and this would not appear to change for a very long time. In effect there would be a reversal of all the conditions that are regarded as normal.

NEW LOOK

At this point it is time to ask whether physicists have to take a new look at the whole situation. It would seem that there are no universal laws, but rather that the laws depend upon conditions as they are found. This is not merely a matter of reality but also of profound philosophical implications. It may be that other views will be expressed and that this interpretation is in itself rejected.

There is still no direct evidence for the existence of the "black hole" but work which is going on at the moment may help to clear up the matter. It is hoped that there will be sufficient data shortly to report on the progress of a new project aimed at providing new evidence.

COMET KOHOUTEK

The comet Kohoutek, which is likely to make a sensational appearance and will be visible to the naked eye for four months or so, will be at its peak in December when it will be visible in full daylight. It will be visible to the naked eye from about the first of November.

There was not time for the organisation of a probe to intercept this comet though in other fields the early warning of its advent is useful. Professional gatherings have been held to set up a study programme and to avoid unnecessary duplication of observations.

Studies will be made in infra-red and observations in the 50–100 micrometre wavelengths will be made from a jet plane. It may well be that a programme will be set for observations from *Skylab*.

It so happens that a number of dispersed observations from automatic satellites and a probe will be able to provide useful data. Satellites *OSO-3* and *OSO-7* will be able to make photographic observations and *Mariner 10* will be able to monitor the inter-planetary medium as it proceeds on its journey to Venus and Mercury.

All these study programmes will help to practice different techniques which can be used for the special observations of Halley's comet which is due in 1986.

LIGHTS IN THE SKY

Three years ago a search for fluorescent pulses, induced by X-ray photons, was made. During this observation the fast atmospheric pulsations of light were discovered. Since this discovery there have been observations which threw more light on these effects.

At Ankara H. Ögelman has made observations with baselines of 175 and 3,300 kilometres. The results of this work are being correlated, but first results seem to indicate that these FAP's, as they are called, appear from discrete directions and are more frequent than was supposed.

The energies are being measured and later results will appear in this column.

MARS VEHICLES

Considerable re-design may be necessary for the manned vehicles to Mars because of the high radiation levels that might be normally encountered.

This conclusion arises from the examination of the materials of the *Apollo* spacecraft after returning from the Moon. The extent of the radiation has supplied the solution and it is thought a re-arrangement of the present design will be possible to overcome this hazard.

PE RONDO PART 3

POWER SUPPLY & MECHANICAL ASSEMBLY

BY R.A.COLE

THE DISCERNING CONSTRUCTORS CHOICE:

★ *A Total Quadraphonic System*

★ *An advanced design AM/FM radio*

★ *Complete loudspeaker enclosure design*

★ *Flexible design allows individual modules to be incorporated in existing equipment*

★ *Switching facilities and modules for SQ, QS(RM) and CD4 systems*

THE previous articles described the construction of the SQ decoder, the power amplifiers, pre-amplifiers and volume/tone/balance controls, their circuits and operation.

The present article is devoted to the construction of the power supply and the construction and assembly of the main chassis member.

POWER SUPPLY

The power requirements for the Rondo are dual rails providing positive and negative supplies with a centre earth for the preamplifiers, tone controls and power amplifiers, and a positive rail and negative earth supply for the tuners, stereo decoder and quadraphonic decoder(s).

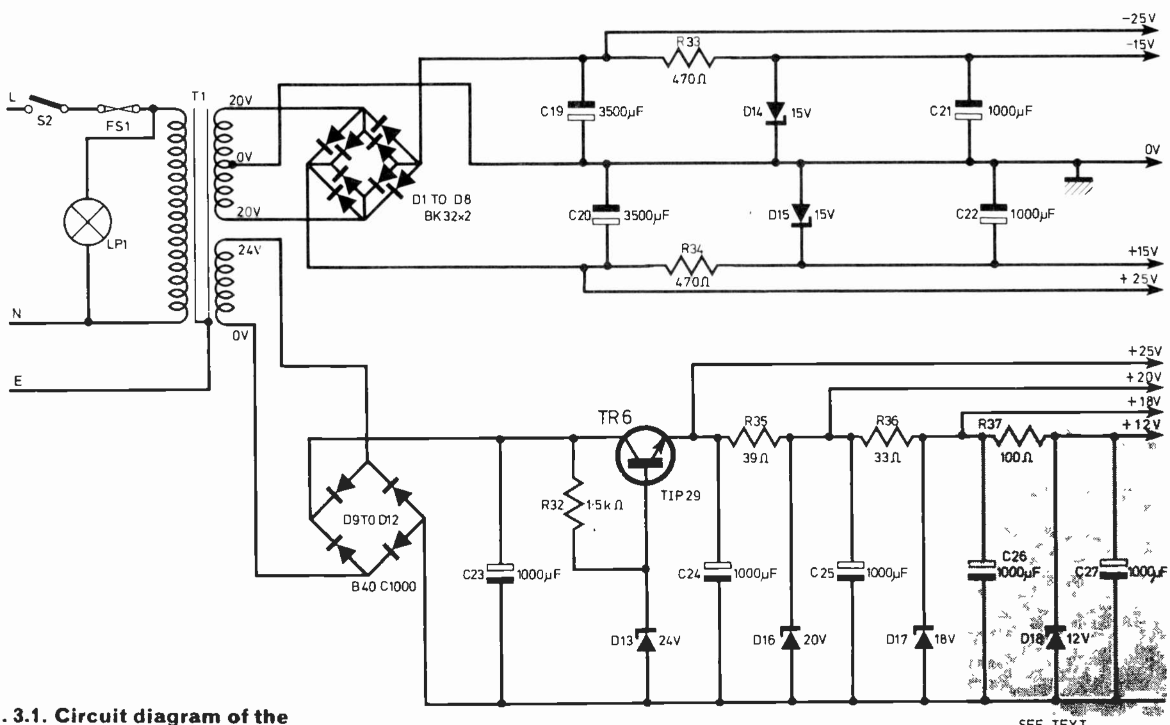


Fig. 3.1. Circuit diagram of the complete power supply

POWER SUPPLY BOARD

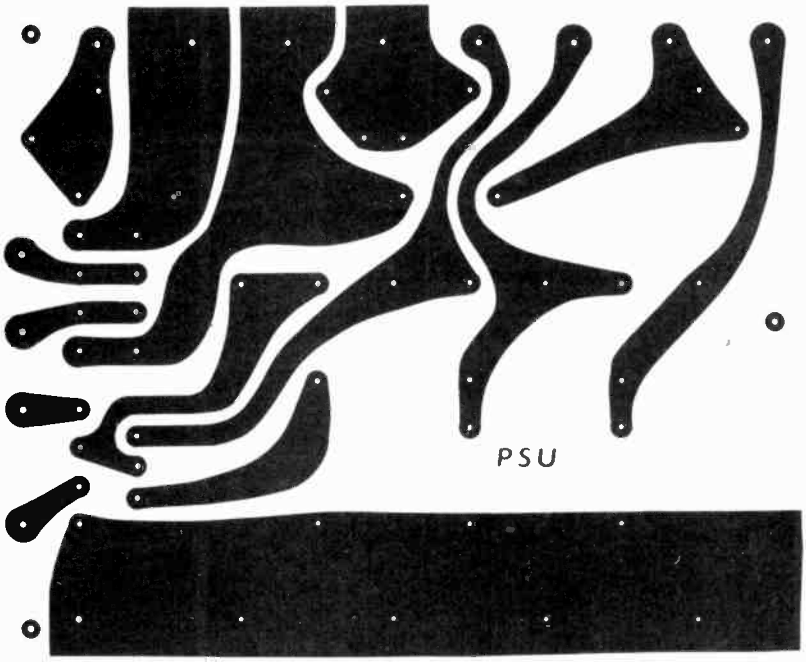


Fig. 3.2. Circuit board master for the Rondo power supply

COMPONENTS . . .

POWER SUPPLY

Resistors

R32 1·5kΩ
R33 470Ω
R34 470Ω
R35 39Ω
R36 33Ω
All ¼W 10%.

Capacitors

C19 3,500μF 40VW
C20 3,500μF 40VW
C21 1,000μF 16VW
C22 1,000μF 16VW
C23 1,000μF 35VW
C24 1,000μF 25VW
C25 1,000μF 25VW
C26 1,000μF 25VW
All elect.

Semiconductors

D1 to 8 BK32 (2 in parallel) Semicron.
D9 to 12 B40 C1000 Semicron.
D13 24V Zener.
D14 & 15 15V 10%. Zener.
D16 20V Zener.
D17 18V Zener.
All Zeners are 400mW
TR6 TIP29

Transformer

T1 Primary 240V a.c.
Secondaries
1, 20–0–20V a.c., 4A.
2, 24V a.c. ½A.

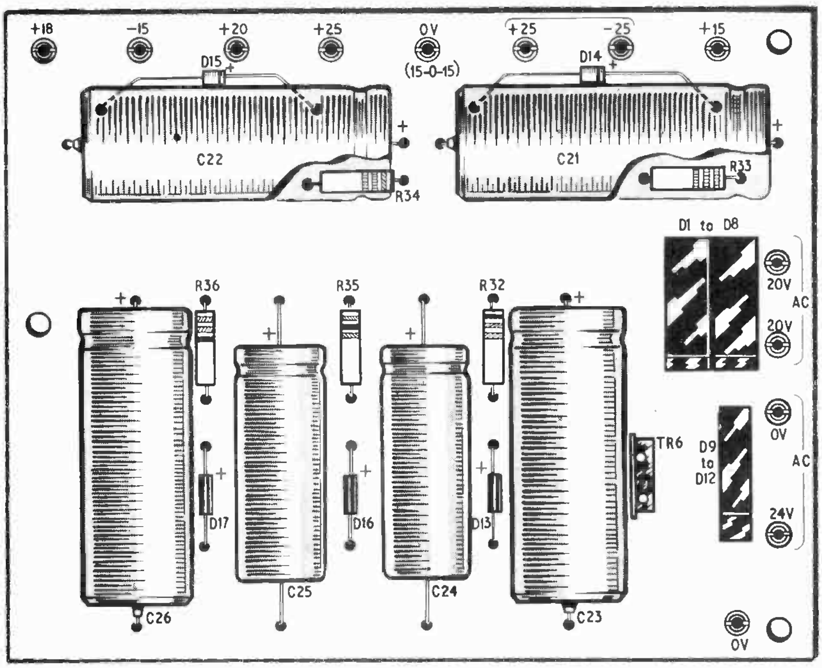


Fig. 3.3. Component layout for the power supply board viewed from the component side

MAIN CHASSIS DETAILS

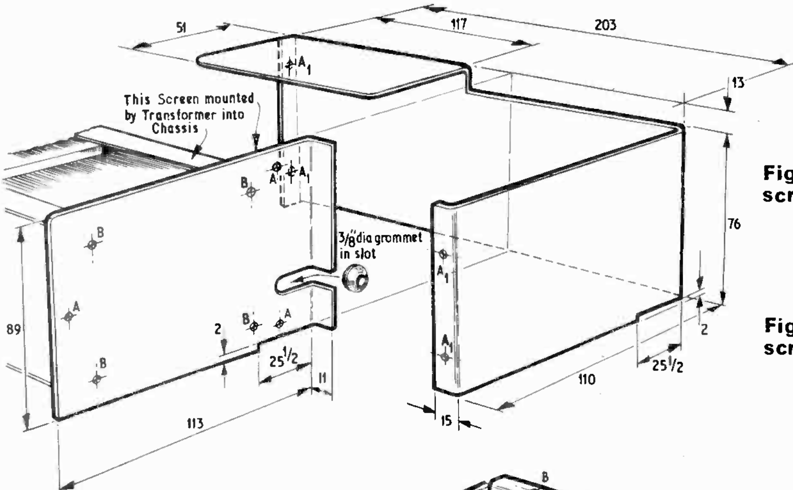


Fig. 3.5. Transformer screen metalwork details

Fig. 3.6. Power supply screen metalwork details

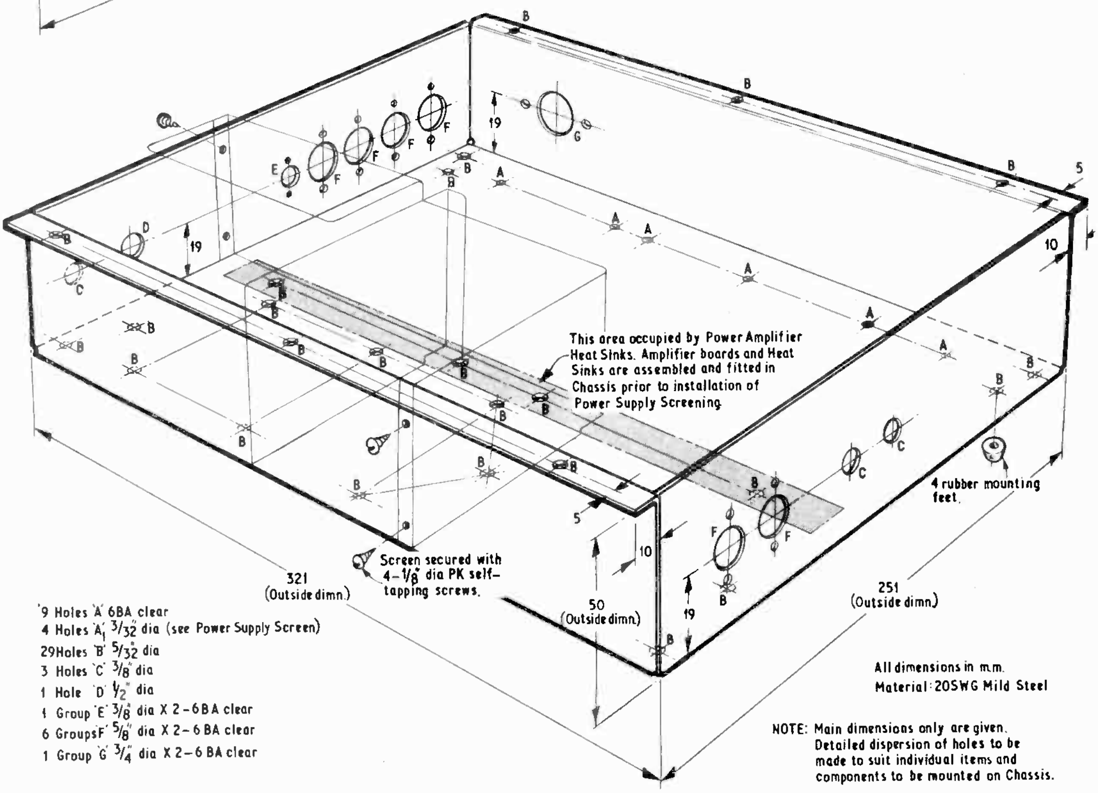


Fig. 3.4. Main supporting chassis metalwork shown in general detail in the fabricated form and with external critical dimensions for simplicity. There should be no reinforcement where the sides meet, as the sides must be able to be pressed inwards when the wooden sleeve is fitted

POWER AMPLIFIERS SUPPLY

The dual rail supply is, as shown in Fig. 3.1, derived from a 20-0-20V transformer T1 winding with a 4A capacity rectified by two bridge rectifiers D1–D8 in parallel. The expedient of using two smaller (at lower cost) unmatched, bridge rectifiers in parallel is open to criticism because of "current hogging". That is, that the rectifier with the lower impedance will have a higher current flow. The rectifiers have been chosen so that, under all operating conditions, there are no detrimental effects due to this phenomenon.

The transformer centre tap is taken direct to the junction of two 3,500μF main smoothing capacitors C19, C20, joined negative to positive, and the rectified d.c. supply to the free positive and negative terminals of these capacitors respectively. The d.c. voltage, after rectification, is around +25 to −25V. (The centre zero is at earth potential.) The supplies to the main power amplifier output stages are taken direct from the main smoothing capacitors.

OTHER BOARD SUPPLIES

All the 748's are fed from ±15V d.c. rails obtained by dropping through resistors R33, R34 from the ±25V supplies smoothed by two 1,000μF capacitors C21, C22. As these rails do not have to be at precisely 15V but the i.c.s have to be protected against exceeding a maximum rating of 18V, they are "clamped" to 15V by two Zener diodes (D14 and D15).

The positive rail and negative earth supply is obtained from a separate winding on the transformer T1. This winding is 24V a.c. at 250mA and is rectified by a 1A bridge rectifier, D9 to D12, smoothed and then regulated by a series regulator circuit TR6, R32 and D13 to 24V d.c. and smoothed again.

From this point is taken the supply to the varicap diodes of the f.m. tuner.

A further ladder of droppers, Zeners and smoothing capacitors produces 20V d.c. to the SQ decoder, 18V d.c. to the a.m. tuner, f.m. tuner head transistors, i.f. stages and the stereo multiplex decoder. The values of the ladder are chosen so that either the a.m. or f.m. tuner may be on, or both tuners off, without disturbing the voltages of the other supplies significantly.

The components C26 and C27 and resistor R37, together with D18 are associated with the tuner unit (yet to be described) and in fact appear on that unit's board. They are shown here merely for completeness.

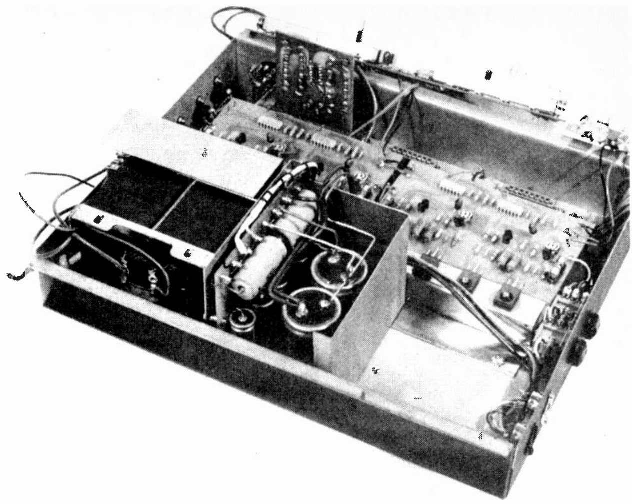
CONSTRUCTION

The power supply p.c.b. master negative is shown in Fig. 3.2 which indicates the simplicity of the circuit in practice.

The component layout appears in Fig. 3.3 which is self explanatory. Capacitors C19 and C20 are too large for board mounting and are in fact clamped in the main chassis.

MAIN CHASSIS

The main chassis member is a rectangular box-form which in fact sits on its back in the final assembly. Thus it is used as a trough with components mounted within it rather than in the more conventional manner.



General view of the "trough" form of the main chassis for the Rondo showing the orientation of the power amplifiers and power supply with some of the general wiring in place. Plug and socket holes are not sized as this will depend on items selected

The chassis is shown in the bent-up form in Fig. 3.4. The material used for the prototype was 20 s.w.g. mild steel plate but of course this may present some difficulties to constructors since it is not easy to bend. Thus it is possible to use 16 s.w.g. "half-hard" aluminium sheet which is somewhat easier to bend or, indeed, to fabricate the structure from flat sheets cut to size. For this reason only the major dimensions have been given as it is felt that each constructor will probably adopt his own style of construction.

It should be added that the chassis, in the prototype design, contains all the various parts of the system and supports the outer wooden case and facia which is in the form of a sleeve which slips over the unit and is fastened to the chassis.

PLUGS AND SOCKETS

As individual constructors may wish to vary the types and sizes of plugs and sockets used the positioning shown is open to variation to suit though of course major shifting of components is not advised as this can create feedback paths for which the equipment is not designed.

CHASSIS SCREENS

The power supply includes the mains transformer, board and main smoothing capacitors and the whole is placed behind a shield to cut down hum pick-up at the pre-amplifier and elsewhere.

Two screens are used, as illustrated in Fig. 3.5 and 6. The smaller acts as a support for the power supply p.c.b. and is fastened to the transformer using 4BA screws. The p.c.b. is then attached to the screen using 6BA screws and ⅛in spacers.

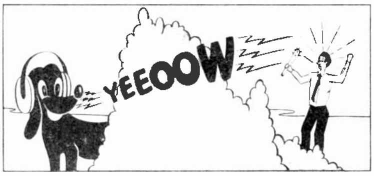
The larger screen is assembled later in the sequence and is held in place using self-tapping screws.

Note that the transistors in the power amplifier last month should be type **MJE3055K**

Next month we will finalise the mechanical assembly details and discuss the unit interwiring

Gerry Brown . . .

ON THE FRINGE



DOGGED RESISTANCE

Honestly, the trouble to which people go in order to maintain their various equilibria.

The latest in this mania for status quo manipulation appeared in a letter to a professional U.S. magazine. This, in fact, took the form of a reply to an earlier piece of correspondence which complained about noise from a barking dog, and which simply requested "Help! Widget wanted to drive the Mutts Nuts."

Help, if this is what it could be referred to, appeared a month later as a package deal comprising a 20kHz oscillator and (twenty watt!) amplifier combo driving a hi-fi tweeter horn. The suggestion was, that by continuous use, although no human would be able to hear the thing, poor ole' Fido would make such an awful din that his ever-loving owner, thinking he'd gone out of his tiny mind, would be just itching the next day to have him put down!

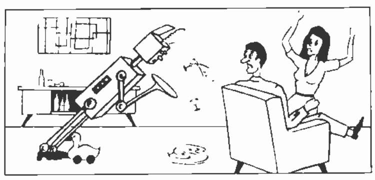
Now no one could accuse me of holding any torches for the canine community, nevertheless, I cannot help feeling that this is a singularly pernicious use of electronics.—One couldn't help noticing that the correspondent had asked to have his name withheld!

LSI or AU PAIR?

The number of times we have to hear about the feasibility of robot "flunkies" in the home, and how extraordinarily easy it's all going to be once they're installed. All you need is a handful of super-LSI chips, and you'll never look back! No doubt, the electronics represent no insurmountable problem, but how practical would something like this be, even assuming the mechanical aspects could be solved?

The variety of jobs that can be performed by automated equipment is already overwhelming; what with tumble driers, telephone answerers, record players, etc., it might even be questionable whether a place *exists* for robots in the true sense of the word. Yet, I read, just last week, that Dr George Müeller of Systems Development Corporation, California, reckons that a computerised set-up of this sort would be a viable proposition within, say, ten years.

Once written, I suppose, executive programmes having the same general format could be hard-wired into the devices prior to despatch. The "crunch" might come when the new owner needed to programme the confounded thing for the sundry tasks around the home.



Imagine trying to write a programme for accomplishing the "simple" job of pouring drinks. You would need to tell it to "come out of your storage cupboard", "turn left after three feet", "continue for nine feet seven inches" (at this point you might be wondering whether it only understood metric), "stop", "move right arm slowly towards cupboard right-hand handle", "grip handle gently and rotate it 180 degrees counter-clockwise" (supposing that the catch didn't release until 181 degrees?).

"Carefully open door 120 degrees, then release handle", "lower arm, and scan inside cupboard for port bottle (does robot think I mean the bottle on the left?), "if located, remove the cork in this bottle and pour a quantity of liquid from the bottle into each of the glasses situated below the bottle rack", "ensure that each glass is only filled to the $\frac{3}{4}$ mark", etc., etc.

With such a system, one need only forget about junior's toy duck, 'plum in the middle' of the automaton's path, to give it a full-blown seizure! A machine able to rely on learning techniques might prove to be a better proposition, always provided you could tolerate the broken glass, wine-sodden carpets, and the bill from the psychiatrist while it got the hang of things!

MAINSTREAM

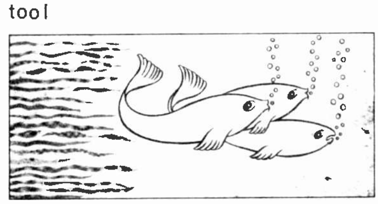
By nature (I'm told) the trout is a lazy sort of fellah; loves to bask himself in the sun, and only makes a sudden dart across the current if, in his myopic way, he fancies he's seen a fly somewhere on the surface. In this life, though, there is rarely anything that escapes exploitation and the trout represents a typical case in point.

Recently, you see, the waterworks at Boran sur Oise, near Paris, have overcome some difficulties associated with the monitoring of pollution levels by recruiting the aid of this delicious member of the aquaticae. Seemingly, ordinary detection/warning systems in this application are insufficiently sensitive; as a corollary, the waterboard's laboratory have "roped-in" three good-sized brown trout to do the job instead.

Each animal is located in a glass-sided tank fed from normal supply water and running at a rate consistent with typical river current. Normally, the trout orientates himself up-stream; however, if conditions cause the water to be slightly polluted, he'll about-turn to face downstream.

By fitting up each of the fish with tiny electrodes, an alarm can be triggered whenever all three fish do a simultaneous "flip round". Individuals turning-tail are ignored by logic ANDing circuits to avoid false alarms.

Several days of this treatment do not appear to upset these creatures, in spite of the fact that if any of them stop swimming they are given an electric shock into the bargain. Since these animals are required to work in a sterile environment one wonders what technical arrangements have been made to feed 'em too!



BACK NUMBERS WANTED

We regret that back numbers of Practical Electronics can no longer be supplied. We will try to publish announcements of readers' requirements (without a guaranteed date) free of charge.

Anyone who can supply the undermentioned are asked to communicate directly with the reader.

December 1971
Mr. J. Bickerstaffe, 15 Deanshill Close, Stafford.

November 1969, February to April 1970
Mr. S. R. Dunning, 103 Glebe Road, Deanshanger, Wolverton, Bucks.

July to October 1972
Mr. J. Y. T. Lee, 20 Wong Chuk Hand Road, 2nd Floor, Aberdeen, Hong Kong.

September 1972
Mr. K. R. Whitbread, 14 The Orchard, Bedford Park, London, W4 1JX.

Any Back Numbers
Mr. D. Lawrence, 8 Stringers Drive, Rodborough, Stroud, Glos.

May 1972
Mr. J. Hoppe, Murraymead, Bracknells Lane, Hartley Wintney, Basingstoke, Hants.

October, November 1972
Mr. L. Davis, 27 Highfield Avenue, Burntwood, Nr. Walsall, Staffs.

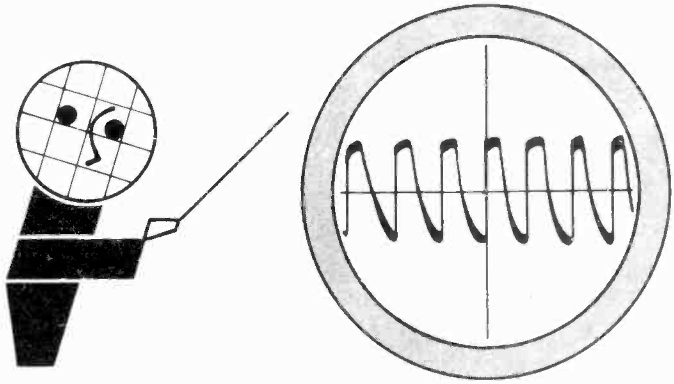
May 1969 to March 1970
T. Hall, 60 Archers Road, Marlborough Estate, Takajuna 10, Auckland, New Zealand.

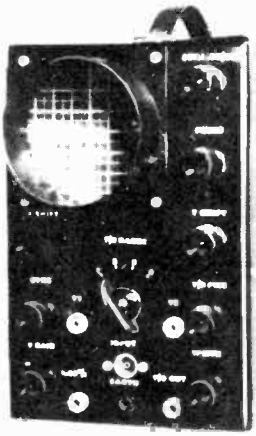
August 1967
Mr. M. Ferguson, 6 Boundary Road, Thornlands, Queensland, 4163, Australia.

look! electronics really mastered

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

no previous knowledge
no unnecessary theory
no "maths"





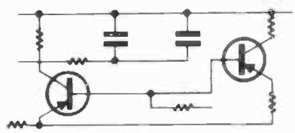
RAPY

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

1/ BUILD AN OSCILLOSCOPE

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

2/ READ, DRAW AND UNDERSTAND CIRCUIT DIAGRAMS



as used currently in the various fields of electronics.

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

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

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

FREE **POST NOW for BROCHURE**

or write if you prefer not to cut page

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

NAME BLOCK CAPS

ADDRESS PLEASE EL113

special free gift also to all our students

Candis Ltd.

P.O. BOX 25, CANTERBURY, KENT
TEL.: CANT. (0227) 52139

THE FAMOUS WELLER NOW AVAILABLE TO YOU

★ TEMPERATURE CONTROLLED
★ IRON PLATED LONG LIFE TIP
★ LOW VOLTAGE ISOLATED ELEMENT

L.E.D. Red, **30p**,
L.E.D. Green, **75p**.
MINITRON 3015F, **£1·50**.
INTEGRATED CIRCUITS in 8-14 D.I.L. packages: 741 **36p; 748 38p**.
Hi-Fi stereo pre-amps.: TBA231 **£1·43**; CA3052 **£1·30**.
F.M. decoder limiter 5111A, **£1**.
0·25 watt audio amp. MFC4000, **45p**.
Timing circuit 555V, **80p**.
3 watt audio amp. SN76013, **£1·75**.
TIS88A, **36p**; TIP41A, **70p**; TIP42A, **85p**.
100V 25A Plastic Power Transistors: TIP35C **£3**; TIP36C **£4**.
2N3055 **50p**.

MINIATURE SWITCHES

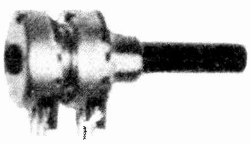
S.P.C.O. Toggle, **35p**.
S.P. Push to make, **29p**.
D.P.D.T. Slide, **10p**.

AEROSOLS

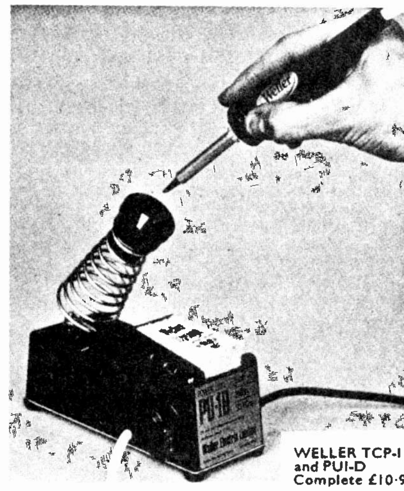
Freezer, **70p**.
Printed Circuit Lacquer, **75p**.
Silicone Grease, **75p**.
Contact Cleaner, **75p**.
Anti-Static Inhibitor, **85p**.

SOLDERING AIDS

ADCOLA L646 23 watt, mains iron, **£2·10**.
De-Soldering braid, **60p**.
18 SWG SOLDER 0·5 kilo, **£1·16**.
22 SWG SOLDER 0·5 kilo, **£1·26**.
18 SWG SOLDER 2·5 kilo, **£5·50**.



P.C. Mounting Stereo Pots 100K Lin. 100K Log. 10K Log. all at **35p**.



WELLER TCP-I and PUI-D Complete £10·90

Please add 10% VAT to total cost of all items

All spares readily available

VARICAP STEREO TUNER F.M.

(ACTUAL BEECHING UNITS) IN STOCK

MODULES LP1185/86	**£9** per pair
REGULATOR MFC4060	**£0·78** each
DECODER MC1310P	**£3·15** each
PRINTED CIRCUIT BOARD—GLASS FIBRE (With lettering)	**£1·87** each
READY BUILT AND TESTED BOARDS	**£23+25p** postage
COMPLETED TUNERS IN TEAK CABINETS	**£34+35p** postage

(BRUSH ALU. FRONT PANEL with 6 BUTTONS, MAINS+5 STATIONS)
VAT. INCLUDED

STILL SOME LEFT!

25 W R.M.S. DISCO AMPLIFIERS (EX JUKE BOX)
ONLY £10 each + 35p postage

CHASSIS CONSTRUCTION WITH POWER SUPPLY S/C PROTECTED. DELIVERS 25W INTO 7Ω (OR 2×15Ω). FROM PICK UP: SENSITIVITY ABOUT 100 MV INTO 1 MΩ. USING 40361/40362/ MJ481/MJ491 TRANSISTORS

EACH ONE TESTED, REQUIRING ONLY A VOLUME CONTROL

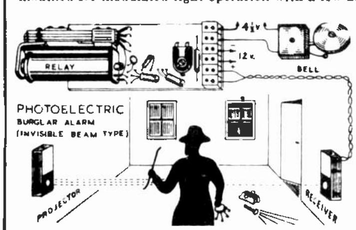
READY BUILT AND TESTED **STEREO DECODERS** FOR 9V-12V SUPPLY **£4·50+10p** postage

B & B ELECTRONICS

64 MANNERS ROAD, BALDERTON, NEWARK NOTTS. Telephone: NEWARK 6895

PHOTOELECTRIC KIT

CONTENTS. P.C. Chassis Board, Chemicals, Etching Manual, Infra-Red Phototransistor, Latching Relay, 2 Transistors, Diode, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation with a few additional components.



PHOTOELECTRIC KIT £2·85

Postage and Pack. 15p (U.K.)
Commonwealth
SURFACE MAIL 25p
AIR MAIL £1·40
Australia, New Zealand, S. Africa, Canada and U.S.A.
Also Essential Data Circuits and Plans for Building 10 Advanced Designs

INVISIBLE BEAM OPTICAL KIT
Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks. Infra-red filter, projector lamp holder, screws, nails, brackets, building plans, etc. Price **£1·45**. Postage and Pack. 10p (U.K.). Commonwealth: Surface Mail 20p, Air Mail 50p.

LONG RANGE INVISIBLE BEAM OPTICAL KIT
CONTENTS: As above. Twice the range of standard kit. Larger Lenses, Filter, etc. Price **£2·10**. Postage 15p (U.K.). Commonwealth: Surface 20p. Air Mail £1·15.

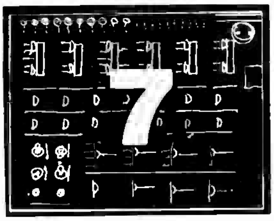
BIOFEEDBACK AMPLIFIER KIT
Tunable, General-Purpose, Interference-Rejecting Differential Amplifier for experimental investigation of signals produced by the brain, heart and muscles. When used with an oscilloscope, or aural indicator, it enables you to monitor your brain-waves, learn to relax, meditate, etc.
CONTENTS: All Capacitors, Resistors, Pots, Semiconductors, I.C., Electrodes, Leads, Chassis, Case, Batteries, Plans and Instructions. Price **£4·75** postage and pack. 25p (U.K.). Commonwealth: Surface 30p. Air Mail £1.

ALPHA-BETHA-THETA BRAINWAVE MONITOR KIT
Aural Brainwave Indicator for use with a Biofeedback Amplifier. Converts subsonic brain frequencies into audible signals for easy recognition.
CONTENTS: Resistors, Pots, Capacitors, Transistors, Diodes, Leads, Chassis, Case, Earphone, Battery, Plans and Instructions. Price **£3·25**, postage and pack. 15p (U.K.). Commonwealth: Surface 25p. Air Mail 75p.

YORK ELECTRICS Mail Order Dept.
335 BATTERSEA PARK ROAD, LONDON, S.W.11

Send S.A.E. for full details, a brief description of all Kits and Projects

LOGIC TUTOR EXPERIMENTS..



THE HALF ADDER

by M. J. Hughes

THE circuit we left you to puzzle over last month was another form of the EXCLUSIVE OR gate. The Boolean expressions for the various nodes are shown in Fig. 1. The outputs of the two gates that are WIRED OR'd together would have been $\bar{A} + \bar{B}$ and A + B respectively without the link between them but as soon as the link is made these two functions become ANDed together and then it is a simple matter of Boolean manipulation to show that the output function is EXCLUSIVE OR.

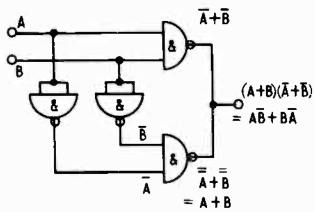


Fig. 1. Answer to last month's problem. The circuit is an EXCLUSIVE OR

0+0 = 0
1+0 = 1
0+1 = 1
1+1 = 0 (carry 1)

Exclusive OR truth table

A	B	$A\bar{B}+B\bar{A}$
0	0	0
1	0	1
0	1	1
1	1	0

Fig. 2. Comparison of binary addition with EXCLUSIVE OR truth table

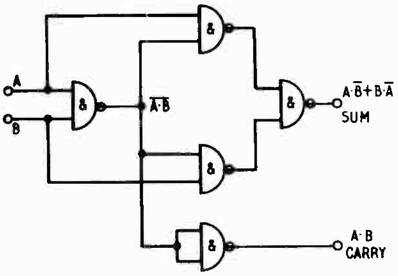
Binary Addition

It is necessary to understand the basic principle of adding together two binary integers. The rules are very simple—in fact exactly the same as in conventional denary arithmetic except that whenever you get a sum greater than 1 you must carry over a digit into the next column. Let's take the simple case of adding two single digit numbers together. We'll call the digits A and B to differentiate between them and show the sum and carry—when necessary—in the following simple table. Note that we are carrying out pure addition here and in this instance + means plus and not OR

Digit A		Digit B		Sum
0	+	0	=	0
1	+	0	=	1
0	+	1	=	1
1	+	1	=	0 (carry 1 over)

In this list of sums we have used every permutation of the two numbers. Compare the arithmetic with the truth table for the EXCLUSIVE OR gate shown in Fig. 2. If we used electrical signals to represent the numbers we wanted to add together and could accept an electrical signal as an answer you can see that the output of an EXCLUSIVE OR gate gives use a true representation of the sum of the two binary integers. It does not, however, give us the carry digit when we want to add 1 and 1. In addition we only need a carry when we have 1 AND 1 so it is a simple matter to provide this output from the same pair of inputs by introducing an AND function.

Fig. 3 shows how this can be done by taking the $\overline{AB}$ function—generated at the centre node of the EXCLUSIVE OR—and inverting it. You can see that the truth table for the circuit shown in Fig. 3 is an exact replica of the answers we would wish to get when carrying out a binary addition. The circuit is called a half adder. As is often the case there are various ways of designing half adders—you now know at least three ways of making the EXCLUSIVE OR function so try making some more half adders yourself on the Logic Tutor.



A	B	SUM	CARRY
0	0	0	0
1	0	1	0
0	1	1	0
1	1	0	1

Fig. 3. A half adder is an EXCLUSIVE OR plus an AND function of the inputs

You might query why this is called a half adder. The reason is that when we come to add together two multidigit numbers (see Fig. 4) our current circuit is quite capable of dealing with the least significant column (i) but when we come on to the other columns we have to be able to add together the respective digits of numbers A and B but also have to be able to add in any carry over that was generated in the previous (lesser significance) column. Thus to add multidigit numbers together we must have a circuit that can handle three inputs.

A circuit that will do this is called the full adder and we shall deal with this next month.

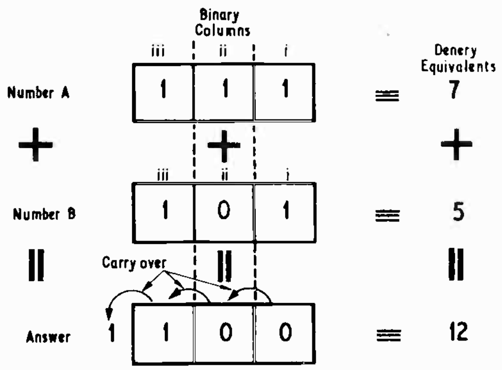


Fig. 4. When carrying out addition of two multidigit numbers a half adder is capable of dealing with column (i) but when it comes to column (ii) there must be provision for three inputs, digit (ii) of A + digit (ii) of B + possible carry over from column (i). The same applies to all higher power columns

PE Sound Synthesiser 10

KEYBOARD

With these added units the keyboard becomes a unique musical instrument . . .

WHEN the Sound Synthesiser was originally presented for publication it was the intention that it should be classed as a general purpose instrument which could be exploited in the widest possible number of ways and yet retain a basic simplicity of design and ease of construction. During the course of the series however many readers have commented that the musical capabilities of the instrument have been severely restricted by the lack of logarithmic v.c.o.s and thus the oscillator to be described in this article has been included in the keyboard unit in the hope that it will put matters right.

Prospective constructors should note that although the logarithmic v.c.o. is based on the linear v.c.o. which was described in Part 3, the parameters of operation are quite different and the setting-up is rather more critical if it is desired to operate the device within the limitations of a precise range of control voltages.

Although limited to about 11 octaves range with the design values given, it is possible to adjust the operating points to cover a much wider bandwidth. The prototype has operated quite happily from less than 1Hz to greater than 150kHz with a control voltage swing of about 11V and there is no reason to suppose that it could not reach 1MHz, or greater, if the integrator output voltage were to be reduced and a faster comparator employed. As a result it is possible that the oscillator may be suitable for a number of applications outside the sphere of sound synthesis.

The v.c.o. is shown in block schematic form in Fig. 10.1. The control voltage to the oscillator is modified in a differential input summer and then applied to a constant current generator housed in a "transistor oven". The output of the current generator is then led to an integrator/comparator stage through the medium of a current switch which is controlled jointly by the comparator and inverter. The triangular wave output is led to a waveform shaping circuit which provides a sine wave having a very low harmonic content.

DESIGN CONSIDERATIONS

It was decided that the best way of providing a log law performance to the basic v.c.o. outlined in Part 3 of the series was to utilise the entirely predictable logarithmic relationship between the base/emitter voltage (V_{be}) and collector current (I_c) of a bipolar transistor.

... Start Here !

This month we start detailing the operation and construction of the keyboard unit for the synthesiser. Regular readers of P.E. who may have been put off by the apparent complexity and/or cost of the synthesiser project as a whole may be interested to learn that the facilities offered by the keyboard unit are such as to allow the instrument to be classed as a music synthesiser in its own right, and at an overall cost of less than £80. Main features of the instrument are as follows:

Two tracking oscillators featuring a variable logarithmic law which allows compatibility with a wide range of control voltages and provides square, triangular and high purity sine wave outputs.

A novel **"floating" divider system** which greatly simplifies tuning the instrument and by means of which the compass of the keyboard can be swung, in tune, from a low frequency of about 6Hz to a high frequency greater than 27kHz. The divider features a switchable "span" facility.

Two modulation amplifiers by means of which the oscillators may frequency modulate one another either separately or at the same time.

Two analogue memory circuits which retain the last programmed divider voltage to either oscillator. Separate portamento controls are incorporated in the hold circuits giving six values of delay from instantaneous to one second.

Two simplified envelope shapers incorporating voltage controlled amplifiers each having a variable Attack and Decay characteristic and featuring a switched percussive attack.

A simple two channel, fixed gain mixer.

Finally, the keyboard divider system incorporates a link switch which allows the two oscillators to be programmed independently by the lower 18 and upper 31 keys respectively. This particular feature greatly improves the "live performance" possibilities. An independent p.s.u. is included.

