

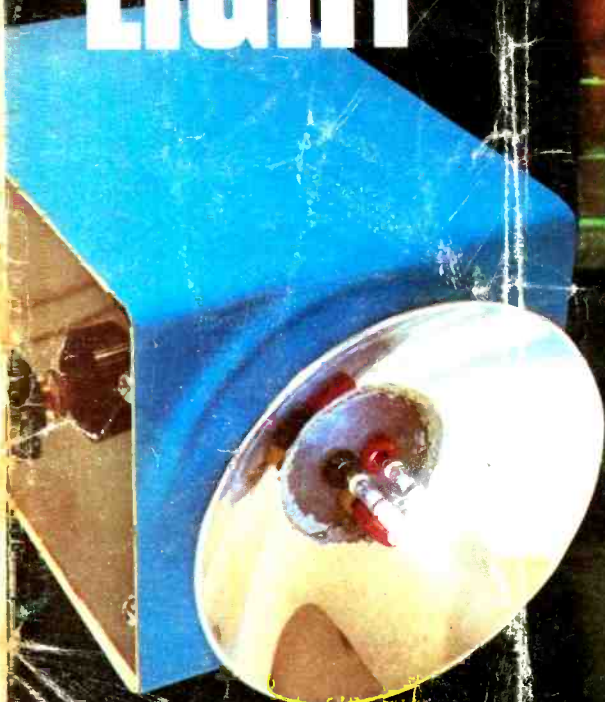
PRACTICAL

# ELECTRONICS

DECEMBER 1973

20p

## PARTY STROBE LIGHT



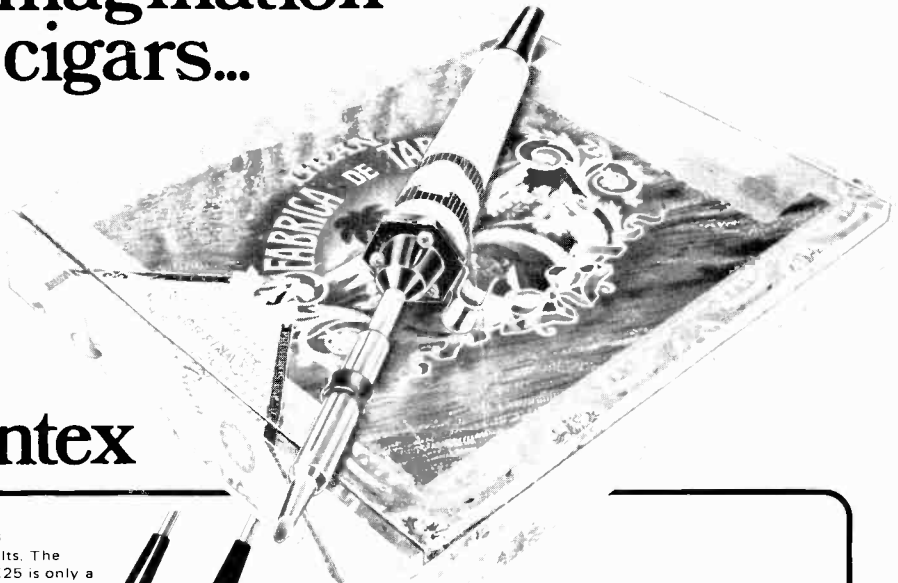
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OPERATED  
FADER**

**2 PROJECTS FOR PARTIES AND DISCOTHEQUES**

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## MODEL X25 Soldering Irons

220-240 Volts or 100-120 Volts. The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with its truly remarkable heat-capacity will easily "out-solder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long life iron-coated bit 1/8". 2 other bits available 3/32" and 3/16". Totally enclosed element ceramic and steel shaft. Bits do not "freeze" and can easily be removed. PRICE £1-93 (rec. retail) P & P 8p. Suitable for production work and as a general purpose iron.



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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.

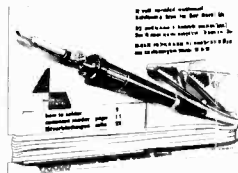
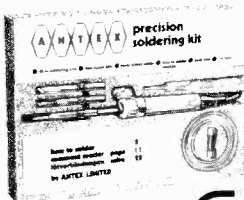


all prices include VAT at 10%



## 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*  
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- P.E. SOUND SYNTHESIZER—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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Applications of phase locked loop integrated circuits 1060
- LOGIC TUTOR EXPERIMENTS—8** *by M. J. Hughes*  
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Our January issue will be published on Friday, December 14, 1973

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Garrard Zero 100 (Auto)	£34.95
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Goldingr G101/P P & C	£21.95
Goldingr GL72	£24.95
Goldingr GL72/P	£31.95
Goldingr GL75	£30.95
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Goldingr GL75 Lid	£4.25
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Amstrad Multiplex 3000	£33.90
Metrosound FMS 20 Mk. II	£37.75
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Goodmans Havant	£35.25
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Keltron KS8	£22.50
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Sinclair Q30	£30.95
Wharfedale Denton II	£62.80

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Goodmans Mod 80 Com	£109.95
Goodmans Mod 90	£76.95
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Please add 11p P. & P. & Ins.

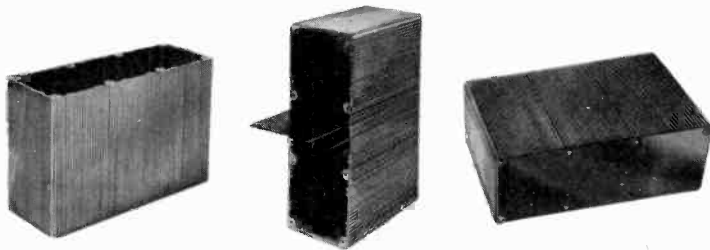
Goldingr G850	£2.75
Goldingr G800	£3.50
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Goldingr G800SE	£10.90
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Shure M55E	£5.00
Shure 75ED Type 2	£9.25
Shure V15	£25.95
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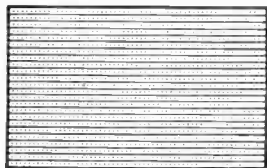
## products available from your local retailer

to assist with all types of home constructor projects



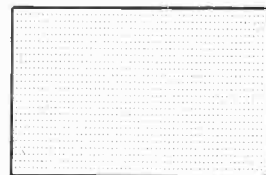
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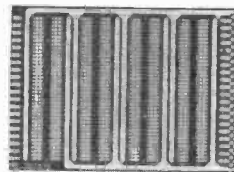
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0.1" and 0.15" pitch.



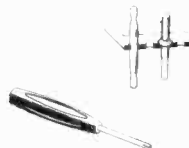
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Top-quality amplifier, BSR turntable, matching speakers. Deck and speaker cabinets you simply wrap round and glue to build. Screw in the amplifier and connect up (all push fit no soldering whatsoever), so simple literally anyone can do it. Except for 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.

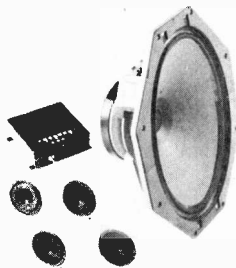
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**OUR PRICE £25·00 + £1·50 p. & p.**



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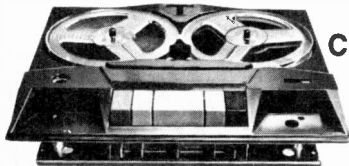
The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7in wide, 2in high and 4½in deep.

- \* 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

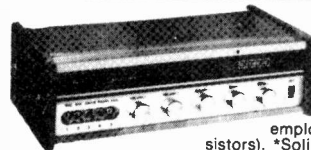
Speaker with baffle and fixing strips £1.65. 23p p. & p., post free if bought with the kit. Send stamped addressed envelope for leaflet.

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.



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employing F.E.T. (Field Effect Transistors). \*Solid State Circuitry. \*Attractive Styling.

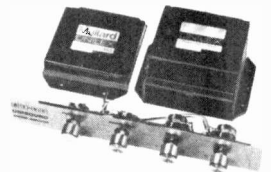
INPUTS 1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of

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.



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The Viscount III, the fabulous Stereo 21 and the Unisound Modules will all accept this unit. **£10.60 p. & p. 90p.** simply connect up.

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25E12 1W KIT: 25 of each E12 value, 10 ohms—1M, a total of 1525 (CARBON FILM 5%), £7.35 net  
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10E12 2W KIT: 10 of each E12 value, 10 ohms—1M, a total of 610 (METAL FILM 5%), £12.65 net

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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.

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MINIATURE 0-25W Vertical or horizontal 6p each 1K, 2K2, 4K7, 10K, etc. up to 1M Ω  
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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

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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
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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 14½p
2.5mm Jack 11p
Phono 5½p

**SOCKETS**

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3 Pin 10p
5 Pin 180° 12p
Std. Jack 14½p
2.5mm Jack 11p
Phono 5½p

**ELECTROLYTIC CAPACITORS. Tubular & Large Cans**

(µF/V): 2, 2.25, 2.2, 6.3, 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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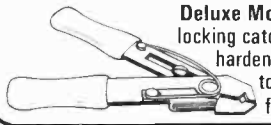
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A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices. We have now finally reduced the modular audio amplifier to a simple input/output device requiring 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.

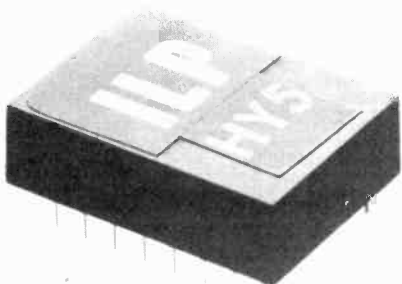
## NEW HY5 PREAMPLIFIER

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.

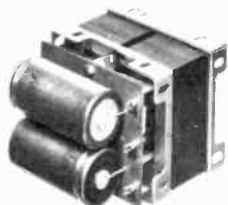


**INPUTS**  
Magnetic Pick-up 3mV (within 1dB RIAA curve)  
Ceramic Pick-up up to 3mV.  
Microphone 10mV.  
Tuner 250mV.  
Auxiliary 3-100mV.  
Input impedance 47kΩ 1 kHz  
**OUTPUTS**  
Tape 100mV.  
Main output. 0dB (0.775V).

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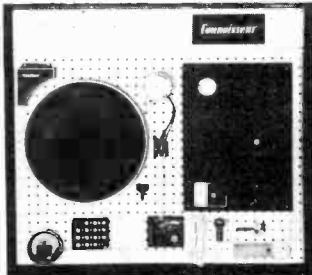
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Please note we reserve the right to substitute at our discretion updated versions of advertised designs where applicable.

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500µA, 55p



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



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Chassis for model 320 £1.75 extra.  
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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.

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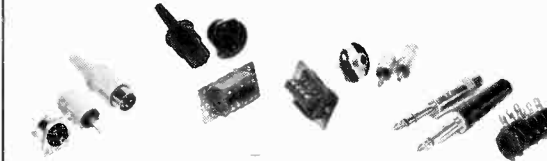
Spring line reverberation unit (as specified)	£2.89
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REc 41A bridge rectifier	£1.06
741C 8-pin DIL	36p
MFC 6040 electronic attenuator	£0.85
SG 3402N for Ring Modulator	£1.89

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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>PLUGS</b>	<b>PLUGS</b>	<b>PLUGS</b>
2 pin (1 flat) 8p	P360 3 pin 1.5A chassis plug with 4 pin, 5 pin A line socket. Per pair 24p	R88 8 way chassis socket 52p	Std. 1/2" stereo plug Plastic 18p
3 pin 9p	SA 2190 3 pin 5A chassis plug 17p		Screened 25p
4 pin, 5 pin B (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
<b>DIN Sockets</b>	<b>McMURDO</b>	<b>JACK</b>	13p; Moulded stereo socket 1/2" with 3 break contacts 18p; 3-5mm. plug plastic 8p; screened 11p; open socket 8p.
2 pin 6p	RP8 8 way chassis plug 38p	Std. 1/2" mono plug Elastic 13p	
3 pin, 4 pin, 5 pin A (180°), 5 pin B (240°), 6 pin 7p		Screened 17p	

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Lacing Cord Strong rayon cored PVC 25m 48p.  
Panel fuse holders 20mm 20p; 1½in 30p.

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

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0-6-5V 100mA 95p. 12-0-12V 50mA 95p.  
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Rotary miniature carbon track 1/2" spindle

<b>Single gang Lin or Log</b> 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M (and 1k Lin) 12p	<b>Single gang with DP switch</b> 250V 2A Log or Lin 5k to 2M as above 28p
<b>Dual gang (Stereo) without switch Log or Lin 5k to 2M as above 38p.</b>	<b>PRESETS</b> Sub-miniature 0-1W Vert or Horiz 100, 250, 500, 1k, 2.5k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M 8p
<b>Wirewound 10% 1W 1/2" spindle 10, 50, 100R 34p; 250, 500, 1k, 5k 33p; 10k, 37p; 25k 40p; 50k 44p.</b>	

## 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

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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	2N2906 10p	1N4007 8p
BC209C 14p	2N2926V 10p	W005 30p
BD131 54p	2N2926G 10p	W04 33p
BD132 67p	741C 8-pin DIL 36p	
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BF194 15p	DIL Sockets 8-pin 20p	
BFY31 16p	14-pin 15p	

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**ALSO AVAILABLE WITH 115/120V SEC. WINDING**

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	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
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 6.7 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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Ref. No.	Amps	Weight lb oz	Size cm.	Secondary Windings	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	9.9 x 10.2 x 8.6 0-12V at 5A x 2	4.30 52
17	16	8	12	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	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.	Amps	Weight lb oz	Size cm.	Secondary Taps	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.	Amps	Weight lb oz	Size cm.	Secondary Taps	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.	Amps	Weight lb oz	Size cm.	Secondary Taps	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

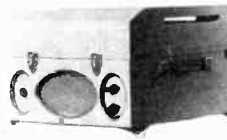
Ref. No.	mA	Weight lb oz	Size cm.	Volts	P & P	
238	200	1	2	2.8 x 2.6 x 2.0	3-0.3	1.10 10
212	1A, 1A	1	4	6.1 x 5.8 x 4.8	0-6, 0-6	1.27 22
13	100	1	4	3.9 x 2.6 x 2.9	0-0.9	64 10
235	330, 330	1	4	4.8 x 2.9 x 3.5	0.9, 0.9	1.27 10
207	500, 500	1	00	6.1 x 5.4 x 4.8	0-8.9, 0-8.9	1.70 22
208	1A, 1A	1	12	7.0 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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UIC00=	12x7400	0-55	UIC46=	5x7446	0-55	UIC86=	5x7486	0-55
UIC01=	12x7401	0-55	UIC48=	5x7448	0-55	UIC90=	5x7490	0-55
UIC03=	12x7402	0-55	UIC50=	12x7450	0-55	UIC91=	5x7491	0-55
UIC04=	12x7403	0-55	UIC51=	12x7451	0-55	UIC92=	5x7492	0-55
UIC04=	12x7404	0-55	UIC53=	12x7453	0-55	UIC93=	5x7493	0-55
UIC05=	12x7405	0-55	UIC54=	12x7454	0-55	UIC94=	5x7494	0-55
UIC06=	8x7406	0-55	UIC55=	12x7455	0-55	UIC95=	5x7495	0-55
UIC07=	8x7407	0-55	UIC60=	12x7460	0-55	UIC96=	5x7496	0-55
UIC10=	12x7410	0-55	UIC70=	8x7470	0-55	UIC100=	5x74100	0-55
UIC20=	12x7420	0-55	UIC72=	8x7472	0-55	UIC121=	5x74121	0-55
UIC30=	12x7430	0-55	UIC73=	8x7473	0-55	UIC122=	5x74122	0-55
UIC40=	12x7440	0-55	UIC74=	8x7474	0-55	UIC123=	5x74123	0-55
UIC41=	5x7441	0-55	UIC76=	8x7476	0-55	UIC151=	5x74151	0-55
UIC42=	5x7442	0-55	UIC80=	5x7480	0-55	UIC154=	5x74154	0-55
UIC43=	5x7443	0-55	UIC82=	5x7482	0-55	UIC193=	5x74193	0-55
UIC44=	5x7444	0-55	UIC83=	5x7483	0-55	UIC199=	5x74199	0-55
UIC45=	5x7445	0-55	UIC83=	5x7483	0-55	UICX1=	25 Assorted 74's 1-85	

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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
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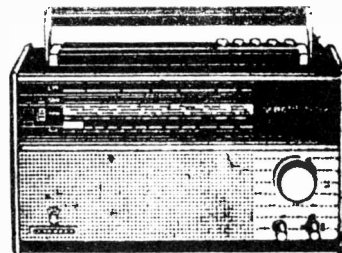
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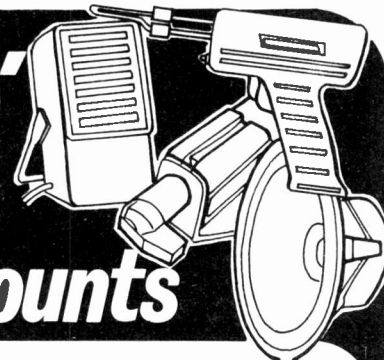
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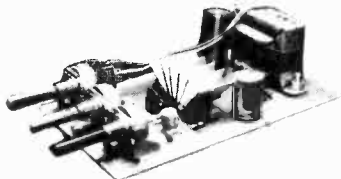
16a WELLFIELD ROAD, LONDON SW16 2BS  
SPECIAL EXPRESS MAIL ORDER SERVICE

Express postage 1p per transistor, over ten post free  
INTEGRATED CIRCUITS 5p + 1p each added

5p	10p	15p	20p	25p	30p	35p	40p	45p	50p	55p	60p	65p	70p	75p	80p	85p	90p	95p	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
IN21	AF212	BY210	OAZ2909	ZS170	AS223	BY211	OAZ210	ZS271	AS224	BY212	OAZ211	ZS107	AS225	BY213	OAZ222	ZS108	AS226	BY214	OAZ223	ZS109	AS227	BY215	OAZ224	ZS110	AS228	BY216	OAZ225	ZS111	AS229	BY217	OAZ226	ZS112	AS230	BY218	OAZ227	ZS113	AS231	BY219	OAZ228	ZS114	AS232	BY220	OAZ229	ZS115	AS233	BY221	OAZ230	ZS116	AS234	BY222	OAZ231	ZS117	AS235	BY223	OAZ232	ZS118	AS236	BY224	OAZ233	ZS119	AS237	BY225	OAZ234	ZS120	AS238	BY226	OAZ235	ZS121	AS239	BY227	OAZ236	ZS122	AS240	BY228	OAZ237	ZS123	AS241	BY229	OAZ238	ZS124	AS242	BY230	OAZ239	ZS125	AS243	BY231	OAZ240	ZS126	AS244	BY232	OAZ241	ZS127	AS245	BY233	OAZ242	ZS128	AS246	BY234	OAZ243	ZS129	AS247	BY235	OAZ244	ZS130	AS248	BY236	OAZ245	ZS131	AS249	BY237	OAZ246	ZS132	AS250	BY238	OAZ247	ZS133	AS251	BY239	OAZ248	ZS134	AS252	BY240	OAZ249	ZS135	AS253	BY241	OAZ250	ZS136	AS254	BY242	OAZ251	ZS137	AS255	BY243	OAZ252	ZS138	AS256	BY244	OAZ253	ZS139	AS257	BY245	OAZ254	ZS140	AS258	BY246	OAZ255	ZS141	AS259	BY247	OAZ256	ZS142	AS260	BY248	OAZ257	ZS143	AS261	BY249	OAZ258	ZS144	AS262	BY250	OAZ259	ZS145	AS263	BY251	OAZ260	ZS146	AS264	BY252	OAZ261	ZS147	AS265	BY253	OAZ262	ZS148	AS266	BY254	OAZ263	ZS149	AS267	BY255	OAZ264	ZS150	AS268	BY256	OAZ265	ZS151	AS269	BY257	OAZ266	ZS152	AS270	BY258	OAZ267	ZS153	AS271	BY259	OAZ268	ZS154	AS272	BY260	OAZ269	ZS155	AS273	BY261	OAZ270	ZS156	AS274	BY262	OAZ271	ZS157	AS275	BY263	OAZ272	ZS158	AS276	BY264	OAZ273	ZS159	AS277	BY265	OAZ274	ZS160	AS278	BY266	OAZ275	ZS161	AS279	BY267	OAZ276	ZS162	AS280	BY268	OAZ277	ZS163	AS281	BY269	OAZ278	ZS164	AS282	BY270	OAZ279	ZS165	AS283	BY271	OAZ280	ZS166	AS284	BY272	OAZ281	ZS167	AS285	BY273	OAZ282	ZS168	AS286	BY274	OAZ283	ZS169	AS287	BY275	OAZ284	ZS170	AS288	BY276	OAZ285	ZS171	AS289	BY277	OAZ286	ZS172	AS290	BY278	OAZ287	ZS173	AS291	BY279	OAZ288	ZS174	AS292	BY280	OAZ289	ZS175	AS293	BY281	OAZ290	ZS176	AS294	BY282	OAZ291	ZS177	AS295	BY283	OAZ292	ZS178	AS296	BY284	OAZ293	ZS179	AS297	BY285	OAZ294	ZS180	AS298	BY286	OAZ295	ZS181	AS299	BY287	OAZ296	ZS182	AS300	BY288	OAZ297	ZS183	AS301	BY289	OAZ298	ZS184	AS302	BY290	OAZ299	ZS185	AS303	BY291	OAZ300	ZS186	AS304	BY292	OAZ301	ZS187	AS305	BY293	OAZ302	ZS188	AS306	BY294	OAZ303	ZS189	AS307	BY295	OAZ304	ZS190	AS308	BY296	OAZ305	ZS191	AS309	BY297	OAZ306	ZS192	AS310	BY298	OAZ307	ZS193	AS311	BY299	OAZ308	ZS194	AS312	BY300	OAZ309	ZS195	AS313	BY301	OAZ310	ZS196	AS314	BY302	OAZ311	ZS197	AS315	BY303	OAZ312	ZS198	AS316	BY304	OAZ313	ZS199	AS317	BY305	OAZ314	ZS200	AS318	BY306	OAZ315	ZS201	AS319	BY307	OAZ316	ZS202	AS320	BY308	OAZ317	ZS203	AS321	BY309	OAZ318	ZS204	AS322	BY310	OAZ319	ZS205	AS323	BY311	OAZ320	ZS206	AS324	BY312	OAZ321	ZS207	AS325	BY313	OAZ322	ZS208	AS326	BY314	OAZ323	ZS209	AS327	BY315	OAZ324	ZS210	AS328	BY316	OAZ325	ZS211	AS329	BY317	OAZ326	ZS212	AS330	BY318	OAZ327	ZS213	AS331	BY319	OAZ328	ZS214	AS332	BY320	OAZ329	ZS215	AS333	BY321	OAZ330	ZS216	AS334	BY322	OAZ331	ZS217	AS335	BY323	OAZ332	ZS218	AS336	BY324	OAZ333	ZS219	AS337	BY325	OAZ334	ZS220	AS338	BY326	OAZ335	ZS221	AS339	BY327	OAZ336	ZS222	AS340	BY328	OAZ337	ZS223	AS341	BY329	OAZ338	ZS224	AS342	BY330	OAZ339	ZS225	AS343	BY331	OAZ340	ZS226	AS344	BY332	OAZ341	ZS227	AS345	BY333	OAZ342	ZS228	AS346	BY334	OAZ343	ZS229	AS347	BY335	OAZ344	ZS230	AS348	BY336	OAZ345	ZS231	AS349	BY337	OAZ346	ZS232	AS350	BY338	OAZ347	ZS233	AS351	BY339	OAZ348	ZS234	AS352	BY340	OAZ349	ZS235	AS353	BY341	OAZ350	ZS236	AS354	BY342	OAZ351	ZS237	AS355	BY343	OAZ352	ZS238	AS356	BY344	OAZ353	ZS239	AS357	BY345	OAZ354	ZS240	AS358	BY346	OAZ355	ZS241	AS359	BY347	OAZ356	ZS242	AS360	BY348	OAZ357	ZS243	AS361	BY349	OAZ358	ZS244	AS362	BY350	OAZ359	ZS245	AS363	BY351	OAZ360	ZS246	AS364	BY352	OAZ361	ZS247	AS365	BY353	OAZ362	ZS248	AS366	BY354	OAZ363	ZS249	AS367	BY355	OAZ364	ZS250	AS368	BY356	OAZ365	ZS251	AS369	BY357	OAZ366	ZS252	AS370	BY358	OAZ367	ZS253	AS371	BY359	OAZ368	ZS254	AS372	BY360	OAZ369	ZS255	AS373	BY361	OAZ370	ZS256	AS374	BY362	OAZ371	ZS257	AS375	BY363	OAZ372	ZS258	AS376	BY364	OAZ373	ZS259	AS377	BY365	OAZ374	ZS260	AS378	BY366	OAZ375	ZS261	AS379	BY367	OAZ376	ZS262	AS380	BY368	OAZ377	ZS263	AS381	BY369	OAZ378	ZS264	AS382	BY370	OAZ379	ZS265	AS383	BY371	OAZ380	ZS266	AS384	BY372	OAZ381	ZS267	AS385	BY373	OAZ382	ZS268	AS386	BY374	OAZ383	ZS269	AS387	BY375	OAZ384	ZS270	AS388	BY376	OAZ385	ZS271	AS389	BY377	OAZ386	ZS272	AS390	BY378	OAZ387	ZS273	AS391	BY379	OAZ388	ZS274	AS392	BY380	OAZ389	ZS275	AS393	BY381	OAZ390	ZS276	AS394	BY382	OAZ391	ZS277	AS395	BY383	OAZ392	ZS278	AS396	BY384	OAZ393	ZS279	AS397	BY385	OAZ394	ZS280	AS398	BY386	OAZ395	ZS281	AS399	BY387	OAZ396	ZS282	AS400	BY388	OAZ397	ZS283	AS401	BY389	OAZ398	ZS284	AS402	BY390	OAZ399	ZS285	AS403	BY391	OAZ400	ZS286	AS404	BY392	OAZ401	ZS287	AS405	BY393	OAZ402	ZS288	AS406	BY394	OAZ403	ZS289	AS407	BY395	OAZ404	ZS290	AS408	BY396	OAZ405	ZS291	AS409	BY397	OAZ406	ZS292	AS410	BY398	OAZ407	ZS293	AS411	BY399	OAZ408	ZS294	AS412	BY400	OAZ409	ZS295	AS413	BY401	OAZ410	ZS296	AS414	BY402	OAZ411	ZS297	AS415	BY403	OAZ412	ZS298	AS416	BY404	OAZ413	ZS299	AS417	BY405	OAZ414	ZS300	AS418	BY406	OAZ415	ZS301	AS419	BY407	OAZ416	ZS302	AS420	BY408	OAZ417	ZS303	AS421	BY409	OAZ418	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# 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%.

