

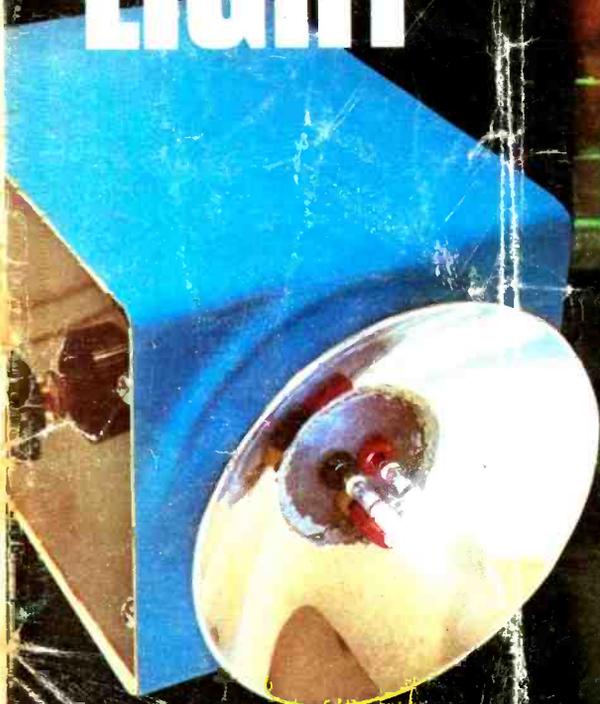
PRACTICAL

# ELECTRONICS

DECEMBER 1973

20p

## PARTY STROBE LIGHT



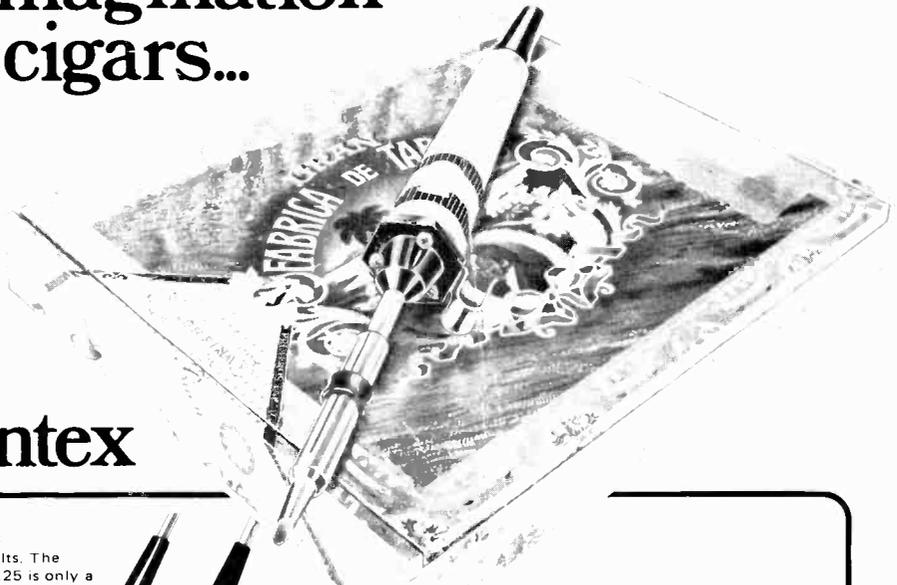
*...and* **VOICE  
OPERATED  
FADER**

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## MODEL CCN

229 volts or 240 volts. The 15 watt miniature model CCN also has negligible leakage.

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PRICE £2-15 (rec. retail) P & P 5p.

MODEL G 18 watt miniature iron, fitted with long-life iron coated bit 3/32". Voltage 240, 220 or 110. PRICE £2-15. (rec. retail) P & P 5p.



MODEL CN Miniature 15 watt soldering iron fitted 3/32" iron coated bit. Many other bits available from 3/64", to 3/16". Voltages 240, 220, 110, 50 or 24. PRICE £1-93. (rec. retail) P & P 5p.

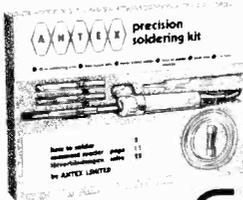


all prices include VAT at 10%



## MODEL SK.2 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder, stand and "How to Solder" booklet. PRICE: £2-87. (rec. retail) P & P 8p.



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PE12

# PRACTICAL ELECTRONICS

VOLUME 9 No. 12 DECEMBER 1973

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## CONSTRUCTIONAL PROJECTS

- PARTY STROBE** *by M. J. Hughes*  
Freeze motion with this party light 1054
- VOICE OPERATED FADER** *by A. J. Russell*  
Fit "talkthrough" to your discotheque 1057
- P.E. RONDO QUADRAPHONIC SOUND SYSTEM—4** *by R. A. Cole*  
Continuing the mechanical construction and wiring 1072
- P.E. SOUND SYNTHESISER—11** *by G. D. Shaw*  
Hold, modulation amplifiers, mixer and envelope shaper for keyboard unit 1082
- 9V BATTERY ELIMINATOR** *by A. M. Rudkin*  
A nine volt power-pack in a battery case 1090

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Our January issue will be published on Friday, December 14, 1973

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Golding G800. Teak finish, plinth and tinted cover with mains lead and DIN plug and screened lead. All fully wired. Please add £1.75 for P. & P. and Ins. **£14.95**

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Garrard Zero 100 (Single)	£30.95
Garrard Zero 100 (Auto)	£34.95
Golding GL85/P P & C	£65.95
Golding G101/P P & C	£21.95
Golding GL72	£24.95
Golding GL72/P	£31.95
Golding GL75	£30.95
Golding GL75/P	£38.95
Golding GL75 Lid	£4.25
Thorens TD125	£60.95
Thorens TD125 AB Mk.II	£93.95
Thorens TD160 AB & C	£51.95
Thorens TD165 AB & C	£45.95
Condor Auto Cleaner (Star Value)	£1.40 P. & P. 15p

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Please add 95p P. & P. & Ins.

Alpha Highgate FT150	£32.95
Amstrad Multiplex 3000	£33.90
Metrosound FMS 20 Mk. II	£37.75
Metrosound FMS 40	£37.75
Philips RH 621	£72.95
Rogers R/brook FET 4 (Cha)	£32.95
Rogers R/brook FET 4 (Cased)	£36.50
Sinclair cased tuner	£27.50
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£1.65 for P. & P. (Per Pair)

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Celestion Ditton 15	£50.75
Celestion Ditton 44	£79.45
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Goodmans Mezo 3	£50.95
Goodmans Havant	£35.25
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Keltron KS8	£22.50
Sinclair Q16	£11.95
Sinclair Q30	£30.95
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Wharfedale Glendale Kit	£29.95
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Rogers R/bourne (Ch)	£54.25
Rogers R/bourne (Ca)	£56.95
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Sinclair 3000	£44.95
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Sinclair Stereo 80 Pre-amp P.O.A.  
Sinclair Z30 Amp £3.85  
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Sinclair PZ5 Power Supp £4.20  
Sinclair PZ6 Power Supp £6.15  
Sinclair PZ8 Mains Trans £4.95  
Sinclair PZ8 Power Supp £6.15

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Please add £1.10 P. & P. & Ins.

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Goodmans Module 80	£62.95
Goodmans Mod 80 Com	£109.95
Goodmans Mod 90	£76.95
Goodmans One-Ten	£92.95
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Rotel 150A	£45.25
Rotel 200A	£57.95
Status STA160	£89.95

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For Garrard SP25, 2025 TC, 3000, BSR, McDonald, MP60 £3.08 P. & P. 71p. For AP76, SL72B, SL95B, etc. £4.85 + 71p P. & P.

## CARTRIDGES

Please add 11p P. & P. & Ins.

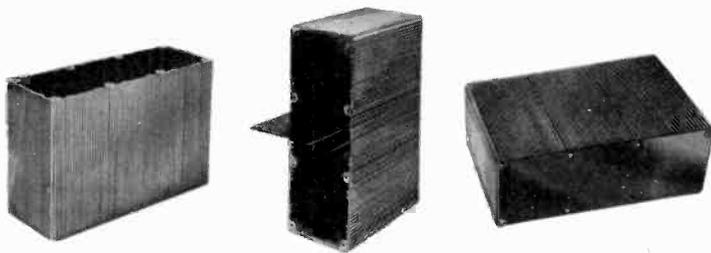
Golding G850	£2.75
Golding G800	£3.50
Golding G800E	£6.30
Golding G800SE	£10.90
Shure M3D	£3.25
Shure M44E	£4.95
Shure M55E	£5.00
Shure 75ED Type 2	£9.25
Shure V15	£25.95
Shure M75EJ Type 2	£7.95
Sonotone 9 TAMC	£1.20
Sonotone V 200E	£8.55
Audio Technica AT66	£3.15
ADC 10E Mk IV	£14.95
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Ronette SM500/E	£7.95



# VERO

## products available from your local retailer

to assist with all types of home constructor projects



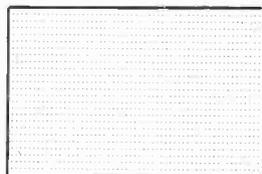
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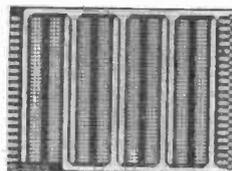
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Can you really get sound quality like this **FOR LESS THAN £19? YES, YOU CAN! WITH THE NEW**

**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!

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

Power Output 2·7 watts per channel and headphone socket with automatic cut-out. Provision for auxiliary inputs—radio, tape, etc., and output for taping discs. Overall dimensions: Speakers approx. 15½ × 8 × 4 in. Complete deck and cover enclose position approx. 15½ × 12 × 6 in.

Personal shoppers and mail order price

**£18·45** INCLUDING VAT / plus £1·60 p. & p.

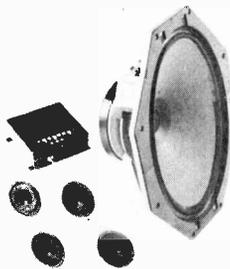
Diamond stylus, if required, £1·37 extra

Specially selected pair of stereo headphones with individual level controls, and padded earpieces to give optimum. £3·85.

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**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 3½in 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.**



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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 x 10½in x 6½in. Drive unit 13in x 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 x 11½in x 9½in. Drive unit 13½in x 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

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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 modulated IF stages which are pre-aligned before despatch. As well as electronic components this kit also contains 2 diamond-spun aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

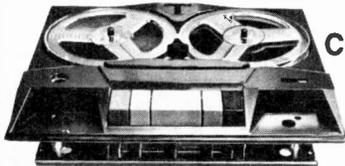
The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7in wide, 2in high and 4½in deep.

- \* 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

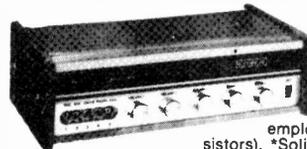
Speaker with baffle and fixing strips £1.65. 23p p. & p., post free if bought with the kit. Send stamped addressed envelope for leaflet.

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.



### PE TAPE LINK CONSTRUCTORS

Suitable 3 speed tape deck, **less heads**. Caters up to 5½ins. spools. 240V AC mains. Unused but store soiled hence no warranty. £1 p. & p. **£4.00**



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\*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.

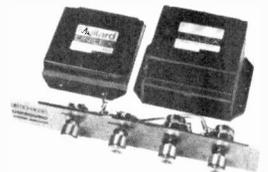
INPUTS 1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of

medium output equipment (Gram. Tuner, Monitor, Organ, etc.). All 250mV sensitivity. Output 20 watts into 8 ohms (suitable for 15 ohms). Size approx. 12½ x 6 x 3½ ins. £13.50 p. & p. 60p.

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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.



### 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. **£10.60 p. & p. 90p.** simply connect up.

**ALL PRICES INC. VAT**

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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, 4½p. 0.22µF, 5½p. 0.33µF, 8p. 0.47µF, 9p. 0.68µF, 11p. 1µF, 15p. 1.5µF, 22p. 2.2µF, 25p.

**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  
½ CF 22-1M 1 0.8 0.65 0.62 0.55 0.5 0.45 2.4 x 7.5  
½ CF 22-2M2 1 0.8 0.65 0.62 0.55 0.5 0.45 3.9 x 10.5  
½ CF 22-1M 0.8 0.65 0.62 0.55 0.5 0.45 5 x 16  
½ MF 10-2M7 1 0.9 0.8 0.7 0.65 0.65 0.6 3 x 7  
½ MF 10-2M2 1 0.9 0.8 0.7 0.65 0.65 0.6 4.2 x 10.8  
½ MF 10-10M 1.5 1.25 1.25 1.1 1 0.95 0.8 6.6 x 18  
2 MF 10-10M 3 2.5 2.5 2 1.75 1.75 1.6 8 x 17.5  
For value mixing prices, please refer to our catalogue. (price in pence each)  
VALUES AVAILABLE—E12 Series only. Net prices above 100.

**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

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1.5µF 63V	6p	68µF 63V	12p
2.2µF 63V	6p	100µF 10V	6p
3.3µF 63V	6p	100µF 25V	6p
4.0µF 63V	6p	100µF 63V	14p
4.7µF 63V	6p	150µF 16V	6p
6.8µF 63V	6p	150µF 63V	15p
8.0µF 63V	6p	220µF 6V	4p
10µF 16V	6p	220µF 10V	6p
10µF 25V	6p	220µF 16V	9p
10µF 63V	6p	220µF 63V	21p
15µF 16V	6p	330µF 16V	12p
15µF 63V	6p	330µF 63V	25p
16µF 40V	6p	470µF 6V	4p
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 6V	4p
47µF 10V	6p	1500µF 16V	25p
47µF 25V	6p	2200µF 10V	25p
47µF 63V	8p	3300µF 6V	4p

**VEROBOARD 0.1 0.15**

2½ x 5"	28p	28p
2½ x 3½"	26p	19p
3½ x 5"	32p	33p
3½ x 3½"	28p	28p
2½ x 1"	7p	7p
2½ x 5" (Plain)	—	14p
2½ x 3½" (Plain)	—	12p
5 x 3½" (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 lin. Single, 16½p. Dual Gang 46p. Log Single with Switch 26p.

Slider Pots. 10K, 100K, 500K, 30mm, 34p. 45mm, 47p. 60mm, 55p.

**DIODES**

IN4001 6½p
IN4002 7½p
IN4003 9p
IN4004 9½p
IN4005 12p
IN4006 14p
IN914 7p
IN916 7p
BA100 10p
OAS 42p
OA47 12p
OA81 11p
OA200 8p

**Integrated Circuits**

µA709C 50p
µA741C 55p
µA723C £1
µL914 35p

**PLUGS**

DIN 2 Pin 12p
3 Pin 13p
5 Pin 180° 15p
Std. Jack 14p
2.5mm Jack 11p
Phono 5½p

**SOCKETS**

DIN 2 Pin 10p
3 Pin 10p
5 Pin 180° 12p
Std. Jack 14p
2.5mm Jack 11p
Phono 5½p

**ELECTROLYTIC CAPACITORS. Tubular & Large Cans**

(µF/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, 51p. 200/10, 100/25, 50/50, 61p. 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.

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TERMS: MAIL ORDER ONLY. C.W.O. Cheques or crossed P.O. payable to Eaton Audio. Minimum order £2. Where P. & P. charges are not shown please add 10p in the £1 to orders under £5. Orders over £5 will be sent free of P. & P. All prices subject to V.A.T.



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**EASY-TO-USE DISPENSERS**



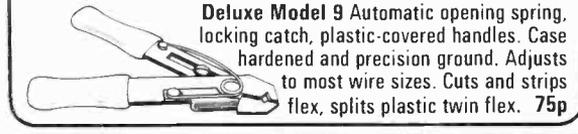
Size 5 Savbit alloy 18 swg, 18p (illustrated). Size 19A 60/40 alloy 18 swg, 18p Size 15 60/40 alloy 22 swg, 22p

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Size 1 cartons in 40/60, 60/40 and Savbit alloys in 7 gauges 25p Size 12 REEL for Service Engineers and Electricians. 18 swg Savbit alloy. 75p

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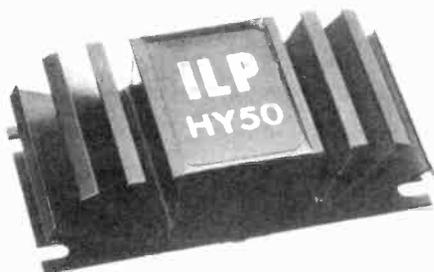
Deluxe Model 9 Automatic opening spring, locking catch, plastic-covered handles. Case hardened and precision ground. Adjusts to most wire sizes. Cuts and strips flex, splits plastic twin flex. 75p

Prices shown are recommended retail, excluding V.A.T. From Electrical and Hardware Shops, if unobtainable, send 10p p&p direct to Multicore Solders Ltd., Hemel Hempstead, Hertfordshire HP2 7EP



**I.L.P. (Electronics) Ltd**

## SECOND GENERATION 25 WATT HYBRID



A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices. We have now finally reduced the modular audio amplifier to a simple input/output device requiring only the addition of a basic unstabilized (split line) power supply. The HY50 takes medium power modules to their logical conclusion by incorporating with it a heatsink, which is designed in special high conductivity alloy sufficient for normal audio use without additional chassis sinking. All this without significantly increasing the size of the module comparable in size to a packet of "King-size" cigarettes. Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

**OUTPUT POWER:** 25W RMS, 50W peak music power.  
**LOAD IMPEDANCE:** 4-16Ω into 8Ω  
**INPUT SENSITIVITY:** 0dB (0.775V RMS).  
**INPUT IMPEDANCE:** 47kΩ.  
**TOTAL HARMONIC DISTORTION:** Less than 0.1% at 25W typically 0.05.  
**SIGNAL/NOISE RATIO:** better than 75dB.  
**FREQUENCY RESPONSE:** 10Hz-50kHz ± 1dB.  
**SUPPLY VOLTAGE:** ± 25V.  
**SIZE:** 105 x 50 x 25mm.  
Price £5.40 mono £10.80 stereo. Price inclusive of VAT & P. & P.

### SPEC.

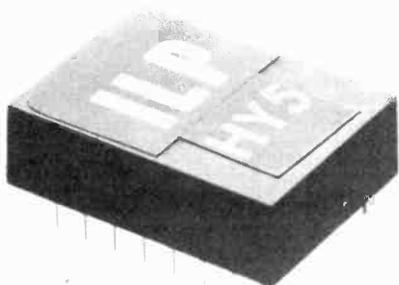
## NEW HY5 PREAMPLIFIER

Unchallenged for two years, the HY5, our unique multifunction preamplifier/tone hybrid, has been brought into line with the advancements in our power hybrids.

Like the HY50, the new HY5 has no external components and has been redesigned to run off a split power line with improvements in signal/noise, overload capability and reduced distortion. The output has been increased to match the power module (0dB), and share the same power supply.

Overall size is reduced by the use of a new thin film circuitry while the device still retains all the functions of the earlier device. When combined with the HY50 and power supply only potentiometers are required to complete a simple mono amplifier with input and output facilities expected to be found on Hi-Fi amplifiers.

The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.

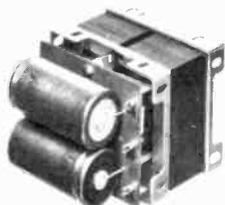


**INPUTS**  
Magnetic Pick-up 3mV (within 1dB RIAA curve)  
Ceramic Pick-up up to 3mV.  
Microphone 10mV.  
Tuner 250mV.  
Auxiliary 3-100mV.  
Input impedance 47kΩ 1 kHz  
**OUTPUTS**  
Tape 100mV.  
Main output. 0dB (0.775V).

### SPEC.

**ACTIVE TONE CONTROLS**  
Treble ± 12dB at 10kHz  
Bass ± 12dB at 100Hz  
**OVERLOAD CAPABILITY**  
(equalization stage) 40dB on most sensitive input.  
**OUTPUT NOISE LEVEL**  
(below 10mV magnetic input) 68dB.  
**DISTORTION** 0.05% at 1kHz.  
**SUPPLY VOLTAGE** ± 16-25V.  
**SUPPLY CURRENT** 15mA.

Price £4.51 mono £9.02 stereo. Price inclusive of VAT & P. & P.



## POWER SUPPLY PSU50

The new PSU50 has a low profile look being only 2½in high and can be used for either mono or stereo systems.

**SPEC.**  
**OUTPUT VOLTAGE** ± 25V.  
**INPUT VOLTAGE** 210-240V.  
**SIZE:** L. 70 D. 90 H. 60mm.

Price £5.23. Price inclusive of VAT & P. & P.

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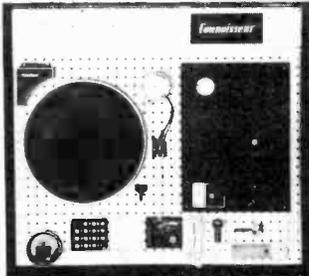
CANTERBURY 63218

Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

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## THE B.D.2 TURNTABLE ASSEMBLY

The Famous B.D.2 belt drive turntable with press button speed change has now been developed to feature a newly designed mat and brushed aluminium trim, and the perspex cover has an easy 'hinged-on, hinged-off' movement. The B.D.2 is available as a chassis unit or spring mounted on a wood plinth.



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**FOR INACCESSIBLE CONTACTS—More than just a cleaner. KONTAKT 60 guarantees perfect cleaning of contacts chemically in accordance with today's technology.**

**KONTAKT offers the following advantages:—**

1. Dissolves oxides and sulphides the safe way without attacking contact substances.
2. Contains carefully selected solvents which do not attack plastics whereas they do dissolve resinified contact greases and dirt.
3. Contains *no silicone*.
4. Contains a light lubricant in order to avoid the contact paths being corroded.
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6. Prevents "creep" currents.

Because of these outstanding properties **KONTAKT 60** is one of the best and most popular contact cleansing agents in the world.

Users include: Rolls-Royce Ltd., C.E.G.B., South of Scotland Electricity Board, Trinity House Workshops, Kolster Brandes, Mullard, Plessey Cos., etc.

### OTHER KONTAKT PRODUCTS ARE:

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| 70 Protective Lacquer            | 80 Special Siliconized Polish     |
| 72 Insulating Spray              | 100 Antistatic Agent for Plastics |
| 75 Cold Spray for Fault Location | 101 Dehydration Fluid             |

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**MULTIMETER** Model C-7081 GN  
Range Doubler 50,000 ohm/volt  
High Sensitivity Meter £12-37.

**TAPE RECORDER LEVEL METER**  
500µA, 55p



**CARDIOID DYNAMIC MICROPHONE**

Model UD-130. Frequency response 50-15,000c/s. Impedance Dual 50K and 600 ohms, £4-95.



4 1/4 in x 3 1/4 in **METER.** 30µA, 50µA or 100µA, £2-86.

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220	8	6	3½	£2.65
221	8	6	6	£2.80
320	12	8	7½	£5.00

Chassis for model 320 £1.75 extra. Please send s.a.e. for free illustrated leaflet.

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MES announce the very latest development in organ circuitry.

### THE DMO2

13 Master Frequencies on ONE tiny circuit board. LOOK AT THESE AMAZING ADVANTAGES

★ 13 frequencies from C8 to C9. ★ Each frequency digitally derived from a SINGLE h.f. master oscillator. ★ Initial tuning for the WHOLE ORGAN: ONE SIMPLE ADJUSTMENT. ★ Relative tuning NEVER DRIFTS! ★ External control allows instant tune-up to other musicians. ★ Outputs will directly drive most types of dividers including the SAJ110. ★ And each output can also be used as a direct tone source. ★ Variable DEPTH AND RATE tremulant optional extra. ★ Gold-plated plug-in die connexion. ★ Complete fibre glass board (including tremulant if required) ONLY 3-7in. x 4-5in. ★ Very low power consumption.

★ EXTREMELY ECONOMICAL PRICE. ★ Ready built, tested DMO2 (with tremulant) ONLY £14.25

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SAJ110 7-stage frequency divider in one 14 pin DIL package. Sine or square wave input allows operation from almost any type of master oscillator including the DMO2 (when 97 notes are available). Square wave outputs may be modified to saw-tooth by the addition of a few components. SAJ110: £2.63 each OR special price for pack of 12: £25.00. S.a.e. please for data sheet.

★ S.a.e. please for full technical details.

Trade enquiries welcome.



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We shall be stocking all the parts for this exciting project, from the special I.C.'s right down to the nuts, bolts and spacers for mounting the Veroboards.

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Spring line reverberation unit (as specified)	£2.89
uA 7815 (15V 1.5A) voltage regulator	£2.30
REc 41A bridge rectifier	£1.06
741C 8-pin DIL	36p
MFC 6040 electronic attenuator	£0.85
SG 3402N for Ring Modulator	£1.89

## CAPACITORS

Sub-miniature Axial lead electrolytic

Mfd V	Price	Mfd V	Price
1	63 6p	68	6-3 6p
1.5	63 6p	68	16 6p
2.2	63 6p	68	63 10p
3.3	63 6p	100	6 6p
4.7	63 6p	100	10 6p
6.8	63 6p	100	25 6p
6.8	63 6p	100	40 6p
10	25 6p	100	63 12p
10	63 6p	150	6-3 6p
15	16 6p	150	16 6p
15	40 6p	150	25 6p
15	63 6p	150	40 10p
22	10 6p	150	63 12p
22	25 6p	220	4 6p
22	63 6p	220	10 6p
33	6-3 6p	220	16 6p
33	16 6p	220	25 10p
33	40 6p	220	40 12p
47	4 6p	220	63 18p
47	10 6p	330	4 6p
47	25 6p	330	10 6p
47	40 6p	330	16 10p
47	63 6p	330	63 22p
		4700	4 22p

## PLUGS AND SOCKETS



<b>DIN PLUGS</b>	<b>MAINS</b>	<b>R88 8 way chassis socket</b>	<b>Std. 1/2" stereo plug</b>
2 pin (1 flat) 8p	P360 3 pin 1.5A chassis plug with line socket. Per pair 24p	52p	18p
3 pin 9p	SA 2190 3 pin 5A chassis plug 17p		Screened 25p
4 pin, 5 pin A (180°), 5 pin B (240°), 6 pin 10p	SA 1862 Line socket for above 19p		Open mono socket 1/2" 10p; Moulded mono socket 1/2" with 2 break contacts 9p; 13p; Moulded stereo socket 1/2" with 3 break contacts 18p; 3.5mm. plug plastic 8p; screened 11p; open socket 8p.
<b>DIN Sockets</b>	<b>McMURDO</b>	<b>JACK</b>	
2 pin 6p	RP8 8 way chassis plug 38p	Std. 1/2" mono plug Elastic 13p; Screened 17p	

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## OMNIUM GATHERUM

PP3, 6 etc. battery clip dual min. 9p.  
FP1, 9 etc. battery clip separate per pair 6p.  
Pair crocodile clips 1 red, 1 black insulated sleeve 7p.  
Solder Multicore 22 s.w.g. 10 metres 20p.  
Silicone grease in special dispenser 20ml 48p.  
Red neon 240V panel mounting 25p.  
Lacing Cord Strong rayon cored PVC 25m 48p.  
Panel fuse holders 20mm 20p; 1½in 30p.

**Transformers**  
LT700 min. output transformer Pri. 1-2kΩ Sec. 6Ω 200mW 35p.

**Sub-min. Mains Transformer**  
0-6-5V 100mA 95p. 12-0-12V 50mA 95p.  
Size: Both approx. 30 x 27 x 25mm.  
**Min. Mains Transformer**  
Size: 46 x 31 x 38mm.  
0-12V 250mA, 0-12V 250mA £1.38.

**Mains transformer MT3AT**  
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**Mains Transformer MT208AT**  
Pri. 200-220-240V, Sec. 0-15-20V 1A, 0-15-20V 1A £3.10.

Also in stock: Wide range of brass and nylon nuts, bolts and washers plus solder tags, shakproof washers, etc.

## POTENTIOMETERS

Rotary miniature carbon track 1/2" spindle

Single gang Lin or Log 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M (and 1k Lin) 12p

<b>Dual gang (Stereo) without switch Log or Lin 5k to 2M as above 38p.</b>	<b>Single gang with DP switch 250V 2A Log or Lin 5k to 2M as above 28p.</b>
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**PRESETS**  
Sub-miniature 0-1W Vert or Horiz 100, 250, 500, 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M 8p.

Wirewound 10% 1W 1/2" spindle 10, 50, 100R 34p; 250, 500, 1k, 5k 33p; 10k, 37p; 25k 40p; 50k 44p.

## RESISTORS

Carbon Film 1/4W 5% 1Ω to 1M; 10% 1.2M to 10M	E12 1p
Carbon Film 1/4W 5% 1Ω to 10Ω; 10% 1.2M to 10M	E24 1p
Carbon Film 1/4W 5% 1Ω to 910k	E12 & E24 1p
Carbon Film 1/4W 5% 10Ω to 10M	E12 3p
Metal Oxide 1/4W 2% 10Ω to 1M	E12 & E24 4p
Wirewound 2 1/4W 10% 0-220ohms to 0-470ohms	E12 10p
Wirewound 2 1/4W 5% 10hm to 270ohms	E12 10p

E12 values 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades  
E24 values 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades

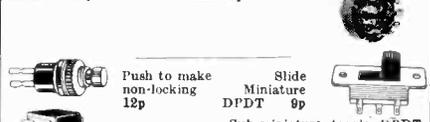
## TRANSISTORS, DIODES & I.C.'s.

AC127 25p	MFP102 30p	2N3033 18p
AC128 20p	OC25 65p	2N3034 54p
AC176 17p	OC28 85p	2N3055 49p
AD149 50p	OC35 60p	2N3819 24p
AD161/2 60p	OC44 20p	OA90 7p
BC107 10p	OC71 20p	OA91 6p
BC108 10p	T1843 28p	1N914 4p
BC109 10p	2N705 10p	1N4148 4p
BC147 10p	2N1304 30p	1N4001 6p
BC148 10p	2N1711 24p	1N4002 61p
BC149 12p	2N2219 25p	1N4003 7p
BC168 13p	2N2646 45p	1N4004 74p
BC169C 12p	2N2905 33p	1N4006 8p
BC182L 12p	2N2907 25p	1N4006 81p
BC204 14p	2N2926 10p	1N4007 8p
BC209C 14p	2N2926V 10p	W005 30p
BD131 54p	2N2926G 10p	W04 33p
BD132 67p	741C 8-pin DIL 36p	
BD131/2 £1-50	741C 14-pin DIL 45p	
BF194 15p	DIL Sockets 8-pin 20p	
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Ref. No.	VA (Watts)	Weight lb oz	Size cm.	P & P £ p
07	20	1 8	7.0 x 6.0 x 6.0	1.94 30
149	60	3 12	9.9 x 7.7 x 8.6	2.88 36
150	100	5 8	9.9 x 8.9 x 8.6	3.16 52
151	200	8 0	12.1 x 9.3 x 10.2	5.31 52
152	250	13 12	12.1 x 11.8 x 10.2	7.01 67
153	350	15 0	14.0 x 10.8 x 11.8	9.40 82
154	500	19 8	14.0 x 13.4 x 11.8	13.55 *
155	750	29 0	17.2 x 14.0 x 14.0	19.26 *
156	1000	38 0	17.2 x 16.6 x 14.0	24.97 *
158	2000	60 0	21.6 x 15.3 x 18.1	41.25 *

## AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	Auto Tops	P & P £ p
113	20	1 0	5.8 x 5.1 x 4.5	0-115-210-240	1.02 22
64	75	2 4	7.0 x 6.4 x 6.1	0-115-210-240	2.00 30
4	150	3 4	8.9 x 7.7 x 7.7	0-115-200-220-240	2.42 36
66	300	6 4	9.9 x 9.6 x 8.6	..	4.70 52
67	500	12 8	12.1 x 11.2 x 10.2	..	6.98 67
84	1000	19 8	14.0 x 13.4 x 14.3	..	12.69 82
93	1500	30 4	14.0 x 15.9 x 14.3	..	18.39 *
95	2000	32 0	17.2 x 16.6 x 14.0	..	24.00 *
73	3000	40 0	21.6 x 13.4 x 18.1	..	32.67 *

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## LOW VOLTAGE SERIES (ISOLATED)

Ref. No.	Amperes	Weight lb oz	Size cm.	Secondary Windings	P & P £ p	
111	0.5	0.25	8	4.8 x 2.9 x 3.5 0-12V at 0.25A x 2	1.02 22	
113	1.0	0.5	1	4	6.1 x 5.8 x 4.8 0-12V at 0.5A x 2	1.22 22
71	2	1	12	7.0 x 6.4 x 6.1 0-12V at 1A x 2	1.60 30	
218	4	2	12	8.3 x 7.7 x 7.0 0-12V at 2A x 2	2.24 36	
70	6	3	8	8.9 x 8.0 x 7.7 0-12V at 3A x 2	2.70 42	
108	8	4	5	8	9.9 x 8.9 x 8.6 0-12V at 4A x 2	3.00 52
72	10	5	6	4	9.9 x 9.6 x 8.6 0-12V at 5A x 2	3.55 52
116	12	6	12	9.9 x 10.2 x 8.6 0-12V at 5A x 2	4.30 52	
17	16	8	12	12.1 x 9.9 x 10.2 0-12V at 8A x 2	5.48 52	
115	20	10	11	8	14.0 x 9.6 x 11.8 0-12V at 10A x 2	6.98 67
187	30	15	8	14.0 x 12.1 x 11.8 0-12V at 15A x 2	12.90 82	
226	60	30	32	0	17.2 x 15.3 x 14.0 0-12V at 30A x 2	23.72 *

## 30 VOLT RANGE

Ref. No.	Amperes	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
112	0.5	1	4	6.1 x 5.8 x 4.8 0-12-15-20-24-30V	1.22 22
79	1.0	2	4	8.0 x 6.7 x 6.1	1.62 30
3	2.0	3	4	8.9 x 7.7 x 7.7	2.43 36
20	3.0	4	8	9.9 x 8.3 x 8.6	2.99 42
21	4.0	6	4	9.9 x 9.6 x 8.6	3.55 52
51	5.0	6	12	12.1 x 8.6 x 10.2	4.42 52
117	6.0	8	0	12.1 x 9.3 x 10.2	5.28 52
88	8.0	12	0	12.1 x 11.8 x 10.2	6.82 67
89	10.0	13	12	14.0 x 10.2 x 11.8	8.36 67

## 50 VOLT RANGE

Ref. No.	Amperes	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
102	0.5	1	12	7.0 x 6.4 x 6.1 0-19-25-33-40-50V	1.60 30
103	1.0	2	12	8.3 x 7.4 x 7.0	2.34 36
104	2.0	3	8	7.9 x 8.9 x 8.6	3.25 42
105	3.0	6	12	9.9 x 10.2 x 8.6	4.41 52
106	4.0	10	0	12.1 x 10.5 x 10.2	5.84 52
107	6.0	12	0	14.0 x 10.2 x 11.8	8.63 67
118	8.0	18	0	14.0 x 12.7 x 11.8	11.27 97
119	10.0	25	0	17.2 x 12.7 x 14.0	14.13 *

## 60 VOLT RANGE

Ref. No.	Amperes	Weight lb oz	Size cm.	Secondary Taps	P & P £ p
124	0.5	2	4	7.0 x 6.7 x 6.1 0-24-30-40-48-60V	1.62 36
126	1.0	3	4	8.9 x 7.7 x 7.7	2.26 36
127	2.0	6	4	9.9 x 9.6 x 8.6	3.55 42
125	3.0	8	12	12.1 x 9.9 x 10.2	5.41 52
123	4.0	13	12	12.1 x 11.8 x 10.2	6.98 67
40	5.0	12	0	14.0 x 12.7 x 11.8	8.28 67
120	6.0	15	8	14.0 x 12.1 x 11.8	10.12 82
121	8.0	25	0	14.0 x 14.7 x 11.8	11.40 *
122	10.0	25	0	17.2 x 12.7 x 14.0	16.75 *
189	12.0	29	0	17.2 x 14.0 x 14.0	18.75 *

## MINIATURE TRANSFORMERS WITH SCREENS

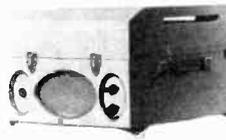
Ref. No.	mA	Weight lb oz	Size cm.	Volts	P & P £ p	
238	200	1	2	2.8 x 2.6 x 2.0	3-0.3	1.10 10
212	1A, 1A	1	4	6.1 x 5.8 x 4.8	0-6, 0-6	1.27 22
13	100	1	4	3.9 x 2.6 x 2.9	0-0.9	64 10
235	330, 330	1	4	4.8 x 2.9 x 3.5	0.9, 0.9	1.27 10
207	500, 500	1	00	6.1 x 5.4 x 4.8	0-8.9, 0-8.9	1.70 22
208	1A, 1A	1	12	7.0 x 6.4 x 6.1	0-8.9, 0-8.9	2.28 30
236	200, 200	1	4	4.8 x 2.9 x 3.5	0-15, 0-15	1.27 10
214	300, 300	1	4	6.1 x 5.8 x 4.8	0-20, 0-20	1.34 22
221	700 (d.c.)	1	8	7.0 x 6.1 x 6.1	20-12, 0-12-20	1.20 30
206	1A, 1A	1	12	8.3 x 7.7 x 7.0	0-15-20, 0-15-20	3.08 38
203	500, 500	2	4	3.7 x 0 x 7.0	0-15-27, 0-15-27	2.36 38
204	1A, 1A	3	4	8.9 x 7.7 x 7.7	0-15-27, 0-15-27	2.39 38

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UIC07=	8 x 7407	0-55
UIC10=	12 x 7410	0-55
UIC12=	12 x 7420	0-55
UIC30=	12 x 7430	0-55
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UIC70=	8 x 7470	0-55
UIC72=	8 x 7472	0-55
UIC73=	8 x 7473	0-55
UIC74=	8 x 7474	0-55
UIC76=	8 x 7476	0-55
UIC80=	5 x 7480	0-55
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5A TO66	0-39	0-52	0-54	0-59	0-75	0-88
5A TO64	0-39	0-52	0-54	0-62	0-75	0-88
7A TO48	0-52	0-55	0-62	0-67	0-84	0-89
10A TO48	0-55	0-63	0-67	0-68	1-07	1-32
10A TO48	0-58	0-62	0-67	0-77	0-87	1-00
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DO7	8016	Plastic	8016	8016	8010	8010	T048
50	0-05	0-06	0-06	0-08	0-15	0-21	0-40
100	0-05	0-07	0-08	0-10	0-17	0-23	0-75
200	0-06	0-10	0-07	0-12	0-22	0-25	1-00
400	0-08	0-15	0-08	0-15	0-30	0-38	1-35
600	0-09	0-17	0-10	0-18	0-36	0-45	1-90
800	0-12	0-19	0-11	0-20	0-38	0-55	2-10
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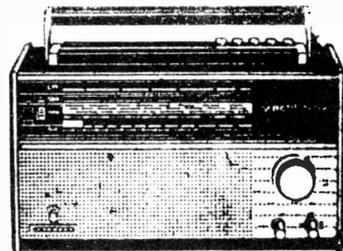
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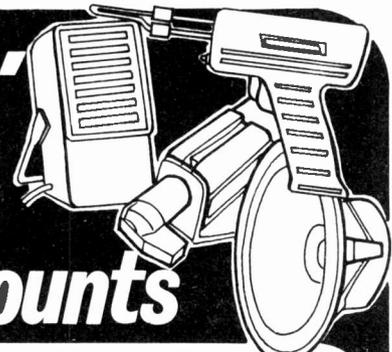
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LOW NOISE CASSETTES		Cassette Head Cleaner	
C60	1-5	6-10	11-20
C90	35p	33p	30p
C120	45p	43p	40p
	55p	52p	50p
			11-20 post free
PLASTIC LIBRARY CASES for		7in Reels	
5in Reels	0-18	CASSETTE CASES	0-10
6 1/2in Reels	0-22	P. & P. 1-3 each 5p; 4 or more	0-20
BIB ACCESSORIES		SPECIAL OFFER	
Tape Editing Kit, Ref. 23	1-30	BUSH Stereo System with Independent	
Recording Tape Splicer, Ref. 20	1-15	Volume, Bass and Treble controls	
Cassette Tape, Editing, Ref. 24	1-40	on each Speaker for optimum repro-	
Cassette Salvage Kit, Ref. 29	0-40	duction. Using Garrard 2025TC Auto	
12" Cassette Case, Ref. 34	1-00	Change Deck in deluxe teak plinth	
Stylus Balance, Ref. 32A	1-15	and cover. Today's Value £49.50.	
Spirit Level, Ref. 46	0-50	OUR PRICE £27.50 + £1.60 P. & M.	
Hi-Fi Stereo Test Cassette	1-80	12 months' Guarantee by the Maker.	
Groove-Kleen Record Cleaner	1-90	THIS IS A BARGAIN NOT TO	
		BE MISSED!	

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## Riversdale Electronics

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P.O. Box 470, Manchester M60 4BU.