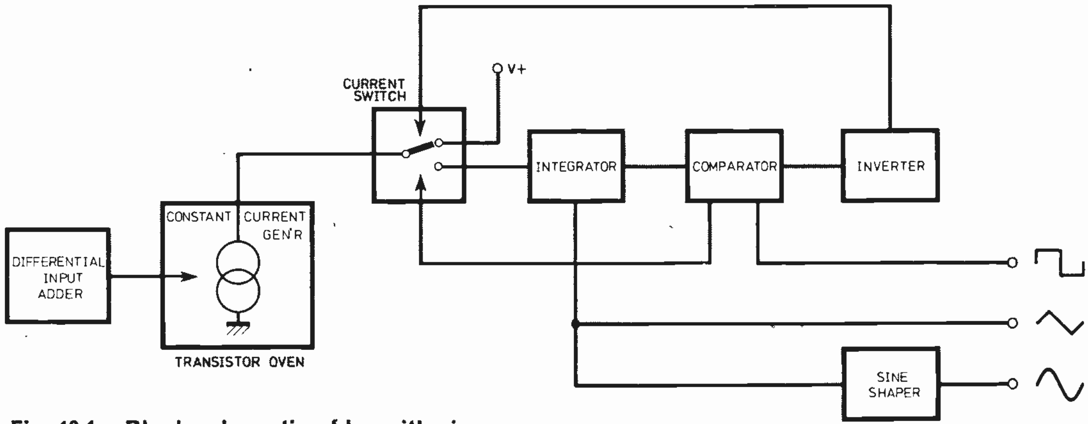


Fig. 10.1. Block schematic of logarithmic v.c.o.

Although the current generator could be almost any discrete transistor the effect of ambient temperature variations would be such as to cause the current demand to vary quite widely and thus adversely affect the "tune" of the oscillator. Consequently it was decided to make use of the inherently close thermal and electrical matching between transistors mounted in a monolithic integrated circuit — the ML3046P and CA3046 both having been tried in the prototype. Extremely close thermal stability is ensured by employing two of the transistors in the array as a heater and sensor respectively and terming the whole arrangement as a "transistor oven."

Fig. 10.2a shows a detailed arrangement of the "oven" while Fig. 10.2b shows the pin connections for the 3046 device. Fig. 10.3 illustrates how the V_{be} of transistors on the array will vary over a wide range of temperatures and provides a guide as to the actual temperature of the chip when the V_{be} of the sensing transistor is known.

In Fig. 10.2a Q1 serves as the heating element while Q2 is used to sense the temperature of the chip. The V_{be} of Q2 is compared with a reference voltage set up by R3, VR1 and R4. The reference voltage will correspond to a temperature which is considerably higher than ambient and will thus be at a lower value than Q2V_{be} when power is first applied. Thus the comparator will switch positive and turn on Q1. As the temperature of the chip rises Q2V_{be} will fall to a point where it is equal to or less than the reference voltage at which time the comparator will switch negative and turn off Q1.

The criteria determining the value of R1 are as follows:—

1. The temperature of the chip must be set considerably above normal ambient conditions (say 40 degrees to 45 degrees Centigrade).

2. The combined power dissipation of Q1 and Q2 must exceed, by a wide margin, the combined power dissipation of the remaining transistors in the array.

3. The current switching of Q1 must not be so violent as to impart a significant jitter to the oscillator waveform.

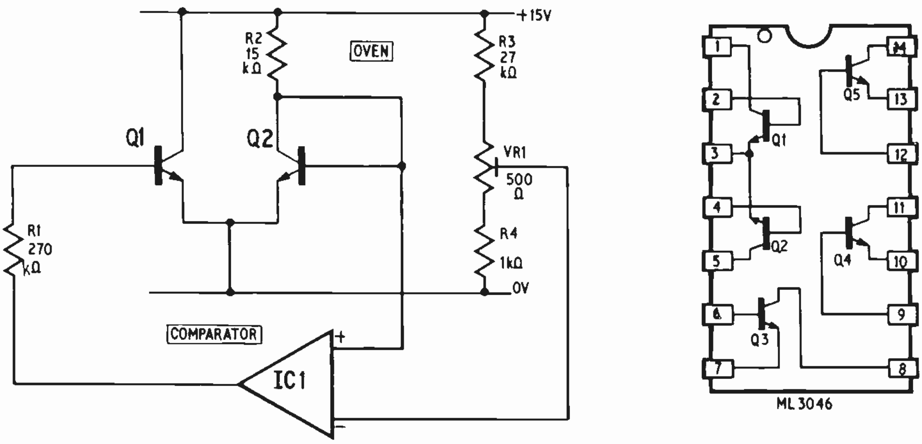


Fig. 10.2(a). Detailed arrangement of the transistor oven; (b) pin connections of the ML3046 and CA3046. Note that pin 13 must be connected to the most negative point in circuit

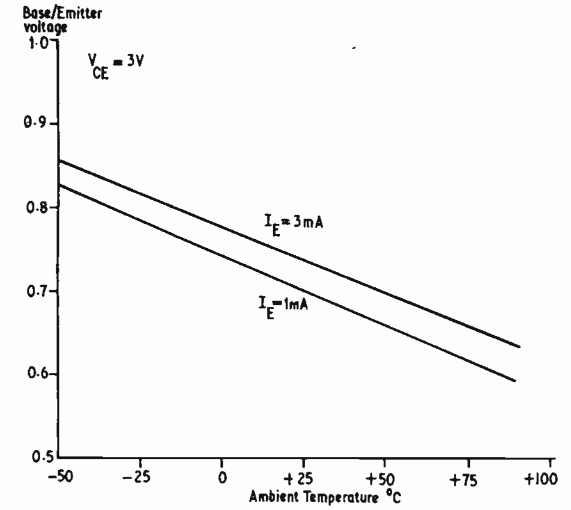


Fig. 10.3. Showing the change in V_{be} for variations in ambient temperature for the ML3046 and CA3046

In practice the value of R1 which gives the closest approach to the above criteria is 270 kilohms. With this value it is possible to set Q2V_{be} to 680mV, that is approximately 45 degrees Centigrade while the combined dissipation of Q1 and Q2 is about 90mW as opposed to the combined dissipation of Q4 and Q5 (the current generators) of about 1·4mW. Detailed setting-up instructions for the "oven" are given later in this article.

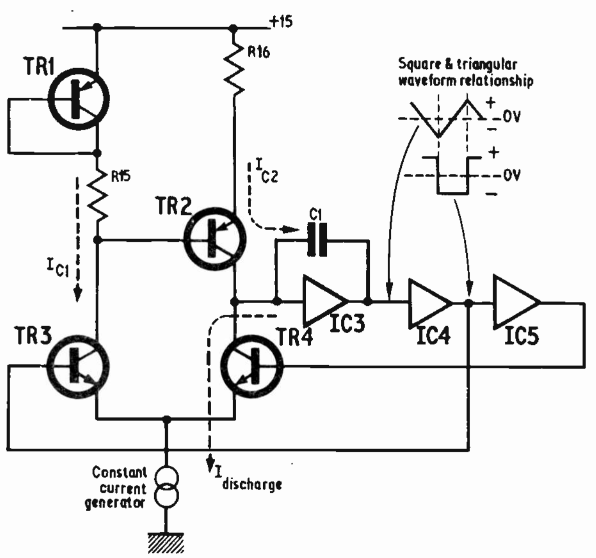


Fig. 10.4. Simplified layout of oscillator section showing operation of current switch

CURRENT SWITCH

Having thus established a thermally stable current generator it now remains to couple this to the input of the v.c.o. In the linear version of the v.c.o. a diode bridge was employed which was switched entirely by the action of the comparator. While this system could no doubt still operate satisfactorily a rather more sophisticated version has been adopted which utilises transistors in place of diodes. The so-called current switch is illustrated in Fig. 10.4. Assuming that the output of IC4 is positive to start with, the operation of the current switch is as follows.

With IC4 positive, the output of IC5 is negative and thus TR3 and TR4 are on and off respectively. With TR3 on the current generator demand will cause a drain across R15 and thus make the base of TR1 more negative than its emitter. TR1 will then turn on in proportion to the demand of the current generator and a current flow I_{c1} is established through TR1, R15 and TR3. I_{c1} will set up a p.d. across R15 which will have the effect of biasing on TR2 and establishing a second current flow, I_{c2} through R16 and TR2.

This latter current flow is entirely dependent upon the demand of the current generator which is varying the p.d. across R15 and thus TR2 may be said to track the demand of the current generator. The closer the matching of R15/R16 and TR1 and TR2, the better will be the tracking and the better the symmetry of the integrator output waveform. Thermal stability is not a problem with TR1 and TR2 since the arrangement gives an equal and opposite reaction between these transistors for any variation in temperature.

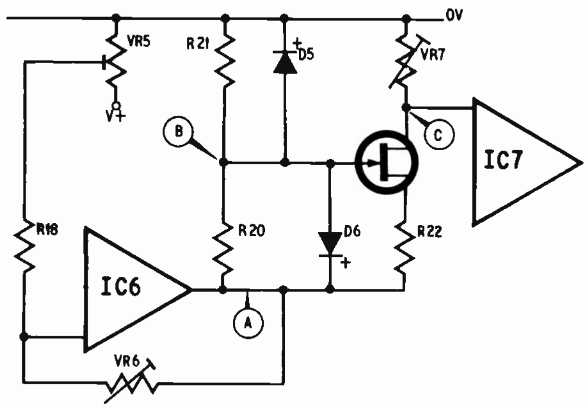
I_{c2} causes the integrator to ramp negatively and at a predetermined negative level IC4 will switch negative and IC5 positive. Thus TR3 and TR4 are now off and on respectively and since TR3 is off so also is TR2 and the current generator now discharges C1 via TR4 at a constant rate. The integrator will thus ramp positively until the switching point of IC4 is reached at which time the cycle repeats.

SINE WAVE SHAPER

The sine wave shaper used in the v.c.o. has been adapted from a design by D. T. Smith which appeared in *Wireless World* (Feb. 1973). Fig. 10.5 shows a detail of the circuit together with the waveforms presented at various points when the circuit is producing a sine wave having a low harmonic content.

The sine-shaper utilises the non-linear characteristics of a field-effect transistor in order to produce the desired output waveform and thus the operating points are quite critical. R20, 21 and D5, 6 provide a network which allows the gate to track the input signal and apply the necessary degree of "pinch-off" as the source signal approaches its maximum on both positive and negative half-cycles. Since the gain of the f.e.t. is changing continuously relative to the input signal the device may be considered to be operating in the ohmic region as a voltage variable resistor.

In Fig. 10.5 VR5 controls the d.c. offset of the input waveform and it is necessary to compensate for slight asymmetries which could be introduced in



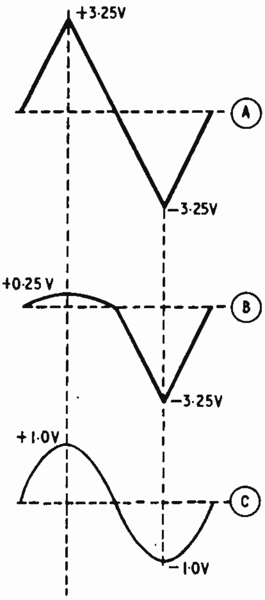


Fig. 10.5. Showing the waveforms occurring in the sine shaper. VR6 is adjusted for minimum third harmonic distortion and VR7 for minimum second harmonic distortion

the oscillator section. Over adjustment of VR5 in either direction can provide an alternative output waveform rich in harmonics.

VR6 sets the input signal level to the network. Too low a setting and the output waveform will be triangular while too much gain will give a waveform which is virtually a rounded off trapezoid. Careful adjustment of VR6 enables third harmonic distortion on the output to be reduced to a minimum.

VR7 controls the output amplitude of the signal. Too great a setting and the sine wave will become peaky while too low a setting will result in a squat, flattened out, waveform. Thus VR7 may be considered to control the second harmonic level and should be adjusted to minimise this characteristic.

BUILDING THE OSCILLATORS

The theoretical circuit of the complete oscillator module is shown in Fig. 10.6 while the recommended circuit board layout is shown in Fig. 10.7. It is strongly urged that construction of the module follows the guidelines suggested otherwise the interdependance of some of the controls is likely to make the final setting-up something of a nightmare.

Construction should start with assembly of the transistor oven, differential input summers and current generators. R1 should be 470 kilohm and left with fairly long leads to facilitate exchange during the final setting-up. Position the temperature control, preset VR1 to the R3 end of its travel to ensure that the comparator goes negative and thus turns off Q1 when power is applied. R10 should then be temporarily linked to the 0V rail and a decision taken as to the fate of R11. This resistor is optional in that it may be utilised to provide a third controlling input to the v.c.o. or it may be omitted at this stage without affecting anything. However, if it is decided to include R11 for the purpose of possible future additions to the circuitry it is important to remember that its presence could possibly compromise the setting-up of the oscillator if certain precautions are not taken.

If a third programming signal is to arrive at the oscillator from a low impedance source such as the output of another operational amplifier it is important that R11 also be temporarily linked to the 0V rail. Alternatively R11 may be left open circuit with the idea of using it only for the provision of occasional programming signals during which the tuning of the oscillator will have to be adjusted by means of VR4. In the setting-up instructions which follow R11 is open circuit.

SETTING UP

Since only one current generator can be set-up at a time the base of the second one (Q5) should be temporarily linked to the −15V rail to reduce the possibility of accidents. Set VR3 so that its value is 530 ohms. Note that if the positive lead of the ohmmeter is coupled to the −15V rail for this measurement the reading will not be compromised by the forward conduction of Q4. Set VR2 to the R6 end of its travel to ensure the minimum forward bias of Q4.

Set VR4 to its minimum setting and connect a milliammeter between the collector of Q4 and the 0V rail as shown in Fig. 10.8. As a safety precaution set the milliammeter to the 25mA range to start with. If the wiring up has been correctly carried out the milliammeter will show no reading when power is applied. On the other hand if the base of Q4 is incorrectly biased towards the positive region Q4 will pass a large current on switch-on which, besides possibly destroying the transistor, could also damage the meter.

Apply power and if no meter movement is observed reset to the 1mA range. Again there should be no obvious reading. Adjust VR2 towards the R5 end until the pointer of the meter makes a definite upward movement. At this point swing VR4 carefully over its full range and observe the maximum current drawn through Q4. The actual figure can vary quite widely at this stage and will probably be in the region 0·25–0·75mA.

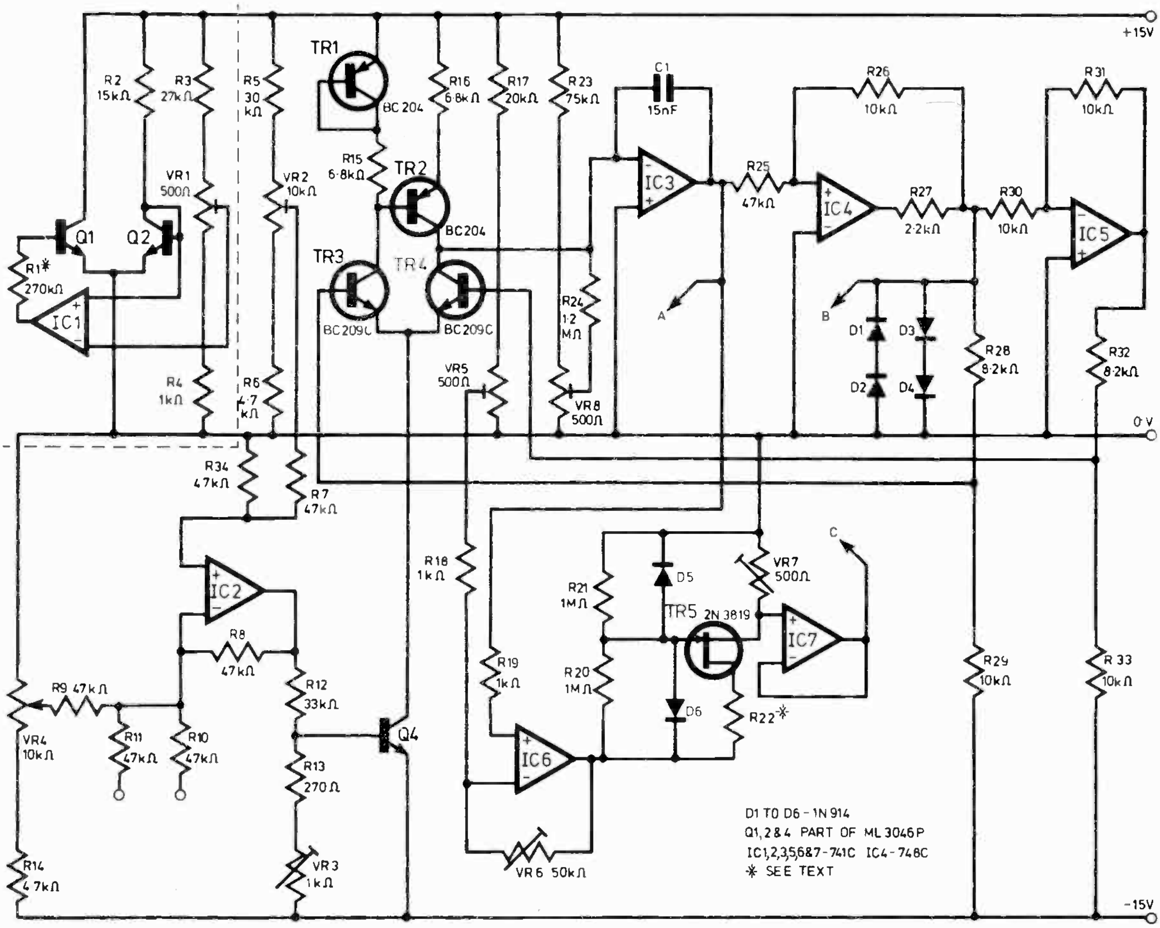


Fig. 10.6. Circuit of complete oscillator module. Points A, B and C are coupled to waveform selector switch

Set VR4 so that the meter is reading 0·2mA and place a slightly moistened finger on IC8—the transistor array. The meter reading should be seen to increase quite rapidly. Having made the above adjustments switch off and remove the meter from the collector circuit of Q4. Without disturbing the setting of any of the potentiometers temporarily link Q4 collector of the 0V rail. The same adjustments should now be made to the circuitry around Q5—having first removed the base/negative rail link.

In this case, however, leave the meter in circuit for the next stage of setting-up which entails fixing the thermal working points of the transistor oven.

Couple the oscilloscope to the output of the comparator IC1 which, at this point, will be about −14V. Carefully adjust VR1 until the comparator switches to +14V. At this time two things will start to happen. The first is that the meter will show a progressive increase in reading which, if the adjustment of VR1 has been made with care, should not exceed 1mA. The second is that within a second or so of the comparator switching positive the oscilloscope trace, which starts as a straight line, will begin to display a varying waveform.

At first the oscillation will zero about a point approximately 12V positive, but, as the chip temperature stabilises, the zero point will move down to about +6V to +9V. Monitor the base emitter voltage of Q2 which should be in the region 650mV to 680mV.

LOW LOAD POINT

At this time all four connected transistors are contributing towards the heating on the chip. Q1 with its 470 kilohms base resistor will be passing about 3mA and contributing about 45mW, Q2 in passing 1mA will be contributing about 15mW whilst Q4 and Q5 will be contributing about 6mW jointly. These latter devices, however, are passing considerably more current than they will be required to do when coupled to their respective oscillators and running at high frequency. It is therefore necessary to establish a low load set point to ensure that the oven maintains the same temperature over the full working range of the oscillators.

On both Q4 and Q5 reduce VR4 to its setting and readjust VR2 hard over towards R6—in other words reduce the forward bias on the transistors to the absolute minimum. These adjustments will cause

VOLTAGE CONTROLLED OSCILLATORS

COMPONENTS . . .

LOGARITHMIC V.C.O.s.
(2 required)

Resistors
R1* 270kΩ (see text)
R2* 15kΩ
R3* 27kΩ
R4* 1kΩ
R5 30kΩ 2% metal oxide
R6 4·7kΩ 2% metal oxide
R7–R11 47kΩ (5 off) 2% metal oxide
R12 33kΩ 2% metal oxide
R13 270Ω 2% metal oxide
R14 4·7kΩ 2% metal oxide
R15–R16 6·8kΩ 2% metal oxide
R17 20kΩ
R18–R19 1kΩ (2 off)
R20–R21 1MΩ (2 off)
R22 See text
R23 75kΩ
R24 1·2MΩ
R25 47kΩ 2% metal oxide
R26 75kΩ 2% metal oxide
R27 2·2kΩ
R28 8·2kΩ
R29–R31 10kΩ (3 off)
R32 8·2kΩ
R33 10kΩ
R34 47kΩ 2% metal oxide

Capacitor
C1 15nF

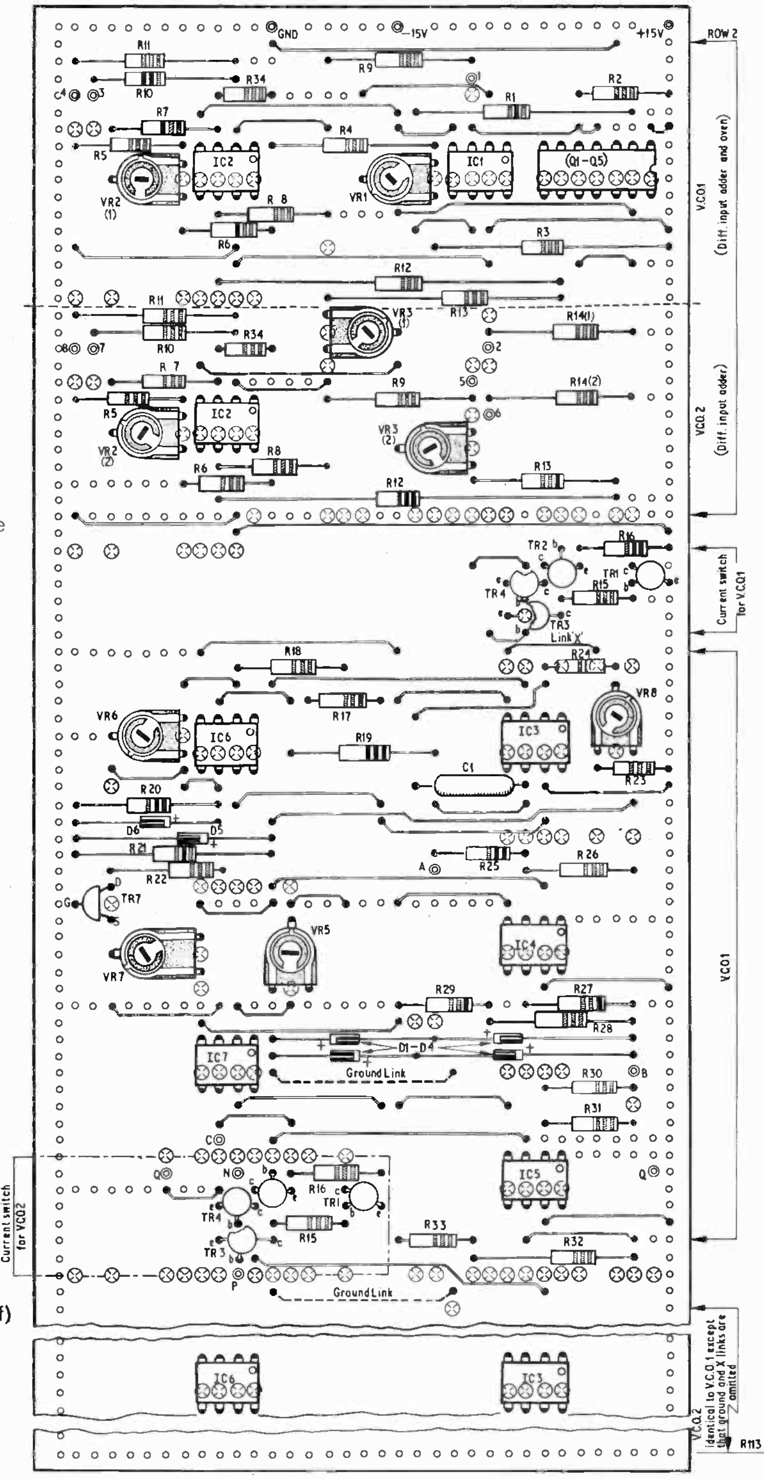
Potentiometers
VR1* 500Ω cermet preset
VR2 10kΩ cermet preset
VR3 1kΩ cermet preset
VR4 10kΩ midget moulded carbon
VR5 500Ω cermet preset
VR6 50kΩ cermet preset
VR7 500Ω cermet preset (see text)
VR8 500Ω cermet preset

Integrated Circuits
IC1* 741C
IC2, IC3, IC5, IC6, IC7 741C (5 off)
IC8* ML3046P (Q1, Q2, Q4, Q5)
IC4 748C

Transistors
TR1–TR2 BC204 (2 off)
TR3–TR4 BC209C (2 off)
TR5 2N3819

Diodes
D1-D6 IN914 (6 off)

Note: For components marked with an asterisk only 1 off is required.

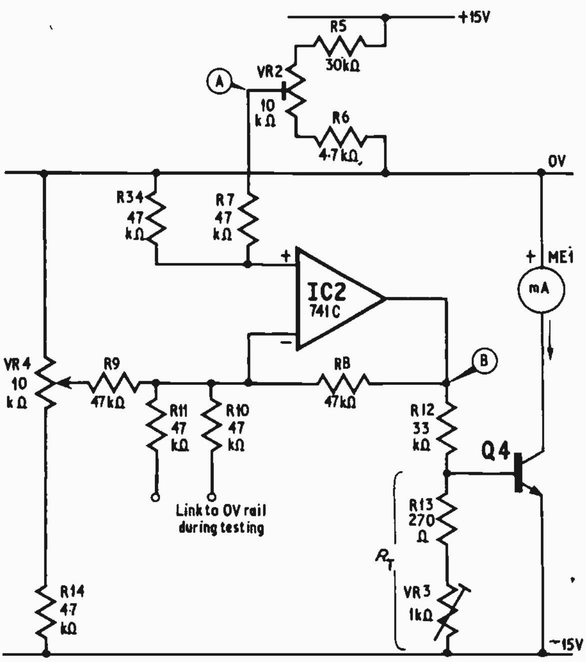


1. Slider VR4 (1)
2. Hi-end VR4 (1)
3. R10 Control Input (1)
4. Spare Control Input (1)
5. Slider VR4 (2)
6. Hi-end VR4 (2)
7. R10 Control Input (2)
8. Spare Control Input (2)

Fig. 10.7. Board layout of oscillator module. Link point Q to Q. Link point N to junction of R33 and R33 on V.C.O.2. Link point P to junction of R28 and R29 on V.C.O.2

the oven temperature to fall and thus the comparator switching waveform will tend to move more positive and revert to a straight line trace.

Monitor the base/emitter voltage of Q2 again which, with the comparator positive, should not be greater than 680mV. If it is, or if, after a few seconds, the comparator waveform does not show signs of rippling, then the heat dissipation of Q1 is insufficient to maintain the set temperature. Much,



Bias Voltage "A"	Total Voltage "B" Bias + Control	Ic	V_{BE} (Q4) (mV)
2·74	2·74	12nA (calc)	395
2·74	5·75	160nA	461
2·74	7·76	600nA	500
2·74	8·76	1·5μA	528
2·74	9·76	3·7μA	550
2·74	10·78	7·0μA	570
2·74	11·78	20·0μA	595
2·74	12·78	41·0μA	617
2·74	14·39	60·0μA	630
	Referred to 0V Rail		Referred to −15V Rail

V_{BE} Qz = 680mV: R_T = 750Ω

Fig. 10.8. Measurements of Q4V_{be} made with Avo 8 which illustrate the degree of error that is possible when interpreting the reading

of course, depends upon the ambient conditions when these measurements are being made and it is best to set up the low load point at the coolest temperature at which the v.c.o. is likely to be operated.

Under cool conditions therefore, if the comparator still does not ripple, it will be necessary to adjust the value of R1 to increase the current through Q1. In the prototype a value of 270 kilohms proved to be satisfactory and gave the desired comparator switching waveform at low load. The value of R1 is quite important because if it is too low the current switched by Q1 will be excessive and cause a considerable degree of jitter on the oscillator waveform.

Monitor Q2V_{be} once more and adjust VR1 as necessary to bring the voltage to 680mV. All setting-up on the prototype oscillator was carried out at this value and it is important to bear in mind that the values of all subsequent measurements bear a close relation to this figure. If Q2V_{be} is lower than 680mV this implies that the temperature of the oven is higher and thus Q4 will pass a higher current for any given value of control voltage. Since the frequency of the oscillator is linearly related to the current through Q4 then the frequency will also be higher.

The reverse will occur if the value of Q2V_{be} is higher than the specified figure. However, for small variations from the specified value, the performance of the oscillator will still remain wholly logarithmic and sufficient tolerance has been allowed in the biasing control VR2 to compensate for such variations. Once satisfied that the upper and lower temperature set points have been correctly established VR1 may be locked with a small dab of non-conductive adhesive such as Araldite. Link the bases of Q4 and Q5 temporarily to the −15V rail.

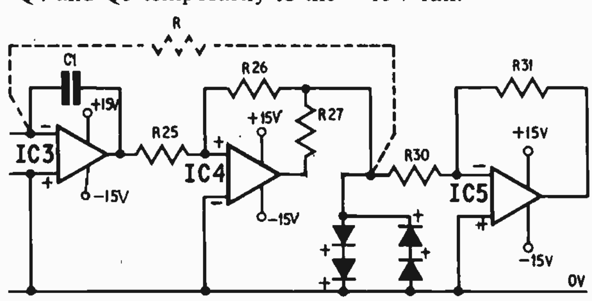


Fig. 10.9. Basic circuit elements of the oscillator and inverter (IC5). Resistor R is any value between 2kΩ and 1MΩ and is temporarily coupled as shown to prove oscillator function

PROVING THE OSCILLATORS

Fig. 10.9 shows the circuit elements involved in the construction of the oscillator section. When these items have been assembled temporarily connect a resistor of between 2 kilohm and 1 megohm from the junction of R27/R30 and the inverting input of IC3. With an oscilloscope monitoring the output of IC3 apply power and a triangular waveform will be observed at a frequency dependent upon the value of linking resistor chosen. Having proved the functioning of the oscillator assemble one current switch and couple to a current generator having first removed its base shorting link. Resistors R28/29 and R32/33 should be added at this time. The purpose of these resistors is to establish a negative bias point for transistors TR3 and TR4 in the

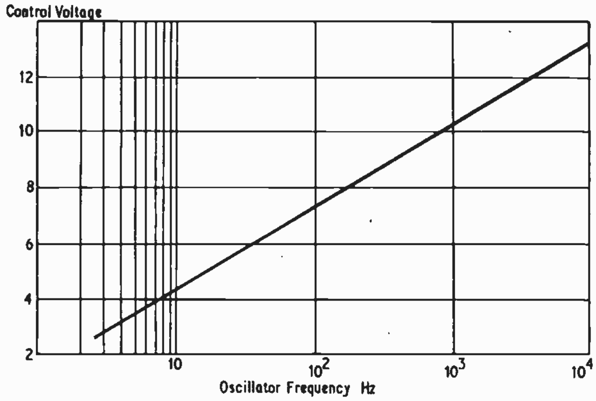


Fig. 10.10. Control voltage/frequency relationship

current switch and whereas the exact value of the resistors concerned is not entirely critical it is important that R28/32 and R29/33 be as closely matched as possible to ensure that the bias points of TR3 and TR4 are the same.

A quick check may now be made to ensure that the separate circuits work together as a complete unit. Remember to reset VR2 and VR4 to about mid position. Depending upon the setting of VR3 it is possible that rotation of VR4 will cause the oscillator to go into saturation towards either extremity but this is not important at this stage and will be dealt with during final setting up.

The next stage is to build the second oscillator following the same general pattern and, having established that it functions, begin the process of matching the performance. The closest possible matching of performance will be obtained if relatively close tolerance components have been used in the construction and, for this reason, 2 per cent resistors have been specified throughout. In particular it is prudent to obtain a matched pair of integrating capacitors (C1).

BIASING

Firstly it is necessary to establish a value of minimum bias on Q4 and Q5 which will support oscillation. Due to the inherently close electrical matching of the transistors on the 3046 the same level of bias will result in current flows through the transistors which are, for all practical purposes, identical. In the prototype it was found that the output of IC2 was at +2·74V referred to the OV rail for an oscillation frequency of 0·2Hz.

Set VR4 to its minimum position and adjust VR2 until the output voltage on IC2 (both oscillators) reaches +2·74V as above. Monitoring the integrator output waveform on both oscillators at the same time, if possible, adjust VR3 on Q4 and Q5 *with the greatest care* so that both oscillators are running at the same frequency—the exact rate is not critical. With VR4 still at its minimum setting apply an external control voltage to R10 on both oscillators at the same time having first broken the temporary link connecting R10 to the OV rail. A fresh 9V battery with a suitable potentiometer coupled across its terminals is ideal for the purpose of providing the control voltage.

Connect the positive end of the battery to the OV rail and the slider of the potentiometer to both R10's. With the slider hard negative monitor the output frequencies of both oscillators, preferably at the same time, and confirm that they are running at the same frequency which should be in the region of 3kHz. Note that since the oscillators are not phase locked a certain degree of drift between them is almost inevitable and it should be the aim to reduce the amount of drift, by adjustment of VR3, to within 1 per cent or better of the frequency being monitored. Thus for a frequency of 3kHz a drift of about 30Hz would be at the limits of acceptability. Compare frequencies at various settings of the potentiometer to ensure that the frequencies and drift relationships remain stable over the full range.

OFFSETTING SATURATION

If, at the minimum setting, either or both oscillators go into saturation due to the adjustments made to VR3 it will be necessary to establish a slightly higher bias point by re-adjustment of VR2 and then repeat the whole of the setting up procedure so far outlined. Careful adjustment will result in a pair of oscillators which track the control voltages very accurately. It should not be the aim to reduce the drift between the oscillators to a very low figure as the beat frequency introduced by a drift of 0·5 per cent to 1 per cent will add interest and colour to the sound when both oscillators are being programmed in harmony. On the other hand a very low beat frequency can add quite unpleasant characteristics to a sound.

When satisfied that the oscillators are tracking over the full range of the control potentiometer the control voltage measured at the output of IC2 should be plotted against the frequency of oscillation at various points in the range. Fig. 10.10 shows the result of plotting the performance of the prototype oscillators.

F.E.T. CHARACTERISTICS

Before beginning the assembly of the sine shaper it is necessary to determine the exact characteristics of the f.e.t. which is to be used in the circuit. The two operational parameters which require to be known are the saturation current (I_{DSS}) at zero gate bias and the gate bias required to reduce the current through the device to negligible proportions. Fig. 10.11a/b illustrates the methods of making the measurements specified. If a variable voltage source

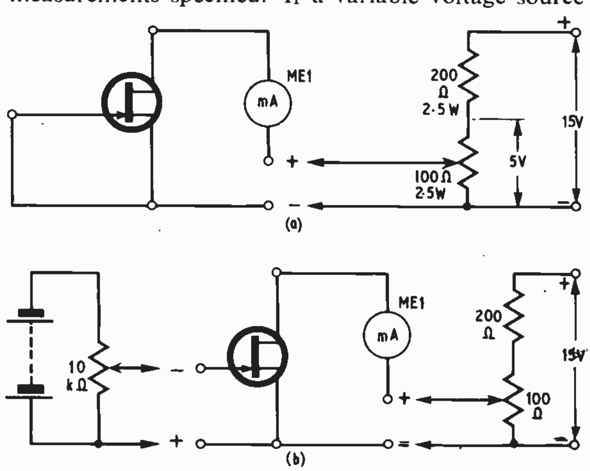


Fig. 10.11(a). Method for determining I_{DSS} at V_{GS}= O(b) method for determining V_{GS} when I_{DS}=O

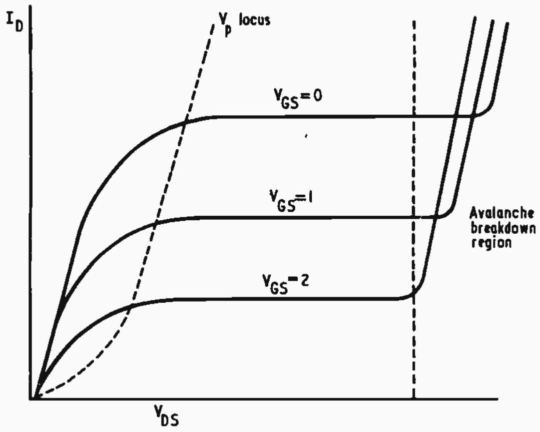


Fig. 10.12. Graph showing how V_p and I_{DSS} vary with V_{GS}

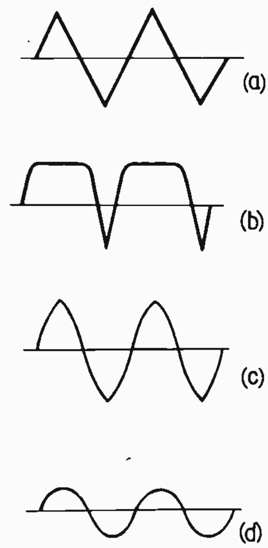


Fig. 10.13. Showing the effect on the sine shaper output waveform of adjustment of VR6 and VR7(a), VR6 too low (b), VR6 too high (c), VR7 too high (d), VR7 too low

is available it is preferable to use this in the source drain circuit rather than the divider arrangement illustrated and thereby gain the benefit of greater accuracy in the measurements.

The first stage is to measure the I_{DSS} at zero gate bias. With the variable voltage source at zero volts and the milliammeter on the 1mA range gradually increase the voltage setting, plotting, at various stages, the current/voltage relationship.

The point which is of interest is that at which further increases in voltage result in only a very small increase in current through the device. The voltage at which this phenomenon first occurs is known as the pinch-off voltage (V_p) and should be carefully recorded. After the pinch-off point has been reached the voltage may be increased quite significantly with very little increase in current until the avalanche breakdown region is reached. At this point the current through the f.e.t. will increase hugely and almost instantaneously and result in the destruction of the device. Hence the requirement to plot the measurements very carefully and note the point at which V_p is reached.

Fig. 10.12 shows a typical family of curves for any one f.e.t. and depicts the way in which the pinch-off voltage reduces as the gate bias is made progressively more negative with respect to the source. The next measurement to make therefore is the point at which the current through the f.e.t. reduces to negligible proportions and the set-up for doing this is illustrated in Fig. 10.11b. Having made the connections shown and with the 10 kilohm potentiometer wiper at the positive end of its travel adjust the variable voltage source so that the meter is indicating the I_{DSS}. At this point gradually advance the wiper and note that the meter reading reduces in proportion. Switch to a lower range on the meter as required and advance until the reading is zero. At this point carefully measure and note the voltage across the gate/source of the f.e.t.

The value of resistor R22 in the sine shaper is calculated on the basis of the readings above in the following way:—

$$R22 = \frac{V_p}{2.I_{DSS}}$$

The V_p in the above calculation refers to the value of gate/source voltage at which the current through the f.e.t. is zero. The value of the resistor will depend on the actual characteristics of individual f.e.t.s but would normally be expected to be quite small. In the prototype, for example, R22 was 180 ohms in one shaper and 270 ohms in the other. The value of VR7 should be chosen to provide a fairly wide margin of adjustment over the calculated value of R22 and in most cases a 500 ohm preset would be satisfactory.

ASSEMBLY

Having completed the above measurements the sine shaper can now be assembled. Bear in mind that f.e.t.s can be rather tricky to handle and it is a wise precaution to solder all the other components in position before actually inserting and fixing the f.e.t.

Setting-up the sine shaper consists of adjusting the values of VR5, 6 and 7 to provide the optimum sine wave. With power on adjust VR4 so that the oscillator is running at about 3kHz and monitor the output of IC7. The preset adjustments should be made with reference to Fig. 10.13 which illustrates the various waveform characteristics associated with these controls.

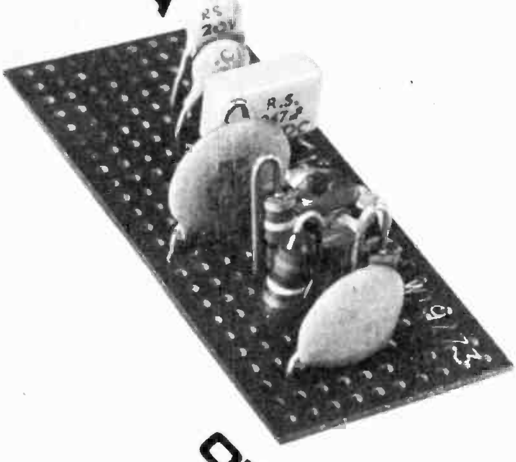
If a sine-wave oscillator is available it is helpful to compare the output of the shaper with a "genuine" sine wave of the same frequency. The scale of the waveform on the oscilloscope screen should be as large as possible for this purpose. This latter procedure was carried out with the prototype shapers and resulted in a sine wave output having a total harmonic distortion of only 1 per cent. A wave analyser or distortion meter if available could enable a higher purity sine wave to be obtained.

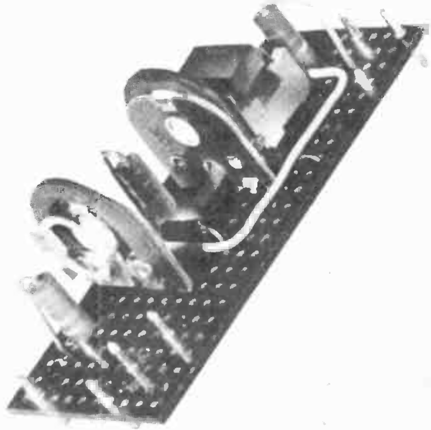
Next month: Envelope shaper, mixer networks and analogue memories for the keyboard unit.

QUICKIES

WAA WAA

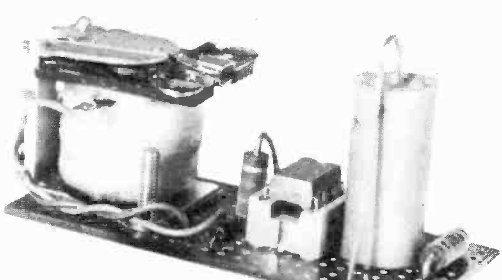
THERMOMETER

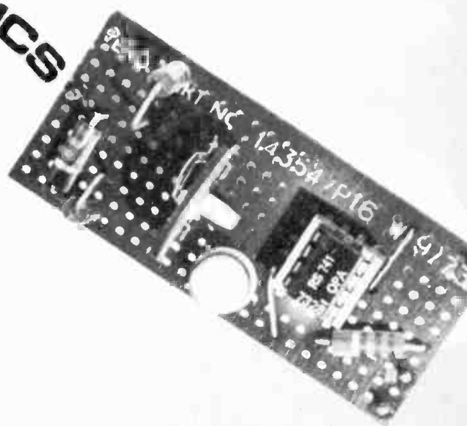




OPTOELECTRONICS

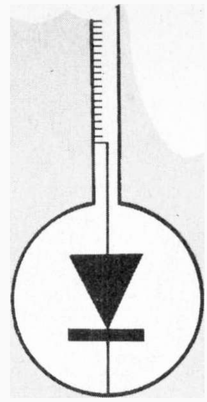
TOUCH SWITCH





4 EASY-TO-BUILD PROJECTS FOR THE WINTER EVENINGS

THERMOMETER



A temperature measuring device with many applications

HENRYS RADIO 2/9/74.