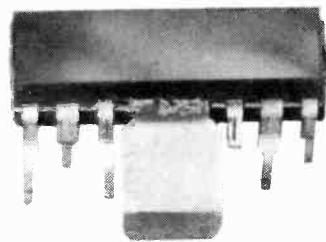
I/P Imp 100k ohm Nom.

£6-30. Post free.

Size: 140 x 80 x 45mm.

## MICROCHIP I.C.

5 watts RMS

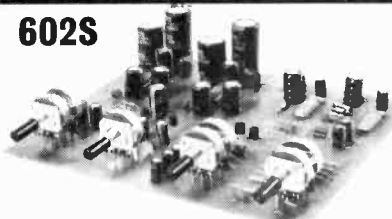


A general purpose Audio i.c. for the constructor capable of 5 watts RMS O/P at less than 1% total distortion, forms an ideal basis for an excellent Hi-Fi system.

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



£49-00. Post free

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

### GUARANTEE

ALL PRODUCTS ARE GUARANTEED AGAINST FAILURE FOR A PERIOD OF 12 MONTHS AND WILL BE SERVICED FREE OF CHARGE IF PURCHASED DIRECT AND REFUNDED TO US FOR REPAIR.

NAME .....

ADDRESS .....

PLEASE SEND .....

(enclose PO/cheque/M.O.) .....

**RAYMER ELECTRONICS LTD.**  
Stanley Road, Cambridge CB5 8LB, England.  
(0223) 54414. Reg. No. 1021295

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10% FOR V.A.T.

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Everything brand new and to makers' specifications.

# ELECTROVALUE

## Electronic Component Specialists

### TRANSISTORS BY SIEMENS AND NEWMARKET

2N3055 npn silicon power	60p
AC153K pnp germanium low power	32p
AC176K npn germanium low power	32p
AD161 npn germanium medium power	42p
AD162 pnp germanium medium power	40p
AF139 pnp germanium UHF	49p
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.

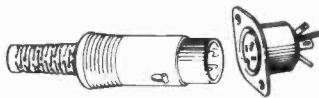
Other semiconductors: AC128, 17p; AF117, 32p; BFY51, 19p. Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

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



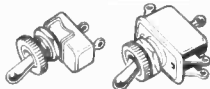
2 way LS —socket 10p, plug 12p  
3 way scr.—socket 10p, plug 12p  
5 way scr.—socket 11p, plug 15p

### 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.

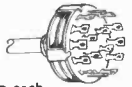


### ROTARY SWITCHES

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	63V	100V
Capacity $\mu$ F	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	—	7p	12p
	100	8p	7p	7p	7p	—	9p	11p
	220	7p	8p	8p	8p	—	10p	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	—	—	—
	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.

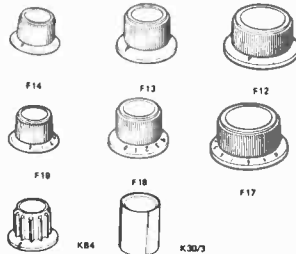
**Minitron Digital Counter**  
Type 3015F. Seven Filament segment indicators: to make 0-9 + decimal point. Compatible with standard logic modules, nett £2.  
Decoder driver type FLL 121T nett £1.36. DIL socket, nett £2.

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.)

### KNOBS

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 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.

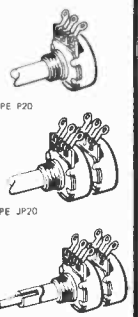
DUAL CONCENTRIC DP20 in any combination of P20 values, 60p; with switch, 72p.

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.



### TRANSFORMERS—MAINS

MT3 30V/2A plus 4 taps	£2-85
MT103 50V/1A plus 4 taps	£2-55
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

### BAXANDALL SPEAKER KIT

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.

Equaliser Assembly, £2.  
Loudspeaker Unit 59RM109, £2-45.  
Cabinet Kit (to Baxandall design), £10-45.

### DISCOUNTS

All items offered for sale in accordance with our stated terms of business, copy of which available on request. Not allowed on net price items. 10% on orders for £5 or more, 15% on orders of £15 or more. Prices subject to alteration without prior notice. Prices quoted DO NOT include V.A.T. Orders received from U.K. customers must be accompanied by an additional 10% of the nett value for V.A.T.

Overseas orders are exempt.

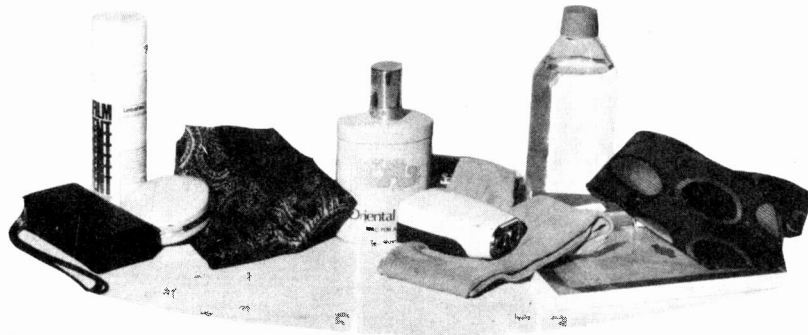
POSTAGE AND PACKING FREE

SURCHARGE 10p on small mail orders under £2. Overseas orders carriage and insurance charged at cost. U.S.A. CUSTOMERS please contact ELECTROVALUE, AMERICA, P.O. BOX 27, Swarthmore, PA 19081.

# ELECTROVALUE

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# If you're stuck for original Christmas presents ideas



## AMTRON offers you a choice of 200



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;

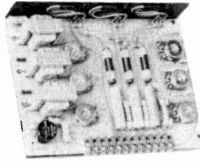
L.F. Instruments; Amateur & Radio control transmitters and receivers; Measuring Instruments; I.C. Digital Equipment etc. Complete blister packs contain full instructions plus solder.

*THE BIG NAME IN  
ELECTRONIC KITS*



AMTRON U.K. LTD · 4 & 7 CASTLE STREET · HASTINGS · SUSSEX · TEL HASTINGS 2875

### Mk III Sound to Light Unit Chassis Version



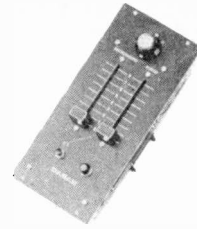
The audio drive voltage is derived directly from the amplifier output or across the speaker load. The unit converts the audio-frequency signals into a three-coloured light display when used with coloured flood lamps or similar; the colour depending on the frequency of the signal and the intensity on 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

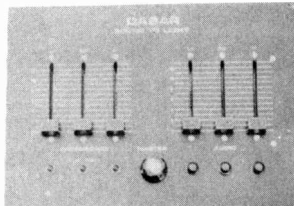
Single channel "Sound to Light" unit with 60mm slider fader controls for audio trigger level and background load dimmer. This unit is switchable for response to High, Mid, and Low frequency audio signals, selected by facia control. A D.J. "pulse-flash" push button is fitted for manual flashing of the 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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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
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AC188K 24p	BC115 20p	BC460 68p	BF197 15p	
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### RESISTORS METAL FILM

5% TOL.  
1/4W, 1/2W, 1W, E12 values to 2.7M all 1p each.  
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.

### 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.

### CABLES AND SCREENED WIRES

Min. mike cable single 7p/metre; Min. twin mike cable 11p/metre; Pick up wire single 7p/metre; Pick up wire twin 11p/metre; Stereo screened twin 10p/metre; 4 core individually screened 14p/metre; Speaker wire twin coded 6p/metre.

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- 4 Transistor Push Pull Amplifier
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- Batteryless Crystal Radio
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Components include:

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## NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors, 9 Tunable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with VHF section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange. Attractive all white case with red grille and carrying strap. Size 9 1/2in x 7in x 2 1/2in approx. Parts price list and plans 30p (FREE with parts).

TOTAL BUILDING COSTS **£6-95** P.P. & INS. 44p  
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## NEW EVERYDAY SERIES

Build this exciting New series of designs

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

TOTAL BUILDING COSTS **£3-60** P.P. & INS. 30p  
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**EV7** Case and looks as above. 7 transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt Battery Push Pull Output. Telescopic Aerial for Short Waves. 3" Loudspeaker. Parts price list and easy build plans 20p. Free with parts.

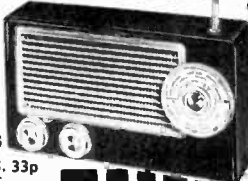
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10 TRANSISTORS. 9 TUNABLE WAVEBANDS. MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS. ALSO AIRCRAFT BAND. Latest 4" 2 watt Ferrite Magnet Loudspeaker. Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic 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.

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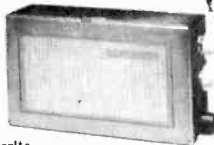
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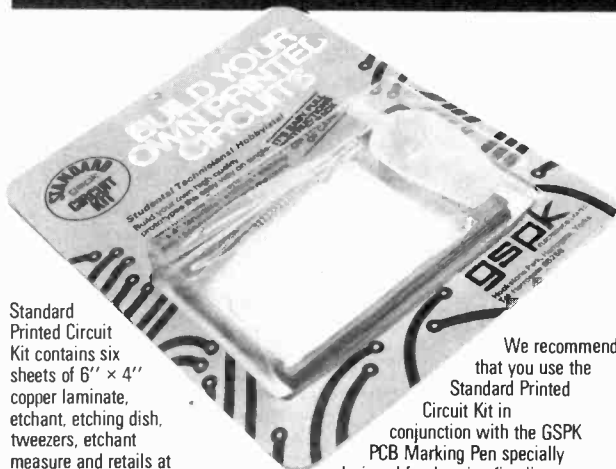
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P.E.58

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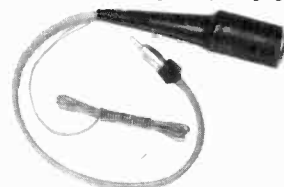


Standard Printed Circuit Kit contains six sheets of 6" x 4" copper laminate, etchant, etching dish, tweezers, etchant measure and retails at **£4.95** including VAT plus postage and packaging -30p.

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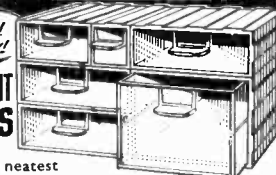
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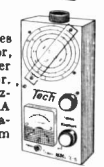
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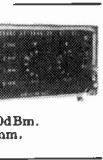
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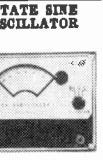
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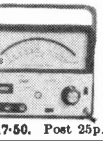
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Master and two substations. Can be used on desk or wall mounted. Complete with cable and batteries

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50V d.c.	£3.60
300V d.c.	£3.60
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5 amp.	£3.10
10 amp.	£3.10
5V d.c.	£3.10
10V d.c.	£3.10
20V d.c.	£3.10
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100-0-100µA	£2.50	50V d.c.	£2.40
200µA	£2.50	300V d.c.	£2.40
500µA	£2.45	15V d.c.	£2.40
500-0-500µA	£2.40	300V d.c.	£2.40
1mA	£2.40	5 Meter 1mA	£2.60
10mA	£2.40	VU Meter	£2.70
50mA	£2.40	1 amp. a.c.*	£2.40
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10 amp.	£2.25
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50µA	£2.55
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100µA	£2.45
100-0-100µA	£2.45
200µA	£2.25
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50-0-50µA	£2.50
100µA	£2.45
100-0-100µA	£2.45
200µA	£2.25
500µA	£2.25
500-0-500µA	£2.25
1mA	£2.25
1-0-1mA	£2.25
2mA	£2.25
5mA	£2.25
10mA	£2.25
20mA	£2.25
50mA	£2.25
100mA	£2.25
150mA	£2.25

**EA.41 REVERBERATION AMPLIFIER**

Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and out—put into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7 1/2" x 3 1/2" x 4 1/2".

**OUR PRICE £7.50 P. & P. 15p**

**1021 STEREO LISTENING STATION**

For balancing and gain selection of loudspeaks, with additional facility for stereo switching, 2 gain controls, speaker on-off slide switch, stereo headphone sockets 6 1/2" x 4 1/4" x 2 1/4".

**OUR PRICE £2.25 P. & P. 20p**

**Type MR.85P. 4 1/4" x 4 1/4" Fronts**

50µA	£3.90
50-0-50µA	£3.60
1 amp.	£3.60
5 amp.	£3.60
15 amp.	£3.60
30 amp.	£3.95
10V d.c.	£3.90
20V d.c.	£3.90
50V d.c.	£3.90
150V d.c.	£3.90
300V d.c.	£3.90
15V a.c.	£3.95
300V a.c.	£3.95
8 Meter 1mA	£3.90
VU Meter	£4.55
1 amp. a.c.*	£3.90
5 amp. a.c.*	£3.90
10 amp. a.c.*	£3.90
20 amp. a.c.*	£3.90
30 amp. a.c.*	£3.90

**Type SD.640 63-5mm x 86mm Fronts**

50µA	£3.05
50-0-50µA	£3.05
100µA	£3.00
100-0-100µA	£3.00
200µA	£3.00
500µA	£2.95
1mA	£2.90
5mA	£2.90
10mA	£2.90
50mA	£2.90
100mA	£2.90
500µA	£2.90
1mA	£2.90
5 amp.	£2.90
10 amp.	£2.90
50V d.c.	£2.90
20V d.c.	£2.90
50V d.c.	£2.90
300V d.c.	£2.90
15V a.c.*	£2.90
300V a.c.*	£2.90
VU Meter	£3.15

**Type MR.65P. 3 1/4" x 3 1/4" Fronts**

50µA	£2.70
50-0-50µA	£2.15
100µA	£2.15
100-0-100µA	£2.10
200µA	£2.05
500µA	£2.05
1mA	£2.00
5mA	£2.00
10mA	£2.00
50mA	£2.00
100mA	£2.00
500µA	£2.00
1mA	£2.00
5 amp.	£2.00
10 amp.	£2.00
50V d.c.	£2.00
20V d.c.	£2.00
50V d.c.	£2.00
300V a.c.	£2.00
15V a.c.*	£2.00
300V a.c.*	£2.00
5 amp. a.c.*	£2.00
10 amp. a.c.*	£2.00
20 amp. a.c.*	£2.00
30 amp. a.c.*	£2.00

**Type MR.88P. 1 1/2" 82mm square Fronts.**

200µA	£2.25
300µA	£2.25
500µA	£2.25
750µA	£2.25
1 amp.	£2.25
2 amp.	£2.25
5 amp.	£2.25
10 amp.	£2.25
10 amp.	£2.25
3V d.c.	£2.25
50µA	£2.55
50-0-50µA	£2.50
100µA	£2.45
100-0-100µA	£2.45
200µA	£2.25
500µA	£2.25
500-0-500µA	£2.25
1mA	£2.25
1-0-1mA	£2.25
2mA	£2.25
5mA	£2.25
10mA	£2.25
20mA	£2.25
50mA	£2.25
100mA	£2.25
150mA	£2.25

**Type PE.70. 3 1/2" 82mm x 1 1/2" 82mm x 2 1/2" deep.**

50µA	£3.75
50-0-50µA	£3.60
100µA	£3.60
100-0-100µA	£3.60
200µA	£3.40
500µA	£3.20
1mA	£3.20
5 amp.	£3.20
10 amp.	£3.20
50V d.c.	£3.20
20V d.c.	£3.20
50V d.c.	£3.20
300V a.c.	£3.25
VU Meter	£3.85

**\*MOVING IRON—ALL OTHERS MOVING COIL**  
 Please add postage

**MP7 MIXER PREAMPLIFIER**

Battery operated. 9 1/4" x 5 1/4" x 3 1/4". Input: Mic: 3 x 3m. 50K. 2.3mV. 600 ohm. Phone mag. 4mV 50K. Phono ceramic 100mV 1 neq. Output 250mV 100K.

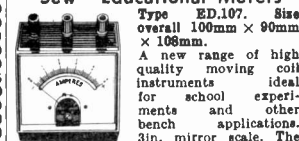
**OUR PRICE £8.97 P. & P. 20p**

**AUDIOTRONIC AM101 STEREO HEADPHONE AMPLIFIER**

All silicon transistor amplifier operates from magnetic ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. Input 5mV/100mV. Output 50mW per channel.

**OUR PRICE £7.50 P. & P. 20p**

**"Sew" Educational Meters**



Type ED.107. Size overall 100mm x 90mm x 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3 1/4" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

15V d.c.	£5.95
20V d.c.	£5.95
50V d.c.	£5.95
300V d.c.	£5.95
Dual range	£7.00
500mA/5A d.c.	£7.00
15A d.c.	£5.95
5A d.c.	£5.95
5V/15V d.c.	£7.00
5V/15V d.c.	£7.00

**"Sew" Bakelite Panel Meters**

**Type MR.65. 3 1/4" square Fronts.**

1 amp.	£2.60
2 amp.	£2.60
5 amp.	£2.60
15 amp.	£2.60
30 amp.	£2.60
50 amp.	£2.60
5V d.c.	£2.60
10V d.c.	£2.60
20V d.c.	£2.60
50V d.c.	£2.60
150V d.c.	£2.60
300V d.c.	£2.60
500µA	£2.60
500-0-500µA	£2.60
1mA	£2.60
1-0-1mA	£2.60
5mA	£2.60
10mA	£2.60
50mA	£2.60
100mA	£2.60
500mA	£2.60

**Type MR.65. 3 1/4" square Fronts.**

1 amp.	£2.60
2 amp.	£2.60
5 amp.	£2.60
15 amp.	£2.60
30 amp.	£2.60
50 amp.	£2.60
5V d.c.	£2.60
10V d.c.	£2.60
20V d.c.	£2.60
50V d.c.	£2.60
150V d.c.	£2.60
300V d.c.	£2.60
500µA	£2.60
500-0-500µA	£2.60
1mA	£2.60
1-0-1mA	£2.60

# G.W.S. G.W.SMITH & CO (RADIO) LTD

## TRIO TR2000 TRANSCIEVER

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.

OUR PRICE **£79.50** Carr. Paid

## TRIO 9R59DS RECEIVER



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.

OUR PRICE **£49.50** Carr. Paid  
FULL RANGE OF TRIO STOCKED

## UR-1A RECEIVER



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 in x 7in. Brand new with instructions.

OUR PRICE **£25.00** Carr. Paid 37p

## UNR 30 RECEIVER



4 Bands covering 550kHz-30MHz. BFO Built-in Speaker 220/240V a.c. Brand new with instructions.

OUR PRICE **£15.75** Carr. Paid 37p

## TRIO JR310 SSB RECEIVER



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.

OUR PRICE **£155.00** Carr. Paid

## 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.

OUR PRICE **£210.00** Carr. Paid

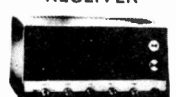
## BELTEK WS400 CAR TRANSCIEVER



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



Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic Aerial. Complete with carrying cases. SKYFON 100mW, £24.95 pair, post 50p. P302 2 CHANNEL 300mW, £52.50 pair, post 50p. P1003 3 CHANNEL 1 watt, £71.25 pair, post 50p. 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 V.A.T.

## 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.

OUR PRICE **£11.95** P. & P. 50p, plus V.A.T.

## 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 10 pin 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**
- LSH60. 3in speaker units. 8 ohms. 20-20,000Hz. Complete with zippered carrying case. **£8.50 P. & P. 30p**
- 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.

OUR PRICE **£8.95** P. & P. 50p

## EMI LOUDSPEAKERS

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. Model 450. 13in x 8in with twin tweeters / crossover. 55-13,000Hz. 5W RMS. Available 8 or 15 ohms. £3.62 each. P. & P. 25p.

## 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. OUR PRICE **£4.50** P. & P. 30p

## 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.: 8.0-16.0MHz; 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.

OUR PRICE **£6.95** P. & P. 35p

## AUDIOTRONIC ARI1000 Sportsman AM/FM Portable

5 wavebands covering A.M.: 535-1605kHz; F.M.: 88-175MHz; A.I.R.: 105-136MHz; P.B.: 147-174MHz; W.B.: 162-5MHz Large horizontal slide dial with logging scale. Slide volume and squelch controls. 7 section telescopic aerial for F.M. and built in ferrite bar for A.M. A.F.C. 3in speaker. Earpiece socket. Green leatherette covering cabinet with 219mm slide panel. Size 135 x 79 x 219mm. Battery/mains operation. OUR PRICE **£11.50** P. & P. 35p

## AUDIOTRONIC AM/FM PORTABLE RADIO AR3000

4 wavebands covering FM 87-108MHz, MW 510-1605kHz, L.W. 145-285kHz, SW 5.8-12.5MHz. Push button wave change plus AFC and on/off. Thumbwheel tuning. Slider volume and tone controls. Earphone socket. Built in and telescopic aerials. Car aerial socket. Battery/Mains operation. OUR PRICE **£14.95** P. & P. 57p

## AUDIOTRONIC DIGITAL CLOCK / AM-FM RADIO

ADC. I Covers AM 540-1600kHz. FM 88-108MHz with AFC. 24 hour fast type digital clock with one minute division. Time change. Illuminated dial. 24 hour alarm setting. Wake up to the sound of music or loud buzzer. Unique sleep switch will automatically turn off radio when you have gone to sleep. Slider volume control. Internal speaker plus socket for earpiece or pillow speaker. A.C. 240V. Size 254 x 92 x 178mm. Complete with earpiece, and operating instructions. OUR PRICE **£12.50** P. & P. 50p

# SAVE UP TO 33 1/3% OR MORE! GWS

## SH028 STEREO HEADPHONES



Outstanding value. Soft earpads, adjustable headband. 8-16 ohms. 20-20,000 Hz. Complete with lead and stereo plug.

**OUR PRICE £1.87 P. & P. 30p**

## LHO2S STEREO HEADPHONES



Lightweight headphones with padded earpieces. 4-16 ohms. 20-20,000 Hz. Complete with 6 ft cord and plug.

**OUR PRICE £1.97 P. & P. 30p**

## TE1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET



Sensitive magnetic headset with soft earpads. Impedance 2,600 ohms (d.c. 600 ohms). Frequency response 200-4,000 Hz.

**OUR PRICE £2.25 P. & P. 30p**

## DHO2S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable headband. 8 ohm impedance. 20-12,000 cps. Complete with lead and plug.



**OUR PRICE £2.25 P. & P. 30p**

## BH001 HEADSET AND BOOM MICROPHONE



Moving coil. Headphone imp. 16 ohms. Mike imp. 200 ohms. Ideal for language teaching, communications etc. Complete with leads and plugs.

**OUR PRICE £4.95 P. & P. 30p**

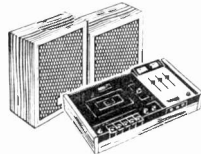
## STEREOSOUND SPEAKERS



Matched pair of bookshelf speakers. Deluxe teak veneered finish. Size 14 1/2 in x 9 1/2 in x 8 3/4 in. 8W RMS. 16W peak. Complete with DIN lead.