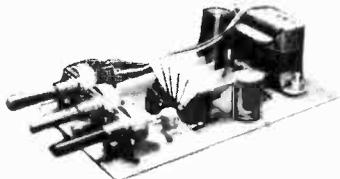
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IN21	5p	AF212	1-50	BY210	0-45	OAZ2909	8p	ZS170	8p
IN23	0-85	ASY26	0-25	BY211	0-40	OAZ210	0-40	ZS271	0-18
IN88	0-88	ASY27	0-20	BY212	0-40	OAZ211	0-40	ZT21	0-85
IN253	0-50	ASY28	0-25	BY213	0-35	OAZ222	0-45	ZT43	0-85
IN256	0-50	ASY29	0-20	BY215	1-25	OAZ223	0-45	ZTX107	0-18
IN645	0-25	ASY36	0-25	BY216	0-60	OAZ224	0-45	ZTX108	0-10
IN726A	0-80	ASY50	0-20	BY288C3V3	0-30	OAZ241	0-25	ZTX300	0-14
IN914	0-05	ASY31	0-40	BZ788C3V3	0-10	OAZ244	0-25	ZTX304	0-94
IN4007	0-15	ASY65	0-20	C111	0-55	OAZ246	0-25	ZTX600	0-15
18113	0-15	ASY65	0-20	C8S1/05	0-30	OAZ290	0-38	ZTX631	0-25
18131	0-12	ASY62	0-25	C8S1/40	0-45	OC18T	0-38		
18202	0-23	ASY66	0-23	C8S2	0-50	OC19	0-38	INTEGRATED	
20371	0-40	ASZ21	1-00	C8S3	0-50	OC20	1-25	CIRCUITS	
20381	0-25	AU101	0-20	C8S4	0-50	OC21	1-25	7400	0-80
20414	0-30	AU110	0-10	C8S5	0-50	OC22	1-25	7401	0-20
20447	0-25	AU110	1-00	C8S6	0-50	OC23	1-25	7402	0-20
2N404	0-25	BC107	0-12	C8S7	0-50	OC24	1-10	7403	0-80
2N697	0-15	BC108	0-12	C8S8	0-50	OC25	0-40	7404	0-80
2N698	0-20	BC109	0-12	C8S9	0-50	OC26	0-35	7405	0-80
2N706	0-10	BC113	0-18	C8S10	0-50	OC27	0-35	7406	0-40
2N708	0-15	BC116	0-20	C8S11	0-50	OC28	0-35	7407	0-40
2N709	0-40	BC116	0-20	C8S12	0-50	OC29	0-65	7408	0-25
2N791	0-55	BC118	0-25	C8S13	0-50	OC30	0-65	7409	0-25
2N1131	0-25	BC121	0-20	C8S14	0-50	OC31	0-65	7410	0-20
2N1132	0-25	BC122	0-20	C8S15	0-50	OC32	0-40	7411	0-25
2N1302	0-18	BC125	0-08	C8S16	0-50	OC33	0-40	7412	0-20
2N1303	0-18	BC126	0-08	C8S17	0-50	OC34	0-70	7413	0-80
2N1304	0-22	BC140	0-45	C8S18	0-50	OC35	0-18	7416	0-30
2N1305	0-22	BC147	0-15	C8S19	0-50	OC36	0-18	7417	0-20
2N1308	0-28	BC148	0-10	C8S20	0-50	OC37	0-18	7420	0-20
2N1307	0-28	BC149	0-12	C8S21	0-50	OC38	0-18	7422	0-25
2N1308	0-28	BC167	0-14	C8S22	0-50	OC39	0-25	7423	0-40
2N1247	0-75	BC168	0-12	C8S23	0-50	OC40	0-25	7424	0-20
2N148	0-60	BC169	0-08	C8S24	0-50	OC41	0-25	7427	0-37
2N2160	0-25	BC169	0-10	C8S25	0-50	OC42	0-25	7428	0-48
2N2215	0-85	BCY31	0-45	C8S26	0-50	OC43	0-25	7430	0-20
2N2219	0-25	BCY32	0-85	C8S27	0-50	OC44	0-18	7432	0-37
2N2369A	0-16	BCY33	0-38	C8S28	0-50	OC45	0-18	7433	0-48
2N2444	1-99	BCY34	0-45	C8S29	0-50	OC46	0-25	7437	0-48
2N2613	0-28	BCY38	0-55	C8S30	0-50	OC47	0-50	7438	0-28
2N2646	0-50	BCY39	1-00	C8S31	0-50	OC48	0-50	7440	0-20
2N2904	0-20	BCY40	0-80	C8S32	0-50	OC49	0-50	7441AN	0-85
2N2904A	0-25	BCY42	0-30	C8S33	0-50	OC50	0-75	7442	0-85
2N2906	0-20	BCY70	0-15	C8S34	0-50	OC51	0-75	7450	0-20
2N2907	0-23	BCZ10	0-20	C8S35	0-50	OC52	0-75	7451	0-20
2N2924	0-23	BCZ10	0-20	C8S36	0-50	OC53	0-75	7453	0-20
2N2925	0-15	BCZ11	0-65	C8S37	0-50	OC54	0-75	7454	0-20
2N2926	0-10	BD121	1-00	C8S38	0-50	OC55	0-25	7456	0-20
2N3054	0-45	BD124	0-80	C8S39	0-50	OC56	0-25	7470	0-38
2N3702	0-11	BD194	0-20	C8S40	0-50	OC57	0-48	7472	0-38
2N3705	0-12	BDY11	1-45	C8S41	0-50	OC58	0-25	7473	0-44
2N3706	0-11	BF115	0-22	C8S42	0-50	OC59	0-25	7474	0-48
2N3707	0-13	BF117	0-50	C8S43	0-50	OC60	0-25	7475	0-59
2N3709	0-10	BF173	0-28	C8S44	0-50	OC61	0-25	7476	0-48
2N3710	0-11	BF181	0-28	C8S45	0-50	OC62	0-25	7482	0-87
2N3711	0-11	BF184	0-22	C8S46	0-50	OC63	0-25	7483	1-20
2N3719	0-35	BF185	0-22	C8S47	0-50	OC64	0-45	7484	1-00
2N5027	0-53	BF194	0-13	C8S48	0-50	OC65	0-45	7486	0-80
2N5088	0-38	BF195	0-13	C8S49	0-50	OC66	0-45	7490	0-20
28301	0-59	BF196	0-15	C8S50	0-50	OC67	0-45	7492	0-75
28304	1-15	BF197	0-15	C8S51	0-50	OC68	0-25	7493	0-75
28501	0-87	BF201	0-20	C8S52	0-50	OC69	0-25	7494	0-85
28703	1-00	BF202	0-20	C8S53	0-50	OC70	0-25	7495	0-85
AA129	0-80	BFX12	0-25	C8S54	0-50	OC71	0-25	7496	1-00
AAZ12	0-75	BFX13	0-25	C8S55	0-50	OC72	0-25	7497	4-82
AAZ13	0-10	BFX29	0-28	C8S56	0-50	OC73	0-25	74100	0-80
AC107	0-35	BFX30	0-28	C8S57	0-50	OC74	0-25	74101	0-57
AC126	0-25	BFX35	0-28	C8S58	0-50	OC75	0-25	74111	0-86
AC127	0-25	BFX63	0-25	C8S59	0-50	OC76	0-25	74118	1-00
AC187	0-20	BFY17	0-25	C8S60	0-50	OC77	0-25	74119	1-02
AC188	0-20	BFY21	0-25	C8S61	0-50	OC78	0-25	74121	0-87
AC189	0-20	BFY22	0-25	C8S62	0-50	OC79	0-25	74122	0-80
AC197	0-20	BFY23	0-20	C8S63	0-50	OC80	0-25	74123	1-44
AC198	0-20	BFY24	0-25	C8S64	0-50	OC81	0-25	74141	1-00
AC199	0-20	BFY25	0-25	C8S65	0-50	OC82	0-25	74145	1-44
AC200	0-20	BFY26	0-25	C8S66	0-50	OC83	0-25	74150	2-30
AC201	0-22	BFY27	0-25	C8S67	0-50	OC84	0-		

# RAYMER ELECTRONICS

## MICROCHIP SERIES HIGH FIDELITY MODULES



### RE 500

Advanced integrated Hi-Fi Amplifier only requires connection to mains speaker and input.

Specifications: load imp 4-16 ohm. Output: 5 watts. Frequency response 20Hz to 35kHz  $\pm 3\text{dB}$ .

Total distortion less than 1%.

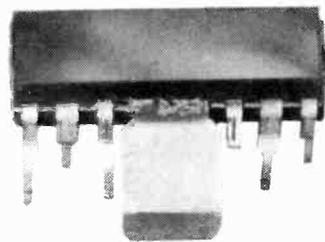
I/P Imp 100k ohm Nom.

£6-30. Post free.

Size: 140 x 80 x 45mm.

## MICROCHIP I.C.

5 watts RMS

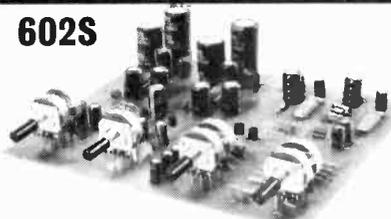


A general purpose Audio i.c. for the constructor capable of 5 watts RMS O/P at less than 1% total distortion, forms an ideal basis for an excellent Hi-Fi system.

Free Data I.C. £1-50.

Data, Printed Circuit Board, 75p. Post paid.

## RE 602S



This amplifier forms an ideal basis for the construction of an advanced stereo system at minimum cost with complete ease of assembly. Designed for use with magnetic preamp inputs and main amplifiers on same PCB.

Specifications:

Power O/P 5W RMS per channel (simultaneously).

Total distortion less than 1%.

Active tone controls.

Bass  $\pm 10\text{dB}$ , Treble  $\pm 12\text{dB}$  @ 100Hz-10kHz.

Freq. response 20Hz to 35kHz  $\pm 3\text{dB}$ .

Sensitivity for full O/P 35mV (Ceramic), 3mV (Magnetic).

Input impedance 60K and 200K Ohms.

Load impedance 8-16 ohms.

Operating Voltage 18-28 Volts D.C.

£16-50. Post free.

Power Supply Extra (RE 30 psu)

## COMPLETE QUADRAPHONIC AMPLIFIER KIT : RE 4K

A Hi-Fi kit comprising CBS SQ decoder, preamplifier and four channel main amplifier. All modules built and tested.

Specifications:

Similar to the Quadrix system (see below) but with four channel main amplifier giving 40 watts total peak power.

This is an opportunity to experience quadrasonic sound at the very minimum of cost.



(Power Amp only shown)

£39-00. Post free

Power Supply Extra (RE 35 psu)

### POWER SUPPLIES RE 30 PSU

Input 240V AC  
O/P 26V DC of 0.6 Amps  
£3-60. Post free

### RE 35 PSU

Input 240V AC  
O/P 26V DC of 1.2 Amps  
£4-60. Post free

## RE QUADRIX

This is a high quality CBS specification SQ decoder with Hi-Fi stereo amplifier. Designed to allow the conversion of any stereo system to full quadrasonic performance with minimum cost. Extraordinary new presence and reality of sound. More than 20 Watts total peak power.

Specifications:

#### Decoder

I/P impedance 40K ohms  
O/P impedance <300 ohms  
Nominal I/P 100mV RMS  
Front separation > 60dB  
Rear separation > 20dB

#### Amplifier

Power O/P 5W RMS per channel (simultaneously)  
Distortion at full O/P less than 1%  
Sensitivity for full O/P 100mV  
Active tone control Bass  $\pm 10\text{dB}$ , Treble  $\pm 12\text{dB}$  @ 100Hz-10kHz  
Load impedance 8-16 ohms



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**Special Offer** SQ records (full quadrasonic sound) available direct. Comprehensive list free on request.

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NPN: BC107 13p, BC108 12p, BC109 13p, BC167 11p, BC168 10p, BC169 11p.	
PNP: BC177 21p, BC178 19p, BC179 21p, BC257 12p, BC258 11p, BC259 13p.	

Standard groupings available.

BD135 npn medium power	37p
BD136 pnp medium power	38p

### DIODES

OA90, OA91, OA95, 6p each; OA200, 9p; OA202, 10p.

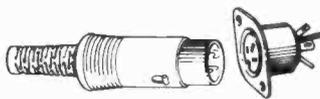
Other semiconductors: AC128, 17p; AF117, 32p; BFY51, 19p. Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

Send S.A.E. for latest supplement of additional lines and price amendments to our No. 6 Catalogue

**ZENER DIODES** full range E24 values: 400mV: 2.7V to 36V, 14p each; 1W: 6.8V to 82V, 21p each; 1.5W: 4.7V to 75V, 48p each. Clip to increase 1.5W rating to 3 watts (type 266F) 4p.

### DIN PLUGS AND SOCKETS

by Hirshmann, 4A rating



2 way LS —socket 10p, plug 12p  
3 way scr.—socket 10p, plug 12p  
5 way scr.—socket 11p, plug 15p

### TRANSISTOR ACCESSORIES

TO3 cover, 7p; Heat sinks 1°C/W, type 6W1, undrilled, 60p.

### SWITCHES

1011 SPST toggle, 20p; 409 DPDT toggle, 29p (these are chrome plated, 2.5A rating); 7201 sub-miniature DPDT 250V a.c./2A, 48p.

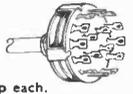


### ROTARY SWITCHES

Radiospares Miniature Mako-switch (in assembly kit form). Shaft, 48p. Wafers, MBB-2P5W, IP11W: BBM1P12W, 2P6W, 3P4W, 4P3W, 6P2W, 32p each.

### WAVECHANGE SWITCHES

IP12W, 2P6W, 3P4W, 413W, 24p each.



### ELECTROLYTIC CAPACITORS

Rated voltage: 3V	6.3V	10V	16V	25V	40V	AXIAL LEAD	
						Capacity $\mu$ F	Price
0.47	—	—	—	—	—	10p	7p
1.0	—	—	—	—	—	10p	7p
2.2	—	—	—	—	—	7p	8p
4.7	—	—	10p	—	—	7p	8p
10	—	—	—	—	—	7p	8p
22	—	7p	7p	—	—	7p	9p
47	7p	8p	8p	8p	—	7p	12p
100	8p	7p	7p	7p	—	9p	11p
220	7p	8p	8p	8p	—	9p	17p
470	8p	9p	9p	10p	—	12p	24p
1,000	10p	12p	12p	17p	—	20p	40p
2,200	14p	17p	22p	25p	36p	40p	—
4,700	25p	28p	37p	41p	54p	—	—
10,000	40p	43p	—	—	—	—	—

Prices subject to amendment by the manufacturer.

### RESISTORS - 10%, 5%, 2%

Code	Power	Tolerance	Range	Values available	i to 9	10 to 99	100 up
C	1/20W	5%	82 $\Omega$ - 220K $\Omega$	E12	9	8	7.5
C	1/8W	5%	4.7 $\Omega$ - 470K $\Omega$	E24	1	0.9	0.75 nett
C	1/4W	5%	4.7 $\Omega$ - 10M $\Omega$	E12	1	0.9	0.75 nett
C	1/2W	5%	4.7 $\Omega$ - 10M $\Omega$	E24	1.2	1	0.95 nett
C	1W	5%	4.7 $\Omega$ - 10M $\Omega$	E12	2.5	2	1.6 nett
MO	1/2W	2%	10 $\Omega$ - 1M $\Omega$	E24	4	3	2 nett
WW	1W	10%	120 $\Omega$ - 3.9 $\Omega$	E12	7	7	6
WW	3W	5%	1 $\Omega$ - 10K $\Omega$	E12	7	7	6
WW	7W	5%	1 $\Omega$ - 10K $\Omega$	E12	9	9	8

Codes: C = carbon film, high stability, low noise. MO = metal oxide, Electroslit TR5, ultra low noise. WW = wire wound, Plessey.

Values: E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82

E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51

62, 75, 91 and their decades.

### POLYCARBONATE—5% TOLERANCE

250V up to 0.1  $\mu$ F: 100V, 0.1  $\mu$ F and above.  
0.01; 0.012; 0.015; 0.018; 0.022; 0.027; 0.033; 0.047; 0.056; 4p each.  
0.068; 0.082; 0.1; 0.12; 0.15; 4p each.  
0.18; 0.22; 5p each.  
0.27; 0.33; 6p.  
0.39 7p.  
0.47 8p.  
0.56 10p.  
0.68 11p.  
1  $\mu$ F 13p. Prices subject to amendment by the manufacturer.

### Minitron Digital Counter

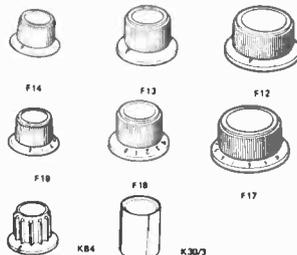
Type 3015F. Seven Filament segment indicators: to make 0-9 + decimal point. Compatible with standard logic modules, nett £2. Decoder driver type FLL 121T nett £1.36. DIL socket, nett £2.

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order.)

### KNOB

All grub screw fitting for  $\frac{1}{8}$ in shafts. Black. For other types —see Catalogue No. 6, p. 54.

F.14 (20mm) pack of 2, 32p; F.13 (26mm) pack of 2, 38p; F.12 (33mm) pack of 2, 40p; F.19 (20mm) pack of 2, 32p; F.18 (26mm) pack of 2, 38p; F.17 (33mm) pack of 2, 40p; KB.4 (20mm) pack of 4, 40p; K30/3 (17mm) aluminium, 24p each.



### POTENTIOMETERS

Rotary, carbon track.

double wiper

SINGLE P20 lin. 100  $\Omega$  to 2.2M  $\Omega$ , 12p; P20 log. 4.7K  $\Omega$  to 2.2Meg, 12p; JP20 log. 4.7K  $\Omega$ , to 2.2M  $\Omega$ , 12p; Dual gang lin. 4.7K  $\Omega$  to 2.2M  $\Omega$ , 42p; Dual log. 4.7K  $\Omega$  to 2.2M  $\Omega$ , 42p; Log/antilog, 10K, 22K, 47K, 1M  $\Omega$  only, 42p; Dual antilog, 10K only, 42p. Any type with 2A D.P. mains switch, 12p extra.

Only decades of 10, 22 and 47 available in ranges quoted.

DUAL CONCENTRIC DP20 in any combination of P20 values, 60p; with switch, 72p.

SLIDER

Lin. or log. 10K to 1 meg. in all popular values, each 26p.

Control knobs blk./white/red/yel./gr./blue/dk. grey/lt. grey, 5p each.

CARBON SKELETON PRE-SETS

Small high quality, PR lin. 100  $\Omega$ , 220  $\Omega$ , 470  $\Omega$ , 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10M  $\Omega$ . Vertical or horizontal mounting, 5p each.

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Orders received from U.K. customers must be accompanied by an additional 10% of the nett value for V.A.T.

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MT104 50V/2A plus 4 taps	£3-50
MT127 60V/2A plus 4 taps	£3-80
I3T05 13V/1A, CT	£1-25
28T05 12+12V, 2-0-2V.	£1-65

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As designed by P. J. Baxandall and described originally in "Wireless World." Simple to assemble, fantastically good results and a greater money saver. Carries 10 watts RMS, 15 ohms impedance. Size 18in x 12in x 10in. Complete kit, including pack-flat cabinet, £14-90 Plus 60p part cost of carr.

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Cabinet Kit (to Baxandall design), £10-45.

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Amtron produce a range of 200 electronic kits which provide something of interest for both dabbler and expert. A few examples are: Power Supplies; Pre-amplifiers;

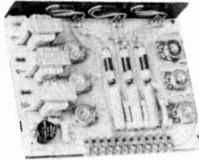
L.F. Instruments; Amateur & Radio control transmitters and receivers; Measuring Instruments; I.C. Digital Equipment etc. Complete blister packs contain full instructions plus solder.

*THE BIG NAME IN  
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### Mk III Sound to Light Unit Chassis Version



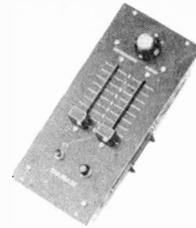
The audio drive voltage is derived directly from the amplifier output or across the speaker load. The unit converts the audio-frequency signals into a three-coloured light display when used with coloured flood lamps or similar; the colour depending on the frequency of the signal and the intensity on the loudness of the audio source. Max. power 1.5kW per channel at 240V a.c. Complete assembly built and tested. Size: 9in x 7in x 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 x 4.8in x 1.5in (with facia). Construction manual available separately at 25p. Kit Price £11.



### STL/1 Single Channel Sound to Light Unit

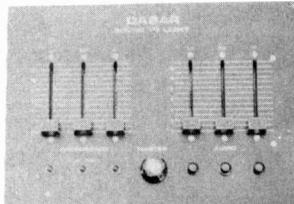
Single channel "Sound to Light" unit with 60mm slider fader controls for audio trigger level and background load dimmer. This unit is switchable for response to High, Mid, and Low frequency audio signals, selected by facia control. A D.J. "pulse-flash" push button is fitted for manual flashing of the lamp load together with neon load indicator. Maximum Load: 1kW at 240V a.c. Size: 8in x 3.6in x 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 x 4.5in x 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 x 8.5in x 4in. Price £42.35.

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AC127	16p	AF181	43p	BC159	14p	BF181	32p	2N3053	23p
AC128	14p	AF239	44p	BC177	20p	BF184	35p	2N3054	57p
AC141K	24p	BC107	12p	BC183L	14p	BF185	35p	2N3055	60p
AC142K	24p	BC108	10p	BC184L	12p	BF186	45p	TIP29	66p
AC176	20p	BC109	12p	BC187	22p	BF194	15p	TIP30	75p
AC187	18p	BC113	25p	BC294	16p	BF195	15p	TI591	48p
AC187K	24p	BC114	30p	BC440	50p	BF196	15p		
AC188K	24p	BC115	20p	BC460	68p	BF197	15p		
AD142	45p	BC116	20p	BD124	80p	BF200	32p		
AD149	45p	BC117	15p	BD131	60p	BF258	40p		
AD161	34p	BC125	14p	BD132	60p	BF259	40p		
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AF118	49p	BC149	13p	BF158	19p	BFX88	30p	1N4148	4p
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1W to 10M E12 values 3p each;  
2W to 10M E12 values 4p each;  
5W wire wound, 10W wire wound 8p and 9p each. See Cat. for values.

### POTENTIOMETERS-CARBON TRACK

5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M.  
Log or lin less switch 11p  
Log or lin with switch 23p  
Dual log less switch 250K.  
500K, 1M, 2M, only 39p  
Dual lin less switch 5K, 10K, 25K, 50K, 100K, only 39p  
Dual log with switch 10K, 100K, 250K, 500K, 1M only 55p

### JACK PLUGS AND SOCKETS

Standard insulated 11p; Standard screened 18p;  
Stereo insulated 22p; Stereo screened 30p;  
3.5mm insulated 8p; 3.5mm screened 12p;  
Standard socket switched 17p; Stereo socket switched 21p; 3.5mm socket switched 6p;  
Standard line socket 15p; Stereo line socket 22p;  
3.5mm line socket 10p.

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### PHONO-D.I.N. PLUGS AND SOCKETS

Phono plug insulated 7p; Phono plug screened 11p; Phono line socket screened 12p; Metal coax plug 8p; 2, 3, 5 pin 180°, 240°, D.I.N. plugs 12p; 4, 6, 7 pin plugs 15p; 2, 3, 5 pin 180° line sockets 13p; 2, 3, 5 pin 180° chassis sockets 7p.

## E. A. HALL (ELECTRONICS)

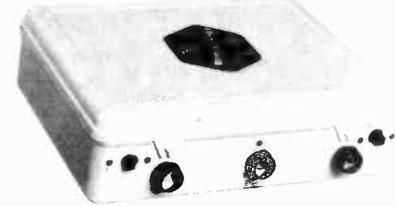
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Components include:

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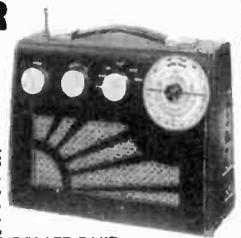
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## ROAMER TEN WITH VHF INCLUDING AIRCRAFT

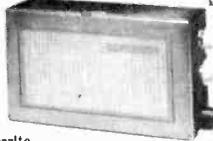
10 TRANSISTORS. 9 TUNABLE WAVEBANDS. MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS. ALSO AIRCRAFT BAND. Latest 4" 2 watt Ferrite Magnet Loudspeaker. Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in x 7in x 4in. Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

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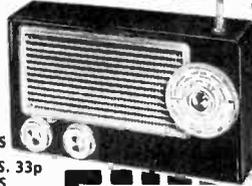
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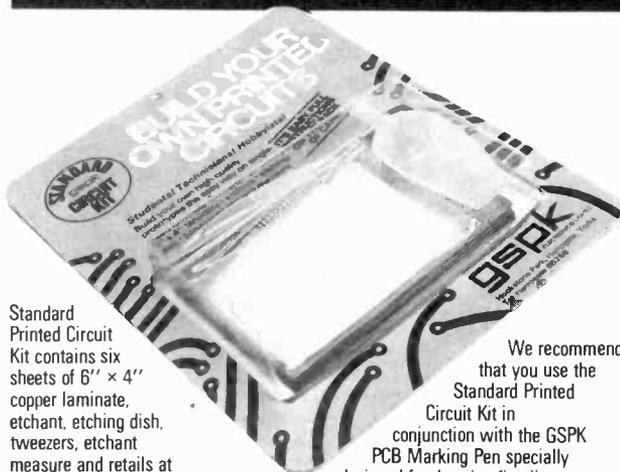
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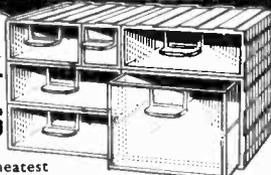
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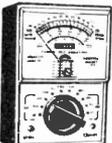
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with overload protection mirror scale 0/0-5/2-5/20/25/100/250/500/1,000V d.c. 0/2-5/10/25/100/250/500/1,000V a.c. 0/50μA/5/50/500mA. 12 amp. d.c. 0/60/126 Meg./60 Meg. **110-50.** Post paid. Leather case **£1-75.**



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Extremely sturdy instrument for general electrical use. 687 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.



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## 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 +60dB. **£13-95.** Post 30p.



## TMK MODEL TW-50K 46 ranges

mirror scale, 50K/V d.c. 3K/V a.c. D.c.: Volts 0-125, 0-25, 2-5, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. Volts: 1-5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. Current: 25, 50μA, 2-5, 5, 25, 30, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: -20 to +81-5dB. **£8-50.** Post 17p.



## 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.**



## TE16A Transistorised

Signal Generator. 5 ranges 400Hz-30kHz. An inexpensive instrument for the handyman. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. 5 1/2 x 3 1/2 in. Complete with instructions and leads. **£8-97.** Post 25p.



## MODEL8-100TR MULTIMETER/TRANSISTOR

TESTER. 100,000 O.P.V. mirror scale/overload protection. 0/0-120/6/3/12/30/120/600V 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.



## 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. 0/25/50MA d.c. -20 to +62dB. 0/5k/50k/500k/5MΩ/500MΩ. **£14-95.** Post 30p.



## KAMODEN 78-200

MULTITESTER High sensitivity tester. 200,000 o.p.v. Overload protection. Mirror scale. Ranges: 0/0-66/0-3/3/30/120/600/1,200V d.c. 0/8/12/60/300/1,200V a.c. 0/16μA/1-2mA/120mA/600mA/12A d.c. 0/32A. 0/2kΩ/200kΩ/2MΩ/200MΩ. **£18-95.** Post 30p.



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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 to +62dB. **£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" x 4" clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. **£12-50.** Post 30p.



## MODEL TE15 GRID DIP

METER Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440KHz-28MHz in 9 coils. 500μA meter. 9V battery operation. Size 180mm x 80mm x 40mm. **£15-00.** Post 20p.



## TMK LAB TESTER

100,000 O.P.V. 6 1/2 in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0-5, 2-5, 5, 10, 25, 50, 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 7 1/2 in x 6 1/2 in x 3 1/2 in. **£18-95.** P. & F. 25p.



## 240° Wide Angle 1ma

Meters MW1-6 60mm square **£3-97** MW1-8 80mm square **£4-97** P. & F. 15p.



## TESS SINE SQUARE WAVE AUDIO GENERATORS

Size: 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. 37p.



## ARF-500 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. A.C. 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 x 90mm x 56mm. **£12-50.** Post 37p.



## BELGO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Size 18-200,000 Hz; Square 18-500 Hz. Output max. +10dB (10 K ohms) Operation internal batteries. Attractive 2-tone case 7 1/2 in x 5 in x 2 in. Price **£17-50.** Carr. 17p.



## TE-40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: 0/1-003/1-3/1/3/10/30/100/300V. R.M.S. 4cps.-1.2 Mc/s. Decibels -40 to +60dB. 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 4 1/2 in mirror scale. Size 5 1/2 in x 4 1/2 in. D.C. volts 0-3-2,000V. A.c. volts 3-300V R.M.S. 8-0-800V P.P. D.c. Current 0-12-12MA. Resistance up to 2,000 ohm. Decibels -20 to +51dB. Complete with leads/instructions. **£17-50.** P. & F. 20p.



## MODEL 449A IN CIRCUIT TRANSISTOR TESTER

Checks Ico and beta in/out. Checks Icco. Checks diodes in/out. Checks SCR, etc. Beta HI 10-500 LO 2-50 Icco 0-5000μA. 220/240V a.c. operation. **£17-50.** Post 25p.



## KAMODEN HMG-500 INSULATION RESISTANCE TESTER

Range 0-1,000 Megohms, 500 Volt. Battery operated. Wide range clear meter range 4 1/2" x 4". Complete with deluxe carrying case, batteries, instructions. **£19-95.** Post 30p.



## MODEL U4811 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. 0/3/7-5/15/30/75/150/300V. 1-5/3/7-5 amp. d.c. 0/75/150/300/750V/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. **£40.** Post 50p.



## MCA-320 AUTOMATIC VOLTAGE STABILISER

Input 88-125V a.c. or 175-250V a.c. Output 120V a.c. or 240V a.c. 200VA rating. **£11-97.** Post 60p.



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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 7 1/2 in. x 5 1/2 in. x 3 1/2 in. **£19-95.** Post 25p.



## PS100B 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 4 1/2 in. x 3 1/2 in. x 6 1/2 in. **£11-97.** Post 25p.



## MODEL TE-300.

30,000 O.P.V. Mirror scale, overload protection 0/0-6/3/15/60/300/1,200V d.c. 0/6/30/120/600/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm -20 to +63dB. **£7-50.** Post 15p.



## MODEL TE-200.

30,000 O.P.V. Mirror scale, overload protection. 0/6/30/125/1,000V d.c. 0/10/50/250/1,000V a.c. 0/50μA/250mA. 0/60K/6 meg Ω. -20 to +62dB. **£4-95.** Post 15p.



## GI-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 x 360mm x 430mm, 115-230V a.c. operation. **£59.** Carr. paid.



## TO-3 PORTABLE OSCILLOSCOPE

8in 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 x 215mm x 330mm. Weight 15 1/2 lb. 220/240V a.c. Supplied brand new with hand-bag. **£52-50.** Carr. 50p.



## RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

5MHz Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in x 4in C.R.T. Calibrated triggered sweep from 0-2μsec 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.



## 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, 1/2 in dia. shafts. Bulk quantities available.



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Fully transistorised portable VHF Transceiver. Will transmit and receive on 6 channels between 144-146MHz. 1W transmitter. 12V d.c. internal or external supply. Built in charger for ni-cad cells. Power/volume switch, squelch control, channel selector, mike socket, earphone/external speaker socket. Complete with microphone. 144.48, 144.72 and 145.32 crystals.

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4 bands covering 550kHz-30MHz continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW. ANL. Variable BFO. 8 meter. Sep. bandspread dial. IF frequency 445kHz audio output 1.5W. Variable RF and AF gain controls 115/250V a.c. Size: 7in x 13in x 10in with instruction manual.

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4 Bands covering 550kHz-30MHz. FET, 8 Meter. Variable BFO for SSB. Built-in Speaker. Bandspread. Sensitivity Control. 220/240V a.c. or 12V d.c. 12 1/2 x 4 1/2 x 7in. Brand new with instructions.

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Covers 3-5, 7, 14, 21, 28, 28.5 and 29.1MHz bands, and WWV 15MHz. SSB, AM and CW. AF output more than 1W. Crystal controlled BFO for SSB. 8 meter. ANL, etc. A.c. 110/120-220/240V. Size 330 x 179 x 310mm.

OUR PRICE **£75.00** Carr. Paid



## TRIO JR599 RECEIVER



9 wavebands covering 1.8-29.7MHz. 144-146MHz and 10-00MHz WWV. SSB, CW, AM and FM. AF output more than 1W. 8 Meter. Squelch control. BFO. Variable RF and AF controls. 4-16 ohm output and phone jack. Power requirements 100/240V a.c. 12-14V d.c.

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## TRIO TS515/PS515 TRANSCIEVER



High quality TS515 SSB/CW amateur band receiver covering 80, 40, 20, 15 and 10 metre bands with PS515 power supply and speaker unit. Transmit/receive frequency 3.5-29.7MHz. Output 1.5W. Power requirements 110-120/220-240V a.c.

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## BELTEK WS400 CAR TRANSCIEVER



Solid state mobile transceiver for 12V d.c. neg. use. Transmits and Receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: Volume/on/off, squelch, channel selector, Internal 3m speaker. Complete with dynamic mike, PTT switch, three sets of crystals for 144.48MHz, 144.60MHz, 145.00MHz, mounting bracket and instructions.

OUR PRICE **£75.00** Carr. Paid

## LAFAYETTE HA-600 RECEIVER



General coverage 150-400kHz. 550kHz-30MHz. FET front end. 2 mech. filters, product detector, variable BFO, noise limiter, 8 Meter. Bandspread. RF Gain. 16in x 9 1/2in x 8 1/2in. 18 lb. 220/240V a.c. or 12V d.c. Brand new with instructions.

OUR PRICE **£50.00** Carr. Paid 50p

## HAND HELD 2-WAY WALKIE TALKIES

Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic Aerial. Complete with carrying cases.

8KYPON  
100mW, £24.95 pair, post 50p.  
P302 2 CHANNEL  
300mW, £52.50 pair, post 50p.  
P1003 3 CHANNEL  
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LICENSE REQUIRED IN U.K.

## AUDIOTRONIC AHP8A 8 TRACK STEREO TAPE PLAYER

Incorporates built in amplifiers giving 2 1/2 + 2 1/2 W r.m.s. output. Push button track selector, illuminated track indicators, slider controls for volume, balance and tone. Attractive cabinet with black and silver trim. Output impedance 8 ohms. 220/240V a.c.

OUR PRICE **£17.25** P. & P. 50p, plus VAT

## AUDIOTRONIC AHP8D 8 TRACK STEREO TAPE DECK

Can be used with most hi-fi amplifiers. Push button track selector and illuminated track indicators. Attractive cabinet with black and silver trim. Output level 750mV. 220/240V a.c.

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## AUDIOTRONIC ACD660 STEREO CASSETTE DECK

A beautifully styled & remarkably low price. Incorporates a host of features including switchable noise filter, normal/chrome tape selector, twin VU meter, slider record/playback level controls, front panel headphone socket, recording indicator lamp, phono/Din line input sockets, 3.5mm mike input sockets, etc. Frequency response 100-8kHz (100-12kHz CrO2). S/N -45dB. Crosstalk -45dB. Separation -35dB. Noise limiter -60dB at 10kHz. Complete with phono connecting leads.

OUR PRICE **£39.50** Carr. Paid 50p

## AUDIOTRONIC STEREO HEADPHONES

LSH20. Individual volume controls. Stereo mono switch. 8 ohms. 40-19,000Hz. **£3.50 P. & P. 30p**

LSH30. Open back type. Individual tone and volume controls. 8 ohms. 30-20,000Hz. **£5.50 P. & P. 30p**

LSH40. Two way speaker system. Individual volume controls. 8 ohms. 20-20,000Hz. **£6.95 P. & P. 30p**

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LQH400. 4-channel dynamic headphones. Each earpiece has 4 drive units. 4-32 ohms. 20-20,000Hz. **£9.95 P. & P. 30p**

LSH50. Electrostatic with self powered energiser and control unit with headphone/ speaker selector. 4-32 ohms. 20-24,000Hz. **£15.95 P. & P. 30p**

## SPECIAL BARGAIN! PHONIC 10, TWO-WAY SPEAKER SYSTEM

Matched pair of compact bookshelf speakers of unique design incorporating 2in. high frequency tweeter and 6in. woofer. 8 ohms impedance. 10 watts power handling. Size 345 x 228 x 110mm.

GWS SPECIAL PRICE **£9.85** per pair P. & P. 50p, plus VAT

## FERGUSON 3416 STEREO TAPE DECK

4 track, 7 1/2, 3 1/2, 1 1/2 i.p.s. Stereo mono record/play. 7in reels. Inputs for dynamic mikes, radiogram. Complete with cover.

OUR PRICE **£41.95** Carr. Paid 75p

## AUDIOTRONIC ACR3500 CAR RADIO

Manual tuning of Medium and Long waves. 12V pos. or neg. earth. Complete with speaker, mounting brackets and instructions.

OUR PRICE **£6.50** P. & P. 50p

## AUDIOTRONIC ACP8 8-TRACK CAR PLAYER

12V neg. earth. Slider controls for Volume, Tone and Balance. Channel selector button with pilot lamp. With speakers, mounting brackets and instructions.

OUR PRICE **£12.50** P. & P. 40p

## BSR 8-TRACK PLAYER CHASSIS

Famous BSR 8 track chassis as used in Model 8 S complete with silver and black escutcheon ready to fit into cabinet. Output 125mV A.C. 240V. Overall size approx. 185 x 215 x 80mm.

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Model 350. 13in x 8in with single tweeter / crossover. 20-20,000Hz. 15W RMS. Available 8 or 15 ohms. **£7.25** each. P. & P. 37p.

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## BINATONE DS100 DIGITAL CLOCK

240V mains operation. Ivory case with large clear numbers for hours, minutes and seconds. Approx. size 6 1/2in x 3in x 3 1/2in.

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## AUDIOTRONIC AMR-9000 GLOBAL AM/FM PORTABLE

10 wavebands covering A.M.: 535-1605kHz; L.W.: 150-380kHz; M.B.: 1.8-4.0MHz; S.W.1.: 4.0-8.0MHz; S.W.2.: 8.0-13.8MHz; S.W.3.: 16-24MHz; P.S.B.1.: 30-50MHz; P.S.B.2.: 148-174MHz; F.M.: 88-108MHz; A.I.R.: 105-136MHz. Features time zone map and timing dial. Large clear scale. Telescopic aerial and built-in aerial. A.F.C. on F.M. 6in x 4in speaker and personal earpiece. Battery/mains operation. Size 345 x 133 x 305mm.

OUR PRICE **£36.00** P. & P. 50p

## AUDIOTRONIC AMB500 MULTI BAND RADIO

5 wavebands covering MW 535-1605kHz and F.M. 88-175MHz. All transistor. Battery or mains operation. Built-in aerial and 8 section telescopic aerial. Complete with batteries, shoulder strap and earpiece.

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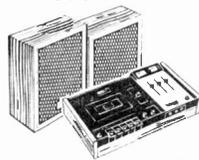
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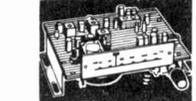
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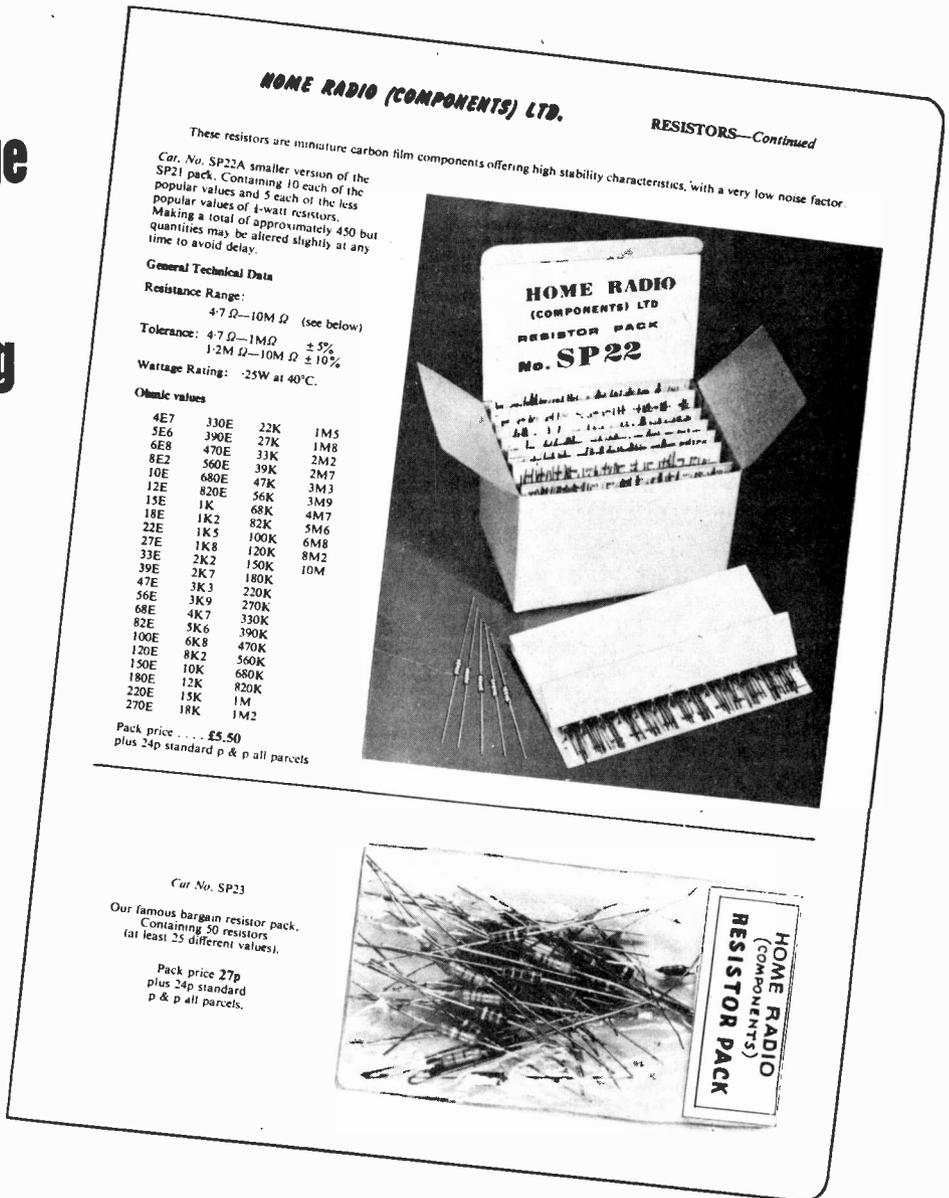
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## TWENTY-FIVE YEARS ON

**T**HE 25th year of the transistor draws to its close. A quarter century of exciting and rapid technological growth justifiably referred to as a revolution, and unlikely to be paralleled within the seeable future.