THE electronic thermometer has been proposed in various forms, usually associated with a thermistor detecting element. This latter is a resistor the value of which changes with changes in temperature, hence the name from thermal resistor.

However, whilst capable of providing an indication with fairly simple circuitry, this device is basically non-linear, the change in resistance for a given change in temperature is not the same for all temperatures.

There is a much smaller and, in linearity terms, more accurate device readily available, the forward - biased semiconductor diode.

COMPONENTS . . .

Resistors
R1 22kΩ
R2 1·5kΩ
R3 1·5kΩ
All 10% ¼W carbon

Potentiometers
VR1 10kΩ } skeleton presets
VR2 22kΩ }

Diodes
D1 1N914 (or 1S914 or other silicon diode)
D2 BZY88 (5·6V) Zener diode

Integrated Circuit
IC1 741 Operational Amplifier

Miscellaneous
ME1 0–1mA Meter (see text)
Veroboard (free with this issue)
Total cost (excluding meter) about 95 pence.
Meters are available from about £2·50.

£3.45 approx.

Diode Probe

It is admitted that the range over which a small silicon switching diode can be used in temperature terms is limited to the area which will not damage the device, namely from around −60°C to +180°C. In addition, the variation of resistance and thus voltage across the diode is very small for a change in temperature of 1 degree C, in the region of 2·5 to 3·5mV.

Thus the change needs to be amplified in some way if it is to be useful.

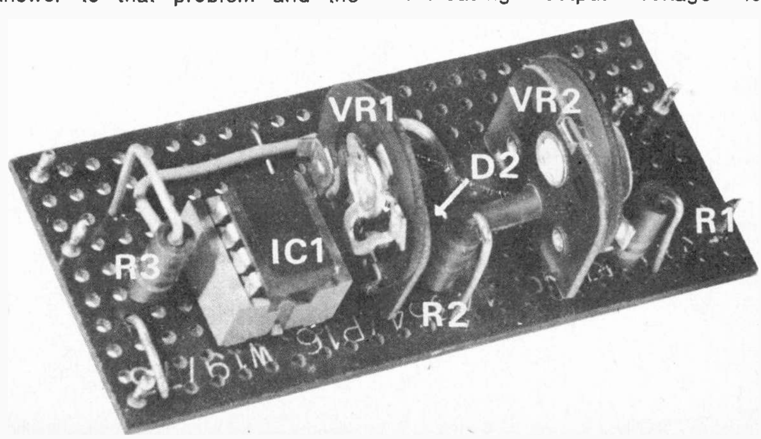
The advent of cheap integrated circuit amplifiers has provided the answer to that problem and the operating range of these diodes is quite sufficient for most applications.

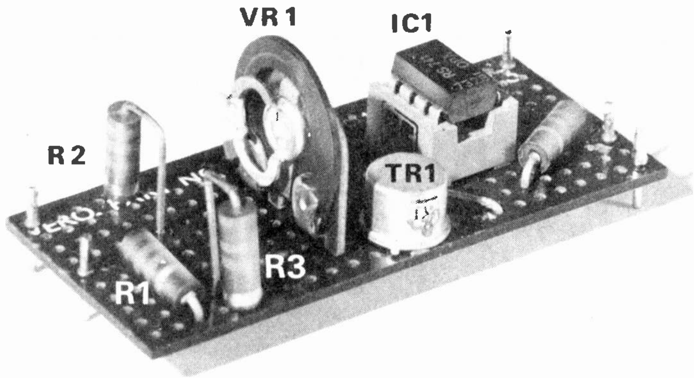
Circuit

A number of alternative approaches offer themselves for use here. One could use the " bridge " method with the measuring diode set up in a bridge circuit and the amplifier looking at the bridge signal.

However, a simpler approach is to use the amplifier as a differential amplifier which can compare two input voltages, one due to the diode and the other variable in order to select the point at which the scale of the instrument starts.

Such a circuit is shown in Fig. 1, where the diode D1 is connected to vary the inverting input of the operational amplifier whilst the non-inverting input is set by the potentiometer VR1. The choice of inputs is required to give an increasing output voltage for





or its holder if one is used as in the prototype, and one to separate the output from VR1.

As can be seen, pins have been used to bring out the battery, input and output connections but of course wiring may be connected directly to the board if desired

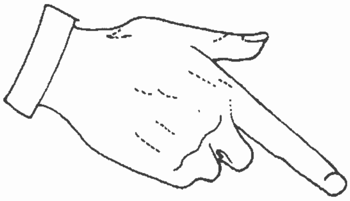
Applications

A circuit of this type can be used anywhere it is necessary to measure and control as a result of light variation. A side light control for a car is a typical idea. Other automotive applications include light actuation of a garage door, car light failure alarm and perhaps even a burglar alarm.

Similarly in the home there are many applications starting off with things like a burglar alarm, light switches to turn house illumination on after dusk both for convenience and security and the like.

In technical areas devices of this sort can be used as object counters on a production line, as end-stops for limiting machine travel, as automatic door openers and so on.

Dependent on the light resistor used the equipment will be sensitive to slightly different areas of the visible light spectrum but for normal visible light work most types will suffice including the well-known ORP 12 and its brothers from Mullard. ★



TOUCH SWITCH

Multi-purpose switching by touch alone

THE touch switch has many household, commercial and industrial applications. Specific examples in each area are intrusion alarms, opening supermarket doors and safety devices for machine operators.

In principle, simply touching a wire or metal plate will cause a relay to operate. To fulfil this the intermediary circuitry must be sufficiently sensitive to detect the very small noise currents provided by the hand.

Timer Chip

Touch switch circuits usually consist of cascaded amplifier stages (f.e.t. or bipolar). Construction of these for a beginner can be irksome and the results disappointing through spurious triggering, a common condition with these circuits

A convenient and economic package which can be simply adapted for this role is the Signetics 555 timer integrated circuit. Although this is usually used to provide accurate delay periods from microseconds to hours it will suit our purpose to use this facility to provide a variable period latch for the relay.

Input sensitivity is extremely high and the chip has a useful relay drive capability so that any relay coil operating in the 6-9V range and up to 200mA.

Simple Circuit

The first thing that one notices in looking at the circuit of Fig. 1 is its simplicity and economy in parts which makes for easy construction.

Since the internal functioning of the 555 was more than adequately covered in the June 1973 issue it will suffice to say that the circuit operates as a sensitive monostable.

In the quiescent state, that is with no hand applied to the touch plate or wire, battery drain is about 7mA none of this being taken by the relay. When a hand is applied relay coil current flows and the contacts close for a period determined by the timing constants R1 and C1.

For the component values shown the time is around 3 seconds but longer delay periods can be achieved by increasing the value of C1. With the resistor given delay periods in seconds for a particular capacitor can be approximated by the simple equation $t = 9C_1$ where C_1 is in microfarads. For a delay of an hour you would, for example, need a 400µF capacitor but leakage would no doubt affect this estimate. A practical limit for very long delays would be about 10,000µF.

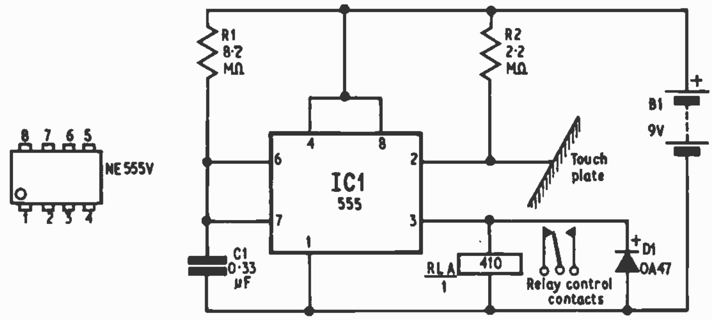


Fig. 1. Circuit of the touch switch

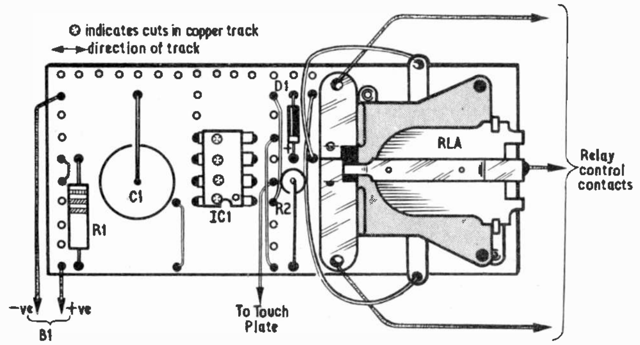


Fig. 2. Component layout and wiring on Veroboard

Triggering

The current required at pin 2 to activate the circuit need only be half a microamp which indicates the extreme sensitivity. Unfortunately this can create problems of backlash triggering particularly with inductive loads. This is obviated by the inclusion of R2

The transient suppressing diode protecting the chip can in fact be any switching diode.

Touch Off

There are times when a touch on/touch off switching facility might be required as with say, a bedside night light. For this do not connect pin 4 to the supply line but to another touch plate. A simple method of providing two adjacent touch plates is to join equal numbers of copper strips on a largish piece of Veroboard and simply wiring each "plate" to the appropriate 555 pin.

Construction

The components are easily mounted on the sample Veroboard as in Fig. 2. Cuts to be made in the copper underside are also clearly shown.

The 8 pin d.i.p. socket was included as it simplifies any future need to remove the chip either through damage or for use in another project

Other Relays

The delay periods provided by the timing component are almost independent of supply voltage. Since the 555 can be operated between 4·5 and 16V the supply rail can be lifted to accommodate other relay drive requirements but this should not exceed 16V and 200mA. ★

COMPONENTS . . .

Resistors
R1 8·2MΩ
R2 2·2MΩ
All 10% ½ watt carbon

Capacitors
C1 0·33µF polyester (see text)

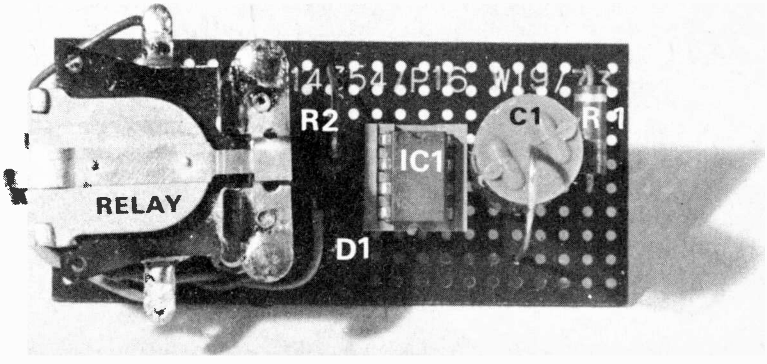
Integrated Circuit
IC1 NE555V (Signetics)

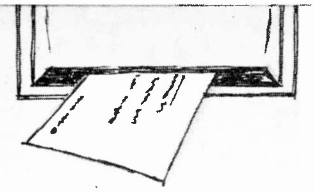
Diode
D1 0A47

Relay
RLA 6V 410Ω coil (type 912 R.S.)

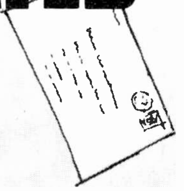
Miscellaneous
Veroboard (free with this issue), 9V battery

£2 approx.

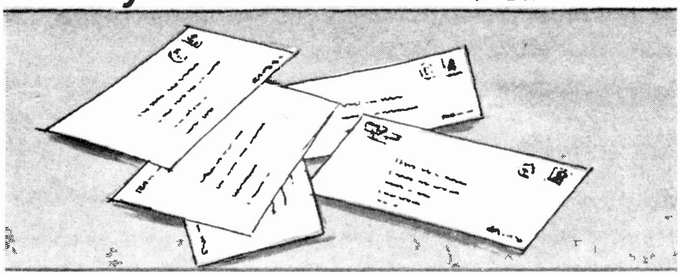




AUTOMATED MAIL



By F. J. MORRIS B.Sc.(Eng.), A.C.G.I.



RAPID, often startling, developments which have been made in the field of telecommunications owe much to the application of electronics. But electronics are, of course, contributing to the advance of other forms of human communication. Take, for example, one of the most traditional communications systems of all—the letter post. Electronics have an essential role in the multi-million pound plans to automate Britain's postal service.

THE NEED FOR AUTOMATION

The need to automate the postal service is imperative for two major reasons. First, to reduce the service's dependence on manpower (75 per cent of all Britain's postal costs are for labour) and secondly to maintain traditionally high standards while meeting the demands of today's fast moving world.

Since each of the 35 million letters the Post Office handles every working day in this country may have to be sorted up to eight times during its journey there is clearly ample scope for mechanisation and, helped by electronics, much has already been achieved. Electronics systems are enabling machines to select, stack and sort letters automatically at speeds far higher than even the most skilful postman-sorter.

The key to automation is the British postcode system, of its kind the most advanced in the world. Postcodes have been developed as the answer, or at least a supremely effective compromise, to the so far insuperable problem of total automation through machine-read addresses. Research is progressing but apart from the obvious difficulties with machine-reading of handwritten addresses it will still be many years before even typescript addresses can be read reliably without unreasonable restrictions on inks or type faces.

The postcode, however, by expressing an address in a machine language, easily keyed and translatable electronically, enables a high degree of automatic sorting to be introduced with present technology.

THE PRESENT SITUATION

Fully mechanised sorting offices are now operating at 12 centres in Britain and the eventual total will be around 100. Progress and the eventual success of the system depend on two factors—the completion of the programme to give each of Britain's 20 million addresses its own postcode; and the subsequent use of the postcodes by the public. In fact, postcoding of the country will be completed by August this year and while use of existing postcodes is rising steadily the importance of maximum use will become clear from the remainder of this article.

THE POSTCODE

The postcode is familiar to most people but the reasoning behind its planning and form is not so widely known and its explanation is appropriate here.

In fact the principle is simple. Each code consists of between five and seven alpha-numerical characters. The first one or two alphabetic characters in the code refer to one of 121 main towns or code centres in the UK (e.g. S for Sheffield, IP for Ipswich, LS for Leeds). A number following the alphabetic characters in the first or "outward" part of the code represents a sub-division of the area (e.g. IP3, IP7, IP17). These districts are geographic units similar in concept to the familiar London postal districts, such as SE1.

Each district is sub-divided into smaller areas or sectors which are again geographic units, represented by the first character or "inward" part of the postcode (e.g. IP3 9--, LS8 5--, etc.). Finally, the last two characters of the postcode give information about a street, part of a street, or, in the case of larger firms, a single address.

Thus a complete code in the case of part of a street in Ipswich for example reads IP3 7PS with the final two letters, PS, pinpointing that part of the street—usually between 15 and 20 addresses.

INITIAL SORTING

During initial sortation specially trained operators at postcoding desks equipped with electronic keyboards read each code and print onto the envelopes a series of code marks. The complete code is translated into a pattern of up to 28 marks and printed in two rows of 14. The code marks are virtually invisible to the naked eye but glow blue under ultra-violet exposure (see Fig. 1). The glow remains for a time after the ultra-violet light has been removed and this after-glow is detected by a photo-multiplier tube and the pattern recovered.

The pattern is next translated electronically to decide into which of 144 sorting boxes the letter is to be deposited by the machine. Once the postcode has been transcribed at the coding desk repeated exposure of the code marks and subsequent reading allow fully automatic sorting of the letter during its journey until it reaches the postman who is to take it on his delivery round.

FOUR PROCESSES

While looking in closer detail at the electronics behind the coding desk and the automatic sorting machine it is necessary to follow in sequence the

*Post Office Mechanisation Branch

four processes which a letter goes through from being received in the sorting office and being slotted automatically into its sorting box on the machine. The first two processes—segregation and facing—are preparatory to the final two—coding and sorting.

When letters arrive in a fully mechanised sorting office those which can be handled by automatic sorting machinery must be segregated from those which cannot. A wide assortment of letter shapes and sizes are found in every mail collection and those that are too unwieldy or thick must be culled from the letter stream before being allowed to pass into and possibly jam, or severely damage, the automatic sorting equipment.

The letters pass through a series of ingenious processes—rotating slatted drums, tilted conveyor belts, spaced rollers—which between them allow the unsuitably sized letters to slip from, or be plucked out of the stream, collected and then sorted by hand. The remaining letters are stacked automatically and passed to the next machine—the automatic letter facer (ALF). This is the first of the automatic sorting stages to employ electronics (see Fig. 2).

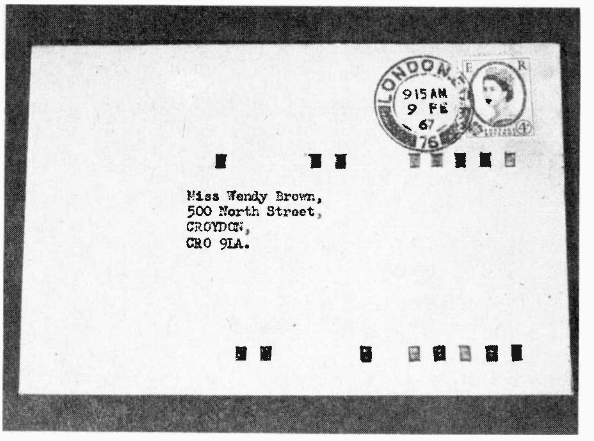


Fig. 1. A typical postcode pattern. The dots imprinted at the coding desk are normally almost invisible to the naked eye and have been outlined here

AUTOMATIC LETTER FACER (ALF)

The job of ALF is to arrange the letters so that they face the same way (the stamp upwards) preparatory to the stamps being postmarked or cancelled. Additionally ALF separates First and Second class letters so that the former may be sorted later.

While the operation of letter sorting machinery relies on the glow picked up from the code-marks printed onto the envelopes at the coding desk, ALF relies on a similar glow effect but obtained from the stamps themselves. Each stamp is surfaced with bars of phosphorescent material. The number of bars differ according to the value of the stamp. This enables the machine to detect if a stamp is present on the envelope, its position and whether the letter is being sent First or Second class.

ALF first strips letters off the feed stack and accelerates them along a series of rollers to obtain a stream of letters with a small gap between each one. The letters then pass under the first of two arrays of ultra-violet (UV) lamps which causes the phosphor on the stamps to glow. The glow continues after the letter has left the UV section and passes under two photo-multiplier tubes.

One of the tubes scans the top section of the letter face (which was exposed to the UV) and the other tube looks at the bottom of the face. In the dark only a tiny current flows in the multiplier but the glow from a UV "excited" stamp boosts the current.

The change in the current is detected and if a stamp is "seen" at either end of the letter face the letter is allowed to pass on. If no glow is picked up ALF assumes that the letter is facing the wrong way up and routes the letter through a twisted belt section to turn the letter over.

Now, all facing the same way, the letters pass under a second series of UV lamps and photomultiplier tubes. This time the number of phosphor bars on the stamps are noted and the letters identified as First or Second Class. At this stage, also, underpaid letters and those bearing no stamps are spotted.

ALF actually sorts letters into five boxes (cancelling their stamps on the way) of which two are for First Class, two for Second Class and the fifth for underpaid letters. Pairs of boxes are needed so that letters with stamps in the leading position can be separated from those with stamps in the trailing position. The operator who unloads ALF correctly combines these two stacks before passing them to the next stage, the postcoding desk.

CODING DESK

The Coding Desk, with the help of an operator, provides each letter with its pattern of UV sensitive marks translated from the postcode. Where letters do not carry a postcode the operators imprint a code giving the post-town destination of the letter which enables initial automatic sorting to go ahead. But without the complete information which the correct postcode provides these letters must pass through a second coding desk to identify the delivery street

Fig. 2. Inside an automatic letter facing machine (ALF) which arranges letters so that they face the same way and the correct way up in the sorting office. ALF also separates first and second class mail and cancels the stamps, dealing with up to 20,000 items of mail an hour

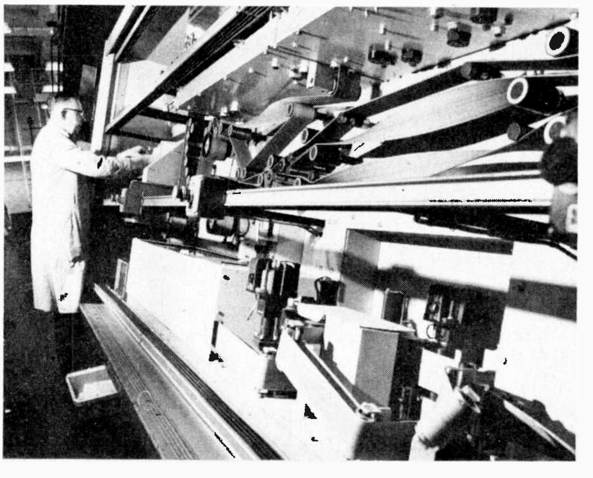
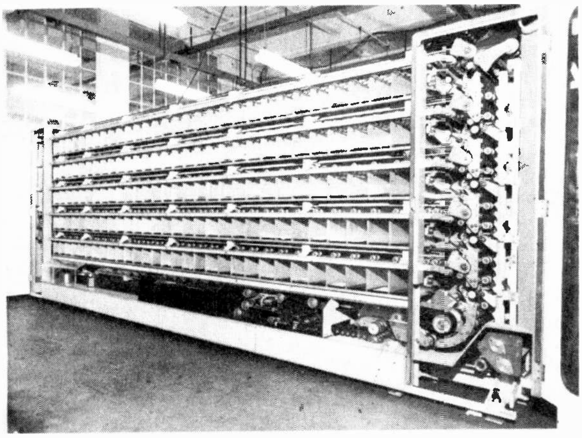


Fig. 3. Letters passing through a postcoding desk operated by a specially trained postman

when they arrive at the delivery sorting office. The full potential of the postcode is therefore missed and hence the importance of using the postcode wherever it is known.

The coding desk presents each letter at a display "window" facing the operator who is seated at a keyboard (see Fig. 3). The operator, who is a specially trained postman, types out the postcode on his keyboard which converts each character into a different pattern of binary signals on six wires.

Fig. 4. A medium speed Letter Sorting Machine with 144 selection boxes. These automatic machines read the first half of the postcode and sort the letters to their office of destination. At this office coded letters are again automatically sorted by machines which read the second half of the code and sort for the appropriate delivery postman



ELECTRONIC TRANSLATOR

The signals from each coding desk keyboard are sent to an electronic translator which contains a memory store of the patterns sent out from the keyboards. The translator recognises when the operator has completed a postcode and converts it into a pattern of 28 binary digits (bits). This 28 bit answer is then transmitted to the coding desk. Once this answer is received the coded letter is moved on to the print position.

Because the code marks are indelible the letter is held for a time in a cancel position so that the operator has time to correct any mistake before the irrevocable printing step is taken.

The information received by the translator on the code pattern to be printed applies to the letter held in the "cancel" position and must be remembered until the letter is printed. Thus two translations must be stored in the desk and kept in synchronisation as the letters pass through. From being first presented in the display window to printing the average time the letter spends in the coding desk is two seconds.

After printing, the letter is ejected and collected and stacked automatically before being passed through the sorting machine. (In delivery offices postcoded letters arriving from other offices have already been through the coding desk stage at the previous office and are simply sorted automatically down to street or single address level. Here the last part, or "inward" code is used).

THE LETTER SORTING MACHINE

Like the coding desk and ALF the sorting machine (see Fig. 4) is fed letters in stacks and has first to separate them into a stream of spaced letters. They are then passed under UV lamps to generate the glow from the imprinted code-marks which are detected by the code-mark reader.

In the reader the row of marks on the letter pass a narrow slot behind which is a photo-multiplier tube which "recognises" each mark it sees by the increased current caused in the tube. The coded marks are read and stored in the sorting machine's memory. The code is fed into a second electronic translator which returns a 15-bit pattern identifying the box to which the letter should be routed.

ROTATION

The machine continues to store the translation and passes it on in stages for every two inches of letter travel. About three feet after passing the code-reader the letter is rotated through 90 degrees to travel the remainder of the machine with its longest edge forwards.

Just before the right-angle rotation a photo-electric beam is broken to give an exact positional reference of the letter within the machine. The original code-mark translation continues to be passed on its stages while the machine keeps track of the letter. When it arrives at the appropriate sorting box the box is opened and the letter has been sorted.

If the sorting machine is being used for outward mail (that is letters which are to go on to another sorting office) the letters are taken from the boxes, bundled and sent on by road or rail in the normal way. If the machine is sorting letters which are to be delivered in the sorting office area (inward mail) the letters are taken from the boxes and prepared for actual delivery by the postman on his round.

SYNCHRONISATION

All three of the machines described in this article, ALF, the coding desk and the sorting machine, must perform the required operation on each letter passing through the machine at the correct relative time.

To achieve this on the sorting machine and ALF it is necessary to pick up a signal to keep the electronics in synchronisation with the machine and hence the letters moving through it. This is achieved

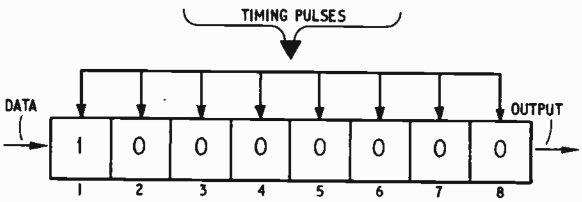


Fig. 5a. Diagrammatic representation of a shift register. The timing pulses cause the data held in each of the bistables to be shifted one place to the right

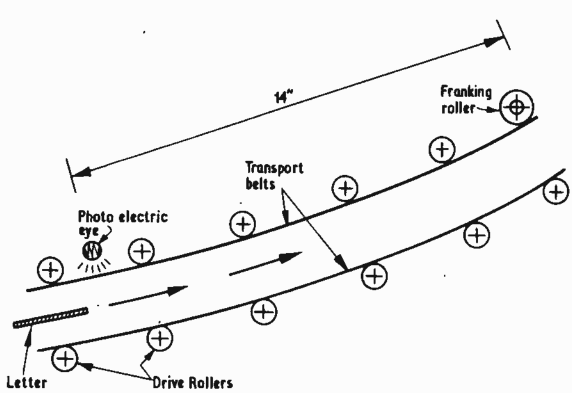


Fig. 5b. After eight shifts the letter will have reached the franking roller and a logic 1 in position 8 of the shift register causes the stamp to be cancelled

by shining a light beam through a series of holes drilled around the perimeter of a wheel driven by the machine's transport belts. A phototransistor is illuminated by the beam whenever a hole passes. The current changes in the phototransistor are detected and used to generate timing pulses which step data through electronic models of the machines and hence control the letter flow.

All the control functions of the machines follow a simple scheme. Somewhere on the machine some characteristic of the letter is inspected and the signals generated are converted to logic voltages. From this information a decision is taken as to which of a number of operations the letter should undergo. However the alternative operations may be carried out some distance down the machine and it is necessary to keep track of the letter and its data until the point of operation is reached.

SHIFT REGISTER

This letter tracking is achieved by storing the data in a shift register and moving it one place down the machine for each timing pulse received. Thus on the sorting machine and ALF each stage of the shift register represents information associated with a letter whose leading edge is in a particular 2in length of belt.

At some later stage on the machine, where the operation has to be carried out, the associated shift register stage can be looked at electronically to detect when the letter is present and then indicate the operation. The word carried down the shift register varies in complexity from a single bit on part of ALF indicating whether or not a letter has to be turned over, to the 15 bits identifying the sorting machine outlet.

The Shift Register has a vital role to play in postal machines; repeatedly information is collected some distance from the position where action is taken on it.

In simple terms, let the figure represent an 8 stage shift register which represents the occupancy of 16 inches of a machine's transport belts. When no letters are present all the stages of the shift register are at logic "0" (Fig. 5a). A photo-electric eye detects the leading edge of a letter and marks the first stage of the shift register at logic "1" so it now reads 100 000 00. Each timing pulse from the machine passes the information on stage down the register. So, after 7 pulses, stage 8 alone will be marked 000 000 01 if no more letters have entered this section of belt.

A logic circuit is used to detect stage 8 being switched to logic "1" and causes the franking roller (14 inches from the photoelectric eye) to operate, cancelling the stamp (Fig. 5b).

Shift registers can be made to carry much more information and this need not all be collected at the same time.

ELECTRONIC CIRCUITS

From the "job descriptions" of the machines involved in automated mail handling it is clear that they rely heavily on electronics for both machine timing control and data storage.

All the electronic circuits required are constructed from components soldered onto small plug-in printed circuit boards. The components used—silicon planar epitaxial diodes and transistors, metal oxide resistors and polystyrene capacitors—are all highly reliable. However reliable, of course, some failures are inevitable, in which case a new circuit can readily be inserted in exchange.

Many thousands of these circuits are in use by the Post Office throughout the country. Although more than a hundred different circuits have been developed for various tasks, perhaps a dozen commonly-used circuits form some 90 per cent of the total.

DIGITAL LOGIC

Most of these common circuits are digital logic circuits requiring inputs of either +6·6 volts (logic "0") or 0 volts (logic "1") and giving outputs at the same levels. Some of the circuits, however, have to interface between the logic system and the electromagnetic devices used to control the machine. One of these gives a logic output when the current in a phototransistor exceeds a certain level; another has to apply voltage to a load device (which could be a diverter or print pin solenoid) whenever its input is at 0 volts. However, not all circuits operate with logic levels at either input or output.

DOLLILOG

The range of logic circuits is often referred to as "Dollilog". This name derives from "Dollis Hill Logic" after the PO Research Station at Dollis Hill where the system was developed.

Some of the more common Dollilog circuits are described briefly in the following paragraphs together with some ideas on how they are used.

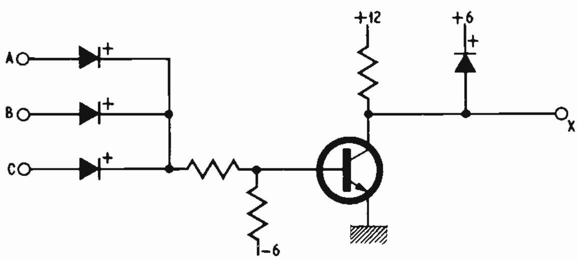


Fig. 6. Circuit diagram of a three input NAND gate used in the Dollilog system

NAND GATE

The diagram (Fig. 6) shows a three input NAND gate. The output (X) of this circuit will be at the logic "0" voltage (+6·6 volts) only if all three of the inputs (A, B and C) are at the logic "1" voltage (0 volts). In this case the transistor will be cut off.

If any one of the inputs is at the logic "0" voltage the transistor will be saturated and the output will be at the logic "1" voltage.

The NAND gate can be used to detect when several different conditions occur simultaneously and cause some process to be carried out.

Other logic circuits are used, one of which only gives the logic "1" output voltage when all three inputs are at logic "0", this being a NOR gate. Another circuit gives a logic "1" if both inputs are the same.

SCHMITT TRIGGER

The Schmitt trigger has two outputs which are never the same. The outputs states interchange when ever an input voltage exceeds one threshold or falls below another.

POWER AMPLIFIER

The power amplifier's output transistor will be saturated whenever the input to the circuit is at logic "1". The usual circuit can control loads of up to 25 watts although other high power versions exist.

BISTABLE MULTIVIBRATOR

The bistable multivibrator is another circuit which has two outputs which are always opposite. The outputs are switched by pulses applied to "set" and "reset" inputs. Bistables can be used to store information.

SHIFT REGISTER

Shift registers are arrays of bistables with a common clock input which can be pulsed to step data along the register.

NEW TECHNOLOGY

To some readers, these circuits will look a little dated. To some extent this is true; it must be remembered, however, that the system has proved satisfactory in use. The Post Office has to consider any change on this scale very seriously. Various factors have to be considered such as replacement cost, the cost of training maintenance engineers in any new system and the compatibility of any new equipment with the old.

At present, many new techniques are being tried and tested. The coding desk keyboard contains a number of DTL integrated circuits while the new memory which will replace the sorting machine's original mechanical memory is being developed using MOS integrated circuits. A new translator uses small general purpose computers rather than specially built electronic circuits. At present, however, only the relatively cheap keyboard, where size is critical, uses integrated circuits in a production item.

★

The Sinclair Cambridge...
no other calculator is so powerful and so compact.

Complete kit-£24·95! (PLUS VAT)

The Cambridge – new from Sinclair
The Cambridge is a new electronic calculator from Sinclair, Europe's largest calculator manufacturer. It offers the power to handle the most complex calculations, in a compact, reliable package. No other calculator can approach the specification below at anything like the price – and by building it yourself you can save a further £5·50!

Truly pocket-sized
With all its calculating capability, the Cambridge still measures just $4\frac{1}{2}$" x 2" x $\frac{11}{16}$". That means you can carry the Cambridge wherever you go without inconvenience – it fits in your pocket with barely a bulge. It runs on ordinary U16-type batteries which give weeks of life before replacement.

Easy to assemble
All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

The cost? Just £27·45!
The Sinclair Cambridge kit is supplied to you direct from the manufacturer. Ready assembled, it costs £32·95 – so you're saving £5·50! Of course we'll be happy to supply you with one ready-assembled if you prefer – it's still far and away the best calculator value on the market.

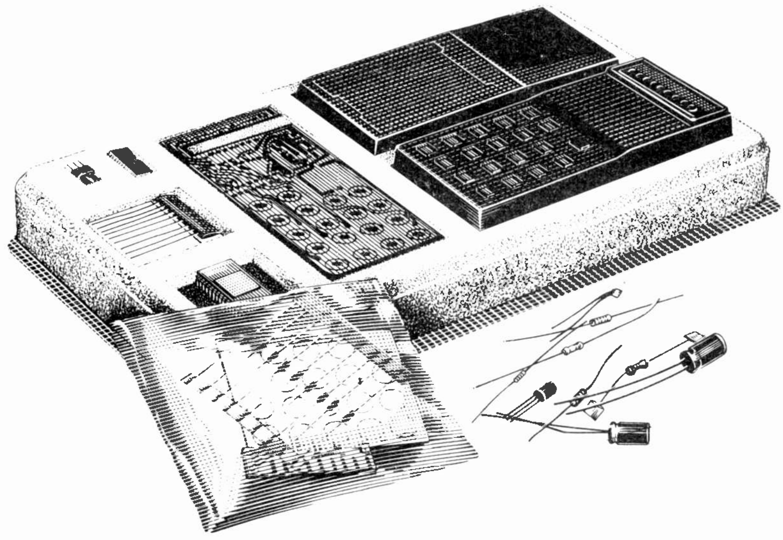
Features of the Sinclair Cambridge
- Uniquely handy package. $4\frac{1}{2}$" x 2" x $\frac{11}{16}$", weight $3\frac{1}{2}$ oz.
- Standard keyboard. All you need for complex calculations.
- Clear-last-entry feature.
- Fully-floating decimal point.
- Algebraic logic.
- Four operators (+, −, x, ÷), with constant on all four.
- Constant acts as last entry in a calculation.
- Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £30.
- Calculates to 8 significant digits, with exponent range from 10^{-20} to 10^{79}.
- Clear, bright 8-digit display.
- Operates for weeks on four U16-type batteries. (MN 2400 recommended.)

A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge.
Assembly time is about 3 hours.

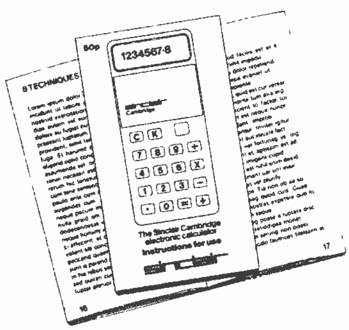
Contents:

1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.



How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations like:

Logs	Sines	Cosines
Tangents	Reciprocals	nth roots
Currency conversion	Compound interest	

and many others . . .

sinclair

Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire
Reg. no: 699483 England
VAT Reg. no: 213 8170 88

Why only Sinclair can make you this offer
The reason's simple: only Sinclair – Europe's largest electronic calculator manufacturer – have the necessary combination of skills and scale.

Sinclair Radionics are the makers of the Executive – the smallest electronic calculator in the world. In spite of being one of the more expensive of the small calculators, it was a runaway best-seller. The experience gained on the Executive has enabled us to design and produce the Cambridge at this remarkably low price.

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 60 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
And *you* benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £24·95 + £2·50 VAT. (Total: £27·45)
Price fully built: £29·95 + £3·00 VAT. (Total: £32·95)

PE/11/73

To: Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire, PE17 4HJ

Please send me

☐ a Sinclair Cambridge calculator kit at £24·95 + £2·50 VAT (Total: £27·45)

☐ a Sinclair Cambridge calculator ready built at £29·95 + £3·00 VAT (Total: £32·95)

*I enclose cheque for £_____, made out to Sinclair Radionics Ltd, and crossed.

*Please debit my *Barclaycard/Access account. Account number ________

*Delete as required.

Name ________________

Address ________________

PLEASE PRINT

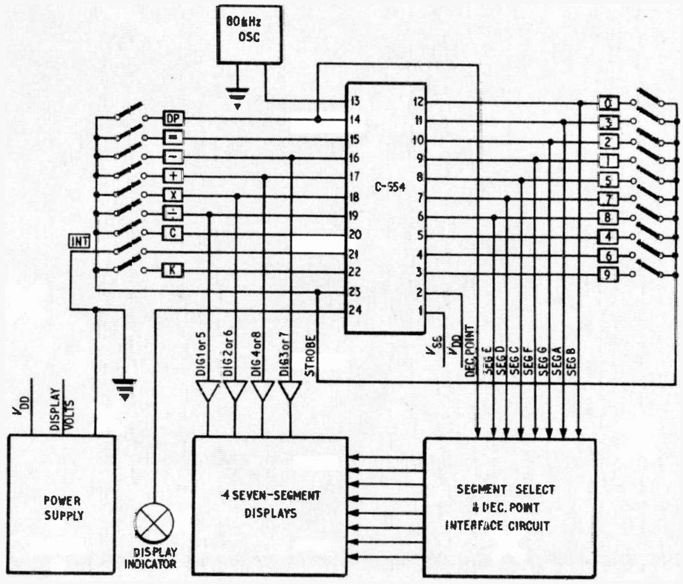


Fig. 1. Block diagram of a four digit calculator using the C554 integrated circuit

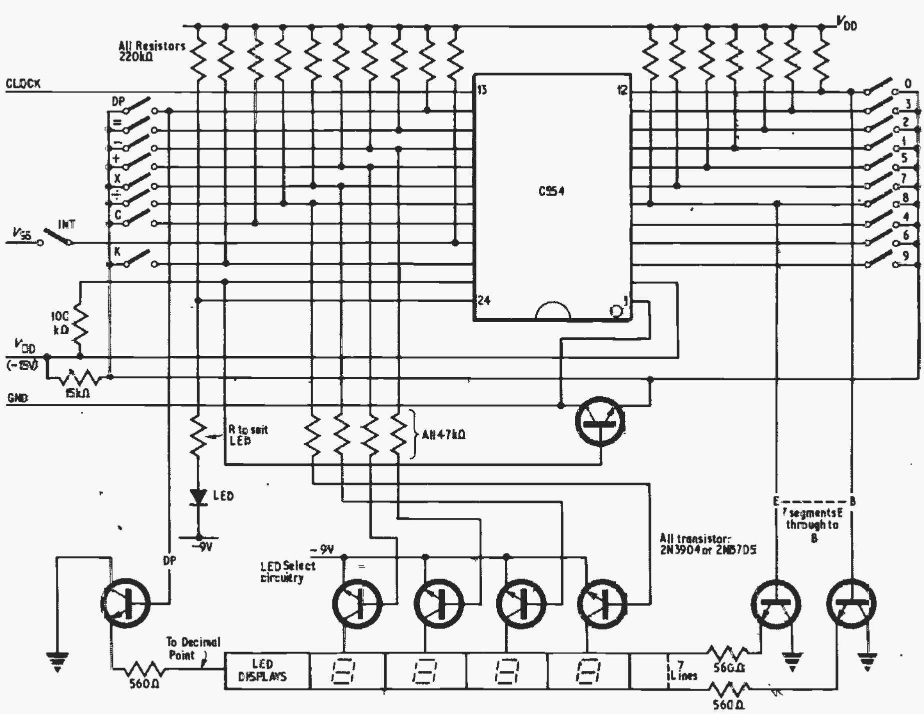


Fig. 2. A more complete circuit diagram showing l.e.d. seven segment display with all the necessary driver transistors. All voltages are with respect to the V_{SS} line

DEVICES ...APPLICATIONS

FOUR DIGIT MOS CALCULATOR I.C.

It seems only a short while ago that we were all impressed by the technology needed to put a complete calculator on one chip, yet already General Instrument Microelectronics have developed a second generation M.O.S. calculator integrated circuit. The main advantage of the new device is greatly reduced power consumption, this being made possible by reducing the necessary supply voltage from 25 volts to 15 volts.

The new calculator i.c.s, type C550 and C554, enable either eight (C550) or four (C554) digit calculators to be built. The reduction in power supply voltage is made possible by the use of new materials. The new process is called General Instrument Advance Nitride Technology (GIANT). Reduction of power supply voltage reduces chip consumption to a mere 150mW.

FOUR DIGIT CALCULATOR

Since eight digit calculator i.c.s are most widely used the more unusual four digit i.c. (C554) will be described. This calculator needs only a four digit display so is much cheaper and probably just as useful as the eight digit type.

Fig. 1 shows the block diagram of a calculator built around the C554. All switches would be contained on a keyboard. Some of the connections to the i.c. are used both as inputs and outputs, this being done to keep the pin count down to 24. The i.c. is driven by an 80kHz clock generator.

The i.c. generates a strobe pulse at pin 23 which is fed to all the keyboard contacts except the interchange (INT) switch. If any of the keyboard contacts are closed during the strobe pulse then the appropriate input will be fed to the i.c. The strobe pulse only occupies a very small proportion of the total clock period, the rest being used to display the output.

DISPLAY

A multiplexing system is used for the output whereby each of the four digits is selected in turn. A seven segment output is generated on the same lines used as numerical inputs (pins 6 to 12) as well as decimal point information. The display can be any seven segment type such as l.e.d., liquid crystal or hot filament; the driver (interface) circuit is the only thing that needs changing.

Fig. 2 shows a more detailed circuit diagram using l.e.d. seven segment displays and single transistor drivers. The 220kΩ resistors are needed because the MOS output transistors are "open drain" types. All voltages are specified with respect to the V_{ss} level. The 560Ω resistors are simply to limit the current through the l.e.d.s and the 4·7kΩ resistors are to limit the transistor base current.