**OUR PRICE £12.95 Carr. Paid**

## SUPER AKAI HI FI CASSETTE BARGAIN



## STEREO CASSETTE RECORDER

For conventional or Chromium Dioxide tape. 4 track recording. Playback. Volume and tone controls. Frequency response 40-16kHz (using CrO<sub>2</sub> tape), distortion better than 2%, wow and flutter better than 0.3% RMS. Complete with pair of matching Akai CS88 speakers. Rec. Price £96-10.

**OUR PRICE £56.50 P. & P. 50p**

**MICROPHONES (P. & P. 50p) ADM Dynamic (pair) £7.50.**

## AUDIOTRONIC ACR14 BATTERY MAINS CASSETTE RECORDER

Portable twin track mono recorder with automatic recording level control. Built in speaker. Ear piece. Input for radio or record player. Fast forward and rewind. Output 500mW; 220/240V a.c. or 6V d.c. operation. Complete with remote control microphone, mains lead, earpiece and batteries.

**OUR PRICE £10.50 P. & P. 50p**

## FANTASTIC OFFER! PORTABLE CASSETTE RECORDER CT5050

Instant recording and playing. Piano key controls. Automatic level control. Built in speaker. Complete with remote control, microphone, carrying case and shoulder strap.

**OUR PRICE £8.50 P. & P. 50p**

## AUDIOTRONIC LOW NOISE CASSETTES

Top Hi-Fi quality in library cases

TYPE	5	10	25
C60	£1.29	£2.53	£5.99
C90	£1.95	£3.82	£9.59
C120	£2.99	£4.48	£10.88

P. & P. 15p Post Free

## RECORD DECK PACKAGES

Carriage and Packing 75p  
Complete units with Stereo cartridge ready wired in plinth and cover.

GARRARD	
2025 TC/9TAHCD	£11.35
SP25 111/G800	£16.50
SP25 111/M44E	£17.95
SP25 111/M44-7	£17.50
SP25 111/M55E	£18.50
SP25 111 Module/M75-6	£19.45
AP76/G800	£26.45
AP76/G800E	£28.65
AP76/M44E	£27.70
AP76/M44-7	£27.20
AP76/M55E	£28.30
AP76/M75E	£34.90
AP76/M75EJ	£30.90
AP76 Module M75-6	£29.10
AP76 Module (less cartridge)	£23.75

868B Module/M70-68M	£32.30
AP96 Module M75-6	£33.20
ZERO 1008 Module/M93E	£44.15
ZERO 1008B Module/M70-68M	£44.20

B.S.R. McDONALD	
210/SC7M	£7.40
MP60/G800	£16.60
MP60/TPD1/ADC K8	£16.80
MP60/M44-7	£17.50
HT70/TPD1/G800	£18.20
HT70/TPD1/ADC K8	£18.10

## RECORD DECKS

Carriage & Packing 50p	
B.S.R. McDONALD	
C114 Mini	£3.95
C129 Mono	£5.60
C137	£7.00
510/TPD1	£18.95
610	£15.45
610/TPD1	£15.45
710	£21.15
810	£28.30
MP60	£28.25
MP60/G800	£10.90
MP60/TPD1	£18.50
MP60/TPD2	£13.55
HT70	£11.60
HT70/G800	£14.25
HT70/TPD1	£16.85

CONNOISSEUR	
BD1 KK	£9.10
BD1 Chassis	£11.35
BD2/SAL2/Plinth/Cover.	£28.70

GARRARD	
2025 T/C Less Cartridge	£6.35
2025 TC/K840A	£6.95
SP25 111	£9.25
SP23111/G800	£10.95
SP25/M75-6	£13.90
AP76	£18.00
SL65B	£11.15
SL72B	£17.75
SL95B	£31.15
401	£24.35
ZERO 1008	£34.90
ZERO 1008B	£27.00

GOLDRING	£22.50
(499)	£22.50
G101P/C	£22.50
GL69/2	£16.75
GL72	£25.45
GL79P	£38.75
GL75P	£41.85
GL78 P/C	£58.25
GL85P/C	£72.00

THORENS	
TD125/11	£59.40
TD125AD/11	£92.05
TL165	£55.80
TL165	£48.80

## SINCLAIR CAMBRIDGE CALCULATOR

To build yourself. Complete kit of parts with step by step instructions to build a full specification pocket sized calculator.

**OUR PRICE £24.95**

P. & P. 50p (Also available ready built (Rec. Price £29.95).

**OUR PRICE £27.20 P. & P. 25p**

## MINUTEMAN MM3 POCKET CALCULATOR

Size only 4 1/2 in x 3 in x 1 in. 8 digit display with overflow and error indicators. Floating decimal. Adds, subtracts, multiplies and divides. Chain and mixed calculations. Constant factor for series multiplication or division. Complete with batteries, instructions and case.

**OUR PRICE £23.95 P. & P. 25p**

**OUR PRICE £28.50 P. & P. 25p**

as above with addition of memory key, percent key and a fixed or floating decimal. Complete with rechargeable batteries, a.c. adaptor, instructions and case.

**OUR PRICE £28.50 P. & P. 25p**

## AUDIOTRONIC DOLBY UNITS

**OUTSTANDING VALUE!**

Reduce tape hiss by 3dB at 600Hz, 6dB at 1200Hz and 10dB for all frequencies above 3000Hz. Size 1 1/2 in x 5 in x 3 1/2 in. a.c. 00/250V2.

**PROCESS TWO**  
For use with cassette and tape recorders. Freq. res. 30Hz—20kHz ±2dB. 8/N of tape monitoring. Switchable multiplex filter. Two Dolby calibration meters. 8/N better than 70dB. Supplied with test cassette or tape as required.

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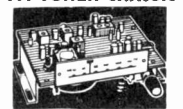
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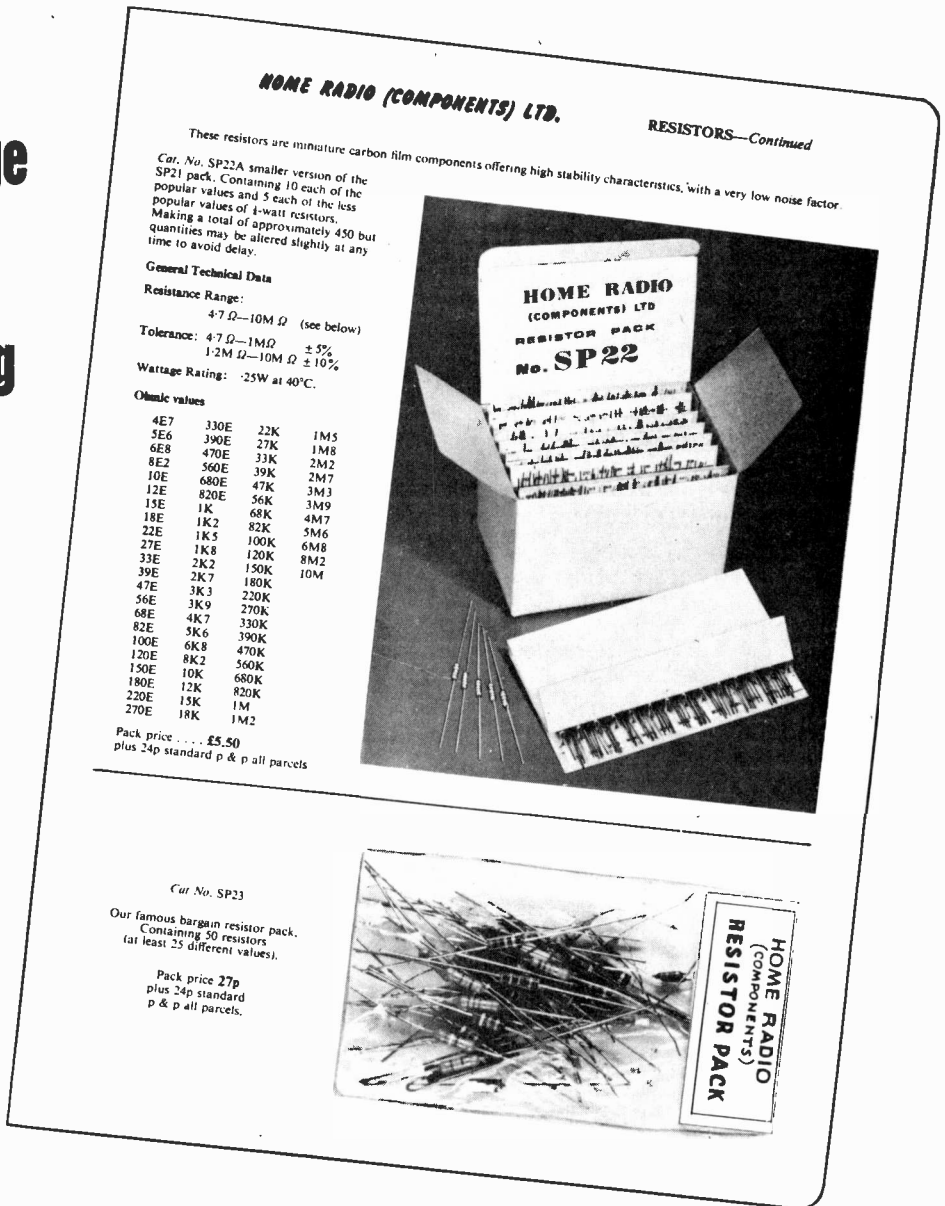


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## TWENTY-FIVE YEARS ON

**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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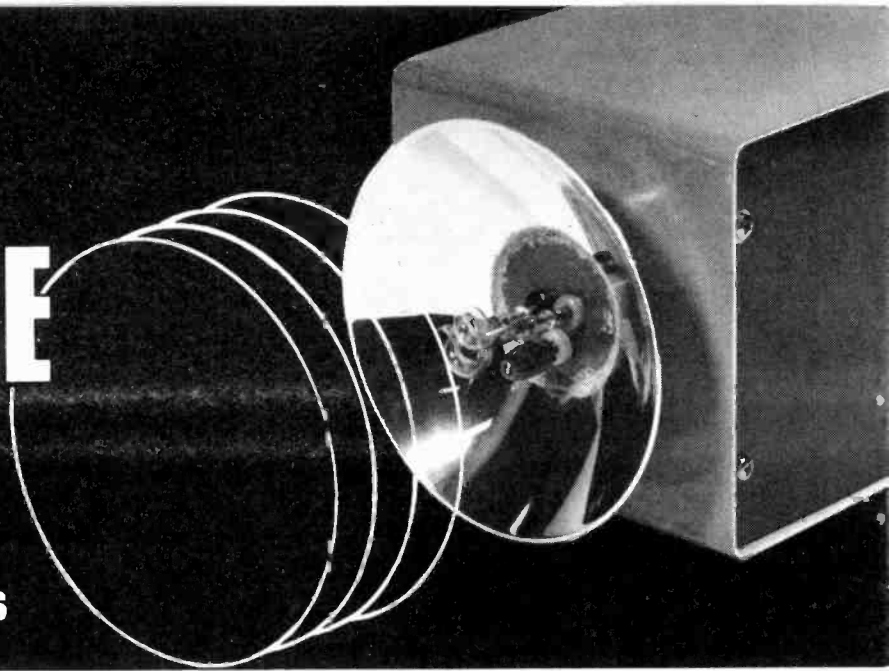
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# PARTY STROBE LIGHT

BY M. HUGHES



**T**HIS strobe 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



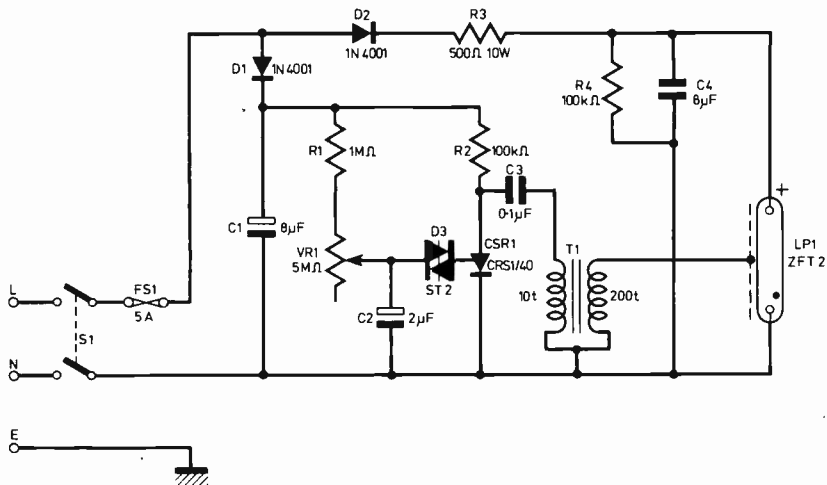


Fig. 1. Circuit diagram of the Party Stroboscope. Note that the case is connected to mains earth

maximum dissipation of 10 watts. It is possible to obtain tubes having a high permitted dissipation but these are quite expensive, particularly those made from quartz.

We can calculate dissipation by multiplying flash energy by the maximum frequency of flashing, with the stroboscope this is  $0.48 \times 20 = 9.6$  watts.

Since this represents nearly the limit of the tube, experimenters should not try to get more light output by increasing the value of C4 without limiting the maximum flash rate proportionally.

Before describing the trigger system, which forms most of the circuitry, a word about R3. The value is reasonably important because it prevents the main capacitor charging before the discharge tube is completely de-ionised; at the same time it must be of low enough a value to ensure that C4 is fully charged before the next trigger pulse. Quite high peak currents flow through this resistor so it should be of at least 10 watts rating and even so will get quite warm in use.

## TRIGGER SYSTEM

To produce the trigger pulses there must be a timing circuit that is adjustable in the range from  $\frac{1}{2}$  second to  $\frac{1}{20}$  second. D1 and C1 form a simple auxiliary d.c. supply of about 350V. C2 will charge up towards 350V and the rate of charge is controlled by the value of R1 and VR1—as the latter is adjustable we can vary the charging rate. In actual fact the potential across C2 will never reach 350V because as soon as it reaches about 25V the diac D3 will start to conduct and any charge held on C2 is applied to the gate electrode of the thyristor.

As soon as C2 is completely discharged the diac becomes non conducting and C2 is able to charge back up towards the 350V. This is a repetitive cycle and the timing is controlled, as we have already said, by the time constant of C2 with the charging resistors but also by the differential between the breakdown voltage of the diac and the potential towards which C2 is charging. Different diacs—particularly the cheaper ones—may have slightly different breakdown voltages so there may be some

variance in timing between different assemblies. This can be compensated for in practice by increasing or decreasing the value of C2. Increase its value if you require a slower repetitive cycle and vice versa.

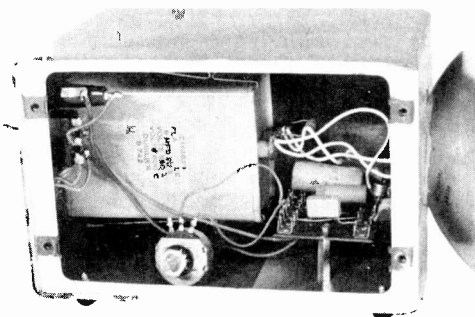
It is most important that you do not exceed a flash rate of 20Hz because you might exceed the power rating of the tube.

## TURN ON

The discharge current from C2 through D3 into the gate of the thyristor causes the thyristor to turn on. C3 has been charged to 350V through R2 and when the thyristor turns on this is discharged through the circuit C3, CSR1, and the primary of T1. The instantaneous current is quite high and the rate of change of flux in the primary of T1 causes a very high voltage pulse across the secondary windings (approximately 7,000V). This pulse is fed to the trigger electrode of the discharge tube.

Component values have all been carefully chosen so that everything happens in the correct time sequence, e.g. C4 and C3 must be fully charged before the highest rate of trigger pulse is generated by C2 and the diac circuitry so do not use values other than those specified.

R4 is a bleed resistor across the main capacitor to ensure that when the unit is switched off any



The strobe unit with a panel removed showing the large paper capacitor (C4)

## 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

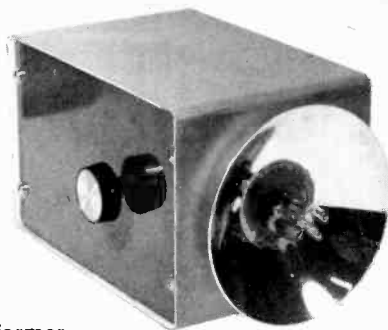
- C1 8 $\mu$ F elect. 500V
- C2 2 $\mu$ F elect. 200V
- C3 0.1 $\mu$ F 400V polyester
- C4 8 $\mu$ F 500V paper

### 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.

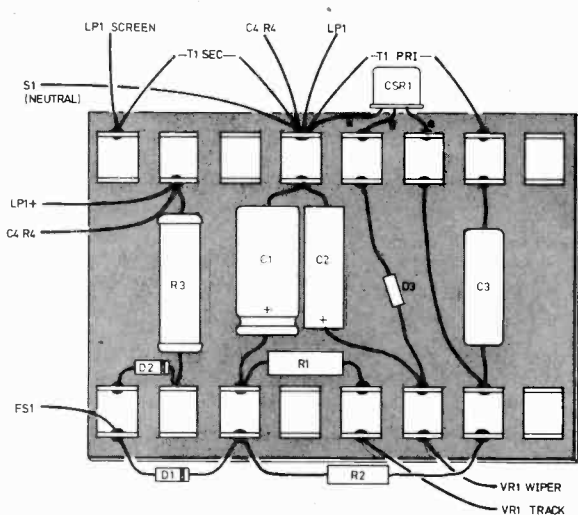


Fig. 2. Component wiring and assembly on group board. Stand-off spacers should be used when connecting to case.

## 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.

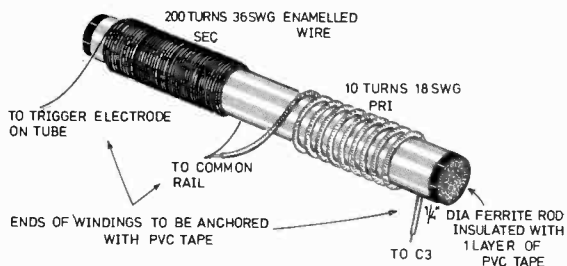


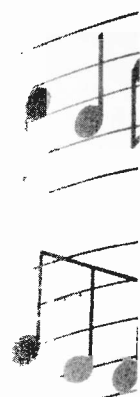
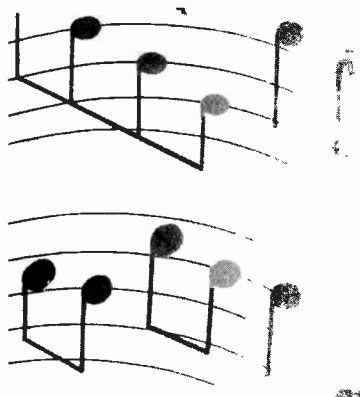
Fig. 3. Winding details of trigger transformer. Both windings are wound in the same sense

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.

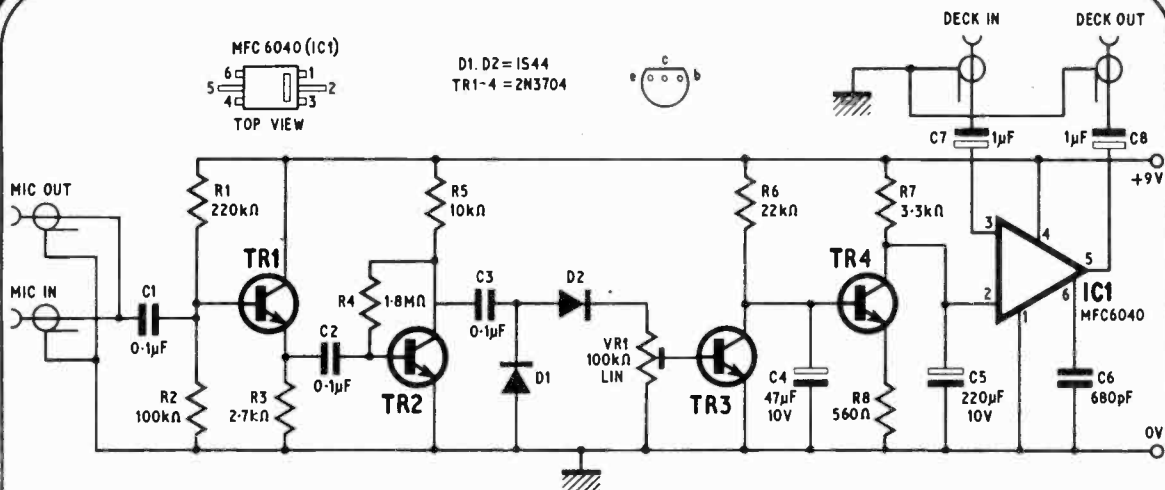


Fig. 1. Circuit diagram of the complete fader which is based on the Motorola MFC 6040 attenuator integrated circuit

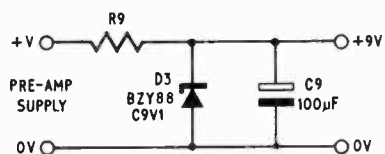


Fig. 2. Circuit of a simple power supply for use with the fader

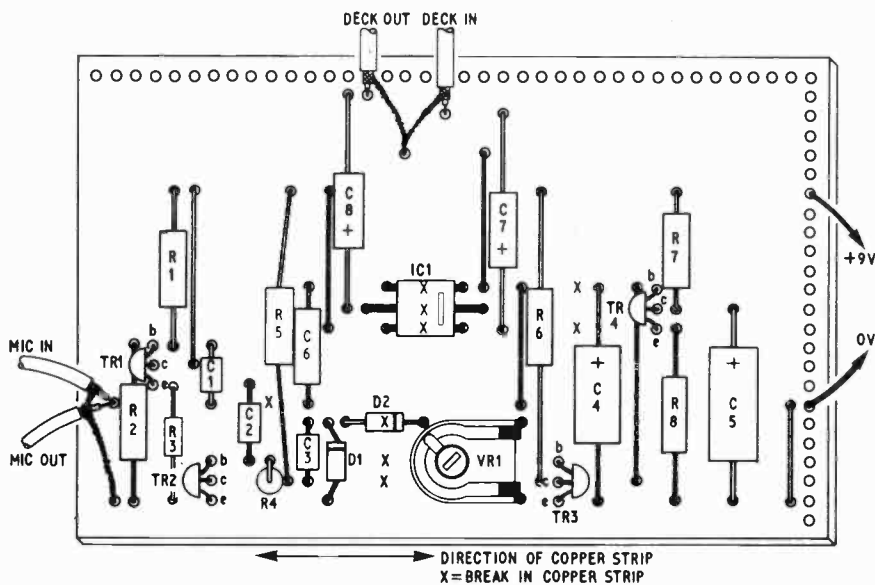


Fig. 3. Component layout and 0.1 in track Veroboard cutting details

## 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

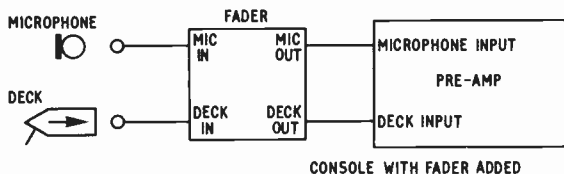
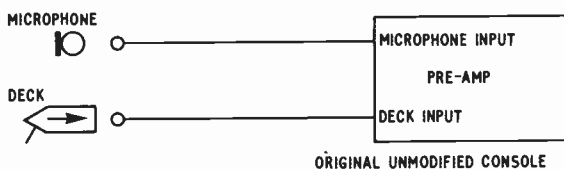


Fig. 4. Discotheque console circuit with and without voice operated fader

### 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...



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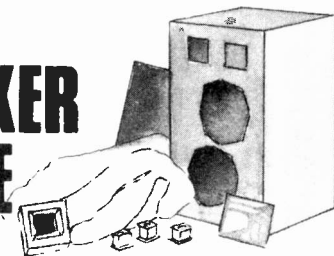
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# PRACTICAL ELECTRONICS

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# 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-

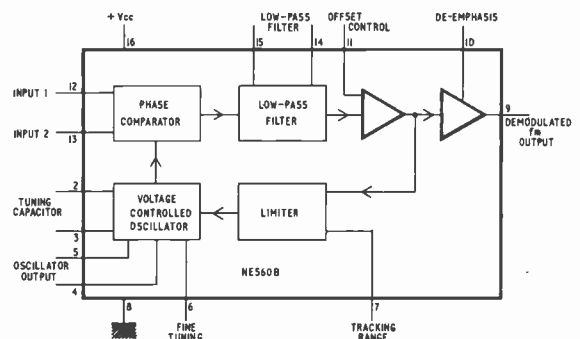
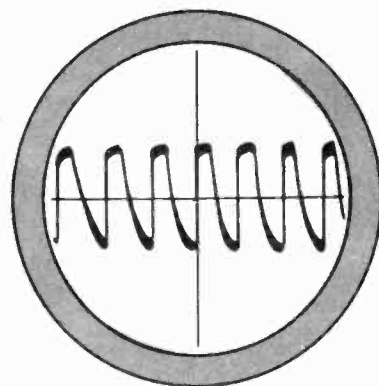