In this issue appears a final article in our special series marking this anniversary of the dawn of the new solid state era. It is written, most fittingly, by a well known contributor and dwells on those now far off days when the transistor was still much of a curiosity and just beginning to cause an upheaval in constructor circles. Established methods of building clearly had to change, but it was far from clear just how.

Much water has flowed under the bridge since then . . . but those early experiments with transistors are worth recalling, though it will all sound very strange to a fair proportion of our readers since there is now a whole generation of constructors brought up entirely on semiconductors.

Yet even our younger post-valve-era readers are not denied the excitement of being involved in great changes in technology. Right at this present moment we are witnessing a "quiet revolution." With hindsight, we know that the discrete semiconductor device represented but the opening phase of this solid state revolution; the culminating achievement has been the creation of the integrated circuit.

So let us turn now from the past and consider what the future holds for the constructor. It will be a future dominated by the i.c., that is obvious. Until, of course, another spectacular discovery leads to the obsolescence of semiconductors—a development not entirely improbable but sufficiently remote in time to be left out of any sensible prognostications at this particular moment.

The i.c. is, in circuit terms, a very large building block and is tending to become even bigger, thanks to l.s.i. This type of device influences very considerably, if it does not dominate entirely, the general pattern of any design in which it is called upon to play a part.

In the future, the drift towards more custom designed i.c.'s may well limit the total number of new devices suitable for constructor applications. Yet amongst the balance there are bound to be an abundance of types than can be usefully employed by the amateur. In this respect, particularly noteworthy at the present time are phase-locked loops. These i.c.'s are beginning to mould the pattern of many equipment designs. They are opening up new fields and revolutionising some traditional designs, especially in the radio receiver area.

Immediately following its introduction, the i.c. was thought by some to represent a threat to home construction activities. Such a pessimistic view has already been proved ill-founded. Looking ahead, there is no reason to suppose any drying up of individual enterprise and ability to extract the maximum advantage from monolithic devices yet to emerge from the microelectronics plants.

F.E.B.

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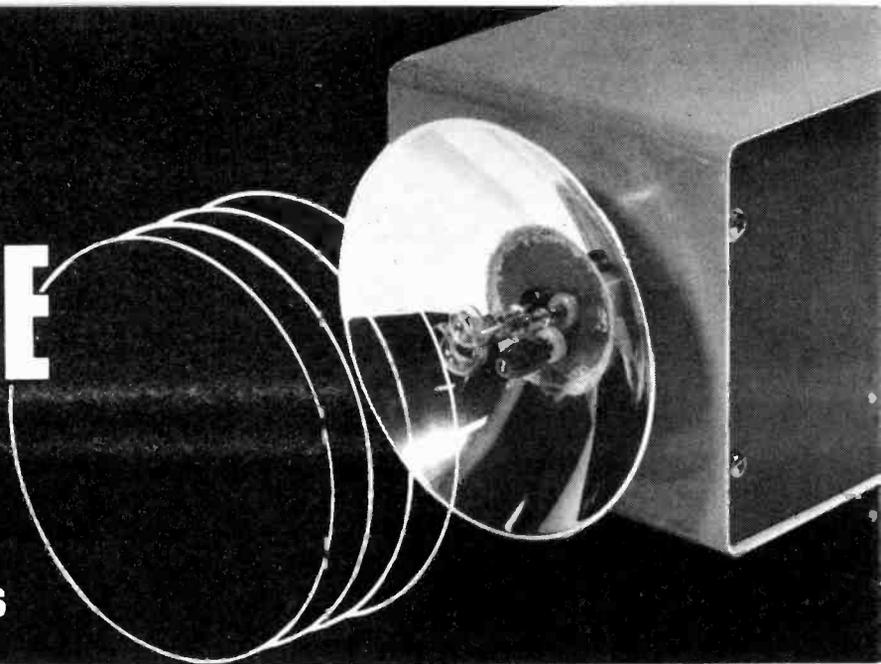
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# PARTY STROBE LIGHT

BY M. HUGHES



**T**HIS stroboscope is designed primarily for use as a lighting effect for parties and discotheques. Its flashing rate is continuously variable from about 2Hz to 20Hz. It can be used—with limitations—for specialised photography but the output power (about half a joule) limits it to use with only medium to high speed black and white films at distances of a few feet. For discotheque work, however, it can be classified as of medium power.

## SOME WARNINGS

Those who intend building the equipment should be fully aware at the outset of their social responsibilities in the operation of such equipment; strobing in the frequency range of 10 to 20Hz can, in some instances, produce hypnotic effects. Excessive use of the strobe should thus be avoided; however, if handled carefully and used in moderation some particularly pleasing lighting effects can be produced.

A further word of warning regarding the construction. Very high voltages are used to charge up high value capacitors—these can be lethal if mis-handled. When testing it is not sufficient simply to switch off the power; the plug should be completely removed from the socket and all capacitors shorted out with an insulated handled screwdriver before any attempt is made to handle the circuitry.

## OPERATION

The principle of operation is quite simple. All we have to do is apply a high voltage across a Xenon gas filled tube from a reasonably high value capacitor. This voltage is arranged to be below the breakdown voltage of the tube so initially no electrical discharge takes place. At some pre-determined time a very high voltage pulse (at low current) is applied to a third electrode fixed to the outside

of the tube—this is called the trigger electrode—and we cause a localised electrical breakdown of the gas between the trigger and one of the primary electrodes. The gas in that locality becomes electrically conducting (or ionised), and the ions produced move rapidly throughout the length of the tube and cause main conduction between the primary electrodes.

For a fraction of a second the tube becomes a short circuit across the capacitor and the full charge held on the latter flows through the tube giving rise to the very bright short duration flash. As soon as the capacitor has fully discharged the tube is extinguished and a fraction of a second later the residual ions of gas revert to their non-conducting state and the tube once more becomes inert. The capacitor can now be recharged and a second trigger pulse applied for the next flash.

## FLASH ENERGY

The energy of the flash is measured in joules and is equivalent to the amount of electrical energy stored in the main capacitor (C4 in Fig. 1). This energy is calculated by using the formula:—

$$\text{Energy} = \frac{1}{2}CV^2 \text{ joules}$$

where C is the value of the capacitor in farads and V is the voltage to which it is charged. In Fig. 1 C4 charges up through a half wave rectifier (D2) and limiting resistor, R3, direct from 250V r.m.s. mains; this means the peak voltage on the capacitor when it is fully charged is about 350V. The energy produced in each flash for the capacity used will be about 0.48 joules.

## LIMITED OUTPUT

Because of the tube rating, if it is flashed too often at too high an energy it will get extremely hot. The tube specified is made of hard glass that has a



## COMPONENTS . . .

### Resistors

- R1 1M $\Omega$
- R2 100k $\Omega$
- R3 500 $\Omega$  10W wirewound
- R4 100k $\Omega$  1W
- All 10%  $\frac{1}{4}$ W except where otherwise stated

### Capacitors

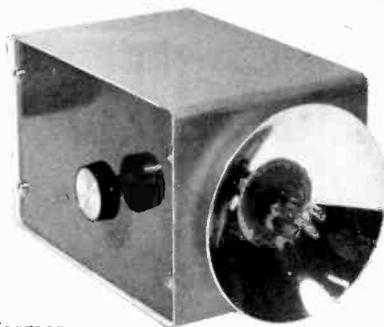
- C1 8 $\mu$ F elect. 500V
- C2 2 $\mu$ F elect. 200V
- C3 0.1 $\mu$ F 400V polyester
- C4 8 $\mu$ F 500V paper

### Diodes

- D1-D2 IN4001 (2 off)
- D3 ST2 Diac (G. W. Smith)

### Xenon Tube

- LP1 Hivac ZFT2 (Townsend and Coates Ltd., Coleman Rd., Leicester)



### Transformer

- T1 Primary, 10 turns 18 s.w.g. enamelled wire; secondary, 200 turns 36 s.w.g. enamelled wire both layer wound on 2in length,  $\frac{1}{4}$ in dia. ferrite rod

### Miscellaneous

- S1 Double pole mains switch; FS1—5A fuse with panel mounted holder; group board; stand off spacers; 3 wander plug sockets; 1 wander plug

high charge stored on C4 is reduced over a short period of time. Do not, however, rely on this—it is always safer to discharge high value capacitors with a screwdriver before touching them.

C4 must be a paper dielectric capacitor rated in excess of 500V. An electrolytic must not be used in any circumstance.

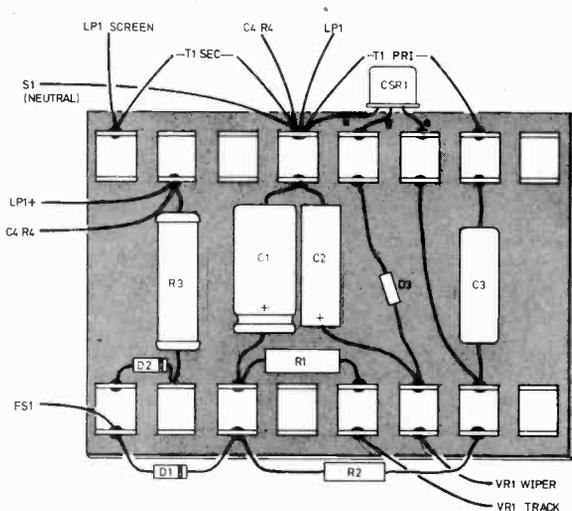


Fig. 2. Component wiring and assembly on group board. Stand-off spacers should be used when connecting to case.

## CONSTRUCTION

Nearly all the circuitry is mounted on a length of group board (Fig. 2) and the only precautions necessary in the layout are that the secondary of T1 (winding details given in Fig. 3) should not be routed too close to any other wiring and R3 should not touch any other components as it gets quite warm. As the discharge current from C4 is very high, fairly heavy gauge wire should be used to connect its terminals to the discharge tube to prevent excessive line drop.

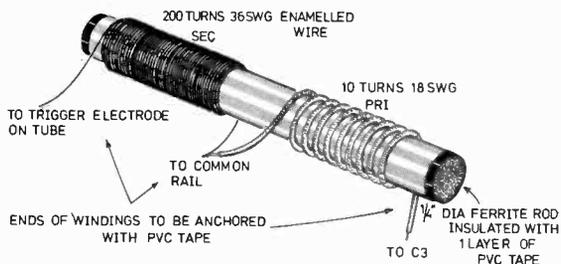


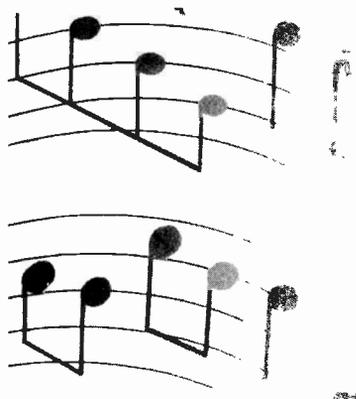
Fig. 3. Winding details of trigger transformer. Both windings are wound in the same sense

All the components should be mounted in a metal case that can be properly earthed; this is essential as all the wiring is live to mains. Wander plug sockets form a convenient way of mounting the tube within the reflector and enable easy change of tubes which have a life expectancy of about a million flashes (this is equivalent to about 25-30 hours of operation at 10 flashes per second).

## REFLECTOR

The reflector was the hardest single item to find. In the end a tour round surplus shops solved the problem where a reflector from an old projector system was found for a few pence. An old car headlight reflector (pre sealed-beam era) would be ideal.

The reflector should be bolted or stuck on the main box and the tube sockets fixed through the rear of the reflector and the case—these add extra mechanical support to the reflector. To make the unit tamper proof it would be advisable to place a clear Perspex guard in front of the tube—if different coloured lighting was required tinted Perspex could be used for this purpose. ★



**T**HIS FADER unit was developed for use in a Discotheque console where it will automatically fade out the music being played when the D.J. makes an announcement *via* the microphone. When the announcement is finished the music is then restored to its original volume.

As the finished unit in its original form measures only 3.75 x 2.5 x 0.5in, it should fit easily into the corner of a Discotheque console.

Whilst no complicated adjustments of the console wiring are required the unit will require some form of power supply as it consumes some 7mA at 9V. This could be taken from the Discotheque supply or be provided by a battery if required.

## CIRCUIT

The circuit is shown in Fig. 1 and, as can be seen, is constructed around the Motorola integrated circuit MFC 6040 which is used as an electronic attenuator. It provides zero attenuation for control voltages below 3.5V and about 90dB attenuation for a 6V control voltage. Thus to give the required control effect we have to derive a rising and falling d.c. level from the microphone signal to fade the deck signal in and out.

TR1 and its associated resistors form an emitter follower which gives the input a high impedance and thus prevents undue loading of the console pre-amplifier. TR2 forms a simple amplifier the output of which goes to the base of TR3 *via* diodes D1 and D2 and VR1. The diodes clamp and rectify the amplified microphone signal and VR1 controls the amount of signal applied to the base of TR3. Thus it controls the sensitivity of the unit.

When there is an input signal at the microphone of sufficient amplitude TR3 is turned hard on and the collector is thus at 0V. C4 prevents this voltage rising appreciably during any short breaks in speech which might occur such as between words or sentences.

Without an input signal TR4 conducts and the collector lies about 2V above earth potential. When TR3 turns on TR4 turns off and C5 charges up *via* R7, providing a rising potential at the control input of IC1.

This in turn attenuates, at a rising rate, the signal from the deck. The initial attenuation must be fairly rapid if the initial part of the announcement is not to be drowned in music.

When TR3 turns off again TR4 turns on and C5 discharges to earth through TR4 and R8 until it reaches a steady level. This gives a falling voltage level to decrease the attenuation provided by IC1.

## POWER SUPPLY

As mentioned, a 9V supply giving about 7mA is needed. If such is already available within the console, all well and good. If not then it is simply a matter of dropping and stabilising the console pre-amplifier supply and this may be done simply by using the circuit of Fig. 2.

In Fig. 2, the resistor R9 drops the supply voltage from the console rail value to 9 volts at which it is clamped by the Zener D3. Capacitor C9 gives smoothing of the output. Using Ohms Law, and given a pre-amplifier voltage of V volts then:—

$$R9 = \frac{(V-9)}{11} \text{ k}\Omega$$
, where R9 is  $\frac{1}{4}$  watt if V is less than 30V or otherwise  $\frac{1}{2}$  watt.

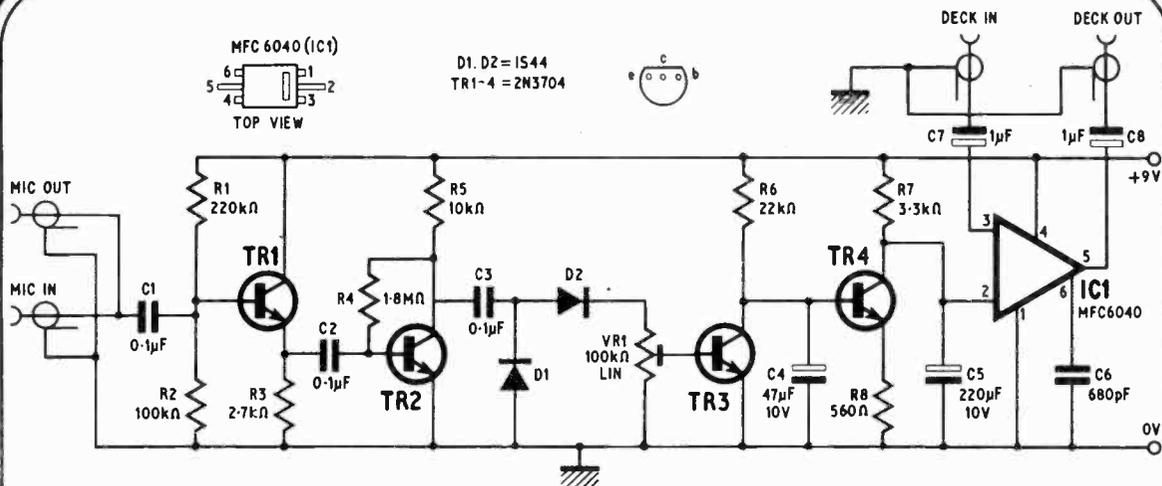


Fig. 1. Circuit diagram of the complete fader which is based on the Motorola MFC 6040 attenuator integrated circuit

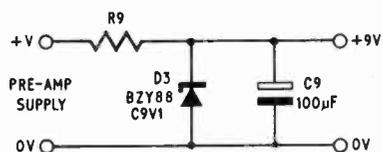


Fig. 2. Circuit of a simple power supply for use with the fader

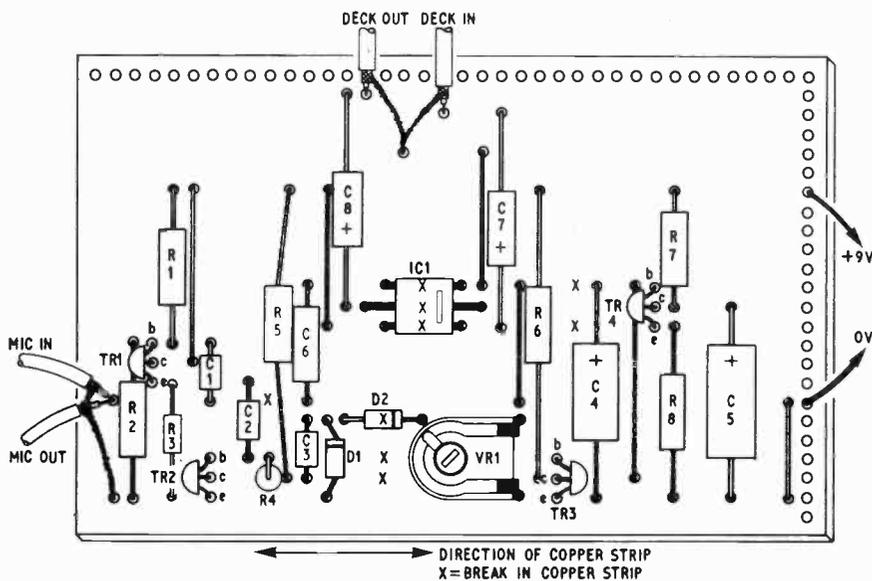


Fig. 3. Component layout and 0.1 in track Veroboard cutting details

## COMPONENTS . . .

### VOICE OPERATED FADER

#### Resistors

R1	220k $\Omega$
R2	100k $\Omega$
R3	2.7k $\Omega$
R4	1.8M $\Omega$
R5	10k $\Omega$
R6	22k $\Omega$
R7	3.3k $\Omega$
R8	560 $\Omega$
R9	See text

#### Capacitors

C1-C3	0.1 $\mu$ F Mylar film
C4	47 $\mu$ F, 10V elect.
C5	220 $\mu$ F 10V elect.
C6	680pF polystyrene
C7, C8	1 $\mu$ F 16V elect.
C9	100 $\mu$ F 10V elect.

#### Semiconductors

TR1-TR4	2N3704
D1, D2	1S44
D3	BZY88 C9V1, 9.1V Zener
IC1	MFC 6040 (Motorola). Available from Jermyn or Arrow Electronics

#### Potentiometers

VR1 100k $\Omega$  linear horizontal mounting pre-set

#### Miscellaneous

0.1in Matrix Veroboard measuring 3.75in  $\times$  2.75in  
Wire and coaxial cable as needed

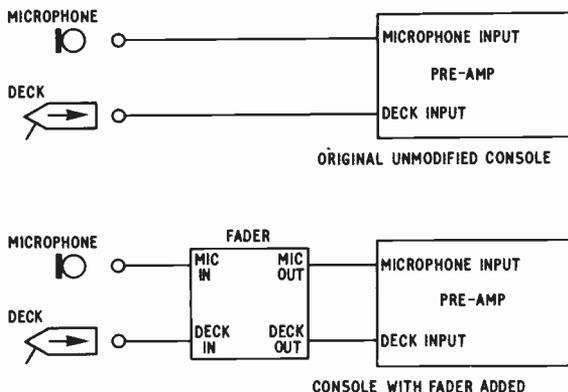


Fig. 4. Discotheque console circuit with and without voice operated fader

### CONSTRUCTION

The unit is quite simple to construct as can be seen from Fig. 3. Using standard 0.1in matrix Veroboard 3.75  $\times$  2.5in the layout of Fig. 3 may be followed. Coaxial cable should be used for the microphone leads to avoid hum pick-up.

Equally, circuit installation is simple as is shown in Fig. 4.

If the circuit of Fig. 2 is to be used, this may be added to the board carrying the main components or simply suspended in the wiring since it consists of so few components. ★

# NEXT MONTH...



## IGNITION TIMING LIGHT

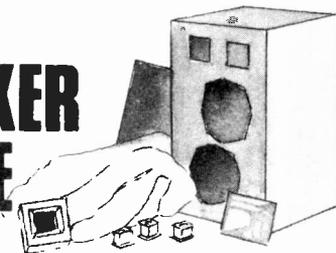
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JANUARY ISSUE ON SALE DECEMBER 14, 1973

# PHASE LOCKED LOOPS

BY J.B. DANCE M.Sc.

THE BASIC theory of phase locked loops has been reviewed in a non-mathematical way in the previous articles in this series. We will now consider in detail the types of phase locked loops which are currently available together with examples of the types of circuit in which they can be used.

Monolithic phase locked loops are necessarily fairly complex devices. In general the various manufacturers have evolved devices which are quite different from one another and they must therefore be considered separately.

## SIGNETICS H.F. LOOPS

The Signetics International Corporation manufacture three rather similar monolithic phase locked loops which can operate at high frequencies. They are the NE560B, the NE561B and the NE562B devices.

These three phase locked loops all employ the same phase detector, the same voltage controlled oscillator and the same voltage regulator stages. The basic parameters are therefore very similar for all the three devices, but there are differences in the metallic interconnections which make some types especially suitable for certain applications.

### NE560B

The NE560B can be regarded as the most fundamental of the three devices. It has the basic phase locked loop structure shown in the block diagram of Fig. 3.1. This device is suitable for high linearity f.m. demodulation, for telemetry decoding, for use in signal generators, in frequency shift keying receivers, in tracking filters, in circuits for exact frequency duplication in a high noise environment, etc.

The voltage controlled oscillator in this device provides two outputs of opposite polarity to each other.

### NE561B

The NE561B contains all the circuitry of the NE560B, but also has an analogue multiplier which can be used as a quadrature detector. This allows the device to be employed for the synchronous

detection of amplitude modulated signals if an external 90 degree phase shift network is added.

The NE561B can also be employed in a.m./f.m. i.f. strips, in signal generators, in telemetry decoders, in tracking filters, etc.

### NE562B

The NE562B is similar to the NE560B, but the loop is broken between the voltage controlled oscillator and the phase comparator. A frequency dividing circuit can therefore be inserted in the loop at this point if it is desired that the voltage controlled oscillator shall operate at a harmonic of the input frequency.

The NE562B is therefore especially useful in frequency synthesisers and for frequency multiplication and division. In addition, it can also be used in f.m. i.f. strips and for most of the other applications for which the NE560B is suitable.

## SUMMARY OF DATA

Each of these three phase locked loops can be operated over a frequency range from less than 1Hz to over 15MHz, the centre or free-running frequency being set by the value of a capacitor connected between two pins of the voltage con-

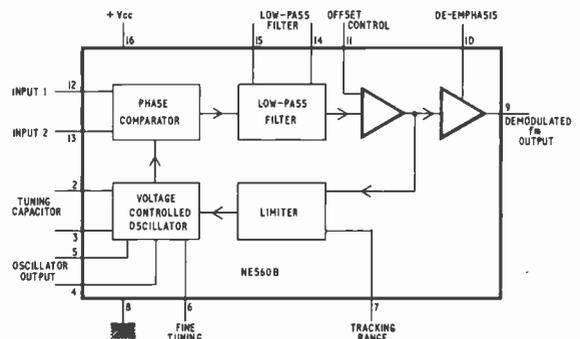
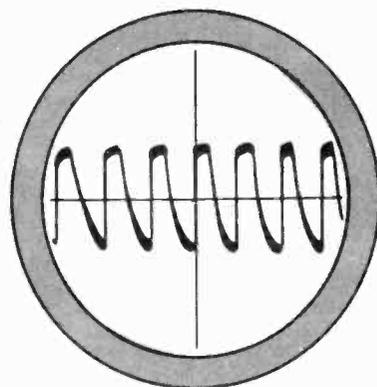
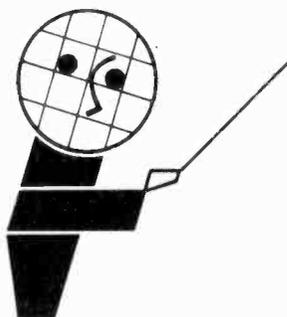


Fig. 3.1. Block diagram of the NE560B phase locked loop. The numbers refer to pins on the dual-in-line versions

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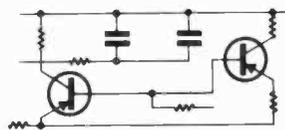
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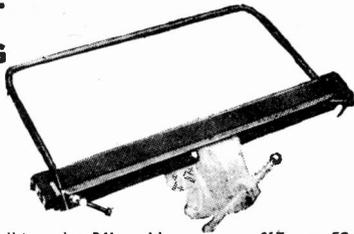
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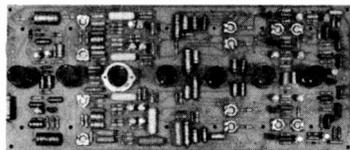
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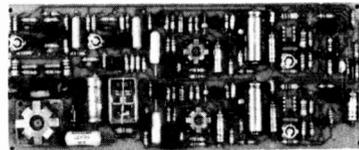
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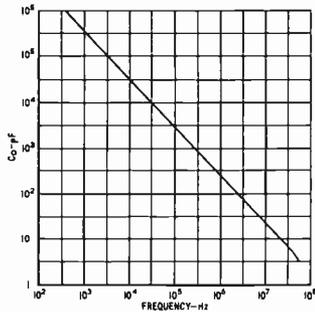
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**Fig. 3.2. Graph showing the relationship between the centre frequency and the value of the timing capacitor**

trolled oscillator. The variation of this frequency with the value of the capacitor is shown in Fig. 3.2.

The control voltage is prevented from exceeding a preset level by a limiter between the control voltage amplifier and the voltage controlled oscillator. This range is known as the tracking range and is set by a control current into pin 7 of the i.c.

The typical operating voltage of these devices is 18V. The NE560B consumes less than 11mA, the NE561B less than 12mA and the NE562B less than 14mA.

The NE560B and the NE561B require a minimum of 100 $\mu$ V for locking, and can take 1V r.m.s. maximum. The corresponding figures for the NE562B are 200 $\mu$ V minimum and 3V r.m.s. maximum.

The maximum output voltage swing is 4V peak-to-peak.

If one applies a 1mV, 10.7MHz f.m. input signal which has a  $\pm 75$ kHz deviation and a 50 ohm source impedance, the demodulated output is typically 60mV in amplitude with a total harmonic distortion of 0.3% (typical).

When one of these loops is used for demodulating f.m. signals a capacitor may be connected from pin 10 to ground to provide de-emphasis.

At operating frequencies below 5MHz the low pass filter may be formed by connecting a capacitor (or capacitor and resistor in series) across the low pass filter terminals. At higher frequencies a capacitor from each terminal to ground should be used to ensure loop stability.

## APPLICATIONS

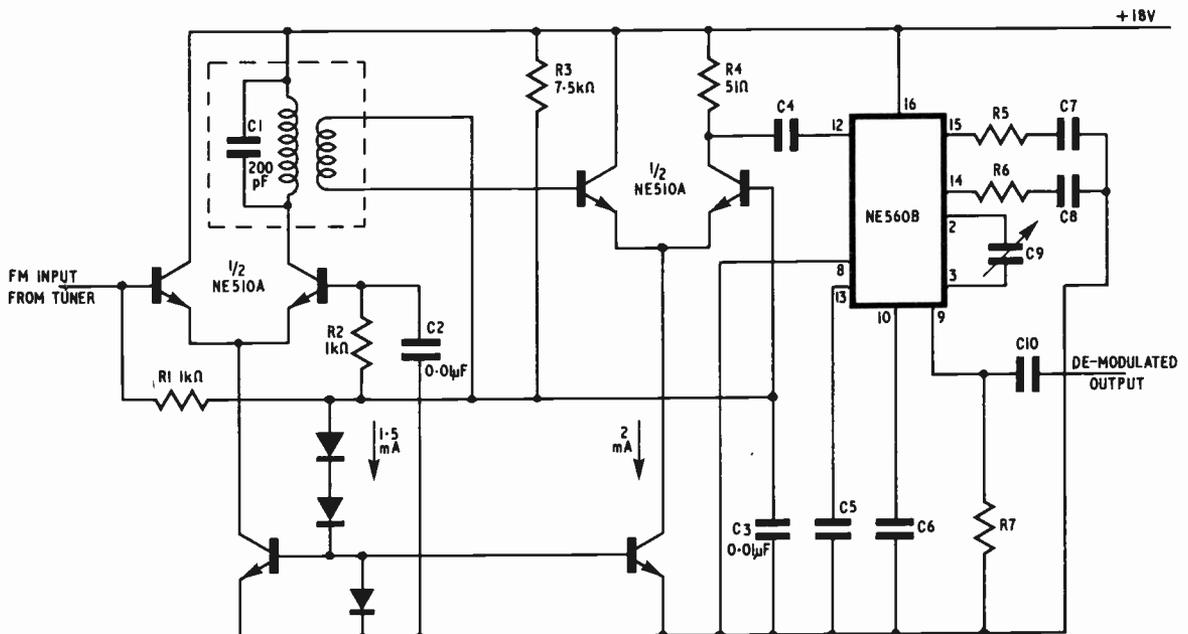
In order to illustrate the usefulness of phase locked loops some circuit diagrams will be given. Whilst it is not possible to give sufficient detail for the systems to be built it is hoped that the information given will give the reader an appreciation of the practical aspects of phase locked loop i.c.s.

## F.M. DEMODULATION

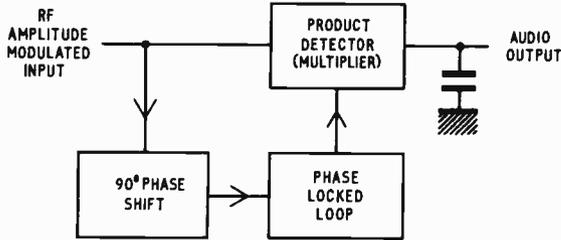
A phase locked loop can replace almost the whole i.f. strip, limiter and f.m. detector of a conventional receiver. A typical circuit using the NE560B as f.m. demodulator with an i.f. amplifier and limiter is shown in Fig. 3.3.

The input from the f.m. tuner unit is first amplified by the two sections of a Signetics NE510A dual high frequency differential amplifier. The low output impedance signal from the NE510A is coupled by C4 to pin 12 of the NE560B. The other input (pin 13) of the phase comparator is grounded with respect to radio frequencies by C5. The capacitors C4 and C5 may each have a value of 20pF when the signal frequency is 10.7MHz.

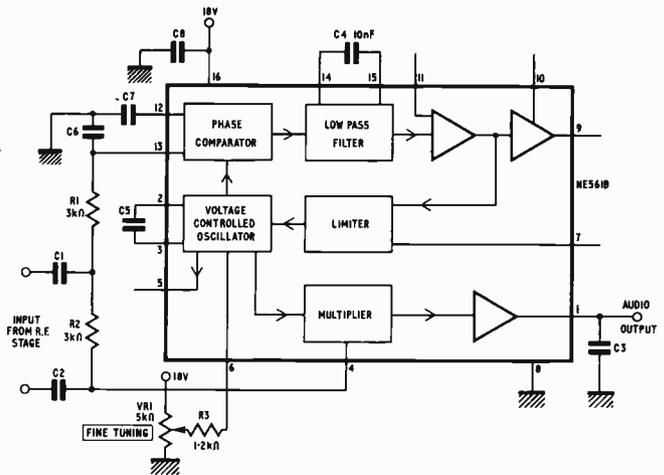
The frequency of the loop is set by the variable capacitor C9 which is connected between pins 2 and 3 so that the centre frequency becomes approximately equal to the signal frequency. The value of C9 may be estimated from Fig. 3.2.



**Fig. 3.3. Circuit diagram of the NE560B used in an f.m. demodulator**



**Fig. 3.4a. Block diagram showing the NE561B used as an a.m. demodulator**



**Fig. 3.4b. Practical circuit of the a.m. demodulator**

Fine tuning is easily accomplished by using a variable capacitor for C9. However, a potentiometer connected between the power supply lines with the slider connected to pin 6 via a 200 ohm current limiting resistor may be employed.

Components R5, R6, C7 and C8 form the low-pass filter which controls the capture range and the selectivity. The value of the capacitors in microfarads is approximately 2660 divided by the required bandwidth in hertz.

### DE-EMPHASIS

The de-emphasis is introduced by merely connecting pin 10 via a capacitor to ground. The value of this capacitor multiplied by the internal eight kilohm resistance should produce a time constant of about 50µs for the standard f.m. broadcasts in the U.K. Thus  $C_6 = 50 \times 10^{-6} / 8000 = 6.25\text{nF}$ , but this value is in no way critical.

### THE NE561B FOR A.M. RECEPTION

The NE561B can be connected as in the block diagram of Fig. 3.4a for the detection of a.m. signals.

The 90 degree phase shift circuit changes the phase of the input signal so that the voltage controlled oscillator in the phase locked loop operates in phase with the input signal. The output from this oscillator is fed to the product detector where it provides the local oscillator signal.

A practical a.m. detector circuit using the NE561B is shown in Fig. 3.4b. It can be used over a fairly wide frequency range, but component values will be quoted for the medium wave band (550kHz to 1.6MHz).

The values of the by-pass and coupling capacitors should be chosen for a low impedance at the operating frequencies. For medium wave use C2, C7 and C8 may therefore be 0.1µF.

### CAPACITOR TUNING

The value of C5 must be selected so that the voltage controlled oscillator operates at the required input signal frequency. If desired, the capacitor C5

may be a variable one, in which case the connections to pin 6 (R3 and VR1) may be omitted.

When a variable capacitor is employed for C5, its value will be approximately 300 divided by the input signal frequency in megahertz at the capacitor setting concerned. For the 550kHz to 1.6MHz range, the value of C5 should range from about 550pF to about 180pF.

### RESISTOR TUNING

If the tuning is to be carried out by the variable resistor VR1, the value of C5 should be chosen so that when no current is injected or removed from pin 6, the voltage controlled oscillator operates at the geometric mean frequency of the band to be received. This geometric mean is equal to the square root of the product of the lowest and highest frequencies in the band. In the case of the 550kHz to 1.6MHz receiver, this mean frequency works out as 940kHz.

The complete medium wave band may be tuned by VR1; this potentiometer may be a ten-turn helical type to permit accurate setting. The value of R3 is selected to give the desired tuning range and will be about 1.2 kilohm when an 18V power supply is employed.

### PHASE SHIFT

The component values of the phase shift circuit may be determined in the following way.

If  $R_1 = R_2 = 3\text{k}\Omega$ , the  $C_1 = C_6 = (1.3 \times 10^{-4} / f)\text{F}$  where  $f$  is the midband frequency. In the medium wave receiver,  $f$  is 0.94MHz and  $C_1 = C_6 = 1.35 \times 10^{-10}\text{F} = 135\text{pF}$ .

### LOW-PASS FILTER

The value of the low-pass filter capacitor, C4, is not at all critical, since no information is derived directly from the loop error signal. One merely requires to establish stable operation. A 10nF capacitor is suitable for C4.

## TAPE RECORDER FLUTTER METER

A circuit devised by R. Blair of Houston using the NE561B in a tape recorder flutter meter is shown in Fig. 3.5. A 3kHz sinewave is fed to the recording head. The output from the replay head is fed to the phase locked loop which detects any variations in frequency from the 3kHz value.

The NE561B circuit is set to a nominal value of 3kHz using the fine tuning control. The demodulated output is capacitively coupled to an amplifier of high input impedance. The output level changes with any change in the frequency of the signal applied to the phase locked loop.

An oscilloscope may be employed to measure the peak deviations and a true r.m.s. voltmeter to make r.m.s. flutter measurements. (The waveform is complex and therefore meters which read the peak or average value will not give true readings.) The output can be filtered to study any selected bands of frequencies.

## THE 565

One of the best known low frequency phase locked loops is the 565 device. This is available as the Signetics NE565A device and as the National Semiconductor LM565CN device in a 14 pin dual-in-line encapsulation. The NE565K and the LM565CH are electrically equivalent devices in a TO-99 circular encapsulation.

The basic circuit for all of these devices together with the pin connections is shown in block form in Fig. 3.6.

The loop is broken between the output of the voltage controlled oscillator and the input to the phase comparator (pins 4 and 5 respectively) so that frequency divider circuits can be inserted at this point for frequency synthesis applications. The low-pass filter is formed by the internal resistor marked RA in Fig. 3.6 and the external capacitor C2.

## FREQUENCY RANGE

The maximum frequency at which the voltage controlled oscillator of the 565 devices can operate is

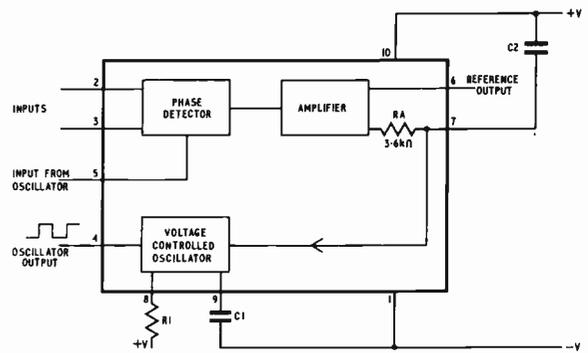


Fig. 3.6. Block diagram of the 565 low frequency phase locked loop. This is the pin numbering for the NE565A (Signetics) and the LM565CN (National Semiconductor), both 14 pin dual-in-line

about 500kHz. The minimum practical operating frequency is set by the maximum value of the timing capacitor (C1 in Fig. 3.6) which can reasonably be used. If one decides that this maximum value is  $10,000\mu\text{F}$ , one can obtain a frequency as low as 0.001Hz.

The free-running frequency of the voltage controlled oscillator is only partly determined by the value of the timing capacitor C1. The frequency can be changed over a range of at least 10:1 using a single value of C1 by varying the value of R1 in the pin 8 circuit; alternatively the value of the current fed to pin 8 may be varied.

The typical variation of the free-running frequency with the value of R1 for four values of the timing capacitor is shown in Fig. 3.7. For any given value of the timing capacitor, the free-running frequency is about an order of magnitude lower than that of the high frequency loops.

The free-running frequency of the 565 oscillator is given by the approximate equation  $f = 1.2 / (4R_1C_1)$  where R1 and C1 are the timing components shown in Fig. 3.6.

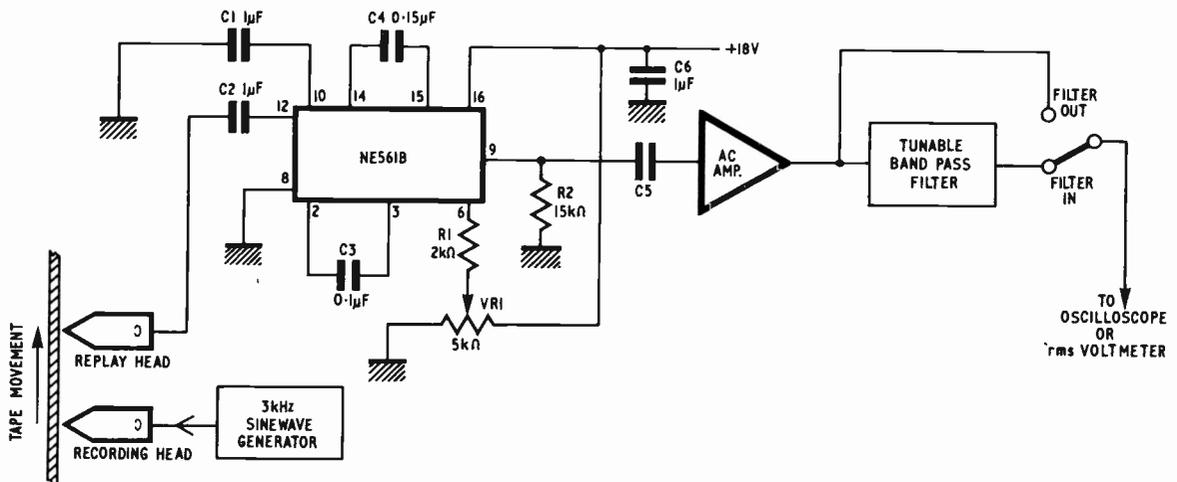
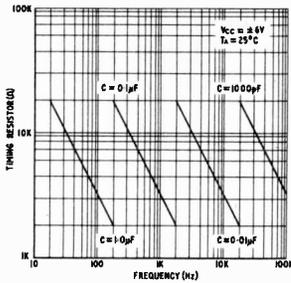


Fig. 3.5. A tape recorder flutter meter using the NE561B phase locked loop



**Fig. 3.7. Relationship between the centre frequency and the timing components for the 565 integrated circuit**

The value of the timing capacitor C1 can vary over wide limits, but the resistor R1 should have a value of between 2kΩ and 20kΩ, the optimum being about 4kΩ.

When using power supply lines which are symmetrical with respect to ground, the range of voltages which may be employed is ±5V to ±12V. When ±6V power supplies are employed, the typical current taken is 8mA with a maximum value of 12mA. The maximum permissible power dissipation is 300mW.