INTERCHANGE SWITCH

One point that has not been so far explained is the interchange switch labelled INT. The C554 has been described as a four digit device in that it only displays four digits at a time but, in fact, it can accept up to eight digit inputs and produces an eight digit output. The interchange switch interchanges the two sets of four digits so that more accurate answers may be obtained if desired. The l.e.d. shown indicates which of the groups is being displayed. The decimal point appears in whichever group is appropriate: if the decimal point does not occur in the group being displayed it will be obvious as all the decimal points on all four digits will be illuminated.

As mentioned earlier the C554 needs a 15V power supply and an 80kHz clock input. Both of these needs can be satisfied with the circuit shown in Fig. 4. An oscillator generates the 80kHz clock pulses and its output is fed to a regulator which gives 15V at up to 10mA.

USING THE CALCULATOR

The C554 can perform all the normal arithmetic operations: addition, subtraction, multiplication and division. The true sign of answers is given if the result is negative the minus sign replacing the most significant digit so that only three digits are available.

There is a single CLEAR key which can be used to clear either the complete calculator or the last entry. If the depression of the CLEAR key is followed by pressing a function key, only the last entry will be cleared; if a digit key is pressed then the whole calculator will be cleared.

There is a CONSTANT facility whereby a result of a calculation might be stored to be used after the entry of another number. The constant store can hold a multiplier, divisor, subtrahend or addend.

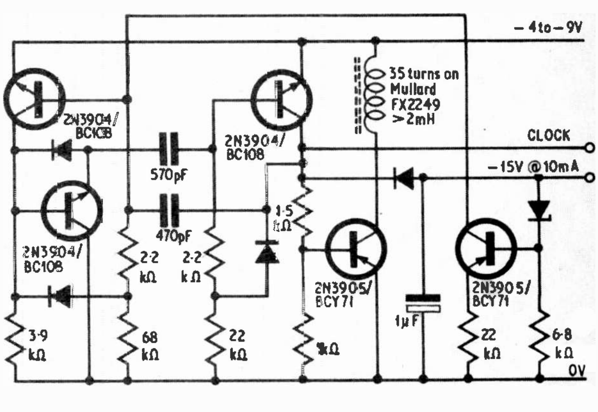


Fig. 3. A power supply and clock generator for the C554 i.c. which is all that is needed to complete the calculator in Fig. 2

Semiconductor TESTER

BY J. H. PERKIN

FOLLOWING the circuit description last month the construction of the semi-conductor Tester will be described.

CONSTRUCTION

Most of the components are mounted on 0·15in matrix Veroboard measuring $3\frac{3}{8}$in × $1\frac{1}{4}$in. Breaks in the copper strips should be made as shown in the Veroboard layout of Fig. 7.

The positions of the components are shown the reverse of Fig. 7, but the layout is not critical. The resistors and capacitors are mounted first, remembering to connect the electrolytic capacitor C6 (2μF) the correct way round i.e. +ve to +ve. The component leads are fed through the Veroboard holes and bent so as to lie along the copper strips. The leads are then cut so that about 0·1in of lead remains on the copper strip, and then the leads are carefully soldered to the strip.

The transistors and diodes are mounted last, care being taken not to overheat the leads as this can cause component failure.

Meter face

The meter face should be modified to include all the numbers in Fig. 8. Letraset can be used for this purpose.

Case and component interconnections

The case used was a 18cm × 15cm × 13·5cm West Hyde MOD303.

The lettering on the front panel may be done using Letraset. The components are then mounted on the front panel and the connections shown in the circuit diagram are made. Use a different coloured wire for each connection link if possible for simplicity.

Connect one male battery connector to a female battery connector by 4in of wire for the battery "jumper" lead.

VEROBOARD PANEL

Printed Circuit Supporting Bracket

The bracket used to support the Veroboard panel may be made from aluminium sheet, 22 s.w.g. being quite suitable.

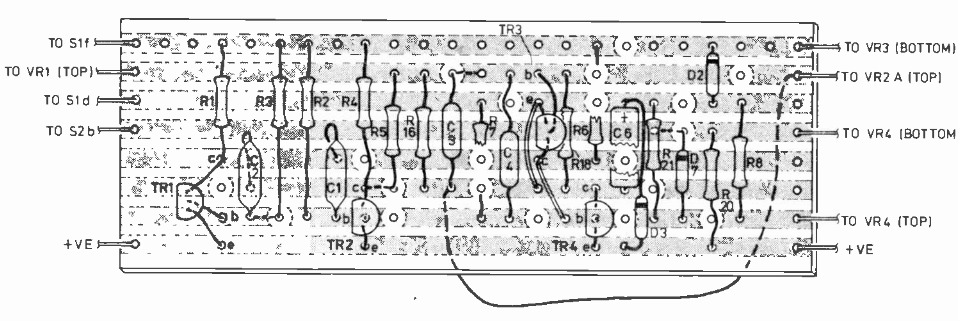


Fig. 7. Layout of the components on the Veroboard panel

Two holes should be made in the Veroboard panel to align with holes made in the bracket.

The batteries are retained in the case in the prototype using one piece of 1in wide elastic which is 8·5in long. Each end of the elastic is secured to the base of the case by a 4BA bolt, and nuts. The feet supplied with the case are now stuck to the base of the case. The test leads are made as shown in Fig 9, each lead being about 60cms long.

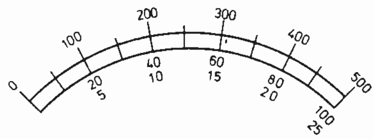


Fig. 8. The modified meter face

TESTING

Testing may be accomplished as follows, the components being tested are listed at the beginning of each test to facilitate fault finding by beginners.

1. S3, Batteries, S1A, S1B, S1C, R9, D4, D5, 52A, 52B, 526, ME1, R14, S4. Socket leads C and E.
   (a) Set METER switch to I_{ceo}, DEVICE switch to PNP, and ON/OFF switch to ON:—meter should indicate zero.
   (b) Connect a resistor of approximately 50 kΩ between leads C and E:—meter should read approximately $200\mu A$.
   (f.s.d. = 10mA).
   (c) Depress F.S.D. ÷ 20 switch:—meter should read approximately $200\mu A$.
   (f.s.d. = 0·5mA). Release F.S.D. ÷ 20 switch.
   (d) Set DEVICE switch to NPN and repeat 1(b) and 1(c).
   (e) Connect lead C to lead E:—meter should read approx. 10mA (f.s.d. = 10mA).
   (f) Set (METER switch to I_c and repeat (e).
   (g) Disconnect lead C from lead E:—meter should read zero.
   Switch OFF tester.
2. R1 to 6, R16, R21, R18, R17, VR2A, C1, C2, C3, C6, D3, D7, TR1 to TR4, S1F, S2A, 52C, Meter, R7, C4.

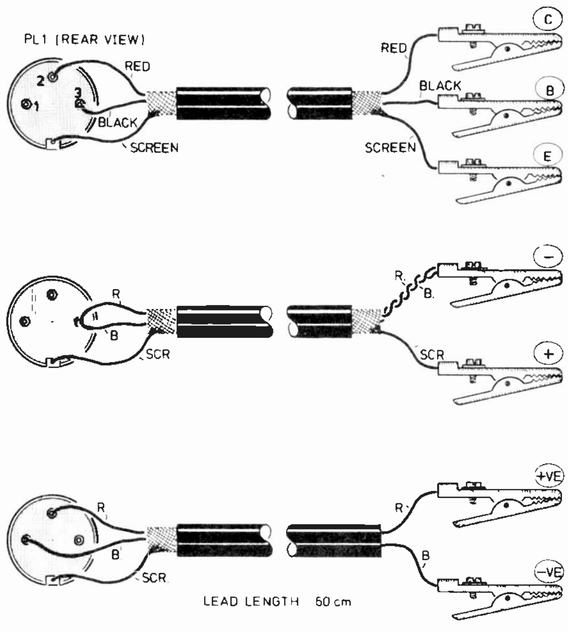
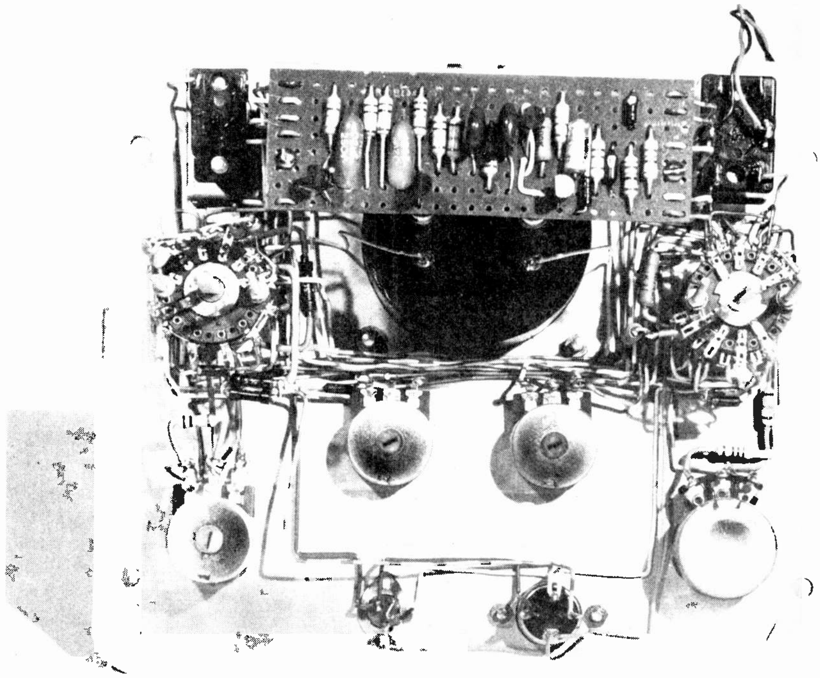
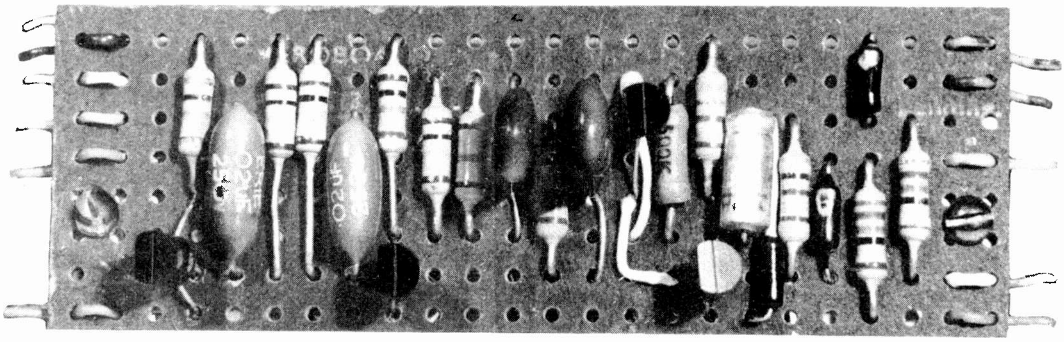


Fig. 9. Transistor, CSR and diode leads



Rear view of the front panel of the Semiconductor Tester



Photograph of the components on the Veroboard panel

(a) set METER switch to h_{fe}, DEVICE SWITCH TO PNP, ON/OFF switch to ON:—meter should read approx. f.s.d. If meter reading is somewhat less than f.s.d. decrease value of R16, if meter reading is greater than f.s.d. increase value of R16.
(b) Set DEVICE switch to NPN:—meter reading should remain as in 2 (a). Switch tester OFF.

3. VR1, R15, R19, C3, R22, S1E, S2D, VR2B, R10.
(a) Connect a "working" transistor to the transistor socket SK1 or the "Flying Leads" lead C to collector, lead B to base, and lead E to emitter. Set METER switch to I_c, DEVICE switch to PNP or NPN depending on transistor type, set SET I_c to min, switch ON tester:—meter reading should increase as SET I_c control is turned from min. to max. Adjust SET I_c so that the meter current is 2mA (f.s.d. = 10mA).
(b) Set METER switch to h_{fe} and adjust h_{fe} control:—it should be possible to find a position where the meter deflection is a minimum. Switch OFF tester and remove the transistor.

4. S1F, LP1, D2, R8, VR4, R20, VR3, D1, R11, S2A, R13, R12, S2C, S4, S2B, S1E, R22, S2D, D6, R23, leads b.
(a) Set DEVICE switch to THY ZEN UJT V, METER switch to THY GATE 1, turn SET I to max. and SET V to min. short leads B and C, switch ON tester and adjust SET V from min. to max.:—meter reading should increase from zero to approx. ¾ f.s.d.
(b) Set SET V to min, depress and hold F.S.D. ÷ 20 switch and adjust SET V for f.s.d., release F.S.D. ÷ 20 switch:—meter should now be 1/20 of f.s.d. Remove short between leads B and C, switch OFF tester.
(c) Set METER switch to THY GATE V, switch ON tester, adjust SET V from min. to max:—meter reading should decrease from 12V to 0V (f.s.d. is 25V).
(d) Set METER switch to THY HOLD I, turn SET I to min, short leads C and E, and increase SET I from min. to max:—meter reading should increase to approximately f.s.d. when lamp L1 should be lit.
(e) Set SET I to min., depress and hold F.S.D. ÷ 20, increase SET I control until meter reads f.s.d., release F.S.D. ÷ 20:—meter should read 1/20 f.s.d.

OPERATING INSTRUCTIONS

Transistor testing

1. Connect transistor to socket SK1 or to flying leads, E to emitter B to base, C to collector.
2. Set DEVICE to PNP or NPN depending on transistor type).
3. Set METER switch to I_{ceo}, switch tester ON—meter shows I_{ceo} (f.s.d. 10mA). Operate F.S.D. ÷ 20 if required.
4. Set METER switch to I_c.
5. Adjust SET I_c control for required I_c on meter (f.s.d. 10mA).
6. Set METER switch to h_{fe}.
7. Adjust h_{fe} control for minimum reading. The h_{fe} is indicated on h_{fe} scale.

Diode Testing

1. Connect to socket SK1 on to flying leads of transistor lead. E to anode and C to cathode.
2. Set METER switch to I_{ceo}.
3. Set DEVICE switch to PNP, switch TESTER ON meter shows forward current (f.s.d. 10mA) RF = $\frac{12000}{I_f \text{ (in mA)}} - 1200$.
4. Set DEVICE switch to NPN—meter shows reverse current
$R_R = \frac{12000}{I_R \text{ (in mA)}} - 1200$ (F.S.D. ÷ 20 may be used if required

Zener Diodes (0-10V)

1. Connect diode to socket SK1 or to flying leads of transistor lead. C to cathode E to anode, connect lead B to lead C.
2. Set DEVICE switch to THY ZEN UJT V.
3. Set SET V to min.
4. Set SET I to min.
5. Switch METER switch to THY GATE V/V, switch tester ON—meter reads Zener voltage (f.s.d. = 25V).
6. Adjust SET I from min. to max. meter reading should only change by a small amount. This check gives a rough indication of the a.c. resistance of the diode. (The current through the diode

at any point can be found by setting meter switch to THY HOLD I, I.

Note that for Zener voltages in excess of 10V it is necessary to insert a battery of known voltage between the emitter lead of the Zener diode and lead E of the tester, then Zener Voltage = meter reading + battery voltage.

Thyristor Testing

1. Connect the thyristor to SK1 or to the flying leads of the transistor testing lead anode to E, cathode to C, Gate to B.
2. Set SET V to min.
3. Set SET I to max.
4. Set DEVICE switch to THY ZEN. UJT. V.
5. Set METER switch to THY GATE I, switch tester ON.
6. Adjust SET V slowly clockwise noting the meter current. When the lamp L1 lights (thyristor conducting). Use FSD ÷ 20 if required. Meter reading to gate trigger current.
7. Set SET V to min.
8. Switch tester OFF then ON—lamp L1 should extinguish indicating that thyristor has reset.
9. Set METER switch to THY GATE V—meter indicates supply voltage.
10. Adjust SET V slowly clockwise—meter reading slowly falls then suddenly drops to zero, note the voltage (trigger voltage) at which the meter reading suddenly falls.
    Gate trigger voltage = Supply voltage —trigger voltage
11. Set SET V to min.
12. Set METER switch to THY HOLD I, I.
13. Adjust SET I from max. to min. and note the point at which the meter current falls to zero, this current is the thyristor holding current. (F.S.D. ÷ 20 may be used if required).

Unijunction transistor testing

1. Set DEVICE switch to THY, ZEN, UJT, V.
2. Set METER switch to THY GATE V, V.
3. Set SET V to min.
4. Connect unijunction to SK1 on to flying leads Base 1 to C, Base 2 to E, Emitter to B.
5. Switch tester ON.
6. Adjust SET V (noting decrease in meter voltage reading until meter "kicks" when:—

$$\text{Intrinsic Standoff ratio} = \frac{\text{decrease in meter voltage}}{\text{maximum meter voltage}}$$

Using tester as a Voltmeter

1. Set DEVICE switch to PNP.
2. Set METER switch to THY GATE U, V.
3. Connect voltmeter lead to voltage to be measured

Using tester as an Ammeter (f.s.d. = 100mA or 5mA).

1. Set METER switch to THY HOLD I, I.
2. Connected current lead to current source (F.S.D. ÷ 20 may be used if required). ★

INDUSTRY NOTEBOOK

By Nexus

TOUGH FIELD

It takes a lot of guts to take on the big boys, especially in a field as tough as mobile radiotelephones. This is the field where household names like Cossor, Ultra and STC have all chucked in the sponge within the past year or so.

Pye is still undisputed market leader and Burndept, strengthened by the acquisition of Cossor and Ultra business, is second. The question is whether Dymar can succeed when better-known companies have failed?

I can report that there was no lack of confidence in the Dymar management when the company launched its new 'Lynx' range of mobiles on September 12. For one thing the Lynx, with a 20W output, has a technical edge on the competition and Dymar has prepared the sales ground well by appointing a nation-wide network of distributors and service centres.

Although Dymar as a name is not yet well known, the company has a huge back-log of experience in both design and manufacture of mobile radio. To date, Dymar has produced 30,000 mobile equipments of which half have been made under contract to other companies' designs and about 7,500 have been land or marine mobiles of Dymar's own design and manufacture.

Approximately £150,000 has been invested in the Lynx development and it could be a real winner. In fact the company expects no less than half the total 1974 turnover in Lynx with the other half split 35 per cent in marine radiotelephones, and 15 per cent in instruments of which Dymar make a range for manufacture, testing and servicing of r.f. systems.

SATELLITE NAVIGATION

While Dymar was launching Lynx in Whitehall, Redifon was launching a marine satellite navigation receiver half-a-mile away in the Strand.

The Redifon Satellite Navigator is another milestone along the road forecast by J. R. Brinkley when, earlier this year, he said the company was now fully committed to a huge modern technology programme to win a large share of the communications and navigation markets. It was on that occasion that he was able to announce that the Redifon Omega Navigator had already been fitted to 100 ships and had realised £0·5 million in revenue.

What industry observers are waiting for now is the Redifon v.h.f./u.h.f. programme. No hardware has yet been announced although R and D expenditure in this area is said to be £100,000. As part of the expansion programme a new plant is under construction in Wales which could ultimately house 1,000 workers.

BATTLE CONTINUES

The light-emitting-diode battle continues with increasing intensity. Ferranti's new green LED's are reported to be coming out of the factory at 1·5 million a year now, stepping up to a rate of 10 million a year by the Spring of '74.

Plessey's Optoelectronics and Microwave Unit at Towcester is also in on the action with a new yellow gallium phosphide device which is claimed to have a higher light output and spot brightness than any other solid state light source currently available. The Towcester Unit is also offering custom-built hybrid arrays in green, yellow and red, a typical array recently produced for a customer having 32 diodes. They are assembled and encapsulated on a metallised ceramic substrate which can include dropping resistors if required.

INSTRUMENTS—A HARD LIFE

The instrument industry is struggling back to life after three years in the doldrums. Renewed activity springs from the big investment programmes now being undertaken by many major user companies.

But the instrument business is no sinecure. John Ceresa, marketing director of Racal Instruments, recalls that 13 years ago a 10MHz counter cost £400. By 1970, in ten years, the price had dropped 75 per cent for the same instrument in a solid state version and with much improved performance and reliability. You then found you had to sell four times as many to make the same turnover and maybe eight times as many to make the same profit.

Another angle on the life and hard times of instrument men comes from David George, managing director of SE Laboratories, one of the companies who have been through a bad patch. He says it is suicidal for any company to try to compete in every generation of instruments. One of the ways of cutting R and D costs is to do a deal with a complementary manufacturer elsewhere in the world. SE Labs has actually done this with Data Precision Corporation in USA.

I note with interest that even Tektronix with a near stranglehold on the top end of the oscilloscope market is finding it hard to expand any further without diversifying into other fields. Although the oscilloscope market shows no signs of a decline—it is still growing at least 10 per cent a year—Tektronix has moved into programmable calculators and more recently has acquired a Californian Company which specialises in TV studio equipment.

AD-POWER WORKS!

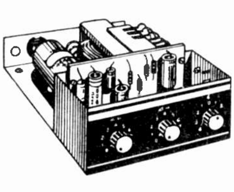
Just when you think there are no surprises left in the industry you encounter another. I had this experience when I visited Kingshill Electronic Products who make professional quality power supplies for the universities, the Government, and the industry in general. The company is a subsidiary of Islington Metal and Plating Works Ltd., one of the pioneers of chromium plating nearly 50 years ago. The electronics off-shoot was started in 1964 by Dr. Henry Herbst who still sits in the managerial chair. His sort of company would normally have a flock of travelling salesmen chatting up potential customers and a sales programme involving appearances at major electronic exhibitions.

Not Kingshill. Herbst has never had a salesman on the road, has never shown at an exhibition. Kingshill sells on press advertising and personal recommendation. It seems to work. The production lines turn out 18,000 units a year which not only go to U.K. users but also to out-of-the-way places like Fiji and Thailand.

The premises were a surprise, too. They were originally stables for the horses of the old London horse-drawn trams. Not so unexpected is that Herbst, with a solid business now established in power supplies and a firm economic base from which to operate, is looking for new electronic fields to conquer.

PRICES NOW INCLUDE VAT

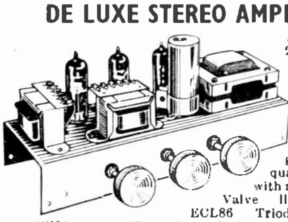
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13W r.m.s. into 8 ohm. Frequency response 12Hz—30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3in high × 6in wide × 7½in deep. A.C. 200/250V.

PRICE £11·60 P. & P. 40p.

DE LUXE STEREO AMPLIFIER



A.c. mains 200-240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300mv for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. **Price £9·90.** P. & P. 50p.

NEW! POWER SUPPLY UNIT

200/240V A.C. input. Four switched fully smoothed D.C. outputs giving 6V and 7½V and 9V and 12V at 1 amp continuous (1½ amp intermittent). Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case, overall size 6" × 3¼" × 2½". Suitable for Transistor Radios, Tape Recorders, Amplifiers, etc., etc. Ready built and tested.

PRICE £5 P. & P. 35p.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2⅞in × 3in approx. **28p** pair. P. & P. 6p.

HIGH GRADE COPPER LAMINATE BOARDS. 8" × 6", 5 for **55p**. P. & P. 23p.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 0-5-10-15-20-25-30-35-40-60V half wave at 1 amp or 10-0-10, 20-0-20, 30-0-30V, at 2 amps full wave. Size 3inL × 3½inW × 3inD. Price **£2·10.** P. & P. 40p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240V Sec. 9-0-9 at 500mA. £1 P. & P. 25p.
Pri. 200/240V Sec. 12-0-12 at 1 amp. **£1·10** P. & P. 26p.
Pri. 200/240V Sec. 10-0-10 at 2 amp. **£1·65** P. & P. 35p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER. For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9-18V. Battery or from H.T. line 200/300V. Frequency response 15Hz-25KHz. Gain 26dB. Solid encapsulation size 1½ × 1¼ × ⅝in. Brand new — complete with instructions. Price **£1.** P. & P. 15p.

3 REFERENCE ENCYCLOPEDIAS FOR ELECTRONIC ENGINEERS AND DESIGNERS, covering between them, transistor characteristics, diode and transistor equivalents. Many thousands of up-to-date European types listed.

Diode Equivalents	**80p**
Transistor Equivalents	**90p**
Transistor Characteristics	**£1·20**
All three together	**£2·60**

POST FREE

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
A must for servicemen and home constructors. Including many 1000's of British, U.S.A., European and Japanese transistors. ONLY **40p.** Post 5p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100μA for balance or tuning. Approx. size 1in × 1in × ⅞in. Limited number **88p.** P. & P. 12p.
NEW ISSUE—Thyristor, Triac, Diac, etc. encyclopedias **95p** Post Free

RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/C129 AUTOCHANGER UNITS. With latest stereo/mono compatible cartridge **£7·60** plus 50p P. & P.
Garrard SP25 Mk. III with heavy precision machined die cast turntable. **£10·56.** Carr. 55p.

PRECISION ENGINEERED PLINTHS

Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60, etc., or B.S.R. C109, C129, A21, etc. Black leatherette finish. Size 12¾in × 14¼in × 3½in high (approx. 7¼in high, including rigid smoked acrylic cover). P. & P. 70p. **Now only £4·95**

LATEST ACOS GP91/1SC Mono Compatible Cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50.** P. & P. 15p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus. Diamond Stereo LP and Sapphire 78. ONLY **£2·30.** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£2·80.** P. & P. 15p.
LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **£1·63.** P. & P. 15p.
LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono/stereo records on mono equipment **£1·50.** P. & P. 15p.

QUALITY RECORD PLAYER AMPLIFIER MK II
A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. × 3 d. × 6 h. Ready built and tested. PRICE **£4·40.** P. & P. 40p. ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£5·85.** P. & P. 60p.

SPECIAL OFFER!!

HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16in high × 10½in wide × 6in deep. Fitted with E.M.I. Ceramic Magnet 13in × 8in bass unit, two H.F. tweeter units and crossover. Max. power handling 10W. Available 3, 8 or 15 ohm impedance.

Our Price £9·25 Carr. 75p.

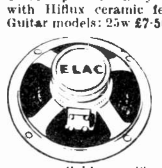
CABINET AVAILABLE SEPARATELY **£4·95.** Carr. 65p.
Also available in 8 ohm with EMI 13in × 8in. bass speaker with parasitic tweeter. **£7 15.** Carr. 75p.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240V. Supplied absolutely Brand New, completely wired and tested with good quality output transformer.

OUR ROCK BOTTOM BARGAIN PRICE £3·30 P. & P. 40p

LOUDSPEAKER BARGAINS
5in 3 ohm **£1·05**, P. & P. 15p. 7 × 4in 3 ohm **£1·15**, P. & P. 20p. 10 × 6in 3 or 15 ohm **£1·90**, P. & P. 30p. E.M.I. 8 × 5in 3 ohm with high flux magnet **£1·62**, P. & P. 20p. E.M.I. 13½ × 8in with high flux ceramic magnet with parasitic tweeter 3, 8, or 15 ohm **£3·50.** P. & P. 30p. E.M.I. 13 × 8in, 3 or 8 or 15 ohm with two inbuilt tweeters and crossover network **£4·65.** P. & P. 30p.
EMI CERAMIC MAGNET HEAVY DUTY TWEETER pprox. 3½in. Av. 3 or 8 or 15 ohms. **£1·25** plus 20p p. & p.
BRAND NEW. 12in 15w H/D Speakers, 3 or 15 ohm. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£7·50.** Guitar models: 25w **£7·50.** 35w **£9·35.** P. & P. 45p each.



SPECIAL OFFER!

LIMITED NUMBER OF BRAND NEW ELAC 10" TWIN CONE LOUDSPEAKERS. With large ceramic magnet and plasticised cone surround. 8 ohm impedance. **£2·70.** P. & P. 35p.

Also available specification as above but size 10" × 6" **£2·70** and size 8" round **£2·60** P. & P. 35p.
12in "RA" TWIN CONE LOUDSPEAKER
10 watts peak handling. 3, 8 or 15 ohm, **£2·45.** P. & P. 36p.
35 ohm SPEAKERS 3". ONLY **70p.** P. & P. 25p.
"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾in × 14 11/16in × 1 3/16in deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£6·55** each. P. & P. 34p.
VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price **85p yd.** length. P. & P. 25p per yd. (min. 1 yd.). S.A.E. for samples.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam ear-muffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30-15,000Hz. Matching impedance 8-16 ohms. Easily converted for mono. PRICE **£3·30.** P. & P. 25p.

HAVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT

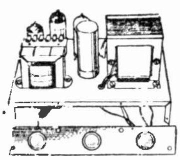
NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EVEN EASIER CONSTRUCTION

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

PRICES AMPLIFIER KIT,	**£11·55**	P. & P. 25p.
(Magnetic input components 33p extra)		
POWER PACK KIT,	**£3.30**	P. & P. 35p.
CABINET,	**£3·30**	P. & P 35p.

(Post Free if all units purchased at same time). Full after sales service. Also available ready built and tested, **£23·10.** Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.

3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£5·50.** P. & P. 45p.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£4·50.** P. & P. 45p.

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **15p** plus S.A.E. (Free with parts). **All parts sold separately.** ONLY **£8·80.** P. & P. 60p. Also available ready built and tested **£12·10.** P. & P. 70p.

Open 9-5.30 Mon. to Fri. 9-5 Sat. Early closing Wed. 1p.m.

A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.

Dept. PE, 170 High St., Merton, London, S.W.19 Tel. 01-540 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

CF

GIRO NO. 331 7056
C.W.O. only. P. & P. 10p on orders below £5
Discount: £10–10%, £20–15% (except net items)
Export Order enquiries welcome (VAT free)

Official Orders accepted from
Educational & Government Departments

ALL PRICES INCLUDE VAT

SPECIAL RESISTOR KITS

10E12 ¼W KIT: 10 of each E12 value, 10 ohms—1M, a total of 610 (CARBON FILM 5%), **£3·10 net**
10E12 ½W KIT: 10 of each E12 value, 10 ohms—1M, a total of 610 (CARBON FILM 5%), **£3·20 net**
25E12 ¼W KIT: 25 of each E12 value, 10 ohms—1M, a total of 1525 (CARBON FILM 5%), **£7·20 net**
25E12 ½W KIT: 25 of each E12 value, 10 ohms—1M, a total of 1525 (CARBON FILM 5%), **£7·35 net**
20E12 ½W KIT: 20 of each E12 value, 10 ohms—1M, a total of 1220 (METAL FILM 5%), **£7·50 net**
15E12 1W KIT: 15 of each E12 value, 10 ohms—1M, a total of 915 (METAL FILM 5%), **£8·15 net**
10E12 2W KIT: 10 of each E12 value, 10 ohms—1M, a total of 610 (METAL FILM 5%), **£12·65 net**

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. Mounting: 0·01µF, 0·015µF, 0·022µF, 0·033µF, 0·047µF, **3½p**. 0·068µF, 0·1µF, **4½p**. 0·15µF, **4½p**. 0·22µF, **5½p**. 0·33µF, **8p**. 0·47µF, **9p**. 0·68µF, **11p**. 1µF, **15p**. 1·5µF, **22p**. 2·2µF, **25p**.

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001µF, 0·0015µF, 0·0022µF, 0·0033µF, 0·0047µF, **2½p**. 0·0068µF, 0·01µF, 0·015µF, 0·022µF, 0·033µF, **3½p**. 0·047µF, 0·068µF, 0·1µF, **4½p**. 0·15µF, **6½p**. 0·22µF, **8½p**. 0·33µF, **12p**. 0·47µF, **14p**.
160V: 0·01µF, 0·015µF, 0·022µF, **2½p**. 0·047µF, 0·068µF, **3½p**. 0·1µF, 0·15µF, **4½p**. 0·22µF, **5p**. 0·33µF, **6p**. 0·47µF, **7½p**. 0·68µF, **11p**. 1µF, **12½p**.

MINIATURE CERAMIC PLATE CAPACITORS

50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8, (µF) 0·01, 0·015, 0·022, 0·033, 0·047, **2½p.** each. 0·1, 30V, **4½p**.; 0·1; 100V, **5½p**.

POLYSTYRENE CAPACITORS 160V 5%

(pF) 10, 15, 22, 33, 47, 68, 100, 150, 220, 330, 470, 680, 1000, 1500, 2200, 3300, 4700, **4p**. 6800, 10,000, **4½p**.

RESISTORS

CF—High Stab Carbon Film, 5% MF—High Stab Metal Film, 5%

W.	Type	Range	1-9	10-49	50-99	100-249	250-499	500-999	1000+	Size mm
¼	CF	22-2M2	1	0·8	0·65	0·62	0·55	0·5	0·45	3·9x10·5
½	CF	22-2M2	1	0·8	0·65	0·62	0·55	0·5	0·45	5·5x16
½	MF	10-2M7	1	0·9	0·8	0·7	0·65	0·65	0·6	3x7
½	MF	10-2M2	1	0·9	0·8	0·7	0·65	0·65	0·6	4·2x10·8
1	MF	10-10M	1·5	1·25	1·25	1·1	1	0·95	0·88	6·6x13
2	MF	10-10M	3	2·5	2·5	2	1·75	1·75	1·6	8x17·5

For value mixing prices, please refer to our catalogue (price in pence each)
VALUES AVAILABLE—E12 Series only.

PRESET SKELETON POTENTIOMETERS

MINIATURE 0·25W Vertical or horizontal **6p** each 1K, 2K2, 4K7, 10K, etc. up to 1M Ω
SUB-MIN 0·05W Vertical, 100 Ω to 220K Ω **5p** each

B. H. COMPONENT FACTORS LTD.

(P.W.) 61 CHEDDINGTON ROAD, PITSTONE, NR. LEIGHTON BUZZARD, BEDS, LU7 9AQ
Tel.: Cheddington 668446 (Std. Code 0296)
PLEASE WRITE FOR FREE CATALOGUE

Miniature Mullard Electrolytics

1·0µF	63V	6p	68µF	16V	6p
1·5µF	63V	6p	68µF	63V	12p
2·2µF	63V	6p	100µF	10V	6p
3·3µF	63V	6p	100µF	25V	6p
4·0µF	40V	6p	100µF	63V	14p
4·7µF	63V	6p	150µF	16V	6p
6·8µF	63V	6p	150µF	63V	15p
8·0µF	40V	6p	220µF	6·4V	6p
10µF	16V	6p	220µF	10V	6p
10µF	25V	6p	220µF	16V	8p
10µF	63V	6p	220µF	63V	21p
15µF	16V	6p	330µF	16V	12p
15µF	63V	6p	330µF	63V	25p
16µF	40V	6p	470µF	6·4V	9p
22µF	25V	6p	470µF	40V	20p
22µF	63V	6p	680µF	16V	15p
32µF	10V	6p	680µF	40V	25p
33µF	16V	6p	1000µF	16V	20p
33µF	40V	6p	1000µF	25V	25p
32µF	63V	6p	1500µF	6·4	15p
47µF	10V	6p	1500µF	16V	25p
47µF	25V	6p	2200µF	10V	25p
47µF	63V	8p	3300µF	6·4	26p

VEROBOARD

	0·1	0·15
2½ x 5"	28p	28p
2½ x 3¾"	26p	19p
3¾ x 5"	32p	33p
3¾ x 3¾"	28p	28p
2½ x 1"	7p	7p
2½ x 5" (Plain)	—	14p
2½ x 3¾" (Plain)	—	12p
5 x 3¾" (Plain)	—	22p
Insertion tool	59p	59p
Track Cutter	44p	44p
Pins, Pkt. 25	10p	10p

TRANSISTORS

AC127	16½p	BC212L	12p
AC128	22p	BC213L	12p
BC107	11p	BC214L	17p
BC108	12p	OC44	18p
BC109	13p	OC71	13p
BC148	12p	OC81	16p
BC149	12p	OC170	23p
BC182L	12p	TIS43	33p
BC183L	12p	2N2926	11p
BC184L	13p	2N3702	11p

POTENTIOMETERS

Carbon Track 5K Ω to 2M Ω, log or linear. Single, **16½p** Dual Gang **46p**. Log Single with DP switch **26p**

DIODES

IN4001	6½p
IN4002	7½p
IN4003	9p
IN4004	9½p
IN4005	12p
IN4006	14p
IN914	7p
IN916	7p
BA100	10p
OA5	42p
OA47	9p
OA81	11p
OA200	8p

PLUGS

DIN 2 Pin	12p
3 Pin	13p
5 Pin 180°	15p
Std. Jack	14½p
2.5mm Jack	11p
Phono	5½p

SOCKETS

DIN 2 Pin	10p
3 Pin	10p
5 Pin 180°	12p
Std. Jack	14½p
2.5mm Jack	11p
Phono	5½p

ELECTROLYTIC CAPACITORS. Tubular & Large Cans

(uF/V): 2·2/25, 2·2/63, 4·7/10, 4·7/25, 4·7/63, 22/10, 22/25, 22/63, **5p**. 2/10, 10/10, 50/10, 100/10, 10/25, 50/25, 10/50, **5½p**. 200/10, 100/25, 50/50, **6½p**. 500/10, 200/25, 100/50, **9p**. 1000/10, 500/25, 200/50, **11p**. 2000/10, 1000/25, 500/50, **16½p**. 1000/50, **39p** 1000/100, **66p**, 2000/25, **27p**. 2500/12, **17p**. 2500/25, **33p**. 2500/50, **62p**. 3000/50, **72p**. 5000/25, **66p**. 5000/50, **94p**. 7000/50, **60p**. 25,000/25, **74p**. HI-VOLT: 8/350, **14p**. 16/350, **19p**. 32/350, **25p**. 50/250, **18p** 100/500, **33p**.

METALLISED PAPER CAPACITORS

250V: 0·05µF, 0·1µF **4½p**, 0·25µF, **5½p**, 0·5µF, **6½p**, 1µF, **9p**.
500V: 0·025µF, 0·05µF, **4½p**. 0·1µF, **5½p**. 0·25µF, **6½p**. 0·5µF, **9p**.
1000V: 0·01µF, **10p**. 0·022µF, **12p**. 0·047µF, 0·1µF, **16p**. 0·22µF, **31p**, 0·47µF. **39p**.

Integrated Circuits

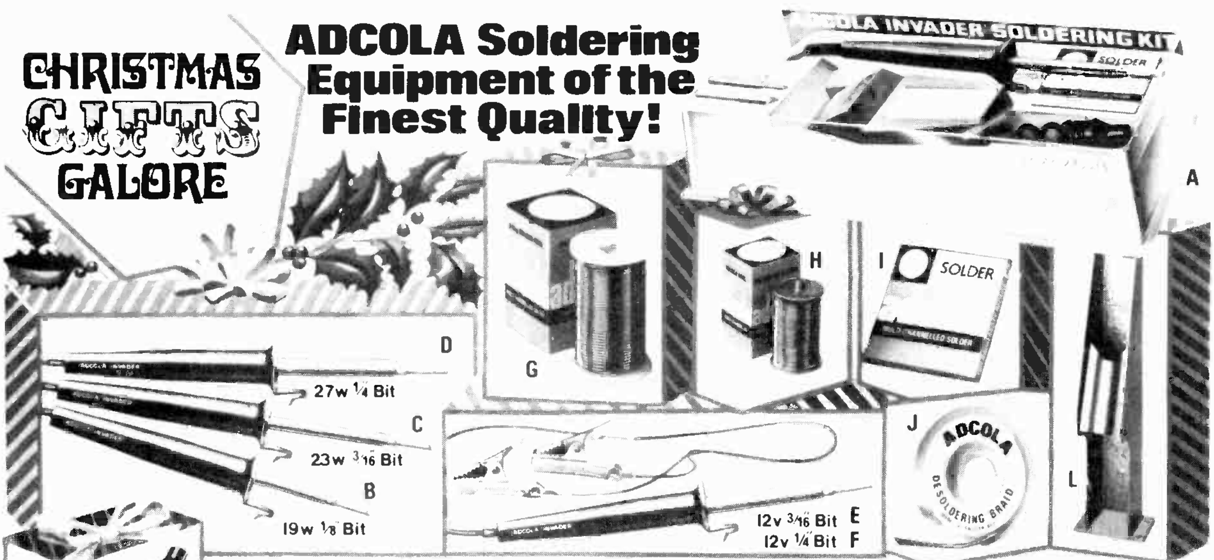
µA709C	50p
µA741C	55p
µA723C	£1
µL914	35p

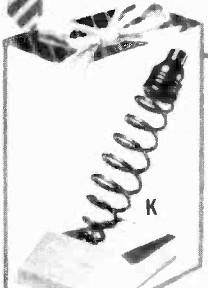
Screened Wire, Metre	5½p
Twin Screened Wire, Metre	10p
Stereo Screened Wire, Metre	10p
Connecting Wire, All colours, Metre	2½p
Neon Bulb, 90V Wire Ended	5 for 24p

QUANTITY DISCOUNT
SPECIAL BULK BUY PRICES ARE AVAILABLE BY QUOTATION FOR LARGE PROJECTS AND TRADE

CHRISTMAS GIFTS GALORE

ADCOLA Soldering Equipment of the Finest Quality!





A INVADER SOLDERING KIT	£4·39	☐
B L706 INVADER	£2·23	☐
C L646 INVADER	£2·42	☐
D L1076 INVADER	£2·48	☐
E BL646 BATTERY MODEL	£3·05	☐
F BL1076 BATTERY MODEL	£3·17	☐
G SOLDER REEL ½ KILO	£1·40	☐
H SOLDER REEL 3 OZ	£0·48	☐
I SOLDER PACK	£0·07	☐
J DE-SOLDERING BRAID	£0·75	☐
K L686 SOLDERING STATION	£1·88	☐
L L68 PROTECTIVE SHIELD	£1·08	☐
New Catalogue		☐

All prices include 10% V.A.T. *Please tick items required.*

Please send me the following items

PRINT NAME

PRINT ADDRESS

PE5

ADCOLA PRODUCTS LTD ADCOLA HOUSE GAUDEN ROAD LONDON, SW4 6LH
V.A.T. REGD. No. 235 6153 72 REGD. No 442762

PHASE LOCKED LOOPS

PART 2:
A.M. AND F.M. DEMODULATION AND FREQUENCY SYNTHESISERS

BY J. B. DANCE M.Sc.

IN LAST MONTH'S article the basic principles of phase locked loops were described. This month we will look at the application of these principles in f.m. radio reception, a.m. demodulation and frequency synthesisers.

RECEIVER TECHNIQUES

An amplitude modulated (a.m.) radio signal consists of a high frequency sine wave, whose frequency is fixed for any particular broadcasting station, but whose amplitude varies in sympathy with the audio signal that is the information to be transmitted. The carrier frequency f_s ranges from about 200kHz up to many megahertz, whilst the audio frequency ranges from 30Hz to 15kHz. The receiver must be able to reproduce the modulating audio signal as faithfully as possible and must provide as much separation as possible between signals whose carrier frequencies are close.

T.R.F. RECEIVERS

One of the simplest forms of radio receiver is the so-called "tuned radio frequency" (t.r.f.) receiver. The basic form of this type of receiver is shown in the block diagram of Fig. 2.1.