Fig. 3.1. Block diagram of the NE560B phase locked loop. The numbers refer to pins on the dual-in-line versions

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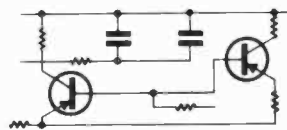
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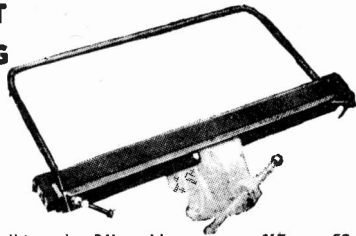
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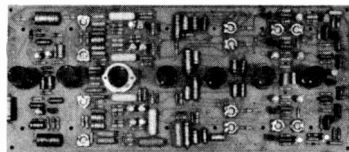
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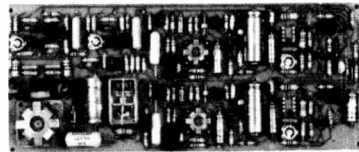
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220/40	6p	220/40	12p	0.47/35	12p	0.022	3p				
220/50	6p	226/63	18p	1.0/35	12p	0.033	3p				
330/10	6p	330/10	6p	1.5/35	12p	0.047	3p				
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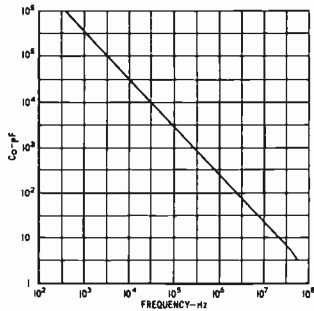
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**Fig. 3.2. Graph showing the relationship between the centre frequency and the value of the timing capacitor**

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

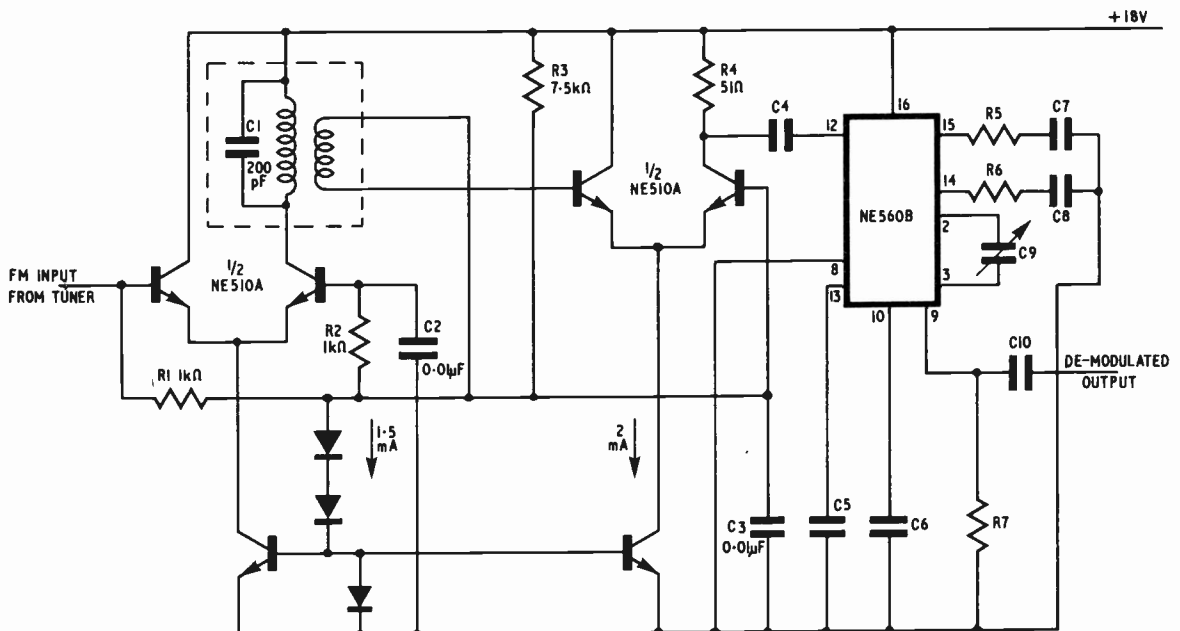
In order to illustrate the usefulness of phase locked loops some circuit diagrams will be given. Whilst it is not possible to give sufficient detail for the systems to be built it is hoped that the information given will give the reader an appreciation of the practical aspects of phase locked loop i.c.s.

## F.M. DEMODULATION

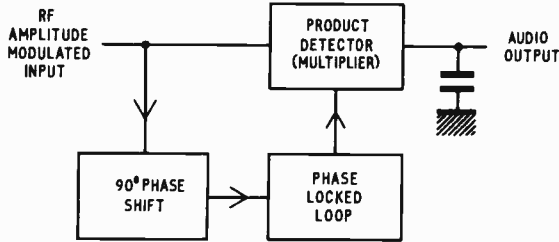
A phase locked loop can replace almost the whole i.f. strip, limiter and f.m. detector of a conventional receiver. A typical circuit using the NE560B as f.m. demodulator with an i.f. amplifier and limiter is shown in Fig. 3.3.

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.

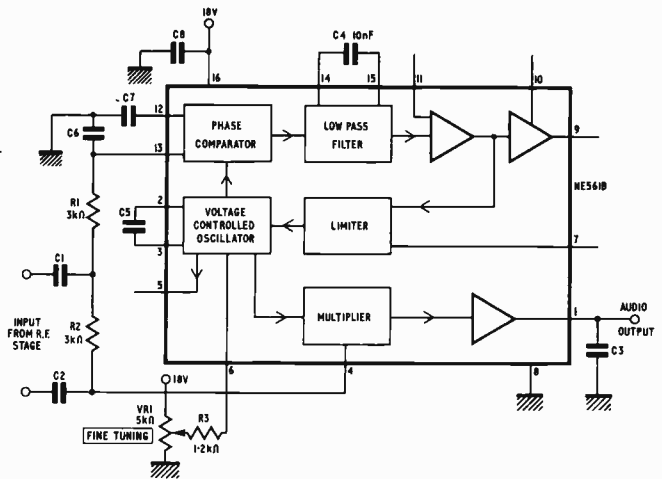
The frequency of the loop is set by the variable capacitor C9 which is connected between pins 2 and 3 so that the centre frequency becomes approximately equal to the signal frequency. The value of C9 may be estimated from Fig. 3.2.



**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

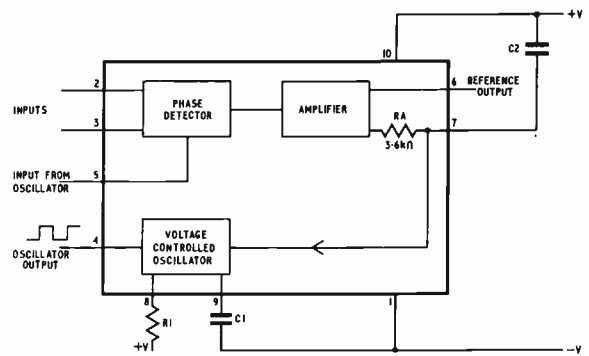
One of the best known low frequency phase locked loops is the 565 device. This is available as the Signetics NE565A device and as the National Semiconductor LM565CN device in a 14 pin dual-in-line encapsulation. The NE565K and the LM565CH are electrically equivalent devices in a TO-99 circular encapsulation.

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



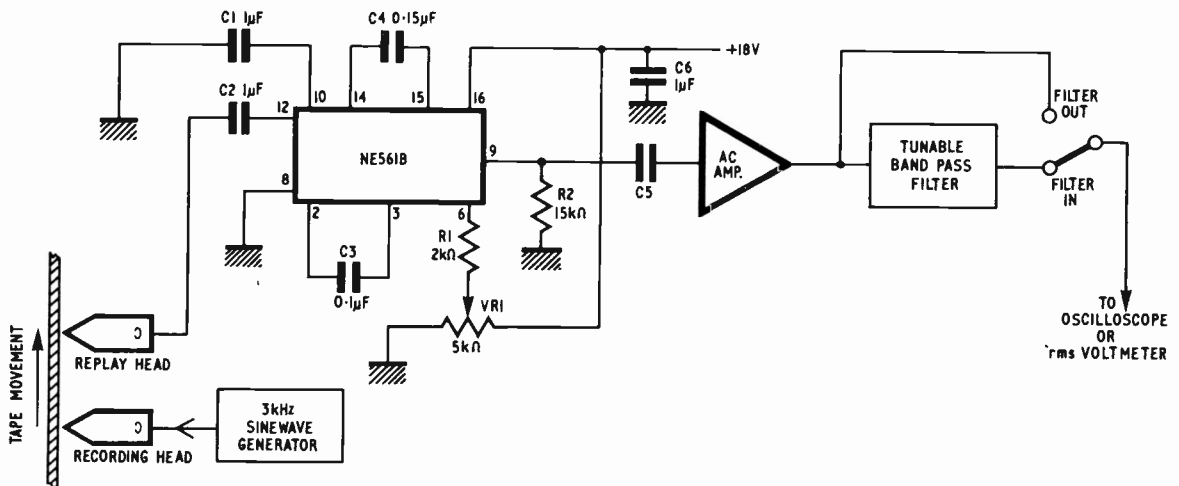
**Fig. 3.6. Block diagram of the 565 low frequency phase locked loop. This is the pin numbering for the NE565A (Signetics) and the LM565CN (National Semiconductor), both 14 pin dual-in-line**

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.

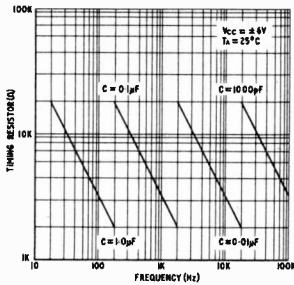
The free-running frequency of the voltage controlled oscillator is only partly determined by the value of the timing capacitor C1. The frequency can be changed over a range of at least 10:1 using a single value of C1 by varying the value of R1 in the pin 8 circuit; alternatively the value of the current 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 2k $\Omega$  and 20k $\Omega$ , the optimum being about 4k $\Omega$ .

When using power supply lines which are symmetrical with respect to ground, the range of voltages which may be employed is  $\pm 5V$  to  $\pm 12V$ . When  $\pm 6V$  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  $\pm 60\%$  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

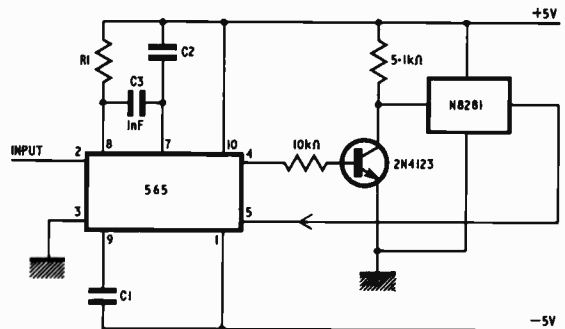
Phase locked loops can be used to detect changes of frequency. Such changes can be produced when the coil of a tuned circuit approaches a piece of metal. Phase locked loops can therefore be used in metal detectors.

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.

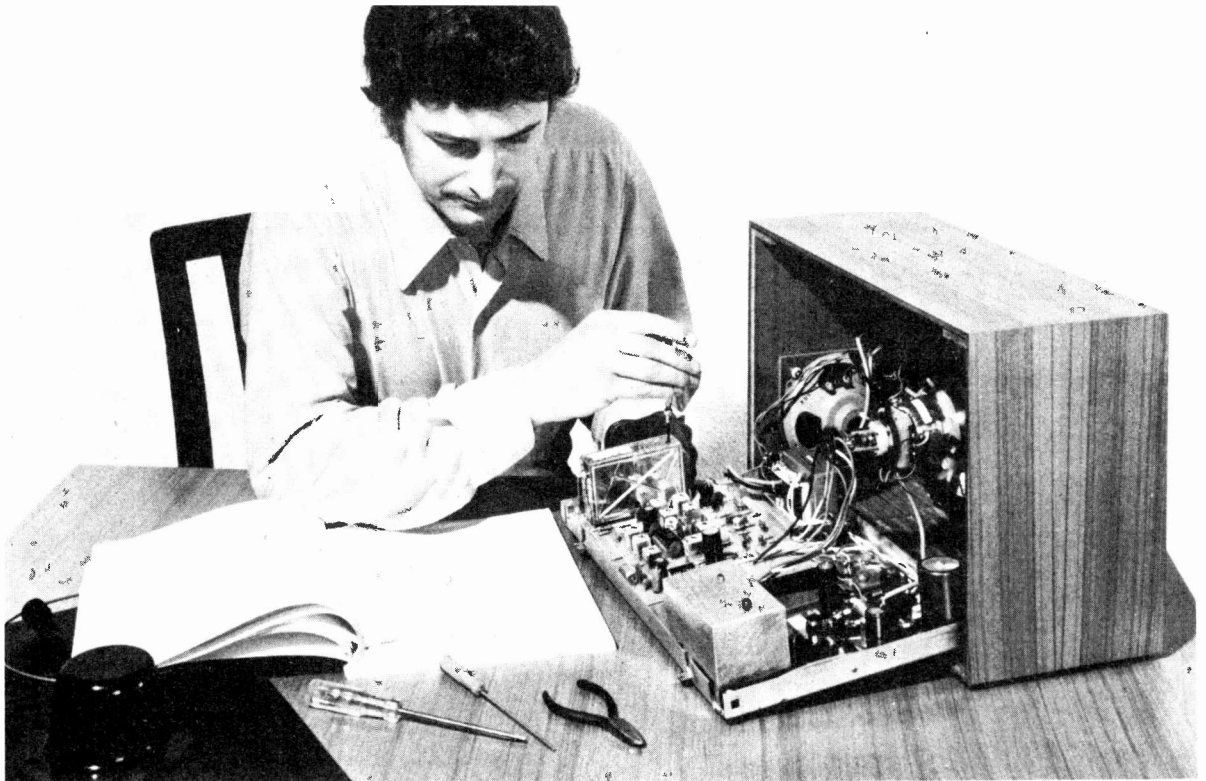
This oscillator is coupled by C3 into the input of the 565 circuit (pin 2). A current source (TR2 and TR3) is employed to supply most of the current of about 2.5mA which passes to pin 8 and which equals the charging and discharging current of C4. The use of this current source increases the output of the loop at pin 7 to about 0.5V for a 1% frequency deviation. (This follows from the fact that the 20k $\Omega$  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  $\pm 100\mu\text{A}$  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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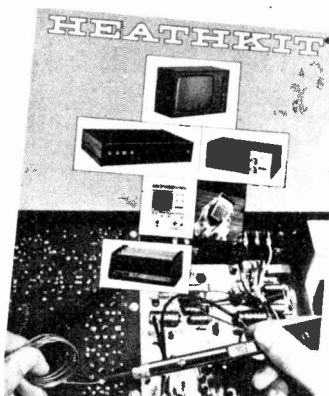
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220µF	6½p	100µF	6½p	2000µF	43p			4.7µF	6½p
330µF	6½p	220µF	8p	3300µF	38p			6.8µF	6½p
1000µF	13p	330µF	10p	6800µF	65p	40 VOLT		10µF	6½p
4700µF	29p	470µF	10p			6.8µF	6½p	22µF	6½p
		1000µF	11p	25 VOLT		15µF	6½p	68µF	10p
		1500µF	20p	10µF	6½p	33µF	6½p	100µF	11p
		2200µF	24p	22µF	6½p	47µF	6½p	150µF	13p
				47µF	6½p	100µF	9p	220µF	19p
		16 VOLT		100µF	8p	220µF	11p	330µF	22p
		15µF	6½p	150µF	8p	470µF	19p	470µF	26p
		33µF	6½p	220µF	10p	680µF	25p	1000µF	44p
		68µF	6½p	470µF	13p	1000µF	25p		
		150µF	18p	680µF	20p	2200µF	44p		
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range 10 ohms to 4.7 megohms.  
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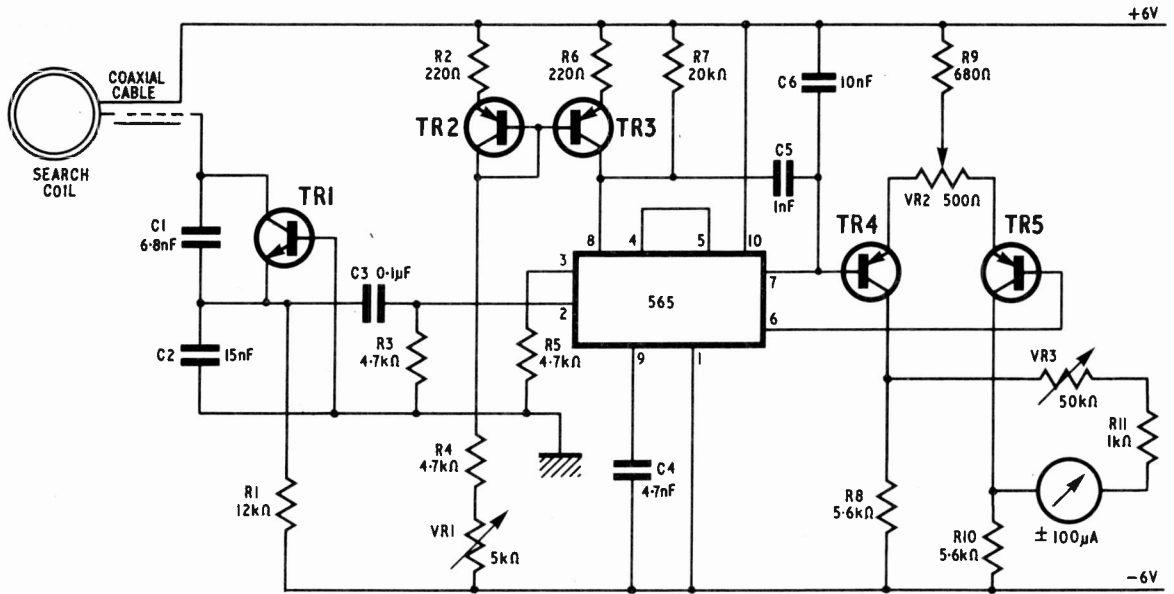


Fig. 3.9. A metal detector using the 565

### 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.

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.

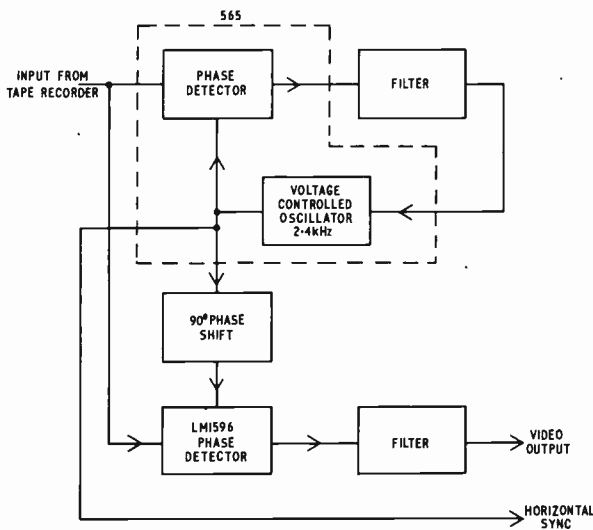


Fig. 3.10. A system for demodulating video signals from the 2.4kHz sub-carrier which is used by weather satellites

### 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.

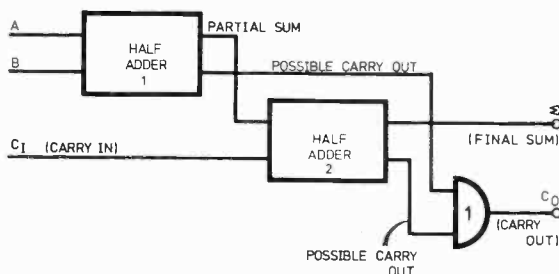


Fig. 8.1. Two HALF ADDERS are combined to form a FULL ADDER.

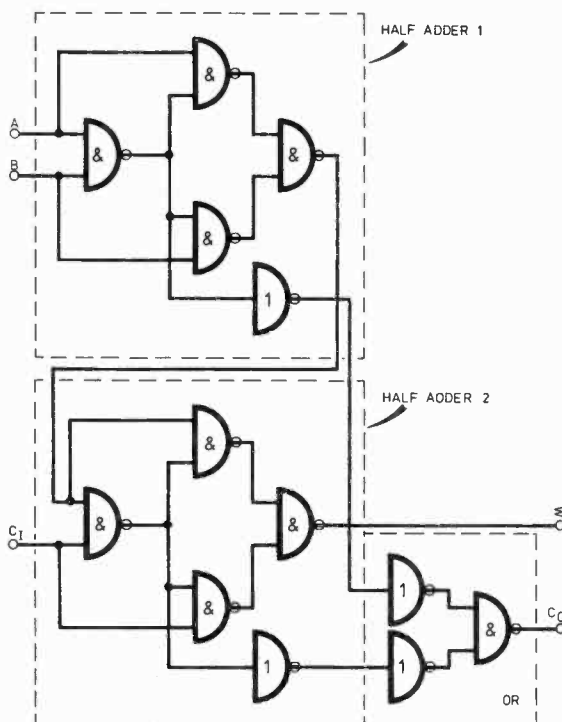


Fig. 8.2. A FULL ADDER using blocks of logic in unsimplified form. Note the two sets of double inversion before the final NAND gate in the  $C_0$  line.





# BOOK REVIEWS

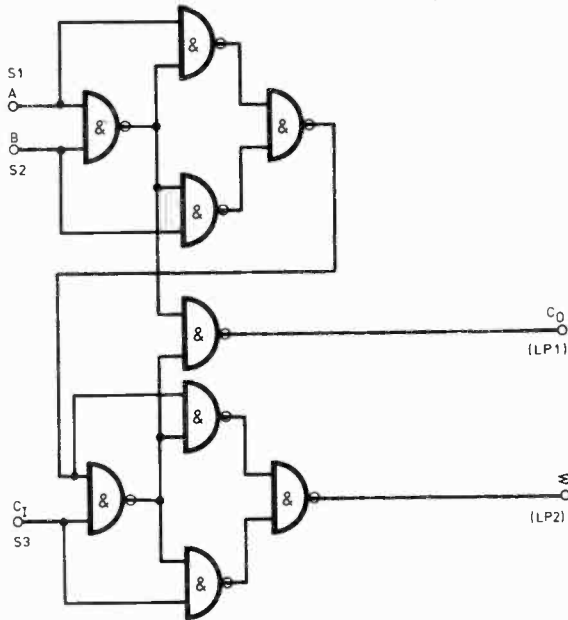


Fig. 8.3. A FULL ADDER that can be built on the Logic Tutor

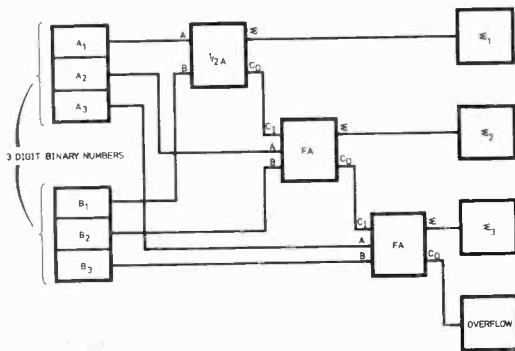


Fig. 8.4. Block diagram of a parallel adder capable of summing two, three-digit binary numbers to give a three- or four-digit answer

## MULTIDIGIT NUMBERS

In practice we have to add multidigit numbers together and the simplest way of doing this is to cascade FULL ADDERS—one after the other. The carry out from the previous column is connected directly to the carry in of the next. Fig. 8.4 is a block diagram of such a summing unit.

A<sub>1</sub> and B<sub>1</sub> are the least significant digits of the respective multidigit numbers and because of this they only need a HALF ADDER to produce a true sum and carry; however, all higher order digits have to be combined in FULL ADDERS.

You would need as many adding stages as there are digits when carrying out the process in parallel form consequently a parallel adder can be quite expensive but it is very fast in operation. A cheaper form is the serial adder (not shown in this series) but there is rather more complexity in handling the carry signals.

★  
by M. J. Hughes

## HOW TO LISTEN TO THE WORLD. 7th EDITION

By J. M. Frost  
Published in the U.K. by Fountain Press  
160 pages, 9in × 6in. Price £1.90

WHILST not exactly filled with "do it yourself" information on the making and using of radio receiving equipment, it does contain considerable information of general interest.

For example, how many people know the frequencies and addresses of a variety of Irish "pirate" stations currently in operation? A section of this volume provides details of a number of revolutionary stations throughout the World and gives information on their mode of operation.

On the technical side there is some interesting discussion on the use of front-end tuners for RX equipment, together with details of some the reader can make. Other chapters cover medium wave working, improving a second-hand set, working South America and a listing of the major broadcast stations.

R.D.R.

## PHOTOCELL APPLICATIONS

Published by English Universities Press  
52 pages, 11½in × 8½in. Price £1.05

AS AN introduction to electronics, photocells of various types provide an excellent starting point as they are easy to understand, they have a multitude of applications and are relatively cheap.