## THE OSCILLATOR

The voltage controlled oscillator circuit used in the 565 devices can be obtained as a separate integrated circuit type 566. It is available as the Signetics 8 pin dual-in-line device type NE566V and the similar National Semiconductor device type LM566CN. The circular TO-99 equivalents are types NE566T and LM566CH. The SE566T and LM566H are close tolerance devices.

In the 565 phase locked loops, triangular and square waves are generated by the voltage controlled oscillator, but no buffer stage is provided to give a triangular wave output as in the 566. The square wave output (about 5.4V peak-to-peak) is available at pin 4 of the 565.

The output of the low-pass filter (pin 7 of Fig. 3.6) is connected internally to the voltage control input of the oscillator. The oscillator frequency can therefore be controlled by a signal fed to the demodulated output terminal (pin 7).

## LOCKING RANGE

The range of input frequencies over which the loop will remain in lock on each side of the centre frequency is given by the approximate expression  $\pm 8f/V$  where  $f$  is the centre frequency and  $V$  is the total voltage between the power supply lines.

The 565 can therefore track the input frequency over a very wide range (typically ±60% of the centre frequency). Locking can be obtained over a greater fraction of the input frequency than in the case of high frequency loops.

The 565 input impedance is typically 10 kilohm (minimum 5 kilohm). The minimum input signal required to produce tracking is typically 1mV r.m.s.

The linearity of the f.m. response is very good (typically about 0.2%).

## FREQUENCY MULTIPLICATION

In the circuit of Fig. 3.8, a frequency divider circuit has been inserted in the loop between pins 4 and 5. The output of the voltage controlled oscillator is divided in frequency by a certain factor and the frequency divided circuit locks with the input signal. The oscillator therefore operates at a higher frequency than the input signal.

The value of C2 should be adequate to eliminate variations in the demodulated output voltage at pin 7 in order to stabilise the voltage controlled oscillator frequency.

The square wave output frequency can be taken from pin 4.

## METAL DETECTOR

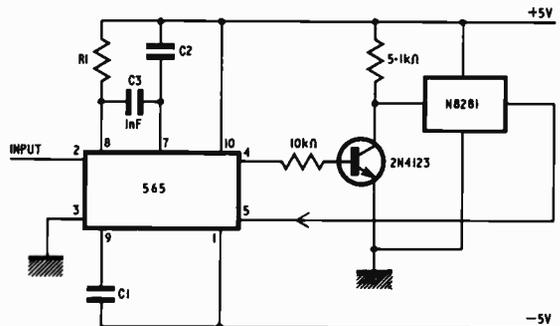
Phase locked loops can be used to detect changes of frequency. Such changes can be produced when the coil of a tuned circuit approaches a piece of metal. Phase locked loops can therefore be used in metal detectors.

A circuit of this type which has been designed by J. Blecksmith of California is shown in Fig. 3.9. The 8in diameter search coil comprises 30 turns of copper wire (26 s.w.g.) and has an inductance of about 0.5mH. It is connected in the Colpitts oscillator circuit of TR1 which operates at about 100kHz.

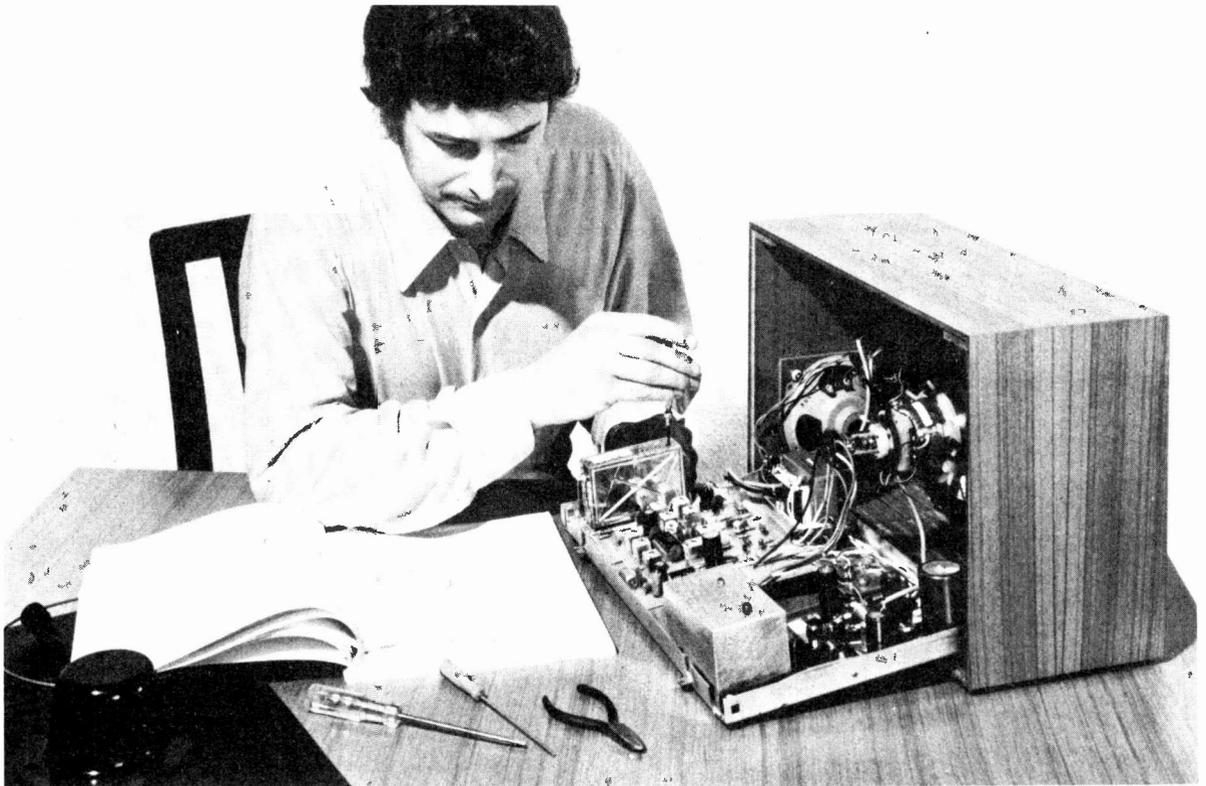
This oscillator is coupled by C3 into the input of the 565 circuit (pin 2). A current source (TR2 and TR3) is employed to supply most of the current of about 2.5mA which passes to pin 8 and which equals the charging and discharging current of C4. The use of this current source increases the output of the loop at pin 7 to about 0.5V for a 1% frequency deviation. (This follows from the fact that the 20kΩ resistor R7 will produce a change in the current to pin 8 of  $0.5/20,000 = 0.025\text{mA}$  for a 0.5V change. In other words a change of 0.5V produces about 1% change in the pin 8 current.)

The output voltage at pin 7 is compared with the reference voltage at pin 6 by the differential amplifier of TR4 and TR5. The output of this amplifier drives a centre reading meter which has a ±100μA scale. The meter zero is set by VR2 and the sensitivity by VR3.

When the search coil is brought near to a non-ferrous metal object, the frequency of the TR1 oscillator circuit will rise and so will the meter indication. Any object containing iron will increase the inductance of the loop and reduce the frequency of oscillation; the meter reading will therefore fall.



**Fig. 3.8. A frequency multiplier using the 565 and a divider**



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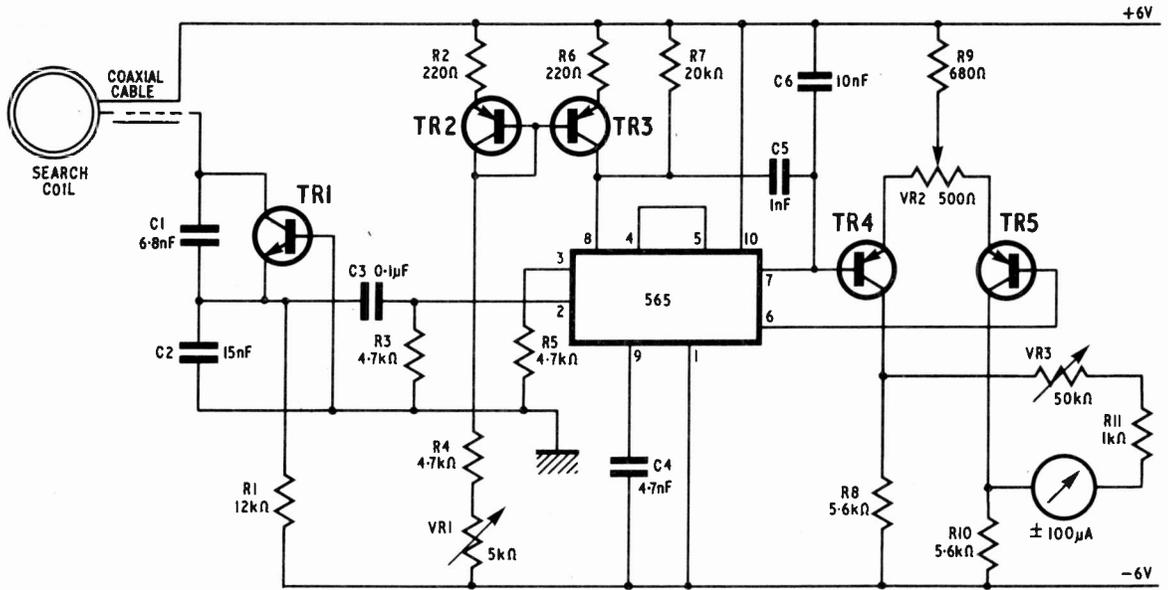


Fig. 3.9. A metal detector using the 565

### WEATHER SATELLITE APPLICATION

As an example of a very different application of the 565, its use in a weather satellite picture demodulator will be outlined.

Weather satellites continually photograph the earth from a distance of typically a few hundred miles. The pictures are stored in an electrostatic Vidicon tube and are read out during the succeeding 200 seconds.

The signal is transmitted on a 137.5MHz carrier frequency modulated with a 2.4kHz sub-carrier; the latter contains the picture information. The demodulated 2.4kHz tone is normally recorded on tape at the receiving station for subsequent processing.

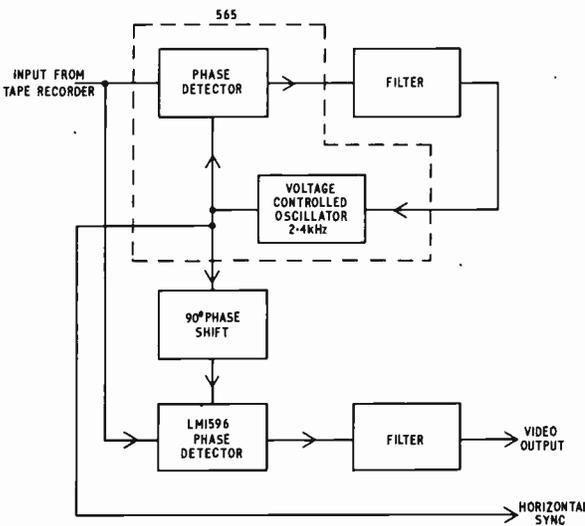


Fig. 3.10. A system for demodulating video signals from the 2.4kHz sub-carrier which is used by weather satellites

When the tape is replayed, it is desirable to reproduce the 2.4kHz sub-carrier using a phase locked loop, since the latter will effectively filter out most of the noise and will track any flutter in the magnetic tape mechanism.

The basic circuit used in this application is shown in Fig. 3.10. The loop locks at the 2.4kHz frequency. If this is also the centre frequency of the loop, the square wave output from pin 4 of the 565 will be 90 degree out of phase with the input.

However, the zero crossing times of the triangular wave across the timing capacitor may be applied to the LM1596 doubled balanced modulator so that switching occurs in phase with the 2.4kHz sub-carrier.

The picture may be reproduced on a cathode ray tube. Detailed circuit information is available in the National Semiconductor report AN-46.

### AVAILABILITY

The Signetics phase locked loops are about the most widely available type at the present time and are available from many of the advertisers in PRACTICAL ELECTRONICS. The NE560B, NE561B and NE562B are available from S.D.S. Components Ltd., Portsmouth PO3 5JW at about £4.20 in small quantities. The Signetics 565, 566 and 567 are obtainable from the same source at about £4, £1.44 and £3.25 respectively.

National Semiconductor devices can be obtained from Semiconductor Specialists, Farfield Road, West Drayton.

Further information on these devices may be obtained from the Signetics Linear Integrated Circuit book and in data and applications notes from Signetics and National Semiconductors.

**Next month: more applications of phase locked loop integrated circuits will be described including stereo decoding**

# LOGIC TUTOR EXPERIMENTS..



## THE FULL ADDER

**I**N PRACTICE we must be able to add together two multi-digit numbers and as we saw last month the HALF ADDER does not go quite far enough to doing this. We have to design a circuit that is capable of accepting the two digits of the column (A with B) and incorporate a possible carry over from the previous (less significant) column.

### TWO STAGES

The simplest way of doing this is to carry out the operation in two stages; first add together the digits that are in the higher significance column—this is done in the HALF ADDER 1 of Fig. 8.1.

If the digits were 0 and 0 we would get a partial sum of 0 and a carry of 0. If either of the digits were 1 we would get a partial sum of 1 and a carry of 0 but if both digits were 1 we would get a partial sum of 0 and a carry of 1.

We shall come back to this carry in a moment but remember that if we get a carry, at all, at the output of HALF ADDER 1 the sum output of it is *bound* to be 0.

We now take the partial sum from the first HALF ADDER and combine it with the carry digit—that might have been generated by the previous column. This is done in HALF ADDER 2. This will generate a final sum and *could* generate a carry.

If you think about it you will see that if a carry is generated at the output of HALF ADDER 1 it is not possible to get a carry from HALF ADDER 2 (because the sum from the first stage would have been bound to be 0). However, if the sum from the first stage was 1 it *might* be that there was a carry in from the previous column and these combine in the second stage to give a carry out as well as the final sum. Whatever happens it is not possible to get a carry out of both stages at the same time so there is no question of having to add two carries together.

### FULL ADDER

Thus to generate a final carry out of the complete unit we only have to OR together the two possible sources of carry. This circuit is called a FULL ADDER and can be made using the building blocks we have already described in NAND form. We need two HALF ADDERS and an OR gate.

An unsimplified circuit showing the discrete stages in NAND logic appears in Fig. 8.2. Do not make this on Logic Tutor because we can simplify the circuit a little. Notice that we have double inversion on the two lines feeding the final NAND gate of the OR block. These negate each other and we are left with a complete FULL ADDER using nine NAND gates in Fig. 8.3. This you can make on Logic Tutor.

Using the switches and lamps and a piece of paper and a pencil show that the circuit truthfully follows the rules of arithmetic necessary to add the three input digits together.

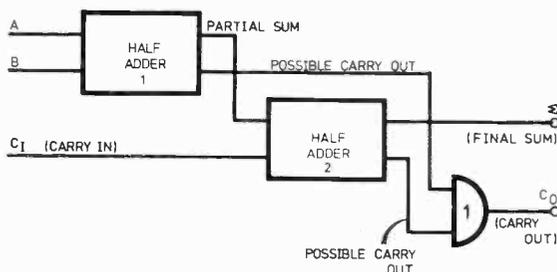


Fig. 8.1. Two HALF ADDERS are combined to form a FULL ADDER.

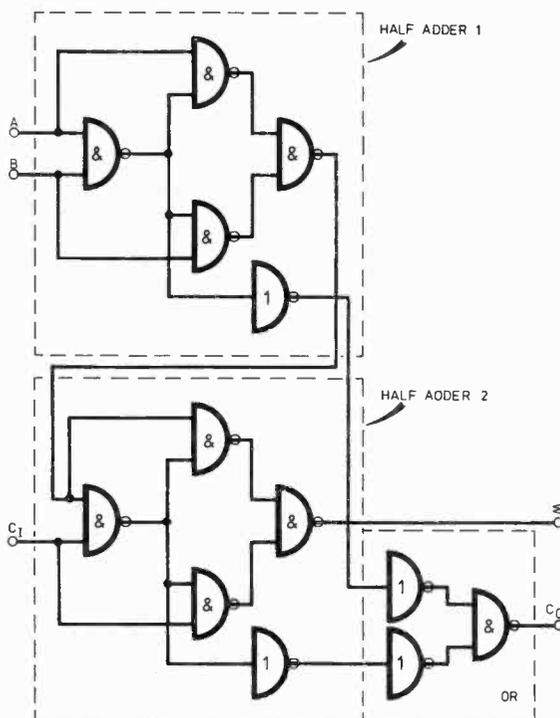
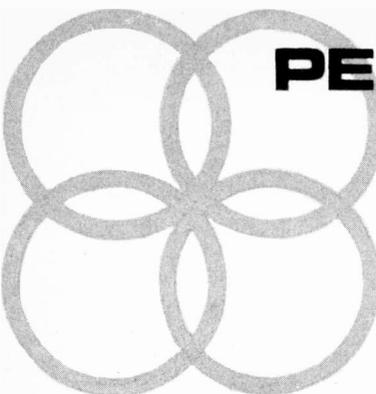


Fig. 8.2. A FULL ADDER using blocks of logic in unsimplified form. Note the two sets of double inversion before the final NAND gate in the  $C_0$  line.





# PERONDO PART 4

## MECHANICAL ASSEMBLY & INTERWIRING

BY R. A. COLE

### FACIA

### SURROUND

### INTERWIRING & HARNESS

IN THE previous parts of the RONDO series we have discussed the construction of the main chassis member which forms a trough-like carrier for the power sections of the system. Now we come to a discussion of the general mechanical assembly and the wiring of the system.

#### GENERAL CONSTRUCTION

The facia of the RONDO system supports both the controls and the r.f. tuning unit, whilst the remainder of the boards are assembled in the chassis pan itself. Thus, as can be seen from Fig. 4.1 the facia consists of an aluminium framework supported on four columns which are held in the main chassis by screws.

The columns support two crossmembers (Fig. 4.1b) made from aluminium angle ( $\frac{1}{4}$ in  $\times$  1in) which in turn support two sections of aluminium extrusion made specially for the RONDO system and available from a number of kit suppliers. The two sections are separated by an inverted "U" section of brushed aluminium provided with ventilation louvres.

For those who wish to make their own facia this may be made up from sheet material bent up into the form at Fig. 4.1a, again supported on the columns and drilled so as to carry a simple aluminium facia in plain sheet. Drilling for this is identical to that for the pre-form material with the addition of master tone board mounting screw holes added.

The plain face area shown above the four input selector push-buttons on the left of the RONDO is allocated to the tuner section, yet to be described.

The final main part of the mechanical assembly is the "wrap-round" or surround which forms the sides of the RONDO. This is made from wood, veneered chipboard, or the like according to taste.

From Fig. 4.2 which shows the surround it will be seen that there are two alternative methods of fixing between the surround and the basic trough chassis. The first is to make use of the natural spring in the bent-up chassis by springing the two longer sides apart slightly such that when the surround is finally lowered over the facia to abut the two flanges on the trough, these are pushed in against the spring action. As the surround is lowered further they will then spring out to engage with the two grooves cut in the inner long surfaces of the surround.

If the constructor prefers, he may replace this method with one in which the surround is reduced in depth by the distance between the lower edge and the grooves and is supported on an extension bolted to the two trough flanges as shown in Fig. 4.2.

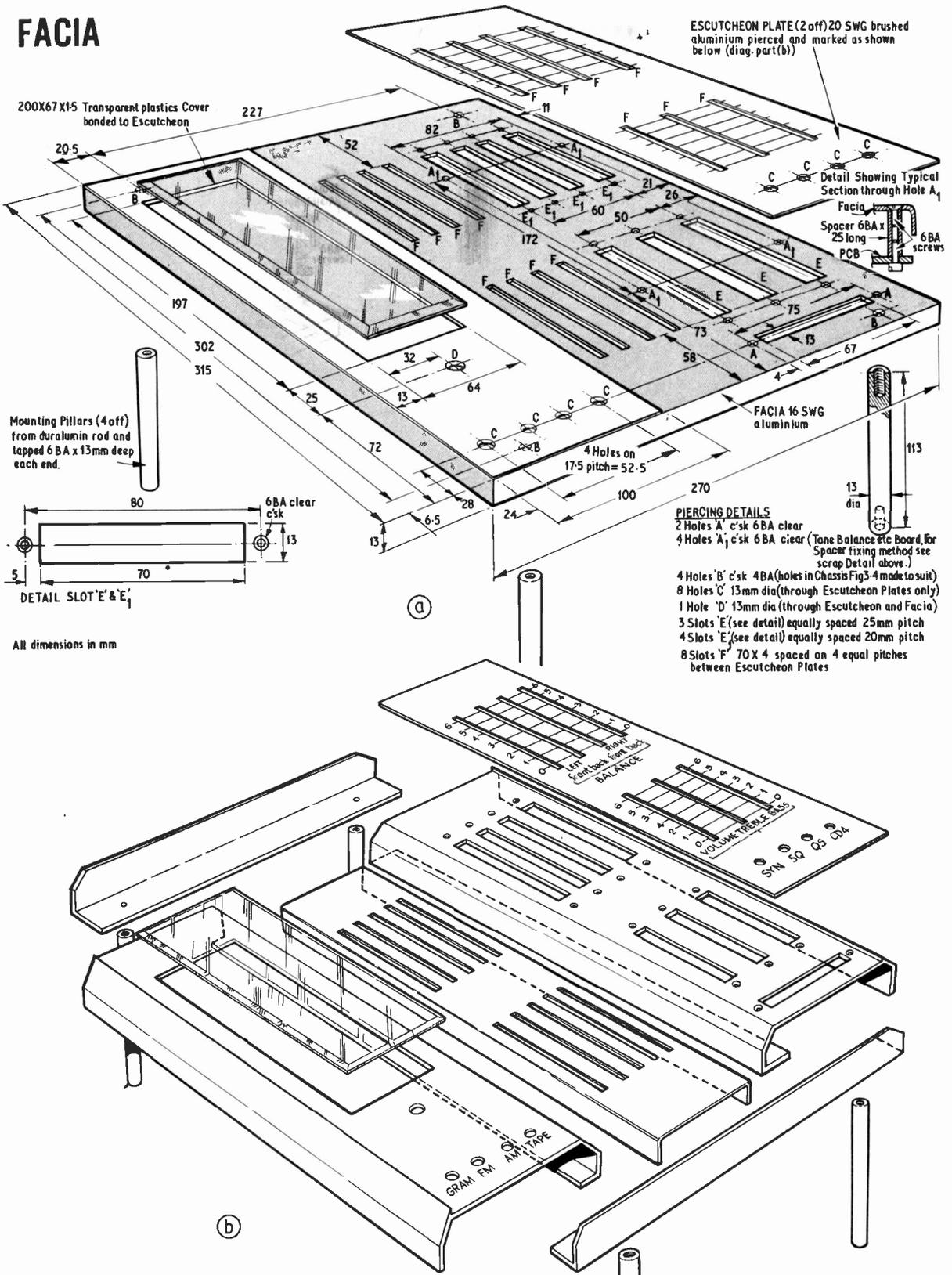
#### WIRING DETAILS

The P.E. RONDO quadraphonic system is quite complex and, if not carefully wired, will result in an untidy maze. It is therefore strongly recommended that a prefabricated wiring harness, or cableform, be made to cover the bulk of the inter-unit wiring.

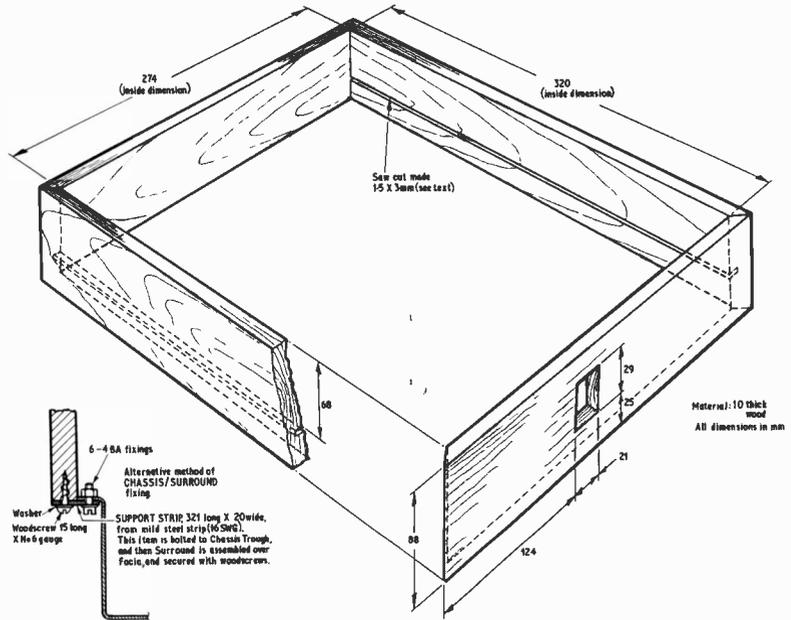
This cableform is constructed by means of a simple jig illustrated in Fig. 4.3 and made from a suitable piece of wood into which a pattern of "pins" is fixed;  $1\frac{1}{2}$ in panel pins are ideal for this purpose. They are hammered into the appropriate points as shown and the heads are then clipped off and the sharp ends smoothed.

When assembling the cableform make certain that each wire or cable is inserted in the order given in Table 4.1, since otherwise both simple mechanical and electrical problems can arise.

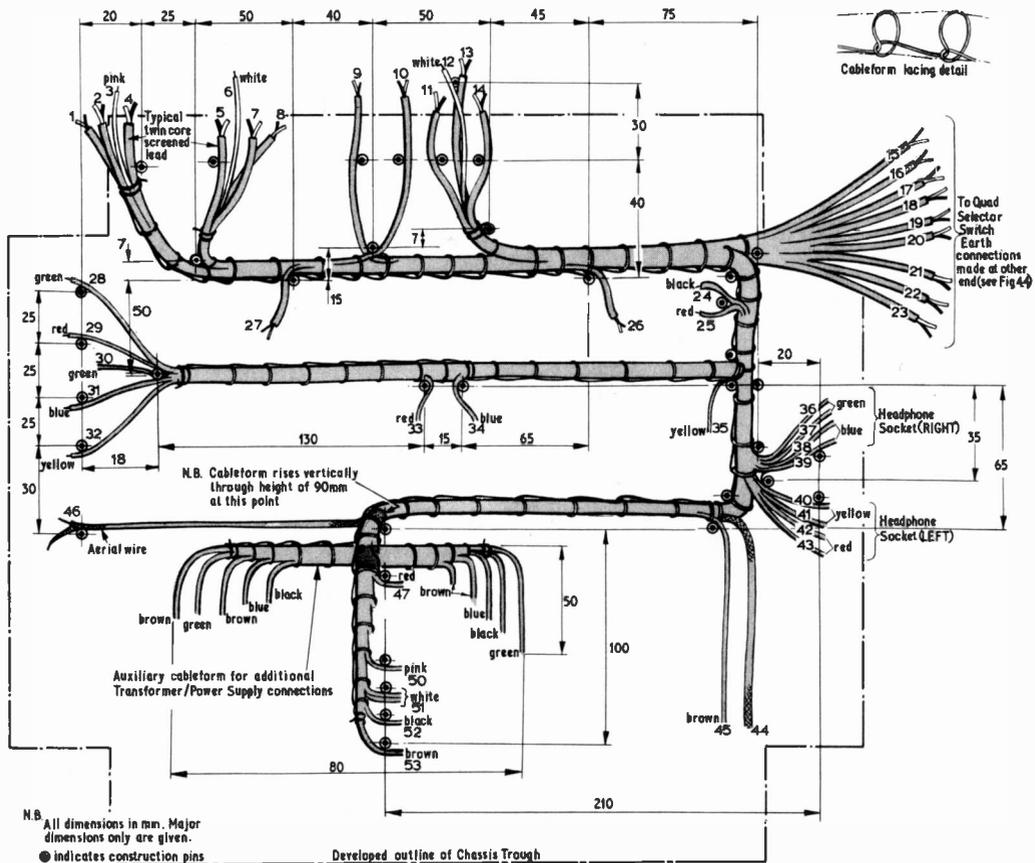
# FACIA



# SURROUND & LOOM



**Fig. 4.2. Construction of the wooden surround with details of the two methods of fixing the trough**



**Fig. 4.3. Details of the cableform wiring harness. Interwiring between the units is greatly simplified if a cableform system is constructed as shown here**

Each piece of wire is firmly secured by wrapping its start end round the first pin and then laying it along the route shown in Fig. 4.3 and the point-to-point wiring and assembly diagram of Fig. 4.4.

The intermediate pins along a route are used as guides and gentle tension is applied to each wire in order to produce a neat and tidy result. At the termination point the wire is again secured to the adjacent pin by wrapping. With the heavier wires it may be found necessary to knot the wire around the pin.

A "tail" some two to three inches long should be left at each end of each wire for later circuit connecting.

The cableform may now be "laced" up using lacing twine or, failing the availability of this, a waxed heavy thread or light nylon line. A simple form of lacing is shown in Fig. 4.3 from which it will be seen that this is merely a matter of tying the cableform into one cohesive unit by using a series of loops around the cables every  $\frac{3}{4}$  in or so.

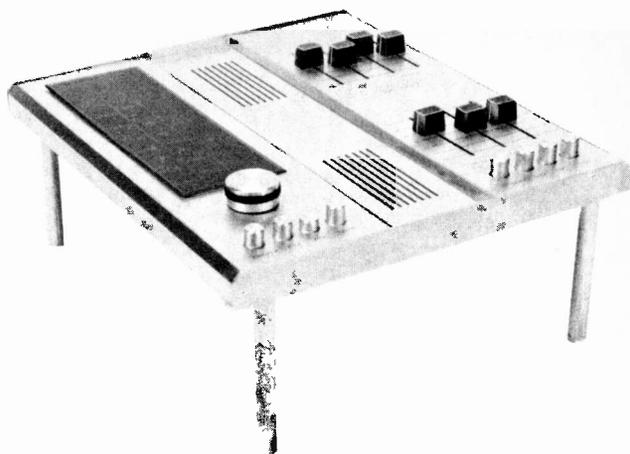
After lacing, the cableform is gently eased from the pins and is now ready for positioning in the trough.

### MECHANICAL ASSEMBLY

The two power amplifiers, already assembled complete with heat sinks, are laid side by side, copper side upwards on the bench. The power rails and earth rails are connected and flying leads are soldered as shown in Fig. 4.6.

The next step is to fit all sockets, rubber feet and mains lead grommet to the chassis as shown in Fig. 4.4. The wiring harness is then laid in the bottom of the main chassis as shown.

Starting at the rear of the chassis carefully identify each wire and its connecting point. Cut the wire tails to length and carefully strip the ends, wrap round and then solder. Repeat this procedure until



all wires that are shown to be terminated are soldered.

The remaining wires and their terminations are associated with the tuner unit which is to be the subject of a separate article and they will be described in detail then.

The two power amplifier boards, now joined together, are placed component side upwards in the chassis. The two right-hand limbs of the wiring harness (as seen from the front of the chassis) should be under the boards and the left-hand limb along the edge of the heat sink.

Ensure that the yellow, blue, red and green wires, in the centre limb of the harness, protrude above the boards at the appropriate outlet points. Cut, strip, wrap and solder them. Similarly treat the red and black wires in the right-hand limb, soldering them to the positive and negative 15 V rails on the power amplifier board.

The two rails are duplicated on the rear power amplifier board and the two boards are joined with short lengths of red and black wire interconnecting the rails.

Table 4.1

Start	Finish	Signal	Cable Type												
1	15	CD4	} Twin screened												
2	16	"													
4	17	"													
5	18	SQ													
7	19	"													
8	20	"													
11	21	QS													
13	22	"													
14	23	"													
9	26	L <sub>A</sub> I/P		} 14/0-0076 Pink											
10	27	R <sub>A</sub> I/P			} White										
3	50	+24V Rail				} "									
6	51	+20V Rail					} Black								
12	51	- 15V "						} Red							
24	52	+15V Rail	} Yellow												
25	47	L <sub>F</sub> O/P							} "						
35	40	"								} Blue					
40	32	"									} "				
34	39	L <sub>B</sub> O/P										} Red			
39	31	"											} Green		
33	43	R <sub>F</sub> O/P												} "	
43	29	"													} Brown
30	36	R <sub>B</sub> O/P													
36	28	"		} Miniature Co-Ax											
53	45	+18V Rail													
46	44	Aerial													

### HEADPHONE SOCKETS

A group of four pairs of wires, each pair of one colour, namely yellow, blue, red and green, protrudes from the front of the harness in line with the headphone sockets. These wires are connected to the headphone sockets, as shown, ensuring that the leads from the power amplifiers go to the appropriate tags on the *right* side of the headphone sockets as viewed from the front of the chassis. If these connections are not correctly made the headphones will not function correctly.

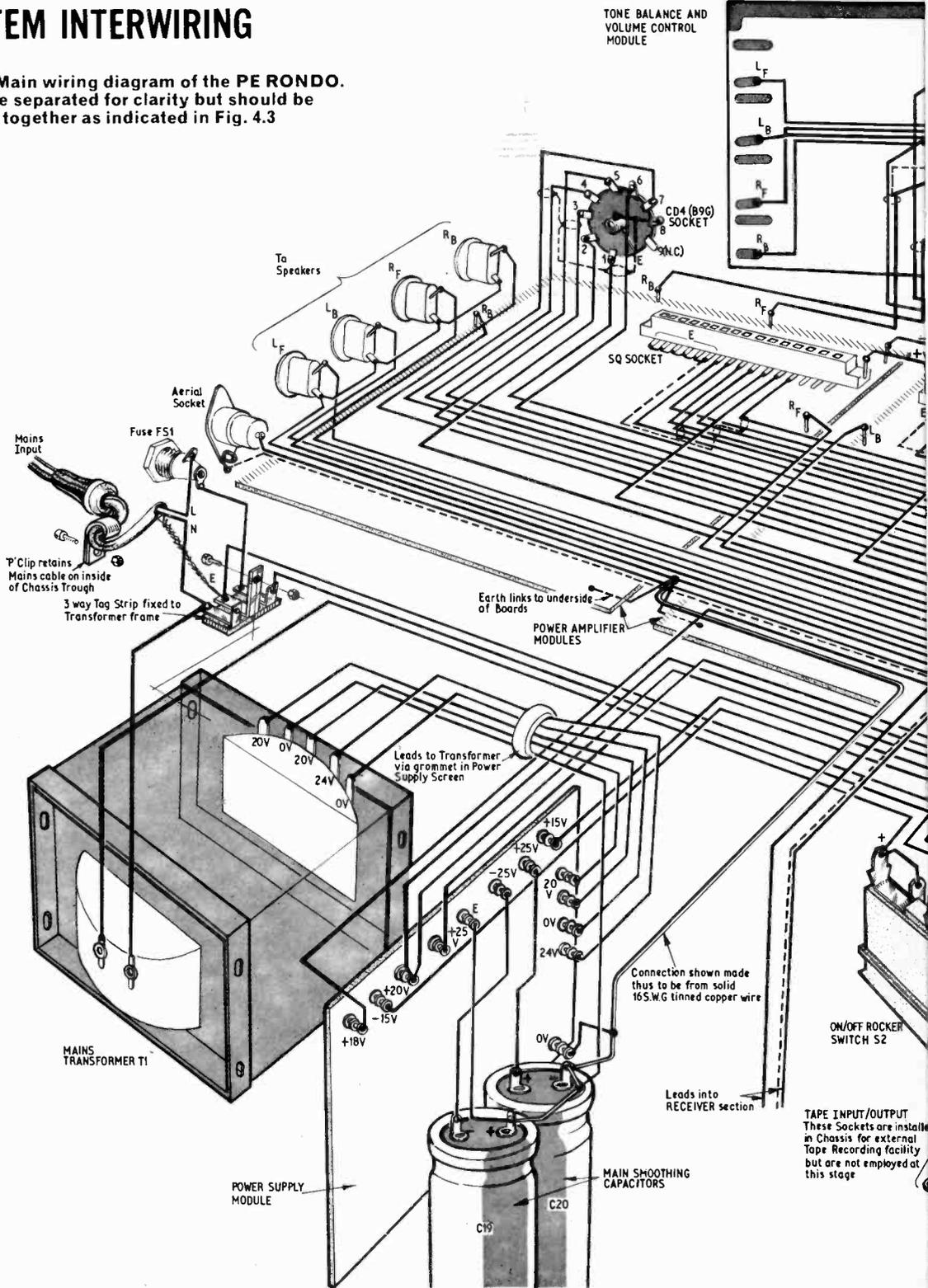
The headphone sockets shown are of the normal three-wire type which can exhibit problems with the amplifiers set to high output levels. It is possible to either damage the headphones or the ear-drums if care is not taken when plugging the headset in.

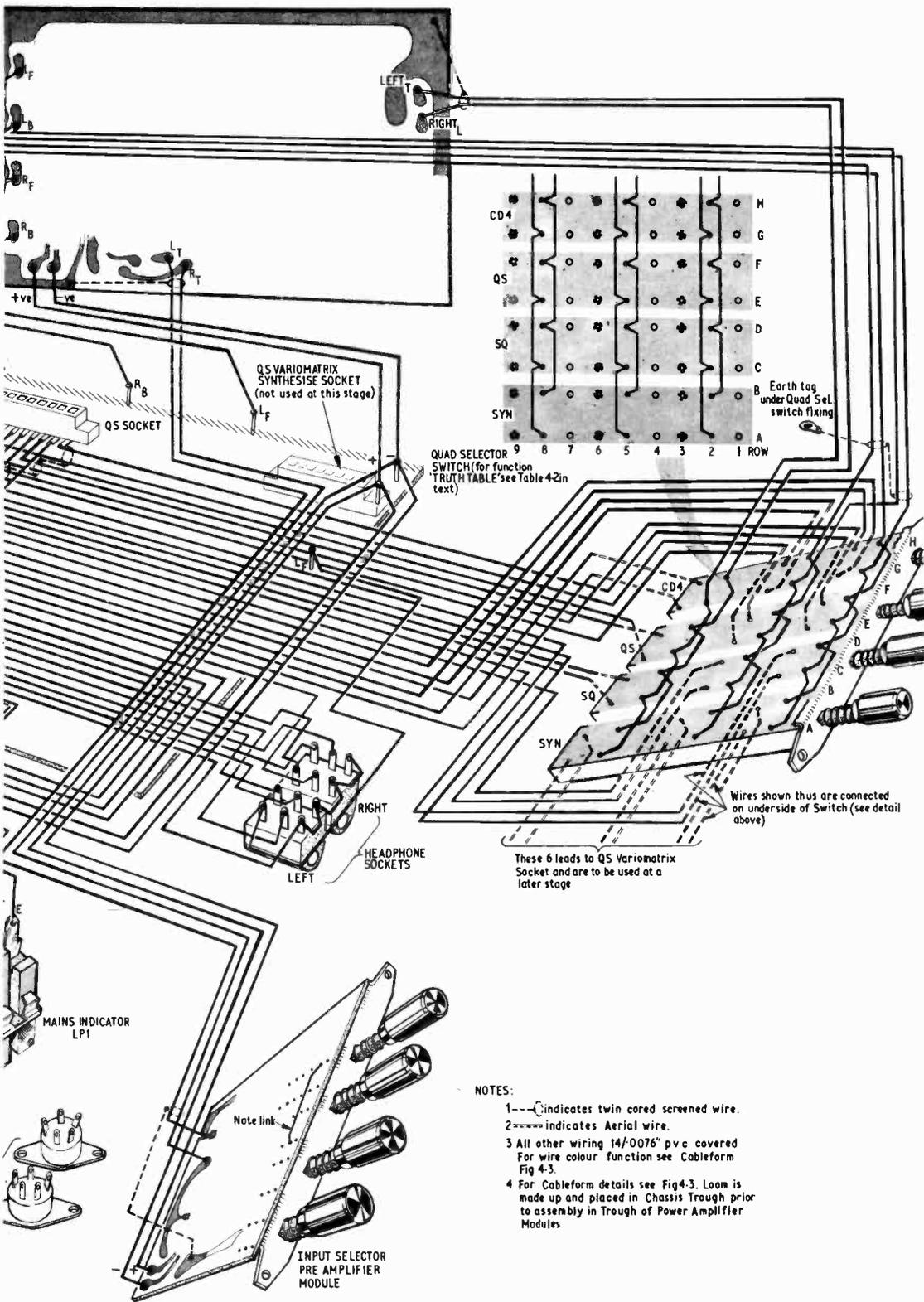
It is therefore recommended that the constructor either takes great care under these circumstances or adopts the use of a new style of socket which has just come onto the market. The new socket interposes a load in series with the headphones in order to limit the output level and current to a safe value.

Using the new sockets, a suitable load resistor for most applications is 220Ω,  $\frac{1}{4}$ W.

# SYSTEM INTERWIRING

Fig. 4.4. Main wiring diagram of the PE RONDO. Wires are separated for clarity but should be grouped together as indicated in Fig. 4.3





NOTES:

- 1--- indicates twin cored screened wire.
- 2==== indicates Aerial wire.
- 3 All other wiring 14/0076" pvc covered  
For wire colour function see Cableform Fig 4-3.
- 4 For Cableform details see Fig 4-3. Loom is made up and placed in Chassis Trough prior to assembly in Trough of Power Amplifier Modules

## POWER SUPPLY SUB-ASSEMBLY

Returning now to the power supply sub-assembly; fit the complete sub-assembly to the chassis with four  $\frac{1}{2}$ in round-head 4BA screws, plain washers, lock washers and nuts. Similarly secure the power amplifiers to the chassis by means of the heat sinks. Fit the main smoothing capacitors to the chassis by means of capacitor clips.

The power supply includes transformer, power board and main smoothing capacitors and is shielded by means of two steel screens. The smaller of these screens, shown in Fig. 3.6, acts as a supporting baffle for the power supply board.

It is first fastened to one end of the mains transformer by four  $\frac{1}{2}$ in round-head 4BA screws, each fitted with one plain washer, one lock washer and a nut. The board is then secured to this baffle by three  $\frac{1}{2}$ in round-head 6BA screws, washers and nuts and, in each case, a  $\frac{1}{8}$ in spacer is interposed between the board and the baffle.