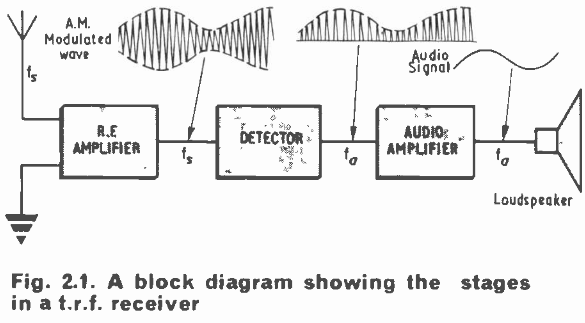


Fig. 2.1. A block diagram showing the stages in a t.r.f. receiver

The incoming signal is amplified in the radio frequency stage. No change in the frequency or in the form of the signal takes place in this stage, but tuned circuits are employed to provide selectivity and to reject unwanted signals of other frequencies.

The signal is then demodulated or detected, usually by a stage that provides some amplification. The audio signal from the detector (f_a) is fed to an audio amplifier which can provide sufficient power output to drive the loudspeaker.

The selectivity provided by receivers of this type is very limited, partly because it is not practical to employ more than about four tuned circuits operating at the radio frequency f_s. Each tuned circuit requires a separate gang of the tuning capacitor and the relatively long connections to this capacitor can lead to unwanted feedback and oscillation.

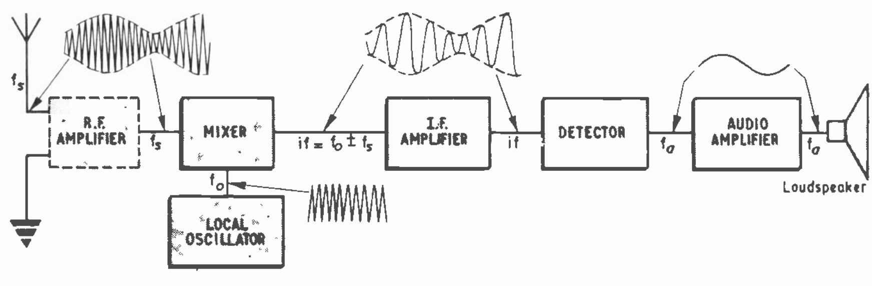
It is normally necessary to employ a fairly large value of tuning capacitor (typically 300pF to 500pF per gang) in order that the desired tuning range can be covered. This may make it impossible to design the tuned circuits for optimum Q factor (especially at high signal frequencies); the selectivity and gain therefore suffer.

The limitations of t.r.f. receivers become very noticeable at the higher frequencies. The pass band is so broad that it is impossible to obtain adequate selectivity and noise rejection, whilst the signal frequency amplification is normally inadequate in the short wave bands.

SUPERHETERODYNE RECEIVERS

Many of the disadvantages of the t.r.f. receiver can be avoided by the use of the superheterodyne principle, but some other undesirable features are then introduced. A block diagram of a superheterodyne receiver is shown in Fig. 2.2.

Fig. 2.2. A block diagram of a superheterodyne receiver. The use of an r.f. stage is optional



The incoming signal from the aerial at a frequency f_s may be fed into a radio frequency stage (shown dotted) or directly into the mixer stage. In the latter stage it is mixed with a frequency f_0 generated by a local oscillator. The frequency f_0 is varied with the frequency to which the receiver is tuned.

The output from the mixer consists mainly of the sum and difference frequencies of the signals which are fed into it, that is, $f_0 + f_s$ and $f_0 - f_s$. It is arranged that the frequency of one of these outputs (normally the difference frequency in receivers covering the long, medium and short wave bands) is kept constant no matter what the frequency of the input signal, f_s. This constant frequency output signal is known as the intermediate frequency or *i.f.*

The mixer stage is followed by one or more stages of amplification at the intermediate frequency. These stages involve the use of a number of tuned circuits (typically six) which resonate at the intermediate frequency.

The intermediate frequency tuned circuits are fixed tuned and they can therefore be designed with the optimum inductance/capacitance ratio for high selectivity and gain; they provide virtually all of the selectivity of the receiver. Each tuned circuit can be incorporated inside a metal can so that unwanted coupling is reduced to a minimum.

DISADVANTAGES OF SUPERHETS

Superheterodyne receivers have the disadvantage that they tend to suffer from spurious responses. Noises such as whistles may be generated when the local oscillator frequency (or one of its harmonics) beats with certain incoming frequencies. One of these undesired responses occurs at the image frequency, where a signal at a frequency of $f_s + 2i.f.$ mixes with the local oscillator frequency to form an interfering signal.

Image frequency interference may be reduced by using tuned circuits before the mixer or by using a high intermediate frequency so that the image frequency is far away from f_s and easily rejected by the tuned circuits in the r.f. amplifier, though this latter method tends to reduce selectivity.

Another disadvantage of superhets is that the tuned circuits used throughout cannot be formed on an integrated circuit chip. Integrated circuits are not only smaller but because of the ease of assembly they greatly reduce labour costs.

THE SYNCHRODYNE

The synchrodyne receiver is the forerunner of the phase locked loop and aroused great interest in the late 1940's. The synchrodyne type of receiver is illustrated in the block diagram of Fig. 2.3.

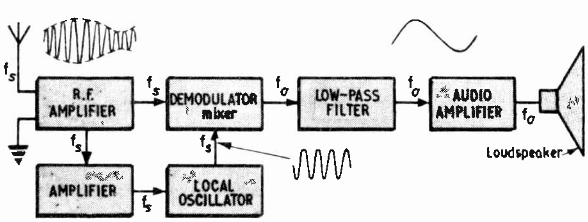


Fig. 2.3. The stages employed in a synchrodyne receiver

The signal from the aerial is fed via an optional radio frequency stage to the demodulator and also, via another amplifier stage, to a local oscillator. This signal keeps the local oscillator locked or synchronised to the input signal frequency—hence the name synchrodyne.

When the two signals of the same frequency come together in the demodulator stage (which is like the mixer of a superheterodyne), sum and difference frequencies are formed. The sum frequency, $2f_s$, is not required and is rejected by the succeeding low-pass filter. One might expect the difference frequency to be zero, but this really means that the carrier frequency is zero. In other words the output of the demodulator in Fig. 2.3 consists of the required audio signal minus the carrier.

Any interfering radio signals will not have the same frequency as the local oscillator. They therefore produce an output signal from the demodulator stage which is normally of a much higher frequency than that due to the wanted signal. The interfering signal cannot pass through the low-pass filter which follows the demodulator.

SYNCHRODYNE SELECTIVITY

One of the great advantages of the synchrodyne is that it does not obtain its selectivity by means of conventional tuned circuits, but by the use of a low-pass audio filter. This low-pass filter can be very simple (see Part 1) and can be designed to cut off at any point so as to provide the desired selectivity. It is easy to make the selectivity variable by adjusting the value of a single component.

Another important advantage of the synchrodyne receiver is that relatively few tuned circuits are employed in it. The only tuned circuit which is essential is the one in the oscillator circuit, but it is normally desirable to include some tuned circuits in the radio frequency stages to prevent very strong unwanted signals from overloading the mixer stage.

The local oscillator of a synchrodyne receiver must be locked in frequency to the wanted signal if one is to avoid the generation of beat frequencies. This type of receiver is either correctly tuned or not tuned at all. Unlike most other forms of receiver, a distorted audio output signal cannot be obtained as a result of the mis-tuning of the local oscillator.

As the local oscillator tuning is altered, the oscillator will remain synchronised to the incoming signal over a certain range, although the local oscillator signal may change in amplitude somewhat. Thus the only effect of a slight oscillator mis-tuning will be an alteration in the audio volume.

ADVANTAGES AND DISADVANTAGES

The synchrodyne receiver does not suffer from image responses. We have seen that an interfering signal at a frequency of twice the intermediate frequency plus the wanted signal frequency can produce an image response in a superheterodyne receiver; in the synchrodyne, however, the "intermediate frequency" is zero and therefore the image frequency becomes equal to the wanted signal frequency.

For domestic listening, the main objection to the use of the synchrodyne receiver is the loud whistles which are generated when one is tuning into a signal. These whistles are, of course, due to the local

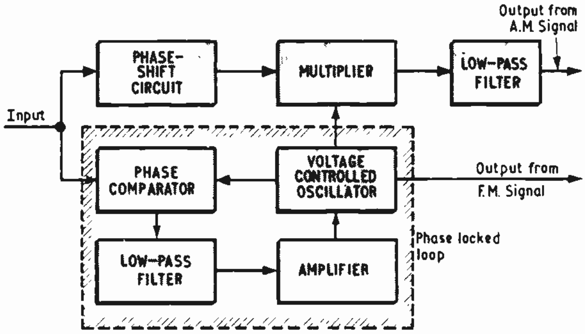


Fig. 2.4. An a.m. demodulator using a phase locked loop. The components of the loop itself are shown inside the box.

oscillator beating with the input signal before their frequencies become locked together. This problem can be overcome by the use of switched tuning.

Another reason for the limited use of synchrodyne receivers in the past has been the lack of simple, but effective phase locking circuits.

Other names for the synchrodyne receiver include "homodyne", "phase conrol" or "PC" receivers, synchronous detectors and phase locked detectors.

A.M. DEMODULATION

The block diagram (Fig. 2.4) shows a practical circuit for a.m. receivers using a phase locked loop.

The phase locked loop (comprising the units shown inside the dotted line) locks onto the input signal in the normal way. The voltage controlled oscillator produces a signal of the same frequency as the input signal, but it is unmodulated.

When the free-running frequency of the voltage controlled oscillator is the same as that of the incoming signal, locking will occur with these two signals 90° out of phase. In the system of Fig. 2.4, the phase shift circuit changes the phase of the input signal by 90° so that it is in phase with the output from the voltage controlled oscillator.

The two signals of the same phase are mixed in a second phase comparator or multiplier. The output from the multiplier is passed through a second low-pass filter so that only the difference frequency remains. This difference frequency is proportional to the amplitude of the input signal and is therefore the required audio output.

Systems such as that shown in Fig. 2.4 provide a higher degree of noise rejection than can be obtained from conventional a.m. demodulators which detect the peaked noise pulses.

F.M. DEMODULATION

The voltage controlled oscillator is normally designed so that its frequency is linearly related to the applied control voltage. As this latter voltage keeps the voltage controlled oscillator frequency the same as the incoming signal frequency, the control voltage is linearly related to the frequency deviation of the input signal.

In other words, the output voltage from the system (Fig. 1.1.) is the demodulated audio signal when the incoming signal is a frequency modulated one. The voltage controlled oscillator produces a greatly amplified copy of the input signal from which most of the noise has been removed.

One might expect that a very simple f.m. receiver could be constructed by merely feeding the input signal to the phase locked loop. In actual practice, however, a somewhat more complex system than this must be employed.

Currently available phase locked loops cannot operate at frequencies above about 60MHz. Most f.m. signals will therefore have to be converted to a lower frequency before they are passed to the phase locked loop. However, it seems likely that phase locked loops will be available at some future date which can operate at typical f.m. frequencies (about 100MHz) and it may then be possible to construct an f.m. receiver without the use of a frequency converter.

SENSITIVITY

Although phase locked loops can operate with a signal of just under a millivolt, some problems do arise if one wishes to operate them from an input of about 10μV (such as one may obtain from a receiving aerial at a considerable distance from the transmitter). It is generally better to amplify the signal before feeding it to the phase locked loop. Some tuned circuits are usually included in the system before the phase locked loop in order to reject signals which could produce spurious responses.

The phase locked loop may be employed to demodulate both narrow and wide band f.m. signals. It offers greater linearity than can be obtained by any other means and is therefore especially suitable for high fidelity systems.

At the other extreme, phase locked loops are employed in communications receivers where they are excellent for recovering weak signals in a noisy region of the radio spectrum.

FREQUENCY SYNTHESISERS

Frequency synthesisers are required for use in radio communications networks which will generate any one of a large number of frequencies with great accuracy at the touch of a button. For example, an aircraft navigation/communication band synthesiser may be required to produce frequencies in the range 108 to 136MHz at 50kHz intervals so as to cover each of the 560 channels.

Such frequency synthesisers can be designed using banks of quartz crystals and tuned circuits. However, it is normally more economic to employ a single quartz crystal to provide one accurate reference frequency and to obtain the other frequencies from it by the use of a phase locked loop together with a digital pulse frequency dividing circuit. This system has the additional advantage that fewer spurious frequencies are generated.

The basic system used in a phase locked loop frequency divider is illustrated by the block diagram of Fig. 2.5. The reference frequency is generated by a very stable quartz crystal controlled oscillator which is kept in a special constant temperature oven. If the frequency of this oscillator is 100kHz, the pulses may be divided in frequency to produce, perhaps, a 1kHz signal. The latter is fed as the reference signal to the input of the phase locked loop of Fig. 2.5.

DIVIDER CIRCUIT

The main difference between the frequency synthesiser circuit of Fig. 2.5 and the simple phase locked loop is the inclusion of a frequency divider circuit

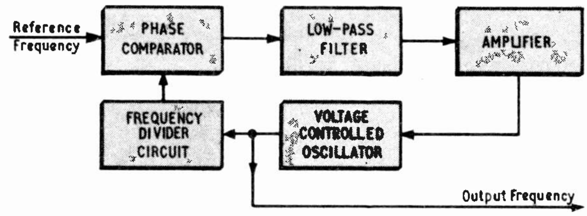


Fig. 2.5. The building blocks of a simple frequency synthesiser using a phase locked loop

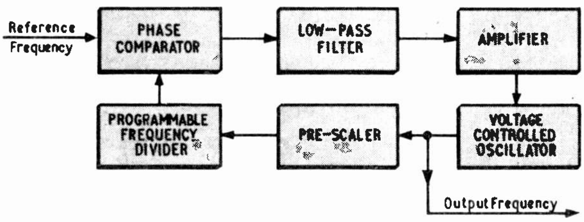


Fig. 2.6. In this type of frequency synthesiser a fast divider (the pre-scaler) is used to divide the pulse frequency.

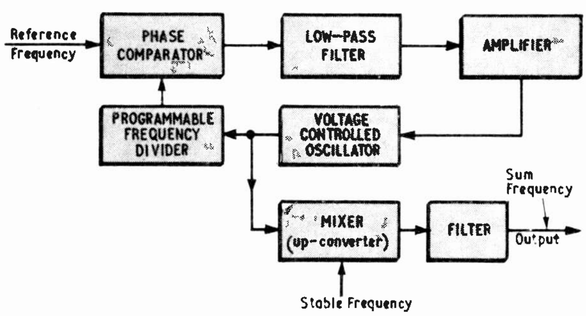


Fig. 2.7. Because phase locked loops can handle only relatively low frequencies, a mixer can be used to multiply the voltage controlled oscillator frequency.

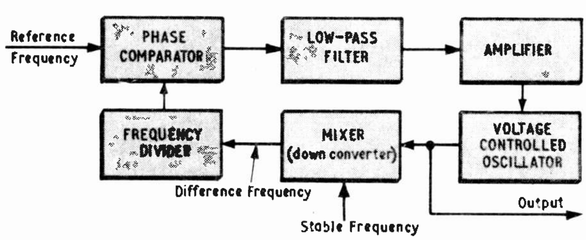


Fig. 2.8. In this type of frequency synthesiser a mixer is used to reduce the high voltage controlled oscillator frequency for the divider stage

between the voltage controlled oscillator and the phase comparator. This enables the voltage controlled oscillator to operate at a much higher frequency than the input reference signal.

If the reference signal has a frequency of 1kHz and the frequency divider is set so that it divides by, say, 569, the phase locked loop will come into lock when the voltage controlled oscillator frequency is 569kHz.

This frequency is divided so that it produces the same frequency as the input reference signal. In order to obtain any other output frequency from the voltage controlled oscillator, it is only necessary to change the factor by which this frequency is divided before it is fed to the phase comparator.

All frequencies generated in this way have the same stability as the reference frequency.

HARMONIC LOCKING

Phase locked loops will lock to a multiple of the input frequency, but the locking range decreases as higher and higher harmonics are used, since the amplitude of such harmonics is low.

Harmonic locking can be used in frequency synthesisers, but in general one should not attempt to lock a phase locked loop to a harmonic higher than about the tenth.

HIGHER FREQUENCIES

Digital frequency synthesisers are often required which will provide outputs of the order of some hundreds of megahertz. Voltage controlled oscillators can generate such frequencies, but programmable counters which can operate at above about 25MHz are very expensive.

It may therefore be more economic to operate the voltage controlled oscillator at a lower frequency and to multiply this frequency by a number of cascaded frequency multiplier stages. However, such a system has the disadvantage that tuned circuits are required in the multiplier stages and these must be re-tuned whenever the frequency is changed.

A more convenient system is shown in Fig. 2.6. The output from the voltage controlled oscillator is divided in frequency by a pre-scaler before being passed to a programmable frequency divider.

Other techniques for obtaining high frequency outputs include mixing the output from the voltage controlled oscillator with a stable frequency. The sum frequency is the required output, as shown in Fig. 2.7.

In yet another system, the output from the voltage controlled oscillator is mixed with a stable reference frequency and the difference frequency output is used to operate the programmable frequency divider. This type of system is illustrated in Fig. 2.8.

If a signal from a frequency synthesiser is fed to the mixer stage of a radio receiver together with the input signal, one can select the signal to be received merely by choosing the ratio by which the voltage controlled oscillator signal is divided. The drift in the tuning of such a system is quite negligible, since the reference frequency is crystal controlled.

Next month this series will continue with a review of the types of phase locked loops available from various manufacturers together with practical examples of the circuits in which they can be used.

YATES ELECTRONICS
(FLITWICK) LTD.
ELSTOW STORAGE DEPOT
KEMPSTON HARDWICK
BEDFORD

C.W.O. PLEASE. POST AND PACKING PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the components listed will be sent free on request. 10p stamp appreciated.

OPEN ALL DAY SATURDAYS

PLEASE ADD 10% VAT

RESISTORS
¼W Iskra high stability carbon film—very low noise—capless construction.
¼W Mullard CR25 carbon film—very small body size 7·5 x 2·5mm.
½W 2% ELECTROSIL TR5

Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
¼	5%	4·7Ω–2·2MΩ	E24	1p	0·8p
¼	10%	3·3MΩ–10MΩ	E12	1p	0·8p
½	2%	10Ω–1MΩ	E24	3·5p	3p
¼	10%	1Ω– 3·9Ω	E12	1p	0·8p
¼	5%	4·7Ω–1MΩ	E12	1p	0·8p
4	10%	1Ω–10Ω	E12	6p	5·5p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK
0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40**. E24 pack 650 resistors **£4·70**.

POTENTIOMETERS
Carbon track 5kΩ to 2MΩ, log or linear (log ¼W, lin ½W).
Single, **12p**. Dual gang (stereo), **40p**. Single D.P. switch **24p**.

SKELETON PRESET POTENTIOMETERS
Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, **5p** each. Miniature 0·25W, **7p** each.

TRANSISTORS

AC107	15p	AF139	32p	BF177	28p	OC45	12p	2N3710	11p
AC126	12p	AF178	32p	BF178	32p	OC70	12p	2N3711	11p
AC127	15p	AF180	40p	BF179	32p	OC71	12p	2N3819	32p
AC128	15p	AF181	40p	BF180	32p	OC72	12p	2N4062	12p
AC131	12p	BC107	12p	BF181	32p	OC81	12p	2N4286	20p
AC132	12p	BC108	12p	BF194	14p	OC82D	12p	2N4289	20p
AC176	15p	BC109	12p	BF195	14p	2N2646	60p	40360	35p
AC187	22p	BC147	12p	BF197	15p	2N2904	20p	40361	35p
AC188	22p	BC148	12p	BF200	32p	2N2926	10p	40362	40p
AD140	50p	BC149	12p	BFY50	20p	2N3054	58p	40408	40p
AD149	45p	BC157	14p	BFY51	20p	2N3055	60p	ZTX108	15p
AD161	33p	BC158	14p	BFY52	20p	2N3702	13p	ZTX300	15p
AD162	36p	BC159	14p	BUY105		2N3703	12p	ZTX302	20p
AF114	20p	BC187	22p		£2·25	2N3704	13p	ZTX500	15p
AF115	20p	BD131	75p	OC26	45p	2N3705	12p	ZTX503	20p
AF116	20p	BD132	75p	OC28	50p	2N3706	11p		
AF117	20p	BD133	75p	OC35	50p	2N3707	12p		
AF118	38p	BF115	25p	OC42	12p	2N3708	10p		
AF126	20p	BF173	20p	OC44	12p	2N3709	11p		

ZENER DIODES
400mW 5% 3·3V to 30V, **12p**.

WIRE WOUND POTS, 3W, 10, 25, 50Ω and decades to 100kΩ, 35p.

DIODES
RECTIFIER

BY127	1250V	1A	12p
BZY10	800V	6A	25p
BZY13	200V	6A	20p
IN4001	50V	1A	7p
IN4004	400V	1A	8p
IN4007	1000V	1A	10p

SIGNAL

OA85	7p
OA90	5p
OA91	5p
OA202	7p
IN4148	5p
BA114	8p

BRUSHED ALUMINIUM PANELS
12in × 6in = **25p**; 12in × 2½in = **10p**; 9in × 2in = **7p**

SLIDER POTENTIOMETERS
86mm × 9mm × 16mm, length of track 59mm.
SINGLE 10K, 25K, 100K log. or lin. **40p**.
DUAL GANG, 10K + 10K etc. log. or lin. **60p**.
KNOB FOR ABOVE **12p**.
FRONT PANEL **65p**.
18 Gauge panel 12in × 4in with slots cut for use with slider pots. Grey or matt black finish complete with fixings for 4 pots.

THERMISTORS

VA1055S	15p
VA1066S	15p
VA1077	15p
RS3	£1·35

THYRISTORS
2N5060 50V 0·8A **30p**, 2N5064 200V 0·8A **47p**, CR51/40 400V 1A **25p**, 106F 50V 4A **40p**, 106D 400V 4A **55p**.

MULLARD POLYESTER CAPACITORS C296 SERIES
400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, **2½p**. 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **3p**. 0·047μF, 0·068μF, 0·1μF, **4p**. 0·15μF, **6p**. 0·22μF, **7½p**. 0·33μF, **11p**. 0·47μF, **13p**.
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p**. 0·1μF **3½p**. 0·15μF **4½p**. 0·22μF, **5p**. 0·33μF, **6p**. 0·47μF, **7½p**. 0·68μF, **11p**. 1·0μF, **13p**.

MULLARD POLYESTER CAPACITORS C280 SERIES
250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p**. 0·033μF, 0·047μF, 0·068μF, **3½p**. 0·1μF, **4p**. 0·15μF, 0·22μF, **5p**. 0·33μF, **6½p**. 0·47μF, **8½p**. 0·68μF, **11p**. 1·0μF, **13p**. 1·5μF, **20p**. 2·2μF, **24p**.

MYLAR FILM CAPACITORS 100V
0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, **2½p**. 0·04μF, 0·05μF, 0·068μF, 0·1μF, **3½p**.

CERAMIC DISC CAPACITORS
100pF to 10,000pF, **2p** each.

ELECTROLYTIC CAPACITORS—MULLARD 015/6/7
(μF/V) 1/63, 1·5/63, 2·2/63, 3·3/63, 4·7/63, 6·8/40, 6·8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33/6·3, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6·3, 68/16, 100/4, 100/10, 100/25, 150/6·3, 150/16, 220/4, 220/6·3, 220/16, 330/4, **6p**. 47/63, 100/40, 150/25, 220/25, 330/10, 470/6·3, **7p**. 68/63, 150/40, 220/40, 330/16, 1,000/4, **10p**. 470/10, 680/6·3, **11p**. 100/63, 150/63, 220/63, 1,000/10, **12p**. 470/25, 680/16, 1,500/6·3, **13p**. 470/40, 680/25, 1,000/16, 1,500/10, 2,200/6·3, **18p**. 330/63, 680/40, 1,000/25, 1,500/16, 2,200/10, 3,300/6·3, 4,700/4, **21p**.

SOLID TANTALUM BEAD CAPACITORS — 12p

0·1μF	35V	2·2μF	35V	22μF	16V
0·22μF	35V	4·7μF	35V	33μF	10V
0·47μF	35V	6·8μF	25V	47μF	6·3V
1·0μF	35V	10μF	25V	100μF	3V

VEROBOARD

	0·1	0·15
2½ × 3¾	22p	16p
2½ × 5	24p	24p
3¾ × 3¾	24p	24p
3¾ × 5	27p	27p
17 × 2½	75p	57½p
17 × 3¾	100p	78p
17 × 5 (plain)	—	82p
17 × 3¾ (plain)	—	60p
17 × 2½ (plain)	—	42p
2½ × 5 (plain)	—	12p
2½ × 3¾ (plain)	—	11p
Pin insertion tool	52p	52p
Spot face cutter	42p	42p
Pkt. 50 pins	20p	20p

JACK PLUGS AND SOCKETS

Standard screened	18p	2·5mm insulated	8p
Standard insulated	12p	3·5mm insulated	8p
Stereo screened	35p	3·5mm screened	13p
Standard socket	15p	2·5mm socket	8p
Stereo socket	18p	3·5mm socket	8p

D.I.N. PLUGS AND SOCKETS
2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin
Plug 12p. Socket 8p.
4 way screened cable, **15p**/metre.
6 way screened cable **22p**/metre.

BATTERY ELIMINATOR — £1·50
9V mains power supply. Same size as PP9 battery.

LARGE (CAN) ELECTROLYTICS

1600μF	64V	74p	2500μF	64V	80p	4500μF	16V	50p
2500μF	40V	74p	2800μF	100V	£2·60	4500μF	25V	£1·68
2500μF	50V	58p	3200μF	16V	50p	5000μF	50V	£1·10

HIGH VOLTAGE TUBULAR CAPACITORS—1,000 VOLT

0·01μF	10p	0·047μF	13p	0·22μF	20p
0·022μF	12p	0·1μF	13p	0·47μF	22p

POLYSTYRENE CAPACITORS 160V 2½%
10pF to 1,000pF E12 Series Values **4p each.**

SMOKE AND COMBUSTIBLE GAS DETECTOR—GD1
The GD1 is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector.
Detector GD1, **£2**. Kit of parts for detectors including GD1 and P.C. board but excluding case. Mains operated detector **£5·20**. 12 or 24V battery operated audible alarm **£7·30**. As above for PP9 battery, **£6·40**.

PRINTED BOARD MARKER — 97p
Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

LARGE RANGE ITT/TEXAS IC's NOW IN STOCK

PRICES ARE CALCULATED ON TOTAL NUMBER ORDERED REGARDLESS OF MIX

	1–11 p	12–24 p	25–99 p	100+ p
7400	18	16	14	13
7401	18	16	14	13
7402	18	16	14	13
7403	18	16	14	13
7404	20	18	16	14
7405	20	18	16	14
7406	50	45	40	35
7407	56	50	44	38
7408	36	30	27	23
7409	36	30	27	33
7410	18	16	14	13
7411	23	21	20	18
7412	36	30	27	23
7413	34	28	26	22
7416	45	43	39	34
7420	18	16	14	13
7421	36	30	27	23
7426	32	29	23	20
7430	20	18	16	14
7432	40	36	32	28
7440	20	18	16	14
7441	80	75	70	65
7442	80	75	70	65
7443	125	120	115	115
7447	175	165	150	120

7448	185	175	170	165
7450	18	16	14	13
7451	18	16	14	13
7453	18	16	14	13
7454	18	16	14	13
7460	18	16	14	13
7470	30	28	25	24
7472	30	28	27	23
7473	40	38	36	30
7474	40	36	32	28
7475	55	52	50	49
7476	40	36	32	30
7480	100	95	90	85
7481	125	115	110	105
7482	100	96	90	85
7483	100	97	95	92
7484	120	115	110	105
7485	250	245	240	230
7486	45	42	37	33
7490	75	67	60	52
7491A	100	92	85	79
7492	75	70	65	60
7493	75	68	60	52
7494	95	90	85	80
7495	105	100	95	90
7496	100	95	90	85
74100	250	240	235	230

74118	100	82	73	64
74121	43	40	38	36
74141	100	95	90	85
74145	150	140	135	130
74150	330	280	250	220
74151	110	100	95	89
74153	120	110	105	95
74154	200	180	170	160
74155	150	120	100	86
74156	130	120	100	96
74180	155	136	112	105
74190	195	190	185	180
74191	195	190	185	180
74192	200	190	180	164
74193	200	180	170	150
74196	200	190	180	170
74197	200	195	180	170

LINEAR IC's

709	14 pin DIL	40p
741	8 pin DIL	40p
741	14 pin DIL	38p
723	14 pin DIL	95p
747	14 pin DIL	85p
748	8 pin DIL	45p
DIL socket.	14 pin and 16 pin	16p

P.E. RONDO

FULL SPECIFICATION KITS

Complete designer approved kits. Full data and even solder included. Top quality PCBs (and components.

* **CBS-SQ MATRIX DECODER**
£8·00 Post Free + 80p VAT

* **PRE-AMP BOARD, COMPLETE**
£3·00 Post Free + 30p VAT

* **MASTER VOL/TONE/BAL. BD.**
£8·50 Post Free + 85p VAT

* **POWER AMP BOARD + HEAT-SINK**
£7·50 Post Free + 75p VAT

* **POWER SUPPLY BOARD**
£5·00 Post Free + 50p VAT

* **MAIN SMOOTHING CAPS**
£0·75 Post Free + 7p VAT

* **MAINS TRANSFORMER**
£6·25 Post Free + 62p VAT

* **PUNCHED CHASSIS**
£2·25 Post Free + 22p VAT

PHASE LOCKED LOOP STEREO DECODER

EASY TO BUILD!
(Approximately 30 mins.)

- EMPLOYS MC1310 IC
- REQUIRES 10-15v d.c.
- NO INSTRUMENTS NEEDED TO SET UP
- SIMPLE INSTRUCTIONS SUPPLIED

COMPLETE KIT £3·40
Plus 34p VAT
AUTOMATIC BEACON FITTING
34p + 3p VAT Extra

All other items will be offered as published
TRADE GLADLY SUPPLIED

STUDIO ELECTRONICS

P.O. BOX No. 18, HARLOW, ESSEX CM18 6SH
Telephone: Harlow (02796) 25457

ORDER—PLEASE SEND

CBS-SQ DEC.	☐	ENCLOSED
PRE-AMP	☐	
MASTER VOL.	☐	£............
POWER AMPS (2 for RONDO)	☐	CHEQUE P.O. M.O.
POWER SUPPLY	☐	
CAPACITORS	☐	
TRANSFORMER	☐	
CHASSIS	☐	
STEREO DECODER	☐	

NAME ....

ADDRESS ....

....

....

.... PE11

UNDERSTANDING SOLID-STATE ELECTRONICS

Basic course in semiconductor theory, Texas Inst. Price £1·40

104 EASY TRANSISTOR PROJECTS YOU CAN BUILD by R. M. Brown. Price £1·30.

INTEGRATED CIRCUIT POCKET BOOK by R. G. Hibberd. Price £2·60.

HOW TO GET THE BEST OUT OF YOUR TAPE RECORDER by P. J. Guy. Price £1·60.

50 PHOTOELECTRIC CIRCUITS AND SYSTEMS by P. S. Smith. Price £1·35.

COLOUR TV WITH PARTICULAR REF. TO PAL SYSTEM by G. N. Patchett. Price £3·10.

GETTING STARTED WITH TRANSISTORS by L. E. Garner. Price £1·30.

TRANSISTOR AUDIO AND RADIO CIRCUITS by Mullard. Price £1·90.

FOUNDATIONS OF WIRELESS AND ELECTRONICS by M. G. Scroggie. Price £2·00.

THE RADIO AMATEUR'S HANDBOOK 1973 by A.R.R.L. Price £2·95.

BEGINNER'S GUIDE TO PRACTICAL ELECTRONICS by R. H. Warring. Price £1·60.

ELECTRONIC ORGAN SERVICING GUIDE by R. G. Middleton. Price £2·40.

ALL PRICES INCLUDE POSTAGE

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books

19-21 PRAED STREET
LONDON W2 1NP

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

I-N-T-E-R-L-O-C-K-I-N-G PLASTIC STORAGE DRAWERS

DISCOUNT PRICES

5 SIZES ALL INTERLOCK

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

BUY AT TRADE PRICES!

SINGLE UNITS (1D) (5ins × 2½ins × 2½ins). £1·40 DOZEN.

DOUBLE UNITS (2D) (5ins × 4½ins × 2½ins). £2·30 DOZEN.

TREBLE (3D) £2·50 for 8.

DOUBLE TREBLE 2 drawers, in one outer case (6D2), £3·60 for 8, **EXTRA LARGE SIZE (6D1)** £3·40 for 8.

PLUS QUANTITY DISCOUNTS!

Orders £10 and over DEDUCT 5% in the £
Orders £20 and over DEDUCT 7½% in the £
Orders £50 and over DEDUCT 10% in the £

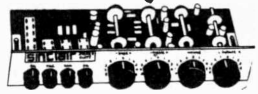
PACKING/POSTAGE/CARRIAGE: Add 35p to all orders under £10. Orders £10 and over, packing/postage/carriage free.

QUOTATIONS FOR LARGER QUANTITIES

Please add 10% V.A.T. to total remittance

FLAIRLINE SUPPLIES (Dept. PE12) 124 Cricklewood Broadway, London, N.W.2 Tel. 01-450 4844

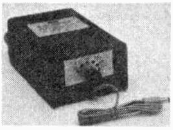
SINCLAIR EQUIPMENT



Project 60 FM Tuner		£15·95	(£1·85)
2 Z30/Stereo 60/PZ5		£16·75	(£2·05)
2 Z30/Stereo 60/PZ6		£18·85	(£2·25)
2 Z50/Stereo 60/PZ8/Trans		£23·20	(£2·70)
Z30 £3·50 (55p)	Stereo 60	£7·80	(98p)
Z50 £4·30 (63p)	Trans for PZ8	£2·95	(50p)
PZ5 £3·47 (57p)	2000 Amp	£22	(£2·70)
PZ6 £6·30 (83p)	3000 Amp	£31·50	(£3·35)
AFU £4·40 (64p)	2000 Tuner	£27	(£2·90)
PZ8 £6·40 (84p)	3000 Tuner	£27	(£2·90)
Q16 £5·90 (79p)	Project 605	£20·98	(£2·40)

PROJECT 60 KIT £2·70 (49p)
Our extremely popular kit contains the extra capacitors, din plugs and sockets, cable and fuse-holder needed to complete Project 60.

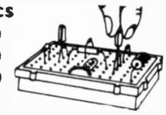
BATTERY ELIMINATOR BARGAIN £3·60 (58p)



Introducing the most versatile battery eliminator ever offered with a high current output that makes it suitable for operating most battery tape recorders, record players, cassette recorders and shavers. Input 200/240V. Output voltage selected by front panel switch may be set to 3V, 4·5V, 6V, 7·5V, 9V and 12V at 500 mA.

IC RADIO CHIP TBA651 £2·10 (32p)
The world's most advanced IC radio chip. Contains RF Amp, oscillator, mixer, IF Amps, wide range AGC circuitry and voltage stabilizer. With data £2·10 (32p). Send S.A.E. for free leaflet. A kit of resistors, capacitors, and IF filters is available to go with the chip for £1·75 (29p).

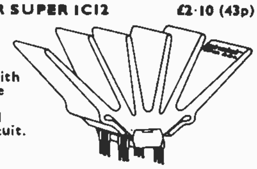
S-DECS AND T-DECS



S-DECS	£1·44	(25p)
T-DECS	£2·88	(40p)
μ-DEC A	£3·18	(43p)

16 dil IC carriers £1·20 (17p)

SINCLAIR SUPER IC12 £2·10 (43p)



Supplied complete with free 44-page instruction booklet and printed circuit.

DELUXE KIT FOR THE IC12
Includes all parts for the printed circuit and volume, bass and treble controls needed to complete the mono version £1·55 (26p). Stereo model with balance control £3·50 (46p).

BASIC KITS FOR THE IC12
Contains components for P.C. board and volume and simple tone controls. Mono version £1·25 (24p). Stereo model with balance control £2·90 (40p).

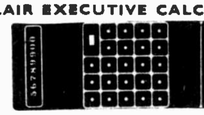
IC12 POWER KIT
A set of components to construct a 28V 0·5A power supply £2·47 (50p).

LOUDSPEAKERS FOR THE IC12
5in 8 ohm £1·10 (27p). 5in × 8in 8 ohm £1·55 (37p). 10in × 6in 15 ohm £2·20 (44p).

PREAMPLIFIER KITS FOR THE IC12
Type 1 for magnetic pickups, mics and tuners, with 3 position equalization switch. Mono model £1·30 (24p). Stereo model £2·30 (34p). Type 2 for ceramic or crystal pickups. Mono 60p (17p). Stereo £1·20 (23p).

SEND S.A.E. FOR FREE LEAFLET ON KITS

SINCLAIR EXECUTIVE CALCULATOR



Now only £34·95 (£3·70)

SWANLEY ELECTRONICS

32 Goldsel Road, Swanley, Kent

Please add the sum shown in brackets after the price to cover the cost of post and VAT.
Mail order only. No callers, please.

INGENUITY UNLIMITED

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.
This is YOUR page and any idea published will be awarded payment according to its merits.

PSU PROTECTION

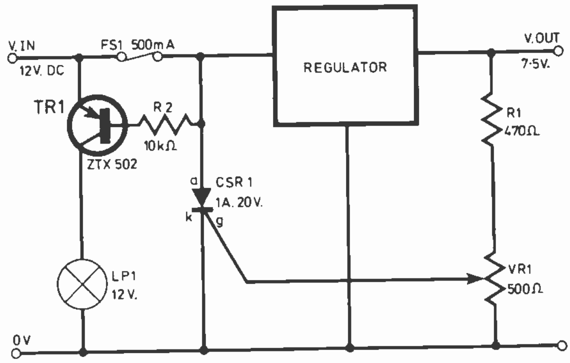


Fig. 1. Power supply protection circuit

When using a regulated PSU to reduce a supply voltage there is always the danger of component failure in the PSU and consequent damage to the equipment. A fuse will protect equipment when an excess of current is drawn but might be too slow to cope with overvoltage conditions.

In Fig. 1 the values shown suit a car battery supply being used to drive a battery tape recorder at 7·5V. The load requirement is 300mA and the trip voltage was set to 8V to protect the recorder in the event of regulator fault.

R1 and VR1 form a potential divider which samples the output voltage as set by adjustment of VR1. The CSR1 is selected to carry at least twice the fuse rating. The full supply voltage is connected to the input of the regulator.

Transistor TR1 is held biased off by R2 and CSR1 so that the lamp LP1 is held off. If the output voltage rises above a set trip value then CSR1 will conduct, FS1 will blow and TR1 will be supplied with base current via R2 and the lamp will light up.

J. Sadler,
Cheshire.

R/C SERVO AMPLIFIER

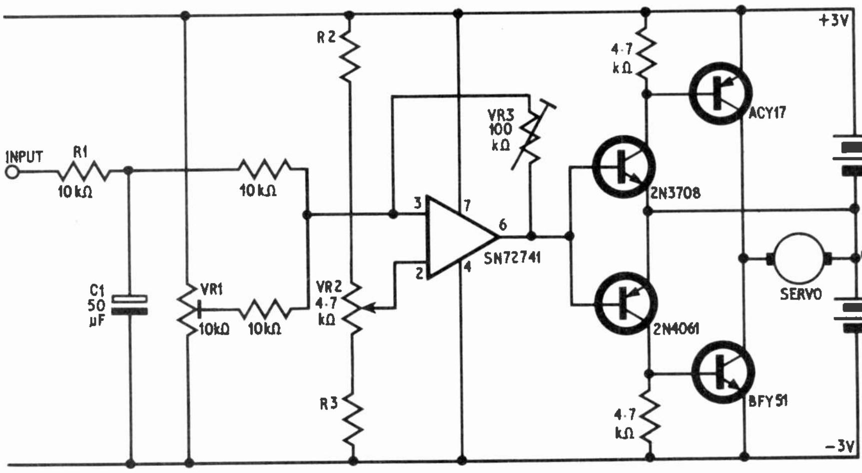


Fig. 1. Circuit diagram for the servo amplifier

A digital proportional decoder was published in the series *Logical Radio Control* (no issues available) and I have developed the following servo amplifier to go with such a device, see Fig. 1. Using a 741 operational amplifier for compactness, the circuit accepts the positive-going pulses, of variable length, from the decoder. These are integrated by R1 and C1 to give a d.c. which, using my decoder, varies from +0·2 to +1·2V.

Potentiometer VR1 is adjusted to give a value equivalent to minus the centre voltage at its wiper. In my case this is −0·7V. The 741 is used as a summation amplifier.

If VR3 is set at 10kΩ so that the gain of the 741 is unity, then the output will be 1·2–0·7V = +0·5V at one transmitter control extreme and 0·2–0·7V = −0·5V at the other. In fact, the gain is set so that the output swings ±3V.

The transistors form a current amplifier to drive the servomotor and feedback from the motor is provided via the potentiometer VR2 which is ganged to the motor. The deadband of the servo may be controlled by varying VR3 and when the optimum value is found replacing with a fixed resistor.

The values of R2 and R3 are found by experiment.

P. Skan,
Sutton Coldfield.

CAR LIGHTS MONITOR

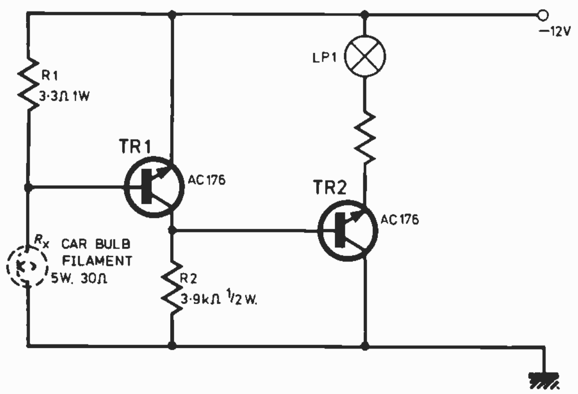


Fig. 1. Circuit diagram of the car lights monitor

Perhaps the enclosed circuit of a car light monitor would be of interest to some of your readers. The circuit, Fig. 1, was designed to indicate the presence of a bulb failure in either the two front side lights or the two rear lights (the number plate light could also be included).

The 3·3Ω resistor R1 makes no visible difference to the bulbs light output as only approximately 1V is dropped across it. When the bulb filament R_x goes open circuit there is no forward bias to TR1 and its collector voltage rises and turns TR2 hard on, illuminating the indicator bulb LP1.

The circuit as shown will operate on positive earth cars; for negative earth cars *pnp* transistors, such as the AC128, should be used. The connecting details are shown in Fig. 2.

A wide variety of bulbs can be used in the LP1 position as long as the ratings of TR2 are not exceeded. The prototype used 6V 0·1A bulbs with 33Ω ballast resistors.