Only a basic knowledge of electronic principles is assumed and practical points such as resistor colour code and circuit symbols are fully covered. The projects range in complexity from a simple exposure meter to a modulated light transmitter and receiver.

Through this book the reader can obtain not only a knowledge of photocells but also other electronic components such as transistors, and thus can discover some of the fascination of electronics.

S.R.L.

## IBA TECHNICAL REVIEW—DIGITAL TELEVISION

Published by the IBA  
64 pages, 9in × 7½in

IN THIS the third of the IBA's Technical Reviews an extremely interesting account of the IBA Engineering Section and its work on digital television is presented. The book includes descriptions of the recent work of the IBA in developing digital standards converters, among them the first digital intercontinental conversion equipment (DICE) now in operational service at Independent Television News.

This book is written by members of the IBA Engineering staff and provides a valuable insight into the design techniques and philosophy behind some interesting projects.

Copies of this book may be obtained on request from: IBA Engineering Information Service, 70 Brompton Road, London, SW3 1EY.

S.R.L.



# PE RONDO 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

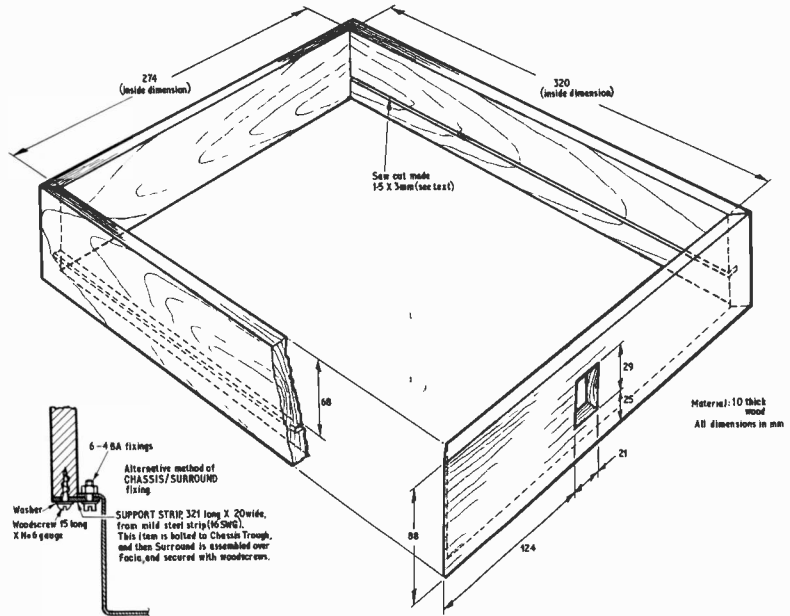
The P.E. RONDO quadraphonic system is quite complex and, if not carefully wired, will result in an untidy maze. It is therefore strongly recommended that a prefabricated wiring harness, or cableform, be made to cover the bulk of the inter-unit wiring.

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.

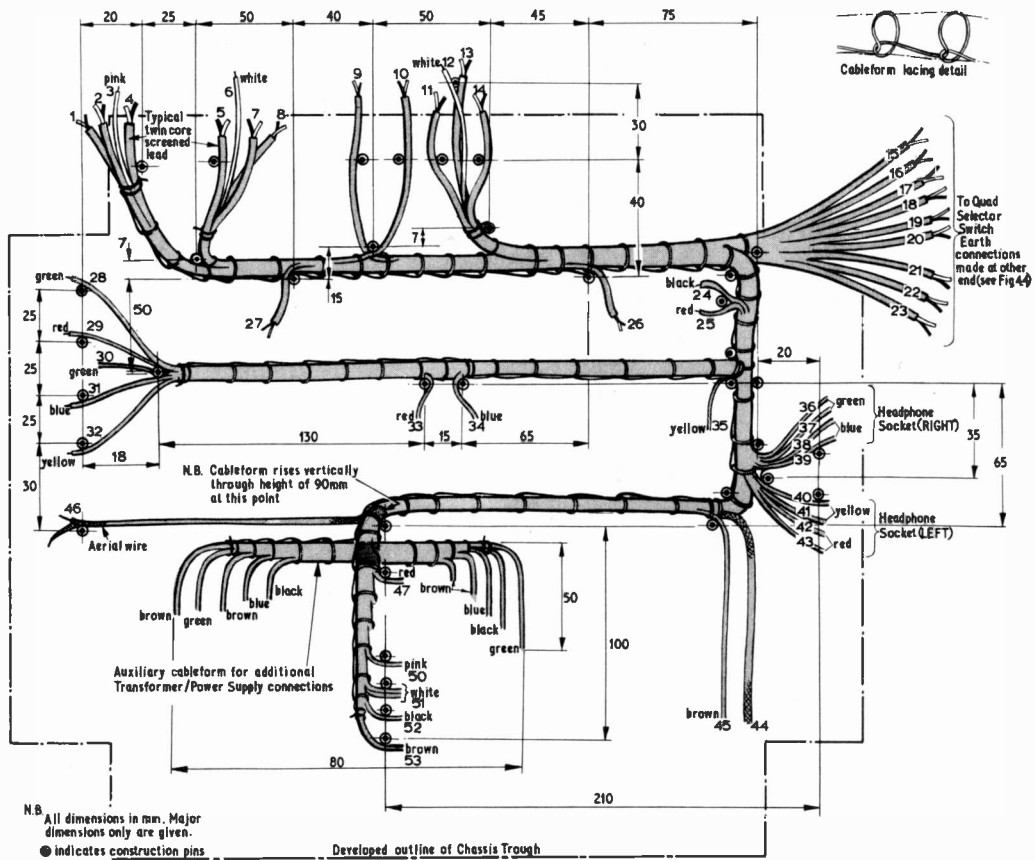
When assembling the cableform make certain that each wire or cable is inserted in the order given in Table 4.1, since otherwise both simple mechanical and electrical problems can arise.



# 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.

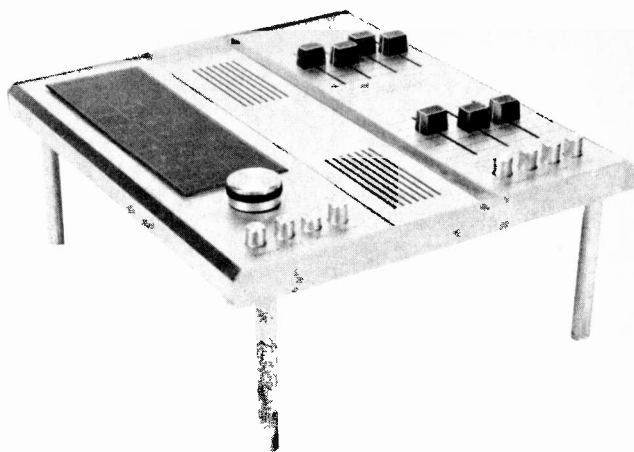
After lacing, the cableform is gently eased from the pins and is now ready for positioning in the trough.

### 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	L <sub>B</sub> O/P									} "				
34	39	"										} Red			
39	31	R <sub>F</sub> O/P											} Green		
33	43	"												} "	
43	29	"													} Brown
30	36	R <sub>B</sub> O/P													
36	28	+18V Rail													
53	45	"													
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.

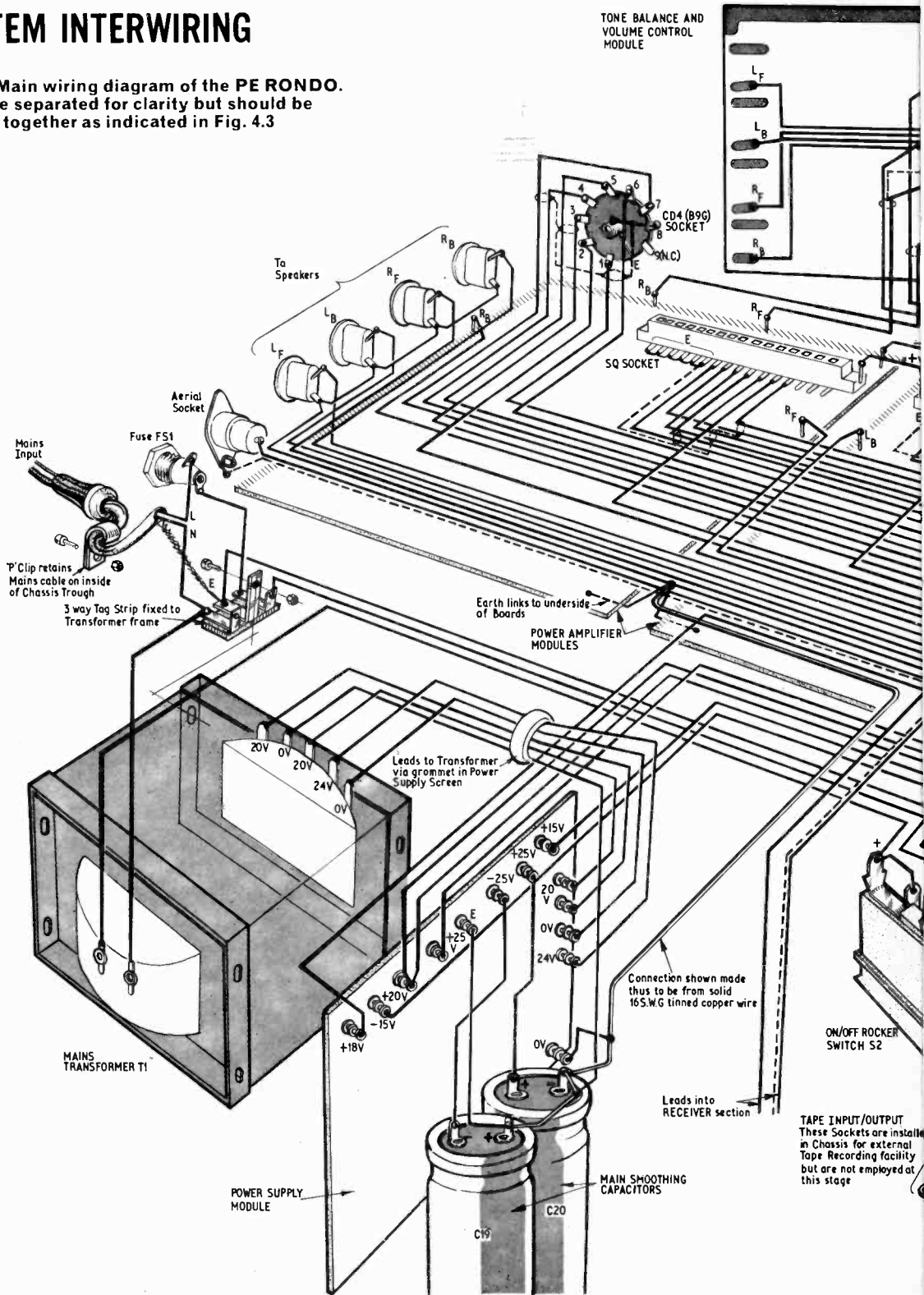
It is therefore recommended that the constructor either takes great care under these circumstances or adopts the use of a new style of socket which has just come onto the market. The new socket interposes a load in series with the headphones in order to limit the output level and current to a safe value.

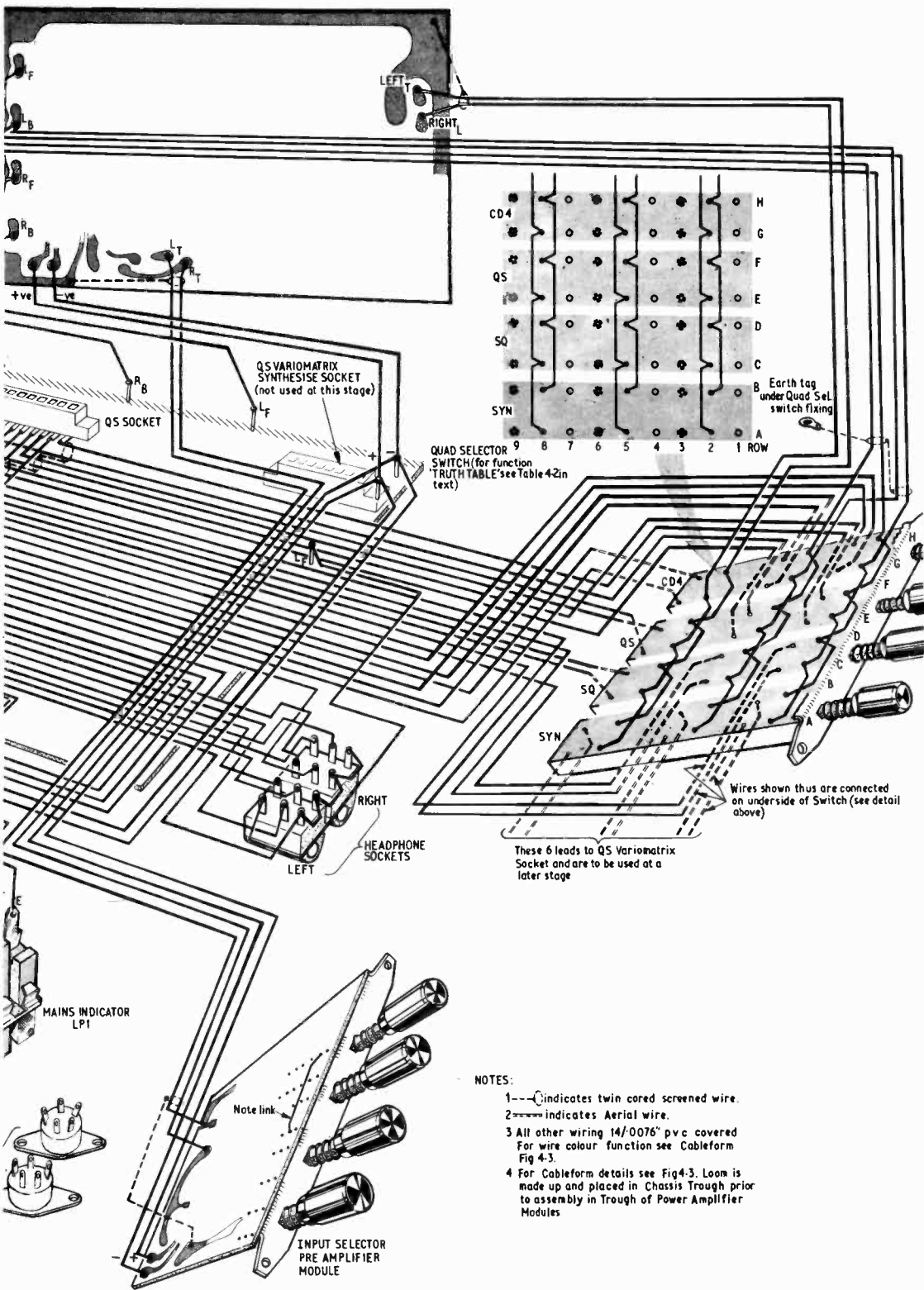
Using the new sockets, a suitable load resistor for most applications is 220Ω,  $\frac{1}{4}$ W.

# 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

TONE BALANCE AND  
VOLUME CONTROL  
MODULE





QUAD SELECTOR SWITCH (for function 'TRUTH TABLE' see Table 4-2 in text)

QS VARIOMATRIX SYNTHESISE SOCKET (not used at this stage)

Wires shown thus are connected on underside of Switch (see detail above)

These 6 leads to QS Variomatrix Socket and are to be used at a later stage

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  $\frac{1}{2}$ 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.

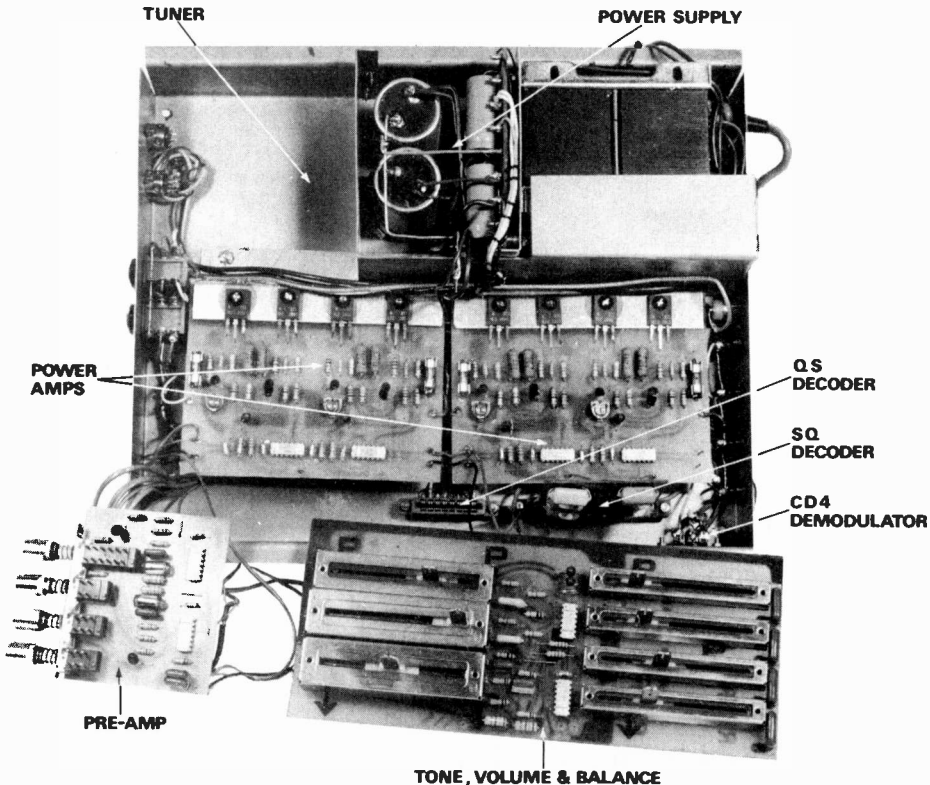
The nine pairs of screened leads protruding from the right-hand front of the wiring harness are carefully stripped and identified. Connection of these leads to the switch bank is carried out with reference to the figure.

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

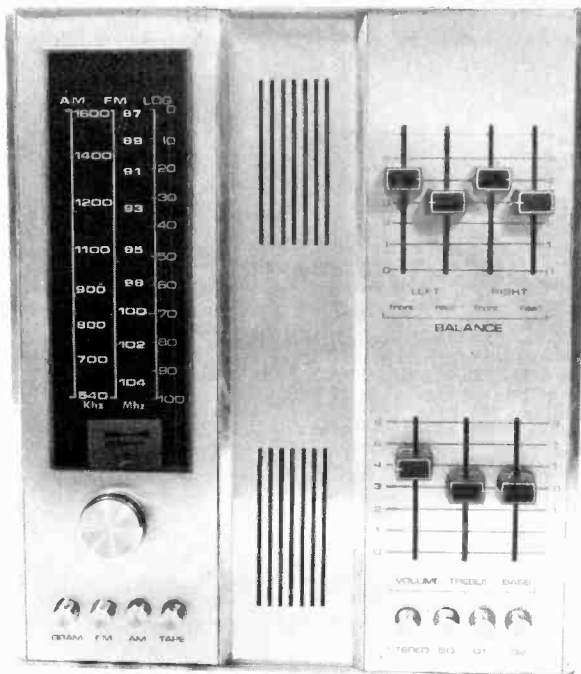
32ft 14/0-0076in stranded single p.v.c. (yellow 3ft, blue 3ft, red 5ft, green 5ft, white 5ft, pink 3ft, brown 6ft, black 2ft)  
20ft twin screened lightweight audio wire  
2ft single screened light co-ax.  
8ft lacing cord  
Mains lead 3-core to suit  
2ft tinned copper 16 s.w.g. wire

### 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.

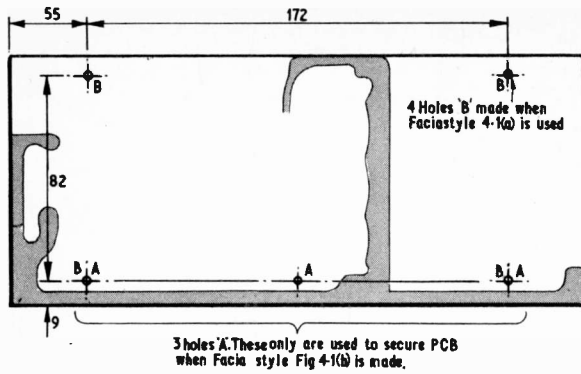


Fig. 4.5. Drilling details of the Tone/Master volume board to suit the facia of Fig. 4.4a.

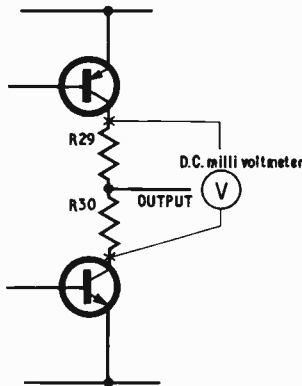


Fig. 4.6. Location of the test points for measurement of the quiescent current in the power amplifiers

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-

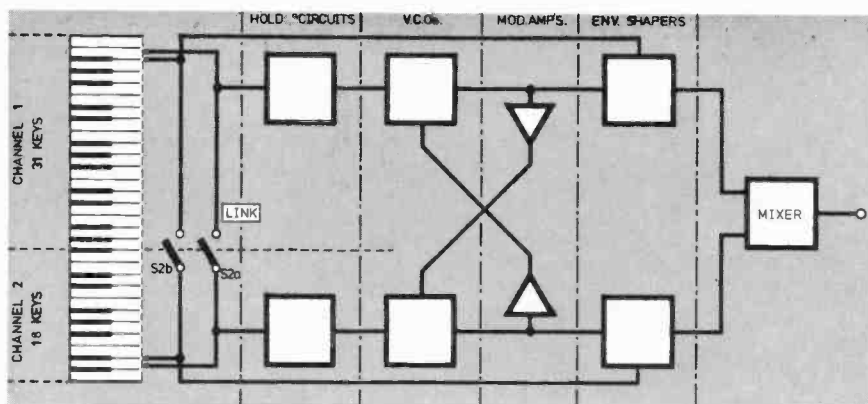


Fig. 11.1. Block schematic of keyboard unit

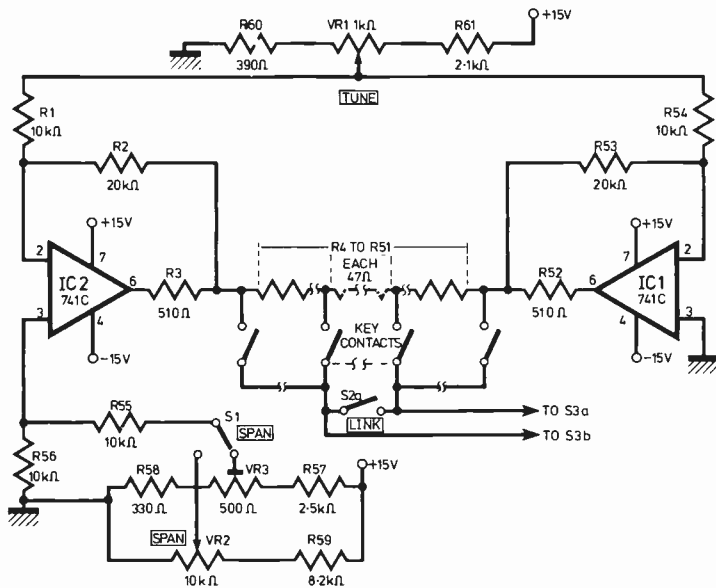


Fig. 11.2. Keyboard divider network

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

## 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

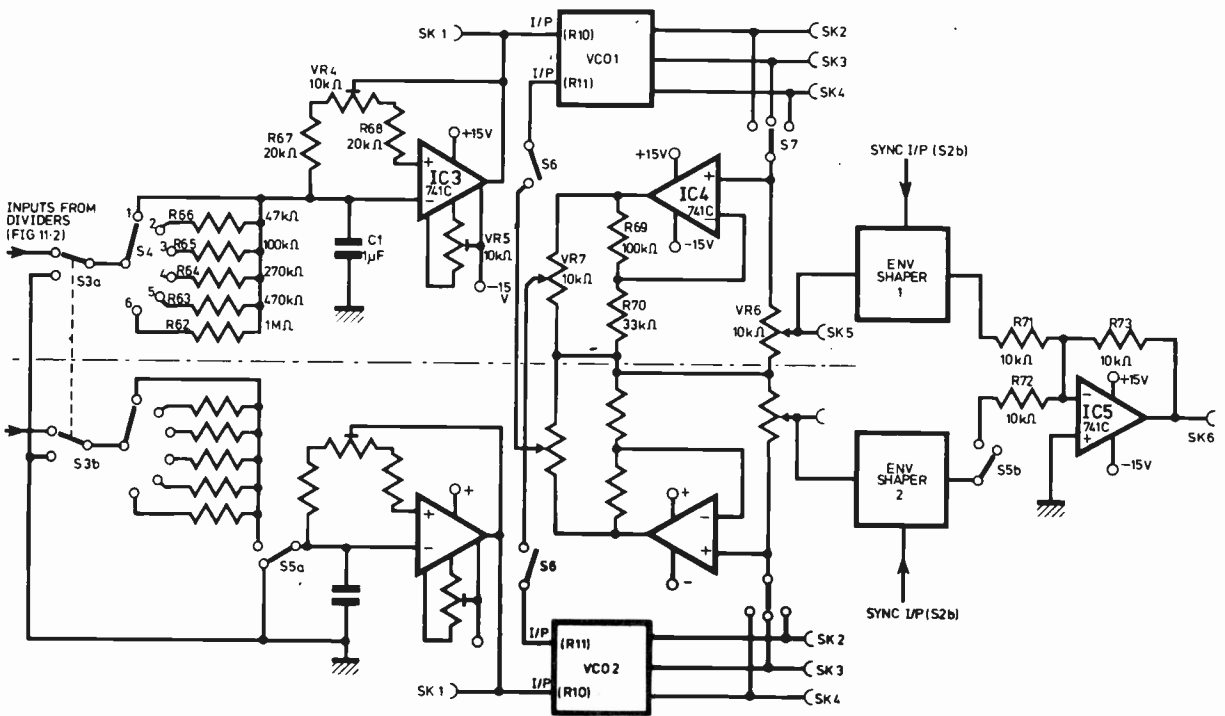


Fig. 11.3. Circuit of hold, modulation amplifier and mixer for both channels with v.c.o. interconnections. The component values for the mirrored hold and modulation amplifier circuits are identical