The larger of the two steel screens is now fitted to the chassis.

Refer to Fig. 4.4 and connect the leads to the power supply coming from the harness. Connect the mains lead and switch/pilot light as shown in Fig. 4.4.

Prepare the pre-amplifier board with flying leads

for connection to the main chassis components. Similarly connect the master volume/tone/balance control board. Reference to Fig. 4.4 will give the necessary guidance.

The four-way, six-change-over, pushbutton bank is now pre-wired in accordance with Fig. 4.4 and Table 4.2.

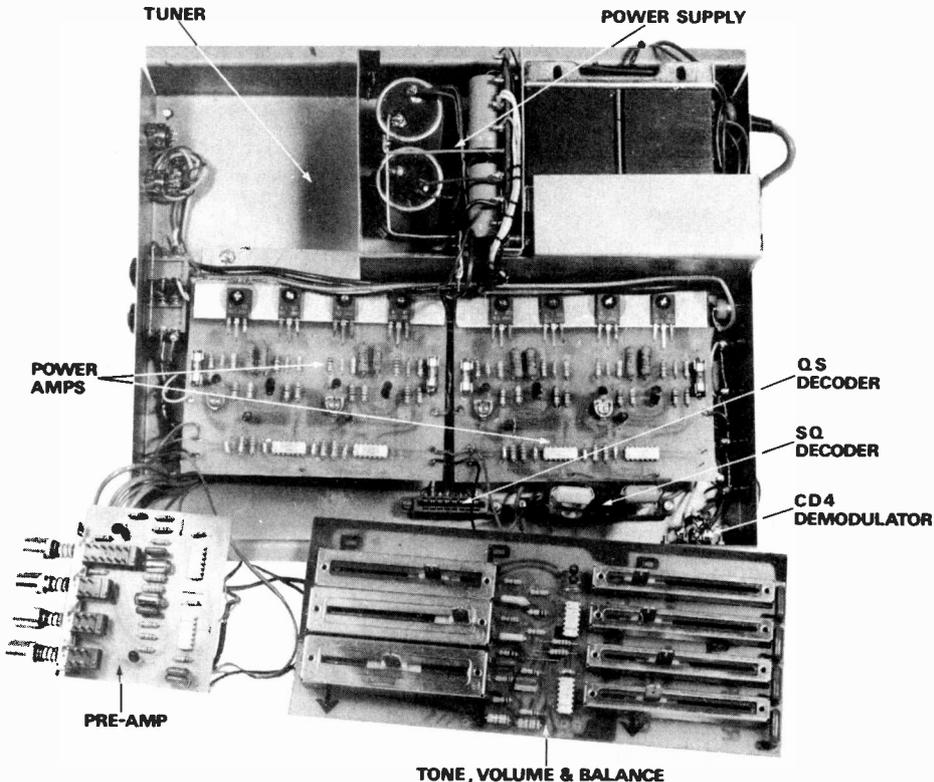
The nine pairs of screened leads protruding from the right-hand front of the wiring harness are carefully stripped and identified. Connection of these leads to the switch bank is carried out with reference to the figure.

Please note that no wiring is provided for the SYNTHESISE position on the pushbutton bank. Details of this facility will be given in a later article together with the wiring of the tape sockets.

Fuses are now inserted into the holders on the power amplifier boards and into the mains fuse holder. See components list for ratings.

## AMPLIFIER CHECKING

Before commencing, carefully check the accuracy and completeness of the wiring. Extra time spent here can save expensive components coming to undue harm. Ideally, a parallel check between the unit, layout drawings and theoretical circuit should be performed.



Connect the speaker outlets to dummy  $8\Omega$  loads. The dummy load may be made up from 15,  $120\Omega$   $\frac{1}{2}W$  carbon resistors connected in parallel. Only one load need be made as each amplifier is tested individually.

As the initial output power will be fairly low on setting up, 2W resistors are adequate. If a cheap  $8\Omega$  loudspeaker is available to monitor each channel as it is set up, so much the better. Do not, however, risk a good loudspeaker at this stage.

Turn the presets on all power amplifier channels to maximum, that is clockwise. Reduce all level and balance controls on the master board to minimum and set the tone controls mid-way.

## COMPONENTS . . .

### Resistors

Headphone load resistors  $220\Omega$   $\frac{1}{2}W$  (4 off)  
Dummy load for testing  $120\Omega$   $\frac{1}{2}W$  (15 off)

### Plugs and Sockets

Speaker sockets 2 pin DIN (4 off)  
Tape in/out sockets 5 pin  $180^\circ$  DIN (2 off)  
Aerial socket Coaxial recessed  
Headphone sockets Switched stereo headphone sockets (2 off)  
CD4 connector B9G valve base  
SQ edge connector 16 way 0.15in pitch edge connector  
QS Variomatrix  
Synthesise socket 8 way 0.15in pitch edge connector  
QS edge connector  
Fuse holder 8 way edge connector 20mm chassis type

### Switches

Push button bank, 4 bank, 17.5mm spacing, with each bank  
6-changeover per bank

### Wiring

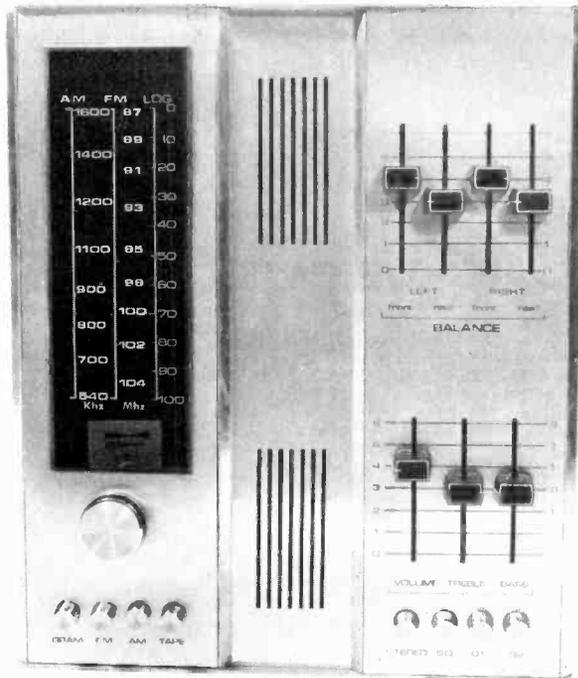
32ft 14/0-0076in stranded single p.v.c. (yellow 3ft, blue 3ft, red 5ft, green 5ft, white 5ft, pink 3ft, brown 6ft, black 2ft)  
20ft twin screened lightweight audio wire  
2ft single screened light co-ax.  
8ft lacing cord  
Mains lead 3-core to suit  
2ft tinned copper 16 s.w.g. wire

### Materials

Aluminium extrusion for facia (available from Sonax Electronics) or plain 18 gauge sheet aluminium if alternative construction method is used. Aluminium "L" or "U" form and  $\frac{3}{8}$ in rod for support members for facia. Boxform surround (from Sonax) or wood to make

### Miscellaneous

3-way terminal tag strip  
Rubber feet (4 off)  
Grommet  $\frac{1}{2}$ in  $\times$   $\frac{1}{4}$ in, sleeved grommet for mains lead  
 $\frac{1}{2}$ in 4BA roundhead screws (17 off)  
4BA nuts, plain washers and lock washers (17 off)  
 $\frac{3}{8}$ in 6BA roundhead bolts (16 off)  
 $\frac{1}{2}$ in 6BA roundhead bolts (6 off)  
 $\frac{3}{8}$ in 6BA roundhead bolts (3 off)  
6BA nuts, plain and lock washers (25 off)



Connect a d.c. millivoltmeter across resistors R29 and R30 as shown in Fig. 4.6 on one power stage. The sum of these two resistors is approximately  $1\Omega$ . Switch on the complete system.

At this stage a variable input transformer (Variac) to adjust the mains supply slowly is very useful, but not essential.

The millivoltmeter should now read from 2 to 10mV d.c.

If the reading is more than 50mV switch off and check wiring again. If all is well, slowly rotate the preset VR8 anticlockwise until a reading of approximately 20mV is obtained. This reading corresponds to approximately 20mA quiescent current.

Disconnect the meter and repeat the procedure on all the remaining power amplifiers in turn.

The main amplifiers are now set for optimum quiescent current conditions and should not require re-setting at all.

## FINAL MECHANICAL ASSEMBLY

The master volume and tone board, preamplifier board and quadraphonic selector switch are all assembled on the facia as shown in Fig. 4.1. It must be remembered that the wiring to these boards should be kept as short as possible to avoid interference and hum. However, they must be sufficiently long to allow both initial assembly and possible later disassembly.

The facia may now be attached to the trough by its pillars and 4BA screws inserted upwards from beneath the trough in the holes provided.

The surround may now be placed over the facia and dropped down to engage with the lips on the trough for either of the two fixing methods described earlier to be effected.

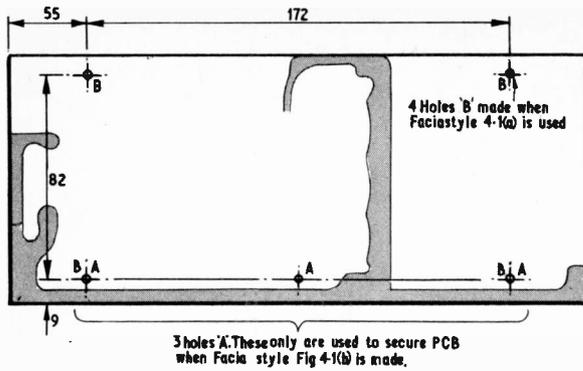


Fig. 4.5. Drilling details of the Tone/Master volume board to suit the facia of Fig. 4.4a.

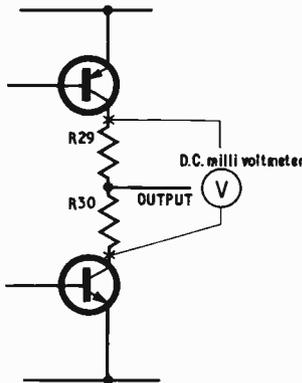


Fig. 4.6. Location of the test points for measurement of the quiescent current in the power amplifiers

Where "spring" locating method is used to retain the surround the exact fit is adjusted as required by applying a slight set to the sprung chassis sides. Be careful not to overdo the tension as this will make subsequent removal of the surround difficult.

Ideally the springing should just cause the flanges to "bite" the surround as it is lowered into position and adjustment can be made in small steps until correct setting is achieved.

To remove the surround using the same method it is simply a matter of placing the finger tips against the long sides from below and pressing lightly inwards until the lips of the flanges release from the grooves. The approach from below is important as working from above is rather difficult. Thus it is simplest to place the unit on a box or other object first so that the hands can be positioned lower than the bottom of the unit.

After releasing from the grooves a gentle upward pressure will slide the surround free for removal.

## EARTHING

The use of a wiring loom reduces the problems encountered with hum and stray pickup and it is for this reason that we have described a loom here. Further steps can be taken to minimise these unwanted signals.

Firstly, ensure that both screens are electrically connected to the main chassis which must be itself

Table 4.1 WIRING OF QUAD SELECTOR SWITCH

TOP SIDE WIRING			
Join A8, C8, E8, G8 =	R <sub>T</sub> input		
Join B8, D8, F8, H8 =	L <sub>T</sub> input		
Join A5, C5, E5, G5 =	L <sub>F</sub>		
Join B5, D5, F5, H5 =	L <sub>B</sub>		
Join A2, C2, E2, G2 =	R <sub>F</sub>		
Join B2, D2, F2, H2 =	R <sub>B</sub>		
} To Fader Inputs			
UNDERSIDE WIRING			
Synthesise	R <sub>F</sub> =3A	L <sub>F</sub> =6A	R <sub>T</sub> =9A
	R <sub>B</sub> =3B	L <sub>B</sub> =6B	L <sub>T</sub> =9B
SQ	R <sub>F</sub> =3C	L <sub>F</sub> =6C	R <sub>T</sub> =9C
	R <sub>B</sub> =3D	L <sub>B</sub> =6D	L <sub>T</sub> =9D
QS	R <sub>F</sub> =3E	L <sub>F</sub> =6E	R <sub>T</sub> =9E
	R <sub>B</sub> =3F	L <sub>B</sub> =6F	L <sub>T</sub> =9F
CD4	R <sub>F</sub> =3G	L <sub>F</sub> =6G	R <sub>T</sub> =9G
	R <sub>B</sub> =3H	L <sub>B</sub> =6H	L <sub>T</sub> =9H
Rows 1, 4 and 7 have no connections			

connected to mains earth. Thus if there is any doubt about good conduction between the screens and chassis it is advisable to either insert a wire link or clean the adjoining faces thoroughly before assembly.

Secondly, there is a very useful technique which can be applied to the RONDO screened leads. Simply make certain that all screens are earthed at the end nearest to the signal source for that particular length of lead. With a system as complex as the RONDO this does make for complexity in deciding which end must be earthed but the results bear out the effort. The constructor may find Fig. 1.15 in the September issue of PRACTICAL ELECTRONICS useful in this context.

If hum is experienced and the circuitry in the area of the decoders is suspected it is advisable to remove the earth connections from both ends of the screened leads between the boards and the selector switch and replace each connection in turn until the hum loop is isolated. This may involve connecting from either end of a cable.

## NOTE.

The output transistors in the power amplifiers should be MJE 3055K and MJE 2955K.

## Next Month: Loudspeaker enclosure design and construction



## RADIO STARS

In the early days of radio astronomy astronomers were constantly pointing out that there were radio sources but no known radio stars. In consequence the actual discovery on rare occasions of a radio star made headlines. Now, however, particularly over the last few months, quite a number have been added to the list. The chance discoveries have now been supplemented by those discovered as a result of a definite programme of search.

Theory suggested that an early type of star which shows emission lines and an excess of infra-red would be a candidate. It is maintained that the infra-red occurs in the surrounding dust and gas. This was the place to look for radio emission.

It is quite a neat piece of work by a team from the Algonquin Radio Observatory in Canada since a comparatively small telescope was used. The telescope operates at a wavelength of 2.8 centimetres and the dish is a mere 46 metres in diameter. Drs Feldman, Marsh and Purton have managed to secure this scoop with apparent ease.

Now, no doubt, the larger telescopes will turn their attention to the matter. Since the astronomers will now know what to look for and where to look, it is to be expected that more will be found and new data will be obtained. It could mean that a new and more successful model of infra-red stars will emerge.

## ANOTHER INTERPRETATION OF THE SIBERIAN METEORITE

The spectacular terrestrial catastrophe that took place in Siberia in 1908, has led to much speculation. No remnants of the meteorite have ever been found so many quite bizarre explanations have been forthcoming, from a crashed space vehicle to a lump of anti-matter.

The force that produced the blast is said to have had an energy output of 0.2 to 20 megatons. The physical effect of this is observable even after many years. There is no crater as such for it is a swampy area.

Dr Stephen Hawking has suggested, in the last year or so, that if black holes do exist they would be of all sizes. Many of these could be quite tiny and may well have been formed after a "big bang" start to the universe.

Since in their travels these small units would suck into themselves matter through which they passed they may well be at the centre of stars and even galaxies. Perhaps here might be found a solution to the problem of gravitational waves.

From the University of Texas comes a suggestion by Dr A. A. Jackson and Dr M. Ryan. They put



forward the idea that one of the small black holes moving at high speed and passing through the atmosphere would produce temperatures of the order of  $10^5$  degrees K.

This would cause ultraviolet radiation and a plasma column would be formed. The black hole would pass right through the Earth because of its small size but would have the mass of an asteroid. This energy would carry it onwards into space.

The plasma column would be dissipated in the surrounding area of entry. This plasma column would be of a deep blue colour. Is it perhaps significant that the many eyewitnesses described the appearance of the sighting as a "bright blue tube".

## EXTRA VEHICULAR ACTIVITY

A new method of control for astronauts is under development by the RCA Company. The astronaut's voice is used to control movements.

This is a truly significant move. It means that the actual movements required can be initiated by voice commands only. There are 12 basic commands that operate the manoeuvring and propulsion system. Thus right, left, up, down, etc. can be brought to any situation. A dream come true for many applications. It is surely not far from this point to the control of vehicles in terrestrial situations.

Other activities planned for the future concern two satellites to be launched in 1975. Some of the instruments to be carried are for the determination of the immediate Earth environment. More data will be made available from the higher levels of the atmosphere particularly the thermosphere. The sort of instrumentation that is required for this work includes an electron tem-

perature probe as well as the usual photometers and spectrometers.

The data to be gathered will be neutral particle and ion compositions, ion and the natural gas temperature, information about the air-glow and the detection of thermal electrons and photoelectrons.

The satellite will weigh about 1,300 pounds and will carry a momentum wheel for stabilisation.

## SKYLAB PRELIMINARY RESULTS

So much data has been gathered on the second *Skylab* period of observation, that it will take some years to evaluate it all.

Perhaps the most consistent of the findings relate to the Sun. The better observation of the structure of the atmosphere of the Sun and in particular the great hole that has been found in the corona may unlock secrets far away from the Sun.

Recently Dr C. H. Barrow of the University of the West Indies has been trying a new correlation of micropulsations from the Sun and those observed in the radiations from Jupiter.

It could well be that the information returned from the Jupiter probe, which should be close to the planet on December 10th, will help to establish a positive result. The micropulsations have been known for some years but because of lack of data from the Sun the matter was only spasmodically reviewed.

The hypothesis involved is an important one for, though there have been a number of models evolved, all lack the sort of confirmation required to establish the facts.

## COMET KOHOUTEK

*Skylab* will have a special mission with respect to the comet *Kohoutek*. The next mission (*Skylab 4*) is the last in the projected series and begins on November 9th.

Seven of the existing instruments will be brought to bear on the comet and the astronauts will have with them a new far-ultraviolet camera. It should be possible to photograph the neutral hydrogen cloud which is estimated to surround the comet and extend to more than six million miles.

Initially the plans are for the *Skylab* mission to be completed by January 4th. It would be a pity if this could not be extended to January 14th to allow further observation. Such a unique opportunity to study the period immediately after the perihelion passage may never come again.

The best time to view the comet for Earth-based observers is at about 12.00 to 14.00 hrs, right ascension, in the morning sky near the area of the bright star *Spica*. This will be around December 4th.

# PE Sound Synthesiser 11

## KEYBOARD

By G.D. SHAW



THE article this month deals with the remainder of the electronics sited within the keyboard unit and details the divider system, the analogue memory or hold circuits, modulation amplifiers, envelope shaper/v.c.a.s and mixer. The overall system has been extensively redesigned to take maximum advantage of the greater versatility of the logarithmic v.c.o.s and with the aim of improving the live performance capability of the instrument.

### BLOCK SCHEMATIC

A block schematic arrangement of the keyboard unit is shown in Fig. 11.1 and the unit has been designed to accommodate a four-octave Kimber-Allen keyboard. The specified keyboard may be obtained through the Electronic Organ Constructors Society at 4 Lees Barn Road, Radcliffe-on-Trent, Nottingham NG12 2DS. The E.O.C.S are also able to supply the contact assemblies and mounting strips. The type of contact assembly required is the G.B.-2 paired contact unit, also by Kimber-Allen.

Although a four-octave keyboard is specified it should be made clear that smaller—or larger—units may be employed with no changes to the circuitry other than the adjustment to the number of divider resistors employed. With respect to the use of smaller keyboards, the E.O.C.S. have informed the author that they have a limited number of two-octave organ keyboards by Herrburger Brooks.

These are full sized timber keys faced with plastic and mounted on a hardwood frame. The keys themselves are in reverse colours with black naturals and white sharps, and although they will require to be sprung by the constructor, the additional work required is reflected in the attractive pricing of £5 per keyboard.

Reverting again to Fig. 11.1 it will be seen that the keying system is divided into two channels each channel having its own electronic assemblies and signal path. Signals from both channels join together in the final circuit, a simple virtual-earth mixer. The purpose of this arrangement is to allow a rhythm accompaniment and melody line to be programmed at the same time, channel 1 programmed by the upper 31 keys and channel 2 by the remainder.

The tuning arrangement allows the transition between the two channels to be musically consecutive. Spread apart by one or more octaves or the channels juxtaposed in terms of frequency with the 31 note channel providing a bass line to a treble channel 2. Since the combined effect of the tuning controls is continuously variable there are a number of intermediate possibilities such as channel 2 dupli-

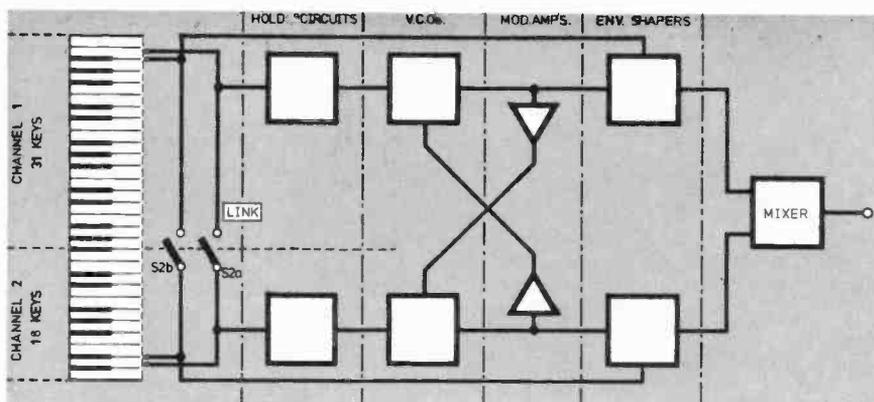


Fig. 11.1. Block schematic of keyboard unit

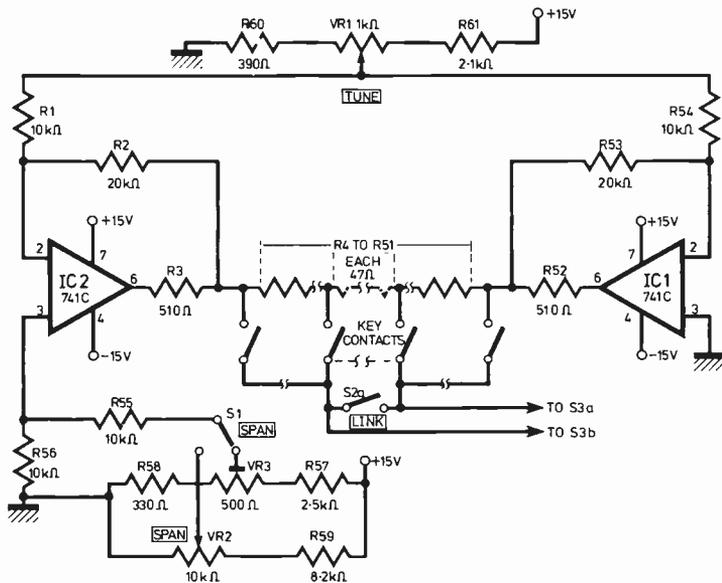


Fig. 11.2. Keyboard divider network

## COMPONENTS . . .

### DIVIDER

#### Resistors

- R1 10kΩ
- R2 20kΩ
- R3 510Ω
- R4-R51 47Ω (48 off)
- R52 510Ω
- R53 20kΩ
- R54-R56 10kΩ (3 off)
- R57 2.5kΩ
- R58 330Ω
- R59 8.2kΩ
- R60 390Ω
- R61 2.1kΩ

All 2% metal oxide

#### Integrated circuits

- IC1-IC2 741C (2 off)

#### Potentiometers

- VR1 1kΩ semi-precision wire-wound
- VR2 10kΩ midget moulded linear carbon
- VR3 500Ω cermet

#### Switches

- S1 s.p.c.o. miniature toggle
- S2 d.p.c.o. miniature toggle

cating sections of channel 1 or, in more bizarre terms, both channels programmed in different keys.

The programming voltage from the keyboard is led to a memory circuit which holds the last voltage entered until such time as a new voltage is programmed or until the hold circuits are grounded. The output voltage from the hold circuit is used to program its respective v.c.o. to the desired frequency which is then amplitude modulated in the envelope shaper/v.c.a. Triggering of the envelope shaper takes place each time a key is depressed in the appropriate channel and each envelope shaper is provided with separate attack and decay controls together with an additional percussive attack facility which may be switched in as desired.

Frequency modulation between oscillators may be achieved by means of the modulation amplifiers which have sufficient gain to swing the frequency of the v.c.o.s through the entire audio spectrum. Finally, a link switch is provided to enable both channels of the system to be programmed in parallel.

## THE DIVIDER NETWORK

Fig. 11.2 shows the theoretical circuit of the keyboard divider network in which resistors R4-R51 inclusive form the actual divider which is "floated" between the outputs of two operational amplifiers. The output of IC1 is coupled to the high frequency end of the divider and IC2 to the low frequency end. R60, VR1 and R61 together form an adjustable divider which is coupled to the inverting inputs of both i.c.s. Thus, by means of VR1, the main tuning control, the voltage on output of

the i.c.s may be swung through a range of rather more than 8 volts.

Since this latter effect will be equal at both ends of the keyboard it is necessary to apply an offset to one of the i.c.s in order that a voltage differential will exist across the divider chain. The offset is applied to the non-inverting input of IC2 through the medium of either one of two divider chains.

## SPAN FACILITY

R57, VR3, R58 provide what has been termed the fixed span facility with the preset VR3 having sufficient swing to enable the V/Octave range to be adjusted between about 400mV/octave to rather more than 1V/octave. R59, VR2 provide the variable span facility which is adjustable over a range of about 8.0V. The setting of VR3 is normally adjusted so that one octave width on the keyboard spans precisely one frequency-octave. VR2 on the other hand enables the frequency spread of one keyboard-octave to be varied between a fraction of a semitone (micro-tones) to several tens of semitones (macro-tones). The actual effect, in terms of frequency range, resulting from the swing on both VR2 and VR3 will depend very much on the requirements demanded by the v.c.o. as a result of the "Law Adjust" setting.

The exact value of the divider resistors R4 to R51 is not too critical except that they should be of sufficiently low a value so that the combined loading of the v.c.o.s does not cause a measurable change in the voltage at any point on the divider. Values between 10 and 60 ohms should meet all the necessary criteria. For best results, however, it is important that, whatever the nominal value of divider resistor chosen, the individual resistors are

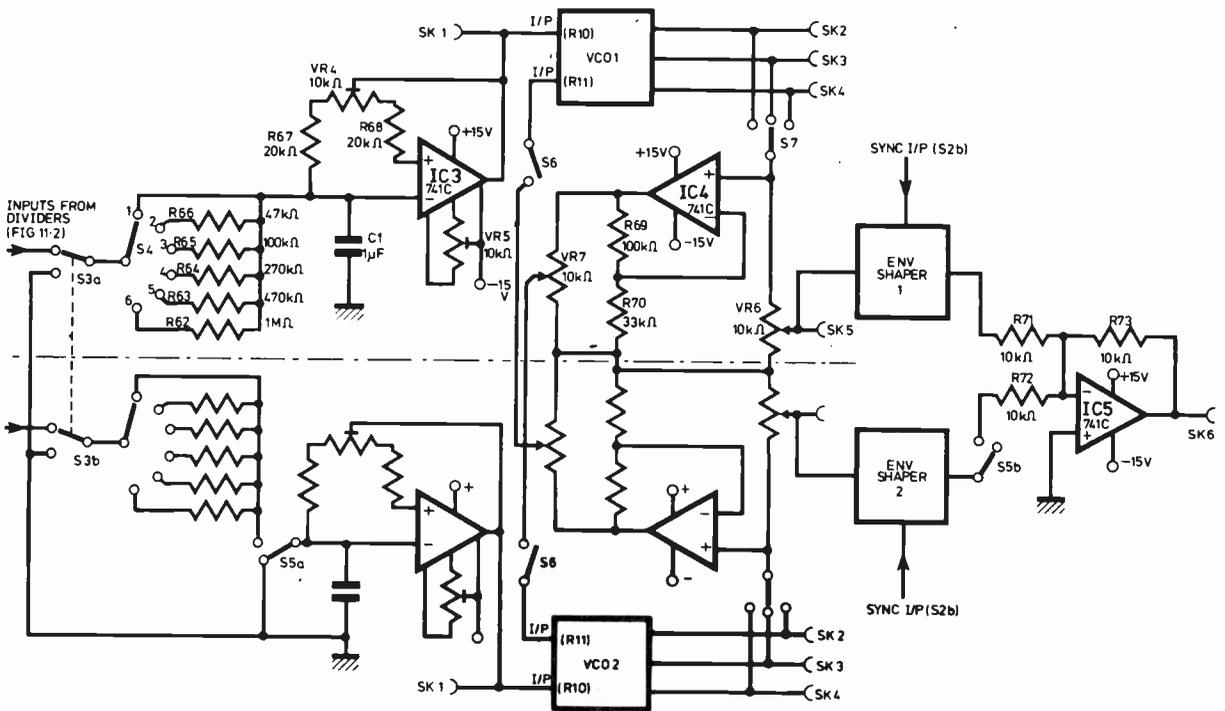


Fig. 11.3. Circuit of hold, modulation amplifier and mixer for both channels with v.c.o. interconnections. The component values for the mirrored hold and modulation amplifier circuits are identical

## COMPONENTS . . .

### HOLD CIRCUIT (2 off)

#### Resistors

R62 1M $\Omega$  5% carbon  
 R63 470k $\Omega$  5% carbon  
 R64 270k $\Omega$  5% carbon  
 R65 100k $\Omega$  5% carbon  
 R66 47k $\Omega$  5% carbon  
 R67 20k $\Omega$  2% metal oxide  
 R68 20k $\Omega$  2% metal oxide

#### Potentiometers

VR4-VR6 10k $\Omega$  15 turn cermet

#### Capacitor

C1 1 $\mu$ F 63V polyester

#### Integrated Circuits

IC3-IC4 741C

#### Switches

S3 2-pole 6-way  
 S4 d.p.c.o. toggle  
 S5 d.p.c.o. toggle

### MODULATION AMPLIFIER (2 off)

#### Resistors

R69 100k $\Omega$   
 R70 33k $\Omega$

#### Integrated Circuit

IC4 741C

#### Potentiometer

VR7 10k $\Omega$  midget moulded linear carbon

#### Switches

S6 s.p.c.o. miniature toggle  
 S7 2-pole 3-way

### MIXER

#### Resistors

R71-R73 10k $\Omega$  (3 off) 5% metal oxide

#### Integrated Circuit

IC5 741C

as closely matched to the nominal value as possible. It is particularly important that the ohmic value of any 12 consecutive resistors in the divider should be a close match with any other selection of 12 consecutive resistors.

The junctions between individual resistors in the divider are hard wired to the moving contact of their respective contact assemblies mounted below the keyboard, the fixed contacts being joined into two bus-bar units which can be joined by means of a link switch. A similar arrangement is employed for the second pair of contacts which serve to provide the sync pulse necessary for the envelope shapers.

## ANALOGUE MEMORY

The divider voltage resulting from the depression of any particular key is routed into the analogue memory circuits via S3 and S4 as shown in Fig. 11.3. The purpose of the hold circuit is to retain the last programmed keyboard voltage for sufficient time to enable the desired tone processing to be completed. For example, with S4 in position 1, the depression of a key is sufficient to cause C1 to become charged to the value associated with that particular key. At the same time a sync-pulse is routed to the envelope shaper which, if it is set to provide a rapid attack, will turn on the v.c.a. and allow the oscillator tone to be heard. If the envelope shaper is also set to provide a long decay, the oscillator tone will immediately begin to die away.

In operation the hold circuit utilises the common-mode rejection of the 741 operational amplifier to provide a very high input impedance. Positive and negative feedback are applied by means of R67 and R68 with VR4 serving to provide a balance between the respective levels of feedback to the inverting and non-inverting inputs of the amplifier. C1 is the reservoir capacitor and is coupled directly to the non-inverting input.

The input impedance of the circuit is given by the paralleled value of R67 + part of VR4, and R68 + part of VR4 times the open loop gain of the amplifier. Thus depending on component tolerances the input impedance can be anywhere within the range 250 to 2,500 megohms and since a 1.0 $\mu$ F capacitor is specified the leakage time constant of the network will similarly vary between 250 and 2,500 seconds.

## PORTAMENTO

When keyboard voltages are routed direct to C1 in the hold circuit the change in level of the charge on C1 is virtually instantaneous. However, if a resistance is interposed between the keyboard and C1 the rate of change of charge is inversely proportional to the value of the resistor. This provides a very convenient means of adding a portamento facility and R62-R66 are included for this purpose, being switched in as required by S4.

Portamento is the name given to the effect when the transition between two successive notes in a musical piece is accomplished in a gliding manner encompassing all the intermediate frequencies.

The nature of the hold circuit requires that the setting-up procedure be followed with great care

since any output offset voltage present will inevitably cause the holding ability of the circuit to wander. With VR4 in its electrical mid position, and with the wiper grounded, a 10 megohm resistor is connected between the output and inverting input of the amplifier. With power on, VR5 is then adjusted so that the output is precisely zero when observed on the most sensitive setting of the oscilloscope. When satisfied that the initial setting up has been correctly accomplished the circuit connections may be made as generally shown in Fig. 11.3 but omitting the connections to the v.c.o. and portamento resistors. With power on again, and observing the output of IC3 on the oscilloscope, apply about -6V transiently to the junction of R67 and C1. Careful adjustment of VR4 will result in virtually negligible drift and, in the prototype, it was found that a drift of 6mV/20 minutes was quite easily attainable.

The -6V charge on C1 during the setting-up procedure is also quite an important value since it will be found that the circuit will have a much greater degree of drift if the applied voltage is significantly higher or lower than this value. For this reason S5 is provided to ground the input of the hold circuit during switch-on or when the keyboard is "idling" for any length of time thus ensuring that the v.c.o. is not over or under driven.

The output of the hold circuit is routed directly to the R10 input of the v.c.o. the three output waveforms of which are, in turn, routed to a selector switch, S7.

## MODULATION AMPLIFIERS

The wiper of S7 is coupled to the v.c.o. level control VR6 and also directly to the non-inverting input of what has been termed the modulation amplifier. The output of the modulation amplifier driven by VCO1 is then routed to the R11 input of VCO2 through S6, a similar arrangement existing between VCO2 and the R11 input of VCO1.

The net result of this arrangement is that each oscillator can frequency modulate the other either separately or at the same time. Although simple in concept this system is capable of generating waveforms having very complex harmonic structures and is thus able to produce an enormously wide range of sounds and effects.

In the modulation amplifiers R69 and R70 set the gain at about 4.5 and VR7 provides a modulation depth control. S5a/b provide a means of turning VCO2 off in the sense that its input and output are isolated and its frequency controllable either by its own manual frequency control or by its associated modulation amplifier or both. The main purpose of this arrangement is to allow VCO2 to provide a vibrato modulation to VCO1.

## ENVELOPE SHAPERS

From the wiper of VR6 the v.c.o. signal is routed into a v.c.a. based on the MFC6040 which is, in turn, controlled by an envelope shaper triggered by depression of any of the keys on the keyboard. The working of the circuit shown in Fig. 11.4 is as follows.

IC1-TR1 represent a current amplifier/follower with overall feedback. The output at the emitter normally is +4.5V under quiescent conditions thus

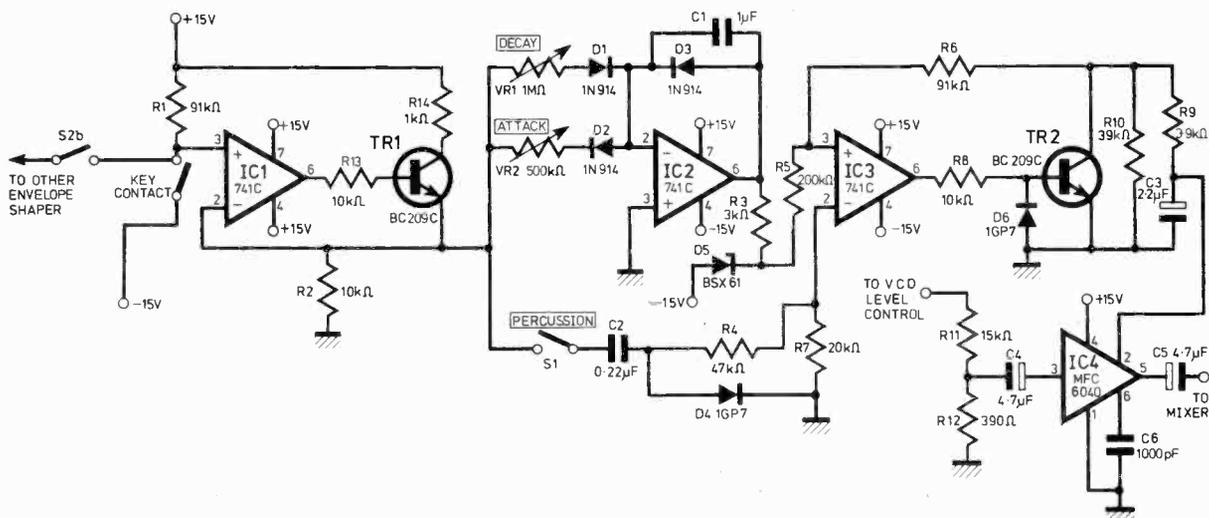


Fig. 11.4. Circuit of keyboard envelope shaper and voltage controlled amplifier

## COMPONENTS . . .

### ENVELOPE SHAPER (2 off)

#### Resistors

R1 91k $\Omega$	R8 10k $\Omega$
R2 10k $\Omega$	R9 3.9k $\Omega$
R3 3k $\Omega$	R10 39k $\Omega$
R4 47k $\Omega$	R11 15k $\Omega$
R5 200k $\Omega$	R12 390 $\Omega$
R6 91k $\Omega$	R13 10k $\Omega$
R7 20k $\Omega$	R14 1k $\Omega$

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

#### Transistors

TR1-TR2 BC209C (2 off)

#### Integrated Circuits

IC1-IC3 741C (3 off)  
IC4 MFC6040

#### Diodes

D1-D3 1N914 (3 off)  
D4 1GP7  
D5 BZX61 V Zener  
D6 1GP7

#### Capacitors

C1 1 $\mu$ F polyester  
C2 0.22 $\mu$ F polyester  
C3 2.2 $\mu$ F 35V tantalum  
C4 4.7 $\mu$ F 35V tantalum  
C5 4.7 $\mu$ F 35V tantalum  
C6 1,000pF polystyrene

#### Miscellaneous

S5 d.p.c.o. toggle, S7-4 pole 3 way rotary (2 required), VR6-10k $\Omega$  midget moulded carbon (2 off), 2mm miniature sockets (12 off), 1-4 octave keyboard, G.B-2 pair contacts (49 off) (see text), contact locating strip.

driving IC1 hard negative, or to  $-12.5$ V as determined by the divider R3-R5. With a negative input signal to the non-inverting input of IC2 the output of this device is also negative and TR1 is turned off. With TR2 off the control input of the MFC6040 rises to +6V and thus attenuates the audio input signal by about 77dB.

The application of a negative trigger pulse to the input of IC1 causes TR1 to turn off and the output at R2 to go to  $-15$ V. C1 thus discharges via D2/VR2 and the output of IC2 rises from  $-12.5$ V to about  $-4$ V. Under these conditions the non-inverting input of IC3 becomes positively biased, its output goes positive turning on TR2 which thus effectively short circuits R10 and causes the control voltage to IC4 to fall to about +4.3V. When the trigger pulse is removed C1 charges to a level again via D1/VR1 and the original situation is positive restored.

A separate percussive attack can be obtained by differentiating the trigger pulse to the envelope shaper by means of C2. The negative differentiated trigger pulse is applied to the inverting input of IC3 with the effect previously described except that in this case the magnitude of the pulse causes the v.c.a. control voltage to fall to +3.7V corresponding to an audio signal amplification of about 12dB. The percussive attack may be used on its own by advancing the trapezoid attack control to the slowest rate and playing the keys in a staccato manner. Alternatively the percussive attack may be mixed with the normal trapezoid control waveform or it may be switched out altogether by means of S1.

The audio signal outputs of the envelope shapers are led to a simple unity gain, virtual earth mixer shown in Fig. 11.3. The level of signal from each channel is controlled directly from VR6 on each of the oscillators.

**Next month: construction of the keyboard housing, wiring and tuning instructions. Details will also be given of a small p.s.u. which will enable the keyboard unit to be operated independently of the main synthesiser.**

# Strictly

by K. Lenton-Smith

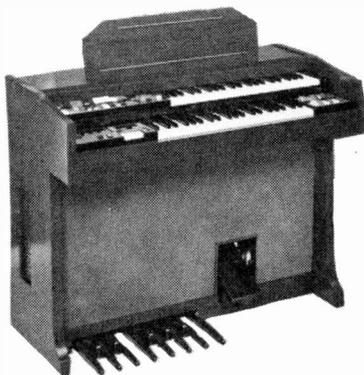
**S**TUDENTS of the Hammond organ can usually detect aurally which models use tone wheels and which use integrated circuits. The "Concorde", introduced over a year ago, was the first Hammond drawbar organ not to use tone wheels. Using L.S.I. techniques it is now possible to synthesise the unique sounds produced by these electromagnetic devices.

Another novel feature of this organ is the multiple derivative divider which divides down the 12 top notes to the sub-octave frequencies giving locked tuning.

Both of these features are also found in the "Regent" cinema type organ which was released recently from the same stable. An adjunct to both instruments is the Automatic Rhythm 3 unit which is unusual in that the waltz may be selected with any other pattern for a rhythm variation (such as waltz/cha-cha!).

## NOTHING NEW

There seems to be nothing radically new in the manufacture of electronic instruments at present. The various makers appear to be using integrated circuits wherever possible, having relegated the transistor to "slave" duty.



The Lowrey Venus Stereo with a.o.c. and a Genie supplying rhythm patterns

Though R/C oscillators are usually considered to be less stable than L/C oscillators, manufacturers are now using carefully designed R/C master oscillators—presumably to reduce weight and the possibility of interaction on small printed circuit boards. The Lowrey "Genie" uses this system.