I. K. Staley,
Mansfield,
Notts.

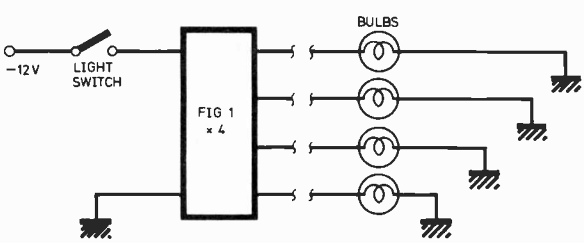
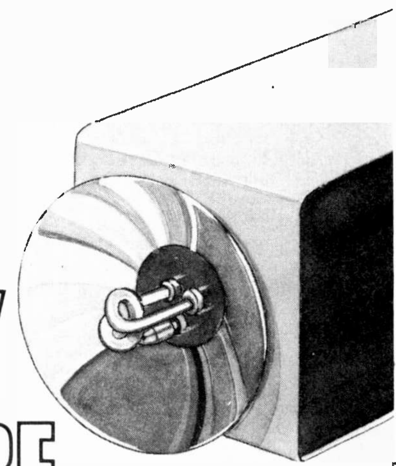


Fig. 2. Showing how the circuit is connected into the car wiring. The circuit in Fig. 1 is repeated for each light to be monitored

NEXT MONTH...



PARTY STROBE LIGHT

Have fun with the Party Strobe!
An easy-to-build, low cost medium power stroboscope which will amuse your friends at parties or discotheques.

VOICE OPERATED FADER

Run a super-efficient Disco—when you speak the music fades and when you stop it comes back up.
Ideal for the tape enthusiast who wants to add commentaries to his recordings.

PE RONDO

PART FOUR

PRACTICAL ELECTRONICS

DECEMBER ISSUE ON SALE NOVEMBER 9, 1973

SAXON ENTERTAINMENTS LTD.

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

Announcing our improved range of constructor modules

FOR DOMESTIC & COMMERCIAL USE

New Versions using 3A "Plastic Power" Driver Transistors now available.

To meet demand, we have included a more powerful module in our well-established and proven range. All these power amplifiers are carefully assembled, tested and guaranteed. They offer superb value for reliability and versatility.

SA35 35W RMS uses 7 transistors and 7 diodes. Carr. paid. **£4·45**

A NEW ADDITION IS THE SA50 at £5·65

Carr. paid. A rugged, well built unit, capable of 50W RMS out, with all the advantages of Saxon Amplifier design and quality. Ready now.

SA100 makes an ideal unit in disco assemblies

A real glutton for work. Reliable, tough and compact. 11 transistors, 6 diodes. Carr. paid. **£10·90**

BRIEF SPEC. FOR ALL THREE MODULES

Freq. response	15–40,000Hz ± 1dB
Distortion	0·2% at 1kHz
Loads	4 to 16 ohms
Quiescent current	15mA
Noise	Better than —75dB
Supply voltage	SA35–45V SA50 45/65V SA100 40–70V
Size	4½in × 4in × 1in (SA100) 4in × 3in × 1in (SA35/SA50)

All modules incorporate OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in its SA100

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

POWER SUPPLIES

FOR THE SA35, SA50 AND SA10 POWER AMPS. ABOVE

PU45	Unstabilised supply for 2 SA35's	£4·90
PU70	Unstabilised supply for one or two SA50 or SA100	£7·75 carr. 40p
PS45	Stabilised module for two SA35's	£3·50 carr. free
MT45	Transformer for above, heavy duty	£2·85 carr. 20p
MT30	Transformer for unstabilised supply complete with rectifier diodes mounted	£3·50 carr. 20p
PS70	Stabilised supply module for one or two SA100's	£4·90 carr. free
MT70	Transformer for PS70	£4·90 carr. 40p

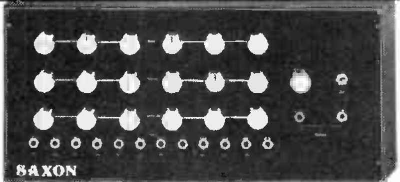
ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD AND SUPPLIED FULLY TESTED

SAXON PA MIXER-CONTROL UNITS

In extra slimline easy-fit case.

Using grouped pairs of inputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master controls. These low-noise units will feed all makes of amplifiers, making them ideal for clubs, discos, etc. Standard jack sockets, compact design. In strong metal cases. All Units guaranteed for 3 years.

- **HIGH AND LOW IMPEDANCE INPUTS**
- **BASS/TREBLE/VOLUME ON EACH PAIR**
- **MASTER CONTROL ON OUTPUT**



M4H
4 high Z, 4 low Z inputs, 4 sets of controls. Case 10" × 8" and only 2½in deep. Carr. paid. **£18·50 + V.A.T.**

M6HL
12 inputs (6 high Z, 6 low Z) 18" × 8" × 2½". Carr. paid **£27·50 + V.A.T.**

Channel section modules, for building your own: gain—16 × (24dB). Tone controls—18dB swing. Carr. paid. **£3·50 + V.A.T.**

CONTROL UNITS

Mono (as shown). Carr. 20p. **£6·50**
For 9 v. battery operation. As stereo model, less mic. input.
Stereo. Carr. 30p. **£15·80**

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½in × 3in × 4in deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass treble, mains on/off.
COMPARABLE TO UNITS AT OVER TWICE THE PRICE.

PLEASE ADD 10% FOR V.A.T. TO TOTAL VALUE OF YOUR ORDER

S.A.E. brings Saxon equipment and bargains list

120 W HEAVY DUTY MODULE

Rugged class A driver stage. This module will run from all our mixers, etc., and most other makes. Delivers 120W into an eight ohm load and employs 4 TO3 can (115W) output transistors.

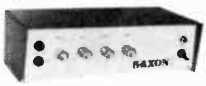
SPECIFICATION
Power output, 120W into 8 ohms
Freq. response, 20–20,000Hz ± 2dB
Input sensitivity, 200mV into 10K
Construction, Fibreglass board
Size, 8in × 4in × 4in (5in with supply)
Low distortion parallel push-pull output stage.

Module and power supply (Carr. 40p) **£18·95**

Another Saxon winner!

- **160 watts version with power supply (Carr. 50p) £27·90**

SOUND AND LIGHT UNITS



Our popular 3 channel model handles up to 3kW (3,000W) of lighting and incorporates versatile sound control arrangement to enable professional standards to be achieved. Both units are excellent examples of Saxon quality and value.

3 CHANNEL UNIT

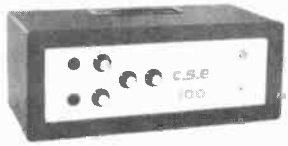
Includes bass, middle and treble as well as master controls, 2 amplifier sockets eliminate need for split leads. Up to 3kW lighting load. Smartly finished steel case. Carr. 30p. **£19·75**

SINGLE CHANNEL UNIT

Operates from 5–100W amplifiers. Supplied for bass note operation, is easily adapted for treble or mid-range at a cost of about 5p. Carr. pd. **£8·90**

COMPLETE AMPLIFIERS

CSE 100 £34·90 carr. free



This versatile unit is now available in a black vynide case and so represents even better value than ever delivering speech and music powers of up to 100W RMS and continuous signal outputs of 70W. Two individually controlled inputs with wide range bass and treble controls.

SAXON 100 £48·50 carr. free

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

LOUDSPEAKERS British made bargains!! 12in 25W 8/15 ohms £5·95 carr. 30p. 15in 50W 8/15 ohm £14·50 carr. 50p. 12in 40W 15,000 gauss magnet system 8/15 ohm £11·50 carr. 40p.

600 Watt 3 colour Light Boxes Smart Rexine finish £15 carr. free.

Order and personal shoppers to:
SAXON ENTERTAINMENTS LTD., 329 Whitehorse Road, W. Croydon, Surrey CRO 2HS
Telephone 01-684 6385
From 9.30 a.m.-5.30 p.m.

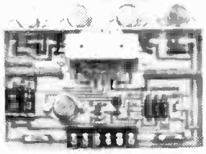
Prices quoted do not include V.A.T. 10% must be added on to total value of order for V.A.T

TRADE AND EXPORT ENQUIRIES INVITED

TERMS OF BUSINESS
Cash with order (C.W.O.). For C.O.D. please add 35p extra, cash by regd. letter please.

TUAC

NEW TUAC POWER MODULES. Now in their second successful year offering more power and quality than ever before.



TP100
Illustrated
£15·25

- ★ 125 Watts RMS continuous sine wave output
- ★ 4 RCA 150 Watt 15 Amp output transistors
- ★ Special layer wound driver transformer
- ★ Short, open, and thermal overload protection
- ★ Compact size: 7 x 6½ x 3 in.

TL100
Illustrated
£11·50

- ★100 Watts RMS sine wave
- ★2 RCA 15 Amp output transistors
- ★Rugged transformer driver
- ★Full thermal overload protection
- ★Compact size: 5 x 5 x 3 in.

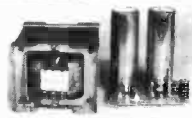
TL60 **£9·75**

- ★ 60 Watts RMS sine wave
- ★RCA 115 Watt output transistors
- ★Only six connections to make
- ★Same size as TL100

Specification on all three power modules :
All output power ratings ±1dB. Output impedance 8–15 Ohms. THD at full power 1% typically 0·5%. Input sensitivity 60mV into 10kΩ. Frequency response 10Hz–25kHz ±2dB. Hum and noise better than −75dB.

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

PS 125	±50 volts for one TP100	£8 75
PS 100	±45 volts for one TL100	£8 00
PS 60	±40 volts for one TL60	£6 75
PSU 2	For supplying Disco Mixer	£3 50

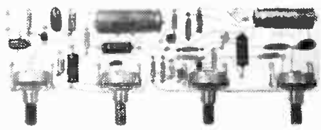


PRE AMPLIFIERS

All Tuac audio modules are constructed on glass fibre P.C. board, are ready assembled and fully tested. Low noise silicon and FET transistors together with H.S. carbon film resistors are used throughout. Extensive research has gone into the various wide range tone control circuits, producing superb sound quality from any signal. Previous range still available. 40V d.c.; 60mV o/p.

VA08	Vol, Treb, Mid and Bass Controls. HI IMP. FET I/P. Suitable Mic, Guitar, Radio, Crystal/Ceramic P.U. Sensitivity 4mV. Treb +35dB at 16kHz. Mid +20–15dB at 1kHz, Bass +20–10bB at 40Hz.	£4·22
VA06	Vol, Treb and Bass Controls. 8mV sensitivity. Treb +28–15dB at 12kHz, Bass ±18dB at 40Hz.	£3·72
AMF01	**Tuac Auto Fade Unit fades music when you speak.** Auto Mic Over-ride for Disco use. Feed Deck and Mic Pre-amps in. Auto fade O/P to main Amp. 30mV operating level. Depth and Vol. Controls.	£4·40

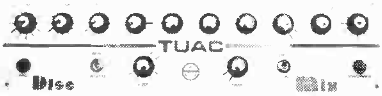
VA08 ILLUSTRATED



SIZE 6½″ x 2″ x 1″

ALL PRICES INCLUDE V.A.T. AND POSTAGE AND PACKING

ACCESS & BARCLAY CARDS ACCEPTED, JUST SEND US YOUR NUMBER. H.P. ARRANGED THROUGH PAYBONDS.



TUAC DISCOTHEQUE MIXER WITH AUTO FADE **£22·50**
Designed for the discerning D.J. of professional standard.
Offering a vast variety of functions.
Controls: Mic Vol, Tone, Over-ride depth, Auto Manual Sw. Tape Vol, L & R Deck Faders, Deck Volume. Treb. & Bass. H. Phon Vol, Selector. Master Vol, on/off sw. Max. output 1V RMS. Specification as VA06. **PANEL SIZE 18″ x 4½″ DEPTH 3″**

TUAC HIGH POWER AMPLIFICATION—built to high standards, and built to last

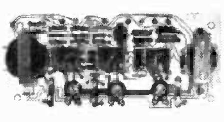
50 WATT RMS SINE WAVE ALL PURPOSE AMPLIFIER

Suitable for Disco, PA, Guitar. 4 inputs, 2 volume controls. Master volume, treble, middle and bass controls. Rugged circuit, rugged leather-cloth covered case, short and open circuit protection. Tone control specification as VA08 pre-amp. FULLY FUSED.

50 WATT £42·25

100 WATT £61·50

TUAC LIGHT MODULATORS



3 Channel SILMB Illus.

Constructed on glass fibre P.C. board, individually tested. **Three channel light modulator** will control three separate sets of lights, up to 1000 Watts each set. One channel responds to the bass, one to the middle, and one to the high frequencies. Input sensitivity only 0·5 Watt! Three individual controls allow for adjustment of the three channels, and a master sensitivity control allows for input levels up to 100 Watts to be safely accommodated. Full interference suppression. Full wave control. Isolating input transformer does not affect Amplifier operation. Fully Fused.

SILMB 3 Channel £17·45

SINGLE CHANNEL VERSION S2LMB
Increased capacity of 1800 Watts. Sensitivity control. Isolating input transformer does not affect amplifier operation.

S2LMB 1 Channel £6·47

MANUFACTURERS OF ELECTRONIC AND AMPLIFICATION EQUIPMENT
SPECIALISTS IN QUALITY TRANSISTOR EQUIPMENT
OPEN 6 DAYS A WEEK. 9.30 a.m. – 6.00 p.m.

TUAC

TRANSISTOR UNIVERSAL AMPLIFICATION COMPANY LTD.
163 MITCHAM ROAD, LONDON SW17 9PG
01-672 3137/9080

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

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

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

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

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

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

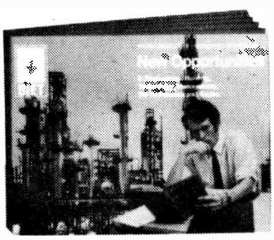
Among many other interesting experiments, the Radio set you build—and it's a good one—is really a bonus. This is first and last a teaching course, but the training is as fascinating as any hobby and it could be the springboard for a career in Radio and Electronics.

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

Specialist Booklet

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

FREE



BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Dept. BPE21 ALDERMASTON COURT, READING RG7 4PF

Accredited by the Council for the Accreditation of Correspondence Colleges.

POST THIS COUPON FOR FREE BOOK

CL BPE21

NAME .... AGE ....
(BLOCK CAPITALS)

ADDRESS ....

....

....

SUBJECT OF INTEREST ....

FM TUNER

NELSON-JONES

PUSH BUTTON VARICAP

Tuning now available.

Six Position variable push button unit with individual frequency scales. **Teak case and full metalwork matches the Texan amp.**

Approved parts of this outstanding design. Featuring 0·75μV sensitivity. Mosfet front end. Ceramic I.F. strip. Triple gang tuning. S.A.E. please for lists.

PE RONDO

We are kit stockists for this excellent design

LIGHT EMITTING DIODES

RED only **29p** each 10 + 23p

GREEN only **69p** each 10 + 59p

7 SEGMENT LED DISPLAY

0·325in Characters 0–9 and nine letters. TTL, DTL compatible. ONLY **£2·46** each, p.p. 10p.

Please add 10% V.A.T. for U.K. orders.

INTEGREX LIMITED, DEPT. P.E.
P.O. BOX 45, DERBY DE1 1TW
Tel.: Repton (0283 89) 3580

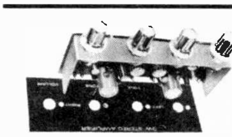
All items advertised in previous numbers of this magazine still available.

4½in × 3½in METER. 30μA, 50μA or 100μA, **£2·86.**

TAPE RECORDER LEVEL METER
500μA, 55p

MULTI-METER
Model 200H
20,000 ohm/volt, **£5·28.**

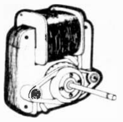
CARDIOID DYNAMIC MICROPHONE
Model UD-130. Frequency response 50–15,000c/s. Impedance Dual 50K and 600 ohms, **£4·95.**



3 WATT STEREO AMPLIFIER
£4·30

All above prices include 10% V.A.T. Please add 10p for P. & P. on orders under £5. LARGE S.A.E. for List No. 6. Special prices for quantity quoted on request.

M. DZIUBAS
158 Bradshawgate • Bolton • Lancs. BL2 1BA

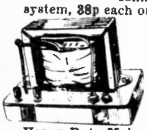


MAINS MOTOR
Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **72p**. Postage 20p for first one then 10p for each one ordered.

MUSIC ON TAPE
A further buy enables us to offer these at an even lower price—namely **65p** each or 5 for **£2·50**. Send for list of titles. We can't repeat when sold out.

BALANCED ARMATURE UNIT
500 ohm, operates as speaker or microphone, so useful in intercom or similar circuits. **37p** each, 10 for **£3·76**.

CAR ELECTRIC PLUG
Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. **38p** each or 10 for **£3·42**.



12 VOLT 1½ AMP POWER PACK
This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mF smoothing. Price **£2·20**, plus 20p post & packing.

Heavy Duty Mains Power Pack. Output voltage adjustable from 15-40V in steps—maximum load 250W—that is from 6 amp at 40V to 15amp at 15V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage adjustment is very quick—simply interchange push on leads. Silicon rectifiers and smoothing by 3,000mF. Price **£6·33** plus 65p post.

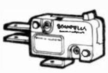
BAKELITE INSTRUMENT CASE
Size approx. 6¾" × 3¾" × 2" deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price. **50p** each.
Paxolin lid **11p** extra.

MINIATURE WAFER SWITCHES
2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **25p** each.

CONNECTING WIRE
7·0076 Copper conductors. 500 metre drums available in the following colours: Red/Brown, Yellow, Green/Grey, Blue/Green, Red/Orange, Green/White, Grey/White, Blue/Orange, Brown/Red, Brown/White, Red/Grey, Blue/Grey, Blue/Brown. Price **£2·20** per drum plus 40p post. State alternative colours.

Screened Cable. 70076 core suitable for pick up or mike lead or for inter-connecting amplifiers. 10 metres. **33p**.

DOOR SWITCH
As fitted to refrigerators, etc. Switches off as door closes. White **17p** each. Black **15p** each.



MICRO SWITCH
5 amp changeover contacts, **11p** each. 10 for **99p**. 15 amp on/off. Model **15p** each. Changeover **19p** each.

U.V. LIGHTING
Useful for flaw detection in metals and for looking for water marks, etc., also for fitting over tropical fish tanks—African violets and other indoor plants which must have U.V. for healthy growth. The outfit comprises of a 12in U.V. tube—choke—starter holder and tube ends. Price **£2·20** plus 20p post.

80 WATT TUBULAR ELEMENTS
Brass encased with beaded flex ends. Standard replacements in most absorbtion type refrigerators but also has dozens of other uses. **83p** each.

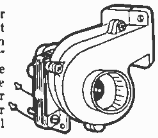
SPIT MOTOR
200-250V Induction Motor, driving a Carter gear box with 1⅛in. of output drive shaft running at 5 revs per minute. Intended for roasting chickens also suitable for driving models—windmills, coloured disc lighting effect, etc., etc. **£2·04** plus 20p post and insurance.

SWITCH TRIGGER MATS
So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc.
24in × 18in **£1·69**.
13in × 10in **£1·21**.

ROCKER SWITCH
13 amp self-fixing into an oblong hole. Size approximately 1" × ⅝" **9p** each, 10 for **82p**.

KETTLE ELEMENTS
Made by the famous A.E.I. Co. Complete with washers and combined fixing ring and plug shroud. Normal 2 round pin and flat pin earth connection and overload reset push button. 2 Models—1⅛in. (approx.) suitable for Swan and other similar models—1⅜in. (approx.) suitable for G.E.C. Hotpoint, etc. All quick boil 2¼kW elements at 240V. Price **£1·38** each.

MULLARD AUDIO AMPLIFIERS
All in module form, each ready built complete with heat sinks and connection tags, data supplied.
Model 1153 500mW power output **72p**.
Model 1172 750mW power output **94p**.
Model EP9000 4 watt power output **£1·66**.
Unilex DIY STEREO. Complete **£11·30**.



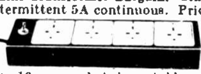
CENTRIFUGAL BLOWER
Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quiet running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½" × 4½" × 4". When mounted by flange, air is blown into the equipment but to suck air out, mount it from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering etc. etc. A real bargain at **£2·05**.

MIGHTY MIDGET
Probably the tiniest possible radio, as described in Practical Wireless, 4 January 73. All electronic parts **£2·20** post paid.

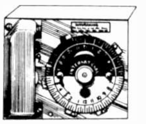
TAPE PLAYBACK UNITS


Mains operated. Made by Reditune the famous "music in the background people". These are complete units for playing tape at standard speed (3¾"). These have a superior motor driven fly wheel to control the tape through the capstan and also an even equally useful valve amplifier with EL84 output. In a steel case with carrying handle. Tested and in good working order **£6·50** or some in need of repair but complete **£3·50**. Cassettes of tape pre-recorded **£1·10** (please state type of music required). 75p carriage up to 200 miles then 50p per 100 miles extra.

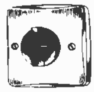
6 MAINS TRANSFORMERS
Our Ref: MTM1 27V at 8A. Upright mounting fully shrouded—flying leads—fully tapped primary. Price **£3·30**.
Our Ref: MTM2. 12V at 1A. Upright mounting with fixing lugs, tag connections. 240V primary—12V 1A secondary. Price **83p**.
Our Ref: MTM3. 6·3V 2A upright mounting with fixing lugs, tag connections, 240V primary 6·3V 2A secondary. Price **77p**.
Our Ref: MTM4. 18V—½A with thermal cut-out. upright mounting with fixing lugs—tag connections. Primary 240V—secondary 18V at ½A. Price **88p**.
Mains Isolation, 350W earth shielded—flex leads—upright mounting lugs for fixing terminals for output. Price **£6·50** each.
Mains Transformer Bargain. Standard mains 240V input. Secondary 2·4V 9A intermittent 5A continuous. Price **55p**.



DISTRIBUTION PANELS
Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2·50** plus 20p post and insurance.



24-HOUR TIME SWITCH
Made by Smiths, these are A.C. mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. Two completely adjustable time periods per 24 hours, 5A changeover contacts will switch circuit on or off during these periods. **£2·75** post and ins. 25p. Additional time contacts **55p** pair.

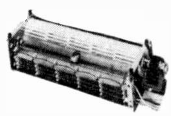


THYRISTOR LIGHT DIMMER
For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price **£2·95**, plus 20p post and insurance. Industrial model 5A **£3·30**. Not on plate.

THIS MONTH'S SNIP
WALL THERMOSTATS
Made by the famous Smiths Instrument Co. called Colourstat. Wall mounting and in a handsome plastic case (cream and beige). Adjustable by slider (lockable) and may be set to control temperatures from around freezing through to 50°C. The slide panel is engraved and indicates "frost, "warm", "very warm", etc. The thermostat will control heaters, etc., up to 15A at normal mains voltage and is ideal for living room, bed room and greenhouse, etc. Price **£1·65**. Don't miss this.

THE TWENTYLITE
Fluorescent lighting units with polyester choke and finished white enamel. 2ft. model, ideal kitchen, bedroom, hallway, porch, lift, etc., with tube. Assembled ready to install. Price **£2·20** + 40p P. & P.

10 AMP. DIMMER/CONTROLLER
For the control of lighting of stage or studio or portable equipment in workshops, etc. This has socket outlets each controlled by 5 AMP Solid State Regulator. Also fitted with master switch fuse and neon indicator and terminating with 6 feet of flex. Overall length 17in. 3⅛in. x 1⅛in. deep. £7·50 plus 25p P. & P.



TANGENTIAL HEATER UNIT
This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. **£3·85**. 2kW Model as above except 2kW **£2·75**. Don't miss this. Control Switch **44p**. P. & P. 40p.

Voltage Changing Transformers made by Parmeko. Upright mounting, fully shrouded and with terminal blocks for input and output. For changing mains voltage, ideal for working low voltage equipment from 230/240 mains and for increasing voltage due to losses in long leads. Voltage up or down between 190–250V 250W. Price **£1·65** plus 30p post, etc.

Door Opening or Platform Rotating Motors. Very powerful motors estimated rating at ¼ h.p. Reversible with gearbox and "V" belt drive wheel of 7in diameter. Price of motor which weighs approx. 15lb is **£10**. *Note.* These are ex-equipment but guaranteed for six months.

Gas and Smoke detector/Sensor—ref. GD1—recently referred to as the electronic nose—**£2** each; circuit of smoke detector alarm included. Constructional details appeared in September's Practical Wireless, so we can supply the SL03D at **£1·75**, the ZN414 at **£1·35**, also most other items, send for PW10 radio parts list.

Spring Return Wafer Switch. As used in intercom and other similar equipment a two wafer 6 pole 3 way switch, spring return from centre position when turned clockwise and permanent off or on when turned anti-clockwise. Price **55p** each.

A.C. Buzzers. 12V. Fix these into a box which will resonate and they will give a loud piercing note. Suitable for alarms or signal. **33p** each.

Push-on Tag Connectors. These are being increasingly used on cars and domestic appliances. 2 sizes prevail, the most popular being for ¼in tag. We offer these at attractive prices. 10 for **10p**; 50 for **40p**; 100 for **70p**; 1,000 for **£5**.

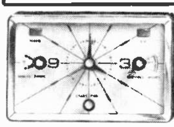
4 Minute Timed On Switch by Smiths. Our ref. TS AU1. This is for processing photographic plates, etc. Has a scale graduated 0–4min. Turn the pointer knob, and set it at the desired time—switch will stay closed until pointer knob returns to zero. Clockwork motor, so can be independent of mains if desired, but the switch itself is double pole, rated 250V, 15Amps. Price **£1·65**.

One Hour Timed On Switch by Smiths. Our ref. TS AU2. As TS AU1 except that the complete rotation of the pointer knob lasts for 1hr. Price **£1·10** each.

DRILL CONTROLLER
NEW IKW MODEL
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·95**. 13p post and p. Made up model also available. **£2·95**.

MAINS TRANSISTOR POWER PACK
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1·10**. Plus 20p postage.

Stereo Pre-amp Module. Mullard ref. LP 7182/2—transistors and all ancillary components mounted on PC board **£1·32** with connection dig.



15A ELECTRICAL PROGRAMMER
Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders — have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price **£2·15** + 20p p. & p. or with glass front chrome bezel **83p** extra.

THERMAL CUTOUT
A miniature device ⅜in dia. on one screw fixing mount—can be used for motor overload protection, fire alarm, soldering iron, switch off, etc., etc. 15 amp contacts open with flame—radiant or conducted heat. **11p** each or 10 for **99p**.

HONEYWELL PUSH BUTTON MICRO SWITCHES
As used in some vending machines, etc. Each switch is a changeover type rated at 15A 250V a.c. Intended for panel mounting with fixing nuts and single black push knob. Single changeover switch **28p**, Double switch **42p**, Triple switch **61p**.

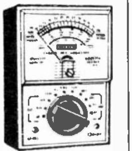
MACLAREN THERMOSTAT
Make and break 20A a.c. with the sensor probe coupled by 2 feet capillary covering range of 10–100°C—complete with large engraved control knob. Price **83p**.

TERMS: 10% discount if ten of an item ordered, send postage where quoted—other items, post free if order for these items is £6·00, otherwise add 20p.

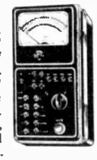
J. BULL (ELECTRICAL) LTD.
(Dept. P.E.), 7 Park Street, Croydon CRO 1YD
Callers to 102/3 Tamworth Road, Croydon

GWS G.W.SMITH & CO (RADIO) LTD

AUDIOTRONIC MODEL ATM.1
Top value 1,000 o.p.v. pocket multimeter. Ranges: 0/10/50/250/1,000V. A.C. and D.C. D.C. Current 0–1mA/100mA. Resistance: 0/150K ohms. Decibels: -10 to +22dB. Size: 90 × 60 × 28mm. Complete with test leads. **£2·95.** Post 15p.



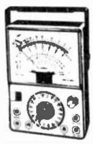
RUSSIAN 22 RANGE MULTIMETER
Model U437 10,000 O.P.V. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1,000V d.c. 2·5/10/50/250/500/1,000V a.c. D.c. current 100wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3mΩ. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE **£4·95.** Post 25p.



MODEL 500 30,000 O.P.V.
with overload protection mirror scale 0/0·5/2·5/20/25/100/250/500/1,000V d.c. 0/2·5/10/25/100/250/500/1,000V a.c. 0/50μA/5/50/500mA. 12 amp. d.c. 0/60/K/6 Meg./60 MegΩ. **£10·50.** Post paid. Leather case **£1·75.**

U4312 MULTIMETER
Extremely sturdy instrument for general electrical use, 667 O.P.V. 0/0·3/1·5/7·5/30/60/150/300/600/900V d.c. and 75mV. 0/0·3/1·5/7·5/30/60/150/300/600/900V a.c. 0/300μA/1·5/6/15/60/150 600MA/1·5/6 amp. d.c. 0/1·5/15/60/150/600MA/1·5/6 amp. a.c. 0/200Ω/3k/30kΩ. Accuracy Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. **£9·75.** Post 25p.

HIOKI MODEL 700X
100,000 O.P.V. Overload protection. Mirror scale. 0·3/0·6/1·2/1·5/8/6/12/30/60/120/300/600/1,200V d.c. 1·5/3/6/12/30/60/150/300/600/1,200V a.c. 15/30μA/3/6/30/60/150/300mA 6/12 amp. d.c. 2K/200K/2 Meg/20 Meg ohm −20 to +63dB. **£14·95.** Post 20p.



MODEL C-7080 EN
Giant 6in mirror scale. 20,000 O.P.V. 0/0·25/1/2·5/10/50/250/1,000/5,000V d.c. 0/2·5/10/50/250/1,000/5,000V a.c. 0/50μA/1/10/100/500mA/10 amp. d.c. 0/2K/200K/20 meg. −20 to +50dB. **£13·95.** Post 35p.

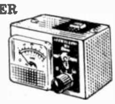
370 WTR MULTIMETER
Features a.c. current ranges. 20,000 O.P.V. 0/0·5/2·5/10/50/250/500/1,000V d.c. 0/2·5/10/50/250/500/1,000V a.c. 0/50μA/1/10/100mA/1/10 amp. d.c. 0/100mA/1/10 amp. a.c. 0/5K/50K/500K/5MEG/50MEG. −20 +62dB. **£17·50.** Post 25p.

TMK LAB TESTER
100,000 O.P.V. 6½in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 500, 1,000V. D.c. current: 10, 100μA, 10, 100, 500mA, 2·5, 10A. Resistance: 1K, 10K, 100K, 10 meg. 100 meg. Decibels: −10 to +49dB. Plastic case with carrying handle, size 7½in × 6½in × 3½in. **£19·95.** P. & P. 25p.

ALL PRICES ARE SUBJECT TO 10% VAT

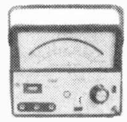
Model S-100TR MULTIMETER/TRANSISTOR TESTER.
100,000 O.P.V. mirror scale/overload protection. 0/0·12/0·6/3/12/30/120/600V d.c. 0/6/30/120/600V a.c. 0/12/600μA/12/300mA/12 amp. d.c. 0/10 K/1 MEG/100 MEG. −20 to +50dB. 0·01–2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. **£14·95.** Post 25p.

LB3 TRANSISTOR TESTER
Tests ICO and B. *Pnp/npn.* Operates from 9V battery. Complete with all instructions, etc. **£3·95.** Post 20p.

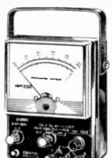


LB4 TRANSISTOR TESTER
Tests PNP or NPN transistors. Audio indication. Operates on two 1·5V batteries. Complete with all instructions, etc. **£4·50.** Post 20p.

MODEL 449A IN CIRCUIT TRANSISTOR TESTER
Checks true a.c beta in/out. Checks Icbo. Checks diodes in/out. Checks SCR, etc. Beta H1 10—500 LO 2—50 Ibco 0·5000μA. 220/240V a.c. operation. **£17·50.** Post 25p.



KAMODEN HM-350 TRANSISTOR TESTER
High quality instrument to test Reverse Leak current and D.C. current. Amplification factor of NPN, PNP, transistors, diodes, SCR's, etc. 4" × 4½" clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. **£12·50.** Post 30p.



TE-65 VALVE VOLTMETER
28 ranges. D.c. volts 1·5–1,500V a.c. volts 1·5–1,500V. Resistance up to 1,000 megohms. 200/240V a.c. operation. Complete with probe and instructions. **£17·50.** Post 30p. Additional probes available: R.F. **£2·12**; H.V. **£2·50.**

KAMODEN 72.200 MULTITESTER
High sensitivity tester. 200,000 o.p.v. Overload protection. Mirror scale. Ranges: 0/0·06/0·3/3/30/120/600/1,200V d.c., 0/3/12/60/300/11,200V a.c. 0/6μA/1·2mA/120mA/600mA/12A d.c. 0/12A a.c. −20 to +63dB. 0/2kΩ/200kΩ/2MΩ/200MΩ. **£16·95.** Post 30p.

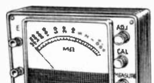
MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER
Sensitivity 330 ohms/Volt a.c. and d.c. Accuracy 0·5% d.c. 1% a.c. Scale length 165mm. 0/300/750μA/1·5/3/7·5/15/30/75/150/300/750mA/1·5/3/7·5 amp. d.c. 0/3/7·5/15/30/75/150/300/750mA/1·5/3/7·5 amp. a.c. 0/75/150/300/750mV/1·5/3/7·5·15·30/75/150/300/750V d.c. 0/750mV/1·5/3/7·5/15/30/75/150/300/750V a.c. Automatic cut out. Supplied complete with test leads, manual and test certificates. **£49.** Post 50p.

KAMODEN HM720B F.E.T. V.O.M.
Input impedance 10MΩ. Ranges: 0/0·25/1/2·5/10/50/250/1,000V d.c. 0/2·5/10/50/250/1,000V a.c. 0/25μA/2·5/25/250MA d.c. −20 to +62dB. 0/5k/50k/500k/5MΩ/500MΩ. **£14·95.** Post 30p.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER
10 meg. input 10 ranges: 01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4cps.-1·2 Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. a.c. **£17·50.** Carr. 25p.

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER
Battery-operated. 11 meg input. 26 ranges. Large 4½in mirror scale. Size 5½in × 4½in × 2½in. D.c. volts 0·3–1,200V. A.c. volts 3–300V R.M.S. 8·0–800V P-P. D.c. Current 0·12–12MA. Resistance up to 2,000M ohm. Decibels −20 to +51dB. Complete with leads/instructions. **£17·50.** P. & P. 20p.

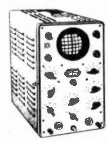
KAMODEN HMG-500 INSULATION RESISTANCE TESTER
Range 0–1,000 Megohms, 500 Volt. Battery operated. Wide range clear meter 4½" × 4". Complete with de-luxe carrying case, batteries, instructions. **£19·95.** Post 30p.



MODEL TE15 GRID DIP METER
Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in 6 coils. 500μA meter. 9V battery operation. Size 180mm × 80mm × 40mm. **£15.** Post 20p.

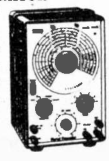
TO-3 PORTABLE OSCILLOSCOPE
3in tube, Y amp. Sensitivity 0·1V p-p/CM. Bandwidth 1·5cps-1·5MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9V. p-p/CM. Bandwidth 1·5cps-800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10cps-300kHz. Synchronisation. Internal/external. Illuminated scale 140mm × 215mm × 330mm. Weight 15½lb. 220/240V a.c. Supplied brand new with handbook. **£52·50.** Carr. 50p.

CI-5 PULSE OSCILLOSCOPE
For display of pulsed and periodic waveforms in electronic circuits VERT. AMP. Bandwidth 10MHz. Sensitivity at 100kHz V RMS/mm. 0·1·25; HOR. AMP. Bandwidth 500kHz. Sensitivity at 100kHz, V RMS/mm. 0·3·25; Pre-set triggered sweep 1·3,000μsec.; free running 20–200,000Hz in nine ranges. Calibrator pips. 220mm × 360mm × 430mm, 115·230V a.c. operation. **£39.** Carr. paid.



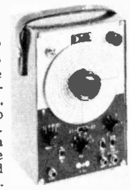
RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE
5MHz Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in × 4in C.R.T. Calibrated triggered sweep from 0·2μ/sec to 100 milli-sec per cm. Free running time base 50 Hz-1MHz. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual. **£87.** Carr. paid.

TE-20D RF SIGNAL GENERATOR
Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output, Xtal socket for calibration. 220/240V a.c. Brand new with instructions. **£17·50.** Carr. 37p. Size 140mm × 215mm × 170mm.

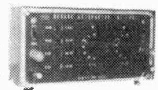


TE22 SINE SQUARE WAVE AUDIO GENERATORS
Sine: 20c/s to 200 kc/s on 4 bands. Square: 20c/s to 30 kc/s. Output impedance 5,000 ohms. 200/250V a.c. Supplied brand new and guaranteed with instruction manual and leads. **£17·50.** Carr. 37½p.

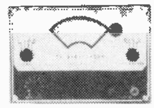
ARF-300 AF/RF SIGNAL GENERATOR
All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine/square 10v. P-P. RF 100 KHz to 200 MHz. Output 1v. maximum. Operation 220/240v. AC. Complete with instructions and leads. **£29·95.** Post 50p.



MODEL AT201 DECADE ATTENUATOR
Frequency range 0-200kHz. Attenuator 0-111dB, 0·1dB step. Impedance 600 ohms. Max. Input power 30dBm. Size 180mm × 90mm × 55mm. **£12·50.** Post 37p.

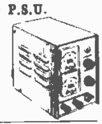


BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR
Sine 18–200,000 Hz: Square 18–50,000 Hz. Output max. +10dB (10 K ohms) Operation internal batteries. Attractive 2-tone case 7½in × 5in × 2in. Price **£17·50.** Carr. 17p.



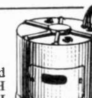
MCA.220 AUTOMATIC VOLTAGE STABILISER
Input 88–125V a.c. or 176–250V a.c. Output 120V a.c. or 240V a.c. 200VA rating. **£11·97.** Post 50p.

PS.200 REGULATED P.S.U.
Solid state. Variable output 5–20V d.c. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240V. a.c. Size 7½in. × 5½in. × 3½in. **£19·95.** Post 25p.



PS.100B REGULATED POWER SUPPLY
Solid state. Output 6, 9 or 12V d.c. up to 3 amps. Meter to monitor current. Input 220/240V a.c. Size 4in. × 3½in. × 6½in. **£11·97.** Post 25p.

230V/240V SMITHS SYNCHRONOUS GEARED MOTORS
Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 2 RPH ACW; 30 RRH CW. **50p** each, Post 12p.



POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼in dia. shafts. Bulk quantities available.

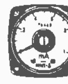
25 WATT. 10/25/50/100/250/500/1000 ohms. **95p.** P. & P. 10p.

50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms. **£1·35.** P. & P. 10p.

100 WATT. 1·5/10/25/50/100/250/500/1000 or 2500 ohms. **£1·95.** P. & P. 15p.

240° Wide Angle 1ma Meters

MW1-6 60mm square **£3·97**
MW1-8 80mm square **£4·97**
Post extra



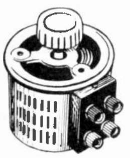
JOSTY KIT
HIGH QUALITY CONSTRUCTION KITS
Appointed stockists at all branches
Complete with comprehensive, easy to follow instructions, and covered by full guarantee
Post and packing 15p per kit

AF20	Mono transistor amplifier	£4.80
AF30	Mono transistor pre amplifier	£2.61
AF310	Mono amplifier (use two for stereo)	£5.91
AT5	Automatic light control	£2.58
AT30	Photo cell switching unit	£5.70
AT50	400W Triac light dimmer/speed control	£4.80
AT56	1,300W Triac light dimmer/speed control	£5.70
AT56	2,200W Triac light dimmer/speed control	£8.90
AT60	Psychedelic light control, single channel	£7.80
AT65	Psychedelic light control 3 channel	£14.65
HF61	Medium wave transistor radio	£3.33
HF75	FM transistor receiver	£2.86
HF310	FM tuner unit	£15.61
HF325	De luxe FM tuner unit	£24.12
HF330	Stereo decoder for HF310/HF325	£9.96
HF395	Aerial amplifier for AM/FM bands I, II, III	£1.77
OP310	Stereo pre-amp for use with 2x AF310	£21.27
GU330	Tremolo unit for guitars etc	£7.50
NT10	Power supply 100 m/a 9V stab 12V unstab	£6.15
NT300	Professional stabilized power supply 2x 30 Volt, 2 2 Amp	£12.51
NT305	Transistor converter 12/15V AC/DC to 6V, 7.5V or 9V DC	£4.50
NT310	Power supply 240V AC to 2x 18V DC at 2 Amps	£4.80
NT315	Power supply 240V AC to 4.5–15V DC 500 m/a	£9.57

"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

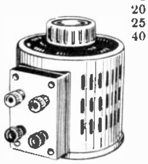
Excellent quality at low cost. All models—Input 230v. 50/60 c/s. Variable output 0-260v.

MODEL S-260 GENERAL PURPOSE BENCH MOUNTING



1 amp.	£7·00
2·5 amp.	£8·05
5 amp.	£11·75
8 amp.	£15·90
10 amp.	£22·50
12 amp.	£23·60
20 amp.	£49·00
25 amp.	£58·00
40 amp.	£82·50

MODEL S-260B



Panel mounting

1 amp	£7·00
2·5 amp	£8·05

Carriage and Packing Extra

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.

80W	£2·35	P. & P. 18p
150W	£3·00	P. & P. 18p
300W	£4·00	P. & P. 23p
500W	£5·80	P. & P. 33p
1000W	£8·25	P. & P. 38p
1500W	£11·25	P. & P. 43p
2250W	£19·00	P. & P. 50p
5000W	£40·00	P. £1P.&

230 VOLT A.C. 50 CYCLES RELAYS

Brand new. 3 sets of changeover contacts at 5 amp. rating. 40p each. Post 10p (100 lots £30) Quantities available.

REFLEX HORN SPEAKER RUH.6

Built in driver unit. Impedance 16 ohm. Power rating 10W. Response 380–7,000Hz. Approx. size 6in × 6in. Weatherproof and shock proof.

OUR PRICE **£4.97** P. & P. 30p

BVD.5 VERNIER TUNING DIAL

Approx. 7-1 ratio planetary drive vernier dials. Log scale 0–180 degrees. Blank scales 1 to 5. Scale width 4½in. Dial size 5in × 3in. Overall size 7¼in × 4¾in × 1⅞in deep including knob and coupling. ¼in dia. shaft.

OUR PRICE **£1·62** P. & P. 15p

SEW CLEAR PLASTIC PANEL METERS

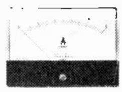
USED EXTENSIVELY BY INDUSTRY, GOVT. DEPTS., EDUCATIONAL AUTHORITIES, ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available.
Send for fully illustrated brochure.