## 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

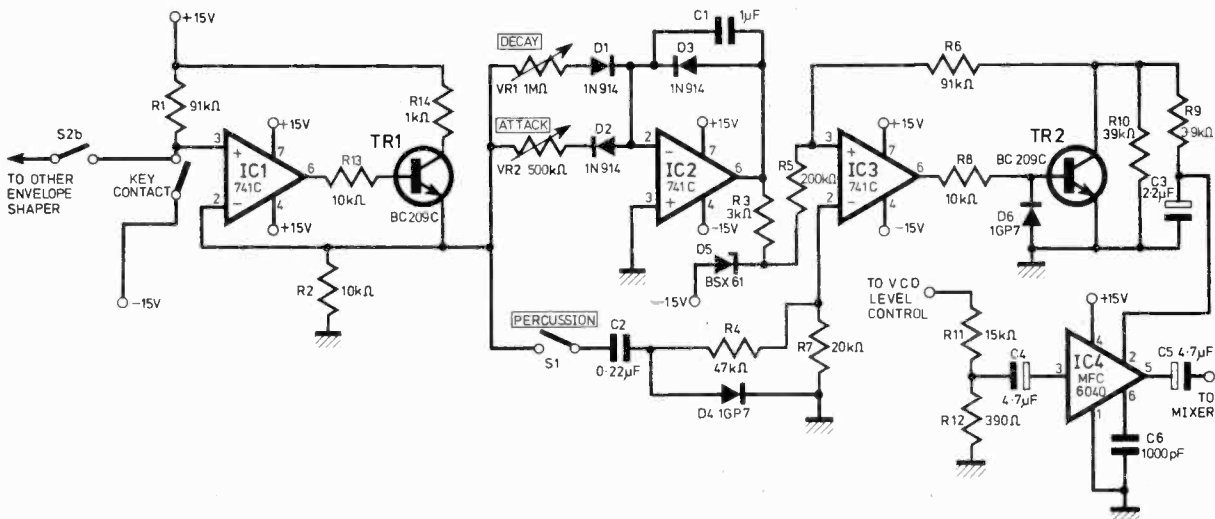


Fig. 11.4. Circuit of keyboard envelope shaper and voltage controlled amplifier

## 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

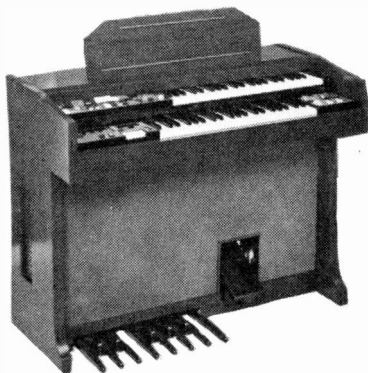
**S**TUDENTS of the Hammond organ can usually detect aurally which models use tone wheels and which use integrated circuits. The "Concorde", introduced over a year ago, was the first Hammond drawbar organ not to use tone wheels. Using L.S.I. techniques it is now possible to synthesise the unique sounds 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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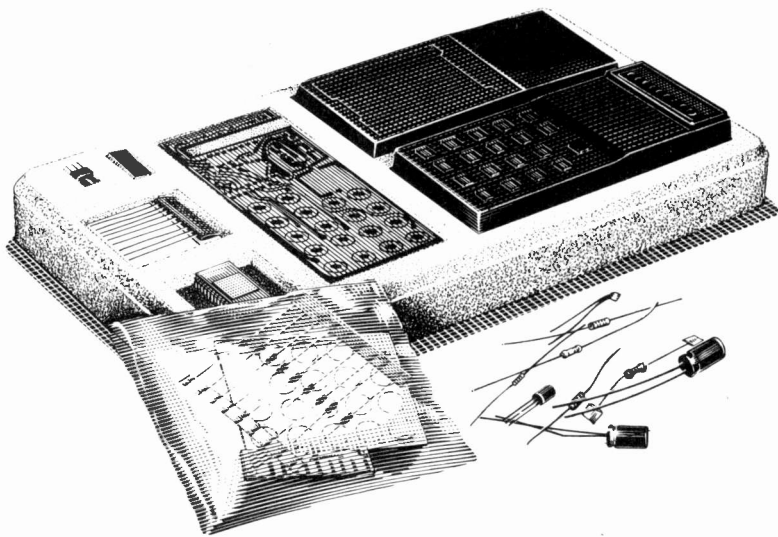
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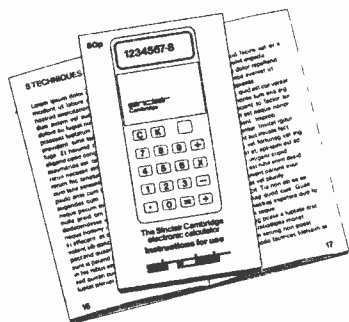
1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



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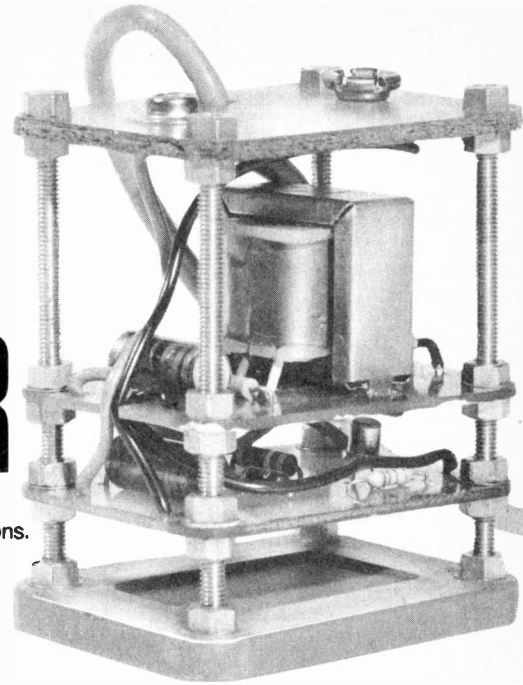
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PLEASE PRINT

# 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.

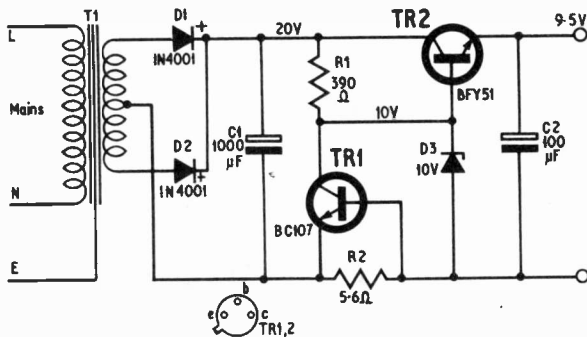


Fig. 1. Circuit diagram of the 9V Battery Eliminator

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.

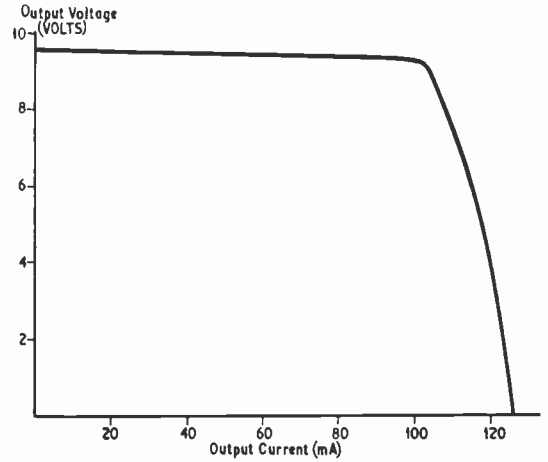


Fig. 2. Graph showing the variation of output voltage with current. The fall off at 100mA is due to the current limiting effect of TR1

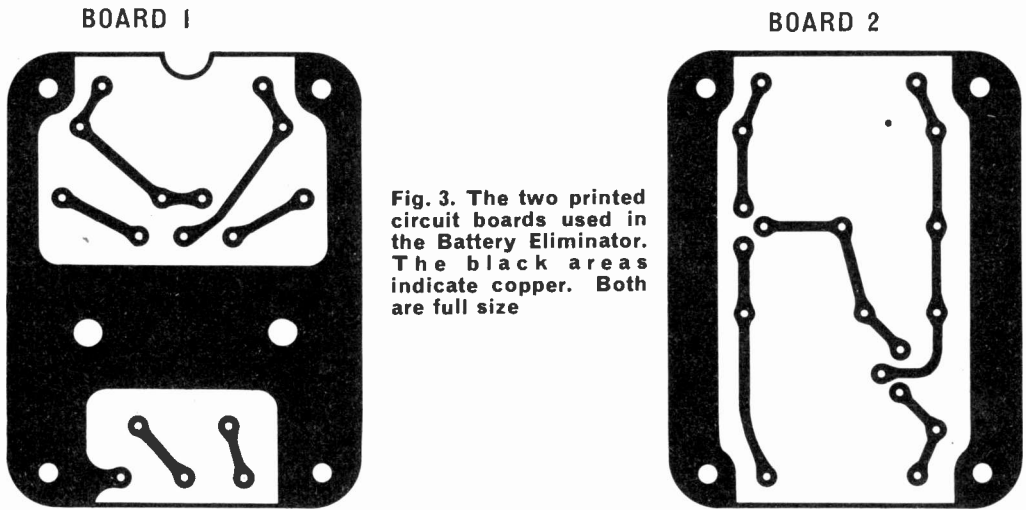


Fig. 3. The two printed circuit boards used in the Battery Eliminator. The black areas indicate copper. Both are full size

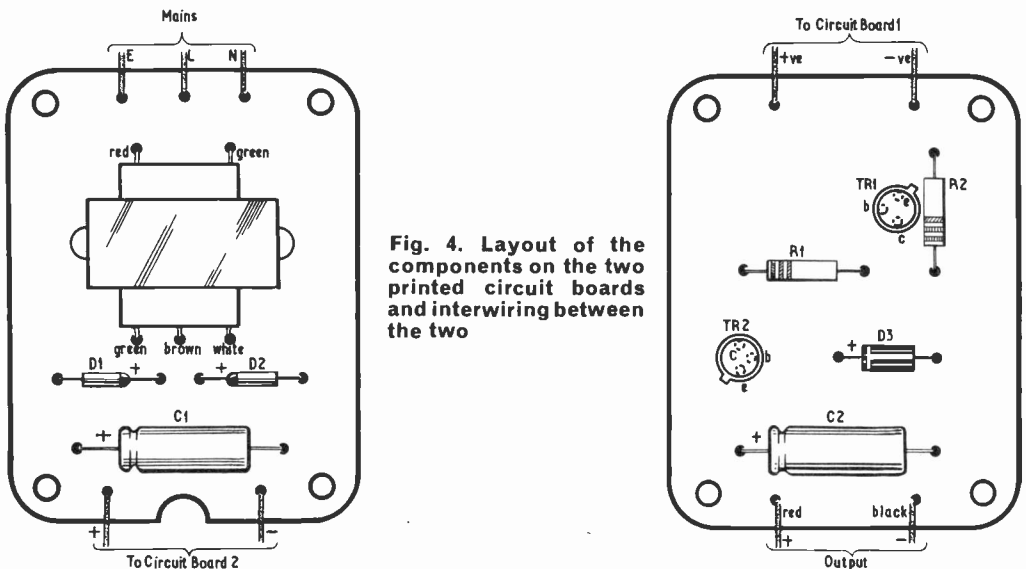
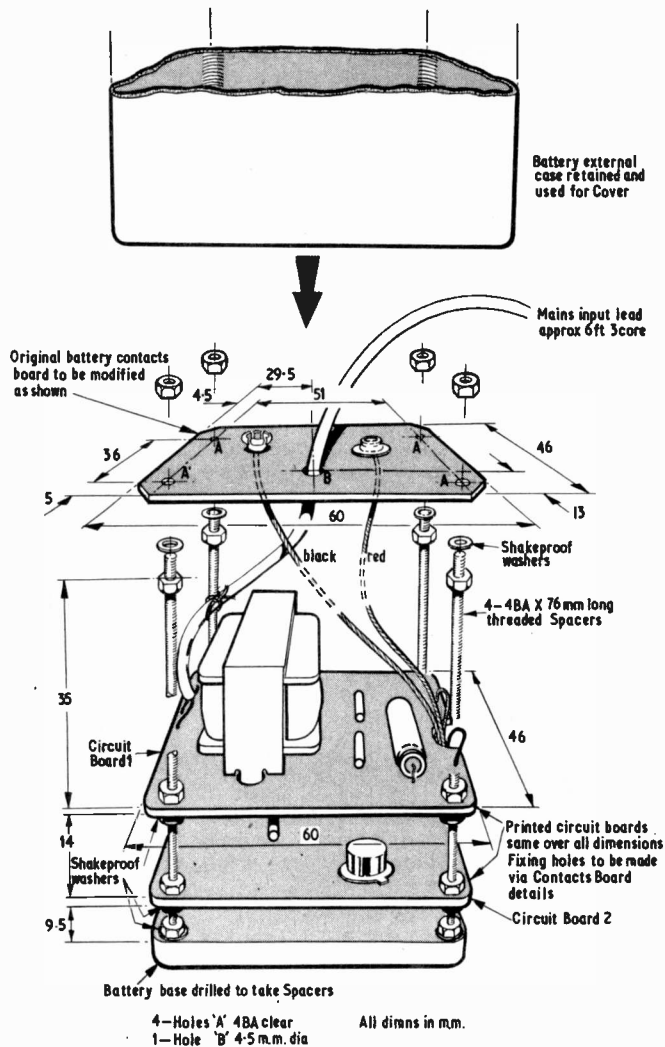


Fig. 4. Layout of the components on the two printed circuit boards and interwiring between the two



**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

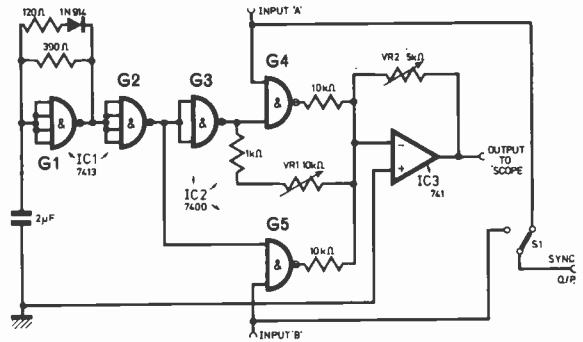


Fig. 1

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 off 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.

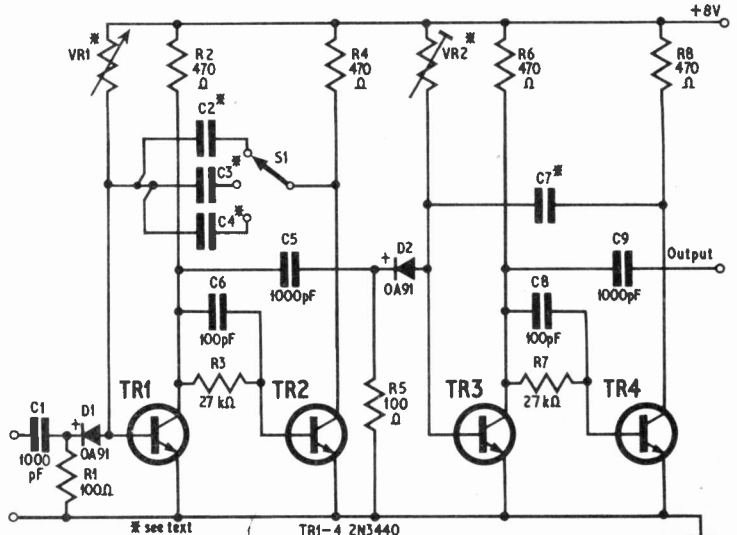
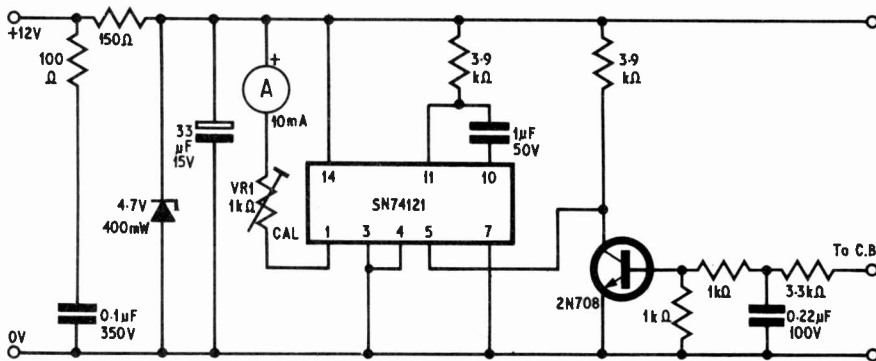


Fig. 1. Simple variable-delay pulse circuit

## SIMPLE TACHOMETER



**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

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

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.

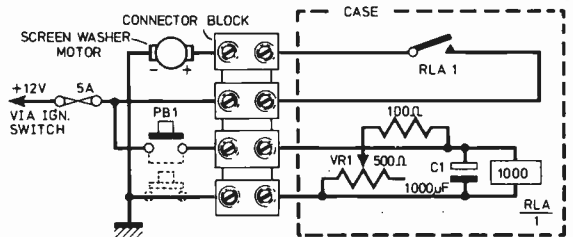
Only two main components are used, a relay and a capacitor, and from Fig. 1 it can be seen that when the washer control button is pressed, C1 is immediately charged up to the full 12V battery voltage and discharges over a period of 10 to 15 seconds through the coil of RLA so closing the contacts RLA1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

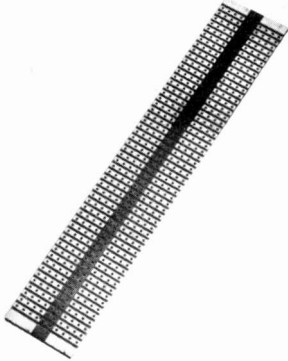
A. Calder,  
Leigh, Lancs.





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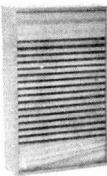


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## MAINS NEON FLASHER

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.

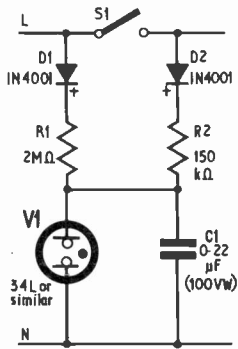


Fig. 1. Circuit diagram for the mains neon flasher

## 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.

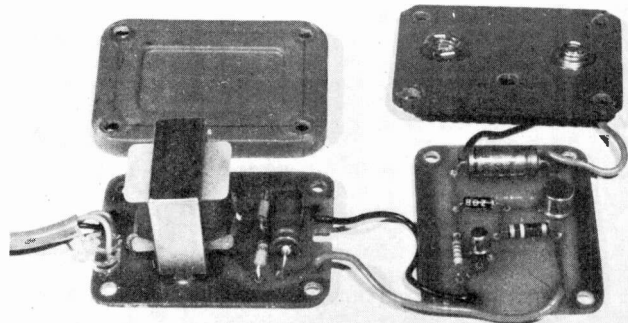
One "trick of the trade" when sawing threaded rod is to thread a nut onto the length to be sawn. After cutting and deburring with a file the nut can be removed and this will automatically re-form the thread on the cut end. This simple procedure saves a good deal of time and temper.

### 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 quadraphony (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!

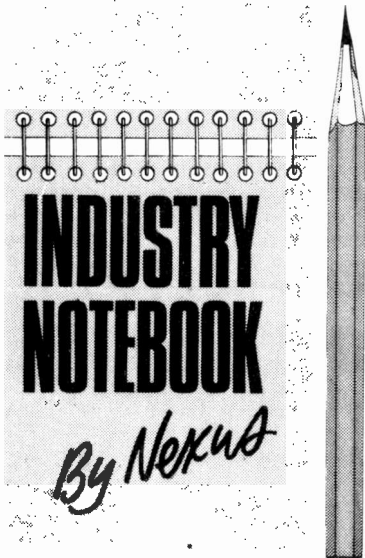
Now this seems infinitely more sensible to me than quadraphony.

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 subcontractors. 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.

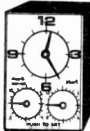
## CONTROL DRILL SPEEDS

### 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 £11.11.

### HI-Q TUNER COMPONENTS

For experimenting with the ZN414.  
KIT NO. 1. Fleesby 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 11n 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 £1 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, £6.69 plus 30p post and service.



### CENTRIFUGAL FAN

Mains operated, turbo blow 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.



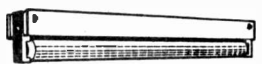
### STANDARD WATER SWITCHES

Standard size 1 1/2in waffer—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	44p	44p	44p	44p	44p	44p
2 poles	44p	44p	44p	44p	44p	44p	44p	44p
3 poles	44p	44p	44p	44p	44p	44p	44p	44p
4 poles	44p	44p	44p	44p	44p	44p	44p	44p
5 poles	44p	44p	44p	44p	44p	44p	44p	44p
6 poles	44p	44p	44p	44p	44p	44p	44p	44p
7 poles	44p	44p	44p	44p	44p	44p	44p	44p
8 poles	44p	44p	44p	44p	44p	44p	44p	44p
9 poles	44p	44p	44p	44p	44p	44p	44p	44p
10 poles	44p	44p	44p	44p	44p	44p	44p	44p
11 poles	44p	44p	44p	44p	44p	44p	44p	44p
12 poles	44p	44p	44p	44p	44p	44p	44p	44p

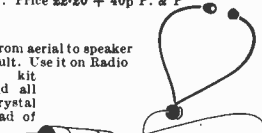
### THE TWENTYLITE

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.



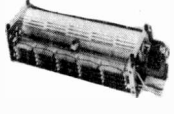
### RADIO STETHOSCOPE

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

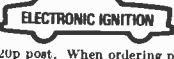
This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any 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 8in price £1.65.

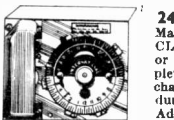
### CAPACITOR DISCHARGE CAR IGNITION

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.



### 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.



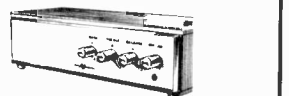
### PHOTO ELECTRIC KIT

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 £11.30 post paid. Optional extras—Cabinet £2.20. Extra front plate £1. Pair of 15 ohm speakers £3.30.



TERMS: 10% discount if ten of an item ordered, send postage where quoted—other items, post free if order for these items is £6.00, otherwise add 20p.

## NEW ITEMS THIS MONTH

**White Rocker Switches.** Four types available, all snip in fixing through oblong hole approx 1 1/2in, all rated at 10A a.c. All have white rocker except 83, which is amber. Our ref R8 S1, push to make, spring return, 14p. Our ref R8 S2, push to break, spring return to on, 14p. Our ref R8 S3, change over contacts, luminous rocker, 28p. Our ref R8 S4, changeover contacts, normal rocker, 16p.

**Rocker Switches.** 15A Pritmac panel mounting, hole size 1 1/2in x 1 1/2in. Our ref R8 S5 price 11p each. 5A made by Mem, their type ref 1600, our ref R8 S6, price 11p each.

**Miniature Hand Microphone.** Dynamic, for tape recorders but equally suitable for amplifiers, good quality with lead and plug, price £1.37.

**Open Coil Relays.** All with 10A change over contacts, all brand new. Our ref REL S1, 12 volt d.c. coil, double pole, 44p. Our ref REL S2, 110 volt a.c. coil, treble pole, 44p. Our ref REL S3, 240 volt a.c. coil, treble pole, 55p.

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

**Mains Connector.** 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 connector 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.