Lowrey are transistorising their automatic orchestra computer circuit, which hitherto used a diode matrix. Unless you play a Lowrey, a.o.c. will not mean much, but the sound is probably unconsciously recognised by those that enjoy light music. Harry Stoneham began to broadcast regularly some six years ago and has been featured by Sam Costa, in "Breakfast Special" and on the Pete Brady Show: more recently, he has appeared in Michael Parkinson's programme. His distinctive sound is usually produced on a Lowrey with the a.o.c. in action, though Harry also plays Hammond with equal dexterity.

A.o.c. allows the performer to play a single note melody on the upper manual (at the selected pitches) which is automatically harmonised with any chord played on the lower manual. Whilst this feature was probably designed with the beginner in mind, the experienced player can produce breathtaking runs of chords. Left hand chords must be sustained when using a.o.c. as the harmonising facility is lost when the accompaniment keys are released.

## REVERBERATION

An electronic instrument played in a public hall may not need reverberation, though a crowd of people will absorb both reverberation and output power. In a small room with fitted carpets and curtains, the instrument will be dead without some reverberation. Adding echo makes the sound source seem to come from deeper within the speaker enclosure and gives a more natural effect.

Tape, delay lines or spring units may be used, the latter still being the

simplest. Some commercial spring units are too small and consequently produce short delay times, often with too much "direct" signal that can only be reduced by going to work on the circuit board.

It is possible to add reverberation to an existing installation without running to the expense of a further power amplifier if some care is taken. The main amplifier loudspeaker signal is tapped off and fed to the secondary of a small output transformer. It is a good precaution to put a 100Ω resistor in series with one lead to prevent robbing, and a small 6V lamp in series with the other to act as a current limiter. The primary winding of this transformer feeds the driver coil of a magnetic unit such as the Gibbs-Hammond.

The driven coil produces only a few millivolts and requires a pre-amplifier with a gain of about 50. It is a fairly easy matter to arrange a pair of BC109 transistors, directly coupled, to recover the signal. Small capacitors should be used at both input and output of this pre-amplifier. The base of the first transistor should be biased by means of a resistor from the emitter of the second transistor.

A 50kΩ potentiometer across the pre-amp output is suggested, with a T attenuator from the slider followed by 250pF before feeding into the main amplifier at a point after the main volume/swell control. The small capacitor tends to accentuate top response. Needless to say, there is some danger of howl due to feedback and the 50kΩ variable should be kept near minimum while setting up. Ideally, the spring driver coil should be fed from a push-pull driver amplifier, but the method outlined above will probably give sufficient echo for most needs, and it has the merit of simplicity.



The Hammond Regent

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- \* Calculates to 8 significant digits, with exponent range from  $10^{-20}$  to  $10^{79}$ .
- \* Clear, bright 8-digit display.
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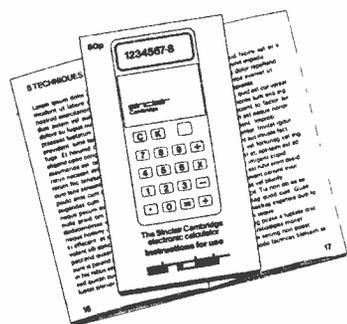
1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



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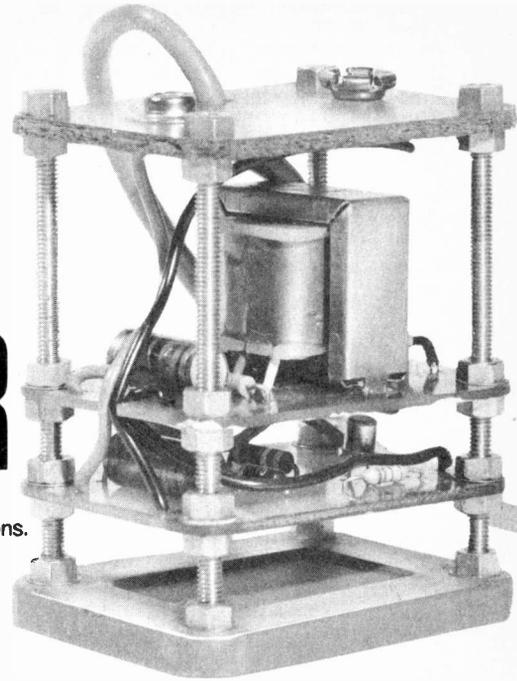
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PLEASE PRINT

# 9V BATTERY ELIMINATOR

BY A.M. RUDKIN B.Sc.(Eng.)Hons.



THERE are many battery operated transistor radios which are used almost entirely in the home, and with the rising cost of replacement batteries the question of a battery eliminator comes to mind. To the home constructor the thought of buying a ready-made unit goes against the grain, but it is not easy to achieve a professional finish in a home-made unit. Fortunately, the battery manufacturer provides us with an easily available case of exactly the right size. The current trend amongst manufacturers is to use a thin metal casing and a battery case of this type can be re-used quite successfully.

Most portable radios used in the home take PP9 batteries or an equivalent and this size is large enough to hold the necessary components to make the eliminator. With a component cost of about £1.50p the unit will pay for itself quite quickly and, of course, the eliminator can easily be removed whenever battery operation is required.

## CIRCUIT DESCRIPTION

As can be seen from Fig. 1, the circuit of the battery eliminator is relatively simple, but despite the simplicity the unit delivers a regulated output voltage and provides protection against overloading or short circuits.

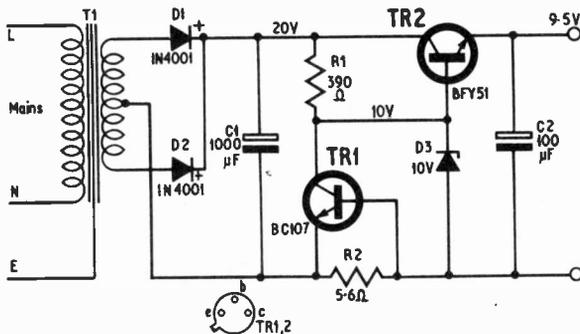


Fig. 1. Circuit diagram of the 9V Battery Eliminator

A miniature mains transformer with a centre-tapped secondary feeds a full-wave rectifier. The reservoir capacitor, C1, smooths the rectified output before it is applied to the series regulator circuit. A 10 volt Zener diode, D3, provides a fixed base voltage to transistor TR2, which in turn provides a fixed output voltage of about 9.5 volts at low impedance.

A second transistor, TR1, provides current limiting protection since its base-emitter junction is connected across a current sensing resistor, R2.

When the current flowing through the resistor exceeds 100mA the transistor begins to turn on and reduces the voltage across the Zener diode thereby reducing the output voltage so that even under short circuit conditions the current through the series regulator never exceeds a safe value.

## COMPONENTS . . .

### Resistors

- R1 390 Ω
- R2 5.6 Ω } ±10% ¼W carbon

### Capacitors

- C1, C2 100µF 25V elect. (2 off)

### Semiconductors

- TR1 BC107
- TR2 BFY51
- D1, D2 1N4001 (2 off)
- D3 10V 400mW Zener

### Transformer

- T1 Mains primary, 14-0-14 50mA secondary (Henry's type MT991)

### Miscellaneous

- Printed circuit board, 4BA studding, mains cable, nuts and washers, old PP9 battery case, interconnecting wire

The graph in Fig. 2 shows the way the output voltage varies with load current and the rapid drop in voltage as the current approaches the 120mA limit can clearly be seen.

An electronic "fuse" of this kind may seem a luxury but in fact it costs less than a fuse link and fuse holder whilst offering a high degree of protection. The simple regulator used in the battery eliminator is quite adequate for use with radio receivers and the ripple on the output is low enough not to cause any audible hum in the radio loud-speaker.

### MOUNTING COMPONENTS

The electronic components are mounted on two small boards which are supported by screwed rods and it is recommended that printed circuits are used. Dimensions of the boards and the track layouts are shown full size in Fig. 3 and Fig. 5. If facilities for making printed boards are not available then as an alternative 0.1in matrix board (without copper strip) may be used with point to point wiring.

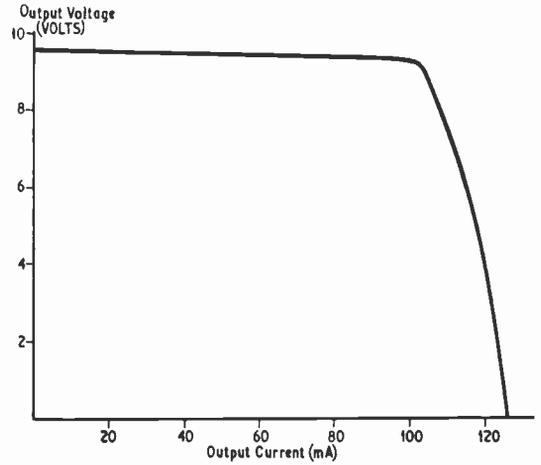


Fig. 2. Graph showing the variation of output voltage with current. The fall off at 100mA is due to the current limiting effect of TR1

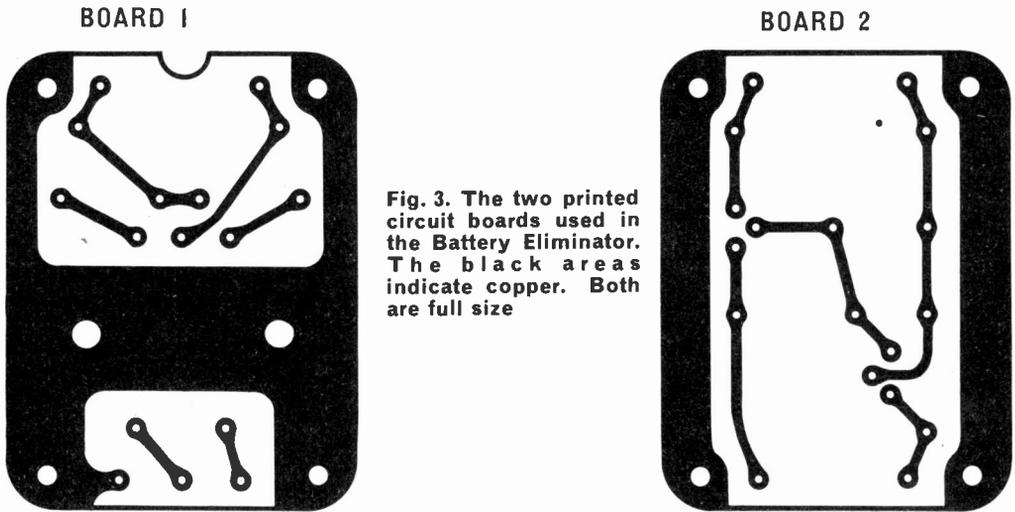


Fig. 3. The two printed circuit boards used in the Battery Eliminator. The black areas indicate copper. Both are full size

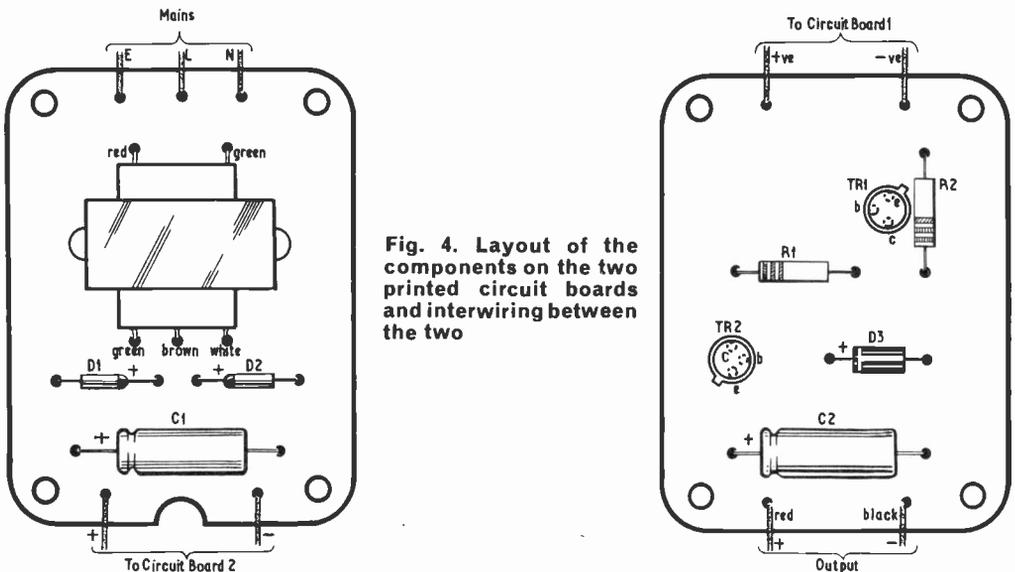
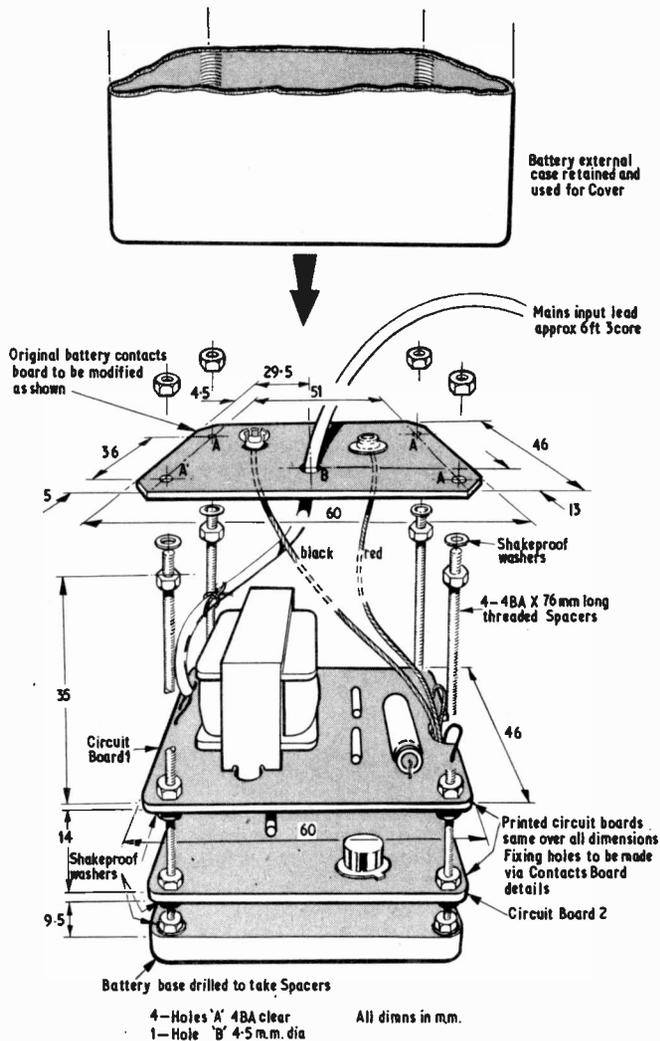


Fig. 4. Layout of the components on the two printed circuit boards and interwiring between the two



**FIG. 5  
EXPLODED  
VIEW**

Before mounting the mains transformer onto the printed circuit board shorten the leads to about  $\frac{1}{2}$  in and strip the sleeving back to expose  $\frac{1}{4}$  in of the wire. Mount the transformer on the board and bend back the fixing lugs to hold it securely in place. Fit the other components and interconnect the two boards as shown in Fig. 4.

Temporarily connect a mains lead and, as a safety precaution during testing, cover the mains connections with self adhesive p.v.c. tape. Apply the mains and check that the output voltage of the regulator board is approximately 9.5 volts. A voltage very different from this value indicates a fault condition and the voltages indicated on the circuit diagram (Fig. 1) may be used to aid in fault finding.

### USING AN OLD BATTERY CASE

It is quite easy to take a battery apart, but some care should be taken in order that the casing may be re-used. The battery should not be so old that the cells have started to leak or the case may be damaged.

In the battery used for the prototype the bottom plate was made of plastic and was held in place by

the metal jacket which was folded over the rim of the plate. This fold was carefully straightened by bending back the metal with a small pair of pliers. After this the contents of the battery can be removed by pressing the top plate of the battery downwards.

The six cells are, of course, no longer required, but the other parts should be kept. Contact between the cells and the top plate with the "snap" connectors is by a thin piece of brass strip and a spring contact. Cut off the brass strip and remove the piece of cardboard which separated the top plate from the cells by cutting around the contacts with a knife blade.

Drill holes in the top and bottom plates in accordance with the dimensions given in Fig. 5. The hole for the mains lead is drilled in the top plate only.

### ASSEMBLY

When the boards are functioning correctly they can be assembled onto the screwed rods. The distances between the boards and the plates are shown

*continued on page 1097*

# 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.

## TRACE DOUBLER FOR TTL COMPATIBLE SIGNALS

THE diagram in Fig. 1 shows a circuit for a trace doubler, which displays the time relationship between two series of pulses.

Gate G1 and its associated diode plus two resistors and capacitor form a clock generator with a mark to space ratio of 1 to 1. Gate G3 provides an inverted clock waveform. One input of G4 is the signal input, "A". One input of G5 is the other signal input, "B". The other input of G4 is connected to the output of G3, the inverted clock. The other input of G5 is connected to the output of G2, the true clock.

These two clock signals are always the opposite of

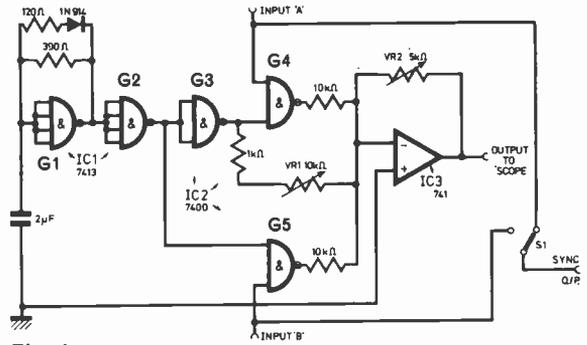


Fig. 1

each other, thus gates G4 and G5 are alternately enabled or disabled. Any output from G4 or G5 is fed to the summing junction of IC3, via a 10kΩ potentiometer and a 1kΩ resistor. The operational amplifier combines the signals and feeds them to the oscilloscope to be displayed.

The idea behind the operation of this circuit is that any signal information from input "A" is added to a constant voltage, the inverted clock and is then displayed below the trace for input "A".

The 10kΩ potentiometer VR1 varies the separation between the traces and VR2 in the operational amplifiers feedback path controls the overall gain of the instrument.

C. Nicol, Brixton, S.W.9.

## SIMPLE VARIABLE-DELAY PULSE CIRCUIT

VARIABLE delay time on a repetitive pulse is frequently required, particularly in those applications concerning transient phenomena. A simple, low cost, and easily constructed electronic circuit is described which enables continuously variable delayed times in the range 10µS to 80mS to be achieved.

The circuit, shown in Fig. 1, consists of two monostables, the first providing the controlled variable delay time and the second giving the delayed output pulse. The master pulse to be delayed is first differentiated by the R1C1 network. The negative-going spike obtained from this network is then used to turn the first monostable over. The turn-over period is given by:—

$$T = 0.7 VR_1 \times C_{2, 3, \text{ or } 4}$$

The positive pulse from the collector of TR1 is fed into the second monostable via another differentiating network. Again the negative-going spike turns the monostable over and a rectangular pulse can be taken from the collector of TR3.

A negative output pulse could be taken from the collector of TR4, but it would be of poor shape due to capacitance C7 charging up via the load R8 in the collector of TR4.

By both making VR1 variable from 100Ω to 10kΩ and by selecting the C2, C3, C4 capacitors having fixed values of 0.1, 1.0 and 10µF a continuously variable delayed output pulse in the range 10µS to 80mS has been obtained.

The delayed times are measured from the negative-going edge of the master pulse. Both shorter than 10µS, and

longer than 80mS can be obtained by suitable choice of the passive components VR1 and C2, C3, C4.

The minimum width of the output pulse is 2µS. This is varied using VR2 (100Ω to 10kΩ) and C7 (4000pF).

The sum of the delayed time and the pulse width must, of course, be shorter than the periodic time of the master pulse. The rise and fall times of the output pulse are respectively, 25 and 30nS.

The delay times of the present circuit have been calibrated against a standard time marker and found to be both reproducible and reliable.

Drs. R. Hackham and P. Johnston  
University of Sheffield.

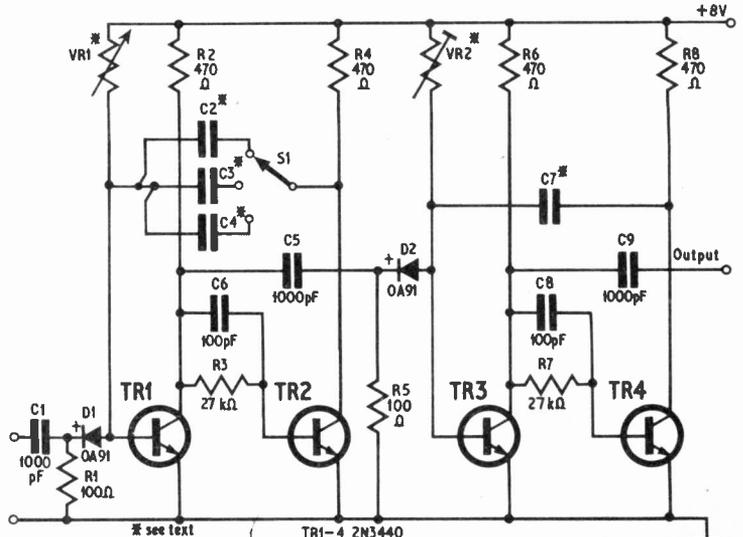
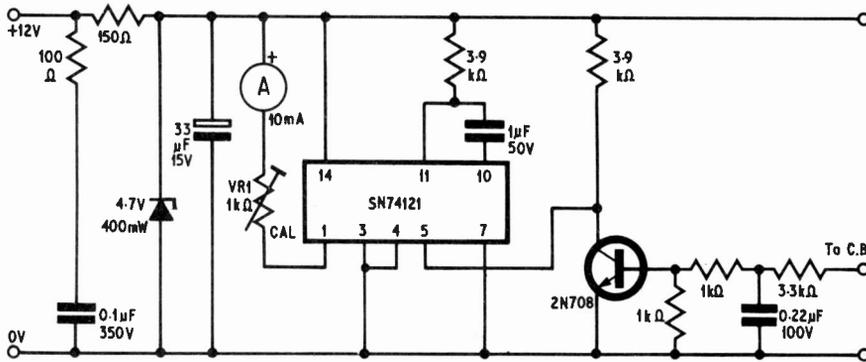


Fig. 1. Simple variable-delay pulse circuit

## SIMPLE TACHOMETER



THE CIRCUIT of a tachometer shown in Fig. 1 is based on the integrated circuit SN74121. This is a monostable device available for under 50 pence.

The circuit can be adapted for a wide range of meters up to 10mA f.s.d. by simply connecting a resistor in series with the meter if required. Initially the design was made for a 12V system but providing the 150Ω series dropper is altered there should be no difficulty in adapting for other voltages.

The timing components are the 3.9kΩ resistor and 1μF capacitor connected to pins 10 and 11, and the capacitor should preferably be a reasonable quality non-electrolytic type.

Meter movement at very low frequencies may be countered by connecting a capacitor across the meter but a good movement should not need this.

Calibration is *via* VR1 preferably against a pulse

**TABLE 1:**  
Calibration Frequency corresponding to 1,000 r.p.m.

No. of Cylinders	2-stroke	4-stroke
	frequency	
1	16.7Hz	8.4Hz
2	33.4Hz	16.7Hz
3	50Hz	—
4	—	33.4Hz
6	—	50Hz
8	—	67Hz

generator of reasonable accuracy. Calibration frequencies are given in Table 1.

C. J. Nother,  
Portsmouth, Hants.

## SCREENWASHER TIMING UNIT

THE device to be described operates the electric screenwashers of a car for a period of up to 10 seconds after a single press of the switch so that one hand does not have to leave the steering wheel for more than a second or so.

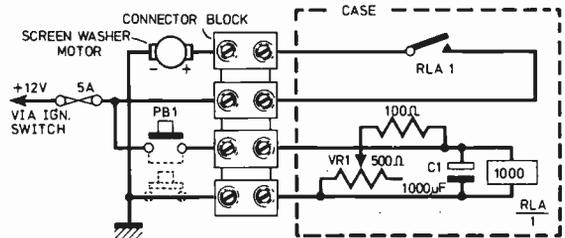
Only two main components are used, a relay and a capacitor, and from Fig. 1 it can be seen that when the washer control button is pressed, C1 is immediately charged up to the full 12V battery voltage and discharges over a period of 10 to 15 seconds through the coil of RLA so closing the contacts RLA1 and operating the washer pump motor.

As C1 discharges through the relay, the current eventually falls to below the hold-in value for the relay, contacts RLA1 separate and the pump stops.

VR1 is used to set the operating time of the pump motor. By filing the copper rivet on the armature flat with the face, the hold-in time can be slightly increased and also has the advantage that the relay drops out suddenly so preventing arcing of the contacts which might occur if they separated more slowly.

The relay used is a PO 3000 type with a 1,000Ω coil with all the contacts removed except for one pair of "make" contacts to increase sensitivity, though if a second pair was fitted combined wash and wipe with "one shot" operation could be achieved.

The can of C1 should be completely insulated before mounting, using p.v.c. tape or tube and the



**Fig. 1. Arrangement of the screenwasher unit**

complete unit should be mounted in a closed steel case in a dry spot away from exhaust pipes. The prototype has functioned perfectly over 1,000 miles with no maintenance being required.

The circuit shown is for 12V negative earth systems. For positive earth the connections to C1 and the washer pump motor merely need to be reversed.

The dotted lines in Fig. 1 show a slight modification which is necessary where the existing switch operates the original washer circuit by shorting one side of the motor to earth, the other side being permanently live, as is often found in the horn circuit.

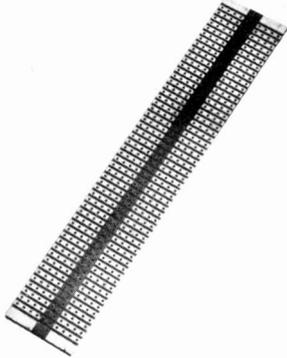
In both cases, connection to the supply should be *via* a 5A fuse to a "live when on" part of the ignition switch or terminal A4 on the fuse box.

A. Calder,  
Leigh, Lancs.



# VEROSTRIP

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## 6 WATT STEREO AMPLIFIERS

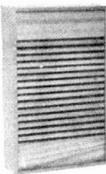


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**PARTRIDGE MAINS ISOLATION TRANSFORMER.** Pri: 105-250V, 6V steps, Sec: 240V, 13 amps. £18, carr. pack. £1-50.

**FARNEKO MAINS TRANSFORMER** Isolated windings. Pri: 200-250V. Sec: 90-120V at 4.5 amp., £4, carr. pack. 75p.

**GARDNER'S POTTED TRANSFORMER, 0-250V.** Pri: 200-250V. Sec. Input: 18V 500mA, 50V 150mA, 6V 250mA output. Size: 3in x 2 1/2in x 2 1/2in, £1, p.p. 25p. Ex equip. tested.

**RIPLEY MAINS TRANSFORMER.** Pri: 110V-240V, Sec: 12-5V: 0.12-5V 750mA/4 7V:0.7 1VIA, £1, p.p. 25p.

**MAINS TRANSFORMER.** Pri: 100-250V, Sec: 22:0-22 200mA, 22:0-22 100mA/4 0:24V 20mA/4, 80p, p.p. 25p.

**MAINS TRANSFORMER.** Pri: 230V, Sec: 14V, 120 amps. £15, p.p. £1-50.

**MAINS TRANSFORMER.** Pri: 100-240V a.c. 35-5-0-35-5V, 27 mA/A, 0-21-5, 260 mA/A, 80p, p.p. 25p.

**TRANSISTOR OUTPUT TRANSFORMER.** Ratio 8:1, 150mH. Centre tap 2 watts. output, 80p, p.p. 8p.

**SMOOTHING CHOKE, 11mH, 1 1/2in x 1 1/2in x 1 1/2in.** 80p, p.p. 8p.

**FINNED ALUMINIUM HEATSINK, 4 1/2in x 8in x 1in, 2 x 2N3055, £1, p.p. 13p.**

**GOODMANS 8in SPEAKERS 3 Ω £1-50, p.p. 28p.**

**FINNED ALUMINIUM HEATSINK. 9in x 8in x 1 1/2in. In C.: 4 x 2N3055, £2, p.p. 29p.**

**GARRARD MAG. TAPE DECKS:** 1 1/2in.p.s., 50V, solenoid operated brakes, etc. Mains voltage motors £7-50 each, p.p. 60p.

**MOYET 3 speed tape deck (1 1/2in x 3 1/2in x 7 1/2in)** reel to reel 7in mains operated, £7-50, p.p. 63p.

**10 REED SWITCHES** operated by push buttons and magnets, 60p, p.p. 25p.

**COMPONENT PANEL, 6 scr's (300V, 1-6A) 6 cond., 15 resistors, 6 diodes, 45p, p.p. 8p.**

**COMPONENT PANEL, 6 scr's (200V 4 amps), 6 condensers, 12 resistors, 30p, p.p. 8p.**

**COMPONENT PANEL (9 ICs FJH131) (1-CA300), 1 crystal 7-68kHz + various other components, £1, p.p. 8p.**

**COMPONENT PANEL, 2 x 500mF 50V, 3 x 100mF 25V, cap. 1 x 2N2812, 2 x 2N404, 3 diodes plus various other components, 10p, p.p. 9p.**

**COMPONENT PANEL, 24 0A81 diodes, 10p, p.p. 8p.**

**VEEDED ROOT ELECTRICAL IMPULSE COUNTER NON-RESETABLE, A.C. 200-250V, £1-10, p.p. 13p.**

**6EC MAINS CIRCUIT BREAKERS, 2 amp or 3 amp, £1 each, p.p. 14p.**

**LEVER ACTION P.O. 1000 TYPE SWITCHES** Lock 4-pole changeover, 15p, p.p. 4p. Ex equip. Lock 2-pole changeover, 10p, p.p. 4p. Ex equip.

**MULLARD & MALLORY SCREW TERMINAL CAPACITORS 4,500µF 64V, 1,100µF 40V, 50p each. 20,000 30V, 25,000 25V, 35,000 15V, 30p each, p.p. 21p.**

**MULLARD FULLWAVE RECTIFIERS** 6-48V, 15 amp, 75p, p.p. 10p.

**BELLING LEE 1-5 amp in-line rubber covered interference suppressor, 25p, p.p. 8p.**

**RUBBER 3 PIN 5 AMP NON-REVERSIBLE CABLE CONNECTORS, 20p, p.p. 5p.**

**SOLENOIDS 12 VOLT PULL ACTION** 2in x 1in x 1in, 40p, p.p. 8p.

**SOLENOIDS 12-24V d.c. pull action 1 1/2in x 1 1/2in x 1 1/2in, 40p, p.p. 5p.**

**SOLENOIDS 240V a.c. pull action 2 1/2in x 1 1/2in x 1 1/2in, 50p, p.p. 9p.**

**BANGALOW WESTON TIME LAPPED METER** Mains operated. 1 1/2in x 1 1/2in x 2in, £1-50 p.p. 7p.

**ARROW RELAY, 240V a.c. coil, double pole change over, 1 make contact's 10A, 240V a.c., 25p, p.p. 9p.**

**OMRON MK2 MIDGET POWER RELAY, 12V d.c. Double pole changeover. New, 70p, p.p. 5p.**

**ETC VARLEY, miniature relays 700 Ω, 17-5-37V, persex cover, 4 pole changeover, 40p, p.p. 5p.**

**POTTER BRUMFIELD 12V d.c. 3 pole changeover with base, contacts rated 7A d.c., £1, p.p. 10p.**

**I.T.T. LOW PROFILE RELAYS. 4 pole c/overs. 600 Ω 12-18V, 75p, p.p. 5p.**

**MAINS RELAYS, 200-250V a.c. 2 makes. Heavy duty contacts, 50p, p.p. 7p.**

**TELESCOPIC AERIALS** Chromed 7in closed, 28in extended, 6 section ball jointed base, 25p, p.p. 5p new.

**PRINTED CIRCUIT BOARD/19 ACY 19's 10 0A200 Diodes: 1 reed relay: 1 AZ 229 zener ass. capacitor/resistors. Power supply 22V, 250 mA d.c. Output 240V a.c., £1, p.p. 25p. Ex equip.**

**WIRING CABLE** Size-1-020. Various colours. 350yds, 60p, p.p. 28p.

**TAPE POSITION INDICATOR** Re-settable 3 digits, 30p, p.p. 5p.

All orders add 10% V.A.T.

**FIELD ELECTRIC LIMITED**  
3 Shenley Road  
Borehamwood, Herts.  
Tel. 01-953 6009

# 0442:62757

THE NUMBER FOR CLOCKS, LSI CHIPS, KITS & DISPLAYS.

Choose a combination from the tables below. get out your Access card and ring the above number, or send us a cheque, MO, PO, etc.

BYWOOD for ADVICE, SERVICE and of course COMPONENTS.

Clock Code	12/24 Hour	4/8 Digit	BCD out	7seg out	MPX'd	1Hz out	AM/PM	Alarm	Date	Snooze	Sleep	Ph Cnt	INTERFACES						Interface Key	Availability	PRICE	
													TIL360	DL34	DL707	DL62	DLG12	TA8055				Drive Volts
MM5311	Y	Y	Y	Y	Y							28	D	D	T	T	-	11-49	8		Stock	11.50
MM5314	Y	Y	Y	Y	Y							24	D	D	T	T	-	11-49	8	δ Days	11.00	
MM5316	Y	4	Y	Y	Y	Y	Y	Y	Y	Y		40	-	-	L	D	K	8-29	4		Stock	16.00
5017AA	Y	6	Y	Y	Y	Y	Y	Y	Y	Y		24	T	T	T	K	-	11-18	16		Stock	14.00
5017BB	Y	6	Y	Y	Y	Y	Y	Y	Y	Y		24	T	T	T	K	-	11-18	16		Ltd	14.00
CT7001	Y	6	Y	Y	Y	Y	Y	Y	Y	Y		28	T	T	T	D	-	11-18			Feb74	18.00

Display Code	Type	Pack	Digs	Digit Size	Drive Req.	Common	Digit Cost £	Unit Cost £
TIL360	LED	16 DIL	6	0.1ins	2v 10mA	Cathode	2.50	15.00
DL707	LED	14 "	1	0.3ins	3v 30mA	Anode	2.00	2.00
DL34	LED	14 "	4	0.1ins	5v 10mA	Cathode	2.50	10.00
DL62	LED	16 "	1	0.6ins	6v 30mA	Anode	6.50	6.50
DG12H	Phosphor Diode.	TUBE	1	12.5mm	25v 1mA	Htr Anode	2.00	2.00
TA8055	Liq.Crys.	EDGE	4	0.6ins	30v 125uA (A.C.)	N/A	3.25	13.00

Sockets - 24 or 28pin 115p, 40pin 135p. Case - Warm red Perspex 250p.

Kits 5017AA or BB + PCB + socket + 4 DG12s + Instructions £24.  
MM5316 + " + " + TA8055 + " £32.

CLOCK DATA SHEETS - SAE. ADVICE - PHONE 0442-62757 CATALOGUE 15p  
POST & PACKING - 10p. OVERSEAS (AIRMAIL) 50p. VAT - ALL PRICES EXCLUDE VAT.  
PAYMENT C.W.O. or ACCOUNT. ACCESS. ORDERS & PAYMENT BY PHONE ACCEPTED.  
QUANTITY DISCOUNTS ON MOST ITEMS - STATE REQUIREMENTS FOR QUOTATION.

# BYWOOD

Bywood Electronics  
181 Ebbwens Road  
Hemel Hempstead  
HP3 9RDB

## MAINS NEON FLASHER

THIS is a circuit which I have developed to remind you to un-plug mains appliances as well as switch them off. The neon glows when the appliance is switched on and flashes when it is switched off until it is unplugged.

With S1 (on/off switch of the appliance) closed (see Fig. 1) the neon lights, R2 dropping the mains voltage to the firing voltage of the neon. With S1 open C1 charges via R1 until it reaches the firing voltage of the neon and then discharges through it, thus making it flash until S1 is closed or the appliance is unplugged.

With such devices fitted to all appliances, a quick look round the room last thing at night will tell you that they are all off and unplugged.

M. J. Maynard,  
Wednesbury, Staffs.

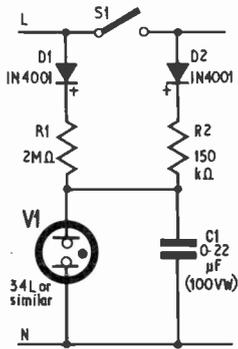


Fig. 1. Circuit diagram for the mains neon flasher

## 9V BATTERY ELIMINATOR

continued from page 1092

in Fig. 5, although the dimension between the connector plate and the mains transformer board may need to be varied slightly to ensure a snug fit inside the battery casing.

Before fitting the connector plate pass the output leads of the regulator board through the slot in the mains transformer board and solder them to the contacts. The plain contact is positive and the castellated contact is negative (on some modern batteries the castellated contact has been replaced by a split contact).

Pass the mains lead through the hole in the connector plate and fit the plate onto the rods. Using p.v.c. lacing cord or thin p.v.c. sleeving, tie the mains lead tightly to one of the screwed rods to prevent the soldered joints being stressed.

The length of the screwed rod is 3in where the battery has a plastic bottom plate, but a slightly longer rod will be needed if a different bottom plate is fitted. The rod is normally supplied in 3ft lengths and can be sawn very easily with a "junior" hacksaw.

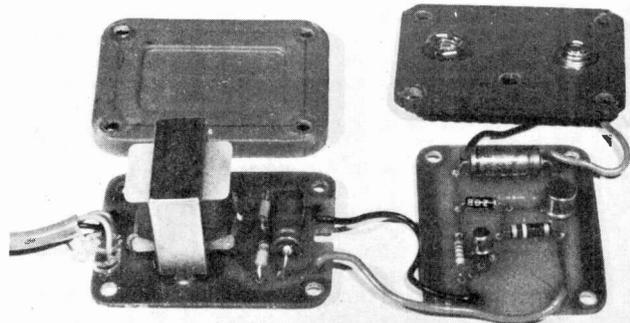
One "trick of the trade" when sawing threaded rod is to thread a nut onto the length to be sawn. After cutting and deburring with a file the nut can be removed and this will automatically re-form the thread on the cut end. This simple procedure saves a good deal of time and temper.

### FINISHING OFF

When the power supply assembly fits the battery case satisfactorily the ends of the brass rod may be filed down level with the tops of the nuts. Finally fit the unit into the case ensuring that "+" marking on the case is closest to the plain contact and carefully re-fold the casing over the bottom plate.

The battery eliminator can then be fitted into the portable radio in place of the normal battery although a slot will need to be made in the radio casing to allow for the mains lead. On the few occasions that the radio is required as a true portable the mains unit can be removed and a battery inserted in exactly the same time as it would take to replace a flat battery. ★

Photograph showing the two component boards and the end plates of the battery before mounting on brass studding



# VIEWPOINT

Sir—Am I alone in thinking that quadrphony (and indeed stereo) is a "con"—or at least an attempt by the industry to create a demand?

I remember several years ago an article in this or a similar magazine, reporting a Continental idea whereby the orchestra performed in the wide end of a large exponential horn—the audience obtaining the effect of hearing a live orchestra through a metre-square hole!

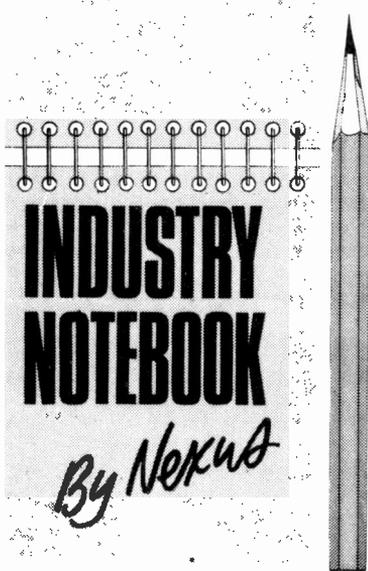
Now this seems infinitely more sensible to me than quadrphony.

Surely the fact that an orchestra, or a pop-group, is ten metres wide is irrelevant. If width is necessary *per se*, why not spread the musicians out more? In fact musicians have always stood as close together as possible. Why?

A group of musicians constitutes a certain size purely because human beings are the size they are, and similarly with instruments.

"Stereo" and "quad" are NOT analogous to stereo pictures. Surely it follows that the industry should be putting the effort into improved colour, stereo pictures instead of the absurdities of "quad"! The present colour T.V. picture is on a par with a washed-out, amateur transparency viewed through a 50p lantern.

E. Wadsworth,  
Huddersfield, Yorks



# INDUSTRY NOTEBOOK

By Nexus

## LIGHT FINGERS

Shop-lifting by well-heeled women in London's West End has been making the headlines. Not so well publicised is the wave of petty and not-so-petty pilfering in the electronic components industry since the upsurge in world demand created a component famine.

As usual, the incidence of crime appears greatest in the United States. Few of the semiconductor manufacturers are immune and hardest hit, according to reports, is Signetics with over £40,000 of goods mysteriously disappearing. Fairchild has also been hit.

It's not only straight pilfering that's worrying the industry. Huge quantities of below-standard products have been hived off onto the market at give-away prices in recent years and many of these are now re-appearing freshly remarked and not necessarily with the original manufacturer's name. These are being bought in good faith and equipment manufacturers have found performance not up to scratch. Motorola has been one company receiving back for replacement falsely marked semiconductors. Over in the States, the police have been sleuthing away and some arrests have been made.

The racketeers have not confined activities to the USA. The very nature of semiconductor devices with their small size, light weight and high intrinsic value makes them a natural for shipping round the world and Bill Richardson, Chairman of Britain's Association of Franchised Distributors of Electronic Components (AFDEC) has warned the industry against dishonest brokers.