TYPE SW.100 100mm × 80mm Fronts

50μA	£4·15	5 amp. d.c.	£3·60
50-0-50μA	£3·95	300V a.c.	£3·70
100μA	£3·95	VU Meter	£4·30
100-0-100μA	£3·90		
500μA	£3·70		
1mA	£3·60		
20V d.c.	£3·60		
50V d.c.	£3·60		
300V d.c.	£3·60		
1 amp. d.c.	£3·60		

Type SD.830 82·5mm × 110mm Fronts



50μA	£3·40	10mA	£3·10
50-0-50μA	£3·40	50mA	£3·10
100μA	£3·35	100mA	£3·10
100-0-100μA	£3·35	500mA	£3·10
200μA	£3·30	1 amp.	£3·10
500μA	£3·15	5 amp.	£3·10
1mA	£3·10	10 amp.	£3·10
5mA	£3·10	5V d.c.	£3·10
		10V d.c.	£3·10
		20V d.c.	£3·10
		50V d.c.	£3·10
		300V d.c.	£3·10
		15V a.c.	£3·30
		300V a.c.	£3·30
		VU Meter	£3·50

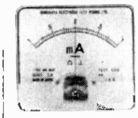
Type SD.640 63·5mm × 85mm Fronts

50μA	£3·05	500mA	£2·90
50-0-50μA	£3·05	1 amp.	£2·90
100μA	£3·00	5 amp.	£2·90
100-0-100μA	£3·00	10 amp.	£2·90
200μA	£3·00	5V d.c.	£2·90
500μA	£2·95	20V d.c.	£2·90
1mA	£2·90	50V d.c.	£2·90
5mA	£2·90	300V d.c.	£2·90
10mA	£2·90	15V a.c.	£3·00
50mA	£2·90	300V a.c.	£3·00
100mA	£2·90	VU Meter	£3·15

Type SD.460 46mm × 59·5mm Fronts

50μA	£2·80	1 amp.	£2·60
50-0-50μA	£2·80	5 amp.	£2·60
100μA	£2·75	10 amp.	£2·60
100-0-100μA	£2·75	5V d.c.	£2·60
200μA	£2·70	10V d.c.	£2·60
500μA	£2·55	20V d.c.	£2·60
1mA	£2·60	50V d.c.	£2·60
5mA	£2·60	300V d.c.	£2·60
10mA	£2·60	15V a.c.	£2·70
50mA	£2·60	300V a.c.	£2·70
100mA	£2·60	VU Meter	£2·90
500mA	£2·60		

Type MR.85P. 4¼in. × 4¼in. Fronts



50μA	£4·40	50mA	£3·90
50-0-50μA	£4·25	100mA	£3·90
100μA	£4·25	500mA	£3·90
100-0-100μA	£4·05	1 amp.	£3·90
200μA	£4·05	5 amp.	£3·90
500μA	£3·90	15 amp.	£3·90
5000-500μA	£3·90	30 amp.	£3·95
1mA	£3·90	20V d.c.	£3·90
1-0-1mA	£3·90	50V d.c.	£3·90
5mA	£3·90	150V d.c.	£3·90
10mA	£3·90	300V d.c.	£3·90
		15V a.c.	£3·95
		300V a.c.	£3·95
		8 Meter 1mA.	£3·90
		VU Meter	£4·55
		1 amp. a.c.*	£3·90
		5 amp. a.c.*	£3·90
		10 amp. a.c.*	£3·90
		20 amp. a.c.*	£3·90
		30 amp. a.c.*	£3·90

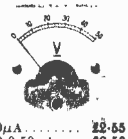
Type MR.52P. 2¼in. square Fronts.

50μA	£3·50	10V d.c.	£2·50
50-0-50μA	£3·05	20V d.c.	£2·50
100μA	£3·00	50V d.c.	£2·50
100-0-100μA	£2·95	300V d.c.	£2·50
500μA	£2·65	15V a.c.	£2·60
1mA	£2·50	300V a.c.	£2·60
5mA	£2·50	8 Meter 1mA.	£2·60
10mA	£2·50	VU Meter	£3·60
50mA	£2·50	1 amp. a.c.*	£2·50
100mA	£2·50	5 amp. a.c.*	£2·50
500mA	£2·50	10 amp. a.c.*	£2·50
1 amp.	£2·50	20 amp. a.c.*	£2·50
5 amp.	£2·50	30 amp. a.c.*	£2·50

Type MR.65P. 3½in. × 3¼in. Fronts

50μA	£3·70	10V d.c.	£2·60
50-0-50μA	£3·15	20V d.c.	£2·60
100μA	£3·15	50V d.c.	£2·60
100-0-100μA	£3·10	150V d.c.	£2·60
200μA	£3·05	300V d.c.	£2·60
500μA	£2·75	15V a.c.	£2·80
500-0500μA	£2·60	50V a.c.	£2·80
1mA	£2·60	150V a.c.	£2·80
5mA	£2·60	300V a.c.	£2·80
10mA	£2·60	500V a.c.	£2·80
50mA	£2·60	8 Meter 1mA.	£2·85
100mA	£2·60	VU Meter	£3·70
500mA	£2·60	50mA a.c.*	£2·60
1 amp.	£2·60	100mA a.c.*	£2·60
5 amp.	£2·60	200mA a.c.*	£2·60
10 amp.	£2·60	500mA a.c.*	£2·60
15 amp.	£2·60	1 amp. a.c.*	£2·60
20 amp.	£2·60	5 amp. a.c.*	£2·60
30 amp.	£2·80	10 amp. a.c.*	£2·60
50 amp.	£2·90	20 amp. a.c.*	£2·60
5V d.c.	£2·60	30 amp. a.c.*	£2·60

Type MR.38P. 1 21/32in. square Fronts.

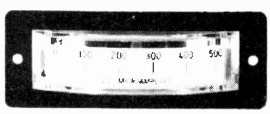


50μA	£2·55	200mA	£2·25
50-0-50μA	£2·50	300mA	£2·25
100μA	£2·45	500mA	£2·25
100-0-100μA	£2·40	750mA	£2·25
200μA	£2·25	1 amp.	£2·25
500μA	£2·25	2 amp.	£2·25
500-0-500μA	£2·25	5 amp.	£2·25
1mA	£2·25	10 amp.	£2.25
1-0-1mA	£2·25	3V d.c.	£2·25
2mA	£2·25	10V d.c.	£2·25
5mA	£2·25	15V d.c.	£2·25
10mA	£2·25	20V d.c.	£2·25
20mA	£2·25	50V d.c.	£2·25
50mA	£2·25	100V d.c.	£2·25
100mA	£2·25	150V d.c.	£2·25
150mA	£2·25	300V d.c.	£2·25
		500V d.c.	£2·25
		750V d.c.	£2·25
		15V a.c.	£2·35
		50V d.c.	£2·30
		150V a.c.	£2·30
		300V a.c.	£2·30
		500V a.c.	£2·30
		8 Meter 1mA.	£2·30
		VU Meter	£2·65

Type MR.45P. 2in. square Fronts.

50μA	£2·70	5 amp.	£2·40
50-0-50μA	£2·65	10V d.c.	£2·40
100μA	£2·60	20V d.c.	£2·40
100-0-100μA	£2·50	50V d.c.	£2·40
200μA	£2·50	300V d.c.	£2·40
500μA	£2·45	15V a.c.	£2·40
500-0-500μA	£2·40	300V a.c.	£2·40
1mA	£2·40	8 Meter 1mA.	£2·50
5mA	£2·40	VU Meter	£2·70
10mA	£2·40	1 amp. a.c.*	£2·40
50mA	£2·40	5 amp. a.c.*	£2·40
100mA	£2·40	10 amp. a.c.*	£2·40
500mA	£2·40	20 amp. a.c.*	£2·40
1 amp.	£2·40	30 amp. a.c.*	£2·40

"SEW" EDGEWISE METERS



Type PE.70. 3 17/32in. × 1 15/32in. × 2¼in. deep.

50μA	£3·75	500μA	£3·20
50-0-50μA	£3·60	1mA	£3·20
100μA	£3·60	300V a.c.	£3·25
100-0-100μA	£3·50	VU Meter	£3·85
200μA	£3·40		

*MOVING IRON—ALL OTHERS MOVING COIL

Please add postage

"SEW" EDUCATIONAL METERS

Type ED.107. Size overall 100mm × 90mm × 108mm.
A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3in. mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

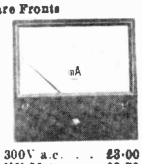
50μA	£6·90	10V d.c.	£5·95
100μA	£6·40	20V d.c.	£5·95
50-0-50μA	£6·40	50V d.c.	£5·95
1mA	£5·95	300V d.c.	£5·95
1-0-1mA	£5·95	Dual range	
1A d.c.	£5·95	500mA/5A d.c.	£7·00
5A d.c.	£5·95	5V/50V d.c.	£7·00

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square Fronts.

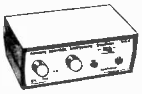
25μA	£4·60	1 amp.	£2·60
50μA	£3·55	5 amp.	£2·60
50-0-50μA	£3·05	15 amp.	£2·60
100μA	£3·00	30 amp.	£2·60
100-0-100μA	£3·00	50 amp.	£2·60
500μA	£2·70	5V d.c.	£2·60
500-0-500μA	£2·60	10V d.c.	£2·60
1mA	£2·60	20V d.c.	£2·60
1-0-1mA	£2·60	50V d.c.	£2·60
5mA	£2·60	150V d.c.	£2·60
10mA	£2·60	300V d.c.	£2·60
50mA	£2·60	50mV d.c.	£2·90
100mA	£2·60	100mV d.c.	£2·90
500mA	£2·60	30V a.c.*	£2·65
		50V a.c.*	£2.65
		150V a.c.*	£2·65
		300V a.c.*	£2.65
		500mA a.c.*	£2·60
		1 amp. a.c.*	£2·60
		5 amp. a.c.*	£2·60
		10 amp. a.c.*	£2·60
		20 amp. a.c.*	£2·60
		30 amp. a.c.*	£2·60
		50 amp. a.c.*	£2·60
		VU Meter	£3·65

Type S-80 80mm square Fronts



50μA	£3·50	300V a.c.	£3·00
50-0-50μA	£3·40	VU Meter	£3·70
100μA	£3·40		
100-0-100μA	£3·30		
500μA	£3·05		
1mA	£3·00		
20V d.c.	£3·00		
50V d.c.	£3·00		
300V d.c.	£3·00		
1 amp. d.c.	£3·00		
5 amp. d.c.	£3·00		

1021 STEREO LISTENING STATION



For balancing and gain selection of loudspks. with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets 6in × 4in × 2½in.

OUR PRICE **£2·25** P. & P. 20p

AUDIOTRONIC AHA101 STEREO HEADPHONE AMPLIFIER

All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. Inputs 5mV/100mV. Output 50mW per channel.

OUR PRICE **£7·50** P. & P. 20p

EA.41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet 7¾in × 3in × 4½in.

OUR PRICE **£7·50** P. & P. 15p

MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individualgain controls enabling complete mixing facilities. Battery operated. 9½in × 5in × 3in. Inputs Mics: 3 × 3mV 50K; 2 × 3mV 600 ohm. Phono mag. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.

OUR PRICE **£8·97** P. & P. 20p

Send S.A.E. for new 8-page list of Semiconductors and Valves

ALL PRICES ARE SUBJECT TO 10% V.A.T.

GWS

ALSO SEE FOLLOWING PAGES

SAVE UP TO 33⅓% OR MORE! GWS

SH628 STEREO HEADPHONES

Outstanding value. Soft ear-pads, adjustable headband. 8-16 ohms. 20-20,000 Hz. Complete with lead and stereo plug.

OUR PRICE **£1·87** P. & P. 30p

LHO2S STEREO HEADPHONES

Lightweight headphones with padded earpieces. 4-16 ohms. 20-20,000 Hz. Complete with 6 ft cord and plug.

OUR PRICE **£1·97** P. & P. 30p

TE1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive magnetic headset with soft earpads. Impedance 2,600 ohms (d.c. 600 ohms). Frequency response 200-4,000 Hz.

OUR PRICE **£2·25** P. & P. 30p

DHO25 STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head-band. 8 ohm impedance. 20-12,000 cps. Complete with lead and plug.

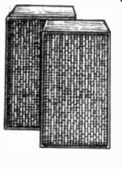
OUR PRICE **£2·25** Carr. 50p

BH001 HEADSET AND BOOM MICROPHONE

Moving coil. Headphone imp. 16 ohms. Mike imp. 200 ohms. Ideal for language teaching, communications etc. Complete with leads and plugs.

OUR PRICE **£4·95** P. & P. 30p

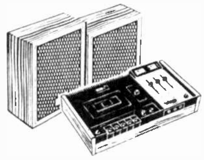
STEREO SPEAKERS



Matched pair of bookshelf speakers. De luxe teak veneered finish. Size 14½ in × 9in × 7½ in 8 ohms. 8W RMS. 16W peak. Complete with DIN lead.

OUR PRICE **£12·95** Carr. Paid

AKAI HI-FI BARGAINS



CS35

STEREO CASSETTE RECORDER

For conventional or Chromium Dioxide tape. 4 track record/playback. Volume and tone controls. Frequency response 40-16kHz (using CrO2 tape), distortion better than 2%, wow and flutter better than 0·2% RMS. Complete with pair of matching Akai CS88 speakers. Rec. Price £96·10.

OUR PRICE **£56·50** P.&P. 50p

CS35D STEREO DECK 4 track record/playback deck. Accepts chrome/regular tape cassettes. Rec. Price £68·30.

GWS PRICE **£44·45** P.&P. 50p

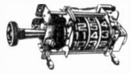
MICROPHONES (P. & P. 50p)
ADM Dynamic (pair) £7·50

3416 STEREO TAPE DECK

4 track. 7½, 3¾, 1⅞ i.p.s. Stereo mono record/play. 7in reels. Inputs for dynamic mikes, radio gram. Complete with cover.

OUR PRICE **£41·95** Carr. 75p

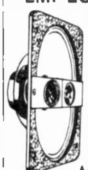
DIGITAL CLOCK MECHANISM DT.55B



Features 24 hour alarm setting with built in buzzer. On/off and auto alarm "sleep" switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off TV, radio, light, etc. and with autosetting will switch on again when required. A.c. 240V operation. Switch rating 250V, 3A.

OUR PRICE **£5·95** P. & P. 30p

EMI LOUDSPEAKERS



Model 350. 13in × 8in with single tweeter /crossover. 20-20,000 Hz. 15W RMS. Available 8 or 15 ohms. £7·25 each. P. & P. 37p.

Model 450. 13in × 8in with twin tweeters/crossover. 55-13,000 Hz. 8W RMS

Available 8 or 15 ohms. £3·62 each. P. & P. 25p.

RECORD DECK PACKAGES

Carriage and Packing 75p
Complete units with Stereo cartridge ready wired in plinth and cover.

GARRARD	
2025 TC/9TAHCD	£11·35
SP25 111/G800	£16·50
SP25 111/M44E	£17·95
SP25 111/M44·7	£17·50
SP25 111/M55E	£18·50
SP25 111 Module/M75-6	£19·45
AP76/G800	£26·45
AP76/G800E	£28·65
AP76/M44E	£27·70
AP76/M44-7	£27·20
AP76/M55E	£28·30
AP76/M75ED	£34·90
AP76/M75EJ	£30·92
AP76 Module M75-6	£29·10
AP96 Module M75-6	£33·20
ZERO 100S Module/M93E	£44·15
B.S.R. McDONALD	
210/8C7M	£7·40
MP60/G800	£16·50
MP60/TPD1/G800	£15·80
MP60/M44-7	£17·50
HT70/TPD1/G800	£19·20
GOLDRING	
GL72/G800	£34·20
GL75/G800	£39·10
GL75/G800E	£41·55

RECORD DECKS

Carriage & Packing 50p

B.S.R. McDONALD	
C114 Mini	£3·95
C129 Mono	£5·50
C137	£7·00
510/TPD1	£13·95
610	£10·55
610/TPD1	£15·45
710	£21·15
810	£26·30
MP60	£8·25
MP60/G800	£10·90
MP60/TPD1	£13·20
MP60/TPD2	£11·25
HT70	£11·60
HT70/G800	£14·25
HT70/TPD1	£16·55
CONNOISSEUR	
BD1 Kit	£9·10
BD1 Chassis	£11·35
BD2/SAU2/Chassis	£22·70
BD2/SAU2/Plinth/Cover	£28·20
GARRARD	
2025 T/C Less Cartridge	£6·35
SP25 111	£9·25
SP25 111/Acos GP104	£6·50
SP25111/G800	£10·95
SP25/M75-6	£13·90
AP76	£18·00
SL65B	£11·15
SL72B	£17·75
SL95B	£31·15
401	£24·35
ZERO 100	£34·10
ZERO 100S	£31·40
GOLDRING	
G99	£22·50
G101P/C	£22·50
GL69/2	£15·75
GL72	£25·45
GL72/P	£33·75
GL75	£32·20
GL75P	£41·65
GL78 P/C	£56·25
GL85/P/C	£72·00
THORENS	
TD125/11	£59·40
TD125AD/11	£92·05
TD160C	£50·80
TL165	£43·80

FANTASTIC OFFER! PORTABLE CASSETTE RECORDER CT5050

Instant recording and playing. Piano key controls. Automatic level control. Built in speaker. Complete with remote control microphone, carrying case and shoulder strap.

OUR PRICE **£8·50** P. & P. 50p

NEW! SINCLAIR CAMBRIDGE CALCULATOR

To build yourself. Complete kit of parts with step by step instructions to build a full specification pocket sized calculator. (Rec. Price £27·23)

OUR PRICE **£24·95** P. & P. 50p

(Also available ready built (Rec. Price £39·95).

OUR PRICE **£27·20** P.&P. 25p

MINUTEMAN MM3 POCKET CALCULATOR

Size only 4 1/16 in × 3in × 1in. 8 digit display with overflow and error indicators. Floating decimal. Adds, subtracts, multiplies and divides. Chain and mixed calculations. Constant factor for series multiplication or division. Complete with batteries, instructions and case.

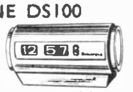
OUR PRICE **£23·95** P.&P. 25p

MINUTEMAN MM3M

as above with addition of memory key, percent key and a fixed or floating decimal. Complete with rechargeable batteries, a.c. adaptor, instructions and case.

OUR PRICE **£28·50** P.&P. 25p

BINATONE DS100 DIGITAL CLOCK



240V mains operation. Ivory case with large clear numbers for hours, minutes and seconds. Approx. size 6¼in × 3in × 3½in.

OUR PRICE **£4·50** P. & P. 30p

SINCLAIR PROJECT 60 PACKAGE DEALS

2 × Z30/Stereo 60/PZ5 £15·95. P. & P. 37p.

2 × Z30/Stereo 60/PZ6 £18·00. P. & P. 37p.

2 × Z50/Stereo 60/PZ8 £20·25. P. & P. 37p.

Transformer for PZ8 £3 extra.

Active Filter Unit £4·45.

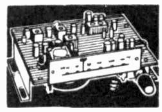
Pair of Q16 Speakers £10·70.

Sinclair Project 605 £20·97. P. & P. 37p.

All Sinclair Products in stock: 2000 Stereo Amplifier, £22·95; 3000 Stereo Amplifier, £28·95; 2000/3000 Stereo Tuner, £26·30.

Q830 Speakers, £29·98 pair, P. & P. 50p each on above items.

FM TUNER CHASSIS



6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6in × 4in × 2½in 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108MHz. Ready built ready for use.

OUR PRICE **£5·95** P. & P. 20p

Stereo Multiplex Adaptor £4·97.

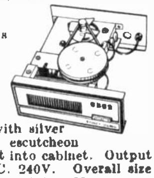
A1018 FM TUNER

Specification as above chassis but complete in cabinet with on/off switch. Size 7½in × 3¼in × 5in.

OUR PRICE **£9·65** P. & P. 30p

Stereo Multiplex Adaptor £4·97.

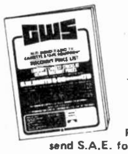
SPECIAL PURCHASE! BSR 8-TRACK PLAYER CHASSIS



Famous BSR 8 track chassis as used in Model TD88 complete with silver and black escutcheon ready to fit into cabinet. Output 125mV A.C. 240V. Overall size approx. 185 × 215 × 80mm.

OUR PRICE **£8·95** P. & P. 50p

LONDON'S LARGEST STOCKS INCLUDING PRODUCTS BY–



ARMSTRONG
CAMBRIDGE
KEF-LUX-NIKKO
SANSUI-SANYO
SONY-TEAC
TRANSCRIPTORS
TRIO-UHER
YAMAHA

Prices on request or send S.A.E. for full Discount List

ALL EQUIPMENT IS FULLY GUARANTEED AND COVERED BY 12 MONTHS FREE SERVICE!

G.W.SMITH & CO (RADIO) LTD

PERSONAL CALLERS WELCOME AT ANY OF OUR RETAIL BRANCHES

CENTRAL LONDON	
257/8, Tottenham Court Rd, W.1.	Tel: 01-580 0670
10, Tottenham Court Rd, W.1.	Tel: 01-637 2232
27, Tottenham Court Rd, W.1.	Tel: 01-636 3715
87, Tottenham Court Rd, W.1.	Tel: 01-580 3739
21, Old Compton Street, W.1.	Tel: 01-437 9369
3, Lisle Street, W.C.2.	Tel: 01-437 8204
34, Lisle Street, W.C.2.	Tel: 01-437 9155
118, Edgware Road, W.2.	Tel: 01-723 9789
193, Edgware Road, W.2.	Tel: 01-723 6211
311, Edgware Road, W.2.	Tel: 01-262 0387
382, Edgware Road, W.2.	Tel: 01-723 4194
152/3, Fleet Street, E.C.4.	Tel: 01-353 2833
378, Harrow Road, W.9.	Tel: 01-286 9530
ESSEX	
86, South Street, Romford.	Tel: Romford 20218
SURREY	
1046, Whitgift Centre, Croydon.	Tel: 01-681 3027
27, Eden Street, Kingston.	Tel: 01-546 7845
32, Hill Street, Richmond.	Tel: 01-948 1441

ALL BRANCHES OPEN 9 a.m.-6 p.m. MONDAY TO SATURDAY

HEAD OFFICE and MAIL ORDER DEPARTMENT
UNIT 4, THE HYDE INDUSTRIAL ESTATE, THE HYDE, LONDON NW9 6JJ
TELEPHONE 01-205 3735

PRICES SUBJECT TO 10% VAT

Order with confidence by Post—but remember to add 10% VAT to total value of order including carriage and packing and send cash with order. PLEASE PRINT NAME & ADDRESS CLEARLY IN CAPITALS.

TELEPHONED ORDERS ACCEPTED FROM ACCESS and BARCLAYCARD HOLDERS

CREDIT TERMS FOR PERSONAL CALLERS (on sales of £50 and over).

All prices correct at 28-9-73 but subject to change without notice. E. & O.E.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0–260V
All Types from ½ to 50 amp from stock.

SHROUDED TYPE

1A £7. Post 50p	**10A £22·50**
2·5A £8·05. Post 60p	**15A £25**
5A £11·75. Post 75p	**20A £49**
	37·5A £82
	50A £98

CARRIAGE AND PACKING EXTRA unless shown

2·5 amp (Panel Mounting) **OPEN TYPE**
1 amp **£7.** Post 50p. 2½ amp **£8·05.** Post 60p.

L.T. TRANSFORMERS

All primaries 220–240V

Type No.	Sec. Taps	Price	Post
1	30, 32, 34, 36V at 5A	£4·70	+45p
2	30, 40, 50V at 5A	£6·90	+60p
3	10, 17, 18V at 10A	£5·00	+50p
4	6, 12V at 20A	£6·50	+60p
5	17, 18, 20V at 20A	£7·30	+60p
6	6, 12, 20V at 20A	£6·90	+60p
7	24A at 10A	£5·30	+50p
8	4, 6, 24, 32V at 12A	£7·20	+60p
9	6 and 12V at 10A	£3·80	+40p

RING TRANSFORMERS

Functional Versatile Educational

These multi-purpose Auto Transformers, with large centre aperture, can be used as a Double wound current Transformer, Auto Transformer, H.T. or L.T. Transformer, by simply hand winding the required number of turns through the centre opening. E.g. using the RT.100 VA Model the output could be wound to give 8V @ 12½A, 4V @ 25A or 2V @ 50A, etc.

Price:
RT.100VA 3·18 turns per V. **£3·00.** Post 35p.
RT.1KVA 1·82 turns per V. **£8·60.** Post 50p.
RT.2KVA 1·5 turns per V. **£14·00.** Post 75p.
RT.3KVA 1·5 turns per V. **£19·00.** post £1.

VOLTAGE CHANGING TRANSFORMER

M.f.g. to highest W.D. spec. Auto wound, and tapped 0–130–160–200–250 at least 2kVA. Can also be used as 230–240V input, 115V out for U.S.A. equipment, or reverse to obtain 240V from 115V. The ideal transformer for making up solid state constant voltage unit, by use of taps the following voltages may be obtained 30–40–50–70–90V at 10 amps. Weight 40lb, length, 260mm, height 190mm, width 230mm. In original maker's wooden case, **£8.** Carr. £1.

PARVALUX Type: SDI. S/86896/OJ

230/250V A.C. 50 r.p.m. 7 lb/in. Continuously rated.
£6. Post 30p incl. base.

600 WATT DIMMER SWITCH

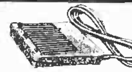
Easily fitted. Fully guaranteed by makers. Will control up to 600W of all lights except fluorescent at mains voltage. Complete with simple instructions. **£2·75.** Post 25p.

2000 WATT POWER CONTROL
For Power tools, Heating, Sewing Machines, Lighting, etc. **£8·00.** Post 27p.

VENNER TIME SWITCH TYPE MSQP

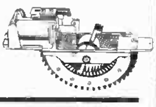
200/250 Volt 2-ON/2-OFF every 24 hours at any manually pre-set time. 20 amp contacts. Fitted diecast case. Tested and in perfect condition **£4·75.** Post 25p.

FOOT SWITCH



Suitable for Motors, Drills, etc., etc. 5 amp. 250 volt. Price **75p.** Post 15p.

UNISELECTOR SWITCHES



***NEW* 4 Bank 25 Way,** 24V d.c. operation. **£6·90.** Post 30p. **6 Bank 25 Way,** 24V d.c. **£7·90.** Post 30p. **8 Bank 25 Way,** 24V d.c. operation. **£9·50.** Post 40p.

TRIACS
GENERAL ELECTRIC POWER-GLAS TRIACS
10 amp. Glass passivated plastic triac. Latest device from U.S.A. Long term reliability. Type SC146D 10 amp, 400 PIV, **£1.** Post 5p. Type SC146E 10 amp, 500 PIV, **£1·30.** Post 5p. (Inclusive of data and application sheet.) Suitable Diac **18p.**

STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

EXPERIMENTERS' ECONOMY KIT
Speed adjustable 1 to 30 flash per sec. All electronic components including Xenon Tube and instructions **£6·30.** Post 30p.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Speed adjustable 1–80 f.p.s.
Approx. ¼ output of Hy-Lyght. Price **£10·50.** Post 50p.

HY-LYGHT STROBE MK III
For use in large rooms, halls and utilises a silica tube, printed circuit. Speed adjustable 0–20 f.p.s. Light output greater than many (so called 4 Joule) strobes. **£12.** Post 50p.

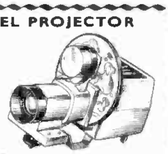
THE 'SUPER' HY-LYGHT KIT
Approx. four times the light output of our well proven Hy-Lyght strobe.
- Variable speed from 1–3 flash per sec.
- Reactor control circuit producing an intense white light. ONLY **£20.** Post 75p.

ROBUST, FULLY VENTILATED METAL CASE. For Hy-Lyght Kit including reflector **£4·75.** Post 25p.
Super Hy-Lyght Kit including reflector **£7.** Post 60p.

7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price **55p.** Post 15p.

RAINBOW STROBE FOUR LIGHT CONTROL MODULE
Will operate four of our Hy-Lyght or Super Hy-Lyght Strobes in either 1, 2, 3, 4 sequence; 2 + 2; or all together. Thoroughly tested and reliable. Complete with full connection instructions. Price: **£18.** Post 50p. Send S.A.E. for details.

COLOUR WHEEL PROJECTOR



Complete with oil-filled colour wheel. 100 watt lamp. 200/240V AC. Features extremely efficient optical system. **£18·50.** Post 50p.

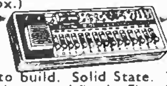
6 INCH COLOUR WHEEL
As used for Disco lighting effects, etc. Price **£5.** Post 30p.

1 R.P.M. MOTOR
220/240 volt a.c., 1 r.p.m. synchronous motor. 2 watt. A/clock. Spindle 10mm long, 3mm dia. Motor only 20mm deep. Fixing centres 44mm. Price **£1·10.** Post 5p. Suitable for above wheel.

BIG BLACK LIGHT

400Watt. Mercury vapour ultra violet lamp. Powerful source of u.v. Innumerable industrial applications also ideal for stage, display, discos, etc. P.F. ballast is essential with these bulbs. Price of matched ballast and bulb **£16.** Post **£1.**
Spare bulb **£7.** Post 40p.

BLACK LIGHT FLUORESCENT U.V. TUBES
4ft 40 watt. Price **£5·50.** Post 30p. **2ft 20 watt, £4·25.** Post 25p. (For use in stan. bi-pin fittings.)
MINI. **12in 8 watt, £1·60.** Post 15p. **9in 6 watt, £1·30.** Post 15p. Complete ballast unit and holders for 9in and 12in tube, **£1·70.** Post 25p. (9in and 12in measures approx.)

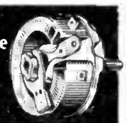


ELECTRONIC ORGAN KIT
Easy to build. Solid State. Two full octaves (less sharps and flats). Fitted hardwood case. Powered by two penlite 1½V batteries. Complete set of parts including speaker, etc., together with full instructions and 10 tunes. Price **£3·25.** Post 35p.

50 in 1 ELECTRONIC PROJECT KIT
50 easy to build Projects. No soldering, no special tools required. The kit includes Speaker, Meter, Relay, Transformer, plus a host of other components and a 56-page instruction leaflet. Some examples of the 50 possible Projects are: Sound Level Meter, 2 Transistor Radio, Amplifier, etc. Price **£7·75.** P. & P. 25p.

All prices are subject to
10% VAT. (10p in the £)
To all orders add 10% VAT to total value of goods including carriage/packaging.

Superior Quality Precision Made NEW POWER RHEOSTATS



New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
25 WATT 10/25/50/100/250/300/500/1k/ohm **95p.** Post 10p.
50 WATT 1/5/10/25/50/100/250/500/1k/1·5k/ohm **£1·35.** Post 10p.
100 WATT 1/5/10/25/50/100/250/500/1k/1·5k/2·5k/3·5k/5k ohm **£1·95.** Post 15p.
Black Silver, Skirted knob calibrated in Nos. 1–9. 1½in. dia. brass bush. Ideal for above Rheostats, 20p each.

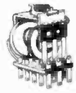
RELAYS SIEMENS, PLESSEY, Etc. MINIATURE RELAYS

Col.(1) Coil ohms	Col. (2) Working d.c. volts	Col. 3 Contracts	Col. (4) Price
52	4–6	6M	60p*
150	6–12	4 c/o	80p*
185	8–12	6M	60p*
280	8–16	2 c/o	60p*
410	10–18	4 c/o	70p*
700	16–24	4M 2B	60p*
700	16–24	4 c/o	80p*
700	15–35	2 c/o HD	70p*
700	16–24	6M	60p*
700	6–12	1 c/o HD	50p*
700	20–30	6 c/o	80p*
1,250	24–36	4 c/o	60p*
2,500	36–45	6M	60p*
2,400	30–48	4 c/o	50p
9,000	40–70	2 c/o	50p*
15k	85–110	6M	50p*

HD = Heavy duty
*Incl. Base
All prices incl. P. & P.

9 VOLT D.C. RELAY
3 c/o 5 amp contacts. 70 ohm coil. **75p.** Post 5p.
12 VOLT D.C. RELAY
3 c/o 5 amp contacts. 120 ohm coil. **75p.** Post 5p.

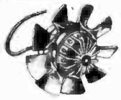
230 VOLT A.C. 'DIAMOND H' RELAYS (Unused)



Three sets c/o contacts rated at 5 amps. PRICE: **55p.** Post 5p. (100 lots) **£40.**
24 volt A.C. 3 c/o **55p.** Post 5p.

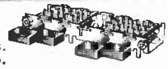
MINIATURE LATCHING RELAY
Manufactured by Clare-Elliott Ltd. Type F. 2 c/o permanent latching in either direction. Coil 1150 ohm, 15–30 Volt D.C. Size ⅞" high, ⅞" wide, ⅞" thick. Complete with 3in. leads. New **65p.** Post 5p.

BLOWER UNIT



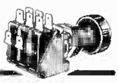
200–240 Volt A.C. Precision German built. Dynamically balanced, quiet, continuously rated, reversible motor. Consumption 60mA. Size 120 mm. dia. ×60 mm. deep. Price **£3.** Post 30p.

4 BANK 3c/o PUSH BUTTON ASSEMBLY



Black rectangular buttons. 5 units (min. order) **85p.** Post 15p.

"HONEYWELL" PUSH BUTTON, PANEL MOUNTING MICRO SWITCH ASSEMBLY



Each bank comprises a c/o rated at 10 amps 240V. A.C. Black knob 1 in. Fixing hole ⅜ in. ONE bank **30p;** TWO bank **40p;** THREE bank **50p.** Quote for quantity.

VERY SPECIAL OFFER

Micro Switch. 5 amp c/o contacts. M.f.g. bg. Honeywell. NEW. **Twenty for £1·50.** Post 10p (min. 20).

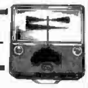
'HONEYWELL' LEVER OPERATED MICROSWITCH

15 amps 250 volt A.C. c/contacts. In maker's carton.
PRICE: 10 for **£1·90.** Post 15p.

INSULATION TESTERS *NEW!*

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in, W.4in, H.6in, weight 6lb. **1,000V,** 1,000 megohms, **£34.** Post 60p. **500V,** 500 megohms, **£28.** Post 60p.

BALANCE/LEVEL METERS



100-0-100 Micro Amp. Size 1½in + 1½in + ⅞in. Price only **70p.** Post 5p.

METERS NEW! 2½in. Flush round. Available in D.C. Amps 1, 5, 10, 15, 20 or A.C. Amps 1, 5, 10, 15, 20, both types **£2·00.** Post 15p. Voltmeter **0–300V** A.C. **£2.** Post 15p.

All Mail Orders—Callers—Ample Parking
Dept. PE11, 57 BRIDGMAN ROAD CHISWICK, LONDON W4 5BB
Phone 01-995 1560
Showroom open Mon.-Fri.

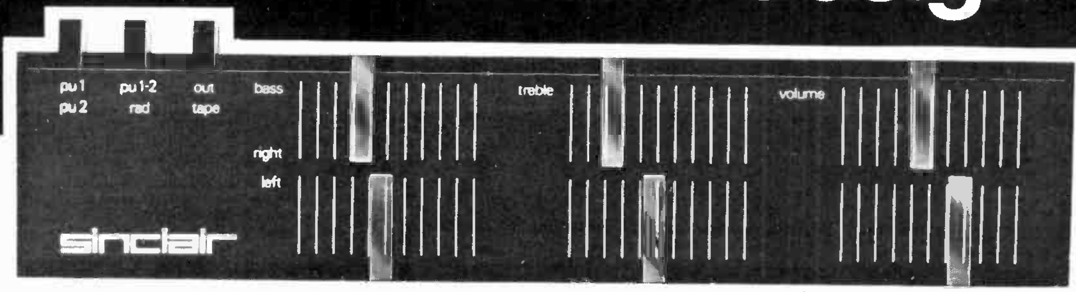
SERVICE TRADING CO

Personal callers only. Open Sat.
9 LITTLE NEWPORT STREET LONDON WC2H 7JJ
Phone 01-437 0576

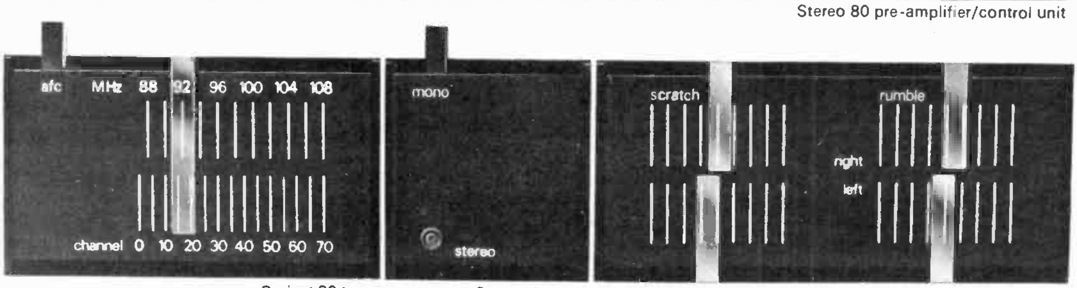
now...

Project 80

... exciting new thinking in modular hi-fi design



Stereo 80 pre-amplifier/control unit

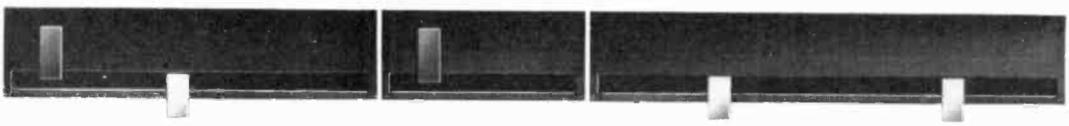


Project 80 tuner

Stereo decoder

Project 80 Active Filter Unit (AFU)

the slimmest, most elegant hi-fi modules ever made



Living with hi-fi takes on new meaning now that Project 80 is here. These amazing new modules mark a brilliant technical advance all round; their size and presentation bring exciting new opportunities to install systems in ways hitherto only dreamed about but never before made practical. You can build a Project 80 system virtually anywhere and it is unbelievably simple to install and connect up. Everything that could possibly be wanted in a top quality do-it-yourself domestic hi-fi system will be found in Project 80 – compactness, elegantly ultra-modern styling, ease of fixing and operation, new control methods, and above all superb performance. New as well as popular established ideas on installation are featured on page four of this announcement to provide just a few examples of the system's fantastic versatility.

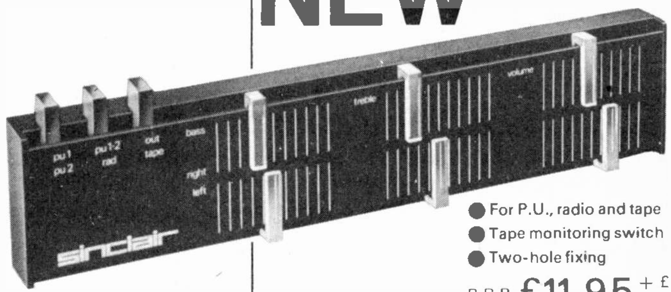
sinclair

INTERNATIONAL AUDIO FAIR STAND 58

Project 80 new modules

Stereo 80 pre-amplifier and control unit

As with other Project 80 units, the Stereo 80 is mounted by means of two bolts fixed at the rear which pass through holes drilled in the wood or plastic on which modules are to be mounted. *All the electronics are contained within the ¾" deep front panel!* Connecting leads are taken away similarly out of sight. Each channel in the Stereo 80 has its own independent tone and volume controls operated by sliders. This enables exceptionally good environmental matching to be obtained. Provision is made for magnetic and ceramic pick-ups, radio and tape in and out. A virtual earth input stage forms part of the up-dated circuitry of the Stereo 80 to ensure the finest possible quality from all signal sources. Generous overload margins are allowed on all inputs. Clear instructions with template are supplied.

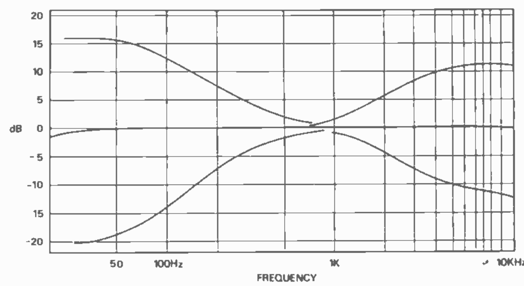


NEW

- For P.U., radio and tape
- Tape monitoring switch
- Two-hole fixing

R.R.P. £11.95 + £1.19 VAT

TECHNICAL SPECIFICATIONS
Size – 260 × 50 × 20mm (10¼ × 2 × ¾ins)
Finish – Black, with white markings
Inputs – Mag P.U. 3mV RIAA corrected; Ceramic P.U. 300 mV
Radio 300 mV, Tape 30 mV
S/N ratio – 60db
Frequency range – 20Hz to 15KHz ± 1dB; 10Hz to 25KHz ± 3dB
Power requirements – 20 to 35 volts
Outputs – 100mV + AB monitoring for tape
Controls – Press button for tape, radio and P.U. selection Volume, Bass +12dB to −14dB at 100Hz, Treble +11dB to −12dB at 10KHz

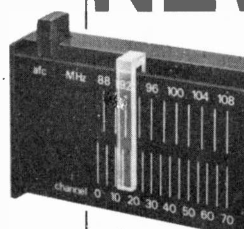


Project 80 FM tuner smaller, more efficient

A truly remarkable tuner in every way – its unbelievably compact size – its original circuitry – its dependable performance – all this in a boldly designed modern case measuring 85 × 50 × 20mm (3½ × 2 × ¾ins). Greater adaptability (and possibly financial convenience) results from the tuner and stereo decoder section being made available separately.

TECHNICAL SPECIFICATIONS
Size – 85 × 50 × 20mm (approx 3½ × 2 × ¾ins)
Tuning range – 87 to 108 MHz
Detector – I.C balanced coincidence, for good A.M. rejection
AFC – Switchable, with thermistor control to prevent from drift
One 26 transistor I.C.
Twin dual varicap tuning
Distortion – 0.3% at 1KHz for 75KHz deviation
Ceramic filter in I.F. section
Aerial impedance – 75 Ω or 240-300 Ω
Sensitivity – 4 microvolts for 30dB quieting
Power requirements – 12 to 45 volts

NEW



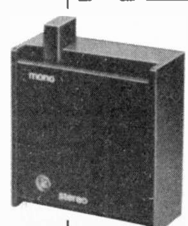
- AFC switch
- Twin dual varicap tuning
- 4-hole ceramic filter
- Slider tuning

R.R.P £11.95 + £1.19 V.A.T.

Project 80 stereo decoder

Making the Project 80 decoder separate from the F.M. tuner gives the constructor a wider choice of systems as well as saving money in cases where stereo reception may not be required. This unit gives a 40dB channel separation with an output of 150mV per channel. The gallium arsenide light emitting beacon automatically lights up to show when a stereo transmission is tuned in. Designed essentially as an integral part of Project 80 systems, this multiplex stereo demodulator may be used in many cases with existing single channel frequency modulated tuners to provide stereo reception.
Size – 47 × 50 × 20mm (1⅞ × 2 × ¾ins)
One 19 transistor I.C.