### GOOD COMPANION I.C. VERSION

We can now offer these again in I.C. version using Ferranti ZN414 and Mullard AF Module 1172. Cabinet size approx. 1 1/2in wide x 8in high x 3in deep. Complete assembly instruction—Excellent tone wood cabinet £5.75 plus 25p post and insurance.



### MOTORS FOR £1.50

As used in racing cars and power models. All battery operated and reversible.



**Mains Transformers.** All by first class makers, all with normal 230V primary and static screen. Our ref TR S1, 6.3V, 3A, with clamp and feet, 88p. Our ref TR S2, made by Finchley for Decca primary tapped 200/340 volt two secondaries 275-0-275 volt at 90MA and 6.4 volt at 3A, this is for above chassis mounting, open construction, price £1.75 plus 25p post. Our ref TR S3, upright mounting with metal shrouds, primary tapped 110 volt and 200/240 volt, two secondaries 50 volt at 2A and 6 volt at 1A, £5.50 plus 25p post.

### PC BOARD MARKER

Valve action fibre tipped marking pen filled with black etch resist—it's easy with this to make a perfect PC board, just draw straight on to the copper—allow 15 minutes to dry, then immerse in ferric chloride or other etchant on removal the circuit stand in high relief, 99p.

### EDUCATIONAL KITS — all with pictorial instructions

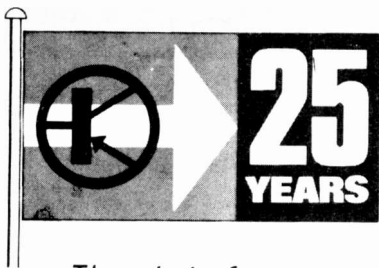
3 kits or more we give FREE an accurate 11 piece balance kit. Price of kits 44p each post paid. Special price for all 7 kits £3.00 with free balance kit.



- KA2 Lens Kit. Eleven parts, concave lens, one convex lens, stage and slit frame, etc.
- KA3 Water Pump Kit. Thirteen parts. Transparent so that operating parts may be observed. You can make Lift pump, Force pump and Force pump with reservoir and nozzle.
- KA4 Buzzer Kit. Eleven parts. Operation of buzzer seen.
- KA7 Electro-Magnet Kit. Fifteen parts, includes compass, showing how magnetism works.
- KA8 Current and Resistance Kit. Twenty-nine parts, including bench and light bulb. "OHMS LAW" etc.
- KA9 Bell Kit. Eight parts, including bell and push button switch. Build a complete electric bell.
- KA10 Morse Key buzzer and bell kit. 25 part kit easy to construct, simple to operate.

## J. BULL (ELECTRICAL) LTD.

(Dept. P.E.), 7 Park Street, Croydon CRO 1YD  
Callers to 102/3 Tamworth Road, Croydon



# 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

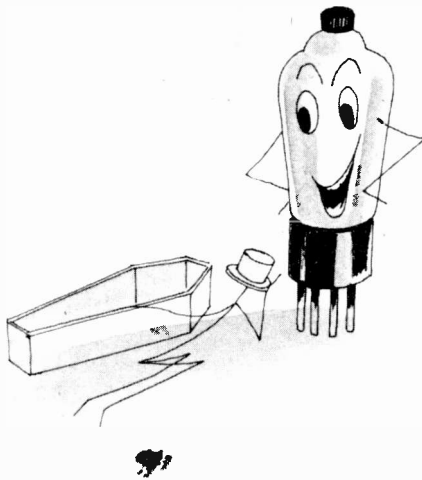
So, in the face of great difficulties you managed first of all to identify the leads on your transistor with an ohmmeter and then to find, or rashly devise a transistor circuit.

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

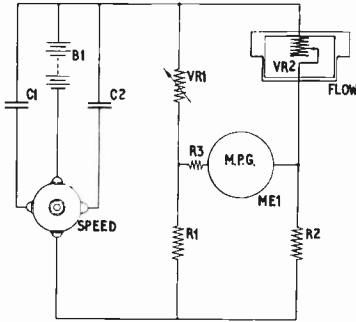


Fig. 1

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

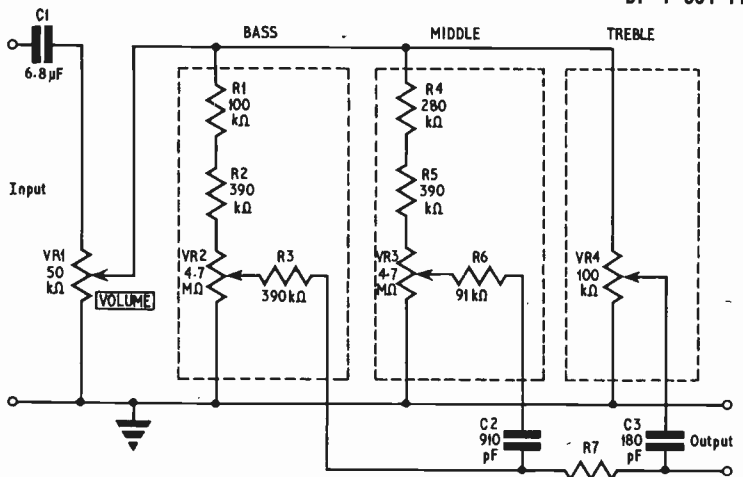


Fig. 1

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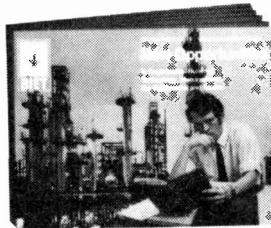
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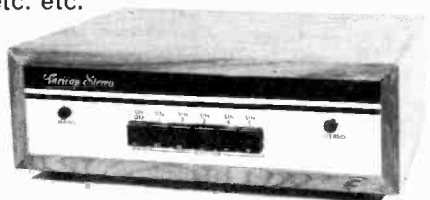
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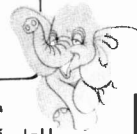
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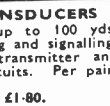


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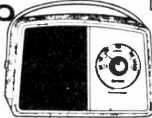
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## BUILD THIS RADIO



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. £39.95 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.



## 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).

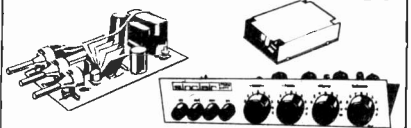
4-300	0.3 watt 9 volt	1.75
104	1 watt 9 volt	2.20
304	3 watt 9 volt	2.50
555	3 watt 12 volt	2.85
E1208	5 watt 12 volt	4.50
608	10 watt 24 volt	4.10
410	10 watt 28 volt	4.95
E1206	15 watt 30 volt	3.57
Z50	30 watt 45 volt	9.75
E1210	2 1/2 + 2 1/2 watt 12 volt	4.37
RE500	5 watt 1C mains operated Amplifier 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	Z50	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	9.50
Audio Filter Unit	5.50
£40 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



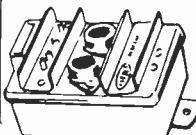
## POWER SUPPLIES FOR EVERY PURPOSE

(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

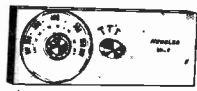
## EASY TO BUILD KITS BY AMTRON—EVERYTHING SUPPLIED

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
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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 2 1/2in x 3 1/2in. 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.

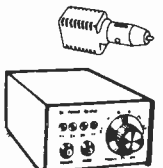
# Henry's RADIO LIMITED

EDGWARE ROAD, W2

SEE FACING  
PAGE FOR  
ADDRESSES

## FIBRE OPTICS

0-01 dia. Mono Filament, £1.50 per 25 metre reel.  
0-13 dia. 64 Fibres Sheathed, £1.00 per metre, SP10Y—12V 0.4-1 amp, 15mm dia. Mares Tails, £9.50.



# Henry's

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

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### STEREO AMPLIFIERS

(Carr./packing 50p)	£
AKAI: A45200	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	32.50
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
TS152	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  
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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; M75EDII	£8.50; M75EIII	£7.95; M75GII	£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 8-80; 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): MP2615N	39.15
(HL): MP261 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: GX T4520KL	103.50
Sony: GX T4730KL	97.50
Philips GF908	102.75
GF825	159.95
RF836	57.20
GF826	41.75
RH81/RH421	84.95
RF839	55.95
GF829	39.95
GF815	47.75
GF808	68.75
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.

MADE TO ORDER £12.50  
OUR PRICE £7.25  
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
Sony M1101	14.65
M1102	12.95

### BATTERY/MAINS CASSETTE

(Carr. etc. 35p)	£
Wien RT452	13.65
Amerlec AC101	12.00
Elizabethan LZ315	12.25
Amerlec AC104	16.00
Philips N2204	20.75
N2205	29.50
Pye 9115	27.75
9118	21.20
Hitachi TRQ291	27.50
Sony M2000G	23.25
MR4010G	28.95
M4000G	49.50
BASF CC9201	37.25
Hitachi TRQ2335	49.50

### BATTERY/MAINS RADIO CASSETTE RECORDERS

(Carr. etc. 30p)	£
Amerlec ACR200	22.00
ACR201	30.00
Elizabethan LZ416	27.25
LZ516	29.10
BASF CC9301	30.75
Philips RR322	28.75
RR413	33.90
RR712	48.30
Sony M4141FG	43.20
M2400W	36.90
M2400FG	36.90
M4000S	65.15
Grundig C250	47.95
Hitachi TRK1240E	29.50
TR51161	35.00
KCT1210L	33.50

### STEREO RECORDER DECKS

(Carr./packing 50p)	£
Amerlec ACR301	£48.00
Philips N2506	44.50
Philips N2410	87.10
Pye 9145	44.50
Tandberg TCD3000	112.00
AKAI CS30D	50.65
CS33D	62.50
GC36D	65.15
GXC40D	57.40
GXC38D Dolby	81.45
GXC46D Dolby	89.15
GXC45D	74.30

TEAC: A250/A350/A450 stocked.

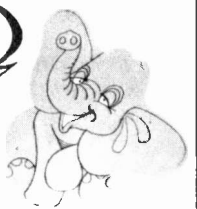
### Reel to Reel

AKAI 400DS	£2.50		
Tandberg 3321X/3341X	107.70		
Large range Akai/Tandberg/Revox/Teac stocked.			
8 Track	£		
AKAI CR81D	53.60		
CR80DS	93.65		
Pioneer: SE20A	£5.90;		
SE30A	£9.45; SE50	£10.95; PC51	£14.75;
SEL25	£7.90; SEL40	£18.60;	
SEL25	£11.15; SEL40	£18.60;	
Accessories:			
H1012/ JB3 Junction Box	£1.40;		
1B3DE Din Junction Box	£1.60;		
1B11D De Luxe Junction Box	£1.95; 0250		
Control Switch	£4.75.		
Control Boxes: G1301 (two phones) £2.62; G1305 Controller £2.15; FF17 2-pairs (Sliders) £6.25; Koss T4A £4.20; Koss T5A £4.95; Koss T10A £8.50; HW Mk.III Controller £6.90.			

### IN CAR ENTERTAINMENT

Car radios (carr./packg. 35p). MW/LW complete with speakers. Shira Touring £7; Shiramatic £9; Philips RN270 £13.65; RP305 £17.40; Pyle 2644 £26.75; 2062
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BEST VALUE IN U.K.



### STEREO RECORDERS

(Carr./packing 70p)	£
AKAI I721L	67.20
Cassette	
AKAI GXC40 Dolby	59.95
GXC46 Dolby	89.95
Philips N2400/RH411	63.75
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/LZI	£13.40
McDonald/BSR TDB85	12.75
TDB3V	15.25

### STEREO TUNER-AMPLIFIERS

(Carr./packing 75p)	£
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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
Rotel RX150A	41.95
RX200A	53.95
RX400A	64.95
RX600A	90.00
RX800	114.50
RX154A	78.30
Tandberg TR200MPX	85.00
TR1000MPX	143.75
TR1010MPX	149.95
Teleton TSF55	57.70

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10% VAT to be added to ALL ORDERS. Prices and description correct at time of press E & OE. All goods offered subject to stock availability.

# Henry's RADIO LIMITED

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**SPECS. MULTIMETER U4324.** Sensitivity 20,000 OPV DC. Usually high current ranges. 3 amps a.c./d.c. Voltages AC3 to 900V d.c. 0-6 to 1200V. Resistance 500 ohms—20-200-2,000kΩ. Transmission level -10 to +12dB. This high quality instrument has diode protection. Complete with test leads, batteries, etc. £8.80 plus 25p P. & P.

**MULTIMETER 4313.** Similar to above but special features include 3 amp current range and instrument is housed in metal case with carrying handle. (Illustrated leaflet sent on request.) ONLY £10.45 plus 30p P. & P.



**SANWA JP-5D SPECS. 2000 OPV 1000V A.C.-D.C. 500 M/A current D.C.** A robust instrument with diode protection. Only £6.64. P. & P. 20p.

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Eagle MT6, 6-0-6, 100 M/A, 95p plus 6p P. & P.  
MT12, 12-0-12, 50 M/A, 95p plus 10p P. & P.  
Eagle Type MT280 6-0-6, 250 M/A } All  
MT150 12-0-12, 150 M/A } £1.43 plus  
MT100 24-0-24, 100 M/A } 12p P. & P.  
R/S 13V 0.5 Amp C.T. } £1.40  
16-3V 0.3 Amp C.T. } plus 12p P. & P.  
Charger Types 9V, 17V.  
1 Amp £1.20 P. & P. 12p  
2 Amp £1.65 P. & P. 12p  
4 Amp £1.95 P. & P. 20p  
6 Amp £2.62 P. & P. 35p

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6-10 11p each. 11 plus 10p each.  
5kΩ 50kΩ 500kΩ }  
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25kΩ 250kΩ 2mΩ }  
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dual less switch 1-5 39p. 5-10 37p. 10 plus 35p.  
Any mix for Quantity Prices. P. & P. 7p.

### MINI LOUSPEAKERS

2 1/2 in 8Ω 50p. 5p P. & P.  
3 1/2 in 8Ω 50p. 5p P. & P.

### ENAMELLED COPPER WIRE

S.W.G. 16, 18, 20, 22, 24, 26, 2oz reels, 26p.  
28, 30, 32, 34, 36, 38, 40, 2oz reels, 36p.  
Postage 1-5, 10p. 6 plus, 15p.

### ANTEX SOLDERING IRON BITS

Chrome Type for 15 watt Models.  
1/2 in, 3/4 in, 1 in. All 26p each. Postage 5p.

### TELESCOPIC AERIAL

Six Section, Swivel Base. Only 20p. P. & P. 5p.

### TURNABLE SERVICES

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Garrard SP25 Mk.I & II. Type M7 £1.10  
S.M.E. 52 Shell £2.77  
Thorens TP50 for TD150 £3.30  
Thorens TP60 for TD160 £3.30  
Golding PH7 for GL85 £3.80  
**Head Slides** Postage 5p. per item  
Garrard C1 for SL75 etc. 50p  
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B.S.R. for MP60, 310, 510, 610 50p  
**Jockey Wheels**  
Garrard SP25 Type etc. 55p  
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9TA/HC LP/LP

### TRANSISTORS

BC107, 108, 109, all 9p each. Any six 50p.  
P. & P. 4p.

### EAGLE LT700 TRANSFORMER

40p. P. & P. 5p.  
NEW MULLARD DATA BOOK 1973/74  
30p. P. & P. 5p.

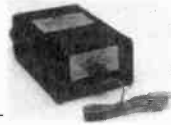
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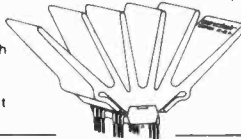
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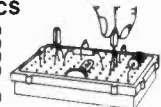
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TRANSFORMER  M.O.  
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HARDWARE   
CONTROL FASCIA

NAME .....

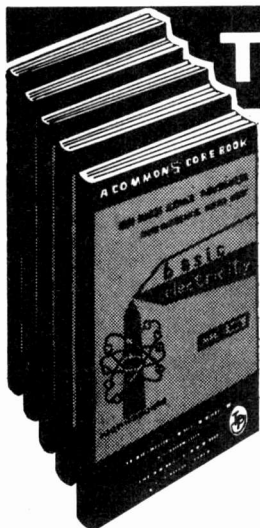
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PE12

<p><b>NEW! NEW! NEW! NEW!</b></p> <p>An aerosol spray providing a convenient means of producing any number of copies of a printed circuit both simply and quickly.</p> <p><b>Method</b> Spray copper laminate board with light sensitive spray. Cover with transparent film upon which circuit has been drawn. Expose to light (No need to use ultra-violet) Spray with developer. Rinse and etch in normal manner.</p> <p>Light sensitive aerosol spray £1 Developer and Etchant 50p (plus postage)</p>		<p><b>SILICON P.N.P.</b></p> <table border="1"> <thead> <tr> <th>Part No.</th> <th>Voltage</th> <th>Frequency</th> <th>Price</th> </tr> </thead> <tbody> <tr><td>BCY71</td><td>45</td><td>200MHz</td><td>12p</td></tr> <tr><td>BFS92</td><td>100</td><td>70MHz</td><td>20p</td></tr> <tr><td>BFS95</td><td>40</td><td>70MHz</td><td>17p</td></tr> <tr><td>BFX12</td><td>25</td><td>210MHz</td><td>10p</td></tr> <tr><td>2N2906</td><td>60</td><td>200MHz</td><td>15p</td></tr> <tr><td>2N3702</td><td>40</td><td>100MHz</td><td>11p</td></tr> <tr><td>2N3703</td><td>50</td><td>100MHz</td><td>12p</td></tr> </tbody> </table>		Part No.	Voltage	Frequency	Price	BCY71	45	200MHz	12p	BFS92	100	70MHz	20p	BFS95	40	70MHz	17p	BFX12	25	210MHz	10p	2N2906	60	200MHz	15p	2N3702	40	100MHz	11p	2N3703	50	100MHz	12p	<table border="1"> <tbody> <tr><td>AF124</td><td>20</td><td>75MHz</td><td>20p</td></tr> <tr><td>AFY19</td><td>32</td><td>350MHz</td><td>20p</td></tr> <tr><td>ASY32</td><td>25</td><td>5MHz</td><td>10p</td></tr> <tr><td>ASZ21</td><td>15</td><td>450MHz</td><td>20p</td></tr> <tr><td>GET113</td><td>32</td><td>—</td><td>10p</td></tr> <tr><td>GET120</td><td>32</td><td>2 watts</td><td>10p</td></tr> <tr><td>OC123</td><td>50</td><td>1MHz</td><td>10p</td></tr> <tr><td>OCP70</td><td>Light-sensitive</td><td>—</td><td>20p</td></tr> <tr><td>2N1307</td><td>30</td><td>10MHz</td><td>15p</td></tr> <tr><td>2N1309</td><td>30</td><td>15MHz</td><td>15p</td></tr> <tr><td>2N443</td><td>60</td><td>150 watts</td><td>£1</td></tr> </tbody> </table>		AF124	20	75MHz	20p	AFY19	32	350MHz	20p	ASY32	25	5MHz	10p	ASZ21	15	450MHz	20p	GET113	32	—	10p	GET120	32	2 watts	10p	OC123	50	1MHz	10p	OCP70	Light-sensitive	—	20p	2N1307	30	10MHz	15p	2N1309	30	15MHz	15p	2N443	60	150 watts	£1	<table border="1"> <tbody> <tr><td>BXY27</td><td>Varactor Diode.</td><td>'S Band.</td><td>£1</td></tr> <tr><td></td><td>Cut-off.</td><td>70 GHz</td><td></td></tr> <tr><td>BXY28</td><td>Varactor Diode.</td><td>Cut-off.</td><td>£1</td></tr> <tr><td></td><td></td><td>100GHz</td><td></td></tr> <tr><td>BXY32</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>150GHz</td><td></td></tr> <tr><td>BXY35A/C</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>25GHz</td><td></td></tr> <tr><td>BXY36C/D</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>75GHz</td><td></td></tr> <tr><td>BXY37C/D</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>100GHz</td><td></td></tr> <tr><td>BXY38C/E</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>120GHz</td><td></td></tr> <tr><td>BXY39C/D</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>150GHz</td><td></td></tr> <tr><td>BXY40D/E</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>180GHz</td><td></td></tr> <tr><td>BXY41C/D/E</td><td>Frequency Multiplier.</td><td>'X Band.</td><td>£1</td></tr> <tr><td></td><td></td><td>200 GHz</td><td></td></tr> </tbody> </table>		BXY27	Varactor Diode.	'S Band.	£1		Cut-off.	70 GHz		BXY28	Varactor Diode.	Cut-off.	£1			100GHz		BXY32	Frequency Multiplier.	'X Band.	£1			150GHz		BXY35A/C	Frequency Multiplier.	'X Band.	£1			25GHz		BXY36C/D	Frequency Multiplier.	'X Band.	£1			75GHz		BXY37C/D	Frequency Multiplier.	'X Band.	£1			100GHz		BXY38C/E	Frequency Multiplier.	'X Band.	£1			120GHz		BXY39C/D	Frequency Multiplier.	'X Band.	£1			150GHz		BXY40D/E	Frequency Multiplier.	'X Band.	£1			180GHz		BXY41C/D/E	Frequency Multiplier.	'X Band.	£1			200 GHz	
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<p><b>SPECIAL OFFER</b></p> <p><b>UNI-JUNCTION TRANSISTOR SIMILAR TO 2N2646 25p</b></p>		<p><b>GERMANIUM P.N.P.</b></p> <table border="1"> <tbody> <tr><td>ACY44</td><td>50</td><td>1MHz</td><td>£1</td></tr> <tr><td>ADY26</td><td>80</td><td>75 watts</td><td>10p</td></tr> </tbody> </table>		ACY44	50	1MHz	£1	ADY26	80	75 watts	10p	<p><b>20 ASSORTED UNUSED MARKED, TESTED TRANSISTORS BC108, ETC.</b></p> <p>POSTAGE 20p      PACK No. 5</p>		<p><b>5 COMPUTER PANELS CONTAINING MASSES OF DIODES, TRANSISTORS, INDUCTORS, RESISTORS AND CAPACITORS</b></p> <p>POSTAGE 27p      PACK No. 7</p>																																																																																																																																																					
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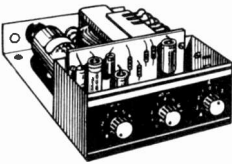
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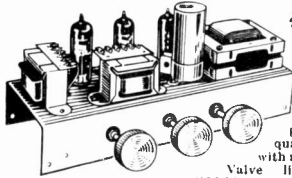


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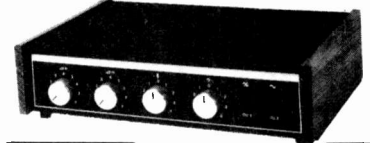
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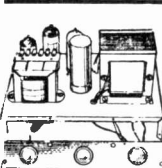
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AC127	15p	AF180	40p	BF179	32p	OC71	12p	2N3819	32p
AC128	15p	AF181	40p	BF180	32p	OC72	12p	2N4062	12p
AC131	12p	BC107	12p	BF181	32p	OC81	12p	2N4286	20p
AC132	12p	BC108	12p	BF194	14p	OC82D	12p	2N4289	20p
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AC188	22p	BC148	12p	BF200	32p	2N2926	10p	40362	40p
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AF117	20p	BD133	75p	OC35	50p	2N3707	12p		
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160V: 0.1μF, 0.15μF, 0.22μF, 0.33μF, 0.47μF, 0.68μF, 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, 330/10, 470/6, 3, 7p. 68/63, 150/40, 220/4, 220/6, 3, 220/16, 330/4, 6p. 47/63, 100/40, 150/25, 220/25, 330/10, 470/6, 3, 7p. 68/63, 150/40, 220/4, 330/16, 1.000/4, 10p. 470/10, 470/25, 330/10, 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)	—	60p
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.

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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

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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
7405	20	18	16	14	7470	30	28	25	24	74153	120	110	105	95
7406	50	45	40	35	7472	30	28	27	23	74154	200	180	170	160
7407	56	50	44	38	7473	40	38	36	30	74155	150	120	100	86
7408	36	30	27	23	7474	40	36	32	28	74156	130	120	100	86
7409	36	30	27	23	7475	55	52	50	49	74180	155	136	112	96
7410	18	16	14	13	7476	40	36	32	30	74190	195	190	185	180
7411	18	16	14	13	7480	100	95	90	85	74191	185	190	185	180
74118	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	709	14 pin DIL			40p
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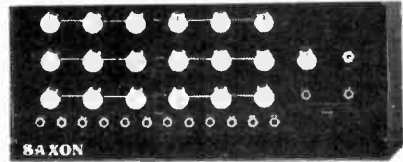
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In extra slimline easy-fit case.

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
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### 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.**

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12 inputs (6 high Z, 6 low Z) 18" x 8" x 2 1/2". Carr. paid

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Channel section modules, for building your own: gain—16 x (24dB). Tone controls—18dB swing. Carr. paid.

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Mono (as shown): **£6.50**

Carr. 20p.