Members of AFDEC are bound by constitution to guarantee all products they sell and this is the best protection. Richardson quotes a case where a UK manufacturer disposed of a bulk quantity of sub-standard products 12 years ago which have recently re-appeared on the UK market through sources which can be traced back through Tel Aviv and Geneva. Buyers beware!

## DEFENCE BOOM

The Royal Navy Equipment Exhibition at Greenwich showed defence equipment manufacturers in good shape, technically and economically. Defence exports have been booming and climbing in value every year. In 1968-69 exports were £150 million, in 1972-73 they had climbed to £345 million and this year will top £400 million, about 40 per cent of all defence equipment manufactured in the UK.

The sales success of recent years owes much to the pioneer work of Sir Raymond Brown who resigned his Chairmanship and business interests in Racal Electronics to become the first Head of Defence Sales in 1966. Present Head of Defence Sales is Sir Lester Sheffield.

The sales organisation does market research, organises exhibitions, assists industry with advice and generally smooths the path between initial enquiry and final sale. Even Royal Fleet Auxiliary vessels are pressed into use as floating exhibition centres. For the past three months RFA *Tarbatness* has been touring the Middle East and Far East on just such a mission.

## FIFTY YEARS ON

This has been a great year for Golden Jubilees marking the 50th anniversary of broadcasting and of many of the pioneering companies that sprang into existence to serve the needs of what was to become an industry in its own right. Of all the celebrations one of the cosiest, if not the biggest, was the informal party given by Eddystone Radio.

Although the company is now part of the giant GEC-Marconi complex, Eddystone's managing director Dick Carroll has managed to preserve the family atmosphere—perhaps not too difficult with so many of the staff having been around for more years than they care to remember.

Enough of the past. How is Eddystone shaping up to the future? Today's sets are all solid-state, modular, up-to-the-minute and selling well. Eddystone profits are buried deep in the corporate

accounts of the parent group but I can reveal that they are healthy in every way. Watch out for new models and an expanded component line in 1974.

## COMPUTERISED METROLOGY

Herbert Controls and Instruments Ltd. was formed in 1969 from three companies in the Alfred Herbert Group and started life with a 50-year background in measurement techniques stretching back to Sigma gas gauges, modern versions of which are still sold to the gas industry. But more recently HCIL moved into the field of mechanical inspection equipment and rapidly established a world reputation for solving difficult problems.

One of HCIL's most remarkable machines is the Sigmatrace designed specifically for inspection of the aerofoil profile of gas and steam turbine compressor blades. This was traditionally a skilled job which took a lot of time and involved lengthy written records which were passed to a blade polisher to iron out humps and hollows and get each blade right. The inspector would compare the workpiece under inspection with a perfect master.

Sigmatrace does the whole job in a minute, complete with a printed record of deviation. Moreover, no master blade is required because all the master profile information is fed into a computer store direct from the drawings. HCIL is doing a roaring trade world wide with this sort of electronic-based metrology and supplies most major automotive and aerospace manufacturers.

The chief engineer of HCIL, Dr. Colin Gaskell, sees computer-controlled gauging becoming really significant in engineering shops where more than 30 measurements are needed on a workpiece. When you get up to 80 measurements a computer is practically a necessity.

## DUCKS AND GROUSE

Mallard is dead—long live Ptarmigan. They are the code names for the army's trunk communications systems. Mallard died after endless discussion. Now Plessey has been appointed prime contractor for the new system, Ptarmigan, with Marconi and STC as sub-contractors. Initial contracts are worth £17 million but the project could lead to £100 million of business over the years.

I marvel at the wit of those who invent code-names. Mallard always seemed a dead duck. And if Ptarmigan doesn't come up to scratch, we'll have something to grouse about.

## Come home to this fine 8 track stereo system

Elegantly styled in teak finished cabinets with satin aluminium trims and controls.

Automatic and manual channel selection with at-a-glance illuminated track indicator.

Separate bass treble and volume controls for exact tone balance.

Full 5 + 5 watt rating from latest integrated circuit amplifiers.

Solidly built bookshelf speaker units house high performance elliptical loudspeakers.

The complete package including mains and speaker leads is ready to play in minutes.

# Quentronic



Price Incl. VAT, P & P

**£28.50**

Manufactured and distributed by  
Quentronic Ltd., 4-6 Mill Lane, Brighouse, Yorks. Telephone: 048 47 4837

## RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are:—  
 2 track record playback heads 50p each.  
 4 track record playback heads 79p each.  
 Erase heads are also available separately—2 track 38p—4 track 56p.  
 MV metal mounting slides 38p each.  
 2 track-heads already fixed on heavy mounting plate with shield £1.22.

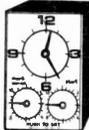


## DRILL CONTROLLER NEW IKW MODEL

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.

## MIGHTY MIDGET

Probably the finest possible radio, as described in *Practical Wireless*, January 73. All electronic parts £2.20 post paid.



## TIME SWITCH

Smith's mains driven clock with 15 amp switch, also notes showing how you can wake up with music playing, kettle boiling or come home to a warm house, warn off burglars, keep pets warm, halve your heating bills, etc. £1.95.

## I CHIP RADIO

Ferranti's latest device ZN414 gives results better than superhet. Supplied complete with technical notes and circuits. £1.98 each. 10 for £17.11.

## HI-Q TUNER COMPONENTS

For experimenting with the ZN414.  
 KIT NO. 1. Fleesky Miniature Tuning Condenser with built-in LW switch and 3in Ferrite slab and litz wound MW coil, 72p.  
 KIT NO. 2. Air spaced tuning condenser 6in ferrite rod litz wound MW and LW coils, 94p.  
 KIT NO. 3. Air spaced TC with slow motion drive 8in ferrite rod, with litz wound LW and MW coils, £1.10.  
 KIT NO. 4. Permeability tuner with fast and slow motion drive and LW loading coil, 50p.

## AUTO-ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete when fitting instructions and ready wired dashboard switch. £6.35 plus 25p post and insurance.

## TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7 1/2 to 47in. Hole in bottom for 6BA screw. 42p. KNUCKLED MODEL FOR F.M. 55p.

## EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc. It's so quiet it can hardly be heard. Compact, 5 1/2in casing with 5 1/2in fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets. £2.75 + 20p P. & P.



## MAINS OPERATED SOLENOIDS

Model 772 — small but powerful 1 1/2in pull—approx. size 1 1/2 x 1 1/2 x 1 1/2in. 68p.  
 Model 4001—1in. pull. size 2 1/2 x 2 x 1 1/2in. 88p.  
 Model 771—1 1/2in. pull. size 3 x 2 1/2 x 2in. £1.98 plus 20p post and insurance.

## 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: PF1, PF3, PF4, PF6, PF7, PF9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only £1.10. Plus 20p postage.

## DESK TELEPHONES

Ex G.P.O. Black standard model with dialing dial but no internal bell. Supplied with connection diagram at each. D150, with bell but without dialing dial £1.85. Model as illustrated with bell and dial £1.50 each plus 30p post for single then 65p per pair.



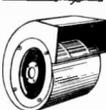
## SMOKE WILL KILL—GAS WILL KILL—FIRE WILL KILL

But, if you install SAGA (our smoke and gas alarm) your family will have the latest electronic protection against these killers. SAGA uses a fantastic electronic sensor which "smells" smoke and gas and sounds the alarm immediately, in a neat case measuring approx. 5in x 3 1/2in x 2 1/2in. It has its own internal alarm, also a connector for additional bells. You just plug it in to the mains and hang it near the ceiling. SAGA uses so little electricity that it will hardly move the meter, leave it on always to give night and day protection. One year's guarantee, also 7-day cash return offer, or kit of parts £5.99. Battery model kit only £4.99), £6.99 plus 30p post and service.



## CENTRIFUGAL FAN

Mains operated, turbo blower type. Pressed steel housing contains motor and impeller. Motor is 1/10th h.p. giving considerable air flows but virtually no noise. Approx. dimensions 10 1/2in wide x 12in dia. outlet into trunking 10 1/2 x 4 1/2in. £6.55 plus £1 post and insurance.



## STANDARD WATER SWITCHES

Standard size 1 1/2in water—silver-plated 5 amp contact, standard 1/2in spindle 2in long—with locking washer and nut.

No. of Poles	2way	3way	4way	6way	8way	9way	10way	12way
1 pole	44p	44p						
2 poles	44p	44p						
3 poles	44p	44p						
4 poles	44p	44p						
5 poles	44p	44p						
6 poles	44p	44p						
7 poles	44p	44p						
8 poles	44p	44p						
9 poles	44p	44p						
10 poles	44p	44p						
11 poles	44p	44p						
12 poles	44p	44p						

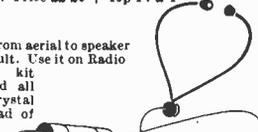
## THE TWENTYLITE

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.



## RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use on Radio TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2.20—twin stethos instead of earpiece 88p extra—post and ins. 20p.



## 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.

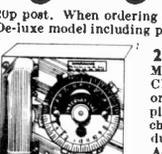


Room Thermostat made by the famous Smith's Company. 15 amp at 250V. Elegant white and beige case, size 4 1/2in long by 1 1/2in square approx. Adjustment is by slider (lockable), adjusts through range 30°-90°F. Special Snip price £1.65.

## CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version (*Practical Wireless*, June). Price £2.55 plus 20p post. When ordering please state whether for positive or negative systems. De-luxe model including printed circuit board, etc. £7.95.

## ELECTRONIC IGNITION



## 24-HOUR TIME SWITCH

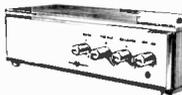
Made by Smiths, these are A.C. mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. Two completely adjustable time periods per 24 hours, 5A changeover contacts will switch circuit on or off during these periods. £2.75 post and ins. 25p. Additional time contacts 55p pair.

## PHOTO ELECTRIC KIT

Contains photo cell, relay, transistor and all parts to make light operated switch. £1.75 plus 20p post and ins.

## MULLARD UNILEX STEREO AMPLIFIER

We demonstrate these daily and almost always a sale results; it really is a cracking amplifier. Only Mullard with their know-how could have made it possible at this low price. SPEC. Mains operated. 4 watts music or speech per channel. Double wired power supply eliminates cross talk. Harmonic distortion less than 2%. Frequency response 50Hz-15kHz. Input suitable for pick up tuner or microphone. 6-month guarantee. Only £11.80 post paid. Optional extras—Cabinet £2.20. Extra front plate £1. Pair of 15 ohm speakers £3.30.



## NEW ITEMS THIS MONTH

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Rocker Switches. 15A Pritmac panel mounting, hole size 1 1/2in x 1/2in. Our ref R8 R5 price 11p each. 5A made by Mem, their type ref 1600, our ref R8 R6, price 11p each.

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Photo Transistor Bargain. First class maker but slightly reject, covered, however, by our normal six month guarantee, these respond to light or infra red. Will work a burglar alarm system, make detector counter, etc. Price £2p complete with three circuits.

Mains Flier. Braided, circular cotton covered, overall 8in x A (23-36) 100 yard coils. Price £2.75 plus 50p post.

Mains Contactor. This serves the same purpose as a treble pole relay but owing to the more robust construction and more positive action it is much more reliable and very suitable for heavy duty mains circuits, for example, where a thermostat has to control a large number of heaters. The contactor has four switches each in its own compartment separate from the others and each able to make and break 10A with complete safety. German made, these measure approx. 2 1/2in x 2 1/2in x 2 1/2in, price £2.20.

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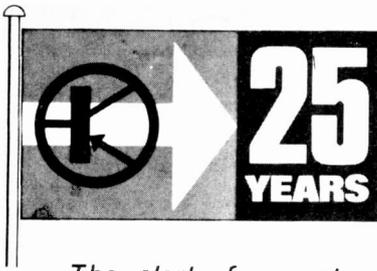
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# Transistors & Constructors

## By D. Bollen

*The start of a great revolution in home construction is recalled by a well-known contributor in this article, which brings to a conclusion our special series commemorating the invention of the transistor*

IN THE TYPICAL home electronics workshop of twenty-five years ago the enthusiast would be surrounded by machines for bending, punching, drilling, and rending asunder sheet metal. Constructional techniques were based upon the chassis, a box-like structure full of holes into which were inserted spindles, screws, valveholders, grommets, and trapped fingers.

Sometimes, when the burden of bashing metal became tiresome, a piece of easily punctured Bakelite might be pressed into service as a breadboard, but this was considered very unprofessional, a throwback to the days of coil winding, capacitor building, and generally doing it yourself.

Components came from two main sources; sturdy ex-government equipment which was cannibalised, sometimes with the aid of a hammer and cold chisel, and the "junk box" where reposed an amorphous heap of very second-hand items, ranging from a leaking electrolytic capacitor dated 1941 to a speaker grille woven to depict a scene of nymphs and satyrs dancing in a woodland setting. These were the lean years just after the war, with no oriental imports, kits of parts or regular sources of "bits".

Into this man's world of hot cathodes and 100 watt soldering irons was born the sub-midget transistor, and the wonder is that it managed to survive at all, let alone replace valves, which everyone said it would never do.



### A TOUGH TIME

Transistor manufacturers were having a tough time trying to fabricate the new device, probably because they were ham-fisted too. In any event, if you were fortunate enough to get hold of a sample in the early fifties it was likely to be one that everybody else had rejected, with a leakage current of two or three milliamps, a current gain of five, and dying from slow contamination.

Compared with a valve this was a pathetic thing indeed!

Assume that you were the proud possessor of a device no bigger than a resistor with three wires sticking out of it. Where did you go from there? Published information was scanty and far from standardised. Maximum ratings were mere hearsay. At the devaluation equivalent of £2 to £4 each, the safest policy was to power the device at the lowest voltage and current at which it was capable of supplying useful work.

As far as circuits went, which was not very far, there was a limited choice between the upside down, thread-in-a-maze American sort, or the UK variety which favoured the powering of each transistor in a multi-stage circuit by its own personal 1.5V cell.

Apart from earth symbols and batteries floating all over the page, there was also a general tendency for transistor symbols to be shown doing a base-down nose dive into the earth rail, this being the only way they could be made to function above 10kHz.

### GREAT DIFFICULTIES

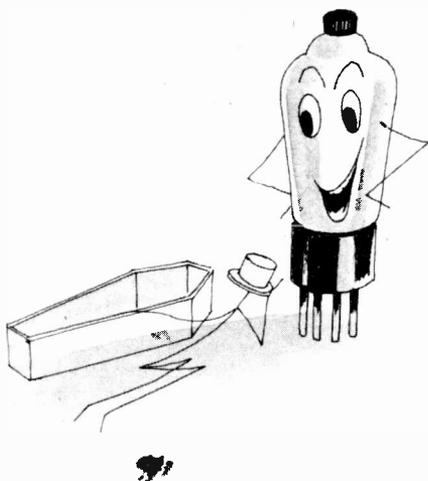
So, in the face of great difficulties you managed first of all to identify the leads on your transistor with an ohmmeter and then to find, or rashly devise a transistor circuit.

Were you supposed to solder the thing to a tag-strip, and mount the resulting assembly on the customary two acres of sheet aluminium? After all, we were here dealing with impedances of a very low order, for which electrolytic capacitors the size of milk bottles would have to be accommodated for coupling and decoupling purposes.

### DELICATELY SOLDERED

The delicately soldered transistor clings to its tag-strip. The scope (ex-government of course) displays a straight line on its axis. Several meters are linked to those parts of the circuit where a voltage or current might conceivably occur.

After inserting the power supply plug into the lowest voltage tap of a grid-bias battery . . . yes, we have oscillation!



True, it is but a crude imitation of what would normally pass as a sine wave from a valve circuit, but it is early days yet. A few more volts perhaps? Why is that meter reading creeping higher and higher? Should the transistor run hot? It has stopped oscillating.

"Grrr! They will never replace valves."

## AVAILABLE TO AMERICAN

The transistor was available to American enthusiasts for about \$18 in 1953. Over here, the ubiquitous OC71 and "red spot" transistors (the latter a polite name for manufacturer's reject) came on the scene in 1956 priced at 24/- and 10/- respectively. Full praise must be given to those suppliers who struggled to bring us the amplifying crystal less than eight years after its invention.

The silicon transistor also took only eight years to reach the home after being first manufactured in 1952.

More than one enterprising magazine contributor of the period went one better and gave full instructions for making a point-contact transistor from an old crystal diode, but the problem here was that an excess of audio signal or marital strife in the home could dislodge the triple catswhisker and thus degraded performance.

Another bright spark discovered that when the paint was scraped off the glass encapsulated OC71 it responded to light in the manner of a photo-transistor. The manufacturers quickly countered this cunning move by filling their transistors with opaque blue putty, labelling the clear putty variety OCP71 and charging more for it.

## NEST OF SNAKES

An innovation of the middle fifties was the transistor radio, which incorporated the new "nest of snakes" unrepairable printed circuit and the fragile ferrite rod aerial. Also at this point in time, the word "transistor" was press-ganged into common English usage to signify a radio receiver which could be employed to annoy people on beaches, and also render the user deaf in one ear by means of a simple unhygienic earphone.

The printed circuit defied all former rules of construction.

Components were held in position by solder alone, a practice which previously would have been considered very naughty. With the passing of the chassis, there was no longer anywhere to mount controls, and this caused quite a few headaches in constructional circles.

Eventually, it was tacitly agreed that serious projects would have their controls mounted on smart metal front panels, while silly projects could use sheet plastic or even wood. Alas, these attempts at standardisation failed miserably.

One breakaway group defiantly insisted on using metal tobacco tins for all projects, while another sect mounted their controls on the printed circuit itself! The latest trend seems to be to bung everything inside a transparent plastic cube or sphere and hope for the best, so confusion still persists.

## ADVANCED STAGE

Valve audio amplifiers had reached an advanced stage of development prior to the introduction of the "jump-a-groove" long-playing record in 1950, but with the coming of the difficult-to-tune f.m. radio in 1955, hi-fi purists were at last able to take time off to just sit and listen to the music, without having to bother about all that nasty distortion of former years.

Unfortunately, this idyllic state lasted only until 1961, when the easy-to-blow power transistor started to appear in output stages, accompanied by something called "the transistor sound".

This unusual effect was characterised by a rattling buzz from loudspeakers when gain controls were turned low. After a good deal of concentrated sleuthing, it transpired that transistor audio amplifiers were subject to crossover distortion, so the purists had to climb out of their armchairs and set about exorcising the demon with cabalistic circuitry.

Since then there has been no further opportunity to listen to music. Elimination of the output transformer led to severe difficulties in trying to match the then extant 15 ohm loudspeakers to amplifiers requiring a four to eight ohm load, and all problems were multiplied by two when stereo came along.

Now they are about to be multiplied by four.

## SURVIVE THE TRANSITION

What has the future in store for those who have managed to survive the transition from valve to transistor? Clearly, the introduction of a new device is often accompanied by unpleasant side-effects. For example, with i.c.s. we have already experienced circuits which are best understood if held upside down in front of a mirror, and the use of postal codes for device numbering is to be deprecated.

Above all, one thing is patently clear. A new device seems to take eight years to mature to amateur status. Furthermore, all information concerning a new device is automatically withheld for five years, or until it becomes obsolete, whichever period is shorter. So it follows that there is no need to get too agitated when a new device comes along, because the threat to one's peace of mind is not immediate.

NOTE: This last point is not quite true since it is the avowed object of PRACTICAL ELECTRONICS to ensure that the reader is informed of interesting developments as soon as possible. Indeed, the problem nowadays would be to avoid doing so—ED.



# PATENTS REVIEW...

## FUEL MONITOR

BP 1 320 039

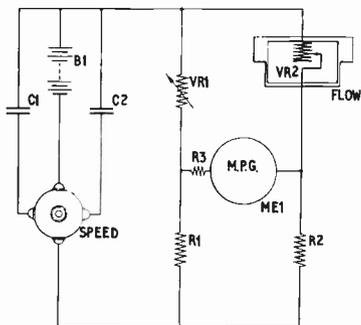


Fig. 1

With petrol likely to be very scarce or more expensive or both in future, devices for accurately measuring vehicle fuel consumption will become more popular.

In BP 1 320 039 Alan Westwood, Peter Davidson and Brian Dean describe and claim just such a device. The circuit Fig. 1 shows a vehicle speed measuring device, a flow meter to measure fuel rate of flow (and thus proportional rate of consumption) and an ammeter for reading m.p.g.

The meter is connected between opposite junctions of a Wheatstone bridge comprising VR2 (which forms part of the flow meter), R2, R1 and VR1 for pre-setting bridge balance. The use of R3 in series with the meter is only necessary with certain meters.

The opposite corners of the bridge are connected together by the vehicle speed measuring device. This includes a rotor geared to the vehicle transmission with brushes which alternately connect capacitors C1, C2 across the vehicle battery and discharge them through the bridge. The capacitors C1, C2 thus charge and discharge alternately to give a signal representative of the vehicle speed.

The flow meter will generally be in the form of a chamber with inlet and fuel outlet pipes and a bellows-type diaphragm. Fuel passing to the engine flows through the chamber to compress the diaphragm in dependence upon fuel flow rate. As the diaphragm is compressed, the value of VR2 resistance is varied by movement of the slider over its track. The value of VR2 resistance is in practice an inverse function of the fuel flow rate.

The reading given on the meter is approximately proportional to an arithmetical relationship between the two signals controlled respectively by the flowmeter and the speed measuring device, being approximately proportional to the current received from the rotor of the speed measuring device multiplied by the imbalance of the bridge circuit due to the flow meter. This reading represents an indication of distance travelled by the vehicle per unit of fuel consumed and the meter ME1 can be calibrated to provide direct readout in miles per gallon.

## NEW APPROACH TO TONE CONTROL

In BP 1 304 774 Wilfred Palmer of Dagenham, Essex, describes a three part tone control circuit for an audio amplifier. By way of example he gives a list of specific values for all the components, see Fig. 1.

The variable potentiometer VR1 and d.c. blocking capacitor C1 form a normal volume control. The slider of VR1 acts as a common input line to the three sections of the tone control, shown dotted.

The bass circuit includes R1 and R2 in series with VR2. The slider of VR2 is in series with R3 which feeds the output terminal.

The mid-range circuit has R4 and R5 in series with VR3, and the slider is also connected to the output via R6 and C2.

The high frequency circuit comprises VR4, the slider being connected to the output via C3.

The resistor R7 between C2 and C3 is intended to isolate the infinite variations of time constant of the treble circuit from the infinite variations of time constant of the mid-range circuit. Also, the resistor acts as an impedance to high frequencies from the bass and mid-range circuits. The inventor suggests that in this way the signals from the middle and treble circuits are cleanly and fully mixed.

The bass circuit presents a high impedance to high frequencies, thereby attenuating them but passing low and mid-range frequencies. This is due to the presence of resistors R1 and R2. The inventor points out that any resistor can be represented by a pure resistance in parallel with the self capacitance across the resistor terminals and there is thus attenuation of high frequency signals by the changes of self capacitance with increasing frequency. By using the resistors in series, total self capacitance is lowered.

The treble circuit presents an increasing impedance as the frequency decreases, thus attenuating low frequencies but passing the high and part of the mid-range frequencies.

The inventor claims that the circuit eliminates the need for attenuators in crossover units and allows infinite variations of the signal fed to loudspeakers over the whole audio spectrum.

BP 1 304 774

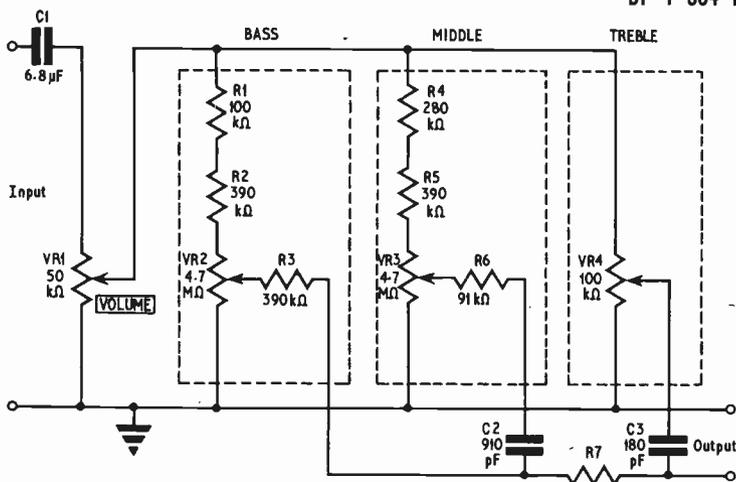


Fig. 1

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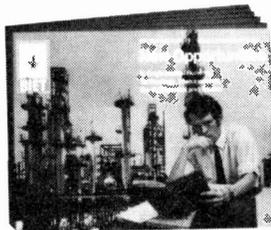
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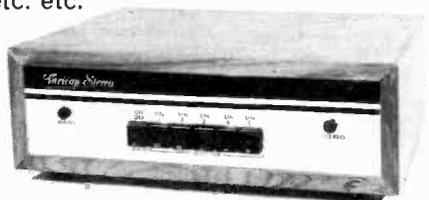
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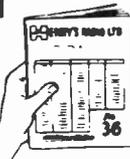
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8N7404AN	24	21	18	8N7454N	20	18	16
8N7405N	20	18	16	8N7460N	20	18	16
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ACY17	35 BCY55	2-50 GET111	55 OC72	25 ZX500	15 2N3790
ACY39	65 BCY70	15 GET115	75 OC81	28 ZG301	40 2N3790
AD149	50 BCY72	13 LM309K1	87 OC83	25 2N706	10 2N3866
AD161	39 BD124	80 MAT121	25 OC140	65 2N930	20 2N3903
AF117	20 BD131	45 MJE340	50 OC170	25 2N987	45 2N4062
AF118	50 BF115	22 MJE520	65 OC200	55 2N1132	25 2N4126
AF139	33 BF180	33 MJE3055	75 OC202	60 2N1320	22 2N4126
AF239	44 BFY13	25 NP7105	45 OC271	60 2N1613	20 2N5457
AS717	30 BFX34	55 NKT404	60 OPR60	45 2N1247	75 25026
BA115	10 BFX88	22 OAS	60 P346A	20 2N2160	69 25303
BAX13	5 BFY50	20 OAB1	10 TIL209	25 2N2926	10 40230
BC107	12 BFY51	20 OAZ200	8 TIP29A	49 2N3053	20 40361
BC108	12 BFY64	45 OAZ202	10 TIP30A	59 2N3054	45 40362
BC109	44 BFX13	25 NP7105	45 OC271	60 2N1613	20 2N5457
BC113	16 B5X20	15 OC28	65 TIP41A	74 2N3440	50 40486
BC147	12 BU105	2-20 OC35	55 TIS43	26 2N3525	80 40430

All types offered subject to availability. Prices correct at time of press. E. & O.E.

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.

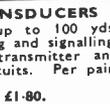


TOSHIBA POWER AND PREAMPLIFIER MODULES  
 TH9013P 20W power amplifier 22-0-22 or single 45V operated, £4.50.



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	BY127
25 .47p each	25 12p each
100 42p each	500 9p each
500 39p each	1000 8p each
1000 34p each	

### ZENER DIODES

400m/w BZY88/8ZXB3	From 3.3V-33V, 10p each.	1-3W 5% Miniature Tubulars	IN4700 series, 18p each.	10W Stnd. Mounting	Z5 6-8V-100V 5%, 40p each.
702C (T05)	75	709C (T05)	39	709C (DIL)	39
723C (T09)	90	723C (DIL)	90	728C (DIL)	45
728C (T09)	45	741C (T05)	50	741C (DIL)	50
747C (T09)	1-00	747C (DIL)	1-00	747C (DIL)	1-00
748C (DIL)	61				

### SILICON RECTIFIERS

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

### MORE OF EVERYTHING AT HENRY'S

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

### TRIACS—Stud Mounting with accessories

Type	P.I.V.	Price ea.
SC35A	100V	80p
SC35B	200V	85p
SC35D	400V	90p
SC35E	500V	£1.20

### 6 AMP RANGE

Type	P.I.V.	Price ea.
SC40A	100V	90p
SC40B	200V	95p
SC40D	400V	£1.20
SC40E	500V	£1.50

### 10 AMP RANGE

Type	P.I.V.	Price ea.
SC45A	100V	£1.05
SC45B	200V	£1.15
SC45D	400V	£1.45
SC45E	500V	£1.85

### 15 AMP RANGE

Type	P.I.V.	Price ea.
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 MA ± 5 AMP P.I.V.

Type	P.I.V.	Price ea.
BO25/05	50V	20p
BO25/10	100V	22p
BO25/20	200V	23p
BO25/40	400V	25p
BO25/60	600V	27p

### 1 AMP RANGE

Type	P.I.V.	Price ea.
BO5/05	50V	20p
BO5/10	100V	22p
BO5/20	200V	23p
BO5/40	400V	25p
BO5/60	600V	27p

### 2 AMP RANGE

Type	P.I.V.	Price ea.
BO10/05	50V	25p
BO10/10	100V	25p
BO10/20	200V	28p
BO10/40	400V	30p

### 3 AMP RANGE

Type	P.I.V.	Price ea.
BO15/05	50V	29p
BO15/10	100V	30p
BO15/20	200V	32p
BO15/40	400V	35p

### 4 AMP RANGE

Type	P.I.V.	Price ea.
BO20/05	50V	35p
BO20/10	100V	40p
BO20/20	200V	45p
BO20/40	400V	50p
BO20/60	600V	55p

### 5 AMP RANGE

Type	P.I.V.	Price ea.
BO25/05	50V	65p
BO25/10	100V	70p
BO25/20	200V	80p
BO25/40	400V	90p
BO25/60	600V	£1.00

### 7 AMP RANGE

Type	P.I.V.	Price ea.
BO35/05	50V	40p
BO35/10	100V	40p
BO35/20	200V	45p
BO35/40	400V	55p
BO35/60	600V	65p
BO35/80	800V	60p
BO35/100	1000V	60p

# 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  
 3033

# 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)  
**2000** (M210) 20k/V Slimline with case, £4.95  
**TH133D** 2k/V Robust with case, £4.95  
**U437** 10k/V Steel case. A.C. up to 40kHz, £4.95  
**U432A** 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** Volt/ohms/R-C sub./RF field/RF gen., £11.25, Carr. 20p

## NEW REVOLUTIONARY SUPERTESTER 680R

**680R** Multi-tester, £18.50  
**Accessories** £  
 Transistor tester 11.00 Gauss meter 11.95  
 Electronic volt-meter 18.00 Signal Injector 5.95  
 Amp/ohm 11.95 EHT Probe 5.95  
 Temperature probe 11.95 Shunts 4.50  
 25/50/100A } each

## 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  
**E4100** Telephone amplifier, £6.15, P. & P. 25p  
**LL1** Door Intercom with PU coil, £3.60, P. & P. 20p  
**Chastalite** (lights as you talk), £13.90, P. & P. 20p  
**IKW** 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** Aircraft band corrector, £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—bandsread 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/pack. 30p.  
**8 TRACK CAR STEREO** (- earth) with speakers, in pods and fixings. £12.50 carr/pack. 40p.  
**HANIMAX HC1000** battery cassette recorder, £10.50 carr/pack. 25p.  
**HANIMAX HC2000** battery/mains cassette recorder, £13.50 carr/pack. 30p.  
**AKAI GXC40** stereo cassette recorder, £59.95 carr/pack. 50p.  
 Pair Akai ADM microphones, £6.95 carr/pack. 20p.  
**5 WAVEBAND PORTABLE TWIN SPEAKER RADIO** FM/MW/SW/ AIR-CRAFT - PUBLIC SERVICES. £10.45 carr/pack. 30p.  
**PORTABLE CASSETTE TAPE PLAYER** - for car or carry around. £7.25 carr/pack. 20p.  
**HANIMAX POCKET CALCULATOR** with % key. £33.50.

## SPECIAL PURCHASES

### AVOMETER MOVEMENTS

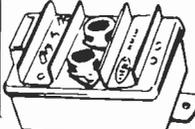
AVO 8 or 9 50mA MOVEMENTS. Ex Brand New AVO's. £3.50. Post 20p.

### UHF TV TUNERS CHANNELS 21 to 64

Brand new transistorised geared tuners for 625 Line Receiver IF output. £2.50. Post 20p.

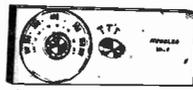
## EASY TO BUILD KITS BY AMTRON—EVERYTHING SUPPLIED

Model No.	£
310 Radio control receiver	2.98
300 4-channel R/C transmitter	5.95
345 Superhet R/C receiver	5.95
455 AM signal generator	12.33
65 Simple transistor tester	1.40
115 8W amplifier	1.40
120 12W amplifier	4.70
125 Stereo control unit	5.70
130 Mono control unit	3.60
605 Power supply for 115	4.55
610 Power supply for 120	4.55
615 Power supply for 2 x 120	5.73
230 AM/FM aerial amplifier	2.93
240 Auto packing light	5.90
275 Mic. preamplifier	6.08
570 LF generator 10Hz—1mHz	15.80
575 Sq. wave generator 20Hz—20kHz	14.60
590 SWR meter	12.85
620 Ni-CAD Charger 1-2-12V	8.00
630 STAB. Power supply 6-12V 0.25-0-1A	8.15
690 D.C. motor speed Gov.	2.87
700 Electronic Chaffinch	7.00
705 Windscreen wiper timer	10.70
760 Acoustic switch	6.85
780 Metal Detector (electronics only)	9.65
790 Capacitive burglar alarm	6.85
835 Guitar preamp	4.25
840 Delay car alarm	6.15
875 CAP. Discharge ignition for car engine (-Ve Earth)	13.15
80 Scope calibrator	2.25
255 Level indicator	6.15
525 120—160MHz VHF timer	11.30
715 Photo cell switch	7.70
795 Electronic continuity tester	4.30
860 Photo timer	13.25
871 Slide projector auto feed control	7.15
235 Acoustic alarm for driver	7.60
465 Quartz XTAL checker	8.75
220 Signal Injector	2.30
390 VOX	15.50
432 Testakit	19.30
670 Buffer Battery Charger	6.55
885 Capacitive Contact Alarm	6.25
850 Electronic Keyer	18.75
820 Electronic Digital Clock	58.50



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 x 2½in x 3½in. 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)	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 recorder/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).

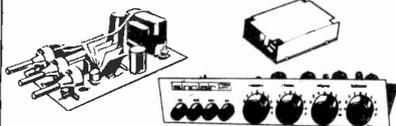
**R730/E73** 2 Track Mono Record Erase Low Imp., 75p pair.

## SINCLAIR, MINIATURE AMPLIFIERS AND TUNER/DECODER

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
1206 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 1C 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 PROJECT 60 (Carr. 20p)	£
Z30 3-57	4.37
Stereo 60 Preamplifier	7.97
PZ5	3.97
PZ6	6.37
PZ20 (for Z50)	4.77
TRANS	2.95
AFU	4.45

NEW SINCLAIR PROJECT 80	£
Stereo Preamplifier	9.90
Audio Filter Unit	5.50
Z40 15 Watt Amplifier	4.30
Z60 25 Watt Amplifier	5.50
PZ5 Model for 1 on Z40	3.98
PZ6 Model (S. Tab.) 1 on Z40	6.25
PZ8 Model (S. Tab.) 1 on Z260	6.30
TRANSFORMER FOR PZ8	2.95



## POWER SUPPLIES FOR EVERY PURPOSE

(All cases unless stated chassis)  
**470C** 6.7/9V 300mA, (Includes Multi-Adaptor for Tape Recorders etc.), £1.95. Post 20p  
**Car Lighter Voltage Adaptors** 300mA (State Voltage £1.95. Post 20p)  
**SC202** 3.16/7.5V 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** 4.5-12V 0.4-1 amp, £6.75. Post 30p  
**SE101A** 3.6/9/12V 1 amp (Stab.), £9.15. Post 25p  
**RP164** 6.7/9/12 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.  
**SP10** 4.5-15mm dia. Mares Tails, £9.50.



# Henry's RADIO LIMITED

EDGWARE ROAD, W2

SEE FACING PAGE FOR ADDRESSES

# Henry's

## DISCOUNT HI-FI, TV, TAPE AND CAR ENTERTAINMENT

Low prices means less VAT - Henry's give full guarantees and demonstrations for callers. Plus big savings. Also at Modern Electrics (Retail) Ltd., 120 Shaftesbury Avenue, W.1.—Your Sony dealer.

### STEREO AMPLIFIERS

(Carr./packing 50p)	£
AKAI: AA5200	61.70
AA5500	78.50
AA5800	117.50
AMSTRAD: IC2000 Mk. II	29.50
4000 Mk. II	23.95
EAGLE: TSA149	25.10
TSA151	34.85
AA2	32.80
AA4	42.45
AA6	55.95
HOWLAND WEST: DA1000	22.45
HENELEC TEXAN: Kit	28.50
HENELEC TEXAN: Built	35.00
NIKKO: TRM300	25.95
TRM400	32.50
PIONEER: SA500A	34.25
ROTEL: RA211	32.65
RA311	41.15
RA611	60.80
RA810	75.75
RA1210	92.50
SINCLAIR: 2000	22.25
3000	28.95
TANDBERG: TA300	66.10
TELETON: SAQ206B	22.50
SAQ307	22.50
GA202	28.50

### STEREO RADIO TUNERS

(Carr./packing 50p)	£
AKAI: AT550	60.50
AT580	94.50
AMSTRAD: 3000	23.55
EAGLE: AA8	40.80
TST152	29.45
HENELEC: Stereo Kit	21.00
Built	24.95
HOWLAND WEST: DA1000T	25.35
PIONEER: TX500A	48.75
ROTEL: RT222	32.65
RT322	43.75
RT622	65.40
SINCLAIR: 2000	26.95
3000	26.95
TELETON: GT202	30.50

### DECODERS/SYNTHESIZERS

(Carr. etc. 30p)	£
DYNACO QUADRATOR	16.90
EAGLE: AA10	12.00
AA26	16.35
TATE 1	7.95
TATE 3 } Chassis	15.75
TATE 4	19.95
TATE 7 } Boxed	25.95

### MATCHED SPEAKER SYSTEMS

Recommended pairs 8 ohms	
RANK DOMUS	
150	26.95 pair
175	33.75 pair
250	53.75 pair
MARSDEN HALL	
110, 10W	22.50 pair
150, 15W	27.50 pair
200, 20W	34.50 pair
DYNACO	
A10	43.00 pair
A25 20-60W	69.00 pair
A35	79.00 pair

WHARFEDALE  
Denton 2, 18W 27.20 pair  
Linton 2, 20W 32.65 pair  
Triton, 25W 40.80 pair  
Melton II 25 watts 51.80 pair  
LEAK  
150, 18W 32.65 pair  
250, 18W 44.30 pair  
CELESTION  
120, 20W 37.80 pair  
County, 25W 33.60 pair  
15, 30W 50.40 pair  
44, 44W 81.20 pair  
U.K.'s largest stockists for KEF Acoustic Research, Mordaunt Short and Cambridge audio speakers. In stock and on demonstration. Phone for keenest price

### STEREO MAGNETIC CARTRIDGES (Carr. etc. 15p)

SHURE	
M3Dm £3.20; M44.7 £3.95; M44E £4.25; M55E £4.95; M44G £4.20; M75/IB £6.75; M75ED11 £8.50; M75E11 £7.95; M75G11 £7.25.	
GOLDRING	
G850 £2.85; G800 £3.95; G800H £3.95; G800E £5.95; G800SE £10.00; G820 £6.70; G820E £10.00; G820SE £13.35.	
ADC	
Q36 £10.70; Q32 £8.70; Q30 £5.90.	
GRADO	
FTR £5.25; F3E £11.25; FTE £8.25; MZ £18.75.	

### EMPIRE

999REX 3.70; 999QUX 4.80; 999XEX 8.90; 999TEX £14.95.	
RONETTE	
SM5007	4.60
SM5007E	4.60
SM500/E	6.95

### RECORD DECK PACKAGES

(Carr./packing 75p)	£
*Less cart.—rest with	
(HL): SP25 III/800 or H	15.95
(M): SP25 III/M7565	19.45
(HL): AP76/G800	25.35
(M): AP76/M7565	29.10
(HL): GL75 P/C	33.50
(HL): GL75 P/C G800	36.65
(HL): GL75 P/C G800E	39.15
(HL): MP60 TPD1 G800	15.80
HT70(TPD) G800	19.50
RANK DOMUS	
BD200	43.60
BD400	53.95
*Pioneer PL12D	31.75
*Thorens TD165	43.80
*Thorens TD 160C	50.80

### STEREO COMPACTS

complete with speakers	
(Carr./packing £1-25)	£
Fidelity: UA3	39.90
Sony: G2601K	125.50
Sony: G2615N	71.50
Sony: GXT4520KL	103.50
Sony: GXT4730KL	97.50

### Philips GF908

102.75	
RF82	159.95
RF836	57.20
GF826	41.75
RH81/RH421	84.95
RF839	55.95
GF829	39.95
GF815	47.75
GF808	66.95
RH814/RH411	96.75
GF603	19.95

### 8 TRACK STEREO HOME UNITS

(Carr./packing 70p)	£
Amerlec ACR301	£48.00
(With MW/FM stereo radio).	

### PORTABLE TV BATTERY—MAINS

(Carr./packing £1-00)	£
Elizabethan T9 (9in)	43.50
Crown 9TV (9in)	46.50
Elizabethan T12 (12in)	43.95
Teleton TW12 (12in)	46.95
Sony 10T150 (9/10in)	52.50

## CASSETTE PLAYER

### FOR CAR—HOME AND AROUND

Actually the price far below the quality of the superb player. It is of beautiful quality both in sound and looks. Features wind-rewind volume and tone controls. Speaker is very good indeed. Comes complete with earphone, batteries. Full guarantee. Optional adaptor to run off car or mains.

OUR PRICE **£7.25** (plus 75p P.P.C.)