NEW



- Solid-state stereo indicating beacon
- Readily adaptable for use with other tuners

R.R.P. £7.45 + 0·74p V.A.T.

new constructional techniques

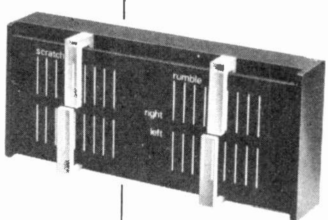
. . .and again Sinclair leads the world

1962 Micro-miniature power amp small enough to stand on a 10p. piece. Slimline pocket receiver smaller than a 20 cigarette pack
1963 Micro-6 receiver, smaller than a matchbox
1964 Pocket F.M. receiver; PWM amp.
1965 Z.12 power amplifier module, PZ.3 power supply
1966 Stereo 25 pre-amp/control unit
1967 Micromatic. Q.14 loudspeaker; the first Neoteric
1968 IC.10, the first ever integrated circuit for constructors' use
1969 Q.16 – improved version of Q.14 Systems 2000 and 3000: Project 60 launched
1970 IC.12: Project 605
1971 Project 60 stereo FM tuner. Z.50: PZ.8
1972 Improvements to Project 60 with Z.50 MK.2 and PZ.8 Mk.3 The Executive Calculator: Digital multi-meter: Q.30 speaker
1973 Cambridge Calculator
PROJECT 80 LAUNCHED
. . . and next ?

Project 80 active filter unit

This efficiently designed unit makes a highly desirable part of any worthwhile system where inputs may be from record, radio or tape As with Stereo 80, separate controls are applied to each channel thereby making it easier to obtain ideal stereo balance in any kind of indoor environment

TECHNICAL SPECIFICATIONS
Size – 108 × 50 × 20mm (4¼ · 2 · ¾ins)
Voltage gain – minus 0 2dB
Frequency response – 36Hz to 22KHz, controls minimum
Distortion – at 1KHz – 0 03% using 30V supply
HF cut off (scratch) – 22KHz to 5·5KHz, 12dB/oct slope
L.F. cut off (rumble) – 28dB at 20Hz, 9dB/oct. slope



NEW

- For scratch and rumble control
- Transistorised active circuitry

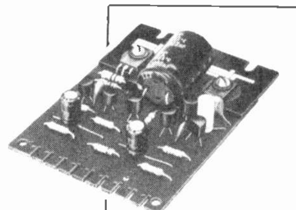
R.R.P. **£6.95** + 0 69p VAT

Z.40 & Z.60 power amplifiers totally short-circuit proof

Either of these entirely newpower amplifiers is intended for use in Project 80 installations although, of course, they are readily adaptable to an even wider range of applications. Both Z 40 and Z.60 incorporate built-in protection against shortcircuiting and risk of damage arising from mis-use is greatly reduced Comprehensive instructions are supplied with each of the modules

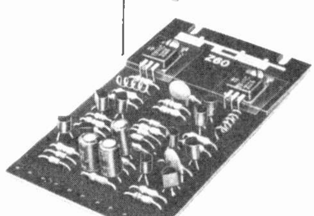
Z.40 Technical Specifications
Size – 55 × 80 × 20mm
(2⅛ × 3⅛ × ¾ins) 9 transistors
Input sensitivity – 100mV
Output – 15 watts RMS continuous into 8 Ω (35V). 30 watts music power into 4 Ω (30V)
Frequency response – 10Hz–100KHz ± 1dB
Signal to noise ratio – 64dB
Distortion – at 10 watts into 8 Ω less than 0·1%
Power requirements – 12-35 volts

Z 60 Technical Specifications
Size – 55 × 98 × 20mm
(2⅛ · 3⅞ × ¾ins) 12 transistors
Input sensitivity – 100-250mV
Output – 25 watts RMS into 8 Ω (45V) 50 watts music power into 4 Ω (50V)
Distortion – typically 0 03%
Frequency response – 10Hz to more than 200KHz ± 1dB
Signal to noise ratio – better than 70dB
Built-in protection against transient overload and short circuit
Load impedance – 4Ωmin, max safe on open circuit



NEW

Z.40
R.R.P **£5.45** + 0 54p V.A.T.

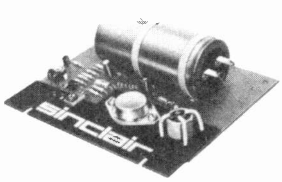


Z.60
RRP **£6.95** + 0 69p V.A.T

Sinclair power supply units PZ.8

the worlds most advanced unit in its class

Stabilised power supply unit. Re-entrant current limiting makes damage from overload or even direct shorting impossible, a principle never before inorporated in a commercially available constructor module Normal working voltage (adjustable) 45V
R R.P. £7.98 + 0 79p V A T
Without mains transformer
PZ.5 30V unstabilised
R.R.P. £4.98 + 0.49p V A T.
PZ.6 35V. stabilised
R R.P £7.98 + 0.79p V A.T.



Recommended Project 80 applications

System	The Units to use	Units cost
Simple battery record player	**Z.40**	**£5.45** +54p V A T
Mains powered record player	**Z.40, PZ.5**	**£10.43** +£1 04 V A T.
30W RMS continuous sine wave stereo amp.	**2 · Z.40s, Stereo 80; PZ.6**	**£30.83** +£3 08 V A T.
50W (8 Ω) RMS continuous sine wave de luxe stereo amplifier	**2 × Z.60s, Stereo 80; PZ.8**	**£33.83** +£3 38 V A T.
Indoor P.A.	**Z.60, PZ.8**	**£14.93** +£1 49 V A T.
Car Radio	**F.M. tuner, Z.40**	**£16.40** +£1 64 V A T.

sinclair

R O. London Rd., St. Ives, Huntingdon PE17 4HS Reg England 699483

TRANNIES

1 Dockyard Station Road, Old Harlow, Essex

All prices inclusive of V.A.T.

P/P 12½p. ● *Catalogue 10p.* ● *(Saturday callers welcome)*

74 Series TTL

	1	25		1	25		1	25		1	25
SN7400	0·17	0·16	SN7426	0·50	0·46	SN7454	0·17	0·16	SN7494	0·85	0·82
SN7401	0·17	0·16	SN7427	0·50	0·46	SN7460	0·17	0·16	SN7495	0·85	0·82
SN7402	0·17	0·16	SN7428	0·77	0·76	SN7470	0·32	0·29	SN7496	0·96	0·93
SN7403	0·17	0·16	SN7430	0·17	0·16	SN7472	0·32	0·29	SN74100	£1·82	£1·76
SN7404	0·17	0·16	SN7432	0·50	0·46	SN7473	0·41	0·39	SN74104	£1·07	£1·04
SN7405	0·17	0·16	SN7433	0·88	0·83	SN7474	0·41	0·39	SN74105	£1·07	£1·04
SN7406	0·39	0·34	SN7437	0·71	0·68	SN7475	0·50	0·48	SN74107	0·44	0·42
SN7407	0·39	0·34	SN7438	0·71	0·68	SN7476	0·44	0·43	SN74110	0·61	0·59
SN7408	0·20	0·19	SN7440	0·17	0·16	SN7480	0·74	0·71	SN74111	£1·38	£1·27
SN7409	0·20	0·19	SN7441	0·74	0·71	SN7481	£1·32	£1·27	SN74118	£1·10	£1·05
SN7410	0·17	0·16	SN7442	0·74	0·71	SN7482	0·96	0·95	SN74119	£1·49	£1·38
SN7411	0·28	0·27	SN7443	£1·43	£1·38	SN7483	£1·21	£1·16	SN74121	0·44	0·41
SN7412	0·39	0·34	SN7444	£1·43	£1·38	SN7484	£1·10	£1·05	SN74122	£1·54	£1·43
SN7413	0·32	0·29	SN7445	£1·98	£1·95	SN7485	£3·96	£2·85	SN74123	£3·08	£2·97
SN7416	0·48	0·44	SN7446	£1·07	£1·04	SN7486	0·35	0·34			
SN7417	0·48	0·44	SN7447	0·98	0·88	SN7489	£6·05	£5·78			
SN7420	0·17	0·16	SN7448	£1·10	£1·07	SN7490	0·68	0·60			
SN7422	0·55	0·53	SN7450	0·17	0·16	SN7491	£1·10	£1·05			
SN7423	0·55	0·53	SN7451	0·17	0·16	SN7492	0·74	0·71			
SN7425	0·55	0·53	SN7453	0·17	0·16	SN7493	0·74	0·71			

* Devices may be mixed to qualify for price breaks.

* 100 plus less 10% off 25 plus break.

Linear Integrated Circuits

301	DIL	0·50	307	TO99	0·69	710C	TO99	0·46	748C	DIL	0·52
301	TO99	0·55	307	8 Pin DIL	0·66	723C	DIL	0·99	748C	TO99	0·42
301	8 Pin DIL	0·48	308	TO99	£6·90	723C	TO99	£1·00	1437	DIL	£1·30
301A	DIL	0·69	308A	TO99	£7·40	741C	8 Pin DIL	0·35	1458	TO99	£1·30
301A	TO99	0·69	709C	DIL	0·35	741C	14 Pin DIL	0·36	3046	DIL	0·84
301A	8 Pin DIL	0·66	709C	TO99	0·34	741C	TO99	0·38			
307	DIL	0·69	710C	DIL	0·44	747C	DIL	0·80			

Electrolytic Capacitors

4 VOLT		10 VOLT		16 VOLT		25 VOLT		63 VOLT	
47µF	6½p	22µF	6½p	1000µF	17p	2200µF	39p	1µF	6½p
100µF	6½p	47µF	6½p	1500µF	25p	5000µF	68p	2·2µF	6½p
220µF	6½p	100µF	6½p	2000µF	43p			4·7µF	6½p
330µF	6½p	220µF	8p	3300µF	38p			6·8µF	6½p
1000µF	13p	330µF	10p	6800µF	65p	**40 VOLT**		10µF	6½p
4700µF	29p	470µF	10p			6·8µF	6½p	22µF	6½p
		1000µF	11p			15µF	6½p	68µF	10p
6·3 VOLT		1500µF	20p	**25 VOLT**		33µF	6½p	100µF	11p
33µF	6½p	2200µF	24p	10µF	6½p	47µF	6½p	150µF	13p
68µF	6½p			22µF	6½p	100µF	9p	220µF	19p
150µF	6½p	**16 VOLT**		47µF	6½p	150µF	10p	330µF	22p
470µF	11p	15µF	6½p	100µF	8p	220µF	11p	470µF	26p
680µF	13p	33µF	6½p	150µF	8p	470µF	19p	1000µF	44p
1500µF	18p	68µF	6½p	220µF	10p	680µF	25p		
2200µF	18p	150µF	8p	470µF	13p	1000µF	25p		
3300µF	26p	220µF	9p	680µF	20p	2200µF	44p		
6800µF	40p	680µF	17p	1000µF	22p	3300µF	65p		

Mullard Polyester's

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01µF, 0·015µF, 0·22µF, 3½p. 0·33µF, 0·047µF, 0·068µF, 4p, 0·1µF, 4½p. 0·15µF, 0·22µF, 5½p. 0·33µF, 7p. 0·47µF, 9½p. 0·68µF, 12p. 1·0µF, 14p. 1·5µF, 22p. 2·2µF, 27p.

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001µF, 0·0015µF, 0·0022µF, 0·0033µF, 0·0047µF, 2½p. 0·0068µF, 0·01µF, 0·015µF, 0·022µF, 0·033µF, 3½p. 0·047µF, 0·068µF, 0·1µF, 4½p. 0·15µF, 6½p. 0·22µF, 8½p. 0·33µF, 12p. 0·47µF, 14p. 160V: 0·01µF, 0·015µF, 0·22µF, 0·033µF, 0·047µF, 0·068µF, 3p. 0·1µF 3½p. 0·15µF, 4½p. 0·22µF, 5½p. 0·33µF, 6½p. 0·47µF, 8½p. 0·68µF, 12p. 1·0µF, 14½p.

Popular Transistors and Diodes

(Many other types stocked)

AC107	16p	AD149	40p	BC157	13p	BFY50	17p	2N3053	26p	40636	66p	OA47	9p
AC126	14p	AD161	32p	BC158	12p	BFY51	17p	2N3054	50p	**DIODES**		OA81	9p
AC127	14p	AD162	32p	BC159	13p	BFY52	17p	2N3055	52p			OA85	11p
AC128	14p	AF114	15p	BC168	11p	MP8111	35p	2N3702	11p	1N914	8p	OA90	8p
AC142K	25p	AF115	15p	BC169	11p	OC28	40p	2N3703	11p	1N916	8p	OA91	8p
AC141K	26p	AF116	15p	BC182	12p	OC35	40p	2N3704	11p	1N4148	5p	OA95	8p
AC176	15p	AF117	15p	BC183	12p	OC36	45p	2N3705	11p	1N4001	4½p		
AC187	14p	BC107	9p	BC184	12p	OC44	14p	2N3706	11p	1N4002	4½p		
AC188	14p	BC108	9p	BC212	12p	OC45	14p	2N3707	11p	1N4003	5½p		
AC187K	25p	BC109	10p	BC213	12p	OC71	14p	2N3708	11p	1N4004	6½p		
AC188K	24p	BC147	11p	BC214	12p	OC81	14p	2N3709	11p	1N4005	8p		
ACY20	22p	BC148	11p	BF194	15p	TIP41A	79p	2N3710	11p	1N4006	9p		
AD140	40p	BC149	12p	BF195	17p	TIP42A	91p	2N3819	28p	1N4007	10p		

Volume controls

POTENTIOMETERS

Carbon track 500Ω to 2·2 meg Ω Log or Linear.
Single 13p. Dual gang (stereo) 44p.
Single type with D.P. switch 26p.

Carbon skeleton presets

Small high quality type (linear only)
All values 100—5 meg ohms.
0·1 watt 6p each
0·25 watt 7p each

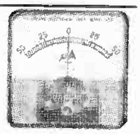
Resistors

		100 plus
¼ watt 5% carbon ..	1p	0·7p
½ watt 5% carbon ..	1p	0·7p
1 watt 10% carbon ..	2½p	2p
range 10 ohms to 4·7 megohms.		
½ watt m/o 2%	3p	2·4p
range 10 ohms to 1 megohms.		

Vereoboard

	0·15 matrix	0·1 matrix
2½ × 3¾	17p	22p
2½ × 5	22p	24p
3¾ × 3¾	22p	24p
3¾ × 5	28p	28p
2½ × 17	60p	79p
3¾ × 17	81p	£1·05
Pin insertion tool ..	—	82p
Spot face cutter	52p	52p
Pack of 36 pins	42p	42p
	20p	20p

SEW Clear Plastic Panel Meter



UP TO 25% OFF POPULAR SEW METERS.

Type MR38P 1-21/32in Square Front

	Normal Price	Our Price
0—500µA	£2·50	£2·05
0—1mA	£2·50	£2·05
0—10mA	£2·50	£2·05
0—100mA	£2·50	£2·05
10—300 volts	£2·50	£2·05
8 meter 1mA	£2·85	£2·05

Type SW100 x 80mm.

	Normal Price	Our Price
0—30µA	£3·74	£2·95
0—50µA	£3·74	£2·95
0—100µA	£3·74	£2·95
0—500µA	£3·45	£2·80
"VU" meter	£3·85	£2·99

Edgewise Meters
3-17/32in x 1-15/32in x 2¾in deep

	Normal Price	Our Price
500µA	£3·52	£2·85
1mA	£3·52	£2·85

Transformers

12-24 volt Secondary

Volts	Amps	Volts	Amps	Part No.	Price inc. P/P
12	500mA	24	250mA	MT111	£1·20
12	1	24	500mA	MT213	£1·26
12	2	24	1	MT71	£1·89

30 volt
Secondary 12, 15, 20, 24, 30v

Amps	Part No.	Price inc. P/P
1	MT79	£2·02
2	MT3	£2·78
5	MT51	£5·21

50 volt
Secondary 19, 25, 33, 40, 50v

Amps	Part No.	Price inc. P/P
1	MT103	£2·54
2	MT104	£3·75
4	MT106	£6·00

Many other types available
See our Catalogue.

AMTRON

We are now Stockists of AMTRON High Quality Construction Kits (S.A.E. for full list)

		£
UK65	Transistor Tester	2·50
UK92	Telephone Amplifier	7·91
UK110	Stereo Amplifier 5 + 5w	11·07
UK115	Hi-Fi Amplifier 8w	4·31
UK120	Hi-Fi Amplifier 12w	5·20
UK125	Stereo Control Unit	6·30
UK160	I.C. Amplifier 8w	11·07
UK220	Signal Injector	2·57
UK235	Acoustic Alarm for Absent-minded Drivers	7·39
UK240	Parking Lights Automatic Switch	8·66
UK500	LW/MW/FM Radio Receiver	35·30
UK515	MW Radio Receiver	9·86
UK640	200mw Light Dimmer	7·24
UK790	Capacitive Burglar Alarm	7·57
UK840	Adjustable time lag car Burglar Alarm	6·81
UK875	Capacitive Discharge Electronic Ignition for internal Combustion Engines	14·51
TRA 1	24-hour Digital Clock	24·50

Practical Electronics Classified Advertisements

RATES: 9p per word (minimum 12 words). Box No. 20p extra. Semi-Display £7 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Manager, "Practical Electronics" IPC MAGAZINES LTD., Fleetway House, Farringdon Street, London EC4H 4AD

SITUATIONS VACANT

YOUR TALENT CAN EARN YOU MONEY

as a

T.V. Engineer

with

Radio Rentals

Britain's No. 1 T.V. Rental Company

Are you on the right lines in your present job? Switch to Radio Rentals and be assured a good future. Here are 5 star reasons for joining us.

★ Full Training given for Colour T.V.

★ 5-day week

★ Private use of a Company Vehicle or generous car allowance

★ 3 weeks' holiday per year, rising to 4 weeks

★ Good salary (up to £34·95 per week after 2 years)

Your present holiday arrangements will be honoured. Work towards a better future, better chances of promotion and more security. Telephone Mr. Mann, 01-540 1304 or write to:

RADIO RENTALS

86 The Broadway • Wimbledon • London • S.W.19

ULSTER:
THE NEW UNIVERSITY
INSTITUTE OF CONTINUING EDUCATION:

MAGEE UNIVERSITY COLLEGE LONDONDERRY

C.C.T.V. TECHNICIAN

Applications are invited for the above post.

Duties will include the operation and maintenance of CCTV services and preparation of programme material.

Qualifications: HNC or equivalent, plus at least seven years' previous experience.

Salary scale: £1,881–£2,241 per annum.

Application forms and further particulars should be obtained from the Registrar, The New University of Ulster, Coleraine, Co. Londonderry, Northern Ireland (quoting Ref. No. 73/130/149/31/98) to whom completed applications, including the names and addresses of three referees, should be returned not later than 31st October, 1973.

FIBRE OPTICS

Flexible Light Pipe for conveying light to inaccessible positions. Fibroflex Type I. Glass 1·14mm effective dia. PVC sheathed. **44p** per metre. (VAT inc.), P. & P. 10p. Any quantity.

Polariser Sheet up to 1 sq. ft. max. size. **16½p** per sq. in. (VAT inc.), P. & P. up to 6 in. square **10p**; over 6 in. square **30p**
★ Cut down glare
★ See those nixie tubes
★ Cross them for light control
★ Make your own strain gauge for plastics and glass

Circuit Board Etching Kits. Full instructions. **£1·37½** (VAT inc.), P. & P. **14p**

Photographic CDS Light Cells—used (with part of original circuit free), **33p** (VAT inc.), Post free.

All items are strictly C.W.O.

From: ARVIN SERVICE COMPANY
12 CAMBRIDGE ROAD
ST. ALBANS

EDUCATIONAL

A SUCCESSFUL CAREER IN RADIO

Get the success you deserve—take an ICS home study course. Pass C&G, M.P.T. exams FIRST TIME! Free books. Low cost. Personal tuition. Send TODAY for FREE Guide on Radio, TV, Electronics, Electrical Engineering.

Name ______________________

Address ______________________

ICS Dept. 730X
Stewarts Road,
London SW8 4UJ

FOR SALE

TV LINE OUT-PUT TRANSFORMERS
Tidman Mail Order Ltd., 236 Sandycombe Road, Richmond, Surrey TW9 2EQ
01-948 3702

CATALOGUE NO. 18, Electronic and Mechanical Components and manufacturers' surplus. Credit vouchers value 50p. Price **23p**, including post. ARTHUR SALLIS RADIO CONTROL LTD., 28 Gardner Street, Brighton, Sussex.

AUDIO MIXER MODULES for hi-fi applications. Catalogue free. Large S.A.E. HILLCREST ELECTRONICS, 123 Harestone Hill, Caterham, Surrey.

FOR SALE Practical Electronics, Nov. '64 to Sept. '73. Unbound. Offers: MR. ANGEL, (01) 736 4057.

AUDIO MIXER MODULES. Catalogue free. Large S.A.E. HILLCREST ELECTRONICS, 123 Harestone Hill, Caterham, Surrey.

SEEN MY CAT? 5,000 items. Mechanical and Electrical Gear, and materials. S.A.E. K. R. WHISTON, Dept. PE, New Mills, Stockport.

Trampus electronix

Add 10% VAT ($\frac{1}{10}$) to all prices. All brand new, no rejects. Money Back Warranty.
5V DIGITAL INDICATOR: 0–9DP socket and filter **£1·45.**
LED TYPE ⅓" 0–9DP DIL **£2·25** each; 6× **£2·19** each. 4 digit type **£11.**
LIGHT EMITTING DIODES. All with data and panel clip. TIL 209 ⅙" dia. **26p.** Red ⅙" dia. type **33p.** Green **75p.** INFRA RED beam LED **£1·10.**
GAS detector **£1·69.** Ultrasonic transducer **£2.**
DALO PCB resist marking pen 69p. Copper board 12" × 6" SRBP **40p.** FeC etch PAK **19p.**
INTEGRATED CIRCUITS: with data if required.
IC LITE SWITCH: Photo amp/trigger 40mA/11–20V relay or TTL **87p.** Dil relay **£1·10.**

IC digital clock

MOS/LSI type. 28 pin, 4 or 6 digit, 12/24hr. Chip with socket **£13;** PCB **£1·69;** KIT **£21·49.** DVM voltmeter **£12.** Data **39p.** 3W AF amp **£1·24.**
741 Dil 8 pin **28p;** 709 **19p.** Dil **29p;** 748 **29p;** mono 710 **33p. 555 TIMER**/mono/astable osc. clock **93p.**
REGULATORS: 1½A 5 to 20V **£1·49;** 723 **57p.**
RECEIVER ZN414 **£1·19.** Mini Rx Kit **£1·99.** 1310 stereo decoder for tuner **£2·69,** KIT **£3·45.**

740 TTL — NEW LOW PRICES

GATES 7400/1/2/3/4/5/10/20/30/40/50, etc., **14p** each. 7413 **27p;** 7441 **73p;** 7447 **£1·09;** 7470, 7472 **28p;** 7473, 7474 **36p;** 7475 **60p;** 7476 **32p;** 7490 **59p;** 7492 **67p;** 7480 **69p;** 7483 **£1·10;** 7486 **37p;** 7493 **73p;** 7494 **83p;** 7495 **83p;** 7496 **89p;** 74121 **45p;** 74141 **99p;** 74190/91/92/93/96 **£2·39.** DIL Plugs/IC case 10mm high 16 pin **35p.**
DIL SOCKETS: low or high profile 8/14/16 pin **13p.**
SEMICONDUCTORS:
2N3055 **40p;** BC107 **8p;** BC108 **8p;** BC109 **8p;** BC147/8/9 **10p;** BC167/8/9 **13p;** BC177/8/9 **15p;** BC182/3/4 **10p;** BC212/3/4 **11p;** BCY70/72 **13p;** BD131/2 **55p;** BFY50/51/52 **13p;** TI843 UJT **24p;** 2N706 **11p;** 2N2369 **12p;** 2N2926Oy **8p;** 2N2646 **49p;** 2N3053 **17p;** 2N3055 **40p;** 2N3614 **55p;** 2N3702/3/4/5/6/7/8/9/10/11 All **9p** each.
FETS: 2N3819 **27p;** 2N3823 **29p;** SCR 400V; 1A **23p;** 4A **55p.** TRANSFORMER: ½A 6 and 12V **£1.**
CAPACITORS: Disc 22pF to 0·1μF **4p.** 25V electrolytic 10, 50, 100μF **5p;** 1,000μF **15p. PRESETS 5p** each. RESISTORS ⅓W 5% **1½p** each.
CARBON POTS 12p each. Dual **40p.** Switch **+12p.**
All Din Plugs **13p;** sockets **9p;** Vero RRP.

FLUORESCENT LIGHTS 12VOLT £2·79

13" 8 watt fully built with diffuser.
TRIO and **CODAR** communications and Hi-Fi retailer. ELECTRONIC ORGANS from **£67.**
PW ELECTRONIC CAR IGNITION KIT £6·67.
VAT: YOU MUST ADD 10% ($\frac{1}{10}$) to all prices.
FREE CAT. S.A.E. Data sheets 8p each. P. & P. 8p. C.W.O. P.O. BOX 29, BRACKNELL, BERKS.

COMPUTER PANELS 6 assorted. No rubbish. **£1** (25p). **M.C. METERS** 3 assorted 2in-3in, **£1·15** (25p). 5 Fig. **RESETTABLE COUNTER** 18/22V. Works on **12V, £2·20** (15p). **SILICON DIODES 650V 1½A.** 10 on tagboard **35p** (5p). New 800V ½A. 6–**25p** (5p). **UNIT WITH 4 × BFY51,** 4 Silicon Diodes, 4 Zeners, caps and resistors **45p** (8p). **COPPER CLAD PAX. PANELS** 5½in × 5½in 6 for **45p** c.p. 7½in × 9in **25p** c.p. 6 for **£1·20** c.p. 8½in × 9in **30p** c.p. 6 for **£1·30** c.p. 10in × 9in **35p** c.p. 6 for **£1·40** c.p. **WIRE ENDED NEONS** 10–**50p** (8p). Bank of 5 with 5·C407 driver trans. **50p** (8p). **POLYSTYRENE CAPACITORS** 125V. 100, 150, 180, 220, 330, 390, 560, 680, 820, 1,200, 1,500, 1,800, 2,200, 2,700, 3,300, 3,900, 5,600, 6,800. 0·01, 0·012. **22p** dozen (8p). Mixed with s/mica 100-**50p** c.p.

7LB ASSORTED COMPONENTS £1·60 c.p.

2LB ASSORTED COMPUTER PANELS £1·60 c.p.

Lists computer panels, etc. 10p stamps refunded on purchase.

J.W.B. RADIO

75 HAYFIELD RD., SALFORD 6, LANCS.
Postage in Brackets — Mail Order Only

---

100 MIXED RESISTORS (our choice), many wire wound. **55p** (10p). 100 mixed capacitors (our choice), silver MICA, polystyrene, ceramic, etc. **55p** (10p). SPECIAL PACK includes 6 mixed pots, 10 mixed valve bases, 100 mixed resistors, 100 mixed capacitors. Good value at **£2·50** (20p). Prices include V.A.T. postage in brackets. No used components. S.A.E. for list. GRC, 82 High Street, Winsford, Cheshire.

NORTHERN IRELAND READERS. BC107—**10p;** BC182L—**10p;** BC184L—**10p;** BC212L—**10p;** 2N3702—**12p;** 2N3055—**65p;** TIS43—**40p;** TIP29—**58p.** Sprague 5μF/150, 10μF/150, 25μF/100. All **10p each.** Full range of radio spares, Eagle, etc. Send large S.A.E. for catalogue. P. & P. 5p per order. R.L.S. ELECTRONICS, 114 High Street, Holywood, Co. Down BT18 9HW.

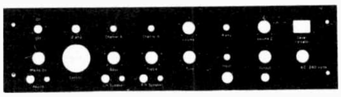
R.T. SERVICES

(MAIL ORDER ONLY)

77 Hayfield Rd., Salford 6, Lancs.

Veroboard 6×5 0·1 Matrix, 2 for **£1.** 4×4¼ 0·1 Matrix, 4 for **£1.** 12×3¾ 0·15 Matrix, **75p** each.
Mullard A.M. Module. I.F. Strip, LP1166, **£1·10** inc. P.P.
FM Tuner with R.F. Stage and A.G.C., 3 transistors, neg. earth, 2½×2×1½ in with circuit, **£1·37½** inc. P.P.
Crouzet Geared Motors, 30-60 r.p.m. New, **£1·54** inc. P.P.
UHF TV Tuners. Transistorised, **£1·65** inc. P.P.
VCR138 CRT. New, boxed, **£3·30** inc. P.P.
Brand New Panel VU Meters, 4½×3¼ in calibrated, **£3·30** inc. P.P.
Transformers. 7·5V + 7·5V ½A, **66p** inc. P.P. 18-0-18V, 200mA + 24V, **77p** inc. P.P. 9-0-9V, 100mA, **69p** inc. P.P. 12-0-12V, 100mA **69p** P.P. 20V, 1A **88p** inc. P.P.
Transformers. 52-0-52V, 1A + 22-0-22V, 200mA, **£2·20** inc. P.P.
P.C. Board. S/S, 5½ × 5½in, 10 for **70p** inc. P.P.
Panel with 5-200 PIV 1A SCRs + 14 OA200 diodes plus components **70p** inc. P.P.
2,500 mfd 100VW capacitor 4½"×1⅜". New, **85p** inc. P.P.
Panel Meter 50μA. Brand new, 4½"×3½". **£3·30.**
Panel with 2 SN7490, 2 SN7441 counting circuit with end connector, **£2·20** inc. P.P.
Panel with 2 min. nixie tubes to slot in, **£2** inc. P.P.

FACIAS AND CONTROL PANEL FRONTS • Made to Order



MANUFACTURED FROM HARDWEARING PLASTIC LAMINATE MATERIAL. AVAILABLE IN WIDE COLOUR CHOICE, INCLUDING WOODGRAIN. LEGEND PERMANENTLY MACHINE ENGRAVED. THE IDEAL AND ECONOMIC ANSWER FOR SINGLE, SHORT BATCH OR EXPERIMENTAL PANELS. SEND DIMENSIONED SKETCH FOR QUOTATION. WE ALSO MANUFACTURE ENGRAVED LABELS AND NAMEPLATES.

RAPOWE SIGN & PRODUCT CO.
32 Sheridan Road, Hereford — Tel. 2415

TELERADIO ELECTRONICS ARE STOCKING THE MODULES FOR THE P.E. RONDO QUADRAPHONIC SYSTEM

Matrix Decoder	**£8·80**
Pre-Amplifier	**£3·30**
Stereo Amplifier	**£8·25**
Controls & balance panel	**£9·35**

Prices include VAT and Post !

Further information gladly supplied on request

TELERADIO
325-7 Fore Street, London N9 0PE
01-807 3719

COMPONENTS GALORE. Pack of 500 mixed components. Manufacturers' surplus plus once used. Pack includes resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers, etc. Send **£1** + 10p P. & P. C.W.O. to: CALEDONIAN COMPONENTS, Strathore Road, Thornton, Fife.

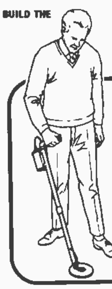
FOR BARGAIN LISTS worth seeing, plus FREE SAMPLES send S.A.E., 2 Richmond Terrace, Ulverston, Lancs.

COMPONENTS, HARDWARE, CARTRIDGES. GP91/3SC **90p.** STYLI from **20p**—V.A.T. included. 16-page lists, 3p stamp. R.F. SUPPLIES, Down Barton, Woodham Road, Woking, Surrey.

MISCELLANEOUS

BUILD THE

TREASURE TRACER MK III Metal Locator



- Varicap tuning
- Excellent sensitivity and stability
- Weighs only 22oz.
- Speaker and earphone operation
- Knocks down to only 17in.
- Prebuilt search coil assembly
- Ministry approved design
- Thoroughly professional finish
- You only need soldering iron, screwdriver, pliers and snips
- Completely new design
  Send s.a.e. for leaflet

Complete kit Post 35p **£9·80** — Built, tested and guaranteed Post 35p **£13·75**

MINIKITS ELECTRONICS, 35a LANGLEY DRIVE, WANSTEAD LONDON E11 2LN (Mail order only)

CONSTRUCTION AIDS. Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards—masters, negatives and boards, one-off or small numbers. Send 6p for list. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warwks.

Build the Mullard C.C.T.V. Camera

Kits are now available with comprehensive construction manual (also available separately at 76½p)

SEND 5" × 7" S.A.E. FOR DETAILS TO:
CROFTON ELECTRONICS
15/17 Cambridge Road, Kingston-on-Thames, Surrey KT1 3NG

METER REPAIRS. Ammeters. Voltmeters, Multi-Range meters, etc., also Linear scale Transistorised Ohmmeters for sale. METER REPAIRS, 39 Chesholm Rd., London N16 0DS.

ALUMINIUM SHEET to individual sizes or in standard packs, **3p** stamp for details. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warwks.

CLEARING LABORATORY, scopes, V.T.V.M's, V.O.M's, H.S. recorders, transcription turntables, electronic testmeters, calibration units, P.S.U.'s, pulse generators, D.C. null-potentiometers, bridges, spectrum analysers, voltage regulators, sig-gens, M C relays, components, etc. Lower Beeding 236.

GLASS FIBRE P.C. BOARD—large supplies available. $\frac{1}{16}$in single sided one ounce copper, **2p** per 3 sq in (under 1ft); **75p** per sq ft (over 1ft). $\frac{1}{16}$in double sided one ounce copper, **1p** per sq in (under 1ft); **£1** per sq ft (over 1ft). Please add 10p per sq ft postage and packing. We can cut to your size at 1p per cut. SOLID STATE LIGHTING, The Firs, Smallworth Lane, Garboldisham, Diss, Norfolk.

A.L.S.

A.L.S. PRESENTS OUR
E.C. 100 Watt Hi-Fi Amplifier
ready drilled P.C.B. with full instructions only £2 plus 10p post.

We also supply:
Service Sheets, Manuals, Books, etc.

See our main advert in 'TELEVISION' or send S.A.E. for details.

10 DRYDEN CHAMBERS, 119 OXFORD ST., LONDON W1R LPA (B).

If you have difficulty in obtaining

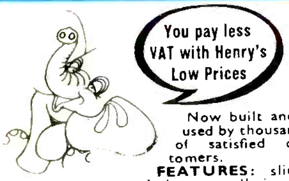
PRACTICAL ELECTRONICS

Please place a regular order with your newsagent or send 1 year's subscription (£2·65) to Subscription Department, Practical Electronics, Tower House, Southampton Street, London WC2E 8QX

Published approximately on the 15th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd.: South Africa—Central News Agency Ltd. Publishers' Subscription Rate (including postage): For one year to any part of the world £2·65.

Henry's

DONT RELY ON YOUR MEMORY
BUY NOW AT BARGAIN PRICES –
Order your latest Henry's Catalogue Price 55p post paid complete with Discount Vouchers



BUILD THE TEXAN

20 + 20 WATT IC STEREO AMPLIFIER

As featured by Practical Wireless 1972

Now built and used by thousands of satisfied customers. **FEATURES:** slim design, overall size in cabinet 15½in × 2¾in × 6¾in 6-IC's, 10 transistors, stabilisers, Gardeners low field transformer, Fibre Glass PC Panel, complete chassis work. Now available built and tested as well as in kit form.
HIGH QUALITY & STABILITY ARE PREDOMINATE FEATURES—DEVELOPED TEXAS ENGINEERS FOR PERFORMANCE, BY RELIABILITY AND EASE OF CONSTRUCTION.
FACILITIES. On/off switch indicator, headphones socket, separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, input selector; Mag. P.U., Radio Tuner, Aux. Can be altered for Mic, Tape, Tape-head, etc. Constructional details Ref. No. 21, 30p. Distributed by Henry's throughout UK.

FREE Teak cabinet with complete kit.

KIT PRICE **£28·50** (+ VAT + 50p carr/packing) or
built and tested **£35·00** (+ VAT + 50p carr packing) as illustrated

BUILD THE NEW HENELEC STEREO FM TUNER

A completely new high stability stereo FM tuner. Features variable capacity diode tuning, stabiliser power supply, IC Decoder, high gain low noise. IF stages. LED indicators, Tuning meter, AFC, Easy to construct and use. Mains operated. Slim modern design with fibre glass PC, teak cabinet, etc. Available as a kit to build or ready built. Overall size: 8in × 2¾in × 6¾in. Produced to give high performance with a realistic price. (Parts list and constructional details Ref. No. 5, 30p.) Henry's are sole distributors UK and Europe.

Kit Price **£21·00** (+ VAT)
or built and tested **£24·95** (+ VAT)

LIVING SOUND LOW NOISE TOP QUALITY CASSETTES MADE BY EMI TO INTERNATIONAL STANDARDS ESPECIALLY FOR HENRY'S. ALL POST PAID LESS THAN ½ REC. PRICES.

	3 for	6 for	10 for	25 for
C60	£1·00	£1·80	£2·80	£6·75
C90	£1·33	£2·57	£4·20	£10·25
C120	£1·62	£3·15	£5·00	£12·25

Quantity and trade enquiries invited.

LEARN A LANGUAGE—complete with phrase book. German, French, Spanish, Italian. £1·36 per course. £5 for any 4.

EARN YOURSELF EASY MONEY, WITH PORTABLE DISCO EQUIPMENT

DISCO MINI: A complete portable disco, fitted mixer/preamp, 2 decks all facilities	£98·50
100 watt amplifier for above	£38·75
SL100: 100 watt mixer/amplifier with slider controls	£69·00
R50: 50 watt mixer/amplifier	£49·50
DISCO AMP: 100 watt mixer/amplifier chassis unit	£65·85
DISCO MIXER/PREAMPLIFIERS (O/P for up to 6-100 watt amplifiers):	
SDLI (rotary controls):	£49·50
SDLII (slider controls):	£58·50
DISCO VOX (slider controls): The complete disco unit	£69·50
DJ100: 100 watt power amplifier for above	£38·75
DJ30L: 3 channel 3kW sound to light	£29·50
DJ40L: as 30L plus built-in microphone	£38·75
DIMANATIC. 1kW adjustable speed auto dimmer	£25·00
SCENESTROBE	£19·00
ROAD STROBE	£25·00
Disco anti-feedback microphone	£11·95
Colt 150 watt liquid wheel projector	£22·50
150 watt QI liquid wheel projector	£50·00
150 watt QI cassette wheel projector	£50·00
Spare Effects cassettes, large range of patterns	£8·00
Mini spot bank fitted 3 lamps	£11·00
Auto Trilite (mini with flashers)	£17·00

MIXERS/MICS/SPEAKERS/LIGHTING, UK's LARGEST RANGE
FREE stock list Ref. No. 18 on request.

All prices carr. paid (UK) (VAT EXTRA).
Barclaycard/Access call, write or phone your order 01-723 6963—easy terms for callers.

TEXAN STEREO SYSTEM

PLUS Price Savings

The Texan Stereo Systems include the high quality Texan Stereo amplifier assembled and ready to use. A pair of Type 200 20 watt Speaker-Tweeter systems, size 12 × 12 × 10in and a choice of Garrard players built into a plinth with cover with Goldring G800 magnetic cartridge. System 25 uses Garrard SP25 Mk.III and system 76 the Garrard AP76 de luxe turntable. All necessary leads are supplied.

SYSTEM 25 (list approx. £109) **£79·50**
SYSTEM 76 (list approx. £117) **£89·50**
(plus 10% VAT and plus £1·45 carr/packing).

BARCLAYCARD/ACCESS
Call, write or phone your order 01-402 4736.
EASY TERMS FOR CALLERS

KITS - TEST GEAR - AMPLIFIERS - SPEAKERS - DECKS POWER SUPPLIES - TRANSISTORS - IC's

See pages 934, 935 and 936 of this magazine

LOW COST HI-FI SPEAKERS SPECIAL OFFERS

EMI 13in × 8in—full range speakers (post 20p each or 30p pair); *150TC—8 ohms Twin Cone 10 watt, **£2·20** each or **£4** pair; *450 10 watt c/o Twin Tweeters 3, 8 or 15 ohms, **£3·50** each or **£6·90** pair; EW 15 watt 8 ohms c/o Tweeter, **£4·30** each or **£7·90** pair; 350 20 watt c/o Tweeters 8 or 15 ohms, **£7·50** each or **£14·20** pair.
* Polished wood cabinet **£4·60**, post 35p.

8 ohms full range (post 20p)
FR4 4in 5 watt, **£4**; FR65 6½in 10 watt, **£5·50**; FR8 8in 15 watt, **£7·60**; FR23 9 × 6in 15 watt, **£6·00.**

BASS AND MID RANGE—8 ohms (post 20p)
AA12 5in 15 watt, **£3·20**; B110 5½in 15 watt, **£5·60**; B200 8in 15 watt, **£6·45**; B139/2 13in × 8in 30 watt LF, **£10·25.**

TWEETERS AND CROSSOVERS (post 20p)
K2006 10 watt 8 or 15 ohms, **£1·90**; FHT6 15 watt 8 ohms, **£3·20**; K2011 30 watt 8 ohms, **£3·75**; T27 KEF, **£4·25**; Axcent 100 30 watt 8 ohms, **£4·90**; K4009 1kHz/5kHz c/o, **£2**; SN75 3kHz var. c/o, **£1·75.**

SPEAKER KITS (carr. etc. 35p)
20-2 8in 30 watt, **£10** each; 20-3 8in 40 watt, **£15** each; LINTON 2 20 watt, **£15·95** pair; GLENDALE 3 30 watt, **£28·95** pair; DOVEDALE 3 50 watt, **£42** pair; KEF KK2, **£20·40** each; KEF KK3, **£32** each.

BUILD YOURSELF A POCKET CALCULATOR

A complete kit, packaged in a polystyrene container and taking about 3 hours to assemble—that's the Sinclair Cambridge pocket calculator from Henry's. Some of the many features include interface chip, thick-film resistor pack, printed circuit board, electronic components pack. Size: 4⅓in long × 2in wide × 11/16in deep.
Free of charge with the kit for the more advanced technologist is a 32-page booklet explaining how to calculate Logs, Tangents, Sines, etc.

Price **£24·95** (+ VAT)
Also assembled ready to use **£27·22** (+ VAT)

10% VAT TO BE ADDED TO ALL ORDERS. Prices and descriptions correct at time of press E & OE.

Henry's RADIO LIMITED
EDGWARE ROAD, W2

404-406 Electronic Components and Equipment 01-402 8381
354-356 High Fidelity and Tape Equipment 01-402 5854/4736
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road, London W2 1BW

Open:- 9 am-6 pm 6 days a week All stores open all day Saturday