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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.

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● 160 watts version with power supply **£27.90** (Carr. 50p)

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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.

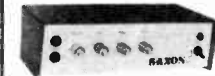
Module and power supply (Carr. 40p)

**£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.



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Includes bass, middle and treble as well as master controls, 2 amplifier sockets eliminate need for split leads. Up to 3kW lighting load. Smartly finished steel case. Carr. 30p. **£19.75**

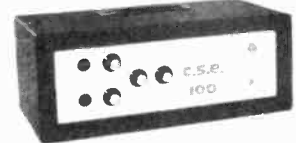
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Operates from 5-100W amplifiers. Supplied for bass note operation, is easily adapted for treble or mid-range at a cost of about 5p. Carr. pd. **£8.90**

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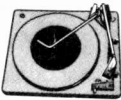
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Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12V or H.T. Line 200-300V d.c. operation. Size: 1 1/2 x 1 1/2 x 1 in. Response 25 c/s to 25 kc/s. 26 dB gain. For use with valve or transistor equipment. £9.9p Post 20p Full instructions supplied. Details S.A.E.

## E.M.I. WOOFER AND TWEETER KIT

Woofers 10 1/2 x 6 1/2in. Ceramic Magnet, 44oz. 13,000 lines. Tweeter 3 1/2in. square, 10,000 lines. Crossover condenser, full instructions supplied. Impedance 3 ohms, power 12 watts. £5.75 Post 25p

## BRITISH FM/VHF TUNING HEART

88 to 108 M/C/S British made. 2 Transistors ready aligned requires 10-7 M/C/S I.F. Complete with tuning gang. Connections supplied but some technical experience essential. Our price £3.95 1 Post 20p

## MAINS TRANSFORMERS ALL POST 25p each

Eagle MT12 12-0-12V 50 mA 90p  
250-0-250 80 mA, 6-3V 3-5A 6-3V 1A or 5V 2A £2.50  
350-0-350 80 mA, 6-3V 3-5A, 6-3V 1A or 5V 2A £3.00  
300-0-300V 120 mA, 6-3V 4A, 6-3V 2A £3.25  
MINIATURE 200V 20 mA, 6-3V 1A x 2 1/2 x 2in £2.50  
MIDGET 220V 45 mA, 6-3V 2A 2 1/2 x 2 1/2 in. 80p  
HEATER TRANS. 6-3V 3A 80p  
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp. 3, 4, 5, 8, 9, 10, 12, 15, 18, 24 and 30V £2.80  
1 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £2.25  
2 amp. 12, 15, 25V 23p; 50V 24p; 30, 36, 40, 48, 60 £3.80  
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £3.75  
3 amp. 5, 8 and 13V £1.00; Dito 5 amp £1.20. 3 amp. 3, 5, 8, 10, 13 and 5-0-5V £1.30. Dito 5 amp. £1.50.  
6-0-6V 500mA 90p 9V 1 amp 85p, 12V 300mA 75p, 12V 500mA 85p, 12V 750mA 85p, 40V 1 amp £1.75.  
AUTO TRANSFORMERS: 115V to 230V or 230V to 115V 150W £2.25; 500W £2.25; 500V £1.00 £1.00 £1.00  
CHARGER TRANSFORMERS. Input 200/250V, for 6 or 12V, 1 1/2 amp £1.50; 2 amp £1.80; 4 amp £2.50  
BATTERY CHARGERS. Ready built with leads and clips 1 1/2 amp £2; 4 amp £4; 5 amp £4.50.  
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs, 1 1/2 amp 40p; 2 amp 55p; 4 amp 85p.

## MAINS ISOLATING TRANSFORMER

Primary 0-110-240V. Secondary 0-240V. 3A. 720W. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. OUR PRICE £10 10p Carr. Famous make. (Valve £18). 60p Can be used as 800W auto transformers 240-110V. IDEAL FOR COLOUR T.V. OR GARDEN TOOLS.

**NEW ELECTROLYTIC CONDENSERS**  
2/350V 14p 250/25V 14p 50-50/300V 50p  
4/350V 14p 500/25V 20p 80-100/350V 85p  
6/450V 18p 1000/25V 35p 32-32/250V 20p  
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  
50/50V 10p 16-16/450V 40p 100-50-50/350V 55p  
100/25V 10p 32-32/350V 40p

**LOW VOLTAGE ELECTROLYTICS.**  
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.  
500mF 12V 15p; 25V 20p; 50V 20p; 100V 20p.  
1000mF 12V 17p; 25V 35p; 50V 47p; 100V 70p.  
2000mF 6V 25p; 25V 42p; 50V 57p.  
2500mF 50V 62p; 3000mF 25V 47p; 50V 85p.  
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.

CERAMIC, 1pF to 0.01mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V-0-1 4p, 0-5 13p; 1mF 15V 15p. 500V-0.001 to 0.05 4p; 0-1 5p; 0.25 8p; 0-47 25p. SILVER MICA. Close tolerance 1%, 2.2-500pF sp. 50-2.200pF 10p; 2.700-5.800 pF 20p; 8.800pF-0.01, mfd 30p each. TWIN GANG, "0-0" 280pF-170pF, 85p; 500pF standard 45p. 365pF-365pF with 25pF+25pF, Slow motion drive 50p. SHORT WAVE SINGLE, 10pF, 30p, 25pF, 50p, 50pF, 55p. NEON PANEL INDICATORS 250V AC/DC. Amber 20p. RESISTORS, 1W 1/4W 20%, 1/2W, 5p, 100 to 10M. HIGH STABILITY W 2%, 10 ohms to 6 meg., 10p. Dito 5%. Preferred values 10 ohms to 10 meg., 4p. WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each; 0.5 ohm to 8.2 ohms 10p. TAPE OSCILLATOR COIL Valve type 35p.

## NEW MODEL "BAKER LOUDSPEAKER", 12IN 50 WATT. GROUP 50/12. 8 OR 15 OHM HIGH POWER. FULL RANGE PROFESSIONAL QUALITY. £17.60

## BAKER MAJOR 12" £9.90

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



Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. £12.50 Please state 3 or 8 or 15 ohms. Post free

## BAKER "BIG-SOUND" SPEAKERS Post free

'Group 25' 'Group 35' 'Group 50'  
12in. £8.80 12in. £9.90 15in. £22  
25W 35W 50W  
3 or 8 or 15 ohm 3 or 8 or 15 ohm 8 or 15 ohm

TEAK VENEERED HI-FI SPEAKER & CABINETS  
For 12in or 10in dia. speaker 20 x 13 x 8in, £3.90. Post 25p  
For 13 x 8in or 8in speaker 16 x 10 x 8in, £3.50. Post 25p  
For 8 x 5in speaker 16 x 8 x 8in, £4.40. Post 25p  
For 8in and tweeter 12 x 8 x 8in, £4.00. Post 25p  
LOUDSPEAKER CABINET WADDING 18in wide, 15p ft.

## GOODMANS 6 1/2in. HI-FI WOOFER

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

**ELAC CONE TWEETER**  
The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3 1/2 x 2 1/2in deep. Rating 10W, 2 ohm. Crossover 95p £1.90 Post 20p.

**SPEAKER COVERING MATERIALS. Samples Large S.A.E.**  
Horn Tweeters 2-18kc/s, 10W 8 ohm or 15 ohm £1.95.  
De Luxe Horn Tweeters 2-18kc/s, 15W, 15 ohm £3.  
CROSSOVERS, TWO-WAY, 3,000 c/s 3 or 8 or 15 ohm 95p.  
LOUDSPEAKERS P.M. 3 OHMS, 7 x 4in, £1.25; 6 1/2in, £1.50; 8 x 5in, £1.80; 10in, £2.00; 8in, £1.75; 10 x 8in, £1.90.  
SPECIAL OFFER! 60 ohm, 2 1/2in, 2 1/2in; 35 ohm, 2 1/2in, 3in, 25 ohm, 2 1/2in dia, 3 1/2in dia, 5in dia. £1 TYPE EACH 15 ohm, 3 1/2in dia, 8 1/2in, 7 x 4in, 8 x 5in. 3 ohm, 2 1/2in, 2 1/2in, 3 1/2in dia, (6 x 4in 8 ohm £1.50).  
RICHARD ALLAN TWIN CONE LOUDSPEAKERS, 8in, DIAMETER 4W £2.50, 10in diameter 5W £2.50; 12in diameter, 8W, £2.85.  
VALVE OUTPUT TRANS. 25, 15p; MIKE TRANS. 50:1 25p. 5 WATT MULTI-RATIO, 3, 8 and 15 ohms 80p. Mike trans. mu metal 100:1 £1.25.

## MAJOR 100 WATT ALL PURPOSE GROUP AMPLIFIER

All purpose transistorised. P.A. for Groups, Diaco and P.A. 4 inputs speech and music, 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. Guaranteed. Details SAE. £49 Carr. SUPER VALVE MODEL, 100W, callers only, £39.



## BARGAIN AM TUNER. Medium Wave. Transistor Superhet, Ferrite aerial. 9 volt. £4.95

**BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER.** Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9V. £3.95  
**TWO CHANNEL STEREO VERSION** £5.95

**BARGAIN 3 WATT AMPLIFIER.** 4 Transistor Push-Pull Ready built, with volume, 18 volt. D.C. Treble and bass controls. £4.50

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

## REVERSIBLE 4 POLE MOTOR

1,400 r.p.m. Reversible 42 Watt, spindle 1 1/2" x 3/4", size 3" x 3", As £1.95 illustrated. With Cooling Fan. a.c. 240V. Post 25p

## ONE RPM GEARED MOTOR 95p

240V a.c. mains. Ideal for displays/diaco light wheels. Post 25p.

## E.M.I. GRAM. MOTOR. £1

2,400 r.p.m. 2 pole 70mA. Size 2 1/2 x 2 1/2in. Post 25p.

## WHITEHORN ROAD, CROYDON

Open 9-6. Wed. 9-1, Sat. 9-5 (Closed for lunch 1.15-2.30) Buses 50, 68, 159. Rail Selhurst. Tel. 01-684 1665

# RADIO COMPONENT SPECIALISTS

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ALL NEW GOODS  
FULLY GUARANTEED

Please add 10% VAT to  
Total Order including P. & P.

**HILLS DYNAMIC HEADPHONE MODEL H-707 VS DE-LUXE**  
An extremely high quality head-phone supplied with Padded Headphone and Earcups together with SLIDER volume controls for precise listening levels. Specially offered at an unbeatable price. 8 ohms. 20-20,000Hz.  
Retail Price OUR PRICE **£5.75** P. & P. 25p



**VEROBOARD** (P. & P. 12p)  
2.5in x 3.75in 19p 16p 10p  
2.5in x 5in 23p 22p 11p  
3.75in x 3.75in 24p 22p —  
3.75in x 5in 26p 26p 17p  
Spot Face Cutter 39p 38p  
Pin Insertion Tool 50p 50p  
Pins—single or double sided. 0.1 or 0.15 pitch. 18p (per pkt. 36).

### ANTEX BITS

(P. & P. 12p)  
Our Price  
1100 for CCN240 1/4in 25p  
1101 for CCN240 1/2in 25p  
1102 for CCN240 3/4in 25p  
50 for X25 1/4in 33p  
51 for X25 1/2in 33p  
52 for X25 3/4in 33p  
Antex Heat Sink 10p

(P. & P. 12p)

**PLINTH AND COVER FOR GARRARD SP-25 III or BSR MP60. Our Price £2.75 (P. & P. 65p)**

**ANTEX SOLDERING IRONS** Rec. Our Price  
(P. & P. 12p) Retail Price  
X25 25 watt £1.92 £1.40  
CCN240 15 watt £2.14 £1.60  
S73 Stand 84p  
X25E Replacement 25W Element £1.06  
CCN240E Replacement 15W Element £1.06

**HILLS DYNAMIC HEADPHONE MODEL H-101 VSM**  
Offered at a remarkably low price supplied with padded Headband and Earcups adjustable volume controls with stereo and mono switch. 8 ohms imp. 30-18,000Hz.  
Rec. Retail Price OUR PRICE **£3.75** P. & P. 25p



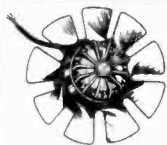
**PLUGS AND SOCKETS** (P. & P. 12p)  
Plain Chassis Sockets  
DIN 2 pin (SPK) 10p 5p  
DIN 3 pin 11p 9p  
DIN 5 pin (180°) 13p 9p  
DIN 5 pin (240°) 13p 9p  
3.5mm Plastic 9p \*9p  
1/2in Mono Plastic 12p \*12p  
1/2in Mono Chrome 16p \*13p  
1/2in Stereo Plastic 20p 22p  
\*Switched

### AUDIO EXTENSION CABLES

(P. & P. 12p)  
HH-101 Straight Headphone Cable 99p  
HH-102 15ft Coiled Headphone Extension Cable £1.45  
GL20 20ft Coiled Guitar Cable, Straight Jackplug to Angled Jackplug £1.30  
SEND FOR OUR FREE CATALOGUE (ENCLOSING 5p STAMP)

## HILLS COMPONENTS LTD.

DEPT. PE12, UNIT No. 6, MELINITE INDUSTRIAL ESTATE, BRIXTON ROAD, WATFORD, HERTS. WD2 5SL. Tel. Watford 27711



### FAN/BLOWER

Precision-built in Germany. Dynamically balanced mains unit (200/240) continuous rated, reversible 60mA on run. Size 5 1/2" dia x 2 1/2" deep. Back plate is tapped for 4 fixing screws (supplied). Well under maker's price at £3. P. & P. 20p. Similar unit to above but 7 1/2" dia. x 3" deep. £3.30. P. & P. 25p.



### SMITHS RINGER-TIMER

Reliable 15 minute times, spring wound (concurrent with time setting) 15 x 1 min. divisions, approximately 1" between divisions. Panel mounting with chrome bezel 3 1/2" dia. £1.40. P. & P. 15p.



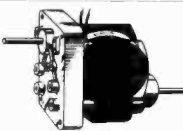
### GEARED MOTORS

"Parvalux" Reversible 100 rpm geared motor. Type 8D14, 230/250V a.c., 22 lb/in. 3" spindle. BRAND NEW £13.70 each. P. & P. 50p.

REVERSIBLE Parvalux type 8D19. 240V a.c. 30rpm. 40 lb/in. Variable angle drive shaft. Ex-equipment in good condition. £7. P. & P. 50p.

SHADED POLE Mains motor. 1 1/2" x 1 1/4" x 2" high. Double ended A shaft projecting 1 1/2" each side of motor. £1. P. & P. 20p.

### OPEN FRAME shaded pole GEARED MOTORS

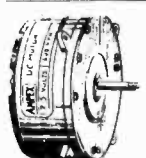


(Dural gear case) 240 a.c., 28rpm. NEW HIGH TORQUE, approx. overall size: 3 1/2" x 3 1/2" x 3 1/2" spindle 1 1/2" dia. as illustrated. £3. P. & P. 30p. Similar to above, 19rpm. £2.70. P. & P. 30p. 110rpm with pressed steel gear case (similar to above but slightly smaller). £2.70. P. & P. 30p.



### SPIT MOTOR

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 1/4"; (80 DB) 1/2" x 3/32" x 1/4". 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" high 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! Size: 12" x 22" x 1/8" x 1/8" 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.

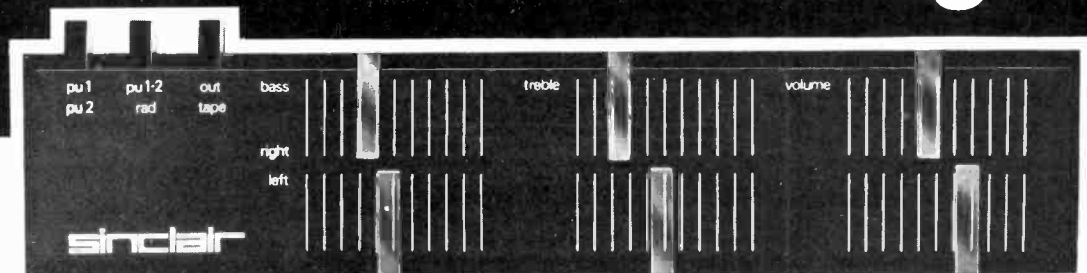
# ELECTRO-TECH COMPONENTS LTD.

315/317 EDGWARE ROAD LONDON, W.2  
Tel. 01-723 5667 01-402 5580

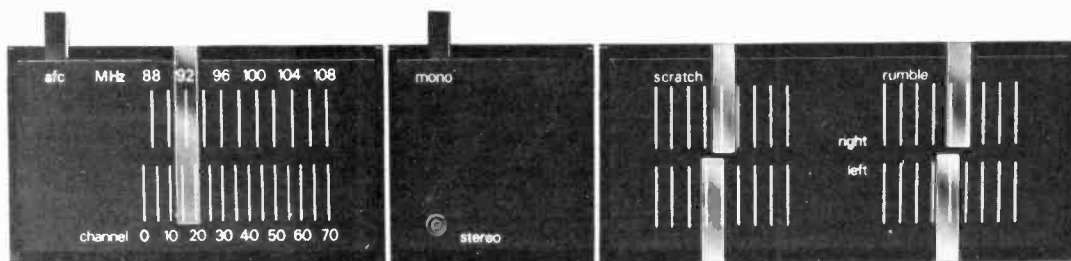
now...

# 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. 300 mV  
 Radio 300 mV, Tape 30 mV  
 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

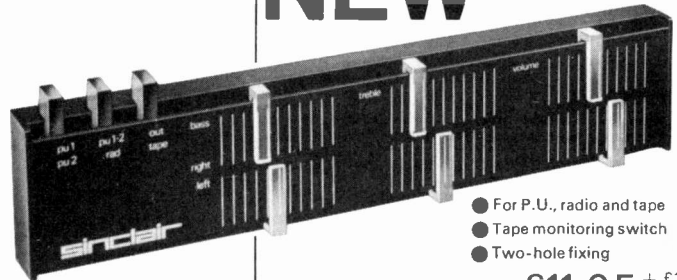
Size - 85 x 50 x 20mm (approx  $3\frac{1}{2}$  x 2 x  $\frac{3}{4}$  ins)  
 Tuning range - 87 to 108 MHz  
 Detector - I.C. balanced coincidence, for good A.M. rejection  
 AFC - Switchable, with thermistor control to prevent from drift  
 One 26 transistor I.C.  
 Twin dual varicap tuning  
 Distortion - 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.

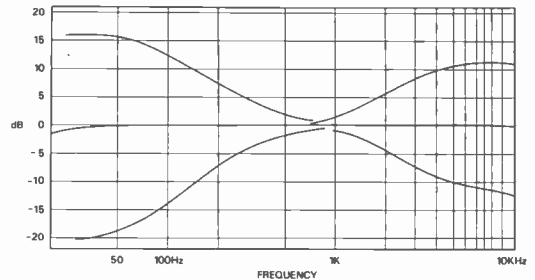
Size - 47 x 50 x 20mm ( $1\frac{3}{4}$  x 2 x  $\frac{3}{4}$  ins)  
 One 19 transistor I.C.

# NEW

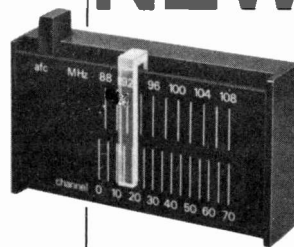


- For P.U., radio and tape
- Tape monitoring switch
- Two-hole fixing

R.R.P. **£11.95** + £1.19 V.A.T.



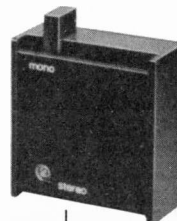
# NEW



- 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

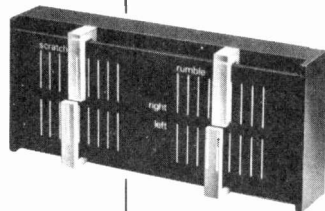
- 1969 Q.16 - improved version of Q.14 Systems 2000 and 3000: Project 60 launched
- 1970 IC.12 Project 60S
- 1971 Project 60 stereo FM tuner Z.50; PZ.8
- 1972 Improvements to Project 60 with Z.50 MK.2 and PZ.8 Mk.3 The Executive Calculator: Digital multi-meter. Q.30 speaker
- 1973 Cambridge Calculator  
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

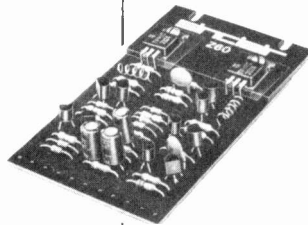
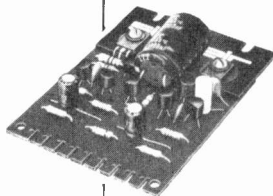
Either of these entirely new power amplifiers is intended for use in Project 80 installations although, of course, they are readily adaptable to an even wider range of applications. Both Z.40 and Z.60 incorporate built-in protection against shortcircuiting and risk of damage arising from mis-use is greatly 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 3/8 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.

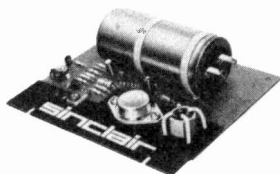
### Z.60

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.



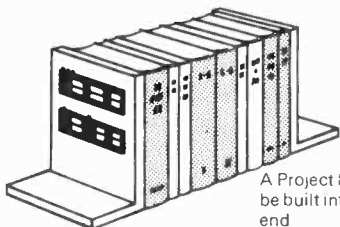
## Recommended Project 80 applications

System	The Units to use	Units cost
Simple battery record player	Z.40	<b>£5.45</b> + £0.54p 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.

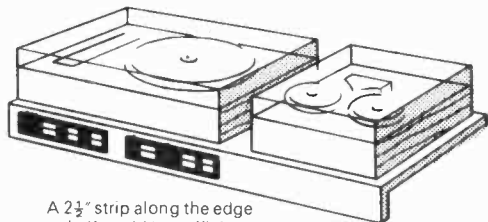
**sinclair**  
R.O. London Rd., St. Ives, Huntingdon PE17 4HS Reg. England 699483

# From Sinclair the worlds most advanced hi-fi modules

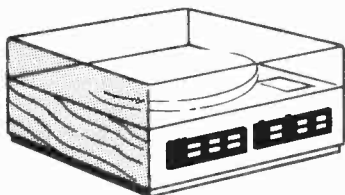
## Sinclair Project 80 the ultra-modern non-obtrusive hi-fi



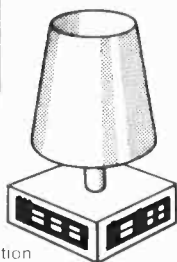
A Project 80 system could be built into a book-shelf end



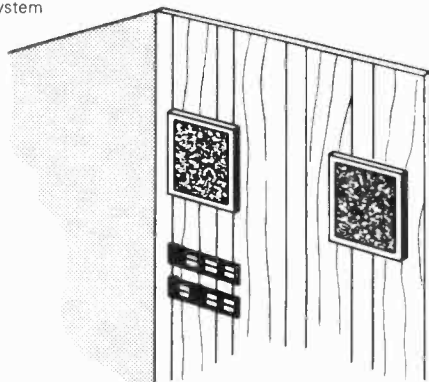
A 2½" strip along the edge a shelf could be sufficient to contain a complete system



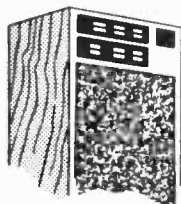
The modules mount very easily onto a playing plinth



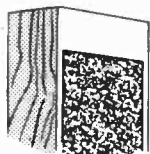
A novel application would be to build around the base of a lampshade



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.

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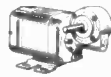
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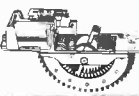
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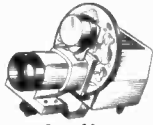
**7-INCH POLISHED REFLECTOR** Ideally suited for above Strobe kits. Price 55p, Post 15p.

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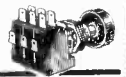
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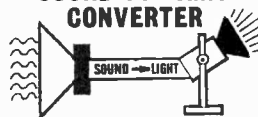
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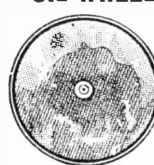
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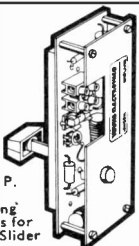
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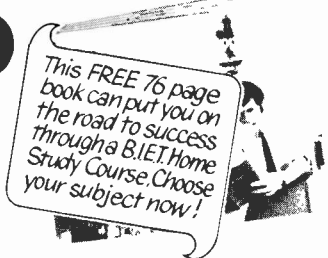
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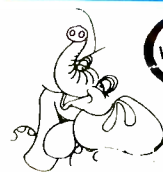
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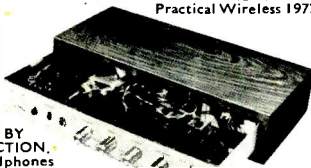
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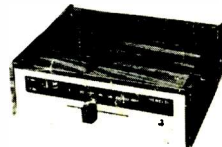
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