CAR CIGAR LIGHTER £1.95  
PLUG-IN ADAPTOR £1.95  
MAINS ADAPTOR £1.95

### DOLBY/NRU

(Carr./packing 30p)	£
Teleton SNR100D	29.50
Philips N6720	15.00
Teac AN60/AN80/AN180 stocked.	

### BATTERY CASSETTE RECORDERS

(Carr. etc. 30p)	£
Amerlec 100	11.00
Wien ET1008	11.00
Philips EL3302	14.40
N2203	16.60
N2211	19.95
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M1102	12.95

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(Carr. etc. 35p)	£
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N2205	29.50
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9118	21.20
Hitachi TRQ291	27.50
Sony M2000G	23.25
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(Carr. etc. 30p)	£
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ACR201	30.00
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RR413	33.90
RR712	48.30
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M2400W	36.90
M2400FG	36.90
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TR51161	35.00
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Philips N2506	44.50
Philips N2410	87.10
Pye 9145	44.50
Tandberg TCD3000	112.00
AKAI: CS30D	50.65
CS33D	62.50
GC336D	65.15
GXC40D	57.40
GXC38D Dolby	81.45
GXC46D Dolby	89.15
GXC45D	74.30

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Reel to Reel	
AKAI: 400DS	62.50
Tandberg 3321X/3341X	107.70
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8 Track	£
AKAI: CR81D	53.60
CR80DS	93.65

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AKAI: GXC40 Dolby	59.95
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N2401/RH411	74.50
N2401S/RH411	79.95
N2405/RH401	49.50
8 Track	
AKAI: CR81	66.20
8 Track Player Decks	
(Carr./packing 35p)	£
Elizabethan 8/LZ1	13.40
McDonald/BSR TDB85	12.75
TDB3V	15.25

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Goodmans Module 80	59.20
Goodmans Module 90	75.75
Goodmans One/Ten	88.50
Pioneer SX525	90.75
SX 626	124.75
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RX200A	53.95
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RX600A	90.00
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ASE20	£7.30;
ASE22	£12.99.
Accessories:	
H1012/ J83 Junction Box	£1.40;
1B3DE Din Junction Box	£1.60;
1B11D De Luxe Junction Box	£1.95;
0250 Phone Switch	£4.75.
Control Boxes: G1301 (two phones) £2.62;	
G1305 Controller £2.15;	
FF17 2-pairs (Sliders) £6.25;	
KSS T4A £4.20;	
Koss T10A £4.95;	
Koss T10A £8.50;	
HV1 Controller £6.90.	

Wharfedale: DD1 £8.95; ISODYN £15.00; Koss: K6 £9.95; K6/LC £11.25; K711 £7.95; KRD711 £7.95; HV1 £17.50; K0727B £12.45; K0747 £15.95; PR04AA £21.95; PRO5LC £23.95.	
Howland West: CIS 2000 £2.75; CIS250 £5.25; CIS1000 £7.50; CIS2000 £15.25.	
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AKAI: ASE11 £4.75; ASE20 £7.30; ASE22 £12.99. Accessories: H1012/ J83 Junction Box £1.40; 1B3DE Din Junction Box £1.60; 1B11D De Luxe Junction Box £1.95; 0250 Phone Switch £4.75. Control Boxes: G1301 (two phones) £2.62; G1305 Controller £2.15; FF17 2-pairs (Sliders) £6.25; KSS T4A £4.20; Koss T10A £4.95; Koss T10A £8.50; HV1 Controller £6.90.

Wharfedale: DD1 £8.95; ISODYN £15.00; Koss: K6 £9.95; K6/LC £11.25; K711 £7.95; KRD711 £7.95; HV1 £17.50; K0727B £12.45; K0747 £15.95; PR04AA £21.95; PRO5LC £23.95. Howland West: CIS 2000 £2.75; CIS250 £5.25; CIS1000 £7.50; CIS2000 £15.25. TTC: G3000 £6.60; G2222 £5.95. Low Cost: MD802 £13.65; MD806 £3.75. Pye 2644 £26.75; 2062

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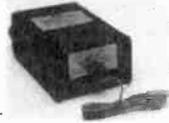
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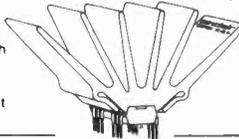
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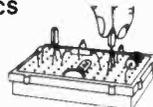
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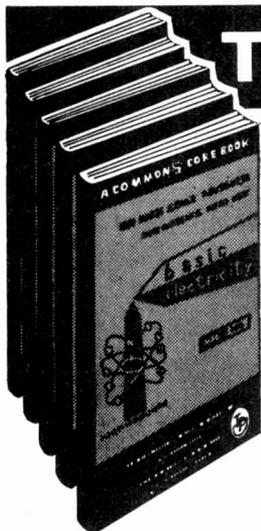
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BXY32	Frequency Multiplier.	'X Band.	£1																																																																																																																																																																
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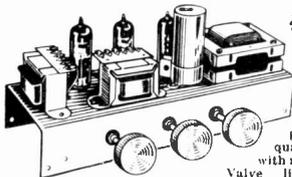


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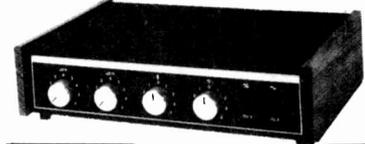
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**NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EASIER CONSTRUCTION**

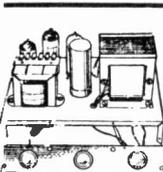
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. (Very simple to modify to suit magnetic cartridge—instructions included). Output stage for any speakers from 5 to 16 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 8 ohms. Frequency response  $\pm 3$ dB 12-30,000Hz. Sensitivity better than 80mV into 16 Ohm. Full power bandwidth  $\pm 3$ dB 12-15,000Hz. Bass boost approx. to  $\pm 12$ dB. Treble cut approx. to  $-16$ dB. Negative feedback 18dB over main amp. Power requirements 35V at 1-0 amp. Overall size—12" wide x 8" deep x 2 1/2" high.

Fully tested 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,** £2.30 P. & P. 35p.

(Post Free if all units purchased at same time). Full sales service. Also available ready built and tested, £28-10. 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 Discosque use, etc.*



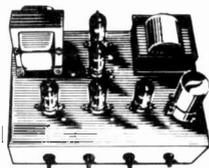
## 3-VALVE AUDIO AMP. HA3 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2in. x 4in. d. x 4 1/2in. h. Incorporates ECC83, EL84, E280 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4 1/2 watts. Front panel, fully drilled and lends itself to 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 HA3A 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 3-15 ohm speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and E280 rectifier. Simple instruction booklet 15p plus S.A.E. (Free with parts). All parts sold separately. ONLY **£3.50**. P. & P. 60p. Also available ready built and tested **£18.10**. P. & P. 70p.

**VYNAIR & BEKINE SPEAKERS & CABINET FABRICS** app. 5 1/2in. wide. Our Price 85p yd. length. P. & P. 25p per yd. (min. 1 yd.). S.A.E. for samples.

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(FLITWICK) LTD.

DEPT. PE, ELSTOW STORAGE DEPOT  
KEMPSTON HARDWICK  
BEDFORD

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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.

CALLERS WELCOME Mon.-Sat. 9 a.m.-5 p.m.  
PLEASE ADD 10% VAT

## RESISTORS

1W Iskra high stability carbon film—very low noise—capless construction.  
1W Mullard CR25 carbon film—very small body size 7.5 x 2.5mm.  
1W 2% ELECTROSIL TR5

Power watts	Tolerance	Range	Values available	Price
1	5%	4.7Ω-2.2MΩ	E24	1-99 100+
1	10%	3.3MΩ-10MΩ	E12	1p 0-8p
1	2%	10Ω-1MΩ	E24	1p 0-8p
1	10%	1Ω-3.9Ω	E12	1p 0-8p
1	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 ±W, lin ±W).  
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	20p	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	50p	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	12p	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

DIODES RECTIFIER	1A	12p	SIGNAL	7p
BY127	1250V	1A	OA85	7p
IN4001	50V	1A	OA90	5p
IN4002	100V	1A	OA91	5p
IN4004	400V	1A	OA202	7p
IN4006	800V	1A	IN4148	8p
IN4007	1000V	1A	BA114	8p

## BRUSHED ALUMINIUM PANELS

12in x 6in = 25p; 12in x 2 1/2in = 10p; 9in x 2in = 7p

## SLIDER POTENTIOMETERS

86mm x 9mm x 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 x 4in with slots cut for use  
with slider pots. Grey or matt black finish com-  
plete with fixings for 4 pots.

## THERMISTORS

VA10555	15p
VA10665	15p
VA1077	15p
R53	£1.35

## THYRISTORS

2N5060 50V 0.8A	30p.
2N5064 200V 0.8A	47p.
CRS1/40 400V 1A	25p.
106F 50V 4A 40p, 106D 400V 4A 65p.	

## MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 2p. 0.0068μF, 0.01μF,  
0.015μF, 0.022μF, 0.033μF, 3p. 0.047μF, 0.068μF, 0.1μF, 4p. 0.15μF, 6p. 0.22μF, 7p.  
0.33μF, 1p. 0.47μF, 13p.

160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 3p. 0.1μF 3p. 0.15μF 4p.  
0.22μF, 5p. 0.33μF, 6p. 0.47μF, 7p. 0.68μF, 11p. 1.0μF, 13p.

## MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0.01μF, 0.015μF, 0.022μF, 3p. 0.033μF, 0.047μF, 0.068μF,  
3p. 0.1μF, 4p. 0.15μF, 0.22μF, 5p. 0.33μF, 6p. 0.47μF, 8p. 0.68μF, 11p. 1.0μF, 13p.  
1.5μF, 20p. 2.2μF, 24p.

## ELECTROLYTIC CAPACITORS—MULLARD O15/6/7

(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, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6, 68/16,  
100/4, 100/10, 100/25, 150/6, 150/16, 220/4, 220/6, 220/16, 330/4, 330/6, 330/16, 470/10,  
470/25, 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, 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

0.1μF 35V	2.2μF 35V	22μF 16V	12p
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

2 1/2 x 3 1/2	0-1	0-15
2 1/2 x 5	24p	24p
2 1/2 x 8	24p	24p
3 1/2 x 5	27p	27p
17 x 2 1/2	75p	57p
17 x 3 1/2	100p	78p
17 x 5 (plain)	—	82p
17 x 3 1/2 (plain)	—	60p
17 x 2 1/2 (plain)	—	12p
2 1/2 x 5 (plain)	—	11p
2 1/2 x 3 1/2 (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	3p	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 100V	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 2 1/2%

10pF to 1,000pF E12 Series Values 4p each.

## SMOKE AND COMBUSTIBLE GAS DETECTOR—GDI

The GDI 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.  
excluding cases. 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	12-24	25-99	100+	7448	185	175	170	165	74118	100	82	73	64
7400	18	16	14	13	7450	18	16	14	13	74121	43	40	38	36
7401	18	16	14	13	7451	18	16	14	13	74141	100	95	90	85
7402	18	16	14	13	7453	18	16	14	13	74145	150	140	135	130
7403	18	16	14	13	7454	18	16	14	13	74150	330	280	250	220
7404	18	16	14	13	7460	18	16	14	13	74151	110	100	95	89
7403	18	16	14	13	7460	18	16	14	13	74151	110	110	105	95
7404	20	18	16	14	7470	30	28	25	24	74153	120	180	170	160
7405	20	18	16	14	7472	30	28	27	23	74154	200	180	170	160
7406	50	45	40	35	7473	40	38	36	30	74155	150	120	100	86
7407	56	50	44	38	7474	40	36	32	28	74156	130	120	100	86
7408	36	30	27	23	7475	55	52	50	49	74180	155	136	112	96
7409	36	30	27	23	7476	40	36	32	30	74190	195	190	185	180
7410	18	16	14	13	7480	100	95	90	85	74191	185	190	185	180
7411	23	21	20	18	7481	125	115	110	105	74192	200	190	180	164
7412	36	30	27	23	7482	100	96	90	85	74193	200	180	170	150
7413	34	28	26	22	7483	100	97	95	92	74196	200	190	180	170
7416	45	43	39	34	7484	120	115	110	105	74197	200	195	180	170
7420	18	16	14	13	7485	250	245	240	230					
7421	36	30	27	23	7486	45	42	37	33					
7426	32	25	23	20	7490	75	67	60	52					
7430	20	18	16	14	7491A	100	92	85	79					
7432	40	36	32	28	7492	75	70	65	60					
7440	20	18	16	14	7493	75	68	60	52					
7441	80	75	70	65	7494									

# SAXON ENTERTAINMENTS LTD.

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

**Better built  
Better performance  
Better value**

## SAXON HI-FI POWER AMPS 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	All modules incorporate OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in its SA100
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	4 1/2in x 4in x 1in (SA100) 4in x 3in x 1in (SA35/SA50)	

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

### POWER SUPPLIES FOR THE SA35, SA50 AND SA100 POWER AMPS. ABOVE

PU45	Unstabilised supply for 2 SA35's	£4.90
P070	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**

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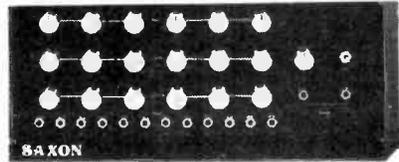
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## SAXON PA MIXER-CONTROL UNITS

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" x 8" and only 2 1/2in deep. Carr. paid.

**£18.50 + V.A.T.**

### M6HL

12 inputs (6 high Z, 6 low Z) 18" x 8" x 2 1/2". Carr. paid

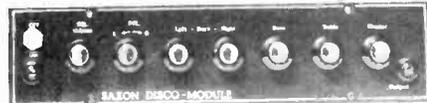
**£27.50 + V.A.T.**

Channel section modules, for building your own: gain—16 x (24dB). Tone controls—18dB swing. Carr. paid.

**£3.50 + V.A.T.**

## CONTROL UNITS

Mono (as shown): **£6.50**  
Carr. 20p.  
For 9V battery operation. As stereo model, less mic. input. Stereo. **£15.80**  
Carr. 30p.



Two decks, and full headphone monitoring. The unit is mains operated and measures 17 1/2in x 3in x 4in deep and is finished with a smart white on black fascia. 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

● 160 watts version with power supply **£27.90**  
(Carr. 50p)

## 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 x 4in x 4in (5in with supply)  
Low distortion parallel push-pull output stage.

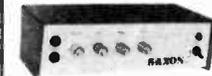
Module and power supply (Carr. 40p)

**£18.95**

**Another Saxon winner!**

## 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. **£19.75**  
Carr. 30p.

### 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. Prices subject to alteration without notice E. & O.E.

# 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
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- 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.

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Please send your brochure telling me all about Amkit.

Name .....

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PE4



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16/450V	22p	1000/50V	47p	32-32/250V	45p
32/450V	35p	8-8/450V	22p	350-50/325V	55p
25/25V	10p	8-16/450V	25p	32-32-32/350V	55p
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2000mF 6V 25p; 25V 42p; 50V 57p.  
2500mF 50V 62p; 3000mF 25V 47p; 50V 85p.  
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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 20W. NOTE: 3 or 8 or 15 ohms must be stated.

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25W 35W 50W  
3 or 8 or 15 ohm 3 or 8 or 15 ohm 8 or 15 ohm

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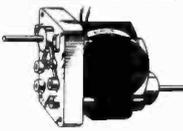
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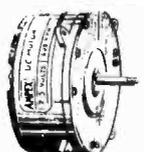


(Dural gear case) 240 a.c., 28rpm. NEW HIGH TORQUE, approx. overall size: 3 1/2" x 3 1/2" x 3 1/2" spindle dia. as illustrated. £3. P. & P. 30p. Similar to above, 19rpm. £2.70. P. & P. 30p. 110rpm with pressed steel gear case (similar to above but slightly smaller). £2.70. P. & P. 30p.



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51rpm. 2 1/2" x 1 1/2" x 6 1/2" high. 240V a.c. Shaft 1/2" o/d, 1 1/2" length with hexagon socket inside. £2. P. & P. 30p.



## AMPEX 7.5v. DC MOTOR

This is an ultra precision tape motor designed for use in the AMPEX model AG20 portable recorder. Torque 450GM/CM. Stall load at 500mA. Draws 60mA on run. 600rpm speed adjustment. Internal A/R/F suppression. 1 1/2" dia. x 1 1/2" spindle, motor 3" dia. x 1 1/2". Original cost £16.50. OUR PRICE £3.30. P. & P. 25p. Large quantities available (special quotations). Mu-metal enclosure available. 75p each. P. & P. FREE.

"DAVENSEY" MAINS SOLENOID 1" travel, 8lb pull (approx.). Size: 2 1/2" long x 23/16" x 2" high. Similar in appearance to "SORENG". £1.65 P. & P. 20p.

## MAINS SOLENOID

This little unit gives vertical lift of approximately 1" through hinged "elbow". Bracket incorporates 2 fixing screws. Length of arm, 2 1/2". 240V a.c. Pull at coil is approximately 1lb. £1. P. & P. FREE. Special quotes for quantities.

## SOLENOIDS by WESTOOL

240 a.c. type MM6. 3lb. pull. 2 1/2" x 1 x 1 1/2". Travel 1". 90p each. P. & P. 10p.  
240 a.c. type MM4. 2lb. pull. 1 1/2" x 1 1/2" x 1". Travel 1/2". 70p each. P. & P. 10p. Quantity discounts: 10-50 10%, 50 upwards 25%.

## "DECCO" MAINS SOLENOID

Compact and very powerful. 16lb. pull. 1/2" travel which can be increased to 1" by removing captive-end-plate. Overall size: 2" x 2 1/2" x 2 1/2" high. £2.20. P. & P. 20p.

## MAINS SOLENOID by MAGNETIC DEVICES LTD.

A beautifully constructed solenoid at half normal price. A 2-sided bracket is incorporated for vertical or horizontal mounting. Size: 2" x 1 1/4" x 1 1/4". Pull is approximately 2lb, plunger travel 1 1/4". Fixing eye takes up to 1" bolt, plunger non-captive. NEW in original maker's boxes. £1.20. P. & P. 20p. Large number available, special price for quantity.

## "CROUZET" MOTORS

Type 965 115/240V. 50Hz. 48W. Stoutly constructed, 2 1/16" dia. x 3 1/2" long plus spindle 1" x 1/2" dia. Anti-clock. £3.30 each. P. & P. 25p.

## "RE CIRK IT" Mains 10amp cut-out

by "Neimman Electric" Germany. Eliminates fuses. Size: 2" x 1" x 1 1/2" deep. 75p each. P. & P. 10p. 4 or more 55p each. P. & P. 20p.

## KNOWLE (U.S.A.) MINIATURE MICROPHONE CAPSULES

Impedance approx. 200Ω, output 60 or 80 DB at 1 Kc. As used in deaf aids, hearing devices, etc. Size (60 DB) 7/32" x 5/32" x 1/2"; (80 DB) 1/2" x 3/32" x 1/2". Equipment, all tested. £1.40 each. P. & P. FREE.

## UNLESS OTHERWISE STATED

all items are NEW and UNUSED. Postal or carriage charges are for Gt. Britain only. We welcome orders from established companies, educational depts., etc. All orders under £2.50. C.W.O., please. Company orders under £2.50, surcharge 60p, unless C.W.O.

## PLUG-IN RELAYS by SCHRACK (Perspex enclosed)

OCTAL (2c/o) 6 amp contacts at following voltages: 48 d.c., 60 d.c., 60 a.c., 110 d.c., 380 a.c. PRICE EACH £1-10.  
11 pin (3 c/o) 6 amp contacts: 12 a.c., 48 d.c., 48 a.c., 60 a.c., 60 d.c., 110 d.c., 115 a.c., 240 a.c. PRICE EACH £1-40.  
RA and RN Series (4 c/o) 3 amp Gold Plated Contacts. Handsome modern construction. 1/2" x 3/4" x 1 1/2" high. Following voltages: 6 a.c., 12 a.c., 24 a.c., 48 a.c., 48 d.c., 60 a.c., 110 d.c., 115 a.c., 120 a.c. PRICE EACH £1.  
Base sockets for all above types 15p. Please add 10p towards P. & P. on all orders.

From JAPAN. TAKAMISAWA Perspex enclosed relay. Type MQ308 24V d.c. 600 ohm (4 c/o). Complete with base socket. 80p. P. & P. 10p.

## SILVANIA MAGNETIC SWITCH

Now complete with reference magnet!  
A magnetically activated switch, vacuum sealed in a glass envelope. Silver contacts, normally closed. Rated 3 amp at 250V. 1 1/2 amp at 240V. Size: (approx.) 1 1/2" long x 1/2" dia. Ideal for burglar alarms, security systems, etc. and wherever non-mechanical switching is required. 10 for £2. P. & P. 15p; 50 for £8.80; 100 for £16.50. P. & P. FREE over 10.

## NORPLEX

The famous American fibre-glass copper-clad laminate. Finest quality with woven glass of Epoxy-resin. Excellent Mech. and Elec. conductive properties. Heat resistant, ideal for P.C.'s, etc. TH18 IS A SPECIAL PURCHASE AND ONLY AVAILABLE WHILE STOCKS LAST! Sizes: 12" x 22" x 1/2" x 24" x 24"; FULL SHEET 43" x 37" (11 sq.ft.). Single-sided Copper with thickness of 1/32", 3/64", 3/32". Also double-sided 1/32", 1/16", 3/32". £1 per sq.ft. Cut sizes (1-10 sq.ft. P. & P. 25p. Full Sheet £8 each. Carr. £1 for 1st sheet plus 25p each additional sheet.

## TANGENTIAL HEATER

Silently driven by shaded pole Mylex motor, powerful and smooth running with aluminium impeller (outlet 3/4" x 1 1/2"). Mains voltage PLUS matching heater unit with spiral element. May be switched for 500 or 1,000W. £2.20. P. & P. 30p.

ALL PRICES  
NOW INCLUDE  
V.A.T.

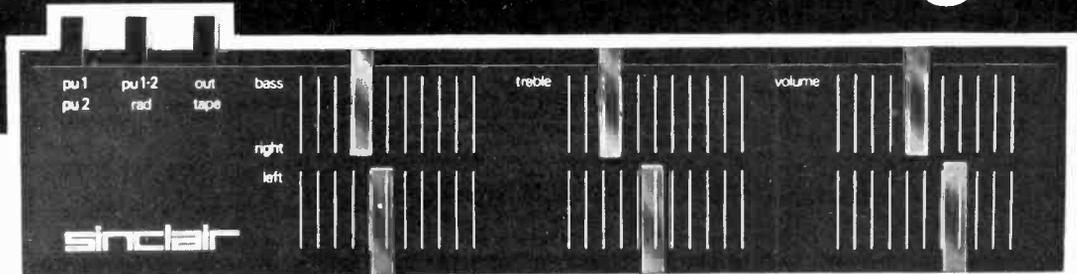
# ELECTRO-TECH COMPONENTS LTD.

315/317 EDGWARE ROAD  
LONDON, W.2  
Tel. 01-723 5667 01-402 5580

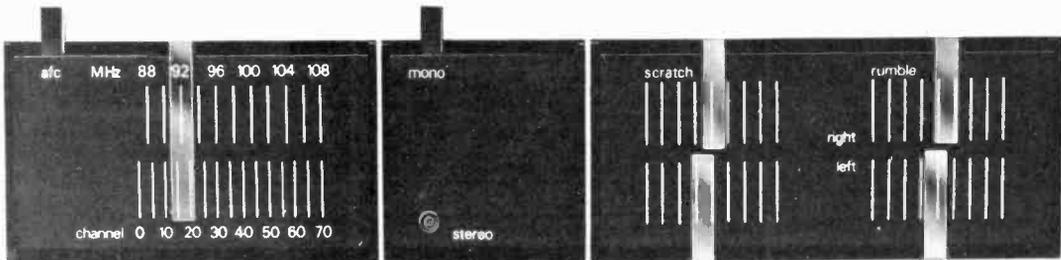
now...

# 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.

# sincor

# 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  $\frac{3}{4}$ " 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.

### TECHNICAL SPECIFICATIONS

Size - 260 x 50 x 20mm ( $10\frac{1}{2}$  x 2 x  $\frac{3}{4}$  ins)  
 Finish - Black, with white markings  
 Inputs - Mag P.U. 3mV RIAA corrected; Ceramic P.U. 300mV  
 Radio 300mV, Tape 30mV  
 S/N ratio - 60db  
 Frequency range - 20Hz to 15KHz  $\pm 1$ dB; 10Hz to 25KHz  $\pm 3$ dB  
 Power requirements - 20 to 35 volts  
 Outputs - 100mV  $\pm$  AB monitoring for tape  
 Controls - Press button for tape, radio and P.U. selection Volume, Bass  $\pm 12$ dB to  $\pm 14$ dB at 100Hz, Treble  $\pm 11$ dB to  $\pm 12$ dB 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 x 50 x 20mm ( $3\frac{1}{2}$  x 2 x  $\frac{3}{4}$  ins). Greater adaptability (and possibly financial convenience) results from the tuner and stereo decoder section being made available separately.

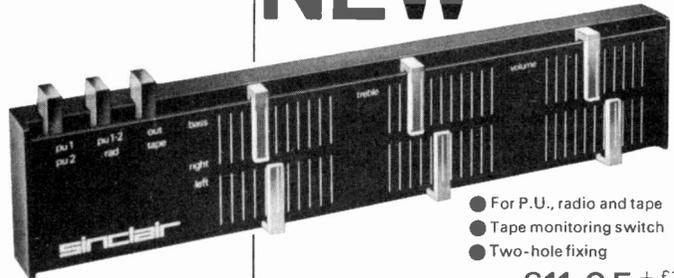
### TECHNICAL SPECIFICATIONS

Size - 85 x 50 x 20mm (approx  $3\frac{1}{2}$  x 2 x  $\frac{3}{4}$  ins)  
 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  $\Omega$  or 240-300  $\Omega$   
 Sensitivity - 4 microvolts for 30dB quieting  
 Power requirements - 12 to 45 volts

## Project 80 stereo decoder

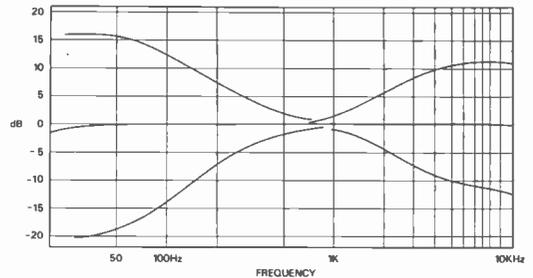
Making the Project 80 decoder separate from the F.M. tuner gives the constructor a wider choice of systems as well as saving money in cases where stereo reception may not be required. This unit gives a 40dB channel separation with an output of 150mV per channel. The gallium arsenide light emitting beacon 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 x 50 x 20mm ( $1\frac{3}{4}$  x 2 x  $\frac{3}{4}$  ins)  
 One 19 transistor I.C.

# NEW

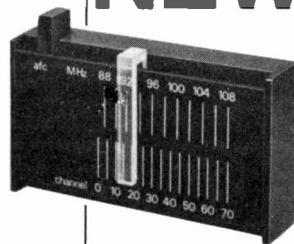


- For P.U., radio and tape
- Tape monitoring switch
- Two-hole fixing

R.R.P. **£11.95** + £1.19 V.A.T.



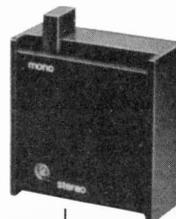
# NEW



- AFC switch
- Twin dual varicap tuning
- 4-hole ceramic filter
- Slider tuning

R.R.P. **£11.95** + £1.19 V.A.T.

# 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

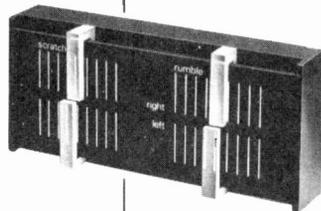
- 1969 Q.16 - improved version of Q.14 Systems 2000 and 3000: Project 60 launched
- 1970 IC.12 Project 60S
- 1971 Project 60 stereo FM tuner Z.50; PZ.8
- 1972 Improvements to Project 60 with Z.50 MK.2 and PZ.8 Mk.3 The Executive Calculator: Digital multi-meter. Q.30 speaker
- 1973 Cambridge Calculator  
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 x 50 x 20mm (4 1/4 x 2 x 3/4 ins)  
Voltage gain - minus 0.2dB  
Frequency response - 36Hz to 22KHz, controls minimum  
Distortion - at 1 KHz - 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 V.A.T.

## Z.40 & Z.60 power amplifiers totally short-circuit proof

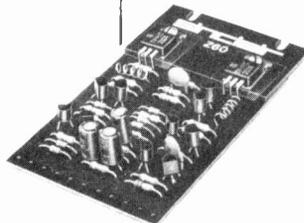
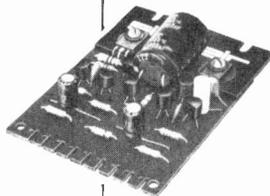
Either of these entirely new power amplifiers is intended for use in Project 80 installations although, of course, they are readily adaptable to an even wider range of applications. Both Z.40 and Z.60 incorporate built-in protection against shortcircuiting and risk of damage arising from mis-use is greatly reduced. Comprehensive instructions are supplied with each of the modules.

### Z.40 Technical Specifications

Size - 55 x 80 x 20mm  
(2 1/8 x 3 1/8 x 3/4 ins) 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 x 98 x 20mm  
(2 1/8 x 3 7/8 x 3/4 ins) 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 - 4Ω min; max safe on open circuit



# NEW

### Z.40

R.R.P. **£5.45** + 0.54p V.A.T.

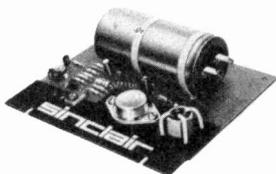
### Z.60

R.R.P. **£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 incorporated 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 unbalanced  
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	<b>£5.45</b> + 54p V.A.T.
Mains powered record player	Z.40, PZ.5	<b>£10.43</b> + £1.04 V.A.T.
30W RMS continuous sine wave stereo amp.	2 x Z.40s, Stereo 80; PZ.6	<b>£30.83</b> + £3.08 V.A.T.
50W (8 Ω) RMS continuous sine wave de luxe stereo	2 x Z.60s, Stereo 80; PZ.8	<b>£33.83</b> + £3.38 V.A.T.
amplifier Indoor P.A.	Z.60, PZ.8	<b>£14.93</b> + £1.49 V.A.T.
Car Radio	F.M. tuner, Z.40	<b>£16.40</b> + £1.64 V.A.T.

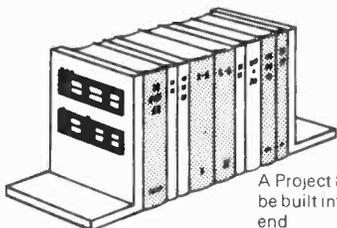
# sinclair

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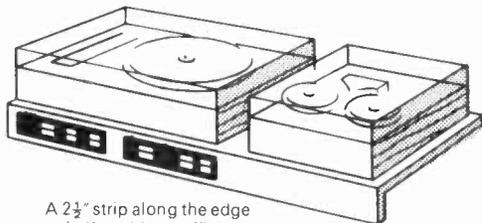
Practical Electronics December 1973

# From Sinclair the worlds most advanced hi-fi modules

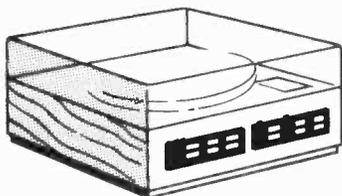
## Sinclair Project 80 the ultra-modern non-obtrusive hi-fi



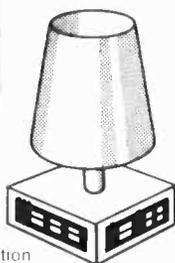
A Project 80 system could be built into a book-shelf end



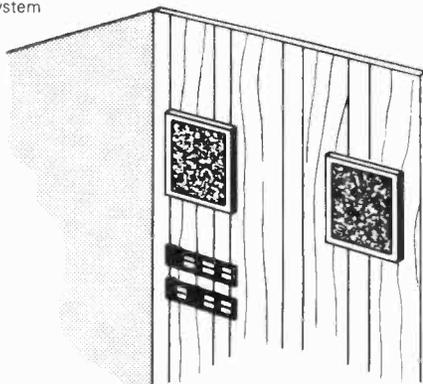
A 2½" strip along the edge a shelf could be sufficient to contain a complete system



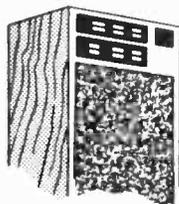
The modules mount very easily onto a playing plinth



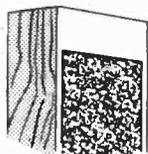
A novel application would be to build around the base of a lampshade



Two Sinclair Q.16 loudspeakers suitably positioned together with Project 80 could be mounted on to a false wall.



Project 80 could be easily mounted onto a loudspeaker cabinet



When you have seen for yourself how fantastically slim and cleverly designed these modules are, further ways will suggest themselves in which they can become a pleasing part of your particular domestic environment.

To SINCLAIR RADIONICS LTD. ST. IVES, HUNTINGDON PE17 4HJ

Please send post paid \_\_\_\_\_

for which I enclose Cash/Cheque for £ \_\_\_\_\_ including V.A.T.

Name \_\_\_\_\_

Address \_\_\_\_\_

PE12

### Guarantee

If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair appointed Stockists also offer this guarantee.

*Should any defect arise in normal use, we will service it without charge. For damage arising from mis-use a small charge (typically £1.00) will be made.*

# sinclair

Sinclair Radionics Ltd.  
London Road, St. Ives,  
Huntingdon PE17 4HJ  
Telephone St. Ives (0480) 64311

## 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 £8.75, Post 50p  
2.5A £10.10, Post 60p  
5A £14.60, Post 75p  
37.5A £102.50  
50A £122.50



2.5 amp OPEN TYPE

**CARRIAGE AND PACKING EXTRA** unless shown (Panel Mounting)  
1 amp £8.75, Post 50p. 2½ amp £10.10, Post 60p.

## 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. Eg. 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.1KVVA 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 tapper 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.

## BLOWER UNIT

200-240 Volt A.C. Precision German built. Dynamically balanced, quiet, continuously rated, reversible motor. Consumption 60mA. Size 120 mm. dia. x 60 mm. deep. Price £3, Post 30p.



## 4 BANK 3c/o PUSH BUTTON ASSEMBLY

Black rectangular buttons. 5 units (min. order) 85p, Post 15p.



## 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 Lamps, 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 design from U.S.A. Long term reliability. Type SC146B 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.

All Mail Orders—Callers—Ample Parking  
**Dept. PE11, 57 BRIDGMAN ROAD CHISWICK, LONDON W4 5BB**  
Phone 01-995 1560  
Showroom open Mon.-Fri.

## 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 1-100 f.p.s. Approx. 2 output of Hy-Light. Price £10.50, Post 50p.

**HY-LIGHT 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-LIGHT KIT

Approx. four times the light output of our well proven Hy-Light 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-Light Kit including reflector £4.75, Post 25p.  
Super Hy-Light 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-Light or Super Hy-Light 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 A.C. 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.



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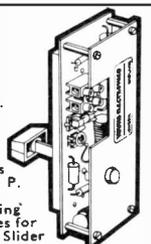
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2N897	1-21	2N3710	0-12	40468A	0-44
2N898	0-25	2N3711	0-09	40600	0-69
2N899	0-52	2N3712	0-12	40601	0-67
2N706	0-16	2N3713	1-95	40602	0-46
2N706A	0-18	2N3714	2-29	40603	0-58
2N708	0-18	2N3715	1-23	40604	0-56
2N711	0-80	2N3716	3-00	40636	1-10
2N718	0-21	2N3717	3-15	40673	0-70
2N718A	0-49	2N3719	3-15	AC1107	0-35
2N720	0-50	2N3790	4-01	AC1113	0-18
2N721	0-55	2N3794	2-26	AC1115	0-16
2N914	0-22	2N3791	2-08	AC1127	0-20
2N916	0-41	2N3792	2-20	AC1126	0-26
2N918	1-50	2N3794	0-10	AC1228	0-25
2N929	0-18	2N3713	0-82	AC141K	0-30
2N930	0-48	2N3820	0-47	AC142K	0-25
2N1090	0-23	2N3823	1-42	AC151V	0-14
2N1091	0-24	2N3824	1-33	AC152V	0-17
2N1131	2-82	2N3826	0-23	AC153	0-22
2N1132	0-55	2N3854	0-18	AC153K	0-25
2N1302	0-16	2N3854A	0-19	AC154	0-20
2N1303	0-20	2N3855	0-19	AC176	0-18
2N1304	0-20	2N3856	0-19	AC187K	0-26
2N1305	0-20	2N3856A	0-20	AC188K	0-26
2N1306	0-22	2N3858	0-17	AC17	0-34
2N1307	0-25	2N3858A	0-19	AC19	0-27
2N1308	0-25	2N3859	0-18	AC219	0-82
2N1309	0-25	2N3859A	0-19	AC220	0-22
2N1483	0-90	2N3865	1-09	AC21	0-28
2N1607	0-24	2N3877	0-25	AC22	0-16
2N1613	0-33	2N3877A	0-28	AC28	0-20
2N1631	0-35	2N3900	0-20	AC30	0-42
2N1637	0-35	2N3900A	0-21	AC39	0-65
2N1701	1-32	2N3901	0-32	AC40	0-17
2N1702	2-15	2N3903	0-24	AC41	0-17
2N1711	0-45	2N3905	0-24	AC44	0-31
2N1893	0-81	2N4036	0-27	AD136V	0-86
2N2102	0-30	2N4037	0-18	AD140	0-55
2N2147	0-70	2N4038	0-10	AD142	0-50
2N2148	0-94	2N4039	0-10	AD143	0-45
2N2192	0-40	2N4057	0-14	AD148V	0-68
2N2192A	1-21	2N4058	0-10	AD150	0-60
2N2193	0-40	2N4059	0-09	AD161	0-45
2N2193A	0-81	2N4061	0-11	AD162	0-45
2N2194	0-75	2N4062	0-11	AD162	0-45
2N2194A	0-80	2N4062	0-11	AD162	0-45
2N2195	0-87	2N4062	0-11	AD161	1-05
2N2196A	0-18	2N4062	0-25	AD162	1-05
2N2218A	0-88	2N4303	0-47	AF109R	0-40
2N2219	0-57	2N4916	0-20	AF14	0-66
2N2219A	0-88	2N4917	0-17	AF115	0-24
2N2220	0-45	2N4918	0-75	AF116	0-25
2N2221	0-41	2N4919	0-84	AF117	0-20
2N2221A	0-63	2N4920	0-99	AF118	0-50
2N2222	0-60	2N4921	0-73	AF121	0-22
2N2222A	0-81	2N4922	0-84	AF124	0-24
2N2368	0-21	2N4923	0-83	AF125	0-25
2N2369	0-37	2N5172	0-12	AF126	0-19
2N2369A	0-43	2N5174	0-03	AF127	0-20
2N2646	0-77	2N5175	0-26	AF139	0-38
2N2647	1-20	2N5176	0-32	AF170	0-25
2N2711	0-30	2N5190	0-92	AF172	0-25
2N2712	0-12	2N5191	0-98	AF178	0-55
2N2713	0-17	2N5192	1-24	AF180	0-50
2N2714	0-18	2N5193	1-01	AF186	0-40
2N2904	0-58	2N5194	1-10	AF200	0-35
2N2904A	0-70	2N5195	1-40	AF239	0-41
2N2905	0-71	2N5245	0-43	AF240	0-72
2N2905A	0-88	2N5458	0-48	AF279	0-54
2N2906	0-65	2N5458	0-48	AF280	0-54
2N2906A	0-70	2N5459	0-49	AF280	0-54
2N2907	0-79	3N128	0-73	AF298	0-54
2N2907A	0-88	3N136	0-82	AF298	0-54
2N2923	0-12	3N136	1-42	AF211	0-55
2N2924	0-14	3N140	0-92	AL102	0-75
2N2925	0-17	3N141	0-81	AL103	0-70
2N2926	0-26	3N142	0-58	ASV26	0-30
Green	0-12	3N143	0-75	ASV27	0-36
Yellow	0-10	3N152	0-82	ASV28	0-36
Orange	0-10	3N153	0-81	ASV29	0-30
2N3053	0-32	3N154	0-84	ASV55	0-25
2N3054	0-76	3N159	1-17	BC107	0-16
2N3055	0-85	3N187	1-55	BC108	0-15
2N3390	0-28	3N200	2-49	BC109	0-19
2N3391	0-28	3N201	1-05	BC113	0-13
2N3391A	0-29			BC114	0-18
2N3392	0-13			BC115	0-15
2N3393	0-12			BC116	0-15
2N3394	0-17	40050	0-78	BC116A	0-18
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2N3404	0-24	40310	0-50	BC119	0-27
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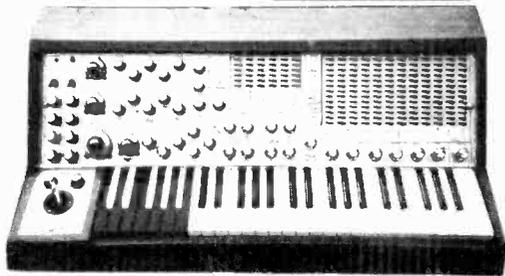
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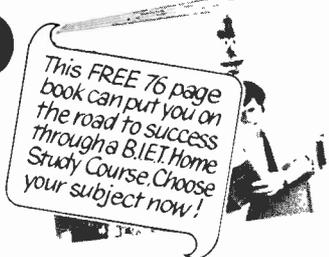
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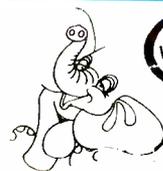
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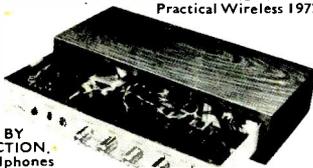
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